Mind the gap:

Information gaps and bridging options in assessing

***in-situ* conservation achievements**

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"Humans live in the present. We look at the world around us and find it difficult to encompass change over great tracts of time. But the perspective of time is important if we are fully to understand the biological processes we are driving by our actions, and, of course, to see where our future as a species lies."

(Leakey and Lewin, 1996: 249)

To my family

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Abbreviations

CBD	Convention on Biological Diversity
CONANP	Comisión Nacional de Áreas Naturales Protegidas (Mexican National Commission for Protected Areas)
CSF	Conservation Success Framework
DPSIR	Driving Forces, Pressures, States, Impacts, Responses
e.g.	Latin *exempli gratia*, English *for the sake of example*
et al.	Latin *et alii*, English *and others*
FAO	Food and Agricultural Organisation
GEF	Global Environment Facility
GESG	Grupo Ecológico Sierra Gorda
GIS	Geographic Information Systems
i.e.	Latin *id est*, English *that is*
IMECBIO	Instituto Manantlán de Ecología y Conservación de la Biodiversidad
in prep.	In preparation
IUCN	International Union for Conservation of Nature
MaB	Man and the Biosphere (UNESCO Programme)
NGO	Non-Governmental Organisation
OECD	Organisation for Economic Cooperation and Development
pers.comm.	Personal communication
PROFEPA	Procuraduría Federal de Protección al Ambiente (Attorney General for Environmental Protection of Mexico)
SGBR	Sierra Gorda Biosphere Reserve
SMBR	Sierra de Manantlán Biosphere Reserve
subm.	Submitted
TNC	The Nature Conservancy
UNEP	United Nations Environment Programme
UNEP-WCMC	UNEP-World Conservation Monitoring Centre
UNESCO	United Nations Educational, Scientific, and Cultural Organisation
WCPA	World Commission on Protected Areas
WDPA	World Database on Protected Areas
WWF	World Wild Fund for Nature

Abstract

The present study reveals a serious lack of openly accessible ecological long-term monitoring data for assessing the effectiveness of protected areas. Such data, however, is crucial for measuring progress towards international conservation targets. Therefore, a method to bridge existing information gaps through social science research is developed, based on an innovative theoretical Conservation Success Framework. The method is applied in two Mexican biosphere reserves, Sierra Gorda and Sierra de Manantlán, by conducting almost 60 interviews with different stakeholders.

Empirical results strengthen the developed method and allow for deep insights into the effectiveness of the protected areas surveyed. Recommendations to address information gaps are given 1) to local practitioners at the two case study sites, and 2) to the international conservation community. A scheme of consolidated actions relating the local to the national and international governance levels is proposed that could help to sustainably and cooperatively mind existing information gaps on *in-situ* conservation achievements, and hopefully close these gaps one day.

Summary

The biodiversity crisis of our time has gained political attention on a global level. International conventions emphasising the urgency of safeguarding genetic, species' and ecosystem diversity have been ratified and ambitious conservation objectives determined. The "2010 Target" of the Convention on Biological Diversity (CBD) aims to significantly reduce the loss of biodiversity by 2010. In order to achieve this, a network of representative and effectively managed protected areas is to be established by 2010 (terrestrial realm) and 2012 respectively (marine realm). The effectiveness of protected areas thus represents one indicator for progress towards the CBD's 2010 Target. However, indicators require information and information is also key to adaptive decision-making in protected area management.

The present study, in a first step, reviews the availability of open access long-term ecological data for assessing the effectiveness of protected areas in conserving biodiversity *in-situ*. This review shows two parallel – though contradictory – phenomena: data overkill and data scarcity. While the number of online databases providing open access data on biodiversity in general has grown tremendously during the last two decades, no long-term ecological data for a larger set of protected areas can be openly accessed. Reasons for this data scarcity are discussed and seem to be manifold: reluctance of governments to provide data that could reveal poor performance, scientific and administrative competitiveness, and a lack of resources to collect and process data on the local level are among the most prominent reasons. Resolving such barriers to more transparency in the effectiveness of *in-situ* conservation remains a difficult task.

Therefore, in a second step, a method to bridge existing information gaps through social science research is developed. Based on theories of successful implementation of *in-situ* conservation, an innovative Conservation Success Framework is developed, which defines and relates conservation needs, conservation capacity and conservation actions – its three main components. The basic assumption of the framework is that *conservation can only be successful where the conservation capacity exists that is required to implement the conservation actions determined by the conservation needs, which are in turn determined by the site-specific vulnerability, external influences and conservation objectives*. The framework forms the backbone for the development of semi-structured open and closed questionnaires and for the design of case studies in two Mexican protected areas, the Sierra Gorda Biosphere Reserve and the Sierra de Manantlán Biosphere Reserve.

Conservation success, however, is often immeasurable in protected areas, because their conservation objectives are too unspecific to identify progress indicators. Therefore, the term “conservation success” cannot easily be transferred from theory into practice and, at the case study level, it is here substituted by “conservation achievements”, i.e. clearly noticeable effects from conservation actions.

Overall, almost 60 interviews were conducted with local practitioners from the sites’ management and staff, local NGOs, local community members, and also national civil servants. The information from the interviews is validated through social science research techniques, such as triangulation of perspectives, naturalistic inquiries, and active and passive observation. Based on the interview results, conservation needs are identified and conservation capacities summarised and discussed for both case study sites. Implemented conservation actions addressing identified conservation needs and conservation capacity constraints are then analysed. In addition, noticeable effects from conservation actions on the state of biodiversity at case study sites, i.e. the conservation achievements, are described. Where locally available, non-open access data (as opposing open access data) are used to verify the findings from the social science research.

Identified conservation achievements at both case study sites are evident both from quantitative information (for example forest cover increase according to non-open access data) and qualitative information (for example perceived change in the occurrence of illegal activities according to interviews). In addition, rather “intangible” indicators that can only be revealed through qualitative surveys are identified for both sites. This study thus highlights the crucial importance of integrating different types of data, ecological and socio-economic, as well as quantitative and qualitative ones. A statement that is generally attributed to Albert Einstein supports this: “*Not everything that can be counted counts and not everything that counts can be counted.*”

The present study concludes with a series of recommendations 1) to local practitioners at the two case study sites, and 2) to the international conservation community.

Local practitioners may benefit from the present study because its results provide for each site a) an overview of existing conservation needs and implemented conservation actions;

b) an easy way to identify action gaps; c) a baseline to identify progress indicators; and d) an overview of diverse perspectives on the current effectiveness of the biosphere reserves. These benefits are considered of particular importance as they can be influential in the revision of the site's management plans, which both are now approximately ten years old and will soon be revised.

The international conservation community will not be able to make a clear statement in the year 2010 about the effectiveness of protected areas on a global level due to a lack of information and transparency. However, the year 2010 should not be considered an end point for measuring progress in *in-situ* conservation; instead protected area quality standards must be created, effectiveness evaluations institutionalised and efforts to foster regular reporting must continue. Consequently, a scheme of consolidated actions from local to national and international level is proposed that could help to sustainably bridge existing information gaps and close them on the long run. In the end, progress reporting on the effectiveness of protected areas, and other indicators, can only improve if different governance levels "mind the information gaps" in cooperation, until continued information gathering and sharing hopefully closes these gaps one day.

Resumen

La crisis de la biodiversidad atrae cada vez más atención política al nivel global. Convenios internacionales, recalcando la importancia de conservar la diversidad genética, así como de las especies y los ecosistemas, han sido ratificados por numerosos países. De esta manera, objetivos ambiciosos de conservación han sido acordados. El „Objetivo 2010" del Convenio sobre la Diversidad Biológica pretende reducir de manera significativa la pérdida de biodiversidad hasta el año 2010. Para realizar este objetivo, una red de áreas protegidas efectivos debe ser establecida. Por lo tanto, la efectividad de áreas protegidas es en sí un indicador de éxito del Objetivo 2010. No obstante, la cuantificación o evaluación de indicadores depende de la disponibilidad de información, mientras que la información en sí es clave para una toma de decisiones adecuada y un manejo sostenible de las áreas protegidas.

El presente estudio revisa, en una primera parte, la disponibilidad de datos ecológicos a largo plazo y su acceso por medio de la World Wide Web para la evaluación de la efectividad de áreas protegidas en la conservación de la biodiversidad *in-situ*. Esto subraya dos fenómenos paralelos – aunque opuestos: la abundancia de datos y su carencia. Mientras que el número de bases de datos en línea que ofrecen libre acceso a datos sobre la biodiversidad en general ha incrementado rápidamente durante las últimas dos décadas, no es posible acceder a datos ecológicos a largo plazo y actuales para numerosas áreas protegidas. Esta carencia de datos se explica por múltiples razones: gobiernos se resisten a publicar datos que podrían indicar deficiencias, existen una competencia a nivel científico y administrativo, y una carencia de recursos para colectar y procesar datos al nivel local. Estos obstáculos dificultan el establecimiento de transparencia en la efectividad de la conservación *in-situ*.

Por consiguiente, en una segunda parte, desarrollamos un método para colmar lagunas actuales en información por medio de una investigación de ciencias sociales. Esta se basa en teorías de la implementación exitosa de la conservación *in-situ*, para desarrollar un Marco Teórico del Éxito en Conservación innovador. Este define y relaciona tres componentes principales: las necesidades de conservación del área, sus capacidades de conservación, y las acciones de conservación. La hipótesis central de nuestro marco teórico es: *la conservación sólo puede ser exitosa donde existe capacidad de conservación suficiente para implementar acciones de conservación determinadas por*

las necesidades locales de conservación. Estas últimas se identifican a partir de la vulnerabilidad del sitio, las influencias externas, y los objetivos de conservación del área protegida. El marco teórico forma la base para el desarrollo de cuestionarios semi-estructurados, con preguntas abiertas y cerradas, y para el diseño de estudios de caso en dos áreas protegidas en México, las Reservas de la Biosfera Sierra Gorda y Sierra de Manantlán.

No obstante, el éxito en conservación en áreas protegidas frecuentemente no se puede medir porque los objetivos de conservación no son suficientemente específicos para la identificación de indicadores de progreso. Por ese motivo, el término "éxito en conservación" no permite una traslación fácil de la teoría a la práctica. Por consecuente, en el nivel de los estudios de caso, substituimos este término por el de "resultados de conservación", o sea resultados de acciones de conservación claramente identificables.

En total, cerca de 60 entrevistas han sido realizadas con especialistas a nivel local del manejo de las áreas protegidas y su personal, organizaciones locales no-gubernamentales, actores locales y funcionarios a nivel nacional. Los datos colectados por medio de las entrevistas fueron validados utilizando métodos de ciencias sociales, así como por la triangulación de los datos colectados, a través de investigación naturalista, y observación activa y pasiva. Por medio del análisis de las entrevistas identificamos las necesidades de conservación y sintetizamos y discutimos las capacidades de conservación para ambos estudios de caso. Luego analizamos las acciones que se implementaron para atender a las necesidades y capacidades de conservación ya identificadas. Aparte, describimos los resultados claramente identificables de las acciones de conservación en el estado de la biodiversidad de ambas áreas protegidas, o sea los resultados de conservación. Utilizamos los datos disponibles a nivel local (que distinguimos de los datos a nivel global accesible por la WWW), cuando estos existen, para verificar los resultados de nuestra investigación de enfoque de ciencias sociales.

En ambos estudios de caso son evidentes resultados de conservación a través de datos cuantitativos (por ejemplo, el incremento de la cobertura forestal según los datos disponibles a nivel local) y cualitativos (por ejemplo, los cambios percibidos por los expertos entrevistados en actividades ilícitas). Además, identificamos indicadores "intangibles", los cuales solamente pueden ser revelados por encuestas cualitativas, para ambos sitios. Nuestro estudio acentúa de esta manera la importancia crítica de integrar diferentes tipos de datos, ecológicos tanto como socio-económicos, y tanto cuantitativos como cualitativos. Concordamos con una afirmación en general atribuida a Albert Einstein: "*No todo lo que se puede contar cuenta y no todo lo que cuenta se puede contar.*"

El estudio presente concluye con una serie de recomendaciones dirigidas a: 1) especialistas locales en las dos regiones de los estudios de caso, y 2) la comunidad de conservación al nivel internacional.

Especialistas locales pueden beneficiar del presente estudio porque sus resultados ofrecen para ambos regiones: a) una orientación sobre las necesidades de conservación actuales y las acciones de conservación implementadas; b) un método fácil para la identificación de vacíos en los programas de conservación; c) una base metodológica para la identificación de indicadores de progreso en el manejo; y d) una orientación sobre diversas perspectivas en la efectividad actual de las reservas de la biosfera. Estos beneficios son particularmente importante porque pueden influir en la revisión de los planes de manejo de ambas áreas protegidas, que en este caso tienen aproximadamente diez años de edad y serán revisados próximamente.

La comunidad de conservación a nivel internacional no será capaz de ofrecer una afirmación clara en el año 2010 sobre la efectividad de las áreas protegidas en el mundo debido a una carencia de información y transparencia en su comunicación. Sin embargo, el año 2010 no debe ser considerado cómo un punto final para la evaluación del progreso en la conservación *in-situ.* En cambio, estándares de calidad en las áreas protegidas deben ser creados, evaluaciones de efectividad deben ser institucionalizadas y esfuerzos para fomentar informes regulares tienen que continuar. En consecuencia, proponemos un esquema de acciones desde el nivel local hasta el nivel nacional e internacional que podría colmar los vacíos actuales de información de manera sustentable y llenarlos a largo plazo. Por último, informes de progreso sobre la efectividad de las áreas protegidas, y otros indicadores, sólo pueden mejorar, si diferentes niveles de gubernancia "atienden los vacíos de información" en cooperación, hasta que ojalá la colección continua de información un día cierre estos vacíos.

Zusammenfassung

Die Biodiversitätskrise unserer Zeit hat mittlerweile global politische Aufmerksamkeit erlangt. Internationale Konventionen, die die Wichtigkeit der Erhaltung von Gen-, Arten- und Ökosystem-Diversität unterstreichen, wurden ratifiziert und somit ambitionierte Naturschutzziele festgelegt. Das „2010-Ziel" der Konvention zur biologischen Vielfalt ist es, den Verlust der Biodiversität bis zum Jahr 2010 signifikant zu reduzieren. Zur Zielerreichung soll bis dahin ein Netzwerk aus effektiven Naturschutzgebieten etabliert sein. Die Effektivität von Schutzgebieten ist somit einer der Erfolgsindikatoren des 2010-Zieles. Die Messbarkeit von Indikatoren ist jedoch abhängig von der Verfügbarkeit entsprechender Informationen, und Informationen sind zudem der Schlüssel zur adaptiven Entscheidungsfindung für ein nachhaltiges Management von Schutzgebieten.

Die hier präsentierte Studie befasst sich im ersten Teil mit der Verfügbarkeit offen zugänglicher ökologischer Langzeitdaten, die eine Abschätzung des Beitrags von Schutzgebieten zur Erhaltung von Biodiversität *in-situ* zulassen. Diese Revision von Datenverfügbarkeit zeigt zwei parallele – und dennoch gegensätzliche – Phänomene auf: ein Übermaß an Daten auf der einen, und einen Mangel an Daten auf der anderen Seite. Während insgesamt die Zahl im Internet frei zugänglicher Biodiversitätsdatenbanken innerhalb der letzten zwei Dekaden immens gestiegen ist, so gibt es bis heute keine Datenbank, die aktuelle ökologische Langzeitdaten von Schutzgebieten zur Verfügung stellt. Die vielfältigen Gründe für diesen Datenmangel werden diskutiert: Allgemeines Widerstreben von Regierungen, Daten zu veröffentlichen, die ihre Effizienz in Frage stellen könnten, wissenschaftliches und administratives Konkurrenzdenken, und ein Mangel an Ressourcen für die Aufnahme und Verarbeitung von Daten befinden sich unter den wichtigsten Gründen. Die Überwindung derartiger Barrieren hin zu mehr Transparenz im Bereich der Effektivität von *in-situ* Naturschutz stellt eine große Herausforderung dar.

Infolge dieser Erkenntnis wird im zweiten Teil der Studie eine Methode zur Überbrückung von Informationslücken durch sozialwissenschaftliche Forschung erarbeitet und angewandt. Auf der Basis von Theorien zur erfolgreichen Umsetzung von *in-situ* Naturschutzmaßnahmen wird ein innovatives Bezugssystem für Naturschutzerfolg entwickelt, welches Naturschutzbedarf, Naturschutzkapazität und Naturschutzaktionen – die drei Hauptbestandteile des Systems – in Relation setzt. Die zugrundeliegende

Annahme des Bezugssystems ist, dass *Naturschutz nur erfolgreich sein kann, wenn ausreichend Naturschutzkapazität besteht, um alle jene Naturschutzaktionen umzusetzen, die aufgrund des Naturschutzbedarfs erforderlich sind. Der Naturschutzbedarf ist determiniert durch situationsspezifische Vulnerabilität, externe Einflüsse und Naturschutzziele des Schutzgebietes.* Das Bezugssystem bildet die Basis für die Entwicklung von semi-strukturierten offenen und geschlossenen Fragebögen und die Planung von Fallstudien in den mexikanischen Biosphärenreservaten Sierra Gorda und Sierra de Manantlán.

In der Praxis ist Naturschutzerfolg jedoch häufig nicht messbar, da die Ziele von Schutzgebieten oftmals sehr unspezifisch formuliert sind, so dass für ihre Erreichung keine Erfolgsindikatoren identifiziert werden können. Folglich kann der Begriff „Naturschutzerfolg“ nicht einfach in die Praxis übersetzt werden und wird hier, für die Realisierung der Fallstudien, durch den Begriff “Naturschutzergebnisse” substituiert, d.h. deutlich erkennbare Resultate von Naturschutzaktionen.

Insgesamt wurden fast 60 Interviews mit Schutzgebietsmanagern, Mitarbeitern des Managements und lokaler Nicht-Regierungsorganisationen, und Bewohnern der Schutzgebiete auf lokaler, sowie Regierungsvertretern auf nationaler Ebene durchgeführt. Die Informationen der Interviews sind durch eine Kombination von Techniken der sozialwissenschaftlichen Forschung, wie Perspektiventriangulation, die Durchführung der Interviews im natürlichen Umfeld der Interviewpartner und aktive und passive Beobachtung validiert. Basierend auf den Interviews werden für beide Fallstudiengebiete Naturschutzbedarf und Naturschutzkapazitäten identifiziert und diskutiert. Umgesetzte Naturschutzaktionen, die den Naturschutzbedarf oder die Naturschutzkapazität beeinflussen sollen, werden analysiert. Darüber hinaus werden deutlich erkennbare Folgen von Naturschutzaktionen, die „Naturschutzergebnisse“, beschrieben. Sofern möglich, werden lokal verfügbare (im Gegensatz zu öffentlich zugänglichen) Daten benutzt, um die Ergebnisse der Sozialforschung und die entwickelte Methode zu verifizieren.

Naturschutzergebnisse sind in beiden Regionen sowohl durch quantitative Informationen (zum Beispiel durch die Zunahme von Waldfläche), als auch durch qualitative Informationen (zum Beispiel durch wahrgenommene Veränderungen in der Häufigkeit illegaler Aktivitäten) nachweisbar. Zusätzlich werden für beide Fälle “nicht greifbare”

Indikatoren für die Schutzgebietseffektivität identifiziert, die nur durch den offenen qualitativen Forschungsansatz entdeckt werden können. Hierdurch unterstreicht die Studie die Wichtigkeit, verschiedene Daten zu integrieren, nicht nur ökologische und sozioökonomische, sondern gleichfalls quantitative und qualitative. Eine Gedanke, der Albert Einstein zugeschrieben wird, unterstützt diese Erkenntnis: "*Nicht alles, was gezählt werden kann, zählt, und nicht alles, was zählt, kann gezählt werden.*"

Die hier präsentierte Studie schließt mit einer Reihe von Empfehlungen 1) für lokale Akteure auf der Ebene der Fallstudien, und 2) für die internationale Naturschutzgemeinschaft.

Lokale Akteure können von der vorgestellten Studie profitieren, da sie für beide Fallstudien a) einen Überblick über existierenden Naturschutzbedarf und implementierte Naturschutzaktionen bietet; b) eine einfache Methode zur Identifikation von Lücken in Naturschutzaktivitäten vorstellt; c) eine Basis schafft, von der aus Erfolgsindikatoren entwickelt werden können; und d) verschiedene Blickwinkel auf die momentane Effektivität der Biosphärenreservate gesammelt darstellt. Die Ergebnisse sind zudem von Bedeutung, da sie die Überarbeitung der Schutzgebiets-Managementpläne, welche nun beide fast zehn Jahre alt sind und baldige Überarbeitung erfordern, beeinflussen können.

Die internationale Naturschutzgemeinschaft wird im Jahr 2010 keine klare Aussage zur globalen Effektivität von Schutzgebieten machen können, da es an entsprechenden Informationen und Transparenz mangelt. Das Jahr 2010 sollte jedoch nicht als Endpunkt für die Messung von Fortschritt im *in-situ* Naturschutz verstanden werden; stattdessen sollten Qualitätsstandards für Schutzgebiete entwickelt und etabliert, Effektivitätsevaluierungen institutionalisiert, und Bemühungen um regelmäßige Fortschrittsberichte vorangetrieben werden. Hierfür wird ein Schema sich gegenseitig ergänzender Aktionen vorgestellt, welches die lokale, sowie nationale und internationale Naturschutz-Ebene einschließt. Dieses Schema kann helfen, existierende Informationslücken nachhaltig zu überbrücken und langfristig zu schließen. Schlussendlich kann die Messbarkeit von Schutzgebietseffektivität, und anderen Indikatoren, nur verbessert werden, wenn verschiedene Governance-Ebenen kooperativ Informationslücken überbrücken, bis diese Lücken eines Tages durch fortschreitende Datenaufnahme und –kommunikation geschlossen werden können.

A. Introduction

The introductory chapter to the present study briefly outlines the study context (section A.1), introduces to the main research questions and goals (section A.2) and explains the structure of the document (section A.3). It closes with a brief section on the affiliation of the research done for the present study to the Governance of Biodiversity (GoBi) Project and academic institutions (section A.4).

A.1 Study context: Biodiversity loss and international response

Some thirty billion species are assumed to have populated planet earth for different periods of time since the evolution of multi-cellular creatures hitherto (Leakey and Lewin, 1996). However, only about 1.78 million extant species have been discovered, described, taxonomically identified and named to date (Chapman, 2006). We cannot be sure about how many more extant species will be found because we do not know how many there currently are. Estimates of total extant species numbers range between 2 and 50 million (Stork, 1993). What we can be sure of is that day by day many of them go extinct – some before we notice they exist. Estimates amount to a loss of two to five species per hour from tropical forests alone (Singh, 2002). The currently documented extinction rate of species is estimated to be up to 1,000 times higher than the natural background extinction rate and may increase to the order of 10,000 times the background rates over the next decades (Millennium Ecosystem Assessment, 2005b)[1].

A substantial number of scientists consider the current era to be the planet's sixth global extinction event (Chapin III *et al.*, 2000; Leakey and Lewin, 1996; Thomas *et al.*, 2004b; UNEP, 2007). The major distinction between the big five mass extinctions of prehistoric times and today's is that the current extinction event is man-made. Also, the latter probably needs only about 200 years to cause the same damage, in terms of species loss, for which the other five took up to a million years each (Singh, 2002).

Humans have always altered their environment. Since they started to populate the planet, they contributed to species extinctions (e.g. Eldredge, 2001; Grayson and Meltzer, 2002). However, the magnitude of human resource use and respective consequences has changed

[1] For discussions on the "natural" character of extinctions and the difference between background and mass extinctions see Aitken (1998) and Wang (2003).

tremendously with the spread of agriculture around 10,000 years ago[2] and, in particular, with industrialisation starting in the 18th century and marking the beginning of what some people call the "Anthropocene" by the end of that century[3].

According to the United Nations' Millennium Ecosystem Assessment, the main drivers for today's loss of biodiversity are habitat change, climate change, invasive alien species, overexploitation and pollution (Millennium Ecosystem Assessment, 2005b). All of these are contributors to the "global change" phenomenon of our time – a concomitant of progress and growth.

Today, more than six billion people require food, fibre, water, shelter, and energy compared to a tenth of this number, approximately 600 million, in the year 1700 (United States Census Bureau, 2007). Extrapolations project an increase to nearly nine billion people by 2050 (Cohen, 2003). The main drivers for biodiversity loss identified by the Millennium Ecosystem Assessment are the expressions of this explosion in the demand for resources. The impacts of these drivers on biodiversity are studied increasingly and on a global level, because these impacts may turn – and are already turning – to jeopardy for human well-being.

WWF's Living Planet Index, which aims at summarising and tracking changes to the health of the planet's ecosystems, has dropped by 29% from 1970 to 2003 (WWF *et al.*, 2006). An estimated total of 75% of all fishing grounds is fully exploited, overexploited, depleted or recovering from depletion (FAO, 2004). Deforestation continues in many parts of the world, at worst in Indonesia where 28,000 square kilometres of forest are lost each year, around 80% of which is cut illegally (EIA/Telapak, 2007). The climate system is warming and accompanying long-term changes in climate have been observed, such as changes in precipitation amounts and aspects of extreme weather (e.g. the intensity of tropical cyclones) (IPCC, 2007). These changes force species to shift their distribution

[2] This has been a parallel process in different parts of the world with southwest Asian agriculture that started with the use of grains at least 12,000 years before turning to systematic cultivation some 10,000 years ago (Piperno *et al.*, 2004).

[3] Crutzen (2002: 23) used the following definition and explanation for the beginning of the Anthropocene: "*It seems appropriate to assign the term 'Anthropocene' to the present, in many ways human-dominated, geological epoch, supplementing the Holocene… The Anthropocene could be said to have started in the latter part of the eighteenth century, when analyses of air trapped in polar ice showed the beginning of growing global concentrations of carbon dioxide and methane. This date also happens to coincide with James Watt's design of the steam engine in 1784.*"

ranges – if they can -, alter species compositions and ecosystem structure, and by doing so can seriously harm biodiversity[4].

Societies around the world have begun to respond to these critical developments in various ways. Governments have incorporated conservation of biodiversity and ecosystem services into their political agenda. Although biodiversity conservation is usually still of lower priority than other issues of political interest, its consideration in the policy arena has resulted in various approaches addressing the issue at multiple levels – from local to global.

The Convention on Biological Diversity (CBD), the widest ranging response, has now been signed by more than 190 countries. All of the signatory parties hence agreed to promote the achievement of the CBD 2010 Target: to significantly reduce the loss of biodiversity by 2010 (Secretariat of the Convention on Biological Diversity, 2005, decision VI/26). Protected areas are considered crucial for the achievement of this target. Consequently, a Programme of Work on Protected Areas (PoWPA) has been developed, outlining *in-situ* conservation measures to be put into practice until 2010. Overall, it is strived for at least ten percent of each ecological region of the world to be effectively protected by then (Secretariat of the Convention on Biological Diversity, 2005, decision VII/30, target 1.1). Similarly, the Millennium Development Goals use the coverage of *in-situ* conservation sites as one indicator for achieving Goal 7: to ensure environmental sustainability (United Nations, 2005). However, several studies show that a legal protection or conservation status alone does not guarantee successful long-term safeguarding of conservation values (e.g. Dudley and Stolton, 1999; Liu *et al.*, 2001; Nellemann *et al.*, 2007; WWF, 2004). These findings triggered calls for a thorough investigation of success and failure of *in-situ* conservation approaches.

From a natural scientific point of view, such an investigation requires detailed ecological data on the effectiveness of *in-situ* conservation. However, where these are lacking at the spatial or temporal resolution required, it becomes imperative to identify other approaches to evaluating the effectiveness of *in-situ* conservation. Such approaches must be as multi-disciplinary in nature as current conservation strategies, "*based on analyses of the complexity of factors that drive biodiversity loss and must seek to involve many different*

[4]The extreme 1998 El Niño event for instance caused a up to 90% bleaching of non-continental coral ecosystems in the Indian Ocean (Spalding and Jarvis, 2002).

actors [,...]” (Wood *et al.*, 2000: 9). The present study develops such an approach and applies it in practice. The main focus of the study is on information for effectiveness evaluations of *in-situ* conservation: its availability, accessibility and options to bridging information gaps and filling them on the long run.

A.2 Main research questions and goals

Based on the given introduction, the five main research questions to be addressed in this study are presented in Table A.1. Each is linked to a determined research goal, respectively.

Table A.1: Main research questions and research goals

Research questions	Research goals
1) What kind of open access data is currently available from effectiveness measurements in protected areas to assess conservation success?	Complete overview of data availability, critical discussion of data sharing limitations, and examples for options to address these limitations.
2) What in fact is conservation success and is it measurable at all?	Critical discussion of the terminology and measurability of conservation success.
3) How can information gaps be bridged in an assessment of conservation success – in theory?	Development of a conceptual conservation success framework leading towards a qualitative social scientific approach to assessing conservation achievements.
4) How can information gaps be bridged in an assessment of conservation achievements – in practice?	Application of the conceptual conservation success framework and analysis of conservation achievements in two Mexican biosphere reserves.
5) What key recommendations can be drawn to enhance the availability of information a) for the case study sites, and b) for the conservation community?	Synthesis of recommendations a) on case study level, and b) for the conservation community.

The following section describes where the research questions and goals are addressed in the overall document and how they are contextually embedded.

A.3 Structure of the document

The present document is organised in **eight main chapters** which are each subdivided into **sections** and **subsections**.

The context of this study as well as the study's research questions and goals are outlined in **chapter A** (see sections A.1 and A.2). The different methods used are all explained in **chapter B**, which starts with an overview of the different theories considered and methods applied and their contribution to achieving the research goals (see Figure B.1). In the following, the different methods are described in detail in separate sections. The most important basic principles of qualitative social science research and the application of the software used for analysing qualitative information are described in detail in the subsections B.4.2 and B.4.3.

Chapter C deals with *in-situ* conservation sites as the here regarded research objects and starts with a short introduction to the history of *in-situ* conservation, showing that attempts to the implementation of *in-situ* conservation reach far back in time and that approaches to *in-situ* conservation are manifold (sections C.1 and C.2). An overview of different types of protected areas and related concepts is provided in section C.3, followed by a detailed description of UNESCO biosphere reserves in section C.4, as the case study sites of this study were both biosphere reserves. Challenges of the biosphere reserve concept are outlined in section C.5. Finally, the relationship of protected areas and biosphere reserves, including differences and common grounds, are discussed in section C.6.

Chapter D provides a summary of further relevant context information of *in-situ* conservation. While section D.1 focuses on the socio-political dimension of conservation, section D.2 discusses the issue of management effectiveness of *in-situ* conservation sites. The state of research is summarised and the principle of adaptive management introduced (subsection D.2.1). Monitoring and evaluation as essential elements in protected area management and effectiveness evaluations are explained followed by a subsection on the information needs for an assessment of conservation success (subsections D.2.2 and D.2.3).

Chapter E reviews the availability and accessibility of open access ecological monitoring data from protected areas and biosphere reserves for the purpose of assessing their effectiveness in conserving biodiversity. The limitations to data sharing on protected area level are identified, initiatives to surpass these limitations are presented and remaining needs discussed (sections E.2 and E.3).

The results of this data review, showing a lack of suitable ecological datasets, made it necessary to develop a theoretical Conservation Success Framework and there from a qualitative social scientific approach to assessing conservation achievements. This is the focus of **chapter F**. At first, the theory behind conservation success and conservation achievements is described, and the DPSIR-Framework for a detailed analysis of threats to biodiversity is introduced (sections F.1 to F.3). Further sections of the chapter explain the separate components of the developed theoretical Conservation Success Framework, their relations and the final framework itself (sections F.4 and F.5) which was applied at the case study sites.

Chapter G describes the case study sites against the background of the Mexican conservation situation. It also provides the results from the practical application of the theoretical Conservation Success Framework in the two Mexican biosphere reserves. The results of the case studies are presented per site and framework component (subsections G.2.8 and G.3.8) and are rounded up by an essay on overall conservation achievements at case study sites (subsections G.2.10 and G.3.10).

Chapter H provides a comparative case study discussion, as well as an overall discussion of the present study, final conclusions and an outlook at potential further research.

Figure A.1 shows the structure of the thesis including cross references to where the responses to the research questions and goals listed in Table A.1 can be found.

The chapters C to H all start with a **short introduction** to the contents of the respective chapter. In addition, the chapters C to G conclude with a brief subsection summarising the **essence** of the respective chapter. Chapter H includes the essence of the overall study in section H.3. (Conclusions) and closes the main part of the document. The structure of the Annex can be found in the Table of Contents (see page v).

Chapter	Components	Cross Reference
A: Introduction	Context, research questions and goals, structure	
B: Methods and data	Overview, detailed description of method components	
C: The research objects	History, recognised types and understanding of *in-situ* conservation sites	
D: The research context	Socio-political dimension and effectiveness of *in-situ* conservation sites	
E: Data availability	State of availability and accessibility, discussion of limitations, needs and initiatives	**Research question and goal 1**
F: The research subject	Conservation success and conservation achievements (theory, definitions, threats, DPSIR-Framework); and	**Research question and goal 2**
F: The theoretical Conservation Success Framework - towards a qualitative social scientific approach to assessing conservation achievements		**Research question and goal 3**
G: The main case studies	Application of the developed method in two biosphere reserves in Mexico (site descriptions and results)	**Research question and goal 4**
H: Discussion, Conclusions and Outlook		**Research question and goal 5**

Figure A.1: Structure of the document including research questions and goals

A.4 Affiliation to the Governance of Biodiversity (GoBi) Project and academic institutions

This PhD thesis has been developed and concluded as part of the Governance of Biodiversity (GoBi) Project, led by Prof. Dr. Susanne Stoll-Kleemann and funded by the Robert Bosch Stiftung. From July 2004 to December 2007 the GoBi Project was affiliated to the Department of Agricultural Economics and Social Sciences of the Faculty of Agriculture and Horticulture of the Humboldt University of Berlin, Germany. With the acceptance of a professorship of Prof. Dr. Susanne Stoll-Kleemann at the Ernst-Moritz-Arndt University of Greifswald, Germany, the GoBi Project moved to the Institute of Geography and Geology, Department of Geography, at the Faculty of Mathematics and Natural Sciences of the Ernst-Moritz-Arndt University of Greifswald in December 2007. The PhD thesis was concluded at and submitted to the Ernst-Moritz-Arndt University of Greifswald, Germany.

B. METHODS AND DATA

Different methods and data had to be combined to achieve the study's research goals. The following section provides a methodological overview before each method component is described in more detail.

B.1 Methodological overview

A schematic overview of the study's research approaches, methods, data and data analysis, results and goals is provided in Figure B.1.

The initial approach (Approach 1 in Figure B.1) to assessing the effectiveness of protected areas and biosphere reserves was a purely natural scientific one. It was planned to evaluate a site's effectiveness in achieving conservation objectives based on openly accessible datasets on the ecological status and trends of biodiversity at the protected area level. The results of this evaluation were to be related to information on management and governance settings (gathered as part of the Governance of Biodiversity-Project, see section A.4), allowing for an overall analysis of management and governance regimes for the successful implementation of *in-situ* conservation. However, an extensive search for open access ecological datasets at the protected area level revealed that such datasets are either not available or not accessible at present, and it thus proved to be impossible to follow this initial approach (see Chapter E and Bertzky and Stoll-Kleemann, 2009).

Results of approach 1 made a different approach necessary, based on other methods and data. For this alternative approach (Approach 2 in Figure B.1), a theoretical framework was developed to understand conservation success. It was then used to develop semi-structured interview guidelines which were applied at case study sites. Where available at site, further monitoring data was used to backup the qualitative data, leading to an integration of different information sources. In the present study, data which was not openly accessible from online databases will be referred to as **non-open access data**, opposing the **open access data** that was searched on the World Wide Web (see Chapter E).

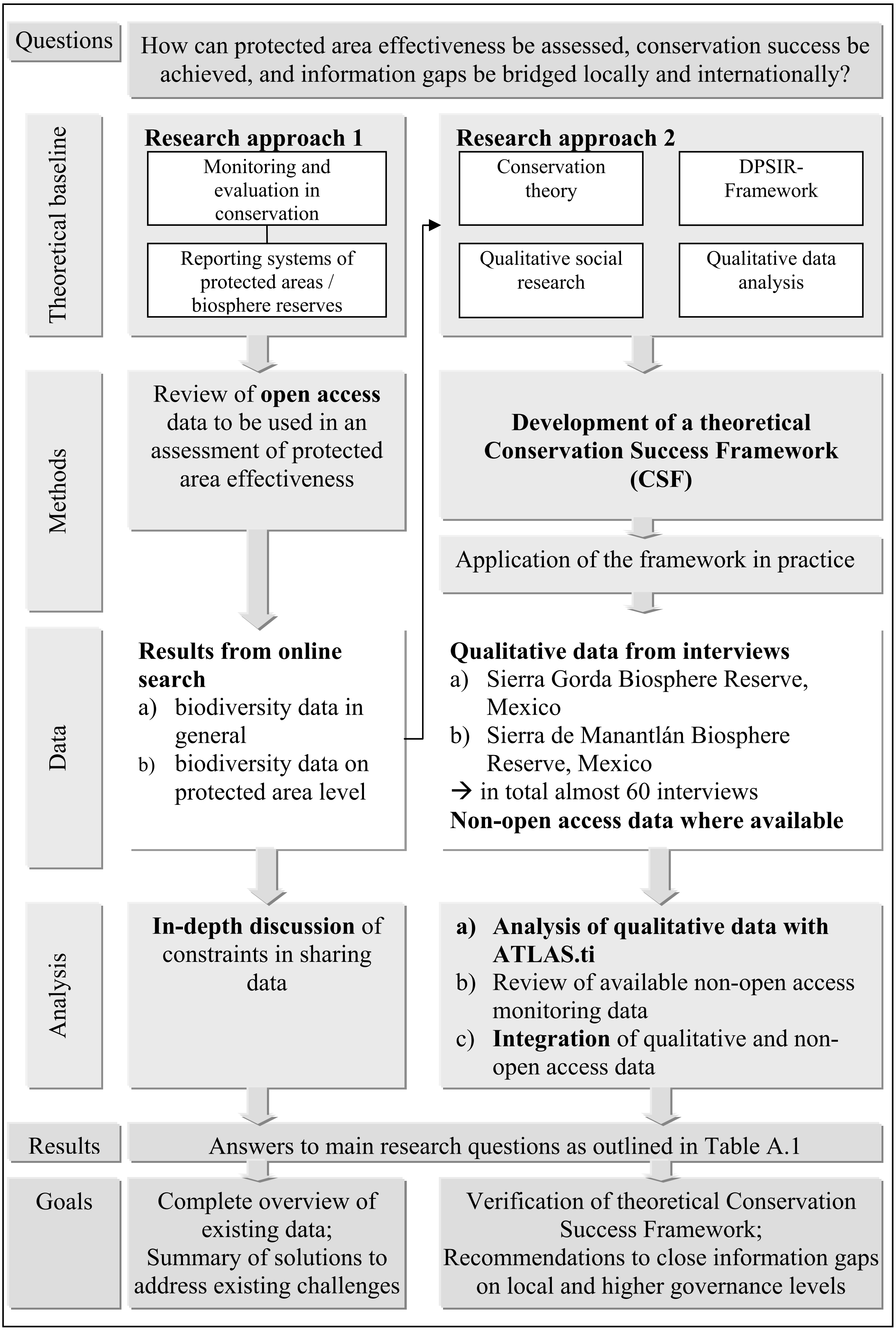


Figure B.1: Methodological overview of the study

B.2 Review of open access data for conservation and management

For **research approach 1** (see Figure B.1), datasets from effectiveness monitoring, in terms of target species' populations, have been searched to assess the conservation success of protected areas. Similar to the study of Bruner *et al.* (2001), but looking at on-the-ground monitoring data instead of remote sensing data, this research sought for inclusion of a large number of protected areas. The underlying assumption was that datasets existed and were openly accessible through the World Wide Web. The data sought had to meet the following criteria:

- They needed to be on the protected area level, i.e. for individual protected areas, not regional or national levels;
- They had to contain information on the population status and trends of site-specific species of conservation concern (e.g. threatened species), which means they had to be gathered through on-the-ground monitoring, not through remote sensing; and
- Corresponding metadata concerning data gathering conditions and standards needed to be available to indicate the data quality.

The search for databases was carried out with Google, the most popular search engine of the World Wide Web, and ecological databases found were listed and were then searched for data on the protected area level. Additionally, the keywords "protected areas", "national parks", "nature reserves", "biosphere reserves", and "monitoring" were included in the search directly. For the databases with data on the protected area level, the origin of data provided and links to other databases, sometimes with more information on the protected area features, were checked. The results of this online search can be found in subsection E.1.1 (data availability in general) and subsection E.1.2 (data availability on protected area level). A full list of the databases found and their locations (URL) on the World Wide Web is provided in Annex II. A detailed analysis of the data limitations and their root causes as well as needs for conservation scientists and practitioners is provided in section E.2, followed by a discussion of existing initiatives that address the limitations, needs and root causes (section E.3). The contents of chapter E are published in the Journal of Environmental Management (Bertzky and Stoll-Kleemann, 2009).

B.3 The theoretical Conservation Success Framework

Following the unsuccessful search for suitable ecological datasets, and supported by similar personal experiences from field work at the protected area level, it was considered indispensable to design an interdisciplinary and ecological data-independent research approach (see approach 2 in Figure B.1). The theoretical backbone of this approach is the so-called "**C**onservation **S**uccess **F**ramework", in the following referred to as **CSF**, which was developed based on a thorough review of relevant literature and theory (see Chapter F) as well as personal experience gathered in field visits. Following the literature review, major issues of interest to this study's perspective on conservation achievements were identified, as well as important factors influencing these issues. Both the issues and influencing factors were then set in relation to identify and define their cause-effect connections.

The Conservation Success Framework as such is not only a key outcome of this study, but its development was also a key prerequisite for the case studies by serving as the background to creating the semi-structured interview guidelines that were applied at the case study sites.

B.4 The main case studies

In **research approach 2** (see Figure B.1), the social science research approach of this study, it is sought to mind existing information gaps by using qualitative data to determine the effectiveness of protected areas.

Subsection B.4.1 outlines the selection process of the case study sites. Brief, but for the understanding of the main case study essential, overviews on the principles of qualitative data collection and processing options for qualitative data follow in the subsections B.4.2 and B.4.3. and the development and analysis of questionnaires is described (see subsection B.4.4).

B.4.1 Case study site selection

Mexico, the country where the case studies were conducted, was mainly chosen due to the comparably high transparency in terms of data and information available as experienced from expert interviews and the search for open access data (see Chapter E). The management of the Sierra Gorda Biosphere Reserve expressed its interest in becoming one of the case study sites as early as of November 2004 (on the IUCN World Conservation Congress in Bangkok, Thailand) including a strong willingness to offer as much non-open access data for verification of the developed method as available. Consequently, the second case study site had to be comparable according to some agreed criteria:

- It had to be a mountain biosphere reserve;
- Its main ecosystem types were to be forest ecosystem types;
- It had to share an equally long history of conservation work.

Having contacted the UNESCO-MaB National Focal Point for Mexican Biosphere Reserves the Sierra de Manantlán Biosphere Reserve was recommended as second case study site. The management of the biosphere reserve seemed likewise interested and it turned out that both sites were so-called “T.Sites”, i.e. listed in the Terrestrial Ecosystem Monitoring Sites (TEMS) database (see GTOS-TEMS, 2008). This was considered another advantageous and joint characteristic of the case study sites.

The conduction of the case studies at the agreed sites was confirmed through an official letter of invitation by the governmental department in charge of protected areas in Mexico (Comisión Nacional de Areas Naturales Protegidas, CONANP), see Annex IV.

B.4.2 Basic principles of qualitative social science research and their consideration in the present study

Qualitative research methods have grown prominent in social science much later than quantitative approaches. The latter were for long considered as “the” way of doing social science research and when first qualitative approaches came up in the 1960’s they were regarded as a separate and contrary movement (Punch, 2006). However, by now qualitative social science has gained widespread acknowledgement. An often cited quotation usually attributed to Albert Einstein (see, e.g., Giangreco and Taylor, 2003; Kaufmann and Kraay, 2008) fits outstandingly well to explain the now appreciated benefit of qualitative social research: “*Not everything that can be counted counts and not everything that counts can be counted.*”.

Empirical evidence supports the considerable potential of qualitative social science research to improve the understanding of complex settings and questions (e.g. Parker and

Kozel, 2007). Jones (2004) nicely phrases the value of qualitative social research by stating that "*In qualitative research, the tyranny of numbers is abandoned for the enigma of words.*" (Jones, 2004: 98).

In order to clarify the important differences between quantitative and qualitative research and emphasise the strengths of qualitative social science research, Figure B.2 opposes the two approaches graphically. As the figure shows, the direction in which a research objective is theoretically and methodologically approached is contrary to each other in quantitative and qualitative social research. Whereas the quantitative approach starts up with an existing theory and hypotheses, the qualitative approach strives for the development of a theoretical concept as the goal of a study. The pool of qualitative data that is gathered in a qualitative research approach thus allows for a theory to emerge from the ground, or as termed among social scientists, it provides the basic conditions for the creation of "grounded theory" (Glaser and Strauss, 1998; Weingand, 1993).

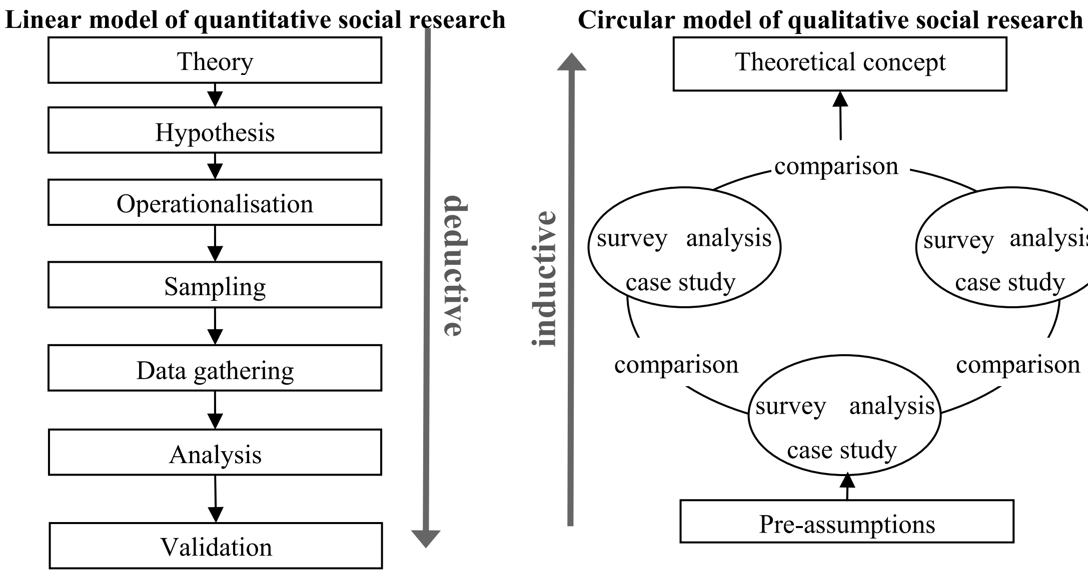


Figure B.2: Comparison between quantitative and qualitative social research
(adapted and translated from Flick, 2006)

As Figure B.2 shows, the qualitative approach explicitly strives for further modifications of the research design in order to suit the study purpose and gathered information can be added up to the further process (Flick, 2006). The **flexibility** that arises from the methodological approach of qualitative social science research is regarded as a major strength by qualitative researchers. Through the absence of predetermined theory and hypotheses, i.e. complete impartiality, and the possibility to maintain a high degree of

openness in the research design, the disclosure of unanticipated information potentially shedding light on complex research settings becomes feasible. Qualitative social science research is therefore of very explorative character in contrary to the quantitative social science that aims at theory verification.

Concerning the research design, sampling techniques differ significantly between qualitative and quantitative studies, too. In qualitative social science research entities are determined through theoretical sampling, a pre-requisite to grounded theory, whereas quantitative social research is characterised by statistical sampling. **Theoretical sampling** aims at including persons and groups according to the expected yield of new input to investigation of the research topic. This means that the pool of samples is of sufficient size once the information gained from the samples has achieved "saturation". In contrary, **statistical sampling** aims at representativeness and therefore the size of the sampling is determined in advance and the sampling will not stop before having reached the intended pool but also certainly will not exceed the predetermined sample size. (Punch, 2006)

The concept of **triangulation** is regarded as specifically important in the context of the present study. The term triangulation, in social research, "*is used to refer to the observation of the research issue from (at least) two different points.*" (Flick, 2004: 178). Triangulation is helpful so as to gain a more comprehensive picture of the contemplated situation and increase objectivity and accountability in qualitative social research (Padgett, 1998). Four different forms of triangulation are distinguished: 1) triangulation of theoretical perspectives, 2) triangulation of data, 3) triangulation of investigators/observers, and 4) triangulation of methods (Flick, 2004; Padgett, 1998). Miles and Huberman (1994) further differentiate between *data source* (including persons, times and places) and *data types* (including for example qualitative text, recordings, and quantitative data).

According to Flick (2006) the triangulation of theoretical perspectives combines:

- Perspective 1, called "*symbolic interactionism*", that refers to the "subjects" of the situation in focus and the significance the situation has on them;
- Perspective 2, called "*ethnomethodology*", that refers to the interaction between the subjects and analyses their discourses, and

- Perspective 3, called "*psychoanalytic perspective*", that refers to implicit/unknowingly existing rules that determine the subjects' behaviour ("culture").

Figure B.3 exemplifies the triangulation of research perspectives after Flick (2006), but adapted to the present research context.

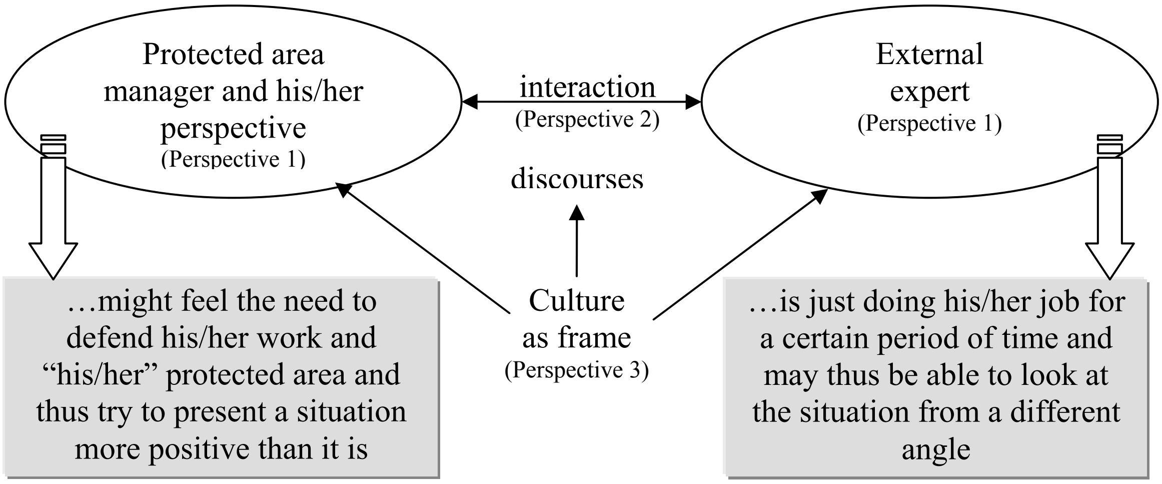


Figure B.3: Triangulation of research perspectives in qualitative research (adapted and translated from Flick, 2006)

While the protected area manager in Figure B.3 looks at the protected area situation from an **inside-in** perspective and at the situation of the protected area surroundings from an **inside-out** perspective, an external expert may be rightly positioned to cover an **outside-in** perspective on the protected area situation. Consequently, by taking into account several different perspectives, objectivity and accountability of the impression and information gained increases significantly.

A common criticism to qualitative research, besides the introduced efforts to reduce subjectivism, is that the perception of individuals is considered reality. However, this is one of the fundamental principles of the symbolic interactionism: the researcher has to look at the world from the perspective of the subjects, he or she is interviewing (Flick, 2006). At this point, the author of the present study strongly agrees with Kaufmann und Kraay (2008: 22) stating that "*Perceptions-based data are extremely valuable, because they capture the views of relevant stakeholders who act on these views*."

In the present study the described principles of social science research were taken into account in many ways. In the case studies conducted as part of the present study, research entities were selected in correspondence with the **theoretical sampling**. The short closed questionnaires applied in addition were used for a more figurative presentation of perceptions of interviewees and also served to assure that a small number of fixed questions were answered in a comparable way (for a more detailed description of the questionnaires please see B.4.4). It is important to remark, however, that it has not been strived for representativeness here and no quantitative sampling was done.

Triangulation has been realised in terms of theoretical perspectives, data sources and type, and methods. **Theoretical perspectives** are triangulated by regarding the interviewees as the subjects of interest but also considering their interaction and culture. **Data source** triangulation was assured by interviewing a large number of stakeholders from different stakeholder groups (e.g. protected area management, staff, and local community members). **Data type** triangulation was adopted through the utilisation of scientific as well as grey literature, governmental and international reports and also existing non-open access data in addition to the survey data gathered from interviews. Moreover, **methodological triangulation** (here corresponding to data gathering methods) was realised by applying open and closed questionnaires in individual and partly group interviews. Personal active and passive observation completes the range of methods applied in the data uptake of the present study. **Active observation** here refers to participation in biosphere reserve activities, for example in the gathering of recyclable material from the villages, **while passive observation** is done by being present without being involved in activities. Throughout the field visits more unrecorded conversations took place with local people, biosphere reserve staff, NGO staff and members of the biosphere reserve management body, thus furthering insights into the place-based situations.

For all methods applied, emphasis was placed upon the realisation of a **naturalistic inquiry** by visiting all interviewees in their day-to-day environments (in offices, private houses, on the field, at school, etc). This is done to further accountability, for example according to Lincoln and Guba (1985).

What has been tried in the present study is to create a picture of the numerous perceptions collected throughout the inquiry. Where quantitative secondary data was available (non-open access data), the gained impression was compared to such data (see subsections G.2.9 and G.3.9). It is one crucial point of the discussion, up to which point the overall lack of quantitative data can be compensated by qualitative social research (see section H.2). Reflections on limitations of the method applied in the present study are included in the discussion Chapter H, subsection H.1.1.

B.4.3 Analysis of qualitative data with ATLAS.ti

The central analytical task of qualitative research is to understand the tenor and meaning of the gathered data (Flick, 2006; Lamnek, 1995). Qualitative data may include text (transcripts, protocols of observations, media data, etc.), graphics, sound, and video. The raw data from qualitative research are often large amounts, primarily unstructured, potentially redundant and sometimes even contradictory. Everyday speech can be ambivalent, statements are usually context bound, and meanings may be hidden "between the lines" (e.g. Seale *et al.*, 2004).

ATLAS.ti is a software tool that belongs to a group of "Computer Assisted Qualitative Data Analysis Software" (CAQDA) tools besides, for example, MAXQDA (Kuckartz, 2007). It was developed in the late 80's and early 90's as part of a research project at the Technical University of Berlin and since then continuously advanced. While it does not automate the analysis of qualitative data – this task remains with the researcher for simple feasibility reasons – ATLAS.ti should be regarded as a workbench that helps to make raw data "describable" and "processable" (Muhr and Friese, 2004). It allows for organising, structuring and administering data files and examining their contents in a strategic manner (Muhr and Friese, 2004). The functions of ATLAS.ti are manifold but for the purpose of the present study only a limited number of functions were necessary and only these will be described in the following.

In the present study, qualitative data encompass text documents in the form of interview transcripts, conversation notes and observation protocols. All qualitative interviews as part of the thesis were recorded (if interviewees agreed), transcribed and analysed in ATLAS.ti. Transcripts do not all exist literally, on the one hand due to technical problems with the recorder, on the other hand due to intimidation of some local community members toward being recorded. However, notes have always been taken as circumstantial as possible and these notes were also processed in ATLAS.ti. Box B.1 defines the most common terms used in the data analysis with ATLAS.ti.

Box B.1: Definitions of most common terms used in the data analysis with ATLAS.ti (after Muhr and Friese, 2004)

Hermeneutic unit: The "idea container" of the project to be analysed in ATLAS.ti, including all data, families, codes, memos, etc.

Primary documents (PDs): Original data, for example interview transcripts and observation protocols.

Families: Clusters of PDs, codes, and memos for easier handling and systematic analysis of groups of codes, memos, or PDs.

Codes: The categories along which the data has been analysed.

Memos: Notes, comments and interpretations inserted by the analysing person.

Query: A search expression built from operands (codes and code families) and operators (e.g. AND, OR, NOT, etc.) that define the conditions that a quotation must meet to be retrieved (e.g., all quotations coded with both codes A and B).

In the process of data analysis, 7 essential steps were followed:

1. The project was created as a new "hermeneutic unit" (HU);
2. "Primary documents" were assigned to the hermeneutic unit;
3. "Families" of documents were created according to the different stakeholder groups interviewed and separately for the two case study sites (see Figure B.4);
4. The texts were read and "codes" assigned to text passages. In the same step, "memos" were written to document ideas and thoughts concerning the marked passages;
5. If the creation of a new code was considered necessary, the earlier text documents were re-coded;
6. "Queries" were done to investigate potential relations of codes and memos were written to keep track of the findings;
7. The coded text passages were allocated to the respective components of the Conservation Success Framework and results written under consideration of all quotations and memos in relation to the different components.

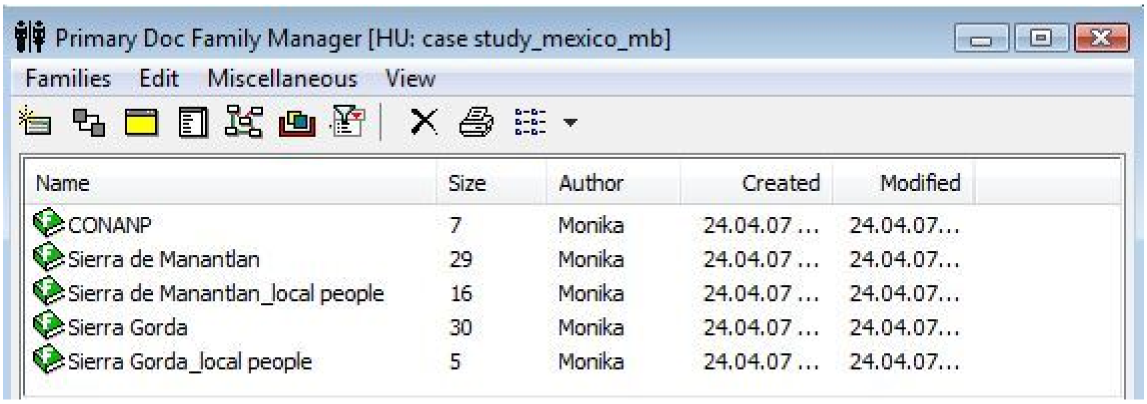


Figure B.4: ATLAS.ti snapshot of the Primary Document Family Manager with created families for the qualitative analysis of conducted interviews

As step 4 from the above list implies, a coding scheme plays an essential role in the analysis of qualitative data. This coding scheme can either be developed beforehand according to the baseline literature or theories, i.e. **deductively,** or by actively processing the data, i.e. **inductively** (Kuckartz, 2007). Alternatively, both approaches can also be applied comprehensively. This is what has been done in the present study. As the case studies were affiliated to the overall research framework of the Governance of Biodiversity (GoBi) Project (see section A.4), the coding scheme that arose from a long-term group process, using protected area expert interviews and relevant literature, was initially applied for the case studies (see Annex III). However, a smaller number of additional codes were added while processing the data in an inductive manner. Another deductive aspect arises from the beforehand development of the theoretical Conservation Success Framework to approach the respective research questions (see Chapter F).

B.4.4 Questionnaire development and analysis

The main case studies were conducted in the Mexican Sierra Gorda and Sierra de Manantlán Biosphere Reserves in March and April 2006. For these case studies, open (semi-structured) and closed multiple-choice questionnaires were developed based on 1) the results of the search for open access data, 2) the review of relevant literature for the development of the Conservation Success Framework and the CSF itself, and 3) personal experience gained through numerous protected area expert interviews conducted during the third World Conservation Congress in Bangkok, Thailand, in 2004, the meeting of the CBD Ad-Hoc Open Ended Working Group on Protected Areas in Montecatini, Italy, in

2005, and small-scale case studies carried out on Cuba, the Seychelles and in Thailand in the years 2004 and 2005.

For each interviewee, the interviewee's name, responsibility/position, years of experience in the region, and working history were noted. Distinctions were made between open questionnaires for interviewees in manager's positions, staff, external experts, local community members, and civil servants from the Comisión Nacional de Àreas Naturales Protegidas (CONANP), the governmental department in charge of protected area coordination on the national level (see subsection G.1.7). The interviews were conducted in a **semi-structured** manner, always spontaneously adapted to the interviewees' willingness and capacity to provide information. This was especially important when interviewees either proved more knowledge on specific issues than expected, or were not as familiar with the region, decision-making and management as expected, due to a lack of experience. By including the viewpoints of different stakeholder groups the triangulation of data was assured so as to increase authenticity of the information gained. Table B.1 defines the different groups of interviewees.

Table B.1: Interview groups differentiated in case studies and definitions

	Interview group	Definition
1	Biosphere reserve (BR) management	Those people working in some kind of management position, e.g. as director, or subdirector, either of the biosphere reserve directory, or of those institutions that are directly involved in the biosphere reserve (co-)management.
2	Biosphere reserve (BR) staff	Those people working as staff members under the above mentioned managers.
3	Local community members	Those people living in the communities within the biosphere reserve boundaries or in transition areas which are not paid for work by the biosphere reserve management or those institutions that are directly involved in the biosphere reserve (co-) management.
4	Civil servants	Those people working for a government agency outside the biosphere reserve (i.e. not local managers paid by the government).
5	External experts	Those people conducting projects or research, as well as consultative services for the biosphere reserve but without working under a contract through the biosphere reserve.

The number of interviews conducted per case study site is presented in Table G.4 and Table G.11, which are displayed in the result sections G.2 and G.3. Table B.2 lists the questions from the open questionnaires together with the group of interviewees referred to and a short explanation of nature and intention of the question. The complete open questionnaires are attached to this document as Annex V, an example interview transcript as Annex VII.

Table B.2: Questions from case study interviews, their nature and intention

No.	Question	Interviewee group	Nature and intention of the question
1	How are conservation objectives achieved in this biosphere reserve (BR)?	BR management, experienced BR staff, external experts	Open question to look at the approach of thinking about conservation achievements and potentially reveal **conservation actions** in place.
2	What is necessary to decide what to do and how to do it (eventually extended with: and under low resources?)	BR management, very experienced BR staff	Open question to look at the process of **decision-making** before taking action and potentially reveal **conservation capacity** at site.
3	What are the five main indicators for conservation success in the biosphere reserve?	BR management, BR staff, external experts	Open question to look at **understanding of indicators** and whether or not people make a clear connection to conservation achievements.
4	What are the five main indicators for biodiversity intactness/ecosystem health in the biosphere reserve?	BR management, BR staff, external experts	Open question as it was expected that many people refer to socio-economic **indicators** for question 3.
5	What effectiveness indicators are used to check progress towards conservation objectives?	BR management, experienced BR staff	Open question to look at **monitoring and evaluation systems** and decision-making processes.
6	What will local people tell me about changes in the environment they may have observed since establishment of the biosphere reserve?	BR management, BR staff, external experts	Open question to **cross-check** the local people's observations of changes since biosphere reserve establishment.
7	What are the major threats to biodiversity and challenges in the biosphere reserve?	BR management, BR staff, external experts, some local community members, civil servants	Open question complemented by closed questions (see further below) given only to managers and staff, feeding into the **conservation needs** component of the CSF.
8	The change of which factor would destroy the whole functioning biosphere reserve?	BR management, experienced BR staff, civil servants	Open question to identify the factor that is of major importance for ongoing biosphere reserve processes, feeding into the **conservation needs** component of the CSF.
9	What changes did you notice in the region since you started working here/with this biosphere reserve?	BR management, BR staff, civil servants	Open question to identify **noticeable effects from conservation actions** or otherwise impacts on the biosphere reserve.

Table B.2 (continued.): Questions from case study interviews, their nature and intention

No.	Question	Interviewee group	Nature and intention of the question
10	What changes did you notice in the region since this is a biosphere reserve /since you are living here?	Local community members	Open question to identify **noticeable effects from conservation actions** or otherwise impacts on the biosphere reserve.
11	Do the two biosphere reserves share a set of conditions supporting the achievements?	Civil servants	Open question to potentially identify **patterns of characteristics** supporting the achievement of conservation objectives.

In addition to the open questions a closed questionnaire was prepared. The closed questionnaire was intentionally handed out posterior to the open questions so as not to tamper the interviewees' open responses by issues included in the closed questionnaires. It consists of **two parts:** part **1)** refers to the identification of major **conservation needs** according to the "*Unified Classification of Direct Threats*" to biodiversity (IUCN-CMP, 2006b, slightly adapted); part **2)** refers to the **identification of changes** in given thematic issues, such as illegal activities, social acceptance, and biodiversity intactness/ecosystem health.

In **part 1,** interviewees were asked to give their opinion on the impact of the threats listed, with impact considered as the spatial extent in which the threat occurs plus the severity of the impact[5]. The questionnaire offered 4 different response categories: (a) no impact, (b) small impact, (c) medium impact, and (d) high impact. In case the interviewees did not feel they could provide a ranking the corresponding tick boxes remained empty.

In the analysis of this data, the **arithmetic mean** was calculated for every threat "i". In order to do so, no impact was calculated as 1, small impact as 2, medium impact as 3 and high impact as 4. The corresponding formula for the arithmetic mean (AM_i) is $\mathbf{AM_i = (x_{ai} * 1 + x_{bi} * 2 + x_{ci} * 3 + x_{di} * 4)/z}$, with x_{ai}, x_{bi}, x_{ci}, and x_{di} being the number of times each category had been selected by survey participants and z being the total number of valid replies. The normalised threat rank (n'_i) was then calculated as $\mathbf{n'_i = AM_i/r * r/AM_{max} = AM_i/AM_{max}}$, with r being the total number of response

[5] This is a recognised way of approaching the actual impact of threats, as e.g. to be seen in Table 3 of Leverington *et al.* (2008a). In the same source, the here selected Unified Classification of Direct Threats is used in management effectiveness evaluations.

categories (here 4) and AM_{max} being the overall maximum value occurring for one of the arithmetic means. The resulting threat ranks then all range between 0 and 1, with 0 resembling “no impact” and 1 “highest impact”. The tables displaying the results of this part of the closed questionnaire are Table G.5 and Table G.12 in chapter G.

In **part 2** of the closed questionnaire interviewees were asked about their opinion with respect to changes in a) integrity of biodiversity; b) illegal activities; c) local people’s awareness; and d) local people’s acceptance. For each aspect there were the response options “strong increase”, “increase”, “stable”, “decrease”, and “strong decrease”. The results were analysed by creating simple graphs in excel presenting the distribution of responses among the given response options (see subsections G.2.8 and G.3.8). Although it was expected from the beginning that the number of filled-in closed questionnaires will not be sufficient for a critical mass they were used to back up the qualitative information gained from open interview questions. However, no representativeness is claimed of course. The complete closed questionnaire is attached to this document as Annex VI.

When results are presented in chapter G the origin of the results will always be indicated by differentiating between results from the open questionnaire and results of part 1 of the closed questionnaire or of part 2 of the closed questionnaire.

C. *IN-SITU* BIODIVERSITY CONSERVATION SITES

"*The environment should not be expected to signal pain on being hurt; it is up to humanity, as a matter of moral principle, to recognise that pain might be imposed and to adopt appropriate avoidance (precautionary) measures.*"
(O'Riordan and Jordan, 1995: 3)

Chapter C provides background information on protected areas as the research objects of the present study. In the first section (C.1), a brief overview is given on the history of protected areas and the term "biodiversity" and the relation between the two issues. The second section (C.2) explains the development of today's understanding of protected areas and their functions. Section C.3 introduces to the different types of protected areas which are internationally recognised. As both case studies of the present study were conducted in biosphere reserves, the UNESCO-MaB Programme and the biosphere reserve concept are then described in more detail in section C.4. The next section, C.5, pinpoints some of the current challenges of the biosphere reserve concept. In section C.6, protected areas and biosphere reserves are discussed alongside each other to emphasise the transferability of the methods and findings of the present study to other types of protected areas. The chapter concludes with a short summary of its essence and meaning for the subsequent chapters (section C.7).

C.1 Protected areas and biodiversity in past and present

The earliest records of people setting aside areas of land to safeguard it from certain anthropogenic impacts (or "imposed pain" as coined in the statement given on the previous page) are dating back to the Mauryan kings of India who established forest and medieval rulers hunting reserves by 300 to 200 Before Christ (Bishop *et al*., 1995). However, from then on until the rise of the "modern" idea of **protected areas** more than 2000 years passed by. The official declaration of the Yellowstone region in the USA in 1872 as a "National Park", namely the world's first of its kind, is generally seen as the starting point of this modern approach to *in-situ* conservation (Bishop *et al*., 2004; Phillips, 2004).

The term **"biodiversity"**, however, had not yet been coined then – and would not be for more than another 100 years. Only the publication of the proceedings of the first National Forum on BioDiversity[6] in 1988 (Wilson and Peter, 1988) resulted in the final spread of the term among the conservation community. It then rapidly received increasing public attention, which manifested itself in a milestone of international cooperation: the Convention on Biological Diversity (CBD). In May 1992 in Nairobi, the CBD was adopted as international environmental law, "the Nairobi Final Act", at the Conference for the Adoption of the Agreed Text of the Convention on Biological Diversity (Secretariat of the Convention on Biological Diversity, 2005). In June 1992, it was signed by 150 countries worldwide at the United Nations Conference on Environment and Development (UNCED) in Rio de Janeiro[7], and in December 1993 the CBD entered into force. By now, around 190 states have signed and biodiversity is a non-debated essential component of natural and interdisciplinary sciences. Using www citation numbers as a measure for its popularity, Norse and Carlton (2003: 1475) concluded that „*although it could be argued that relativity [...] was the most powerful scientific idea from the twentieth century, biological diversity is now cited more than thrice as often*".

The protected area movement has certainly been influenced by the term as well and today it is rather unthinkable that discussions on protected areas will not be discussions on

[6] The first National Forum on BioDiversity (merged from "biological diversity") took place in September 1986 in Washington D.C. and the term "biodiversity" has been introduced by the staff of the National Research Council.
[7] This conference is also known as the "World Summit" or the "Rio Conference".

biodiversity at the same time. Box C.1 provides widely accepted definitions of the terms "biodiversity" and "protected area".

Box C.1: Definitions of the terms "biodiversity" and "protected area" (after the Secretariat of the Convention on Biological Diversity, 2005; and Dudley, 2008)

Biodiversity
The CBD in Article 2 defines biodiversity as "*the variability among living organisms from all sources, including, inter alia, terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part; this includes diversity within species, between species and of ecosystems*" (Secretariat of the Convention on Biological Diversity, 2005: 5).

Protected Area
The International Union for Conservation of Nature in their Guidelines for Applying Protected Area Management Categories defines a protected area as *"A clearly defined geographical space, recognised, dedicated and managed, through legal or other effective means, to achieve the long-term conservation of nature with associated ecosystem services and cultural values."* (Dudley, 2008: 8).

The biggest project ever to evaluate the status of the world's biodiversity has been initiated by United Nations Secretary-General Kofi Annan in the year 2000: the Millennium Ecosystem Assessment. More than 2000 contributors have summarised whatever knowledge exists on the changing state of nature and the corresponding relevance for human well-being. The results of the Millennium Ecosystem Assessment were published in 2005. One of the major findings is that "*Over the past 50 years, humans have changed ecosystems more rapidly and extensively than in any comparable period of time in human history, largely to meet rapidly growing demands for food, fresh water, timber, fibre, and fuel. This has resulted in a substantial and largely irreversible loss in the diversity of life on Earth.*" (Millennium Ecosystem Assessment, 2005d: 1).

During the same 50 years of time, protected areas as a measure to counteract this natural resource degradation gained considerable attention and the number of sites under protection increased from less than 10,000 to more than 120,000 sites globally (Chape *et al.*, 2005; UNEP-WCMC, 2008). By now, about 12.2% of the national terrestrial territory are covered by nationally designated protected areas (UNEP-WCMC, 2008).

Unfortunately, the protection of the marine realm lags far behind the one of the terrestrial realm. By the end of 2007 only 4435 marine protected areas (MPAs) were designated, covering 2.35 million square kilometres of sea surface approximately corresponding to only 0.65% of the world's oceans (Wood, 2007). As percentage of the world's territorial seas, in autumn 2008 marine protected areas covered 5.9% (UNEP-WCMC, 2008). These are astonishingly small amounts, especially when considering that more than 70% of the overall global surface is covered by seas and oceans (Cheung *et al.*, 2005). A similar serious under-representation has been identified for freshwater protected areas, with a best global estimate of only 1.54% of lake systems being protected (Dudley and Parrish, 2006). Above this, the idea of designating offshore and high seas[8] protected areas is still in its infancy (Bishop *et al.*, 1995; UNEP-WCMC, 2008)[9]. In many countries, however, the process of designating protected areas is still underway, and this is especially true for marine and freshwater ones.

The understanding of what protected areas are and how *in-situ* conservation is practiced changed considerably in time. The next section will therefore introduce to today's understanding of protected areas.

C.2 The understanding of protected areas in the 21st century

Two contrary paradigms to *in-situ* conservation were practiced through time: Traditionally, people were strictly excluded from protected areas, based on the assumption that conservation and human presence are incompatible (Büscher and Dietz, 2005; Phillips, 2003; Spierenburg and Wels, 2006). This approach to *in-situ* conservation was called "fences and fines" or "fortress" approach (Brandon and Wells, 1992). In many cases, the denial or reduction in public access to natural resources without adequate economic compensation or provision of alternative income opportunities resulted in resettlements and an increased poverty level of local communities (Lockwood and Kothari, 2006)[10]. This led to a growing loss of trust and support on the local level of *in-situ* conservation, was considered an impasse for conservation, and resulted in a remarkable shift to a very different paradigm.

[8] High seas are those marine areas outside of the 200 mile Exclusive Economic Zones of countries (WWF/IUCN, 2001).
[9] This is also reflected in the publication of a separate issue of the IUCN *Parks* Magazine in 2005 entitled "*High Seas Marine Protected Areas*", *Parks* 15 (3).
[10] In fact, resettlements still occur, especially where in a top-down approach to protected area designation a high level political decision is followed by the relocation of entire villages from their original location to somewhere outside the newly created protected area boundaries (Cernea and Schmidt-Soltau, 2006).

The today applied more holistic and “people centred” conservation approach does not necessarily exclude people but instead tries to actively involve different stakeholder groups in conservation (Brown, 2003; Phillips, 2003; Stoll-Kleemann, 2005)[11]. This conservation approach was for the first time openly and in front of a large audience addressed by the conservation community on the Third World Congress on National Parks and Protected Areas in Bali in 1982, where the importance of community involvement, the links between conservation and development and international collaboration were recognised (Phillips, 2003). The movement experienced further strengthening at the next World Congress on National Parks and Protected Areas in Caracas in 1992, and also the 1997 Albany Conference of the IUCN World Commission on Protected Areas under the title “*Protected Areas in the 21st Century: From Islands to Networks*” (IUCN-WCPA, 1998). In 2003, the Durban Accord and the Durban Action Plan, outcomes of the 2003 World Parks Congress in Durban, South Africa, once more highlighted the importance of creating synergies between conservation and sustainable development instead of regarding both as being incompatible and thus affirming a new paradigm for protected areas as follows: “*In this changing world, we need a fresh and innovative approach to protected areas and their role in broader conservation and development agendas. This approach demands the maintenance and enhancement of our core conservation goals, equitably integrating them with the interests of all affected people. In this way the synergy between conservation, the maintenance of life-support systems and sustainable development is forged. We see protected areas as vital means to achieve this synergy efficiently and cost effectively. We see protected areas as providers of benefits beyond boundaries on a map, beyond the boundaries of nation states, across societies, genders, and generations.*” (IUCN, 2005a: 220).

The theoretical grounding of this paradigm shift roots, for example, in a deeper understanding of the linkage between sustainable development and conservation, but also in human rights (Phillips, 2003). Conservation efforts need to affirm human dignity, as expressed in political, economic and cultural self-determination (e.g. Brechin *et al.*, 2002). On this basis, dialogue and negotiations are important tools for conservation which is primarily conceived as a social and political process. An extended comparison of the

[11] However, there is opposition against this new paradigm as well, for instance as expressed by Lock and Dearden (2005).

traditional and modern conservation paradigm is provided by Phillips (2003). The theoretical groundings are addressed in more detail in section D.1.

In the following sections and subsections, the variety of different protected area types will be introduced in the light of today's understanding of protected areas.

C.3 Protected area types

Reasons for the designation of a site as a protected area may vary from unique scenic beauty to biodiversity features that are considered to be worthy of protection[12]. Table C.1 provides an overview of potential reasons for the designation of protected areas.

Table C.1: Potential reasons for the designation of protected areas according to ecological organisation levels and conservation objectives

Objective / Level	Maintenance/protection	Recovery/restoration	Connectivity
Species	• To safeguard species/ habitats with high numbers of species and/or endemics; • To provide space for species in specific stages of their life cycle (e.g. breeding sites of sea turtles).	• To allow for recovery of populations of species; • To restore typical species communities and vegetation structures. inter-twined	• To provide space for migratory movements of single species or groups of species.
Ecosystems	• To conserve intact ecosystems and thus the goods and services they provide.	• To re-establish previously deteriorated functioning ecosystems and thus their goods and services.	• To provide space for shifting species distribution ranges and movements as a result of climate change.
Landscapes	• To respect and conserve cultural, aesthetic and/or religious significance of landscapes; • To conserve agricultural landscapes that have proved to be of importance for certain biodiversity values or sustainable use practices.	• To restore scenic beauty; • To restore landscapes of cultural, aesthetic and/or religious significance.	

[12] In Japan, for instance, Hiwasaki (2005) reports that "*land is not "set aside" for nature conservation, but designated as national park wherever the need to preserve "scenic beauty" has been recognised, regardless of land ownership or land use.*" (Hiwasaki, 2005: 753).

The various reasons translate into a broad range of options for protected area management objectives that have resulted in a large variety of protected area categories. Each country usually has its own legally established category system for protected areas, and category names according to protected area objectives have been chosen independently from one country to the next (Lockwood, 2006). This has led to over thousand names to describe protected areas (Chape *et al*., 2005), for instance about 50 alone in Australia (Phillips, 2004). Lithuania, as a comparison, only has nine main categories, but then further subdivides these into up to ten subcategories each (e.g. telmological and talasological state reserves) (Baškyte *et al*., 2006).

As an additional complexity, the category systems may vary not only between national levels but also on regional levels. Europe presents a good example for this complexity: While the Natura 2000 Programme aims at the creation of a European Union Network of Special Areas for Conservation (SACs) under the Birds and Habitats Directive (Simpson, 2002), Specially Protected Areas of Mediterranean Importance (SPAMIs) are declared under the Barcelona Convention (Da Cruz, 2002), and Areas of Special Conservation Interest (ASCIs) for the whole of Europe are declared as part of the Emerald Network that resulted from the Bern Convention (Fernández-Galliano, 2002).

Moreover, as a final escalation of complexity, many sites have multiple designations, for example a national, a regional and several international ones plus an officially assigned IUCN protected area management category (see next subsection for details). In fact, there is one site in Europe that is involved in *seven* international agreements and programmes (Harrison, 2002) – whereby the value of every single one of them becomes questionable. Consequently, confusion arose among the conservation community, as on an international level a protected areas' census or comparative studies have become nearly impossible due to the wide variety of different category names, although many of them overlap or exactly correspond to each other according to their definitions (Bishop *et al*., 2004).

The following two subsections provide a brief description of the globally agreed IUCN protected area management categories, as well as further global initiatives and programmes which also recognise and designate specific sites. Section C.4 then has a special focus on UNESCO's biosphere reserve concept as biosphere reserves represent the main objects under investigation of the present study.

C.3.1 IUCN protected area management categories

In 1978 the International Union for Conservation of Nature (IUCN) published the first version of a generally agreed protected area management category system, consisting of ten different protected area types. However, limitations of the system soon became apparent, such as a vague scope of what was to be covered and unclear distinctions of the categories (Dudley, 2008; Phillips, 2004). Hence, after thorough revision a new version was passed in 1994, now consisting of six protected area management categories that differ from each other in what management objectives are foreseen to be of priority and what activities should be avoided (see Table C.2 after Dudley, 2008).

Approximately 60% of all protected areas are classified under the IUCN system for protected area management categories (Lockwood, 2006; UNEP-WCMC, 2008). The six categories are also increasingly incorporated into national legislation systems to reduce the above described complexity of categories (Dillon, 2004; Stolton *et al*., 2004). In order for a site to be officially assigned to one of the IUCN categories, an application needs to be submitted for each site by the national government and meet certain criteria (Chape, 2004). The site retains its original name and also receives the category number of the IUCN management category that has been allocated. This number is included in the periodically published United Nations List of Protected Areas and the World Database of Protected Areas run by the UNEP-World Conservation Monitoring Centre (UNEP-WCMC, see Chape *et al*., 2003). The assignment of marine protected areas to one of the six categories requires special consideration and is discussed in Kelleher (1999) and Wells and Day (2004).

Ravenel and Redford (2005) trace back the history of the IUCN protected area categories and investigate the trend towards increasing human presence inside protected areas along with the explained paradigm shift in conservation. Further information and explanation on the correct use and implementation of the categories is provided by Bishop *et al.* (2004), Dudley and Philipps (2006) and Dudley (2008). A new guidebook for applying the IUCN protected area management categories was launched at the World Conservation Congress in Barcelona in October 2008 (Dudley, 2008). The guidebook includes a slightly changed definition of protected areas compared to the one agreed on and published in 1994 (IUCN, 1994) and aims to facilitate the application of the categories in practice. Table C.2 presents and defines the IUCN protected area management categories.

Table C.2: IUCN protected area management categories (after Dudley, 2008)

Category	Name	Definition
Ia	**Strict Nature Reserve**	Category Ia are strictly protected areas set aside to protect biodiversity and also possibly geological/geomorphological features, where human visitation, use and impacts are strictly controlled and limited to ensure protection of the conservation values. Such protected areas can serve as indispensable reference areas for scientific research and monitoring.
Ib	**Wilderness Area**	Category Ib protected areas are usually large unmodified or slightly modified areas, retaining their natural character and influence, without permanent or significant human habitation, which are protected and managed so as to preserve their natural condition.
II	**National Park**	Category II protected areas are large natural or near natural areas set aside to protect large-scale ecological processes, along with the complement of species and ecosystems characteristic of the area, which also provide a foundation for environmentally and culturally compatible spiritual, scientific, educational, recreational and visitor opportunities.
III	**Natural Monument**	Category III protected areas are set aside to protect a specific natural monument, which can be a landform, sea mount, submarine cavern, geological feature such as a cave or even a living feature such as an ancient grove. They are generally quite small protected areas and often have high visitor value.
IV	**Habitat/Species Management Area**	Category IV protected areas aim to protect particular species or habitats and management reflects this priority. Many category IV protected areas will need regular, active interventions to address the requirements of particular species or to maintain habitats, but this is not a requirement of the category.
V	**Protected Landscape/Sea-scape**	A protected area where the interaction of people and nature over time has produced an area of distinct character with significant ecological, biological, cultural and scenic value; and where safeguarding the integrity of this interaction is vital to protecting and sustaining the area and its associated nature conservation and other values.
VI	**Managed Resource Protected Area**	Category VI protected areas conserve ecosystems and habitats, together with associated cultural values and traditional natural resource management systems. They are generally large, with most of the area in a natural condition, where a proportion is under sustainable natural resource management and where low-level non-industrial use of natural resources compatible with nature conservation is seen as one of the main aims of the area.

As announced earlier there are several other international protection designations for *in-situ* conservation areas. The most widespread will be introduced in the following.

C.3.2 Further globally recognised protected area designations

In addition to the titles agreed upon under the IUCN protected area category system there are some other recognised titles for areas, which are, at least in parts, dedicated to support and realise biodiversity conservation. This subsection only introduces to those sites that are designated under initiatives and programmes with global coverage. Regionally recognised sites will not be detailed any further.

The three major globally recognised designations of protected areas besides the ones under IUCN standards are Ramsar Wetlands of International Importance, UNESCO World Heritage sites, and UNESCO Man and the Biosphere (MaB) Reserves (Lockwood, 2006).

Ramsar Wetlands of International Importance are declared under the Ramsar Convention, "*an intergovernmental treaty that provides the frameworks for national action and international cooperation for the conservation and wise use of wetlands and their resources*" (Taylor, 2002: 42). The Ramsar Convention, which was initiated in 1991 in the Iranian town of Ramsar, is now signed by 154 member parties and the list of Wetlands of International Importance now consists of 1650 sites totalling 1,496 million square kilometres (Secretariat of the Convention on Wetlands, 2007). Each contracting party is required to at least designate one site which is supposed to be managed in order to maintain its ecological character. Those sites that are endangered by degradation may be listed on the "*Montreux record*" and may seek a Ramsar Advisory Mission to assist in finding a solution for the problem at place (Taylor, 2002).

