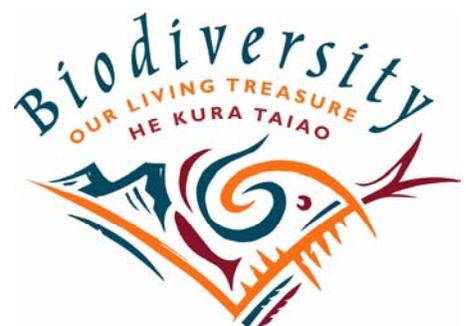# Sharing Biodiversity Data, Information and Knowledge

A Strategy for the Terrestrial and Freshwater Biodiversity Information System (TFBIS)

Support seamless access to essential biodiversity data, information and knowledge to achieve the goals of the NZ Biodiversity Strategy 2000

Table of Contents

Foreword

This strategy outlines the priorities for the TFBIS Programme for the next five years and beyond. The changes that will be implemented through the strategy will ensure the TFBIS Programme continues to meet the outcomes of Theme Nine (*Information, Knowledge and Capacity*) of the New Zealand Biodiversity Strategy and is in accordance with Cabinet direction.

The TFBIS Programme has a Biodiversity Sector wide focus and this document is the result of an extensive series of discussions and consultations with that sector. The level of cooperation, knowledge sharing and goodwill exchanged throughout the formative planning stages of the strategy was also reflected in the later national public consultation process. This engagement and collaboration is essential given the connectivity of the biodiversity systems we work with and the size of our nation. I thank the Steering Committee members and all those individuals who contributed to the process. The strategy is stronger because of their participation.

The Programme will continue to play its part in championing a collaborative and a cross sector approach to meet the challenges within the TFBIS brief. I am sure all biodiversity managers, researchers, scientists and the general public, who have the need for accurate data and information, will continue to benefit from the services and systems provided by agencies and organisations through TFBIS funding.

The strategy's implementation will also contribute to the Department of Conservation's Strategic Directions by facilitating conservation gains through the funding of projects that improve data and information access, that create systems that improve biodiversity management and research and that support biodiversity information services. Through funding these types of initiatives the Programme will contribute to four of the seven revised Departmental Intermediate Outcomes planned for the 2008 Statement of Intent.

I am looking forward to my continuing association with the TFBIS Steering Committee and the Biodiversity Sector agencies as we move toward the first decade milestone for the Biodiversity Strategy. At the time when this document is reviewed I hope that it will be seen as having been a progressive and positive strategy which has delivered to the sector on its promises.

Sue Paterson

General Manager

Marketing & Communications Group

Department of Conservation Head Office

Summary

The Terrestrial and Freshwater Biodiversity Information System (TFBIS) fund was established in 2000 as a part of the New Zealand Biodiversity Strategy to help achieve Objective 9.5, which is about consolidating and sharing information about indigenous biodiversity. It has funded many projects, including the digitisation of collection and observation records and of print publications, and a number of important biodiversity information management systems and tools. Through the actions of the fund it is understood that progress on Objective 9.5 from the Biodiversity Strategy has been substantial.

It is now time to renew the strategic direction the programme will take over the next five to ten years. To achieve this, the alignment and coverage of the funded projects to date has been assessed. Through a series of internal meetings the TFBIS Committee has evaluated the results and prepared a draft strategy for consultation. Following consultation through regional workshops this final version of the strategy has been completed.

Where we are now

Over the first five years the majority of applications were well aligned with the original TFBIS strategy. Funding allocations, however, were heavily biased towards the digitisation of, and improving access to, existing data and information. Less money than originally anticipated was spent on managing information better, filling data and information gaps, and coordinating efforts better.

Many improvements to biodiversity information systems over the last five years have come as a result of TFBIS funding. The increased amount of data available online, and the wealth of digitised literature now available are valued highly by people in local government, NGOs, government departments, research institutes, museums and universities.

There are a number of areas indicated in the regional workshops where more progress is required. These included addressing the lack of awareness in local government and in DOC conservancies about TFBIS funded data, information and systems, addressing the large gaps in availability of spatial data, and improving the consistency of data collection. Improvements could also be made in providing integration of data across local, regional and national scales. More interpreted and derived information, layers and tools are required, and TFBIS should now increase its focus on data and information focused on ecosystems (not just species), and on biodiversity on private land.

A number of government information management strategies and initiatives have been produced in the last five years. These include the Biosecurity Strategy, Digital Strategy, e-Government Strategy, the Geospatial Strategy, the Ocean Survey 20/20 data management programme, and Ministry of Research, Science and Technology (MoRST) work to provide a more stable funding environment, including enabling non-competitive investment to support the 'backbone' of New Zealand science (essential infrastructure, databases, and collections). These initiatives point towards the need for more interconnection of information systems across agencies.

Technologies to allow sharing and federation of research data, information and tools are rapidly gaining in sophistication and maturity. Grid computing and web services are maturing to enable secure interconnection of data between different systems and organisations. Geographic information systems (GIS) are beginning to provide the ability to visually combine data held by different organisations focused on a particular geographic area. All of this enables a more interconnected, 'federated', approach to achieving the TFBIS integrated data access 'meta-system'. This 'meta-system' is now beginning to emerge.

Trends influencing the direction of environmental science and management include a move towards more integrated science, entailing understanding the human impact on the environment, and a rapid emergence of community-led conservation. There is a transition to understanding how to restore damaged ecosystems, and a move from species-based to site-based management. Questions of global significance such as climate change are becoming prominent.

Increased interaction between research agencies and management agencies such as DOC and local government is occurring. This still needs careful nurturing and support, and the TFBIS Programme is well placed to take a leadership role in helping facilitate collaboration and the integration of data across local, regional and national scales.

Where we want to be

It is 2015. The TFBIS Programme has, over the last eight years, contributed significantly to the availability of, and accessibility to, biodiversity data and information, and the sharing of knowledge and best practice. This has played a large role in enabling progress towards the goals of the NZ Biodiversity Strategy 2000. Good data and information management is recognised at a political and senior management level as being fundamental to preserving biodiversity.

As a result of the efforts of TFBIS it is much easier to measure achievement toward national goals, and to measure agency performance in contributing to biodiversity management. Some research can be done more cheaply due to less effort having to be expended on data collection. New research has been generated through combination and interpretation of existing datasets.

From one place, end-users can search biodiversity data and information across a wide range of different datasets. The TFBIS 'meta-system' comprises an interconnected set of databases, information repositories and tools, spread across a number of organisations. Data and information are readily available on a large proportion of described indigenous species, their habitats and distributions, and on ecosystems. There is good coverage of data for both public and private land and biodiversity data can be compared across local, regional and national scales. Contributors to biodiversity actively share knowledge on best practices. As such better decisions can be made in biodiversity management, and it is possible to react faster to threats. Biodiversity management is well linked with biosecurity and biotechnology.

Datasets are connected with international initiatives and global data repositories such as the Global Biodiversity Information Facility (GBIF) and Ocean Biogeographic Information System (OBIS). New Zealand is seen within the international biodiversity community as being a leader in management of biodiversity data and information.

There are national standards for biodiversity data. Standards definition is an ongoing process involving all sector participants. This is supported by active communities of practice on data standards, curation, data quality, and management of biodiversity information systems. Non-governmental organisations (NGOs) and community groups are increasingly involved in biodiversity preservation, and are contributing significant volumes of observational records.

Duplication of effort and cost, and redundant data collection seldom occur. Policy and management decisions are well informed. Political decisions are based on an increasingly accurate national picture of the state of biodiversity, the human impacts causing its degradation, and the economic effects of its loss.

How we will get there

To achieve the TFBIS vision a set of goals and action areas have been determined. These are:

Goals	Action Areas
1. A robust infrastructure exists to support the interoperability, interconnection and sharing of biodiversity data and information	1.1 Plan and develop tools and infrastructure components to increase interoperability between sources of national biodiversity data and information 1.2 Develop privacy, data access, and intellectual property policies and frameworks 1.3 Develop and propagate standards for data storage, curation and exchange 1.4 Prepare plans and guides for the supply and management of biodiversity data and information
2. All important biodiversity data and information are secured against loss and are available digitally	2.1 Digitise priority publications 2.2 Digitise and capture priority collection and survey data 2.3 Secure digital data and information against loss
3. Biodiversity data and information are accessible to, and usable by, everyone who needs them	3.1 Expose existing data and information sources for improved access 3.2 Develop tools to allow better interpretation of primary data 3.3 Provide national level topic-specific repositories and portals
4. Critical gaps in national biodiversity data and information are filled	4.1 Develop new information derived from existing data 4.2 Contribute to funding of priority surveys not covered by existing funding processes (e.g. FRST)
5. People involved in biodiversity research, policy and management know each other, coordinate their efforts, and share their knowledge	5.1 Support meetings and workshops 5.2 Support the implementation of processes and technologies to improve interagency dialogue

A set of evaluation criteria have been developed for projects under each of the action areas.

To achieve the vision and goals there will be some changes to funding emphasis. These include a reduction of spending on digitisation of existing data and information, an increase in spending

on connecting infrastructure, some funding to fill data and information gaps, and a more proactive emphasis on the coordination of efforts across the sector.

To better meet the needs of end-users, a TFBIS-led assessment of the data, information and tools needed by contributors to biodiversity conservation, will be undertaken, with more detailed analysis of user needs as a part of the funding application process. More specific training and communication as a part of funded projects will be required.

Changes to the application process will include instituting two levels of application (for small projects and large projects), and a two-stage bid process for larger projects, including the requirement for an initial user needs analysis phase. Specific changes will be made to application forms, including more emphasis on user needs analysis, the fit with the goals and action areas, user implementation planning, and success criteria and measures.

Changes will also be made to the project evaluation process to bring it into line with the new strategic framework. The TFBIS Programme will initiate some increased promotional efforts to better communicate TFBIS project outputs. These will include changes to the web site, and the introduction of a newsletter. The programme may also proactively initiate a number of projects over the next three years to plan and build biodiversity informatics infrastructure, and improve relationships, communication and sharing of knowledge between biodiversity contributors.

TFBIS has a sound plan of action, and applicants have a solid set of goals and criteria for projects over the next eight years. By executing these, the TFBIS Programme will continue to make significant contributions to the achievement of the NZBS goals for 2020.

1   Introduction

1.1   New Zealand Biodiversity Strategy

The New Zealand Biodiversity Strategy (NZBS) was published in 2000. The Department of Conservation (DOC) is coordinating its implementation, and seven other government agencies are implementing parts of it: the Ministry for the Environment (MfE), the Ministry of Agriculture and Forestry (MAF), the Ministry of Fisheries (MFish), the Ministry of Research, Science and Technology (MoRST), the Foundation for Research, Science and Technology (FRST), Te Puni Kōkiri (TPK), and the Ministry of Foreign Affairs and Trade (MFAT).

