Selecting Human Dimensions Economic Indicators for South Florida Coastal Marine Ecosystems

Version: 19 May 2013

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Summary

The Marine and Estuarine Goal Setting for South Florida (MARES) project is developing a suite of indicators and indices that can provide an integrated assessment of the South Florida coastal marine ecosystem. Indicators, in this context, incorporate data on one or more variables to assess conditions in the coastal marine environment and communities of people who depend on it. In the latter case, human dimensions (HD) indicators use data that are either economic or non-economic in character to assess the services and benefits that the ecosystem provides to people. These are known as human dimensions indicators because they relate to the human dimensions of the ecosystem. The development of human dimensions indicators is proceeding along two paths: HD economic indicators and HD non-economic indicators. This distinction was made due to differences in human dimensions science methodologies and the expertise of the researchers involved in the MARES project.

This whitepaper describes the development and initial application of five human dimensions economic indicators and related total system indices, as identified in Table 1. The indicators assess conditions related to the Ecosystem Services of recreation, food supply, ornamental resources, and property protection. Scoring these indicators is based on year-to-year changes in a related metric, for example: the annual number of park visitors. The scoring includes adjustments to take into account the influence of other factors, such as conditions in the economy and currency exchange rates, that are not related to the level of ecosystem service but can also contribute to a change in the metric. Therefore, the resulting score reflects the economic benefits received due to the quality and quantity of ecosystem services. While the scores reported in Table 1 are based on actual conditions in the ecosystem, the results reported here are intended primarily for use in evaluating and refining the implementation of these proposed HD economic indicators and indices.

The term “economic” has many uses and definitions. For the purposes of the human dimensions economic indicators for the south Florida marine ecosystem, the term “economic” refers to:

1. The income, wealth, and human wellbeing obtained from the exchange of goods and services; and,
2. The human decision-making process used to choose the quantity and quality of goods and services consumed and produced for the purpose of maximizing human wellbeing subject to many constraints including access to information, production inputs and markets; social customs; and politics.

Table 1: Human Dimensions - Economic Indicators for the South Florida Coastal Marine Ecosystem

HD Economic Indicator	Ecosystem Service Measured by Indicator	Total-system Score
Coastal Park Visitation	Recreation - Beach and Wildlife-related recreation activities and reef snorkeling and diving	5 (increasing)
Number of Registered Recreational Boats (16 feet or larger)	Recreation and Food Supply - Offshore marine and wildlife-related recreational activities; Opportunity to catch and consume recreational fishery species	5 (increasing)
Pounds of Commercial Seafood Landed (finfish, invertebrates and shrimp)	Food Supply - Opportunity to harvest and consume commercial fishery species	5 (increasing)
Number of Live Marine Organisms Landed	Ornamental Resources - Opportunity to collect and culture tropical marine species	1 (decreasing)
Dollar Value of Insured Flood Damage Claims Paid	Property Protection - Protection of property from coastal storm damages	1 (decreasing)

Human dimensions (HD) economic indicators reflect the human uses of Ecosystem Services that contribute to the economy and/or that improve human wellbeing and that are influenced by the environmental attributes that people care about. If one seeks to restore, modify or sustain a large, complex, regional ecological landscape like South Florida it is essential for scientists, managers and stakeholders to agree upon how well they are meeting their goals. Indicators can help evaluate the social, economic and ecosystem services changes resulting from management actions and can help measure or document success. They provide information and context to adapt and improve, add, replace or remove projects as new scientific information becomes available.

The process of developing HD economic indicators begins with the information assembled into the integrated conceptual ecosystem models of the coastal marine ecosystem, especially the Ecosystem Services identified in these models. HD economic indicators provide information on the type of use, quantity, quality, and value of the Ecosystem Services. A number of possible indicators are explored, based on the goals for ecosystem management and on econometric data that are either available or can be obtained. Potential indicators are assessed for characteristics desired in an indicator to select which ones to develop further.

Background

Why do we need Human Dimension (HD) economic indicators?

HD economic indicators of ecosystem services can serve a critical role in the management of marine resources by substantiating the link between human well-being and ecosystem health; prioritizing management goals; and validating ecosystem management efforts by helping to document economic gains. HD economic indicators provide quantitative measures of changes in human well-being resulting from changes in ecosystem services - for example an increase in fish landings following an improvement in seagrass health; and a boost in dive trip satisfaction with coral reef restoration.

By monitoring HD economic indicators we can report on the status of the ecosystem as it provides ecosystem services to humans; track changes in ecosystem services over time; and identify those ecosystem services most in need of management. For additional detail, the reader is referred to Box 1.

Box 1. HD economic indicators address the following questions

1. What is the status of the services provided by the ecosystem?
   a. How many people live in the area?
   b. How many people actively and passively use the coastal resources?
   c. What activities do people enjoy?
   d. What commercial activities do the resources support?
   e. How many visitors travel to the area to enjoy the resources?
   f. What do visitors contribute to the economy?
2. Has the quality of service changed over time? In what direction? What can we expect in the future?
3. How will the quality and quantities of ecosystem services respond to changes in management (e.g. restoration; water quality improvement; pollution remediation; marine life sanctions)?
4. In developing management options, which services, regions, stressors and pressures should be prioritized for management measures?
5. What level of protection should be provided to the ecosystem as it serves human wants and needs?
6. How does management benefit resource users and the local economy?

How do we identify and define candidate HD economic indicators?

HD economic indicators provide information on the type of use, quantity, quality, and value of the services provided by the coastal and marine ecosystems. For South Florida coastal and marine ecosystems we can begin by addressing the following questions:

3. What do people want and need from South Florida marine ecosystems?
4. What attributes of the ecosystem do people care about?
5. If the ecosystem service changes, which economic and human activities will be affected?
6. How does the condition of the ecosystem affect these economic and human activities?
7. Which metrics best reflect the output and value of these services?

Scientists and resource managers and current restoration programs, conservation efforts, and local action strategies can be tapped for information. To this end, a literature review was conducted and scientific input was collected from discussions at MARES workshops. From this information, a long list of candidate HD economic indicators was compiled. Summarized in Table 2 are HD economic indicators. By combining human dimensions and ecological indicators, we can characterize the status of South Florida's coastal and marine ecosystems and the services they provide.

Table 2: Candidate HD economic indicators and the ecosystem services they reflect

	Ecosystem Service							
Potential Indicator	Aesthetic Environments	Educational Opportunities	Scientific Resources	Food Supply	Ornamental Resources	Pollution Treatment	Property Protection	Recreational Opportunities
Property Values	✓						✓	✓
Net resident migration	✓							✓
College course offerings		✓						
Research activity	X	X	✓					
Commercial seafood harvest				✓				X
Value of harvested seafood and marine life				✓	✓			X
Seafood safety			X	✓				
Catch per unit effort (CPUE)				✓	✓			X
Marine life harvest	X			X	✓			X
Pollution treatment cost savings						✓	X	
Property Loss	X						✓	
Health and extent of mangrove communities	✓	X	X	✓		✓	✓	✓
Health and extent of seagrass communities	✓	X	X	✓		✓	✓	✓
Park use	X	X						✓
Boat use	X							✓
Recreational fishing interest								✓
Recreational activity, expenditures	✓							✓
Subsistence fishing participation	X			✓				
Sand and beach quality	✓	X	✓			X	X	✓
Coral reef health and water quality	✓	X	✓	✓	✓			✓
Fish number, size, diversity	X	X	X	✓	✓			✓
Acceptability of reef crowding								✓
Acceptability of reef conditions	X	X	X					✓
Satisfaction with reef conditions	✓							✓
Commercial activity				X				✓
GSP – Gross State Product				X				✓
GDP – National Gross Domestic Product				X				✓
Foreign exchange rate				✓				✓
Unemployment rate								✓
Seafood imports				✓				

✓ Value may be useful as an HD indicator of ecosystem services; X Value indirectly reflects the ecosystem service

How do we evaluate candidate indicators? What criteria should we use to pare the list?

To communicate the condition of the ecosystem to overworked managers, busy politicians, and the general public, the set of indicators for reporting should be succinct (as opposed to comprehensive). A concise report built around carefully selected indicators will serve to highlight key ecosystem uses, services, stressors, and trends and articulate management goals and targets.

Closely following the work of Doren et al[1] and Pendleton[2], we developed a list of criteria evaluation questions to evaluate and critique the long list of candidate indicators. These criteria and abbreviations are provided in Table 3.

To be useful for management, HD economic indicators should be built around data that is current to provide a relevant depiction of conditions. As well, the same data should be collected continuously to allow for comparisons in subsequent years. Following on criteria evaluation question number 5, each indicator may be further scrutinized by asking:

1. Does the data exist? Is it current? Will updates be available?
2. Is the information meaningful? Is the data scope and scale relevant?
3. Is the collection method rigorous and dependable?
4. What gaps remain?
5. What new data is needed?

Suggested metrics to use. To minimize the influence of external non-environmental factors, the HD economic indicators should be measured in units of human use or consumption as opposed to value or supply. Suggested metrics include resident population, property damage insurance claims, number of fishing licenses, number of registered boats coastal park attendance, number of visitor days, and fish landings.