The UNESCO World Heritage Convention arose from the United Nations Conference on the Human Environment held in Stockholm in 1972 and took effect in 1975 (Thorsell, 2003). **World Heritage sites** may either be natural, cultural, or mixed sites. The most important criterion for inscription to the World Heritage List is "*outstanding universal value*" in terms of natural and/or cultural features (UNESCO, 1972). This criterion aims at creating a list of sites which represent the "best of best" examples for *uniqueness* of natural and cultural value worldwide. However, in the biodiversity conservation context, only the natural (and eventually mixed) World Heritage sites are comparable to other protected area designations. IUCN acts as the technical advisory body for natural sites and is the key organisation for the evaluation of sites proposed for inscription and monitoring of sites recorded on the "*List of World Heritage in Danger*" (UNESCO-WHC, 2006). By the end of 2008, 679 cultural, 174 natural and 25 mixed sites were recorded from 145 of the 185 State Parties to the Convention (UNESCO-WHC, 2008).

The second of UNESCO's instruments for biodiversity and ecosystem conservation is represented by the **biosphere reserve concept**. Being a main focus of this study, the biosphere reserve concept will be introduced separately in the following section.

C.4 The UNESCO MaB Programme and the biosphere reserve concept

According to Batisse (1993) UNESCO's Man and the Biosphere (MaB) Programme *"was the first deliberate international effort to identify ways and means of sustainable development of terrestrial ecosystems"* (Batisse, 1993: 3). UNESCO's MaB Programme itself arose from the 1968 Conference on the Rational Use and Conservation of the Resources of the Biosphere as an international and interdisciplinary research programme to summarise knowledge and specialists on sustainable natural resource use and management (Batisse, 1986). One of the major achievements of the MaB Programme is the biosphere reserve concept, which was born in the early 1970s. According to UNESCO (1987: 18) biosphere reserves were then defined as "*...protected areas of representative terrestrial and coastal environments which have been internationally recognised under the UNESCO MaB Programme for their value in conservation and in providing the scientific knowledge, skills and human values to support sustainable development. Biosphere reserves are united to form a worldwide network which facilitates sharing of information relevant to the conservation and management of natural and managed ecosystems.*" The first biosphere reserves (BRs) were designated in 1976, most of them at this point in time in the United States (UNESCO-MaB, 2005).

By the beginning of 2008, the number of sites increased to now 531, located in 105 countries (some of which are transboundary sites, one even a trans-continental site) (UNESCO-MaB, 2008). Each of these sites contributes to the World Network of Biosphere Reserves (WNBR). Figure C.1 details the increase in the number of biosphere reserves worldwide since the establishment of the concept.

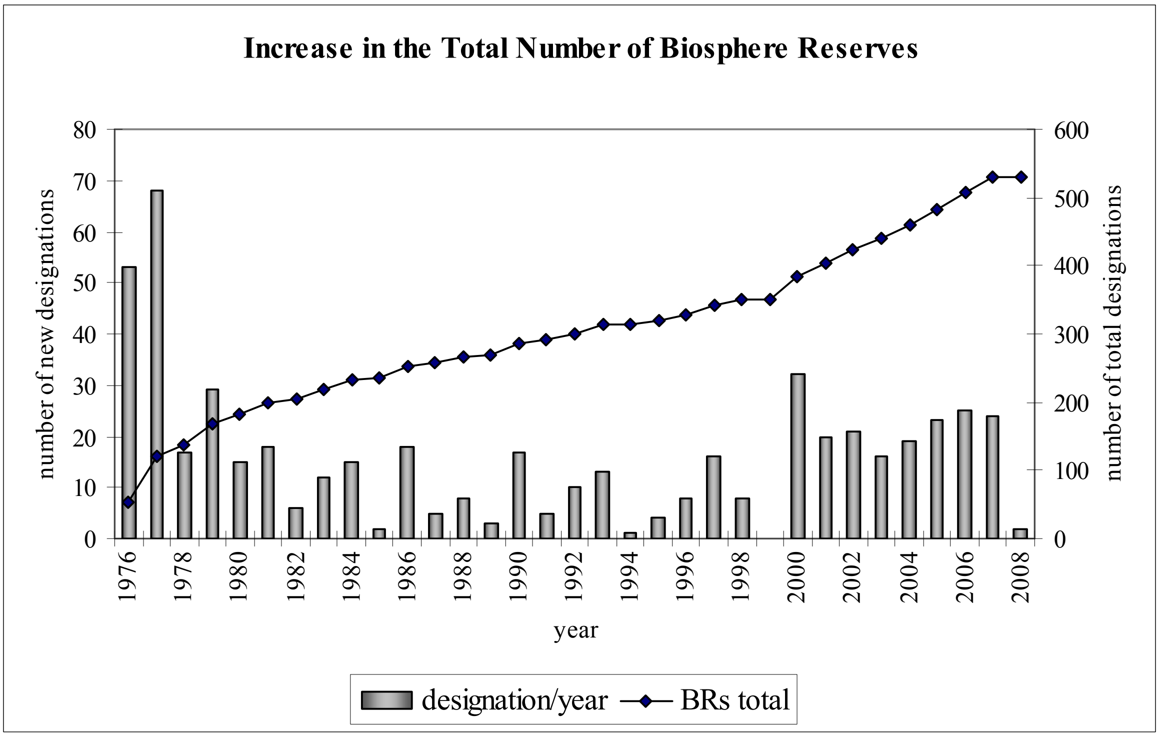


Figure C.1: Increase in the global number of biosphere reserves between 1976 and 2008 (data source: UNESCO-MaB, 2008)

Since the establishment of the biosphere reserve concept, Biosphere Reserves Congresses take place approximately every 12 years (UNESCO, 2008a). A so-called *Action Plan for Biosphere Reserves* arose from the First International Biosphere Reserve Congress in Minsk in 1983, organised by UNESCO and UNEP in cooperation with FAO and IUCN (UNESCO Executive Board, 1985). This Action Plan proposed a range of activities for the comprehensive implementation of the biosphere reserve concept to the member states of the MaB Programme. The Advisory Committee for Biosphere Reserves, established in 1991 by the Executive Board of UNESCO, subsequently evaluated the progress towards the targets defined in this Action Plan. Next, a strategy for the role of biosphere reserves in the 21st century was elaborated. The results of the evaluation as well as the draft strategy were presented at the International Conference on Biosphere Reserves in Seville, Spain, in 1995. Together with some 400 experts from 102 countries a draft "**Statutory Framework**" of the World Network of Biosphere Reserves and the "**Seville Strategy**" as a visionary instrument for biosphere reserves in the 21st century were compiled (UNESCO, 1996). The following subsection provides a brief overview of the main contents of these two important outputs of the Seville Conference.

C.4.1 The Seville Outcomes

The **Statutory Framework** of the WNBR "*has been formulated with the objective of enhancing the effectiveness of individual biosphere reserves and strengthening common understanding, communication and co-operation at regional and international levels*" (UNESCO, 1996: 16). It sets the "rules of the game" for the definition, designation, and functioning of biosphere reserves and the biosphere reserve concept. Box C.2 defines biosphere reserves and clarifies their functions after UNESCO (1996).

Box C.2: Definition and functions of biosphere reserves (after UNESCO, 1996)

Statutory Framework, Article 1 – Definition (UNESCO, 1996: 16)
Biosphere Reserves are areas of terrestrial and coastal/marine ecosystems or a combination thereof, which are internationally recognised within the framework of UNESCO's programme on Man and the Biosphere (MaB), in accordance with the present Statutory Framework.

Statutory Framework, Article 3 – Functions (UNESCO, 1996: 16)
In combining the three functions below, biosphere reserves should strive to be sites of excellence to explore and demonstrate approaches to conservation and sustainable development on a regional scale:

(i) conservation - contribute to the conservation of landscapes, ecosystems, species and genetic variation;
(ii) development - foster economic and human development which is socio-culturally and ecologically sustainable;
(iii) logistic support - support for demonstration projects, environmental education and training, research and monitoring related to local, regional, national and global issues of conservation and sustainable development.

The threefold functions of biosphere reserves (see Box C.2) are sought to be accomplished by establishing a zonation system, with "*core areas, which have to be strictly protected to meet the conservation objectives; the buffer zone, which should be clearly delimited for management purposes; and the transition area, which can extend over the territory where co-operation with local people for sustainable development can be organised.*" (Batisse, 1993: 3). Figure C.2 illustrates the zonation as proposed for biosphere reserves. In practice, there is often more than one core area established. The Mata Atlântica Biosphere Reserve along the coast of Brazil probably provides the most complex structure a biosphere reserve can possibly have as it includes several hundred core areas while passing through 15 Brazilian states and covering an area of about 350,000 square kilometres (Lino and de Moraes, 2005).

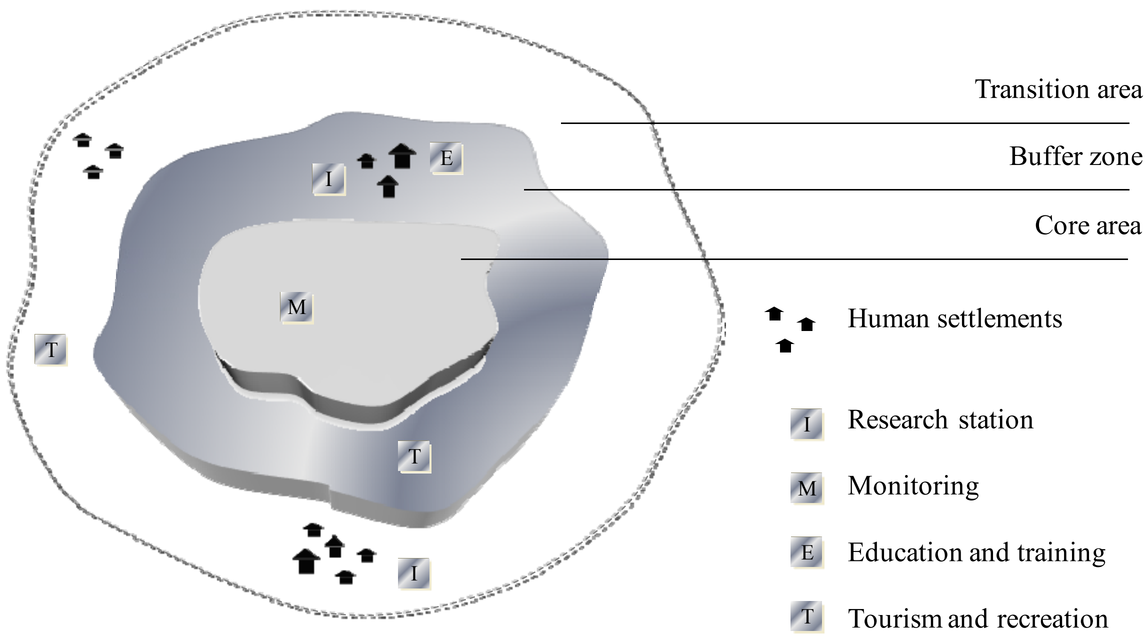


Figure C.2: Zonation system of biosphere reserves (after UNESCO, 2000)

The **Seville Strategy** adopts the original biosphere reserve concept to the expected challenges of the 21st century. It is founded on ten key directions for the vision of the world's biosphere reserves in the future and defines four major goals with several objectives each, as shown in Box C.3.

Box C.3: Major goals and objectives of the Seville Strategy (after UNESCO, 1996)

Goal I:	**Use Biosphere Reserves to Conserve Natural and Cultural Diversity**
Objective I.1:	Improve the coverage of natural and cultural biodiversity by means of the World Network of Biosphere Reserves
Objective I.2:	Integrate biosphere reserves into conservation planning
Goal II:	**Utilise Biosphere Reserves as Models of Land Management and of Approaches to Sustainable Development**
Objective II.1:	Secure the support and involvement of local people
Objective II.2:	Ensure better harmonisation and interaction among the different biosphere reserve zones
Objective II.3:	Integrate biosphere reserves into regional planning
Goal III:	**Use Biosphere Reserves for Research, Monitoring, Education and Training**
Objective III.1:	Improve knowledge of interactions between humans and the biosphere
Objective III.2:	Improve monitoring activities
Objective III.3:	Improve education, public awareness and involvement
Objective III.4:	Improve training for specialists and managers
Goal IV:	**Implement the Biosphere Reserve Concept**
Objective IV.1:	Integrate the functions of biosphere reserves
Objective IV.2:	Strengthen the World Network of Biosphere Reserves

The Seville Strategy has led to a "*new dynamism*" of biosphere reserves (UNESCO, 1999). Subsequently to its adoption, MaB National Committees were restructured, regional biosphere reserve networks established[13] and the "*periodic review*" process (Article 9 of the Statutory Framework) was established as a mechanism to encourage the coherent implementation of the biosphere reserve concept (Price, 2002; UNESCO, 1999).

C.4.2 From Seville to Madrid

Five years after Seville the status of implementation of the Seville Strategy was evaluated at the occasion of the 16th session of the MaB Council in Pamplona, Spain. This "Seville +5" International Meeting of experts on the implementation of the Seville Strategy resulted in a comprehensive list of conclusions and suggestions for the future of biosphere reserves and the World Network of Biosphere Reserves (UNESCO, 2001). Bridgewater (2001b) summarises the conclusions of specific importance by pointing at four major issues:

- Science represents the necessary base for a satisfactory biosphere reserve network;
- The biosphere reserve network is vitally concerned with the conservation of biodiversity and must be linked with sustainable human development;
- Local people are the key to success (or failure) in any biosphere reserve; and
- Biosphere reserves are as much about economy as ecology.

Based on Seville + 5, Bridgewater (2001a: 1) comments on the understanding of biosphere reserves by stating that "*The new generation of biosphere reserves is a precursor of the types of flexible, large-scale co-management systems, seen by the World Commission on Protected Areas as an imperative for viable protected areas in the future*". Moreover, biosphere reserves are regarded as being model regions for the implementation of the CBD ecosystem approach, a strategy for the integrated management of land, water, and living resources, that promotes conservation and sustainable development in an equitable way (Bridgewater, 2001a; Bridgewater, 2002; UNESCO, 2000). In addition, it is also proposed that lessons learned from biosphere

[13] AfriMAB, ArabMAB, CYTED (Ibero-American Programme for the Development of Science and Technology), EABRN (East Asian Biosphere Reserve Network), EuroMAB (Covering 50 countries in Europe and North America), IberoMAB (Latin American Biosphere Reserve Network aiming at strengthening the MAB Programme in Latin American countries, Spain and Portugal), PacMAB (Pacific Man and the Biosphere Network of the Federated States of Micronesia, Kiribati, Palau and Samoa) and Redbios (Red del Atlántico Este de Reservas de Biosfera including the Canary Islands (Spain), Cape Verde, Mauritania, Madeira and Azores (Portugal), Morocco and Senegal) (UNESCO, 2007).

reserves are to be considered in the design of protected areas as well as in their integration into the broader landscape (IUCN, 2005a).

In February 2008 the Third World Congress of Biosphere Reserves took place in Madrid, Spain. The progress since the Seville meeting was revised, critical discussion points around the concept were picked up, and the role of biosphere reserves in the face of global change and international conservation and development targets were discussed. The main outputs are the Madrid Declaration and the Madrid Action Plan, which were adopted by the International Coordinating Council (ICC) and are summarised in the following subsection.

C.4.3 The Madrid Outcomes

The Madrid Declaration and the Madrid Action Plan frame the most recent definition and role of individual biosphere reserves and the World Network of Biosphere Reserves. Both documents build on the Seville Strategy and were informed by a consultation process of Member States (via regional networks, such as EuroMaB) and involving the MaB bureau, the International Advisory Committee and the MaB Secretariat. (UNESCO, 2008b; UNESCO, 2008c)

The **Madrid Declaration** urges the UNESCO, its Member States and the Secretariat to **optimise the use of biosphere reserves** to promote sustainable development and the functioning of the World Network of Biosphere Reserves to exchange knowledge and share lessons learned during the United Nations Decade of Education for Sustainable Development (UNDESD, 2005-2014). The Secretariat is to be committed to reviewing the implementation of the Seville Strategy and to identifying recommendations for an improvement of the implementation on multiple scales is emphasised. The declaration furthermore stresses the **importance of cooperations** within the UN system, especially UNDP and UNEP, to demonstrate the contribution of biosphere reserves to achieving international commitments (e.g. the Millennium Development Goals). **Sustainable funding** of biosphere reserves and related institutions represents a special focus to reinforce the concept and enable the implementation of the Madrid Action Plan. The potential for action regarding “new challenges”, such as climate change, demography, and the loss of traditional knowledge is emphasised, as well as the potential of biosphere reserves as places for investment and innovation. Once again, the **promotion of MaB**

and the World Network of Biosphere Reserves as global, regional and national fora for people's engagement in seeking solutions to local problems and targets is underlined. Finally, variations in the naming of biosphere reserves are officially recognised while the term "biosphere reserve" is agreed to be maintained due to its international degree of popularity. (UNESCO, 2008c)

The **Madrid Action Plan**, based on the briefly introduced declaration, clarifies the agreed actions to be targeted in biosphere reserves and MaB related institutions (MaB National Focal Points, the MaB Secretariat, etc.) between 2008 and 2013. Four main action areas have been identified: 1) cooperation, management and communication; 2) zonation – linking functions to space; 3) science and capacity enhancement; and 4) partnerships.

These four main action areas include a total of 31 targets and 65 actions to achieve the revised vision and mission of the MaB Programme (see Box C.4 for the vision and mission). The targets are linked to success indicators, responsibilities for action are determined and partners listed. (UNESCO, 2008b)

Box C.4: Vision and Mission Statement for the World Network of Biosphere Reserves (after UNESCO, 2008b)

Vision

The World Network of Biosphere Reserves of the Man and the Biosphere Programme consists of sites of excellence to foster harmonious integration of people and nature for sustainable development through participation, knowledge sharing, poverty reduction and human well-being improvements, cultural values and society's ability to cope with change, thus contributing to the Millennium Development Goals (UNESCO, 2008b: 5).

Mission

To ensure environmental, economic, social (including cultural and spiritual) sustainability through:

- Development and coordination of a worldwide network of places acting as demonstration areas and learning sites with the aim of maintaining and developing ecological and cultural diversity, and securing ecosystem services for human well-being;
- Development and integration of knowledge including science for advancing our understanding of interactions between people and the rest of nature;
- Building global capacity for the management of complex socio-ecological systems particularly through encouraging greater dialogue at the science-policy interface, environmental education and multi-media outreach to the wider community (UNESCO, 2008b: 6).

C.5 Challenges of the biosphere reserve concept

The outcomes of the Madrid Congress emphasise some important challenges of the biosphere reserve concept, mainly relating to the subsequent three issues:

1. The actual realisation of the concept and the World Network of Biosphere Reserves in practice (IUCN, 1998a; Rösler, 1996);
2. The unfortunate choice of the term "*biosphere reserve*" (McNeely, 1982; Phillips, 1998b; Rösler, 1996); and
3. The placement and importance of biosphere reserves alongside the IUCN protected area management categories.

So far, as it was experienced in the GoBi Project, knowledge exchange between biosphere reserves is limited, as is the functioning of the World Network of Biosphere Reserves. There is – as much as it is the case for protected areas – a general lack of financial capacity that impedes on the implementation of the biosphere reserve concept in all its facets (Schliep *et al.*, subm.). The importance of the review process was again clearly stressed. In addition, and compared to the Seville Strategy, the importance to clarify the contribution of biosphere reserves to international commitments is more emphatically stressed.

Overall, the Madrid declaration aims at demonstrating the valuable niche which biosphere reserves can fill in the face of the growing challenges of global change. The importance of urbanisation and climate change in the Madrid Action Plan clearly support this movement. Unfortunately, the targets and success indicators of the Madrid Action Plan mostly lack a clear definition or a comparable base as the current status of many of the success indicators is unknown[14]. This clearly questions the feasibility of the defined actions.

The flexibility of the biosphere reserve concept is often praised advantageous for its implementation. Yet, a higher flexibility may also allow for too many options of interpretation, several of which could be misleading. The global survey that was conducted in the GoBi Project has proven that when only looking at zoning schemes of

[14] For instance action area 3 target 23 is "A mechanism for biosphere reserves to address urban issues in a regional context". The corresponding action is "Facilitate the integration of urban areas into biosphere reserves" and the success indicator "Number of biosphere reserves integrating urban areas". However, it remains unclear what is actually meant with "mechanism" and the number of biosphere reserves integrating urban areas must not indicate the existence of a mechanism to address urban issues in a regional context.

different biosphere reserves a series of misinterpretations become apparent, for example relating to buffer zones missing or unimplemented. In addition, the functioning of the World Network of Biosphere Reserves depends on the up-to-dateness of the respective database – which is in large parts seriously out of date as research within the GoBi Project likewise revealed (unpublished results). The concept though lacks much more than financial resources and partnerships to approach its own realisation.

For several countries the use of the term "reserve" is inadequate in the light of their history. This applies for instance to South Africa where the term "reserve" raises memories of the Apartheid regime, but also to other countries for different reasons. It is at least partly therefore that in some countries biosphere reserves have alternative names, such as biosphere regions, areas, territories, etc. (UNESCO, 2008b). Wherever the title alone raises antagonism to the concept, its implementation may be bound to fail.

The third issue mentioned above will be separately addressed in the following section due to its importance for the transfer of the results of the present study from biosphere reserves to other protected areas.

C.6 Protected areas and biosphere reserves – differences and common grounds

While biosphere reserves were recognised as a separate protected area category in the first categorisation system compiled by IUCN in 1978 they were then excluded from the list in the system's revised version of 1994 (IUCN, 1994). Several arguments have finally led to this exclusion (after Bridgewater *et al.*, 1996; Phillips, 1998a):

- Biosphere reserves do not follow the primary aim of biodiversity protection and/or conservation *in each of the three zones*, while this is the necessary condition for allocation to one of the protected area management categories under IUCN standards;
- The multiple objectives of biosphere reserves usually allow for allocation of parts of the biosphere reserve to one or more of the IUCN protected area categories;
- Many times the transition area of biosphere reserves (if defined and included) does not apply to any of the IUCN protected area management categories (linked to point 1 as the transition area does not aim at biodiversity protection and/or conservation);

- While biosphere reserves are an international designation they are not necessarily bound to national law. "*Their existence is thus a matter of national, regional and local values, not an imposed exterior arbitrary code.*" (Bridgewater *et al*., 1996: 4).

Table C.3 relates the three zones of a biosphere reserve to the IUCN protected area management categories according to Phillips (1998a).

Table C.3: Relationship between IUCN protected area management categories and biosphere reserve zones (after Phillips, 1998a)

IUCN Category	Biosphere Reserve Zone		
	Core area	Buffer zone	Transition area
I to III	yes	no	no
IV	yes	yes	no
V	no	yes	perhaps
VI	perhaps	yes	perhaps
yes = compatibility of management purposes no = incompatibility of management purposes perhaps = management purpose may be compatible			

As a matter of fact, the majority of biosphere reserves has more than one designation. In most cases one or more of the core areas are legally established national parks, strict nature reserves, wilderness areas and/or world heritage sites (Phillips, 1998a). In addition, there are also cases in which other protected areas are designated within the buffer zone or transition area. However, the biosphere reserve concept offers kind of a frame for those protected areas already established as well as for other protected areas to be established according to the designated zones. Vice versa, the IUCN protected area management category system can inform the planning, management and effectiveness of biosphere reserves (Bishop *et al*., 2004; Bridgewater *et al*., 1996). As Price (2002) states: the concept of biosphere reserves was "*implemented directly through the World Network of Biosphere Reserves and implicitly through the design and management of many protected areas around the world.*" (Price, 2002: 13). Jeffrey McNeely in the year 1982 used a still much more direct wording: "*... a biosphere reserve is not just another pretty place; it's an idea and an approach to management. In an ideal world, all protected areas would be managed in a "biosphere reserve manner"...In this sense, all of the world's protected areas may one day be "biosphere reserves" as well, or at least managed in a "biosphere reserve manner".*" (McNeely, 1982: 59).

There is thus an obvious complementarity of biosphere reserves and protected areas. The historical surplus of the biosphere reserve concept - the parallel focus on sustainable development - strongly emphasises this complementarity, as it is by now recognised in the milestone documents for protected areas as an essential component (The CBD Programme of Work on Protected Areas and the Durban Action Plan). Ishwaran (2005: 21) frames it this way: all the dimension of biosphere reserves "*are now integral part of the "modern" protected area paradigm as understood at the 5th World Parks Congress in 2003.*"

Many protected areas today have declared buffer zones surrounding them[15]. With management activities increasingly outstretching into these buffer zones, the setting largely resembles biosphere reserve's core areas and buffer zones[16]. Vice versa, biosphere reserves do not always have a declared transition area[17], which means they may consist of the same components as a national park with a buffer zone. In several countries, biosphere reserves belong to the national protected area category systems and so are considered protected areas – at least on a national level (e.g. in Germany, Mexico, Canada, etc.).

Against this background, an inconsistency in the inclusion and exclusion of biosphere reserves in the communication of protected areas is considered problematic. Rösler (1996) states that "*On the UNESCO Conference on Biosphere Reserves in Sevilla, Spain, in 1995, it was decided that Biosphere Reserves are not a category for protection*" (Rösler, 1996: 47). The Madrid outcomes reflect that there are notions to define a niche for biosphere reserves that justifies for the concept to be in place besides today's modern protected areas[18]. While it is obviously true that the principles of implementation of the

[15] This leads back to the suggested activity 1.2.3 of the Programme of Work on Protected Areas, which calls the Parties of the CBD to "*Integrate regional, national and sub-national systems of protected areas into broader land- and seascape, inter alia by establishing and managing [...] and/or buffer zones, where appropriate, to maintain ecological processes and also taking into account the needs of migratory species.*" (Secretariat of the Convention on Biological Diversity, 2005: 1269, decision VII/28).

[16] Although it still needs to be taken into account that management structures of biosphere reserves may be very different from those of protected areas. While some biosphere reserve do have a certain management authority, others are managed by fairly heterogeneous "management bodies". Some specialists therefore even prefer to talk about "coordinators" in the case of biosphere reserves, instead of "managers" (Bioret, 2001).

[17] However, the Madrid Declaration now called for a clear determination of biosphere reserve boundaries, including the transition areas. This was not obligatory before February 2008.

[18] The Madrid Action Plan, e.g., claims that it aims to "*raise biosphere reserves to be the principal internationally-designated areas dedicated to sustainable development in the 21st century*" (UNESCO, 2008b: 1)

latter now resemble to those of the biosphere reserve concept in several aspects (see Ishwaran, 2005), it is considered questionable whether it is actually necessary to force up a bigger distinction between protected areas and biosphere reserves. Instead, the optimisation of the use of the existing complementarity effects could be far more emphasised.

In addition, what should definitely be taken into consideration is how to deal with biosphere reserves in the face of international conservation goals. So far, biosphere reserves may contribute largely to the national percentage of territory coverage under protection, as they are usually large in size, especially when a transition area is designated. However, the latter is not conforming to any of the international protected area designations, and so the country coverage under protection may become considerably biased in an international comparison (e.g. Barsch, 2008). This issue becomes even more important now that transition areas are a must-designate according to the Madrid agreements (UNESCO, 2008b). More clarity and guidance is thus urgently needed to acknowledge the contribution of biosphere reserves to international targets while staying honest towards these commitments at the same time.

The case studies conducted as part of the present study very well reflect the contribution of the two researched biosphere reserves to biodiversity conservation. It is believed that the developed research method as well as insights gained could very well also apply to other protected areas in general. In the following, as it is done in much of the recognised literature quoted so far, the term "protected areas" may also include biosphere reserves. Where necessary, distinctions will be clarified.

C.7 Essence of chapter C

Protected areas are considered as the cornerstones of *in-situ* biodiversity conservation. However, their traditional role to protect nature (or specific features of nature) has largely changed and expanded through the years. Today their role is not only to maintain and/or restore biodiversity, but also to conserve cultural values, support sustainable development, and educate and attract visitors, besides others. This has lead to a variety of different protected area types with different priority management objectives. Six protected area management categories, developed by the International Union for Conservation of Nature, are globally recognised. However, other global *in-situ* conservation approaches exist, and one of them, the UNESCO-MaB biosphere reserve concept, plays a special role in the present study as both case studies were conducted in biosphere reserves. The biosphere reserve concept represents a holistic approach to reconciling nature conservation with sustainable development. However, internationally, biosphere reserves have undergone some conceptual changes since they came into existence in the early 1970's and have repeatedly been subject to debates in conservation concerning their functions and principal objectives. While the UNESCO therefore tries to define a more concrete niche for biosphere reserves besides protected areas and other international *in-situ* conservation initiatives, they are still oftentimes largely overlapping with protected areas and are fully treated as protected areas in several countries. Against this background, the focus of this study, information gaps and bridging options in assessing *in-situ* conservation achievements, well applies to biosphere reserves and protected areas in equal measure. Chapter C has established the background knowledge for this understanding.

D. Socio-Political Context and Effectiveness of Protected Areas

"*National parks and other kinds of protected areas cannot be understood in isolation from the social, political, economic and ecological processes which affect them. Ultimately, solutions for many of the threats facing protected areas belong in the realm of national and international politics*." (McNeely, 1995: 23)

Chapter D outlines the socio-economic context of protected areas, clarifies its influence on the management effectiveness of protected areas, and summarises the current knowledge on protected area effectiveness.

Section D.1 begins with the theory of common pool resource use with an emphasis on the special case of protected areas. Against this background, the issue of protected area governance is explained and the recognised protected area governance types are presented. The concept and role of stakeholder participation in protected area governance and management is then introduced as a widely promoted means to address the common pool resource challenge and contribute to the effectiveness of protected areas.

Based on this context, section D.2 summarises the current knowledge on the effectiveness of protected areas and corresponding management and assessment methods. Monitoring and evaluation, the key activities for such assessments, are separately addressed. The chapter concludes with an overview of information needs for assessing the effectiveness of protected areas in conserving biodiversity *in-situ* (subsection D.2.3).

D.1 The socio-political dimension of conservation

In-situ conservation takes places in coupled human-environment systems, also called socio- or social-ecological systems (e.g. Turner *et al*., 2003; Young *et al*., 2006). Protected areas have social, economic and political effects on their surroundings and vice versa (West *et al*., 2006). This is also expressed in the statement of Jeffrey McNeely quoted at the beginning of chapter D.

Chapter C explained the evolution of *in-situ* conservation to a highly complex multidisciplinary dimension: While the establishment and management of protected areas under the "fines and fences" approach to conservation was a question of legally setting aside space, under the holistic approach it turns into a question of poverty alleviation, peace, sustainable resource use, property rights, stakeholder engagement, empowerment, incentives, and numerous other sensitive issues, many of which relate to human rights and dignity. This multidisciplinary dimension is further examined in the following subsections, which focus on selected aspects of the socio-political dimension of conservation that are of special importance for the present study. The underlying social theory that relates to these aspects is briefly introduced as well.

D.1.1 Protected areas and common pool resources

The implementation of protected areas represents, in most cases, a change in local natural resource use policies. Many times, the natural resources concerned were before accessible for different stakeholder groups as "*common pool resources*". Gibson *et al.* (2000) define common pool resources as "*goods that can be kept from potential users only at great cost or with difficulty but that are subtractable in consumption and can thus disappear*" (Gibson *et al*., 2000: 28). Consequently, common pool resources share one characteristic with public goods (the cost of exclusion) and one with private goods (subtractability) (Nagendra and Ostrom, 2008). Large-scale common pool resources include, for instance, the world's oceans outside the countries' exclusive economic zones, or international rivers and lakes (Nagendra and Ostrom, 2008). On a smaller scale, all natural resources that follow the two characteristics described above belong to common pool resources.

Centuries Before Christ, Aristotle already argued that "*What is common to the greatest number gets the least amount of care. Men pay most attention to what is their own: they* *care less for what is common*“[19]. However, this concept only gained major attention again in the late 1960’s, when Garrett Hardin published an article entitled “*The tragedy of the commons*” (Hardin, 1968): Hardin argued that natural resources, as long as they are perceived as common pool resources, are condemned to be overexploited. He concluded that “*freedom in a commons brings ruin to all*” (Hardin, 1968: 1244) and regarded government (or private) ownership and strict enforcement of regulations for access and use of resources as the only solution to the tragedy of the commons.

The decisions upon changes in common property regimes and the use of common pool resources are oftentimes taken by governmental decision-makers in a **top-down** approach (Armitage, 2008; Asian Development Bank, 2008; Lovell *et al.*, 2002; Tietenberg, 2002). Hardin’s conclusion stimulated national governments to declare “*government ownership the only way to save resources from destruction*” (Nagendra and Ostrom, 2008: 1). A crucial challenge of such top-down decision-making is the multi-dimensional distance between the decision-makers and the people affected by the decisions: There may not only be spatial distance, but also a distance between livelihood standards, habits, and day to day concerns. This multi-dimensional distance may generate difficult-to-overcome obstacles to the successful implementation of resource use policies.

The establishment of a protected area can be regarded as the attempt to exclude the inside resources from common pool resources and thus safeguard them from overexploitation. However, many cases are known where the establishment of a protected area happened in a top-down approach against the will of affected people, disrupting their traditionally existing property regimes and/or resulting in their (further) impoverishment (e.g. Cernea and Schmidt-Soltau, 2006; Colchester *et al.*, 2006; Pathak *et al.*, 2005). The ignorance of people’s needs in early stages of protected area planning and establishment but also in the management of an established protected area can thus create serious conflicts and has done so repeatedly (Brockington and Igoe, 2006; Carey *et al.*, 2000). Moreover, badly planned or unethical conservation practices towards human communities may not only result in conflicts but also in negative consequences for biodiversity, as illustrated in Figure D.1. In such cases, the imposition of government control to local conditions in a top-down approach does not solve but worsen the tragedy of the commons.

[19] Aristotle (384-322 B.C.), in his book *Politics*, book II, chapter III (quoted in Baden and Noonan, 1998).

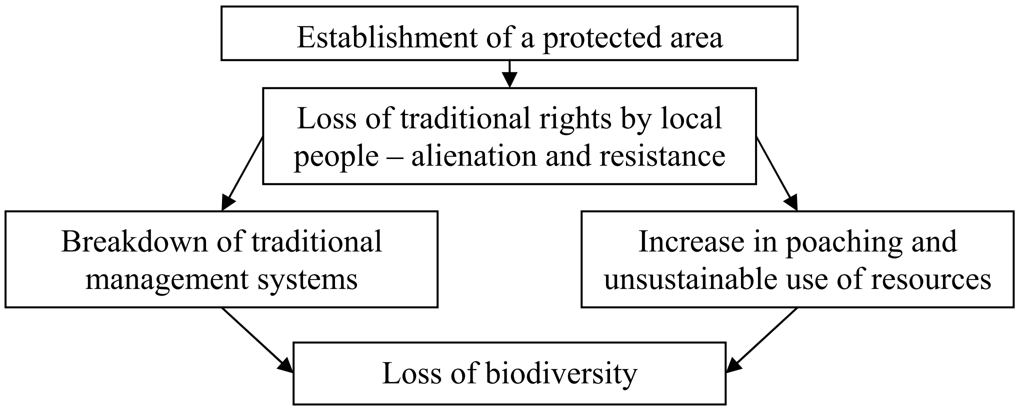


Figure D.1: Potential biological consequences of badly planned or unethical conservation practices towards human communities (after Carey *et al.*, 2000)

Practical evidence questions Hardin's proposed solution of government ownership and top-down control to the tragedy of the commons and led to numerous debates about successful management of common pool resources (e.g. Berkes *et al.*, 1989; Dietz *et al.*, 2003; Ostrom, 2007; Ostrom *et al.*, 2007). For example, Berkes *et al.* (1989) provide examples for communities who themselves created institutional arrangements to assure sustainability of the common pool resources they depend on, and today numerous such examples are known (e.g. Kothari, 2006; Kothari *et al.*, 2000). Ostrom (1998: 68) emphasised that "*rules, physical and material conditions, and community attributes shape action arenas and incentives faced by individuals*" and that "*these conditions combine to determine outcomes.*" Here, rules, physical and material conditions and community attributes need to be considered as variables that can be expressed in many different potential values leading to a large variety of socio-ecological systems. Considering government ownership as a "universal remedy" to all resource use challenges would imply that all socio-ecological systems react in the same way upon imposed governmental control systems, which is clearly not the case (Ostrom, 2007; Ostrom *et al.*, 2007). Instead, different property regimes and approaches to common pool resource management impact on outcomes by shaping incentives of resource users and resource managers (Agrawal, 2003; Ostrom, 1998).

Agrawal (2001) conducted a review of influential studies on facilitating conditions for sustainable management of the commons. He provides a list of critical enabling conditions which are grouped into 1) resource system characteristics, 2) group characteristics, 3) relationship between resource system characteristics and group characteristics, 4) institutional arrangements, 5) relationship between resource system and institutional arrangements, and 6) external environment (Agrawal, 2001). In total, Agrawal (2001) lists 33 such critical enabling conditions, ranging from “shared norms” (group characteristics) and “ease in enforcement of rules” (institutional arrangements) to “appropriate levels of external aid to compensate local users for conservation activities” (external environment). The broad range of conditions impacting on the sustainable use of natural resources again stresses the argument that there cannot be a single solution to every resource use challenge within different socio-ecological systems.

Agrawal and Ostrom (2006) therefore emphasise the need to examine where governance processes intersect with ecological systems, and identify how they are organised and how they can be strengthened in favour of more effective natural resource management. This would contribute significantly to the understanding of the integral link between socio-economic-cultural and ecological systems, which is the very base for achieving sustainability (Folke *et al.*, 2007). The Institutional Analysis and Development Framework (IAD) is one approach that can be used for such an examination (e.g. Agrawal and Ostrom, 2001; Pomeroy and Goetze, 2003): It links the characteristics of a physical environment (including its natural resources) with those of the general cultural setting to identify and analyse interactions between the physical environment and socio-cultural and institutional realms (Ostrom, 1994; Ostrom, 1998; Ostrom, 2005). The present study partly resembles an Institutional Analysis; however, an individual research framework, adapted to the research focus, has been developed and applied here (see Chapter F).

Today, many institutional arrangements are established for the management of protected areas. This has led to the recognition of different “governance types” in the protected area context which will be introduced in the following subsection.

D.1.2 Protected area governance

The debates on natural resource management summarised in subsection D.1.1 stimulated discussion about existing management regimes in protected areas. In some countries, decentralisation is considered a way to overcome the mentioned distance between decision-makers and those local stakeholders which are affected by political decision-making in natural resource use (Agrawal and Gupta, 2005; Scanlon and Burhenne-Guilmin, 2004), as this may mean that governmental entities are responsible for decision-making on a level closer to the natural resources at stake. However, it may also mean that management decisions are taken by other institutions than the government (see Table D.1). Berkes (2007: 15189) claims the "*assumption of ownership of wildlife resources by the state*" to be a "*historic anomaly*". As mentioned earlier, many cases are known where local communities themselves have created institutional arrangements to assure sustainability of the resources they depend on (see also Hayes and Ostrom, 2005). However, several other options exist, each based on separate rules and institutional arrangements. Based on this trend of diversification of institutional settings, Stoll-Kleemann *et al.* (2003: 247) state "*Government is becoming governance as the twenty-first century dawns.*"

The questions of who has the power to decide, and how power and responsibility is distributed and used is covered by the term "*governance*". Box D.1 defines the term after the Institute on Governance (2002).

Box D.1: Definition of the term "governance" (after the Institute on Governance, 2002)

Governance is the interaction among institutions, processes, and traditions that determines how power is exercised, how decisions are taken on issues of public and often private concern, and how citizens or other stakeholders have their say. Fundamentally, governance is about power, relationships, and accountability: who has influence, who decides, and how decision-makers are held accountable. Governance may be used in different contexts – global, national and local, and social and institutional. Governance occurs wherever people organise themselves – formally and informally – to develop rules and relationships with each other in pursuing their objectives and goals.

Governance arrangements in the protected area context express themselves through legal and policy frameworks, strategies and action plans including mechanisms for tracking progress in implementing policies and plans and for monitoring effectiveness (Scanlon and Burhenne-Guilmin, 2004). The decision-making arrangements in and around protected areas, the distribution of resources and responsibilities, and the organisational structures of protected areas are the result of the existing social and (national) political system. Governance aspects constitute a part of the working conditions for protected area management and influence its effectiveness (Abrams *et al*., 2003).

Borrini-Feyerabend (2003) distinguishes between four different protected area governance types which are further divided into subtypes (see Table D.1). This division into subtypes demonstrates the variety of institutional arrangements within the four governance types.

Table D.1: Protected area governance types and subtypes (after Borrini-Feyerabend, 2003)

Governance type	Subtypes
A. Government managed protected areas	Federal or national ministry or agency in charge
	Local/municipal ministry or agency in charge
	Government-delegated management (e.g. to an NGO)
B. Co-managed protected areas	Transboundary management
	Collaborative management (various forms of pluralist influence)
	Joint management (pluralist management board)
C. Private protected areas	Declared and run by individual land-owner
	Declared and run by non-profit organisations (e.g. NGOs, universities, etc.)
	Declared and run by for profit organisations (e.g. individual or corporate landowners)
D. Community-conserved areas	Declared and run by indigenous people
	Declared and run by local communities

Protected areas declared and managed by the government represent the "classical" protected area management regime and were mentioned earlier already. However, **government managed protected areas** also include areas which are managed by an NGO to which the management has been delegated by the government. When Hardin published his article on the tragedy of the commons (Hardin, 1968), such a variety of governance types was not yet recognised and it remains unknown whether he would have considered government-delegated management as a part of his proposed solution.

Co-managed protected areas allow for a large number of different management structures. Definitions for the term "co-management" in natural resource management are numerous (Borrini-Feyerabend *et al.*, 2004b). Borrini-Feyerabend *et al.* (2004a: XV) define a co-managed protected area as a "*Government-designated protected area where decision-making power, responsibility and accountability are shared between governmental agencies and other stakeholders, in particular the indigenous peoples and local and mobile communities that depend on that area culturally and/or for their livelihoods.*" In this case, and in contrast to the following two governance types, the designating institution is again the government. Among co-managed protected areas, transboundary management was the earliest practised subtype, following the expansion of Albert National Park across the borders of the colonies of Belgian Congo and Ruanda-Urundi[20] (Chester, 2006).

Private protected areas may be owned by individuals, communities, corporations or non-governmental organisations (Mitchell, 2005). Private protected areas are no innovation of the 21st century, as the first private land trust came into existence in the USA as early as 1891 (Langholz, 2005). Many private protected areas have no formal (legal) protected area designation and are considered fragile by some as resource use rights may quickly change when these private properties are sold to another owner (Mitchell, 2005). However, their potential contribution to global biodiversity conservation is considered to be substantial (Sims-Castley *et al.*, 2005, and other contributions in the same journal issue).

Community-conserved areas are "*Natural and modified ecosystems, including significant biodiversity, ecological services and cultural values, voluntarily conserved by indigenous peoples and local and mobile communities through customary laws or other effective means*" (Borrini-Feyerabend *et al.*, 2004a: XV). Despite the long history of conservation through local communities and numerous examples for successful maintenance of natural resources at such sites, most community-conserved areas are located outside protected areas and they are only seldom recognised in formal national protected area systems or international protected area databases (Borrini-Feyerabend and Dudley, 2007; Brown and Kothari, 2002; Kothari, 2006; Pathak *et al.*, 2005). However, community-conserved areas receive increasing attention, for instance at international conservation events (Kothari, 2006).

A combination of protected area governance types with IUCN protected area management categories leads to a matrix of multiple combinations of protected area governance and management schemes (Borrini-Feyerabend *et al.*, 2004a). Existing examples can be found for every resulting combination, which indicates that governance types are "category neutral" (Borrini-Feyerabend *et al.*, 2004a: 24). However, as mentioned earlier, especially many private and community-conserved areas are not yet assigned to an IUCN protected area category (e.g. Kothari, 2006; Mitchell, 2005); thus

[20] Ruanda-Urundi: "*A league of Nations territory under Belgian rule*" (Chester, 2006).

the various combinations within such a matrix are not equally represented in terms of numbers.

As each of the governance types listed may prove effective under certain conditions, it is not easy to determine which of them is best suited for a specific situation. However, there is agreement on a series of characteristics that constitute “good governance”, comprising voice and accountability, political stability and absence of violence, government effectiveness, regulatory quality, rule of law, and control of corruption (International Bank for Reconstruction and Development / World Bank, 2006). Good governance is considered to be one of the most important factors for poverty alleviation and sustainable development (Hill, 2004; International Bank for Reconstruction and Development / World Bank, 2008; United Nations, 2002) and therefore also plays a significant role in the protected area context.

The different governance types and subtypes presented in Table D.1 potentially involve numerous stakeholders in protected area decision-making, such as NGOs, individual land owners, universities, indigenous people and local communities. Stakeholder participation may have a significant impact on the successful implementation of protected areas and is therefore addressed separately in the following subsection.

D.1.3 Stakeholder participation in protected area decision-making

Several of the protected area governance types suggest that management decisions need not be taken by a single authority. The involvement of stakeholders in protected area governance and management can help to avoid “*authoritarian protectionism*”, a term coined by Wilshusen *et al.* (2002), and thus supports the shift away from the “fences and fines” approach to conservation (see section C.2). Today, a “participatory” approach to *in-situ* conservation is regarded almost mandatory (e.g. Global Environment Facility, 1999; Margoluis and Salafsky, 1998; Phillips, 2003; Scanlon and Burhenne-Guilmin, 2004; Stoll-Kleemann and Welp, 2008).

Existing definitions of the term “stakeholder participation” allow for a broad range of variation in the degree of participation realised (Berghöfer and Berghöfer, 2006; Pretty, 2002): While the term may be understood as the pure process of informing stakeholders about decisions taken, it may also culminate in the complete transfer of responsibilities to a certain stakeholder, for instance a local community living in or adjacent to a protected area, or a group of stakeholders. Table D.2 provides a classification of different levels of community participation adapted from Singh *et al.* (2000).

Table D.2: Classification of different levels of participation (adapted from Singh *et al.*, 2000)

Level of participation	Nature of participation
1. Provision of free labour	While in earlier days communities were forced to provide free labour it is now tried to persuade them to provide free labour or other inputs for public projects, especially those designed by others to be for “the community’s benefit”.
2. Prior information about the project/activity	Involves informing affected people of the impending project or activity that will have an impact on their lives.
3. Public hearings	Involves communicating to the affected people, in advance, details of the proposed activity or project and giving them the opportunity to express their views on the impacts of the project.
4. Consulting the people	Involves discussing with the people the sorts of interventions required to address the problem that they are facing.
5. Sharing control with the people (joint management)	Involves the seeking of the community’s approval before activities or projects are initiated in their defined area.
6. Absolute control	Involves the community solely having the power to decide on the management and use of a resource.

The long-term involvement of stakeholders in decision-making processes creates social capital and represents a form of empowerment (O'Riordan and Stoll-Kleemann, 2002; Pretty, 2002). Empirical evidence shows that empowerment of stakeholders in biodiversity conservation activities and decision-making may increase acceptance of regulations and by doing so reduce external pressures on biodiversity conservation efforts (e.g. Ancrenaz *et al.*, 2007; Asian Development Bank, 2008; Lebel *et al.*, 2008). Redford and Fearn (2007: 11) claim that “*Given the limited capacity of most governments in developing countries to enforce existing regulations, […], conservation success is likely dependent on local acceptance or resistance*.” The empowerment of people, especially in the rural tropics, is generally considered a promising strategy to improve biodiversity conservation efforts (Ehrlich and Pringle, 2008). According to O’Riordan and Stoll-Kleemann (2002: 91) in an ideal case of socio-economic empowerment “*communities obtain collective responsibility for their own future and become managers of their own development.*” Achieving this may help solving the tragedy of the commons and this argument has become one of the drivers for the increased implementation of participatory approaches in natural resource management.

Margoluis and Salafsky (1998: 23-24) identify six principle characteristics of full and successful stakeholder participation in conservation and development projects:

1. It gives stakeholders **control** over how project activities affect their lives;
2. It is essential to sustainability as it leads to a better **understanding** of the importance of conservation and inspires a greater **commitment** to long-term conservation goals;
3. It generates a **sense of ownership** which usually means that stakeholders are more likely to support and defend the project when necessary;
4. It provides an **opportunity for learning** as it builds capacity and facilitates exchange of information;
5. It leads to **responsibility** (closely linked to principle 3) for the achievement of objectives;
6. It is not exclusive to or controlled by one group but instead every stakeholder group should have **equal access and equal voice**.

Ideally, participation turns into partnership between the different stakeholder groups, implying an agreed vision for biodiversity conservation and sustainable resource use (Hemmati *et al.*, 2002; Stoll-Kleemann and O`Riordan, 2002). However, despite the numerous and convincing arguments for stakeholder participation, some challenges need to be considered: Where people are not accustomed to being part of decision-making processes, the realisation of stakeholder participation usually requires for long-term capacity building activities, including public education and the strengthening of social networks (Millennium Ecosystem Assessment, 2005a). Equal access of all stakeholders to information on the resources at stake and the decision-making processes as such is another major requirement if stakeholder participation is to succeed (Millennium Ecosystem Assessment, 2005a). These requirements increase the time and resources needed for the implementation of resource use policies under participation of stakeholders (Ostrom, 1999; Stoll-Kleemann and Welp, 2008). In addition, social, political, cultural, ethnic and economic differences may exist among different stakeholders (Colfer and Byron, 2001), resulting in different or even competing interests in the resources concerned.

If informed decisions are to be mutually agreed upon, a large portion of tolerance, mutual respect, willingness to find consensus and a well developed sense of justice are required

(Hemmati *et al.*, 2002). Otherwise the participation of stakeholders may slow down decision-making processes considerably and come at the expense of biodiversity conservation. Therefore, the involvement of stakeholders in decision-making and management of natural resources does not guarantee success (Margoluis and Salafsky, 1998; Stoll-Kleemann and Welp, 2008), and a range of different perspectives exists on the degree of participation vs. top-down enforcement needed (e.g. Stoll-Kleemann, 2005).

In addition to stakeholder participation, further empowering measures relevant to biodiversity conservation are security of tenure, material benefit-sharing mechanisms, development inputs, training and education, and social recognition (Kothari, 2000; O'Riordan and Stoll-Kleemann, 2002; Oviedo *et al.*, 2000). The results of the case studies, conducted as part of the present study, demonstrate the importance of such incentives in practice for the overall effectiveness of protected areas (see subsections G.2.8 and G.3.8).

D.2 The effectiveness of protected areas

The previous section has examined numerous aspects which have an influence on the effectiveness of protected areas, such as the socio-political context, governance arrangements and the consideration of stakeholder needs and interests. This section now provides an overview of the state of knowledge on the effectiveness of protected areas and corresponding assessment methods.

While protected areas are widely regarded as an effective means for *in-situ* biodiversity conservation (e.g. Chape *et al.*, 2005; Gidda and Mulongoy, 2004; Millennium Ecosystem Assessment, 2005d), the growing pressure on the world's resources heavily impedes on the achievement of conservation objectives. At the same time, however, protected areas are used as performance indicators in international conservation agreements, such as the "2010 Target" of the Convention on Biological Diversity (CBD): At the 2002 World Summit on Sustainable Development in Johannesburg, 190 countries agreed to "*…achieve by 2010 a significant reduction of the current rate of biodiversity loss at the global, regional, and national level […].*" (Secretariat of the Convention on Biological Diversity, 2005, decision VI/26, p. 948). One of the indicators identified in order to check the progress already made toward reaching this ambitious target is the world's coverage of protected areas (Balmford *et al.*, 2005a; Balmford *et al.*, 2005b). However, only those protected areas that do in fact achieve their conservation objectives truly contribute to compliance with the CBD 2010 Target (Chape *et al*., 2005). Therefore, activity 4.2.2 of the CBD Programme of Work on Protected Areas is to "*implement management effectiveness evaluations of at least 30 percent of each Party's protected areas by 2010 and of national protected area systems, and, as appropriate, ecological networks*" (Secretariat of the Convention on Biological Diversity, 2005: 1279). In addition, protected area managers are also increasingly required to evaluate their effectiveness in achieving conservation objectives for funding and accountability reasons (e.g. Leverington *et al*., 2008a; Parrish *et al*., 2003).

Research has shown that legal declaration can itself help protect an area from some pressures (Rodriguez and Rodriguez-Clark, 2001). In their study on impacts of anthropogenic threats on 93 protected areas, Bruner *et al.* (2001: 125) conclude that "*the majority of parks are successful at stopping land clearing, and to a lesser degree effective at mitigating logging, hunting, fire, and grazing.*" However, there are numerous examples known where this is not the case, and several studies have expressed growing concern about the success of protected areas in achieving their targets (e.g. Carey *et al.*, 2000; Depondt and Green, 2006; Dudley *et al.*, 2003; Jepson *et al.*, 2002; Liu *et al.*, 2001; Nellemann *et al.*, 2007), not only in developing countries but also in industrialised ones (e.g. Haslett, 2002)[21]. An extreme example is the Chinese Wolong Nature Reserve, one of the world's first "panda parks", where a study revealed that degradation inside the park has increased to levels higher than in areas outside the park since the reserve's establishment in 1975 (Liu *et al*., 2001). Illegal logging is reported to occur in 37 out of 41 protected areas in Indonesia (Nellemann *et al*., 2007). A comprehensive assessment of protected area effectiveness conducted by WWF International on more than 200 forest protected areas also emphasises that a legal protected area status does not necessarily result in the effective protection of site-specific natural values (WWF, 2004). Protected areas that are unable to maintain the values for which they were established are known as "paper parks". Dudley and Stolton (1999: 7) define a paper park as "*a legally established protected area where experts believe current protection activities are insufficient to halt degradation.*"

[21] Considering this, some members of the conservation community have even called for a return to stricter protection through authoritarian enforcement practices. According to Wilshusen *et al.* (2002: 18) "*they argue that dire circumstances require extreme measures.*"

D.2.1 Methods for assessing the effectiveness of protected areas

Concerns about the paper park issue have triggered calls for assessing the effectiveness of protected areas. Such assessments usually refer to "protected area management effectiveness", a term that comprises the effectiveness of three main components of protected area management according to Hockings *et al.* (2000): design issues relating to both individual sites and to protected area systems; appropriateness of management systems and processes; and delivery of protected area objectives. The terms in use in the present study, "conservation success" and "conservation achievements", most closely relate to the third of the three components, the delivery of protected area objectives. They are further discussed in chapter F.

The need for effectiveness assessments was first openly discussed at the 3rd World Congress on National Parks in Bali in the year 1982 (Leverington *et al*., 2008a). In the year 1995 IUCN's World Commission on Protected Areas (WCPA) set up a Management Effectiveness Task Force[22] to address the paper parks issue. This task force developed the protected area management effectiveness framework, a general framework that proposes the consideration of a carefully selected set of factors in effectiveness assessments. The selected factors, which have all been identified as potentially influencing a site's performance, are allocated to the six steps of an ideal **adaptive management** cycle for protected area management as depicted in Figure D.2 (after Hockings *et al.*, 2006).

Adaptive management, according to Salafsky *et al.* (2001: 12), is defined as follows: "*Adaptive management incorporates research into conservation action. Specifically, it is the integration of design, management, and monitoring to systematically test assumptions in order to adapt and learn*." The importance of adaptive management systems for *in-situ* conservation sites is widely acknowledged (e.g. IUCN, 2004; Oglethorpe, 2002; Salafsky *et al.*, 2002). Salafsky *et al.* (2001) define a starting point, five necessary steps and the iteration link as essential elements of an adaptive management system:

Start: *Establish a clear and common purpose*
Step A: *Design an explicit model of your system*
Step B: *Develop a management plan that maximises results and learning*
Step C: *Develop a monitoring plan to test your assumptions*

[22] In the year 2001 this task force was replaced by the WCPA Thematic Programme on Management Effectiveness of Protected Areas.

Step D: *Implement your management and monitoring plans*

Step E: *Analyze Data and Communicate Results*

Iterate: *Use results to adapt and learn*

These elements reflect the same logic as the adaptive management cycle after Hockings *et al.* (2006) (Figure D.2).

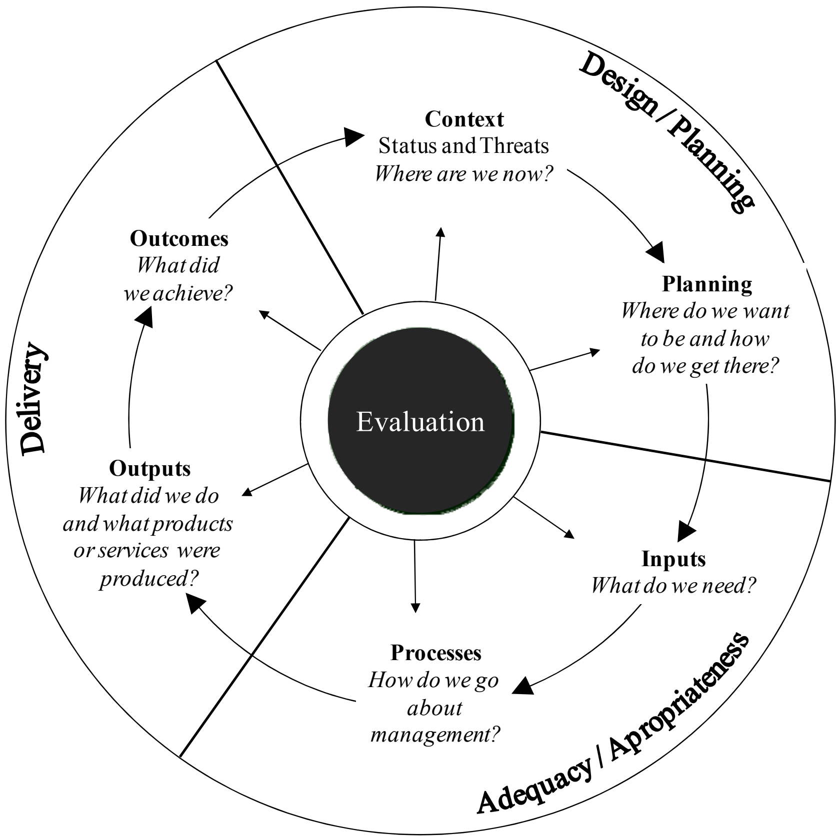


Figure D.2: The adaptive management cycle (after Hockings *et al.,* 2006)

Several approaches used for protected area effectiveness assessments are based on the adaptive management concept and the protected area management effectiveness framework developed by the WCPA task force, such as the Site-based Management Effectiveness Tracking Tool after Stolton *et al.* (2003) and WWF's Rapid Assessment and Prioritisation of Protected Area Management (RAPPAM) methodology (Ervin, 2003). While the Tracking Tool has strict limitations in terms of site comparison, the RAPPAM methodology enables "*a rapid assessment of the overall management effectiveness of protected areas within a particular country or region"* (Ervin, 2003: 3) and has been applied to the protected areas in South Africa (Goodman, 2003), China

(Diqiang *et al*., 2003), Bhutan (Tshering, 2003), Russia (Tyrlyshkin *et al*., 2003), Cambodia (Lacerda *et al*., 2004) and Nepal (Nepali *et al*., 2006), among others. Separate approaches have been developed for the special case of marine protected areas (e.g. Pomeroy *et al.*, 2005; Staub and Hatziolos, 2004; Wells and Mangubhai, 2004).

A differentiation of assessment methods can thus be made according to the scope of their application:

- Single site evaluations with focus either on the evaluation of management effectiveness or ecological integrity (see Table D.3 for example studies);
- Protected area portfolio evaluations, with portfolio representing a series or collection of protected areas (Gaston *et al*., 2006; Pressey and Taffs, 2001); and
- Protected area network evaluations, with networks ideally representing and safeguarding a whole country's, continent's, or even the world's ecosystems (e.g. Mora *et al.*, 2006; Pressey and Taffs, 2001; Rodrigues *et al.*, 2004; Soutullo and Gudynas, 2006).

The most recent study on the global number of protected area management effectiveness evaluations recorded over 6,300 existing assessments (Leverington *et al*., 2008a). They are mostly based on the RAPPAM methodology (applied in more than 1,400 protected areas) and the Tracking Tool (applied in more than 1,000 protected areas). The study also reveals that management effectiveness increased in 193 out of 263 sites with repeated evaluations and decreased in about 60 sites (Leverington *et al*., 2008a). Leverington *et al.* (2008b) also provide a good overview of a large number of different approaches for assessing management effectiveness.

Table D.3: Examples for studies on protected area management effectiveness

	Study	Focus	Short method description
Terrestrial	Blom *et al.* (2004)	Examination of the status of the protected areas of the Central African Republic in the light of their potential for long-term protection of biodiversity.	Existing data about the protected areas was compiled and combined with the authors' own experiences, government sources and expert interviews. Mid- and long-term conservation potential was quantified assessing the following factors: threat, biodiversity significance, integrity and management. Scores of each factor were then averaged for an overall assessment of conservation potential.

Table D.3 (continued): Examples for studies on protected area management effectiveness

	Study	Focus	Short method description
Terrestrial	Bruner *et al.* (2001)	Evaluation of the effectiveness of 93 parks in 22 tropical countries in protecting biodiversity.	Effectiveness assessed from three perspectives: land clearing within the boundaries of parks since establishment, current condition of parks compared with the condition of their surroundings, and factors correlated with effective park protection.
	Struhsaker *et al.* (2005)	Evaluation of problems and correlates of success for 16 African forest protected areas.	Collection of quantitative and qualitative information (except monitoring data as it was not available). Allocation of overall success score to each evaluated protected area. Application of statistical methods (Pearson product-moment correlation coefficients and normal probability plots).
	Gaston *et al.* (2006)	Evaluation of the ecological effectiveness of the protected areas of the UK.	Evaluation of monitoring data collected following a common standard and assignation of each protected area to one of six categories: favourable, unfavourable-recovering, unfavourable-no change, unfavourable-declining, part-destroyed or destroyed.
	Gilligan *et al.* (2005)	Evaluation of management effectiveness of Finland's protected areas.	Based on WCPA framework but adapted to the conditions of Finland; consisted of a literature review and the development of specific questions referring to Finland's context, a rapid self-assessment of 70 protected areas, finalised by a field assessment.
	Lü *et al.* (2003)	Evaluation of the effectiveness of protected areas, China's Wolong Biosphere Reserve as an example.	Evaluation through development of a general framework to integrate necessary steps into an operational system. Data collection through questionnaire surveys, then fuzzy modelling to analyse and integrate the data collected.
	Dudley *et al.* (2007)	Evaluation of management effectiveness in 331 forest protected areas of 51 countries.	Based on the WWF/World Bank Tracking Tool and the 2004 study by WWF (2004).
Terrestrial and marine	Department of Environment and Conservation (NSW) (2005)	Evaluation of management effectiveness of 639 parks within New South Wales, Australia.	Based on the WCPA framework with a set of 16 indicators selected as the most appropriate ones for the evaluation. Very broad information from all sites and some more detailed information from a smaller subset of sites.
Marine	Pomeroy *et al.* (2007)	Assessment of the success of selected community managed marine protected areas in the Philippines.	Observed difference in biological characteristics (e.g. coral health) inside and outside marine protected areas used to determine variables that can help identifying successful community-based marine protected areas.

An important question is why so many assessments are based on expert opinion instead of ecological and socio-economic monitoring data. This is in part due to the fact that in some cases where monitoring programmes exist, monitoring has not been and is not done for the purpose of assessing effectiveness. In such cases, the monitoring data collected cannot be used for evaluations. In addition, while it is generally recommended to implement monitoring programmes in protected areas and biosphere reserves, many sites lack adequate capacities (financial, technical or skill-related) for doing so (Barsch, 2008; Leverington *et al*., 2008a). Such limitations are further discussed in subsection E.2.4. Generally, however, the importance of monitoring is beyond controversy. Calls for more science-based management are increasing (e.g. Carleton Ray and Mc-Cormick Ray, 2003; Crooks and Sanjayan, 2006; Gutzwiller, 2002; Mansourian *et al*., 2005) and monitoring is a precondition for this, as monitoring is where the data, the science-base, originates from. This issue is therefore briefly addressed in the following subsection.

D.2.2 Monitoring and evaluation

In the conservation context, monitoring can be defined as "*the collection and analysis of repeated observations or measurements to evaluate changes in condition and progress toward meeting an objective*" (Elzinga *et al*., 1998: 1). The definition of the term "monitoring" has changed remarkably over time. While initially understood as the pure collection of field data, the repetitive nature is now much more emphasised, as is the use of the data in management decision-making (Braun, 2005; Stoll-Kleemann and Bertzky, 2006). Monitoring can be done in various ways, for example professionally or locally-based (Danielsen *et al*., 2005), and for various purposes, such as ecological or climate change impact assessments (Mandelik *et al*., 2005; Payet, 2006). It can also track changes in the socio-economic situation within and around protected areas (Lotze-Campen *et al*., 2008). In the field of nature conservation, a subdivision according to data gathering purposes can be made as shown in Table D.4.

In order to emphasise the importance of using monitoring data to evaluate the performance of institutions, projects and activities, the term monitoring is these days usually accompanied by the term evaluation: monitoring and evaluation (M&E) (e.g. Guijt and Woodhill, 2002; Mackay, 2007; Stoll-Kleemann and Bertzky, 2006).

Table D.4: Possible classifications of monitoring and evaluation activities (adapted from Stoll-Kleemann and Bertzky, 2006)

Author	Stem *et al.* (2003)	Kremen *et al.* (1994)	Sheil (2002)
Context	Measuring conservation impact to improve project management	Ecological monitoring in integrated conservation and development programmes	Conservation monitoring to support conservation priorities
Sub-division	Basic research	Biodiversity monitoring	Identifying and assessing threats and problems
	Status assessment	Implementation monitoring	Implementation monitoring
	Measuring effectiveness		Effectiveness monitoring
	Accounting and certification		Extensive inventories and repeated estimates

While numerous tools exist to develop site-specifically adapted monitoring and evaluation systems (e.g. Block *et al*., 2001; Gerber *et al*., 2005; Green *et al*., 2005; Lü *et al*., 2003; Tucker *et al*., 2005), implementation in practice usually tails, many times due to lack of financial and technical capacities (see subsection E.2.4). In the worst case, the results of inadequately designed and implemented monitoring activities may even be counterproductive for the achievement of conservation objectives (Legg and Nagy, 2006). Simply having a monitoring system implemented at a site therefore must not indicate successful conservation. Instead, it is the match of having an adapted monitoring system and using the information collected for checking progress towards objectives and learning from successes and failures – as noted in the adaptive management concept – that may result in successful conservation.

D.2.3 Information needs for assessing the effectiveness of protected areas in conserving biodiversity *in-situ*

The main focus of this study is on effectiveness monitoring, i.e. conservation outcomes based, for which it is not sufficient to know whether or not conservation actions are implemented as planned (implementation monitoring, see Table D.4). The fact that conservation actions that address threats to conservation values are in place is an indicator for the awareness towards existing threats (as identified by applying the DPSIR-Framework, see section F.3), and for sure it is far easier to monitor the implementation of activities than their effect on the environment, i.e. the conservation targets and objectives. However, without monitoring their effect it remains unsure whether or not these actions are adequate, efficient and effective. Outcomes from conservation actions can be reflected in a variety of ways, such as better water quality, less erosion, recovery after eutrophication, or increase in species' population sizes. Outcomes of conservation actions may also be changes in people's attitudes and behaviour towards nature. In this case, information needed would come from social or socio-economic data rather than ecological data. However, the focus in the following chapter will be on ecological monitoring data as this reflects the natural scientific approach that was first taken to the present study (see Figure B.1).

As species' population dynamics are many times chosen as an indicator for the status of ecosystems, or directly represent conservation targets, species monitoring data can reflect effects of conservation actions in an exemplified manner (Tucker, 2005; Tucker *et al.*, 2005). It is thus the aim of chapter E to describe the state of available and accessible data from species monitoring in protected areas for an assessment of conservation success, and discuss limitations and existing initiatives to overcome these limitations.

D.3 Essence of chapter D

Chapter D bridges the socio-political context of protected areas with the challenge of their effective management and required processes for effectiveness assessments.

According to Hardin's tragedy of the commons, common pool resources are threatened with degradation unless they are government owned and access to and use of them is strictly controlled and enforced. Opponents to his view, however, argue that other options for sustainable management and use of common pool resources do exist, each based on different institutional arrangements. This point of view is also reflected in the variety of today's recognised protected area governance types. The term "governance" does here relate to all questions of power, which can be distributed in many different ways among resource managers and users. Several of the protected area governance types and subtypes are based on the participation of different stakeholders in protected area decision-making and management. Participation can be interpreted in different ways, with low levels of participation referring to informing stakeholders of decisions taken and high levels of participation referring to the complete transfer of decision-making processes to stakeholders or stakeholder representatives. Overall, stakeholder participation is considered a crucial means to increase acceptance of protected area regulations, and thus overall protected area effectiveness.

However, while protected area governance has diversified and good examples exist for participatory management of protected areas, the effectiveness of protected areas is often limited. Many cases are known where protected areas fail to protect their natural and/or cultural values, often due to socio-political pressures on these sites. This awareness has triggered calls for assessing protected area management effectiveness and numerous approaches have been developed for this. However, an assessment of management effectiveness requires information on environmental changes within and around a protected area as a consequence of conservation actions and/or external pressures. Targeted long-term monitoring in protected areas can yield such information. Here, chapter D connects to the next chapter, in which the availability of such data from the World Wide Web is analysed and discussed.

E. Open Access Data for Conservation and Management

"Much of the relevant information on the status of species is anecdotal, and it is therefore difficult to develop a quantitative overview of global trends." (UNEP, 2002: 122)

Chapter E presents the results of an extensive search for open access online information for conservation and management. It thus replies to research question 1 (see Table A.1): **What kind of open access data is currently available from effectiveness measurements in protected areas to assess conservation success?**

In section E.1 the current availability of openly accessible online data from effectiveness monitoring is described on (1) the general level, and (2) the protected area level. The results of section E.1 revealed the need to discuss different challenges presented by available, non-open access, and non-existing data, which is done in section E.2. Section E.3 then provides an overview of identified needs, potential solutions and already existing initiatives to tackle the challenges addressed in section E.2. Research goal 1 (see Table A.1), to provide a **complete overview of data availability on protected area level, critically discuss data sharing limitations, and give examples for options to address these limitations**, is achieved in the current chapter.

E.1 Current openly accessible data from effectiveness monitoring

As it was mentioned in section B.2, the review of available and openly accessible data explicitly looked at online databases. Therefore, a large number of online databases will appear in the following sections and subsections. These databases are cited in brackets, "[database]", within the following sections and subsections to indicate their appearance in an overview table of all databases in Annex II.

The contents of this chapter are published in the Journal of Environmental Management (Bertzky and Stoll-Kleemann, 2009).

E.1.1 Data availability on a general level

The U.S. Freedom of Information Act, enacted in 1966, represents one of the first major milestones for public access to research results by legally acknowledging the people's right to obtain information from government agencies (United States Department of Justice, 2007). In the same year, the International Council for Science (ICSU) established the Committee for Data on Science and Technology (CODATA). CODATA primarily aims at globally promoting the evaluation, compilation, and dissemination of data for science and technology (CODATA, 2007). In parallel, technical advances enhanced the World Wide Web, which is consequently now regarded as the most suitable and major instrument for data provision. The Budapest Open Access Initiative on making scientific research results freely available on the Internet, launched in 2001 (Budapest Open Access Initiative, 2001), and the Berlin Declaration on Open Access to Knowledge in the Sciences and Humanities, which has now been signed by 230 organisations worldwide, further supported the progress of data sharing (Berlin Declaration, 2003).

The number of online databases providing biodiversity information which have come into existence in the past decade has become virtually uncountable. Kagan (2006) mentions discovering 4,620,000 Web links for the term "Biodiversity Information" in some quick searches on Google. The technical advancements of our time have allowed the transformation of loads of existing information, for example, about ecosystems, species distribution, and red-list status from museum collections, as well as published research studies and library catalogues, into digital formats. These advances have subsequently reduced the former challenges given by distances and connectivity and triggered today's "global village" era (Paehlke, 2004) and the rise of "virtual laboratories" (Canessa *et al*., 2002).

With awareness of the increasing difficulty for end users to handle the variety of databases, global initiatives to facilitate the distribution of existing data and connect several existing databases, as well as deliver data mining tools, have been started. The Convention on Biological Diversity (CBD), for example, established the Internet-based Clearing-House Mechanism [CHM] (Secretariat of the Convention on Biological Diversity, 2007b) to foster the development of a global mechanism for exchanging and integrating information on biodiversity (CBD, 1999). The Global Biodiversity Information Facilities [GBIF] established a database which queries data from about 190 data providers from all over the world (e.g. [Red List], [ITIS], [Species2000], etc.) and, hence, significantly facilitates the search for open access data. NASA's Global Change Master Directory [GCMD] includes not only biodiversity data but furthermore information on atmosphere, hydrosphere, land surface, and other topics.

However, the large number of available databases does not provide for equal coverage of data availability for all parts of the world. The entire Arctic biome, as well as remote pelagic and deep-sea waters, are still fairly underrepresented, as can be seen when querying the Mammal Network Information System [MANIS] or the Ocean Biogeographic Information System [OBIS]. Initiatives to fill these gaps and under-representations are underway. This is especially expressed by the 2007 International Polar Year (IPY) that was endorsed or supported by more than 60 international and national organisations, such as The Royal Society of London and the Census of Marine Life Network (IPY Joint Committee, 2007).

In a field of investigation as broad as biodiversity science, data published are naturally extremely heterogeneous, depending on the methods chosen for data uptake and the purpose for which they have been gathered. The "species 2000" project, for example, has the goal "*to create a validated checklist of all the world's species (plants, animals, fungi and microbes)*" [species2000]. In contrast, "Reefbase" aims at provision of information to "*facilitate sustainable management of coral reefs and related coastal/marine environments, in order to benefit poor people in developing countries whose livelihoods depend on these natural resources*" [Reefbase]. These two examples clearly point out the argument of Smith *et al*. (2000), who see a clear distinction between biodiversity databases based on historical data from collections (updated with new findings) and biodiversity conservation databases used to support conservation decisions.

Besides the differences in geographical data coverage and purposes of existing databases, it needs to be emphasised that there are crucial differences in the magnitude of contribution to data provision by various countries. While, in general, data availability is still much greater for industrial countries than for developing ones (Alcamo and Bennett, 2003), steep gradients exist. Most free and open data initiatives are, in fact, of US, Canadian, UK, or Australian origin, while the contribution by most of the other G8 and U.N. Security Council countries remains far behind. Within the industrialised and G8 Countries, UK and Switzerland have more high-quality online biodiversity data than, say, Germany or Russia. Mexico and Costa Rica have more data online than much richer countries like Italy or France. This “digital divide” is particularly noticeable in former colonies, for example French-speaking West Africa, the Belgian Congo, or Portuguese colonies worldwide, and for countries with great cultures such as France, Russia, and China. They all still need to adjust to the digital realities and culture of the new millennium.

Overall, there are crucial shortcomings in the provision of metadata for existing datasets. While big data providers, such as the Global Biodiversity Information Facility (GBIF), usually have their own set of metadata standards, these are lacking in numerous other cases. The lack of metadata, however, strictly limits the scope of opportunities for data usage.

E.1.2 Data availability on the protected area level

Regarding protected areas, despite the development of large online databases that provide impressive amounts of data on different policy-relevant scales, the availability of ecological and biodiversity data is still very limited and only a few databases have an explicit worldwide focus on protected areas. Table E.1 gives an overview of existing databases on the protected area level with global coverage. Figure E.1 illustrates their interconnectedness as well as their linkage to some of the biggest non-protected area-level databases (the abbreviation PA is used for the term “protected areas” in Figure E.1). Connection, in this case, refers either to direct links leading to other databases or data fed from one database to another. Where arrows are unidirectional, one database was linked to another but not vice versa, as checked in a large number of random tests.

Table E.1: Protected area databases with global coverage

World Database on Protected Areas (WDPA)	
Managed by	UNEP-WCMC with IUCN WCPA and the WDPA Consortium
Content	legal status, context and management of individual protected areas, maps
URL	http://www.wdpa.org/
Links	UNEP-WCMC, UNESCO-MaB and WHC, Ramsar, national and regional databases, GBIF species information
MPA global – A database of the World's Marine Protected Areas	
Managed by	University of British Columbia's Fisheries Centre. Result of a formal collaboration between WWF, UNEP-WCMC and IUCN-WCPA
Content	spatial, habitat, administrative, and regulative information (in progress)
URL	http://www.mpaglobal.org/home.html
Links	based on WDPA information
ICE Biological Inventories of the World's Protected Areas	
Managed by	ICE with US MaB, UNESCO-MaB, NBII, US National Park Service, Biological Resources Discipline of the USGS
Content	species inventories of plants and animals reported from the world's protected areas
URL	http://www.ice.ucdavis.edu/bioinventory/bioinventory.html
Links	UNESCO-MaB, UNESCO WHC, UNEP-WCMC, Fishbase
Ramsar wetlands database	
Managed by	Wetlands International under contract to the Ramsar Convention Secretariat
Content	information on wetland types, land uses, threats, hydrological values of the sites, etc.
URL	http://www.wetlands.org/RSDB/Default.htm
Links	very few links to other databases
Man and Biosphere Network (MaBnet)	
Managed by	UNESCO MaB
Content	*Inter alia* general description of each site, a list of research and monitoring activities, contacts
URL	http://www.unesco.org/mab/
Links	TEMS, Ramsar, UNESCO WHC
UNESCO World Heritage List	
Managed by	UNESCO WH Centre
Content	brief site description, links to advisory body evaluations, periodic reporting documents, etc.
URL	http://whc.unesco.org/en/list/
Links	UNEP-WCMC, few links to UNESCO-MaB or Ramsar

The World Database on Protected Areas [WDPA] is the most comprehensive dataset on protected areas worldwide, underpinning the production of the United Nations List of Protected Areas (Secretariat of the Convention on Biological Diversity, 2004). In Figure E.1, it is presented in the centre of the PA-level databases as it connects with most other

PA-level databases. It is managed by the United Nations Environment Programme-World Conservation Monitoring Centre (UNEP-WCMC) in partnership with the IUCN World Commission on Protected Areas (WCPA) and the World Database on Protected Areas Consortium; thus, the UNEP-WCMC also feeds information into the World Database on Protected Areas. The WDPA is interlinked with the databases of UNESCO-MaB Biosphere Reserves [UNESCO-MaB], Ramsar Wetlands of International Importance [Ramsar Wetlands Database], UNESCO World Heritage Sites [UNESCO-WH], the Global Marine Protected Area database [Global MPA], the GBIF database (since October 2008), as well as national and regional databases.

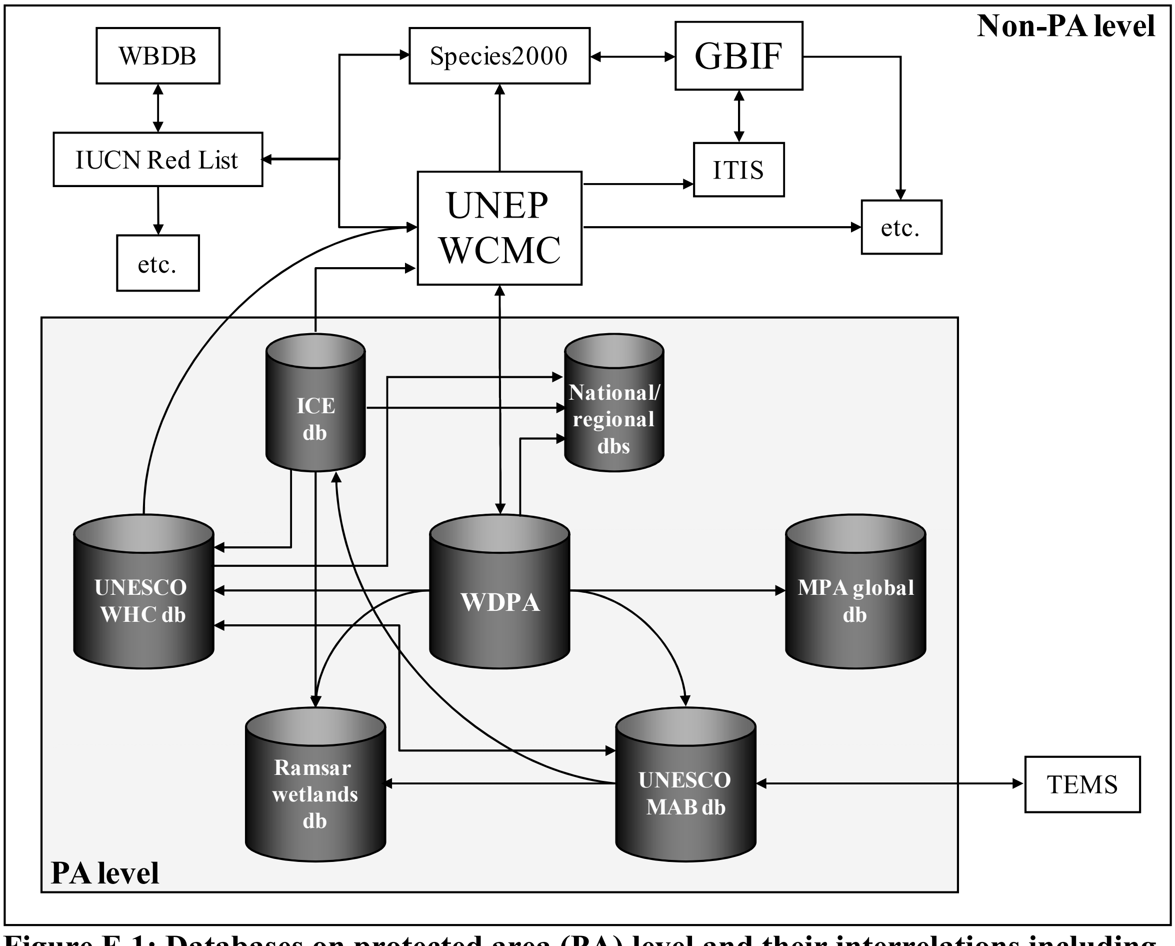


Figure E.1: Databases on protected area (PA) level and their interrelations including selective non-PA level databases

(db/s = database/s; GBIF = Global Biodiversity Information Facility; ICE = Information Center for the Environment; ITIS = Integrated Taxonomic Information System; IUCN = World Conservation Union; MaB = Man and the Biosphere Programme; MPA = Marine Protected Areas; TEMS = Terrestrial Ecosystem Monitoring Sites; UNEP-WCMC = United Nations Environment Programme - World Conservation Monitoring Centre; WBDB = World Birds Database; WDPA = World Database on Protected Areas; WHC = World Heritage Convention)

The UNESCO-MaB database lists all those Biosphere Reserves that are partially or wholly World Heritage (http://www.unesco.org/mab/BRs/brs_whc.shtml), Ramsar sites (www.unesco.org/mab/BRs/brs_ramsar.shtml), or even both (www.unesco.org/mab/BRs/ brs_whc_ramsar.shtml), and links them with the corresponding UNESCO WH and Ramsar pages. These, in turn, are linked to UNEP-WCMC information pages [UNEP-WCMC]. Beyond this, information pages of those Biosphere Reserves that overlap or include Terrestrial Ecosystem Monitoring Sites (TEMS) are linked with TEMS's relevant site information, which is non-PA level [TEMS].

Although Ramsar site information pages always mention whether the site belongs to a Biosphere Reserve or contains overlaps with World Heritage sites, they very seldom link to the corresponding UNESCO-MaB and WHC information pages. The same is true for WHC information pages. The World Heritage sites that are partially/wholly Ramsar sites or include one or more of them are listed on www.ramsar.org/world_heritage.htm. There was just one direct link to Ramsar information (Ichkeul National Park, Tunisia), which was broken, and there were very few links to corresponding MaB information.

The ICE database [ICE] is actually one result of a UNESCO-MaB initiative called Biosphere Reserve Integrated Monitoring (BRIM), which is mentioned again in section E.3. The ICE database, in fact, provides lists of species occurring within protected areas but unfortunately without offering further data on these species. Although it links to several other data providers, a sample revealed that a crucial number of these links is broken. The last update on this database, according to the Web page, was in July 2005.

As Figure E.1 illustrates, we already face a complex network of databases on protected area levels. The ever-growing number of existing non-PA level databases further increases this complexity. This is especially true if the newly established ones are not or cannot be included in one of the data search engines merging information from a large number of primary data providers, such as GBIF.

There are three exceptions in comparison to most other databases. Firstly, the World Bird Database [WBDB], established and managed by BirdLife International (BirdLife International, 2006), Endemic Bird Areas (EBAs), and Important Bird Areas (IBAs), which, in many cases, overlap with protected areas, are described, including estimations on population size and trends of some of the bird species at the site. The database is linked with IUCN's Red List of Threatened Species (IUCN-SSC, 2008) [IUCN Red List of Threatened Species]. However, this only allows for an impression of conservation achievements in terms of birds in those protected areas overlapping with EBAs or IBAs and the "knowledge" about the sites is often rated as "incomplete" or "poor". Above this, EBAs and IBAs in many cases only cover a very small fraction of the entire protected area, and are not legally embedded in national protected area systems.

