ECONOMIC VALUATION OF ALTERNATIVE RECREATIONAL BAG LIMITS FOR SPINY LOBSTERS IN THE FLORIDA KEYS NATIONAL MARINE SANCTUARY

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PURPOSE: Begun in 1992, the Recreational Lobster Survey is part of an ongoing effort to value the recreational fishery for spiny lobster (*Panulirus argus*). The primary purpose of the survey is to support the management of spiny lobsters through valuation of potential changes in recreational bag limits, estimation of recreational catch, and estimation of economic impact of recreational lobster fishing. This report focuses on economic valuation of alternative recreational bag limits statewide and within the Florida Keys National Marine Sanctuary (FKNMS) conducted by Milon (2004).

EXISTING REGULATIONS: In Florida, the recreational lobster season is split into a 2-day sport season, usually occurring in July, and the regular season, which runs from August to March. Recreational spiny lobster licenses (purchased as an additional stamp on the State saltwater fishing license) are required for harvest and bag limits are in place to control the number of lobsters harvested per day. These additional stamp for lobsters currently cost $2.00 annually in addition to saltwater fishing license fees. During the 2-day sport season, the bag limits are 6 lobsters per person per day in Monroe County (Florida Keys) and Biscayne National Park and 12 lobsters per person per day for the rest of Florida. During the regular season, lobster bag limits are 6 lobsters per person per day for all of Florida. Lobster harvest is prohibited at all times in Everglades National Park, Dry Tortugas National Park, and no take areas in the FKNMS. During the sport season, lobster harvest is prohibited in John Pennekamp Coral Reef State Park. Other limitations also apply, including minimum size requirements and certain restrictions on night diving for lobsters.

SURVEY QUESTIONS: The survey explored willingness to pay (WTP) by recreational lobster fishers for a special permit to avoid a decrease in bag limits (referred to herein as WTP-1) and WTP for a special permit to allow an increase in bag limits (WTP-2). The special permit was described in the survey as an additional stamp that would be purchased along with the existing license stamp required to harvest spiny lobster. This report explores the results of the three WTP surveys that have been conducted to date:

- 2001 regular season survey, which surveyed regular season participants and asked about WTP for the regular season only;
- 2001 2-day sport season survey, which surveyed 2-day sport season participants and asked about WTP for the 2-day sport season only; and
- 1992 survey: which surveyed 2-day sport season participants but did not ask about WTP for a specific season (could be assumed to be both the 2-day sport season and the regular season).

For WTP-1, the protocol used in all three surveys was a proposed decrease in recreational lobster bag limits of 2 lobsters per day, which would reduce the limits from 6 to 4 lobsters per day in Monroe County. For WTP-2, the proposed increases were from 6 lobsters to 14 lobsters in the 1992 survey. For 2001, the regular season survey proposed an increase from 6 to 8 lobsters per day during the regular season throughout Florida, while the sport season survey proposed an increase of 6 lobsters per day for the 2-day sport season only (from 6 to 12 lobsters for Monroe County and from 12 to 18 lobsters for the rest of Florida). Given that the lobster bag limit increases were different for each survey, WTP per lobster was used as a WTP estimate rather than total WTP for the additional license stamp.

SURVEY RESPONSE As shown in Table 1, for the 2001 two-day season, of 4,809 potential respondents, 466 surveys were returned as undeliverable, yielding a net sample of 4,323. 1976 completed surveys were received for a 45 percent response rate. For the 2001 regular season, 5,191 respondents were originally selected. This sample was reduced to 4668 after 523 surveys were returned as undeliverable. Of these, 1904 completed questionnaires were received for a 41 percent response rate.

Table 1: 2001 sample size breakdown

	2-day sport season (July)	regular season (Aug.-March)
surveys mailed	4809	5191
surveys returned as undeliverable	466	523
net sample size	4323	4668
completed surveys (n)	**1976**	**1904**
response rate	**45%**	**41%**

DATA ANALYSIS: There were two issues with the data analysis that required special treatment to estimate econometric models for the WTP response. The first issue is with the survey format itself; the second stems from the survey results. The elicitation format used in the surveys was a payment card with 11 values ranging from $1 to $14 and a 'more than $14' value. Therefore, each response was presented as a range of values and several sets of WTP estimates were calculated from these responses. Lower bound estimates and conditional means are presented in the following section. [1]