Metrics to avoid. Commercial expenditures and revenues data are typically unavailable and generally difficult to obtain. Consumer and producer surplus values will typically require annual studies, which are unlikely to receive sufficient funding. Values for non-market goods may not be comparable from year to year.

[1] Robert F. Doren, Joel C. Trexler, Andrew D. Gottlieb, Matthew C. Harwell, Ecological indicators for system-wide assessment of the greater Everglades ecosystem restoration program, 2009, s2 – s16.

[2] Pendleton, 2007. …more

Table 3: Abbreviations for Criteria Evaluation Questions

Criteria evaluation question	Abbreviation
1. Is the indicator relevant? Is it **linked** to the condition of the ecosystem?	Linked
2. Is the indicator **responsive**? Does it vary immediately when conditions change? Can it be used to signal changing conditions?	Quick
3. Is the indicator response **predictable**?	Predictable
4. Is the indicator **credible**? Is there scientific and managerial support for use of the indicator?	Credible
5. Is the indicator feasible? Can it be **measured**? Is the data already being collected? Is the collection regular, rigorous, and dependable into the foreseeable future?	Measureable
6. Does the indicator measure a **system-wide effect**? Is it applicable for the entire ecosystem?	System-wide
7. Does the indicator denote **value**? Is it associated with human use or activity?	Value
8. Can the indicator be **explained easily**? Does it resonate with the public?	Understood
9. Is the indicator **consistent**? Will it show human gains only when the ecosystem condition improves?	Consistent
10. Can the indicator be used for **setting goals and targets**?	Targets
11. Is the indicator **problem-specific**? Can it provide direction for management?	Specific
12. Which ecosystem component within **DPSER**[3] does the indicator address?	DPSER

[3] DPSER refers to the MARES conceptual ecosystem model that is comprised of Drivers, Pressures, ecosystem States, Ecosystem Services and Response (DPSER).

Approach to Selecting and evaluating HD Economic Indicators

Ecosystem services for South Florida coastal and marine ecosystems are as follows: Aesthetic Environments, Climate Stability, Cultural Identity, Educational Opportunities, Food Supply, Existence, Ornamental Resources, Pollution Treatment, Property Protection, Recreational Opportunities, and Scientific Resources. We first develop candidate HD economic indicators around these services. Second we suggest a plausible metric to quantify each candidate indicator. Third we answer the criteria evaluation questions for each candidate indicator-metric pair. Fourth we critique the data available for each metric. Fifth we identify data gaps and suggest alternate data and data needs.

We answered each question with a simple "Yes", "No" or "Maybe" where in some cases, M could mean "Maybe", "Somewhat" or "It depends" depending on the type of ambiguity. Our evaluation of the candidate indicators is shown in Tables 4, 5, and 6.

Table 4: Evaluation of candidate HD economic indicators for the Ecosystem Services: Aesthetic value, Education opportunities, and Scientific resources (a)

Ecosystem Service	**Aesthetic value**		**Educational opportunities**	**Scientific resources**
Indicator	Property Values	Net resident migration	College course offerings	Research activity
Measurement units	*Median price $ per home sold*	*Population*	*Courses in marine ecology, student credit hours*	*Federal and International research grants $*
Linked	Y	M	Y	Y
Quick	N	N	N	N
Predictable	Y	M	N	N
Credible	Y	M	M	M
Measureable	Y	Y	Y	Y
System-wide	N	N	Y	Y
Value	Y	Y	Y	Y
Understood	Y	M	Y	Y
Consistent	N	N	N	N
Targets	N	N	N	N
Specific	N	N	N	N
DPSER	E	D, E	E	E

(a) Y=yes, N=no, M=maybe, somewhat, or depends, and DPSER – Driver, Pressure, State, Ecosystem Service, Response. These evaluation answers are for illustration and remain open for further discussion and debate.

Table 5: Evaluation of candidate HD economic indicators for the Ecosystem Services: Food supply, Ornamental resources, Pollution treatment, and Property protection (a)

Ecosystem Service	**Food supply**			**Ornamental resources**	**Pollution treatment**	**Property protection**
Indicator	Commercial seafood harvest	Value of harvested fish	Catch per unit effort	Marine life harvest	Treatment cost savings	Property Loss
Measurement units	*Tons per species, Pounds of seafood*	*$ per pound, ex-vessel*	*Catch per unit effort*	*Number of animals landed, value of product sold*	*Water treatment cost $, storm water, wastewater, potable water*	*Flood insurance claims $*
Linked	Y	M	Y	Y	Y	Y
Quick	Y	N	Y	Y	N	N
Predictable	M	N	M	M	N	N
Credible	M	N	Y	M	M	M
Measureable	Y	Y	Y	M	Y	Y
System-wide	M	Y	M	N	N	N
Value	Y	Y	Y	Y	Y	Y
Understood	Y	Y	Y	Y	Y	Y
Consistent	Y	N	Y	N	N	N
Targets	Y	N	M	N	N	N
Specific	Y	N	Y	N	N	N
DPSER	P, E	D, E	E	P, E	E	E

(a) Y=yes, N=no, M=maybe, somewhat, depends, and DPSER – Driver, Pressure, Ecosystem Service, Response. These evaluation answers are for illustration and remain open for further discussion and debate.

Table 6: Evaluation of candidate HD economic indicators for the Ecosystem Service: Recreational opportunities (a)

Ecosystem Service	**Recreational opportunities**							
Indicator	Park use	Boat use	Recreational fishing interest	Recreational activity	Sand and beach quality for recreation	Reef and water quality for diving	Fish number, size, diversity	Commercial activity
Measurement units	*Annual visits per park*	*Number of registered boats, Boat trips per year*	*Number of fishing licenses, Fishing trips, Fishing days*	*Participation rate, Spending per visit, Frequency of visits*	*State indicator*	*State indicator*	*State indicator*	*Diving and fishing trips hired*
Linked	Y	Y	Y	Y	Y	Y	Y	Y
Quick	Y	N	Y	Y	Y	Y	Y	Y
Predictable	Y	Y	Y	Y	Y	Y	Y	Y
Credible	Y	N	Y	Y	Y	Y	Y	Y
Measureable	Y	Y	M	M	Y	Y	Y	Y
System-wide	N	M	M	M	N	N	N	N
Value	Y	Y	Y	Y	N	N	N	Y
Understood	Y	Y	Y	Y	Y	Y	Y	Y
Consistent	N	M	Y	N	Y	Y	Y	N
Targets	Y	Y	Y	N	Y	Y	Y	N
Specific	M	N	Y	N	Y	Y	Y	N
DPSER	E	E	E	E	S	S	S	E

(a) Y=yes, N=no, M=maybe, somewhat, depends, and DPSER – Driver, Pressure, State, Ecosystem Service, Response. These evaluation answers are for illustration and remain open for further discussion and debate.

Results: Aggregate Indices

To further simplify presentation and assure that information is interpreted accurately, statistical measures can be used to combine HD economic indicators into an aggregate index with an easy to understand scale. For this analysis we use a 5 point scale where a 5 is "good" and 1 is "poor."

HD economic indicators were developed to provide metrics for assessing annual changes in ecosystem services from year to year as they are affected by the quality and quantity of the environmental attributes that people care about. The indicators developed below are not meant to be all of the HD economic indicators that would be useful and relevant, but they provide a good start to the discussion and practice.

The HD economic indicators developed by the MARES project are provided in Table 7. All indicators are the percent change in the metric from year 1 to year 2. Year 1 and Year 2 should be the same for all indicators used to assess the ecosystem services during a one-year time period. In this text, the Coastal Park Visitation and the Number of Registered Recreational Boats indicators use the 2010 and 2011 time period while the other indicators use the 2009 and 2010 time period because 2011 data is not yet available. The purpose of this section is to describe how to measure, score, and use the indicators.

Each HD economic indicator and the methods used to measure, score, index and interpret the indicator are provided as follows.

Table 7: HD economic indicators Developed for the MARES Project, Indicator Definition is the Percent Change from $Year_1$ to $Year_2$

HD economic indicator	Ecosystem Service	Definition of Ecosystem Service
Coastal Park Visitation	Recreation	Beach and Wildlife-related recreation activities and reef snorkeling and diving
Number of Registered Recreational Boats (16 feet or larger)	Recreation and Food Supply	Offshore marine and wildlife-related recreational activities; Opportunity to catch and consume recreational fishery species
Pounds of Commercial Seafood Landed (finfish, invertebrates and shrimp)	Food Supply	Opportunity to harvest and consume commercial fishery species
Number of Live Marine Organisms Landed	Ornamental Resources	Opportunity to collect and culture tropical marine species
Dollar Value of Insured Flood Damage Claims Paid	Property Protection	Protection of property from coastal storm damages

Indicator: Coastal Park Visitation

The coastal park visitation indicator is the annual percent change in the annual attendance at all of the Florida State and National Parks located directly on the coast. Attendance is the number of people entering the park. This indicator is developed for each of the three south Florida areas: southeast Florida, southwest Florida and the Florida Keys / Dry Tortugas. After these indicators are scored, the three scores are averaged to obtain the indicator score for south Florida. The list of Florida and National parks in each area, their annual attendance in 2010 and 2011 and the percent changes are provided in Table 8. Attendance at other coastal parks owned by cities and counties may also be included in this indicator.

