



Florida Reef Resilience Program Economics of Coral Reef Ecosystems

By

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Recreational Reef Use



- **2000-01 Socioeconomic Study of Reefs in Southeast Florida (Palm Beach, Broward, Miami-Dade and Monroe counties).**
- **2003 Martin County added.**
- **Separate studies done on residents and visitors to each county.**
- **Study limited to those who access the reefs (artificial and natural) by boat.**
- **Use estimated in annual person-days (one person doing an activity a whole day or any part of a day).**



Recreational Use of Reefs



- **Estimates of person-days of use by:**
 - (1) County where activity took place (location of reefs)**
 - (2) Place of residence of user (resident of county versus visitor to county)**
 - (3) Type of reef (artificial or natural)**
 - (4) Type of activity (snorkeling, SCUBA diving, fishing & glass-bottom boat rides)**
 - (5) Type of boat access (for hire, rental and private household)**



Recreational Reef Use



By County and Type of Reef

Person-days (millions)

County	Natural	Artificial	All Reefs	% Natural
Martin	0.27	0.26	0.53	50.9
Palm Beach	2.83	1.41	4.24	66.7
Broward	5.46	3.98	9.44	57.8
Miami-Dade	6.22	2.95	9.17	67.8
Monroe	3.88	1.58	5.46	70.0
Total	18.65	12.70	31.35	59.5



Recreational Reef Use



By User Type and Reef Type

Person-days (millions)

User type	Natural	Artificial	All Reefs	% Natural
Residents	9.78	5.14	14.92	65.5
Visitors	8.87	7.56	16.43	54.0
All Users	18.65	12.70	31.35	59.5

- Residents account for 52.4% of natural reef use.
- Residents account for 40.5% of artificial reef use.
- Residents account for 47.6% of all reef use.



Recreational Reef Use



By Activity and Reef Type

Person-days (millions)

Activity	Natural	Artificial	All Reefs	% Natural
Snorkeling	4.24	4.14	8.38	50.6
SCUBA Diving	4.56	3.09	7.65	59.6
Fishing	9.72	5.46	15.18	64.0
Glass-bottom boat	0.12	0.02	0.14	85.7
Total	18.65	12.70	31.35	59.5

- Fishing accounted for 52 percent of all natural reef use.
- Fishing accounted for 43 percent of all artificial reef use.
- Fishing accounted for 48 percent of all reef use.



Market Economic Value of Recreational Reef Use



- **Economists refer to Market Economic Value as Economic Impact on Local, Regional or National Economies.**
- **For recreational reef use, we measure the amount of spending in the local county economy that users make and the associated impacts on Sales/output, Income and jobs. Sometimes we estimate the tax revenues generated by the spending.**
- **Impact estimates also include the “ripple” or “multiplier” impacts. It is customary when doing local economic impact to not include multiplier impacts for spending by local residents, since it is in most cases double counting (included in the multiplier process for visitor spending).**
- **Estimates were made by county, residence of user, type of reef and activity.**



Market Economic Value of Recreational Use



By Type of Reef

(Billions of \$ and Number of full and part-time jobs)

Reef Type	Spending	Sales/Output	Income	Employment
Natural	1.8	2.7	1.2	43,470
Artificial	1.1	1.7	0.786	27,055
All Reefs	2.9	4.4	2.0	70,523

- Natural reefs accounted for
- 62% of recreational reef use spending.
- 61% of recreational reef use Sales/output impact.
- 60% of recreational reef use Income impact.
- 62% of recreational reef use employment impact.



Nonmarket Economic Recreational Use Value



Def. Consumer's surplus: The amount of value a consumer receives from the consumption of a good or service over and above what they have to pay to obtain the good or service.

- **Since no one owns the reef resources and can charge a price for their use, the estimated consumer's surplus is the direct economic use value of the reef resource.**
- **Estimates of Annual Direct User Value are available by:**
 - (1) **County of where the activity took place (location of the reefs)**
 - (2) **Place of residence of user (resident of county or visitor to county)**
 - (3) **Type of reef (artificial, natural and new artificial)**
 - (4) **Type of Activity (snorkeling, SCUBA diving and fishing)**



Nonmarket Economic Recreational Use Value



By Type of User and Reef

(Millions \$)

Type of User	Existing Natural	Existing Artificial	All Existing	New Artificial
Residents	82.87	15.86	50.43	3.33
Visitors	151.06	72.89	210.56	24.49
Total	233.93	88.75	260.99	27.82

- Natural reefs are more valuable than artificial reefs.
- Visitors have higher value for the reefs.
- Residents accounted for 52% of all natural reef use, but only 35% of the nonmarket economic use value.