The vision in the biodiversity strategy is:

> *New Zealanders value and better understand biodiversity; we all work together to protect, sustain and restore our biodiversity, and enjoy and share in its benefits, as the foundation of a sustainable economy and society; iwi and hapu as kaitiaki are active partners in managing biodiversity; the full range of New Zealand's indigenous ecosystems and species thrive from the mountains to the ocean depths; and the genetic resources of our important introduced species are secure, and in turn support our indigenous biodiversity.*

The NZBS sets out four goals:

- ***Goal One: Community and individual action, responsibility and benefits** - Enhance community and individual understanding about biodiversity, and inform, motivate and support widespread and coordinated community action to conserve and sustainably use biodiversity; and enable communities and individuals to equitably share responsibility for, and benefits from, conserving and sustainably using New Zealand's biodiversity, including the benefits from the use of indigenous genetic resources.*

- ***Goal Two: Treaty of Waitangi** - Actively protect iwi and hapu interests in indigenous biodiversity, and build and strengthen partnerships between government agencies and iwi and hapu in conserving and sustainably using indigenous biodiversity.*

- ***Goal Three: Halt the decline in New Zealand's indigenous biodiversity** - Maintain and restore a full range of remaining natural habitats and ecosystems to a healthy functioning state, enhance critically scarce habitats, and sustain the more modified ecosystems in production and urban environments; and do what else is necessary to maintain and restore viable populations of all indigenous species and subspecies across their natural range and maintain their genetic diversity.*

- ***Goal Four: Genetic resources of introduced species** - Maintain the genetic resources of introduced species that are important for economic, biological and cultural reasons by conserving their genetic diversity.*

The NZBS establishes a framework for action to achieve the above goals. Objectives and actions in this framework are grouped into ten biodiversity themes. One of these is ***Theme Nine: Information, Knowledge and Capacity***. The scope of Theme Nine is:

> *Adequate information, knowledge and capacity underpin the effective implementation of all biodiversity management actions proposed in this Strategy. This theme focuses on our needs — at a national, regional and local level — to improve and share knowledge, information and experience, build our capacity to more effectively manage biodiversity, and learn lessons by monitoring and reporting progress.*

The following objective was seen as a priority within the NZBS:

> ***Objective 9.5 Share Information and best practice***
>
> *Consolidate and share existing and new information, methods, technologies and management experiences so that others can benefit from relevant knowledge about indigenous biodiversity.*
>
> ***Actions:***
>
> *a) Develop resources and systems that promote the consolidation and sharing of information about indigenous biodiversity and hands-on biodiversity management.*
>
> *Key players: MfE, DoC, MAF, MFish, MoRST, LAs, research providers, iwi/hapu*

Finally, the actions were grouped into nine priority areas including:

> ***3. Becoming smarter biodiversity managers***
>
> *Good accessible information, underpinned by a growing knowledge base and the capacity to take action, are vital precursors to achieving most actions in this Strategy. Improved systems to promote information sharing, a consistent approach to monitoring and user-friendly reporting at national, regional and local levels are keys to enabling people to adapt their actions to contribute towards achieving New Zealand's biodiversity goals (Actions 9.3b and 9.4a). These information systems will share information not only about progress on actions and results, but also on the best practice hands-on techniques needed to deal with specific pests and restoration of ecosystems (Action 9.5a)."*

The TFBIS Programme was set up through Biodiversity Package funding to help achieve Objective 9.5, through Action 9.5a.

1.2   Process

In 2005 the TFBIS Committee initiated strategic planning to review progress and determine the direction the programme should take in the future. To begin the process a report was commissioned to assess the alignment and coverage of the funded projects to date against the programme's priorities and criteria. This formed the basis of discussion at a one-day strategy meeting by the committee on 19 October 2005 to review the progress made over the last five years. Initial discussions were also held on the way forward for the period 2006 - 2010. A vision to 'Support seamless accessibility of essential biodiversity data to achieve the goals of the NZ Biodiversity Strategy 2000' was drafted.

A TFBIS Programme Strategy Position Paper was written in January 2006 and considered by the committee on 16 February 2006. A two-day workshop was then held in May 2006 to consider the questions raised in the discussion paper, and to set out a draft strategy.

The TFBIS Committee then initiated a consultation phase for the strategy, held during March 2007. This was run through a series of regional workshops entitled "TFBIS Strategy Workshop, Biodiversity Information in the new Millennium". The rationale for regional workshops was to get as full engagement as possible from current and potential end users of TFBIS outputs, including those in Regional councils, DOC conservancies, and NGOs. Workshops were held in Wellington, Nelson, Christchurch, Dunedin, Hamilton and Auckland and were well attended by a range of stakeholders, contributors and end users across the sector.

Following the workshops the Strategy was redrafted, and reviewed by the TFBIS Committee in a two day workshop in June 2007.

1.3   Acknowledgements

1.4   Contents of this TFBIS Strategy

This TFBIS Strategy contains:

Where we are now

- A description of the history of the TFBIS Programme

- A summary of results of the review of alignment and coverage of projects funded against the original strategy

- A description of progress to date by the TFBIS Programme

- An analysis of who uses TFBIS

- An explanation of related strategies and initiatives in central and local government that may have an impact on TFBIS

- A summary of important technology and environmental science and management trends

Where we want to be

- The vision for TFBIS to 2015

- The TFBIS mission

- A set of goals for the programme

How we will get there

- A description of the scope of TFBIS

- Action areas and evaluation criteria for each of the goals

- Changes to the way the programme will be administered and managed

Bibliography

Appendix

- Sector strategies

2   Where we are now

"The future is already here. It's just not widely distributed yet."
William Gibson, author of Neuromancer

This section contains a description of progress to date by TFBIS, including the history of the programme, a summary of results of the review of alignment and coverage of projects funded against the original strategy, and the wider biodiversity information management community's views on TFBIS achievements. It also contains an explanation of related strategies and initiatives in central and local government that may have an impact on TFBIS, a summary of important trends in technology and environmental science and management, and an explanation of biodiversity informatics architecture issues.

2.1   History

Since its inception in 2000, the TFBIS Programme has funded over 100 projects, enabled the digitisation of many thousands of collection and observation records and of many books and journal articles, supported the information management needs of volunteer-based NGOs, and contributed to the development of a number of important biodiversity information management systems and tools. The full project list is available at
http://www.biodiversity.govt.nz/land/nzbs/tfbis/tfbis/projects/index.html

The original strategy for the fund, which was developed between 2000 and early 2002, involved wide consultation through regional workshops. It listed six broad issues, related to: potential users being unaware of potentially useful data and information resources; national and regional programmes to manage biodiversity not being well advertised; some distrust and concern handicapping the acquisition and use of data and information; inadequate information management practices handicapping use of these resources; some data and information to enable improved biodiversity management not existing; and some relationships between biodiversity management contributors being weak. These were reflected in five new project categories: Improve Access to Information; Improve Access to Data; Manage Data and Information Better; Fill Data and Information Gaps; and Coordinate Efforts Better.

Many, but not all, of the issues and initiatives suggested in the original strategy have been addressed.

2.2   Alignment and coverage review

In August 2005 a review was conducted to assess the alignment and coverage of the projects TFBIS has funded to date against the issues, project categories, types and criteria defined in the original strategy. The report found the large majority of applications were well aligned with the original TFBIS strategy, but identified that funding allocations had been heavily biased toward those categories of projects related to (1) improved access to information and (2) improved access to data. Less money than originally anticipated had been allocated to the remaining three categories: managing information better, filling data and information gaps, and coordinating efforts better.

The diagram on the following page shows the expenditure by project category anticipated at the beginning of the programme, and that actually made over the first five years.

Funding Budgeted by Project Category
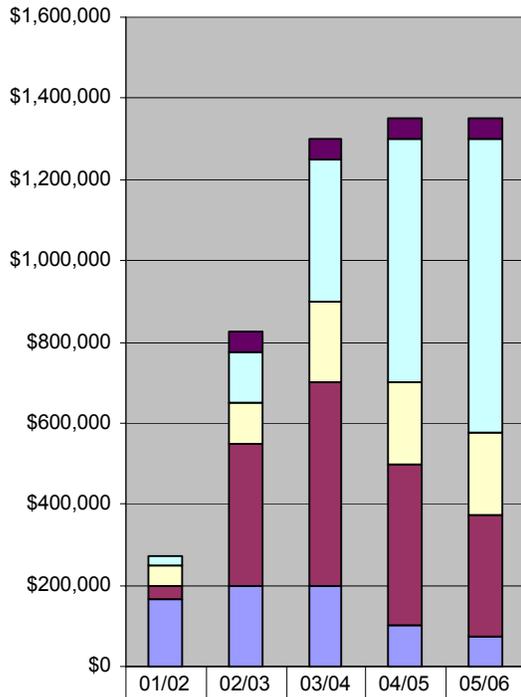
	01/02	02/03	03/04	04/05	05/06
■ 5. Co-Ordinate Efforts Better	0	50,000	50,000	50,000	50,000
□ 4. Fill Data and Information Gaps	20,000	125,000	350,000	600,000	725,000
□ 3. Manage Data and Information Better	52,500	100,000	200,000	200,000	200,000
■ 2. Improve Access to Data	30,000	350,000	500,000	400,000	300,000
□ 1. Improve Access to Information	168,000	200,000	200,000	100,000	75,000

Funds Allocated by Project Category
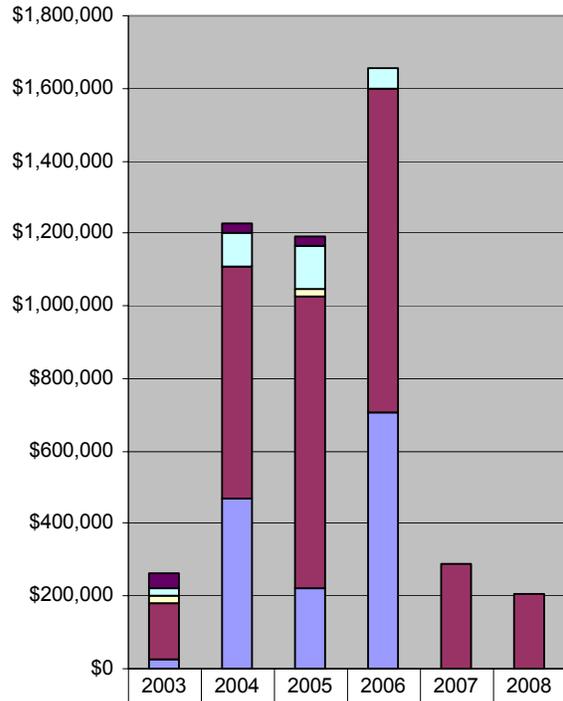
	2003	2004	2005	2006	2007	2008
■ 5	42500	23500	27500			
□ 4	20000	94150	116000	60000		
□ 3	19000		22500			
■ 2	156000	640000	806000	890100	287000	205000
□ 1	26500	467500	219500	706450		

When expenditure was analysed by project type, the results showed an even greater skew:

Types of New Project	# of projects	Funds Spent	% Total Funds
1.1 Digitise priority publications	36	$790,100	16%
1.2 Develop new priority website services	20	$756,000	16%
2.1 Digitise priority collection and survey data	35	$2,213,600	46%
2.2 Provide improved access to national scale databases and datasets	11	$934,500	19%
3.1 Prepare plans and guides for the supply and management of biodiversity data and information	2	$12,000	0%
3.2 Contribute to the development of a national environmental data and information infrastructure	2	$29,500	1%
4.1 Contribute to funding of priority surveys	0	$0	0%
5.1 Sponsor meetings and workshops	6	$93,500	2%

Fully 62% of the fund has been spent on digitisation of publications and collection and survey data. 35% was spent on enabling improved access to those data and information. Only 3% was spent on plans and guides, infrastructure, surveys and meetings and workshops.

Of the six broad issues raised in the original strategy, four were relatively well catered for, with a skew towards the one major issue (lack of data and information) that aligned with the two heavily funded project categories mentioned above. The issues relating to 'national and regional programmes/projects to conserve and manage biodiversity not being well advertised', and 'some levels of distrust and concern handicapping the acquisition and use of biodiversity data and information', were not seen as having been addressed in any significant way.

The review concluded that the original project types and assessment criteria were perhaps too tightly defined, or at least not comprehensive enough. It seems possible that, because of this, they might have been ignored in favour of 'gut feel' decisions. This in turn may have been one factor leading to the underfunding of some project categories. It should be noted that the committee did not receive and reject a lot of applications in the underfunded categories. It seems likely that this is partly because some categories and project types require coordinated effort between agencies, rather than bids from individual providers. It is also likely that, with shifts in the view of the committee over time, communication to the sector reduced the number of bids for some project categories, especially category 4 'Fill Data and Information Gaps'.

To date the projects funded have largely been applicant driven. The fund set up the initial project categories, types and assessment criteria, but has given little further guidance to applicants as to the types of projects it would like to fund.

2.3   Progress to date

During 2005 and 2006 progress of the NZBS was reviewed by Bruce Clarkson and Wren Green. Their report entitled "Review of the New Zealand Biodiversity Strategy Themes", submitted to the Biodiversity Chief Executives in March 2006, states:

> ### *Progress in sharing and reporting information and best practice*
>
> *Substantial progress has been made with this objective through the Biodiversity Package funding of the TFBIS Programme. This has resulted in a significant amount of data and information being made available to parties interested in maintaining and restoring indigenous ecosystems. The impacts of this action on biodiversity outcomes are however difficult to determine on the basis of the information we have been provided with. The nature of several of the projects funded and the apparent dominance of research providers in determining the type and nature of data and information being made available suggests to us the need for greater involvement of end users in deciding which projects will give greatest on-the-ground benefits. Aspects of accessibility, data querying and manipulation also need to be considered in close dialogue with potential end users.*

During the consultation phase for this strategy, participants at the regional workshops were asked how they and their organisations had benefited from improved biodiversity information systems over the last five years. Many of the improvements had come as a result of TFBIS funding. In particular, participants valued the increased amount of data available online including that through Landcare Research's Plant and Fungi web sites and names systems, the National Vegetation Survey Databank (NVS), NIWA's Freshwater Biota Information System (FBIS), and DOC's Bioweb and DOC GIS systems.