Table 8: Annual Attendance at Florida State and National Parks in Southeast Florida, Florida Keys / Dry Tortugas and Southwest Florida (a,b)

Property designation	County	2009–10 (2010)	2010–11 (2011)	% Change
Southeast Florida				
Hugh Taylor Birch	Broward	238,038	269,632	13.3%
John U. Lloyd Beach	Broward	476,492	508,375	6.7%
Atlantic Ridge	Martin	2,969	2,037	-31.4%
Jonathan Dickinson	Martin	154,737	176,018	13.8%
Seabranch Preserve	Martin	10,840	10,656	-1.7%
Jack Island	Martin, Palm Beach	40,125	3,678	-90.8%
Barnacle Historic, The	Miami-Dade	30,418	46,884	54.1%
Bill Baggs Cape Florida	Miami-Dade	766,384	714,865	-6.7%
Oleta River	Miami-Dade	323,596	339,060	4.8%
John D. MacArthur Beach	Palm Beach	133,097	153,755	15.5%
Biscayne National Park	Miami-Dade	467,612	476,077	1.8%
Total Southeast Florida		**2,644,308**	**2,701,037**	**2.1%**
Florida Keys / Dry Tortugas				
Bahia Honda	Monroe	484,070	535,578	10.6%
Curry Hammock Monroe	Monroe	73,846	86,242	16.8%
Dagny Johnson Key Largo Hammock Botanical	Monroe	13,212	14,458	9.4%
Ft. Zachary Taylor Historic	Monroe	388,521	425,993	9.6%
Indian Key Historic	Monroe	31,234	36,763	17.7%
John Pennekamp Coral Reef	Monroe	721,091	718,303	-0.4%
Lignumvitae Key Botanical	Monroe	27,800	32,904	18.4%
Long Key	Monroe	89,426	81,862	-8.5%
San Pedro Underwater Archaeological Preserve	Monroe	2,988	3,393	13.6%
Windley Key Fossil Reef Geological	Monroe	13,791	15,557	12.8%
Dry Tortugas National Park	Monroe	53,890	75,171	39.5%
Total Florida Keys/ Dry Tortugas		**1,899,869**	**2,026,224**	**6.7%**

Property designation	County	2009–10 (2010)	2010–11 (2011)	% Change
Southwest Florida				
Collier-Seminole	Collier	70,211	58,276	-17.0%
Delnor-Wiggins Pass	Collier	403,183	460,350	14.2%
Fakahatchee Strand Preserve	Collier	142,059	126,034	-11.3%
Cayo Costa	Lee	99,233	102,207	3.0%
Estero Bay Preserve	Lee	3,816	3,933	3.1%
Gasparilla Island	Lee	734,113	823,526	12.2%
Koreshan Historic	Lee	67,090	65,039	-3.1%
Lover's Key	Lee	742,643	754,692	1.6%
Mound Key Archaeological	Lee	1,675	1,915	14.3%
Total Southwest Florida		**2,264,023**	**2,395,972**	**5.5%**

(a) From Florida Department of Environmental Protection and 2011 Florida Statistical Abstract, University of Florida Bureau of Economic and Business Research. Visitations at Big Cypress and Everglades National Park were not included because most of the visitation is inland.
(b) Attendance is the number of people entering the park.

As presented in Table 8, attendance at the coastal parks increased by 2.1 percent in southeast Florida; increased by 6.7 percent in the Florida Keys (Monroe County); and increased by 5.5 percent in southwest Florida.

These percentages are scaled to a number between 1 and 5 according to the ranges provided in Table 9.

Table 9: Scoring Method for Percent Change in Park Visitation

% Change in Park Visitation from Previous Year	Number of Points
If greater than or equal to 20%	5.00
If greater than or equal to 10% and less than 20%	4.55
If greater than or equal to 5% and less than 10%	4.09
If greater than 1% and less than 5%	3.64
If greater than 0% and less than or equal to 1%	3.18
If equal to 0%	2.73
If less than 0% but greater than or equal to -1%	2.27
If less than -1% but greater than -5%	1.82
If less than or equal to -5% but greater than -10%	1.36
If less than or equal to -10% but greater than -20%	0.91
If less than or equal to -20%	0.45

Using Table 9, coastal park visitation in southeast Florida would receive 3.64 points; visitation in the Florida Keys would receive 4.09 points; and visitation in southwest Florida would receive 4.09 points.

Before deciding if the points assigned to these indicators indicates increasing, stable or decreasing qualities and quantities of environmental attributes, an adjustment to these point assignments is necessary. This is because visitation will change from one year to the next due to factors other than the quality and quantity of environmental attributes. Future research should focus on the influence of factors on coastal park visitation. At this time professional economists' opinions regarding the primary factors that influence coastal park visitation were used to develop the point adjustment. This method can change as research results become available. For this project, the decision was made to incorporate into the indicator point system the percent change from year to year in two primary factors that affect coastal park visitation: the county's resident population and the number of visitors to the county.

The data needed to calculate the change in resident population in each south Florida area is readily available from the Florida Legislature, Office of Economic and Demographic Research. Percent increases in the county resident population from one year to the next would be expected to increase visitation at the county's coastal parks, all other factors equal. Likewise, percent decreases in the county resident population would be expected to decrease park visitation, all other factors equal.

The number of visitors to the county is not as easily measured from the available data. However, there are factors that strongly influence tourism and this data is readily available. For our three south Florida areas, these factors are the average percent change in the Florida and U.S. employment rate from the previous year and the percent change in the U.S. dollars per Canadian dollar exchange rate from the previous year.

The employment rate was chosen because a majority of visitors to south Florida are from the United States, particularly Florida, and it reflects general economic conditions that affect the wealth of U.S. and Florida residents and their propensity to spend money on vacations. The employment rate is equal to 100 minus the unemployment rate reported as a percent. The unemployment rate for Florida and the United States is from the Florida Statistical Abstract, 2011, Chapter 6 – Labor Force, Employment and Earnings, Table 6.10 and Table 6.11 (University of Florida, Bureau of Business and Economic Research, Gainesville, Florida). The number of county visitors from the United States and their lengths of stay are expected to increase from year to year if the average Florida and U.S. employment rate increases during the same period, all other factors equal.

The U.S. / Canadian exchange rate was chosen because the largest proportions of international visitors to south Florida are from Canada. The exchange rate used is the U.S. dollars per Canadian dollar and the data is from www.bankofcanada.ca. If the U.S./Canada exchange rate increases from year to year then international visitation from Canada will increase because Canadians are receiving more U.S. dollars for their Canadian dollar, all other factors equal.

The evidence supporting these conclusions is provided in Table 10 which presents, for each county, the percent of visitors from the United States, the percent of international visitors from Canada, and Canada's ranking among international origins.

Table 10: Origin of Visitors to South Florida Counties

County	% of Visitors from the U.S.	% of non-US Visitors from Canada	Canada's Ranking non-US Visitor Origins
Lee	80%	25%	1
Collier	80%	11%	2
Monroe (Florida Keys)	80%	40%	1
Miami-Dade	52%	10%	1
Broward	84%	25%	1
Palm Beach	90%	26%	1
Martin	98%	50%	1

From: Leeworthy and Wiley, Florida Keys 2007-08 Visitor Study, NOAA; Miami-Dade County's 2010 Visitor Study; Leeworthy and Wiley, Profiles and Economic Contribution: General Visitors to Broward County, Florida, 2000-2001, NOAA; Palm Beach County Tourism, 2008-2009 and 5 year average, Tourist Development Council; Hazen and Sawyer, Socioeconomic Study of Reefs in Martin County, Florida, 2003; Lee County Tourist Development Council, Annual Visitor Profile and Occupancy Analysis, 2010; Collier County Tourist Development Council, 2011 Annual Visitor Profile.

For each county and region, the county population data in 2010 and 2011 and the percent change from 2010 to 2011 are provided in Table 11.

Table 11: County Resident Populations in 2010 and 2011 (a)

County or Region (b)	2010	2011	Change
Florida Keys / Dry Tortugas			
Monroe County	**73,090**	**72,670**	**-0.6%**
Southwest Florida			
Lee County	618,754	625,310	
Collier County	321,520	323,785	
Total Southwest Florida	**940,274**	**949,095**	**0.9%**
Southeast Florida			
Martin County	146,318	146,689	
Palm Beach County	1,320,134	1,325,758	
Broward County	1,748,066	1,753,162	
Miami-Dade County	2,496,435	2,516,515	
Total Southeast Florida	**5,710,953**	**5,742,124**	**0.5%**

(a) From Florida Legislature, Office of Economic and Demographic Research.
(b) Monroe County is the Florida Keys. Southwest Florida includes Lee and Collier counties and southeast Florida includes Martin, Palm Beach, Broward and Miami-Dade counties.

The Florida and U.S. employment rates and the U.S. dollar / Canadian dollar exchange rate in 2010 and 2011 are provided in Table 12 along with the percent changes from 2010 to 2011.

