ELSEVIER

Ocean & Coastal Management 42 (1999) 1019–1040

Ocean & Coastal Management

www.elsevier.com/locate/ocecoaman

Perceptions and attitudes regarding marine reserves: a comparison of stakeholder groups in the Florida Keys National Marine Sanctuary

Daniel Suman[a,*], Manoj Shivlani[a], J. Walter Milon[b]

[a]*Division of Marine Affairs & Policy, Rosenstiel School of Marine and Atmospheric Science, University of Miami, 4600 Rickenbacker Causeway, Miami, FL 33149, USA*

[b]*Food and Resource Economics Department, University of Florida, Gainesville, FL 32611, USA*

Abstract

The Florida Keys National Marine Sanctuary (FKNMS) developed a zoning plan as part of its overall management plan, fully implemented as of 1997. The plan created several closed areas or harvest refugia in which consumptive activities are prohibited. This research reports results of surveys that we conducted with members of three stakeholder groups in the Florida Keys: commercial fishers, dive operators, and members of local environmental groups. Surveys requested responses regarding the information sources individuals tapped when learning of the zoning plan and the FKNMS; their degree of public participation; their perceptions and acceptance of the zoning strategy and the process of its design; and the expected outcomes of the zoning strategy. Many responses show significant differences among the three groups. Fishers felt highly alienated from the process of zone designation and displayed a sense of anger and powerlessness with respect to what they considered to be an attempt to exclude their group from the harvest refugia. Dive operators demonstrated the highest levels of participation in the designation process, but were concerned that refugia regulations could limit their activities in the future. Members of environmental groups were the strongest supporters of the harvest refugia concept and the FKNMS. This research suggests numerous ways in which marine resource managers could improve their public outreach and information dissemination strategies when developing future harvest refugia and marine protected areas.

* Corresponding author. Tel.: + 305-361-4685; fax: + 305-361-4675.
E-mail address: dsuman@rsmas.miami.edu (D. Suman)

0964-5691/00/$ - see front matter
PII: S0964-5691(99)00062-9

1. Introduction

Marine protected areas and their subset of marine reserves (closed areas, harvest refugia, or "no take" zones) are enjoying increasing use as fisheries management tools and as strategies to protect marine biodiversity [1–3]. Designation of a marine reserve involves ecological issues and uncertainties (location, size, shape, duration, placement in series, terms of access). Marine reserve designation also raises a number of social science questions [4–7]. These issues include the political acceptability of the marine reserve concept, the social/economic groups that will stand to gain and lose as a result of reserve creation, and the perceptions and opinions that group members possess about the marine reserve. Nevertheless, few studies have explored the public's concerns regarding the development of marine reserves [5,8].

We have conducted comprehensive surveys of different users of a newly designated marine reserve in the Florida Keys in order to (1) understand the social and economic interests and characteristics of the groups, (2) assess the groups' opinions/perceptions of the harvest refugia and their design and development, (3) elucidate the obstacles faced by marine reserve managers during the designation process, and (4) recommend strategies that managers might consider when working with user groups and the public on reserve design and development. The results of this research have applicability to the formation of marine reserves and harvest refugia wherever they might be located.

2. Introduction to the Florida Keys National Marine Sanctuary

Congress designated the 9515 km^2 Florida Keys National Marine Sanctuary (FKNMS) in 1990 as part of the National Oceanic and Atmospheric Administration's (NOAA) National Marine Sanctuary Program. The purpose of the designation was to protect the coral reefs, sea grasses, mangroves, and other marine resources of the Florida Keys. The enabling legislation (P.L. 101-605, §7(a)(2)) mandated that NOAA develop a *temporal and spatial* zoning strategy as part of the Sanctuary Management Plan to ensure resource protection [9].

NOAA coordinated the lengthy development of the Draft Management Plan (DMP) that was released in March 1995. The DMP focused planning efforts on ten action plans. The Zoning Action Plan proposed five distinct types of zones: Replenishment Reserves, Sanctuary Preservation Areas (SPAs), Wildlife Management Areas, Special-use Areas, and Existing Management Areas [10,11] (Fig. 1). The three proposed Replenishment Reserves (Key Largo, Sambos, Dry Tortugas) would have accounted for about 5% of the Sanctuary's area (487 km^2), while the 19 small SPAs, protecting heavily used shallow reefs, totaled 15.55 km^2. Generally, the Replenishment Reserves and SPAs were to be "no-take" areas where consumptive uses would be prohibited.[1] Replenishment Reserves were large areas with contiguous, diverse

[1] Actually, the Key Largo Replenishment Reserve would have allowed catch-and-release fishing from the shore to a depth of 12 feet and lobster-trapping on sandy bottoms or seagrass beds.