Secondly, the most extensive database explicitly focusing on population dynamics, and thus putting data in a historical context, is the Global Population Dynamics Database [GPDD] (NERC Centre for Population Biology, 1999). There is the possibility to search for specific locations and the list of sites available does cover some protected areas. However, most of them are located in the UK and data gathering, or the maintenance of updating the database, obviously stopped after 1992.

The third exception is the database of the History of Marine Animal Populations [HMAP] research programme as the historical component of the Census of Marine Life Network. The research programme examines the ecological impacts of large-scale harvesting, long-term changes in stock abundance, and the role of marine resources in historical development. The entire database is available for download. Unfortunately it remains impossible to connect the data to the protected area context.

In addition to the databases mentioned so far, numerous regional and national protected area databases have been established. Not all of them can be mentioned here; instead just three examples will be given. The database of the Comisión Nacional de Áreas Naturales Protegidas [CONANP] is outstanding in that it comprises all types of protected areas throughout the country and includes, where available, information on problems and challenges at the various sites, land tenure issues, social and cultural characteristics, *inter alia*, thus including information that extends beyond what is presented by many other databases. The database of the European Nature Information System [EUNIS] of the European Environment Agency even provides some information on the national and international threat status and extent of species and provides links to GBIF, UNEP-WCMC, and Fauna Europaea [Fauna Europaea], among others. The threat status information, however, again does not relate to the site level, so that no statements can be made regarding conservation achievements within the protected area.

An updated database on the protected areas of the United States and Canada has been compiled by the Conservation Biology Institute and the World Wildlife Fund U.S. [CBI/WWF PAD] (DellaSala *et al*., 2001). However, the data provided aims at enabling gap analyses to detect where species lack adequate levels of protection and thus cannot be used for assessing conservation achievements. Furthermore, the database is not free of charge or openly accessible.

Concluding this section, it can be stated that, with few exceptions, information on protected areas available from online databases is, so far, mainly descriptive. Beyond this, information about the sites' success in achieving conservation objectives or data that can be used for assessing protected area effectiveness is not included. Even the WDPA, the largest and most comprehensive database on protected areas, cannot be used in this context. A study by Blom *et al.* (2004) on the status of protected areas in the Central African Republic produced an updated database of existing protected areas in the country. The authors of the study, furthermore, reached the more general conclusion that "*the present databases of the World Conservation Monitoring Centre (WCMC), United Nations Environment Programme (UNEP), and the Conservation Union (IUCN) are incomplete or nonexistent*" (Blom *et al*., 2004: 480).

Several factors help explain the status quo of online data availability with respect to protected areas. The following sections look at these and identify what is needed to help rectify the situation.

E.2 Challenges presented by available, non-open access, and non-existing data

Beyond a doubt we are facing two parallel phenomena: (1) data overkill, and (2) data scarcity. This paradox will be further discussed in the following.

Openly accessible data have grown so numerous that, for the general public, it is getting ever more difficult to keep an overview, let alone manage it. It is certainly unquestioned that this variety and amount of data is, in fact, very useful for the investigation of multitudinous scientific questions; it shows the diversity of life on earth. There are popular examples, such as the use of freely accessible and countless species collection points from museum data, herbaria, and academic research institutions for metadata analysis in species distribution modelling and management planning (examples are Elith *et al*., 2006; Elith and Leathwick, 2007; Graham *et al*., 2004; Myers and Mertz, 1998; Rodríguez *et al*., 2007; Sommer *et al*., 2003; Thuiller, 2003; Townsend Peterson and Kluza, 2003).

However, despite this fact, functional gaps remain obvious: Laihonen *et al.* (2004), having studied the information content of the CBD's Clearing House Mechanism regarding value for end users and usability, states that "*…although the basic idea of the national CHM has been realised fairly well, the information provided by the national Web sites is scarce and unprocessed. Especially the amount and processing of taxonomic, ecological and spatial information needs to be increased.*" (Laihonen *et al*., 2004: 99). The UNEP (2002), in their Global Environmental Outlook 3, comes to a similar conclusion, commenting on the available data related to the status of species in general (not exclusively provided by the Clearing House Mechanism) by stating that "*much of the relevant information on the status of species is anecdotal, and it is therefore difficult to develop a quantitative overview of global trends.*" (UNEP, 2002: 122). Above this, as a matter of fact, a large amount of data from open access databases is mutually incompatible (Edwards *et al*., 2000). This has its roots in both information technology issues and the conceptual inconsistency of methodologies used to collect data (for a discussion of the latter, see, e.g., Poteete and Ostrom, 2004). Inconsistent methods can well be made compatible if responsible funding agencies, governments, and university and NGO scientists show the will to make it happen. If survey protocols, metadata, and statistical issues were universally accepted and promoted by the people in charge, this problem could be significantly reduced.

Furthermore, in many cases, the data available is not put in a historical context (exceptions are, e.g., the IUCN Red List of Endangered Species, the World Birds Database, the Global Popoulation Dynamics Database, and the History of Marine Animal Populations, as introduced before). Doubtlessly, along a time-scale, biodiversity data would be of extreme value (Sugden and Pennisi, 2000), opening up a whole range of new options for application, e.g., biodiversity assessments (Laliberte and Ripple, 2003; Lotze *et al*., 2006; Willis *et al*., 2005), which need a baseline against which to be compared.

Apart from the issues related to available, open access online data, we face an equally serious problem resulting from non-open access and non-existing data, a phenomenon that expresses itself publicly as "data scarcity". A (somewhat rhetorical) question that arises is: how much data actually exists but is currently piled up on desks and stored in bookshelves rather than being made available? Experts for the State of Alaska, in the government and outside, estimate that over 40% of field data never see the eye of the public (Huettmann pers. comm. in 2007). While there is no general reply, four well-known reasons for not publishing data that have been collected are:

1. Scientific and administrative competitiveness (non-open access data);
2. Sensitivity of the data (non-open access data);
3. Reluctance of governments, organisations, and institutions to provide information that could be considered to reflect poorly on their performance as conservation managers (non-open access or non-existing data); and
4. Lack of personnel and technical capacity (non-open access or non-existing data).

Each of the four reasons will subsequently be addressed in more detail.

E.2.1 Scientific and administrative competitiveness (non-open access data)

In biodiversity and conservation, the greater good matters the most. Unfortunately, a false focus has developed by being wrongly competitive on research data and science for conservation and ecology. This is an indicator of a misleadingly promoted economy applied worldwide, focusing on egoistic wealth and growth at all costs, but ignoring the wider benefit for the global village (see, for instance, Huettmann and Czech, 2006; Trauger *et al*., 2003). As a spillover, it widely affects value systems and human cultures, including how we deal with data.

Giving away data before having used it extensively for one's own purposes means offering others the possibility to extract its essence and benefit from it, for example, to raise funding for doing more research. With the increasing scarcity of funds for research of any kind, a tendency toward "data hoarding" and scepticism towards data-sharing initiatives has gained some prevalence. A recent editorial in *Nature*, which introduced the term "scientific competitiveness", claims that the biggest obstacle to fulfilling the vision of sharing all existing data is, in fact, cultural (Nature, 2005).

A further wide-ranging problem is the politics of project funding, data gathering, accessibility, and provision (or its avoidance). One aspect of this problem is what could analogously be called "administrative competitiveness". In many countries, different agencies are responsible for data gathering, for example, the forest administration for state forests and the environmental agency for all other areas (agricultural landscapes, lakes, etc.). Within the same federal government, paid by national tax money, very often there is an unwillingness to cooperate or, even more problematic, a dispute around the fear that a competing agency could interfere with the data-collecting agency's area of competence (Stoll-Kleemann, 2001). Very often there is a traditional enmity between these two agencies (also traditionally between agricultural and environmental agencies, federal and state, fisheries and transportation institutions) whose historical roots run deep but are counterproductive. Besides this more structural-political-administrative but wasteful competitiveness among agencies, problems between high-ranking individuals (e.g. power games and inappropriate vanities between ministers) hinder cooperation in making data collection or provision possible. Of course, many more players with very different interests are involved in data collection and provision than the two agencies mentioned in the example above. They include, among others, universities, various agencies at different levels of government (federal, state, district, or community), representatives of lobbies, and private landowners. Sometimes protected areas have their own administrative bodies but have to cooperate with some of the players mentioned above (touching the debate on whether or not participation is always the most adequate approach in resource management, see, e.g., Cooke and Kothari, 2001). Particular problems with inconsistency of data can also exist within countries that are based on a federal structure because, in that case, data gathering, accessibility, and provision may vary in nearly every single federal state. To make the confusion complete, differing administrative responsibilities exist not only due to the varieties of ecosystems (e.g., forest or open landscape) or property rights (state, community, or private), but are also dependent on the category of protection assigned. This means that even in state forests, very different agencies are responsible for data gathering depending on whether it is a strict natural forest reserve (state law), a Natura 2000 area (based on EU law), or a "normal" state forest, etc.

E.2.2 Sensitivity of the data (non-open access data)

National security concerns about the provision of some of the existing government data, for example, driven by economic pressures, often restrict the scope of data that is made publicly available (Esanu and Uhlir, 2004). This is despite every established open access data agreement. In the protected area context, publishing, for example, data on the distribution of scarce and highly endangered species may result in increasing pressure on them. Given that, for instance, the market value (including the black market price) of one specimen of the Lears Macaw (*Anodorhynchus leari*) is around 30,000 Euros (Theile *et al*., 2004), even if the distribution of the species is known, the location of nests for instance is not, and conservationists are certainly not interested in publishing this information and thus potentially promoting illegal trade.

For an assessment of a protected area's effectiveness, it would be very interesting to know whether endangered species are better off within the protected area compared to outside, but it is especially this information that needs to be handled with extreme care. Still, as it is framed by the National Biodiversity Network Trust (2001: 9), "*Making biodiversity data available should reduce the risk of damage to the environment. If it is likely to have the opposite effect, availability may need to be controlled.*"

E.2.3 Reluctance to provide information that could be considered to reflect poorly on the performance of conservation managers (non-open access or non-existing data)

Managers of protected areas are under increasing pressure to evaluate the effectiveness of their efforts to attain conservation objectives for a number of reasons (Parrish *et al*., 2003). There are public pressures, as well as pressures brought by personal promotion and funding interests. Interest in reaching the CBD 2010 Target should certainly be among them, and the number of management effectiveness evaluations increased significantly as a response to the adoption of the target, but, at the local level, funding and accountability issues are at least as important, if not more so. Conservation actions are known to have failed to achieve their initial goals in the past and thus donor agencies are increasingly concerned about whether or not their money is effectively invested in conservation.

Yet, in practice, occasionally, where the capacity to gather and provide data in fact exists, data owners become notoriously adept at holding a tight rein on the provision of data out of a certain fear that evaluation may be done to harm or criticise (e.g. Dusenbury *et al.*, 2000; Thomas, 2006). In the end, not only on the local level but also on higher political levels, governmental entities may neglect the publication of evaluation data to avoid external criticism or similar loss in reputation and integrity. All of these come in a time where resource conflicts and lack of public trust in official institutions are at a prime

(Paehlke, 2004). Here, cultural root causes do play significant roles, for instance in those countries where open criticism is generally opposed and evaluations are the subject of general refusal (e.g. Lü *et al.*, 2003). Hockings *et al*. (2006: 45) frames this as "*the lack of a conducive environment for undertaking assessments, the absence of an "assessment culture" in many areas, a lack of understanding of and support for assessments by communities and protected area staff, and fear of the political and sometimes controversial nature of assessments.*"

The question of how and why data is provided, withheld, or manipulated in the name of biodiversity politics is certainly an exciting issue that warrants a research project of its own. However, there can be no doubt that the new concept of open access and public information requires a new policy, philosophy, concept, and role regarding experts, science, and society.

E.2.4 Lack of personnel and technical capacity (non-open access or non-existing data)

Overall, it can be stated that even if all data that exist were made available, large gaps, thematic (e.g. focusing on protected areas) and/or geographic (e.g. concerning the Arctic and pelagic waters, see above), could still doubtlessly be identified where available and openly accessible data remains scarce. Some reasons for this are very obvious, such as the pure lack of personnel for collecting data, as well as lack of a technical infrastructure and expertise to maintain, process, and analyse them in quantitative terms and for efficient management. This becomes particularly clear if one looks at the CBD's indicators for measuring the achievement of the CBD 2010 Target. Taking a closer look, for instance, at the indicator "area of forest, agriculture, and aquaculture under sustainable management", it must be admitted that, in fact, a whole set of indicators to evaluate whether an implemented management system is sustainable or not is demanded. Another clear example is the proposed indicator "extent and condition of estuaries", which includes an entire assessment of the conservation status of estuaries, again asking for a large number of further indicators.

The empirical complexity (work force, expert knowledge, and time needed) of only collecting the data, not to mention processing or uploading it to the World Wide Web for open access, is masked behind the ease of merely placing an item of interest on a list of indicators. Strengths and weaknesses of the indicators selected to track progress towards achieving the CBD 2010 Target have been discussed in further detail, for example, in Brauer *et al.* (2005).

With awareness of the remaining lack of manpower, time, and money to start gathering information now, to sidestep this effort and still determine whether or not the CBD 2010 Target has been reached, Brooks and Kennedy (2004: 1046) state that "*the indicators listed […] will require the use of existing data sets*". This is where the vicious circle closes, at least in a broader study that depends on ease of access to this data.

Regarding protected areas, it needs to be emphasised that financial shortcomings are among the major challenges for the site's management, not only in developing countries but also in developed ones (Emerton *et al*., 2006). Protected area managers are facing increasingly long task lists since there is an increased emphasis on people-oriented approaches in nature conservation (Jeanrenaud, 2002). Phillips (2003: 24) even states that "*we are in danger of making the manager's job undoable.*" The development and long-term implementation of a sound monitoring and evaluation system is often believed to be only possible at the expense of other urgent activities due to a lack of resources. Available resources need to be allocated strategically to address the most pressing site-specific conservation needs (Marsh *et al*., 2007; Salzer and Salafsky, 2006). The public provision of data that is collected at site will then surely lag behind more urgent allegiances. However, when turning around the perspective, it could be argued that we do not need more money but could instead save money through efficient monitoring. Developing countries, however, often still lack the technical equipment for collecting data, let alone feeding them into open access databases, even if they wanted. The Governance of Biodiversity (GoBi) Project, in its Global Survey on Biosphere Reserve Management (qualitative and quantitative interview series with 213 biosphere reserve representatives of the by then 492 internationally designated biosphere reserves, see, e.g., Mehring and Stoll-Kleemann, 2008; Schliep *et al.*, 2008; Stoll-Kleemann and Welp, 2008), repeatedly experienced this lack in technical equipment as several of the interview partners depended on public Internet cafés to connect to the World Wide Web. However, the outlook of wireless Internet connections, for example, for public schools, villages, and libraries could change this problem dramatically (Huettmann pers. comm. in 2007 for Nicaragua).

E.3 Needs, potential solutions, and existing initiatives

Section E.2 clearly revealed a series of needs for each of which potential solutions will be presented and existing initiatives introduced. The identified needs can be grouped into four distinguishable thematic subjects:

1. To reduce conceptual data inconsistencies, and complexity in data handling (available data);
2. To promote the reduction of sensitivity of certain data or to handle sensitive data with special care (non-open access data);
3. To strongly promote, teach, and implement open access initiatives and the willingness to share data, which includes reducing the scientific and administrative competitiveness, as well as the general reluctance against evaluation processes (non-open access data and non-existing data); and
4. To foster financial and/or technical capacity building activities for collection, analysis, and use of monitoring data in protected areas (non-existing data).

While the first and the last of these thematic issues root back to rather technical challenges, the second and third are both caused by fears of data being misused in different ways, to harm nature, career, and power. Each of the four points is discussed in the following and existing initiatives addressing the identified needs are presented. It is not intended to provide a complete overview of all existing initiatives but, instead, only a small fraction is presented as being appropriate for the focus of this study. Table 3 at the end of this section provides a summary of all discussion points.

E.3.1 Reducing conceptual data inconsistency and complexity in data handling (available data)

Conceptual data inconsistency can be tackled by standardising monitoring processes and surveillance of compliance. For the facilitation of the development of conceptually consistent monitoring and evaluation systems, several software packages and computer tools have come into existence. Although they actually look in a more holistic way at the standardisation and facilitation of protected area management processes, the development of monitoring and evaluation systems is necessarily included as well.

As part of UNESCO's MaB Programme, for example, a biodiversity monitoring software package called BioMon (Biodiversity Monitoring Database) has been developed "*as a* *framework for managing data, standardising data analysis and presentations, and assisting with the exchange and publication of the results*" (Smithsonian Institution, 2006). With this software tool, data from field research can be filled into prepared data sheets, and calculations can be done automatically to save time and effort. BioMon is a resource tool among the MaB's Biosphere Reserve Integrated Monitoring (BRIM) initiatives that "*undertakes abiotic, biodiversity, socio-economic and integrated monitoring in the World Network of Biosphere Reserves. Its goal is to provide a platform for the integration of the resulting information/data*" (UNESCO-BRIM, 2006). A link to biotic information about biosphere reserves leads back to the ICE database on the protected-area level (see Figure E.1). Unfortunately, there is no information available to date about the actual magnitude of application of the tool among the world's biosphere reserves and no example cases are known from the broad base of the GoBi Project's data pool where it is actually applied.

Concerning strategic planning and management of protected areas, there are further software tools available, partly free of charge, such as The Nature Conservancy's Conservation Action Planning (CAP) Excel Tool (ConserveOnline, 2007), as well as its advanced software version, the Conservation Measures Partnership's Adaptive Management Software, Miradi (Conservation Measures Partnership, 2007). Both of them provide strategic guidance in the sound identification of indicators for site-specific monitoring systems. However, although the introduced tools support standardised approaches for the development of monitoring systems, significant room for decision-making with respect to the chosen methods for data gathering remains.

One large-scale initiative to address methodological consistency is formed by the Group on Earth Observations. This intergovernmental consortium is leading a worldwide effort to establish the Global Earth Observation System of Systems (GEOSS, URL: http://www.earthobservations.org/index.html). It aims at collecting and provisioning datasets from thousands of Earth-observing instruments worldwide to feed into policy decision-making and allow for evidence-based management. Up to now, 71 countries and the European Commission are contributing to GEOSS. They all agree in respecting non-proprietary standards (with preference given to formal international standards) for collecting and disseminating data, metadata, and products. Metadata and quality indications are regarded as natural components of the GEOSS's structure. (GEO, 2007)

On a smaller scale, the International Forestry Resources and Institutions (IFRI) programme sets a milestone by creating standard protocols for data collection to be used by all scholars actively working in IFRI's international network of research centres. The acquired data then has to be contributed to a common database. A common set of data-collection instruments and common methods of data collection avoids inconsistency and assures comparability (Poteete and Ostrom, 2004).

Regarding the technical problems in data handling, a universal scheme to gather and store biodiversity data certainly is of enormous value. But the task also involves an immense degree of complexity. Ultimately, it also needs to be implemented and established. An initial effort in this direction has already been made to help cope with this constant problem. Led by the U.S. National Center for Ecological Analysis and Synthesis (NCEAS), and the Long Term Ecological Research Network (LTER), a "*method for formalising and standardising the set of concepts that are essential for describing ecological data, as well as the format for recording this information [...] to promote preservation and long-term utility of the growing archives of ecological data*" has been developed. It is known as the EML, Ecological Metadata Language, based on XML (eXtensible Markup Language) standards (Knowledge Network for Biocomplexity, 2006). Unfortunately, it is not yet widely accepted or part of the ISO. Similar initiatives that follow the same logic almost identically are currently coming forward with the ISO standards on Metadata.

E.3.2 Promoting the reduction of sensitivity of certain data or handle sensitive data with special care (non-open access data)

Without a doubt, openly accessible information should lead to improved conservation management in protected areas, and not harm their biodiversity values. To tackle the fear of individual data abuse is substantially more difficult then resolving technical constraints in data uptake and handling.

For protected areas, sensitivity of data may refer to any kind of information of commercial interest brought by International Corporations or black market demands. There are few imaginable potential solutions for reducing the sensitivity of data on species of extraordinary interest on the black market: a globally outstretching change of black market demands, or otherwise a much stronger control of black market dynamics and sanctioning of illegal trade. Both these options are hardly realisable. The Convention on International Trade in Endangered Species of Wild Fauna and Flora [CITES] provides information on affected species and establishes the necessary international legal framework for the prevention of trade of endangered species and for an effective regulation of trade in others. However, an ongoing effort and commitment is needed, together with intense cooperation of numerous countries in this interest, to reduce the sensitivity of some data on certain species in the long term.

The National Biodiversity Network Trust proposes a list of criteria to identify the sensitivity of such data for data holders and calls for an approval of the user who wishes to access the data to avoid the misuse of information (National Biodiversity Network Trust, 2001). Beyond this, they argue that "*often the perceived level of risk can be reduced with improved trust between individuals*" (National Biodiversity Network Trust, 2001: 8). This statement is crucial, as it may actually be regarded as questioning the overall focus on data sensitivity as a reason for not sharing data. It could be argued that sensitivity is rather used as an excuse to avoid touching the much more delicate issue of mistrust. Feelings of competitiveness, again, are closely linked to this issue.

A fine example of an international initiative to promote a "culture of security" with reference to information handling and distribution is presented by the Organisation for Economic Co-Operation and Development (OECD, 2002).

E.3.3 Promoting open access initiatives and the willingness to share data (non-open access data and non-existing data)

The key challenge of this point is to overcome the fear of misuse of published information for both competitiveness and personal reasons alike. Where administrative competitiveness hinders effective management, we face classic cases of wrongful administration and management, defying concepts science-based management and sustainability governments have actually legally agreed on.

The Berlin and Budapest Declarations (see above) obviously have not achieved what they promised. Whether the reason is to be found in a lack of will, in the lack of enforcement, or in obstacles relating to administrative and scientific competitiveness remains vague. Further initiatives are now focusing on simplified open access of data specifically in environmental sciences. The UK established a counterpart to the U.S. FOIA for data on the environment, the Environmental Information Regulations 2004, which likewise obliges public authorities to "*progressively make [the] information available to the public by electronic means which are easily accessible*" (Environmental Information Regulations, 2004). However, it sets double-standards because sensitive information related to the royal family and national security, for instance, is excluded, and thus undermines the overall concept of taxpayers being in charge of their country in a democratic process. Similar problems are known for the European Union's approach to open access. GBIF supports the open access initiative with its Participants' Statement on Free and Open Data Access (GBIF, 2005). For the specific case of conservation science, the Conservation Commons, for instance, seeks improvement of "*open access to and unrestricted use of data, information, and knowledge related to the conservation of biodiversity with the belief that this will contribute to improving conservation outcomes*" (IUCN, 2005b).

Incentives as well as adequate license models for the protection of intellectual property play key roles in this endeavour to increase the willingness to share data in general (Klump *et al*., 2006). This may also reduce scientific and administrative competitiveness.
Beyond this, a consistent introduction of evaluation procedures in protected area management represents an option to overcome reluctance and fear. In most job positions, the quality of work is measured according to objectives met and outputs produced. A growing number of economic branches need to assure the achievement of quality standards. They are thus requested to participate in regular, independent evaluations, as well as in the environmental sector (e.g., organic food production, eco-tourism facilities, products of members of the forest, and marine stewardship council, etc.), of which results are usually accessible for the consumer. Large organisations and institutions increasingly apply regular self-reporting procedures, voluntary quality certifications, or allow for external reviewers or evaluators to check on their performance.

Throughout evaluation processes, it is important to spread the right message about what the intention of these evaluations is. Hockings *et al.* (2006) points out that "*Whatever purposes it may serve, evaluation should be seen primarily as a tool to assist managers in their work, not as a system for watching and punishing managers for inadequate performance. Evaluation must be used positively to support managers and be seen as a normal part of the process of management.*" (Hockings *et al*., 2006: 5).

In the protected area context, different possibilities for guaranteeing effectiveness have been proposed and discussed (Dudley *et al*., 2003; Dudley *et al*., 2004). Certification systems, such as those for organic agriculture, are regarded as an option for a standardised way of reporting for international environmental agreements and are, in fact, already applied in some protected areas (Hockings and Dudley, 2007).

Huettmann (2005) further extends proposals for self-reporting systems and certification by calling for a standard management documentation system for every single wildlife management decision, in line with the ISO certification processes. This recommends the standardised online publication of such data as well as an involved quality check. The establishment of such a system actually meets more than one of the identified needs outlined in this section and represents a very promising initiative for action.

The standard introduction of such a system could, if equally promoted as an essential component in protected area management around the world, less voluntarily, but still effectively, reduce reluctance against the public follow-up of decision-making processes according to existing data and effectiveness in conservation. However, there should be mechanisms in place to avoid the misuse of results of certification or self-reporting procedures in that, for example, funding is then only allocated to those protected areas that result positively (because this might imply that investments are efficiently and effectively used), or only to those that result negatively (because this might imply that investments are urgently needed). The latter point, *inter alia*, frames the remaining opposition against mechanisms for increased accountability of protected areas.

E.3.4 Fostering financial and/or technical capacity building activities for collection, analysis, and use of monitoring data in protected areas (non-existing data)

There is most obviously awareness about the challenges presented by lacking financial and technical capacities in protected areas. Sustainable financing has played a key role in all the latest meetings and congresses on protected areas and is addressed in numerous recent publications (e.g. Font *et al.*, 2004; IUCN, 1998b; Verweij and de Man, 2005).

With financial resources being the basis for the establishment of monitoring systems and provision of data gathered on the protected area level, the need for financial sustainability must be regarded as the primary need of all. Options exploited to ensure long-term funding in protected areas are manifold but site-specific. They range from the classical approach of promoting tourism to obtaining payments for environmental services. There are numerous best-case examples known from sites successful in assuring financial resources (e.g. Emerton *et al.*, 2006). In any case, extensive expert knowledge is needed to make full use of site-specific opportunities. Here emerges the second possible capacity gap: the lack of knowledge, not only on funding opportunities, but also on existing guidelines and tools for the development and implementation of site-specifically adapted monitoring systems and data handling. Overall, such gaps in capacity may be overcome autonomously when access to open sources of information on the World Wide Web is given, for example, through the use of the Protected Areas Learning Network [PALnet]. PALnet is a component of the Ecosystems, Protected Areas, and People (EPP) project that was initiated with support from the UN Foundation and United Nations Environment Programme, Global Environment Facility, with contributions from Conservation International, The Nature Conservancy, the World Resources Institute, and World Wildlife Fund U.S. (IUCN-WCPA, 2003). PALnet explicitly aims at being an "*interactive, Web-based knowledge management tool for protected area managers and stakeholders […] to promote peer-based learning interactions across regions and ecosystem types.*" Information on certain issues can easily be queried, for example, in terms of fundraising or monitoring, with expert contact details as well as literature and best-practice examples being provided to the user. For the special case of biosphere reserves, the Governance of Biodiversity (GoBi) Project is launching a Centre for Biosphere Reserve Advancement (C-BRA). C-BRA will not only make the findings of the GoBi Project easily available from an expert knowledge platform to biosphere reserve practitioners but also offer a decision-support system to foster adaptive management (see www.biodiversitygovernance.de).

Similarly, the Foundations of Success [FOS], a small, non-profit organisation, commits itself to working with practitioners to undertake conservation in a more effective way by implementing adaptive management practices. It follows the vision to support an "*engaged conservation community working in a collaborative, transparent, and respectful manner, with the knowledge that the approaches and interventions it is using are likely to achieve measurable long-term success*" (Foundations of Success, 2006). The FOS Web page provides a database on information resources on the issues of adaptive management and monitoring and evaluation in conservation. Together, with the Wildlife

Conservation Society (WCS) and Conservation International (CI), FOS developed the Measuring Conservation Impact Project (MCI) (Stem *et al*., 2003). The MCI Project supports efforts to improve monitoring and evaluation in conservation by sharing working experience in conservation and other fields to measure project and intervention successes (Stem *et al*., 2003). Finally, in close collaboration with the Foundations of Success, the Conservation Measures Partnership (CMP) was founded in 2002, a partnership of Non-Governmental Organisations dedicated to conservation. CMP explicitly focuses on the improvement of "*ways to design, manage, and measure the impacts of their conservation actions*" (Conservation Measures Partnership, 2006).

Although we lack a true concept of how to best implement and carry out Adaptive Management with Digital Tools (Walters, 1986), the chosen examples prove that measures have been taken to address knowledge gaps with respect to funding, monitoring, and numerous other issues of interest in the protected area management context. The awareness level of the presented information providers should be strengthened further, though, to make better use of their power in building capacity where it is still lacking.

Furthermore, with all the information provided and tools in place, it needs to be stressed that access to the World Wide Web is nowadays often taken for granted, though not always given, especially in remote areas of developing countries (e.g. Trauger *et al.*, 2003). This fact somehow questions the "global village" term in that, in reality, only a select fraction of the world comprises this global village, although technical advances allow for consistent interconnectedness. With the digital divide still in place, many parts of the world are still far from assured access to information of any kind, a fact that may tend to get buried in oblivion among global village members. For any of these unconnected places in the world, the entire variety of introduced databases and information providers remains out of reach.

Table E.2 summarises the introduced needs, possible solutions, and existing initiatives to address the identified difficulties in data-sharing on protected area level – and beyond.

Table E.2: Available, non-open access, and non-existing data: needs, possible solutions, and existing initiatives

Needs	Possible solutions	Existing initiatives
To reduce conceptual inconsistency and complexity in data handling (available data)	Standardisation of data collection protocols	IFRI protocols and data gathering and handling conditions
	Standardisation of approaches for the development of monitoring systems (only partly tackling the problem)	Application of existing simple tools, such as BRIM, CAP, and the Adaptive Management Software Tool Miradi
	Facilitation of systems for data handling	Ecological Metadata Language (EML)
To promote the reduction of sensitivity of certain data or handle sensitive data with special care (non-open access data)	Increase of enforcement and control of black market activities	CITES
	Evaluation of sensitivity and approval of data users to avoid misuse	Data exchange principles of the National Biodiversity Network Trust
	Promote a "culture of security" in data handling and distribution	OECD guidelines for the Security of Information Systems and Networks
To promote open access initiatives and the willingness to share data, which includes reducing the scientific and administrative competitiveness, as well as the general reluctance against evaluation processes (non-open access data and non-existing data)	Obligation for data holders to publicly provide data	US FOIA, Berlin and Budapest Declaration, UK Environmental Information Regulations
	Assurance of intellectual property rights and offering incentives for provision of data	Creative commons license
	Standardisation of evaluation procedures as essential elements in protected area management	Self-reporting or certification systems (Dudley *et al.*, 2003; Dudley *et al.*, 2004)
		Decision-making reporting ISO standard system after Huettmann (2005)
To foster financial and/or technical capacity building activities for collection, analysis, and use of monitoring data in protected areas (non-existing data)	Full exploitation of existing online information and further support through new tools	PALnet, FOS online, Conservation Measures Partnership, C-BRA
	Raise external funds, market-based fees for goods and services, etc.	Numerous examples to be found in Emerton *et al.* (2006)

E.4 Essence of chapter E

Chapter E describes a contrary phenomenon that dominates freely available and accessible data for conservation and management from the World Wide Web: data overkill on the one and data scarcity on the other hand. This means, while the number of biodiversity databases announced on the internet has become virtually uncountable, not a single database appears to focus on monitoring information from protected area level that could be used for an assessment of protected area effectiveness in conserving biodiversity *in-situ*. This is surprising in the face of international conservation targets whose indicators require for this very information. A variety of very different reasons seems to be responsible for this situation. On a local level, it is often a lack of capacities that hampers the gathering of long-term data on changes in the state of conservation targets, as much in terms of personnel, as in terms of knowledge and equipment. However, in case the required capacities exist, other obstacles hinder the sharing of information, such as academic and scientific competitiveness and the general reluctance towards assessments as such. On a national and international level, the lack of standard systems for data uptake, use and security, respectively applying to metadata, represents a serious shortcoming. Different initiatives tackle the issue at different levels; however, assessments of conservation success in protected areas cannot yet be approached through freely available data from the World Wide Web.

The insights gained revealed the necessity to differently approach an assessment of protected area effectiveness in conserving biodiversity. The following chapter provides the theoretical background for this endeavour.

F. DEVELOPING A THEORETICAL CONSERVATION SUCCESS FRAMEWORK

"*To most effectively measure conservation impact, it is critical to understand the context in which conservation interventions take place and the cause and effect relationships that affect the state of conservation*." (Stem *et al*., 2003: 9)

The lack of open access data from effectiveness monitoring on protected area level (see chapter E) revealed that a different approach to assessing protected area effectiveness is required to achieve the research goals of this study. Therefore, a theoretical Conservation Success Framework is first developed in this chapter and then applied in two biosphere reserves in Mexico (see chapter G).

Section F.1 of this chapter addresses research question 2 of the present study (see Table A.1): **What in fact is conservation success and is it measurable at all?** The question is addressed by providing a critical discussion of the conservation success terminology which represents a theoretical background for the following sections (research goal 2, see Table A.1). In the following, options for the analysis of threats to biodiversity are reviewed (F.2) and an analytical framework for such an analysis is introduced (F.3). The theoretical background provided in sections F.1 to F.3 lays the foundation for the development of the theoretical Conservation Success Framework described in sections F.4 and F.5. The chapter thus also addresses research question 3 and achieves research goal 3 (see Table A.1): **How can information gaps be bridged in an assessment of conservation success – in theory?**

F.1 The term "conservation success" and its measurability

The term "conservation success" is used in the theoretical framework that is developed in this study but has otherwise been largely avoided in this study for the reasons outlined in the following.

The term "conservation success" is frequently applied in conservation science in very different contexts and no overall definition seems to exist. Before defining "conservation success", one first needs to clarify what "conservation" aims at. Beazley *et al.* (1993: 52) state that "*Conservation, [...], has three principal aims: to conserve the life-support systems that nature provides; to conserve the diversity of life on Earth; and to ensure that all uses of renewable resources are sustainable.*" Based on this statement, conservation success would mean the achievement of any or all of these principal aims. However, this renders conservation success virtually immeasurable for a number of reasons: We lack knowledge about the functioning of the life-support systems that nature provides (e.g. Tilman, 2000); we still only know a small fraction of life on Earth (Chapman, 2006; Leakey and Lewin, 1996; Raven and Williams, 2000); our knowledge of the requirements of the species we know is limited (Bennett, 2003); and the sustainability concept as such is too multi-facetted to be easily measurable (Kemp and Martens, 2007). Thus only selected aspects of the above principal aims can be measured, leaving gaps for criticism as to the correctness of claiming conservation success.

In the protected area context, conservation success may also be measured against the defined conservation objectives of a specific site. It is in general expected that protected areas have a series of specific conservation objectives that guide their work. The clearer these objectives are formulated, the higher is the probability that conservation success can be measured quantitatively using natural scientific methods. The identification of clear and specific conservation objectives is a key recommendation of protected area management guidelines (e.g. Day *et al.*, 2002; Hockings *et al.*, 2006; Mapstone, 2004). Despite this guidance, conservation objectives of protected areas are often too unspecific and broad, for example by referring to the maintenance of ecosystem integrity or health, or to ecosystem functioning (see Table F.1). However, due to the unspecific and broad nature of these terms, they do not allow for a measurement of conservation success.

The often used term "ecosystem integrity" is defined as "*the extent to which the interrelationships among and within ecosystems remain intact so that the number and variety of living organisms can be maintained*" (World Bank, 2003). It is by some used synonymously with "ecosystem health" (e.g. UNESCO-WWAP, 2006) and its definition comes close to the definition of "ecosystem health" provided by the United Nations Environment Programme (UNEP, 2007: 518): "*The degree to which ecological factors and their interactions are reasonably complete and functioning for continued resilience, productivity and renewal of the ecosystem.*" However, none of the definitions makes conservation success measurable, as we still lack knowledge on such interactions and what makes them complete and functioning. Besides, words such as "reasonably" are subject to interpretation and still increase the unattainable nature of several of the terms in use in conservation science. Criticism on the use and abuse of these terms goes as far as Fitzsimmons (1999) who questions how the term "ecosystem integrity" can be used if the term "ecosystem" as such cannot be made applicable. Fitzsimmons states that ecosystems are by no means self-contained units and thus the allocation of ecosystem types to the planet's surface is an issue of pure subjectivism. Shafer (1999: 128) notes in contrast that "*it is not uncommon to lose sight of one's goal*", and this does not only apply for biodiversity conservation. Still, the challenge to measure conservation success remains, and therefore it would be valuable if clumsy conservation terms can be operationalised.

The aforementioned protected area management guidelines recommend to leave terms such as "ecosystem integrity" for vision- and mission-wordings and to specify conservation objectives in such a way that they allow for measuring progress (Day *et al*., 2002; Hockings *et al*., 2006; Mapstone, 2004). Tucker *et al.* (2005: 31) define "objectives" in the conservation context as: *"...specific outcomes or targets that the management activities will be designed to achieve. Objectives should be clear descriptions of a measurable standard to be achieved, or a desired state, threshold value, amount of change, or trend that you are seeking to establish*." Overall, conservation objectives should be SMART, i.e. Specific, Measurable, Achievable, Realistic, and Time-specific (Ervin *et al*., 2007; Tucker *et al*., 2005).

A quick review of ten openly accessible protected area management plans[23] demonstrates, however, the variety of terms in use for protected area visions, missions, conservation objectives and further specified subcategories of objectives. The existing lack of specificity of defined conservation objectives is revealed even at the lowest (and thus most specific) hierarchical level of conservation objective categories (see Table F.1).

Table F.1: Comparison of terms in use for conservation objectives in ten protected area management plans

Site name	Terms in use (hierarchical order)	Example from the lowest hierarchical level
Bale Mountains National Park, Ethiopia (Frankfurt Zoological Society, 2007)	• Purpose of the park • Management strategies and objectives • Specific objectives	Specific objective 1.2 (p. 41): Fire extent, frequency and intensity managed.
Banff National Park, Canada (Environment Canada and Parks Canada, 2007)	• Vision • Strategic goals • Objectives	Objective (p. 17): To eliminate fishing where human use threatens native species or genetic diversity.
Bontebok National Park, South Africa (South African National Parks, 2006)	• Vision • High-level objectives • Objectives • Sub-objectives	Sub-objective (p. 14): Improve and restore local hydrological regime and natural functioning of Breede River.
Booderee National Park, Australia (Booderee National Park Board of Management and Director of Managements, 2002)	• Vision • Key objectives • Aims	Aim (p. 49): To protect the clarity and quality of the Park's marine waters and freshwater ecosystems.
Central Balkan National Park, Bulgaria (Iankov, 2001)	• Purpose of the park • Goals • Long-term objectives • Management objectives	Management objective (p. 106): Create conditions for preservation of the species of conservation significance in the Park.
Gra Gra Lagoon National Park, Belize (Meermann and Wilson, 2005)	• No vision/purpose • Strategic long-term goal • Medium-term objectives	Medium-term objectives (p. 62): Ecological viability is not compromised by up-stream influences in the watershed.
Hawar Islands National Park, Bahrain (Pilcher *et al.*, 2003)	• No vision/purpose • Strategic actions • Management goals	Management goals (p. 46): To apply ecosystem-based management to The Hawar Islands Protected Areas.
Serengeti National Park (SENAPA), Tanzania (Tanzania National Parks, 2006)	• Purpose of the park • Management strategies • Conservation targets • Programme objectives	Programme objectives (p. 30): The conservation and ecological status of SENAPA Conservation Targets enhanced and threats reduced.

[23] The management plans were searched with Google. Documents from native English speaking countries are much more numerous on the World Wide Web than from other countries. Due to the focus on terminology, for comparability, only English documents were reviewed here. The selected plans cover ten different countries from several continents, but may nevertheless not be representative overall.

Table F.1 (continued): Comparison of terms in use for conservation objectives in ten protected area management plans

Site name	Terms in use (hierarchical order)	Example from the lowest hierarchical level
Virachey National Park, Cambodia (Ministry of Environment Cambodia, 2003)	• Purpose of the park • Mission statement • Vision • Goals • Objectives	Objective (p. 46): To ensure sustainable utilisation of protected area resources by local communities.
Wicklow Mountains National Park, Ireland (Government of Ireland, 2005)	• Ideal aims • Principal management objectives	Principal management objectives (p. 5): To maintain and where possible enhance the ecological value of all natural and semi-natural habitats and geological features within the Wicklow Mountains National Park.

In several of the management plans included in Table F.1, measurability is more a feature of the proposed strategies, also called actions or key actions, for achieving objectives than of the objectives themselves. Some of the management plans define indicators for measuring progress of these actions. In those cases where The Nature Conservancy's Conservation Action Planning approach is applied, indicators refer for example to the defined "conservation targets" or their "key ecological attributes" (e.g. Frankfurt Zoological Society, 2007; Tanzania National Parks, 2006). Both approaches allow for measuring success, although it is necessary to differentiate between success in implementing specific actions as planned and success in achieving conservation objectives (according to different monitoring types, see Table D.4). For the latter, outcome-related information is needed, which is often lacking or incomplete (see Chapter E and Leverington *et al.*, 2008a). Overall, conservation success therefore remains a term that is very difficult to apply and measure properly – at least in practice.

Consequently, the terms in use in this study are shifting from the largely intangible "conservation success", which is used in the theoretical sections, towards "conservation achievements", which is used when applying the CSF in practice (see Chapter G). In the context of this study, "conservation achievements" are defined as *the achievements made through conservation actions taken either to directly address conservation objectives and targets (e.g. target species, ecosystems) or to tackle indirect influences on conservation objectives and targets*. This definition of conservation achievements allows for assessing conservation progress: By avoiding the difficult-to-define and -quantify term "success" and instead studying noticeable effects of conservation actions on the state of conservation, conservation achievements can in fact be researched and reported.

The following section reviews options for analysing threats to biodiversity. This is of special importance as threats to biodiversity are the agents shaping the state of conservation of the world's ecosystems.

F.2 Analysing threats to biodiversity

Every place on earth is as it is because of historical and current forces. The historical forces range from prehistoric events to historical events, including human resource use patterns from their early start until now. Current forces refer to today's influences of any kind as a consequence of the past and present. In the following, every type of human interference with natural processes and patterns of biodiversity, whether negative or positive, is called "external influence" although it is recognised that man is part of nature and thus of course not "unnatural" or "excluded" from nature – a repeated criticism on the often strictly applied differentiation between man and nature (McNeely, 2002; Wallace *et al*., 1996).

Natural systems have an intrinsic ability to buffer or resist negative external influences, restore themselves and adapt to changed conditions (e.g. the natural capacity of mangrove ecosystems to buffer the coastline from storms and even tsunamis) (Beazley *et al*., 1993). However, this ability varies between sites, systems, and is certainly limited. The ability of a natural system to buffer, resist, restore and/or adapt relate to the concepts of vulnerability and adaptive capacity. Both concepts have developed independently and there are numerous definitions of the two terms (Janssen and Ostrom, 2006). Box F.1 summarises the definitions of the terms.

Box F.1: Definitions of the terms "vulnerability" and "adaptive capacity" (after Millennium Ecosystem Assessment, 2005c)

Vulnerability:
Exposure to contingencies and stress, and the difficulty in coping with them. Three major dimensions of vulnerability are involved: exposure to stresses, perturbations, and shocks; the sensitivity of people, places, ecosystems, and species to the stress or perturbation, including their capacity to anticipate and cope with the stress; and the resilience of the exposed people, places, ecosystems, and species in terms of their capacity to absorb shocks and perturbations while maintaining function. (Millennium Ecosystem Assessment, 2005c: 103)

Box F.2 (continued): Definitions of the terms "vulnerability" and "adaptive capacity" (after Millennium Ecosystem Assessment, 2005c)

Adaptive capacity:
The general ability of institutions, systems, and individuals to adjust to potential damage, to take advantage of opportunities, or to cope with the consequences. (Millennium Ecosystem Assessment, 2005c: 97)

Where natural systems are exposed to external influences, their vulnerability and adaptive capacity determine the impacts of these influences on the integrity of the systems. Margoluis and Salafsky (2001: 9) define threats as "*those dynamic influences that cause some degree of deterioration or destruction of the biodiversity in the site*". They also point to the broad range of terms in use for threats, i.e. "pressures", "impacts", "drivers" or "barriers" (Margoluis and Salafsky, 2001). No matter how these external influences are termed, they can be studied in much more detail to better understand how and why they happen and with which consequences, if the term "threat" is disintegrated into its "components". Figure F.1 presents three different approaches: The first approach distinguishes between indirect and direct threats (IUCN-CMP, 2006a; Margoluis and Salafsky, 2001). The second approach regards threats as consisting of a stress that impacts on a conservation target as well as a source as the agent causing the stress (The Nature Conservancy, 2003). In addition, stresses and sources may be accompanied by further underlying causes (Ibisch and Bertzky, 2006). The third approach differentiates between ultimate, or root causes and proximate causes of biodiversity loss (Lambin *et al.*, 2001; Pressey *et al.*, 2007; Wilson *et al.*, 2005; Wood *et al.*, 2000).

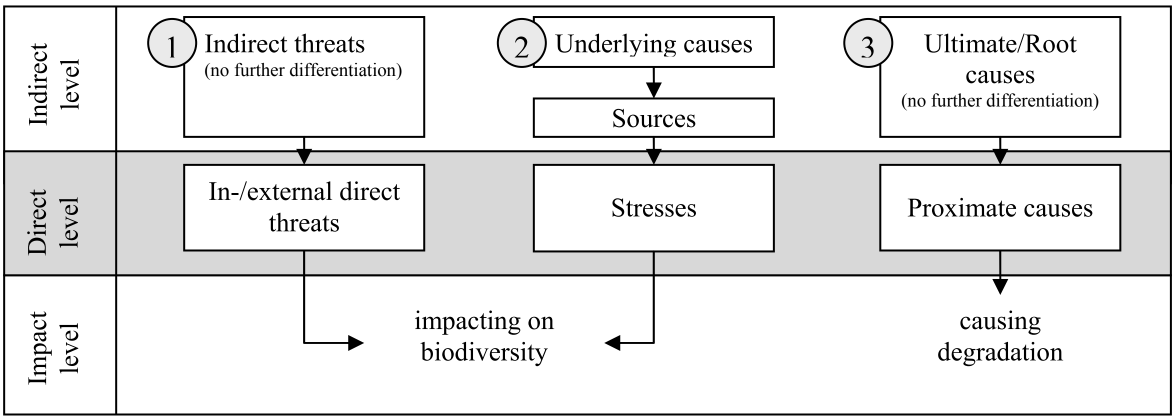


Figure F.1: Different possibilities to disintegrate threats to biodiversity into their components
(1: according to IUCN-CMP, 2006a, Margoluis and Salafsky, 2001; 2: according to The Nature Conservancy, 2003, Ibisch and Bertzky, 2006; 3: according to Lambin *et al.*, 2001, Pressey *et al.*, 2007, Wilson *et al.,* 2005, Wood *et al.*, 2000)

While the terminology of the three approaches differs, the connection of the separate components of each approach ultimately results in a causal chain further explaining threats to biodiversity. Figure F.2 gives an example for a cause-effect relationship threatening a conservation target.

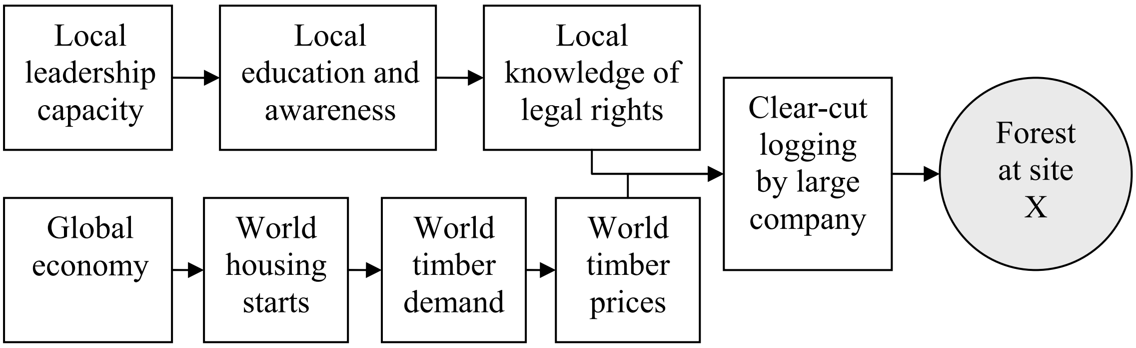


Figure F.2: Example of a causal chain of factors affecting a conservation target (after Salafsky *et al.*, 2002)

As indicated in Figure F.2, threats can be split up in more and more detail. In the given case, the ultimate threat, global economy, leads to the direct threat, clear-cut logging, in three steps. In the end, it is a matter of choice how far a threat is split up into its ingredients, how many intermediate steps can be clearly identified and what is defined as the ultimate cause. While, for example, climate change can be regarded as an “ultimate cause” resulting in species’ distribution shifts (e.g. UNEP, 2006), it could also be argued that anthropogenic CO_2-emissions or human energy consumption do in fact represent the “ultimate cause” (Nelson, 2005). Obviously, there is space for individual interpretation when one looks closer at the components of threats, but categorisations are nonetheless helpful for a better understanding of causal chains of threats to biodiversity. The latter especially help to a) more easily identify indicators to keep track of the dynamics of a threat; and b) more easily identify potential counteractions.

Both points are of importance in the context of this study, and point b) leads over to the next section as these counteractions are the missing link for investigating conservation success (in theory) and conservation achievements (in practice): Ideally, every threat to the conservation values of a protected area, or at least one of its components, should be addressed by a counteraction. One analytical framework, which was not introduced so far, explicitly includes "responses" to existing threats, in the sense of counteractions: the DPSIR-Framework. This framework is introduced separately in the following section[24].

F.3 The DPSIR-Framework

The DPSIR-Framework looks at disturbances to natural systems by disintegrating them into **D**riving forces, **P**ressures, **S**tates, **I**mpacts, and **R**esponses. It was introduced by the European Environment Agency (European Environment Agency, 1998; European Environment Agency, 1999) and originates from OECD's Pressure-State-Response (PSR)-Framework (OECD, 1993). Figure F.3 shows the framework and its components.

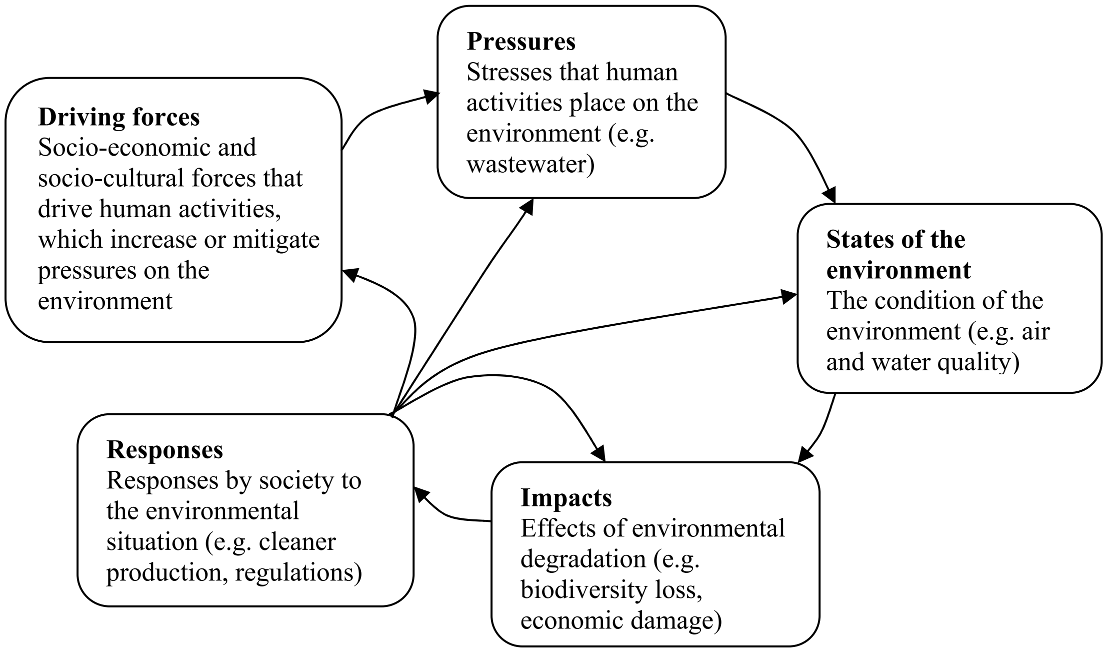


Figure F.3: The DPSIR-Framework (after UNEP/GRID-Arendal, 2002)

The DPSIR-Framework has been applied in integrated studies of social-ecological system management (Bidone and Lacerda, 2004; Bowen and Riley, 2003; Pirrone *et al.*, 2005) but also with the aim to structure and facilitate the identification of adequate environmental indicators (European Environment Agency, 2004; UNEP/RIVM, 1999). In addition, the framework represents the backbone of large-scale assessments of the world's ecosystems, such as the Global Environmental Outlook (GEO) of the United Nations

[24] The 5S-Framework developed by The Nature Conservancy includes strategies similar to the responses that are part of the DPSIR-Framework (The Nature Conservancy, 2003); however, the DPSIR-Framework is preferred here because it allows for more detailed insights into threats.

Environment Programme (UNEP, 2007) and the Millennium Ecosystem Assessment (Nelson, 2005). Given this broad range of successful applications, it is considered well suited for the present study as well.

Before the DPSIR-Framework is applied here, and to increase clarity in later sections, potential driving forces are grouped into thematic categories. Table F.2 compares the different thematic categories of driving forces used in existing studies.

Table F.2: Comparison of thematic categories of driving forces

Source	Theme of the study	Subdivision of driving forces
Geist and Lambin (2001)	A meta-analysis of proximate and underlying causes for tropical deforestation	• Demographic • Economic • Technological • Policy/institutional • Cultural/socio-political
Hostettler (2007)	Land use changes and transnational migration: the impact of remittances in Western Mexico	• Economic (market prices) • Environmental (variability of rainfall, soil quality, topography) • Political/institutional (agricultural subsidies, land tenure) • Demographic (labour availability)
Nelson (2005)	Discussion of drivers of ecosystem change as part of the Millennium Ecosystem Assessment	• Demographic • Economic • Socio-political • Cultural and religious • Science and Technology
UNEP (2006)	Africa Environment Outlook 2 – Our Environment, Our Wealth	• Demographics • Health • Economics • Social issues • Culture • Technology • Institutions and governance • Peace and conflicts • Natural disasters and climate change
UNEP (2007)	Global Environmental Outlook (GEO) 4 – environment for development	• Demography • Economic development • Human development • Science and technology • Governance • Culture and environment

Several thematic categories, such as demographics and economics, appear in each of the existing subdivisions. For other categories differences can be found, partly accounting for the specific needs of each study. An important distinction can be made according to the perspective of the existing studies: the GEO 4 uses the DPSIR-Framework to assess the changes in human well-being. Thus, poverty is considered an impact on society as a result of, for example, pollution, degradation and/or depletion of air, water, minerals and land (including desertification) (UNEP, 2007:xxii). However, when changing the perspective and assessing changes in ecosystem and biodiversity status, poverty becomes instead a driving force for overexploitation of resources (e.g. Mellor, 2002). The GEO 4 notes accordingly that "*Poverty is both a cause and a consequence of land degradation: poor people are forced to put immediate needs before the long-term quality of the land, while degraded farmland and poor yields contribute to food and income insecurity*." (UNEP, 2007: 196).

Here the category system used by Geist and Lambin (2001) is followed, as their study represents a similar perspective as the present study. Yet Geist and Lambin's "underlying causes" are termed "driving forces" throughout this study. Table F.3 explains with numerous examples how the thematic categories of driving forces are defined here (see Geist and Lambin, 2001: 9-10). Where original definitions were too much focused on deforestation, they were adapted according to the needs of the present study.

Table F.3: Definition of the thematic categories of driving forces used in the present study (adapted from Geist and Lambin, 2001)

Category	Subcategory	Includes
Demographic driving forces (human population dynamics)	(no subcategories)	Population pressure
		Population growth
		Natural increment (fertility, mortality)
		Migration
		Population density
		(Uneven) Spatial population distribution
		Life cycle features (e.g. age distribution)
Economic driving forces (economic growth, change or development, commercialisation)	Market growth and commercialisation	Rapid market growth (especially of the export oriented sector), rise of cash economy, increasing commercialisation, incorporation into (world) economy
		Increased market accessibility (especially of semi-urban and urban markets)
		Growth of sectoral industries (resource-related, agriculture-related, mineral-related, others)
		Lucrative foreign exchange earnings
		Growth of demand for consumer goods and services procured with cash due to a rise in well-being (unspecified, resource-related, agriculture-related, housing & transport)
	Specific economic structures	Large individual (mostly) speculative gains
		Poverty and related factors (lack of income opportunities, joblessness, resource poverty, low living standard, etc.)
		Economic downturn, crisis conditions
		Indebtedness, heavy foreign debt

Table F.3 (continued): Definition of the thematic categories of driving forces used in the present study (adapted from Geist and Lambin, 2001)

Category	Subcategory	Includes
Economic driving forces (economic growth, change or development, commercialisation)	Urbanisation and industrialisation	Urbanisation: growth of urban markets
		Industrialisation: rapid build-up of new basic, heavy and resource-based industries
	Special economic parameters	Comparative advantages due to cheap, abundant production factors in resource extraction & use
		Special, mainly artificially low kept production conditions
		Price (value) increases (of fuel, land, cash crops)
		Price decreases (of cash crops)
Technological driving forces (technological change or progress)	Agro-technological change	Land-use intensification
		Land-use extensification
		Agricultural involution
		Other changes (landholding, production orientation, etc.)
	Technological applications in the resource sector	Damage and wastage due to poor resource-use performance
		Wastage in resource processing, poor industry performance
		Lack of cheap, technological alternatives to wood fuel; poor domestic & industrial furnace performance
	Other production factors in agriculture	Low level of technological inputs (unspecified)
		Land-related factors (landlessness, land scarcity)
		Labour –related factors (limited labour availability)
		Capital-related factors (no credits, limited irrigation)
Policy and institutional driving forces	Formal policies	On taxation, charges, tariffs, prices
		On credits, subsidies, licenses, concessions, (logging) bans
		On economic development (agriculture, infrastructure)
		On finance, legislation, investment, trade
		On population (migration)
		On land
		Other pro-resource-use policy (unspecified)
	Informal policies (policy climate)	Corruption, lawlessness
		Growth or development coalitions at work
		Poor performance, mismanagement
		Clientelism, vested (private) interests
		Redefinition of (resource-use) policy goals
	Property rights (regimes)	Insecure ownership, land tenure insecurity (unspecified)
		Land race, race for property rights
		Titling, legalisation, consolidation (of individual titles)
		Malfunctioning customary rights
		Low empowerment, deprivation, marginality
		Open access conditions
Cultural (or socio-political) driving forces	Public attitudes, values, beliefs	Public unconcern or lack of (public, political) support for biodiversity conservation and sustainable use: low morale or education, frontier mentality, and dominance of other public attitudes (modernisation, development, nation-building, etc.)
		Unconcern about the welfare of others and future generations, or disregard of the “ sacredness of nature“
		Beliefs about how environmental conditions affect those things which individual values
	Individual and household behaviour	Unconcern by individuals about the environment as reflected in increasing levels of demands, aspirations, materials and energy consumption, commonly associated with commercialisation and increased income
		Situation-specific behaviour of actors: rent-seeking, non-profit orientation, tradition/imitation/continuation of inherited modes of resource use

According to the given definitions, poverty is considered as an economic driving force in the present study, despite its multifaceted nature. Climate change, although a crucial threat to biodiversity in many parts of the world, does not appear in Table F.3 because it is considered a consequence of global population and income growth in interaction with technological advances (see also Nelson, 2005). This example emphasises that it may still be too simplistic to look at causal chains rather than **causal networks**. Niemeijer and de Groot (2007) argue that causal networks do much better approach the complexities of reality than causal chains. For this very reason the DPSIR-Framework in the present study is applied, as far as possible, in such a way that interrelations of its components are considered.

Sections F.1 to F.3 should be considered as a baseline for understanding the following section that explains the components of the Conservation Success Framework. The relation of the DPSIR-Framework to the Conservation Success Framework will be clarified at the end of chapter F.

F.4 The components of the Conservation Success Framework

Considering the serious shortcomings of existing and accessible data for an assessment of conservation achievements it was necessary to develop a conceptual theoretical framework that could help to gain a better understanding of basic requirements for achieving conservation success. The development of this so-called Conservation Success Framework (CSF) addresses research goal 3 and follows from theoretical reflections in previous sections.

The theoretical Conservation Success Framework consists of three main components: **conservation needs, conservation capacity and conservation actions**. The three components and their connections will be introduced in the following subsections and the overall framework will be described in section F.5.

The presentation of the case study results in chapter G will follow the here given order of components of the Conservation Success Framework, i.e. first describe all conditions under which actions are implemented (framed by conservation needs and capacities) and then look at the conservation actions at site.

F.4.1 Conservation needs

The term "conservation needs" is widely used and recognised in biodiversity conservation science (e.g. Commission on Geosciences Environment and Resources, 2001; Hedges *et al.*, 2005). In the present study *conservation needs* are defined as:

> *…needs arising from states of or threats to biodiversity within or in the surroundings of an in-situ conservation site that require for being addressed through conservation actions, either in addition to or according to determined conservation objectives.*

Conservation needs are influenced by a site's vulnerability and adaptive capacity to external influences. Vulnerability and adaptive capacity are shaped by a site's history and further influenced by a large number of potential threats to biodiversity. These threats consist of driving forces, pressures, states and impacts (DPSI), as introduced in section F.3. Conservation objectives of a site may also influence its conservation needs.

The logic behind the "conservation needs" component is exemplified as follows: First it is important to note that threats and their components (see section F.2) do a) vary from one site to the next, and b) cause different types of impacts on biodiversity in different sites. For instance, a site X that just started recovering from massive anthropogenic alteration may seem much more hospitable towards newly arriving invasive species than an intact site Y – and so the magnitude of impacts will vary as well (see Figure F.4). Presumably, the vision at site X is to improve the status of the sites' ecosystems, while at site Y it is aimed at maintaining the current status. This clearly influences the tasks required at each site: Site X needs to both address external influences and directly support the recovery process. Site Y in turn does not need to support recovery processes but instead "only" needs to minimise external influences to maintain the current status. However, assuming that site X is a very remote place while site Y is adjacent to large-scale settlements, the efforts required at site Y to maintain the current status may be larger than those required to recover site X. The example is illustrated in Figure F.4.

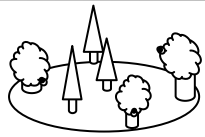
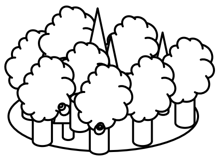
Site characteristics	Threat	Impact	Conservation needs
	Invasive alien species →	High →	High
Site X • recovering • remote	Exploitation of resources →	Does not apply → site remote → no impact →	None
	Invasive alien species →	Low → no easy establishment →	Low
Site Y • intact • adjacent to settlements	Exploitation of resources →	High →	High

Figure F.4: Example for site-specific differences in conservation needs

Consequently, there are different needs for conservation in different sites, which requires specific conservation actions to address these needs. Determined conservation objectives (e.g. from a protected area management plan) may either directly reflect these needs or focus on certain additional targets. Threats and conservation objectives also represent an essential element in the WCPA framework for evaluating protected area management effectiveness by Hockings *et al.* (2006) (see subsection D.2.1). However, the management effectiveness evaluation systems following the WCPA framework do not necessarily regard threats in much more detail[25], and are not done through a qualitative survey involving a larger number of stakeholders – as is the case in the present study.

As the definition of conservation needs implies, conservation actions are essentially tied to this component. Above this, they represent the "R" of the DPSIR-Framework: the responses to the driving forces, pressures, states and impacts at a site. However, no action can be implemented without the capacities required for doing so. Therefore, the conservation capacity component will be described next.

[25] There are certainly exceptional studies that paid more attention to threats than others but the general framework does not necessarily require a detailed assessment of threats.

F.4.2 Conservation capacity

Where there are conservation needs and thus a need for action, it is essential that the capacities required to address this need exist. In the present study *conservation capacity* is defined as:

> *…the existing overall capacity that exists to address conservation needs through conservation actions. This capacity consists of financial, infrastructural, personnel, scientific and social capital including skills and training of the management body, staff and all those people involved in conservation actions in and around the protected area. The conditions, under which this capacity exists, for example, in terms of stakeholder interests and attitudes, further determine their efficiency and effectiveness.*

This definition is derived from the management capacity concept as developed by Hockings and Phillips (1999) and illustrated in Figure F.5. The resources dimension, however, is here regarded in a more holistic way than by Hockings and Phillips (1999) and therefore includes skills and leadership characteristics as well as internal management processes that may increase or decrease overall conservation capacity. Carey *et al.* (2000) refer to a „lack of capacity" in cases where there is a lack of political/legislative support, unclear or contradictory legislation, and/or a lack of land-use plans and management plans.

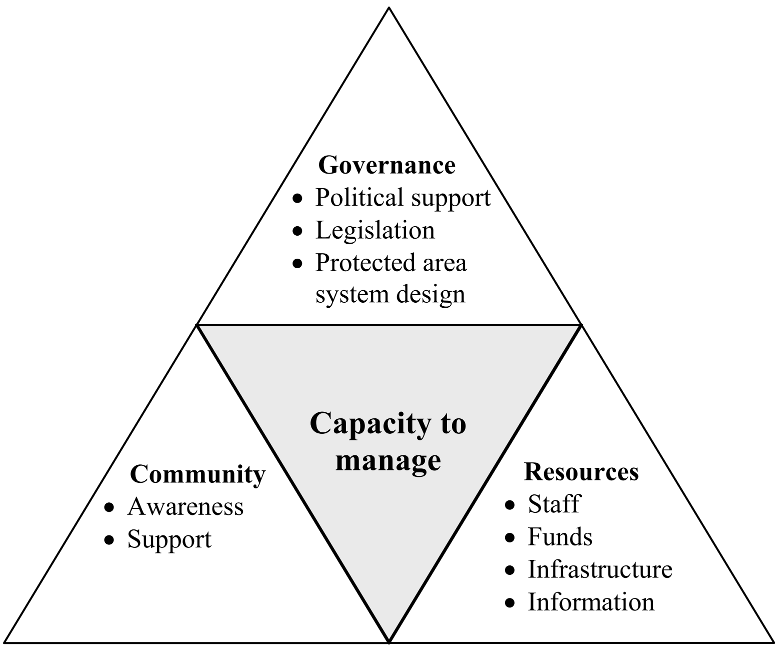


Figure F.5: The dimensions of capacity to manage protected areas (adapted from Hockings and Phillips, 1999)

From the above it is clear that the achievement of conservation objectives is not only dependent on implementing the right conservation actions, but also on several other conditions beyond control of protected area managers. Booth *et al.* (2005), Hough (2007), and UNDP-GEF (2005), all cited in Ervin *et al.* (2007), define conservation capacity along three broad levels:

Individual level: The degree to which protected area staff have the skills, knowledge and competencies needed to effectively manage a protected area site or system.

Institutional level: The degree to which a protected area institution has the internal and external structures and processes in place needed to enable the effective management of a protected area system.

Societal level: The degree to which the laws, policies and practices of a range of environmental, social and economic sectors provide a favourable environment for the establishment and management of a protected area system.

Both definitions, the one given by Hockings and Phillips (1999) and the one given by Ervin *et al.* (2007), encompass many identical aspects, however, they grasp these aspects according to different perspectives. In the present study the dimensions of conservation capacity according to Hockings and Phillips (1999) will be followed, as their special emphasis on the governance dimension is considered crucial (see also subsection D.1.2).

Potential overlaps between dimensions of conservation capacity and driving forces can pose a problem: What can be regarded a cultural driving force, such as “lack of environmental awareness”, could also be regarded as part of the community component of the capacity definition illustrated in Figure F.5. This results from the close link between the two components, conservation needs and conservation capacity, of the Conservation Success Framework. However, in the case studies, a distinction will be made according to whether a factor decreases or increases the conservation capacity at a site, or indirectly or directly influences a site’s conservation needs. Where a factor interacts with both components it will also be considered under both components.

The resulting component of existing conservation needs and capacities are conservation actions as introduced in the following subsection.

F.4.3 Conservation actions

Conservation actions are here defined as:

> *…those actions triggered and/or implemented by the management body or cooperating actors within or in the surroundings of an in-situ conservation site, that directly or indirectly address the conservation needs, the conservation objectives or the conservation capacity at site.*

This component of the Conservation Success Framework was inspired by the Unified Classification of Conservation Actions of IUCN and the Conservation Measures Partnership (IUCN-CMP, 2006a) as well as the DPSIR-Framework. In the Conservation Success Framework, the conservation actions represent the "R" of the DPSIR-Framework, the responses. Figure F.6 illustrates three types of conservation actions (A, B, C) according to their target (adapted from IUCN-CMP, 2006a).

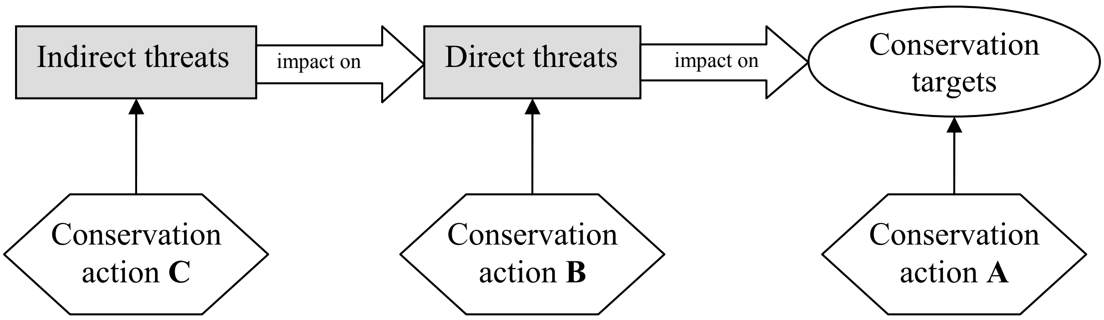


Figure F.6: Three types of conservation actions differentiated according to their target (adapted from IUCN-CMP, 2006a)

While conservation action A directly addresses the conservation targets at site (e.g. the population of a species), conservation action B tackles those threats that are directly impacting on the conservation targets (e.g. poaching). Conservation action C, on the other hand, addresses the root causes of the direct threats, here called "indirect threats".

In contrast, Salafsky and Wollenberg (2000) compare three types of conservation strategies as illustrated in Figure F.7. Rectangles within the figure indicate conditions at the project site, hexagons the interventions undertaken by the project team. Again it is clear that the figure presents causal chains for understanding conservation measures. The classic protected area strategy (a) reflects authoritarian protectionism and thus the traditional approach to nature conservation (see section C.2). The substitution strategy (b) expects that the increased benefits from alternative livelihood activities release the pressure on biodiversity by reducing internal threats, while external threats remain unaddressed. In the linked incentives strategy (c) local stakeholders become involved in conservation actions through incentives for conservation. Here, once local stakeholders take over responsibility for conservation, the exploitation of the commons can be reduced. Moreover, if stakeholders engage in addressing internal and external threats, conservation actions otherwise required from the management can also be reduced. This applied to the example created in Figure F.4 means that site Y could be released from pressure arising from adjacent settlements and resulting resource exploitation through increased acceptance and, in consequence, the site's conservation needs would decrease.

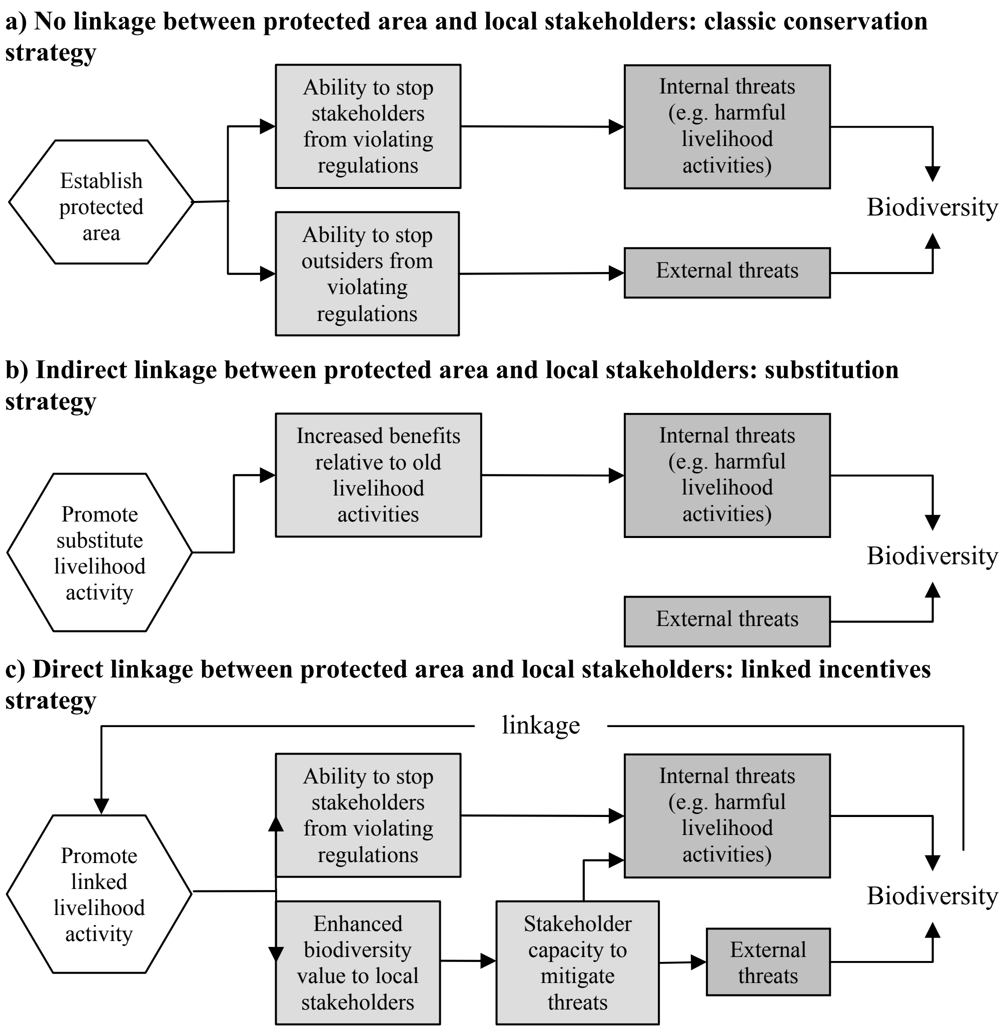


Figure F.7: Different conservation strategies (after Salafsky and Wollenberg, 2000) (Rectangles indicate conditions at the project site, hexagons the interventions undertaken by the project team)

Although the three strategies in Figure F.7 show various options to achieve conservation objectives, one option is still missing: to improve the conditions under which it is attempted to achieve conservation objectives, i.e. the conservation capacity. The Unified Classification of Conservation Actions (IUCN-CMP, 2006a) also includes fundraising and training of staff as conservation actions and, correspondingly, Leverington *et al.* (2008a) in their global study on protected area management effectiveness evaluations again emphasise the importance of adequate staffing, funding, training and equipment. This is what connects the conservation actions component to the conservation capacity component. The definition of conservation actions used in the present study, as given above, therefore includes the term "conservation capacity".

F.5 The Conservation Success Framework and its applicability in practice

The foregoing subsections imply the basic assumption behind the Conservation Success Framework (CSF): *Conservation can only be successful where the conservation capacity exists that is required to implement the conservation actions determined by the conservation needs, which are in turn determined by the site-specific vulnerability, external influences and conservation objectives*.

As noted in section B.3, the CSF passed two stages of development; the much more complex first version is illustrated in Figure F.8, the final one in Figure F.9. The first version of the CSF could be simplified by combining several components; e.g. hazardous events, exposure and adaptive capacity were first integrated into vulnerability and then into the conservation needs component, which includes the driving forces, pressures, states and impacts of the DPSIR-Framework. The main components, **conservation needs**, **conservation capacity** and **conservation actions**, have remained identical throughout the development of the CSF.

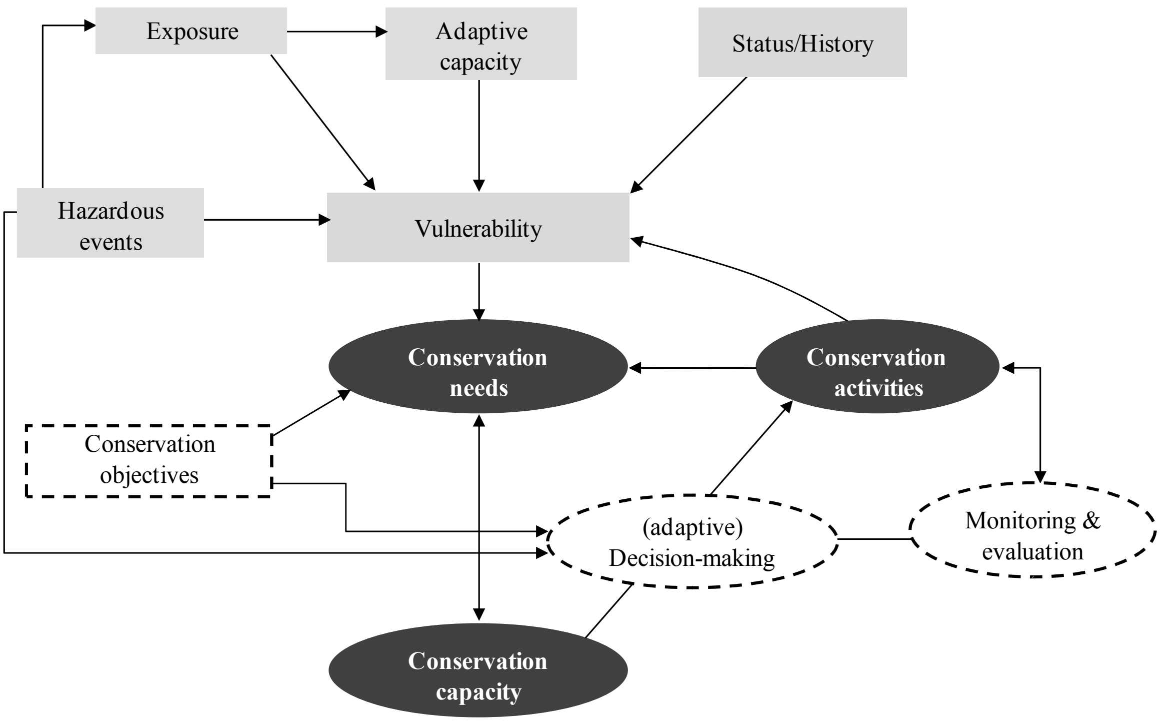


Figure F.8: First version of the Conservation Success Framework
(Dark grey: main components of the CSF; white: key structures (here conservation objectives, rectangle) and processes (here decision-making, monitoring and evaluation, ovals) of protected area management; light grey: aspects influencing a site's vulnerability; arrows indicating the direction of influence)

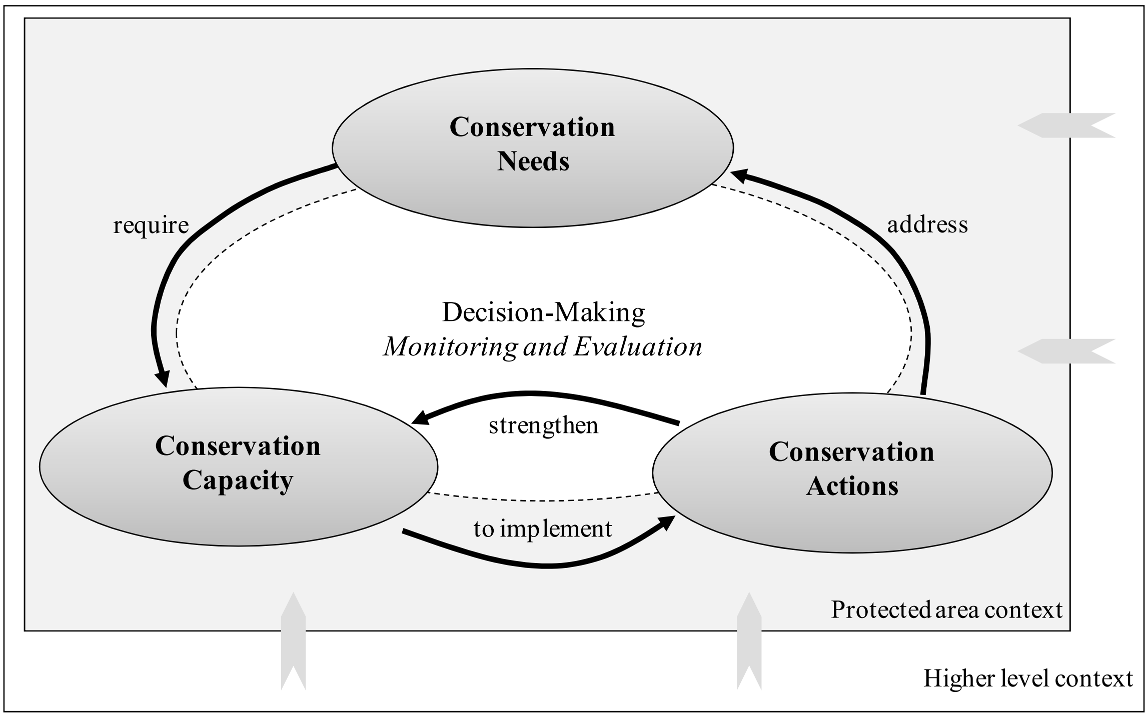


Figure F.9: Final version of the Conservation Success Framework

Two components of the final CSF have not been introduced so far: Firstly, conservation needs, actions and capacity are integrally linked by **the decision-making processes** at site: One approach to decision-making may determine other conservation needs and actions than another approach, and thus they may lead to different conservation action plans and differences in the allocation of resources (conservation capacity). Secondly, ideally, monitoring and evaluation is constantly carried out for all three components of the CSF in order to enable an adaptive management system. While Chapters D and E pointed out that in practice this is often not the case, it represents an essential component in a theoretical framework for conservation success.

In the analysis of the qualitative data from the case studies conducted, all components of the CSF were taken into account, and it has been tried to reconstruct the interdependency of the main components and empirically prove their fundamental role in achieving conservation objectives in protected areas and biosphere reserves respectively. The development of the qualitative open and closed questionnaires was based upon the here developed framework (this is reflected, e.g., in Table B.2).

In the presentation of the case study results, the following questions, representing the three main components of the CSF, are addressed:

1. What are the most pressing conservation needs requiring action (alongside the predetermined conservation objectives of the site)?
2. What conservation capacity is available and what are limitations to these capacities?
3. What conservation actions are implemented to address the identified conservation needs and, if applicable, conservation capacity?

In addition, the application of the CSF in practice revealed the need for one more crucial question:

4. What are the noticeable effects that demonstrate the adequacy and effectiveness of the conservation actions implemented?

Finally, for a validation of the impressions obtained from the social survey, the following question was asked:

5. Are the impressions obtained from the social survey supported by existing non-open access data?

Each of the questions is addressed in a separate subsection and each case study section concludes with a summary subsection on conservation achievements at site. However, it has been intentionally avoided to use a scoring system for conservation achievements because this study is based on qualitative data that does not allow for scoring without great simplification. Hockings *et al.* (2007) also recommend not to use a ranking or scoring system for management effectiveness evaluations of World Heritage sites, in order to avoid the loss of any information along the way. The full potential of qualitative data can only be realised if it is not pressed into a scoring or ranking system. This again emphasises the need to talk about conservation achievements rather than conservation success.

F.6 Essence of chapter F

The term "conservation success" is widely used but virtually immeasurable for two reasons: (1) The definition of the term "conservation" encompasses too many complex aspects to allow for a measurement of conservation success; and (2) conservation objectives of protected areas often suffer from a similar lack of clarity and/or specificity, and thus measurability. Consequently, the term "conservation success" is only used in theoretical considerations within this manuscript. The term "conservation achievements" is introduced as a substitute that allows for assessing conservation achievements in practice even if clear conservation objectives are not available.

In practice, conservation actions are either implemented to restore degraded ecosystems, or to maintain and safeguard them from negative influences. These negative influences are often called "threats" and can be assessed in much more detail by splitting them into **D**riving forces, **P**ressures, **S**tates and **I**mpacts as in the DPSIR-Framework. The letter "R" in the abbreviation stands for "response" and refers to the anthropogenic reaction to driving forces, pressures, states and impacts on the environment. The DPSIR-Framework is an analytical backbone of the here developed theoretical Conservation Success Framework (CSF).

The CSF consists of three main components: conservation needs, conservation capacity, and conservation actions. Conservation needs represent the requirements for conservation action of a protected area and depend on the place-based driving forces, pressures, states and impacts as well as the determined conservation objectives. Conservation capacity represents the capacity to address conservation needs. It depends on resources (e.g. financial, personnel, equipment, and skills), governance (e.g. political support, legal framework) and community level aspects (e.g. acceptance, support). The conservation actions represent the "responses" to conservation needs. The CSF is thus based on the assumption that *Conservation can only be successful where the conservation capacity exists that is required to implement the conservation actions determined by the conservation needs, which are in turn determined by the site-specific vulnerability, external influences and conservation objectives*. The CSF was used to develop the questionnaires for the assessment of conservation achievements in two Mexican case study sites. The case studies, and thus the application of the CSF in practice, are the focus of the following chapter.