Table 12: Florida and U.S. Employment Rates and U.S. / Canadian Exchange Rate, 2010 and 2011

Year	Florida Employment Rate (a)	U.S. Employment Rate (b)	Exchange Rate (c)
2010	88.5%	90.4	1.03
2011	89.2%	91.0	0.99
% change from 2010 to 2011	0.78%	0.66%	**-4.0%**
Average % change	**0.72%**		

(a) The Florida employment rate is equal to 100 minus the Florida unemployment rate from the Florida Statistical Abstract, 2011.

(b) The U.S. employment rate is equal to 100 minus the U.S. unemployment rate from the U.S Bureau of Labor Statistics website.

(c) From www.bankofcanada.ca. U.S. dollars per Canadian dollar.

The percent changes provided in Tables 11 and 12 were assigned points on a scale of -1.25 to 1.25 using the ranges provided in Table 13. For example, if the local population increased by more than 20 percent, then the indicator score is reduced by 1.25 points. These adjustments are further explained below.

The assigned points as indicated in Table 13 are added to the Coastal Park Visitation point score to obtain the total adjusted score for this indicator. The total adjusted score for each south Florida area is calculated in Table 14.

Table 13: Adjustments to Indicator Score that Reflect Non-Ecosystem Factors Affecting Coastal Park Visitation

Range of Values (% Change from Previous Year)	Local Population	Average State and US Employment Rate	Exchange Rate
	Point Adjustment		
If greater than or equal to 20%	-1.25	-1.25	-1.25
If greater than or equal to 10% and less than 20%	-0.94	-0.94	-0.94
If greater than or equal to 5% and less than 10%	-0.47	-0.47	-0.47
If greater than 1% and less than 5%	-0.19	-0.19	-0.19
If greater than 0% & less than or equal to 1%	-0.03	-0.03	-0.03
If equal to 0%	0.00	0.00	0.00
If less than 0% but greater than or equal to -1%	0.03	0.03	0.03
If less than -1% but greater than -5%	0.19	0.19	0.19
If less than or equal to -5% but greater than -10%	0.47	0.47	0.47
If less than or equal to -10% but greater than -20%	0.94	0.94	0.94
If less than or equal to -20%	1.25	1.25	1.25

Table 14: Calculation of Total Adjusted Score of the Coastal Park Visitation Indicator

Row No.	Measurements	Southeast Florida		Southwest Florida		Florida Keys / Dry Tortugas	
		From 2010 to 2011		From 2010 to 2011		From 2010 to 2011	
		% Change	Points	% Change	Points	% Change	Points
(1)	% Change in Coastal Park Visitation	2.12%	3.64	5.51%	4.09	6.65%	4.09
(2)	% Change in Local Resident Population	0.55%	-0.03	0.94%	-0.03	-0.57%	0.03
(3)	Average % Change in State and US Employment Rate	0.72%	-0.03	0.72%	-0.03	0.72%	-0.03
(4)	% Change in U.S. Dollars Per Canadian Dollar Exchange Rate	-3.98%	0.19	-3.98%	0.19	-3.98%	0.19
(5)	**Total Adjusted Points**		**3.77**		**4.22**		**4.28**

Southeast Florida will be the example used to demonstrate how the total adjusted score of the Coastal Park Visitation Indicator is calculated and interpreted. For southeast Florida, coastal park visitation increased by 2.12 percent from 2010 to 2011 earning 3.64 points. Because the southeast Florida resident population increased by 0.55 percent, 0.03 points is subtracted from the 3.64 points to account for the positive influence of this factor's increase on visitation. If the resident population had not changed, then park visitation would have been lower.

The average Florida and U.S. employment rate increased by 0.72 percent and this increase helped increase park visitation. Therefore, 0.03 points is subtracted from the 3.64 points to account for the influence of tourists on park visitation. If the employment rate had been unchanged, then park visitation would have been lower.

The number of U.S. dollars that can be obtained from one Canadian dollar fell by 3.98 percent. This reduced the number of tourists to southeast Florida and made the increase in coastal park visitation lower than it would have been if there had been no change in the exchange rate. Therefore, 0.19 points is added to the 3.64 points to remove the influence of this factor from the indicator value.

The total adjusted score for the Coastal Park Visitation Indicator in southeast Florida representing the 2010 to 2011 change in the demand for ecosystem services due to changes in the environmental attributes is 3.77 points (3.64 – 0.03 – 0.03 + 0.19 = 3.77). The indicator score for southwest Florida is 4.22 points and the indicator score for the Florida Keys / Dry Tortugas is 4.28 points. To calculate the indicator score for the entire south Florida region, the scores of the three areas are averaged together. The Coastal Park Visitation Indicator score for the south Florida marine ecosystem is 4.09 points.

These scores are scaled to an index number between 1 and 5 and assigned an interpretation based on the index number. This scaling and interpretation is provided in Table 15.

Table 15: Indicator Index Value – Scale Total Adjusted Score to a Number between 1 and 5

Range of Total Adjusted Points	Indicator Index Value	Demand for Ecosystem Service due to Quality/ Quantity of Environmental Attributes is:
If total points greater than 3.18	5	**Increasing (Good or Green)**
If total points greater than or equal to 2.27 and less than or equal to 3.18	3	**Stable (Fair or Yellow)**
If total points less than 2.27	1	**Decreasing (Poor or Red)**

The breakpoints of the ranges in Table 15 reflect the ranges in Table 9 which is the unadjusted point system for the change in coastal park visitation. If the total score is greater than 3.18, then visitation increased by at least 1 percent during the year and demand for the ecosystem services provided by coastal park recreation increased due to the qualities and quantities of the associated environmental attributes. If the score is between 2.27 and 3.18, inclusive, then the percent change in visitation was between -1 percent and 1 percent and the demands for the ecosystem services provided by coastal park visitation are stable. If the score is less than 2.27, then visitation fell by more than one percent and the demands for the ecosystem services are decreasing.

The Coastal Park Visitation Indicator index values for the three areas and for south Florida are presented in Table 16. The table indicates that in all areas of south Florida, the Coastal Park Visitation Indicator Index Value is 5 which means that the demands for the recreation ecosystem services is increasing due to the qualities and quantities of the associated environmental attributes. Bear in mind that the point adjustments used to calculate the score and the index value take into account the main non-ecosystem factors that affect park visitation – resident population and tourism. The manager should also take into account any known year to year changes in other non-ecosystem factors, such as increases in the number of parking spaces that may also have affected visitation. For these other factors, a similar point adjustment may be made. Additional guidance on how to create point adjustments is provided in the following sections describing the other economic indicators.

Table 16: Indicator Index Value for Coastal Park Visitation -South Florida Marine Ecosystems

Area	Total Adjusted Score	Indicator Index Value	Demand for Ecosystem Service is:
Southeast Florida	3.76	5	**Increasing (Good or Green)**
Southwest Florida	4.22	5	**Increasing (Good or Green)**
Florida Keys / Dry Tortugas	4.28	5	**Increasing (Good or Green)**
South Florida Region	4.09	5	**Increasing (Good or Green)**

Indicator: Number of Registered Recreational Boats 16 feet or larger

The Number of Registered Boats Indicator is the percent change in the number of recreational (non-commercial) boats registered in the counties that comprise each area. All boat owners must register their boats each year and pay a registration fee in order to have the privilege of driving the boat on any water body. For this indicator, only boats 16 feet long or larger are included because the focus of this project is offshore marine recreation activities where boats of this size are most common. This definition excludes wave runners even though these boats are used in offshore marine waters. One indicator each is constructed for southeast Florida, southwest Florida and the Florida Keys / Dry Tortugas. After these indicators are scored, the three values are averaged to obtain the indicator score for south Florida. The number of registered boats 16 feet or larger by county and area in 2010 and 2011 and the percent changes are provided in Table 17.

Table 17: Number of Registered Boats Greater than 16 Feet (a)

Area	2010	2011	Change
Southeast Florida			
Martin County	10,801	10,909	
Palm Beach County	26,641	25,678	
Broward County	27,034	26,810	
Miami-Dade County	40,082	39,670	
Total Southeast Florida	**104,558**	**103,067**	**-1.4%**
Florida Keys / Dry Tortugas			
Monroe County	**17,397**	**17,486**	**0.5%**
Southwest Florida			
Lee County	30,374	29,932	
Collier County	14,945	14,482	
Total Southwest Florida	**45,319**	**44,414**	**-2.0%**

(a) From Florida Department of Highway Safety and Motor Vehicles website.

As presented in Table 17, the number of registered boats fell by 1.4 percent in southeast Florida, increased by 0.5 percent in the Florida Keys, and fell 2 percent in southwest Florida.

These percentages are scaled to a number between 1 and 5 according to the ranges provided in Table 18. This scoring method is the same as what is used for the Percent Change in Park Visitation that was presented in Table 9.

Table 18: Scoring Method for Percent Change in Number of Registered Recreational Boats

Percent Change in Number of Registered Boats from Previous Year	Number of Points
If greater than or equal to 20%	5.00
If greater than or equal to 10% and less than 20%	4.55
If greater than or equal to 5% and less than 10%	4.09
If greater than 1% and less than 5%	3.64
If greater than or equal to 0% and less than or equal to 1%	3.18
If equal to 0	2.73
If less than 0 but greater than or equal to -1%	2.27
If less than -1% but greater than -5%	1.82
If less than or equal to -5% but greater than -10%	1.36
If less than or equal to -10% but greater than -20%	0.91
If less than or equal to -20%	0.45

So the number of registered boats indicator for southeast Florida would receive 1.82 points; registered boats in the Florida Keys would receive 3.18 points and registered boats in southwest Florida would receive 1.82 points.