Participants also highly valued the wealth of digitised literature now available, including the Journals of the Royal Society, the NZ Flora and Fauna series, the New Zealand Journal of Ecology, and the New Zealand Entomologist.

A number of areas where more progress was required included addressing the lack of awareness in local government and in DOC conservancies about TFBIS funded data, information and systems, addressing the large gaps in availability of spatial data, and improving the consistency of data collection. Improvements could also be made in providing integration of data across local, regional and national scales. It was felt that more interpreted and derived information, layers and tools were required, and that TFBIS should now increase its focus on data and information focused on ecosystems (not just species), and on biodiversity on private land.

2.4   Who uses TFBIS?

The Terrestrial and Freshwater Biodiversity Information System (TFBIS) Programme supports the conservation of New Zealand's indigenous biodiversity, by increasing awareness of and access to fundamental data and information about terrestrial and freshwater biota and biodiversity.

Data, information and computer systems are only useful to the extent that they help people achieve real biodiversity outcomes, so understanding and meeting the needs of end-users is important. The original TFBIS strategy identified a number of types of contributions that people make to biodiversity conservation:

- **Groundworkers -** people who, for example, plant trees and build fences, regardless of the primary intent (i.e. for biodiversity conservation or stock control).

- **Planners -** people who prioritise desired biodiversity outcomes and/or the actions at specific places.

- **Surveyors -** people who survey the biodiversity of places.

- **Advisors -** agency staff or contractors who advise groundworkers, planners and surveyors about, for example, biodiversity context, management techniques, and funding sources for biodiversity management.

- **Scientists -** people who provide new knowledge about biodiversity and how to manage it.

- **Information custodians -** people who look after data and information resources.

It went on to say:

> *most contributors do more than one type of action, but some people do one only. Some contributors focus their efforts on a single type of ecosystem (e.g. forests), while others work in a range of ecosystem types. Contributors can work at different scales: neighbourhood/local, regional and/or national. Contributors can be employees of agencies or organizations, self-employed and/or volunteers.*

Within this range of roles there is a tension around factors such as the geographic scale, level of detail and precision, type of language used, sophistication of tools, timeframes for data gathering and preservation, quality of data required, and quality of data able to be contributed. Scientists for example are concerned with describing species and understanding ecosystems and for this they need high-quality data to validate research hypotheses, whereas groundworkers want simple, straightforward answers to specific, local questions. Where the 'groundworker' category also includes members of the public, the information needs to be presented in ways they are capable of interpreting and acting on.

In the past, traditional models of scientific research and conservation management made a fairly clear distinction between the 'providers' of knowledge (scientists), and the 'end users' of that knowledge (advisors, planners and groundworkers). Scientists collected data, and interpreted it to form new knowledge. The primary method for transfer of that knowledge was through research publications and contract reports.

As technology has advanced this distinction between knowledge providers and end users has begun to blur. Technology is beginning to allow all contributors to biodiversity to collect data, share it with each other, and add to an emerging national picture. Scientists become end users of data collected by private individuals and conservation management agencies and can do more and better research as a result. Interpreted layers and tools can encapsulate scientific models and allow a much broader range of people to make informed decisions. It is easier to share knowledge, both of science and of practical hands-on biodiversity management between people separated by distance.

There is some indication that in its first five years the TFBIS Programme may have benefited scientists, and DOC planners and advisers to a greater extent than the other types of contributors. This was perhaps necessary and appropriate as there was much to be done in making primary data and information available and accessible, and in implementing geospatial tools for biodiversity management on the conservation estate. Now that technology and the availability of data have improved, it is time to focus efforts on helping all biodiversity contributors to work together towards national biodiversity goals. This will be done by integrating approaches, collection methods, standards and systems across local, regional and national levels, by developing tools to allow interpretation of primary data by wider audiences, and by enabling the sharing of information on best practice hands-on techniques.

2.5   Sector strategies and initiatives

There are many other strategies and initiatives that impact on TFBIS. Most important is the aforementioned review of the New Zealand Biodiversity Strategy. Other strategies that are important for TFBIS to consider include the New Zealand Biosecurity Strategy and Biosecurity Science Strategy, the Digital Strategy, e-Government Strategy, the New Zealand Digital Content Strategy, the Geospatial Strategy, and the Ocean Survey 20/20 data management programme. There are also a number of initiatives led by the Ministry of Research, Science and Technology (MoRST), including the Advanced Network, involvement in the Global Biodiversity Information Facility (GBIF), the Environment Roadmap, policy work on research data saving and sharing, and Envirolink. These strategies and initiatives all point towards the need for more interconnection of information systems across agencies. This concept of 'federated systems' is very important to TFBIS, as a single, centralised biodiversity information system is not viable in New Zealand. TFBIS has to a certain extent been a leader in this federated approach. The various other strategies mentioned are likely to open up even more opportunities for TFBIS to realise its vision.

The relationship between the TFBIS Strategy and other strategies and programmes currently under way in central government is represented in the diagram below.

Relationships between Strategies, Funds and Initiatives that may impact on TFBIS
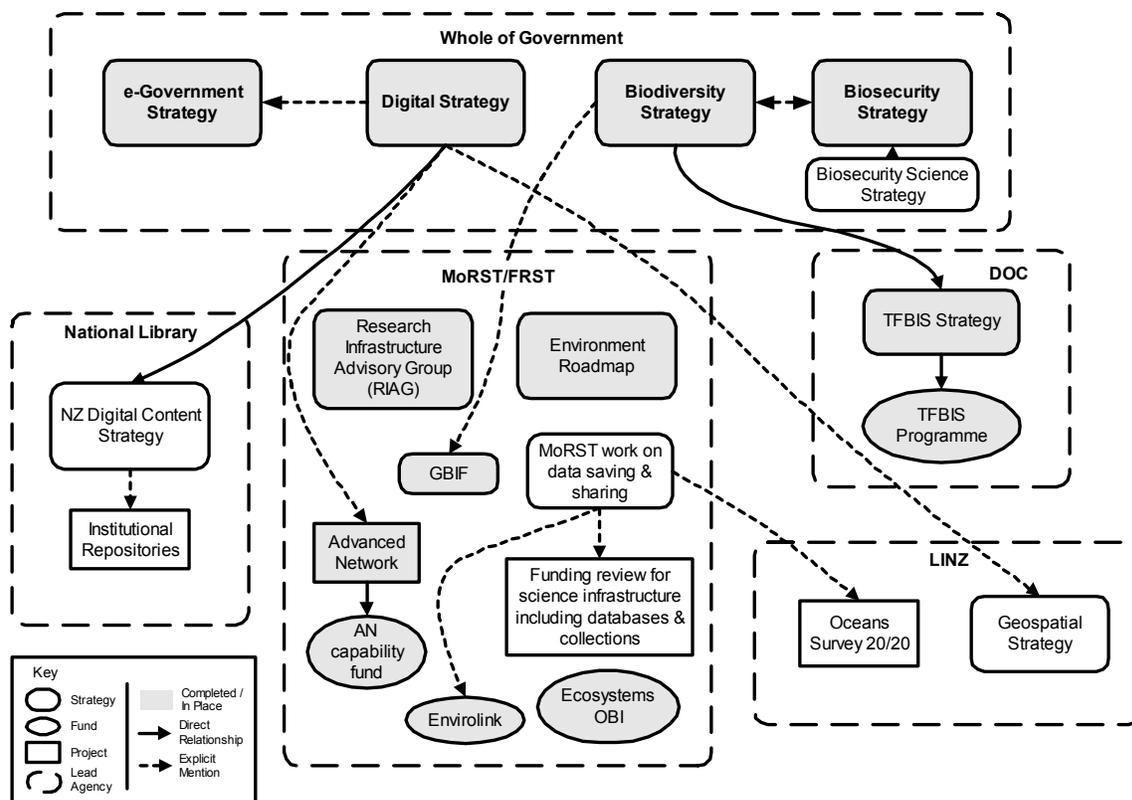
More detailed descriptions of each of these sector strategies and initiatives, and their impact on TFBIS can be found in the Appendix.

2.6   Technology trends

Broad access to research data, and their optimum exploitation, requires appropriately designed technological infrastructure, broad international agreement on interoperability, and effective data quality controls. (OECD 2003)

Technologies to allow sharing and federation of research data, information and tools across organisational boundaries are rapidly gaining in sophistication and maturity. There is a convergence of grid computing services standards and web services standards. Through both the Internet and next-generation advanced networks, we are shifting from a large 'library' of textual information, to a true 'platform' for collaborative research. Datasets, modelling tools, and processing power can be drawn from different parts of the network in real time to work on specific problems or experiments 'in virtuo'.

Collaborative information management tools such as blogs and wikis are starting to enable greater participation in international research projects. Video conferencing and access grids also support this.

As web services standards mature, the ability to safely and securely interconnect data in real time between different systems and organisations is improving. As GIS tools improve and national standards are defined, the ability to visually combine data held by different organisations focused on a particular geographic area (e.g. a wetland) will enable improved decision making.

All of this makes possible a more interconnected, federated, 'ground-upwards' approach to achieving the TFBIS 'meta-system'. As this takes shape it will be essential to focus clearly on the needs of the end-users of the information (both conservation managers and scientists), to ensure the technology comes together in a way that they can use to achieve real biodiversity outcomes.

2.7   Environmental science and management trends

Aspects of research in environmental science and management that are well established include basic taxonomic research, and analysis of ecosystems and their dynamics. A number of trends, however, are influencing the direction of the whole field.

There is a move towards more integrated science. Understanding the environment is as much about understanding the human impact upon it, and the social systems that shape those impacts, as it is about understanding the physical world. Social science is becoming more important in helping understand the cultural and economic implications of environmental change, and in increasing the success of initiatives to conserve ecosystems and manage environments sustainably.

There has also been a rapid emergence of community-led conservation. There are of course limits to what community initiatives can contribute to national biodiversity outcomes. They do however play an important part in increasing the public's awareness of, and sympathy towards, environmental issues and therefore have other long-term benefits for biodiversity. The mobilisation of communities in biodiversity and conservation activities also means essentially a larger workforce, but an associated need to tailor information to a non-scientific audience. There is still work to be done in achieving this.

Regional councils are engaging in community-led conservation and biodiversity initiatives and need support in this. There is also the need for increased interaction between research agencies and management agencies including DOC and the regional councils. The FRST Outcome Based Investment (OBI) process is a step towards this, but overcoming traditional attitudes of self-reliance, organisational boundaries, and competing objectives is a continuing challenge.

Questions of global significance are also high on the research agenda, with climate change being an important example. There is also a move from merely understanding biodiversity and protecting individual species to a focus on restoration of entire ecosystems. This international trend involves attempting to understand the functioning and dynamics of an ecosystem, and learning how to restore it if it becomes damaged (or destroyed). This research is useful in terms of understanding the real costs of such undertakings, and therefore justifying scaling back of damaging economic activity, or justifying the case for any development to be sustainable. This goes hand-in-hand with a shift towards research into urban sustainability. Alongside this trend in research is a shift in biodiversity management from species-led strategies and initiatives towards site-based ones. This change is currently under way in DOC and in local government in New Zealand.

There is a growing trend towards understanding ecosystems in terms of the services they provide, and the ways those services contribute to food production and human health. The environment is becoming inextricably linked to the economics of production and trade.

As an adjunct to this there is a trend towards attempting to increase the degree to which commercial value can be extracted from environmental data and information. This is valuable but can pose some challenges to open access to data and information.

There is a progressive move towards using computer models to aid in understanding ecosystems. In biodiversity there are significant challenges in terms of lack of predictability because of the truly complex nature of biological entities and the myriad of causal interactions in biological systems. These types of computer-based modelling both require and generate significant amounts of data.

As the TFBIS community is well aware, there is also a trend in research towards increased use of technology, including databases, remote sensing, GIS, and analytical tools. There is some concern that increased reliance on technology will come with a loss of connection to real, grounded, experiential understanding of natural environments. Along with increased use of technology in research there is the need for technology to support biodiversity management. The ongoing drive towards federation and interconnection of primary data is important in a research context, but for biodiversity management there is more of a need for access to interpreted versions of those data (such as that in Land Environments of New Zealand, LENZ). These types of models, classifications, and analytical tools are becoming increasingly important.

