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Aerial survey of sea turtles, marine mammals and vessel usage  
along the southeast Florida coast, Haulover Inlet to Sand Key:

Phase 2.

by

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## INTRODUCTION

This is the second report on aerial surveys to document marine turtle and marine mammal occurrence and distribution along Florida's southeast coast (Haulover Inlet to Sand Key) and describe vessel usage patterns in the Florida Keys National Marine Sanctuary (FKNMS) (Appendix 1). Results from the first report reported 16 surveys between September 28, 1992 and December 10, 1993 (McClellan et. al., 1994). This report adds 19 additional surveys to the study and extends the time period to December 31, 1994. Survey times averaged 99 minutes (range 27 to 192 minutes). A total of 584 turtles (loggerhead, green, and leatherback), 450 dolphin (bottlenose and pantropical spotted) and 6,493 vessels (fishing, dive and cruising) were documented during 35 surveys.

## METHODS

During the first year of the study, aerial surveys were attempted twice a week along the southeast Florida coast between Haulover Inlet and Key West (Fig. 1). Starting in January 1994, surveys were attempted once a week on Fridays. All flights were aboard United States Coast Guard aircraft based at Opalocka Airport, Opalocka, Florida. Two survey platforms were utilized, a RJ-8 fixed wing single engine airplane (2 flights) and a Dolphin helicopter (33 flights). The helicopter was preferred since it could carry more observers and hover if necessary when species identification was being attempted. The number of observers and crew ranged from two on the airplane to a maximum of five on the helicopter (Table 1). Flights were conducted at an altitude of 50

to 85 meters at a speed of approximately 100 knots. Flights were not attempted when weather conditions were unfavorable.

The study area was divided into seven approximately equal zones (Fig. 1.):

- Zone 1 - Haulover Inlet to NE Corner
- Zone 2 - NE Corner to Red 4 Buoy
- Zone 3 - Red 4 Buoy to French Reef
- Zone 4 - French Reef to Red 18 Buoy
- Zone 5 - Red 18 Buoy to Delta Shoals
- Zone 6 - Delta Shoals to American Shoals
- Zone 7 - American Shoals to Sand Key

Initially, surveys began at Haulover Inlet, continued down the reef line as far as possible (usually to Sombrero Light) in the allotted flight time and returned to the airport in a straight line over Florida Bay and the Everglades. This flight plan was chosen to maximize the survey distance along the reef line in two hours of flying time. After the third survey the flight plan was changed to return approximately one-half mile offshore of the reef line to maximize survey time for marine turtles and mammals in two hours flying time. Friday afternoon flights from 1230 to 1500 hours were chosen to maximize vessel counts and to minimize glare. In January 1994, the plan was changed to leave Opalocka airport at 0800 hours and fly the entire reef tract to Sand Key. After landing to eat and refuel, we then flew back counting turtles and dolphins approximately one-half mile off the reef tract.

Vessels were counted only on the southbound portion of each flight to avoid duplication of data. Diving and fishing vessels

were listed as recreational, commercial/lobster, charter/yacht, or unknown. Dive boats were identified when a dive flag was displayed or divers were present in the water. Commercial/lobster vessels generally had a large identification number on the roof or side and possibly traps on deck. Vessels larger than 35 feet were considered charter/yacht, recreational vessels those smaller. Cruising/sailing vessels were also recorded (Appendix 1).

One observer was responsible for documenting vessels, while all observers, including the pilots and crew chief, assisted in sighting marine turtles and mammals. Latitude and longitude were recorded for each sighting via a Global Positioning System (GPS) unit located on the aircraft control panel. The time of each sighting was also recorded.

## RESULTS AND DISCUSSION

### Marine Turtles

A total of 584 marine turtles were observed during the study (Table 1), from shallow hard-bottom areas in Hawks Channel shoreward of the reef to one-half mile offshore of the reef. More turtles were sighted in zone 4 (Fig. 2) than the other areas. Marine turtles were observed on all surveys with an average number of turtles per survey of 16.7 (range 1 to 60) (Figure 3). There was an average of 0.17 sightings per minute (range 0.01 to 0.91) (Fig. 4). More turtles were actually sighted in the spring (April - June) because of the high variance caused by one sample in Mar 1994 (Table 1).

The total number of turtles sighted by the zone and date of the

survey is shown in Figure 5, most animals observed in the middle keys.