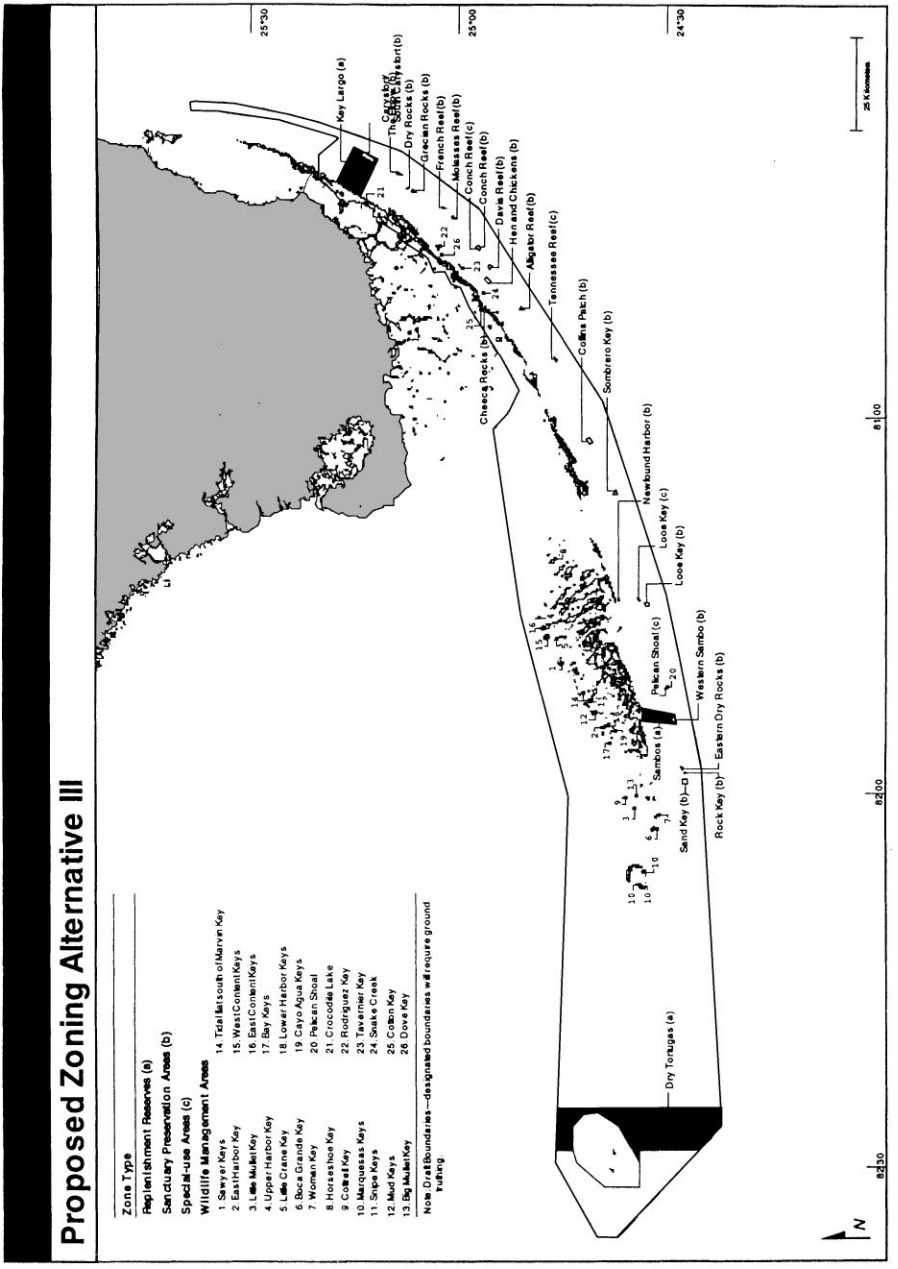

Fig. 1. Proposed zoning plan for the FKNMS (March 1995).

habitats intended "to minimize human influences, to provide natural spawning, nursery, and permanent residence areas for the replenishment and genetic protection of marine life" [10]. SPAs encompass small, biologically important areas, especially shallow coral reefs, within which uses may be restricted "to avoid concentrations of uses that could result in significant declines in species populations or habitat [or] to reduce conflicts between uses ..." [10]. The Draft Management Plan also proposed four "Special-Use Areas" designated for research only that would account for an area of 1.86 km^2. Designation of Wildlife Management Areas would restrict human access to bird nesting and feeding areas, as well as turtle nesting sites. Existing Management Areas were sites within the FKNMS borders that were managed by Florida or federal regulations prior to FKNMS designation, i.e. two smaller National Marine Sanctuaries, National Wildlife Refuges, State Parks, State Aquatic Preserves.

The public hearing process exposed the extremely contentious nature of the FKNMS, especially the Zoning Action Plan [9,12]. Many public comments questioned the hypothesis that the Replenishment Reserves would export adult fish and larvae to the surrounding waters. [13,14]. Opposition to the FKNMS was led by the Conch Coalition, a loosely organized grassroots group comprised of treasure salvors, commercial fishermen, real estate interests, and other Monroe County residents who waived an anti-regulation banner and opposed non-local involvement in development of the FKNMS [15]. Concern centered on a perceived excess of regulation, intervention by the federal government, and displacement of traditional users and uses.

The acrimonious and polarized debate on these issues delayed the release of the FKNMS Final Management Plan until September 1996 [9]. NOAA significantly altered some aspects of the Zoning Action Plan, designating only one small "no take" reserve (Western Sambos) of the three that it originally had proposed [16] (Fig. 2). NOAA also postponed establishment of the large Dry Tortugas Replenishment Reserve pending further studies on the final boundary.[2] Finally, NOAA changed the name "Replenishment Reserve" to "Ecological Reserve" to "reflect public concerns over the purpose of these areas" [16].

As a result of the modifications, NOAA zoned only about 0.3% of the FKNMS or 30 km^2 as an "Ecological Reserve". Eighteen small SPAs (16.51 km^2) were designated to protect shallow reef areas that experience heavy diving pressure [11,16]. Ecological politics had taken their toll on implementation of harvest refugia.

3. Stakeholder groups

Numerous stakeholder groups play a role in marine environmental politics of the Florida Keys. These groups represent the permanent population of 80,000 Monroe

[2] In 1998, the FKNMS commenced the Dry Tortugas 2000 (DT2K) process, which will lead to the implementation of a no-take reserve in the Dry Tortugas area by Spring 2000. As part of the Supplemental EIS (SEIS) that it is preparing, the FKNMS held scoping meetings in late 1998 and plans to release the draft EIS in mid to late 1999. The Sanctuary Advisory Council (SAC) appointed a working group, consisting of both SAC members and other experts familiar with the Dry Tortugas area, to review and recommend strategies, regulations, and boundaries concerning what would be the largest no-take reserve of the FKNMS.

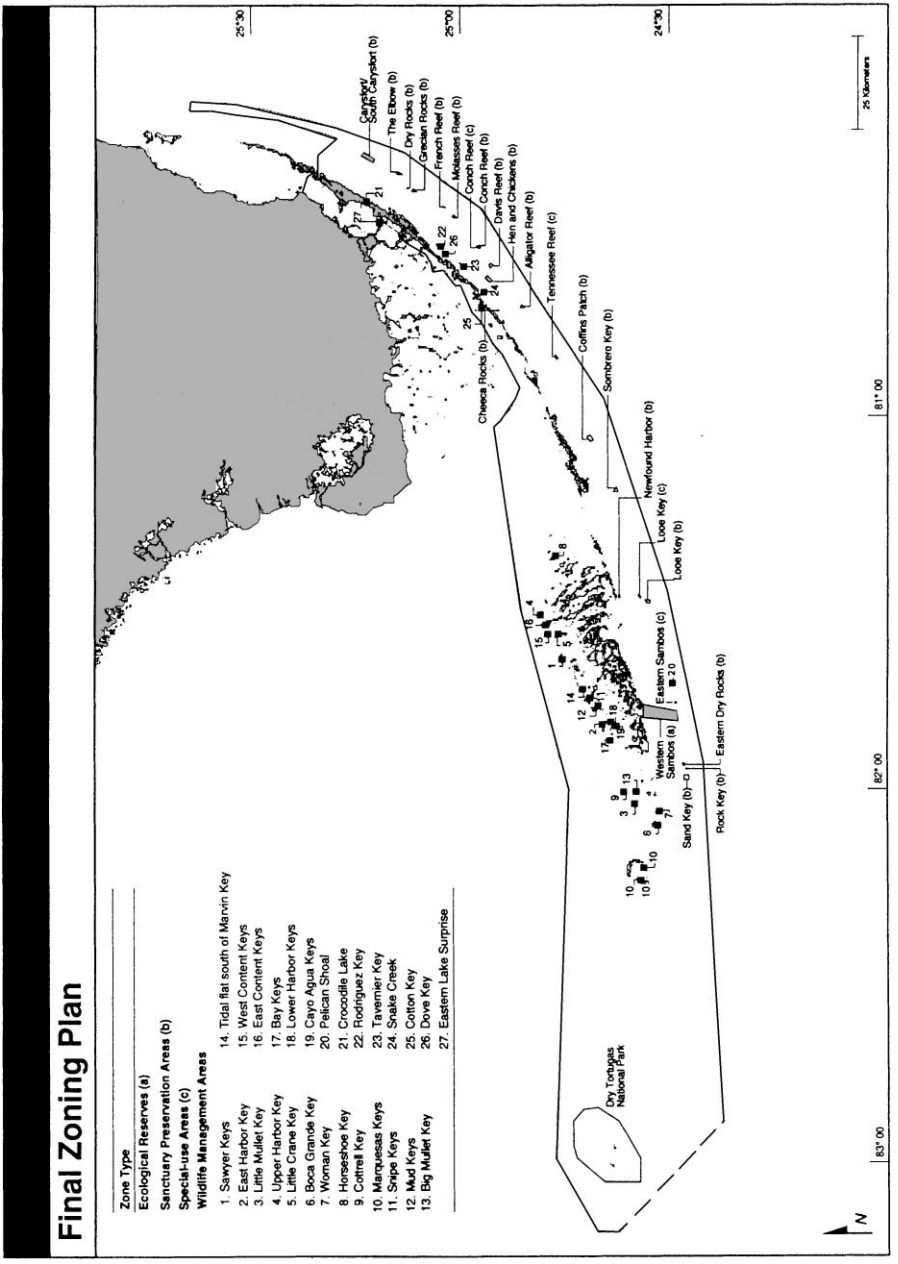

Fig. 2. Final zoning plan for the FKNMS (September 1996).

