

## Effects of Recreational and Commercial Fishing on Spiny Lobster Abundance at Looe Key National Marine Sanctuary

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### ABSTRACT

Impacts of recreational and commercial harvest on the abundance of spiny lobster, *Panulirus argus*, were studied at Looe Key National Marine Sanctuary, Florida. Spiny lobster abundance following the two-day sport diver season decreased by 55% in the reef flat in 1987, and in the fore reef by 33% in 1987 and 36% in 1988. However, no changes in *P. argus* abundance were observed in the patch reef either year, and lobster abundance in the reef flat increased 12% following the 1988 sport dive season. There were 3.8 times more recreational divers visiting the fore reef and reef flat during the 1987 sport dive season than there were in 1988; few visited the patch reefs. We conclude that spiny lobster abundance is adversely impacted by sport diver activity within the sanctuary. *P. argus* abundance in all zones decreased steadily over the first 30 days following the open season, resulting from the combined effects of recreational diving and commercial trap fishing.

The Florida Department of Natural Resources conducted a two year field study on distribution and abundance of the spiny lobster, *P. argus*, inside Looe Key National Marine Sanctuary (LKNMS). LKNMS is an 18.6 km<sup>2</sup> area whose landward boundary is 4.8 km south of Big Pine Key, Florida. Within the sanctuary, a Core Area (~ 0.5 km<sup>2</sup>) where special restrictions apply encompasses portions of the fore reef and reef flat. Lobster trap fishing occurs throughout the sanctuary with the exception of the Core Area, where it is prohibited. Diving for *P. argus* is permitted throughout the sanctuary, but because divers are prohibited from touching corals inside the Core Area, LKNMS staff have successfully used this rule to reduce spiny lobster harvesting on the fore reef. However, spiny lobsters are routinely taken by divers on the adjacent reef flat.

During the course of this study, *P. argus* abundance was monitored before and after the sport dive seasons of 1987 and 1988. In this report, we present preliminary data on changes in *P. argus* abundance during July through September of 1987 and 1988 and discuss these data with respect to recreational diver and trap harvest impacts.

### METHODS

Abundance of spiny lobsters was estimated by visually surveying, using SCUBA, 6 sites on the fore reef, 8 sites on the reef flat (9 during 1988), and 6 patch reefs. Area of the fore reef sites ranged from 1238 m<sup>2</sup> to 1701 m<sup>2</sup>. Reef flat sites were either isolated coral heads (4 in 1987, 5 in 1988) or seagrass bed

blowouts (4). Area of the patch reefs ranged from 409 m<sup>2</sup> to 1443 m<sup>2</sup>. Each site was sampled biweekly during 1987 and once every 4 weeks during 1988.

### RESULTS

During the 1987 sport dive season, visitation at LKNMS by recreational divers (*e.g.*, people diving from private vessels) was 3.8 times that of 1988 (Table 1). The state and federal seasons fell on different dates in 1987, directing recreational divers to one or the other portion of the fishery. Further, weather was calm offshore. In contrast, during 1988, the state and federal sport dive seasons were combined and weather conditions were poor. Because of the unfavorable conditions offshore, visitation at LKNMS was low (LKNMS, daily visitor census reports), and most visitors spent little or no time diving at LKNMS before returning to calmer nearshore waters during 1988 (B. Causey, Sanctuary Manager, pers. comm.).

During the first month following the opening of the regular spiny lobster season, visitation patterns of recreational divers and divers from charter vessels were similar between years (Table 1). Dive charter vessels utilize the fore reef extensively, but rarely use the reef flat. Most prohibit their divers from taking spiny lobsters from the Looe Key reef. Recreational divers, however, are often observed on the reef flat. During the first month of the season in both years, commercial trap fishermen placed many traps along the reef flat boundary of the Core Area (J. Hunt, pers. obs.). The number of trap fishermen utilizing sanctuary waters was constant during both years (Table 1).

Spiny lobster abundance on the fore reef decreased during both years immediately following the sport dive season (33% in 1987, 36% in 1988) (Table 2). On the reef flat, abundance decreased markedly (55%) after the sport dive season in 1987, but actually increased slightly (12%) in 1988. Approximately one month after the season had opened, lobster number dropped to low levels both years. On patch reefs, abundance remained constant until September during both years, whereupon levels dropped by about 50%. This decrease is likely related to the first placing of traps in this zone each year. Incidence of recreational diving in the patch reef zone is very low (B. Causey, pers. comm.).

### DISCUSSION

Results presented here indicate that recreational divers contribute to decreased spiny lobster abundance within LKNMS. Recreational diver impact was particularly evident on the reef flat during 1987 when visitation levels were high during the sport dive season and diving effort was concentrated there. Spiny lobster abundance immediately following the 1987 sport dive season decreased by 55% when compared to pre-sport dive season levels. In contrast, lobster abundance was unchanged immediately after the 1988 sport dive season.