New Zealand's environmental science, management practices, and data collection activities have achieved a high reputation internationally. Continuing to make best use of the data we have will be critical to maintaining this situation.

2.8   Biodiversity informatics architecture

In their summary report from the TFBIS workshops in 2002, Joseph Arand and Glen Lauder stated:

> *The TFBIS Programme cannot create the New Zealand terrestrial and freshwater biodiversity information system, because the 'system' (in an informal sense) already exists: It is a complex system that comprises data and information:*
>
> - *in paper and/or digital formats*
>
> - *as, among other things, papers, books, survey reports, restoration guides, scientific reports, raw datasets, databases and associated analysis tools*
>
> - *and located in public and personal libraries and archives, on desks, in shoeboxes, on personal computers and Internet servers, and in people's heads.*
>
> *The TFBIS Programme can enhance the existing terrestrial and freshwater biodiversity information system, by funding projects that will help to resolve priority information issues.*

These statements still hold true. It seems highly unlikely that there will ever be one single, all-encompassing system that incorporates all the data, information, and functionality needed to manage biodiversity in New Zealand. A 'meta-system' created by the willingness of organisations to share data with each other does, however, appear to be feasible. It incorporates many distinct and discrete databases, information repositories, and tools. By encouraging interoperability and cooperation between agencies there is the potential to gain a 'whole is greater than the sum of the parts' situation. There is some evidence that this is already occurring. Examples include the storage of freshwater data by regional councils in the Freshwater Biodiversity Information System (FBIS) at NIWA, and the use of the Landcare Research Plant Names web service by two regional councils and a community organisation, New Zealand Ecological Restoration Network (NZERN).

Many components in this 'meta-system' can be created by individual agencies. While serving the greater good, they are often targeted at solving particular problems, or improving research in a particular area. Some components, however, are essentially 'infrastructure' - they benefit the whole system in a 'diffuse' sort of way. They become very valuable, but there is often the lack of individual gain for any one organisation to 'just build it'. It is like asking every driver to build all the roads in their suburb. If there is sufficient shared vision, however, TFBIS may be able to encourage development of some of these 'infrastructure' components through projects involving collaboration between a number of agencies.

As the many biodiversity information systems in New Zealand become more interoperable, through data quality and certainty, and sharing of unique keys for taxonomic names, and standard geospatial references, conceptualising a whole systems 'architecture' becomes possible. There is a trend towards sector-wide information systems architectural approaches in central government. The Justice, Health and Education sectors have all begun this process, assisted by the ICT unit of the State Services Commission as part of the e-Government Strategy.

TFBIS could play an important leadership role in establishing the architecture for biodiversity and perhaps the entire environmental sector, but it cannot do the whole job itself. Cooperation and coordination with other government agencies (such as DOC, MAF, MfE, MFish, MoRST and others) will be essential.

3 Where we want to be

"The outstanding feature of today's march is that we have seen new land to the South never seen by human eyes before. Great snow clad heights which we did not see on our journey South on the last Expedition for we were too close to the land or rather foothills and now at the great distance we are out they can plainly be seen."
Sir Ernest Henry Shackleton, Heart of the Atlantic, 22 November 1908

The desired outcome for 2020 for the NZBS *Theme Nine: Information, Knowledge and Capacity* provides important guidance for the direction of the TFBIS Programme. Two excerpts from the outcome statement for 2020 are of particular relevance:

> *We have become more effective as a country at learning about biodiversity and our management of it. Decisions that affect New Zealand's biodiversity are based on sufficient and timely information and effective management approaches, underpinned by a growing knowledge base which draws on local and traditional knowledge (matauranga Maori).*

> *We have become more systematic in our management of biodiversity. A bioregional approach to the assessment of biodiversity and coordination of its management draws effectively on the knowledge, skills and experience of national, regional and local organisations, communities, iwi and hapu, and individuals. Information about biodiversity at all levels is widely accessible, and resource managers are able to select the best mix of management tools from a range of mechanisms to suit local conditions. Those responsible for managing activities that affect biodiversity have sufficient capacity to do so, and share their skills and experience with others.*

This section presents the vision that TFBIS aspires to for 2015, and a set of goals to direct action towards the achievement of that vision.

3.1 TFBIS Vision 2015

It is 2015. The TFBIS Programme has, over the last eight years, contributed significantly to the availability of, and accessibility to, biodiversity data and information, and the sharing of knowledge and best practice. This has played a large role in enabling progress towards the goals of the NZ Biodiversity Strategy 2000. Good data and information management is recognised at a political and senior management level as being fundamental to preserving biodiversity.

As a result of the efforts of TFBIS it is much easier to measure achievement toward national goals, and to measure agency performance in contributing to biodiversity management. Some research can be done more cheaply due to less effort having to be expended on data collection. New research has been generated through combination and interpretation of existing datasets.

Data and information are readily available on a large proportion of described indigenous species, their habitats and distributions, and on ecosystems. There is good coverage of data for both public and private land and biodiversity data can be compared across local, regional and national scales. Contributors to biodiversity actively share knowledge on best practices. As such better decisions can be made in biodiversity management, and it is possible to react faster to threats. Biodiversity management is well linked with biosecurity and biotechnology.

Duplication of effort and cost, and redundant data collection seldom occur. Policy and management decisions are well informed. Political decisions are based on an increasingly accurate national picture of the state of biodiversity, the human impacts causing its degradation, and the economic effects of its loss.

3.2   Mission

The mission for TFBIS is to:

"Support seamless access to essential biodiversity data, information and knowledge to achieve the goals of the NZ Biodiversity Strategy 2000"

3.3   Goals

The NZBS objective on which the TFBIS Programme is based is:

> ### Objective 9.5 Share Information and best practice
>
> *Consolidate and share existing and new information, methods, technologies and management experiences so that others can benefit from relevant knowledge about indigenous biodiversity.*

To support the achievement of this objective there are five major goals for the TFBIS Programme. These are:

1. **A robust infrastructure exists to support the interoperability, interconnection and sharing of biodiversity data and information**

2. **Important biodiversity data and information are secured against loss and are available digitally**

3. **Biodiversity data and information are accessible to, and usable by, everyone who needs them**

4. **Gaps in national biodiversity data and information are filled**

5. **People involved in biodiversity research, policy and management actively work together, coordinate their efforts, and share their knowledge**

These goals are expanded further in the following subsections.

3.3.1   Stable and enabling infrastructure

Biodiversity data and information are discoverable, connected and interoperable regardless of where they are stored. Shared infrastructure components support the exchange of data and information between agencies, and facilitate contextual linkages between different repositories based on parameters such as species, location, ecosystem type, and management/control activities.

Data can be readily shared while protecting privacy, safety and intellectual property where necessary. Sophisticated data sharing policies and frameworks exist to enable the highest possible extraction of value from existing datasets while preserving the rights of individuals and organisations.

There are national standards for collection, storage, curation and exchange for the majority of biodiversity data. Standards definition is an ongoing, lively process and many sector participants are involved in enhancing and agreeing standards. There is an appropriate level of local innovation and autonomy around methods for biodiversity data collection. Increasingly data can be compared across local, regional and national scales. National and international standards for biodiversity data are well aligned. Groups such as volunteer organisations and NGOs have access to best practice knowledge and guidelines on ways to organise and manage their biodiversity data and information.

Datasets are connected, where appropriate, with international initiatives and global data repositories such as GBIF. New Zealand is seen within the international biodiversity community

as being, for its size, a leader in the management of biodiversity data and information, and responsibly meeting its international commitments.

3.3.2 Data/information are secured against loss and available digitally

The nation's key biodiversity related datasets are identified, and they are well stewarded and have stable funding arrangements. All important data are protected against loss and are available in digital form. All historical scientific publications useful to biodiversity management have been digitised.

NGOs and community groups contribute significant volumes of high-quality observational records to the national picture. These data are interoperable and useful in comparison with the more rigorous data collected by government agencies and research organisations.

Data and information relating to biodiversity on private land, including that collected by private sector consultants is preserved and, within appropriate limits of privacy and confidentiality, is available for use by others.

3.3.3 Data/information are accessible and usable

End-users can search and query biodiversity data and information from many places, across a wide range of different datasets. They can also search through a single centralised biodiversity portal. The TFBIS 'meta-system' comprises a federated, interconnected set of databases, analytical tools, and information repositories, spread across a number of organisations including central government agencies, research organisations, museums, and NGOs.

It is possible to search for a particular species and find the majority of data and information about that species, including collections, observation records, distributions, habitat information, information on preservation and/or control methods, and relevant research publications. It is also possible to search for data and information on ecosystems, communities, and ecosystem services. Data, information and knowledge are useful for a range of purposes including species and habitat conservation, ecosystems restoration, pest control, and local and national biosecurity management.

Users can query by location and view observation, distribution and ecosystems data using geospatial tools. These tools are able to aggregate data from different organisations and display it on a single geospatial interface.

While in many cases users may have to delve into individual systems, read documents, or talk to people in order to get what they need, the 'meta-system' allows them to find out what data and information exist, where they are stored, and who to contact to get them. Large amounts of data and information are available for viewing online, download, and integration into other systems directly. In addition a range of tools and layers of interpreted information enable researchers, planners, groundworkers, advisors and policy makers alike to engage with the nation's collective stores of knowledge about biodiversity, in ways they can all understand and use.

3.3.4 Gaps in data are filled

Gaps in priority data and information required to manage biodiversity are being identified and filled by the science system, management agencies, NGOs and the general public. TFBIS is able to fill some of the critical gaps where other funding sources cannot.

New information layers are being derived from primary data to enable the extraction of new value and make those data easier to interpret and use in decision making.

3.3.5 People know each other and share knowledge

Relationships between contributors to biodiversity conservation are strong. Good relationships and communication networks exist across agencies and between people who perform different roles in the sector. Knowledge on best practice methods and technologies for biodiversity management are shared. People know who to ask when they need help or advice. Scientific research is well communicated, as are practical management experiences. People meet regularly and share their ideas. There is a culture of focusing on the big picture and sharing the knowledge and expertise to achieve the Biodiversity Strategy goals.

4 How we will get there

"We've removed the ceiling above our dreams. There are no more impossible dreams."
The Reverend Jesse Louis Jackson

This section defines the scope of TFBIS, provides a set of action areas for each major strategic goal, explains changes to funding emphasis for the programme, and outlines required changes to programme management and administration.

4.1 Scope of TFBIS

This strategy reconfirms the scope of TFBIS as follows:

Terrestrial and freshwater – TFBIS is focused on biodiversity on land, and in our rivers and lakes. While it is acknowledged that there is a need for a marine equivalent of the programme, TFBIS cannot fund projects relating to marine biodiversity as this is outside the Programme's mandate.

Species and ecosystems – while much of the initial focus for TFBIS has been on data and information relating to individual species, its scope includes ecosystems. All other things being equal, projects relating to biological communities and ecosystems have just as much priority for funding as those relating to individual species.

Local, regional and national – the purpose of TFBIS is to help bring about an integrated picture of our biodiversity, and to share data, information and knowledge. This happens at many scales. TFBIS is not exclusively focused on 'national only' data and information, and can fund projects at local or regional levels where this meets a national priority benefit. Any such projects however must integrate through standards and where possible shared infrastructure to form part of the wider national picture.

Public and private land – much of our remaining biodiversity is in native bush and wetland remnants on the 70% of New Zealand land that is in private ownership. TFBIS is just as committed to facilitating the management of the biodiversity data on private land as it is on public land.

Data, information and knowledge – TFBIS functions at all of these levels. Digitising, providing stores for, and methods of access to a) primary data and b) information in the form of publications and tools; and facilitating the sharing of knowledge in people's heads through face to face meetings and online forums are all equally valid means.

Federated – The TFBIS Programme will not attempt to create a single New Zealand terrestrial and freshwater biodiversity information system. It will support the emergence of a 'meta-system' comprising many distinct and discrete databases, information repositories, and tools, integrated through standards in a distributed and federated architecture.