County (Florida Keys) residents and, in addition, approximately 2.5 million tourists who visit the county each year [17]. This research focuses on three stakeholder groups: commercial fishers, commercial dive operators, and members of local environmental groups. All have a special interest in the harvest refugia of the FKNMS that they voiced during the public hearing process. Commercial fishers were concerned about "creeping" fishery regulations and exclusion from primary fishing areas. Dive operators carry scuba and snorkeling enthusiasts to the shallow coral reefs, many of which would be designated as SPAs, and wished to guarantee their continued access to these areas. National and local environmental groups have long lobbied for increased protection of the marine resources of the Florida Keys and increased restrictions on consumptive use of the marine resources.

Approximately 2400 persons in the Florida Keys hold a Florida Saltwater Products License (SPL) and are classified as *commercial fishers* [18]. Of these individuals, greater than half are fulltime fishers. The Florida Keys' fisheries are multispecies-based, and the target species depend on the season and applicability of restrictive regulations [19]. Important fishery resources include stone crab, lobster, shrimp, snappers and groupers, mackerel, tropical fish and sponges, and offshore species (dolphin and tuna). In 1995, Monroe County's (Florida Keys) shellfish and finfish landings had a dockside value of $68.9 million, or 20–25% of the state's total dockside value [20,21]. Monroe County commercial fishers harvest a major portion of their total catch inside the boundaries of the FKNMS [22]. Our surveys indicated that the average replacement value of vessel and equipment for a Florida Keys commercial fisher is approximately $121,000. Many of the fishers affiliate themselves with commercial fishing lobbying groups, such as Monroe County Commercial Fishermen (24% membership of fishers surveyed) and Organized Fishermen of Florida (19% of fishers surveyed). The majority of this group fished in the Florida Keys for greater than a decade, indicating long-term involvement with the fishery industry and regulators.

Approximately 20–30% of the 3 million visitors to Monroe County dive or snorkel during their visit [23]. Visitors to the Florida Keys spend about $31 million per year on scuba diving and snorkeling activities [24]. While some visitors have their own boat, many divers pay a *commercial dive operator* to transport them to a dive site. We identified approximately 75 commercial dive operators in Monroe County, who took an estimated 80% of their clientele to FKNMS zones in 1995 [25]. The FKNMS reported that approximately 80–85% of the snorkelers and divers in the region use the SPAs [16]. Our interviews indicated that most dive operators were relative newcomers to the business, less than 30% having been involved for over 10 years. About 40% and 20%, respectively, were affiliated with the regional dive organizations, the Florida Association of Diver Operators (FADO) and the Keys Association of Dive Operators (KADO). Dive operators must make a considerable capital investment to enter the business. The average cost of vessel, dive gear, and other equipment is $210,000 per operator. Annual maintenance costs and trip expenses require an additional $83,000 per operator.

National environmental groups, such as The Nature Conservancy, the Center for Marine Conservation, World Wildlife Fund, and The Wilderness Society have

supported NOAA's efforts to implement the FKNMS. *Local environmental groups*, such as Reef Relief, Last Stand, and the Sanctuary Friends of the Florida Keys, claiming a membership of over 3600 persons and focusing on local issues, also actively participated in the FKNMS planning process. Reef Relief advocates coral reef protection and maintains mooring buoy programs at popular reef sites in the Lower and Middle Keys [26]. Last Stand is a grassroots environmental group based in Key West that is dedicated to maintaining the quality of life in the Florida Keys [27]. Sanctuary Friends is a loosely-knit group of people united in their efforts to support NOAA's actions to implement the FKNMS [28]. Over half of the members of these local groups engage in non-consumptive, marine-based activities, such as swimming, snorkeling, boating, and bird-watching. These individuals are also Sanctuary users, although their uses are largely not commercial or extractive.

4. Survey methodologies

During 1995, we developed three surveys to characterize the demographic, social, and economic status of members of the three stakeholder groups. Additional questions probed informational sources on the FKNMS and Zoning Action Plan, participation in various types of public fora, perceptions and acceptance of the Sanctuary zoning strategy, and expected outcomes of the zoning strategy [29]. The three groups of surveys were essentially identical with the exception of a few questions. We developed questionnaires in consultation with organizations of commercial fishers, dive operators, and environmental groups and revised the surveys as a result of pilot field tests.

We conducted personal interview surveys with commercial fishers and dive operators and mail surveys with members of environmental groups between June 1995 and March 1996. In total, the research team sampled 337 commercial fishers or 15% of the total pool of the 2430 SPL holders who resided in Monroe County. Interviewees were randomly selected from SPL lists and contacted through the major fish houses in the Florida Keys, the commercial fishing organizations, the Florida Sea Grant extension agent, and phone calls. Based on the total pool of commercial fishers, we determined that a randomized sample size of 332 interviewees would achieve a sample error of plus or minus 5% of the total sample within a 95% confidence interval. The ratios of full-time/part-time fishers in our sample paralleled that in the total population, as did the breakdown of Upper, Middle, and Lower Keys fishers [22].[3]

"Dive operators" conduct businesses that specialize exclusively in diving/snorkeling, transport divers to specific field sites, own or lease a dive shop, operate throughout the year, and utilize vessels equipped especially for diving. We identified 75 "dive operators" in Monroe County and conducted personal interviews with 62 of these individuals or 83% of that pool. Thirteen dive operators refused to participate in our

[3] The "Upper Keys" extends from Key Largo to Long Key; the "Middle Keys" includes Marathon; and the "Lower Keys" reaches from Big Pine Key to Key West.

research efforts. The regional breakdown of dive operator surveys was as follows: 36 in the Upper Keys, 7 in the Middle Keys, and 19 in the Lower Keys.

We obtained the mailing lists of the membership of three local environmental groups (Reef Relief, Last Stand, Sanctuary Friends of the Florida Keys) and sent questionnaires to the pool of 3680 individuals. We received mail responses from 401 environmental group members or 11% of the total sample. The low response rate may be due to the high level of transients or membership lists which were not up-to-date. We only included environmental group members who were also residents of Monroe County (280 individuals) in our statistical analyses in order to compare this group with commercial fishers and dive operators who were also Monroe County residents.

Attitude and perception questions elicited responses that indicated degrees of support for or opposition to statements, i.e. Likert scale survey techniques [7,29]. For this analysis, we report support/agreement with a statement, as either Strongly Agree and Moderately Agree. Similarly, opposition/disagreement with a statement is either Strongly Disagree and Moderately Disagree. Neutral responses to the statements were also elicited. Tables report the mean responses where the scale of responses is $+1$ (agree), 0 (neutral), or -1 (disagree).