As was done for the Coastal Park Visitation Indicator, these points are adjusted to remove the influence of factors other than the qualities and quantities of the ecosystem services that are provided by the environmental attributes. The factors identified for the Number of Registered Recreational Boats Indicator are (1) the percent change in the area's resident population; (2) the average percent change in the State and US employment rate; and (3) the percent change in the real retail price of gasoline in the southeastern United States.

Population is a factor affecting the number of registered recreational boats because the higher the area's resident population, the more people who will own a boat, especially in coastal counties such as those in south Florida. The average employment rate in Florida and the U.S. is a factor because this statistic reflects the changing wealth of local residents through their own employment and investment opportunities as reflected in the State employment rate and the U.S. employment rate. Gasoline prices are a factor because fuel is usually one of the largest expenses associated with operating a boat and is a significant consideration in whether boats will be purchased and used. The data for resident population and the Florida and U.S. employment rates were presented in Table 11 and Table 12, respectively. The gasoline price data is provided in Table 19.

Table 19: Lower Atlantic Regular Conventional Retail Gasoline Prices (Dollars per Gallon) (a)

Year	Nominal Dollars	Real (2011) Dollars (b)
2010	$2.72	$2.77
2011	$3.46	$3.46
Percent Change		**24.86%**

(a) From U.S. Energy Information Administration website. Average annual price. Lower Atlantic includes Florida, Georgia, North Carolina, South Carolina, Virginia and West Virginia.

(b) Nominal dollars were adjusted to real 2011 dollars using the GDP Chained Price Index from: http://www.whitehouse.gov/omb/budget/Historicals/.

The percent changes in these factors were assigned points on a scale of -1.25 to 1.25 using the ranges provided in Table 20. These scoring systems for population and employment are the same as what was used for the Percent Change in Park Visitation that was presented in Table 13. The scoring for gas price is the same except that the signs are reversed to reflect the negative relationship between gas price and the number of boat registrations.

Table 20: Adjustments to Score that Reflect Non-Ecosystem Factors Affecting the Number of Registered Recreational Boats

Range of Values (Change from Previous Year)	Local Population	Average State and US Employment	Real Retail Gasoline Price
	Point Adjustment		
If greater than or equal to 20%	-1.25	-1.25	1.25
If greater than or equal to 10% and less than 20%	-0.94	-0.94	0.94
If greater than or equal to 5% and less than 10%	-0.47	-0.47	0.47
If greater than 1% and less than 5%	-0.19	-0.19	0.19
If greater than 0% & less than or equal to 1%	-0.03	-0.03	0.03
If equal to 0%	0.00	0.00	0.00
If less than 0% but greater than or equal to -1%	0.03	0.03	-0.03
If less than -1% but greater than -5%	0.19	0.19	-0.19
If less than or equal to -5% but greater than -10%	0.47	0.47	-0.47
If less than or equal to -10% but greater than -20%	0.94	0.94	-0.94
If less than or equal to -20%	1.25	1.25	-1.25

The assigned points are added to the Number of Registered Boats score to obtain the total adjusted score of this indicator. The total score for each south Florida area is calculated in Table 21.

Table 21: Calculation of Total Adjusted Score of the Number of Registered Recreational Boats Indicator

Row No.	Measurements	Southeast Florida		Southwest Florida		Florida Keys / Dry Tortugas	
		From 2010 to 2011		From 2010 to 2011		From 2010 to 2011	
		% Change	Points	% Change	Points	% Change	Points
(1)	% Change in Number of Registered Recreational Boats greater than 16 feet	-1.43%	1.82	-2.00%	1.82	0.51%	3.18
(2)	% Change in Local Resident Population	0.55%	-0.03	0.94%	-0.03	-0.57%	0.03
(3)	Average % Change in State and US Employment Rate	0.72%	-0.03	0.72%	-0.03	0.72%	-0.03
(4)	% Change in Real Retail Gasoline Price per Gallon	24.86%	1.25	24.86%	1.25	24.86%	1.25
(5)	**Total Adjusted Points**		**3.01**		**3.01**		**4.43**

Southwest Florida will be the example used to demonstrate how the total adjusted score of the Number of Registered Recreational Boats Indicator is calculated and interpreted. For southwest Florida, the number of registered boats fell by 2.00 percent from 2010 to 2011 earning 1.82 points. Because the southwest Florida resident population increased by 0.94 percent, 0.03 points is subtracted from the 1.82 points to account for the positive influence of this factor's increase on boating. If the resident population had not changed, then the number of registered boats would have been lower.

The average Florida and U.S. employment rate increased by 0.72 percent and this increase helped increase the number of registered boats. Therefore, 0.03 points is subtracted from the 1.82 points to account for the influence of local resident wealth. If the employment rate had been unchanged, then the number of registered boats would have been lower.

The percent change in the real retail gasoline price increased by 25 percent from 2010 to 2011. This reduced the number of registered boats and made the percent reduction in the number of registered boats higher than it would have been if there had been no change in gas prices. Therefore, 1.25 points is added to the 1.82 points to remove the influence of this factor from the indicator value.

The total adjusted score for the Number of Registered Recreational Boats Indicator in southwest Florida representing the 2010 to 2011 change in the demand for ecosystem services due to changes in the environmental attributes is 3.01 points (1.82 – 0.03 – 0.03 + 1.25 = 3.01). The indicator score for southeast Florida is also 3.01 points and the indicator score for the Florida Keys / Dry Tortugas is 4.43 points. To calculate the indicator score for the entire south Florida region, the scores of the three areas are averaged together. The Number of Registered Recreational Boats Indicator score for the south Florida marine ecosystem is 3.48 points.

These total adjusted points are scaled to an index number between 1 and 5 and assigned an interpretation based on the index number. This scaling and interpretation is provided in Table 22 which is the same table as Table 15 which was used to index the Coastal Park Visitation Indicator.

Table 22: Indicator Index Value – Scale Total Adjusted Points to a Number between 1 and 5

Range of Total Adjusted Score	Indicator Index Value	Demand for Ecosystem Service due to Quality/ Quantity of Environmental Attributes is:
If total points greater than 3.18	5	**Increasing (Good or Green)**
If total points greater than or equal to 2.27 and less than or equal to 3.18	3	**Stable (Fair or Yellow)**
If total points less than 2.27	1	**Decreasing (Poor or Red)**

As with the Coastal Park Visitation Indicator, the breakpoints of the ranges in Table 22 reflect the ranges in Table 18 which is the unadjusted point system for the change in the number of registered boats. If the total adjusted point value is greater than 3.18, then the number of registered boats increased by at least 1 percent during the year and demand for the ecosystem services increased due to the qualities and quantities of the associated environmental attributes. If the value is between 2.27 and 3.18, inclusive, then the percent change in number of registered boats was between -1 percent and 1 percent and the demands for the ecosystem services are stable. If the value is less than 2.27, then the number of registered boats fell by more than one percent and the demands for the ecosystem services are decreasing.

The Number of Registered Recreational Boats Indicator index values for the three areas and for south Florida are presented in Table 23.

Table 23: Indicator Index Value for Number of Registered Recreational Boats, South Florida Marine Ecosystems

Area	Total Adjusted Score	Indicator Index Value	Demand for Ecosystem Service is:
Southeast Florida	3.01	3	**Stable (Fair or Yellow)**
Southwest Florida	3.01	3	**Stable (Fair or Yellow)**
Florida Keys / Dry Tortugas	4.43	5	**Increasing (Good or Green)**
South Florida Region	3.48	5	**Increasing (Good or Green)**

The table indicates that in southeast and southwest Florida, the total adjusted score for the number of registered recreational boats is 3. This means that from 2010 to 2011 the demands for the offshore marine recreational ecosystem services in these areas were stable due to the qualities and quantities of the associated environmental attributes. In the Florida Keys / Dry Tortugas, the total adjusted score for the number of registered recreational boats is 5. This means that from 2010 to 2011 the demands for the offshore marine recreational ecosystem services of this area were increasing due to the qualities and quantities of the associated environmental attributes. Bear in mind that the point adjustments take into account the main non-ecosystem factors that affect the number of registered boats – resident population, resident wealth and fuel cost. The manager should also take into account any known year to year changes in other non-ecosystem factors that might have a significant influence on the number of registered boats. For these other factors, a similar point adjustment may be made.

Indicator: Pounds of Commercial Seafood Landed (finfish, invertebrates and shrimp)

The Pounds of Seafood Landed Indicator is the percent change in the pounds of seafood landed commercially in the counties that comprise each south Florida area. The Florida Fish and Wildlife Conservation Commission reports annual commercial landings by county. While the term “landed” does not necessarily mean that the seafood was caught in the coastal county’s marine waters, the majority of the pounds landed would have been caught off of the county’s coast. One indicator each is constructed for southeast Florida, southwest Florida and the Florida Keys / Dry Tortugas. After these indicators are scored, the three scores are averaged to obtain the indicator score for south Florida.