4.2   Goals and Action Areas

To deliver on the TFBIS vision a set of action areas have been identified under each major goal.
These are as follows:

Goals	Action Areas
1. **A robust infrastructure exists to support the interoperability, interconnection and sharing of biodiversity data and information**	**1.1 Plan and develop tools and infrastructure components to increase interoperability between sources of national biodiversity data and information** **1.2 Develop privacy, data access, and intellectual property policies and frameworks** **1.3 Develop and propagate standards for data storage, curation and exchange** **1.4 Prepare plans and guides for the supply and management of biodiversity data and information**
2. **All important biodiversity data and information are secured against loss and are available digitally**	**2.1 Digitise priority publications** **2.2 Digitise and capture priority collection and survey data** **2.3 Secure digital data and information against loss**
3. **Biodiversity data and information are accessible to, and usable by, everyone who needs them**	**3.1 Expose existing data and information sources for improved access** **3.2 Develop tools to allow better interpretation of primary data** **3.3 Provide national level topic-specific repositories and portals**
4. **Critical gaps in national biodiversity data and information are filled**	**4.1 Develop new information derived from existing data** **4.2 Contribute to funding of priority surveys not covered by existing funding processes (e.g. FRST)**
5. **People involved in biodiversity policy, research and management know each other, coordinate their efforts, and share their knowledge**	**5.1 Support meetings and workshops** **5.2 Support the implementation of processes and technologies to improve interagency dialogue**

These action areas, and criteria for projects within them, are expanded on the following pages.

4.2.1 Enabling infrastructure

The focus for this goal and action areas is to plan and provide enabling infrastructure. This includes metadata management systems, thesauri, data exchange schema and protocols, spatial data integration tools, decision support systems, web services, and portals for discovery and access. Much effort has already gone into digitising primary data and print publications. Many of these however are still locked within individual repositories. The value of these resources will be significantly increased when they can be compared and combined in new ways, while retaining their underlying context and provenance.

> **Goal:** A robust infrastructure exists to support the interoperability, interconnection and sharing of biodiversity data and information
>
> **Action Areas:**
>
> 1. **Plan and develop infrastructure components to increase interoperability between sources of national biodiversity data and information**
>
> 2. **Develop privacy, data access, and intellectual property policies and frameworks**
>
> 3. **Develop and propagate standards for data storage, curation and exchange**
>
> 4. **Prepare plans and guides for the supply and management of biodiversity data and information**

Criteria:

1. **Infrastructure components** – these must be national in scope. Projects must have multi agency support and demonstrate buy-in and collaboration between all necessary agencies on the proposed solution and ongoing governance. Projects must generate new value by increasing interoperability between, enabling contextual links between, or providing a repository for biodiversity data or information that has previously been difficult to locate, access or use.

2. **Privacy, data access, and IP policies and frameworks** – these may have a specific focus on one system or topic domain, but must be made freely available for adaptation to other systems and domains. They should be focused on providing more access to data and information than is currently possible with less sophisticated policies, while protecting privacy, safety and intellectual property as required, and facilitating attribution, acknowledgement and reporting of use. Projects can be applied for by one agency, but should demonstrate the support of end users who will benefit from increased access to the data/information.

3. **Standards** – where possible standards developed should draw from existing international standards and standards setting processes. Projects should present a clear plan for the propagation and adoption of the standard by end users. Ideally there should be an established demand for a standard from a number of agencies. Priority will be given to standards development for the storage, curation, and exchange of data, however standards for data collection will also be considered. Where possible standards development should utilise the State Services Commission e-GIF processes.

4. **Plans and guides** – Plans will only be funded for volunteer organisations, non-government organisations and small government agencies that do not have existing capacity. Examples include information systems strategies and geospatial data/information plans. Guides for supplying or managing biodiversity data and information must be generic, not specific to an individual agency, but could be geared towards one topic domain (e.g. pests), or one organisation type (e.g. local government). Where possible guides should incorporate all relevant standards and privacy, data access, and IP policies.

4.2.2 Preserved and available

There is still much data only available in non-digital form. This includes print publications, physical collections and associated documents and notes, and survey data sheets and reports. Some data and information are in digital form but are poorly curated and are at risk of loss. This goal and its action areas focus on preserving and preparing existing data and information for uptake.

> **Goal:** All important biodiversity data and information are secured against loss and are available digitally
>
> **Action Areas:**
>
> 1. **Digitise priority publications**
> 2. **Digitise and capture priority collection and survey data**
> 3. **Secure digital data against loss**

While it is an enormous task, ongoing support should be given to the digitisation of established collections and survey data that contribute to achieving the National Biodiversity Strategy goals, at least until other funding sources become available for this task. This includes two new areas of focus, marshalling historical 'volunteer' data through NGOs, and the preservation of biodiversity data collected on private land.

Criteria:

1. **Digitise priority publications –** in the broad sense criteria for what constitutes 'priority' publications should involve the degree to which having improved access to those publications will allow contributors to biodiversity conservation to achieve Biodiversity Strategy goals. In a practical sense, this should be assessed using a range of factors including the number and breadth of potential users, evidence of support from those users, the threat status of taxa or ecosystems addressed in those publications, their utility in practical biodiversity management or applied research, and the rarity and risk of loss of the print publications themselves. Priority should be given to applications that will use best practice, low cost digitisation methods as demonstrated in a number of recent TFBIS projects. It should be understood that the scale of the publication digitisation task is potentially surmountable by 2020, unlike the digitisation of collections.

2. **Digitise and capture priority collection and survey data** – because completing the digitisation of all existing data is an enormous task, and is very unlikely to be achievable within TFBIS resources by 2020, care must be taken in prioritisation of these projects. Applicants should clearly demonstrate the expected uses for these data, and the benefits to biodiversity expected as a result. End user support (be that from researchers, field workers, advisors or any other user group) must be evident. Digitisation of collections and survey data should result in those data being made available externally (to the digitising agency), either through existing websites or portals, or through the development of new portals. Where possible data should be fed into established data repositories, or existing repositories should be upgraded to support appropriate levels of data integrity and curation for the new data. Priority will be given to applications that demonstrate well-planned processes for ongoing data maintenance and curation.

3. **Secure digital data and information against loss –** this applies where digital data is at risk of loss from technological obsolescence (e.g. storage in old formats), physical decay of storage media, lack of resources for adequate curation, or for NGOs, lack of adequate disaster recovery measures. Projects may involve transfer of data into new formats or existing repositories under similar criteria to action area 2 above, curation and data quality enhancements, and for NGOs, some funding for disaster recovery plans and measures.

4.2.3 Accessible and usable

There are many individual databases and information repositories that are not currently accessible outside the organisations that hold them. The focus of this goal and its action areas is to make data and information in these repositories easier to access and use, either through exposing them for external access, or aggregating them into national topic-specific portals.

A new area of emphasis is on making existing data easier to use and interpret through the development of tools for non-specialists, including those in local government, DOC conservancies, and the general public.

> **Goal:** Biodiversity data and information are accessible to, and usable by everyone who needs them
>
> **Action Areas:**
>
> 1. **Expose important existing data and information sources for improved access**
>
> 2. **Develop tools to allow better interpretation of primary data**
>
> 3. **Provide national level topic-specific repositories and portals**

Projects that come within these action areas are likely to be closely related to, or draw from those within the 'Enabling infrastructure' goal above, in particular infrastructure components and data storage, curation and exchange standards.

Criteria:

1. **Expose existing data and information** – providing improved access to existing sources of data and information should be done through technologies (such as web sites and portals) that deliver the widest level of access appropriate given the nature of the data. Priority will be given to systems that also expose data and information in machine-readable formats (e.g. webservices) that can be directly consumed by other systems. Where possible systems should use available standards for data exchange. The focus of this action area is to provide improved and sustainable access to existing, individual systems (e.g. through web enablement).

2. **Tools for better interpretation of primary data** – tools should enable non-specialist users (e.g. biodiversity managers) to view, visualise and make sense of data in ways they have not been able to before. This could include geospatial and mapping interfaces, decision support systems and graphing, modelling and simulation tools. Priority will be given to applications that demonstrate clear plans for user needs analysis, have a focus on user centred design and usability engineering, and provide programmes for promoting new tools, and training end users.

3. **Provide national level topic-specific repositories and portals** – these should enable improved access to data and information on a specific topic relating to biodiversity. Examples could include pests (or particular types of pests), particular groups of flora or fauna, ecosystem types (e.g. wetlands), or conservation efforts (e.g. restoration projects). Priority will be given to projects that enable many agencies and organisations to contribute their data and information (either through federation or direct deposit into a centralised system) rather than just enabling access to data from one particular agency. Projects should focus where possible on compiling or aggregating data and information across local, regional and national scales. FBIS and the Biological Recording Network are good examples of this kind of project.

4.2.4 Gaps are filled

The original TFBIS strategy anticipated being able to make significant contributions to the collection of new data. This did not however occur, partly due to the sheer size of the digitisation task and the lack of any other funding sources for digitisation, and partly because it was difficult to understand priorities for survey work.

> **Goal:** Critical gaps in national biodiversity data and information are filled
>
> **Action Areas:**
>
> 1. **Develop new information derived from existing data**
>
> 2. **Contribute to priority surveys not covered by existing funding processes**

The programme will still fund the filling of data and information gaps, but only where these are very high value to biodiversity management, or where they are the 'final jigsaw piece' that completes a large existing dataset.

Criteria:

1. **Develop new information derived from existing data** – this action area supports the development of new information where this clearly meets a biodiversity planning or management need, and where this addresses critical gaps that are unlikely to be otherwise filled. The focus is on situations where there is adequate underpinning data, but some interpretation by experts is needed to turn the data into information usable by a much wider range of non-specialists, and where this cannot easily be done through automated tools. Examples include the development of interactive keys, new geospatial layers, rules for decision support systems, or new classification systems. Often this new information will by necessity be a 'once-off' development, however where possible new information should integrate into tools that allow ongoing interpretation of new data. Applications must articulate the end user need this new information will meet, and demonstrate clear end user support.

2. **Contribute to priority surveys not covered by existing funding processes** – in exceptional and compelling circumstances TFBIS will fund projects to fill small but critical gaps in data. It applies where there are identified gaps in data that if filled will complete a larger picture or existing dataset, and in so doing make a discernible difference to the attainability of particular biodiversity outcomes. This includes for example where a local or regional scale survey will help to complete an important national information resource or significantly enhance the utility of a particular tool. Applicants should explain why the proposed survey has not been able to be covered through existing research or inventory and monitoring funding processes (e.g. Marsden, FRST, DOC), demonstrate where the survey(s) fit within the priorities set through those processes, and explain the uses the new data will be put to, and the associated biodiversity outcomes that are anticipated. Priority will be given to applications that use established standards for data collection, and that can demonstrate how and where their data will be integrated into existing repositories.

4.2.5 Knowledge is shared

There is still a lack of communication between some biodiversity contributors. This goal and its action areas aim to improve the coordination of efforts and the sharing of best practice. While data and information are very important, there is some knowledge that is best shared through conversations between people both online and offline. Improved relationships between biodiversity contributors are also likely to increase

> **Goal:** People involved in biodiversity research, policy and management actively work together, coordinate their efforts, and share their knowledge
>
> **Action Areas:**
>
> 1. **Support meetings and workshops**
>
> 2. **Support the implementation of processes and technologies to improve dialogue between biodiversity contributors**

cooperation on efforts, standards, and the free and open exchange of data and information in the future.

Criteria:

1. **Support meetings and workshops** – projects in this action area should focus on bringing people together to better coordinate biodiversity data management efforts across the sector. Emphasis should be put on events at which TFBIS support will increase or enhance opportunities for biodiversity contributors to meet each other face to face, discuss useful sources of data and information, and learn more about novel, emerging, good or best practice in biodiversity data and information management. Where they already exist, established groups, forums and events should be supported. Where possible meetings and workshops should be used as an opportunity to improve awareness of TFBIS funded systems and data/information resources. It is noted that TFBIS may need to be proactive in initiating some projects under this action area.

2. **Support the implementation of processes and technologies to support dialogue between biodiversity contributors** – this action area should focus on developing communities of practice and online collaboration tools to support discussion and communication between biodiversity contributors. Priority will be given to projects that will connect people across agency/organisation boundaries, and/or across biodiversity contributor role boundaries (e.g. researchers, policy makers, advisors). As above, where they exist, established groups should be supported and enabled with new collaboration tools. Priority will be given to applicants that demonstrate clear buy-in from proposed users of the tools. Specific and tangible outcomes from improved communication do not need to be predicted in advance. Applications, however, that can show some connection to real world opportunities or problems that might be solved through improved communication will be looked on favourably.