G. From Theory to Practice: The Main Case Studies

"*Objectives can be reached through the people's conscience and the creation of alternatives.*" (Interview statement 23:5)

Chapter G replies to research question 4 of the present study (see Table A.1): **How can information gaps be bridged in an assessment of conservation achievements – in practice?**

The survey approach consisting of open and closed questions, which was designed alongside the Conservation Success Framework (see chapter F), was applied in two biosphere reserves in Central Mexico. The first section of Chapter G therefore gives a brief introduction to the country of Mexico as the host country for both case studies (G.1). The sections G.2 and G.3 are each dedicated to one case study site and constructed in equal manner: At first, the case study site's social, economic, political, as well as geographical and ecological characteristics are described. Subsequently, the biosphere reserve management system is explained and determined management objectives are listed. Based on this information, the results from the survey are presented by separately analysing conservation needs, conservation capacity, conservation actions, and noticeable effects from conservation actions. The findings are further strengthened by secondary non-open access data. Each section, G.2 and G.3, concludes with an essay on the place-based conservation achievements derived from the case study results. Through this, research goal 4, **the application of the theoretical Conservation Success Framework and analysis of conservation achievements in two Mexican biosphere reserves** (see Table A.1), is achieved.

G.1 Mexico: Country introduction

G.1.1 Location and size

Mexico, the northernmost country of Latin America, stretches across a total territory of two million square kilometres in almost equal parts north and south of the Tropic of Cancer (23°26′N of the Equator). This total area includes around 50,000 square kilometres of water surface. The country borders in the North with the United States of America, in the South and West with the North Pacific Ocean, in the Southeast with Guatemala, Belize, and the Caribbean Sea, and in the East with the Gulf of Mexico.
Physiographically, the lands east of the Isthmus of Tehuantepec, including the Yucatán Peninsula, belong to the region of Central America. The United Nations consider Mexico to be a Central American country, too (UNSD, 2007). However, according to other classification systems, Mexico belongs to the North American group of countries (Mexico is for example a member of the North American Free Trade Agreement, NAFTA).

G.1.2 Administration and politics

The country is a democratic federal republic, comprised of 31 states and Mexico Federal District, which constitutes the nation’s capital (geographic coordinates 19°24′ N, 99°09′ W). Above this, about 2,000 municipalities are legally recognised. Map G.1 shows the country including its state boundaries and major cities.

Mexico’s formal government institutions are defined by the constitution of 1917. It is widely considered to be “*an expression of popular will that guarantees labour and civil rights, electoral democracy, and national independence*” (Library of Congress, 2006: 19). Since 1917, the constitution experienced constant amendments, including, for example, the granting of women’s suffrage and the easing of nationalist restrictions on foreign investment in 1992 (Library of Congress, 2006).

Map G.1: Mexico: State boundaries and cities with more than 1 million inhabitants (data source: WDPA, 2006, and base data of the Environmental Systems Research Institute, Inc., ESRI)

The country's president, Felipe de Jesus Calderón Hinojosa, a candidate of the National Action Party (PAN), took office in December 2006 after successful election by popular vote in July 2006. The legislative period amounts to a single six year term. The president is chief of state, head of government, commander in chief of the armed forces, and also appoints the cabinet (Library of Congress, 2006). Calderón stated that his top priorities will be, among others, the reduction of poverty and the creation of jobs (CIA, 2007). When the present case studies were conducted, it was Vicente Fox, equally from the National Action Party, who still held the appointment of presidency.

G.1.3 Socio-economy

Demographics

The Mexican population increased by 22% between 1990 and 2001 (OECD, 2003) and population numbers are estimated to have surpassed 108.8 million by now with an estimated growth rate of 1.15% for the year 2007 (CIA, 2007). While the fertility rate as births per woman shows a considerable decrease between 1990 and 2005, the life expectancy is continuously rising according to data provided by the World Bank (2007b) (see Figure G.1).

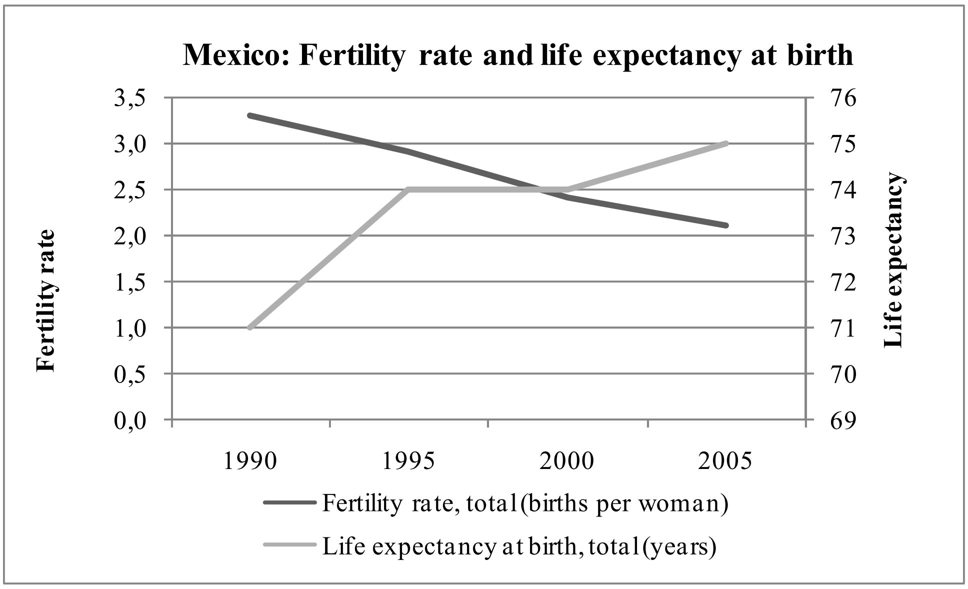


Figure G.1: Mexico: Fertility rate and life expectancy at birth (data source: World Bank, 2007b)

Latest calculations of population density show a variation between 6 habitants per square kilometre in Baja California Sur and 5,799 habitants per square kilometre in the Federal District, the country's capital (INEGI, 2000).

Migration plays a significant demographic role in Mexico. International net migratory flow is 13 fold compared to the one three decades ago (Delgado Wise and Mañán García, 2005) and about 18 million Mexicans were reported to reside outside Mexico in 2000 (Moloeznik, 2003). For the period between 2005 and 2050 the country is projected to rank second after China in terms of annual average of net emigration (minus 293,000 people per year) without this influencing on the overall population which is still projected to increase (United Nations, 2006). The majority of migrants leave the country to enter the United States of America and benefit from better job opportunities and higher incomes (Delgado Wise and Mañán García, 2005). About 150,000 Mexicans per year are believed to still traverse the border to the United States of America illegally (Joseph and Henderson, 2002).

Economy

The country follows a free market economy that recently entered the trillion dollar class (CIA, 2007). Twelve free trade agreements with more than 40 countries have been established resulting in more than 90% of Mexico's international trade being under free trade agreements (e.g. the North American Free Trade Agreement, NAFTA). Major export commodities are manufactured goods, oil and oil products, silver, fruits, vegetables, coffee, and cotton. The country is Latin America's most important exporting country by far (OECD, 2003). Main export partners, as of 2006, are the US (78.7%), Canada (6%), and Spain (1.4%). At about 10,700 US$ (2006 estimate), Mexico's per capita income, accords to one fourth of the United States' one, with a real growth rate of 4.8% (2006 estimate) (CIA 2007). Figure G.2 shows the development of the country's Gross National Income per capita (GNI/cap) and the development observed in trade between 1990 and 2005 (World Bank, 2007b).

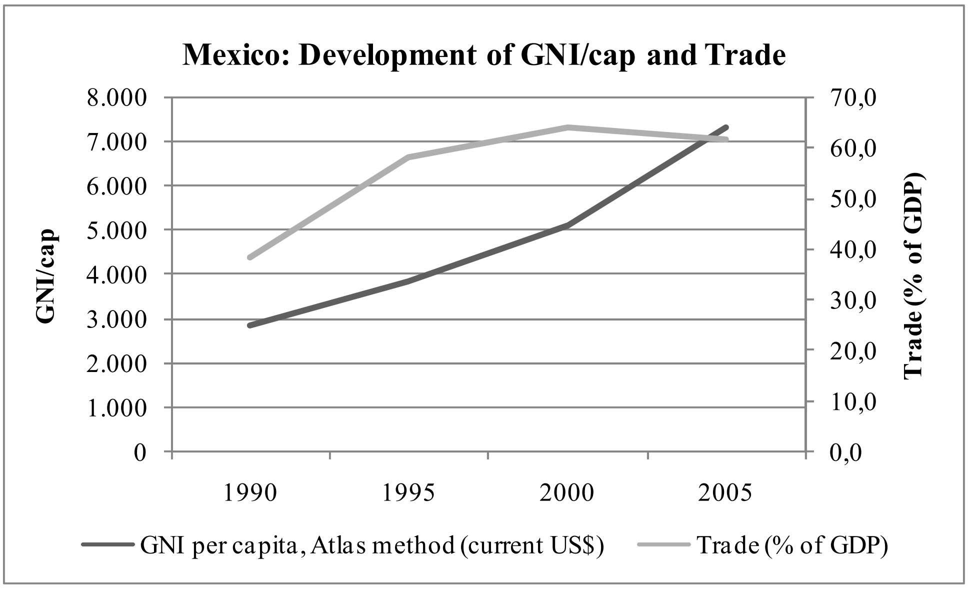


Figure G.2: Mexico: Development of Gross National Income per capita (GNI/cap) and trade (data source: World Bank, 2007b)

Although Mexico has experienced a remarkable economic growth in the last decade, about 40% of the population still lives below the poverty line (CIA 2007). This fact points towards a large gap between the rich and the poor of the country. As a matter of fact, compared with other OECD member countries, Mexico's Gross Domestic Product (GDP) per capita is among the lowest and income inequality among the greatest of all OECD countries (OECD, 2003). These facts demonstrate the dynamic but still difficult economic state of the country.

Land use and property rights

Approximately 56.2% of the country's terrestrial area is occupied by agricultural land (World Bank, 2007a). Extensive irrigation projects mainly conducted in the 1940s and 50s resulted in a significant increase in Mexican cropland, especially in the North. One third of the Mexican territory is designated as grazing land. Another 9% consist of forest or woodland, wherefrom 59% are in the tropics, 15% in the subtropical zone and about 26% in the temperate and cool zones (Library of Congress, 2006) (see also Map G.3).

Based on the 1917 constitution, the entire Mexican territory was declared state property and the government then had the right to transfer the land back to individuals and communities. As a result of this, it is now differed between two types of communal land ownership: 1) the *ejido* (about 30,000 of them), and 2) the communal lands. The *ejido* properties derive from the 1910 revolution, the 1917 constitution as an outcome of it, and the agrarian reform that went on for four decades. They are usually "*land assignments to peasants with no specific identity as communities, cultures, or indigenous people, who are typically mestizos.*" (Burger *et al*., 2001: 53). The communal lands have resulted from rights recognised by the Spanish Crown to original settlers.

G.1.4 Culture

It is difficult to describe Mexican culture in a short summary – just because it is so rich. The best known Mexican ancient civilisations are supposedly the Teotihuacán (they collapsed around Anno Domini 650), the Mayas (between Anno Domini 600 and 900), and the Aztecs (since Anno Domini 1300) (Library of Congress, 2006). Today there are two main ethnic categories, the "Mestizo" and the "Indian/Amerindian" which are defined broadly along cultural rather than racial lines. "Mestizos" usually have a solely European background, a mixed European-indigenous ancestry, or are indigenous but have adopted the dominant Hispanic societal values. The Indian/Amerindian category in turn refers to residents without European or mixed background, who stick to traditional societal values instead of the introduced Hispanic ones. About 60% of Mexico's inhabitants are mestizos, 30% Amerindian or predominantly Amerindian, 9% white or European and 1% "others". (Library of Congress, 2006)

The cultural diversity is reflected in the number of spoken languages besides Spanish, which is the dominant language for Mestizos and Amerindian likewise. Specialists reported to have identified more than 90 individual languages (Library of Congress, 2006). Finally, Mexico's cultural diversity is not only restricted to ethnic groups but also applies to the immense richness in agricultural crops with maize being by far the most diverse crop (countless landraces[26] are cultivated).

[26] Landrace – A crop variety having a broad genetic base (highly heterozygous in genetic terms) and resulting from centuries of development and adaptation to particular soil types and microclimates. Landraces have been improved by local farmers using traditional selection processes, rather than by professional plant breeding methods, and are an important source of diverse genes for plant breeders. (CEC, 2004)

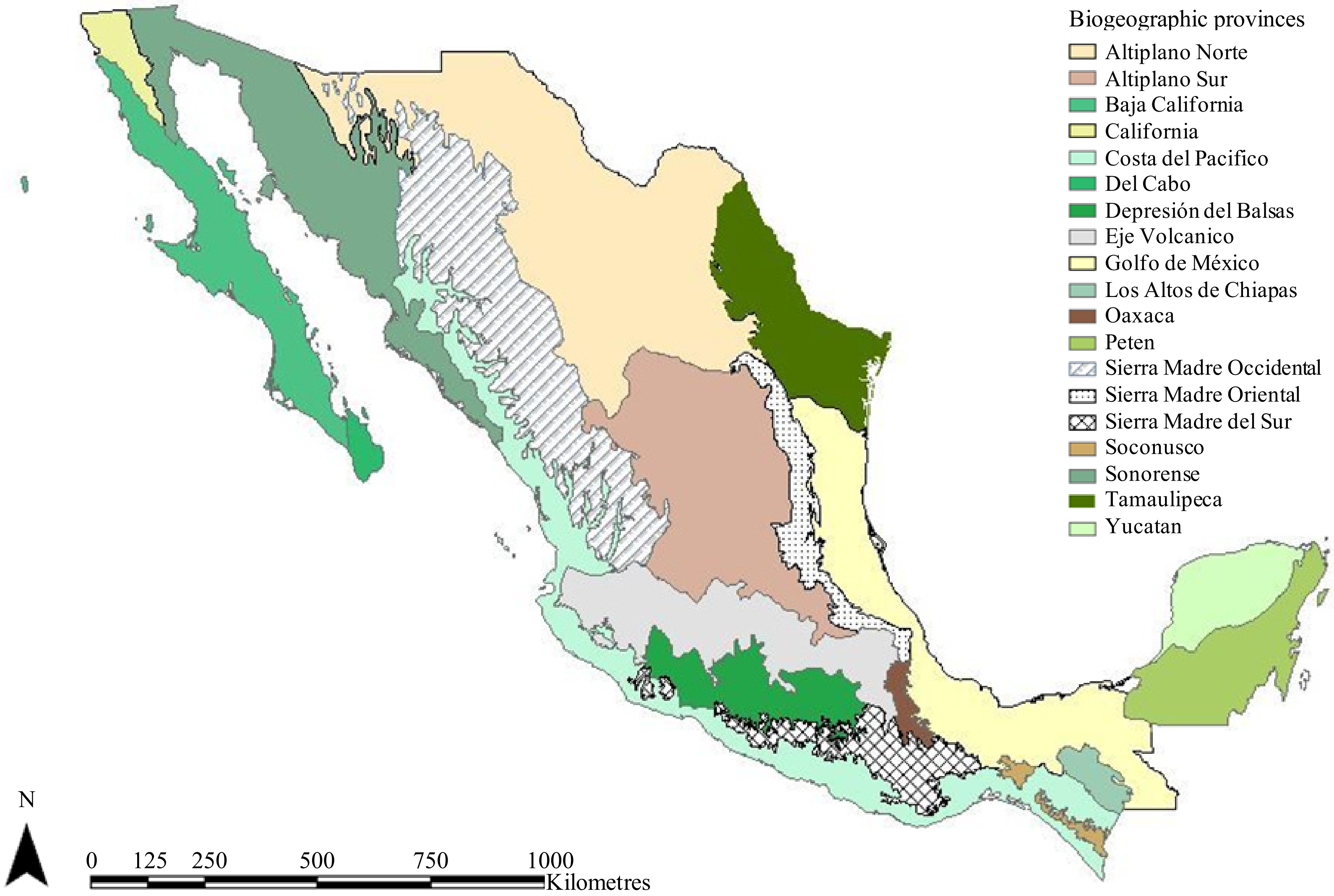
G.1.5 Geography and ecology

Topography

Mexico is a mountainous country with a central highland and upstream coastal plains. The topographic diversity of Mexico results from strong tectonic activity in the Cenozoic, which lifted more than 65% of the country’s surface up to more than 1,000 metres above sea level (CONABIO, 1998). Today, the country’s highest elevation is the tip of the Pico de Orizaba, also known as Citlaltépetl, with an altitude of 5,700 metres. It is part of the Trans-Mexican Volcanic Belt that stretches 900 kilometres from West to East across Central-Southern Mexico. Several other high peaks are to be found along this Volcanic Belt, for example the Nevado de Colima (4,339 m), Nevado de Toluca (4,577 m), Popocatépetl (5,452 m), and Sierra Negra (4,580 m), from East to West. All these volcanoes are active or dormant, the most active one being the Nevado de Colima who erupted more than 40 times since 1576 and showed ongoing eruptive activity by the beginning of 2008.

The Balsas River divides the Trans-Mexican Volcanic Belt from the Sierra Madre del Sur. This mountain range extends 1,000 kilometres towards the Isthmus of Tehuantepec. North of the Trans-Mexican Volcanic Belt lies the Mexican Plateau (Mexican Altiplano) (Sommerhoff and Weber, 1999). It reaches altitudes of up to 2,000 metres in Central Mexico while the North averages 1,100 metres in elevation. The Mexican Plateau is bordered by the Sierra Madre Oriental in the East and the Sierra Madre Occidental in the West, respectively. The two ranges differ significantly from each other. The Western Sierra Madre is a wide volcanic plateau range while the Eastern Sierra Madre is a range of fold mountains consisting of Mesozoic marine sediments (Sommerhoff and Weber, 1999). Map G.2 displays the biogeographic provinces of Mexico including the here mentioned mountain ranges[27].

[27] The names of the provinces have not been translated as no official translations seem to exist (see Morrone *et al.*, 1999).



Map G.2: Biogeographic provinces of Mexico (data source: CONABIO, 1997)

Climate

The country's climate is so broadly diversified that basically all possible climate types and subtypes are covered, and the change from a dry to a humid climate may occur within a distance of only a few kilometres (CONABIO, 1998). The tropic of cancer divides Mexico broadly into a tropic southern and a subtropic northern half.

Weather and climate are manipulated by the tropical trade wind circulation and the non-tropical west wind circulation together with the country's topography. The resulting precipitation pattern is characterised by a) the Atlantic side of the country being more humid than the Pacific one, b) the mountain edges of Sierra Madre Oriental and Sierra Madre Occidental being more humid than the highlands, and c) the luff of the Sierras being more humid than the lee sides in the shade of the trade wind. Instead of thermal seasons, Mexico is dominated by hygric seasons with a sharp distinction between rainy and dry periods. All hygric climatic zones are represented, from arid across sub-arid, semi-arid and semi-humid to sub-humid and humid zones. Both coastlines of the country are regularly afflicted by tropical hurricanes. They evolve above the warm tropical oceans in late summer and autumn, when water temperatures exceed 26-27 degree Celsius. (Sommerhoff and Weber, 1999)

Biodiversity

Mexico's biodiversity is a consequence of its overall diversity in terms of topography, climate, and culture. This country's diversity in all these aspects and the convergence of nearctic and neotropic biogeographical regions have made Mexico one of the world's richest countries in terms of its biological diversity – it holds the fourth rank among the 17 so-called "megadiverse" countries of the world (Mittermeier *et al*., 1997). It provides habitat to approximately 10% of all globally known reptile and mammal species and to more than 11% of all known birds and mosses. A total of 50 important bird areas are to be found within Mexican territory (Comisión para la Cooperación Ambiental, 1999)[28]. Endemism is highest in amphibians where 65% of the Mexican species do not occur anywhere else but in Mexico (CONABIO, 2006). Endemism in reptiles follows close behind with 57% endemics and endemic vascular plants account for 52% of the country's known plant species (CONABIO, 2006). Figure G.3 shows known and estimated species

[28] Both case study sites include each one of these 50 important bird areas according to the Comisión para la Cooperación Ambiental (1999).

numbers for Mexico compared to global totals (on a logarithmic scale), Figure G.4 the percentage of endemics per species group.

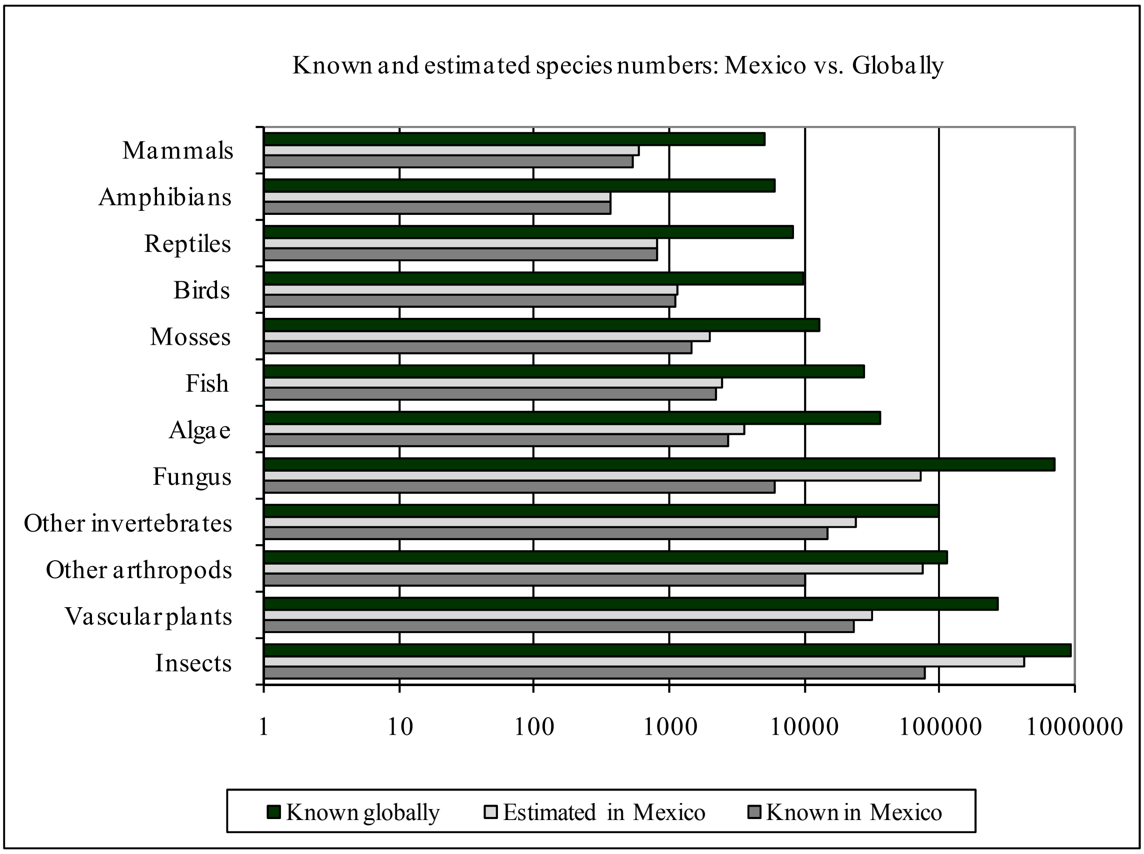


Figure G.3: Known and estimated species numbers for Mexico compared to global totals (logarithmic scale, data source: CONABIO, 2006)

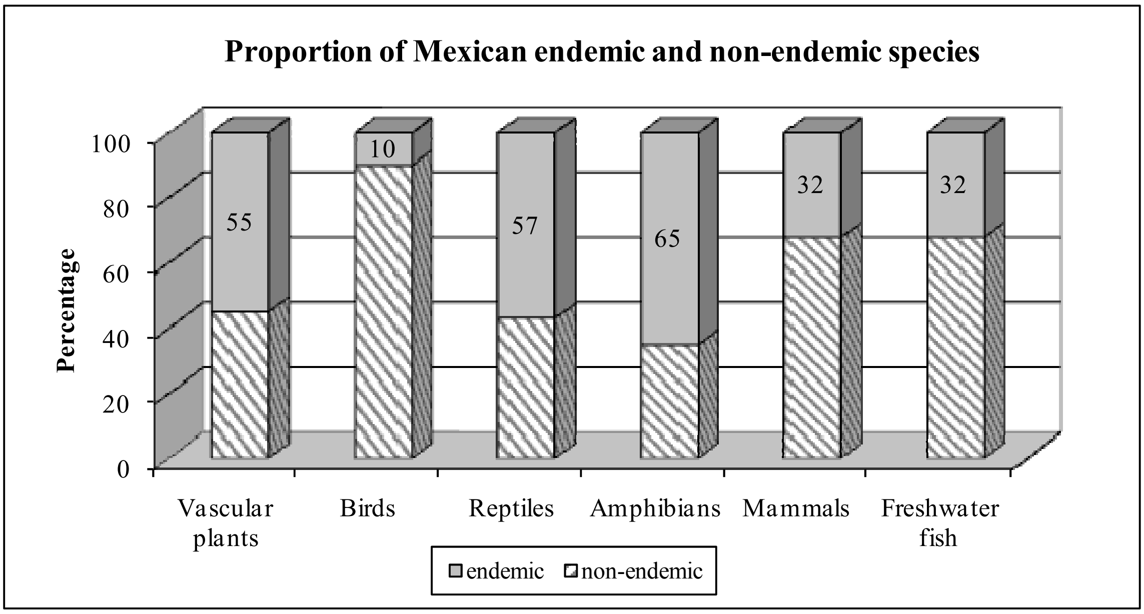
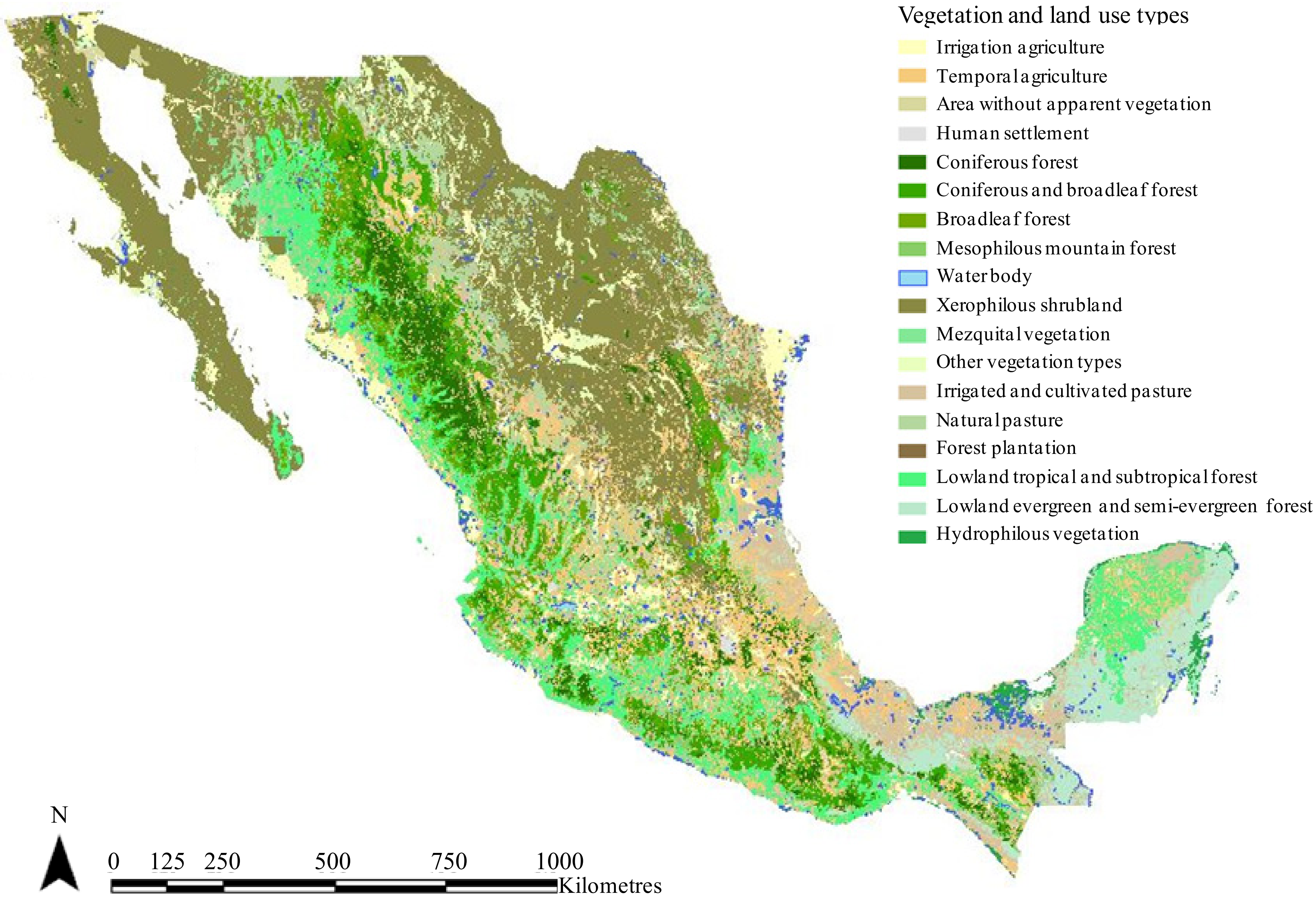


Figure G.4: Proportion of Mexican endemic and non-endemic species per species group (data source: CONABIO, 2006)

Mexico's ecosystem diversity is equally exceptional and there have been numerous attempts to classify Mexico's natural ecosystems into clearly distinguishable ecological land classes based on different biogeographical concepts: The Commission for Environmental Cooperation (1997) proposes, for example, a very rough classification into 1) North American Deserts, 2) Great Plains, 3) Southern Semi-Arid Highlands, 4) Temperate Sierras, 5) Tropical Dry Forests, and 6) Tropical Humid Forests. Toledo and Ordoñez (1996, cited in CONABIO 1998) sum up the above mentioned categories 1 and 2 and name the result "arid-semiarid zone". However, towards the coast they create an additional class named "transition zone ocean-land". Based on the comprehensive Udvardy (1975) system for the classification of terrestrial ecoregions, Olson *et al.* (2001) distinguish between 867 separate ecosystem types on earth, 50 of which comprise Mexico's environment (see also Ricketts *et al*., 1999). As this cannot be illustrated in a simple map, Map G.3 shows a simpler division into vegetation and land use types as of the year 2000 (after INE, 2002).



Map G.3: Vegetation and land use types of Mexico in the year 2000 (data source: INE, 2002)

G.1.6 Environmental issues

Mexico has a long history of environmental degradation and recent economic growth has further intensified this trend. Habitat transformation and the exploitation of natural resources on a grand scale started as early as 1519 when the Spanish conquistadores stepped on Mexican ground. For three centuries the country remained under foreign reign. During this time, “New Spain”, as Mexico was called then, was the largest provider of resources for the Spanish Empire. In 1810 the country launched its war for independence which went on for 11 years until the Spanish recognised Mexican independence in 1821. Unfortunately, the country’s independence did not translate into a period of relaxation of natural resource use. By the end of the 19th century plantations of sugarcane, coffee, cocoa, and tobacco, besides others, had largely modified the landscapes and natural ecosystems, especially since the railway and telegraph additionally decimated the country’s forest cover (Castañeda Rincón, 2006). This resource consumption trend continued similarly into the twentieth century. However, Mexico’s recent rapid economic development has led to another heavy and harmful increase in natural resource consumption. It is widely accepted, that economic growth impacts negatively on natural resources if it is not designed to happen in an environmentally sustainable manner but instead runs uncontrolled (e.g. Trauger *et al*., 2003). This is what happened in Mexico still more emphasised within the last two decades. Having transformed from a resource-dependent and closed economy to an export-driven manufacturer, a lack of environmental enforcement has resulted in increasing levels of air pollution and unsustainable resource use within the last 25 years (Heinrich Böll Foundation North America, 2004).

Although the North American Free Trade Agreement (NAFTA) was regarded as a unique chance for Mexico to become competitive on the international market, the financial cost of environmental degradation associated with the economic growth that resulted from joining NAFTA was massive (e.g. King, 2006). Intensification of agriculture – and related environmental effects - were also supported by a national cash-transfer programme (Programa de Apoyos Directos al Campo, PROCAMPO), which provided farmers with liquidity for the adjustment of their production to the new set of relative prices (Sadoulet *et al*., 2001). Mexico’s National Institute of Statistics, Geography and Informatics considers that this cost exceeded 10% of the GDP between 1989 and 2003, with an annual average of 36 billion dollars in damages (47 million dollars only in 1999)

(Ningu *et al.*, 2006). This by far outweighs the simultaneous economic growth valued at 14 billion US dollars per year.

Environmental pressures in Mexico are not only reflected in economic damage, but also in human health: It has been estimated that about 35% of Mexico's disease burden has environmental origins (INE, 2004). Air pollution is now considered the most serious environmental problem (EIA, 2007), especially affecting the habitants of the largest cities, such as Mexico City and Guadalajara.

The country also faces serious water shortages and pollution. 102 out of the country's 258 main aquifer units are currently overdrawn, mainly in the country's central and northern regions, and disturbingly these 102 aquifers are directly related to the most important industrial and urban centres (Arreguín-Cortés and López-Pérez, 2007). Since NAFTA encouraged the intensification of agricultural production, the environmental impact of agrochemicals such as fertilisers, herbicides, and pesticides increased significantly. This was accompanied by unsustainable levels of irrigation and soil erosion and had further effects on the environment and biodiversity (Arreguín-Cortés and López-Pérez, 2007). The Rio Grande/Rio Bravo, the northern boundary river between Mexico and the United States of America, is among the "World's Top Ten Rivers at Risk" due to water overextraction and the resulting high concentrations of pollutants (Wong *et al.*, 2007).

Deforestation, though having slowed down somewhat during the last five years, still continues (see Table G.1). In the year 2000 the total forest area still comprised approximately 655.4 thousand square kilometres (World Bank, 2007a) compared to 642.4 thousand square kilometres in 2005.

Table G.1: Forest area in Mexico and annual change rate (after FAO, 2007)

Forest area 2005			Annual change rate			
Total forest	% of land area	Forest plantations	1990 - 2000		2000 - 2005	
(1000 km²)	(%)	(1000 km²)	(1000 km²)	(%)	(1000 km²)	(%)
642.38	33.7	10.58	-3.48	-0.5	-2.60	-0.4

In a global comparison of environmental performance, Mexico ranks on the 66th position with an Environmental Performance Index (EPI) of 64.8 (total number of assessed countries = 133, highest possible score = 100) (Esty *et al.*, 2006). Table G.2 summarises the factors contributing to Mexico's overall Environmental Performance Index. Among OECD country members Mexico holds the last rank (29) and among the members of the Free Trade Area of the Americas, FTAA, Mexico holds the fourth to last rank (20), with only Bolivia, El Salvador, and Haiti ranking lower. Mexico is also among the global bottom performers in terms of tropospheric ozone concentrations and faces crucial problems with high nitrogen loading of soils due to its high-input agriculture. (Esty *et al.*, 2006)

Table G.2: Factors contributing to Mexico's Environmental Performance Index, EPI (after Esty *et al.*, 2006)

EPI Factors contributing to overall rank	Score (maximum 100)	Rank	Total of countries ranked
Environmental health	80.6	51	133
Air quality	34.6	111	133
Water	21.2	132	133
Biodiversity and habitat protection	48.5	75	133
Productive natural resources	72.4	75	131
Sustainable energy	67.6	89	133

For IUCN's 2007 Red List of Threatened Species 3,347 Mexican species were assessed according to their threat status (global total: 41,415 species) (IUCN-SSC, 2007): 19 of these are considered extinct, 8 extinct in the wild and 840 species, i.e. 25% of all Mexican species assessed, fall below the species considered as "threatened" (this includes 181 species classified as critically endangered, 290 species classified as endangered and 369 species classified as vulnerable). The Global Invasive Species Database (GISD) lists 113 invasive[29] species for Mexico, whose distribution among species groups is illustrated in Figure G.5 (after GISD, 2007).

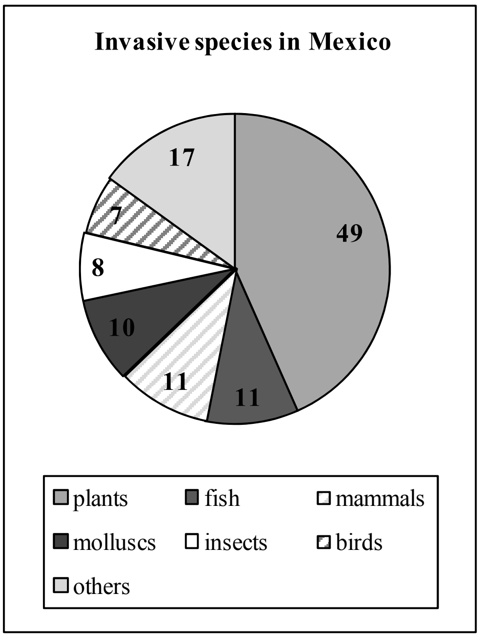


Figure G.5: Invasive species in Mexico according to species group (data source: GISD, 2007)

[29] 42 of which are listed in the GISD (2007) although their natural distribution range includes Mexico. The CBD does not give a separate definition for invasive species in terms of non-aliens but still harmful, but instead only defines the terms "alien species" and "invasive alien species" (Annex to decision VI/23, SCBD 2005: 883)

The Intergovernmental Panel on Climate Change in its Fourth Assessment (Parry *et al*., 2007) considers of high confidence that a significant number of Mexican species will face extinction under future climate change. This is mainly due to a foreseen replacement of tropical forest of central and southern Mexico by savannas and semi-arid vegetation by arid vegetation in parts of central and northern Mexico. Thomas *et al.* (2004a) expect countrywide losses between 8 and 26% in mammal species, 5 and 8% in bird species, and 7 and 19% in butterfly species (always calculated with or without dispersal) (Thomas *et al*., 2004a). Synergistic effects of climate change together with land use further increase the pressure on species (Parry *et al*., 2007).

Being immediately exposed to the El Niño Southern Oscillation (ENSO) and La Niña effects, which are agreed to gain intensity from climate change, the country is annually hit by tropical storms and hurricanes. The economic impact, for example, of Hurricane Wilma that passed the Yucatan peninsula in October 2005 amounts to an estimated 1,881 million US$ and 95% of tourist infrastructure were left seriously damaged. Rising sea levels and warming sea surface temperatures are further accompanying ENSO consequences, threatening the coastline, especially remaining mangrove forests (more than 65% of which have already been destroyed according to Sims and Reid, 2006), and the coral reefs. The most intense El Niño phenomena occurred in the years 1982/1983 and 1997/98. The ENSO period of the year 1998 also turned out to be the worst fire season on record with the burned area being roughly twice the normal mean size (~ 5,837 square kilometres according to Rodriguez Trejo and Pyne, 1999).

Both case study sites of the present study are mountain biosphere reserves. Mountain regions are especially vulnerable toward climate change, as they often hold important watersheds and serve as refuges for numerous species (Secretariat of the Convention on Biological Diversity, 2007a). A summary of global climate change consequences, future predictions and vulnerabilities on country level is given in SEMARNAT (2006)[30].

G.1.7 Biodiversity governance and protected areas

The government of Mexico replies to environmental challenges in multiple ways. To date, almost 100 international agreements dealing with environmental issues have been signed

[30] As a response to this, a National Strategy of Climate Action discussing the opportunities for mitigating and adapting to further climate change impacts has been prepared (CICC, 2006).

(Gobierno de los Estados Unidos Mexicanos, 2007). Among these are, for example, the United Nations Framework Convention on Climate Change (UNFCCC) including its Kyoto Protocol, the United Nations Framework Convention to Combat Desertification (UNFCCD), the Convention on International Trade of Endangered Species (CITES), and the United Nations Millennium Development Goals (MDGs).

In September 2008 the Mexican Government was incorporated as a member to the International Union for Conservation of Nature, IUCN (IUCN, 2008). Next to the government, 15 non-governmental Mexican organisations are members of the world's largest conservation union, IUCN, some of them since 1992 already (IUCN, 2008).

Since 1993, the country is also an active member of the Convention on Biological Diversity (CBD). In order to implement the international targets of the CBD, a National Biodiversity Strategy was developed and published in the year 2000 (CONABIO, 2000). It is based on a 1998 "snapshot" report of the status quo of Mexico's biodiversity (CONABIO, 1998). The Ecological Equilibrium and Environmental Protection General Act (Ley General del Equilibrio Ecológico y la Protección al Ambiente, LGEEPA) forms the legal backbone of all conservation activities in Mexico. The Secretariat of the Environment and Natural Resources (SEMARNAT) enforces the law, regulations, standards, and programmes issued by it through the National Institute of Ecology (Instituto Nacional de Ecología, INE) and the Federal Attorney Generalship of Environmental Protection (Procuraduría Federal de Protección del Ambiente, PROFEPA).

Although a national protected area system (Sistema Nacional de Areas Naturales Protegidas, SINAP) was created during the 1980's already (Blauert *et al.*, 2006), it was only the 1998 status report, in which *in-situ* conservation was identified as one of the strategic priority issues in the National Biodiversity Strategy. The National Commission of Natural Protected Areas (Comisión Nacional de Áreas Naturales Protegidas, CONANP) is responsible for this priority issue. CONANP is a deconcentrated governmental unit under the Secretariat of the Environment and Natural Resources and explicitly in charge of the conservation of the country's natural heritage through natural protected areas and regions of conservation priority (Regiones Prioritarias para la Conservación, RPC).

Following Mexico's integrated approach to biodiversity conservation, CONANP's work is based on a so-called Conservation for Development Strategy with Regional Sustainable Development Programmes (Programas de Desarrollo Regional Sustentable, ProDERS) as their key element (SEMARNAT / CONANP, 2004). Originally the General Directory of Regional Programmes (Dirección General de Programas Regionales, DGPR) of the Secretariat of Agriculture, Stockbreeding, Rural Development, Fisheries and Food (Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación, SAGARPA) was responsible for these ProDERS. However, growing awareness of the close interrelation between the country's socio-economic and environmental problems led to the transfer of the ProDERS to CONANP in 2001 (SEMARNAT / CONANP, 2004). This is remarkable, in that now a single governmental commission is in charge of conservation and sustainable development issues at the same time – an exceptional chance for the implementation of biosphere reserves.

CONANP working plans are prepared on a five year base and designed to build onto each other (SEMARNAT / CONANP, 2007). By the beginning of each year an achievements report for the previous year is published in order to raise awareness and enhance transparency (CONANP, 2008c). The agency is working in close collaboration with several other deconcentrated governmental entities, whose responsibilities are complementary to each other. These are for example the National Commission for the Knowledge and Use of Biodiversity (Comisión Nacional para el Conocimiento y Uso de la Biodiversidad, CONABIO), the Mexican National Institute of Ecology (Instituto Nacional de Ecología, INE) and the Federal Attorney Generalship of Environmental Protection (Procuraduría Federal de Protección del Ambiente, PROFEPA) (SEMARNAT, 2007). All of them also belong to the governmental Secretariat of the Environment and Natural Resources (SEMARNAT). The National Commission of Forestry (Comisión Nacional Forestal, CONAFOR), also a decentralised governmental entity, represents another important cooperation partner for CONANP, for example through their economic compensations for the maintenance of ecosystem services which are increasingly regarded as an important economic incentive for local land owners living within or around natural protected areas.

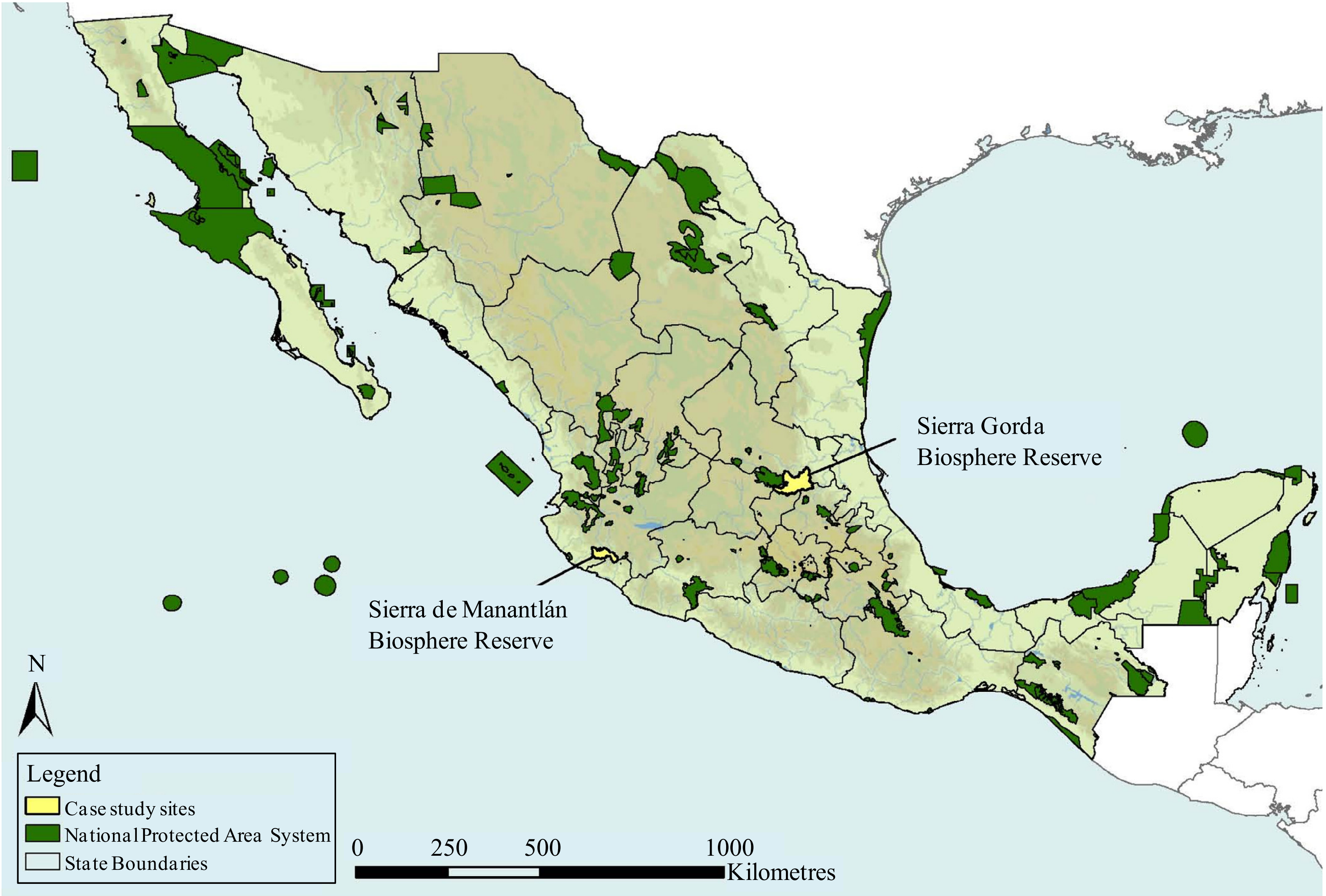
The Mexican National System of Protected Areas (Sistema Nacional de Areas Nacionales Protegidas, SINAP) now consists of 164 protected areas, distributed among six different categories as shown in Table G.3 (after CONANP, 2008b). The total area coverage of these protected areas accounts for about 11.7% of the country's national territory. Map G.4 shows the Mexican protected area network. The case study sites of the present study are marked yellow in Map G.4 to indicate their location within the country's National System of Protected Areas.

Table G.3: The Mexican National System of Protected Areas (after CONANP, 2008b)

Number of sites	Category	Territorial surface in km²	% of national territory
38	Biosphere Reserves	118,464.62	~ 6%
68	National Parks	15,056.43	~ 0.8%
4	Natural Monuments	140.93	~ 7.1 * e^{-5}%
7	Natural Resource Protection Areas	34,673.86	~ 1.8%
29	Areas for Protection of Flora and Fauna	60,773.84	~ 3.1%
17	Sanctuaries	6.89	~ 3.5 * e^{-6}%
1	Other categories	1,867.34	~ 9.5 * e^{-4}%
164	total	230,983.91	~ 11.7%

Mexico is in fact one of the few countries in which biosphere reserves and the principles of the Seville Strategy have been incorporated into national law (Jaeger, 2005). The MaB National Committee is affiliated to the renowned National Institute of Ecology and its current president also represents the MaB National Focal Point. Mexico is an active member of the IberoMaB regional network and even local level representatives frequently participate in regional meetings.

The General Directory for Regional Operation of the SEMARNAT is responsible for the linkage between the national and local level. Several regional directories and regional coordinators have been established through this general directory to build the vertical bridge between the different governmental levels (see also Schliep *et al.*, subm., on regional governance). Their responsibilities reach down to the local level of the country's natural protected areas. The General Directory for Regional Operation coordinates these regional directories. (CONANP, 2006a)



Map G.4: The Mexican National System of Protected Areas (data source: CONANP, 2008a, and base data of the Environmental Systems Research Institute, Inc., ESRI)

G.1.8 Current availability of biodiversity data from Mexico

As emphasised earlier (see subsection E.1.2), Mexico, compared to numerous other countries, keeps transparency in terms of biodiversity information at high levels. CONANP offers a variety of publications, produces annual reports on its achievements, and has a separate GIS section where data can be downloaded as shapefiles for the direct use in Geographic Information Systems, and also in Google Earth. Some information is provided for each protected area, where available, links are included to the official protected area homepages, and management plans can be downloaded. In addition to CONANP, information is also provided by the National Institute of Ecology (INE), mostly in the form of open access publications but also as digital maps. Metadata is always provided separately. Finally, the National Institute of Geographical Statistics and Informatics (Instituto Nacional de Estadística Geográphica e Informática, INEGI) provides huge amounts of statistical socio-economic data on national or federal level and further digital maps. Overall, the country contributes actively to all the environmental agreements that have been signed. This is clearly expressed by the progress reports to be found, such as the Second Country Report to the United Nations Framework Convention on Climate Change (UNFCCC) (CICC, 2001), the 2005 Progress Report on the Objectives of the Millennium Development Goals (Gobierno de la República de México, 2005), and the Third National Report on the Implementation of the Convention on Biological Diversity (SEMARNAT and CONABIO, 2006).

Despite this high level of transparency, however, it remains difficult to find openly accessible data to gain an idea of conservation achievements inside the existing protected areas. However, efforts to address this very problem are underway: Having recognised the need to document progress toward national conservation objectives as well as objectives on protected area level, CONANP developed the National System of Information, Monitoring and Evaluation for Conservation (Sistema Nacional de Información, Monitoreo y Evaluación para la Conservación, SIMEC) (CONANP, 2006b). All those protected areas in which long-term monitoring of species has been done are listed and the data are downloadable for free from the internet. This is up to now possible for 30 protected areas out of the overall 164 sites established on Mexican territory. The data of 10 sites participating in CONANP's National Programme for Monitoring of Birds in Federal Protected Areas can be downloaded as well. Data availability from case study sites will be separately described in the subsections G.2.7 and G.3.7.

G.2 The Sierra Gorda Biosphere Reserve

Photo G.1: Landscape of the Sierra Gorda Biosphere Reserve (SGBR)

Photo G.2: The mission of Jalpan de Serra, SGBR

The Mexican Sierra Gorda Biosphere Reserve is internationally recognised in several ways. Besides being part of the World Network of Biosphere Reserves, the region includes one Wetland of International Importance (Ramsar site), the Presa Jalpan (Wetlands International, 2007), was declared as an Important Bird Area (IBA) (Comisión para la Cooperación Ambiental, 1999), and includes the Franciscan Missions Cultural World Heritage site (World Heritage Centre, 2003).

G.2.1 Location and size

The Mexican Sierra Gorda Biosphere Reserve (SGBR) is located in the Sierra Madre Oriental of Central Mexico, between 20°50’ and 21°45’ Northern latitude and 98°50’ and 100°10’ Eastern longitude (SEMARNAP, 2000). It covers 3,835.67 square kilometres of land, representing around 32% of the northern part of the state of Querétaro. The Santa Maria River marks the natural boundary in the North, the Moctezuma River in the Southeast (SEMARNAP, 2000).

Of the total area, 248.03 square kilometres (~ 6.4% of the total size) are designated as core areas (eleven sites). The remaining 3587.64 square kilometres (~ 93.6% of the total size) represent the buffer zone (INE, 1999). The core areas are Sótano de Barro, Cañon de Ayutla, Puente Santa María, Raudal del Buey, Chacas, Barranca de Paguas, Cañada de las Avispas, Joya del Hielo, Cañon de Moctezuma, Cerro Grande and Mazatiapán

(SEMARNAP, 2000) (see Map G.5[31]). A transition area is not officially designated. However, the transition area is broadly defined as the area that surrounds the biosphere reserve's boundaries and is naturally linked to the SGBR in terms of biophysical, ecological and socio-economic processes (SEMARNAP, 2000).

G.2.2 Administration and politics

The SGBR stretches across five municipalities of the state of Querétaro. Arroyo Seco, Jalpan de Serra and Landa de Matamoros are entirely included in the SGBR, Pinal de Amoles is represented with 88.03% and Peñamiller with 69.7% (SEMARNAP, 2000).

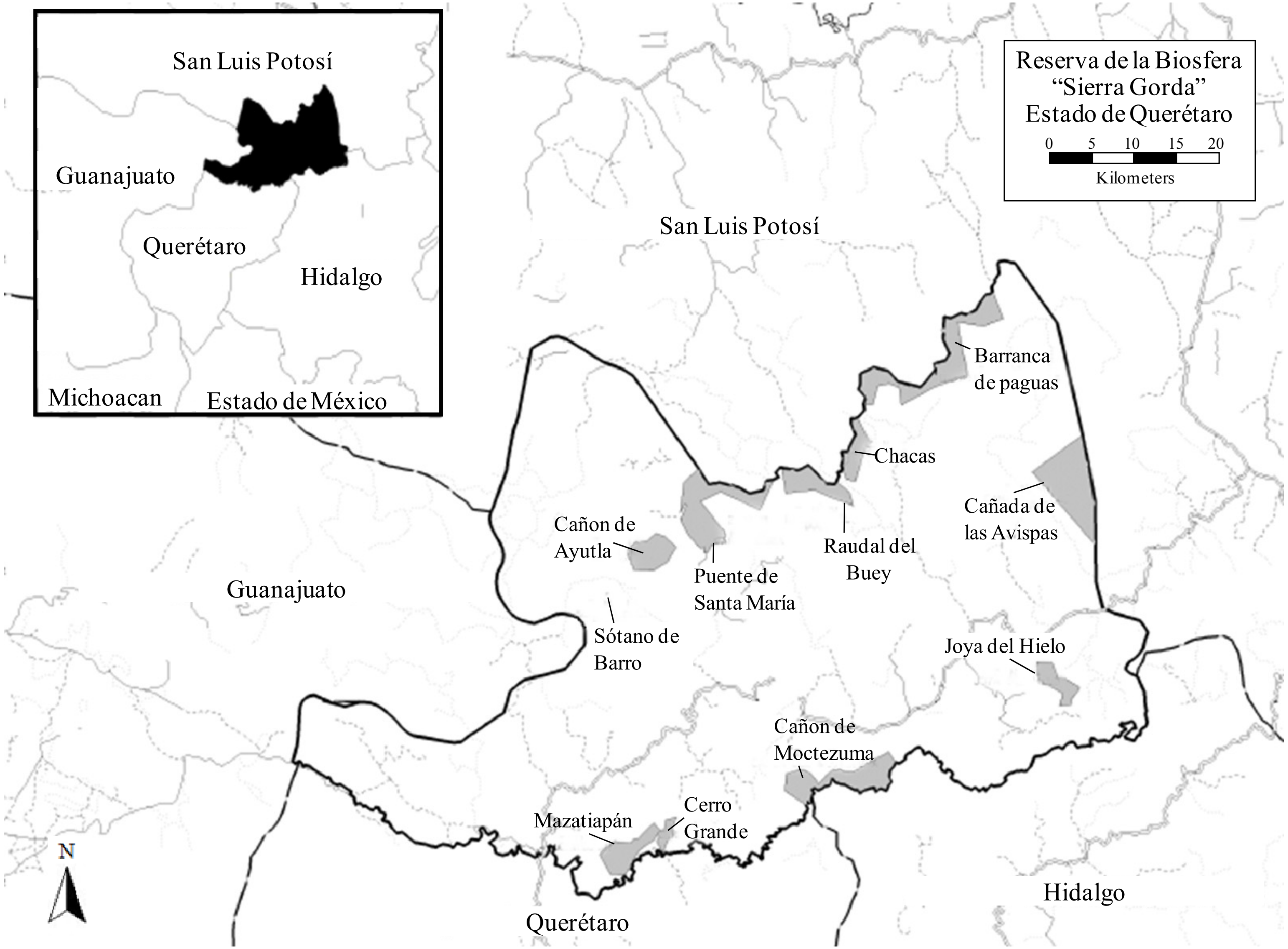
Each of the five municipalities within the SGBR has an own municipal president. This means that activities of the SGBR need to be coordinated in agreement with these local authorities as well as with the state's governor, located in the state capital, the town of Querétaro. More information on governance and management structures and processes is provided in subsection G.2.5.

G.2.3 Socio-economy

Demography

The SGBR is one of the most densely populated protected areas in Mexico (UNDP-GEF, 2001). It is home to about 100,000 inhabitants, widespread among 638 communities within the five municipalities included in the region (GESG, 2001a) . Most of these communities have less than 500, about 54% even less than 100 inhabitants (GESG, 2001a). While demographic trends for the total state of Querétaro point upwards (population growth in 2005 was at 2.3% compared to 4.1% in 1980 after INEGI, 2006), a population decrease can be observed in other parts of the SGBR. This is due to the fact that a considerable fraction of habitants, especially from today's young generation, emigrates to the United States (Cevallos, 2007, and own communication).

[31] All maps from the Sierra Gorda Biosphere Reserve have been reviewed and verified by an expert of the SGBR, confirmed via Email on the 14.07.2008.



Map G.5: Location of the Sierra Gorda Biosphere Reserve, core areas marked and labelled (source: SEMARNAP, 2000, adapted)

The Grupo Ecológico Sierra Gorda reports that more than 35% of the human population migrates, mainly working age men, and gives an overall population growth rate of 1.73% within the SGBR (GESG, 2001a). 23.3% of the population of 15 years or older is illiterate (GESG, 2001a). Only 31.5% of the residents finished primary education in contrary to 59.1% nationwide (UNDP-GEF, 2001). The issue of migration plays a significant role in the Sierra Gorda region. However, as it impacts on the functioning of the SGBR it is addressed in the results section (see Box G.2).

Economy

Agriculture and cattle farming represent the most important economic branches in the SGBR. Slash- and burn agriculture is widely distributed (UNDP-GEF, 2001). Main agricultural products are maize, beans, green chilli, cascabel chilli, tomato, tomatillo, chickpea, sorghum and barley. Some fruits (many of which are citrus fruits, also mango and guava) and coffee are cultivated in smaller amounts as well (UNDP-GEF, 2001). Most agricultural activity is for auto-consumption. The cultivated cattle are mainly cows, sheep, and goats, as well as pigs and horses. Extensive livestock husbandry takes place in about 56% of the biosphere reserve (UNDP-GEF, 2001). Besides agriculture and cattle farming, some smallholders extract different forest products. However, this only affects about 130 square kilometres of the SGBR (~ 4%) (UNDP-GEF, 2001).

Of the economically active population about 30.96% do not receive income, 48.01% receive between 0 and 2 minimum daily wages[32], 14.3% receive 2 or more minimum daily wages, 6.73% remain unspecified (INE, 1999; UNDP-GEF, 2001). About 60.5% of the population of the SGBR works in the primary sector, 17.2% in the secondary, and 16.58% in the third sector; 5.9% remain unspecified here (INE, 1999). A total of 77.78% of the total working force earns less than 7 dollars a day (GESG, 2001a). Around 79% of housings do not have access to sanitary services (De la Torre Borja *et al.*, 2000). The region shows some of the lowest social and economic development indicators in Mexico (UNDP-GEF, 2001).

[32] These figures are from the year 2001. Querétaro belongs to the geographical area C concerning minimum wages. In 2001 the minimum daily wage in the geographical area C was 35.10 pesos. Today this figure has increased to about 49.50 pesos (Mexicanlaws S.A. de C.V., 2007). Under today's currency rate (27.03.2008: 0.09353) the 2001 figure corresponds to 3.29 USD, while the 2008 figure corresponds to 4.63 USD. In the original document two minimum daily wages are translated into 5.80 USD (UNDP-GEF, 2001).

Property rights and land use system

There are three different land tenure types in the SGBR: Nearly 70% of the area is private property, while the remaining 30% are either municipal or *ejido* owned properties[33] (UNDP-GEF, 2001). Without any state owned ground the only ways to declare parts of the territory strictly protected are either by buying land for this special purpose or by negotiating with land owners and convince them to realise biodiversity protection on their properties. Both ways have been used in the SGBR: The local Grupo Ecológico Sierra Gorda (GESG) mediated encounters between land owners and private donors that resulted in the protection of additional 6.85 square kilometres of significant cloud forest. In addition to this, the Grupo Ecológico Sierra Gorda is custodian of another 5.40 square kilometres property acquired from private funds (World Land Trust, 2006). Just at the beginning of 2007 another 3.79 square kilometres of private owned land within the Joya del Hielo core area were acquired by the Grupo Ecológico Sierra Gorda with financial support from the Dutch IUCN Committee and the US Danmuth Foundation to improve the conservation status (GESG, 2007a). Figure G.6 presents the dedication of the land to the main vegetation and land use types according to de la Llata Gómez *et al.* (2006). The steep slopes of parts of the SGBR set natural limits to the range of land use options.

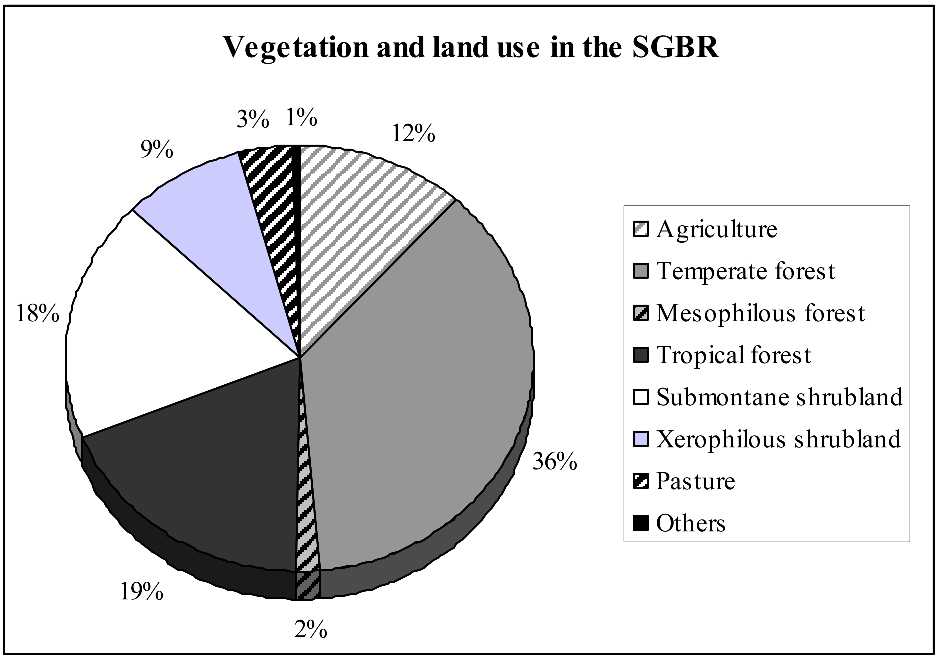


Figure G.6: Distribution of territory to main vegetation and land use types in the Sierra Gorda Biosphere Reserve (data source: De la Llata Gómez *et al.*, 2006)

33 An *ejido* owned property is a "*collectively managed social property resulting from the Mexican Revolution*" (Vidal *et al.*, 2004: 71).

G.2.4 Geography and ecology

Topography

The SGBR is positioned between the Arctic Neotropical and the Mesoamerican Mountain regions (Sierra Madre Oriental). Altitudinal gradients range from about 300 to more than 3,000 metres. The mountains of the Sierra Madre fall down in slopes which are considerably steep in some parts of the reserve with falling gradients of up to 70% degree (SEMARNAP, 2000). The highest elevations are the Cerro de La Calentura and the Cerro de La Pingüica with 3,060 metres and 3,100 metres above sea level (SEMARNAP, 2000). They are located within the municipality Pinal de Amoles.

The region belongs to the Pánuco river basin through the two important rivers Moctezuma and Santa María. These two in turn are fed by the rivers Escanela, Tancuilín, Extoraz, Ayutla, and Concá (Pedraza Ruiz, 2008).

Climate

Humid winds from the Gulf of Mexico hit the mountains of the Sierra and lead to a maximum precipitation of up to 1,500 millimetre per year on the eastern slopes of the mountains while in the mountain shades precipitation does not exceed 350 millimetre per year (GESG, 2001a). This leads to a range of climatic zones, from highly humid to seriously dry ones. In addition, there are large differences in mean annual temperatures. In the high altitudes of Pinal de Amoles the mean annual temperature is approximately 13 degree Celsius while the low lying regions, such as Jalpan de Serra, have a much higher mean annual temperature of about 24 degree Celsius. Minimum temperatures are reached in December and January and maximum temperatures in April and May.

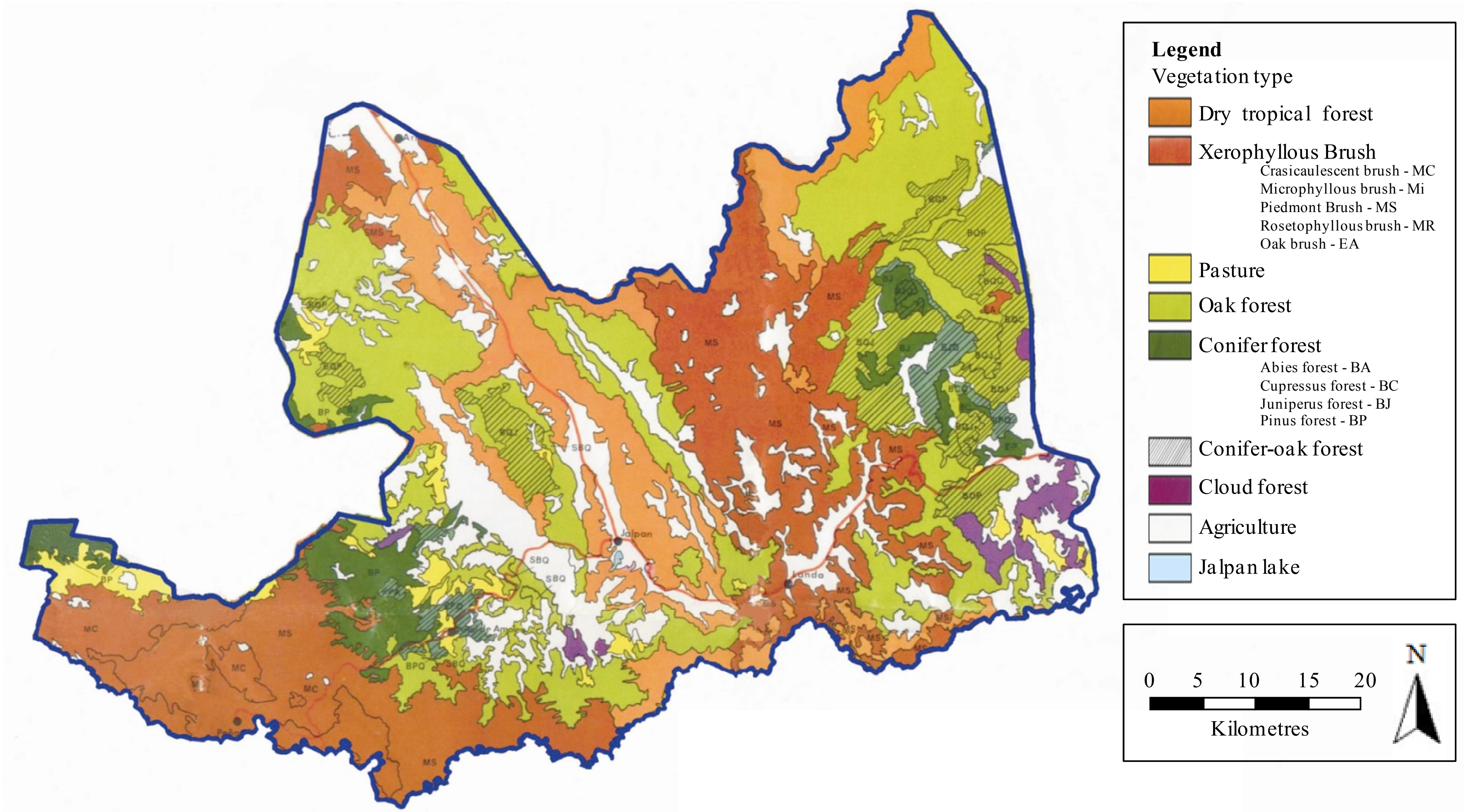
Biodiversity

The SGBR is considered the most ecosystem diverse natural protected area in Mexico (UNDP-GEF, 2001). Tropical sclerophyllous forest represents the predominant ecosystem type in the SGBR. Furthermore, sub-sclerophyllous forest, xerophyllous matorral, oak forest, coniferous forest, mesophilous montane forest and gallery vegetation along rivers contribute significantly to the diverse landscape (UNESCO-MaB, 2007b). Overall, 14 different vegetation types can be identified (see Map G.6). The forest occupies about

2682.50 square kilometres, corresponding to approximately 70% of the total area of the SGBR (GEF, 2001). Approximately two thirds of the SGBR territory can be considered well-preserved ecosystems, corresponding to about 2530,00 square kilometres (Ruiz Corzo, 2005; UNDP-GEF, 2001).

The region's high ecosystem diversity and, additionally, the strategic positioning in the biogeographic transition zone are accompanied by remarkable species richness. Figure G.7 lists the number of species according to different groups reported from the Sierra Gorda Biosphere Reserve[34].

[34] Data originates from the next version of the SGBR management plan, which is currently under preparation by the Comisión Nacional de Áreas Naturales Protegidas, CONANP, as confirmed via Email on 27.08.2008 by Roberto Pedraza Ruiz.



Map G.6: Vegetation types of the Sierra Gorda Biosphere Reserve (source: Zamudio *et al.*, 1992, adapted)

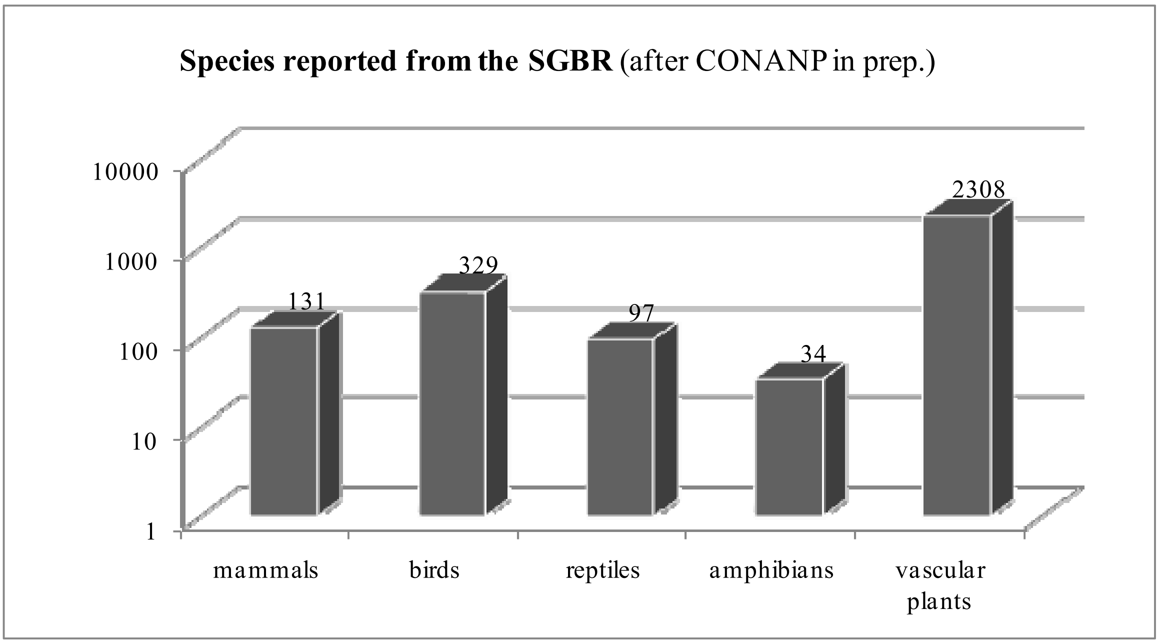


Figure G.7: Species reported from the Sierra Gorda Biosphere Reserve (SGBR) (data source: CONANP, in prep.)

During the last years, botanical research led to the discovery and description of 22 more vascular plant species to be found in the SGBR, but still large parts of the area remain unresearched. Based on this and in regard of the site's ecosystem diversity, the number of vascular plants indentified so far is expected to further increase in the future. (CONANP, in prep.)

In the faunal kingdom it is especially remarkable that all six Mexican felid species can be found within the SGBR: jaguar (*Panthera onca*), ocelot (*Leopardus pardalis*), puma (*Puma concolor*), lynx (*Lynx rufus*), tiger cat (*Leopardus tigrinus*), and jaguarundi (*Herpailurus yaguarondi*) (INE, 1999). The only primate species originally occurring in the region, the spider monkey *Ateles geoffroyi*, probably already went extinct some time ago. Under a certain protection category are, for example, the jaguar (*Panthera onca*) and the ocelot (*Leopardus pardalis*) (INE, 1999), as well as the black bear (*Ursus americanus*) and the military macaw (*Ara militaris*) (GEF, 2001). The percentage of flora and fauna species under a certain protection category is shown in Figure G.8.

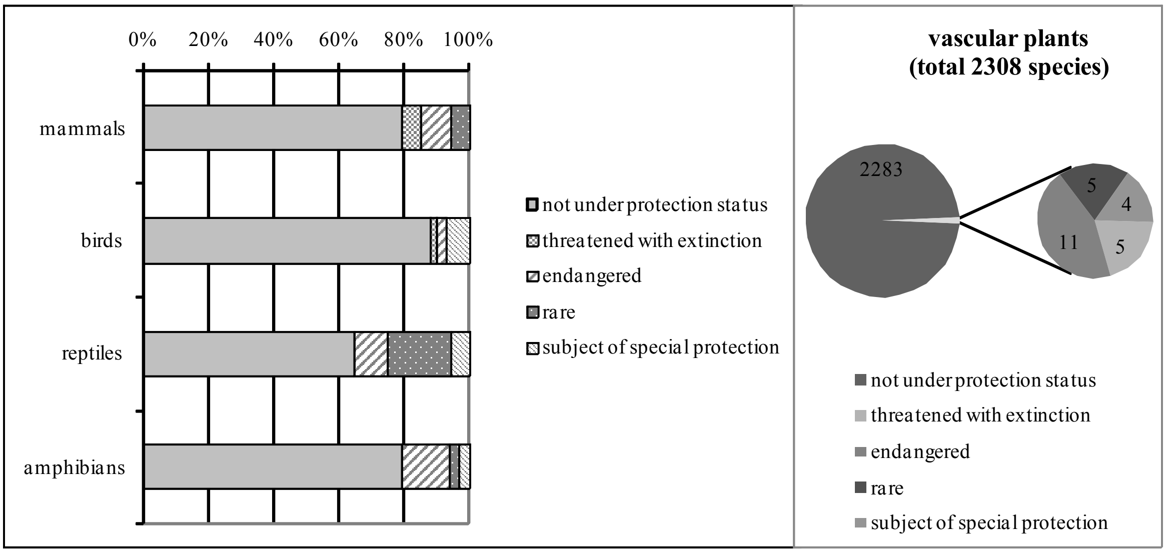


Figure G.8: Classification of species of the Sierra Gorda Biosphere Reserve in threat/protection categories (data source: CONANP, in prep.; INE, 1999)

G.2.5 Governance and management

The SGBR realises a public-private co-management between the federal government (the SGBR directorate facilitated through CONANP) and the civil society organisation Grupo Ecológico Sierra Gorda (GESG). The Grupo Ecológico Sierra Gorda arose from grassroots initiatives. It started working in 1987 and was declared a civil non-profit association in 1989. In May 1996 it was converted into a private assistance institution. (UNDP-GEF, 2001).

The Grupo Ecológico Sierra Gorda and the directorate of the biosphere reserve are supported by the Sierra Gorda Ecological Patronage, whose task is to identify sponsors to finance their work (UNDP-GEF, 2001). In the year 2000, one year before acceptance of the SGBR as part of UNESCO-MaB World Network of Biosphere Reserves, the Grupo Ecológico Sierra Gorda obtained the approval for a large-scale project entitled *Biodiversity Conservation in the Sierra Gorda Biosphere Reserve* by the Global Environment Facility (the project will in the following be abbreviated as "GEF project"). The GEF project is administered by the local office of the United Nations Development Programme (UNDP), and managed by CONANP. The Global Environment Facility provided a leverage fund of 6.7 million US$ for seven years while the Grupo Ecológico Sierra Gorda is generating an additional 25 million US$ in co- and associated financing by cooperating with numerous project partners (GEF, 2004), such as the Schwab Foundation, the US Fish and Wildlife Service, The Earth Island Institute, Shell, the

Mexican WalMart Foundation, and HP, besides several others (GESG, 2007b). Financial sustainability also forms one aspired output of the GEF project.

Within the SGBR there are today several different actors which have set up cooperative and complementary programmes to support sustainable development in the region: Next to the Grupo Ecológico Sierra Gorda and the SGBR directorate, there is the GEF project managed by UNDP and an NGO entitled Bosque Sustentable, founded in the year 2001 in order to reply to the site specific demands in terms of sustainable forestry.

The Grupo Ecológico Sierra Gorda has split its activities into three major streamlines: community development, land management for conservation, and environmental education. The community development programme addresses rural women by supporting them in small-scale activities to create their own income and build capacity. The land management for conservation programme focuses on the protection of the core areas of the SGBR and other sites of special conservation value, for example through the establishment of conservation payments for the land owners (e.g. by CONAFOR as mentioned above). The third programme aims at creating an environmental community culture as a baseline for sustainable development now and in the future. The programme works with 161 schools in 112 communities (pers. comm. in 2006). The GEF project contributes to sustainable development in its objective to develop and demonstrate biodiversity-friendly and sustainable alternative livelihood options, for example through the establishment of ecotourism projects and sustainable commercialisation of non-timber products. The work of Bosque Sustentable overlaps with the aforementioned in that the NGO takes over the establishment of plantations for the local demand for wood, promotes soil and water conservation for local communities as well as fire prevention and control, besides others[35].

The Grupo Ecológico Sierra Gorda is cooperating with local communities as well as public authorities in the Sierra Gorda region since more than 20 years. The management plan of the Sierra Gorda Biosphere Reserve arose after a long-term consultation process with the local population and several other stakeholder groups (GESG, 2001b). Active participation is realised by open meetings with communities in order to identify local needs and develop site specific sustainable development projects which are jointly put

[35] More information about the different programmes and activities can be obtained from the SGBR webpage: http://www.sierragorda.net/.

into practice. Furthest outreach to local communities is achieved through the education and capacity building programmes, as mentioned above. By the end of 2004, 214 communities were either receiving training, implementing actions for conservation and sustainable development, or participating in actions in favour of biodiversity within the Sierra Gorda region (Ruiz Corzo, 2005). The active involvement of the local population in the planning processes for the assignment of the region as a biosphere reserve is considered best practice of participation in the context of the National Programme for Natural Protected Areas 1995-2000 (GEF, 2001).

Cooperation has been established on international, national and local level and in terms of funding as well as in terms of technical and scientific support. Cooperation partners, however, have grown too numerous to introduce all of them in this context. An extensive list is to be found at the SierraGordaNet (2008b).

G.2.6 Management objectives

Objectives of the biosphere reserve, according to the SGBR management plan (INE, 1999), are displayed in Box G.1[36].

Box G.1: Objectives of the Sierra Gorda Biosphere Reserve (after INE, 1999)

General objective:

The **preservation and rehabilitation of the ecosystems of the biosphere reserve**, such as the semi-deciduous forests, tropical subhumid forests, pine and holmoak forests, xerophilous matorral (scrubland, bushes), its natural resources, biodiversity and evolutionary processes, as well as the **initiation and orientation of a regulated use** of its natural components that assures their permanency for future generations, and the achievement of an **economic and social development** for the inhabitants of the region.

Specific objectives:

- To establish **management strategies for the conservation** of ecosystems and their components, and to adapt the current production systems to obtain their sustainability.
- To **restore and rehabilitate** degraded natural systems, such as the region of mesophilous forest of Agua Zarca and the mountainous massif of Pinal de Amoles.
- To **identify, become acquainted with and complete the existing information** on natural components and their processes by promoting the applied investigation of sustainability criteria for natural resource use.

[36] It has been tried to translate the objectives as close to the original Spanish wording as possible.

Box G.1 (continued): Objectives of the Sierra Gorda Biosphere Reserve (after INE, 1999)

Specific objectives:

- To continuously **obtain information** on parameters and indicators of the processes taking place in the biosphere reserve and their changes, further contributing to the evaluation of the environmental impact.
- To **establish a rational system of natural resource use** with the aim to create a culture of sustainability.
- To **ensure compatibility of urban development, recreation and eco-tourism with nature conservation**, and to introduce measures for the reduction of generated impacts.
- To establish **preventive action and strategic planning to decrease and avoid contamination, deterioration and degradation** of resources and the substantial costs they carry along; also to realise corrective action and application of sanctions as a last possible means.
- To **cultivate positive values, habits and attitudes** as well as participation for the residents of the biosphere reserve to gain consciousness and value the environment.
- To **distribute the significance, importance, objectives, projects and targets of the biosphere reserve**, inside and outside its boundaries, favouring that its inhabitants appreciate the environment and turn its conservation into an essential part of their daily life.
- To **adopt technologies and methods for the holistic use of natural resources** and achieve their practice and permanent application, as well as the facilitation of new productive strategies.
- To **maintain the regional culture** to recover, "re-valuate" and distribute the individual identity among the local people.

Not all of the objectives directly refer to biodiversity conservation. However, they are all indirectly related to either release pressures from resources, or enhance awareness of and support through the local communities from within and around the SGBR. Some other specific objectives refer to a necessary increase in knowledge on biodiversity and thus the capacity of the management. Unfortunately, they are little specific and difficult to measure.

Comprehensively to or overlapping with the objectives given in Box G.1, the large-scale conservation project funded by the Global Environment Facility (GEF) also follows two immediate objectives:

1. To strengthen management capacities in order to sustain efforts for the sustainable use of the reserve's globally significant biodiversity over the long-term; and
2. To increase the value of biodiversity conservation and sustainable use so as to ensure long-term sustainability of project benefits (GEF, 2001).

By combining and relating the objectives from the management plan and the GEF project to each other, an overall strategic approach for implementation of the SGBR is revealed and well responds to the principles of the biosphere reserve concept (as was explained in section C.4). The strategic approach is shown in Figure G.9. The GEF project components were explicitly designed to consolidate the potential to successfully implement the biosphere reserve concept in the Mexican Sierra Gorda.