The surveys began with general questions that identified the social and economic status of the interviewees: age, ethnicity, income and economic activities, group memberships, and uses of the marine environmental resources. Questionnaires then elicited responses regarding the sources of information used to obtain information regarding the FKNMS zoning strategy, the relative value and usefulness of these information sources, and the types of public participation activities in which the interviewees engaged.

We then tested for differences in the three groups' attitudes and perceptions regarding the fairness of the FKNMS planning process, the perceived purpose of the zones, potential beneficiaries of the zoning strategy, and overall support for the zoning strategy of the FKNMS.

5. Survey results and their significance

Using the surveys, we obtained information on the three groups' sources of information regarding the FKNMS zoning strategy, participation in public fora, and their perceptions regarding the planning process, purpose of the zones, beneficiaries of zones, and support for the zoning strategy. We performed inter-group comparisons that indicate the statistical significance of the differences in responses to all questions.

5.1. Information sources

We asked all survey participants to indicate whether they had used any of 13 different information sources to learn about the FKNMS and its zoning strategy. These sources included several from NOAA, the commercial media, and anti- and pro-Sanctuary groups. Table 1 ("Informational Sources Used by Group Members") compares the informational sources used by the three groups. We used the

Table 1
Informational sources used by group members

Source of information	Group score[a]		
	Dive operators MEAN	Environmental groups MEAN	Commercial fishers MEAN[b]
A. NOAA personnel	0.53^{A}	0.33^{A}	0.23^{A}
B. Draft Management Plan	0.69^{A}	0.46^{A}	0.35^{A}
C. NOAA literature	0.44^{A}	0.40^{B}	0.29^{AB}
D. NOAA meetings	0.56^{AB}	0.38^{A}	0.37^{B}
E. Newspapers	0.66	0.83	0.75
F. Radio/TV	0.40	0.52	0.45
G. Anti-Sanctuary groups	0.32	0.24	0.33
H. Commercial fishing groups	0.03^{A}	0.11^{B}	0.36^{AB}
I. Environmental groups	0.39^{A}	0.57^{A}	0.07^{A}
J. Government fisheries scientists	0.18	0.12	0.15
K. Sea Grant Extension Service	0.03	0.09	0.15
L. Rumors, grapevine	0.66^{A}	0.35^{AB}	0.66^{B}
M. No knowledge of Sanctuary or zones	0.05	0.03	0.07
N. Dive Organizations	0.76		

[a]Scale of responses: 1 = yes; 0 = no.
[b]The superscripts A and B denote responses that are statistically different at the 5% significance level; means with the same lettered superscripts are statistically different.

Kruskal–Wallis test to determine the statistical significance between group responses. Our tables indicate whether pairwise tests of the group means were statistically different. Results reported in Table 1 indicate that the most significant differences between the three groups involves the use of NOAA activities and materials. We also note significant differences between groups' use of each others' materials.

Table 2 ("Perceived Usefulness of Information Sources") compares how each group viewed the usefulness of the information sources that they consulted. Intergroup comparisons are again based on the Kruskal–Wallis test. The most significant differences between the three groups involves the use of materials published by one of the three groups, newspapers, and NOAA publications and personnel. However, we noted no difference in the groups' perception of the usefulness of NOAA meetings.

The commercial fishers' five most common sources of information were newspapers (75% of respondents), rumors (66%), TV/radio (45%), NOAA public meetings (37%), and commercial fishing organizations (36%). Fishers who used the specific information sources considered that the newspapers, rumors, and commercial fishing organizations supplied the most useful and reliable source of information.

Sources of information most referred to by dive operators were publications of dive organizations (76%), NOAA's Draft Management Plan (69%), rumors (66%), newspapers (66%), and NOAA public meetings (56%). Respondents reported that, among the sources they used, they considered the FKNMS Draft Management Plan and the NOAA public meetings to be the most useful and reliable sources.

Table 2
Perceived usefulness of information sources

Source of information	Group score[a]		
	Dive operators MEAN	Environmental groups MEAN	Commercial fishers MEAN[b]
A. NOAA personnel	0.24^{A}	0.18^{B}	0.05^{AB}
B. Draft Management Plan	0.39^{a}	0.35^{B}	0.13^{AB}
C. NOAA literature	0.10^{A}	0.19^{AB}	0.07^{B}
D. NOAA meetings	0.29	0.19	0.14
E. Newspapers	0.16^{A}	0.40^{A}	0.27^{A}
F. Radio/TV	0.05	0.12	0.07
G. Anti-Sanctuary groups	0.05	0.05	0.13
H. Commercial fishing groups	0.02^{A}	0.03^{B}	0.23^{AB}
I. Environmental groups	0.05^{A}	0.24^{AB}	0.01^{B}
J. Government fisheries scientists	0.05	0.03	0.03
K. Sea Grant Extension Service	0.02	0.00	0.07
L. Rumors, grapevine	0.10^{A}	0.04^{B}	0.24^{AB}

[a]Scale of responses: 1 = useful; 0 = not useful.
[b]The superscripts A and B denote responses that are statistically different at the 5% significance level; means with the same lettered superscripts are statistically different.

For environmental group members, the five most popular sources of information were newspapers (83%), publications from their own environmental group (57%), TV/radio (52%), and NOAA's Draft Management Plan (46%). Environmental group members ranked newspapers, followed by the FKNMS Management Plan as the most useful sources of information.

5.2. Public participation

Participation in public fora varied among the three interest groups. Participation in one or more NOAA workshops, hearings, or meetings ranged between 65% (dive operators), 44% (commercial fishers), and 40% (environmental group members). Attendance at Sanctuary Advisory Council meetings followed a similar trend: 34% (dive operators), 25% (commercial fishers), and 16% (environmental group members). Likewise, 79% of dive operators, 48% of commercial fishers, and only 44% of environmental group members read parts of the Draft Management Plan. Dive operators appeared to be the most engaged in public participation opportunities, while environmental group members were the least engaged.

Table 3 ("Public Participation by Group Members") compares the Sanctuary-planning activities in which the members of the three user groups participated. The table indicates whether pairwise tests of group means were different. Results presented in Table 3 indicate that there were significant intergroup differences in 6 of 8 participatory activities. Dive operators were more likely that the other groups to attend NOAA

Table 3
Public participation by group members

Participatory activity	Group score[a]		
	Dive operators MEAN	Environmental groups MEAN	Commercial fishers MEAN[b]
A. SAC meetings	0.34^{A}	0.16^{AB}	0.25^{B}
B. NOAA meetings	0.65^{AB}	0.40^{A}	0.44^{B}
C. Info Expos	0.32^{AB}	0.13^{A}	0.10^{B}
D. Visits to Sanctuary offices	0.45^{AB}	0.22^{A}	0.16^{B}
E. Letters to Sanctuary	0.24	0.26	0.16
F. Read Draft Management Plan	0.79^{AB}	0.44^{A}	0.48^{B}
G. Read NOAA literature	0.74^{A}	0.55^{A}	0.42^{A}
H. Town meetings	0.44	0.34	0.27

[a]Scale of responses: 1 = yes; 0 = no.
[b]The superscripts A and B denote responses that are statistically different at the 5% significance level; means with the same lettered superscripts are statistically different.

meetings and Info Expos, read the DMP or other NOAA literature, or visit the Sanctuary office. Dive operators and commercial fishers display higher attendance at the SAC meetings than environmental group members.