Nonmarket Passive Economic Use Value



Def. Passive Economic Use Value: This is the economic value people have for a resource to protect or restore it to a certain condition even though they never have used or intend to use the resource. This value has been referred to as bequest value of the willingness to pay so that future generations have the opportunity to experience the resource in a certain condition or existence value or the willingness to pay to simply know that a resource will be protected or restored to a certain condition.

NOTE: We have not estimated these values for coral reefs anywhere in the world. However, we are currently doing this for Hawaii's coral reef ecosystem. In the Tortugas ER, we used a "*policy analysis*" employing conservative lower bound estimates of what these values might be, and they exceeded all direct use values.

Other economic values not included: Option value or willingness to pay by current nonusers to ensure a resource is protected or restored to a certain condition so they might use it in the future—a kind of insurance policy. Quasi-option value or the value we might obtain from future discoveries like medicinal properties of the corals. Scientific value and educational value.



Asset Value of Reef



Def. Asset Value: This is the amount someone would be willing to pay today if they could own the reef resources and charge a price for their use. It is like the value of a house or a car in which the asset has a certain life and it yields a stream of services over the life of the asset. But at any point in time there is a price someone would be willing to pay to own it.

• We estimate the asset value of the reefs for recreational use using conservative lower bound assumptions:

- (1) the reefs have an indefinite life (perpetuity).
- (2) Annual reef use is constant in the future (our inability to forecast out very far).
- (3) Annual user value per unit of use is constant in the future (our inability to estimate people's preferences very far into the future).
- (4) A real (net of inflation) discount rate or interest rate of 3% to convert future dollars to current dollars.



Asset Value of the Reefs



Asset Value of Recreational Use (Billions \$)

Existing Natural Reefs **\$7.7**

Existing Artificial Reefs **\$2.9**

All Existing Reefs **\$8.7**

New Artificial Reefs **\$0.931**

- **It would be worth investing today \$931 million in new artificial reefs in southeast Florida.**



Importance/Satisfaction Ratings



- **25 natural resource attributes, facilities and services rated on a five point scale for both how important they were to the user and how satisfied they were with them.**
- **FKNMS Only.**
- **Resident and visitors to Monroe County/Florida Keys**
- **1995-96 and 2000-01**
- **Comparisons of changes over same five-year period for selected measurements where socioeconomic and ecological measurements available:**
 - (1) amount of living coral**
 - (2) clarity of water (visibility)**
 - (3) diversity of sea life**
 - (4) abundance of fish**