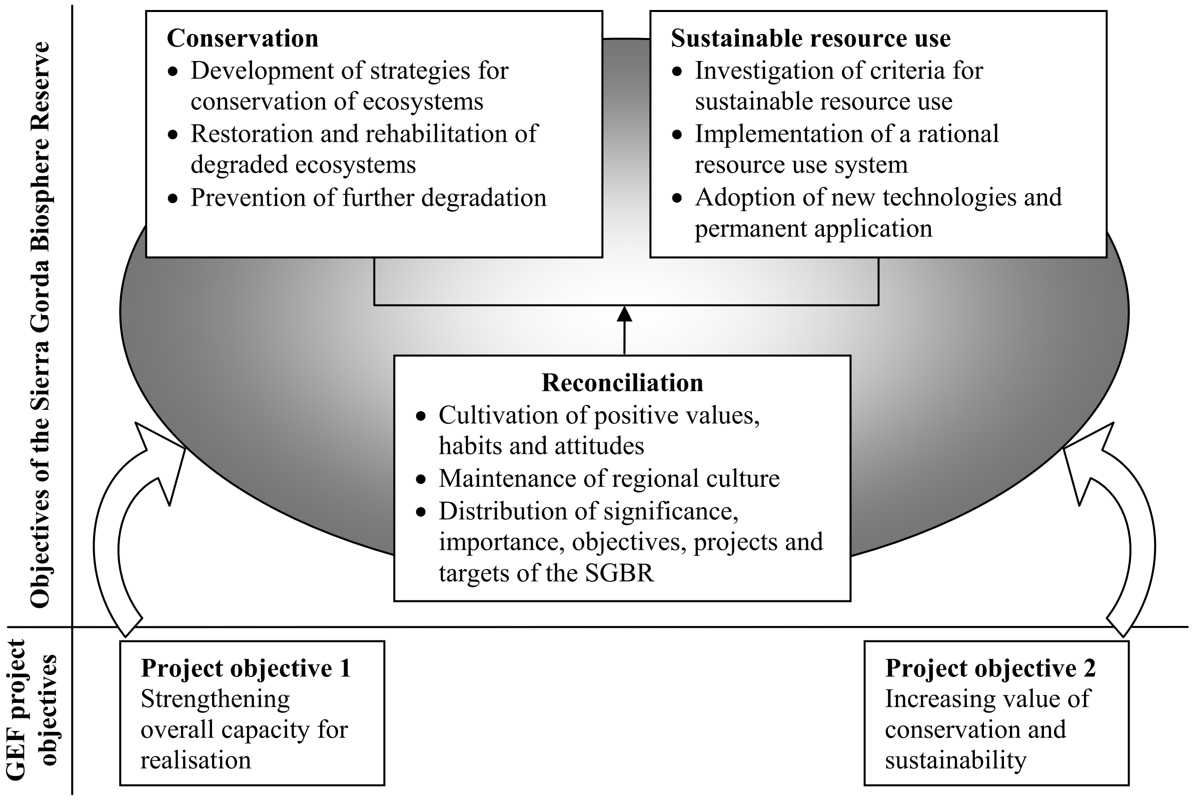


Figure G.9: Strategic approach to implementation of the Sierra Gorda Biosphere Reserve according to the site's management and GEF project objectives

While the objectives given in the management plan as well as the objectives of the GEF project are very unspecific and thus remain immeasurable (see section F.1), some performance indicators were still determined as part of the GEF project. Further information on these indicators is provided in the subsection G.2.9.

G.2.7 Current availability of biodiversity data

The conservation history of the site is responsible for the ratio between "grey literature"[37] and scientific publications about conservation in the SGBR. The biosphere reserve is comparably "young", accepted as a member of the World Network of Biosphere Reserves in 2001, and funding from the Global Environment Facility, a big international donor requesting scientific proof of effective and efficient use of funds, started only in the same year. Although before 2001 socio-economic work had been conducted for approximately 15 years, activities were hardly monitored and scientific studies in the region were rare. During the last years this situation changed remarkably. Cooperation with scientific departments of the University of Querétaro resulted in several research projects being conducted within the SGBR boundaries. Among them are, for example, studies of water quality and also species monitoring via camera traps[38]. As part of the GEF project, a series of performance indicators was selected to measure the project's progress and are since then regularly monitored (Ruiz Corzo, 2005). The SGBR region has been mapped and data is available for being used in a Geographic Information System (GIS). A considerable amount of research has been done through the cooperation with numerous external national and international institutions and experts. The Querétaro Natural Resource Centre recently published an extended study of vegetation, land use and landscape units in the SGBR (De la Llata Gómez *et al.*, 2006). The study also looks at changes in forest cover and land use between 1973 and 2004 and results can thus well be considered as indicating consequences of conservation action in the region (it was therefore used to validate the finding from the qualitative study in subsection G.2.9). Human-wildlife interactions have been investigated (Arroyo-Quiroz and Pérez-Gil Salcido, 2005), and baseline research has been conducted and published, for example floristic inventories (Cartujano *et al.*, 2002).

There is frequently new information about activities conducted, findings of studies, newly established cooperations, or awards gained in the SGBR news bulletin that is published thrice a year by the Grupo Ecológico Sierra Gorda. In mid 2007, a report was published by the independent Venture Technology Group on Social Return on Investment of the

[37] "Grey literature" is understood as literature that did not appear in official reports or scientific journals but instead in the form of unofficial reports or (online) newspaper articles.
[38] Only recently amazing pictures were taken by camera traps from Jaguar and several other species, see Photo G.9. and Photo G.10.

SGBR (Galimidi and Olsen, 2007). The report includes some information on indicators of interest and is further addressed in subsection G.2.9.

However, the publication of research results in scientific journals is still comparably low. Despite the fact that the site is a member of the Network of Terrestrial Ecosystem Monitoring Sites (TEMS), as indicated in the respective website (see GTOS-TEMS, 2008), no further monitoring information is provided here and there does not seem to be awareness of this membership on local level.

The Sierra Gorda Biosphere Reserve does not yet contribute to either the Mexican National System of Information, Monitoring and Evaluation for Conservation (CONANP, 2006b) or the National Programme for Monitoring of Birds in Federal Protected Areas.

G.2.8 Case study results: Application of the Conservation Success Framework to the Sierra Gorda Biosphere Reserve

All insights presented in the following result from the conducted interviews as well as personal passive and active observations and, where available, additional information from literature and maintained contact with the interviewees from research sites. Table G.4 lists the interviews that have been conducted within the SGBR or about the SGBR according to different interview groups. As it was assured to treat the information from interviews anonymously, the table is not further subdivided and no names of interviewees are mentioned throughout this document. For the same reason, the institutional affiliation of the interviewees cannot be provided for all interview groups. When presenting the results, for scientific correctness, quotations are always given including the interview number and the quotation number as allocated by the qualitative data analysis software ATLAS.ti (see subsection B.4.3) in brackets. The triangulation diagram in Figure G.10 shows the various perspectives that are included in the overall picture of the site's situation to assure a high validity of the data.

Table G.4: Interviews conducted in the Sierra Gorda Biosphere Reserve (SGBR)

Group	Affiliation	Number of interviews
Management	GESG, SGBR, GEF project (UNDP), NGO (Bosque Sustentable)	5
Staff	GESG, SGBR, GEF project (UNDP), NGO (Bosque Sustentable)	13
Local people[39]		5
External experts		1
Civil servants	CONANP	6
	Total	**30**

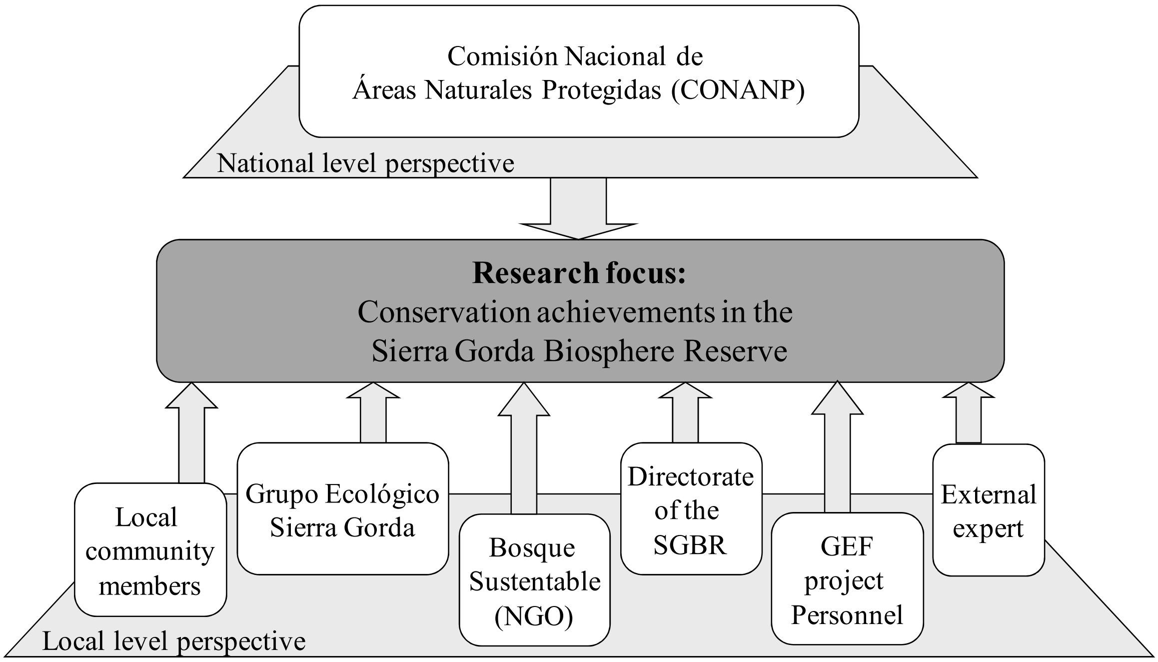
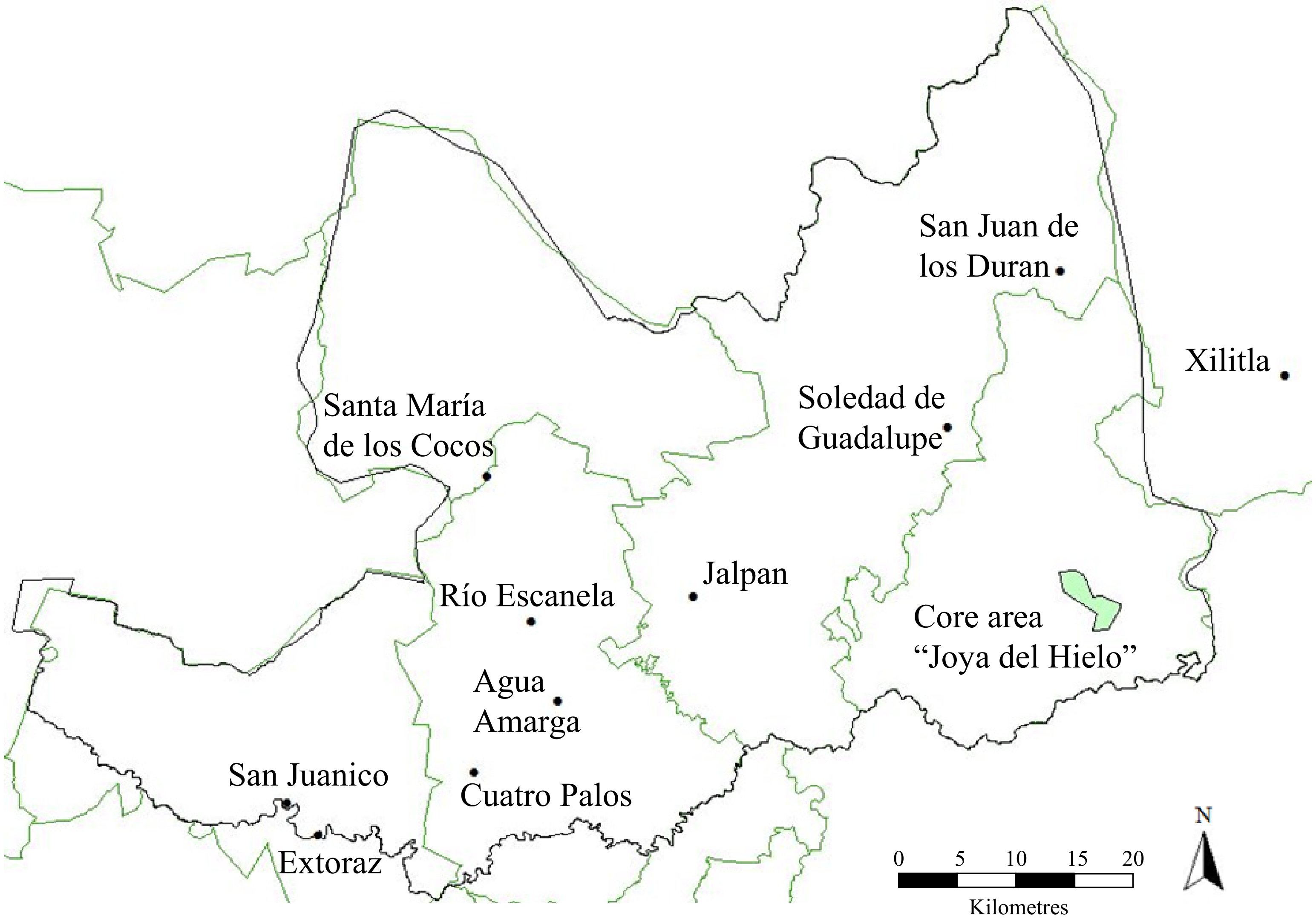


Figure G.10: Triangulation diagram of the qualitative survey in the Sierra Gorda Biosphere Reserve (SGBR)

A number of places within the biosphere reserve were visited to either conduct interviews or for personal active and passive observation purposes. The places visited were Jalpan de Serra, Agua Amarga, Cuatro Palos, Extoraz, San Juanico, Río Escanela, Santa María de los Cocos, Soledad de Guadalupe, San Juan de los Durán, Xilitla (outside the buffer zone) and the core area “Joya del Hielo” (see Map G.7, green lines mark municipality boundaries).

[39] Three of the local community members interviewed are working closely with the SGBR management and staff as “promoters”, as explained further below.



Map G.7: Visited places in the Sierra Gorda Biosphere Reserve (source: Grupo Ecológico Sierra Gorda, adapted)
(Black outline marks the biosphere reserve boundary; green lines mark municipality boundaries)

In the following, results will be presented alongside the following scheme presented in table format:

Subsection	Focus question / issue
Conservation needs (Driving forces, Pressures, States, Impacts)	What are the most pressing conservation needs requiring action (alongside the predetermined conservation objectives of the site)?
Conservation capacity	How does the site do in terms of conservation capacity and what are limitations to these capacities?
Conservation actions (Responses)	What conservation actions are implemented to address the identified conservation needs and, if applicable, conservation capacity?
Relation of results with existing data	What are visible and/or measured effects demonstrating the adequacy and effectiveness of the conservation actions in place?
Conservation achievements in the Sierra Gorda Biosphere Reserve	Summary of insights into conservation achievements at site (see subsection G.2.10)

Results from personal active and passive observation are also included. Recommendations that can be synthesised from the findings are included in the joint case study discussion in subsection H.1.3.

Conservation needs

The objectives of the SGBR, as they appear in the management plan, must have been set in the year 1999 or earlier, as the publication year indicates (INE, 1999). The case study presented here was conducted in the year 2006. The interview questions addressing conservation needs may therefore very well reveal a slightly different picture of what needs to be done, than the one gained from SGBR management objectives as determined in the management plan: Whereas progress may have been made on some issues, new challenges may have appeared as well or grown since the compilation of the management plan. A calibration of the then set objectives and impressions gained leads to the final identification of conservation needs.

According to the above presented objectives of the SGBR (see subsection G.2.6), some conservation needs become visible: They refer to restoration and rehabilitation of several parts of the SGBR, reduction and avoidance of contamination, deterioration and degradation, and closely related to this the transformation of unsustainable resource use patterns and productive techniques into more lasting ones. In the following, it is tried to further specify and update conservation needs as derived from the results of the closed and open questionnaires. In order to do so, **part 1 of the closed questionnaire** as well as the here relevant **replies to the open questionnaire** were analysed and related.

The codes queried with ATLAS.ti to specify and update the conservation needs from the **open questionnaire** are “driving forces”, “pressures”, “states: geo-ecological”, “states: socio-economic”, and “impact”, as well as the codes within the code group “conservation needs/threats” (see Annex III). Identified driving forces from open questions are allocated to the categories **demographic**, **economic**, **technological, policy and institutional** and **cultural** (socio-political)[40] (see Table F.3). Wherever possible, threats will not only be explained as causal chains but instead through causal networks. It is not intended to follow the above given order of driving force categories within the text but instead the threat situation will be explained in a logical text flow which may demand for a shifted order or repeated mentioning of categories.

Table G.5 presents the results from **part 1 of the closed questionnaire** on threats to biodiversity within the SGBR (n = 22). Only the 20 threats ranked highest are shown and only highly ranked threats will be discussed and related to the results from the open questionnaire. The full table including the threat ranking for all 38 threats is attached to this document in Annex VIII.

Table G.5: SGBR – Results from the threat ranking in part 1 of the closed questionnaire, top 20 (n = 22)

Threat	Normalised value	Valid replies	Threat group according to IUCN-CMP (2006b)
roads and railroads	1.00	20	transportation infrastructure
grazing and ranching	0.96	19	resource harvesting
solid waste (garbage, flotsam, jetsam)	0.96	19	pollution
agriculture and plantations	0.95	20	habitat conversion and degradation
utility lines	0.95	20	transportation infrastructure
gathering	0.94	16	resource harvesting
nutrient loads (e.g. nitrogen from farms)	0.92	18	pollution
climate variability	0.91	19	climate change
altered hydrologic regimes	0.90	20	habitat conversion and degradation
chemicals and toxins	0.89	19	pollution

[40] This is not done for the results from the closed questionnaire as it deals with threats without further distinguishing driving forces, pressures, states and impacts.

Table G.5 (continued): SGBR - Results from the threat ranking in part 1 of the closed questionnaire, top 20 (n = 22)

Threat	Normalised value	Valid replies	Threat group according to IUCN-CMP (2006b)
invasive alien species	0.86	18	invasive and other critical species
housing and urban development	0.84	20	habitat conversion and degradation
mining	0.84	19	energy and mining
logging	0.83	20	resource harvesting
habitat shifting and alteration	0.79	20	climate change
natural system modification	0.78	20	habitat conversion and degradation
altered fire regimes	0.76	20	habitat conversion and degradation
hunting, trapping, fishing	0.75	20	resource harvesting
commercial and industrial development	0.68	20	habitat conversion and degradation
motor-powered recreation and work	0.68	20	recreation/work in natural habitats

Threats related to transportation and infrastructure rank on the first and fifth position in Table F.3. From the open questions, it was emphasised out of three different perspectives (SGBR management, staff and external experts) that one of the main driving forces for current and potential future challenges is to be found in **infrastructural mega projects** (combination of demographic, economic and cultural driving forces as can be derived from Table F.3) as exemplified in the following quotation: "*If the government, from whatever level, municipal, national or federal, determines what the political priorities are, to generate freshwater infrastructure, an embankment dam, to provide Querétaro with water in order to prevent the economy from collapse and the people from a lack of water, then they do not care to knock over a protected area declaration or a core area*." (4:63, civil servant). Such political decisions may then be expressed as above and below ground construction (pressures), potentially leading to habitat destruction and fragmentation (state: geo-ecological): "*In reality it is the mega projects that have large-scale impacts on these areas, because it is them who are fragmenting the ecosystems*" (4:76, civil servant). The mega projects that are affecting, and may in future even more severely affect the SGBR, encompass the construction of roads, dams, and utility lines, as well as the exploitation of below ground resources (see below paragraph on exploitation of below ground resources).

However, the interviewee from quotation 4:63 does not only consider the rising demand for infrastructure to be a threat but instead as well the political priority setting. As it is the case in most countries, political decision-makers in Mexico seem to generally allocate a higher priority to economics (and thus also to mega projects) than to conservation (a combination of public unconcern about the environment, i.e. a cultural driving force, and urbanisation and market growth, an economic driving force, as can be derived from Table F.3). In this context, one more driving force can be found that facilitates especially the exploitation of below ground resources, i.e. **mining** activities, within protected areas in Mexico. One interview partner entitled this driving force a **lack of congruence in the Mexican legislation** (4:46) (policy/institutional driving force) and it refers to the fact that "*The radius of competence of the Law of Ecological Equilibrium spans the renewable resources. But the non-renewable resources that are to be found below ground fall below the Federal Law of Mines."* (4:50, civil servant). Consequently, the declaration of a protected area actually only declares the renewable resources protected (soil, air, water, biodiversity), but never the non-renewable ones. It is above this even impossible to safeguard land by becoming its' private owner: "*Independently from the existing property type [private, ejido, communal, federal], the below ground resources are owned by the state.*" (4:54, civil servant). This implies, that the government can always decide to exploit below ground resources, independently from who owns the land and whether the location of those resources is within a protected area or not. This contradiction within the legislation is well known to civil servants: "*It seems an incongruity that one encourages the declaration of a superficial layer to be protected and then afterwards it is a concession to be exploited.*" (4:57). One of the existing mines (silver) was passed while visiting field sites in Aguamarga. Although currently not exploited it is expected that one day the mine may be re-activated with significant impact on the environment (pers. comm. SGBR management in 2006). It is, however, reasonable that the mines are ranked lower than other mega project activities in Table G.5, as there are apparently only few and currently inactive mines within the SGBR while the construction of roads, hydropower plants and utility lines is more heavily discussed. At the time of the research stay there were ongoing debates on the construction of several dams within the boundaries of the SGBR[41], a mega project that involves the alteration of hydrological regimes (pressure) (52:17, civil servant) which is another of the higher ranked threats in Table G.5.

As a matter of fact the need for more infrastructure (roads, utility lines, dams) mainly originates from the expansion of the city of Santiago de Querétaro and thus from outside

[41] The outcomes of the discussions have been reported and are presented in chapter G.2.8.

the SGBR. Here, a **population growth** (demographic driving force) from 456,458 inhabitants in 1990 to 734,139 in 2005 has been observed and is projected to surpass 820,000 by 2010 (SEDESU, 2008). However, the population of Jalpan de Serra, located in the heart of the SGBR, is equally increasing with an observed population growth between 1990 and 2005 from 19,246 to 22,025 and a projection of nearly 25,800 by 2010 (SEDESU, 2008). Even the population numbers of three of the smaller municipalities, namely Arroyo Seco, Landa de Matamoros and Pinal de Amoles, are expected to increase towards 2010. Only the population of the municipality of Peñamiller is expected to decrease (SEDESU, 2008). An increase in population may directly be related to a simultaneous expansion of agricultural land (pressure). Of course this again is closely tied to the distribution of the human population within the SGBR and thus does not apply equally across the region. While the above figures point towards an upright tendency for human population numbers within the SGBR, the population density outside the SGBR is definitely much higher (SEDESU, 2008): The city of Querétaro is a very fast growing city and its growth does not slow down so far. The rising demand for more customer goods and services by people outside the SGBR leads to pressures within the SGBR in terms of the discussed mega projects. The impression gained from part 1 of the closed questionnaire concerning threats from transportation infrastructure and mining (see Table G.5) is thus well reflected through the qualitative and further secondary data. Figure G.11 shows the cause and effect network for the above discussed threats. The figure refers to “potential pressures”, “potential states” and “potential impacts” as currently above and below ground construction is not happening but feared to happen in the future.

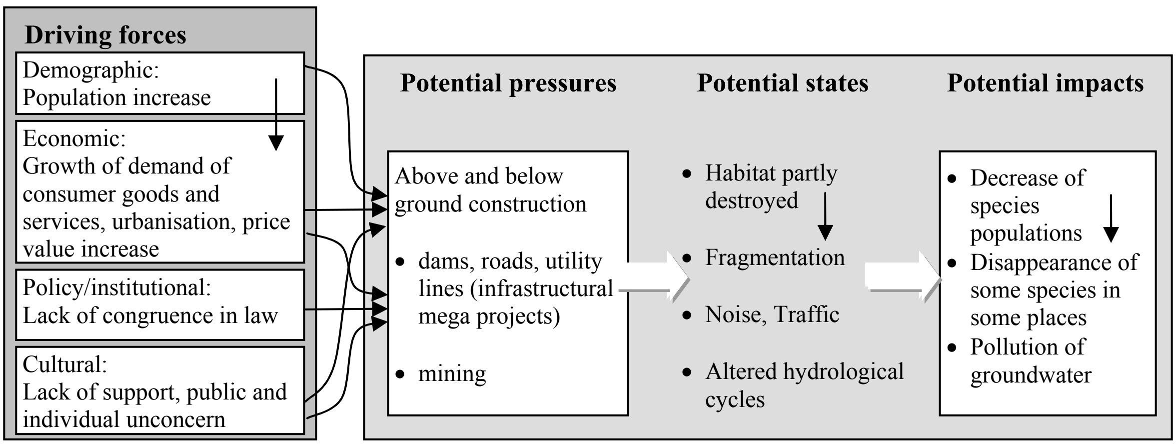


Figure G.11: SGBR – Cause and effect network for above and below ground construction

Concerning demographic changes within the SGBR there were contrary opinions among the interviewees. Several argued that the human population inside the SGBR cannot be increasing due to the large number of people emigrating from the area of the biosphere reserve. Box G.2 summarises details on migration patterns in the SGBR and corresponding interview quotations.

Box G.2: Migration patterns in the Sierra Gorda Biosphere Reserve

Typical migration patterns can be observed with people leaving the most marginalised and poor areas and moving to larger towns: A local community member from a small village, for instance, stated that within a single month ten inhabitants left the village (47:15) – a relatively large portion where the total number of inhabitants does not exceed 200. However, Jalpan de Serra belongs to those larger towns where people resettle (if not in Santiago de Querétaro), as the above given numbers show. The pressure on resources thus shifts away from the countryside and towards the more and more urbanising heart of the SGBR. At the same time, there is a significant drift of inhabitants of the Sierra Gorda region towards the United States. One interviewee from the biosphere reserve management concludes that this emigration is in fact beneficial to the Sierra Gorda: "*...we have about 40,000 people in the United States, mainly men, who in turn do not exert pressure on the natural resources [here]*." (40:15)

This is confirmed by another SGBR staff member (34:36), and the same is outlined in an online article posted by the COM+ Alliance of Communicators for Sustainable Development by the beginning of June 2007 (Cevallos, 2007). The article is entitled "Emigration a Blessing for Biosphere Reserve" and states that: "*Pressure on natural resources and biodiversity in Mexico's Sierra Gorda Biosphere Reserve has been reduced as a result of the emigration of half its human inhabitants - some 50,000 people - to the United States.*"

There is subsequently an obvious discrepancy between figures of and opinions about the regional demography – and its impact on natural resources. Taken that the overall pressure on resources was decreasing it remains questionable why figures provided by a governmental agency (SEDESU) show the contrary and seven different interview partners independently mentioned population growth as one of the most critical challenges of the SGBR (14:39, SGBR management, 19:17, 39:33, 44:7, SFBR staff members, 13:31, 45:27, 51:12, local community members).

Migration, however, is not only regarded as a blessing, but also as a trigger for changed consumption patterns and a **value crisis** (cultural driving force). One SGBR staff member named this phenomenon a "transculturalisation" when talking about the biggest threats and challenges of the SGBR: "*...another [challenge/threat], well, the transculturalisation of migrants is a threat for the region because they are introducing styles of different lives.*" (34:57, SGBR staff). Similarly, another SGBR staff member calls this a "historical isolation" and a "strong injection" into the traditional culture of the SGBR (39:10, SGBR staff member). A considerable number of residents receive financial support by those who left the region and now work in the USA. A civil servant also considers migration and returning migrants as a problem while emphasising that it is not site-specific for the SGBR but applies to many other places in Mexico as well (38:26).

The incentive to leave the region of the SGBR is presumably connected to the living conditions in these mountains. Except for Jalpan de Serra, conditions are characterised by high degrees of **marginalisation** (policy/institutional driving force) and **poverty** (economic driving force): "*People are still worried about what to eat, we have to remember that they come from rural regions, and in Mexico the indicators of poverty in the rural regions are... these are very marginalised people, people living under high degrees of marginalisation, and this implies that at first they are thinking about how to solve…, about how they are going to get food for today and tomorrow. And the issue of environmental management is a long-term issue, right?*" (4:108, civil servant). Marginalisation and poverty are characteristics often accompanied by a lack of education facilities and so it is the case in the Sierra Gorda region. Not all of the 638 communities have schools, some visit the schools of neighbouring communities, but especially higher education facilities are scarce for the rural inhabitants of the SGBR (e.g. 26:1, local community members). It is thus comprehensible that living conditions shape the decision-making of local community members on two primary issues:

1. Migration (if possible); and
2. Natural resource use and resource use practices.

The issue of migration and its consequences in the context of the SGBR is described in Box G.2. If migration is not an option for local people, high marginalisation and poverty signify an urgent need for income opportunities/alternatives, especially when resource use restrictions come along with protected area declarations. Local people under such living conditions may, without income opportunities or alternatives, feel more prone to use natural resources in a way that leads to short term yields but is **unsustainable** or even to **illegally** use natural resources (pressures). Inhabitants of the very marginal parts of the SGBR, for example, still depend on wood for cooking and are thus forced to get firewood from somewhere in their environment (34:47, SGBR staff member, and 45:38, local community member) (lack of alternatives to wood as fuel, technological driving force).

Concrete pressures that are believed to arise from the living conditions, according to the interviewees, primarily refer to illegal hunting and logging. Both illegal activities have been mentioned numerous times, also in the context of indicators for conservation achievements as “reduction of illegal hunting/logging” (e.g. in 5:14, 28:10, 34:34, 39:35, 41:10, SGBR staff, and 13:15, 47:14, local community members). Apparently, some species are traded on some black market as mentioned in 28:24 and 49:11 (both SGBR staff). Illegal activities are among the top 20 threats in Table G.5, namely gathering (rank 6), logging (ranks 14) and hunting, trapping, and fishing (rank 18). Surprisingly, gathering was not an issue in interviews although it ranks comparably high. Other pressures arising from the living conditions within the SGBR are unsustainable land use practices (e.g. 19:8 and 41:18, SGBR staff). Figure G.12 shows the causal network for the driving forces and respective consequences arising from the living conditions within the Sierra Gorda region.

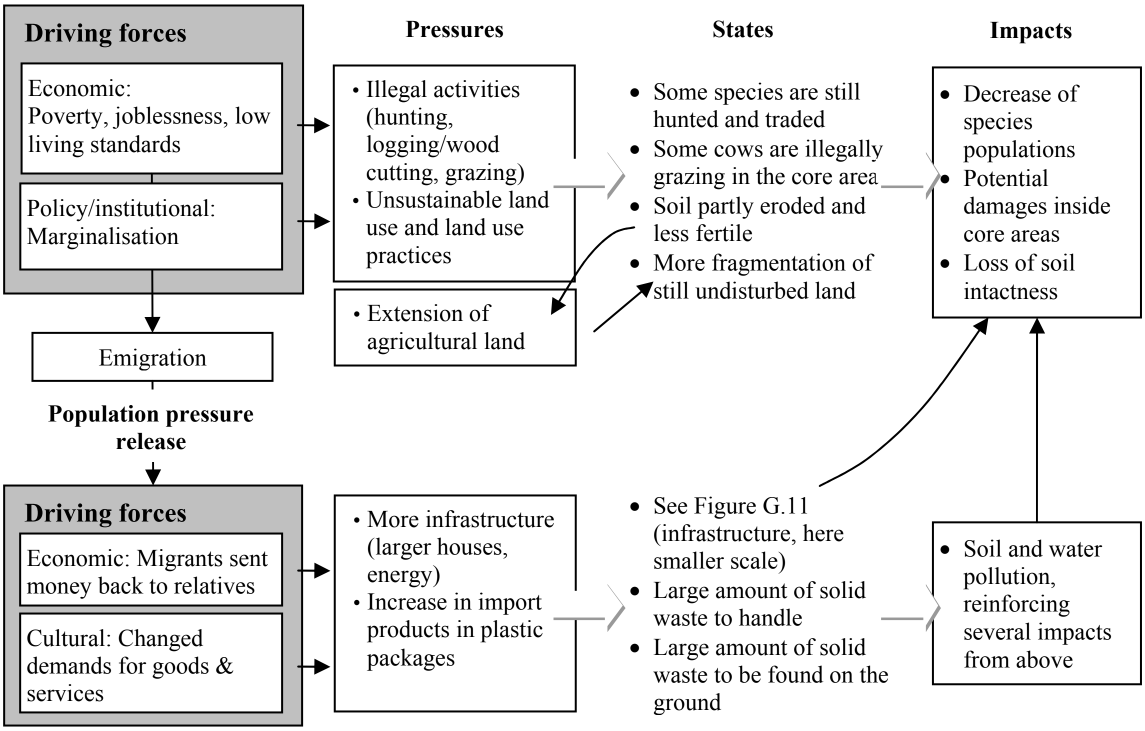


Figure G.12: SGBR – Cause and effect network for poverty and marginalisation

Unsustainable land use practices come along with expansion of agricultural land and rising cattle numbers and seem to be aggravated by and closely tied to some cultural driving force which was highlighted numerous times by interviewees of all different interviewee groups[42]. This cultural driving force does, for instance, refer to people's definition of well-being as exemplified in the following quotation: "*Until now having a cow defines the social status. It is more than not having a cow.*" (24:47, SGBR management). An increase in population or income within the SGBR (e.g. as a result of ex-residents sending money back to their relatives within the SGBR) can thus result in higher numbers of cattle and in turn more space needed for grazing and ranching (pressures), not only more land for crop cultivation. Indeed, grazing and ranching, as well as agriculture and plantations are two threats also ranked among the most severe in part 1 of the closed questionnaire (see Table G.5). During the field visit of the core area Joya del Hielo a number of cows were found grazing inside the core area (state, see Figure G.12). Although this is prohibited, it is difficult to control as parts of the core area are private property and regulations are based on agreements with the owners of the land only (policy/institutional driving force: land tenure situation).

The pressure exerted by the rising demand for farmland is emphasised by a repeatedly mentioned cultural driving force, expressed in the general notion that "land exists to be cultivated": "*They use all territory to grow crops and it does not matter whether this is flat or steep territory, it is for cultivation*." (45:5, local community member). Such indifferent use may quickly result in erosion (pressure) and infertility (state), even intensifying the need for still more agricultural land, as confirmed by the following statement: "*We are cultivating ever more land, yes, but this is land that will yield for two or three years, then it will collapse and finish the ecosystem*." (4:83, civil servant). However, this attitude is not considered to be site-specific for the SGBR and is regarded to be nationwide promoted by some political projects that were launched to meet development targets, as shown in this statement: "*Well, for me, […] looking at the context of this reserve, I think that there is still a lot of conscience missing in the same sector, in the governmental sector. The [...] government impacted a lot on the reserve, and I think they do the same in all the other reserves, due to the particular development interests, …*" (53:49-53:51, SGBR management when asked about the biggest challenge for the SGBR). A civil servant confirms this statement and explains it in more detail: "*They promote projects that disagree with conservation. Such as PROCAMPO[43], right? I do not know whether you have heard of this one, but in this country for quite some years I am*

[42] In these cases the code "driving force" co-occurred together with "attitude towards conservation" and/or "cultural dimension including traditional knowledge".
[43] A cash transfer programme with income multipliers promoted by the Mexican government.

fighting against the idea that the entire country must be covered with land for sowings and that all over the country there must be cattle. Nevertheless, recently I found out – I thought we were ahead of this – [...] that there are still people who keep on thinking that you can put agriculture and cattle ranching in every place of the country." (4:78 and 4:127[44]). The increase in farmland is followed by high nutrient loads from fertilizers, explaining the high ranking of the corresponding threat in Table G.12 (rank 7).

The identified attitude towards land use is considered part of what some interviewees call a **lack of conservation culture** (19:19, 44:18, SGBR staff) (cultural driving force) as it is described in the following statement by a local community member: "*But what I noticed is that we are little futuristic ["futuristas"], I mean, we think…, we are very egoistic, we do not think of anything but the present and of how I myself can benefit, but we do not analogically think of our children, our grandchildren, that they will also walk the world and that maybe we do not leave the proper conditions for them so they can also develop themselves or live their lives a "normal" way*." (45:16). In the SGBR context, this lack of conservation culture is expressed in two more habits that were repeatedly mentioned as critical for conservation achievements: the "children's game" of killing birds with slingshots (pressure) (13:17, 13:18, local community member, and 34:31, SGBR staff), and the habit to just drop garbage instead of carrying it to a dustbin (pressure) (50:4, external expert). The latter habit is assumed to be a consequence of the society turning towards throwaway packing: "*...the garbage for instance, 30-40 years ago all products came on returnable base, now everything is throwaway packing. We are entering a throwaway society, and we as Mexicans,... in those years everything we put in our mouth, well, was to just drop, it didn't look nice but it wasn't a contaminant. And we, we kept this custom, you eat and then you just drop the rest, only that today you do not drop the paring of a fruit but the packing of some comestible.*" (45:28, local community member). Especially along the roads within the SGBR significant amounts of garbage can be observed (state). As the roads climb up into the mountains the roadsides are mostly steep and garbage thrown down there is difficult to re-collect. This does not go unnoticed from the SGBR management: "*I feel ashamed, I really feel ashamed when I see the state of the roadsides; although we cleaned them up many times together with the local inhabitants, others are coming and again drop their garbage*." (40:35, SGBR management).

[44] The quotation has two numbers as two parts of the paragraph were coded separately.

The problem that is also touched by this statement is that it may not be enough to convince the local community members of the SGBR of the importance to dispose solid waste as long as non-residents are responsible for the pollution alongside the main roads. The pressure exerted by solid waste therefore does not only originate from inside the SGBR but is significantly reinforced by external visitors and passersby. In consequence, solid waste in terms of garbage (except flotsam and jetsam that do not apply for the SGBR) is well placed among the uppermost threats in Table G.5.

Concluding the issue of lacking conservation culture, it needs to be remarked that the observed value crisis from returning migrants as described in Box G.2 may naturally reinforce the lack of conservation culture, for example by further strengthening the shift towards a throwaway society. Therefore, a direct relation can be identified between poverty and marginalisation as driving forces triggering migration and the value crisis as a cultural driving force that may be reinforced by changed lifestyle expectations of returning migrants. Figure G.12 shows the causal network for the lack of conservation culture as a driving force in the SGBR.

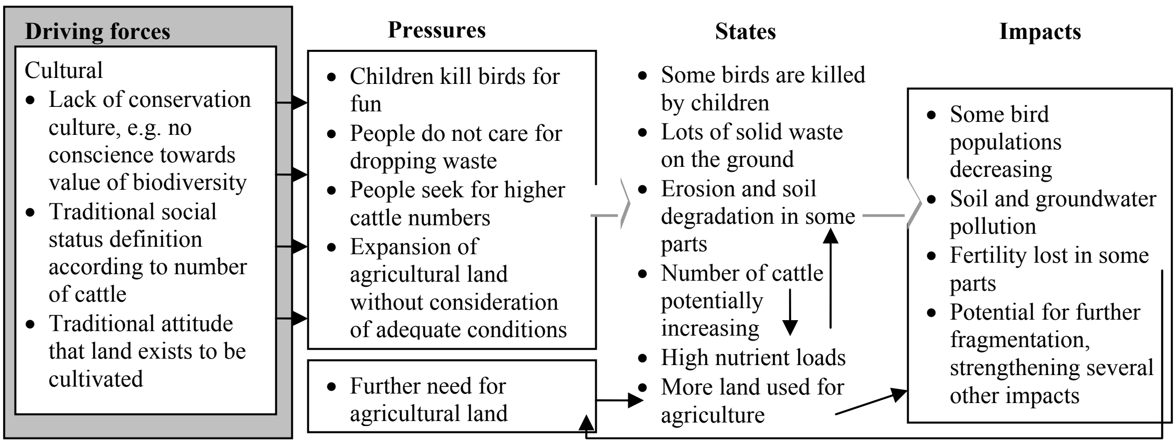


Figure G.13: SGBR – Cause and effect network for lack of conservation culture

Finally, one more threat seems to be of outstanding importance: **climate change** (caused by global population and income growth in interaction with technological advances according to Geist and Lambin, 2001). The consequences of climate change may exert pressure on the environment in different ways, for example by causing more severe drought and thus facilitating wildfires, increasing water stress, optimising the climate for invasive species to establish or overall fostering the system's vulnerability. While fires are often caused by anthropogenic activities some interviewees directly related them to climate change (e.g. 51:13, local community member, and 35:43, civil servant, see below). One interviewee, when asked about what factor could destroy the whole SGBR as a functioning system, replied: "*Climate change, wildfires, these areas are very vulnerable to wildfires.*" (35:43, civil servant). This statement is supported by many other interviewees from different interviewee groups (29:49, 30:22, 34:65, and 41:15 by SGBR staff, 35:43, 52:18 by civil servants, 51:14 by a local community member).

The perception of climate change and fires as a threat to the SGBR may be influenced by the fact that the year 1998 was outstandingly troublesome for the region, with serious droughts and wildfires related to this year's El Niño event as described by a member of the SGBR management (40:56): "*The 98 wildfires affected us very strongly, look, they affected us because since 1993 there wasn't as much rain as before but much less, notably; in 1997, in November, there was such a strong cold, but it was a cold… it wasn't a cold like others [...] but instead a dry cold that dried so many trees that had already been vulnerable from lack of humidity, and it was an intense cold without the tiniest bit of humidity until July 1998, when it finally rained, but it rained very little again since last year.*" The statement is also supported by another SGBR staff member (39:39) and scientific literature also confirms the historic drought and extraordinary fire season of the year 1998 (Rodriguez Trejo and Pyne, 1999; Rowell and Moore, 2000). Rodríguez-Trejo and Fulé (2003) cite an unpublished government report that states that 14,445 fires affected 8,496.32 square kilometres of land in Mexico and the smoke reached the United States and other nations of the Caribbean.

The impacts of climate change are obviously noticeable in the SGBR in terms of more heat, less rain and shifted rainy seasons (pressures), as confirmed by SGBR staff (29:35, 33:28), as well as local community members (6:9, 47:11): "*River beds have fallen dry due to the strong heat; well, for me the change is visible, it wasn't like this the years before […], in Tancoyol a professor told me we reached 50 degree Celsius, this is something we have never seen in the years before.*" (33:28, SGBR staff). Such extreme temperatures and droughts may certainly facilitate larger impacts of wildfires. One local community member even states that the increasing heat and the reduction in rain manifests itself in a difficulty to cultivate several crops (6:9). Another interviewee also relates the increase in plagues (pressure) to the changing climatic conditions: "*Yes, because climate change* *creates plagues in the different forests, and unfortunately these places are inaccessible to treat this plague and this is provoking, well, the degradation of the forest. Yes, it is notorious the changing climate in our reserve.*“ (34:59, and also confirmed by 41:28, both SGBR staff). Impacts from plagues are reflected in the comparably high ranking of invasive alien species (rank 11) in Table G.12.

All the described impacts explain why several interviewees consider climate change to be one of the biggest current threats to biodiversity conservation within the SGBR (e.g. in 30:19, 34:65, 54:17, SGBR staff). The two threats climate variability and habitat change and alteration, both falling below the threat group “climate change”, are ranked comparably high (see Table G.5) and thus confirm the impression gained from the interviews. Figure G.14 demonstrates the cause and effect network of climate change as a driving force. As impacts from the mentioned pressures and states were hardly addressed in interviews, some impacts are included as “potential impacts” in Figure G.14.

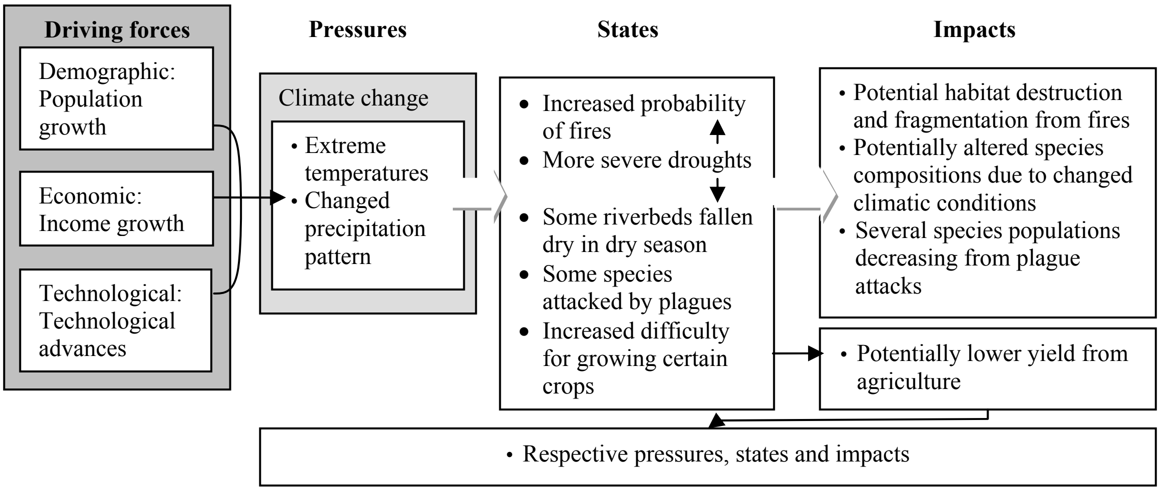


Figure G.14: SGBR – Cause and effect network for climate change

Replies to the question of the change of what factor could actually destroy the overall biosphere reserve regarded as a functioning system referred to three man issues: sharp shifts in political decision-making[45] (24:49, SGBR management, 28:27 and 54:18, SGBR staff, 42:8, civil servant), the disappearance of the Grupo Ecológico as motivating force for the implementation of the biosphere reserve and for combating external impacts

[45] This issue was clearly feared due to the approaching presidential elections in the country in July 2006 and the potential of subsequently changing responsibilities.

(31:27, SGBR management, 5:17 and 34:55, SGBR staff), and finally climate change (as described above). Chemicals and toxins appear among the top 20 threats in Table G.12 but no interview statements exist on the issue.

Hence, concluding this subsection, the most pressing conservation needs are summarised in Box G.3 (the order of issues in Box G.3 does not indicate an overall urgency rank).

Box G.3: Most pressing conservation needs of the Sierra Gorda Biosphere Reserve

1. Prevention of increasing pressure on resources through population growth, large-scale economic interests and their consequences (above and below ground construction);
2. Reduction of marginalisation and poverty;
3. Transformation of unsustainable agricultural practices into sustainable ones and halt of illegal resource use and further expansion of agricultural land;
4. Introduction of conservation culture and related consumption and behavioural patterns;
5. Prevention and combat of fires and plagues, potentially related to climate change.

According to the definition given in subsection F.4.1, conservation needs refers to both, the given objectives from the management plan and the issues identified from interviews. The conservation needs shown in Box G.3 are to a large extent reflected in the management objectives determined in the SGBR management plan (INE, 1999). However, some differences can be identified:

- Large-scale economic interests are not mentioned among the description of problems in the management plan and thus seem to have increased in importance since then[46];
- The issue of climate change does not appear in the management plan;
- The existence of invasive species is mentioned once (INE, 1999: 48), but was not further detailed and no separate action is proposed to address the challenge; and
- Restoration and rehabilitation received less attention in the interviews than in the management plan, potentially due to numerous efforts already in place.

[46] However, in a document describing the SGBR's Japanese Award for the Most Innovative Development Project the issue is mentioned as a challenge apart from those included in the management plan (Ruiz Corzo, 2005).

Conservation capacity

The conservation capacity of the Sierra Gorda Biosphere Reserve will be described by referring to **resources**, **governance** and **community** aspects as part of the conservation capacity component of the CSF (see subsection F.4.2)[47].

The resources component of conservation capacity includes, for example, staff, equipment and budget as well as knowledge, skills and qualities. The following paragraphs relate the findings from the qualitative questionnaire to these aspects.

The SGBR, compared to other biosphere reserves around the world (unpublished results of the GoBi Project), is with a team of more than 100 people **well staffed**. Staffing grew considerably through the GEF project funding but it is aimed to keep up staffing numbers even after the project through constant fundraising efforts (pers. comm. SGBR management in 2006 and 2008) and funding security was recently confirmed for at least the year 2009 (pers. comm. in 2008). Concerning **financial capacities** besides the GEF project, the SGBR is obviously very experienced in seeking opportunities for cooperation and financial support, has a separate person in charge of fundraising, and looks at a long list of small-scale national as well as international sponsors (SierraGordaNet, 2008b). With funding originating from a variety of sources, the dependency on one certain financial source is lower and overall financial sustainability strengthened (Emerton *et al.*, 2006). **Equipment and working facilities** are well established with numerous offices and new and partly Hewlett Packard sponsored PC's and office technology. Above this, only recently the "Centro Tierra" unclosed its doors to the public. The institution includes the new office buildings of the SGBR directorate, the Grupo Ecológico Sierra Gorda, as well as the NGO Bosque Sustentable, and an additional capacitating centre and computer pool. Training courses are offered according to different technical levels, to the general public as well as to personnel of other protected areas (see SierraGordaNet, 2007a). Equipment in terms of vehicles in the SGBR seems to be good as well. Vehicles were partly provided by the government, others belong to the Grupo Ecológico Sierra Gorda, and some have specifically been acquired for the purpose of wildfire combat. However, it needs to be remarked that the site characteristics in terms of the size of the biosphere reserve and distribution of the local population requires for a high number of vehicles. Single actions

[47] In ATLAS.ti they are marked with one of the codes from the code group "conservation capacity", see Annex III.

in communities or at project sites may turn into very time and energy consuming undertakings in the SGBR. The maintenance of working relations with local community members is only possible with sufficient vehicles, fuel and time available. A one way trip to visit a project site may easily cover several hours time. Now taken that, in addition to this, communities within the SGBR are so widely scattered, it becomes even more difficult to maintain a network of relations to local people and authorities. The disposability of numerous vehicles adequate to climb up and down the steep and partly poorly developed mountain passes is thus a pre-condition for action.

In addition to vehicle equipment, the presence of people representing the interests of the SGBR at the local level bridges an otherwise definite difficulty, namely a more frequent presence of project staff in the communities and at project sites. Communication with these so-called "promoters" works on a weekly base, as described by the following interviewee: "*Well, we meet every week, we discuss field activities and we meet with our supervisors and comment to them about the advancement we made with our awareness raising, about our forests, where there are possible places to do reforestation, right? And obviously they are accompanying us to do field visits.*" (13:48, local community member and promoter[48]).

Three very significant strengths of the conservation capacity have been mentioned so far: significant staffing and equipment, a separate staff for fundraising to maintain staffing and equipment, and the strategy of having local promoters to support several action lines at project sites. These are crucial assets obviously contributing largely to the conservation capacity of the SGBR. Above this, the overall history of conservation work in the region seems to be of outstanding importance, characterised by the **constant presence of key actors**, who created an atmosphere of cooperation among stakeholders and thus the base for a stable biosphere reserve. The SGBR management clearly profits from the fact that key actors do not change with political elections but are independent from such dynamics. It is furthermore part of the reserve's strategy to mainly employ people with broad local to regional experience and knowledge (29:14, SGBR staff). This is considered crucial to achieve the site's conservation objectives as described by one member of the SGBR staff: "*And maybe that was the success of the Grupo Ecológico Sierra Gorda, that from the beginning these were people from this region being well aware of the necessities. You*

[48] Three of the local community members interviewed in the SGBR are promoting the reserve's objectives on community level.

have to know the mentalities in order to carry them step by step forward. And I think that this is where the success in conservation lies." (29:16, SGBR staff). Such **continuance** of personnel and deep **knowledge** of the place significantly benefits the stabilisation and maintenance of personal relationships with local community members (40:11, SGBR management). This strength is also recognised and emphasised by civil servants as the following example demonstrates: "*In the case of the Sierra Gorda, we had as a positive factor the existence of an NGO […] that had a markedly exact and detailed knowledge; I am not telling you about knowing the region and knowing that this is a Prosopis-species or that this is a wild boar, no, but that you can ask a person [staff] and they tell you "this person is Don Luís, he has a bike repair shop", because you see this, you note that they know the inhabitants, virtually as if they were the "secret service" of the Sierra.*" (38:5 and 38:6).

In addition to this deep knowledge, it has become obvious that **leadership characteristics** and a remarkable **commitment** of all the people involved in implementing the SGBR always have been and are still the motor to implementation of more projects, more cooperations, to identifying new funding opportunities and mechanisms for compensation, besides others: "*The interest [that key actors of the SGBR have] in conservation is what makes a lot of things move, what detects the spaces, the capacities, not only on a local level, but even on an international level. […] Without doubt those motivators are essential, there are many in many places of the world, but well, we have the fortune that one of them is here.*" (24:5 and 24:8, SGBR management).

Unfortunately, the same character trait that has contributed to making the SGBR a well equipped protected area where conservation actions are passionately pushed forward is at times understood as being inconvenient or **too energetic** (38:28, civil servant). This obviously created a slight weakness in the cooperation with the national political level, although it is confirmed to have improved during the last years (3:3, civil servant).

One more weakness also originates from the history of the site and refers to the **initial lack of scientific research and monitoring** (3:19, civil servant). However, there seems to be awareness for the need of more scientific research and monitoring, also supported through monitoring and evaluation activities as part of the GEF project, and ever more projects are thus specifically implemented to overcome this weakness (as described earlier). One member of the SGBR management explains: "*We have an interior* *evaluation and a coordinator who is specifically in charge of this and who is continuously observing how we are doing with the process of the proposed activities and what is going on; we are continuously sitting together to see how we are doing, because for us this is important.*" (40:41).

In terms of governance aspects of conservation capacity, another clear advantage of the SGBR is its type of **protected area declaration** which is stated to be comparably stable. Apparently, Mexican protected areas may either have a national declaration, or a federal one, the latter being much more fragile towards political disturbances than the first as explained by a civil servant in the following: "*Many times the local declarations are very vulnerable or depend a lot on whether the municipal president changes for instance, no? We have cases where the municipal president declares a protected area, the municipal president changes three years later [...], quits the declaration and sells his/her terrains at the best price. Now we have the case of [...], it was only just declared a natural protected area in December 2004, the government of the state declared it, then the governor changed in November 2005 and the current governor withdraws the declaration. This does not happen with federal declarations. The declaration process [...] is very complex and thus it is as complex to withdraw it*." (4:31 – 4:34).

In addition to this important point, the Mexican system of protected areas also profits from the existence of **regional coordinators** representing a linkage between the local and the national governmental level. These positions were established in an effort to decentralise the national governmental agency in charge of natural protected areas in 2003 in order to strengthen interactions between protected area decision-makers (4:112, civil servant).

Trust and acceptance of SGBR residents, as well as their opponents mistrust and rejection, are important influencing factors on the community aspects of conservation capacity. While conflicts were mentioned in some interviews, the interviewees then mostly referred to past conflicts (e.g. 38:16, 42:17, civil servants, and 40:8, SGBR management), or legislatory conflicts on the national level (as under policy/institutional driving forces). Only very few times these conflicts seem to be actually influencing either the functioning of the biosphere reserve or its acceptance by local community members. This is for instance the case when conflicts turn up on the community level in the course of participatory projects established to create income alternatives (e.g. 6:7, SGBR staff member). The interviewee, in this case, explains that, unfortunately, in one of the projects implemented one local community member behaved dominant in the course of the project and thus avoided other people from participating. This in turn influences the overall success of the project and sheds a false light on its initial intuition. However, according to information gathered, this is a singular case. Overall, the most crucial conflict faced is apparently of human-wildlife nature and has emerged only recently. Since wildlife seems to recover there are increasing announcements of big cats, jaguar and puma, attacking cattle, as exemplified in the following quotation: "*And concerning the cats, recently we had a lot of reports from local people who believe that the big cats are looting their goats, their livestock*." (29:29, SGBR staff).

Not only the recovering populations of big cats appear to be problematic, but as well the recovering deer populations feeding on crops (19:19, SGBR staff, 40:24, 53:38, SGBR management). Above this, in one interview even the rare black bear was reported to cause damage to local people's cattle (53:34, SGBR management). As soon as wildlife harms local peoples' livelihoods, the acceptance of the biosphere reserve as such, as well as of the restrictions that may come along with its implementation, may become weakened. In the SGBR region, a lack of acceptance can be observed in some places by a fraction of local inhabitants, as explained by a local community member and promoter of the SGBR: "*But there are also other people who, well, who don't like it. These people are always in the defence because they think that someone comes for them and ..., that we try to, I don't know, to occupy their territory with something they are not interested in; they do not regard this as something viable.*" (45:18, local community member). Overall, the perception of the level of acceptance or rejection of the biosphere reserve by local community members varies among interviewees. While one community member estimates a 50:50 relation between acceptance and rejection (47:12), one SGBR management member states that: "*I can tell you that about 99 percent of the residents agrees with the biosphere reserve and is content to live within a reserve. I do not believe that there are 1,000 people, 1,000 voices who say they do not agree.*" (40:10). Personal observation rather supports the latter statement as in many situations, without any influence through SGBR employees, positive impressions on the attitude of the local community towards the SGBR were gained. These are further described under the subsection on noticeable effects from conservation actions.

Concluding this subsection, Table G.6 summarises the identified facilitating and impeding conditions shaping conservation capacity in the Sierra Gorda Biosphere Reserve. Several of the impeding conditions listed in Table G.6 engage with each other: Where leadership characteristics were considered "too energetic" this led to a weakened cooperation. Similarly, the human-wildlife conflicts contribute to some residents still holding a contraposition to the SGBR.

Table G.6: SGBR – Facilitating and impeding conditions for conservation capacity

Capacity component	Facilitating conditions	Impeding conditions
Resources	• Well staffed and equipped, good working facilities; • Extra fundraising personnel, no dependency on just one source of funding; • Deep knowledge of the region, also due to many staff originating from the Sierra Gorda region; • Long conservation history; • Consistency of key actors; • Strong leadership characteristics; • Commitment; • Broad network of cooperation.	• Initially no resources used/available for research and monitoring – backlog demand; • Leadership characteristics partly regarded as too energetic.
Governance	• Legal declaration comparably stable; • Existence of regional coordinators linking the national and local level.	• Cooperation between local and national level was weakened in the past, now improving
Community	• Local promoters supporting projects; • High level of trust and acceptance.	• Widely scattered, thus difficult to reach; • Some residents still in contraposition to the SGBR; • Human-wildlife conflicts.

Subsequent to the conservation needs and capacities, the following subsection will now look at the conservation actions in place in the Sierra Gorda Biosphere Reserve.

Conservation actions

In this subsection, the implemented conservation actions addressing either the identified conservation needs or further strengthening the conservation capacity are presented[49].

Large-scale economic interests (economic driving forces) are difficult to address for the biosphere reserve management body. However, the tight cooperation between the biosphere reserve management body, stakeholders and local residents appears to have a strengthening effect on efforts to avoid decisions to construct infrastructure and exploit below ground resources. Furthermore, the **Grupo Ecológico Sierra Gorda is actively engaging in the negotiation of decisions on construction** in the region. Governmental decisions that are considered to be counteracting the conservation objectives of the biosphere reserve are not accepted right away. Several of the key actors of the SGBR dedicate their time and expertise to such negotiations whenever necessary (see "Effects from conservation actions" for outcomes of such negotiations).

Projects fostering the sustainable development of the region were initiated long before the declaration of the SGBR but through increased resources they have now grown more numerous and are reinforced and refined. One member of the SGBR management explains them briefly as follows: "*We are trying to capacitate the people in alternatives, such as to make pottery, such as to make joinery [...], such as beehives, honey production, fish cultivation, the use of wildlife in a sustainable manner.*" (40:50, SGBR management). In addition to these examples, there is much hope that benefits from **sustainable tourism** projects may increase in the future. While the region attracts tourists through its Franciscan Missions declared as Cultural World Heritage by the UNESCO, eco-tourism facilities have in the meantime also been installed in six more locations, namely Quatro Palos, La Trinidad, Río Blanco, Río Escanela, Santa María de Cocos, and San Juan de los Durán (several of them are shown in Map G.7). Moreover, first projects have been implemented to receive **payments for ecosystem services** (e.g. 31:6, 49:12, 53:53, SGBR management). In 2006, for instance, local land owners as direct beneficiaries sold 0.15 square kilometres of private property for reforestation over a period of 15 years to the United Nations Foundation, a process that was facilitated by the SGBR directory and the Grupo Ecológico Sierra Gorda (Pedraza Ruiz, 2008).

[49] In ATLAS.ti they are marked with the code "response" as part of the DPSIR system plus one of the codes from the code group "conservation actions", see Annex III.

The overall objective of all these programmes is the **creation of income alternatives** for the local poor and in parallel the reduction of pressures on natural resources arising as a consequence of poverty and marginalisation. They do thus address several of the most crucial conservation needs well on their roots.

The difficulty to consider in the context of these projects is that implementation alone is insufficient but instead each of the projects needs a close follow up, needs to be accompanied and guided until one day it ideally becomes autonomous, as described by one SGBR staff member: "*..., but still, until today we cannot leave them alone, we have to accompany them in all processes, and this applies to all the small businesses, […], because these are people who do not know anything about the life outside their communities and the way in which they use to live, so they do not know about accountancy, they do not know how to create a bank account, […], and I think it will still take us years until we can leave them alone.*" (29:7 and 29:8, SGBR staff). The responsible SGBR employees therefore look after all projects as long as necessary after their establishment. Access to the market for all local products is also facilitated to ensure the sustainability of these projects (26:7, local community member).

The SGBR staff team working within the GEF project and dedicated to implementation and follow up of the described projects consists of five people. They run more than 20 projects (status quo in March 2006, see 29:1) in different municipalities as part of the GEF project action line 5: development of sustainable economic alternatives (SierraGordaNet, 2007c). Further support to realising this action line is provided by staff of the local NGO Bosque Sustentable. The NGO is also engaged in creating benefits for local communities through commercial plantations as well as the maintenance and restoration of natural forest (e.g. 13:3 and 45:3, 45:4 local community members, 39:28, SGBR staff, 49:5 SGBR management, 50:2, external expert). All activities are closely coordinated and aim at overall consolidation.

Several projects have been visited during the research stay, for example, the pottery, the carpentry, and several eco-tourism facilities (see Photo G.3 and Photo G.4). Some of the eco-tourism facilities were still under construction but it was planned to finish them in the same year (2006).

Photo G.3: Half-finished pottery products in the SGBR

Photo G.4: A carpentry in the SGBR

However, doubts were expressed not on the ecotourism potential of the region but instead on the feasibility and long-term success of these projects, as expressed in the following statement: "*Oh, this is a very special case, the Sierra Gorda. From the scenic perspective and from the resource perspective it would be ideal for ecotourism, but it is far from every place. I mean, if you want to go there from Querétaro it is three and a half hours, if you want to go from Mexico City it is five and a half hours, and if you want to go from Tampico it is five and a half hours. Therefore, the ecotourism, I do not know how much success this can have in the Sierra Gorda.*" (39:39, civil servant). One personal observation adds up to this statement: No public transport exists to visit the ecotourism sites so far. Moreover, doubts exist on whether visitors will make use of the facilities all year round and not only for certain holidays, as they apparently do so far (38:40, civil servant and personal observation). Unfortunately, this immensely increased holiday traffic then seems to also result in a significant increase of solid waste newly contaminating the environment of the SGBR (44:17, SGBR staff).

Awareness raising and environmental education are repeatedly described as key conservation actions to achieve conservation objectives, as exemplified in the following statement: "*I think it is the only way, through people, a lot of environmental education together with support, just like we do this.*" (29:11, SGBR staff, also supported by 30:1, 43:4, 54:2, SGBR staff, and 31:10, SGBR management). As a matter of fact, sensitising activities have started around 16 years ago already and were continuously extended since then. As of March 2006, environmental education involved 161 schools in 112 communities of the region. The activities implemented comprise awareness raising sessions, children's forests, earth festivals, nature appreciation and birding tours, video screenings, and cleaning campaigns, besides others (SierraGordaNet, 2007b). Didactic material is continuously further developed and improved for the lecturers. However, not only school children are targeted by these activities, but also the children's adults so to consolidate the sensitisation efforts. Other awareness raising campaigns focus on the impacts of fire and its prevention and are specifically designed for local *ejido* members and farmers (28:22, SGBR staff). Finally, it is also tried to include local authorities in sensitisation programmes because the decisions they take may result more harmful for the biosphere reserve than the ones individual community members take: "*...and sensitising very much the local authorities as well so that their public works become sustainable.*" (29:12, SGBR staff).

The environmental education team consists of more than ten people, several of which had been local teachers before working for the SGBR (34:9, SGBR staff and pers. comm. in 2006)[50]. The team is supported by about 17 local promoters (as of March 2006, see 34:7, SGBR staff), i.e. school teachers who agree with the objectives of the biosphere reserve's environmental education programme. They themselves receive capacity building on environmental issues by the SGBR staff and then further promote the education and awareness raising activities of the SGBR. They also represent the principal contact persons in those local communities where environment education is realised.

In a one day field visit, the author participated in a so-called "Fiesta de la Tierra" (earth festival) that took place at two schools outside the buffer zone of the biosphere reserve (in the municipality of Xilitla) and talked to staff of the environmental education programme as well as to school children's parents (see Photo G.5 and Photo G.6). The introduced awareness raising and environmental education activities address several of the identified conservation needs, i.e. the ones arising from the lack of conservation culture.

[50] As a matter of fact, the main initiator of the SGBR was a local music teacher before dedicating time and efforts to conservation and sustainable development of the region.

Photo G.5: School children on the "Fiesta de la Tierra" in the SGBR


Photo G.6: Play of the environmental education team of the SGBR

A member of the SGBR staff states that there is the need to develop a special plan to treat the transculturalisation problem (34:58) but no such strategy exists so far. Unsustainable agricultural practices and erosion are treated by sensitisation activities and the **introduction of new practices** to avoid erosion and stabilise the ground (34:30, SGBR staff, pers. comm. and personal observation in 2006). Heavily degraded areas are restored and reforested wherever possible (24:34, SGBR management, and 33:9, 34:30 SGBR staff) and species who disappeared from degraded areas are reintroduced (40:51, SGBR management).

Finally, a compensation mechanism has been introduced to reimburse the loss of cattle and crops to recovering wildlife. Through such economic compensation, it is tried to dismantle the potential lack of acceptance of the SGBR as a result of human-wildlife conflicts (29:31, SGBR staff).

In addition to addressing the driving forces of existing conservation needs, further conservation actions do complementarily try to **avoid pressures** where possible, and also try to **improve undesirable states** of the environment: The large amounts of solid waste polluting the environment (state) is addressed by several parallel activities. **Cleaning campaigns** as part of the environmental education activities have already been mentioned earlier (and are also mentioned in 34:4, SGBR staff). In addition, the SGBR took over the responsibilities to create **recycling centres** and transport the recyclables to treatment plants (34:13, SGBR staff, 53:41, SGBR management and personal observation). These activities are under responsibility of a smaller staff group focusing on improvement and health of the communities. Recycling centres have been seen to exist in most places that were visited during the research stay, and for one day the author participated in collecting the recyclables and transporting them to the larger regional repository (see Photo G.7). Threats from artificially caused fires are on the one hand tried to avoid through sensitisation efforts but additionally supported by **fire control teams** and campaigns consisting of local promoters (e.g. 31:5, SGBR management) (see Photo G.8). Concerning the plagues in the region, one SGBR management member mentioned that it is tried to keep the populations as low as possible (49:8) but no further information was provided.

Overall, an impression of helplessness was gained concerning options to address climate change consequences, as to be seen in the following quotation from an SGBR staff member: "*You can work with the people, but the changes of climate we cannot avoid. And how can we protect all the animals, what can we do?*" (29:37).

Photo G.7: Plastic bottles collected for recycling in the SGBR

Photo G.8: Poster appeal to avoid forest fires in the SGBR

Enforcement to avoid illegal activities is not a separate action line of the SGBR but rather incorporated in several of the other action lines. In sensitisation efforts, for instance, local community members are asked to take over control functions on the local level, in the context of fire control (as mentioned earlier) but also in the context of illegal activities (34:34, 54:11 and 54:12, SGBR staff). Basically every inhabitant of the SGBR is asked to announce when illegal activities occur, and it is thus tried to make enforcement an autonomous process. One staff member stated to be in charge of issues related to rule enforcement and vigilance (53:36, SGBR management). However, no personnel exist in the sense of "guards" focusing on the detection and follow up of illegal activities. Some interviewees held the view that enforcement activities are still too weak within the SGBR (e.g. 43:15, SGBR staff, 45:57, local community member). When interviews turned towards enforcement, it was repeatedly mentioned that the Federal Attorney Generalship of Environmental Protection (Procuraduría Federal de Protección del Ambiente, PROFEPA) is the responsible agency for such action (28:14, SGBR staff, 53:52, civil servant). However, another civil servant also stated that PROFEPA is far from having the personnel capacities to get the task done in all of the Mexican protected areas (35:53). One member of the SGBR management in turn called for more support in the sense of enforcement of rules from municipal presidencies (40:36, SGBR management).

Complementary to the so far mentioned activities, **scientific research** in the SGBR continuously increased during the last years. While initially there was no connection to academic research institutions and little research was thus conducted, the SGBR has by now established numerous cooperative projects with national (e.g. the University of Querétaro, 39:18, 41:19, SGBR staff) and international research institutions (e.g. the U.S. Fish and Wildlife Service and others, as mentioned under "Conservation capacity"). External experts are consulted for issues such as water management, pressure reduction (e.g. shifting towards solar cooking, see 34:47, SGBR staff) and alternative income creation. Research on birds and insects has been reported (19:11, SGBR staff) and camera trapping for the detection of large mammals and birds is realised as well (40:45, 53:31, SGBR management, 41:1, SGBR staff) (See Photo G.9 and Photo G.10, photo credits: Roberto Pedraza and Alfredo Morales[51]).

[51] Permission for the use of the pictures obtained via Email on the 19th of November 2007.

Photo G.9: Jaguar picture from camera trap in the SGBR, example 1 (photo credits: Roberto Pedraza and Alfredo Morales)

Photo G.10: Jaguar picture from camera trap in the SGBR, example 2 (photo credits: Roberto Pedraza and Alfredo Morales)

Monitoring and evaluation has likewise gained importance, especially since the start of the GEF project that required to be monitored against fixed targets. With monitoring from previous years missing, social surveys had also been conducted on specific issues, for example, the perception of changes in illegal activities (logging and poaching, e.g. 5:9, SGBR staff), and the perception of the environment in general (24:37, SGBR management). Water quality is obviously measured frequently in several parts of the SGBR (24:31, SGBR management), and changes in forest cover were studied using remote sensing data (13:11, local community member, 29:27, 39:13, SGBR staff, 53:26, SGBR management, and see also De la Llata Gómez *et al.*, 2006).

Conclusively to this subsection it can be stated that many of the realised conservation actions do directly address the identified driving forces, pressures, states and impacts – and thus the identified conservation needs. For every conservation need a strategy seems to be underlying the series of conservation actions in place. Table G.7 shows the needs, detected underlying strategies and corresponding conservation actions.

Table G.7: SGBR – Strategies and conservation actions to address conservation needs

Needs	Strategy	Conservation actions
1. Prevention of increasing pressure on resources through population growth and large-scale economic interests	Proactive avoidance and defence (if necessary)	• Maintenance of relationships; • Active participation in negotiations with decision-makers.
2. Reduction of poverty and marginalisation	Well-being enhancement and pressure reduction	• Creation of income alternatives in terms of alternative production and payments for ecosystem services; • Introduction of more sustainable resource use practices (solar cook, erosion barriers, etc.).
3. Transformation of unsustainable agricultural practices into sustainable ones and halt of illegal resource use	Training and responsibility transfer	• Awareness raising and targeted training; • Mobilisation of local promoters to take over surveillance functions.
4. Introduction of conservation culture and minimisation of transculturalisation influence	Sensitisation and backwards transculturalisation	• Environmental education for school kids, students, parents, local community members, and local authorities; • Awareness raising in terms of fire control, illegal activities, waste management, water management.
5. Prevention and combat of fires and plagues, potentially related to climate change	Prevention and combat (as far as possible)	• Knowledge production (research), awareness raising; • Mobilisation of fire brigades.

Figure G.15 represents a synthesis of all cause and effect networks presented under "Conservation needs". Arrows to indicate linkages between network components are left out for more clearness. Every dark green triangle indicates that the respective driving force, pressure, state or impact is addressed by at least one conservation action. Hence, Figure G.15 shows the many ways in which conservation needs are addressed by conservation actions in the SGBR. In addition, it reflects for which driving forces, pressures, states or impacts no conservation action could be identified as a "response". Potential reasons for this may be very different in nature: Some driving forces cannot be influenced by local action, such as national or international price value dynamics. In other cases, the biosphere reserve management may have decided to address a pressure rather than addressing its impacts, and this could be the simple reason why some impacts remain unaddressed. In some cases, however, action gaps may also exist.

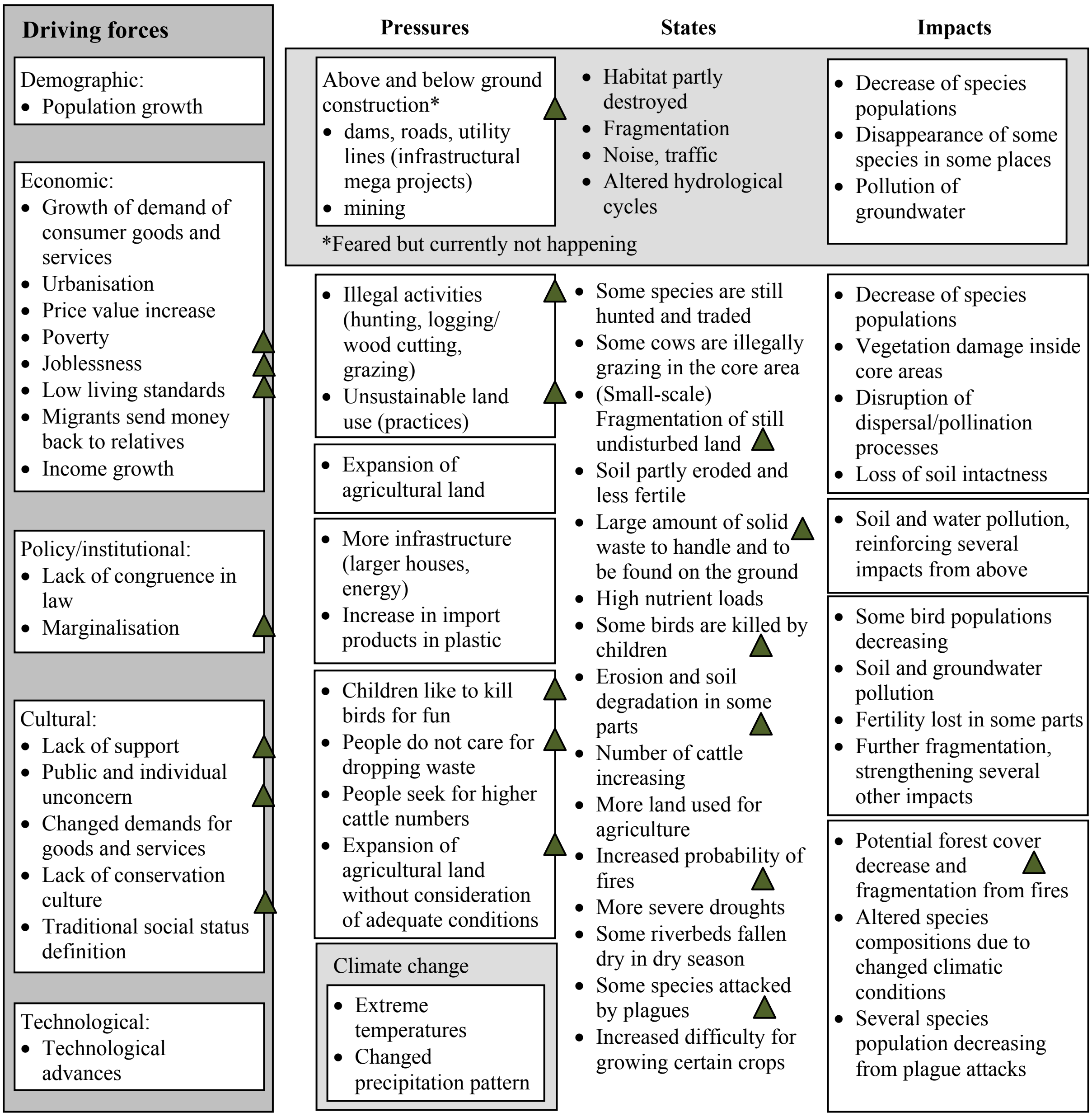


Figure G.15: SGBR – DPSIs and conservation actions (Rs)
(Green triangles represent at least one identified conservation action addressing the respective driving forces, pressures, states and impacts)

In addition to conservation actions addressing the conservation needs, others aim at strengthening conservation capacity, especially where there are constraints, as indicated in Table G.6. As it was the case for conservation needs, certain strategies for addressing such constraints were detected from the study's findings. They are shown in Table G.8. As Table G.6 pointed out, some of the constraints to conservation capacity were rather attached to the past by interviewees than mentioned as being a current problem. No direct actions addressing these constraints were identified through the qualitative survey.

Table G.8: SGBR – Strategies and conservation actions to address capacity constraints

Capacity constraint	Strategy	Conservation actions
1. Backlog demand in terms of research and monitoring	Strategic catch-up	• Cooperation with University of Querétaro as an academic partner; • Monitoring activities introduced for flagship species (e.g. jaguar, puma).
2. Remaining lack of acceptance	Trust creation and compensation	• Compensation for damage caused by wildlife; • Involvement of residents and responsibility transfer.

Effects from conservation actions

This subsection describes the observed and reported effects from conservation actions. Where possible, results from the qualitative survey are related to the corresponding question of **part 2 of the closed questionnaire** (see subsection B.4.4). The order in which effects from actions are described follows the order of issues in previous subsections as far as this is possible. Where effects root back to several different conservation actions this is explained in the text. The subsection is completed by general indications for the overall status of the SGBR that were identified in the case study.

During the research stay some interviewees showed serious concern about potential political decisions with respect to new **above and below ground constructions** within the SGBR. However, as reported in October 2007, the construction of a high-voltage utility line was avoided through rejection of the permit for construction by the Grupo Ecológico Sierra Gorda. Above this, a plan to build six new hydropower plants was changed after negotiation with the SGBR management and only one plant will be built now spanning a height of 15 instead of 80 metres. Obviously, this progress of decision-making was also supported by responsible civil servants from CONANP (pers. comm. via email on 15.10.2007).

Effects from projects to create **alternative incomes** may either be found in direct financial benefits for local communities, or otherwise in the reduced pressure on natural resources as a result of introduced alternatives. As described earlier, several of the implemented projects to create income alternatives have been visited. One participant from the pottery stated that the products can sometimes be sold, but income is not yet regularly gained (6:5, local community member). It is therefore tried to increase the quality of the products and identify markets allowing more regular sales (19:20, SGBR staff). A specialist has especially been called to look after the product quality and also lives within the community. The situation is similar at the carpentry, which still does not create large benefits. However, during the research stay it was obvious that external interest in wooden products from this community was increasing (26:7, SGBR staff). Above this, ecotourism facilities also benefited from the existence of the carpentry, as many pieces for the construction and furniture were produced here (26:3, local community members). For one of the operating ecotourism sites it was stated that ten visitor groups had been there during the year 2005, mainly groups of school children and all staying for about one week, thus resulting in clear benefits for the about 10 local people involved (pers. comm. in 2006). Further financial benefits are gained from payments for environmental services. One member of the SGBR staff stated that for 32 land properties such payments were already received (49:12, SGBR management). Pedraza Ruiz (2008), in an article on "compensation for conservation", summarises established projects and programmes in the context of payments for environmental services. In September 2008, a project of the Grupo Ecológico Sierra Gorda entitled "Reducing impacts of ranching on biodiversity" gained a grant of the 2008 Global Development Marketplace on Sustainable Agriculture for Development hosted by the World Bank. In this project, payments for ecosystem services and the creation of income alternatives successfully reduced impacts from intensive cattle farming (SierraGordaNet, 2008a; World Bank, 2008). One local community member reports an observation which reflects such a shift in income gaining activities: "*[...] one has seen that people refrain a bit from forest and agricultural activities. In fact I believe that the number of cattle that existed decreased during the last years and the people already have another option for the conservation of the forests, right?*" (13:8).

In this case it can be assumed that changes did not only occur with respect to income alternatives (to fight poverty as an economic driving force) but potentially also with respect to the traditional definition of the local people's social status (cultural driving force). As a matter of fact, the reduction of pressures may result from several conservation actions besides the creation of income alternatives, including all the awareness raising and environmental education activities. Interviewees' responses to the question of what indicators could be used to see whether or not conservation objectives are achieved also included a variety of indicators with a clear focus on pressure reduction and subsequently expected consequences. Most frequently mentioned were the reduction

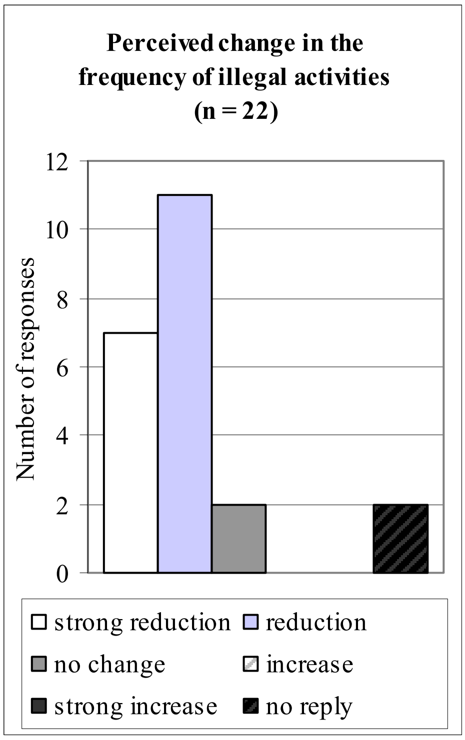


Figure G.16: SGBR - Perceived change in the frequency of illegal activities

of artificially caused fires and of illegal activities in general, as well as the increase in forest cover and species populations. Apparently, illegal activities have been a much larger problem in the past than presently: "*I remember that several years ago, when the project started, there was illegal deer hunting in this region.*" (13:15, local community member). About today's still occurring illegal activities in the SGBR interviewees agreed that they have become less frequent (28:12, SGBR staff, 45:47, 47:14, local community members). The results from the corresponding question in part 2 of the closed questionnaire reflect this, as can be seen in Figure G.16. However, some statements question whether this reduction is actually a result of the introduction of alternatives or rather goes back to the knowledge about sanctions for the commitment of illegal activities: Interviewee: "*It is forbidden to hunt animals.";* Author: "*And people do accept this?*"; Interviewee: "*People in a way do not accept this voluntarily, but they know there are sanctions for when they go hunting.*" (45:24, local community member, and also supported by 13:16, local community member). Taken that enforcement was in general considered to be comparably weak, it is surprising that sanctions seem to still stop some people from illegal activities. However, it could be the involvement of local people in vigilance having this effect, as the following statement points out: "*People come and denounce to the Grupo Ecológico Sierra Gorda anonymously who is doing harm to nature, such as burning the forest, cutting trees, provoking fires, killing deer, capturing wild animals, they are already coming to report this to us.*" (34:34, SGBR staff). The impression is strengthened by further similar statements, as, for example, by SGBR staff (28:10 and 54:12) and a local community member (13:28). This may indicate that an internal vigilance system is starting to develop.

Efforts to control and avoid fires are also reported to show positive effects (29:34 and 34:62, SGBR staff), especially linked to those areas that receive payments for environmental services: "*In those regions forest fires are 100% reduced.*" (53:55, SGBR management). As a consequence of reduced illegal logging and fires, in addition to reforestation actions, several interviewees talked about the increase in forest cover within the SGBR as an important indicator for achieving conservation objectives: "*And also the recovery of the forest cover, you see on the maps from years ago and on satellite images years later how the patches are extending*." (29:26, SGBR staff, also supported by 43:8, SGBR staff, 6:4, 13:7, and 45:22, local community members). Another staff member reports: "*We see more and more mountains full of trees.*" (34:15) and the management confirms by saying: "*We have a forest cover by far larger than 20 years ago or 10 years ago. Much larger.*" (40:21). Stability of limits between forest and agricultural area is obviously a fixed indicator as part of the GEF project. Here it was agreed that agricultural activities are not supposed to enter a defined zone surrounding the core areas. As far as reported, the indicator is stable with the exception of the Cañon de Moctezuma for which a diagnosis to identify the status and potential counteractions was in preparation at the time of the case study (5:6 and 5:7, SGBR staff).

The recovery of the vegetation together with reduced illegal activities comes along with the apparent recovery of several target species: "*The recovery of wild fauna here is an evidentiary fact. We have recovery of populations of very important wild game, testimony of native people from the region that wild game and wild fauna are returning*." (53:29, SGBR management, also 24:34). Reports of sightings of key species by SGBR inhabitants are confirmed by another staff member: "*Today we can see them in the region, thanks to the protection that was done, and many people have already seen them in some occasion and many let us know, the teachers, the kids, the people from the communities who have seen wild game, in this place or in that place. So yes, concerning this, well, I could say, that yes, they are reproducing. They are not being killed that much anymore*." (33:8). Statements from several other interviews also confirm this impression (6:4, 13:14 local community member, 29:24, SGBR staff). Obviously, these recovery processes also apply to the feline species of the SGBR. While this is more difficult to notice in case of the small species, the presence of jaguar and puma becomes evident from the rising number of attacks on cattle, causing the human-wildlife conflicts mentioned earlier (e.g. 40:47, SGBR management). However, the target species mentioned so far do not occur in all of the different ecosystems of the SGBR. In the semi-desert it will not be useful to look after deer, for instance. Still, an increase in bird species was also reported to be clearly noticeable (34:48, SGBR staff, 49:49, SGBR management) and might be better transferable to semi-desert ecosystems.