5.3. *Perceptions on the sanctuary process, outcomes, and designation*

We report some of the results from the user group surveys in Tables 4–6. These results provide insight into the different positions of the three groups and the perspectives of group members to public processes. The questions that we have selected illustrate the perceptions of respondents to concepts, such as the usefulness of NOAA's information on harvest refugia, the fairness of NOAA's process in developing zoning regulations, engagement in the public participation process, the purpose of the "no take" zones, perceived beneficiaries of the zones, perceived positive economic benefits of the zones, support for the siting of the zones, and support for the establishment of the FKNMS.

Table 4 ("Perceptions of Group Members to the Sanctuary Process") reports group reactions to statements concerning the sanctuary process. All questions produced significantly difference responses between 2 and 3 of the groups. Generally, fishers reacted most negatively to NOAA's process of Sanctuary and zone development, while environmental group members were most supportive. In the majority of questions, dive operator responses were intermediate between environmentalist and fishers, but significantly different.

NOAA-generated information on the "no take" zones was generally not well-received by commercial fishers; only 10% of that group considered NOAA materials to give satisfactory consideration to zones' positive and negative effects

Table 4
Perceptions of group members to the Sanctuary process

Statement	Group score[a]		
	Dive operators MEAN	Environmental groups MEAN	Commercial fishers MEAN[b]
A. The information provided by NOAA about the DMP contains everything you needed to know about the plan.	0.04^{A}	0.32^{B}	-0.54^{AB}
B. The information provided by NOAA about the zones contains everything you needed to know about the zones.	0.23^{A}	0.36^{B}	-0.49^{AB}
C. The information provided by NOAA has helped you understand the overall effects of the zoning strategy.	-0.05^{A}	0.36^{A}	-0.52^{A}
D. The process of workshops and meetings to develop Sanctuary regulations has been open and fair to all groups.	0.38^{A}	0.42^{B}	-0.25^{AB}
E. The process to develop boundaries and regulations for the zones has been open and fair to all groups.	0.10^{A}	0.35^{B}	-0.67^{AB}
F. It does not matter whether the average person participated in the Sanctuary process because the average person could not influence the final decisions.	0.00^{A}	-0.34^{A}	0.55^{A}
G. NOAA has not given consideration to local government concerns in developing regulations for the Sanctuary.	0.04^{A}	-0.47^{A}	0.69^{A}
H. NOAA has not given consideration to individual citizen concerns in developing regulations for the Sanctuary.	0.34^{A}	-0.39^{A}	0.77^{A}
I. The average person will not be able to voice his opinions on the usefulness of Sanctuary regulations once enacted.	0.34^{A}	-0.20^{A}	0.75^{A}
J. The procedures that NOAA has established to deal with Sanctuary violations are fair and just.	-0.19^{A}	0.19^{A}	-0.69^{A}

[a]Scale of responses: 1 = agree; 0 = neutral; −1 = disagree.
[b]The superscripts A and B denote responses that are statistically different at the 5% significance level; means with the same lettered superscripts are statistically different.

(Question 4-A). Dive operators and environmental group members had a much more positive opinion of NOAA information (37% and 39%, respectively).

The perception of NOAA's "fairness" in the development of zoning regulations and boundaries varied among the three stakeholder groups (Question 4-E). Only 9% of the commercial fishers agreed with this concept, while agreement among the other two groups was 39% for dive operators and 47% for environmental group members.

Table 5
Perceptions of group members to the purposes and outcomes of the Sanctuary

Statement	Group score[a]		
	Dive operators MEAN	Environmental groups MEAN	Commercial fishers MEAN[b]
A. The main purpose of the zones is to increase overall stocks inside the zones.	0.78[A]	0.64[B]	0.00[AB]
B. The main purpose of the zones is to increase overall stocks outside the zones.	0.41[A]	0.39[B]	− 0.44[AB]
C. The main purpose of the zones is to conserve and protect biodiversity inside the zones.	0.75[A]	0.80[B]	0.33[AB]
D. The primary group that will benefit from the zoning strategy is commercial fishermen.	− 0.39[A]	− 0.26[B]	− 0.87[AB]
E. The primary group that will benefit from the zoning strategy is recreational fishermen.	− 0.18	− 0.12	− 0.26
F. Zones are the most effective way to reduce conflicts between different user groups.	− 0.18[A]	0.32[A]	− 0.69[A]
G. Zones are the most effective way of restoring coral reefs in the Florida Keys.	− 0.14[A]	0.47[A]	− 0.52[A]
H. The long-term effects of the zoning strategy on the economy of the Florida Keys will be positive.	0.29[A]	0.62[A]	− 0.55[A]

[a]Scale of responses: 1 = agree; 0 = neutral; − 1 = disagree.
[b]The superscripts A and B denote responses that are statistically different at the 5% significance level; means with the same lettered superscripts are statistically different.

Commercial fishers felt that they would be harmed the most by the creation of "no take" zones. They perceived themselves not to be part of the process that developed zone location, size, and governing regulations.

Commercial fishers displayed a high degree of alienation from the public process (Questions 4-F & 4-I). Two-thirds of commercial fishers believed that public participation was futile because it could not influence the outcome, and three-fourths of fishers believed that they would be unable to state their opinions about zones once they were established.

Responses between the three groups regarding the purpose of the zones showed significant differences in 7 of 8 questions, as reported in Table 5 ("Perceptions of Group Members to the Purposes and Outcomes of the Sanctuary"). Dive operators and environmental group members were more likely than fishers to believe that the zones would produce some ecological change. Responses to questions concerning the social and economic impacts of zones were significantly different among all three groups with dive operators occupying the intermediate position.

Table 6
Perceptions of group members to the zone designation and the FKNMS

Statement	Group score[a]		
	Dive operators MEAN	Environmental groups MEAN	Commercial fishers MEAN[b]
A. I support the establishment of zones somewhere in the Florida Keys.	0.57^{A}	0.75^{B}	-0.37^{AB}
B. I support the establishment of zones in the exact locations proposed in the Sanctuary Draft Management Plan.	-0.04^{A}	0.24^{B}	-0.84^{AB}
C. I generally support the establishment of the Florida Keys National Marine Sanctuary.	0.45^{A}	0.72^{A}	-0.66^{A}

[a]Scale of responses: 1 = agree; 0 = neutral; −1 = disagree.
[b]The superscripts A and B denote responses that are statistically different at the 5% significance level; means with the same lettered superscripts are statistically different.

The groups varied considerably in their perceptions of the ecological purposes of zones (Questions 5-A, 5-B, 5-C). All groups considered enhancement of biological diversity inside the zones to be their primary purpose. The concept that replenishment reserves might export fish larvae and adults and increase the fish stocks in adjacent waters was met with skepticism by all groups. Only about a quarter of fishers agreed that replenishment was a purpose of zones (Question 5-B), while 60% of dive operators and 56% of environmental group members expressed agreement with the concept.