The second problem with data analysis was the large number of zero responses; that is, respondents who indicated a WTP of $0.00 for either an avoidance of a decrease in bag limit or an increase in bag limits. The large proportion of $0 responses creates an asymmetrical distribution that violates the standard assumption of a normal distribution in econometric modeling. The surveys included follow-up questions to elicit the reasons behind $0 responses, which included protest bids that objected to the WTP exercise, individuals who did not wish to pay any more than they are currently

[1] That is, if someone circled $6.00 on their payment card, indicating that they were willing to pay $6.00 for the proposed bag limit change, and the next highest value on their payment card was $7.00, then we can assume that the respondent is willing to pay somewhere between $6.00 and $7.00 for the change, but we do not know where in that range the true WTP lies. Therefore, we could use a lower bound estimate ($6.00) or we could use a mean ($6.50). The lower bound estimate is more conservative while the mean will yield a higher WTP.

paying for a license, and individuals who did not feel that they were capable of catching numbers of lobsters over the lowest bag limit proposed. These $0 responses can be divided into two major categories: (1) those respondents who were indifferent to the proposed changes and therefore are "not in the market" for a change in bag limits or (2) those respondents interested in the proposed change but that did not give a positive WTP because they protest making a payment or the lowest response amount is higher than their true WTP. Some of the models required exclusion of those respondents who were not in the market for a change in bag limits; this limited sample size increased the mean WTP since it excluded many $0 responses.

RESULTS: Overall, the range of estimates for WTP per lobster ranged from $0.35 to $2.31, depending on the method of calculation, season (2-day sport versus regular season) and whether the estimate was for avoidance of a bag limit decrease or WTP for a bag limit increase.

Lower bound estimates of WTP per lobster are presented in Table 2. As shown in Table 2, a clear trend in WTP from 1992 to 2001 does not emerge. For the 2001 regular season, WTP1 decreased from $1.20 in 1992 (adjusted to 2001 dollars) to $1.04 in 2001 regular season and WTP2 increased from $0.48 in 1992 to $1.03 in the 2001 regular season. The 2001 2-day sport season showed a lower WTP1 and WTP2 than either the 1992 survey or the 2001 regular season. This result is intuitive because the sport season is so much shorter than the regular season.

In addition to lower bound estimates, conditional means of WTP1 and WTP2 were calculated, which resulted in a range of WTPs higher than the lower bound estimates. Conditional mean of the full sample was $1.23. This was higher than the lower bound estimates presented above because the conditional mean used midpoint intervals rather than lower bound intervals. The restricted sample, which eliminated many of the $0.00 responses for people who indicated that they were "not in the market" for the additional license stamp, resulted in a conditional mean of $2.31.

Table 2: Lower bound estimates of willingness to pay (WTP) per lobster

	1992 survey (in 2001 dollars)*	2001 2-day sport season	2001 regular season
WTP per lobster to avoid decrease in bag limit (WTP 1)	$ 1.20	$0.69	$1.04
WTP per lobster for an increase in bag limit (WTP 2)	$ 0.48	$0.35	$1.03

*note: the WTP figures for 1992 have been adjusted for inflation to 2001 dollars. Actual WTP results in 1992 dollars were $0.94 per lobster to avoid a decrease in bag limits and $0.37 per lobster for an increase in bag limits.

Data analysis showed that WTP was positively correlated with individual catch rate; that is, the more lobsters an individual catches, the higher he or she is willing to pay for an increased bag limit or avoidance of a decrease in bag limits.

Using lower bound estimates, the total WTP-1 (to avoid a 2-lobster decrease in bag limits) was $166,100 for licensed lobster fishers statewide and $103,120 for those who fished in the FKNMS. This figure includes both the 2001 2-day sport season and the 2001 regular season and means that the licensed recreational lobster fishers throughout the State of Florida would be collectively willing to pay an estimated $166,100 to avoid a decrease in recreational bag limits of 2 lobsters per day for both the sport season and the regular season. The total WTP-2 for a 6-lobster increase in bag limits during the 2001 sport season was $94,500 statewide and $58,800 for those who fished in the FKNMS, while the total WTP-2 for a 2-lobster increase in bag limits during the 2001 regular season was $103,000 statewide and $63,860 for those who fished in the FKNMS.[2] Those who fished in the FKNMS accounted for 62 percent of the value. Refer to Table 3 for a tabular display of the various WTPs, with FKNMS values in parentheses.