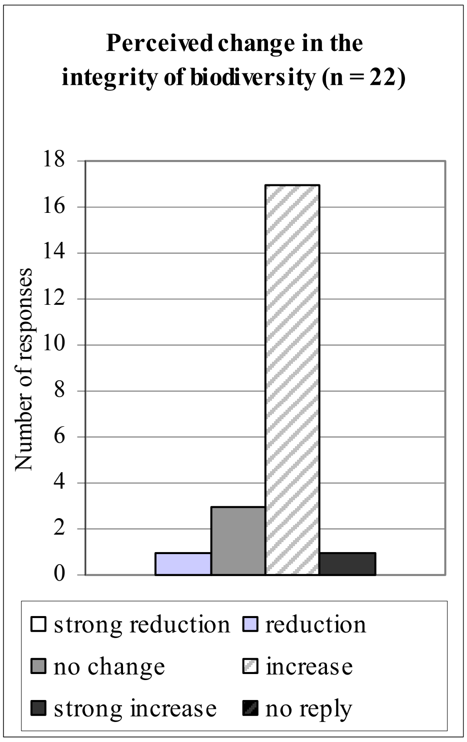


Figure G.17: SGBR – Perceived change in the integrity of biodiversity

Overall, the perception of changes in the integrity of biodiversity from part 2 of the closed questionnaire shows a clear upwards trend as to be seen in Figure G.17. A civil servant strengthens this by saying: "*The state of conservation of the Sierra Gorda is much better than I would have been able to imagine.*" (38:19).

Positive effects from conservation actions are also reported from soil and water management: "*The conditions of the soil are getting better, the soil is recovering, the ground is recovering. We don't allow it any longer that the soil is worn out, that it is washed off from the current, that means it is successful.*" (45:17, local community member). Water quality is said to be much better since cleaning campaigns collected the garbage from the riversides (34:50, SGBR staff). Again this points to a clear linkage of issues, namely water and waste, where the improvement of management of the latter may trigger improvement of the first. A lot of interviewees pointed out that, especially in terms of waste management, there are clear signs that corresponding conservation actions show positive effects: "*Yes, that works. Here we do the same work, because, well, at the beginning, the waste, we all tried to hide it, right? And we didn't like to even think about making use of it, did we? It seemed to us like something ugly, something unpleasant. And then, well, with all the programmes that were established in the reserve, such as the recollection of solid waste, well they have changed some things.*" (45:31, local community member). By now, private initiatives to support the management of solid waste can be observed on the local level: "*So we have as a result that people in the communities try to participate, starting their own cleaning campaigns, their own waste separation campaigns, with the aim to keep the place clean.*" (34:26, SGBR staff, supported by 13:40, local community member), and similarly:

"*Students as they are, 500 of them, formed 15 ecoclubs, these guys are extremely active in environmental education at schools and have their own action initiatives. This is also a product of awareness*." (40:26, SGBR staff). As it is indicated by this example, participation, and the willingness of local community members to participate in conservation actions is reported to be notably increasing. The same impression is gained from the closed question of part 2 of the closed questionnaire on changes in the intensity of support of conservation actions from local community members (see Figure G.18). More and more often local community members are turning towards the SGBR and express their wish to become involved in conservation actions (34:22, SGBR staff), and even local authorities are believed to be more aware now and act accordingly: "*It is not only students, but instead also the men do reforestation, everybody is doing sanitation until up to the authorities; something very important, the change of the attitude within authorities who now also have their own actions to the benefit of the environment, to the benefit of sustainability. It is the fact that now the public works are much more focussed on sustainability.*" (40:27, SGBR management). While these quotations sound promising for a future betterment of the waste situation in the SGBR, one interviewee assumes that there is still a long way to go before, instead of only handling the waste, its production (which is related to consumption behaviour) can be reduced as well (54:5, SGBR staff).

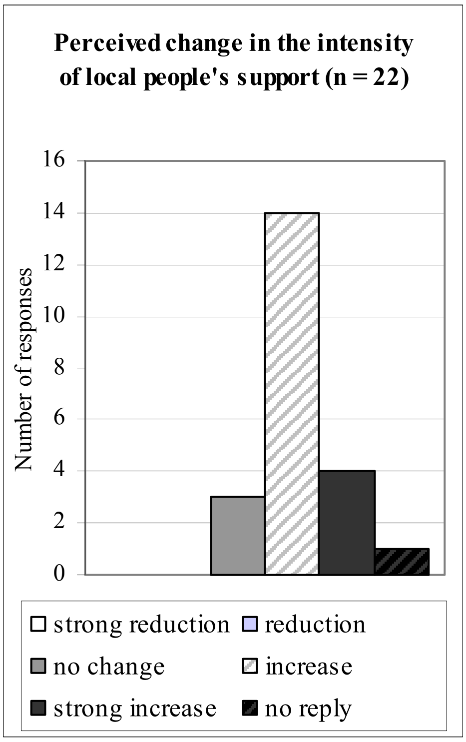


Figure G.18: SGBR – Perceived change in the intensity of local people's support

As a matter of fact the last given statements refer to indicators that are much more difficult to observe, let alone measure, because they are rather "intangible" and deal with changes in attitude and resulting behaviour. However, during the research stay in the SGBR, indications for such changes were obvious and foster the notion that the impact achieved through conservation work has turned the region into a remarkable model for long-term awareness raising. This becomes most obvious when comparing the situation

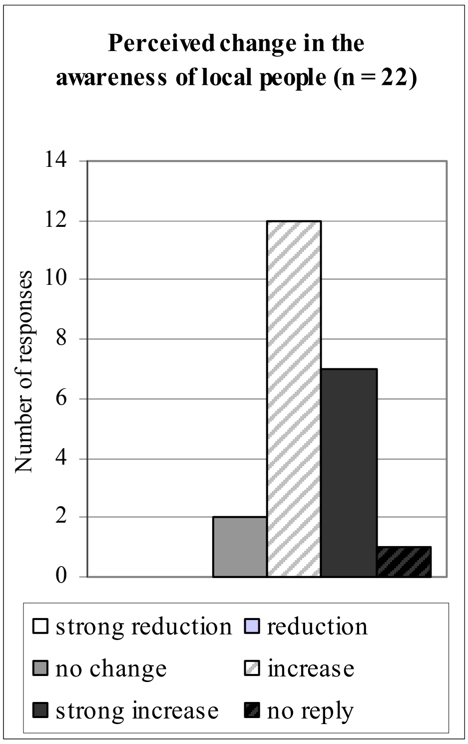


Figure G.19: SGBR – Perceived change in the awareness of local people

inside the SGBR with the situation in its surroundings, as has been done by a civil servant: "*I don't know whether you passed by San Luis Potosí, […], I mean, you are noticing that the frontier of the state of San Luis Potosí is not only a political frontier, it is also an ideological frontier, an ethnic frontier*." (38:21). A difference in environmental awareness inside and outside the SGBR is also confirmed by SGBR staff: "*[Conscience] is a little less here, in the Sierra Gorda there is an advantage because in 1990 they started with environmental education and here [in the state of San Luis Potosí] only a few years ago.*" (33:26). The results from the closed question of part 2 of the closed questionnaire again firm up these statements (see Figure G.19).

Finally, there is one more valuable indicator for what has been achieved in the Sierra Gorda Biosphere Reserve: "*Their work [the work of the Grupo Ecológico Sierra Gorda] has permeated into the surroundings of this natural protected area, and then this motivated the interest in establishing a natural protected area in the neighbouring states as well. It seems to me that this is a bit like the work has impacted on the adjacent regions*." (4:45, civil servant). As a matter of fact, after a proposal had been submitted to the governmental agency in charge by the end of 2005 (SEMARNAT *et al*., 2005), the "Sierra Gorda de Guanajuato Biosphere Reserve" was recognised as a national level biosphere reserve in February 2007 (CONANP, 2007).

The following subsection links non-open access data on the changing state of natural and social indicators to the findings of the study as presented so far.

G.2.9 Relation of detected effects of conservation actions to existing non-open access data

Although information in terms of ecological long-term monitoring data is limited for the SGBR, comparisons of gained impressions with existing data and information can be done. These comparisons are mainly based on three sources of non-open access data[52]:

1. A monitoring and evaluation document from the GEF project (Ruiz Corzo, 2005)[53];
2. A study of De la Llata Gómez *et al.* from the Querétaro Natural Resources Centre (Centro Queretano de Recursos Naturales) on changes in forest cover in the Sierra Gorda (De la Llata Gómez *et al.*, 2006); and
3. A report on a Social Return on Investment (SROI) Analysis conducted by the independent Social Venture Technology Group and published in June 2007 (Galimidi and Olsen, 2007)[54]

The three documents jointly provide a large number of measured indicators, ranging from forest cover change and fragmentation across the number of local people trained and to perceived changes in illegal activities. However, most of the indicators need to be considered as proxy-indicators as they were not originally defined to respond to the present research question.

Document 1 represents an intermediate evaluation of progress towards the objectives of the seven year GEF project. Six main outputs were agreed at the beginning and indicators defined for each of them. The six outputs are 1) Reserve management infrastructure is strengthened; 2) Policy, ecological and socioeconomic baseline assessments are undertaken; 3) Implementation of adaptive and participatory reserve management; 4) Financial sustainability of reserve management is assured; 5) Biodiversity-friendly and sustainable alternative livelihood options are developed and demonstrated; 6) An environmental awareness and public awareness campaign is undertaken. Except output number 5 these outputs mainly strengthen the conservation capacity. Output number 5,

[52] In November 2008 an article was published on land use and cover change in Mexican protected areas (Figueroa and Sánchez-Cordero, 2008) that could have been used in addition to the three documents mentioned here. However, as it was published only few days before the submission of the thesis, it is only addressed in an additional paragraph of the discussion in chapter H.
[53] This is a self-evaluation report (i.e. non-independent).
[54] "Social Return on Investment" defines the estimated amount of return an organisation gets per dollar invested. According to Galimidi and Olsen (2007) "*an SROI factor of 0.75 means that for each dollar that Sierra Gorda invested they got back 0.75 USD worth of social return.*" (Galimidi and Olsen, 2007: 10).

however, addresses the poverty challenge of the Sierra Gorda and thus aims at well-being enhancement and parallel release of pressure on natural resources. (Ruiz Corzo, 2005)

Document 2 explicitly addresses the changes in forest cover and land use by analysing remote sensing data (satellite images). It was initiated as a result of contradictory assumptions about deforestation and recovery rates within the Sierra Gorda. Land use and vegetation types were analysed and data compared between 1973 and 2004 (De la Llata Gómez *et al.*, 2006).

The Social Return on Investment (SROI) Analysis, document 3, focuses on work on environmental education and training as well as fundraising and political advocacy within the SGBR. It needs to be remarked, however, that the data feeding into this report was not gathered by the authors themselves but mainly provided by the SGBR management and staff (Galimidi and Olsen, 2007). It may thus even overlap with the information included in Ruiz Corzo (2005). Moreover, for certain aspects the report includes estimations instead of scientifically based findings and information included was therefore treated with care[55].

In the following, existing data from these three documents will be related to the identified conservation needs in Table G.9 and conservation constraints in Table G.10. In one column, the identified conservation needs/capacity constraints are listed. In another column, those proxy-indicators reflecting progress made through conservation actions addressing the needs/constraints are listed, and the available indicator values are given. The impression gained through the qualitative survey and additional closed questionnaire results is broadly indicated in a separate column. The source of the data is added in the last column, named "S", with number **1** for Ruiz Corzo (2005), number **2** for de la Llata Gómez *et al.* (2006), and number **3** for Galimidi and Olsen (2007). All indicator values given from source 1 are end 2004 values, source 2 is separately illustrated and explained in Figure G.20 and source 3 consists of information until mid 2006. One indicator is mentioned twice, once in Table G.9 relating conservation needs with existing indicators, and once in Table G.10 relating capacity constraints with existing indicators, as it can be applied equally to two different issues. The indicator is set in italic both times to mark it.

[55] Findings from the present study could consequently be considered as a backwards triangulation for the findings of the SROI Analysis of Galimidi and Olsen (2007).

Table G.9: SGBR – Relation of measured indicators to identified conservation needs

Conservation needs	Strategy	Qualitative impression	Indicator	Value	S
1. Prevention of increasing pressure on resources	Proactive avoidance and defence	positive, effort needs continuance	No indicators available		
2. Reduction of poverty and marginalisation	Well-being enhancement and pressure reduction	positive	Number of communities and beneficiaries of productive projects	2001: 203 direct beneficiaries from 46 communities End 2004: 2,166 direct beneficiaries from 92 communities	1
			Income generated by projects compatible with conservation	From 0 in 2001 to 4,330,952.23 pesos of income by the end of 2004.	1
			Number of new businesses and products developed	Between 2001 and 2006 a total of 26 new businesses and 125 new products were developed.	3
3. Transformation of unsustainable agricultural practices into sustainable ones and halt of illegal resource use	Training and responsibility transfer	positive	Percentage of people taking action in favour of the SGBR's objectives	Preliminary survey results from 33 communities, n = 335: Always: 21.8%, almost always: 16.7%, sometimes: 55.5%, never: 3.6%, n.a. 3.6%	1
			Number of people receiving some sort of environmental training	2006: 44,807 people received some sort of environmental training. This corresponds to about 49% of the population of the SGBR.	3
			Increase in ha of vegetation within a radius of 5 kilometres of the core areas	2001-04: Cañada de las Avispas: +0.9, Joya del Hielo: +2.1, Cañon de Moctezuma: +1.2, Northern core areas: +1.8, Cerro Grande and Mazatiapan: -0.4 (thousands of ha of vegetation within 5km of each core area), based on satellite images (+/- 6.2% margin of error)	1
			Number of eight hour work shifts created	2001-2006: 275,227 eight hour work shifts created	3
			Increase in the forest surface area in the zones of influence of the core areas	2001-04: "Xilitla" zone: + 5,213.6 ha, "Pinal" zone: + 3,987.6 ha, based on satellite images (+/- 6.2% margin of error)	1
			Number of ha of forest under regularised timber use	2001: 3,136.71 ha, 2004: 28,119.83 ha	1
			Increase in regularised forest area having a sustainable management programme in operation	All forest under regularised timber use has a sustainable management programme in operation.	1

Table G.9 (continued): SGBR – Relation of measured indicators to identified conservation needs

Conservation needs	Strategy	Qualitative impression	Indicator	Value	S
3. Transformation of unsustainable agricultural practices into sustainable ones and halt of illegal resource use (continued)	Training and responsibility transfer	positive	Limit of forest stable or moving away from core areas	Limits all stable except northwest part of Cañon de Moctezuma, where it moved towards the core area.	1
			Reduction in the frequency of illegal logging	Preliminary results of a survey in 33 communities, n = 335: diminished: 47.8%, constant: 26.3%, increased: 11%, n.a. 14.9%	1
			Reduction in the frequency of illegal hunting	Preliminary results of a survey in 33 communities, n = 335: diminished: 66.6%, constant: 15.2%, increased: 5.4%, n.a. 12.8%	1
			Number of cattle present in the Barranca de Paguas core area	Reduction from 272 head of cattle in 2001 to 133 head of cattle by the end of 2004.	1
			Decrease in deforestation and increase in forest recovery	See Figure G.20	2
4. Introduction of conservation culture and minimisation of transculturalisation influence	Sensitisation and backwards trans-culturalisation	positive, but influence on transcul-turalisation limited	*Regional education and awareness campaign designed and implemented*	Campaign expanded and under implementation.	1
			Number of recycling centres and tons of recycled materials collected annually	2001: 53 recycling centres, 91 tons managed; End 2004: 75 recycling centres, 185 tons delivered to the processing plant.	1
			Number of garbage collected and clean up cost prevented	2001-2006: 873 tons of garbage were collected, of which an estimated 60% would have been dumped, incurring clean-up costs of 1,000 $ per ton.	3
5. Prevention and combat of fires and plagues	Prevention and combat (as far as possible)	positive concerning fire combat, worries about plague impacts	Increase in the number of fire brigades organised and trained	30 voluntary brigades organised and trained, of which 18 are equipped, 5 other fire-fighting brigades	1
			Number of km of fire breaks managed annually to protect high-risk core areas Cañada de las Avispas and Joya del Hielo	2001: 40 km; 2004: 40 km	1

Table G.10: SGBR – Relation of measured indicators to identified capacity constraints

Capacity constraint	Strategy	Qualitative impression	Indicator	Value	S
Backlog demand in terms of research and monitoring	Strategic catch-up	Positive, yet to be improved	Number of studies carried out to establish baselines, monitor ecologic and socioeconomic conditions, and for other purposes of the project	2001: 47 studies End 2004: 83 studies	1
			Number of planning instruments implemented and operating in the SGBR and its zone of influence	2001: 9 End 2004: 17	1
			Number of community committees formed for the implementation and monitoring of actions for conservation and sustainable use of resources	2001: 128; 2004: 292	1
Remaining lack of acceptance	Trust creation and compensation	Positive, some worries remaining	Number of actions carried out and amount of public investment compatible with conservation and sustainable use, measured annually and increased by the end of the project	2001: 45 actions, $ 12,068.582 in public investment (year 2000 used as baseline); End 2004: 207 actions $ 57,740,518.35 in public investment (Note: Due to the passage of a new Public Transparency Law in 2003, more information is available for the current measurement (calendar year 2004) than was available for the measurement of the baseline.)	1
			Number of communities receiving training, or implementing or participating in actions in favour of biodiversity via the project	2001: 142; End 2004: 214	1
			Regional education and awareness campaign designed and implemented	Campaign expanded and under implementation	1

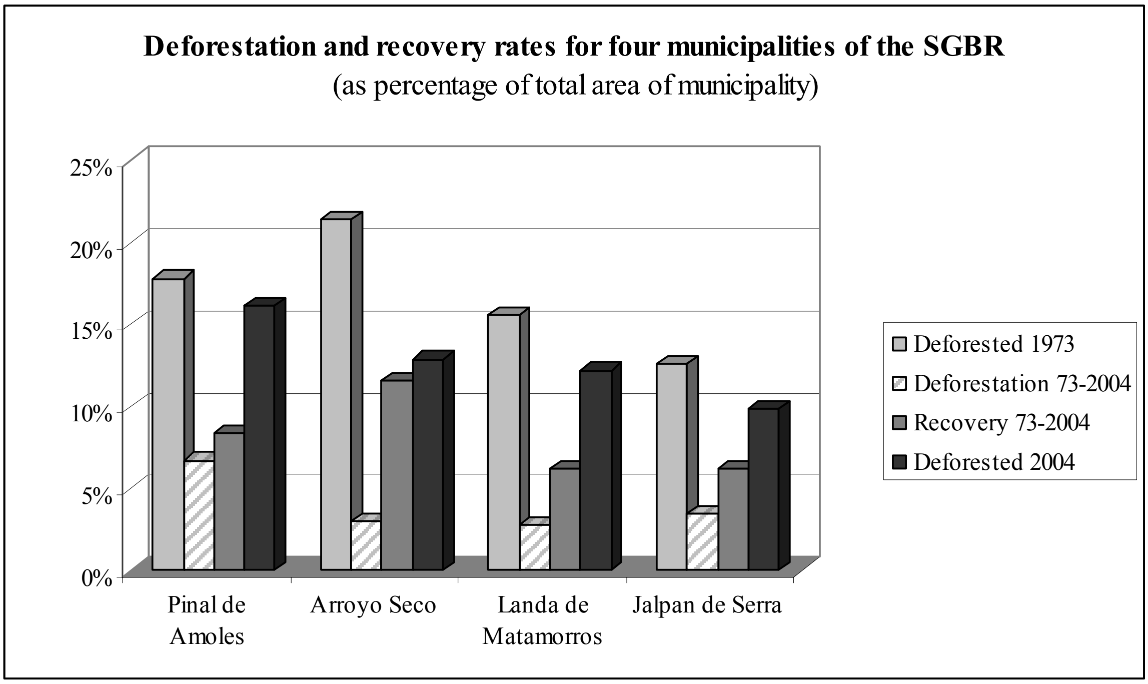


Figure G.20: Deforestation and recovery rates for four municipalities of the SGBR (data source: De la Llata Gómez *et al.*, 2006)

All existent data clearly reinforce the impressions gained from the open and closed questionnaires applied in the present study. Above this, the indicators could as well be used to measure overall progress, not only concerning the GEF project outcomes but also the management plan objectives. The Social Return on Investment report (document 3) oftentimes lacks further information on data uptake and results presented. Therefore, parts of the information could not be used. In addition, it would be interesting to know more about some of the indicators included in document 1, for example, what type of planning instruments are implemented and which of the aspired objectives or outcomes they actually support. The issue touches the metadata problem that is part of chapter E on data availability.

The following subsection summarises the findings from the SGBR case study.

G.2.10 Conservation achievements in the Sierra Gorda Biosphere Reserve

The conservation objectives of the Sierra Gorda Biosphere Reserve, as outlined in the management plan of the site (INE, 1999), are not very specific. They rather broadly emphasise the importance of maintaining and restoring degraded parts of the reserve, support biodiversity conservation and sustainable resource use, and supporting local communities and traditional culture. As such, they do not allow for an assessment of conservation success. The analysis of the interviews conducted with different stakeholder groups nevertheless painted an extended picture of the situation at site.

Conservation needs do still largely overlap with the identified conservation objectives of the management plan. A stronger emphasis was revealed from the study concerning macroeconomic external interests (above- and below-ground construction) and wildfires and plagues, the latter two representing threats that were assumed to be related to climate change by most interviewees.

Conservation capacity seems impressively high with slight constraints regarding a backlog in research and monitoring activities which roots back to the site's history and a smaller fraction of local residents still rejecting the SGBR and its objectives. Past discrepancies between responsibilities from the local and higher level institutions may potentially still be noticeable but would have needed a deeper field inquiry. The overall capacity at site received a major enhancement with the start of the GEF project. It is important to now assure that the capacity can be kept upright when the funds of the Global Environment Facility run out.

The identified needs are all addressed in a combination of **conservation actions**, with the only exception being the issue of plagues (invasive alien species). The combat of certain harmful species seems to be outstandingly complex and work force and funding lacking to adequately react. Actions to further strengthen the capacity at site or reduce constraints on capacities are likewise numerous.

Reports on **effects from conservation actions** clearly demonstrate positive impacts on biodiversity and human well-being, and considerably stressed the linkage of both issues to each other. The fact that key actors of the SGBR are able to defend the Sierra Gorda region against many decisions on above and below ground construction proves that, although political decisions under ignorance of existing protected areas can theoretically be taken, it is still possible to avoid them. Whilst most actions implemented through the SGBR can hopefully one day be reduced and become autonomous (first signals are noticeable), others will naturally remain a top priority for the management. Among them, again, are the impacts of climate change but also the human-wildlife conflicts when animal populations continue to increase. This is of specific importance as some of the core areas of the SGBR are comparably small and not entirely surrounded by buffer zones.

Although the conducted survey does not allow for a concrete evaluation of conservation success, conservation achievements are clearly visible for all of the determined objectives of the management plan. However, thanks to the large-scale Global Environment Facility (GEF) fund, since 2001 the activities in the region received another boost forward along a clear project strategy that included clear outcomes and performance indicators. These outcomes and performance indicators can be aligned with the conservation objectives of the SGBR. In parallel to the image gained from the conducted survey, they thus allow for an approximation to assessing conservation achievements. Taking into account the available non-open access information on performance indicators, the impression gained from the conducted survey is considerably stabilised. Two more information sources likewise support the results of the study. The findings will be discussed in the joint case study discussion in section H.1.

G.3 The Sierra de Manantlán Biosphere Reserve

Photo G.11: The Ayuquila River of the Sierra de Manantlán Biosphere Reserve (SMBR)

Photo G.12: Local people in an SMBR community

The Sierra de Manantlán Biosphere Reserve, besides being a member of the World Network of Biosphere Reserves, furthermore receives international recognition by being declared as an Important Bird Area (IBA) (Comisión para la Cooperación Ambiental, 1999).

G.3.1 Location and size

The Sierra de Manantlán Biosphere Reserve (SMBR) is located in the Southern part of the state of Jalisco and crosses the state boundaries into the North of Colima (~ 10% of the SMBR's total area). The region stretches between 19°26' and 19°42' Northern latitude and 104°27' and 103°51' Eastern longitude (Martínez R. and Ramírez R., 1998). Its total area is 1,395.57 square kilometres of which 419.01 are comprised by three core areas (Las Joyas, El Tigre and Cerro Grande) surrounded by 976.76 square kilometres of buffer zone (see Map G.8[56]). The transition area is not declared but activities go far beyond the actual SMBR boundaries.

[56] All maps of the Sierra de Manantlán Biosphere Reserve have been reviewed and verified by an expert of the SMBR, confirmed via Email on the 08.07.2008.

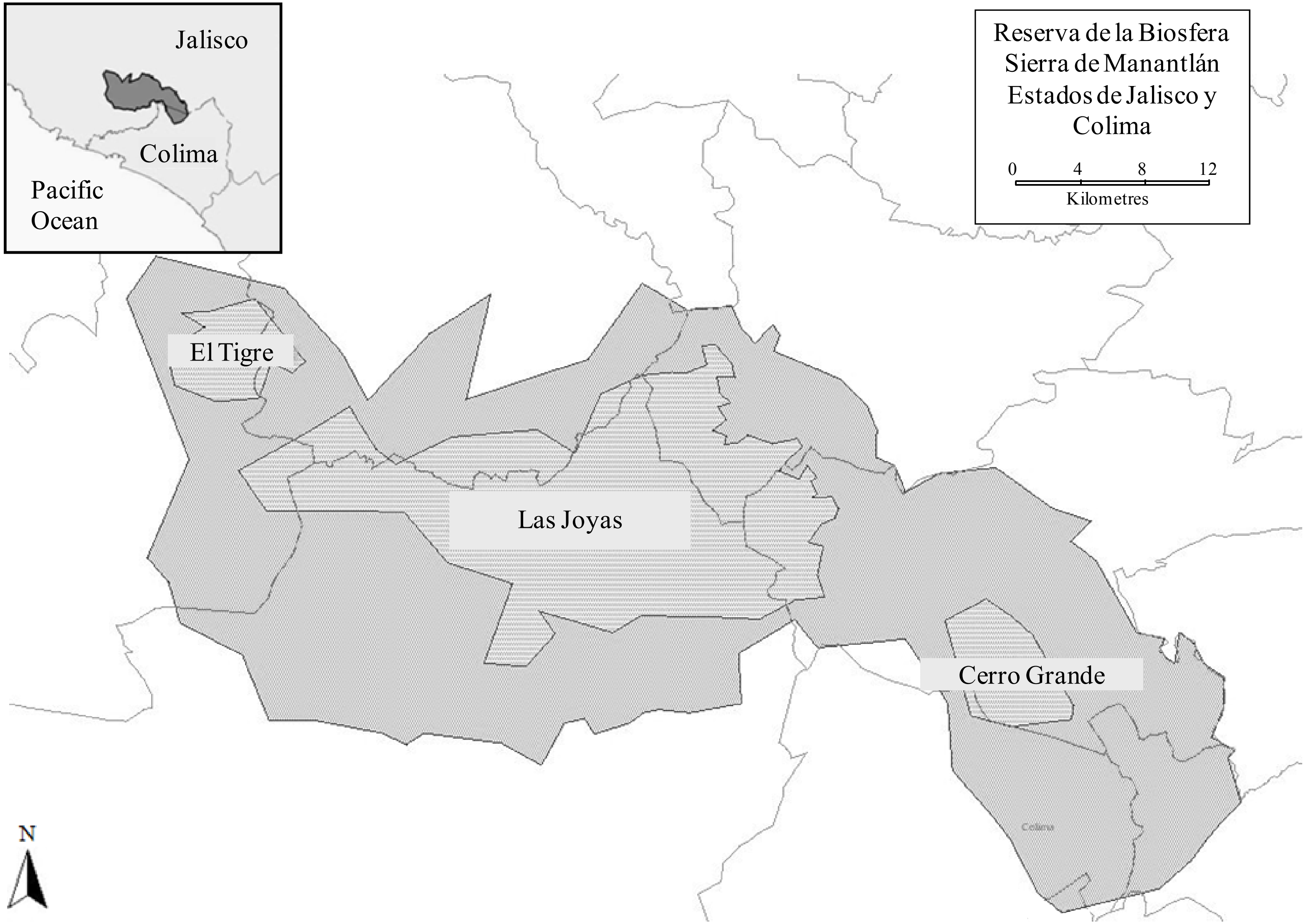
G.3.2 Administration and politics

Seven municipalities are partly located within the SMBR boundaries. Five of them belong to the state of Jalisco, namely Autlán de Navarro, Cuautitlán de García Barragán, Casimiro Castillo, Tolimán and Tuxcacuesco, two more to the state of Colima, namely Minatitlán and Comala (INE, 2000). Due to this fact, the management of the SMBR needs to be coordinated in agreement with two different state governors and, depending on the actions, with seven municipal presidents. Above this, as activities initiated by the SMBR reach far beyond the SMBR boundaries, even more coordinative work needs to be done with local authorities. A separate subsection looks at existing structures and processes of governance and management of the SMBR (see G.3.5). As no municipality is entirely located within the SMBR, it is still more difficult to gather information on demography and socio-economy of the site, because governmental statistical summaries refer to municipality levels.

G.3.3 Socio-economy

Demography

Approximately 30,000 people distributed in 31 agrarian communities inhabit the SMBR (Jardel Pelaez *et al*., 2004a). In the year 2002, a decreasing trend in population numbers of about 0.46% (for the total biosphere reserve) was provided by Gómez García (2002). An estimated 34% of the SMBR residents were unemployed in 2002 (Gómez García, 2002). This circumstance facilitates the considerable emigration movements out of the Sierra de Manantlán, especially with the intention to find a job elsewhere. (INE, 2000)



Map G.8: Location of the Sierra de Manantlán Biosphere Reserve, core areas marked and labelled (source: INE, 2000, adapted)

Economy

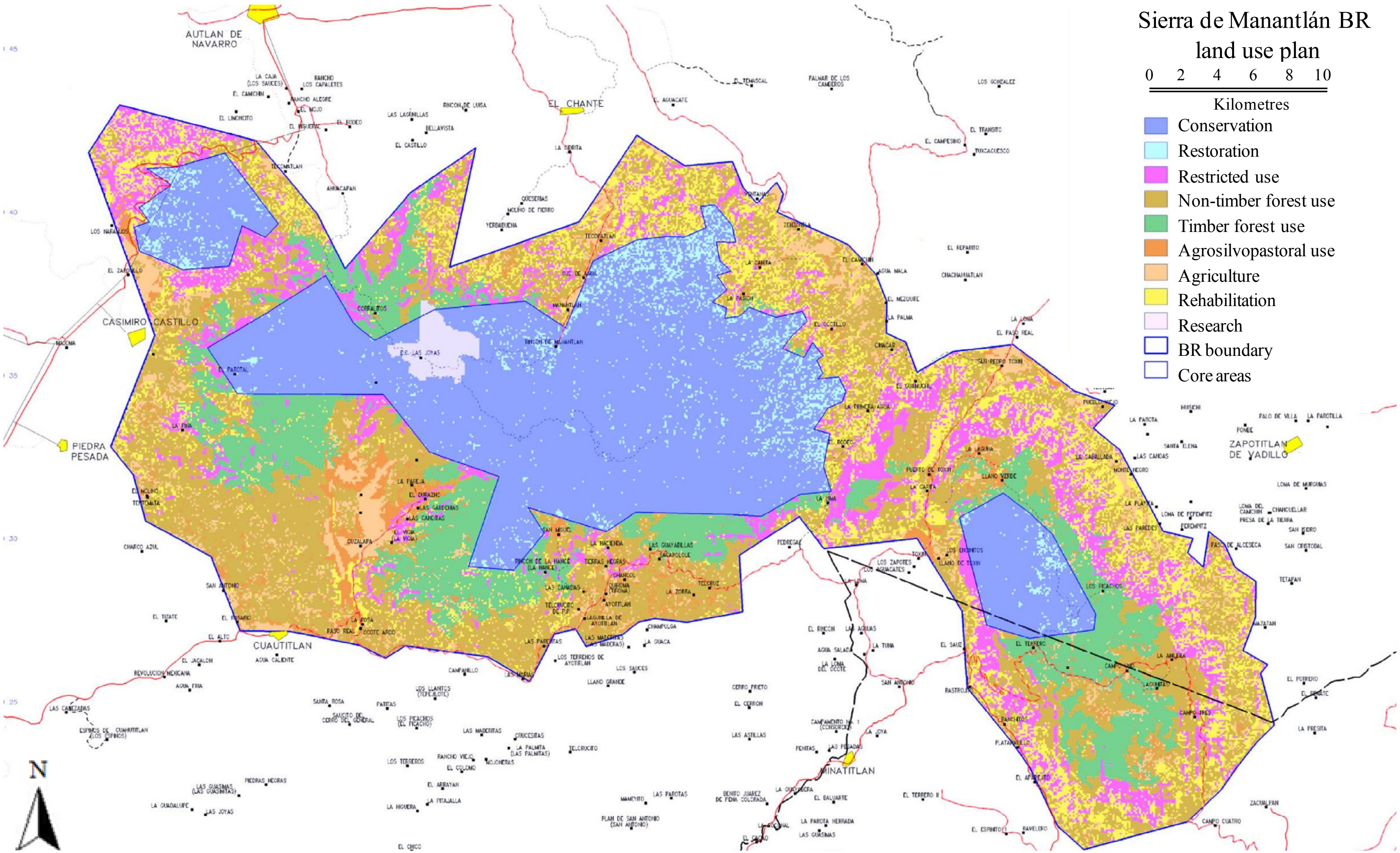
Poverty and marginalisation are high in most parts of the SMBR and growing towards the interior where many small settlements lack access to basic services, such as drinking water and electricity (INE, 2000). Inhabitants do thus strongly depend on the use of natural resources. Agriculture, mainly the cultivation of maize and beans, represents one of the main economic activities. Cattle farming has become ever more important during the last years, too, and commercial forestry is the third economic branch of significance in the SMBR. However, most of the economic activities are to a large degree for subsistence and auto consumption, and regional products hardly enter the market. Where this happens, however, their integration into productive chains is fragile. While living conditions vary across the SMBR, there is a tendency for an increase of poverty and marginalisation towards the inner parts of the biosphere reserve. (INE, 2000)

Property rights and land use system

About 70% of the SMBR territory is communal land of indigenous communities and *ejidos*[57], the remaining 30% are small private plots of (mostly) absentee owners (Jardel Pelaez *et al*., 2004a). In addition to this, the University of Guadalajara owns an area of about 12.45 square kilometres: In 1984 the government of Jalisco bought this site of real estate in the mountains of today's biosphere reserve and asked the University of Guadalajara to make use of it for conservation, education, research, and management purposes (Jardel Pelaez and Santana Castellón, 2007). This property is since 1986 called "Las Joyas Research Station" and constitutes part of one of the three core areas of the SMBR. In April 2007 the government of Jalisco announced the bestowal of the area to the University of Guadalajara, emphasising that they deserved this ownership after 23 years of fruitful research and conservation activities in Las Joyas (Álvarez, 2007).

The heterogeneous topography sets natural limits to the use of the land, for example through steep slopes, a criterion that fed into assessments of land use adequacy. According to these, about 170 square kilometres of forest within the SMBR only allow for very restricted resource use and are recommended to be considered protected forest. (INE, 2000). Map G.9 shows the land use plan of the Sierra de Manantlán Biosphere Reserve.

[57] An *ejido* owned property is a "*collectively managed social property resulting from the Mexican Revolution*" (Vidal *et al*., 2004: 71).



Map G.9: Land use plan of the Sierra de Manantlán Biosphere Reserve (source: INE, 2000, adapted)

G.3.4 Geography and ecology

Topography

The SMBR encompasses north-eastern parts of the Sierra Madre del Sur with altitudes ranging from 350 to 2,860 metres. It can be topographically divided into the extensive western part with the highest altitudes, and the eastern part, consisting of the Cerro de Enmedio and the Cerro Grande (INE, 2000). The highest point is the Cerro de las Capillas, which is considered the geographical centre of the SMBR. The terrain of the entire region is very complex, largely dissected with deep valleys and steep slopes (INE, 2000). The region plays a fundamental role as guardian of the upper portions of three watersheds which supply more than 400,000 people living in Jalisco and Colima (Jardel Pelaez *et al*., 2004a), the watersheds of the rivers Ayuquila-Armería, Marabosco and Purificación. The Ayuquila River also serves as a natural boundary of the biosphere reserve in the Northeast.

Climate

The SMBR is located in the very North of the intertropical convergence zone. The climate is influenced by various factors, such as the proximity to the Pacific Ocean and also the amplitude of the altitudinal gradient. Consequently, the mean annual temperature ranges between 16 and 22 degree Celsius in different parts of the SMBR with the exception of the Southeast, where mean annual temperatures are as high as 26 degree Celsius. A similar variability is found in precipitation patterns, supported by the rain shadow effects of the mountains, that lead to highest humidity in the southern slopes and decreasing trends towards the North (Jardel Pelaez *et al*., 2003). Maximum figures are also observed in the Southeast where a medium annual precipitation of 1,700 millimetres is reached. In contrary, in some parts in the North of the SMBR the medium annual precipitation does not exceed 600 millimetres. The rainy season is usually around four months between June and September. (INE, 2000)

Biogeography and biodiversity

Main habitat types in the Sierra de Manantlán Biosphere Reserve are deciduous tropical dry forest, semi-deciduous forest, cloud forest, different types of pine and oak forests, rivers and riparian vegetation (UNESCO-MaB, 2007a). Information on the number of vegetation types varies: According to INE (2000), 13 different vegetation types are represented, while according to Graf Montero *et al.* (2002), only nine can be distinguished. Map G.10 displays the vegetation cover of the SMBR (as of 1993).

Altitudinal range and geomorphologic complexity are responsible for the floristic and faunistic diversity of the SMBR. Figure G.21 illustrates the species numbers reported from the Sierra de Manantlán Biosphere Reserve after INE (2000).

At least ten mammal species of the SMBR or their populations are considered endangered on the national level: the nutria (*Lutra longicaudis*), margay (*Leopardus wiedii*), jaguarundi (*Herpailurus yagoaroundi* syn. *Felis yagoaroundi*), ocelot (*Leopardus pardalis*), puma (*Puma concolor*), bobcat (*Lynx rufus*), jaguar (*Panthera onca*), and shrew (*Megasorex gigas*), as well as four nectarivorous bat species (*Leptonycteris nivalis*, *L. curasoae*, *Musonycterus harrisoni* and *Choeronycteris mexicana*) (INE, 2000). Figure G.22 displays the allocation of species to threat/protection categories after INE (2000).

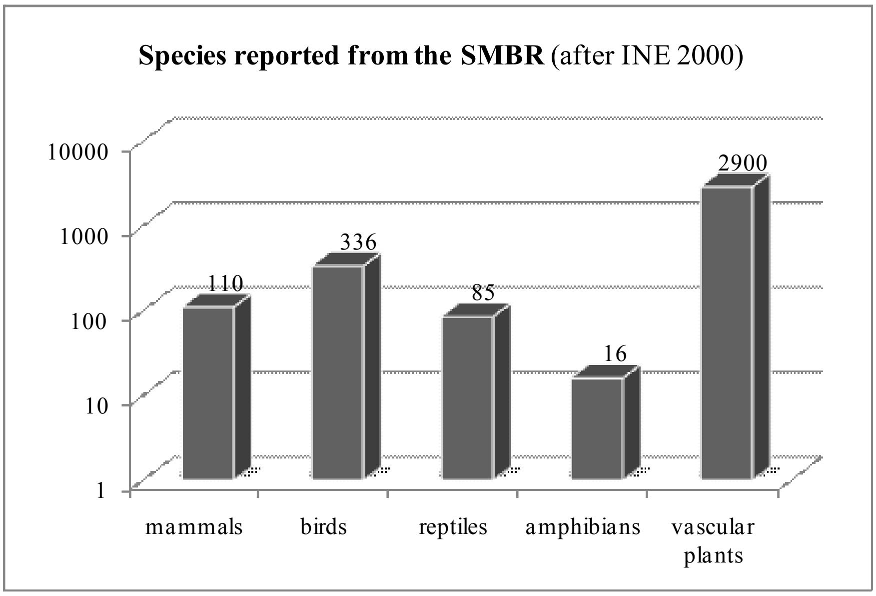
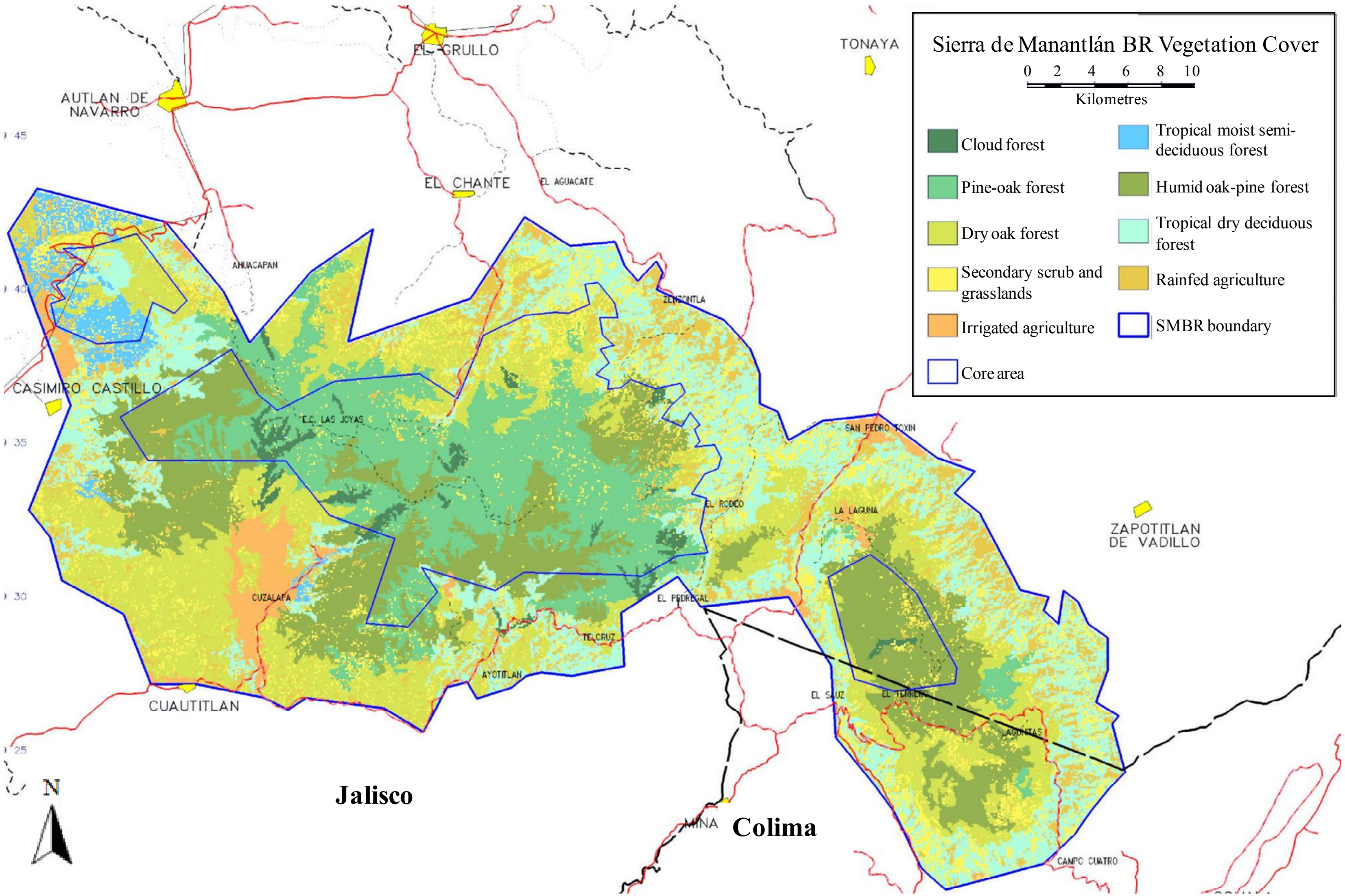


Figure G.21: Species reported from the Sierra de Manantlán Biosphere Reserve (SMBR) (data source: INE, 2000)



Map G.10: Vegetation cover of the Sierra de Manantlán Biosphere Reserve (source: INE, 2000, based on Jardel Pelaez, 1993)

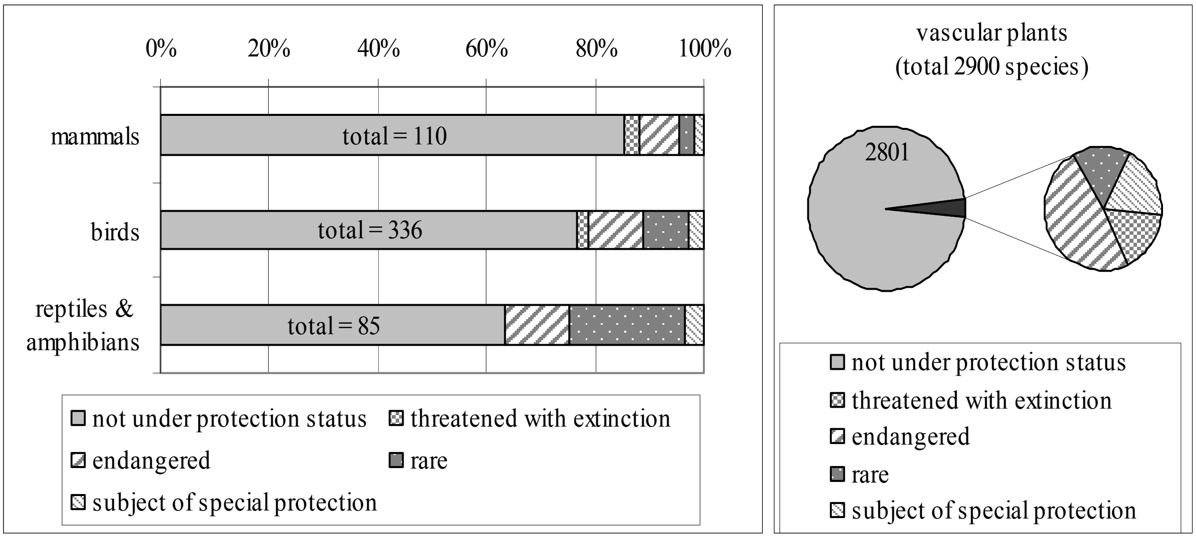


Figure G.22: Classification of species reported from the Sierra de Manantlán Biosphere Reserve in threat/protection categories (data source: INE, 2000)

G.3.5 Governance and management

The site's conservation history goes back to 1979 when researchers from the Mexican University of Guadalajara and the US University of Wisconsin Madison discovered a wild maize species named *Zea diploperennis* (Mexican common name: teocintle) in the region of today's biosphere reserve. This maize species hosts several remarkable genetic features expressed as immunity or resistance to the major diseases of commercial maize (Iltis *et al*., 1979). It is thus of very high conservation value with respect to its genetic potential. Subsequently to this discovery, the researchers from the University of Guadalajara continued studying the region. In 1985 the "Las Joyas Research Station" ("Laboratorio Natural Las Joyas") was founded as an institution of the University of Guadalajara, especially dedicated to researching the region "Las Joyas", which is one of the core areas of today's SMBR. The researchers of the Las Joyas Research Station finally achieved the declaration of the territory of the Sierra de Manantlán as a biosphere reserve, first in 1987 by federal decree, then in 1988 also internationally by the UNESCO. Today, the university department in charge of the Las Joyas Research Station is called the Manantlán Institute of Ecology and Biodiversity (Instituto Manantlán de Ecología y Biodiversidad, IMECBIO).

Having started research out of academic interest, the initial ten years of the SMBR, 1985-1995, were financially supported by the World Wildlife Fund (Cuevas Guzmán and Jardel Peláez, 2004). However, six years passed by between the establishment of the biosphere reserve and the set up of a formal management board by the CONANP in 1993 (Torres, 2007). Researchers of the IMECBIO represented the only reference institution of the SMBR within these years. However, it needs to be stressed that the staff from IMECBIO is supporting the biosphere reserve in parallel to their daily jobs as professors of the Centro Universitario Costa del Sur (CUCSUR), a branch of the University of Guadalajara. To additionally address a series of regional activities (not necessarily restricted to the SMBR territory) the local Fundación Manantlán para la Biodiversidad de Occidente A.C. (MABIO A.C.) was founded by the beginning of the year 2000. During its first years of existence it received financial backup from the Fondo Mexicano Para la Conservación de la Naturaleza (FMCN), the National Fish and Wildlife Foundation (NFWF), the World Wildlife Fund (WWF), Conservation International (CI) and The Nature Conservancy (TNC), then was supposed to become one of the administrators of the Global Environment Facilities (GEF) funds (Jardel Pelaez *et al*., 2004b).

The directorship of the SMBR and IMECBIO cooperated closely in the implementation of a community development and natural resource management programme. Four main objectives were determined (after INE, 2000):

- Implementation of a social development model based on sustainable natural resource use compatible with ecological conservation;
- Promotion of organisational processes, based on democratic and participatory principles in order to achieve sustainable resource use, the reduction of poverty and social inequality, and the improvement of living standards;
- Development of a regional land-use planning model for sustainability; and
- Promotion of education as well as communication processes between inhabitants, producers, civil servants, practitioners and scientists that permit the acknowledgement, valorisation, appropriation and application of both local empirical and scientific knowledge to achieve sustainable regional development.

As part of this programme capacity building activities are organised with local communities, options of alternative income generation are developed, payments for environmental services have been facilitated, environmental education programmes were implemented, and numerous other initiatives have been installed.

While the directorship, the main management body, is occupied by CONANP as a governmental agency, a strong emphasis is placed upon local people's participation in decision-making processes. In order to facilitate this, the head office of the SMBR established so-called "technical advisory councils" (in Spanish "*consejos asesores*") in 1997, one for Jalisco and one for Colima, in which communities, social organisations, and local academic institutions are represented (Graf Montero *et al.*, 2001). The technical advisory council" is in place to create "*institutional spaces for the participation and representation of agrarian communities, municipalities, social organisations, state representatives, and the two state universities of Jalisco and Colima*" (Jardel Pelaez *et al.*, 2004a: 217). In 2004 the advisory councils included a total of 22 of the 28 *ejidos*, three indigenous communities, three indigenous social organisations, eight municipalities, two universities, two NGOs, a representative of each of the two state governments and a representative of the federal government (Graf Montero and Santana Castellón, 2004). The impact of the advisory council on the biosphere reserve management has been investigated in detail in Thueler (2005) and Graf Montero *et al.* (2003). Repeatedly, the advisory councils of the SMBR served as a model for successful involvement of local communities in biosphere reserve management (Blauert *et al.*, 2006; Díaz Ávila *et al.*, 2005).

G.3.6 Management objectives

The objectives of the SMBR according to its management plan are subdivided into conservation objectives, development objectives, and research and education objectives, as displayed in Box G.4[58]. As it was the case in the previously described case study, all of the determined management objectives of the SMBR do directly or indirectly aim at an overall improvement of the conservation status of biodiversity within the SMBR.

[58] It has been tried to translate the objectives as close to the original Spanish wording as possible.

Box G.4: Objectives of the Sierra de Manantlán Biosphere Reserve (after INE, 2000)

1. Conservation

- To contribute to the maintenance of essential ecological processes for the functioning of ecosystems, the production of natural resources, and the generation of environmental services on which society depends.
- To contribute to the maintenance of biodiversity (species, genes and ecosystems) from the occident of Mexico and protect endemics, species endangered, threatened with extinction, vulnerable, rare or in need of special protection.
- To facilitate recovery, restoration or rehabilitation of areas degraded by inadequate management practices.
- To promote recognition and protection of values of cultural, archaeological and historical heritage.
- To maintain and promote natural resource use forms that are adapted to the site's ecological and social conditions and contribute to the conservation of biodiversity and ecological processes.
- To protect landscapes and scenic values.
- To generate conscience about environmental problems and appreciation of natural values, and promote a change in values and attitudes of social actors to the benefit of the conservation of natural and cultural heritage.

2. Social development

- To orchestrate a strategy of social development that is based on the sustainable use of natural resources compatible with ecological conservation.
- To promote a process of organisation of the inhabitants of the reserve based on democratic and participative principles, to achieve sustainable use of natural resources contributing to improve the quality of life and reduce inequality and poverty.
- To develop an ecological arrangement model for the productive activities and the land tenure situation with a perspective of regional development oriented on sustainability.
- To promote a process of education, communication and exchange between inhabitants, producers, functionaries, technicians, and scientists, that allows for the recognition, valuing, appropriation, and application of empiric, as well as scientific knowledge for the sustainable management of natural resources.
- To support the initiatives of indigenous communities of the reserve for the retrieval of the cultural heritage and the strengthening of its identity, as well as types of social organisation.

3. Scientific research and education

- To generate scientific knowledge about the structure, functioning and dynamics of ecosystems and social systems and their interactions.
- To offer conditions for scientific research and monitoring of environmental conditions and ecological and social processes as part of the World Network of Biosphere Reserves and the National System of Protected Areas (SINAP)
- To generate models for the management of natural resources and explore in a participative manner appropriate and adaptable technology for social development and conservation.
- To offer conditions for the formation of human resources in the field of ecology, sustainable management of natural resources and social development that strengthens the capacity of actors involved in the management of the reserve.

The objectives listed in Box G.4 can be reorganised to reveal a strategic approach for the implementation of the SMBR, as is displayed in Figure G.23. One field of action has been added to the figure by grouping some of the issues from bullet points in Box G.4: actions to foster the **reconciliation** of conservation and social development. By doing so, the strategy for implementation of the biosphere reserve concept becomes more apparent. Scientific research is done on conservation as well as social development issues and research results can feed into management decision-making. Compared to the SGBR, much more room is here given to scientific research, while there is no large-scale project in place to strengthen overall capacity, as was the case in the SGBR. This emphasis on scientific research clearly stems from the history of the site's development. This has a considerable impact on the availability of information, as introduced in the following subsection and again discussed in section H.1.

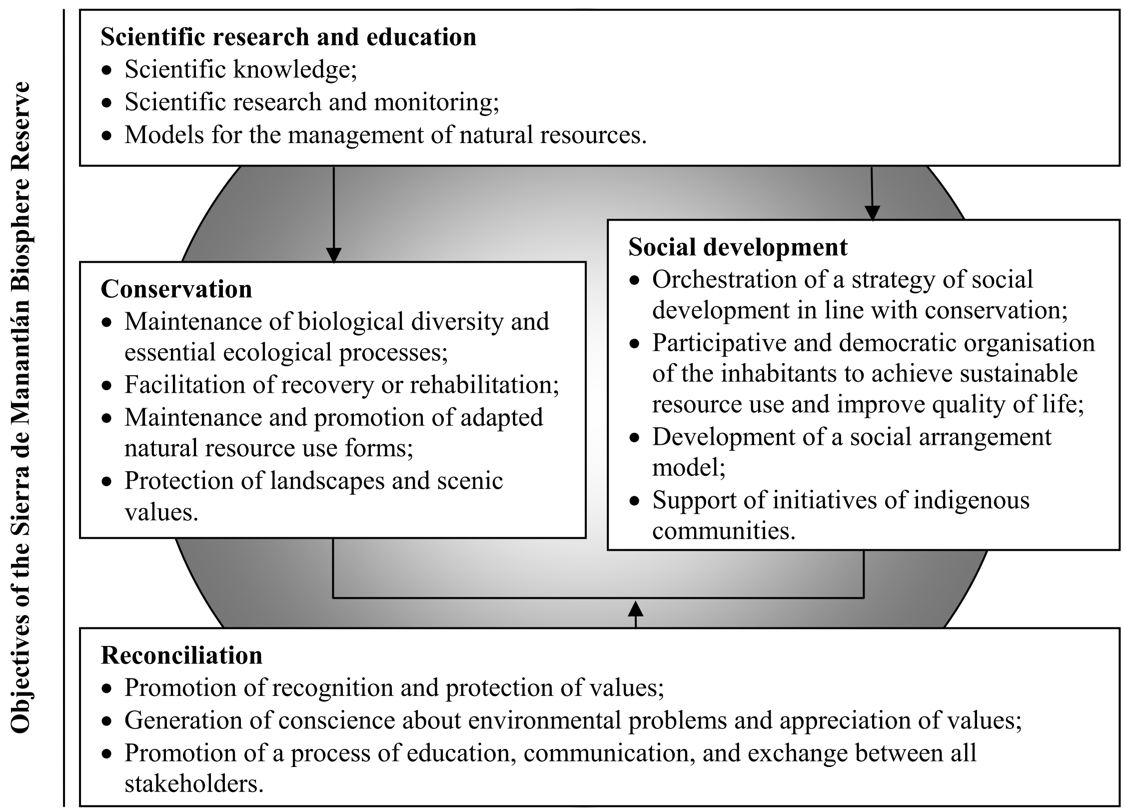


Figure G.23: Strategic approach to implementation of the Sierra de Manantlán Biosphere Reserve according to the site's management objectives

G.3.7 Current availability of biodiversity data

Due to its close linkage to an academic institution, much research has been conducted in the Sierra de Manantlán Biosphere Reserve. Until 2004, more than 100 articles including results of research within the SMBR, mainly the region of the Las Joyas Research Station, were published (Santana Castellón and Jardel Peláez, 2004). Though not all of this is easily accessible (due to subscriptions needed to download scientific journal articles) a lot of information can be compiled for the SMBR.

Still, even after 30 years of research, there are new species found and described, for example, *Aristolochia manantlanensis* (Santana-Michel, 2007) and *Wilsonia citrina* (Contreras-Martínez *et al*., 2006). Obviously, emphasis is placed upon the scientifically correct description of every new discovery in species and it is considered important to always publish these results as to be seen in numerous examples, for example in Balcazar-Lara (2000), Guzman (1999), or Rodríguez and Ortiz Catedral (2006). Much research has also been realised on water resource management due to the importance of the Ayuquila River for water provision for several hundred thousand people in Jalisco and Colima, examples of which are Gerritsen *et al.* (2005), Graf Montero *et al.* (2006) and Martínez Riviera *et al.* (2000). Restoration activities, again especially within the region of the Las Joyas Research Station, are well documented and monitored (e.g. Jardel Pelaez, 2008). Fire management has obviously been another of the main activities in the region, as indicated by numerous publications, for example Jardel Pelaez *et al.* (2003; 2006). Regularly, the biosphere reserve contributes with articles to the magazine of the University of Guadalajara, the issues of which can be accessed online[59].

The Sierra de Manantlán Biosphere Reserve is member of the International Network of Long-Term Ecological Research (LTER), respectively the Mexican Network of Long-Term Ecological Research, and through this provides some further information on the corresponding internet presence[60]. The SMBR also contributes to the National System of Information, Monitoring and Evaluation for Conservation (CONANP, 2006b) and to the National Programme for Monitoring of Birds in Federal Protected Areas. In addition, the Sierra de Manantlán Biosphere Reserve, just like the Sierra Gorda Biosphere Reserve, is listed on the Network of Terrestrial Ecosystem Monitoring Sites (TEMS). However, at

[59] According to information received by email from the editorial staff, the SMBR published six articles in the University magazine since 1996.
[60] See http://www.mexlter.org.mx.

site there was a clear lack of awareness of this membership and the corresponding website does not provide further monitoring data.

G.3.8 Case study results: Application of the Conservation Success Framework to the Sierra de Manantlán Biosphere Reserve

All insights presented in the following result from the conducted interviews as well as personal passive and active observation and, where available, additional information from literature and maintained contact with the interviewees from research sites. Table G.11 lists the interviews that were conducted in or on the SMBR according to different interview groups. The allocations of interviewees to interview groups are clarified in the second column. As it was assured to treat the information from interviews anonymously, the table is not further subdivided and there are no names of interviewees given throughout this document. Instead, for scientific correctness, quotations are always given including the interview and the quotation number in brackets. The triangulation diagram of Figure G.24 shows the various perspectives that are included in the overall picture of the site's situation to assure a high validity of the data.

Table G.11: Interviews conducted in the Sierra de Manantlán Biosphere Reserve (SMBR)

Group	Affiliation	Number of interviews
Management	Directorship, IMECBIO, CUCSUR, MABIO	3
Staff	Directorship, IMECBIO, CUCSUR,	5
Local people		16
Civil servants	CONANP	5
	Total	29

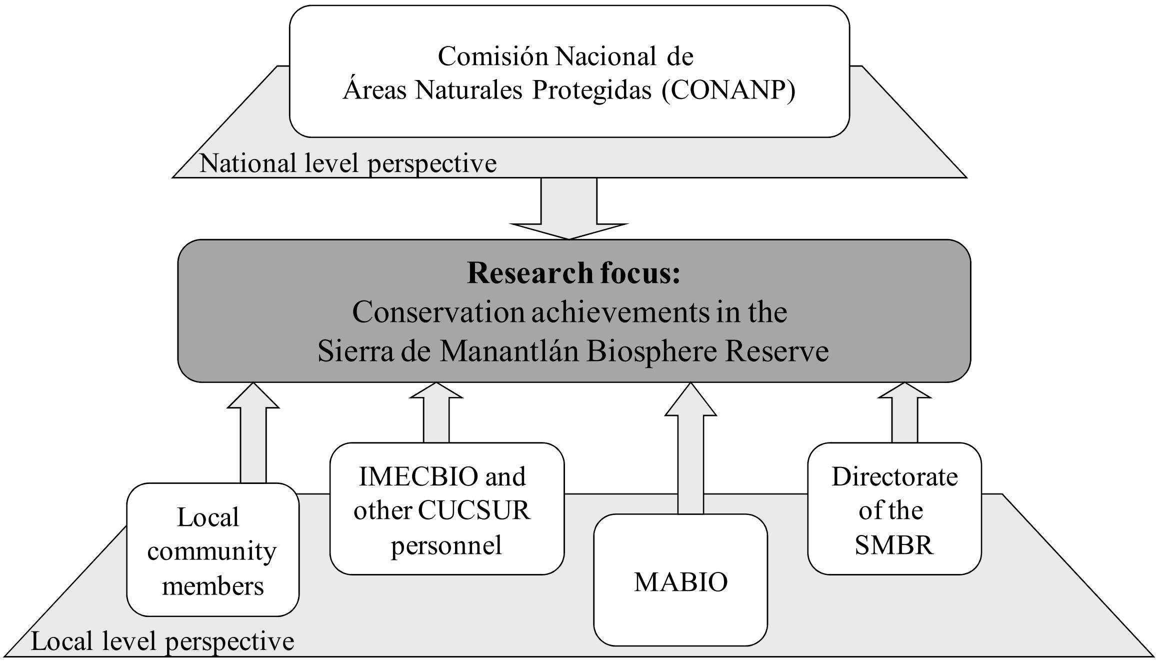
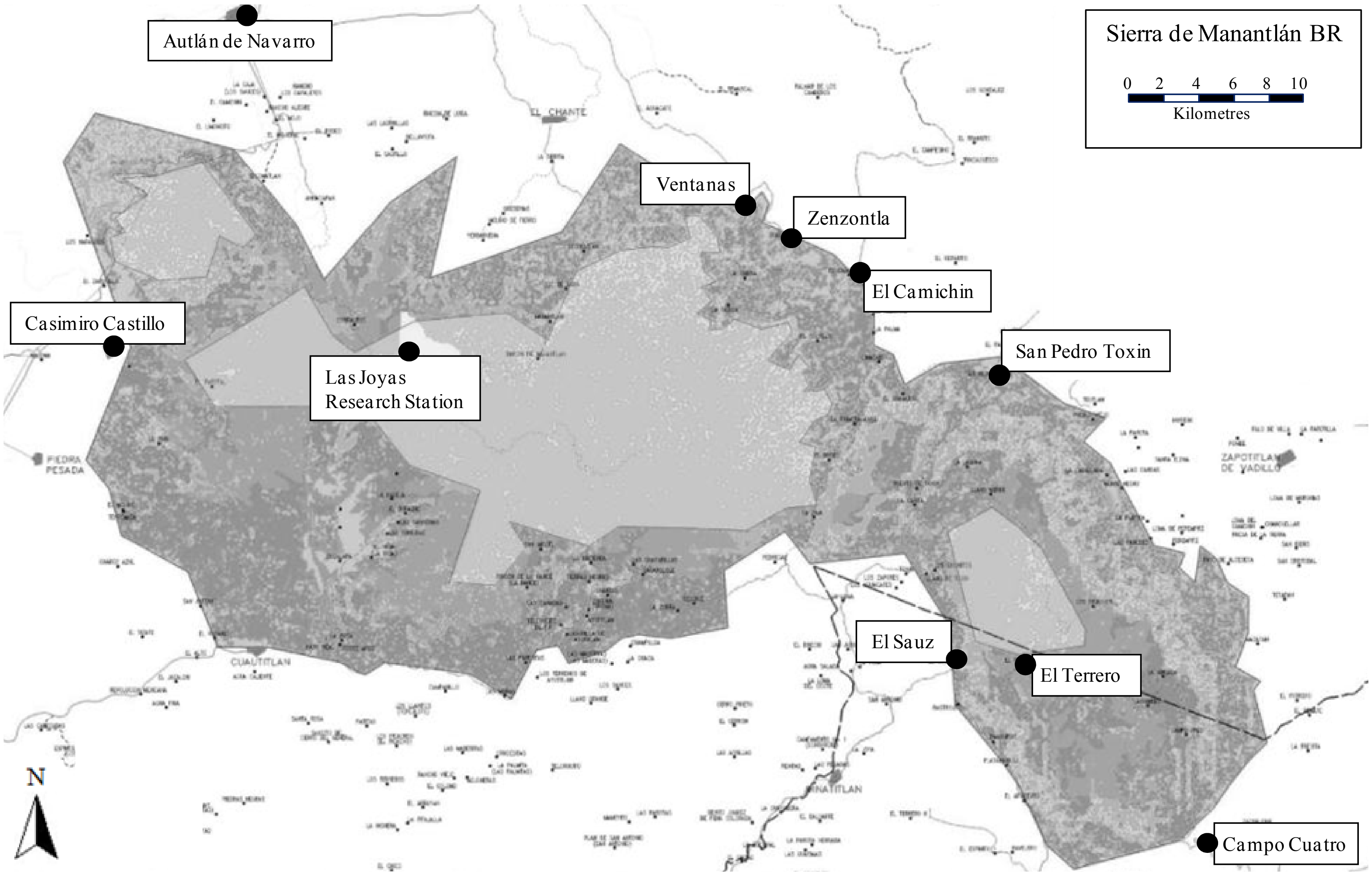


Figure G.24: Triangulation diagram of the qualitative survey in the Sierra de Manantlán Biosphere Reserve (SMBR)

Within the biosphere reserve and in its area of influence[61] the following sites were visited during the research stay: Autlán, Casimiro Castillo, Unión de Tula, El Grullo, Ventanas, Zenzontla, Camichin, San Pedro Toxín, El Terrero, Campo Cuatro, El Sauz, several sites along the Ayuquila River, and the research station "Las Joyas" in one of the core areas (see Map G.11[62]).

[61] "Area of influence" here refers to the area outside the defined buffer area. Usually, this would be the tranistion area in the biosphere reserve concept. However, a tranistion area is not officially declared around the SMBR and therefore the term "area of influence" is used.
[62] El Grullo and Unión de Tula are located further north from Autlán de Navarro and are thus not included in the map.



Map G.11: Visited places in the Sierra de Manantlán Biosphere Reserve (source: IMECBIO, adapted)

In the following, results will be presented alongside the following scheme presented in table format:

Subsection	Focus question / issue
Conservation needs (Driving forces, Pressures, States, Impacts)	What are the most pressing conservation needs requiring action (alongside the predetermined conservation objectives of the site)?
Conservation capacity	How does the site do in terms of conservation capacity and what are limitations to this capacity?
Conservation actions (Responses)	What conservation actions are implemented to address the identified conservation needs and, if applicable, conservation capacity?
Relation of results with existing data	What are visible and/or measured effects demonstrating the adequacy and effectiveness of the conservation actions in place?
Conservation achievements in the Sierra de Manantlán Biosphere Reserve	Summary of insights into conservation achievements at site (see subsection G.3.10)

As the result section of the Sierra Gorda Biosphere Reserve preceded the results of the Sierra de Manantlán Biosphere Reserve it is now possible to highlight obvious similarities and differences. Whenever it is regarded necessary to do so, those will be mentioned. A detailed discussion of the two sites with regards to information gaps and bridging options is provided in section H.1. Recommendations that can be synthesised from the findings of the survey in the Sierra de Manantlán are presented in subsection H.1.3.

Conservation needs

The management objectives included in the management plan (see Box G.4) are put in a rather general wording and point at conservation needs ranging from species and ecosystem processes protection to awareness raising and a shift towards more sustainable resource use methods. In the following, it is therefore tried to identify more specific conservation needs as derived from the results of the conducted survey. In order to do so **part 1 of the closed questionnaire** as well as the here relevant **replies to the open questionnaire** were analysed and related.

Only eight participants of the survey in the SMBR filled in the **closed questionnaire**, because the questionnaire could only be filled in by experienced SMBR experts (manager, staff and NGO) and only eight interviewees felt they could fill it in. It is therefore important to remark that it is not strived for representativeness (see subsection B.4.4 for more detail). However, the results of part 1 of the closed questionnaire serve as an orientation for the order of conservation needs referred to in this subsection.

The codes from ATLAS.ti analyses that are regarded to specify and verify the conservation needs from the **open questionnaire** are “driving forces”, “pressures”, “states: geo-ecological”, “states: socio-economic”, and “impact”, as well as the codes within the code group “conservation needs/threats” (see Annex III). Identified driving forces from open questions are allocated to the categories **demographic**, **economic**, **technological, policy and institutional** and **cultural** (socio-political)[63] (see Table F.3). The relations of driving forces, pressures, states and impacts are taken into account. Wherever possible, threats will not only be explained as causal chains but instead through causal networks. It is not intended to follow the above given order of driving force categories within the text but instead the threat situation will be described in a logical text flow which may demand for a shifted order or repeated mentioning of categories.

Table G.12 presents the results from the threat ranking that was done in **part 1 of the closed questionnaire**. Only the first 20 threats are shown and highly ranked threats will be discussed and related to the results from the open questionnaire. The full table including the threat ranking for all 38 threats is attached to this document in Annex IX.

Table G.12: SMBR – Results from the threat ranking in part 1 of the closed questionnaire, top 20 (n = 8)

Threat	Normalised value	Valid replies	Threat group according to IUCN-CMP (2006b)
grazing and ranching	1.00	7	resource harvesting
altered fire regimes	0.88	8	habitat conversion and degradation
solid waste (garbage, flotsam, jetsam)	0.88	8	pollution
altered hydrologic regimes	0.80	8	habitat conversion and degradation
mining	0.80	8	energy and mining
roads and railroads	0.77	8	transportation infrastructure
hunting, trapping, fishing	0.77	8	resource harvesting
logging	0.77	8	resource harvesting
agriculture and plantations	0.73	8	habitat conversion and degradation
recreation areas	0.73	8	habitat conversion and degradation

[63] This is not done for the results from the closed questionnaire as it deals with threats without further distinguishing driving forces, pressures, states and impacts.

Table G.12 (continued): SMBR – Results from the threat ranking in part 1 of the closed questionnaire, top 20 (n = 8)

Threat	Normalised value	Valid replies	Threat group according to IUCN-CMP (2006b)
commercial and industrial development	0.66	8	habitat conversion and degradation
natural system modification	0.66	8	habitat conversion and degradation
utility lines	0.66	8	transportation infrastructure
habitat shifting and alteration	0.66	8	climate change
climate variability	0.66	8	climate change
motor-powered recreation and work	0.63	7	recreation/work in natural habitats
housing and urban development	0.62	8	habitat conversion and degradation
industrial waste and residual materials	0.62	8	pollution
greenhouse gases	0.62	8	pollution
introduced genetic material	0.62	8	invasive and other critical species

For the Sierra de Manantlán Biosphere Reserve **grazing and ranching** is ranked as the highest threat by far according to Table G.12. A combination of driving forces leads to the expansion of grazing and ranching land: Cattle farming is one of the most widely established traditional ways to earn a living in the marginalised regions of Mexico (economic driving force) and the number of cattle represents the social status of their owner (cultural driving force) (23:37, SMBR staff). Grazing and ranching is repeatedly mentioned in the context of land use change as a pressing need for action by SMBR staff (46:26, 17:21, 36:28), management (48:21, 48:37) and also a civil servant (55:35). The expansion of grazing and ranching activities in terms of habitat transformation, however, is stated not to be equally distributed throughout the SMBR: "*And the other pressure occurring in the southern part of the reserve is the change towards agriculture and cattle farming.*" (48:37, SMBR management). From the interviews it was clear, that grazing and ranching and also other types of land use changes are intertwined with **altered fire regimes** (ranked second in Table G.12) as a threat to achieving conservation objectives. Parts of the reserve are currently recovering from past deforestation: "*Backwards there was no control of the reserve and lots were deforested.*" (15:2, local community member). However, habitat transformation for grazing, ranching and agricultural practices usually involves human caused fires, and sufficient care of the fires to avoid damage beyond the own property often seems to be lacking: "*Others [talking about threats] are the forest fires as a consequence, the fact that some people do not pay attention to extinguishing the fires*." (15:22, local community member). Where agricultural activities in *ejidos* are little organised or controlled by *ejido* members themselves, an unnecessary damage of forest from burning for agriculture is reported (8:4, SMBR staff, 27:22 and 27:23, local community members). In fact, during the research stay, it was observed that even for cleaning the road side, the there growing vegetation is set to light but then left alone. As it may become extremely hot and dry in the SMBR region, such little fires may easily cause serious damage. During the interviews, the pressure from potential fires was mentioned numerous times and by all different interview groups (e.g. 9:54, SMBR management, 16:14, 17:20, 23:30, 36:23, SMBR staff, 35:44, civil servant).

The problem with altered fire regimes can be related to **general unconcern** as a cultural driving force but may be amplified by climate change[64] consequences as well (15:21 and 15:22, local community member). These consequences are reflected in **altered hydrologic regimes** (pressure) and have been mentioned, for example, in terms of prolonged dry seasons and changed rain patterns (states): "*Before, there were quite clear rainy seasons. […] And now with agriculture it is difficult. […] Now there is more rain but it remains in one or two months, therefore there is a complete disorder.*" (15:19, local community member). The statement is confirmed by another resident (14:18) and also SMBR staff (23:24). The transformed rain pattern results in a lack of water in other periods of the year and was several times mentioned together with an observed increase in temperature (15:21, 25:7, 37:36, local community members, 18:10, SMBR staff, 55:63, civil servant). It was even reported that climate change is made a discussion point in public assemblies by residents themselves (23:24, SMBR staff).

Table G.12 well reflects the perceived importance of altered fire and hydrologic regimes, while the two threats grouped under climate change (namely "habitat shifting and alteration" and "climate variability") follow some ranks behind. Still, the alteration of these regimes is obviously believed to be related to climate change, or at least amplified through global climatic changes. A local community member added up that "*In the ejido many people do not know how to conserve the water.*" (27:5), and thus further underlines the need for action on the issue of water management.

[64] According to the selected system for classification of driving forces (see section F.3), climate change is a pressure that derives from the driving forces population growth, economic growth and technological advances. These three are therefore included in Figure G.25.

Figure G.25 shows the cause and effect network for grazing and ranching, as well as altered fire and hydrologic regimes, and climate change. As interviewees did not talk about impacts of the described pressures and states, Figure G.25 gives "potential impacts" as logical consequences of the identified driving forces, pressures and states.

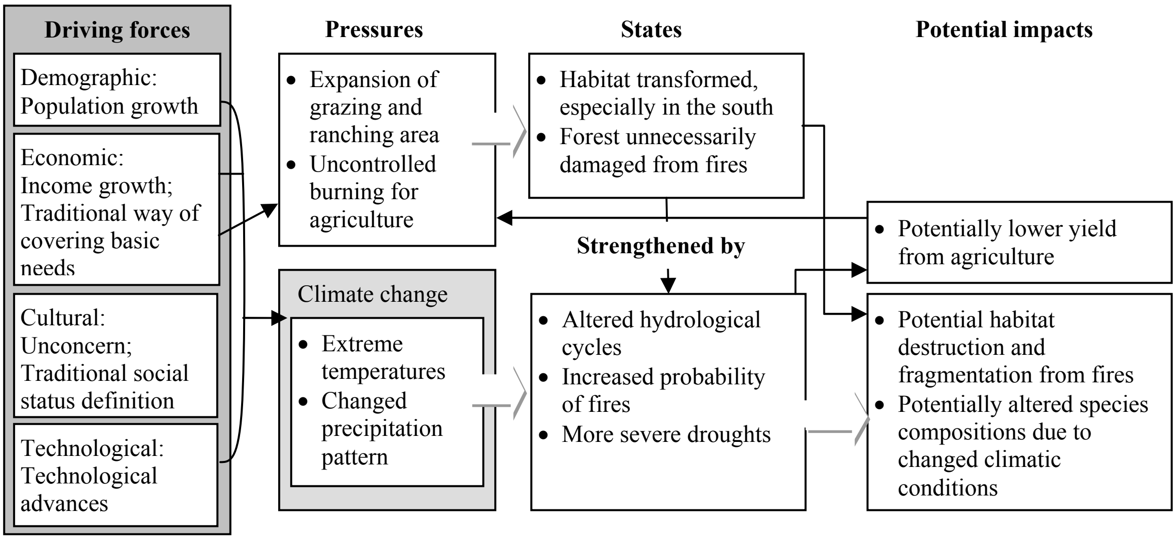


Figure G.25: SMBR – Cause and effect network for grazing and ranching, altered fire and hydrologic regimes, and climate change

Solid waste ranks second together with altered fire regimes in Table G.12. One SMBR staff describes the problem as follows: "*Waste is still a big problem. The market sells so much throwaway packing; people do not know what to do with all this*." (2:7, SMBR staff). The argument points towards different driving forces: At first, market products change according to local consumer demands (cultural driving force), but are influenced by higher level economic market dynamics as well (economic driving force) (Regmi and Gehlhar, 2005). But changing demands for goods and services require for changing infrastructure to deal with the oddments of the new market products (technological driving force). The statement therefore also questions the existence of the necessary infrastructure to deal with the amounts of solid waste accumulating in the region. Moreover, the problem is stated to be reinforced by passersby and tourists dropping waste alongside the roads (12:14, local community members), which again links to the cultural driving force of general unconcern, but goes here beyond the boundaries of the SMBR. The problem of tourists causing pollution through solid waste may also serve as an explanation for recreation areas appearing as a threat among the top 20 in Table G.12.

Pupils from one of the schools where environmental education is offered complain that many times it is difficult to convince others not to drop waste, as they think "*if others do, why shouldn't I?*" (11:14, local community members).

The pollution problem in the SMBR, however, is not restricted to solid waste. Being such an important watershed the water quality and quantity of the main rivers crossing the Sierra de Manantlán is crucial. Solid waste in terms of flotsam is one problem but the other one which was repeatedly mentioned refers to "*contamination of the river by factories*" (48:20, SMBR management, supported by 23:25, SMBR staff, 7:7 and 20:6, local community members). This threat roots back to a technological driving force on the one hand (damage due to poor/lack of disposal facilities) and a policy/institutional driving force on the other (lack of law on uncontrolled/illegal waste disposal into water) (pers. comm. 27.05.2008[65]). Even during the research stay, while visiting several communities along the Ayuquila River, local people asked SMBR staff for the reason for the recent discovery of larger numbers of dead fish in the water, as they feared industrial pollution again. The pollution of the river does not only impact on the river fauna and flora but also increases the dependency of local people on non-river resources (20:4, local community member). It was therefore expected to find industrial pollution on a higher rank in Table G.12. Figure G.26 shows the causal network for different types of pollution in the SMBR. Again, interviewees only seldom talked about impacts of the described driving forces, pressures and states. This is indicated through the word "potential" in Figure G.26.

[65] The expert consulted in this regard stated that it was not possible to stop the waste water disposal through pollution data from the river water because no respective law does exist but instead it was necessary to prove an air pollution level above determined standards.

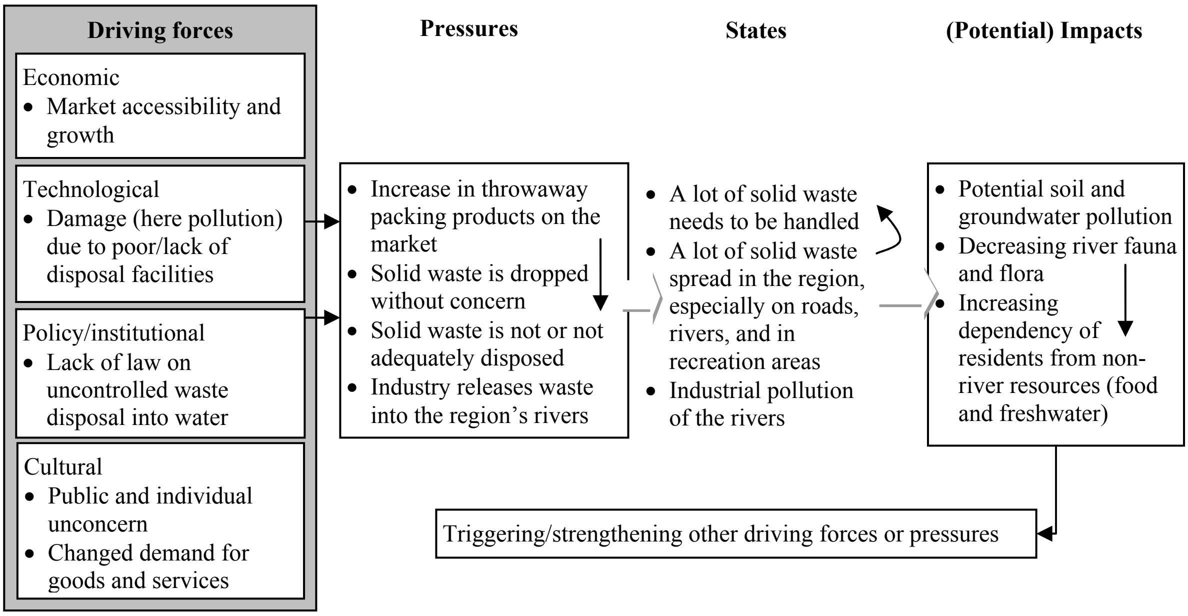


Figure G.26: SMBR – Cause and effect network for pollution

Mining ranks much higher for the SMBR than it was the case in the SGBR (compare Table G.5 and Table G.12). This is for good reason as explained by an interviewee from the SMBR management group: "*The whole biosphere reserve is franchised for exploitation, exploitation in the sense of mining. Now there are no mining activities within the reserve, but there is a very strong potential and there is also pressure to broaden the mining activities in the periphery of the reserve.*" (48:31, supported by 9:18, both SMBR management). Especially the mining company Peña Colorada shows continuing interest in accessing the region, although their plans are opposed by local community members (Torres, 2007). A combination of driving forces founds the suspected pressure from mining activities: The aforementioned **lack of congruence in the Mexican law** (policy/institutional driving forces, see results for the SGBR) applies as a crucial driver in the SMBR as well, but occurs here together with the corresponding land use rights in terms of already existing concessions for mining (also policy/institutional driving force) and allows for politicians to decide in favour of economy and disregarding the site's status as a protected area (4:50, civil servant). **Price value increases**, for example, on the global market (economic driving force) may lead to a renewed interest in exploiting mineral resources. **Unconcern** for the environmental consequences of such activities (cultural driving force) completes the pattern of drivers for mining to happen within Mexican protected areas, and here the Sierra de Manantlán Biosphere Reserve.

The threat from external interest in terms of resource extraction for economic benefits in general was also mentioned by a civil servant (55:12) and an SMBR staff member (36:24). The latter exemplifies the statement by referring to the region's timber. Above this, political decision-making counteracting the achievement of conservation objectives also applies to infrastructural development: "*Another [threat] deals with the development of constructions and projects, the development that is promoted by the same government.*" (9:25, SMBR management). This statement supports the high ranking of the creation of roads and railroads in Table G.12. Infrastructural projects can be considered a result of a combination of demographic, economic and cultural driving forces according to the selected classification system of driving forces (see F.3, Table F.3). Figure G.27 demonstrates the causal network for above and below ground construction (exploitation of below ground resources and infrastructure projects) in the SMBR. The displayed pressures, states and impacts from mining in Figure G.27 are so far potential pressures, states and impacts, as below ground resources are not yet exploited through mining companies, but changes in political priority setting are feared to trigger exploitation (see quotation given above).