Few individuals from any group considered that commercial fishers would be the primary beneficiaries of the zoning strategy (Question 5-D), and a mere 5% of fishers considered themselves to be beneficiaries. Half of the environmental group members and a third of the dive operators believed that zones would be the most effective way to reduce user group conflicts (Question 5-F). Similarly, 52% of dive operators considered the economic effects of zones to be positive (Question 5-H). About 70% of environmental group members believed that zones would have a positive economic benefit, perhaps from improved marine conservation and increased ecotourism.

Table 6 ("Perceptions of Group Members to the Zone Designation and the FKNMS") compares group support for the broader issues of zone and FKNMS designation. Support for the establishment of zones somewhere in the Florida Keys was especially high for dive operators (76%) and environmental group members (80%) as they considered that their interests would advance as a result (Question 6-A). Support dropped, however, when they responded to a question about the exact zone locations that the Draft Management Plan proposed (Question 6-B). Support dropped in this case to 41% of dive operators and environmental group members. A large number of stakeholders recognized the benefits of harvest refugia but may prefer not

to have one in their vicinity ("Not-In-My-Back-Yard" or NIMBY). Even 28% of commercial fishers supported establishment of "no-take" zones somewhere in the Florida Keys, but only 6% could embrace the exact locations that NOAA recommended. Fishers' responses were significantly different from those of dive operators and environmental group members.

More generally, support for the FKNMS varied significantly by stakeholder group (Question 6-C). About 83% and 65% of environmental group members and dive operators, respectively, supported the establishment of the FKNMS. However, only 14% of commercial fishers were FKNMS proponents. The three group responses were significantly different from each other.

6. Discussion

6.1. Perceptions and positions of the three stakeholder groups

Our research results indicate significant differences in the responses of the three stakeholder groups to numerous survey questions. This suggests that the groups hold different positions with respect to the harvest refugia designation process, the purposes and effectiveness of the zones, and even whether they should exist or not. Marine reserve managers must comprehend the concerns, perceptions, and positions of different segments of society if they are to be effective stewards of reserve resources.

Commercial fishermen demonstrated high degrees of alienation from the FKNMS planning process and overwhelming opposition to the designation of the FKNMS and its zoning strategy. Even when they believed that they could actually participate in the modification of regulations, fishers tended to conclude that their opinions would not alter the current scenario. Commercial fishers' responses to survey questions concerning the fairness of NOAA's process of zone establishment, the ability of an individual to influence the agency's decisions, and the willingness of NOAA to address individual citizen concerns were significantly different from responses of the other two groups. Moreover, fishers' responses revealed a high level of frustration and powerlessness against what they perceived to be NOAA's insensitive and unfair processes. One fisher's comment summarized this view when he mentioned that "[a]t meetings we listen to them, but they don't listen to us. They don't care what we say." Perhaps fishers' independent nature and occupation and their repeated negative experiences with numerous government fisheries regulations explain this attitude. Commercial fishers in Monroe County must deal with complex, and often contradictory, regulations of the Florida Marine Fisheries Commission, the South Atlantic Fishery Management Council, and the Gulf of Mexico Fishery Management Council. By 1986, the National Park Service had prohibited commercial fishing in nearby Everglades National Park [30]. In 1991, the Florida Legislature adopted the Spiny Lobster Trap Certificate Program which reduced the total number of traps and permitted transferability of trap certificates (F.S. sec. 370.142). Many Florida Keys fishers oppose this Lobster Trap Certificate Program [31]. In 1994, Florida voters adopted a constitutional amendment to ban gill nets from state waters, a measure that

largely affected commercial fishers [32]. Many commercial fishermen (and other Sanctuary opponents) became frustrated and angered after the November 1996 non-binding referendum on the FKNMS. Despite the results of the referendum (55% against FKNMS designation, 45% supporting FKNMS designation), the planning process continued forward [9,33].

Commercial fishers repeatedly mentioned that, through its zoning strategy, NOAA "was trying to force them out of business". They considered themselves to be the group with the least to benefit from harvest refugia establishment. Many commercial fishers stated that they would suffer a negative economic impact from the "no take" zones. Florida Keys commercial fishermen have a high economic stake in their fisheries, as reflected by the $121,000 average replacement cost of their vessel and equipment. Fishers generally feared "another layer of bureaucracy" and "creeping regulations" that would become more restrictive with time. "We've got plenty of laws and fishing regulations; we don't need a replenishment reserve," indicated one fisher. This group generally expressed that the zones were "turning the Florida Keys into a park" and would cause increased crowding in the open access waters.

Fishers were dissatisfied with the information they received from NOAA regarding the proposed zoning strategy and especially the "no-take" zones. They consistently perceived that the information NOAA provided about the zones was insufficient and did not include scientific uncertainties or potential negative impacts. Moreover, they believed that the region's national parks (Everglades and Dry Tortugas) were de facto fishery reserves, obviating the need for additional sanctuary efforts in this area. (In fact, both national parks allow recreational fishing, while prohibiting commercial fishing.) Other fishers questioned the potential effectiveness of harvest refugia in the Florida Keys where species of interest (spiny lobster and small snappers) migrate and, therefore, would not benefit from spatial protection.

Despite their alienation, general opposition to harvest refugia, and dissatisfaction with the information that NOAA provided, fishers' responses suggest some possible bridges to cooperation with marine managers. Almost half of the sampled fishers participated in some public fora regarding the FKNMS designation; the participation rate in SAC meetings was higher than that of environmental group members, who generally seem to believe that the "natural resource administrative system" works for them. It is rather ironic that the vocal participation of fishers, who appear to be so alienated from resource management, actually succeeded in reducing the size and number of the "no take" areas of the FKNMS between the time of release of the draft and final management plans. On the other hand, the fact that a quarter of commercial fishers embraced the harvest refugia concept somewhere in the Florida Keys, as long as the location did not impact their present fishing activities, suggests that a minority group of fishers had adopted a conservation ethic. Others indicated that they might be able to accept these zones if divers were also prohibited from the areas.

While *dive operators* generally are not consumptive users of marine resources, their businesses are clearly dependent on their access to healthy coral reefs. This group displayed the highest indices of participation in public fora, perhaps related to an average capital investment of $225,000 per dive operator that we surveyed and the direct economic benefits they receive from use of the SPAs. Although dive operators

show some skepticism regarding the public participation process, their group displayed significantly higher levels of participation in all citizen activities than the other two stakeholder groups. Generally, dive operators' belief that their businesses will directly benefit from the creation of SPAs affects their perception of the zoning plan. Restriction on consumptive uses may improve the health of marine resources and, therefore, increase the quality of the diving experience. As one of the only commercial groups allowed to operate in the SPAs and Ecological Reserves, dive operators will enjoy reduced resource competition with fishers. SPAs will most likely attract larger numbers of divers to the Florida Keys and, therefore, benefit this stakeholder group. Some dive operations expressed concern that in the future the Sanctuary might limit the number of divers at a dive site through use of the "carrying capacity" concept or user fees (which dive operators could subsequently pass on to divers). Many dive operators believed that the critical threat to the health of the coral reefs in the Florida Keys was poor water quality and that zoning efforts would not attack this problem. Dive operators' intermediate positions on a number of survey questions related to the process for developing sanctuary regulations reflect this group's concern for the uncertainties related to SPA regulations and future use of these zones. However, these potential fears did not greatly reduce dive operators' support for the establishment of zones. Dive operators supported the establishment of the FKNMS less than environmental group members but more than commercial fishers.