The pounds of seafood landed by county and area in 2009 and 2010 and the percent changes are provided in Table 24. The data for 2011 were not yet available at the time this evaluation was

conducted. In southeast Florida, total landings increased by 30 percent from 7.4 million pounds in 2009 to 9.6 million pounds in 2010. In the Florida Keys / Dry Tortugas, landings increased by 14 percent from 11.2 million pounds in 2009 to 12.7 million pounds in 2010. In southwest Florida, landings fell by 3.2 percent, from 8.8 million pounds to 8.5 million pounds. This reduction reflects Collier County's drop in landings of 48 percent which was primarily due to a 900,000 pound drop in Spanish mackerel landings.

Table 24: Pounds of Seafood Landed by the Commercial Fishery (a)

Area	2009	2010	Change
Southeast Florida			
Martin County	2,836,834	3,162,759	
Palm Beach County	1,870,619	2,913,194	
Broward County	876,857	929,878	
Miami-Dade County	1,772,725	2,554,172	
Total Southeast Florida	**7,357,035**	**9,560,003**	**29.9%**
Florida Keys / Dry Tortugas			
Monroe County	**11,167,728**	**12,682,763**	**13.6%**
Southwest Florida			
Lee County	5,839,223	6,978,700	
Collier County	2,936,803	1,517,484	
Total Southwest Florida	**8,776,026**	**8,496,184**	**-3.2%**

(a) From the Florida Fish and Wildlife Conservation Commission.

A very large variety of commercial seafood is harvested offshore of south Florida. The most predominant species landed by weight in southeast Florida are king and Spanish mackerel; black mullet; yellowtail snapper; swordfish; spiny lobster and pink shrimp. In the Florida Keys / Dry Tortugas the predominant species are yellowtail snapper; king mackerel; ballyhoo; stone crab; spiny lobster; and pink shrimp. In southwest Florida, the predominant species are king and Spanish mackerel; black mullet; blue crab; stone crab; spiny lobster and pink shrimp.

These percentages are scaled to a number between 1 and 5 according to the ranges provided in Table 25. This scoring method is the same as what is used for the other indicators.

Table 25: Scoring Method for Percent Change in Pounds of Commercial Seafood Landed

Change in Pounds Landed from Previous Year	Number of Points
If greater than or equal to 20%	5.00
If greater than or equal to 10% and less than 20%	4.55
If greater than or equal to 5% and less than 10%	4.09
If greater than 1% and less than 5%	3.64
If greater than 0% and less than or equal to 1%	3.18
If equal to 0%	2.73
If less than 0% but greater than or equal to -1%	2.27
If less than -1% but greater than -5%	1.82
If less than or equal to -5% but greater than -10%	1.36
If less than or equal to -10% but greater than -20%	0.91
If less than or equal to -20%	0.45

So the Pounds of Commercial Seafood Landed indicator for southeast Florida would receive 5.00 points; seafood landed in the Florida Keys would receive 4.55 points and seafood landed in southwest Florida would receive 1.82 points.

As is done for the other economic indicators, these points are adjusted to remove the influence of factors other than the qualities and quantities of the ecosystem services that are provided by the environmental attributes. The factors identified for the Pounds of Commercial Seafood Landed Indicator are (1) the percent change in average per pound real price received by commercial fishers for the seafood landed; and (2) the percent change in the real retail price of diesel fuel in the southeastern United States.

Changes in the prices received by commercial fishers for the fin-fish, invertebrates (crabs, lobsters, etc.) and shrimp landed in south Florida will change the profitability of commercial fishing and the quantity of seafood landed. As ex-vessel prices go up, more commercial fishing trips will be taken and the more people will fish commercially. This will increase the pounds of seafood landed.

The cost of boat fuel is a significant part of commercial fishing costs. As boat fuel costs go up, the profitability of fishing falls. Fewer commercial fishing trips will be taken and fewer people will fish commercially.

The average prices received by commercial fishers for their 2009 and 2010 landings in price per pound landed are provided in Table 26. These prices were estimated as the total ex-vessel value of landings in each area divided by the total pounds of species landed.

Table 26: Average Prices Received by Commercial Fishers for their 2009 and 2010 Seafood Landings in Price per Pound

Year	Southeast Florida	Florida Keys / Dry Tortugas	Southwest Florida
Average Price of fish landed - nominal $ per pound			
2009	$1.43	$2.46	$1.82
2010	$1.69	$3.99	$2.26
Average Price of Fish Landed - real 2011 $ per pound			
2009	$1.48	$2.53	$1.87
2010	$1.72	$4.07	$2.31
2009 to 2010 Percent change	**16.43%**	**60.86%**	**23.05%**

(a) The prices used are the ex-vessel prices by species from the Florida Fish and Wildlife Conservation Commission website. Average ex-vessel prices by species are weighted by the pounds of fish landed by species in each area.

The diesel fuel price data is provided in Table 27.

Table 27: Lower Atlantic U.S. Number 2 Retail Diesel Prices (Dollars per Gallon) (a)

Year	Nominal Dollars	Real (2011) Dollars (b)
2009	$2.47	$2.54
2010	$2.99	$3.05
Percent change		**20.17%**

(a) From U.S. Energy Information Administration website. Average annual price. Lower Atlantic includes Florida, Georgia, North Carolina, South Carolina, Virginia and West Virginia.

(b) Nominal dollars were adjusted to real 2011 dollars using the GDP Chained Price Index from:

http://www.whitehouse.gov/omb/budget/Historicals/.

The percent changes in these factors were assigned points on a scale of -1.25 to 1.25 using the ranges provided in Table 28. This scoring method is the same as what is used for the economic indicators discussed previously.

Table 28: Adjustments to Score that Reflect Non-Ecosystem Factors Affecting the Pounds of Seafood Landed Indicator

Range of Values (% Change from Previous Year)	Average Prices Received by Commercial Fishers	Retail Diesel Price
	Point Adjustment	
If greater than or equal to 20%	-1.25	1.25
If greater than or equal to 10% and less than 20%	-0.94	0.94
If greater than or equal to 5% and less than 10%	-0.47	0.47
If greater than 1% and less than 5%	-0.19	0.19
If greater than 0% & less than or equal to 1%	-0.03	0.03
If equal to 0%	0.00	0.00
If less than 0% but greater than or equal to -1%	0.03	-0.03
If less than -1% but greater than -5%	0.19	-0.19
If less than or equal to -5% but greater than -10%	0.47	-0.47
If less than or equal to -10% but greater than -20%	0.94	-0.94
If less than or equal to -20%	1.25	-1.25

The assigned points are added to the Pounds of Seafood Landed Indicator score to obtain the total adjusted score of this indicator. The total adjusted score for each south Florida area is calculated in Table 29.

Table 29: Calculation of Total Adjusted Score of the Pounds of Commercial Seafood Landed Indicator

Row No.	Measurements	Southeast Florida		Southwest Florida		Florida Keys / Dry Tortugas	
		From 2009 to 2010		From 2009 to 2010		From 2009 to 2010	
		% Change	Points	% Change	Points	% Change	Points
(1)	% Change in Pounds of Seafood Harvested	29.94%	5.00	-3.19%	1.82	13.57%	4.55
(2)	% Change in Real Ex-vessel Seafood Price	16.43%	-0.94	23.05%	-1.25	60.86%	-1.25
(3)	% Change in Real Retail Diesel Fuel Price	20.17%	1.25	20.17%	1.25	20.17%	1.25
(4)	**Total Adjusted Points**		**5.31**		**1.82**		**4.55**

The Florida Keys / Dry Tortugas will be the example used to demonstrate how the total adjusted score of the Pounds of Commercial Seafood Landed Indicator is calculated and interpreted. For the Florida Keys/ Dry Tortugas, the pounds of commercial seafood landed increased by 14 percent from 2009 to 2010 earning 4.55 points. Because the real ex-vessel seafood prices increased by 61 percent, 1.25 points is subtracted from the 4.55 points to account for the positive influence of this factor's increase on commercial fishing harvest. If the real ex-vessel seafood prices had not changed, then the pounds of seafood landed would have been lower.

The real retail diesel fuel price increased by 20 percent and this increase helped reduce the pounds of seafood landed. Therefore, 1.25 points is added to the 4.55 points to account for the negative influence of boat fuel prices. If real diesel prices had been unchanged, then the pounds of seafood landed would have been higher.

The total adjusted score for the Pounds of Commercial Seafood Landed Indicator in the Florida Keys / Dry Tortugas representing the 2009 to 2010 change in the demand for ecosystem services due to changes in the environmental attributes is 4.55 points (4.55 – 1.25 + 1.25 = 4.55). The indicator score for southeast Florida is 5.31 points and the indicator score for southwest Florida is 1.82 points. To calculate the indicator score for the entire south Florida region, the total adjusted scores of the three areas are averaged together. The Pounds of Commercial Seafood Landed Indicator score for the south Florida marine ecosystem is 3.89 points.

These total adjusted scores are scaled to an index number between 1 and 5 and assigned an interpretation based on the index number. This scaling and interpretation is provided in Table 30 which is the same table used to index the Coastal Park Visitation Indicator and the Number of Registered Recreational Boats Indicator.