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**Table 1.** Visitation patterns at Looe Key National Marine Sanctuary. Sport weekend: 1987 - July 18 & 19; 1988 - July 30 & 31. Closed week: 1987 - July 20-25; 1988 - August 1-5. Open season(calculations include the first 30 days only): 1987 - July 26; 1988 - August 6. Mean = mean number of divers or commercial vessels per day. S.D. = standard deviation.

	Recreational Divers		Charter Boat Divers		Commercial Trap Boats	
	1987	1988	1987	1988	1987	1988
<b>Sport Dive Weekend</b>						
Mean	138	37	96	30	7	0
S.D.	29.7	6.5	0	42.4	1.4	0
Total	276	73	192	60	14	0
<b>Closed Week</b>						
Mean	136	68	96	69	4	3
S.D.	82.4	15.9	16.9	11.5	2.5	2.1
Total	543	270	384	276	13	11
<b>Open Season</b>						
Mean	111	79	100	97	3	3
S.D.	54.6	51.9	38.1	48.4	1.5	2.2
Total	2664	2050	2394	2508	70	76

**Table 2.** Total number of spiny lobsters observed on fore reef, reef flat, and patch reef research sites during July-September.

Dates	Fore Reef		Reef Flat		Patch Reefs	
1987 <sup>1</sup> , 1988 <sup>2</sup>	87	88	87	88	87	88
July 6-15, July 5-26	51	58	36	29	68	67
July 20-30	34		16			64
August 3-12, August 2-15	31	37	23	33	59	116
August 19-26	30		8			61
Aug.30-Sept.12, Aug. 30-Sept. 22	24	22 <sup>3</sup>	4	13 <sup>4</sup>	30	36
September 13-26	25		5			22

<sup>1</sup>Sport dive season - July 18-19, Opening day July 26

<sup>2</sup>Sport dive season - July 30-31, Opening day August 6

<sup>3</sup>One site not sampled

<sup>4</sup>Two sites not sampled

This is likely related to the low visitation observed during 1988. Davis (1977a, 1977b) observed a 58% decrease in *P. argus* abundance following an entire open season in the sport harvest area of Fort Jefferson National Monument, Dry Tortugas, Florida, whereas abundance in the control area remained constant. Evaluation of these data by the National Park Service resulted in the closure of Fort Jefferson National Monument to all spiny lobster fishing on April 1, 1974 (G.E. Davis, pers. comm., May 17, 1989).

Abundance on the LKNMS fore reef decreased similarly both years. Here spiny lobster behavioral changes may have an impact equal to diver harvest in affecting abundance. Only 5 incidents of lobster catching were recorded on the fore reef during both years (LKNMS, daily visitor census reports), and in many of these instances, divers were persuaded to return lobsters to the water (B. Green and K. Hartsing, LKNMS officers, pers. comm.). Even with these efforts, some of these spiny lobsters probably died due to the effects of exposure and handling (Hunt *et al.*, 1986). Additionally, we observed an increase in broken lobster antennae on the fore reef at this time (FDNR, unpub. data). Disturbance by sport divers may cause increased emigration of *P. argus* from the fore reef. Davis (1977a) documented greater dispersal rates of *P. argus* where sport diver harvest occurred than in unfished control areas at Fort Jefferson National Monument. Behavioral changes related to the cessation of spawning in late July and early August (FDNR, unpub. data) may also contribute to these movements. In order to elucidate the relative importance of these factors, further analysis of these data will be required.

The difference between recreational diver impacts during the sport diving season and trap fishing impacts during the first weeks of the open season may be one of scale. Trap fishing impacts are fishery wide whereas recreational diver impacts, although substantial, are likely limited to localized regions of diver concentration. Lyons and Hunt (1991) observed that catch rates of legal-sized lobster in traps decreased by 77% within 2 weeks into the season. This decrease occurred at five research sites in the Atlantic Ocean and Florida Bay. At Looe Key, recreational diver impacts on abundance of *P. argus* were only observed on the reef flat. Before and after comparisons at additional locations where sport lobster divers congregate combined with visitation estimates, as shown here, will further elucidate these patterns.

#### **Implications to Sanctuary Management**

These results indicate that relatively small effort, concentrated locally for a short period of time can have considerable impact on the abundance of targeted species, in this case spiny lobsters. In this light, the goal of any sanctuary needs careful evaluation. One possible goal could be to establish an area where one or more species are provided a refuge from consumptive use. If so, potential

impacts from all user groups should be considered. The best solution may be prohibition of consumptive use, rather than a two-tiered system such as is in effect in the LKNMS Core Area.

Secondly, when determining the appropriate size for a marine sanctuary, consideration should be given to the foraging range of the species whose protection is desired. Australian spiny lobster, *P. cygnus*, often forage as much as 500 m from their dens at night (Jernakoff *et al.*, 1987). Comparable data for *P. argus* do not exist, but given their roughly equivalent sizes and behavioral patterns, *P. argus* foraging distances are likely similar. At Looe Key, the reef flat provides considerable denning habitat, but reef flat lobsters are captured during their nighttime foraging period by lobster traps placed along the nearby Core Area boundary. In order to better protect these spiny lobsters, the Core Area boundary should include an adequately sized buffer zone surrounding the area designated for protection.

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