Members of local environmental groups were most supportive of the FKNMS and the zoning strategies. In fact, many of them felt that NOAA should have gone further than it did. For example, the average percentage of the FKNMS area that environmental group respondents would reserve as "no take" zones was 33%, as compared to the DMP proposal of 5%. Most of these individuals engaged in some type of nonconsumptive use of Florida Keys marine resources (such as swimming, snorkeling, kayaking, boating, and bird-watching) and would receive no direct monetary gain or loss from the zoning plan. Nevertheless, they believed that restrictions on consumptive uses would elevate the public's enjoyment of nonconsumptive uses. Ironically, while they displayed the least evidence of alienation from the public process and the greatest support for NOAA's efforts, environmental group members had relatively low participation in public fora. Their participation levels were usually similar to those of commercial fishers, but less than those of dive operators. Perhaps, the absence of a direct economic link to the harvest refugia explains this lower level of participation. Membership in an environmental group is often a passive activity that involves little more than payment of dues. Alternatively, these individuals might have felt that the FKNMS operated in their interests and, therefore, their presence was not necessary.

6.2. Sources of information

Dive operators, followed by environmental group members and then by commercial fishers, made greatest use of NOAA personnel and the Draft Management Plan for information about the marine reserves. Dive operators and environmental members also considered these information sources to be more useful than did the fishers.

Dive operators cited NOAA public meetings as a source of information more than commercial fishers or environmental group members. NOAA appeared to reach both dive operators and environmental group members with the agency's traditional methods of information dissemination with greater success than it reached commercial fishers. Use of newspapers and the broadcast media was high, but not significantly different for the three groups. Each group obtained information from their own groups (monthly newsletters and updates) significantly more than did other groups. For example, commercial fishers depended on commercial fishing groups for reliable information and trusted that information source. The other groups responded similarly to their respective information source. This suggests that NOAA could conduct outreach efforts through each group's newsletter or organization and, thereby, craft an individualized message based on the concerns, language, and nuances of each group. Marine resource managers should not assume that standard informational sources (public hearings, management plans) will reach all groups with equal success. NOAA's use of non-traditional information outlets might also reduce the high dependence on rumors as information sources.

6.3. NIMBY

The research illustrates the NIMBY ("Not-In-My-Back-Yard") concept with respect to marine reserves. Wolfenden et al. [5] also observed this phenomenon in New Zealand. All three groups demonstrated less support for establishment of reserves in the exact locations proposed in the Draft Management Plan (DMP) than they did for establishment of reserves "somewhere in the Florida Keys". The reasons for this discrepancy may vary. Many environmental group members preferred a greater extension of "no-take" areas than NOAA had proposed in the DMP. Most likely, however, members of all three groups considered the restrictions on their activities that an adjacent reserve might imply. For example, residents of the affluent Ocean Reef Club development in Key Largo generally support marine conservation efforts, but they also enjoy fishing and argued that the Key Largo Replenishment Reserve be moved south so as not to abut their properties [34]. A small group of commercial fishers (27%) sensed the possible benefits that harvest refugia could have on fish stocks, but this support dissipated (6%) when the boundaries were drawn on a map and the area appeared too close to their fishing grounds. NOAA might address the NIMBY effect by developing zone boundaries with input from the affected communities by means of focus groups and workshops. This methodology would clearly recognize that social and economic factors are as important as biological factors in the development of these zones [35].

6.4. Replenishment reserve concept

NOAA's original attempts to convince the public of the replenishment reserve concept did not meet with great success among any of the three stakeholder groups, although dive operators and environmental group members accepted this concept significantly more than commercial fishers. Changing the name of these areas from

"Replenishment Reserves" to "Ecological Reserves" before releasing the Final Management Plan suggests that NOAA may have realized this. The agency wisely eliminated a name that confused the public and was a lightning rod for the opposition.

In the future, NOAA must address the scientific uncertainties surrounding the replenishment reserve concept. Had government scientists been able to show evidence to support reserve implementation in the Florida Keys, many fishers may have accepted the concept. The FKNMS is required to evaluate the management plan every five years (Year 2002) and, therefore, demonstrate the outcomes of the Ecological Reserves (15 CFR sec. 922.160(b)). Positive biological results from the Western Sambos Ecological Reserve may convince the public of the benefits of this type of zone in the Florida Keys and open the door to further use of this management tool.

6.5. *NOAA's public participation strategy*

Despite NOAA's monumental efforts to develop a zoning strategy for the FKNMS that was ecologically supportable and politically fair, the agency found political waters in the Florida Keys to be turbulent. Although NOAA distributed thousands of copies of the three volume FKNMS Draft Management Plan, many individuals (especially commercial fishers) considered the document to be too voluminous and complex to be of much benefit to resource users. Despite NOAA's provisions for multiple opportunities for public participation (significantly more than mandated by statutes and regulations), large numbers of persons from all three user groups felt alienated from the participatory process.

In the future, a marine resource agency, such as NOAA, might consider development of abbreviated planning documents that would be more "user friendly" and tailored to the interests of different user groups. The documents should also be understandable by major user groups that do not speak English, such as Cuban fishermen who account for about 20% of the fishing population in the Florida Keys [22]. Perhaps NOAA could employ Sanctuary "extension" agents (community workers) to interact directly with small focus groups of resource users at convenient locations and times. For example, NOAA might develop a joint extension process through commercial fishing organizations and meet commercial fishers at nearby fish houses during non-fishing hours to discuss the zoning strategy and other aspects of the FKNMS. Participatory mechanisms must evolve from rigid forms of one-way communication (resource manager to resource user) to flexible fora with open discussion. Perhaps, NOAA could empower user groups to conduct their own background/baseline research into the potential impacts of marine zoning by granting modest research funds to the user groups themselves. Subsequently, NOAA could utilize this information when developing boundaries or regulations for the zones or compensating users for the zones' negative impacts. NOAA could adopt these techniques to increase user input and initiate co-management of marine resources.

NOAA should also conduct surveys, similar to those that we conducted, to identify public concerns and priorities regarding the reserves. As Wolfenden et al. [5] and

Cocklin et al. [8] noted, failure to accurately comprehend public opinion can delay reserve implementation and cause "poor public relations". Moreover, without involvement and support of local communities, the reserve may not fulfill its goal of marine resource protection due to lack of compliance with regulations [36]. This social impact research should begin early in the process of development of the marine reserve.

7. Conclusion

In the future, NOAA should consider planning for harvest refugia or "no take" zones as their own and comprehend the relevance of these zones without preconceived notions about details of these areas. This could mitigate the perception of a "top–down" decision, obtain resource information from fishers, and improve integration of fishers into the planning process. A modified planning process might avoid the following criticism from a fisher: "NOAA told us where the replenishment reserves would be; they didn't ask us." Details should emanate from focus groups between resource managers and consumptive and non-consumptive users. The ultimate goal for resource managers must be to convince stakeholder groups to embrace harvest refugia as their own and comprehend the relevance of these zones to their group's interests [37]. These efforts would be positive steps toward a system of "co-management" of marine resources [38].