Table 30: Indicator Index Value – Scale Total Adjusted Points to a Number between 1 and 5

Range of Total Adjusted Score	Indicator Index Value	Demand for Ecosystem Service due to Quality/ Quantity of Environmental Attributes is:
If total points greater than 3.18	5	**Increasing (Good or Green)**
If total points greater than or equal to 2.27 and less than or equal to 3.18	3	**Stable (Fair or Yellow)**
If total points less than 2.27	1	**Decreasing (Poor or Red)**

As with the previously discussed indicators, the breakpoints of the ranges in Table 30 reflect the ranges in Table 25 which is the unadjusted scoring system for the change in the pounds of commercial seafood landed. The Pounds of Commercial Seafood Landed Indicator index values for the three areas and for south Florida are presented in Table 31.

Table 31: Indicator Index Value for the Pounds of Commercial Seafood Landed, South Florida Marine Ecosystems

Area	Total Adjusted Score	Indicator Index Value	Demand for Ecosystem Service is:
Southeast Florida	5.31	5	**Increasing (Good or Green)**
Southwest Florida	1.82	1	**Decreasing (Poor or Red)**
Florida Keys / Dry Tortugas	4.55	5	**Increasing (Good or Green)**
South Florida Region	3.89	5	**Increasing (Good or Green)**

The table indicates that in southeast Florida and the Florida Keys/ Dry Tortugas, the index value for pounds of commercial seafood landed is 5. This means that from 2009 to 2010 the demands for the commercial fishing ecosystem services increased due to the qualities and quantities of the associated environmental attributes. In southwest Florida, the index value for pounds of commercial seafood landed is 1. This means that from 2009 to 2010 the demands for the commercial fishing ecosystem services decreased due to the qualities and quantities of the associated environmental attributes. Bear in mind that the point adjustments take into account the main non-ecosystem factors that affect the pounds of commercial seafood landed – seafood prices received by fishers and fuel cost. The manager should also take into account any known year to year changes in other non-ecosystem factors that might have a significant influence on the pounds of commercial seafood landings. For these other factors, a similar point adjustment may be made.

Indicator: Number of Live Marine Organisms Landed

The Number of Live Marine Organisms Landed Indicator is the percent change in the number of commercial live marine plants and animals landed each year in the counties that comprise each south Florida area. The Florida Fish and Wildlife Conservation Commission reports commercial landings data by county. While the term "landed" does not necessarily mean that the organisms were caught in the coastal county's marine waters, the majority would have been caught off of the county's coast. One indicator each is constructed for southeast Florida, southwest Florida and the Florida Keys / Dry Tortugas. After these indicators are scored, the three scores are averaged to obtain the indicator score for south Florida.

The number of live marine organisms landed by county and area in 2009 and 2010 and the percent changes are provided in Table 32. The data for 2011 were not yet available at the time this evaluation was conducted. In southeast Florida, total landings fell 32 percent from 513,000 organisms in 2009 to 348,000 organisms in 2010. In the Florida Keys / Dry Tortugas, landings fell 5 percent from 4.5 million organisms in 2009 to 4.3 million organisms in 2010. There are very few to no organisms landed in southwest Florida.

A very large variety of marine organisms is harvested offshore of south Florida for the tropical fish market. The most predominant species landed by number in both areas of south Florida are crabs and snails. Other important but less predominant species are shrimp, anemones, urchins, angelfish and octocorals.

Table 32: Number of Live Marine Organisms Landed by the Commercial Fishery (a)

Area	2009	2010	Change
Southeast Florida	512,821	348,239	**-32.09%**
Florida Keys, Florida	4,467,946	4,262,578	**-4.60%**

(a) From the Florida Fish and Wildlife Conservation Commission.

The same factors, scaling and adjustment methods used for the Pounds of Commercial Seafood Landed Indicator is also used for the Number of Live Marine Organisms Landed Indicator. These factors are the percent change in the real ex-vessel price of the marine organisms landed and the percent change in the real diesel fuel price. The scaling method for the number of live marine organisms landed is the same as that provided in Table 25. The diesel price data was provided in Table 27 and the point adjustment system for the ex-vessel price of the landings and diesel fuel price is that same as that provided Table 28.

The data for the ex-vessel price of marine landings in 2009 and 2010 and the percent change is provided in Table 33. These prices were estimated as the total ex-vessel value of landings in each area divided by the total pounds of species landed.

Table 33: Average Prices Received by Commercial Fishers for their 2009 and 2010 Live Marine Landings in Price per Pound

Year	Southeast Florida	Florida Keys / Dry Tortugas
Average Price of live marine landings - nominal $ per pound		
2009	$0.56	$0.41
2010	$0.72	$0.37
Average Price of live marine landings - real 2011 $ per pound		
2009	$0.58	$0.42
2010	$0.73	$0.38
2009 to 2010 Percent change	**26.11%**	**-9.55%**

(a) The prices used are the ex-vessel prices by species from the Florida Fish and Wildlife Conservation Commission website. Average ex-vessel prices by species are weighted by the number of organisms landed by species in each area.

The total adjusted value for the Number of Live Marine Organisms Landed for each south Florida area is calculated in Table 34.

Table 34: Calculation of Total Adjusted Score of the Number of Live Marine Organisms Landed Indicator

Row No.	Measurements	Southeast Florida		Florida Keys / Dry Tortugas	
		From 2009 to 2010		From 2009 to 2010	
		% Change	Points	% Change	Points
(1)	% Change in Number of Live Marine Landings	-32.09%	0.45	-4.60%	1.82
(2)	% Change in Real Ex-vessel Marine Animal Price	26.11%	-1.25	-9.55%	0.47
(3)	% Change in Real Retail Diesel Fuel Price	20.17%	1.25	20.17%	1.25
(4)	**Total Adjusted Points**		**0.45**		**3.54**

The Florida Keys / Dry Tortugas will be the example used to demonstrate how the total adjusted score of the Number of Live Marine Organisms Landed Indicator is calculated and interpreted. For the Florida Keys/ Dry Tortugas, the number of marine organisms landed fell 4.60 percent from 2009 to 2010 earning 1.82 points. Because the real ex-vessel marine animal prices fell 9.55 percent, 0.47 points is added to the 1.82 points to account for the negative influence of this factor's reduction on commercial marine animal landings. If the ex-vessel prices received for live organisms had not changed, the number of live organisms landed would have been higher.

The real retail diesel fuel price increased by 20 percent and this increase helped reduce the number of live organisms landed. Therefore, 1.25 points is added to the 1.82 points to account for the negative influence of boat fuel prices. If real diesel prices had been unchanged, then the number of live organisms landed would have been higher.

The total adjusted score for the Number of Live Marine Organisms Landed Indicator in the Florida Keys / Dry Tortugas representing the 2009 to 2010 change in the demand for ecosystem services due to changes in the environmental attributes is 3.54 points (1.82 + 0.47 + 1.25 = 3.54). The indicator score for southeast Florida is 0.45 points. To calculate the indicator score for the entire south Florida region, the total adjusted score of the two areas are averaged together. The Number of Live Marine Organisms Landed Indicator score for the south Florida marine ecosystem is 2.00 points.

These total adjusted scores are scaled to an index number between 1 and 5 and assigned an interpretation based on the index number. This scaling and interpretation is the same as was provided in Table 30 which is the same table used for the other indicators. The Number of Live Marine Organisms Landed Indicator index values for the two areas and for south Florida are presented in Table 35.

Table 35: Indicator Index Value for the Number of Live Marine Organisms Landed

Area	Total Adjusted Score	Indicator Index Value	Demand for Ecosystem Service is:
Southeast Florida	0.45	1	**Decreasing (Poor or Red)**
Southwest Florida	Insignificant Number Landed		
Florida Keys / Dry Tortugas	3.54	5	**Increasing (Good or Green)**
South Florida Region	2.00	1	**Decreasing (Poor or Red)**

The table indicates that in southeast Florida, the number of live marine organisms landed index value is 1. This means that from 2009 to 2010 the demands for the ornamental ecosystem services fell due to the qualities and quantities of the associated environmental attributes. In the Florida Keys / Dry Tortugas, the number of live marine organisms landed index value is 5. This means that from 2009 to 2010 the demands for the ornamental ecosystem services in this area increased due to the qualities and quantities of the associated environmental attributes. Bear in mind that the point adjustments take into account the main non-ecosystem factors that affect the number of live marine organisms landed – animal prices received by fishers and fuel cost. The manager should also take into account any known year to year changes in other non-ecosystem factors that might have a significant influence on the number of live marine animal landings. For these other factors, a similar point adjustment may be made.

Indicator: Dollar Value of Insured Flood Damage Claims Paid

The Dollar Value of Insured Flood Damage Claims Paid Indicator is the annual percent change in the real dollar value of the flood damage claims paid by the National Flood Insurance Program (NFIP) to those who live in the south Florida counties. This program is the only guaranteed flood insurance available.

One indicator each is constructed for southeast Florida, southwest Florida and the Florida Keys / Dry Tortugas. After these indicators are scored, the three scores are averaged to obtain the indicator value for south Florida. The total annual dollar value of insured flood damage claims paid by NFIP in 2009 and 2010 and the percent changes are provided in Table 36.