4.3   Funding emphasis

TFBIS funds will not be split into separate pools for allocation, nor will absolute budgets be set for each of the goals and action areas. However, a set of ranges for the approximate expenditure under each goal has been determined. These will give guidance to the TFBIS Committee in their allocation of funds. These indicative ranges are:

Goal	Funding %
1. Enabling infrastructure	30-60%
2. Data and information are preserved and available	10-25%
3. Data and information are accessible and usable	10-25%
4. Critical gaps are filled	10-25%
5. Knowledge is shared	5-10%

These ranges indicate some important shifts in emphasis for the fund. These are:

- A reduction of spending on digitisation of existing data and information

- A significant increase in spending on providing underlying and connecting infrastructure, along with supporting standards, privacy, data access, and intellectual property policy

- Some funding to fill data and information gaps

- More proactive emphasis on the coordination of efforts across the sector

Although digitisation is very useful, expenditure on it must be balanced against making the information easily available, and making people aware of it. The reasoning for increased expenditure on infrastructure is that without it, the full benefit of interagency sharing of information and data, involving the ability to find, compare, and integrate data sources with other systems, will not be realised.

It should be noted that the spending on infrastructural components is likely to be significant over the next three to four years, but may ease off after that, once major components are in place. These ratios will be reviewed after three years.

While there will be some funding to fill data and information gaps, as mentioned above this is not at the level envisaged in the original TFBIS strategy. Alignment and prioritisation of survey work with real biodiversity outcomes and management efforts is already a part of research programmes through the FRST Outcome-Based Investment (OBI) processes, and by DOC as a part of its inventory and monitoring programmes. If TFBIS were to also fund these activities it would duplicate this prioritisation process, or risk expensive surveys being conducted with little benefit. TFBIS will fund priority surveys where there is a clear need, and one that has not been addressed within the above programmes. The action area '4.1 Develop new information derived from existing data' is also included under this goal. This involves value-added, interpreted layers and classification systems such as LENZ. These are seen as being very valuable for end-users in DOC and local government, and are likely to represent at least half the expenditure in this project category.

It is likely that TFBIS will be more proactive in some areas than it has in the past, especially for projects under goals '1. Enabling infrastructure' and '5. Knowledge is shared', and will actively solicit bids or initiate projects in these areas. This is because such projects will benefit many organisations rather than any one provider, and are unlikely to occur within a purely 'applicant led' approach.

4.4   Changes to TFBIS Programme Management

Achieving the vision for TFBIS will require a number of changes to the way the programme is managed, the expectations it places on applicants, and the way it communicates with end users.

This includes:

- Improved user needs assessment processes

- More promotion of, and training in TFBIS project outputs

- Resulting changes to the funding application process

- Use of specific evaluation criteria and the TFBIS Strategy goals to inform funding decisions

- The TFBIS Programme proactively commissioning some projects

- Some additional measurement of TFBIS outputs and outcomes

These changes are expanded on in the following subsections.

4.4.1   Improved user needs assessment

There is a wide range of contributors to biodiversity outcomes (as discussed in section 2.4 above). To levels varying from project to project, all of these contributors are 'end users' of TFBIS project outputs. To date TFBIS has funded projects that cater right across this range of roles. In some situations user-needs surveys have been conducted. However, there have been some barriers to comprehensive and thorough end-user needs analysis. These were discussed in detail in the TFBIS Programme Alignment and Coverage Report (Carver 2005).

The overall level of analysis of end-user needs for TFBIS-funded projects has in the past been relatively light. There has been a general shift in science funding from output-based to outcome-based investment, which has encouraged research providers to think about, and consult end-users on what they need to achieve their outcomes. This 'outcome focus' should also be reflected in the process used for TFBIS funded projects. A number of changes will therefore be made to the TFBIS Programme and funding process to encourage more detailed assessment and analysis of end-user needs. These changes will include:

1. Applicants will be required to submit user needs analysis/scoping studies for large or high risk projects, and will be able to specifically request funding for the preparation of user needs analysis/scoping studies before asking TFBIS to commit to funding the full project

2. More rigorous criteria in initial funding applications for all projects, including identification of the target audiences for the system or data/information, including who, why (what they will use it for), how often, an explanation of how the user-needs information was gathered, and some supporting statements from potential end users

3. At the discretion of the TFBIS Committee, conducting a technical review by specialists and consulting directly with end-users as a part of a 'go/no go' decision on certain large applications

4. In some cases, where deemed necessary by the TFBIS Committee or Fund Manager, increased levels of project reporting, both during and after the project

5. Publication/review of project outputs and outcomes

As a part of these changes TFBIS will prepare some guidance for applicants on best practice in user requirements analysis.

4.4.2 Promotion and training

During the consultation process on this strategy it became very clear that outside the CRIs and DOC head office the level of awareness of TFBIS funded outputs was less than optimal. Many people who could benefit from the systems, data and information TFBIS has provided are not aware they exist.

More emphasis on promotion and training in new and existing systems is therefore likely to be very useful. This will involve the following changes to the funding conditions and process:

1. Specifying a certain percentage of individual project budgets be allocated to promotion and awareness raising for new systems, along with a description required in project applications as to how that promotion will be done, and holding back a percentage of the final payment due until that promotion and awareness raising is completed.

2. Encouraging some expenditure on training. This will need to vary across the different types of projects, for example a pure digitisation project would require very little training, whereas an analytical tool such as LENZ would require more. Training could vary from production of system manuals and help documentation to workshops and in-person training sessions.

The promotion and awareness raising aspect could also include a number of projects to be initiated by the TFBIS Programme including:

- A six monthly TFBIS newsletter promoting new and/or existing outputs

- A page on the TFBIS website that provides links to the products of TFBIS (as distinct from just the current list of projects funded). This would be a very first step towards a true Biodiversity Portal.

- A survey of existing and potential users on the level of uptake and use of available system

- A roadshow involving a set of regional seminars educating end users on the systems, tools, data and information that TFBIS has provided. This could involve presentations and demonstrations from people who have developed these systems.

- Participation by TFBIS staff or representatives at conferences or meetings held by related groups (e.g. Ecological Society conferences, regional and national biodiversity forums)

4.4.3 Revisions to the application process

A number of changes will be made to the funding application process to support the TFBIS Strategy. These are:

1. The requirement for evidence of adequate user needs analysis for all projects. At the very least this will require identification of the target audiences for the system including who, why (what they will use it for), how often, and an explanation of how that information was gathered, and of the further steps that will be taken to consult with end users during the project.

2. For projects that are higher in cost (e.g. over $80,000), or for projects with a significant degree of risk, uncertainty or complexity a full scoping study will be expected. This should include an appropriate level of user needs analysis, risk analysis, project planning and cost breakdown. Funding will be available for scoping studies to meet this requirement.

3. Additions to the project application form including:

a. Explanation of benefits to biodiversity managers, and user needs analysis (as above)

b. An indication from applicants as to which of the new TFBIS goals and action areas the project fits within

c. Definition of which data collection, storage and/or exchange standards will be used

d. The requirement for details on a user implementation plan including training, communications, promotion and awareness-raising for new systems

e. An indication of how data storage, safe-keeping, backup and security will be addressed

f. Specification of success criteria and measures for the project

g. Where possible the way that the project fits in with other sector priority setting processes and reflects those priorities

h. The expected ongoing maintenance costs for the project and how those will be met

4.4.4 Evaluation process

The process used by the TFBIS Committee to evaluate applications will be revised to align it with the goals, action areas, and criteria defined in this strategy. This will involve additions to the 'Guide To Deciding On Applications For Funding' checksheet including:

- The fit of the project to TFBIS Strategy goals and action areas, using the action area evaluation criteria as a guide

- Quality of assessment of end user needs, and level of end user support indicated

- Level of planning for effective end user uptake

- Other new additions to the application form as above

In addition it is suggested that a register of funding apportionment across the action areas be maintained. This would be used on an ongoing basis to help the committee and the TFBIS General Manager to review expenditure against planned funding profiles.

4.4.5 Measurement

To date the TFBIS Programme has simply measured the number and type of projects funded, and the delivery of contracted outputs. A number of additional measures will now be put in place. Measuring the achievements of a fund like TFBIS is inherently complex. In many cases it is very difficult to predict or trace cause-and-effect relationships between digitisation of a set of data, creation of an access portal, or holding a workshop and actual biodiversity outcomes. So many factors influence outcomes that isolating a single cause can be impossible. In moving along the continuum from measuring outputs to measuring outcomes, measurement becomes inherently more complex, difficult and expensive. Some progress can however be made towards measuring TFBIS achievements

The following approach will therefore be implemented over the next two years and will be reviewed as needed.

Measures of:	Metrics	Measured By
Completion	Number and % of projects completed within each action area Total fund apportionment in each action area	The TFBIS fund manager **6 monthly**
Volume	Number of people shown the new or existing systems or trained in their use	Reported on by applicants in post project reviews (typically 6 months after conclusion of the project) Collated by TFBIS administration staff **Annually**
Usage	Number of unique visitors to web portals each month	Reported on by applicants in post project reviews Collated by TFBIS administration staff **Annually**
	Average length of time users spend on web portals	
	Geographic/organisational spread of end-users	
	Number of new records added to systems such as FBIS, BRN each month	
	Number of posts on online forums	
Value	Surveys of relative value of TFBIS-funded data, information and systems to end-users in their jobs (e.g. qualitative ranking)	Run by TFBIS fund manager or external contractor **Every two years**
	Anecdotes of use of TFBIS-funded systems in achieving biodiversity outcomes (% of positive anecdotes gathered per system)	

Measurement will move from focusing on project completion, to incorporating project objectives, and uptake of the data, information and/or systems by end-users.

4.4.6 Action Plan

The following is the set of actions recommended for initiation by the TFBIS Programme (in addition to the administration of regular funding rounds).

Promotion and awareness:

- Develop a page on the TFBIS website that provides links to the products of TFBIS (as distinct from just the current list of projects funded).

- Establish a TFBIS Newsletter

- Initiate promotional events such as a roadshow and/or participation at conferences or meetings held by related groups.

- Survey existing and potential users on the level of uptake and use of existing systems.

Programme administration:

- Redevelop the application form to include the changes indicated above

- Change the funding criteria and process to specify a certain percentage of individual project budget be allocated to promotion and awareness-raising of new systems, and where necessary to training

- Develop some guidance on best practice methods for end-user needs analysis

- Revise guidelines for project evaluation

- Establish new measurement and reporting procedures

Infrastructure projects TFBIS may choose to proactively initiate:

- Work with experts from Landcare Research, NIWA, DOC and others in the biodiversity/environmental sector to set general federated architectural guiding principles and identify/confirm key 'infrastructure' components and standards that would be unlikely to occur without being initiated by the TFBIS Programme

- Run a set of targeted workshops to encourage national standards definition and adoption across local government. This could include presentations on best practice, and demonstrating what different agencies are doing. This could be done in conjunction with Envirolink.

- Biodiversity Portal – one central site that provides links to, and federated search across, a wide range of New Zealand biodiversity data and information. This could utilise some GBIF technology, and could help connect New Zealand biodata with GBIF - a kind of a biodiversity 'Google' for New Zealand. This would include an Environmental Data Directory – a system that records the content, location and other metadata about all possible biodiversity-related datasets in New Zealand. It may also include a People Finder – a way to aggregate and search across information about particular individual researchers, conservation managers, regional council staff involved in biodiversity, and other active members of communities and NGOs.

- Particular topic-specific systems or portals that span multiple agencies and provide for consolidation or aggregation in a way not currently possible (e.g. a repository for data/reports for biodiversity on private land, or a Virtual Herbarium Network)

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Appendices

Appendix 1. Detailed sector strategies

This appendix contains summaries of a number of strategies and their relevance to TFBIS including The New Zealand Biosecurity Strategy, the Biosecurity Science Strategy, the Digital Strategy, the New Zealand Digital Content Strategy, the e-Government Strategy, the Geospatial Strategy, Ocean Survey 20/20, and a number of MoRST initiatives.

New Zealand Biosecurity Strategy

The New Zealand Biosecurity Strategy was published by the Biosecurity Council in 2003. There are close links between biosecurity and biodiversity management, and the strategies make explicit reference to each other. The Biosecurity Strategy also makes some specific statements about access to data and information, including the following:

> *Vision*
>
> *New Zealanders have confidence in the management of biosecurity risks and are satisfied there is strong leadership and commitment at all levels. The biosecurity system is well organised, information is shared and efforts are well coordinated and focused.*
>
> *Decisions are founded on good information, based on quality science, taking into account the full range of values at stake and with transparent tradeoffs.*
>
> *Gaps*
>
> *Important biosecurity data is stored in a range of information systems run by different groups. This results in gaps and duplication, inconsistency and poor accessibility of information. A coordinated information strategy is needed to ensure this information is shared.*
>
> *Expectations*
>
> *19. That the appropriate data management systems are in place to support quality decision-making and performance monitoring*
>
> *45. That quality information is available to the public to help them identify new or emerging pests*

Maintaining an understanding of the way biodiversity information systems impact on biosecurity, and vice versa will be increasingly important for TFBIS moving forward.