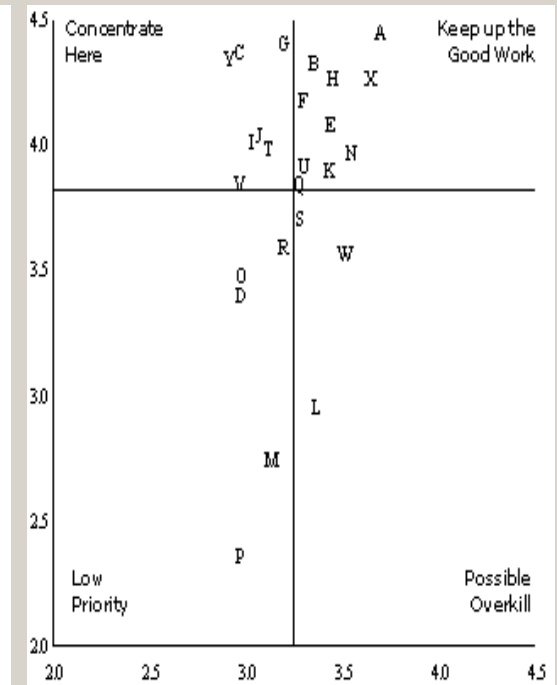
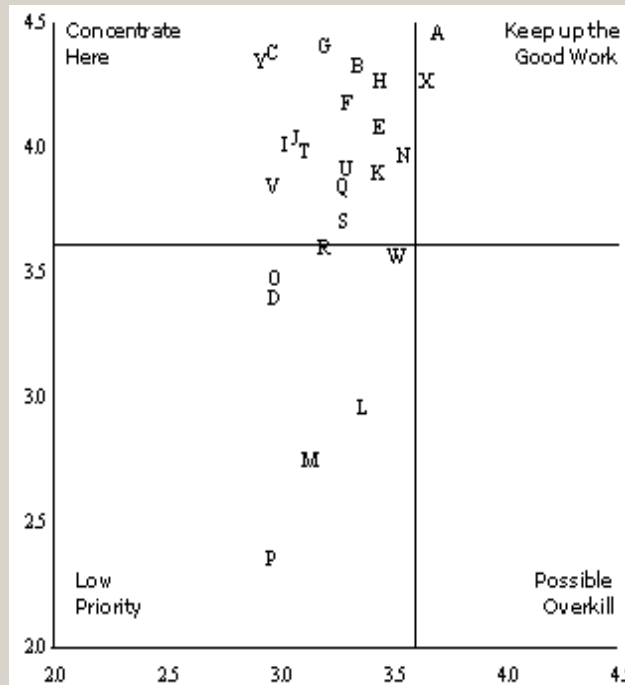
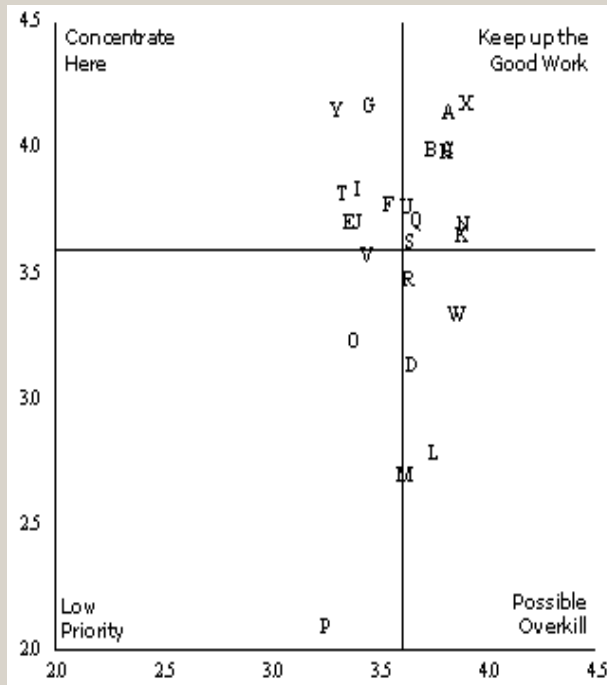
Importance-Satisfaction Ratings



Visitors 1995-96

Visitors 2000-01

Visitors 2000-01



- A = Water Clarity**
- B=Amount of Living Coral**
- C=Many Different Kinds of Fish and Sea Life to View**
- D=Many Different Kinds of Fish and Sea Life to Catch**
- F=Large Numbers of Fish**



1995-96 and 2000-01 Five-year Comparison

Socioeconomic (Satisfaction Scores)

Diversity

Visitors **significant decline**
Residents **significant decline**

Abundance

Visitors **significant decline**
Residents **significant decline**

Amount of Living Coral

Visitors **significant decline**
Residents **significant decline**

Water Clarity

Visitors **decline not significant**
Residents **significant decline**

Ecological

Increase (REEF)

Targeted species (+)

Non-targeted species (+/-)