If using the conditional mean of $1.23 per lobster instead of the lower bound estimates, the total WTP to avoid a 2-lobster decrease for both seasons would be $233,700 in 2001 statewide and $145,140 for those who fished in the FKNMS. Willingness to pay for a 2-lobster bag limit increase during the regular season would be about $123,000 statewide and $76,260 for those who fished in the FKNMS. Florida lobster fishers would be willing to pay about $332,100 for bag limit increase of 6 additional lobster per day during the sport season statewide and $206,640 for those who fished in the FKNMS. As discussed above, the conditional mean for the restricted population sample increased from $1.23 per lobster to $2.31 per lobster when those "not in the market" for a bag limit change were excluded from the sample. The restricted sample analyzed 4744 positive responses out of a total sample of 8678, or 55%. Therefore, when determining the total willingness to pay by all Florida lobster fishers, only 55% of the lobster fishers were used to determine total WTP. These calculations resulted in very similar estimates to the conditional mean of the full sample: $239,933 for WTP-1 to avoid a 2-lobster decrease during both seasons statewide and $149,009 for those who fished in the FKNMS; $126,281 for a 2-lobster increase during the regular season statewide and $78,293 for those who fished in the FKNMS; and $340,958 for a 6-lobster bag limit increase during the sport season statewide and $212,148 for those who fished in the FKNMS.

[2] These totals use 2001 estimates of statewide licensed lobster fishers generated by the Florida Marine Research Institute of 45,000 (28,000 FKNMS) for the sport season and 50,000 (31,000 FKNMS) for the regular season. These totals were used for the lower bound estimate and the conditional mean estimate for the full sample. The restricted sample excluded those $0.00 responses given by those "not in the market" for bag limit changes. This sample used 4744 responses out of 8678, or 55%. Therefore, the lobster fishers used for the restricted sample estimate were 55% of the total, or 24,600 (15,306 FKNMS) for the sport season and 27,333 (16,946 FKNMS) for the regular season.

Table 3: Estimates of total willingness to pay (WTP) for bag limit changes among all Florida lobster fishers during 2001			
	lower bound estimate	conditional mean-full sample	conditional mean-restricted sample
Total WTP-1 to avoid a 2-lobster bag limit decrease (for both seasons)	$166,100 ($103,120)	$233,700 ($145,140)	$239,933 ($149,009)
Total WTP-2 for a 2-lobster bag limit increase during 2001 regular season	$103,000 ($68,860)	$123,000 ($76,260)	$126,281 ($78,293)
Total WTP-2 for a 6-lobster bag limit increase during 2001 sport season	$94,500 ($58,800)	$332,100 ($206,640)	$340,958 ($212,148)

FKNMS values in parentheses.

OTHER CONSIDERATIONS: It should be noted that there are alternative values for spiny lobsters in the FKNMS, including non-consumptive use values (namely, other reef users such as divers and snorkelers value observations of the lobsters) and passive use values, including option value and existence value. Although difficult to quantify, these alternative values should be considered against the consumptive values generated by this study. A 2001 study of recreational divers in the Turks and Caicos Islands indicated that spiny lobsters do have a non-extractive value. Although the nature of the study did not yield a clear WTP per lobster, presence of spiny lobsters resulted in an increased market share for a more expensive dive trip compared with a lower priced dive with no lobsters (Rudd 2001). Other considerations should include impacts of raised or lowered bag limits on lobster population dynamics.

Finally, the impact of spending by lobster fishers on the local economy should be considered along with WTP for changes in bag limits. The Florida Keys is a tourism-based economy, and lobster fishers spent approximately 25% more per person-day compared to general visitors during 2000-2001 (Leeworthy and Wiley 2002). However, non-consumptive uses of the area's marine resources are perhaps more beneficial to the region's economy. Non-residents of the Florida Keys that visited the region to dive the coral reefs and not to fish for lobsters spent more on a person-day basis than did recreational lobster fishers (Johns et al 2003). Consequently, when assessing the economic benefit of the lobster fishery upon the region, manager must also consider that benefit in light of environmental impacts that lobster fishing— resulting not only from recreational diving but also from commercial trap gear—has upon the region's marine resources.

In sum, recreational lobster fishers in the Florida Keys have exhibited a willingness to pay for higher bag limits on spiny lobsters as well as a willingness to pay to avoid decreases in these bag limits. During the sport season, spiny lobster fishermen would be willing to pay significantly more per lobster to avoid a decrease in the bag limits versus their willingness to pay for an increase in bag

limits. This willingness to pay should be balanced, however, against competing uses of the lobsters, such as wildlife viewing by divers and snorkelers and the commercial fishery.

References

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