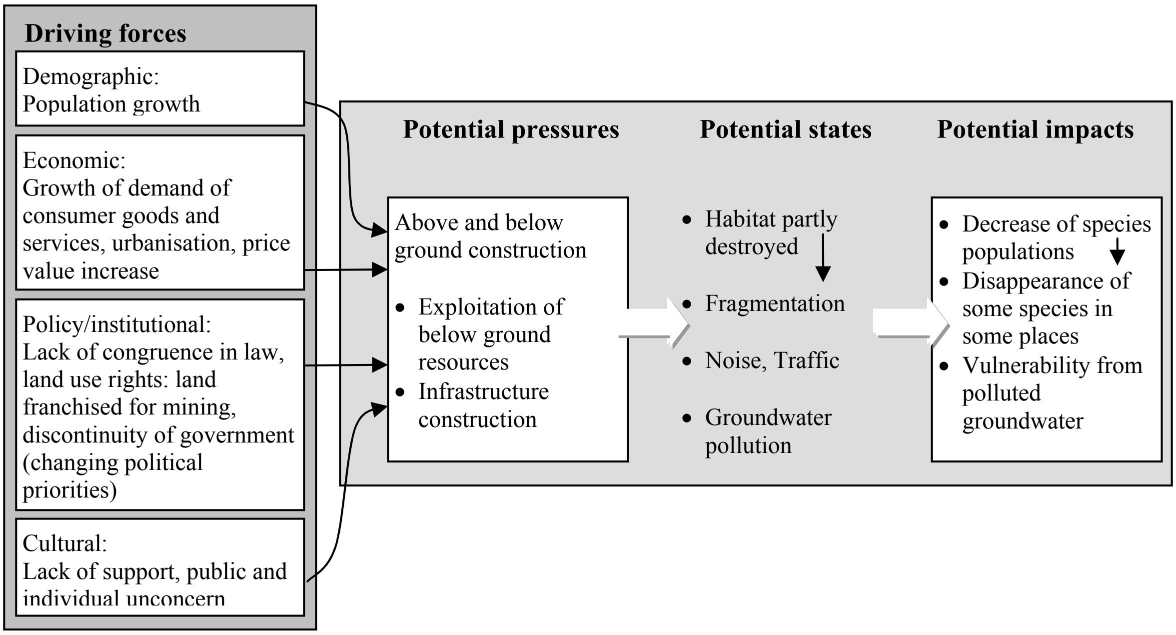


Figure G.27: SMBR – Cause and effect network for above and below ground construction

Illegal activities are reported to occur in the SMBR and may, as it was the case in the SGBR, root back to poverty and marginalisation challenges (4:108, civil servant). The importance of the issue is well reflected in the positioning of hunting, trapping, fishing, and logging among the other ranked threats in Table G.12. Illegal hunting was mentioned most often (12:8, 18:12, 32:9, local community members, 23:31, SMBR staff), specifically targeting deer and peccary (16:16, SMBR staff), but also catching birds (same interview), and logging. Although the children's game of killing birds cannot be called an illegal activity, it was mentioned in this context in the SMBR (37:33, local community member, 11:15, local community members (pupils)). In the context of illegal activities, a local community member expressed the need to have an enforcement system, not only to avoid, for example, hunting and poaching, but also to control tourism activities and keep tourists from dropping and leaving waste (12:11). In the same way, threats from uncontrolled tourism activities were emphasised by the SMBR management (48:39). One interviewee described the need for stricter enforcement, meaning the introduction of sanctions, in a well chosen analogy: "*It is the same with the safety belt, here it is a rare thing to put it on; we will only put it once they start to fine us for not doing so.*" (15:15, local community member).

Finally, one more illegal activity was mentioned to be influential to the achievement of conservation objectives in the SMBR. One member of the SMBR management stated: "*One more threat which is also important is the question of* ***narcotraffic****, and not so much because the production of narcotics covers so much space but instead because of their intrusion into the internal life of the communities and above all also into the political dynamics of the region. In a sudden, it is interest in narcotics that at times even arrives at occupying political positions.*" (9:24, SMBR management). Unfortunately, no more insights were gained into how narcotraffic interferes with habits of residents and politicians and thus contributes to other impacts on the achievement of conservation objectives. Two publications mention the cultivation of illegal plants (marihuana and poppies) in relation to forest fires (Jardel Pelaez *et al*., 2003; Jardel Pelaez *et al*., 2006). Jardel *et al.* (2006) mentions that 14.9% of all fires registered in the SMBR roots back to illegal cultivations[66]. However, as can be derived from the statement, the phenomenon presumably shifts interests of stakeholders, potentially towards unsustainable, destructive or illegal activities. Narcotraffic as an influential factor on the functioning of protected areas seems to be a fairly well known issue in some Latin American countries (e.g.

[66] The fire is then used to clean up the terrain and not leave back any trace of narcotic cultivation.

Fjeldsa *et al*., 2005). Another example exists from two more biosphere reserves in Mexico, where studies revealed the same problem (Brusca *et al*., 2001).

While **invasive alien species** are comparably low in the threat ranking (it is not among the top 20), three different interviews emphasised the threat they exert on the region's biodiversity (9:16 and 9:18, SMBR management, 16:6 and 36:29, SMBR staff). One staff member pointed out that studies have shown that two to three percent of the floral species occurring in the Las Joyas core area are exotic and invasive (36:29, SMBR staff). Impressions gained from open questions do thus not coincide with the results of part 1 of the closed questionnaire on the issue of invasive alien species.

Concluding this subsection, Box G.5 summarises the most urgent conservation needs of the SMBR as identified through this study. The order of issues in Box G.5 does not indicate an overall urgency rank.

Box G.5: Most pressing conservation needs of the Sierra de Manantlán Biosphere Reserve

1. Prevention and minimisation of uncontrolled grazing and ranching activities;
2. Prevention and combat of human caused fires (strengthened through climate change impacts);
3. Reduction of the pollution and contamination of the region's water body's and in general minimisation and combat of pollution from solid waste;
4. Combat of decisions deriving from external economic interests in the natural resources of the SMBR;
5. Minimisation of illegal activities (including narcotraffic and illicit crop cultivation);
6. Combat of invasive alien species.

There is hardly a relation visible between the identified conservation needs and the management objectives as determined in the management plan. However, all the needs are mentioned in those chapters of the SMBR management plan where environmental and natural resources issues are outlined (INE, 2000).

Conservation capacity

The conservation capacity of the Sierra de Manantlán Biosphere Reserve will be described by referring to **resources**, **governance** and **community** aspects as part of the conservation capacity component of the CSF (see subsection F.4.2)[67].

The SMBR, compared to the SGBR, is run under a very different management setting. CONANP employees are at site and responsible for the management since 1994, but the biosphere reserve arose much earlier out of scientific interest in biological research in the today called core area Las Joyas. Therefore, a significant number of the key actors of the biosphere reserve belong to the South Coast Unit of the University of Guadalajara. They triggered and accompanied the declaration process of the protected area and are looking back at the longest working experience in the region. The academic linkage of the SMBR has led to the **large amount of scientific research** in the region and translates into the impressive knowledge base in place that can be used to support management decisions.

While the close linkage to an academic institution is of clear advantage in the face of scientific knowledge, university key actors face a difficult challenge: They have to manage their university obligations in parallel to their interest in a successful implementation of the biosphere reserve. The tasks coming along with a university position plus the tasks in favour of the biosphere reserve do sum up to a **double job position of academic key actors**. This was different in the early days of academic research in the region: In 1985 research staff was located at the Natural Laboratory Las Joyas de la Sierra de Manantlán in El Grullo, a small community close to the Las Joyas Research Station. In 1993, due to its remarkable research achievements, it was elevated to the status of an institute, now called Instituto Manantlán de Ecología y Conservación de la Biodiversidad (IMECBIO). In 1995 it then moved to Autlán and was integrated into the Southern Coast Unit of the University of Guadalajara. It is since then that the key actors who have accompanied the SMBR through its evolution returned to the “normal” university obligations, and consequently had to trade some of their time and energy for biosphere reserve implementation off for university responsibilities (9:50 and 9:62, SMBR management). Hence it is difficult to give clear numbers of people who are engaged in the implementation of the SMBR – at least full time. IMECBIO is staffed with

[67] In ATLAS.ti they are marked with one of the codes from the code group “conservation capacity”, see Annex III.

around 60 people, 16 of which work in administration (DERN, 2007), but university activities certainly do not fully overlap with the needs for action of the biosphere reserve. Moreover, there are students and researchers conducting studies in the Las Joyas region and other parts of the biosphere reserve, a mentioned number of 40 people. However, only about one quarter of them is estimated to conduct research that actually supports the management of the SMBR (48:38, SMBR management).

Equipment in terms of vehicles, computers and working facilities seems to be well established. The CONANP team works in a separate office building and is completely equipped by governmental funds. The IMECBIO is located at the university campus with a range of offices and equipment. Vehicles are provided by both, the government and the university. While the size of the SMBR as well as the number of residents is less than 50% of the size and resident number of the SGBR, a larger number of vehicles is still indispensable for realisation of conservation actions in the SMBR.

Being aware of the difficulty to give consideration to the university duties as well as to the SMBR implementation, some mechanisms were developed to cover such capacity gaps: Around the environmental education coordinator, for instance, a group of student voluntaries teamed up and now supports respective activities. Likewise, independent cleaning campaigns have been conducted by voluntary supporters. In several cases, the **continuance** of several key actors, as it was the case in the SGBR, seems to clearly contribute to strengthening the relation to local community and *ejido* members. Some *ejidos* are in the meantime outstandingly well organised and autonomously apply the management principles of the SMBR within their territories (pers. comm. in 2006 and passive observation). Above this, continuously a very high **commitment** of all people involved in the implementation of the biosphere reserve was clearly visible during the research stay. All these conditions provide a considerable support to the SMBR's conservation capacity.

The SMBR benefits from the existence of the Fundación Manantlán as an entity that is dedicated to detecting potential donors and raising funds for the benefit of the biosphere reserve. This is of special importance as explained by a civil servant: "*Another important challenge for Manantlán is to consolidate financial security with external funds that do not necessarily originate from the government.*" (4:19). While some funds have been raised from national cooperations so far, donor cooperations are still weakly developed and long-term funding thus remains instable.

The Sierra de Manantlán Biosphere Reserve suffers from another remarkable difficulty: The **director's position was not occupied** for a longer period of time. There were quick shifts on this position since 2002 before it became vacant in early 2005 and was not filled until at least late 2006[68]. At first, the quick changes resulted in conflicts with local communities and *ejido* members as promises by one director were neglected by the next resulting in a loss of trust and acceptance (1:1, local community member). A member of the SMBR management interview group describes this problem as one of the main threats in the region: "*And well, for me, one of the strongest threats is that activities lose consensus among local actors on account of the conflicts along the changes of the director, [...]. This is a crucial institutional threat, there was a conflict situation inside the advisory council that amounted to, well, it continues to worsen, the loss of the progress in public participation.*" (48:34, SMBR management). Recent news confirm that this situation is still ongoing (Milenio Guadalajara, 29.12.2007, and pers. comm. in May 2008). Obviously, there was a proposal to reduce the number of representatives from local communities in the two advisory councils, which was then opposed by the local community members themselves as well as university key actors (e.g. Torres, 2007, and pers. comm. in 2008).

A certain degree of **resistance** against the principles and restrictions coming along with the realisation of the biosphere reserve concept was detected during the research stay. In one *ejido*, residents complained about not getting the permission from the SMBR to burn their fields, while they urgently needed to do so before the start of the upcoming rainy season (8:1, local community members). SMBR staff in contrary argued that the requested information on who is burning what land and when still has not been compiled and passed on by the *ejido* and that it is not possible to allow for uncontrolled burning (8:3, SMBR staff).

Resistance against the biosphere reserve may also arise from **human-wildlife conflicts** which were repeatedly reported from the SMBR (48:11, SMBR management, 1:3, SMBR staff, 1:3 and 7:8, local community members). One local community member complained

[68] Articles from online newspapers published after late 2006 mention a new person in charge of the position.

to have lost 70 pieces of cattle already to wild cats (1:3, local community member). However, a staff member explained that such loss only occurs when residents lead their cattle into the core areas for grazing, which is illegal (pers. comm. in 2006). As a matter of fact, some of the communities are located at the very border of the core area where such an argument may stand firm. On the other hand, especially those communities which are close to core areas may indeed naturally suffer more from wildlife damage to cattle as wild cats do not stick to mapped zoning schemes. In addition to cattle loss, one staff member also reported an accident with a large feline on one of the major roads traversing the SMBR (pers. comm. in 2006).

Decision-making on governmental level was mentioned much more often as a crucial point by interviewees from the SMBR than it was the case in the SGBR. Whenever an interviewee turned toward the issue, the upcoming elections of summer 2006 were directly or indirectly emphasised: "*Political changes always bring challenges, such as programmes counteracting conservation*" (46:31, SMBR staff). Even civil servants affirmed the threat exposed by **political discontinuity**: "*If there is no political continuity [it is a threat], because the current government, for the last five years, shows a high commitment for nature.*" (42:8). Especially where new political responsibilities involve a change in protected area management positions, they may result harmful to the overall functioning of the site. Discontinuity in leading positions within a protected area may then result in mistrust from local residents, as the above given statement confirms. Opinions on the potential impact of a changed government, however, varied. One member mentioned that governmental changes should not significantly impact on the functioning of the SMBR because of the broad and for long established **network of contacts and cooperations** (48:39, SMBR management).

Concluding this subsection, the facilitating and impeding conditions to the conservation capacity of the Sierra de Manantlán Biosphere Reserve are summarised in Table G.13.

Table G.13: SMBR – Facilitating and impeding conditions of conservation capacity

Capacity component	Facilitating conditions	Impeding conditions
Resources	• Equipment good, working facilities good; • Extra fundraising personnel; • Deep knowledge of the region; • Long research history; • Consistency of key actors; • Commitment; • Broad network of contacts.	• University obligations impede on dedication of academics to implementing the SMBR; • External long-term funding remains a challenge; • No director in place (at the time of the case study conduction).
Governance	• Legal declaration comparably stable; • Existence of regional coordinators linking the national and local level.	• Consensus of the advisory council weakened; • Vulnerable to political discontinuity.
Community	• Local volunteers supporting projects; • Some *ejidos* very well organised and not much support needed from SMBR staff.	• Some trust lost from broken promises → some residents still in contraposition to the SGBR; • Human-wildlife conflicts.

As it was the case in the SGBR, several of these conditions are related to each other, such as the vacant director's position with a loss of trust on the local level.

Conservation actions

In this subsection, the implemented conservation actions addressing either the identified conservation needs or further strengthening the conservation capacity are presented[69].

Conservation actions addressing conservation needs in the SMBR cover an area three times larger than the biosphere reserve itself (9:30, SMBR management). As only the core areas and the buffer zone are legally designated, the magnitude of the transition area can be freely interpreted by the site's management and accordingly stretches far into the region that is provided with freshwater from the Sierra de Manantlán watershed.

When asking what method is regarded adequate to achieve conservation objectives, the need for a combination of two essential strands of activities was emphasised, as exemplified in the following quotation: "*Objectives can be reached through the people's conscience and the creation of alternatives.*" (23:5, SMBR staff, also 2:16, 17:5 and 17:6, SMBR staff). This opinion is supported by the site's management as well, while

[69] In ATLAS.ti they are marked with the code "response" as part of the DPSIR system plus one of the codes from the code group "conservation actions", see Annex III.

participation, here through the so-called advisory councils, is considered fundamental (36:3-36:5, SMBR management).

Via environmental education and the identification, establishment and support of income alternatives, several conservation needs are addressed at their roots. A civil servant reflects about the history of environmental education programmes in the Sierra de Manantlán: "*There was a very interesting sensitisation programme, an environmental education programme, entitled the "campaign for pride", and it was initiated about 15 years ago in the Manantlán Biosphere Reserve working precisely to be able to feed into the people the care for their forests*." (55:33, civil servant). Environmental education thematically ranges from awareness for the value of biodiversity to fire prevention (see Photo G.13) and pollution, inter alia. During the research stay the environmental education team was accompanied to several schools and interviews were done with groups of pupils and also with teachers. At the schools, environmental education was still a young discipline but very welcome (10:7, own observation). The education team does not only teach but instead also pick up solid waste, which is separately collected at the schools (paper, recyclables, see Photo G.14), and transports it to recycling centres. The solid waste problem is thus not only addressed through awareness raising, but instead the state of pollution from solid waste is also tackled. For the same purpose, recycling centres and cleaning initiatives were established in several communities (2:3 and 2:5, SMBR staff), and an outstanding effort is done concerning the cleanliness of the rivers. On a regular base the communities along the Ayuquila River are visited in order to check the state of the river. One such trip was attended and own impressions gathered. Also, a member of the education team was accompanied to presentations in front of local authorities on the importance of the river and progress made in keeping it clean. Hence, environmental education does not only involve pupils but also turns towards adults and local-level decision-makers.

Photo G.13: Sign board of the *ejido* El Terrero in the SMBR: "We protect our pride through forest fire prevention"

Photo G.14: Sign board in the SMBR asking local people to participate in the recycling programmes

A local community member, however, expressed doubts on the sufficiency of current environmental education in the surroundings of the SMBR: "*I think that so far this is no real environmental education. I mean, there are courses, people tell the pupils that they have to look after the environment but I think one must learn this right from a baseline on. From childhood on.*" (15:13, local community member). This criticism in fact can hardly address the SMBR as such, because its environmental education team is working very efficiently and with a wide outreach, but instead turns toward higher level political decision-makers and the general situation in schools: Where environmental issues lack due consideration in nationwide education systems, no protected area management and staff can be expected to fully compensate this. This applies specifically to biosphere reserves, being *in-situ* conservation sites of usually very large size and including considerable resident numbers.

The control of grazing and ranching activities was described as outstandingly difficult by SMBR management and staff members (see Photo G.15). Still, it is tried to convince residents to shift toward certified ecological meat and reduce the number of cattle while being better paid for the certified meat than before (23:35 – 23:36, SMBR staff). In a simple calculation people are shown they can benefit from having fewer cattle. Sensitisation and environmental education programmes further the efforts to convince people to let go from their traditional definition of the social status ("*the number of cattle determines the social status*"). Overall, the only way to sustainably reduce cattle numbers again is the provision and successful implementation of income alternatives. The creation of such **income alternatives** is realised in different ways, one of which is the introduction of payments for ecosystem services: "*Currently, more than 15 ejidos out of 29 which exist in the Sierra de Manantlán Biosphere Reserve are supported, for instance from payments for environmental services. This is a direct payment from the National Forestry Commission through the Mexican Forest Fund to accredit water producing areas. Payments for hydrological environmental services.*" (55:23, civil servant). The SMBR management and stuff introduced and supported seasonal employees and sustainable development with several projects as confirmed by interviewees (12:2, local community member and 55:91, civil servant). Such projects focus on embroidery, dried fruit production, honey, medicinal plants, and handicrafts (36:5, SMBR management). One project was visited where tortillas were produced, but unfortunately the machine was broken and the local community members did not have the training to fix it themselves. In addition to this, compensation payments have been introduced for cattle lost through wildlife damage. However, the system was claimed to be difficult in practice, for example when wildlife damage is not immediately reported and then cannot be traced back to large felines (1:5, local community member). Another resident mentioned that it would be good if there was a separate person responsible specifically for human-wildlife conflicts and conservation, which does not seem to be the case (7:10, local community member).

In addition to the so far mentioned approaches to improving livelihoods, it is also tried to canalise income of local community or *ejido* members through sustainable tourism projects. While facilities at some places seemed well developed, a resident complained about a bird watching project having started but never completed: "*Well, concerning the footpath, there it is, but still it does not work, [...], it is there for five years now already and is nothing but abandoned and nothing is done about it.*" (18:2 and 18:8, local community member). There thus seems to be a discrepancy between planned projects and their follow up that could either be corrected by the SMBR responsibilities, or by the local community members themselves who wish to benefit from such facilities one day. The difficulty to accompany each project sufficiently until autonomy is reached was touched in the SGBR context as well.

Environmental education and provision of alternative incomes, here also in terms of the introduction of sustainable resource use principles, are also the main strands of action to reduce and avoid **illegal activities**: "*There is no more wood cutting because several* *municipalities realise the utilisation of resources in a viable manner*" (17:22, SMBR staff). One local community member mentioned that people who disrespect the SMBR's rules are prosecuted (27:17) but no separate personnel seems to be responsible for **enforcement** activities, and surveillance was stated to be very scarce (18:13, local community member). Only the region of the Las Joyas Research Station seems to have some surveillance measures established (46:14, SMBR staff). It is also the only core area in which some parts are fenced in. This is due to the extensive **restoration** efforts for the forest inside the core area (Jardel Pelaez, 2008). Overall, the enforcement situation coincides with the one in the SGBR and is nationwide linked to the respective agency in charge, the Federal Attorney Generalship of Environmental Protection (Procuraduría Federal de Protección del Ambiente, PROFEPA).

Fires, artificially caused or not, are tried to avoid and combat likewise. SMBR staff is continuously communicating via radio units to inform about signs of smoke above the reserve's territory and their origins, and fire stations are in place to detect fires in early stage. A civil servant confirms the long history of fire abatement in the SMBR: "*These are among the first programmes they had, particularly Manantlán*." (35:46, civil servant). *Ejidos* are also involved in the efforts to prevent, report and combat fires: "*The majority of the ejidos already has surveillance committees; they have committees who participate in controlling and combating forest fires.*" (55:38, civil servant). Fire management is also done by cutting forest aisles to slow down or stop fires where they cannot be avoided (16:5, SMBR staff). In addition to this, degraded forest areas are restored so as to overall increase forest cover inside the SMBR (23:10, SMBR staff).

River pollution by industrial waste in the Ayuquila River does not have many potential sources to originate from but an upstream sugar cane factory. In the year 1994, the SMBR facilitated the formation of "River Defense Committees" consisting of local community members from riparian settlements affected by the river pollution (Graf Montero *et al.*, 1996). Early negotiations with the responsible institution were unsuccessful until it was possible to detect evidence for the illegitimate treatment of waste water. This finally led to a change in the factory's waste water management system in the year 2000 (Graf Montero *et al.*, 2007). However, at times, respective responsibilities still neglect their charge when pollution is observed anew (20:6, personal note from conversation with local SMBR staff). To sustainably stabilise the situation, local residents are also trained in water management. One project was visited where a community was asked to use drainage water from a new well instead of the river. They were found active in construction of the well, while the material had been provided from the SMBR (see Photo G.16).

Photo G.15: Cattle on burned ground in the SMBR

Photo G.16: Local people building a well to save river water in the SMBR

On the same day, while visiting several communities, local residents repeatedly asked SMBR staff about the status of the river water. They reported that few days earlier dead fish had been found in the water, and thus feared that the river was contaminated again (7:7 and 20:6, local community members). The SMBR staff had obviously shown immediate reaction, the water had been tested for toxics already, and it was found that no toxics but instead a short-time oxygen reduction in the water had caused the death of some fish. The oxygen reduction was believed to be caused by the release of molasses into the river by the nearby sugar factory (20:6 and 20:7, personal notes from conversation with SMBR staff). Regular tests are conducted by involving residents to constantly control the water quality and ensure quick reaction if needed (37:7, local community member).

Together with another *ejido* a yearly “Fiesta del Río” is organised. On a special holiday the site attracts large numbers of national visitors. The *ejido* is therefore trained in waste management during the visitor’s season and the event is also used to raise awareness for the importance of the river’s freshwater.

External interests are currently not applying to the SMBR but represent a constant threat. The main hope for avoiding them is based on the broad and stable network of contacts to local and national authorities and stakeholders.

With respect to **invasive alien species** the same attitude was found that seemed to be dominant in the SGBR: While the issue was taken serious and awareness toward the pressure exposed to biodiversity by existing invasives high, the range of options to combat them was perceived limited. During the research stay an external expert was to come by and consult on how to react (16:7, SMBR management). It remains unknown, whether or what actions were implemented since then to address the challenge.

As it was mentioned earlier, much research has been conducted in the SMBR, especially in the region of the Las Joyas Research Station. This is historically linked to the site's academic background and reflected by most research being conducted by university staff (17:8, 23:6, SMBR staff). One staff member stated research to be the base for management of the SMBR: "*...to understand the biological situation but also the social one*." (46:1). While several monitoring projects were obviously realised, a member of the SMBR management emphasised that they were usually lacking permanence (9:51). Another interviewee from the SMBR management, while recognising the importance of evaluating the site's progress towards achieving the objectives of the biosphere reserve, claimed that no evaluation is currently done (48:34). However, a civil servant explains this by referring to the point at which the management of the SMBR currently stands: "*The management programme of Manantlán complied with the application period and will now initiate an evaluation process on how much has been achieved with this working programme of five years and to revise the scenarios on how far we have progressed, how far we have had an impact on people so that we can come up with an earnest compromise for the people of the communities in the conservation sections.*" (55:95). During the research stay the author was informed that the conduction of the Rapid Assessment and Prioritisation for Protected Area Management Methodology (RAPPAM) was planned in the SMBR, but so far no results have been made available.

Conclusively to this subsection it can be stated that many of the realised conservation actions do directly address the driving forces, pressures, states and impacts – and thus the identified conservation needs. For every conservation need a strategy seems to be underlying the series of conservation actions in place. Table G.14 shows the main needs, the identified strategies and corresponding conservation actions.

Table G.14: SMBR – Strategies and conservation actions to address conservation needs

Need	Strategy	Conservation actions
1. Prevention and minimisation of uncontrolled grazing and ranching activities	Alternative livelihood provision, sensitisation and conviction by numbers	• Creation of income alternatives in terms of alternative production and payments for ecosystem services; • Introduction of more sustainable resource use practices.
2. Prevention and combat of human caused fires	Mobilisation and management	• Awareness raising; • Involvement of residents in control and combat of fires; • Introduction of control systems for agricultural burning.
3. Reduction of the pollution and contamination of the region's water bodies and in general minimisation and combat of pollution from solid waste	Cleaning and future avoidance	• Cleaning campaigns; • Regular checks along the river; • Negotiation with industry; • Introduction of recycling systems and export of recyclables.
4. Combat of decisions deriving from external economic interests in the natural resources of the SMBR	Networking	• Maintenance of working relations with authorities from local to national level.
5. Minimisation of illegal activities (including narcotraffic and illicit crop cultivation)	Sensitisation, alternative livelihood creation and compensation	• Environmental education for school kids, students, parents, local community members, and local authorities; • Compensation for damage caused by wildlife.
6. Combat of invasive species	Under negotiation	• Expert consultation

Figure G.28 presents a synthesis of all cause and effect networks presented under "Conservation needs". For spatial reasons the term "driving force" is abbreviated as "DF" in Figure G.28. Arrows to indicate linkages between network components are left out for more clearness. Every dark green triangle indicates that the respective driving force, pressure, state or impact is addressed by at least one conservation action. Hence Figure

G.28 shows the many ways in which conservation needs are addressed by conservation actions in the SMBR. In addition, it reflects for which driving forces, pressures, states or impacts no conservation action could be identified as a “response”. Potential reasons for this may be very different in nature: Some driving forces cannot be influenced by local action, such as national or international price value dynamics. In other cases the biosphere reserve management may have decided to address a pressure rather than addressing its impacts and this could be the simple reason why some impacts remain unaddressed. In some cases, however, action gaps may also exist.

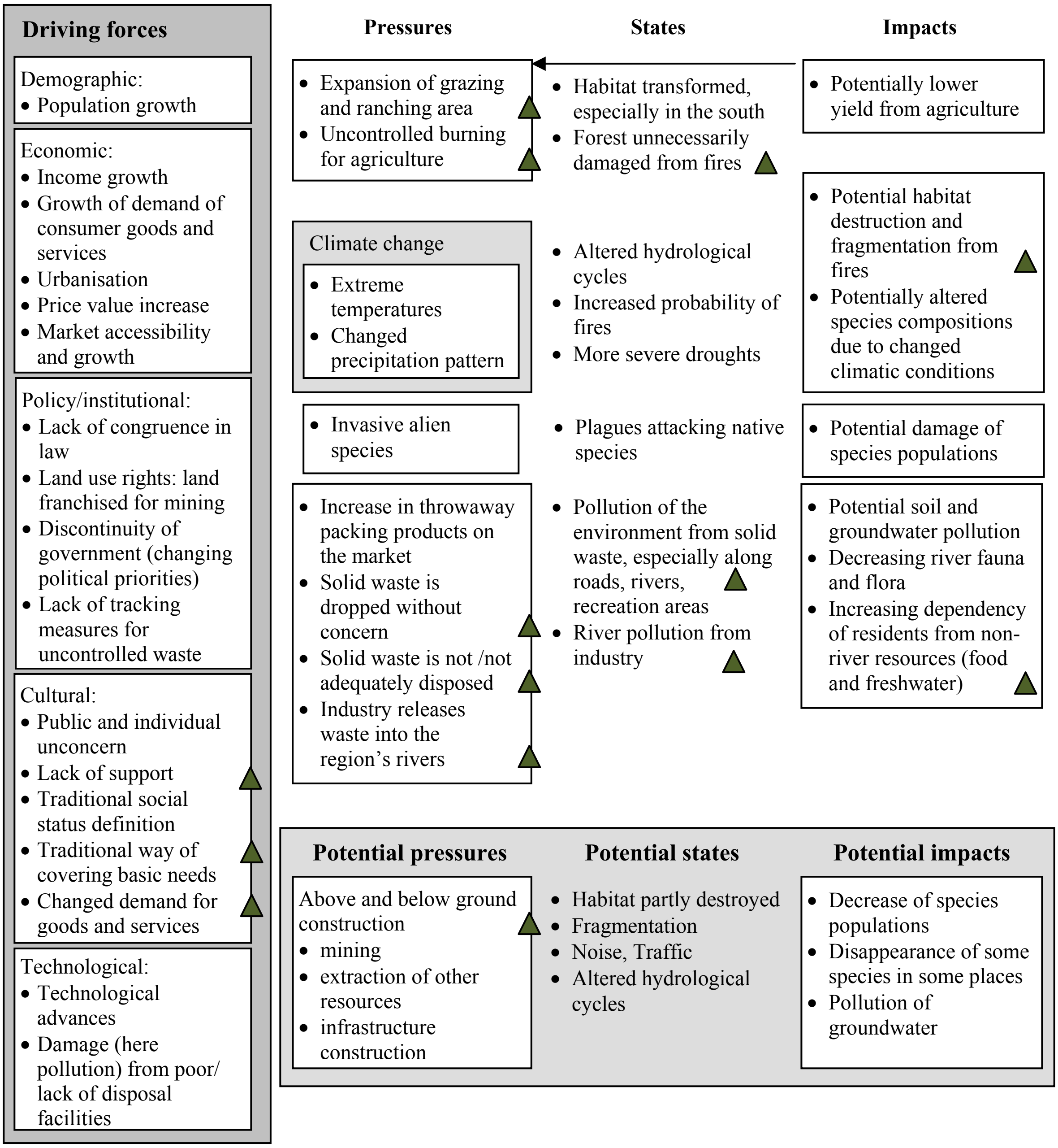


Figure G.28: SMBR – DPSIs and conservation actions (Rs)

Those conservation actions that do not address the conservation needs aim at strengthening conservation capacity, especially where there are constraints, as identified earlier (see Table G.13). As it was the case for conservation needs, certain strategies may also be synthesised from the study's findings. They are shown in Table G.15.

Table G.15: SMBR – Strategies and conservation actions to address capacity constraints

Capacity constraint	Strategy	Conservation actions
1. External long-term funding remains a challenge	Networking and outreach	• Application of separate initiatives for environmental awards; • Cooperation with national donors.
2. Some trust lost from broken promises → some residents still in contraposition to the SGBR	Close cooperation and support	• Regular visits of communities and *ejidos*; • Support where advice or help is needed.
3. Human-wildlife conflicts	Compensation	• Compensation mechanism in place.

University key actors try hard to re-strengthen the consensus among members of the advisory councils while still supporting the local people's interest in remaining part of decision-making processes. However, information from online newspaper articles indicate ongoing internal conflicts (e.g. Milenio Guadalajara, 29.12.2007).

Effects from conservation actions

This subsection describes the observed and reported effects from conservation actions. Where possible, results from the qualitative survey are related to the corresponding question of **part 2 of the closed questionnaire** (see subsection B.4.4). The order in which effects from actions are described follows the order of issues in previous subsections as far as this is possible. Where effects root back to several different conservation actions this is explained in the text. The subsection is completed by general indications for the overall status of the SMBR that were identified from the case study.

When interviewees were asked what indicators they regarded as the most adequate for conservation achievements in the SMBR, they mostly referred to an increase in forest cover (17:12 and 23:12, SMBR staff, 36:9, SMBR management), the maintenance or betterment of the quality of river water and products (46:22, SMBR staff and 48:22, SMBR management), and the recovery of burned habitat (23:17, SMBR staff). The increasing signs for the presence of certain species were also mentioned (23:11, SMBR staff, 9:11, SMBR management), although some doubt was expressed with respect to puma and jaguar presence as an indicator, as it is loss of cattle alone that leads to the impression of larger populations of wildcats (48:11, SMBR management).

Statements confirming the increase in forest cover were numerous and given in all visited sites in and around the biosphere reserve (e.g. 12:3, 15:4 and 15:6, 18:9, 32:4, local community members). While visiting some schools in the transition area of the biosphere reserve, the pupils emphasised the big difference in vegetation cover inside and outside the SMBR by stating that "*there is so much green*" inside the SMBR (10:4 and 11:6, local community members (pupils)). Another interviewee, when asked what changes were noticed since conservation work is done in the SMBR, even pointed at the surrounding hills and stressed that all this had been deforested, but thanks to the reforestations and other initiatives from the SMBR it looked much better again today. The *ejido* member furthermore recalled that the larger forest areas also contribute to better conserving water which they all need very urgently (20:10). Another interviewee summarised the trends by saying that "*The forest looks better every month.*" (27:9, local community member).

The recovery of the forest is accompanied by the recovery of certain species besides the large felines. More deer and birds were reported, but also wild boar (16:8, SMBR staff, 21:8, 27:11, local community members). It is easy for local community members to take notice of the growing presence of the reserve's fauna, as "*they [the animals] come as far down as to the communities*" (46:11, SMBR staff). While some local community members were not able to name all the animals they see, they still recognised there was more to see around than years ago (e.g. 25:4, local community member).

Interestingly, results of the closed questionnaire on changes in the integrity of biodiversity show an equal distribution of responses among "no change" and "increase" (see Figure G.29).

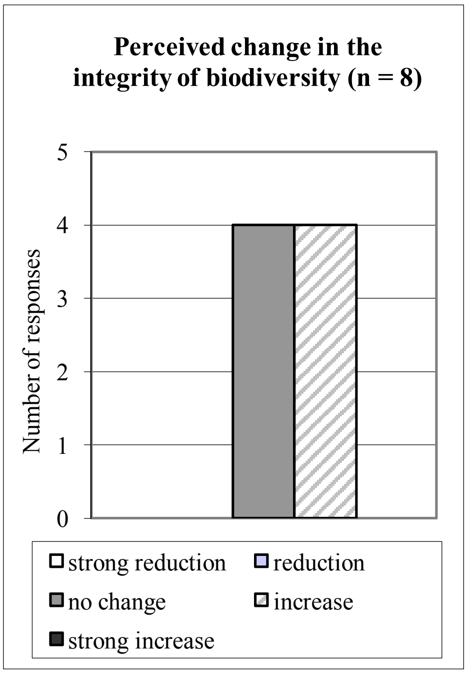


Figure G.29: SMBR – Perceived change in the integrity of biodiversity

A civil servant relates the improvement in terms of the site's fauna and flora directly to the residents' participation and involvement in conservation actions: "*Starting in the very moment, in which the people participate, the improvement of the management is noticeable, especially in some fields, the management of forest, agriculture and fisheries, and this is manifested in the fact that there is every time a higher quantity of fauna, for instance, that was not to be seen anymore before, such as the jaguar, there is more and more presence of jaguar, of puma, big species which twenty years ago were noticed only very rarely.*" (55:40 and 55:43, civil servant). This increasing local support is confirmed by several local community members as exemplified in the following quotations: "*We are helping them [the SMBR management and staff] to take care of the forests, if we do not take care the forest fires will burn the whole reserve.*" (32:7, local community member), and "*Well, I am working with them [the SMBR management and staff] on this, as they tell us we should take care of the forest as good as we can, and we are working in agreement with them*" (21:1, local community member). The closed questionnaire results point in the same direction concerning the increase in the people's support of the reserve (see Figure G.30).

The voluntary support of conservation actions by local people can be directly related to an increased acceptance of the biosphere reserve. During interviews, local community members repeatedly pointed out that the initial scepticism towards potentially upcoming restrictions through the SMBR establishment is increasingly replaced by trust and acceptance, because obviously the biosphere reserve is "a good thing" (8:7, 12:3, 14:3, 15:17, 21:5, 32:6, local community members): "*Now people already understand why the reserve is there and why we work with them [the SMBR management and staff].*" (37:20, local community member). This understanding also roots back to awareness raising and environmental education efforts that were continuously realised for several years now, especially by university personnel, but also the SMBR directory. One *ejido* member, when asking for his/her opinion concerning major threats to biodiversity of the SMBR, explained that in "his/her" *ejido* people had gained so much awareness that threats from anthropogenic influences have turned much less probable (27:12). During the school visits in the SMBR transition area it was observed that pupils reacted in a very positive way towards the environmental education team (10:7, own observation). Pupils confirmed that they are gaining another perspective on their own behaviour since they are taught on environmental issues (10:2, local community members). One interviewee contributes with experiences from the own family: "*I can see this in my family, the kids, they have more awareness already. Because when we travel we take a plastic bag for the rubbish and we didn't do this before.*" (15:14, local community member). The high number of times the SMBR residents talked about climatic changes in the region also reflects a significant level of awareness for this issue (e.g. 14:8, 15:7, 25:7, 37:35, all local community members). The overall increase in awareness is well reflected in Figure G.31.

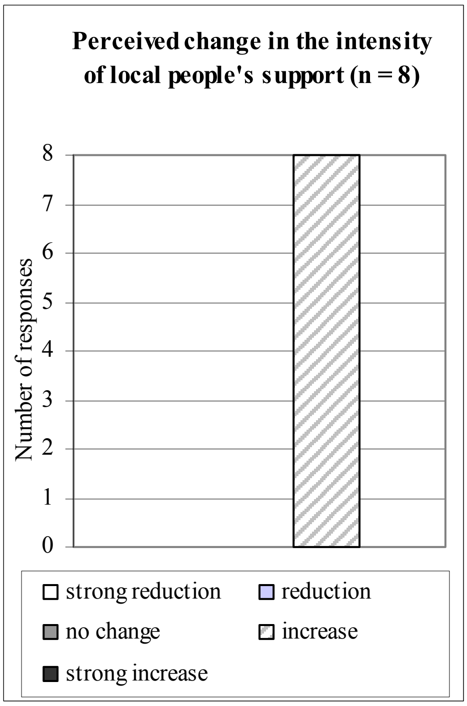


Figure G.30: SMBR – Perceived change in the intensity of local people's support

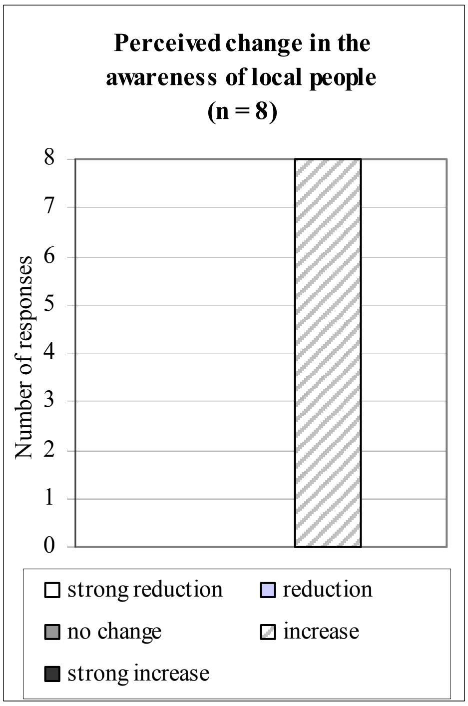


Figure G.31: SMBR – Perceived change in the awareness of local people

With higher awareness and support from the local community level it can be expected that uncontrolled burning and illegal activities are in a decline as well. Indeed, this was stated several times and even directly linked to the strong company of local residents and support of the SMBR, as to be seen in the following quotation: "*Yes, we go for it altogether and take care, so that the hill is not burned all over. And this is why there is more vegetation, because step by step they cease from this [uncontrolled burning].*" (25:3, local community member). The same applies to the support of local people in terms of combating illegal activities: "*There were some people where you could see that they go hunting and I told them "listen, there is no permission for you to kill [animals]", because in other times there were no animals, neither birds nor others.*" (37:27, local community member).

A decrease in illegal activities is confirmed by various sources, SMBR staff (17:22, 23:32) as well as local community members (14:6, 21:10, 32:4). Few statements refer to still ongoing illegal activities, among which hunting seems to still dominate other types of illegal activities (e.g. 12:9, local community member). Results from part 2 of the closed questionnaire show the same perception by SMBR management and staff members (see Figure G.32). The given statements indicate that such support from local level through self organised surveillance mechanisms may very well compensate some part of the lacking surveillance system of the SMBR management. In the given example, the local community members voluntarily take over the function of guards, hence contributing significantly to the conservation capacity of the SMBR. However, the follow up of the remaining illegal activities in order to enforce them still represents a so far unsolved issue.

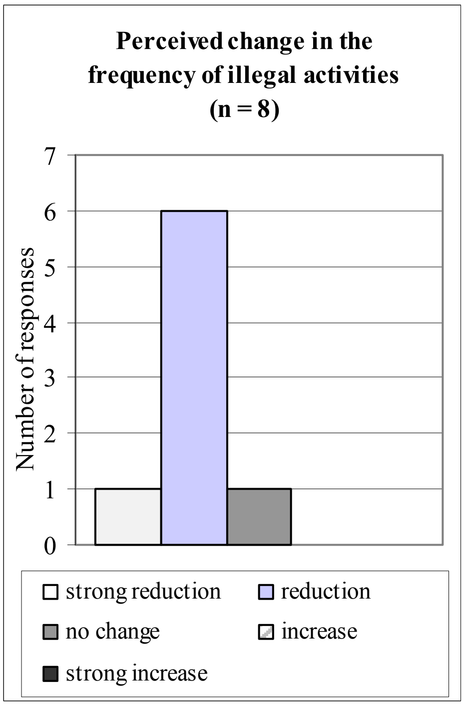


Figure G.32: SMBR – Perceived change in the frequency of illegal activities

The increase of forest cover, the recovery of species populations and the reduction of illegal activities can be regarded as positive effects from a combination of conservation actions, for instance awareness raising, education and involvement as mentioned, but also the introduction of alternative income opportunities, for example payments for environmental services[70]: "*Now they [local community members] see a real benefit and therefore, through these benefits, they are motivated to support the conservation work. This is no longer the forest that exists without a single value and which they are not allowed to touch. Now I have to take care of it so that it keeps generating resources. So they participate in programmes on control and management of forest fires, the management of cattle farming, of agriculture. There is already a stronger surveillance realised by themselves in a direct way towards their natural resources, towards the extraction of flora and fauna.*" (55:24, civil servant).

A local community member reports on some known cases where residents, which were involved in the timber market before, probably shifted towards income alternatives in the meantime: "*I also know people who dealt with this, people who, in other times, did everything related to deforestation and selling of timber, but now I haven't seen this anymore [...], it was their work all the time and now they dedicate themselves to other things.*" (15:6). Monetary benefits for the local communities and *ejidos* and a noticeable increase in livelihoods were repeatedly mentioned as being crucial (37:13, local community member, 46:30, SMBR staff), and have obviously created an improvement in the cooperation atmosphere (e.g. 25:5, local community member). One interviewee reports that the SMBR management and staff also canalised further governmental support for the region: "*Through them we also get a lot of help from the government, it is a great benefit for us.*" (21:4, local community member).

However, while these statements exemplify the effect of financial benefits, it obviously does not go unnoticed either, that the SMBR is of much more than monetary value: "*This could also be a benefit from the reserve because I think if it did not exist, we would have much more difficult conditions here [referring to climate change impacts]. And you can notice here that the ecosystems resist, resist towards the difficulties that come by in the environment.*" (15:7, local community member). The statement not only includes a personal opinion on the integrity of the ecosystems of the SMBR ("resistant"), but it also speaks for itself in that it demonstrates a high level of awareness of the interviewee.

[70] The interviewee quoted here used the Spanish expression "servicios ambientales", that literally translates into "environmental services". However, otherwise, throughout the presented work the term "ecosystem services" is preferred.

Concerning the pollution problem, the reported case of industrial river pollution seems to represent an individual case. Overall, a betterment was confirmed by interviewees (20:5, local community member, and 48:36, SMBR management, see Photo G.17), although a certain pressure on the river remains (48:36, SMBR management). In passive observation of presentations to local authorities given by university personnel, pictures were shown comparing the situation of the Ayuquila River before the cleaning campaigns started and afterwards. The difference was remarkable and pointed towards the amount of efforts done in cleaning campaigns.

Photo G.17: Children bathing in today's much cleaner Ayuquila River of the SMBR

Along the roadsides, the pollution from solid waste was also believed to be on a downwards trend, not only due to the cleaning campaigns, but also as a consequence of rising awareness (10:3, local community member). Referring to visitors still increasing the solid waste problem, a member of the SMBR staff stated that: "*They do not leave that much garbage anymore, or use so much throwaway packing.*" (2:13).

Two interviewees mentioned that some bird species' populations had declined over the years but no concrete reasons were given (14:4, local community member, and 23:23, SMBR staff).

Unfortunately, there seems to be ongoing disagreement between the SMBR directory and the IMECBIO. A quick search in the archives of the online journal "Proceso Jalisco" by early 2008 lead to 29 hits for the word “Manantlán”, most of which related to an exchange of opinions on articles accusing the academic staff involved in the site’s management to ignore local communities and doing “fruitless work”. The accused argue for this to be false (see Jardel Pelaez *et al*., 2007). The last entry is from the end of January 2008. An article published in the online journal “Milenio” states that the Sierra de Manantlán now faces a “five year crisis” in terms of discrepancies between stakeholder groups, i.e. university responsibilities, CONANP officials, communities and powerful industry (Del Castillo, 2008).

G.3.9 Relation of detected effects of conservation actions to existing non-open access data

In the case of the Sierra de Manantlán it is considerably harder to link existing data to the findings. The reason for this is not that data is lacking, but instead that information is widely distributed in scientific papers and reports and no summary report seems to exist. Many scientific papers focus on a certain part of the SMBR, such as a community or *ejido*, but then the same data does not exist from other *ejidos* and cannot be extrapolated. The Las Joyas Research Station is comparably well researched in contrary to the other two core areas. In addition, Del Castillo (2008) states that, by the beginning of 2008, progress indicators for the SMBR are still lacking.

Still, some existing information from a variety of publications can be related to the study’s findings[71]. However, most of the indicators need to be considered as proxy-indicators as they were not originally defined to respond to the present research question. Table G.16 shows the identified conservation needs and strategies and links them to indicators that can be derived from papers, reports and grey literature, which are cited in a separate column. The impression gained through the qualitative survey and additional closed questionnaire results is broadly indicated in a separate column as well.

For the capacity constraints that were identified and summarised in Table G.15 no further information in terms of indicators has been found.

[71] In November 2008 an article was published on land use and cover change in Mexican protected areas (Figueroa and Sánchez-Cordero, 2008) that could have been used in addition to the publications included in Table G.16. However, as it was published only few days before the submission of the thesis, it is only addressed in an additional paragraph of the discussion in chapter H.

Table G.16: SMBR – Relation of measured indicators to identified conservation needs

Conservation needs	Strategy	Qualitative impression	Indicator	Value	Source
1. Prevention and minimisation of uncontrolled grazing and ranching activities	Alternative livelihood provision, sensitisation and conviction by numbers	neutral	Number of community members guided to return to semi-intensive agriculture	92	Carrillo (2003)
			Number of sites where sustainable tourism management is promoted	Cerro Grande, especially San Pedro Toxín, Ayuquila River Environmental Festival	Graf Montero *et al.*(2006), Robert Barde *et al.* (2001)
			Direct canalising of financial investment via projects managed coordinative with other institutions	Between 1995 and 2002 about 12 million pesos	Santana Castellón *et al.* (2002)
2. Prevention and combat of human caused fires	Mobilisation and management	positive	Square kilometres of forest affected by fires between 1995 and 2004	See Figure G.33	Jardel Peláez *et al.* (2006)
			Number of fires detected per year between 1995 and 2004	See Figure G.33	Jardel Peláez *et al.* (2006)
			Mean number of square kilometres burnt per fire per year between 1995 and 2004	See Figure G.34	Jardel Peláez *et al.* (2006)
			Forest cover change	In 20 years of conservation work, the forest cover in Las Joyas increased from 76% to 92%.	Jardel Peláez and Santana Castellón (2007) and Jardel Pelaez (2008)
				Between 1972 and 2000 the forest cover of the *ejido* Ayutitlán and the indigenous community of Cuzalapa decreased.	Cárdenas-Hernández *et al.* (2007)

Table G.16 (continued): SMBR – Relation of measured indicators to identified conservation needs

Conservation needs	Strategy	Qualitative impression	Indicator	Value	Source
3. Reduction of the pollution and contamination of the region's water body's and in general minimisation and combat of pollution from solid waste	Cleaning and future avoidance	positive	Reduction in number of tons of recollected solid waste per day	El Grullo: Reduction between 1996 and 1998 from 20 tons per day to 8 tons per day.	García Ruvalcaba (2002)
				El Grullo 2006: Volume of solid waste produced is now reduced by almost 60%.	Graf Montero *et al.*(2006)
			Value increase in the established trust fund as part of the Inter-Municipal Initiative for the Integrated Management of the Ayuquila River Basin	2003: ~ US$ 100,000 2006: ~ US$ 400,000	Graf Montero *et al.*(2006)
4. Combat of decisions deriving from external economic interests in the natural resources of the SMBR	Networking	neutral	Currently under strong pressure	/	e.g. Del Castillo (2008)
5. Minimisation of illegal activities (including narcotraffic and illicit crop cultivation)	Sensitisation, alternative livelihood creation and compensation	positive	Number of people reached through environmental education programmes per year	Between 10,000 and 18,000	Santana Castellón *et al.* (2002)
				The environmental education programme implemented in 2003 reaches more than 10,000 people each year.	Graf Montero *et al.*(2006)
6. Combat of invasive species	Under negotiation	weakly negative	No information available		

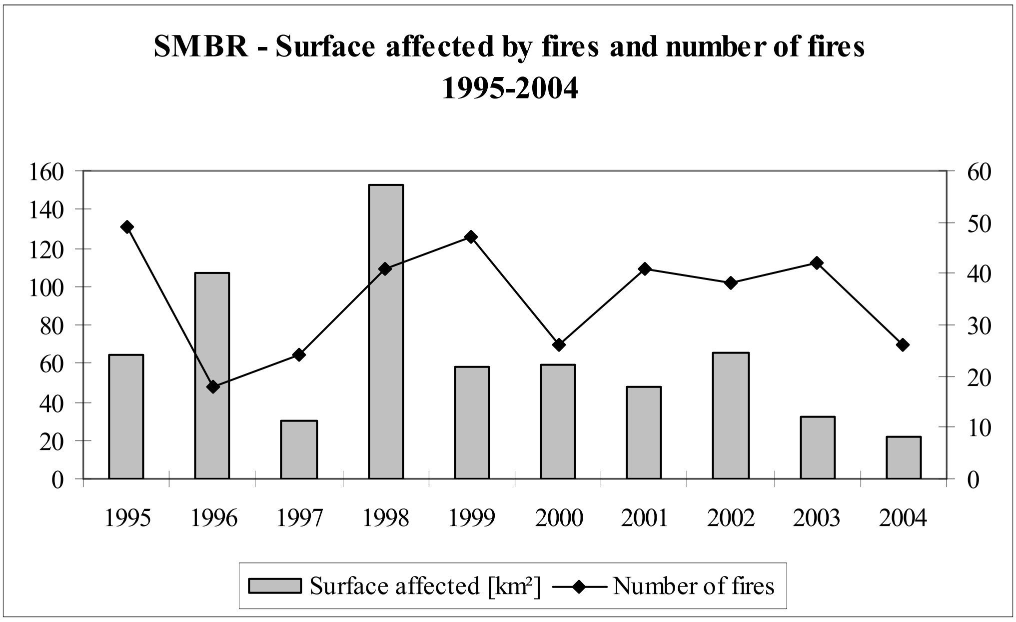


Figure G.33: SMBR – Surface affected by fires and number of fires registered between 1995 and 2004 (after Jardel Pelaez *et al*., 2006)

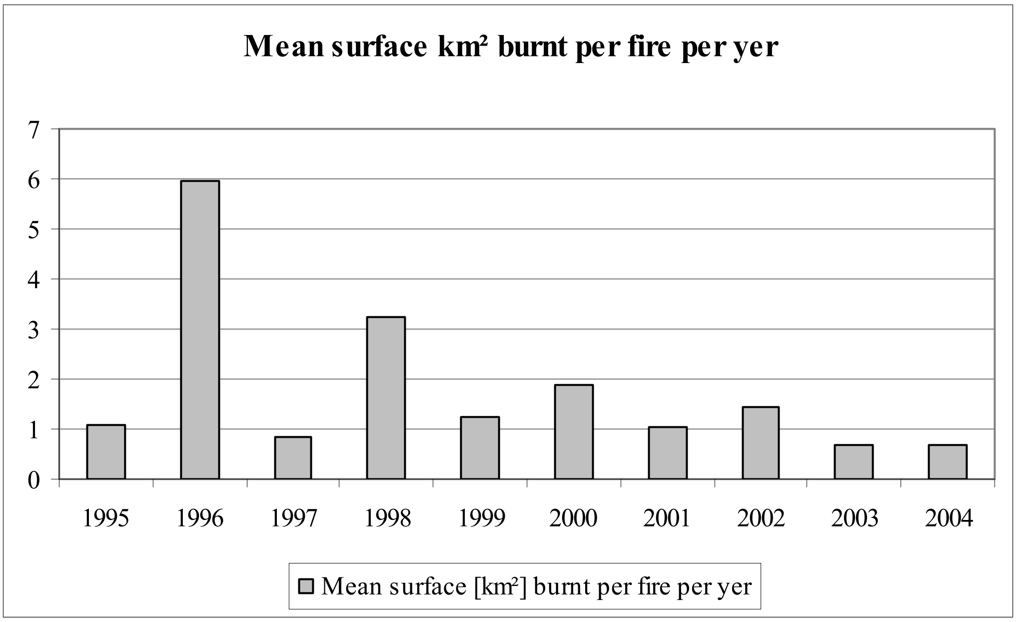


Figure G.34: SMBR – Mean surface square kilometres burnt per fire per year (after Jardel Pelaez *et al*., 2006)

In addition to the indicator values of Table G.16 concerning forest cover changes, Hostettler (2007) reports an increase in pine-oak forest (also including other forest types, such as fir-oak-pine forest and tropical montane cloud forest) in the municipality of Autlán of 0.69% between 1990 and 2000 and relates this to the large portion of this forest type included within the SMBR where stricter regulations for forest use are in place. The national average is a decrease of 5.24% in pine-oak forest area (Hostettler, 2007). Within the area of the Las Joyas Research Station the forest cover is reported to have increased from 75.9 to 91.8% within the last 20 years.

The impressions gained during the qualitative survey correlate with the existing information in that there are numerous examples for considerable conservation achievements, for example with respect to protection of the Ayuquila River. Concerns, however, remain on other issues, such as, for example, invasive species, and currently specifically in terms of internal and external stakeholder conflicts as newspaper contributions indicate (as mentioned earlier).

G.3.10 Conservation achievements in the Sierra de Manantlán Biosphere Reserve

As it was the case in the Sierra Gorda Biosphere Reserves, the objectives of the SMBR were only broadly framed in the site's management plan (INE, 2000). In addition to this, they did not link back to environmental problems at site, but instead environmental problems were separately introduced in the management plan (INE, 2000, Chapter 4.6). However, the **conservation needs** identified through the qualitative survey reflected many of the issues of concern in earlier days of the biosphere reserve. Climate change seems to have come up during the last years, as it is no issue of concern in the management plan from the year 2000.

Conservation capacity is on the one hand remarkable due to the affiliation of the biosphere reserve to an academic institution; on the other hand, however, it suffers from the fact that all academic staff has a normal day to day university job besides their engagement in the functioning of the SMBR. While the considerable dedication of several key actors of the SMBR may partly outweigh this constraint on capacity, the integration of university obligations with needs for actions of the SMBR lags behind.

Still, there can be no doubt on the fact that remarkable conservation work is done in the SMBR. A series of **conservation actions** address the identified conservation needs strategically and scientific research continuously feeds into further planning.

Conservation actions addressing constraints on conservation capacity likewise exist but less information was provided on this issue[72].

Effects from conservation actions were clearly noticeable from the qualitative survey. While the respective conservation needs remain, a positive impression on conservation achievements was gained on the issues of fire reduction and management, as well as reduction of river pollution, treatment of solid waste and reduction of illegal activities. Hardly any information was gained on the need to stop the expansion of agricultural land and cattle farming. During the research stay the pressure from outside interests seemed to be existent but not acute. Some worries, however, remained concerning invasive species and information is lacking on how these are treated. The qualitative survey did not provide further details on diversification of the funding sources and a solution for the double-job imposition of academic personnel is simply not in sight.

A comparison with existing data reveals a similar overall picture for the situation at site, although not all of the identified conservation needs can be backed up by indicators from existing non-open access data. Especially for identified capacity constraints data was lacking to validate the findings.

Latest news available from online newspapers suggests that currently the functioning of the cooperation between key stakeholders of the SMBR seems very fragile, which may have a seriously destabilising effect on the overall system. Ongoing conflicts between stakeholders may potentially further weaken the consensus within the advisory council and can thus result in decreasing participation and acceptance of the overall SMBR and its objectives. With parallel increasing pressure through external interests in exploiting the resources, the site currently seems to be facing a serious crisis. While this does not yet impair the conservation achievements of the SMBR, it may potentially turn into a driving force for degradation in the future.

[72] This may well be related to the much higher number of interviewees from local communities. The issue will be further discussed in chapter H.

G.4 Essence of chapter G

Chapter G puts the developed Conservation Success Framework (see section F.5) into practice and explores its applicability in two Mexican protected areas, the Sierra Gorda Biosphere Reserve and the Sierra de Manantlán Biosphere Reserve.

In-situ biodiversity conservation is taken serious in Mexico and both case study sites present outstanding examples for protected areas where the willingness and dedication of people has served as a motor for conservation, although their management systems and histories of development differ considerably.

The case studies exemplify the value and importance of the survey design by compiling numerous of expressive statements of stakeholders on conservation needs, conservation capacity, conservation actions, and the noticeable effects of the latter. Both sites implement a remarkable amount of conservation actions to address place-based conservation needs. Evidence for their success was found for many of them, both through qualitative and also non-open access quantitative data, while few conservation needs remain unaddressed and special challenges. The following chapter discusses the findings in more detail.

H. DISCUSSION, CONCLUSIONS AND OUTLOOK

"*Humans live in the present. We look at the world around us and find it difficult to encompass change over great tracts of time. But the perspective of time is important if we are fully to understand the biological processes we are driving by our actions, and, of course, to see where our future as a species lies*." (Leakey and Lewin, 1996: 249)

Chapter H is the final chapter of the present study. Its objective is to discuss the findings, synthesise the main conclusions and give an outlook on further studies of interest on the background of the presented work. By doing so, the fifth and last main research question of the present study is addressed (see Table A.1): **What key recommendations can be drawn to enhance the availability of information a) for the case study sites, and b) for the conservation community?**

In section H.1 the results from the case studies in two Mexican biosphere reserves (see Chapter G) are discussed in a combined and comparative way. This includes reflections on the qualitative survey, the application of the Conservation Success Framework and the place-based results from the biosphere reserves.

Section H.2 discusses the overall results of the present study, which means the insights into data availability for conservation and management (Chapter E) and the case studies' findings (Chapter G).

Section H.3 presents the conclusions that can be drawn from the present study. Altogether, the sections H.2 and H.3 accomplish the fifth research goal, **to provide a synthesis of recommendations at case study and conservation community level** (see Table A.1).

The chapter is closed by an outlook (H.4) on potential further research or follow-up action to the conclusions. The outlook also closes the main part of the manuscript.

H.1 Combined case study discussion

This section is divided into three subsections. The first addresses methodological aspects of the case studies. The second discusses the adequacy of the theoretical Conservation Success Framework in the light of the case study experience. In the third subsection, the results of the two case studies will be regarded in a comparative manner, leading to a series of practical recommendations. All three subsections form the base for the overall discussion of the study presented in section H.2.

H.1.1 Advantages and limitations of the method

The qualitative survey has led to deep insights into the situational settings of the two case study sites. This is an advantage of qualitative surveys: A large amount of complementary information can be gathered in a comparably short period of time. This is especially true when the sampling can be done completely independently, following the principle of achieving saturation as regards informational content. Unfortunately, given the time constraints for the research stay, there was a strict dependence on using duty excursions of biosphere reserve staff for field visits and interviews. Consequently, interview sites could not be chosen independently. Also, referring to the selection of interview partners, it needs to be mentioned, that, unfortunately, a gender balance of interviewees could not be achieved. The majority of interviewees was male (relation ca. 3:1) for two reasons: 1) There were more male people employed in the institutions considered as stakeholders to the present study; and 2) especially on the local level, women were more reluctant in giving interviews. However, as the interviews revealed a range of differentiated perspectives on conservation achievements, including both positive and critical points, and the triangulation of information sources supports the insights gained, it is not believed that the above mentioned restrictions in interview site and partner selection have led to a bias of results.

Still, the number of times specific issues were mentioned in the interviews needs to be carefully considered for various reasons: In the case of the Sierra de Manantlán, for instance, twice as many local community members as staff and management members were interviewed. This may influence the importance which was overall given to issues such as cattle farming. Local community members do not consider cattle farming as an activity with adverse effects on the environment, because a) cattle farming is an important and integral part of their living, and b) they regard the environment around them from a different perspective than a conservationist who tries to identify factors impacting on the state of biodiversity.

In addition, statements from interviewees, especially local community members, may only apply to the site where the interviewee lives. However, the names of these sites are not mentioned in this study to protect the interviewees' anonymity, considering that in some places only very few people were interviewed and it may be possible to trace back critical statements to individuals. This leads to a general methodological question: Has the difference in the number of interviews conducted per stakeholder group per site potentially lead to a bias in the analysis? While this cannot entirely be ruled out, a systematic bias is considered unlikely for the following reasons:

- Each statement was considered important and no statement was left out when it appeared to potentially add further information to the overall picture;
- The pure number of mentions of a specific issue did not necessarily influence the overall picture; invasive alien species, for example, were not mentioned by many interviewees but are regarded as problematic at both case study sites (see Box G.3 and Box G.5). In this way, awareness is raised even on specific issues that appear to only apply to a single site.

Considering that the results of the case studies reflect a picture that was gained during a comparably short research stay, a large amount of further information was included from scientific and grey literature to broaden and deepen the impression gained, but also to further strengthen the applied principle of triangulation (e.g. after Flick, 2004). This was a time consuming but necessary step for the validation of the interview results.

It is certainly possible to achieve still higher data validity and assure a more balanced coverage of all stakeholders. However, considering its results and existing information on indicators (see Table G.9, Table G.10 and Table G.16), the present study appears to have pinpointed numerous relevant aspects of the case study sites' situations. Although it is the local stakeholders and decision-makers who are best informed about the context of "their" biosphere reserve, they may have never looked at a summary of triangulated perspectives on their situation with a special emphasis on information gaps and bridging options. The results of the present study should therefore be regarded as an information source and a tool to further planning and management.

The present study clearly proves the value of qualitative open surveys. Intangible and difficult-to-quantify indicators were identified for both sites and although they cannot be translated into quantitative values, their significance is beyond controversy. The reasons for this will be discussed in more detail in subsection H.1.3.

H.1.2 The theoretical Conservation Success Framework in the light of the case study experience

The two case studies clearly demonstrate the necessity to include the three components **conservation needs**, **conservation capacity** and **conservation actions** into the Conservation Success Framework (CSF). In the following, this necessity will be argued in more detail for each component in the light of the case study experience. In addition, the importance of the **relation between the three components** is emphasised and **resource theory, the theoretical CSF and its application in practice** are discussed. The subsection concludes with reflections on the position of **the CSF and its practical application alongside established management effectiveness evaluation methods**.

The three components of the Conservation Success Framework: conservation needs, conservation capacity and conservation actions

The **conservation needs** component of the CSF was created and the name “conservation needs” selected after having reviewed empirical studies on challenges protected area managers are expected to address (see Chapter F). The adequacy of this component in terms of its naming, definition and function within the CSF is clearly supported by the case study experience. This becomes obvious when regarding the nature of the conservation objectives of both case study sites: While the identified conservation needs largely reflect the conservation objectives as outlined in the site’s management plan in the case of the Sierra Gorda Biosphere Reserve, the case of the Sierra de Manantlán Biosphere Reserve shows that this must not necessarily be the case. Here, conservation objectives are framed in a more overarching way without relating to specific needs at site. In general, however, conservation objectives from a site’s management plan could also point towards further issues of importance that were not found through a qualitative survey but still deserve consideration.

This underlines the importance to not treat conservation needs and objectives interchangeably but to consider them as complementary to each other, as the CSF does. If the management plan of the Sierra de Manantlán Biosphere Reserve included concrete conservation actions to address threats in addition to the broad conservation objectives, the key conservation needs identified through the qualitative survey would likely be better reflected in the plan. The approach to derive conservation needs from threats (consisting of DPSI's) as well as from conservation objectives, as shown in Figure H.1, is thus empirically strengthened through the case studies.

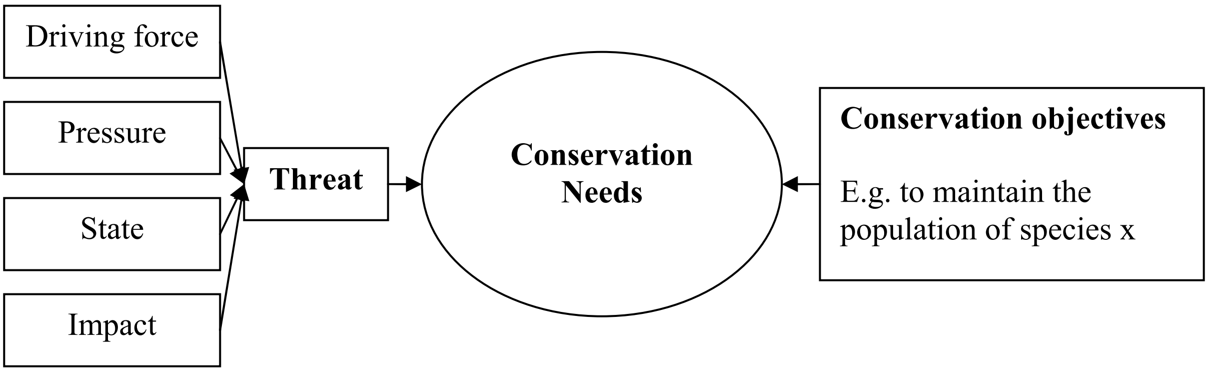


Figure H.1: Inference of the conservation needs component of the Conservation Success Framework

The two case studies also demonstrate the value of splitting up the existing threats into driving forces, pressures, states, and impacts, because:

- The split up allows for the identification and illustration of the specific threat components that the current conservation actions are targeting – and where potential action gaps exist;
- Existing indicators can be related to either the driving forces, pressures, states and impacts, or also to the actions addressing the driving forces, pressures, states and impacts. This is an important step for identifying further indicators as proposed for example by the European Environment Agency (1999) and Pirrone *et al.* (2005). While in the Miradi Adaptive Management Software for Conservation Projects (Conservation Measures Partnership, 2007) and in TNC's Conservation Action Planning (The Nature Conservancy, 2007) threats are split up into stresses and sources, the identification of indicators to track changes in threats as well as conservation targets is done in the same way.

In general, however, it needs to be remarked that many interviewees rather talked about pressures, than about driving forces, impacts and states. It is therefore challenging to create complete causal chains (or networks) from interview statements. In a repeated survey it is recommended to discuss the findings with key actors in the end (e.g. in a workshop) in order to better complete causal chains and networks. However, both results chapters have been reviewed by one local specialist per biosphere reserve and no corrections were requested.

The function of the conservation needs component is very clear: Without its existence, it is impossible to check whether the most pressing place-based conservation needs are addressed by conservation actions. The component is therefore indispensable for the CSF.

The **conservation capacity** component of the CSF has also proven to be highly valuable through the case studies, especially its broad definition that allows for consideration of many potential impact factors on conservation capacity. Concerning the resources aspects of the conservation capacity component, funding and staffing prove to have crucial impacts on the place-based situations. Especially in the Sierra Gorda Biosphere Reserve the increased capacity in terms of funding and personnel as a result of the long-term GEF project reflects this. Usually, the financial capacities of protected areas are regarded as the very base for other types of resources (e.g. personnel, equipment) (e.g. Carabias Lillo *et al.*, 2004) and their continuous lack, especially in developing countries, impacts on management effectiveness, as also emphasised by Bruner *et al.* (2004). However, characters of social capital, such as leadership, may play an equally important role for successful protected area management (e.g. Stoll-Kleemann and Bertzky, 2008) and are therefore well placed among the resources aspects of conservation capacity. This is clearly visible in both case study sites: In the Sierra Gorda Biosphere Reserve the leadership characteristics of the site's long-term key actors recently contributed to preventing the construction of eight hydropower plants. In the Sierra de Manantlán, long-term efforts of key actors from the university resulted in a change of the sewage water disposal system of the sugarcane factory upstream of the Ayuquila River, which led to a significant improvement of the river's water quality. Without the commitment and leadership qualities of key actors these conservation achievements would not have been possible.

In addition to the resources aspects of conservation capacity in the CSF, the governance aspects have proven important, too, especially in terms of inter-relations and partnerships between decision-makers in the two case study sites. The potential of the latter to have a crucial stabilising or also destabilising effect on the overall "system" of a protected area was specifically visible through the internal conflicts of the Sierra de Manantlán Biosphere Reserve. Here, existing discrepancies between actors involved in the management of the site are threatening the relation to local communities and may result in a loss of acceptance of the biosphere reserve with further crucial impacts on conservation achievements. The importance of governance in conservation is also stressed by Lee and Jetz (2008) who state that "*... for successful biodiversity protection factors representing the capacity for conservation, such as the quality of national governance and wealth are particularly critical.*" (Lee and Jetz, 2008: 7). While they focus on the national level the same certainly applies to sub-national levels as well.

Finally, the importance of community aspects became obvious. Where human-wildlife conflicts exist, local people's attitudes towards conservation may suffer significantly and impede on the implementation of further conservation actions (e.g. Kidegesho *et al*., 2007; Wang *et al*., 2006). On the other hand, where community initiatives were developed and are running autonomously by now, such as the local cleaning campaigns at both case study sites, this a) reduces the conservation needs, and b) remarkably adds to the overall conservation capacity.

The **conservation actions** component of the CSF represents the link between existing site-specific conservation needs and conservation capacity and is therefore an indispensable component of the CSF. In practice, the identification of conservation actions addressing conservation needs proved to be comparably easy. When asking interviewees how conservation objectives are achieved, they often responded by referring to conservation actions implemented. Interviewees also appeared to be happy to talk about conservation initiatives in place. However, an important difference needs to be made between those conservation actions in place to address conservation needs and those in place to address conservation capacity. Capacity challenges, for example in terms of human-wildlife conflicts, were many times mentioned when interviews turned towards indicators for recovering wildlife (e.g. 29:31, SGBR staff and 40:47 SGBR management). However, such actions were not addressed in a separate question. This may mean that some of such actions addressing conservation capacity constraints were not mentioned by interviewees. In general, it is considered possible that conservation actions addressing conservation capacity constraints are rather perceived as “management activities” than actual conservation actions. However, the Unified Classification of Conservation Actions (IUCN-CMP, 2006a), which was used in this study, also includes all such actions which address conservation capacity constraints or aim at strengthening existing capacities. In a repeated study, it could be considered to include one more question in the questionnaire that specifically addresses such actions in order to gain a deeper insight into the issue. At this point, the case study experience has revealed an option for improvement of the questionnaire to result in a more holistic information input into the CSF.

The relation between the CSF components

The close relation between the three main components of the CSF, conservation needs, conservation capacity, and conservation actions is considered empirically confirmed through the case studies as again explained in the following example: While in both sites the need to address the challenge of invasive alien species was identified, no specific capacity appeared to exists, neither in terms of funding, nor in terms of expert knowledge. Therefore, targeted conservation actions were very limited here.

The importance to regard conservation needs and capacity in relation to each other was recently also stressed by Lee and Jetz (2008). The resources component of capacity in their study is approached through the national Gross Domestic Product (GDP) per capita, however, the qualitative survey of the present study allows deeper insights into this issue (especially as being applied at the local, not the national level) although no questions were asked about the site’s budget: Through the cross-checking of whether needs and capacity constraints are addressed, it is possible to side-step detailed questions on how much and how efficiently funds are used in *in-situ* conservation. The Conservation Action Planning approach of The Nature Conservancy (The Nature Conservancy, 2007) and the Miradi Adaptive Management Software for Conservation Projects (Conservation Measures Partnership, 2007) do similarly emphasise the importance to directly relate actions to needs (although the terminology differs slightly) in order to make sure that the most pressing conservation needs are addressed (FOS and Benetech, 2008; The Nature Conservancy, 2007).

Resource theory, the theoretical CSF and its application in practice

The experience from both case study sites is consistent with the common pool resources theory as introduced in section D.1: The transfer of responsibilities to local communities may be followed by an improved engagement in or higher acceptance of conservation measures according to solutions discussed for solving the “Tragedy of the Commons” (Berkes, 2007; Berkes *et al.*, 1989; Ostrom, 1990; Ostrom *et al.*, 2007). This was especially obvious in some of the visited *ejidos* within the Sierra de Manantlán Biosphere Reserve, where sustainable natural resource management appeared to be realised almost entirely by the *ejido* members themselves. However, in other *ejidos* of the same site, poor local governance followed by a neglect of specific resource use rights resulted in resentment of *ejido* members towards the SMBR personnel. If this results in continuing uncontrolled burning of fields for agriculture this could lead to an increase in the total burnt area within the Sierra de Manantlán Biosphere Reserve. The lacking sense of responsibility for the intactness of the surrounding ecosystems thus furthers the unsustainable use of natural resources as described by Hardin (1968) and supported by Baden and Noonan (1998), Dietz *et al.* (2003), Folke (2007), and others.

A discrepancy can however be identified between the theoretical CSF and its application in practice. The CSF represents a theoretical framework, which can only lead to conservation success when the conservation needs are “smaller” than the capacity and actions combined, so that the subsequent formula applies:

If conservation capacity + conservation actions - conservation needs ≥ 0 then = conservation success

This is based on the assumption that conservation actions do adequately address the conservation needs, and conservation targets (e.g. target species) reply in a positive way to these actions. This adequacy of capacity allocation and actions implemented is included in this assumption taken that an adaptive management decision-making system is in place, as also included in the CSF. Practice, however, does not translate into a mathematical formula. Such a calculation would require a scoring system, a weighing system for the degree of impact of separate factors and crucial simplification of findings in order to press them into a ranking scheme (see e.g. Stem *et al.*, 2003). This, however, is not the purpose of the present study as crucial information included in the qualitative data gathered would be lost during the processing. Therefore, practical implementation of the framework needs the inclusion of one more essential question: **What are noticeable effects of conservation actions?** Without this question, the above given assumption on adequacy of and positive reply to conservation actions remains unaddressed and it is impossible to make a statement on conservation achievements. Only if effects from action are in fact positive, the conditions for achieving conservation success may be existent. Translated back into the theoretical framework, the positive effects should in the long run either increase the conservation capacity, or decrease conservation needs. This phenomenon is exemplified through the case studies, where local conservation campaigns have become autonomous and thus increase the conservation capacity at both sites. An adaptive management system that keeps track of such dynamics may consequently reallocate resources according to changing needs, actions and capacities. The inclusion of the question of noticeable effects thus bridges the gap between theory and practical application of the CSF. The necessity to differ between the terms "conservation success" (here only used in theory) and "conservation achievements" (here used in practice), however, remains.

The Conservation Success Framework and established management effectiveness evaluation methods

Several of the existing approaches to assessing management effectiveness tend to simplify and score (see comparisons in Hockings, 2003; Stem *et al.*, 2003). However, intangible and difficult-to-quantify indicators for conservation success and failure may be lost in this process and the equal weighing of each influencing factor may result in an overall picture which is too symmetrical and thus does not reflect reality. The Sierra de Manantlán case study clearly shows that an equal weighing of factors may result in a wrong picture: The loss of consensus within the advisory council and among key stakeholders can potentially trigger a much more serious loss of local people's acceptance, followed by further detrimental consequences. Even the powerful affiliation of the site to an academic institution is unlikely to mitigate this situation, especially as the academic stakeholders are facing internal discrepancies with the biosphere reserve directory.

Stem *et al.* (2003: 9) state that "*To most effectively measure conservation impact, it is critical to understand the context in which conservation interventions take place and the cause and effect relationships that affect the state of conservation*." If only ecological monitoring data existed, serious contextual threats to sustainable conservation, such as internal conflicts, would remain hidden. As the case study results suggest, considerable conservation achievements can be reported from the Sierra de Manantlán Biosphere Reserve, but may still not be enough for safeguarding its biodiversity values if existing conflicts intensify and external interests manage to step in by making use of the current vulnerability of the site's management.

The questions that necessarily derive from this are: How much ecological monitoring data is actually needed and how far should it be complemented by qualitative and intangible indicators? These questions are key to assessments of management effectiveness. Experience with existing assessment methods shows that the answer depends on the purpose of the study (e.g. Hockings, 2003). If the purpose is to compare protected area characteristics, for example in terms of staffing, between sites, as can be done with the RAPPAM methodology (Ervin, 2003), then a smaller and fix set of quantitative and qualitative performance indicators estimated and ranked by local experts may be sufficient. Other methods, such as the Enhancing Our Heritage approach, do explicitly aim at providing on-site management support and deliberately avoid an overall scoring system (Hockings *et al.*, 2007; Hockings *et al.*, 2008). This is done for the same reason as in the present study: to allow for as much information as available to feed into the final assessment. The amount of data available to carry out such an assessment is then determined by two criteria:

1. Qualitative information saturation, and
2. The availability of quantitative data

This applies to any assessment of protected area management effectiveness. However, personnel and financial capacities may also determine the detail of such assessments. While the present study analysed a large amount of qualitative data in very much detail, this is a very time consuming endeavour and may not always be repeatable.

In conclusion to subsection H.1.2, the theoretical Conservation Success Framework developed in the present study is considered to form a stable and well argued theoretical base. Its application reveals cause and effect relationships that significantly contribute to clarifying the place-based situations and identifying potential action and information gaps. The case studies empirically proved the importance of all components of the framework. However, the developed research approach to assessing conservation achievements does not present the “re-invention of the wheel” compared to existing management effectiveness evaluation methods. On the one hand, the principles of existing methods have been considered in the development of the CSF and its application in practice. On the other hand, however, the theoretical development of the CSF and the research approach at the case study sites represent an innovation in both theory and practice of conservation.

H.1.3 Recommendations for bridging existing information gaps at case study sites

In this subsection, practical recommendations to bridge existing information gaps at case study sites will be given to local stakeholders.

At both case study sites an impressive number of conservation actions are implemented to address the sites’ conservation needs. The most direct way for analysing whether or not these actions lead to achieving determined objectives from a natural scientific perspective would be through ecological monitoring data that demonstrate the response of natural features to these actions. Many times, however, such data does not exist or was not collected continuously or consistently enough to indicate changes. In addition, some conservation objectives or indicators are difficult to measure quantitatively, and different natural features respond over different time scales. It is for example possible to achieve the reforestation of a few hectares of land within a decade, but the introduction of a conservation culture into people’s attitudes and behaviour is an inter-generational, large-scale process that is ongoing and cannot directly be measured quantitatively. Figure H.2 exemplifies these differences in time-frame and measurability of conservation objectives and indicators.

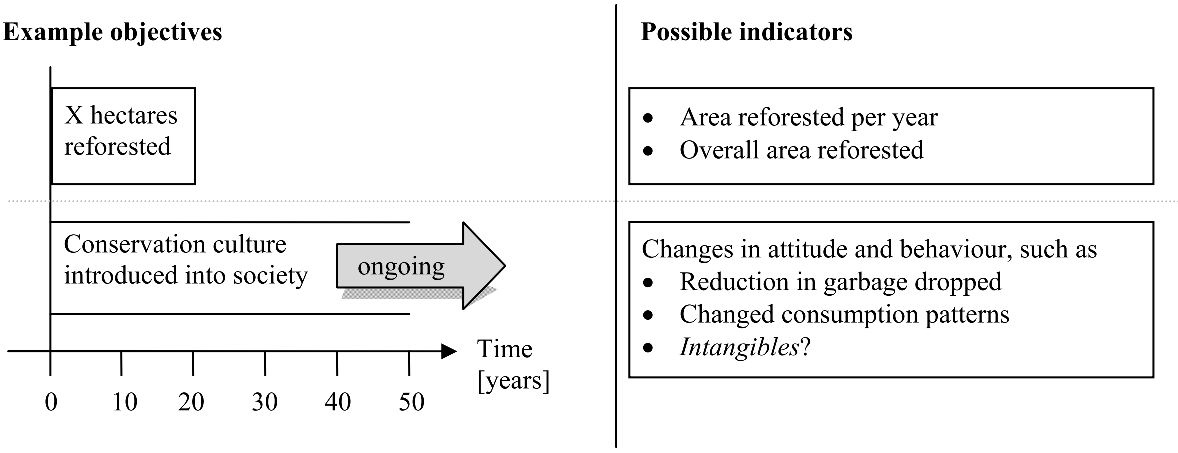


Figure H.2: Time-frame and measurability of conservation objectives and possible indicators

The question of existing information gaps therefore does not only concern ecological and socio-economic monitoring data but also difficult-to-quantify, more "soft value" indicators, in Figure H.2 named "intangibles". Both types of information gaps, hard and soft, are therefore discussed in the following, before bridging options are summarised for both case study sites at the end of this subsection.

Hard and soft value information at the case study sites: availability, lack, and sharing

Data availability differed remarkably between the case study sites, largely due to differences in the sites' conservation history (see Table H.1).

Table H.1: Comparison of conservation history of and data availability at case study sites

	Sierra Gorda	Sierra de Manantlán
Start of actions	~ 20 years ago	~ 20 years ago
Trigger for action	Local grassroots initiative to conserve natural values and enhance well-being	Academic initiative to conduct research and conserve genetic diversity
Existing information	Hardly any research papers, a lot of grey literature, recent monitoring and evaluation reports	Countless research papers, some grey literature, no monitoring and evaluation reports
Available information	Everything available was passed on	Many articles were passed on, many more were available online, large portion could not be fed into this study

Unexpectedly, although much more research literature exists from the Sierra de Manantlán Biosphere Reserve, there was more data from performance evaluations available from the Sierra Gorda Biosphere Reserve. The relative scarcity of data suitable for an assessment of conservation achievements from the SMBR is astonishing given the long history of academic research at site. While it is possible that some existing documents or other data sources were not found, the lack of effectiveness indicators mentioned by an interviewee from the SMBR management group supports the conclusion that data on the effectiveness of the site in achieving conservation objectives does not yet exist (interview statement number 48:34).

The phenomenon of parallel data overkill and data scarcity, as it was identified on a global level in Chapter E, seems to be reflected also from the SMBR. Existing data is certainly very valuable for the management of the site and does already feed into management decision-making, for example in relation to the management of wildfire. However, key information required for an assessment of conservation achievements cannot easily be found or openly accessed. It was for example impossible to access existing data on the change of water quality from the rivers of the Sierra de Manantlán although it can be expected to exist (RED MEX-LTER, 2008). In the year 2006 it was planned to conduct a RAPPAM study in the SMBR but unfortunately, according to latest information, the plan was cancelled again (pers. com. via Email on the 13th of June 2008).

In the case of the Sierra Gorda Biosphere Reserve, the latest evaluation reports (Galimidi and Olsen, 2007; Ruiz Corzo, 2005) and the study on forest cover changes (De la Llata Gómez *et al.*, 2006) were very helpful to support the qualitative survey results. However, performance monitoring only started here when the GEF project was launched and required indicators had to be monitored. This points out the problem that performance monitoring is not yet regarded as a standard for many *in-situ* conservation sites. It is hoped that the SGBR will, now that a monitoring scheme is in place, continue to further develop this and monitor its own performance.

By the beginning of November 2008 an article was published on the effectiveness of national protected areas in Mexico in the journal "Biodiversity Conservation" (Figueroa and Sánchez-Cordero, 2008)[73]. In this article, land use and land cover changes within and

[73] The present PhD thesis was submitted in mid November 2008. For this reason this article could only be considered in the discussion, not in other sections of the thesis anymore.

outside 69 national protected areas were compared using satellite images from 1993 and 2002, and an effectiveness indice calculated. Both case study sites of the present study are included in this article. The Sierra de Manantlán Biosphere Reserve resulted effective by this comparison – and again this corresponds to the findings presented in subsection G.3.8. However, the Sierra Gorda Biosphere Reserve was considered non-effective (Figueroa and Sánchez-Cordero, 2008). In that, the article contradicts to the data from De la Llata Gómez *et al.* (2006) and the findings presented in subsection G.2.8. Different reasons are possible, ranging from methodological issues up to the fact that De la Llata Gómez *et al.* investigated changes at a much larger time frame, namely between 1973 and 2004. This contradiction further emphasises the need to continue monitoring efforts, keep track of the changes noticed in both studies (De la Llata Gómez *et al.*, 2006; Figueroa and Sánchez-Cordero, 2008), and follow up on the origin of different findings.