Species identification was attempted but was not always possible since most observers did not have experience in aerial identification of marine turtles. In addition, this lack of experience could possibly have biased the number of turtle sightings due to the learning curve involved in developing appropriate search images for sighting and identifying marine turtles. Marine turtles positively identified to species (Table 1) included 141 (24.1%) loggerheads (Caretta caretta), 20 (3.4%) green (Chelonia mydas) and 2 (<1%) leatherbacks (Dermodochelys coriacea). Unknown species were recorded for 421 (72.0%) turtle sightings. One of the leatherbacks was entangled in a lobster trap buoy line and was cut free by Florida Marine Patrol officers after notification by the aerial flight crew. In a previous aerial survey over the same area Thompson and Shoop (1983) identified 87 (78.4%) loggerheads, 4 (3.6%) greens, and 20 (18.0%) unknowns.

#### Marine mammals

Bottlenose dolphin (Tursiops truncatus) and pantropical spotted dolphins (Stella attenuata) were both observed during the surveys (Table 1). Sightings of bottlenose dolphins occurred 68 times with a total of 403 animals. Unknown number of individuals occurred on four pod sightings. Sightings of the spotted dolphins occurred twice with 47 animals seen. Estimated pod sizes ranged from single animals to more than 25. Bottlenose dolphins occurred on the reef proper or just offshore while the spotted dolphins were all

observed in deeper waters.

### Vessels

Vessel sightings in the study area were recorded to determine patterns of usage in the FKNMS (Appendix 2). The number of boats observed was dependent upon weather, sea conditions, and time of day, week, and month. The survey on July 28, 1994 contained the greatest number of vessels (predominantly dive) because it was during the mini-lobster season (Fig. 6). Fishing vessels were more abundant during the fall and winter while dive vessels were most prevalent in the spring and summer. (Figs. 7, 7A, 7B).

The total number of boats observed and survey times is depicted in Figure 6. Recreational vessels (2,360) constituted the majority of the types of fishing vessels observed. More fishing boats were observed in the middle keys (Fig. 8 and 10). Zone 4 (French reef to Red buoy 18) had the greatest total vessel usage; zone 7 the least (Fig. 8). Fishing boats (3,421) were more scattered around the FKNMS while dive boats (2,285) were concentrated on the major reef areas, especially French, Molasses and Looe Key reefs (Fig. 9 and 11).

### FUTURE PLANS

Phase three of the aerial survey study will add twice a month flights to Sands Key. Return flights to base will continue to count only turtles back to Fowey light. Precise species identifications of marine turtles will be attempted. Vessel usage will be plotted using SURFER programs to better locate reef areas, SPAS, and closed areas.

## ACKNOWLEDGEMENTS

I thank the pilots and crewmen of the U. S. Coast Guard who assisted in the aerial surveys, especially Lt. J. Bevelaqua and Lt. M. Marro. Thank go to J. Bohnsack, D. Harper, and N. Thompson for contributions and comments. A. Woodhead assisted in logistical support and also flew many flights. S. Bolden, J. Contillo, J. Javech, M. Judge, Lt.(jg) G. Konoval, A. Martinez, and W. Teas all assisted in data collection.

## LITERATURE CITED

- McClellan, D.B., Lt. J. Bevelaqua, S. Bolden, W. Teas, N. Thompson, and A. Martinez. Aerial survey for sea turtles, marine mammals, and vessel counts along the southeast Florida coast from Haulover Inlet to Key West: a progress report. 16 p.
- Thompson, N. J. and C. R. Shoop. 1983. Southeast turtle survey (SETS), pelagic surveys. Final report to the National Marine Fisheries Service. Aero-Marine Surveys, Inc., Groton, CT. 76 p.

TABLE 1. Summary of aerial surveys, September 28, 1992 to December 30, 1994.