Had NOAA revised its public participation strategy and improved its working relationships with all user groups in the Florida Keys, the agency might have been able to develop a zoning strategy that protected a more extensive area of the FKNMS and engaged the enthusiastic support of larger percentages of all consumptive and non-consumptive stakeholder groups. This is unfortunate because the harvest refugia originally were the centerpiece of the NOAA's strategy for the FKNMS. Instead, the original replenishment reserve strategy was sacrificed to appease sanctuary critics and gain sufficient political support for the broader sanctuary concept. However, compromising the existence or the boundaries of these zones may present a strategic opportunity for resource managers [8].

Marine resource managers must recognize that creation of "no-take" marine reserves involves a shift in property regime away from open-access. Such fundamental changes demand careful prior social and economic analyses. The biological success of these areas will ultimately depend on support of local resource users which can only result from new public outreach efforts and inclusion of resource users in the various stages of reserve planning and implementation.

Acknowledgements

This research was supported by a grant from the Marine and Coastal Ecosystems Directorate of the US Man and the Biosphere Program.

References

[1] Agardy TS. Marine protected areas and ocean conservation. Austin, TX: R.G. Landes Co. 1997. 244pp.

[2] Ballantine WJ. Networks of "no-take" marine reserves are practical and necessary. In: Shackell NL, Martin Willison JH, editors. Marine protected areas and sustainable fisheries. Wolfville, Nova Scotia, Canada: Science and Management of Protected Areas Association, 1995. p. 13–20.

[3] Bohnsack JA. Marine reserves, zoning, and the future of fisheries management. Fisheries 1996;21(9):14–6.

[4] Hoagland P, Yoshiaki K, Broadus JM. A methodological review of net benefit evaluation for marine reserves. Environmentally Sustainable Development Series Paper No. 027. The World Bank, Washington, DC, 1995.

[5] Wolfenden J, Cram F, Kirkwood B. Marine reserves in New Zealand: a survey of community reactions. Ocean and Coastal Management 1994;25(1):31–51.

[6] Farrow S. Marine protected areas: emerging economics. Marine Policy 1996;20(6):439–46.

[7] Shafer CS, Benzaken D. User perceptions about wilderness on Australia's Great Barrier Reef. Coastal Management 1998;26(2):79–91.

[8] Cocklin C, Craw M, McAuley I. Marine reserves in New Zealand: use rights, public attitudes, and social impacts. Coastal Management 1998;26(3):213–31.

[9] Suman DO. The Florida Keys National Marine Sanctuary: a case study of an innovative federal-state partnership in marine resource management. Coastal Management 1997;25(3):293–324.

[10] NOAA. Florida Keys National Marine Sanctuary, Draft management plan/environmental impact statement, vol. 1. Silver Spring, MD: NOAA, 1995.

[11] Bohnsack JA, Consensus development and the use of marine reserves in the Florida Keys, USA. Proceedings of the Eighth International Coral Reef Symposium, vol. 2. 1997. p. 1927–30.

[12] National Research Council. Striking a balance: improving stewardship of marine areas. Washington, DC: National Academy Press, 1997. 177 pp.

[13] Florida Sportsman Magazine, Florida's marine waters: "One Big Replenishment Zone", unpublished manuscript, 1995.

[14] Monroe County Commercial Fishermen, Inc. A report and review of the draft management plan for the Florida Keys National Marine Sanctuary. December 5, 1995.

[15] Conch Coalition News, Winter 1994. Conch Coalition membership form and Mission Statement, 1995.

[16] NOAA. Florida Keys National Marine Sanctuary, Final management plan/environmental impact statement, vol. 1. Silver Spring, MD: NOAA, 1996.

[17] Leeworthy VR. Technical appendix: sampling methodologies and estimation methods applied to the Florida Keys/Key West Visitors Surveys. Silver Spring, MD: NOAA, 1996.

[18] Florida Department of Environmental Protection. Saltwater products systems, SPL Holders, Tallahassee, FL.

[19] Bohnsack JA, Harper DE, McClellan DB. Fisheries trends from Monroe County, Florida. Bulletin of Marine Science 1994;54(3):982–1018.

[20] Florida Department of Environmental Protection. 1995 Florida Statewide and Monroe County Edited Landings Data. St. Petersburg, FL: Florida Marine Research Institute, 1996.

[21] Chiappone, M., Sluka, R. Site characterization for the Florida Keys National Marine Sanctuary and Environs: fish and fisheries, vol. 6. Zenda, WI: The Preserver, 1996. 149 pp.

[22] Milon JW, Suman DO, Shivlani M, Cochran KA. Commercial fishers' perceptions of marine reserves for the Florida Keys National Marine Sanctuary. Florida Sea Grant technical paper-89, 1997.

[23] Leeworthy VR, Wiley PC. Visitor profiles: Florida Keys/Key West. Silver Spring, MD: NOAA, 1996.

[24] English DBK, Kriesel W, Leeworthy VR, Wiley PC. Economic contribution of recreating visitors to the Florida Keys/Key West. Silver Spring, MD: NOAA, 1996.

[25] Shivlani MP, Suman DO. Dive operator use patterns in the designated Florida Keys National Marine Sanctuary no-take zones: a GIS analysis. Environmental Management, in press.

[26] Quirolo D. Reef mooring buoys and reef conservation in the Florida Keys: a community and NGO approach. In: White A, Hale L, Renard Y, Cortesi L, editors. Collaborative and community-based management of coral reefs: lessons from experience. West Hartford, CT: Kumarian Press, 1994. p. 80–90.
[27] Bugle Call: The Last Stand Newsletter, April 1997.
[28] Lee K. September 11, 1997, personal communication.
[29] Alreck PL, Settle RB, The survey research handbook. Homewood, IL: Richard D. Irwin, 1985. 429 pp.
[30] Florida Marine Fisheries Commission. A study of potential impacts of the Save Our Sealife Net Ban Proposal: a report to the legislature, 1993.
[31] Shivlani MP, Milon JW. Sociocultural effects of a market-based fishery management program in the Florida Keys. Coastal management, in press.
[32] Barnes JC. Save Our Sealife or Save Our Seafood?: a case study of conflict in the management of Florida's marine resources. In: Suman D, Shivlani M, Villanueva M, editors. Urban growth and sustainable habitats: case studies of policy conflicts in South Florida's coastal environment. Miami, FL: University of Miami, 1995. p. 69–91.
[33] Sanctuary and incumbents fall. Florida Keys Keynoter, November 6, 1996. p. 1.
[34] Ritz D. Ocean reef Community Association. Comment at the FKNMS public hearing on the FKNMS Draft Management Plan, Key Largo, FL, November 3, 1995.
[35] Kelleher G, Kenchington R. Guidelines for establishing marine protected areas. Gland, Switzerland: IUCN, 1992. 79 pp.
[36] Wells S, White AT. Involving the community. In: Gubbay S, editor. Marine protected areas: principles and techniques for management. London: Chapman & Hall, 1995. p. 61–84.
[37] Kelly GC, Public participation and perceived relevance as critical factors in marine park management. Proceedings of the Seventh International Coral Reef Symposium, vol. 2. 1992. p. 1033–7.
[38] McCay BJ. Common and private concerns. In: Hanna SS, Folke C, Maler K-G, editors. Rights to nature. Washington, DC: Island Press, 1996. p. 111–26.