Biosecurity Science Strategy

This draft strategy was released for consultation in November 2006. Its executive summary states:

> *The draft Biosecurity Science, Research and Technology Strategy for New Zealand addresses the expectations of The Biosecurity Strategy for New Zealand 2003 by providing guidance, with respect to priority science needs, for biosecurity science funders, providers and users.*

The draft strategy has an action area under one of its goals that has particular relevance to TFBIS. This is because the two fields are closely related, and some of the information generated by scientific research is of benefit for both biodiversity and biosecurity management purposes. The draft strategy includes:

> *Goal 3: Science Uptake: Ensuring that science is responsive to biosecurity needs and priorities and that uptake is timely and effective*

Objective 3.1: *To ensure ease of access to biosecurity science outputs so that uptake is timely and effective*

Action area 3.1.1 Develop systems to enable rapid and efficient access to up-to-date biosecurity science information

Biosecurity science information is currently distributed in numerous unconnected databases and in both peer reviewed and "grey" literature such as project reports. Effective uptake of science into all biosecurity activities from operational through to international standard setting and trade negotiations requires that this information is easily accessible at international, national and regional levels so the best science can be used to inform biosecurity decision making. Information systems must enable efficient reporting and data retrieval relating to biosecurity risks to New Zealand.

While it is not anticipated that this will be provided through a contestable fund like TFBIS, some coordination between TFBIS and Biosecurity NZ is suggested in order to maximise the benefits from investments made across the two domains.

Digital Strategy

The Digital Strategy was published by the Ministry of Economic Development in mid-2005. It sets out three major 'enablers' – Content, Confidence, and Connection. 'Content' involves providing all New Zealanders with seamless, easy access to the information that is important to their lives, businesses, and cultural identity. 'Confidence' involves raising the ICT skill levels of all New Zealanders. 'Connection' refers to infrastructure such as broadband, and the Advanced Network.

The Content and Connection enablers are particularly important to the TFBIS Strategy. In relation to Content, the Digital Strategy raises the need:

To respond to two important trends:

- *globalisation and the rapid expansion of access to information*

- *the falling cost and growing reach of technology*

by ensuring that uniquely New Zealand content is made available to enrich our lives and tell our stories to the world. In doing so we will use ICT to unlock the valuable repositories of information that have not yet been digitised, create new content, map our existing digital assets, and improve Internet access to the richness of our digital resources. This will give New Zealanders access to information that is important to all areas of our lives. To become a true Knowledge Society, New Zealand needs to focus on information-rich activities: those in which we create, collect, manage, process, store, move, or access information via a networked environment.

While the Digital Strategy does not refer specifically to research data, it does mention a number of important initiatives, including the National Content Strategy, and the Geospatial Strategy (see below). In addition, the initial draft of the Digital Strategy, released in June 2004, stated:

"*New Zealanders will have easy access to their national heritage collections and to the national stock of research and science knowledge. New Zealand's science and technology research communities will be globally connected and supported by a world-class advanced network infrastructure.*"

"*The government has an established role in: providing a range of scientific, technical and statistical data, including location-based information such as the land registration system and topographic and oceanographic data sets; providing access to international knowledge and research, by buying licences for overseas databases and maintaining*"

national research collections held in Crown Research Institutes, national institutions and universities".

While these references were removed in the final version of the Digital Strategy, at a MoRST workshop on research data saving and sharing held in June 2005, a senior representative from the Ministry of Economic Development assured attendees that the specific references to research data were only removed due to the length of the document, and the intent still remained the same.

The New Zealand Digital Content Strategy

One of the actions stemming from the Content enabler in the Digital Strategy is the New Zealand Digital Content Strategy. The draft strategy was released for consultation in November 2006. The purpose for the strategy is:

To provide a focus on, and promote understanding of, the digital content issues for New Zealanders in the next five years; and respond to the gaps and opportunities that face us in bringing New Zealand online.

The NZ Digital Content Strategy identifies three broad types of content:

Content can be viewed as being of three types: formal, informal and commercial. They broadly correlate to the government, community and business sectors and each type of content has certain characteristics.

The strategy identifies three major goals

1. *Content important to New Zealand is easy to access, is protected, and kept safe for use by future generations;*

2. *New Zealanders and New Zealand organisations are at the forefront of creating and sharing digital content;*

3. *New Zealand is a world leader in leveraging digital content and new commercial opportunities.*

The first goal is of particular relevance to TFBIS in that it shares similar objectives to the TFBIS Strategy goals 'Preserved and available' and 'Accessible and usable'. This goal has a number of proposed actions as follows:

- *adopt and promote appropriate international standards for content creation, digitisation and management of rights;*

- *make publicly-funded and community generated content visible and easily accessible by storing it in interoperable, standards-based "digital warehouses";*

- *make New Zealand content visible to the world by providing a gateway to uniquely New Zealand digital content and non-digital content;*

- *build on the government's investment in the National Digital Heritage Archive by developing an across-sector strategy for the preservation of formal digital content;*

- *review the institutional form of organisations involved in the preservation of, and public access to, film, video and sound content;*

- *support the introduction of a Creative Commons licence for New Zealand;*

- *promote greater public understanding of rights and responsibilities under Copyright legislation, including protection of intellectual and cultural property rights.*

Actions that are eventually taken under this strategy should be closely monitored by TFBIS. In particular the adoption of standards for digitisation and management of rights, may assist in relation to digitisation of publications by the TFBIS Programme. Stores for digital content as mentioned above may also be able to be leveraged by TFBIS providers.

Goal 2 also has a set of proposed actions that may be of relevance:

- *significantly increase the store of New Zealand digital content online through a nationwide digitisation programme of key local, regional and national content;*

- *provide support and advice to communities on the standards and tools that enable creation and sharing of content;*

- *support the creation, sharing and preservation of digital content by community groups, hapu, iwi, and individuals through the establishment of a community digital content network.*

Again, digitisation technologies and approaches implied above may be of benefit to TFBIS.

Institutional repositories

Another important project currently under way at the National Library is encouraging the use of 'Institutional Repositories'. These are defined as:

> *a set of services for storing and making available digital research materials created by an institution and its community- a digital collection of the community's research output. IRs form part of a larger national, regional and global system of Open Access repositories, indexed in a standardised way and searchable using one interface. They can also be the foundation for new models of scholarly publishing and communication.*

The National Library has investigated options for institutional repositories for the New Zealand research sector and has made findings available through a Report of Findings, and through a one day symposium held on 23 November 2005. A number of New Zealand universities are already in the process of setting up repositories. This project is of particular relevance to TFBIS for two reasons:

- TFBIS has funded the digitisation of a number of scholarly works (e.g. ecological research papers, New Zealand fauna and flora series).

- There is an increasing need to connect research findings with the underlying data, and make both accessible.

e-Government Strategy

In 2001 the New Zealand Government published, through the State Services Commission (SSC), its e-Government Strategy. This was updated in 2003, and again in November 2006. The current strategy sets out milestones as follows:

> *By 2007, information and communication technologies will be integral to the delivery of government information, services, and processes.*

> *By 2010, the operation of government will be transformed, as government agencies and their partners use technology to provide user-centred information and services and achieve joint outcomes.*

By 2020, people's engagement with the government will have been transformed, as increasing and innovative use is made of the opportunities offered by network technologies.

The ICT unit of SSC is responsible for guiding the implementation of the strategy. A number of initiatives are involved including the e-Government Interoperability Framework (eGIF), the NZGLS metadata standard, a Shared Workspaces project, the whole-of-government Intranet, and the government shared network. These cross-agency initiatives may provide some additional infrastructure useful for TFBIS, and at the very least will serve to increase agencies' understanding of the benefits of dataset federation and open access.

As a part of the eGIF, the ICT unit has developed a standards definition process. This may be useful in the TFBIS context in terms of 'endorsing' biodiversity informatics standards such as the Darwin Core, ABCD, and the Linnaean Core. Some discussions have already occurred between TFBIS providers and the SSC, on this topic.

Geospatial Strategy

Land Information New Zealand (LINZ) has coordinated the development of a Geospatial Strategy for New Zealand. This process began in late 2004 and the strategy was published in April 2007. The strategy sets out four goals:

1. *establish the governance structure required to optimise the benefits from government's geospatial resources*

2. *ensure the capture, preservation and maintenance of fundamental (i.e. priority) geospatial datasets, and set guidelines for non-fundamental geospatial data*

3. *ensure that government geospatial information and services can be readily discovered, appraised and accessed*

4. *ensure that geospatial datasets, services and systems owned by different government agencies and local government can be combined and reused for multiple purposes.*

Goals 2, 3, and 4 are of particular relevance to TFBIS. A very large proportion of data digitised and made accessible through TFBIS funding, and of importance to biodiversity has a spatial component. Combining these data across datasets and agencies, and displaying it spatially will increase the amount of information on species distribution and how they are changing over time. This, combined with sharing spatial data on aspects such as research activities, endangered species relocations, and pest control activities has the potential to enable significant improvements in decision-making for biodiversity management.

In particular the following actions should be considered when TFBIS is engaging in any standards definition, and data management plan projects:

5.3.1 Data: *e) Develop and promote best practice policies, guidelines and practices for the management and use of non-fundamental geospatial datasets.*

5.4.1 Access:

a) *Develop and maintain metadata in accordance with an agreed geospatial metadata standard, and align with international standards.*

b) *Make fundamental geospatial datasets discoverable and accessible according to agreed policies and standards.*

c) *Encourage public agencies to make their nonfundamental datasets discoverable and accessible according to best practice policies and standards.*

5.5.1 Interoperability: a) Under the umbrella of e-GIF, establish a framework of policies (including any legislative obligations), standards and guidelines for discovering, accessing and using geospatial information, according to best practice.

Ocean Survey 20/20

In 2005 the Government approved a fifteen-year programme for surveying New Zealand's total ocean area, known as Ocean Survey 20/20, coordinated by LINZ. The knowledge gained will enable New Zealand to demonstrate stewardship, sustainably manage ocean resources and facilitate safe navigation. The scope of the project includes the exclusive economic zone, continental shelf, and Ross Sea region and the subsurface, sea-floor, water column and atmosphere within.

As a part of this programme of work, a data management gaps analysis is being conducted. Its purpose is to assess current sector capacity and capability for cross-agency data management and interoperability, and to identify gaps between the status quo and what would be needed to achieve the Ocean Survey 20/20 vision. The focus of the project is on identifying and assessing gaps in marine data management rather than gaps in marine data.

The gaps analysis includes interviews with dataset holders to identify overall data management practices, a survey of existing datasets, and a number of workshops to develop an action plan for moving forward. It seems likely that this project will recommend a number of infrastructural components similar to those under consideration by TFBIS, in particular a portal for marine data. This process should be monitored carefully as there are significant potential synergies between TFBIS and the data management aspects of Ocean Survey 20/20.

MoRST Initiatives

The Ministry of Research, Science and Technology has undertaken a number of initiatives over the last three years which may impact on TFBIS. These include:

- Research Infrastructure Advisory Group (RIAG)
- The Advanced Network
- Environment Roadmap (MoRST/FRST)
- Policy work on data saving & sharing
- Envirolink

Research Infrastructure Advisory Group (RIAG)

From the MoRST web site:

> *MoRST has been investigating how investment in research infrastructure is supported by the Government. Two key things have come out of this work.*

> *We have established a Research Infrastructure Advisory Group (RIAG). The purpose of RIAG is to provide advice to MoRST on the scientific merit and the strategic impact of investing in particular items of research infrastructure.*

> *We have also developed a policy statement. This document provides a framework for RIAG. It sets out key policy principles that need to be taken into account. It also sets out the proposal process. This work has been informed by two recent investment cases. These are the Synchrotron and the Advanced Network.*

In the policy statement the following definition for 'large scale research infrastructure' is provided:

> *Infrastructure that is of prohibitive cost to an organisation or organisations in terms of purchasing (capital), operating and maintenance, or facilitating access arrangements.*

This is of relevance to TFBIS in that a number of components that may make up the 'meta information system' supporting biodiversity management in the future are infrastructural. That is, they are of use to all relevant agencies and organisations, but outside of the reach of any one agency to fund. Currently RIAG's view on assets is focused on physical infrastructure rather than software. RIAG was set up to deal with cases such as Synchrotrons and research vessels (e.g. the *Tangaroa*). It is unlikely that this focus will change in the near future, and there are a number of other mechanisms under consideration to deal with research informatics infrastructure. It still seems useful, however, that RIAG is kept within the 'radar' of the TFBIS community.