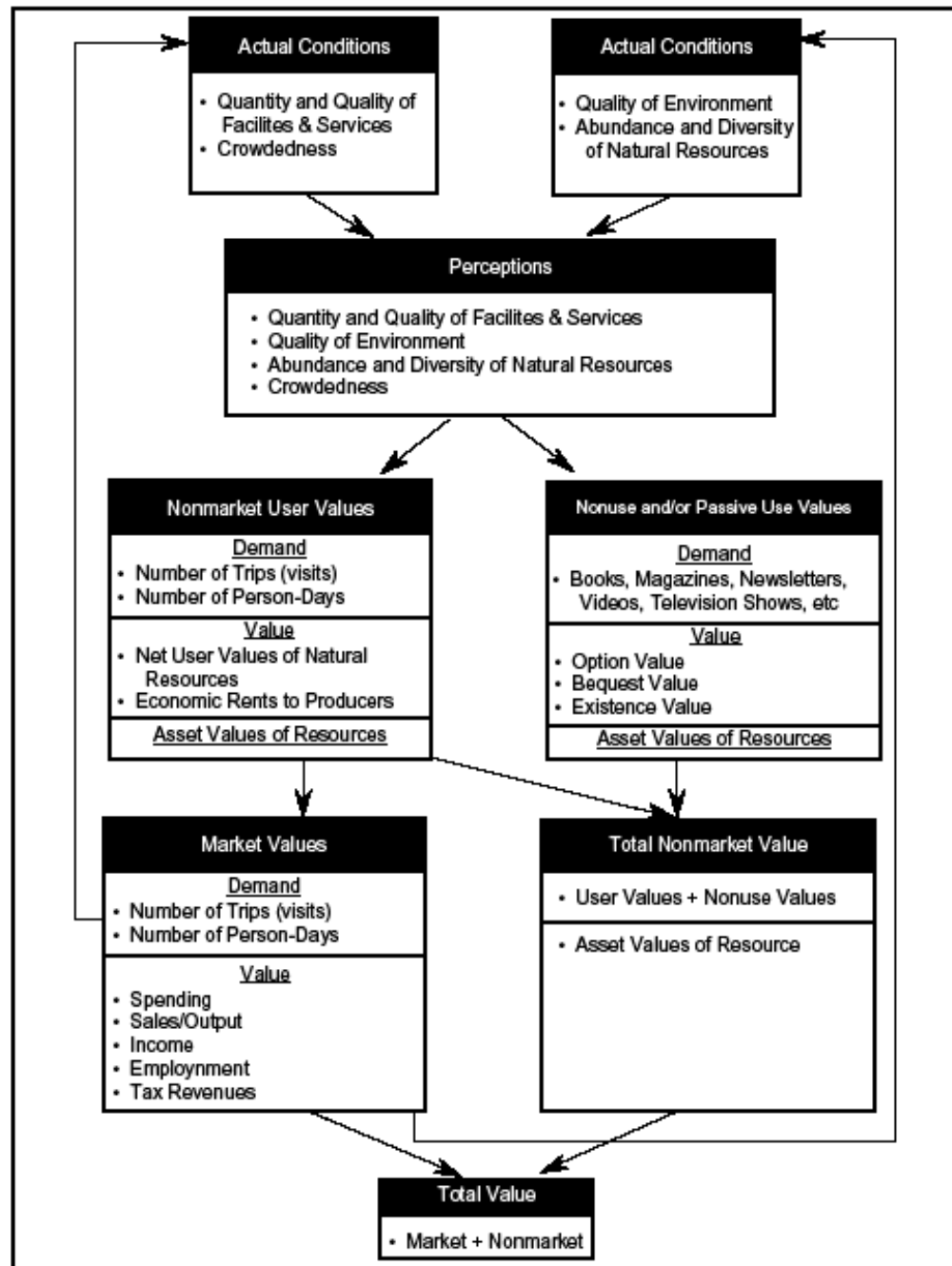
Spiny Lobsters (-)

37% decline in live stony coral
increase in disease infection

No trend



Figure 1. Conceptual Model Linking the Economy and Environment





Management Applications



A. Zone Effectiveness

- **Commercial Fishing Panels 1998-2006**

- Sambos Ecological Reserve – No short-term financial impact. First two years of implementation, Sambos Panel had highest increase in earnings.**

- **Tortugas Integrated Assessment – Five years Pre and Post implementation of the Tortugas Ecological Reserve**

Preliminary conclusion: No impacts to commercial and recreational fisheries. Impacts dominated by fuel price increases, drops in shrimp prices and grouper regulations.



B. Damage Assessment, Restoration & Mitigation

- **Broward County Beach Renourishment**

Tradeoff between recreational beach use and recreational reef use.

Economic values of recreational reef use used to justify mitigation of damage to reefs from beach renourishment.



C. New Artificial Reefs

- **U.S. S. Spiegel Grove – 510’ retired Navy Vessel sunk off Key Largo as an artificial reef**
 - (1) **Artificial reefs can reduce usage on surrounding natural reefs.**
 - (2) **Net increase in dive business and local economy from increase in total dive use.**
 - (3) **Win-Win outcome for economy and environment.**