There is a noticeable difference between the data that was initially searched for and the data that was in the end used to validate the qualitative survey results. The information used was in many cases more a substitute to the information searched. Still, there were hardly any ecological hard facts available, especially such recorded over time. It would have been very helpful to have more monitoring data concerning the status of flora and fauna. For Manantlán, some data seems to exist, for example on birds, as stated on the homepage of the Red Mexicana de Investigación Ecológica a Largo Plazo (RED MEX-LTER, 2008). However, this data was not accessible. Wherever this was the case, the statements made by interviewees remain the only source of information. It is also important to remark that remote sensing data, another potential source of ecological information, does not provide information on the status of fauna species and is especially unsuitable in places with naturally scarce vegetation (e.g. Strand *et al.*, 2007) – which is the case for a smaller part of the SGBR as well. However, the combination of forest cover increase demonstrated by De la Llata Gómez *et al.* (2006) and the increased number of sightings of flagship fauna species can be regarded as a proxy for the missing ecological data on the dynamics of species' populations.

Overall, the data situation at both case study sites further emphasises the existing difficulty in handling but also communicating data. The Sierra de Manantlán Biosphere Reserve, while benefiting remarkably from the numerous research projects conducted by the University, could still improve the communication of existing data in the field of effectiveness monitoring. In turn, the Sierra Gorda Biosphere Reserve could still further strengthen the cooperation with the University of Querétaro in order to conduct joint monitoring and research projects with the university's scientists and students.

Scientific or academic competitiveness was identified as one potential reason for data retention in chapter E. The close cooperation of the SMBR with an academic institution which naturally has a strong interest in protecting the data it gathered and publishing its own research results may lead to the assumption that some form of competitiveness exists here. Yet there is no conclusive evidence for this from the case study in the Sierra de Manantlán Biosphere Reserve. On the other hand, the willingness to provide whatever data existed on the Sierra Gorda Biosphere Reserve was peculiar and may be related to an obvious absence of scientific or academic competitiveness.

The case studies stressed one more important principle: It is always a combination of different types of data that leads to the best overall picture of the situation at a site. From both biosphere reserves, much of the available and accessible data was not of ecological but socio-economic nature. However, it should be considered that both sites are heavily populated and therefore conservation needs and potential indicators at these sites can be expected to be closely related to the socio-economic situation. In a site under considerable less anthropogenic influence, where socio-economic indicators are less relevant for an assessment of conservation achievements, the dependency from ecological monitoring data is much stronger.

Both case study sites have revealed a series of intangibles, or difficult-to-quantify indicators for the performance of biosphere reserves and also, as is the special focus here, for conservation achievements. These indicators can neither be anticipated nor be presented by numbers. Glenn *et al.* (2000: 16) state that "*man's impacts do not always appear as sudden, obvious jumps in easily detected signals, but are typically subtle, creeping changes in sometimes unexpected indicators, slowly manifest over many decades.*" The same can apply to nature's response to man's impact (with the exception of complete and rapid destruction) – in terms of external influences as well as conservation efforts. But does this mean those indicators should be ignored? The results of the case studies argue for the importance not to ignore such indicators as their value is too high to be ignored.

One indicator that was identified to play an outstanding role in both case study sites is the **continuance of key actors and processes**. In a resource management concept that is based on reconciliation of development and conservation, trust and understanding between key stakeholders are pivotal for any conservation achievement. This underlines the importance of governance issues for the successful implementation of biosphere reserves: In the Sierra Gorda Biosphere Reserve, where the positions of local actors involved in the site's management do not depend on governmental office periods, the existing relationship and trust among these actors can be further strengthened, knowledge of the region and understanding of the people's needs increased and, as a consequence, overall acceptance of the biosphere reserve may rise. In the Sierra de Manantlán Biosphere Reserve the same applies to numerous key actors from the university involved. However, there the biosphere reserve director has changed several times within a few years which resulted in a significant loss of trust and increased scepticism now posing a problem for many of the key actors. The case studies have clearly demonstrated the stabilising – or destabilising – influence such dynamics can have. However, in a purely quantitative assessment this would not have been revealed. When asked for his opinion on how to make sure conservation objectives can in fact be achieved in protected areas, a civil servant explained the importance of continuance as follows: "*I think [one starts] with a clear vision of conservation, establish a management model for a protected area and give continuance to it through time. We cannot continuously test models or people; we need a continuance of processes, not only ecological ones, but social and economic ones. We need stability in all the aspects for being able to go forward little by little, this means, these are very long processes because they are concerned with the perception of the people towards conservation. But I believe as long as there is a clear model of conservation and people who can provide this continuance in alliances, I believe that we can think of conservation as something feasible in the medium and long term.*" (55:69, civil servant).

However, while continuance can still easily be taken into account in the conservation capacity component of the Conservation Success Framework, by far less tangible indicators were especially evident in the Sierra Gorda Biosphere Reserve. They concentrate on three interesting observations:

- Numerous local community members were reported to have replaced in their vocabulary the term "soil" with "mother earth";

- When arriving in a remote village, all the school children came running towards the SGBR's staff, waving, smiling and shouting "Ecología!", obviously more than happy to see them; and
- Communities from the adjacent State of Guanajuato were so impressed by the activities conducted in the SGBR that they promoted the establishment of a biosphere reserve in "their" State, which is now the "Reserva de la Biosfera Sierra Gorda de Guanajuato".

All these are consequences from the activities within the biosphere reserve. They are difficult to anticipate in advance and impossible to quantify; however, they are still expressive and useful as indicators for local achievements. Although intangible indicators do not fit in pre-determined assessment schemes, there should be space for noting and communicating them. In the end, these are indicators for an ongoing introduction of conservation culture - difficult-to-measure, but obviously observable.

In addition, in both biosphere reserves some activities, such as cleaning campaigns, have become autonomous and independent from the sites' management. This does not only increase the conservation capacity at both sites, but is also likely to decrease their conservation needs. And it indicates that interest in conservation is growing among local people. This is fundamental for local awareness and for the germination of conservation culture as a prerequisite for sustainable and thus longer-term thinking.

According to Dixon "*the short-term, narrow, survival-oriented perspective of the human mind is a key driver of Unsustainability*" (Dixon, 2004: 3). Any indication for the development of a longer-term and wider perspective of the human mind should therefore be considered of immense value in the endeavour to reconcile conservation and natural resource use towards sustainability. However, this cannot happen as long as survival-oriented drivers, such as hunger, dominate the lives of people. Again, this supports the close relation between what was once regarded counteracting to each other: conservation and development.

Recommendations for case study sites

The recommendations that can be synthesised for the case study sites refer to three main issues:

1. Handling of existing information
2. Revision of the management plans
3. Future consolidation of information

1. Handling of existing information

The Sierra Gorda Biosphere Reserve has made a good start in terms of data gathering through the GEF project. This project is now coming to an end but, fortunately, it was designed in such a way as to ensure the maintenance of facilities and personnel capacity even after the project's end so that there is hope that the existing conservation capacity can be retained[74]. The existing information represents a very good base for the monitoring of ongoing conservation actions. However, it is important that monitoring data is gathered continuously over the years and it is therefore recommended not to stop the measurements that were done for the GEF project but to continue to gather at least those which will still provide valuable information on the progress of conservation achievements. Moreover, it could be an interesting option to also engage in some national programme, such as the RED MEX-LTER, and to exchange knowledge on monitoring programmes. A stronger emphasis on outcome monitoring (much of what has been done so far is rather implementation monitoring) is recommended as well. Existing tools, such as TNC's CAP or Miradi, are very helpful for the development of such monitoring systems, and the identification of indicators (Conservation Measures Partnership, 2007; ConserveOnline, 2007; The Nature Conservancy, 2007).

The Sierra de Manantlán Biosphere Reserve hosts an impressive amount of research and monitoring information. However, it was not possible to find a synthesis document in which the existing information is related back to the biosphere reserve's objectives in order to inform about any conservation achievements made over the past 20 years. This is unfortunate, especially as there seems to be so much information available, which could be used to convince those who have expressed their doubts on the value of the biosphere reserve and the research conducted by the university. If such a synthesis document is

[74] Funding for the year 2009 is obviously secured as was reported in October 2008.

indeed lacking, it is recommended to place priority on its preparation, also because it will be crucial for the revision of the management plan. It also appears that several monitoring activities are not conducted with equal emphasis throughout the biosphere reserve. While the Las Joyas core area is definitely a priority region for research and monitoring, it is recommended to also intensify monitoring activities in other parts of the biosphere reserve to get a more complete picture of conservation progress.

2. Revision of the management plans

The management plan of the SGBR was published in 1999 (INE, 1999), the one of the SMBR in the year 2000 (INE, 2000), so both will celebrate their tenth anniversary within the next two years. It can thus be expected that revised versions of these plans will be developed at some point in time. Within the current management plans, a timeline for revision has not been determined. According to latest information, a revision was planned for the management plan of the Sierra de Manantlán Biosphere Reserve but was not realised due to the current internal management conflicts (pers. com. via Email on the 13th of June 2008). For the Sierra Gorda Biosphere Reserve it has been reported that a revised version is in preparation (pers. comm. via Email on the 27th of August 2008). Therefore it is recommended to define a **time line** for the revision and to include in the revised management plans a **time frame** that indicates when the next revision should be done.

Second, it is recommended to include **much more specific conservation objectives** into the management plans. If it is wished to phrase the objectives more broadly, then more specific subobjectives should be included which are more easily measurable and operational (as was mentioned before, existing tools, such as TNC's CAP (ConserveOnline, 2007; The Nature Conservancy, 2007) or Miradi (Conservation Measures Partnership, 2007), do not only help to identify indicators but also help to phrase very clear objectives).

Third, the present study includes several ideas which could be picked up in the revision of the management plans. For example, the **dissection of threats** to biodiversity into driving forces, pressures, states and impacts could be incorporated into the situational analysis. This is recommended, as mentioned earlier, to allow for more specifically identifying where there is still **room for action** which is not used so far. Figure G.15 and Figure G.28 give an example for how this could be done. Then, it may also be helpful to identify

missing indicators. The Table G.9 and Table G.10 for the SGBR and Table G.16 for the SMBR could be used as a basis for this or as a proxy for an assessment of progress. The consideration of these recommendations is regarded as the pre-condition to achieving a consolidation of information in the future.

3. Future consolidation of information

Based on revised management plans, which include relevant indicators, both biosphere reserves should assess the feasibility of gathering the required data in the long run. In doing so, closer collaboration with close-by existing academic institutions should be considered, as is already the case in the Sierra de Manantlán Biosphere Reserve. However, as some interviewees pointed out that not all of the research done in the region is in fact useful for the biosphere reserve (e.g. 9:50, SMBR management), this could still be optimised. In case of the Sierra Gorda Biosphere Reserve, the cooperation with the University of Querétaro could be strengthened as well, with emphasis on two action levels:

- Required data should be gathered with the support of trained students, for example in the form of theses, and research results directly passed on to feed into management. Priority studies could be announced publicly and interested students should be encouraged to give priority to studying missing indicators;
- The latest tools for strategic management and monitoring should become integral part of the study courses in natural resource management to build future capacity and promote the importance of monitoring and evaluation for adaptive management.

The southern coastal branch of the University of Guadalajara, affiliated to the Sierra de Manantlán Biosphere Reserve, offers courses in natural resource management and the University of Querétaro, close to the Sierra Gorda Biosphere Reserve, offers courses in natural resource management as part of their natural scientific PhD programme. In both cases, today’s requirements for managing a biosphere reserve could very well help to shape the content of these courses. Moreover, regular excursions and studies could be conducted to look into the management of biosphere reserves in practice. This should be especially easy to implement in the Sierra de Manantlán Biosphere Reserve, where the academic key actors are already involved in the management of the site. In both sites this could considerably enhance the future conservation capacity. In addition, the sustainability of monitoring processes could be enhanced if they become a natural part of student activities. This would address the problem noted by Aldrich *et al.* (2004: 17): "*Most monitoring and evaluation systems fail after a few years because they run out of money and choice of indicators needs to be influenced and to some extent constrained by the accessibility over time.*"

A civil servant during an interview comparably points towards the value of participation for capacity increase: "*This we have to strengthen in our institution […] that neither has sufficient personnel nor resources to realise vigilance in all the places where we want this to be done. But it is tried to get more and more [capacity] with the participation of the people who live there, other local authorities, non-governmental authorities, social organisations who participate, because otherwise the federal government alone won't be able to achieve this and we also won't achieve it if we destine more money into it.*" (35:52 – 35:55). From here, a link can once more be drawn to Hardin's Tragedy of the Commons (Hardin, 1968), assuming that participation increases a feeling of responsibility and may thus support a mental shift towards sustainability thinking.

H.2 Overall discussion of the thesis

The present study leads to two major points of general discussion (apart from the specific case study discussion above) which will be discussed in the following:

1. The value of values in conservation;
2. Recommendations to the international conservation community for bridging information gaps now and avoiding them in the future

H.2.1 The value of values in conservation

Traditionally, quantifiable values were treated as the correct and most convincing measure in natural as well as social sciences (e.g. Punch, 2006). Qualitative social sciences have taken much longer until they were widely recognised as equally valuable – but they are still regarded with scepticism by some. In the literature it often remains unclear whether the call for more science-based decision-making in conservation refers to quantitative science alone, or also to qualitative science (e.g. Nichols and Williams, 2006; Stevens *et al*., 2007). One of the few papers focussing clearly on qualitative science-based research is Welp *et al.* (2006), yet it does not relate to monitoring information. While the present study underlines the importance of science-based management, it also stresses the necessity to consider both quantitative and qualitative information in management and monitoring as both types of information complement each other.

The adaptive management cycle after Hockings *et al.* (2006) recommends to evaluate context, planning, input, processes, output and outcomes in protected area management. Some of these components (e.g. inputs in terms of funding, staff, etc.) can comparably "easy" be quantified. However, in many cases, existing approaches for assessing management effectiveness use (qualitative) expert opinions instead of hard-facts, and responses are then ranked and a quantitative value is allocated to each response (e.g. Ervin, 2003; Stolton *et al.*, 2003). While this speeds up the assessment process, valuable information may be lost in the process. The Enhancing our Heritage approach, as mentioned earlier, in contrast does not rank given responses so not to lose valuable information (Hockings *et al.*, 2007; Hockings *et al.*, 2008). However, it is also the most detailed and thus time-consuming and cost-intensive approach to assessing management effectiveness (Leverington *et al.*, 2008b). Consequently, so far, there seems to be a trade-off between detail and non-quantification on the one hand and speed and quantification on the other.

Socio-economic monitoring, whether of qualitative or quantitative nature, has not yet become a natural part of monitoring activities in protected areas although the importance of such information is beyond controversy (Lotze-Campen *et al.*, 2008). Another crucial information gap that still exists is outcomes-based ecological monitoring (Leverington *et al.*, 2008a). Depending on what the conservation objectives are, there is a need for both quantitative and qualitative measures (e.g. for the broad objective of introducing a conservation culture into local communities), and both should be equally valued. This is also the main focus of the "Sustainability Geoscope" as proposed by Lotze-Campen *et al.* (2008).

Many times the purpose of an assessment of management effectiveness is misunderstood as being a performance assessment of protected area managers that is required by external interest groups and that requires extra efforts (e.g. Hockings and Dudley, 2007). Above all, the protected area managers themselves should however be interested in understanding how well they are performing, especially in face of the very limited resources for conservation. Once this understanding has reached the local level – for example through higher levels leading by example – information uptake can become institutionalised and a natural part of protected area management. Evaluation processes may then no longer be regarded as requiring so much extra effort and being an additional burden to the countless other obligations protected area managers are facing today. Cooperation with close-by universities may also help to accomplish the task of gathering required data and conducting base line studies as discussed for the case study sites (and see also Bertzky and Stoll-Kleemann, 2008).

Although it is useful, as a starting point, to assess management effectiveness once, the overall goal must be the institutionalised and science-based regular assessment of performance, including conservation outcomes, based on both quantitative and qualitative information. The further development, promotion, and establishment of certification schemes for sustainable quality enhancement of protected areas and biosphere reserves is considered crucial to achieve this objective (see also section E.3, Dudley, 2004; Schliep *et al.*, subm.).

Difficult-to-quantify indicators and so-called "intangibles" should not be ignored as they can make a valuable contribution to conservation science. This would also be in line with Einstein's notion that "*Not everything that can be counted counts and not everything that counts can be counted.*" (see, e.g., Giangreco and Taylor, 2003; Kaufmann and Kraay, 2008, also subsection B.4.1). Both conservation science and practice could only benefit if these principles are adhered to.

One more additional remark needs to be made with respect to "the value of values in conservation": The present study deals in many ways with values. When considered from a contents perspective, these values are principally linked to "valuable information" for conservation and management. However, the issue of conservation as a whole is value loaded in an ethical sense as well and many value loaded terms of conservation science appear throughout this thesis, such as vulnerability, ecosystem integrity or health, pressures and impacts, to name but a few. Considering the sensitivity and controversy around many of these terms they are used with care and in the spirit of Hayles (1995), who states that "*Values are too often treated in scientific discourse as if they were written not in the book of nature but in an appendix to it, added on afterward rather than* *intrinsic to the stories through which we constitute nature for ourselves and others*." (Hayles, 1995: 55). This applies to the entire study presented.

H.2.2 Recommendations to the international conservation community for bridging information gaps now and avoiding them in the future

The growing demand for data sharing in biodiversity science in general is reflected in the number and numerous purposes of existing databases (see Chapter E). The need for data that is suitable for effectiveness assessments of conservation actions and protected areas has been recognised and ambitious initiatives have been established as a consequence (see also section E.3). An impressive effort has been made to further develop and expand these initiatives, and specialists around the globe are working on common standards for data uptake, storage and upload and the implementation of adequate site-specific monitoring and evaluation systems. However, while it could not be expected that the existing databases would be perfectly suited to answer the research question the natural scientific approach to this study focussed on (see Figure B.1), it seems unfortunate that not a single one has been suitable for this, despite the pressing need for such information. It is not known how much data actually exists in databases that cannot be accessed online, but could be used for national assessments of the achievement of the CBD 2010 Target. However, it is beyond doubt that by the year 2010 it will not be possible to give a holistic picture of the progress made towards the protected area management effectiveness indicator for the 2010 Target of the CBD. In general, the indicators that were determined for the CBD 2010 Target (see e.g. Balmford *et al.*, 2005b) are headline indicators, each thus requiring another comprehensive set of indicators to provide a picture on the state of the headline ones. However, the science behind many of these indicators is still in its infancy (Mace and Baillie, 2007, and pers. comm. by the Biodiversity Indicators Partnership in May 2008), and therefore cannot create sufficient information until 2010 to reflect the status of the selected indicators.

The issue of protected area management effectiveness was first raised at the 1983 World Parks Congress in Bali (Hockings *et al.*, 2004) and the Management Effectiveness Task Force of the World Commission on Protected Areas only exists since 1995 (Dudley *et al.*, 2003). So far, management effectiveness evaluations have only been conducted in about 6% of the more than 100,000 designated protected areas around the world (Leverington *et al.*, 2008a). While further evaluations will for sure be conducted during the next years, the target of evaluating 30% of all existing protected areas until 2010 will not be achieved. Moreover, conducting an assessment does not yet mean that the assessed protected area is successful in conserving biodiversity.

This raises the question what other information could possibly be provided on the protected area level by 2010 in order to bridge the existing information gap. Where information on the effectiveness of protected areas is missing, the present study suggests that it is important to know whether or not the basic conditions for achieving conservation objectives are in place. This question can be answered by relating site-based conservation needs to conservation capacity through easily understandable and compact questionnaires, which follow for example the here used Unified Classification of Direct Threats (IUCN-CMP, 2006b) and include a question on how adequately or not the threats can be addressed by the existing capacity. This approach would provide "something" instead of "nothing" and, if this information is collected and communicated in any case, it would also demonstrate to the wider public the seriousness of shortcomings most protected area managers are facing. By doing this, many site managers would not have to be reluctant anymore to their sites being assessed because this approach would enable everyone to understand why some objectives cannot be achieved under existing conditions.

Criticism towards effectiveness evaluations refers to either the difficulty of ensuring the validity of evaluations or to potential funding disadvantages feared by protected area managers as a result of valid but negative evaluations (Dudley *et al*., 2003; Hockings *et al*., 2004). Concerning the first one, a validity check is always a challenge. If an assessment is carried out as a self-assessment it may be biased due to polarised insider interests. In turn, if it is carried out by an external expert, this person may lack local knowledge and potentially misinterpret given information. In the national parks of the UK a mechanism has been established whereby protected area managers first do a self-assessment and then pass it on to an external expert for review (Lloyd *et al*., 2005). This approach could be used to increase overall validity. Concerning the second criticism, an assessment should in general never be used to retain financial resources from a site either because a) “it does not function anyway”, or b) “it functions and thus does not need so much money”. Where the capacities are well developed the aim should always be to at least maintain this state. Where there are serious shortcomings this needs to be much more clearly communicated as a call for help from separate sites. This could for instance be done through the World Database on Protected Areas (WDPA). Arguments against inclusion of such information to online databases are also discussed in Hockings *et al.* (2004).

Of course, the inclusion of every bit of new information into the WDPA would require a considerable effort also in terms of data handling at the international level (here UNEP-WCMC), and it is important not to forget that resources are limited there as well. However, as the CBD 2010 Target is a target agreed on by 190 states, there should be an international interest in the measuring of progress towards this target and also in the communication of existing information in this regard. The facilitation of a certain level of transparency through improved information handling and communication should therefore be of interest to the 190 state parties to the CBD. Regional networks and alliances supporting the reporting about progress on international conservation targets could possibly reduce the additional effort from increasing amounts of open access data.

Overall, there does not seem to be much awareness so far about the fact that the world expects protected area managers to defend, with minimum conservation capacity, large tracts of land against external influences as wide ranging as illegal activities, invasive alien species and climate change. Moreover, today they are in parallel often tasked with, for example, eliminating poverty and resolving conflicts. Many times conservation is claimed to fail, to have been ineffective and to miss targets over and over again (e.g. Haslett, 2002). This may have led to a reluctance of protected area managers in communicating failures which is problematic for two reasons: Firstly, as it is the case in many aspects of life, a lot can be learned from failures, not only from success, and it would be important to share such lessons learned in any case. Secondly, if it was made more visible why it is so difficult to do successful conservation, and what minimum requirements are needed in order to be more effective and efficient[75], then it would be evident that such accusations of constant failure are inappropriate. Again, the key to the communication of this misstate is information – and information sharing – on both successes and failures.

To date, the sharing of biodiversity information is often claimed to serve the global village to work with this data and do research on countless topics but not so much to

[75] This does not only refer to financial resources but also to other aspects of conservation capacity such as governance structures and processes.

communicate what this data means for humanity as a whole. Towards 2010 and beyond, the value and usefulness of protected area and management effectiveness information needs to be much more promoted and awareness and interest should be raised among the global public. Protected area managers need to understand the benefits they can gain from evaluations. Subsequently, data gathering needs to become a natural part of day to day work instead of being regarded as a massive one-time effort that protected area managers are asked to do by external funding agents for example. Otherwise, if information gathering does not become routine, reporting cannot become routine and sharing of this information can consequently never happen.

One of the key lessons learned from the Countdown 2010 initiative in relation to the state of information on the indicators that were chosen for measuring progress on the achievement of the CBD 2010 Target is: The demand for information on the indicators did not adequately consider the feasibility for gathering, accessing and handling such sensitive information until the set deadline for the CBD 2010 Target.

H.3 Conclusions

The present study leads to some major conclusions concerning the state of the information on protected area effectiveness that is available to the conservation community and the global public. These conclusions do in fact not only apply to the special case of protected area information but can also be transferred to other fields where information gaps exist.

First of all, consolidated action on several governance levels is urgently needed to address the clear information gaps and existing oppositions against information sharing in conservation science. Those levels encompass the local protected area management body, local (academic) capacity building institutions and authorities, but also regional, national and international capacity-building and decision-making levels. Figure H.3 shows several of the actions needed on local, national and international level.

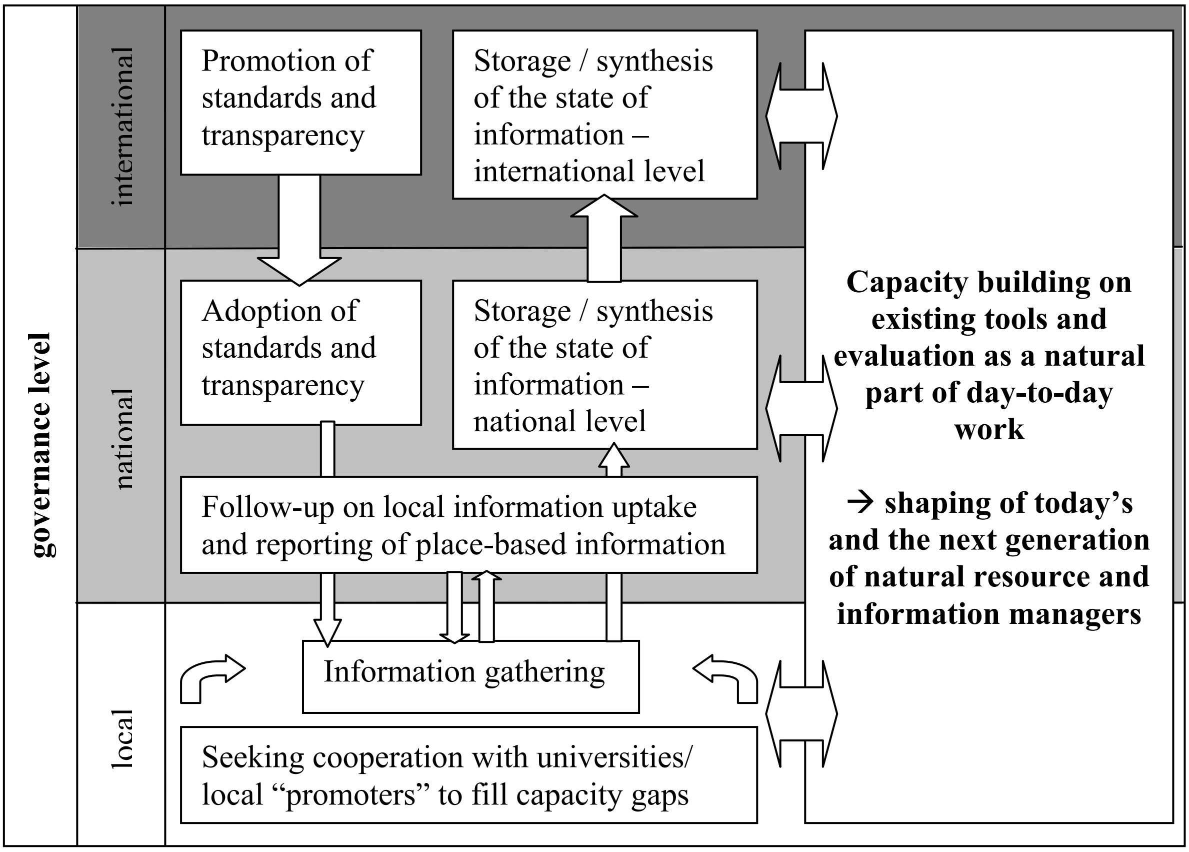


Figure H.3: Consolidated actions needed on different governance levels to address existing information gaps

One main field of action applies to all of these levels: The training of today's and the next generation of natural resource and information managers. This training should aim to accomplish a reduction in reluctance against assessments and to promote existing tools for the development of monitoring systems, data gathering, analysing and reporting.

Training targeting today's generation of natural resource and information managers would presumably have to be fostered at the national level, but international initiatives exist as well, for instance through the Global Biodiversity Information Facility (GBIF, 2008). The Sierra Gorda Biosphere Reserve addresses the issue locally, without initiation at the national level, through the recently established "Centro Tierra" where regular training courses are being held. There are certainly many ways to support such training initiatives and opportunities may differ from one site and country to the next.

For the training of the next generation, universities are perfectly suited as partners in conservation science. Globally, the number of study courses related to natural resource management has grown considerably during the last decade. The contents of these study courses should be strategically designed to ensure the next generation of natural resource and information managers' willingness and capacity to measure and communicate progress in conservation to the wider public. Where capacity gaps exist in gathering or analysing data in protected areas, options should be explored how to regularly involve trained students in these activities as part of their education (Bertzky and Stoll-Kleemann, 2008). In addition, baseline studies needed for better management could also be conducted as student theses. Both case study sites of the present study are located close to universities as well, and in the case of the Sierra de Manantlán the university is already involved in the management of the biosphere reserve. However, both sites do not yet make optimum use of this advantage, although this would not only significantly increase the capacity at site but also support the realisation of adaptive management for better conservation outcomes.

At the national level, some form of follow-up on regular reporting needs to turn into a standard activity. Some international conventions and programmes already require regular reporting (e.g. the World Heritage Convention and UNESCO-MaB) but no information is available on whether sites do reply to these calls, or how many of them. Some form of follow-up would also be adequate given the CBD parties' agreement to regularly report to the CBD Secretariat on their progress in achieving international targets. The national level thus represents the first information synthesis level and communication channel towards higher level information centres. This function needs to be realised and accompanied by respective accountability.

At the international level, the agreement on data and metadata standards is of major importance. Creativity is required for this very difficult task as data formats, uptake and storage methods are currently too manifold to allow for a translation into a single standard. Moreover, agreed standards need to be successfully communicated down to the national and local levels. The further development of certification schemes for protected areas and biosphere reserves should incorporate such standards as well (Dudley, 2004; Schliep *et al.*, subm., see also section E.3). Here, first proposals for quality management standards are under development for marine protected areas (Thompson *et al.*, 2008). Good cooperation and communication between the different governance levels play a key role all over.

At all these levels, power relations are closely linked to the uptake, analysis and sharing of information. Ideally, all institutions promoting performance assessments on the different levels should themselves undergo regular assessments, because only if an "assessment and information sharing culture" is introduced in a holistic manner into different levels of decision-making it will be possible to sustainably promote performance assessments and reporting as a natural part of day-to-day work. For this to be successful, the purpose of and the urgent need for data gathering and information sharing have to be communicated and promoted much more clearly and with a special emphasis on long-term monitoring initiatives.

The importance of monitoring change over time (and this again may refer to quantitative as well as qualitative information) has been stressed by Leakey and Lewin (1996: 249): "*Humans live in the present. We look at the world around us and find it difficult to encompass change over great tracts of time. But the perspective of time is important if we are fully to understand the biological processes we are driving by our actions, and, of course, to see where our future as a species lies*." This meaning of long-term information still needs to be much more widely distributed.

One of the key arguments for removing the existing barriers to information sharing is that sustainability thinking cannot function and will not establish in society as long as individual reluctance, career consideration, and competitiveness dominate this field of work. Folke *et al.* (2002: 8) state: "*Building social-ecological resilience requires understanding of ecosystems that incorporates the knowledge of local users. Thus the ecological ignorance of some contemporary societies undermines resilience*." However, this message has not yet come across to the wider public – or at least has not entered relevant decision-making levels.

On the other hand, the absence of information, whether on threats to biodiversity or on conservation progress, should not be accepted as an excuse for inaction or the reduction of political support. The consequence of lacking information is uncertainty, but under conditions of uncertainty applies the precautionary principle: The precautionary principle refers to proactive implementation of measures to prevent potential future harm on the environment, and ultimately humankind. The principle "*is accepted by many national governments and supra-national entities such as the United Nations and the European Union for example, as a guiding principle for policy-making.*" (O'Riordan and Jordan, 1995: 2). The establishment and implementation of protected areas can be considered one means to apply the principle (e.g. Kaur *et al.*, 2005). However, against the background of the described paper parks dilemma, the current political support of *in-situ* conservation is obviously insufficient.

It is not a surprising and new phenomenon that nature conservation usually appears at the bottom of political agendas. The question is whether we should and can continue to accept this. The 9th Conference of the Parties to the CBD that took place in Bonn in May 2008 and the IUCN World Conservation Congress that took place in Barcelona in October 2008 were just two recent large-scale occasions where the conservation community came together to move conservation forward. Some major decisions were taken to further strengthen conservation efforts worldwide, for example for the advancement of marine conservation. The importance of biodiversity was clearly demonstrated through both quantitative and qualitative values at both events. Yet there was also agreement that the CBD 2010 Target will be missed by far (and see also, e.g., Mace and Baillie, 2007). In the end, however, 2010 should rather be regarded as a starting point instead of an ending point in measuring progress in conservation, while reinforcing the commitment to the precautionary principle at the same time. Only if the conservation community keeps pushing forward with the evaluation of progress, promotes transparency in its communication, and further increases political support of *in-situ* conservation, the world will be capable to one day make a clear statement on where our future as a species lies.

H.4 Outlook

The present study can be regarded as a basis for a series of advanced studies on information gaps and bridging options in conservation science. Chapter E provides a user's perspective on existing online databases and may serve as a necessary background for the advancement of databases containing protected area information including the further development of data standards. However, it also points towards existing cultural obstacles to information sharing, which could be researched in much more detail across the broad range of global cultural contexts. Chapter G, in contrary, looks at the information situation on the local case study level. The results of this chapter in the light of the global state of online information on protected areas and specifically management effectiveness could serve as the background for a future **pilot project**: In (at least) one of the two case study sites of the present study conditions could be created to fill information gaps while in parallel facilitating the communication channels to share the expected information with the global conservation community. This could be done by considering the different governance levels impacting on this information uptake and flow as demonstrated in Figure H.3. Interesting research questions would then include:

- How can and should the issue of monitoring and evaluation be included in university study courses to support information sharing in future? (Local level under consideration of international standards, tools and methods);
- How can the cooperation between academic institutions and protected areas be promoted and governed to maximise mutual benefits? (Local level under consideration of protected area needs and capacity gaps); and
- How can the communication of evaluation results to national and international information management levels be facilitated? (Vertical cross-level question combining the local level with the national and international level)

The questions 1 and 2 already translated into a project proposal in cooperation with the Universidad Técnica Particular de Loja and the close-by Podocarpus National Park in Southern Ecuador (Bertzky and Stoll-Kleemann, 2008). However, for a holistic betterment of the current information situation all action points identified in Figure H.3 would have to be equally promoted in a consolidated manner and – as far as possible – globally. Consequently, the study leaves much room for projects and further studies to be done in relation to information gaps and bridging options in protected area management in the future.

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Annex I. Glossary of key terms defined for this study

Conservation achievements
...are here defined as the achievements made through conservation actions taken either to directly address conservation objectives and targets (e.g. target species, ecosystems) or to tackle indirect influences on conservation objectives and targets.

Conservation actions
…are here defined as those actions triggered and/or implemented by the management body or cooperating actors within or in the surroundings of an *in-situ* conservation site, that directly or indirectly address the conservation needs, the conservation objectives or the conservation capacity at site.

Conservation capacity
...is here defined as the existing overall capacity that exists to address conservation needs through conservation actions. This capacity consists of financial, infrastructural, personnel, scientific and social capital including skills and training of the management body, staff and all those people involved in conservation actions in and around the protected area. The conditions, under which this capacity exists, e.g. in terms of stakeholder interests and attitudes, further determine their efficiency and effectiveness.

Conservation needs
…are here defined as needs arising from states of or threats to biodiversity within or in the surroundings of an *in-situ* conservation site that require for being addressed through conservation actions, either in addition to or according to determined conservation objectives.

Annex II. List of databases mentioned in Chapter E

Database	URL	Retrieved
BioMon - the Biodiversity Monitoring Database	http://nationalzoo.si.edu/ConservationAndScience/MAB/biomon/.	24.02.2006
BirdLife International - Datazone	http://www.birdlife.org/datazone/index.html	24.02.2006
CBI/WWF PAD	http://www.consbio.org/cbi/projects/PAD/index.htm	30.07.2007
CITES - Convention on International Trade in Endangered Species of Wild Fauna and Flora	http://www.cites.org/	17.05.2007
CONABIO - Comisión Nacional para el conocimiento y el uso de la Biodiversidad	http://www.conabio.gob.mx/	05.05.2007
EUNIS - European Nature Information System	http://eunis.eea.europa.eu/	12.05.2007
Fauna Europaea	http://www.faunaeur.org/	12.05.2007
Fishbase	http://www.fishbase.org/	05.05.2007
GBIF - Global Biodiversity Information Facilities	www.gbif.org	05.05.2007
GCMD - Global Change Master Directory (NASA)	http://gcmd.nasa.gov/	01.08.2007
Global Population Dynamics Database	http://www.sw.ic.ac.uk/cpb/cpb/gpdd.html	05.02.2007
GROMS - Global Register of Migratory Species	http://www.groms.de/	05.05.2007
HMAP - History of Marine Animal Populations	http://www.hull.ac.uk/hmap/hmapportal.htm	27.07.2007
ICE - Information Center for the Environment Biological Inventory Database	http://www.ice.ucdavis.edu/bioinventory/bioinventory.html	05.05.2007
INBIO - Instituto Nacional de Biodiversidad de Costa Rica	http://www.inbio.ac.cr/es/default.html	05.05.2007
ITIS - Integrated Taxonomic Information System	http://www.itis.gov/	05.05.2007
IUCN Red List of Threatened Species	http://www.redlist.org	10.11.2004
MANIS - Mammal Network Information System	http://manisnet.org/manis/	16.04.2007
Missouri Botanical Garden	http://www.mobot.org/	05.05.2007
MPA global - Marine Protected Areas	http://www.mpaglobal.org/home.html	05.05.2007
NatureServe	http://www.natureserve.org/	05.05.2007
NBII - National Biological Information Infrastructure, USGS initiative	http://159.189.176.5/portal/server.pt	05.05.2007
OBIS seamap - Ocean Biogeographic Information System	www.iobis.org	16.04.2007
Ramsar Wetlands	http://www.wetlands.org/RSDB/Default.htm	05.05.2007
Reefbase	www.reefbase.org	05.05.2007

Annex II (continued): List of databases mentioned in Chapter E

Database	URL	Retrieved
Species 2000	www.sp2000.org	02.10.2008
TEMS - Terrestrial Ecosystem Monitoring Sites	http://www.fao.org/gtos/tems/	05.05.2007
UNEP WCMC - World Conservation Monitoring Centre	http://www.unep-wcmc.org/index.cfm	05.05.2007
UNESCO BRIM	http://www.unesco.org/mab/BRs/brim.shtml	09.03.2006
UNESCO MAB - Biosphere Reserves	http://www.unesco.org/mab/wnbrs.shtml	05.05.2007
UNESCO WHC - World Heritage Sites	http://whc.unesco.org/en/list/	05.05.2007
World Database on Protected Areas	http://sea.unep-wcmc.org/wdbpa	05.05.2007

Annex III. Coding scheme applied for qualitative analysis of survey results in ATLAS.ti

Only those codes which were relevant for the present study are listed and explained here.

General codes

Success factor
…describes (internal/external) aspects that directly or indirectly benefit nature conservation within the protected area or the achievement of the protected area management's formulated targets (which can be of ecological, as well as economic or social nature); critical element, which is necessary for the achievement of conservation success in the protected area; an element that is vital for a strategy to be successful; recommendation; objectives/benefits

Failure factor
…describes (internal/external) aspects or elements that directly or indirectly hinder/impede nature conservation within the protected area or the achievement of the protected area management's formulated targets (which can be of ecological, as well as economic or social nature); not meeting a desirable or intended objective due to this factor; critiques and difficulties, conflicts.

Driving Force
In the indicator system of the European Environment Agency, indicators for driving forces describe the social, demographic and economic developments in societies and the corresponding changes in life styles, overall levels of consumption and production patterns. Primary driving forces are population growth and developments in the needs and activities of individuals. These primary driving forces provoke changes in the overall levels of production and consumption. Through these changes in production and consumption, the driving forces exert pressure on the environment.

Pressure
In the indicator system of the European Environment Agency, pressure indicators describe developments in release of substances (emissions), physical and biological agents, the use of resources and the use of land. The pressures exerted by society are transported and transformed in a variety of natural processes to manifest themselves in changes in environmental conditions.

State: geo-ecological
…describes the current situation of the ecosystem itself (environmental conditions of natural system): physical, ecological, geographic position, ecological design; e.g. inhabitant numbers, date of establishment, infrastructure, regeneration of nature, etc. (Definition exceeds the definition of "state" in the DPSIR-Framework)

State: socio-economic
…describes the current socio-economic situation of the protected area. Socio-economy is the study of the relationship between economic activity and social life. Socio-economic information refers to improvements in metrics such as Gross Domestic Product (GDP), life expectancy, literacy, levels of employment, among others.

Impact
The impact is the environmental damage caused by driving forces and resulting pressures and states.

Response
In the indicator system of the European Environment Agency, response indicators refer to responses by groups (and individuals) in society, as well as government attempts to prevent, compensate, ameliorate or adapt to changes in the state of the environment. Some societal responses may be regarded as negative driving forces, since they aim at redirecting prevailing trends in consumption and production patterns. Other responses aim at raising the efficiency of products and processes, through stimulating the development and penetration of clean technologies.

Actors

Actor: Governmental Organisation (GO)
State representative, administrative and supervising body over a state/country, or organisation or company or agency owned or controlled wholly or partly by the government, government department, or government agency; in contrast to Non-Governmental Organisation (NGO).

Actor: Non-Governmental Organisation (NGO)
In its broadest sense, a non-governmental organisation is one that is not directly part of the structure of government. Term sometimes substituted by “non-profit organisation”, examples: CI, TNC, WWF, WCS, but also local NGOs; including indigenous organisations.

Actor: local/regional authorities
Administrative offices of an administrative unit smaller than a state or province; political support at regional or local level.

Actor: local communities
A group of people living in a particular local area, local population who lives in or adjacent to the protected area;

Actor: profit organisation
Commercial organisation/industry with profit-interests; industry groups, industry, as well as tour organiser, tour operator.

Actor: others
Every stakeholder group that does not fit to any of the codes above, except the protected area/biosphere reserve management and staff, for example consultant, external researchers, university, etc.

Actor: protected area/biosphere reserve management
Member of the management (body) of the protected area/biosphere reserve or the management (body) in general without reference to a single actor within the management.

Conservation needs/Threats

Over exploitation and habitat transformation
Over exploitation: The excessive use of raw materials without considering the long-term ecological impacts of such use; Habitat transformation: change/alteration of major natural habitats, e.g. deforestation for subsequent agricultural use (e.g. shifting cultivation).

Urbanisation and land use change
Urbanisation: increase over time in the population of cities in relation to the region's rural population; Land-use change: change of land use system, e.g. from plantation to agriculture and vice versa

Illegal activities
Any human activities (e.g. use, transport, processing, trade) that are inconsistent with national (or sub-national (local) / international) laws.

Climate change
A change of climate which is attributed directly or indirectly to human activity that alters the composition of the global atmosphere and which is in addition to natural climate variability observed over comparable time periods.

Invasive alien species
A species introduced outside its normal distribution and whose establishment and spread modifies ecosystems, habitats, or species.

Pollution
Direct or indirect man-made pollution of ecosystem components such as air, water and soil in gas, liquid or solid form.

Fire (developed in addition to existing scheme)
Natural or human-caused fires impacting on the conservation status within the protected area.

Conservation capacity

Leadership
Management skills, vision, commitment, ability to lead and motivate, thematic know-how.

Staff/skills
Training, number, skills, educational background, etc.

Access, equipment, communication
Access: in terms of infrastructure (roads etc.); Equipment: in terms of vehicles, instrument needed for tasks; Communication: technical communication, communication strategies, etc.

Funding/Finances
Provided capital (money) for the protected area and its management; costs and expenses, funding of protected area, external funding, funding generated by the protected area, efficiency of resource allocation.

Boundary demarcation
Defined/determined limits of the protected area, including the zonation scheme and the demarcation of land use areas.

Land tenure situation and property rights
Distribution of land ownership inside and outside the protected area boundaries; legal or moral ownership; resettlement; publicly/state, commercially, privately owned land, property interests, land register, legally defined estate.

Cultural dimension including traditional knowledge
Handling (hearing, consideration, denial) of traditional knowledge (mostly knowledge that is not written down in books or journals, word-of-mouth knowledge).

Stakeholder participation
Including all degrees of participation, from information sharing to co-management; collaboration with local associations, relation of local people with the protected area.

Collaboration/communication
Continuous work together, interaction and knowledge exchange between the protected area management and other actors (governmental or non-governmental, national or foreign, regional or local) in order to achieve one/more joint target(s).

Trust (developed in addition to existing scheme)
Referring to the relation between the protected area management and staff and other stakeholders; trust develops from long-term cooperation between stakeholders. A lack of trust could have been coded with conflicts but the importance of trust in both case study sites justified the creation of a separate code.

Awareness (developed in addition to existing scheme)
Referring to the consciousness of stakeholders about the importance of the protected area, conservation actions, ecosystem goods and services, etc.

Attitude towards conservation
Attitudes are positive, negative or neutral views of an "attitude object" (here: conservation and the biosphere reserves) resulting from judgements.

Restrictions (developed in addition to existing scheme)
Referring to restrictions in land and resource use patterns as a result of the protected area establishment and implementation.

Conflicts
Conflicts between residents (including civil war), between residents and the protected area, other stakeholders and residents or other stakeholders and the protected area.

- **Human-wildlife conflicts** (developed in addition to existing scheme)
  Conflicts between residents and wild fauna, usually expressed as damage caused by wildlife.

- **Conflicting rules/legislation** (developed in addition to existing scheme)
  National legislation counteracting conservation measures and allowing for political decision-makers to sidestep protected area legislation.

Mechanism for conflict management
Approaches to actively deal with conflicts such as round table discussions, ad hoc working groups or external mediator; among local people, between the protected area management and local people, between local people and other actors.

Corruption
An act done with an intent to give some advantage inconsistent with official duty and the rights of others; corruption at protected area level, at higher levels with direct or indirect negative impact on protected area success.

Conservation actions

Practical conservation measures
Activities to protect or restore nature, such as protection against erosion, wildlife management, fire management, reforestation, etc.

Rural development/income generating activities/incentives/benefits
In general actions and initiatives taken to improve livelihoods in non-urban neighbourhoods, countryside, and remote villages; every measure or activity that leads to develop the rural region within or around the protected area, to enhance living conditions of local people; income generation activities, training and implementation, benefit sharing, etc.

Tourism
All relating aspects of tourism/tourists in terms of success (nature or eco-tourism for income generation; infrastructure for tourist access) as well as failure factor (too many people/tourists visiting the protected area/mass tourism).

Capacity building/environmental education
Teaching and training of sustainable resource use and interaction between humans and the environment; public information centre, school programmes, sensitisation and awareness raising activities.

Rule enforcement and existence/control
All information concerning protected area rules; rule making process, application of sanctions, transfer of rules, rule perception; enforcement: patrols, also concerning other actors besides protected area/biosphere reserve management (bodies).

Economic compensation
Compensatory payment for damage of local communities' goods or disadvantages caused e.g. by wildlife or restrictions coming along with the establishment and implementation of protected areas/biosphere reserves.

Decision-making/politics

Decision-making/politics: national
Political decisions, programmes and policies on the national level exerting influences on the protected area; national conservation policies & programmes, clearly defined

responsibilities, sustainable economic strategies and programmes, national conservation system and biodiversity policy, distribution of government responsibilities.

Decision-making/politics: local/regional
Political decisions, programmes and policies on the regional/local level exerting influences on the protected area; local authorities, community structures, political support at regional/local level.

Decision-making/politics: international/multilateral environmental agreement
International labels (biosphere reserve, world heritage site, Ramsar wetland of international importance, …); Multilateral Environmental Agreements (CBD, Millennium Development Goals); international politics and decision-making on the international level.

Decision-making/politics: protected area/biosphere reserve management level
Local decisions taken by the protected area/biosphere reserve management (body) referring to planning, actions, implementation, etc.

<u>Monitoring and evaluation</u>

Research activities/monitoring
Activities (long- and short-term) in the area of research (ecological, social, (socio-) economic), monitoring, monitoring tools.

Monitoring and evaluation for adaptive management
Monitoring and evaluation of protected area structures and processes for adaptive management as an iterative process of optimal decision-making in the face of uncertainty, with an aim to reducing that uncertainty over time via system monitoring.

Indicators (developed in addition to existing scheme)
Indicators used by the protected area to measure progress towards targets; adequate indicators mentioned by interviewees that could be used to measure progress towards targets.

<u>Changes and future perspectives</u>

Changes in the past: geo-ecological
Trend over the last years/months in ecological sense: e.g. increase/decrease in population dynamics (floral and faunal) in the last years.

Changes in the past: socio-economic
Trend over the last years/months in socio-economic sense: improvement/degradation in metrics such as Gross Domestic Product, life expectancy, literacy, levels of employment etc.

Perspectives: geo-ecological
Expected changes in the future in ecological sense: e.g. expected increase/decrease in population dynamics (floral and faunal); including wishes and needs.

Perspectives: socio-economic
Expected changes in the future in socio-economic sense: improvement/degradation in metrics such as Gross Domestic Product, life expectancy, literacy, levels of employment etc.; including wishes and needs.

Annex IV. Invitation letter from the Mexican Comisión Nacional de Areas Naturales Protegidas (CONANP)

COMISION NACIONAL DE AREAS NATURALES PROTEGIDAS

Camino al Ajusco
No. 200, P.B.,
Col. Jardines en la
Montaña,
Tlalpan, México, D. F.,
C. P. 14210,
Tels. 54496300 exts.
17014, 17165 y 17126
Fax 54497030

COMISIÓN NACIONAL DE ÁREAS NATURALES PROTEGIDAS
DIRECCIÓN DE EVALUACIÓN Y SEGUIMIENTO

OFICIO NO. 20

Ciudad de México, a 17 de marzo de 2006

A QUIEN CORRESPONDA
PRESENTE

Por este conducto, les informo que la Srita. Monika Bertzky es estudiante de Doctorado de la Universidad de Humboldt en Berlín Alemania, y esta desarrollando la tesis denominada "Éxito en la conservación en reservas de la biosfera bajo cambio global". Como parte del desarrollo de su tesis de doctorado se encuentra realizando una serie de entrevistas en las Reservas de la Biosfera Sierra de Manantlán en Jalisco y Sierra Gorda en Querétaro.

Esta investigación es de sumo de interés para la institución, porque los resultados de la tesis serán enviados a la CONANP para que sean utilizados por el personal de ambas reservas.

Por lo anterior, les solicito de la manera más atenta le brinden el apoyo que requiera para poder desarrollar su investigación de la forma más adecuada. En caso de tener alguna duda al respecto quedo a sus órdenes.

Sin otro particular, reciba un cordial saludo.

ATENTAMENTE
LA DIRECTORA

Rocío ES.

BIOL. ROCÍO ESQUIVEL SOLÍS

C.p.p Dr. Ernesto Enkerlin H.- Presidente de la CONANP.- Para su conocimiento
Martha Isabel Ruiz Corzo.- Directora de la Reserva de la Biosfera Sierra Gorda.- Presente
Personal de la Reserva de la Biosfera Sierra de Manantlán.- Presente

Annex V. Open questionnaires applied in the survey

Información básica / Basic information:

1. Nombre / name
2. Responsibilidad y/o posición / responsibility and/or position
3. Años de experiencia (en el área/las actividades) / years of experience (in the region/these activities)
4. história de trabajo / professional history

Interview group: Biosphere Reserve Management

1. **Qué le parece, por medio de qué es posible alcanzar los objetivos de conservación en la reserva de la biosfera?/**What do you think makes this biosphere reserve achieve conservation objectives?
2. **Qué es necesario para decidir qué hacer y cómo hacerlo?/**What is needed to decide what to do and how to do it?
3. **Cuáles son los 5 indicadores más importantes para el éxito en conservación en el área?/**What are the 5 most important indices for conservation success in this area?
4. **Cuáles son los 5 indicadores más cruciales/decisivos para la integridad de la biodiversidad en el área?/**What are the 5 most crucial indices of biodiversity intactness in the area?
5. **Cuáles indicadores de efectividad se usa para controlar progreso en implementación de planes y efectividad de actividades?/**Which effectiveness indicators are in place to check progress of implementation and performance of activities?
6. **Que me va a comentar la población local sobre cambios que podían observer desde el establecimiento de la reserva de la biosfera?/**What will local people tell me about changes in the environment they may have observed since establishment of the biosphere reserve?
7. **Cuáles son las amenazas/retos/desafíos más críticas para la biodiversidad del reserva de la biosfera?/**What are the major threats to biodiversity/challenges in the biosphere reserve?
8. **El cambio de cuál factor podría destruir todo el sistema de la reserva de la biosfera?/**The change of which factor could destroy the whole functioning system?

9. **Cuáles cambios se podía observar desde hace Usted vive/trabaja aqui?/**What changes could you observe since you are living/working here?

Interview group: Biosphere Reserve Staff

1. **Qué le parece, por medio de qué es posible alcanzar los objetivos de conservación en la reserva de la biosfera?/**What do you think makes this biosphere reserve achieve conservation objectives?

2. **Cómo se puede ver que las actividades de conservación resultan exitosas?/**How is it possible to see that conservation activities turn out successful?

3. **Cuáles son los 5 indicadores más cruciales/decisivos para la integridad de la biodiversidad en el área?/**What are the 5 most crucial indices of biodiversity intactness in the area?

4. **Que me va a comentar la población local sobre cambios que podían observer desde hase el establecimiento de la reserva de la biosfera?/**What will local people tell me about changes in the environment they may have observed since establishment of the biosphere reserve?

5. **Cuáles son las amenazas/retos/desafíos más críticas para la biodiversidad de la reserva de la biosfera?/**What are the major threats to biodiversity/challenges in the biosphere reserve?

6. **El cambio de cuál factor podría destruir todo el sistema de la reserva de la biosfera?/**The change of which factor could destroy the whole functioning system?

7. **Cuáles cambios se podía observar desde hace Usted vive/trabaja aqui?/**What changes could you observe since you are living/working here?

Interview group: Civil Servants

1. **Cuáles son las amenazas/retos/desafíos más críticas para la biodiversidad de la reserva de la biosfera?/**What are the major threats to biodiversity/challenges in the biosphere reserve?

2. **El cambio de cuál factor podría destruir todo el sistema de la reserva de la biosfera?/**The change of which factor could destroy the whole functioning system?

3. **Cuáles cambios se podía observar desde hace Usted trabaja con la/las dos reserva/s de la biosfera?/**What changes could you observe since you are working with this/the two biosphere reserves?

4. **Es que las dos reservas de biosfera comparten una selección de condiciones importantes apoyando la obtención de sus objetivos?**/Do the two biosphere reserves share a set of conditions supporting the achievements?

Interview group: Local Community Members

1. **Cuáles son las amenazas/retos/desafíos más críticas para la biodiversidad de la reserva de la biosfera?**/What are the major threats to biodiversity/challenges in the biosphere reserve?
2. **Cuáles cambios se podía observar desde hace Usted vive/trabaja aqui?**/What changes could you observe since you are living/working here?

Annex VI. Closed questionnaire applied in the survey

Part 1

Question: **Cual es el impacto de las amenazas siguientes en la Reserva de la Biosfera?/**What is the impact of the following threats in the biosphere reserve?

Legend:
1 = Ningun impacto a la biodiversidad
No impact on biodiversity within the biosphere reserve
2 = Poco impacto a la biodiversidad en la reserva de la biosfera
Low impact on biodiversity within the biosphere reserve
3 = Medio impacto a la biodiversidad dentro de la reserva de la biosfera
Medium impact on biodiversity within the biosphere reserve
4 = Alto impacto a la biodiversidad dentro de la reserva de la biosfera
High impact on biodiversity within the biosphere reserve

Impacto se define como extension mas severidad de la amenaza/*Impact is defined as extension plus severity of the threat.*

En el caso que algunas de las actividades siguientes ocurren pero no parecen tener impactos y asi no se demuestran como amenazas, por favor marca 1/*In case some of the following activities occur but do not seem to have an impact and thus cannot be considered threats please mark 1.*

Amenaza/*Threat*		**Impacto/*Impact*** 1	2	3	4
Conversión del habitat y degradación/ *Habitat conversion and degradation*	vivienda y desarrollo urbano/*housing and urban development*				
	desarrollo comercial y industrial/*commercial and industrial development*				
	agricultúra y plantaciones/*agriculture and plantations*				
	áreas de recreación/*recreation areas*				
	actividades militarias/*military activities*				
	modificación del sistema natural/*natural system modifications*				
	regímenes de fuego modificados/*altered fire regimes*				
	regímenes hidrológicos modificados/*altered hydrologic regimes*				
Infraestructura de transportación/ *Infrastructure and transportation*	carreteras y ferrocarilles/*roads and railroads*				
	líneas de utilidad (energía y recursos)/*utility lines*				
	rutas de navegación/*shipping lanes*				
	trayectorias de vuelo/*flight paths*				
Energía y minería/ *Energy and mining*	perforación de petróleo y gas/*oil and gas drilling*				
	minería/*mining*				
	energía renovable/*renewable energy*				

Amenaza/*Threat*		**Impacto/I*mpact*** 1	2	3	4
Cosecha de recursos/ *Resource harvesting*	caza/caza furtiva, pezca/*illegal hunting, trapping, fishing*				
	recogida/recolección/*gathering*				
	tala/*logging*				
	pasto y ganadería/*grazing and ranching*				
Recreación/trabajo en hábitats naturales/ *Recreation and work in natural habitats*	recreación y trabajo con energía de motor/*motor-powered recreation and work*				
	recreación y trabajo con energía humana/*human-powered recreation and work*				
	investigación científica/*scientific research*				
Polución/ *Pollution*	sustancias químicas y toxicas/*chemicals and toxins*				
	carga de nutrientes (pej nitrógeno de fincas)/*nutrient loads*				
	residuos solidos (basura, pecios, lastre)/*solid waste*				
	residuos industrials/*industrial pollution*				
	gases de efecto invernadero/*greenhouse gases*				
	materiales radioactivas/*radioactive material*				
	sal (pej residual de irrigación)/*salt*				
	polución sónico (ruido)/*sonic pollution*				
	polución termal (calor de central eléctrica)/*thermal pollution*				
	polución de luz (luz de áreas urbanas)/*light pollution*				
Especies invasoras o otras especies críticas/ *Invasive and other critical species.*	especies invasivas/*invasive species*				
	especies nativas problematicas/*problematic native species*				
	materials genéticos introducidos/*introduced genetic material*				
	hibridación de especies/*species hybridization*				
Cambio climático/ *Climate change*	movimiento y modificación de hábitat/*habitat shifting and alteration*				
	variabilidad climática/*climatic vulnerability*				

Part 2

Question: **Cómo se cambiaron los aspectos siguientes durante los últimos años dentro de la reserva de la biosfera?**/*How did the following aspects change during the last years within the biosphere reserve?*

	cambio/*change*				
	aumento fuerte/*strong increase*	aumento/ *increase*	constante/ *constant*	reducción/ *reduction*	reducción fuerte/ *strong reduction*
actividades ilegales dentro de la reserva de la biosfera/*illegal activities inside the biosphere reserve*					
integridad de biodiversidad/*integrity of biodiversity*					
conciencia de la población local/*awareness of local people*					
aceptancía de la población local/*acceptance of local people*					

Annex VII. Example interview transcript

It was agreed to treat all interviews anonymously. Therefore, questions concerning the interviewee's personal background were deleted from the here shown transcript. Names of other people or places which were mentioned in the interview but could potentially allow tracing back the personality of the interviewee have been replaced by "XXX". A sequence of three dots, "..." indicates a break in the interviewee's fluency. Finally, the square brackets, [ ] indicate where one or few words could not be transcribed for poor quality of the audio record.

M: Como se llega a los objetivos de conservación en la reserva de la biosfera (RB)?

Interviewee: No es una sola cuestion, no? Es el conjunto, la suma de muchas cosas, tienes que empezar con lo que es la política pública, hablando de la cuestion mas de gestión, el aspecto de vinculación de política entre dependencias, y mucho tiene que ver con voluntad politica para generar las … aptas para el desarrollo de las programas. en un otro sentido, se necesita mucha interesa y voluntad del parte de la sociedad civil para poder involucarla en el proceso de apropriación de ideas que pues tal vez alguien tiene y que se escucha como buena idea pero que en realidad no puede resultar tanto ... o puede no ser tan atractiva para quien la percibe, no?, entonces hay su alto grado de importancia en esta parte. Y yo creo que la mas trascendiente es un ... motivador, que en este caso es XXX, es XXX que ha logrado mover todo este tipo de... bueno los involucrados, no? porque no se puede hacer las cosas solo. nuestro mundo no está diseñado para eso. pero se ha convertido en este [ ] a la interes que ella tiene a la convención es que muchos de las cosas se mueven y de que encuentra los espacios, la capacidad [ ] no solo al nivel local [ ], sino al nivel incluso internacional. si eso, y ha logrado también en una parte muy importante lo que es el éxito, este tipo de actividad que es la imágen y la promoción más allá de la fronteras, no? si nadie sabe lo que estas haciendo puede ser muy bueno pero solo será bueno para tí. y cuando encuentrase con otras gargantas pues es mucho mas facil poder dar entender lo que quieres. hacer que te escuchen. no es un tema facil, el tema ambiental no es precisamente el primero en la lista de prioridades mundiales, estamos en el septimo/octavo lugar, si en el mejor de los casos, entonces no es facil hacerles escuchar pero sin duda esa gente motivadores es esencial. hay muchos en muchos lugares de la planeta, pero pues tenemos la fortuna que aqui contamos con uno, no?

M: Y qué es necesario para decidir qué hacer y como hacerlo?

Interviewee: Primero tener claro que es lo que quieres. Que buscas, cual es tu meta. Si no tienes claridad en cual es tu meta, no sera posible que te pueda definir cuales son las [ ]. Y en segunda una [ ] comun, con quienes son tus colaboradores, quienes son tus ayudantes o quienes son tus motivadores personales. Si no cuentas con la misma idea termines muy dificil seguir adelante. Y en otro sentido el poder de comunicación, es básico el poder de comunicación. Si no hay comunicación, si no hay confianza para lo bueno, y tolerancia no se va. Es una experiencia que se lleva en todos lugares.

M: Y con poca capacidad, cómo se puede decidir lo que es lo mas importante que hacer?

Interviewee: Mira, cuando tienes poca capacidad, tu espectro de posibilidad también es muy reducido. Entonces, tengo un amigo que agradezco mucho esa frase que me dijo alguna vez: “la falta de opciones clarifica la mente”. Si no tienes alternativas no te preocupes, haz la única que tienes, si? Y en ese mismo sentido va mucho de lo que es el funcionamiento. Yo creo que en ese proyecto hemos pasado por esa etapa, sin duda la carencia de capacidades fue una limitante en cierto momento, y despues el contar con esas capacidades, esas nuevas capacidades organisacionales, pero no solo organisacionales sino técnicas, lo que ha permitido un fortalecimiento. Yo te puedo decir de la area forestal que, cuando yo la [ ] un area muy pobre, con poca capacidad y con poca idea, con poco conocimiento [ ], y afortunadamente encontré colaboradores muy buenos, si que supieron ayudarme a [ ] esto, no? Entonces yo estoy convencido de que los logros de fortalecimiento en el XXX son muy muy, no solo prometadores, sino muy gratificantes, esa palabra en [ ] personal, y creo también que eso es parte de lo que ha ayudado llevar el nivel técnico del proyecto en si, no? Creo que nos podemos poner a [ ] en muchas areas con expertos de todo el planeta, y no [ ] atrás. Entonces, para mi el valor mas importante en el tema de recursos humanos es lo que mas nos va a preocupar, no solamente mantenerlos sino [ ] permitir su crecimiento.

M: Cuales son los 5 indicadores mas importantes para el éxito en conservación en la reserva de la biosfera?

Interviewee: Uno sin duda es la participación social, si no contamos con la participación social no va a ver éxito. Y también estoy convencido que la única forma para lograr la participación social es permitiendole a la sociedad el uso de sus recursos evidentemente de una forma digamos controlada, pero dandoles elementos culturales, y el cambio de actitud les permita percibir de diferente forma a esos recursos. El segundo es la efectividad institucional de enlaces y [ ] que es el logro conjunto de esfuerzos de todos los actores involucrados no solos en los proyectos sino en la región y hablamos de tendencias de [ ] del estado de los municipios porque solo enlazando el proyecto con todos y cada uno [ ] ganademos un objetivo comun, no?

M: Y cómo se puede medir efectividad institucional?

Interviewee: Inversión pública en aspectos ambientales o de conservación. Otro es la efectividad de actividades de restauración y recuperación, si nuestros espacios se recuperan, ayuda a nuestros recursos de agua, a nuestra disponibilidad de recursos para la población sin que existe el detrimento de las existencias - eso es otro de los indicadores. Si porque [ ] mucha agua, no? Como en la zona de XXX, pero si no lo [ ], de nada sirve. Y aqui eso es que nos pasa. Llueve mucho en ocasiones en la parte alta, pero es agua que no es disponible, porque no hay las obras, no hay las estrategias adecuadas para colectar igual a toda esa agua, no? Otra sin duda es el propio fortalecimiento de las instituciones implementadoras. Sino se fortaleze el XXX, XXX, la dirección de la reserva, quien va a continuar con este trabajo? Entonces, es muy importante el fortalecimiento institucional y organizacional de los actores principales, no? Cuando se busca un financiamiento no sea para mantener una estructura sino realmente para ejercerlo en las actividades. Es la causa de las organizaciones grandes. Llega el punto en que crecen y los recursos que buscan son para mantenerse, para automantenerse. Y ya no estan llegando recursos efectivos para el desarrollo. Eso es un peligro latente que yo veo aqui y que en el futuro cercano deberan [ ] . La preocupación mas sea el financiamiento para la autogestión de la organización, sino para la generación de nuevas oportunidades en las comunidades y en el desarrollo social, es el basico para el desarrollo y la conservación. Y un quinto indicador pudiera ser muy bien el aspecto cultural, el como la cultura de la conservación está impactando en la población porque finalmente si esta población no es la encargada en proteger SUS recursos, no importan quien dija, ni que gobierno exista, ni que leyes haya, los recursos van a [ ]. Entonces si no existe este trabajo de cultura pues tampoco el futuro, no, con respecto a la conservación? Estes son mas o menos los indicadores que veo yo.

M: Y cuales son 5 indicadores ecológicos para ver el estado de conservación de la RB?

Interviewee: Incremento de cobertura forestal, reduciendo la fragmentación, aún [ ] de especies silvestres, comunidades en desarrollo, lo que quiere decir que son comunidades con los estratos de dar y que se mantienen en reproducción. Y podrían ser aspectos un poco mas físicos, no? En el caso de agua, bueno, incremento de la calidad del agua, reducción de erosión, productividad agricola, productividad pecuaria, todos ellos. [ ] En la semana pasada he visto un documento sobre esto... aqui esta. Es un documento muy sencillo pero pongo algunos indicadores, por ejemplo los aspectos del suelo, todo lo que es cobertura vegetal, erosión hídrica, erosión aeolica, ... presencia y ausencia de esencias tóxicas. Lo que es vegetación es cobertura de estrato, estrato arbollo, fragmentación, densidad, altura, diametro, diversidad de especies, estado de desarrollo, ...

M: Y se está mediendo todos estoy aqui?

Interviewee (looking at the document)**:** No, no todos, algunos de estas si, bueno la mayoría. En la fauna es abundancia, desarrollo, diversidad, densidad, disponibilidad. Todos estos [ ] que no se está mediendo aqui, estarémos hablando del aire. En el aire si no hay ninguna, en suelo ... no, pero en general todos los demas, en el caso de agua dos no, [ ] y propriedad física. Pero la calidad del agua si. Mas o menos eso son los indicadores.

M: Que puedo preguntar a la población local sobre cambios que ellos deberían haber notados como consecuencias de las actividades de conservación?

Interviewee: Primera: Hay mas agua disponible o no? Es una de las problemas mas graves, hay poca agua disponible. Especies de fauna visibles. La gente cuenta de que hace años había pero ya no y ahora afortunadamente los han visto otra vez. En la forma como trabajan sus desechos, sus residuos solidos. Muchos ya los trabajan, ya hacen separación. En los lugares donde existe ya separación pues ya es notable, no? Con las condiciones de infraestructura y comunicación que existen aqui pues creo que eso es uno de los logros mas notables de este proyecto. La percepción de la población infantil/juvenil hacía el medio ambiente. Eso es otra [ ] muy importante. Ya no se [ ] de la minima forma la disponibilidad de los recursos, ahora todo es muy limitado y los jovenes y los niños están muy concientos de que eso es limitado. En comparación nuestros padres y nuestra misma generación, pues la mía, creo que eres mucho mas joven que yo, no es todavía.

M: Cuales indicadores de actuación se usa para controlar el progreso en la implementación de los proyectos?

Interviewee: Pues basicamente ellos que platicamos.

M: Y cuales son los desafíos y amenazas mas críticas para la biodiversidad?

Interviewee: Para la biodiversidad el incremento demográfico. Si mas gente hay, pues mas necesidades tiene. La disminuición del ciclo hidrológico normal. Si la gente no obtiene de sus tierras cultivables lo que obtenía hace unos años por modificación del ciclo hidrológico, pues va a acabar [ ] una vez después, porque tienen que abrir mas espacios para obtener lo que requieren, no? A mi no me gusta hablar mal ni de la ganadería ni de la agricultura, porque son actividades que la gente historicamente está acostumbrada. Está acostumbrado a producir, a tener vacas o maíz, y esta es una cultura que es difícil convertir, por supuesto es posible pero nos llevaría mas de un, mas de una decada, no? Parece que tenemos cambios generacionales. Y si, habrá que decía que la ganadería es una amenaza, que la agricultura es una amenaza, yo no lo veo así, desafortunadamente no tenemos la cultura del uso multiple. Y yo soy convencido de que hay espacios que se puede usar para la agricultura y la ganadería y al mismo tiempo puede servir para la fauna y la flora silvestre y al mismo tiempo servir como generador do otros servicios ambientales. Yo creo que la cultura de los servicios ambientales es algo que [ ] desarrollar fuertemente. Algunos todavía no comprendemos muy bien. Pero sin duda es uno de los espacios con mas futuro dentro de la conciencia social y su visión hacía la biodiversidad, para evitar que sea una amenaza. Como el lugar de beneficiarme de abrir 20 hectáreas para tener una vaca, mejor cubro 20 ha y me beneficio y beneficio a otros, mejor que si tuviera una vaca. Pero son [ ] culturales, no? Eso a lo mejor que la gente llega conocerlo. Hasta ahora tener una vaca define el estatus social. Es mas que no tener una vaca. Y amenazas en realidad, pues tampoco me gusta hablar mal de la urbanización y del incremento de las comodidades y servicios, porque son necesarios. Yo tampoco ya no me veo viviendo como hace 15 años en la selva, no lo haría. Necesito estos comodidades por muy basicas que sean, necesito caminos, necesito agua potable, necesito drenaje, electricidad, pero todo tiene acomodo [ ] de alguna forma, y aqui hablamos sobre políticas públicas adecuadas para ellos.

M: Y el cambio de cual factor puede destruir toda la reserva de biosfera?

Interviewee: No creo que sea un factor en especial, pero si creo que uno muy importante pudiera ser el aspecto político. Si las políticas públicas cambian pero no favorablemente, puede verse amenazada la estabilidad o la vocación actual aunque afortunadamente la sociedad civil [ ] estar lista para replicar y mientras la conciencia de la sociedad civil se mantiene, pues habrá.. me preocupara que en realidad la sociedad se perdiera, o sea esa voluntad, pero creo que es algo mas dificil. En realidad hay mas resistencia civil que en el interior, no?

M: Es muy probable que se va a cambiar tan rapido?

Interviewee: No es uno punto que sería de hoy hasta mañana cambia pero sin duda hay cambio, trae cambios mas pequeños, y la suma de los cambios mas pequeños es la que te da este cambio drástico. Yo creo que si que hay un cambio en las políticas públicas, se mantendría mucha de la dinámica, pero tal vez con [ ] si se modificarían, no? La llegar a recursos es una muy importante, si no llega a recursos, muy dificil a sostener, muy dificil, volveré muy complicado. Por eso se necesita la inversión pública, la inversión privada y se necesita de esos gestores para poder hacer llegar a esos recursos, y si la política cambia y se [ ] la existencia de los recursos o ya no existen esos gestores vuelven de ser partes de los [ ] de un todo, no?

M: Si, muchissimas gracias por su tiempo.

Annex VIII. Complete threat ranking for the Sierra Gorda Biosphere Reserve

Threat	Normalised value	Valid replies	Threat group according to IUCN-CMP (2006b)
roads and railroads	1.00	20	transportation infrastructure
grazing and ranching	0.96	19	resource harvesting
solid waste (garbage, flotsam, jetsam)	0.96	19	pollution
agriculture and plantations	0.95	20	habitat conversion and degradation
utility lines	0.95	20	transportation infrastructure
gathering	0.94	16	resource harvesting
nutrient loads (e.g. nitrogen from farms)	0.92	18	pollution
climate variability	0.91	19	climate change
altered hydrologic regimes	0.90	20	habitat conversion and degradation
chemicals and toxins	0.89	19	pollution
invasive alien species	0.86	18	invasive and other critical species
housing and urban development	0.84	20	habitat conversion and degradation
mining	0.84	19	energy and mining
logging	0.83	20	resource harvesting
habitat shifting and alteration	0.79	20	climate change
natural system modification	0.78	20	habitat conversion and degradation
altered fire regimes	0.76	20	habitat conversion and degradation
hunting, trapping, fishing	0.75	20	resource harvesting
commercial and industrial development	0.68	20	habitat conversion and degradation
motor-powered recreation and work	0.68	20	recreation/work in natural habitats
sonic pollution	0.66	19	pollution
problematic native species	0.64	17	invasive and other critical species
light pollution	0.60	20	pollution
industrial waste and residual materials	0.59	19	pollution
greenhouse gases	0.57	20	pollution
human-powered recreation and work	0.57	19	recreation/work in natural habitats
introduced genetic material	0.57	18	invasive and other critical species
recreation areas	0.56	20	habitat conversion and degradation
salt (e.g. residue from irrigation)	0.54	19	pollution
hybridisation	0.51	18	invasive and other critical species
renewable energy	0.45	19	energy and mining
radioactive materials	0.45	19	pollution
military activities	0.43	18	habitat conversion and degradation
scientific research	0.43	20	recreation/work in natural habitats

Annex IX. Complete threat ranking for the Sierra de Manantlán Biosphere Reserve

Threat	Normalised value	Valid replies	Threat group according to IUCN-CMP (2006b)
grazing and ranching	1.00	7	resource harvesting
altered fire regimes	0.88	8	habitat conversion and degradation
solid waste (garbage, flotsam, jetsam)	0.88	8	pollution
altered hydrologic regimes	0.80	8	habitat conversion and degradation
mining	0.80	8	energy and mining
roads and railroads	0.77	8	transportation infrastructure
hunting, trapping, fishing	0.77	8	resource harvesting
logging	0.77	8	resource harvesting
agriculture and plantations	0.73	8	habitat conversion and degradation
recreation areas	0.73	8	habitat conversion and degradation
commercial and industrial development	0.66	8	habitat conversion and degradation
natural system modification	0.66	8	habitat conversion and degradation
utility lines	0.66	8	transportation infrastructure
habitat shifting and alteration	0.66	8	climate change
climate variability	0.66	8	climate change
motor-powered recreation and work	0.63	7	recreation/work in natural habitats
housing and urban development	0.62	8	habitat conversion and degradation
industrial waste and residual materials	0.62	8	pollution
greenhouse gases	0.62	8	pollution
introduced genetic material	0.62	8	invasive and other critical species
hybridisation	0.58	8	invasive and other critical species
invasive alien species	0.55	8	invasive and other critical species
human-powered recreation and work	0.54	7	recreation/work in natural habitats
nutrient loads (e.g. nitrogen from farms)	0.54	7	pollution
gathering	0.53	6	resource harvesting
renewable energy	0.50	7	energy and mining
scientific research	0.47	8	recreation/work in natural habitats
chemicals and toxins	0.46	7	pollution
salt (e.g. residue from irrigation)	0.46	7	pollution
flight paths	0.42	7	transportation infrastructure
oil and gas drilling	0.42	7	energy and mining
military activities	0.38	7	habitat conversion and degradation
shipping lanes	0.38	7	transportation infrastructure
light pollution	0.38	7	pollution
radioactive materials	0.33	7	pollution
sonic pollution	0.33	7	pollution
problematic native species	0.33	7	invasive and other critical species
thermal pollution	0.29	7	pollution

Erklärung

Hiermit erkläre ich, dass diese Arbeit bisher von mir weder an der Mathematisch-Naturwissenschaftlichen Fakultät der Ernst-Moritz-Arndt-Universität Greifswald noch einer anderen wissenschaftlichen Einrichtung zum Zwecke der Promotion eingereicht wurde.

Ferner erkläre ich, dass ich diese Arbeit selbständig verfasst und keine anderen als die darin angegebenen Hilfsmittel benutzt habe.

Curriculum Vitae – Monika Bertzky

Personal information

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Education and training

April 2008	**Seminar** *Management Effectiveness and Quality Criteria in European Protected Areas. Sharing experiences and promoting good management*, Vilm, Germany, 21.-22.04.2008.
Summer 2007	**University course** *Communication and Cooperation,* Humboldt University of Berlin, Germany ("excellent").
November 2006	**Seminar** *Qualitative Data Analysis with Atlas.ti,* Humboldt University of Berlin, Germany, 22.-23.11.2006.
September 2005	**Summer school** *Integrated Assessment of Vulnerable Ecosystems under Global Change (AVEC)*, EU Concerted Action, Peyresq, France, 19.-30.09.2005.
June 2005	**Seminar** *Social, Economic and Cultural Criteria and Indicators for Protected Area Management,* Humboldt University of Berlin, Germany, with the GoBi Research Project, Marc Hockings, Seema Bhatt, Franz Gatzweiler, Marion Glaser, Lisa Hiwasaki, Helen Ross and Heidi Wittmer, 19.06.-22.06.2005.
Since July 2004	**PhD student** in the *Governance of Biodiversity (GoBi)* Research Project (*funded by the Robert Bosch Foundation*, see www.biodiversitygovernance.de).
1998 - 2003	**MSc in biology (German diploma)** Rheinische Friedrich-Wilhelms University of Bonn, Germany Thesis: *Development of a computerized model for the assessment of the conservation status of phytogenetic resources on the example of selected species from Bolivia* ("excellent").

Professional experience in Germany

2008	Lecturing on *Sustainability and Carrying Capacity* in the Seminar 'Sustainability Science' at the Ernst-Moritz-Arndt University of Greifswald, Germany.
2007	Teaching contract for a lecture about *Protected Area Management* in the study course 'International Forest Ecosystem Management' at the University of Applied Sciences Eberswalde, Germany.
Since July 2004	Research fellow in the GoBi Research Project at the Humboldt University of Berlin and since January 2008 at the Ernst-Moritz-Arndt University of Greifswald.
Summer 2004	Teaching contract for a lecture about *Biological Diversity* in the study course 'International Forest Ecosystem Management' at the University of Applied Sciences Eberswalde, Germany.
Summer 2004	Teaching contract for a tutorial about *Application of HTML and Dreamweaver* in the study course 'International Forest Ecosystem Information Technology' at the University of Applied Sciences Eberswalde, Germany.
Winter 2003–2004	Scientific assistant at the Nees-Institute for Biodiversity of Plants, Rheinische Friedrich-Wilhelms-University of Bonn, Germany.
1999–2003	Student assistant at the Nees-Institute for Biodiversity of Plants and the Institute of Botanical Anatomy, Rheinische Friedrich-Wilhelms-University of Bonn, Germany.

Experience abroad

October 2006	**Ecuador,** teaching on a summer school at the Universidad Técnica Particular de Loja in Loja *(funded by the Robert Bosch Foundation and the German Research Society, DFG)*.
March 2006	**Mexico,** case studies in two biosphere reserves: Sierra Gorda and Sierra de Manantlán.
January 2005	**Seychelles,** evaluation of capacity building activities with IUCN and protected area expert interviews.
December 2004	**Thailand,** protected area expert interviews and site visits.
October 2004	**Cuba,** expert interviews, Biosphere Reserves Sierra del Rosario and Ciénaga de Zapata.
November 2002	**Bolivia**, Santa Cruz de la Sierra, 6 months stay for development of diploma thesis at the Fundación Amigos de la Naturaleza, FAN (*funded by the German Academic Exchange Service, DAAD*).
October 2001	**Bolivia,** Santa Cruz de la Sierra, 3 months voluntary participation in conservation project and practical course at the Fundación Amigos de la Naturaleza, FAN.
Summer 2000	**Tanzania,** Amani Forest Reserve, Eastern Arc Mountains (course in tropical ecology organised and *funded by the Tropical Biology Association, TBA*).

Selected congresses and meetings

October 2008	IUCN World Conservation Congress, Barcelona, Spain, 04.-14.10.2008.
May 2008	9th Conference of the Parties to the Convention on Biological Diversity, COP9, Bonn, Germany, 19.-31.05.2008.
July 2007	Annual meeting of the Society for Conservation Biology, Port Elizabeth, South Africa, 01.-05.07.2007.
November 2006	2006 Berlin Conference on the Human Dimensions of Global Environmental Change. 'Resource Policies, Effectiveness, Efficiency, and Equity', Berlin, Germany, 17.-18.11.2006.
June 2005	First meeting of the Ad Hoc Open Ended Working Group on Protected Areas of the Convention on Biological Diversity (CBD), Montecatini, Italy, 12.-17.6.2005.
November 2004	IUCN World Conservation Congress, Bangkok, Thailand, 17.-25.11.2004.

Presentations and invited talks

07.10.2008	*Mediators of change? The relevance and potential of protected areas for adaptation to climate change.* Introductory presentation to a thematic workshop at the IUCN World Conservation Congress in Barcelona, Spain.
09.07.2008	*Web-based databases as tools for conservation planning.* Contribution to a workshop of the United Nations Environment Programme - World Conservation Monitoring Centre (UNEP-WCMC) and the Global Biodiversity Information Facility (GBIF). UNEP-WCMC, Cambridge, UK.
25.06.2008	*Leverington et al. (2008): Global study on management effectiveness in protected areas - an overview.* Ernst Moritz Arndt University of Greifswald, Germany, Seminar 'Protected area management'.
18.10.2007	*New challenges in protected area management*. University of Applied Sciences, Eberswalde, Germany, Colloquium 'Sustainable Forest Management', (presentation prepared together with Bastian Bomhard, IUCN)
30.04.2007	*The reason why we need effective protected areas: the case of biodiversity loss.* Humboldt University of Berlin, Master's course module 'Methods in Sustainability Science with an Emphasis on Protected Area Management'.
October 2006	*Qualitative social research in natural resource management.* Universidad Técnica Particular de Loja, Ecuador, part of the module 'The socio-economic dimensions of natural resource management' in an interdisciplinary summer school.
08.05.2006	*Biodiversity baseline knowledge – the need for conservation.* Humboldt University of Berlin, Master's course module 'Protected Area Management', 08.05.2006.
30.06.2005	*How effective is technical capacity building in achieving conservation goals? Evaluation of an IUCN workshop on detection and monitoring of marine introduced species.* University of Applied Sciences Eberswalde, study course 'International Forest Ecosystem Management" as part of the lecture 'International Topics'. (together with Ameer Abdulla, IUCN)
26.10.2004	*Perspectivas interdisciplinarias al éxito en conservación,* International Colloquium 'For a Culture of Nature', UNESCO, La Habana, Cuba, 26.10.2004.

Special skills and achievements

- Scholar of the Tropical Biology Association (TBA) in 2000
- Scholar of the German Academic Exchange Service (DAAD) in 2002/2003
- Member of the IUCN World Commission on Protected Areas (WCPA)
- Advanced PC skills: Word, Excel, Powerpoint, Access, ATLAS.ti (software for qualitative data analysis), Endnote, HTML, Dreamweaver, ArcGIS (basic knowledge)
- Languages: German (mother tongue), English (fluent), Spanish (good), French (seven years at school), Russian (five years at school)

Publications

Articles in peer-reviewed journals

Schliep, R., Bertzky, M., Fritz-Vietta, N.F.V., Stoll-Kleemann, S. (subm.). The Cinderella Syndrom. Assessing Governance of Biosphere Reserves. Land Use Policy.

Bertzky, M.; Stoll-Kleemann, S. (2009). Multi-level discrepancies with sharing data on protected areas: What we have and what we need for the global village. Journal of Environmental Management 90: 8-24.

Schliep, R., M. Bertzky, M. Hirschnitz, Stoll-Kleemann, S. (2008). Changing climate in protected areas? Risk Perception of Climate Change by Biosphere Reserve Managers. GAIA 17/S1: 116-124.

Book Chapters

Stoll-Kleemann, S., Bertzky, M. (2008). Umweltethisch relevante Erfolgsfaktoren von Schutzgebieten in Entwicklungsländern: Schutzgebiete im Spannungsfeld zwischen globaler Verantwortung und lokaler Umsetzung. Bruckmeier, K., Serbser, W. (eds.) Ethik und Umweltpolitik. Humanökologische Positionen und Perspektiven. Edition Humanökologie, Band 6. München: Oekom Verlag: 349-370.

Ibisch, P.L., Bertzky, M. (2006). Conservation of Biodiversity. Barthlott, W., Porembski, S, Linsenmair, K.E. (eds.) Biodiversity. In: Encyclopedia of Life Support Systems (EOLSS), Developed under the Auspices of the UNESCO, Oxford ,UK: EOLSS Publishers [http://www.eolss.net].

Stoll-Kleemann, S., Bertzky, M. (2006). Biodiversity Management and Monitoring in Protected Areas - State of the Art and Current Trends. Sonak, S. (ed.). Multiple Dimensions of Global Environmental Change. New Delhi, India: Teri Press, 143-169.

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