The Advanced Network

Many countries have had very high speed 'advanced networks' for research in place for several years. New Zealand's, the Research and Education Advanced Network for New Zealand, came online during 2006.

Now that the Advanced Network is in place, having systems that enable the best possible access to and sharing of research data will be important. A significant component of this will be awareness of, and online ability to search for and visualise, research/research-useful datasets. The Advanced Network Backgrounder document produced by MoRST describes a number of 'middleware' application categories emerging overseas to assist with advanced network use. These include Grid Services/Resource Management, Knowledge Management, and Collaboration tools. The Knowledge Management category includes:

> "*Tools and services that enable indexing, archiving, discovery, analysis, integration, management and preservation of large heterogeneous distributed data repositories and digital archives.*"

The document also says that:

> *A key area of work for the AN project is "capability building" in the above middleware tools and services so that New Zealand researchers and educationalists can quickly be effective users and develop collaborative relationships. Significant dedicated funding will be available to ensure the desired outcomes in capability building.*

Some of these middleware tools, and some projects funded through the capability-building programme are likely to be grid computing or advanced research network-specific (and therefore of limited use to those outside the Advanced Network, such as DOC, Regional Councils). Developments in this area, however, warrant careful consideration in the TFBIS context, as much of the underlying data used in grid applications such as ecosystems and environmental modelling come from the same datasets that have been populated and made available through TFBIS funding.

GBIF

New Zealand is a member of the Global Biodiversity Information Facility (GBIF). New Zealand joined GBIF in February 2001. MoRST is responsible for coordinating New Zealand's efforts to meet its obligations to GBIF. From the MoRST web site:

> *GBIF is a network of biodiversity databases and information technology tools that will enable users to navigate and put to use the world's vast quantities of biodiversity information.*

It will help researchers and people managing biosecurity and biodiversity in New Zealand to find extremely useful information from a wide range of national and international databases. They will be able to find out about species similar to New Zealand's native plants and animals, and also about pests with the potential to get into New Zealand in the future.

Dr David Penman, a New Zealand scientist, was recently appointed as the Chair of the Governing Board for GBIF. More information on GBIF can be found at http://www.gbif.org.

MoRST is committed to New Zealand's ongoing involvement in GBIF. They see GBIF as offering important opportunities for the advancement of digital access to biodiversity related data held in New Zealand and overseas institutions. GBIF is starting to contribute data, data exchange standards and technology tools and platforms for the sharing of species data. These are likely to have benefit both in terms of meeting our international obligations, and in improving biodiversity and biosecurity research and management within New Zealand. A New Zealand Biodiversity portal, built using GBIF technologies could, for example, achieve both these aims.

Although MoRST funds the New Zealand membership to GBIF and contributes to the attendance of New Zealand delegates at GBIF meetings, it is not able to fund the digitisation of data, or the connection of data to GBIF. As such, funds such as TFBIS play an important role in making this happen. Continued dialogue between MoRST, TFBIS and the community of data providers and users will be necessary in coordinating these efforts.

Environment Roadmap

MoRST, in collaboration with FRST and other government agencies, published a roadmap for Environment Research in June 2007. In their words:

Roadmaps are documents that provide an overview of an area of science activity important to Government and to New Zealand and outline the desired directions for that science activity into the future.

They are intended to be a communications link between Government's strategies and policies for New Zealand and publicly-funded research, science and technology in New Zealand.

.....

Roadmaps are a type of strategy, but unlike most research strategies, will provide broad context and high level directions, rather than specific research action plans.

The Environment Research roadmap identifies six broad environmental research areas:

- *Global environmental change*

- *Land, water and coasts*

- *Urban design and hazards*

- *Biosecurity*

- *Biodiversity*

- *Oceanic systems*

These research areas are set in the context of three overarching themes:

Systems understanding and integration. *Understanding of environmental systems requires more effective integration across multiple disciplines. Examples of areas where improved systems knowledge is needed include: interaction of groundwater and surface*

waters; impacts of freshwater on coastal environments; understanding ecosystem aspects of fisheries management; and understanding the biophysical, socio-economic and health dimensions of urban design.

Transfer and uptake*. Addressing this need requires greater focus on predictive science and solutions-oriented research, improved use of management initiatives to help advance scientific understanding, and improved communication techniques such as visualisation.*

Information systems*. This includes databases, collections, data management, accessibility to data and using new data collection technologies. Improved integration across disciplines and improved transfer and uptake of research cannot occur unless data management is improved.*

These themes are largely consistent with the TFBIS Strategy. The 'Transfer and uptake' theme is related to the 'Accessible and usable' goal in terms of improving transfer of science through developing tools to allow better interpretation of primary data. The 'Information systems' theme is tightly related to the TFBIS Strategy at all levels. In particular the roadmap mentions the need to 'scale down' large datasets through approaches such as classification systems to make them useful to environmental managers. The roadmap also focuses on the potential growth in environmental sensing technologies. The type and volume of data that could be generated by these technologies may have an impact on TFBIS priorities in the future.

The 'Information systems' theme contains the following direction and actions

Direction 3 *- The government wants to see additional effort on environmental sensing networks and data management to improve frameworks for measuring, monitoring and managing the environment.*

Actions:

- *MoRST will work with regional councils, departments, science providers and FRST to explore, at a national level, opportunities for environmental sensing networks and data management improvements.*

- *Research organisations and other owners of research infrastructure to continue to explore ways of working more collaboratively; partly to share the costs and partly to provide good access to critical research infrastructure.*

This work should be monitored by TFBIS as it progresses as it may open up more opportunities for cross agency projects to support biodiversity data management, and biodiversity outcomes.

Research e-data saving and sharing

Over the last three years MoRST has undertaken internal work around the notions of research data saving and sharing. In October 2004 they commissioned a report entitled '*Review of Environmental Science Data within Landcare Research and NIWA*'. This report found that CRIs had made significant advances in digitising data and making it accessible over the web. There were, however, some challenges, in particular around the funding structures for the Nationally Significant Databases and Collections.

This report prompted further thinking in MoRST, which culminated in the production of two papers and a national workshop in June 2005. The paper on international approaches to publicly funded research data policy (Cameron 2005), and a discussion paper on research data saving and sharing in New Zealand (Carver 2005), were used as background reading for the workshop. The workshop brought together around 50 people from research funding agencies, Government departments and research providers in the social and environmental sectors. Many of the issues

in terms of technology, data quality, intellectual property, and funding were discussed. The following are some excerpts from the workshop summary report:

> *Following the individual sessions each sector reported back. Both the environmental and social groups concurred with the 'framework for data saving and sharing' proposed in the MoRST discussion paper for the workshop. This included a federated system, where agencies are responsible for saving and sharing data. To do so means the development and adoption of interoperability standards, including metadata standards. An interoperable, federated system for data also assumes that 'custodian' responsibilities are adequately funded and organisations have access to the informatics expertise to curate data to appropriate standards.*

> *The workshop strengthened the vision of a federated, interoperable approach to access and sharing of publicly funded research outputs and data. This approach is consistent with initiatives to facilitate a 'whole of research, and science' approach across the tertiary, science, government and where appropriate private sectors to support the vision of public access to publicly funded research output.*

For the environmental sector a number of suggestions were documented as follows:

- *Promote a federated model for the sharing of research outputs and associated data*

- *Encourage interoperability and data curation to enable sharing of data*

- *Discuss with the State Services Commission the desirability of appropriate data exchange standards within the e-government Interoperability Framework (e-GIF)*

- *Consider as part of building capability for the Advanced Network, possible middleware that may support collective approaches for improved data curation*

- *Foster policies for research data saving and sharing through science purchase arrangements*

- *Trial a federated interoperable approach to data saving and sharing within the Oceans 20/20*

- *Ensure R,S&T is engaged with other government initiatives which will enhance data saving and sharing practice – e.g. Digital Strategy*

- *Work with the National Library on the concept of research repositories and with nominated CRIs to trial a research repository.*

- *Liaise with those working on the various, multiple, data curation policies and initiatives to ensure these are congruent with supporting the vision of public availability of publicly funded research data wherever possible.*

- *Refresh policy on the criteria and funding arrangements for nationally significant databases held by the science system.*

- *Explore policy settings around science funding of data (including nationally significant data sets).*

There is now an increasing acknowledgement by central government that databases are a key part of science infrastructure. In the Cabinet paper entitled "A More Effective and Stable Funding Environment for Science" published in April 2006, the Minister for Research, Science and Technology proposed five key changes to the science system, including:

iv. enabling non-competitive investment to support the "backbone" of New Zealand science (essential infrastructure, databases, and collections)

Cabinet tasked MoRST to report back to the Minister of Research, Science and Technology on the policy settings, criteria and funding options for "backbone" investments. This is an important step in ensuring that primary data are preserved and well curated for future needs. This work has resulted in two consultation documents "A More Stable Funding Environment – 'Backbone'" and "Public Access to Research Information – Consultation Paper".

The ongoing impact of this work should be monitored closely by TFBIS. It holds some real promise that more stable funding may be provided for the nationally significant databases, enabling TFBIS to focus on more value-added products above the primary data layer. It is also possible that some of the larger infrastructural investments that TFBIS makes could become part of the 'backbone'. MoRST has expressed their hope that TFBIS will embrace the notion of federated and interconnected information systems and will continue to make significant progress in this area.

Envirolink

Envirolink is a funding scheme initiated by MoRST and delivered through FRST. It is specifically targeted at supporting Regional Councils to access advice and management tools from CRIs and some not-for-profit research associations. This is done through small advice grants, medium advice grants, and tools development. Tools development has some relevance in the TFBIS context. From the FRST website:

> *Tools development funding is used to support development and adoption of natural resource and environmental management tools for use by all regional councils and Unitary authorities. These tools may be physical technologies or something more conceptual, such as a formalised or systematic approach to problem solving or analysis.*

Given the trends in biodiversity information management in Regional Councils as identified by TFBIS in an earlier report, it seems possible that there may be some synergies between TFBIS and Envirolink. Some applications, for example, may be redirected from one fund to the other. There may even be the potential for certain systems to be partly funded from each scheme. Regardless of whether this occurs or not, it seems very likely that some of the outputs from Envirolink will contribute functionality or data to the emerging terrestrial and freshwater biodiversity information 'meta-system'.

Other Influences

In addition to the above, there are a number of other projects that are likely to have some impact on TFBIS. These are:

- The Department of Conservation - Natural Heritage Management System (NHMS), currently in initial planning stages

- Ministry for the Environment - NZ Carbon Accounting System supporting Kyoto, Environmental Metadata Framework. Environmental Performance Indicators, and State of the Environment reporting

- Foundation for Research, Science and Technology - Ecosystem OBIs, and Defining NZ Biota OBIs

- Statistics New Zealand - project on linked indicators
  http://www.stats.govt.nz/analytical-reports/linked-indicators/environmental-indicators.htm

- Biotechnology Strategy - explicitly mentions need for biotechnology strategy to support biodiversity and biosecurity.
  http://www.morst.govt.nz/?CHANNEL=BIOTECHNOLOGY&PAGE=Biotechnology

- Legislation including the Resource Management Act, Biosecurity Act, Conservation Act, and the Hazardous Substances and New Organisms Act

- Global initiatives and international agreements – Global Biodiversity Information Facility (GBIF), Convention on Biological Diversity (CBD), Global Taxonomy Initiative (GTI), Ocean Biogeographic Information System (OBIS), Kyoto reporting (carbon dioxide emissions), Montreal Process (sustainable forest management), International Pollinator Initiative, 2010 Global Strategy for Plant Conservation, Oceans 20/20, Species 2000, Barcode of Life, ATOL (Assembling the Tree of Life), IPPC (International Plant Protection Convention), Global Invasive Species programme.

These influences will need to be monitored on an ongoing basis by both the TFBIS Committee, and providers bidding for funds.