Table 36: Total Flood Damage Claims Paid by the National Flood Insurance Program by Area (a)

Area	2009	2010	% Change
Nominal Dollars			
Broward County	$21,436,524	$470,175	
Martin County	$2,019	0	
Miami-Dade County	$25,985,630	$1,677,507	
Palm Beach County	$240,563	$162,871	
Total Southeast Florida	$47,664,736	$2,310,553	-95%
Florida Keys (Monroe County)	$74,009	$121,886	65%
Collier County	$17,116	$0	
Lee County	$3,522	$50,523	
Total Southwest Florida	$20,638	$50,523	145%
Real Dollars (2011) (b)			
Southeast Florida	$49,053,699	$2,356,134	**-95%**
Florida Keys (Monroe County)	$76,166	$124,290	**63%**
Southwest Florida	$21,239	$51,520	**143%**

(a) From email exchange with NFIP (nfipstat.com).

(b) Nominal dollars were adjusted to real 2011 dollars using the U.S. Gross Domestic Product (GDP) Chained Price Index.

As presented in Table 36, the real value of flood damage claims paid in southeast Florida fell 95 percent from 2009 to 2010. The real value of flood damage claims paid to Florida Keys residents and businesses increased by 63 percent. In southwest Florida, the real value of paid flood damage claims increased by 143 percent.

These percentages are scaled to a number between 1 and 5 according to the ranges provided in Table 37.

Table 37: Scoring Method for Percent Change in Real Dollar Value of Insured Flood Damage Claims Paid

Percent Change in Flood Claims Paid from Previous Year	Number of Points
If greater than or equal to 20%	0.45
If greater than or equal to 10% and less than 20%	0.91
If greater than or equal to 5% and less than 10%	1.36
If greater than 1% and less than 5%	1.82
If greater than 0% and less than or equal to 1%	2.27
If equal to 0%	2.73
If less than 0% but greater than or equal to -1%	3.18
If less than -1% but greater than -5%	3.64
If less than or equal to -5% but greater than -10%	4.09
If less than or equal to -10% but greater than -20%	4.55
If less than or equal to -20%	5.00

Using Table 37, flood damage claims paid in southeast Florida would receive 5.00 points; claims paid in the Florida Keys would receive 0.45 points; and claims paid in southwest Florida would receive 0.45 points.

Before deciding if the points assigned to these indicators indicates increasing, stable or decreasing qualities and quantities of environmental attributes, an adjustment to these point assignments is necessary. This is because the value of flood damages will change from year to year due to factors other than the quality and quantity of the environmental attributes. Future research should focus on the influence of primary factors on the value of insured flood damage claims paid.

Flooding from hurricanes and major storms are covered under the NFIP. For this project, the decision was made to incorporate into the indicator point system the following two factors: (1) the change in the number of hurricanes and major storms from the previous year and (2) the change in the number of hurricanes greater than category 2 from the previous year. These two factors would significantly affect the extent of flooding in an area and the value of insured flood insurance claims paid regardless of the quality and quantity of the environmental attributes that provide storm damage and flood protection.

The number of hurricanes and major storms that affected each area in 2009 and 2010 are provided in Table 38.

Table 38: Number of Hurricanes and Major Storms by Area in 2009 and 2010

Year	Number of Hurricanes & Major Storms	Number of Hurricanes Greater than Category 2
Southeast Florida		
2009	1	0
2010	0	0
Difference from 2009 to 2010	-1	0
Florida Keys		
2009	0	0
2010	0	0
Difference from 2009 to 2010	0	0
Southwest Florida		
2009	0	0
2010	0	0
Difference from 2009 to 2010	0	0

(a) From NOAA and counties websites.

The differences provided in Table 38 were assigned points on a scale of -5.00 to 5.00 using the ranges provided in Table 39.

Table 39: Adjustments to Score that Reflect Non-Ecosystem Factors Affecting the Real Value of Insured Flood Damage Claims Paid

Range of Values (Change from Previous Year)	Number of Hurricanes & Major Storms	Number of Hurricanes Greater than Category 2
	Point Adjustment	
If greater than or equal to 3	5.00	5.00
If 2	3.00	3.00
If 1	2.00	2.00
If 0	0.00	0.00
If -1	-2.00	-2.00
If -2	-3.00	-3.00
If less than -3	-5.00	-5.00

The assigned points are added to the Real Value of Insured Flood Damage Claims Paid Value to obtain the total adjusted value of this indicator. The total adjusted value for each south Florida area is calculated in Table 40.

Table 40: Calculation of Total Adjusted Score of the Real Value of Insured Flood Damage Claims Paid Indicator

Row No.	Measurements	Southeast Florida		Southwest Florida		Florida Keys / Dry Tortugas	
		From 2009 to 2010		From 2009 to 2010		From 2009 to 2010	
		% Change	Points	% Change	Points	% Change	Points
(1)	Percent Change in Real Value of Insured Flood Damage Claims Paid	-95.20%	5.00	142.57%	0.45	63.18%	0.45
(2)	Change in Number of Hurricanes & Major Storms from previous year	-1.00	-2.00	0.00	0.00	0.00	0.00
(3)	Change in Number of Hurricanes Greater than Category 2 from previous year	0.00	0.00	0.00	0.00	0.00	0.00
(5)	**Total Adjusted Points**		**3.00**		**0.45**		**0.45**

Southeast Florida will be the example used to demonstrate how the total adjusted score of the Flood Damage Claims Indicator is calculated and interpreted. For southeast Florida, flood damage claims fell 95 percent from 2009 to 2010 earning 5.00 points. In 2009, a major storm hit Miami-Dade and Broward counties causing significant flood damage. Because the number of hurricanes and major storms in southeast Florida fell by 1 storm, 2.00 points is subtracted from the 5.00 points. If there had been no change in the number of hurricanes and storms, the insured flood damage claims paid would have been much lower in 2009 and the percent reduction in claims would not have been as large.

There was no change in the number of hurricanes greater than category 2. Therefore, no additional adjustment was made to the indicator value and the total adjusted points for southeast Florida is 3.00 (5.00 – 2.00 = 3.00). If there had been one more hurricane greater than category 2 in 2010 than in 2009, then 2.00 points would have been added to the 5.00 points to account for the fact that insured flood damages would have been greater in 2010 and the percent reduction in claims would not have been as large.

The indicator score for the Florida Keys / Dry Tortugas is 0.45 points and the indicator score for southwest Florida is also 0.45 points. To calculate the indicator score for the entire south Florida region, the total adjusted scores of the three areas are averaged together. The Real Dollar Value

of Insured Flood Damage Claims Paid Indicator score for the south Florida marine ecosystem is 1.73 points.

These total adjusted scores are scaled to an index number between 1 and 5 and assigned an interpretation based on the index number. This scaling and interpretation is provided in Table 41. This scaling is the same as the other economic indicators.

Table 41: Indicator Index Value – Scale Total Adjusted Points to a Number between 1 and 5

Range of Total Adjusted Score	Indicator Index Value	Demand for Ecosystem Service is:
If total points greater than 3.18	5	**Increasing (Good or Green)**
If total points greater than or equal to 2.27 and less than or equal to 3.18	3	**Stable (Fair or Yellow)**
If total points less than 2.27	1	**Decreasing (Poor or Red)**

The Real Dollar Value of Insured Flood Damage Claims Paid Indicator index values for the three areas and for south Florida are presented in Table 42.

Table 42: Indicator Index Value for Real Dollar Value of Insured Flood Damage Claims Paid South Florida Marine Ecosystems

Area	Total Adjusted Points	Indicator Index Value	Demand for Ecosystem Service is:
Southeast Florida	3.00	3	**Stable (Fair or Yellow)**
Southwest Florida	0.45	1	**Decreasing (Poor or Red)**
Florida Keys / Dry Tortugas	0.45	1	**Decreasing (Poor or Red)**
South Florida Region	1.73	1	**Decreasing (Poor or Red)**

The table indicates that in southwest Florida and the Florida Keys, the indicator index value is 1. This means that the environmental attributes that protect properties from flooding did not provide as great a level of protection in 2010 as they did in 2009. In southeast Florida, the indicator index value is 3. This means that the flood protection provided by the environmental attributes was stable between the two years. Bear in mind that the point adjustments take into

account the main non-ecosystem factors that affect flood damage claims – hurricanes and major storms. The manager should also take into account any known year to year changes in other non-ecosystem factors. For these other factors, a similar point adjustment may be made.

Discussion: When do we need HD economic indicators?

While historic data can be used to show past trends, experts assert that for best use, data collection, analysis, and monitoring should begin before impacts occur and in advance of restoration.

Ecological indicators must be combined with the economic indicators to make the final assessment of the state of ecosystem services. Here we presented a preliminary assessment using the stop-light approach on the state of several key ecosystem services using Human Dimensions economic indicators. However, short-term economic indicators can yield a "false" signal about the state of ecosystem services if natural capital is being sacrificed for short-term economic gain. The resulting lower stock of natural capital would then yield lower flows of ecosystem services over the longer-term.