DATE	ZONES SURVEYED	AIRCRAFT TYPE	NO. OF OBSERVERS	BOAT SURVEY	TURTLE SURVEY TIME (Min)	NO. OF GREEN TURTLES SIGHTED	NO. OF LEATHERBACK TURTLES SIGHTED	NO. OF LOGGERHEAD TURTLES SIGHTED	NO. OF UNKNOWN TURTLES SIGHTED	NO. OF BOTTLENOSE DOLPHINS SIGHTED	NO. OF SPOTTED DOLPHINS SIGHTED	NO. OF FISHING VESSELS	NO. OF DIVING VESSELS	NO. OF CRUISING VESSELS
28-Sep-92	1-5	HELICOPTER	5	69	69	1	0	2	5	0	0	54	10	8
18-Dec-92	1-5	AIRPLANE	2	112	112	0	0	0	5	0	0	72	17	4
28-Jan-93	1-6	HELICOPTER	4	67	67	0	0	0	1	0	0	423	40	14
05-Mar-93	1-6	HELICOPTER	4	67	67	0	1	0	9	6	0	396	56	124
23-Apr-93	1-7	AIRPLANE	2	77	77	0	0	0	3	0	0	70	21	47
16-May-93	1-6	HELICOPTER	4	66	66	1	0	2	57	26	0	71	98	38
04-Jun-93	1-4	HELICOPTER	3	71	103	2	0	5	1	8	0	62	16	4
01-Jul-93	1-5	HELICOPTER	3	45	88	0	0	1	8	7	0	51	29	13
11-Aug-93	1-6	HELICOPTER	4	67	123	0	0	1	43	14	0	98	236	22
27-Aug-93	1-6	HELICOPTER	4	61	118	0	1	0	30	1	25	54	66	0
10-Sep-93	1-5	HELICOPTER	3	49	78	0	0	24	0	3	0	1	56	0
24-Sep-93	2-6	HELICOPTER	3	55	55	0	0	0	6	10	0	87	49	71
08-Oct-93	1-5	HELICOPTER	3	59	107	4	0	3	16	8	0	71	20	22
22-Oct-93	2-6	HELICOPTER	4	39	78	0	0	0	5	0	0	89	36	81
19-Nov-93	2-4	HELICOPTER	5	27	27	0	0	0	6	0	0	30	33	0
10-Dec-93	1-6	HELICOPTER	3	61	128	0	0	12	15	10	0	104	41	11
11-Mar-94	1-7	HELICOPTER	3	127	127	0	0	10	1	10	0	53	5	4
25-Mar-94	1-5	HELICOPTER	4	78	151	3	0	17	38	32	0	136	67	14
02-Apr-94	2-7	HELICOPTER	3	61	135	0	0	7	13	0	0	90	65	9
06-May-94	1-5	HELICOPTER	4	58	77	1	0	3	3	4	0	99	80	23
27-May-94	2-7	HELICOPTER	5	60	91	0	0	4	19	1	0	48	30	17
24-Jun-94	1-5	HELICOPTER	4	65	105	1	0	7	10	9	0	31	43	21
15-Jul-94	2-6	HELICOPTER	4	65	99	0	0	2	15	19	0	35	42	30
27-Jul-94	6-7	HELICOPTER	3	74	74	0	0	4	2	0	0	9	123	6
28-Jul-94	1-7	HELICOPTER	3	111	111	0	0	10	18	3	0	42	504	14
19-Aug-94	2-7	HELICOPTER	4	60	123	0	0	5	20	16	0	44	58	13
26-Aug-94	2-7	HELICOPTER	4	77	105	0	0	0	12	0	0	57	70	3
16-Sep-94	2-7	HELICOPTER	3	55	116	0	0	0	3	8	0	24	57	10
23-Sep-94	2-7	HELICOPTER	5	75	144	0	0	0	9	10	0	92	35	0
14-Oct-94	2-7	HELICOPTER	4	88	88	1	0	0	9	116	0	136	47	29
21-Oct-94	2-7	HELICOPTER	4	81	81	1	0	3	2	0	0	108	36	5
27-Oct-94	1-7	HELICOPTER	4	90	90	0	0	0	4	8	0	85	38	21
18-Nov-94	2-7	HELICOPTER	3	73	95	1	0	0	7	54	0	180	20	33
09-Dec-94	2-7	HELICOPTER	3	87	87	1	0	4	7	0	0	124	36	43
30-Dec-94	1-7	HELICOPTER	3	110	192	3	0	12	19	20	22	295	103	33
TOTAL						20	2	141	421	405	47	3421	2285	787

\* = Some zones were not completely surveyed

Key to zones: 1 = Haulover Inlet to NE Corner, 2 = NE Corner to Red 4 buoy, 3 = Red 4 buoy to French Reef, 4 = French Reef to Red 18 buoy, 5 = Red 18 buoy to Delta Shoals, 6 = Delta Shoals to American Shoals, 7 = American Shoals to Sand Key

Figure 1. Proposed Florida Keys National Marine Sanctuary.

# Florida Keys National Marine Sanctuary

Advisory Council Zoning Subcommittee

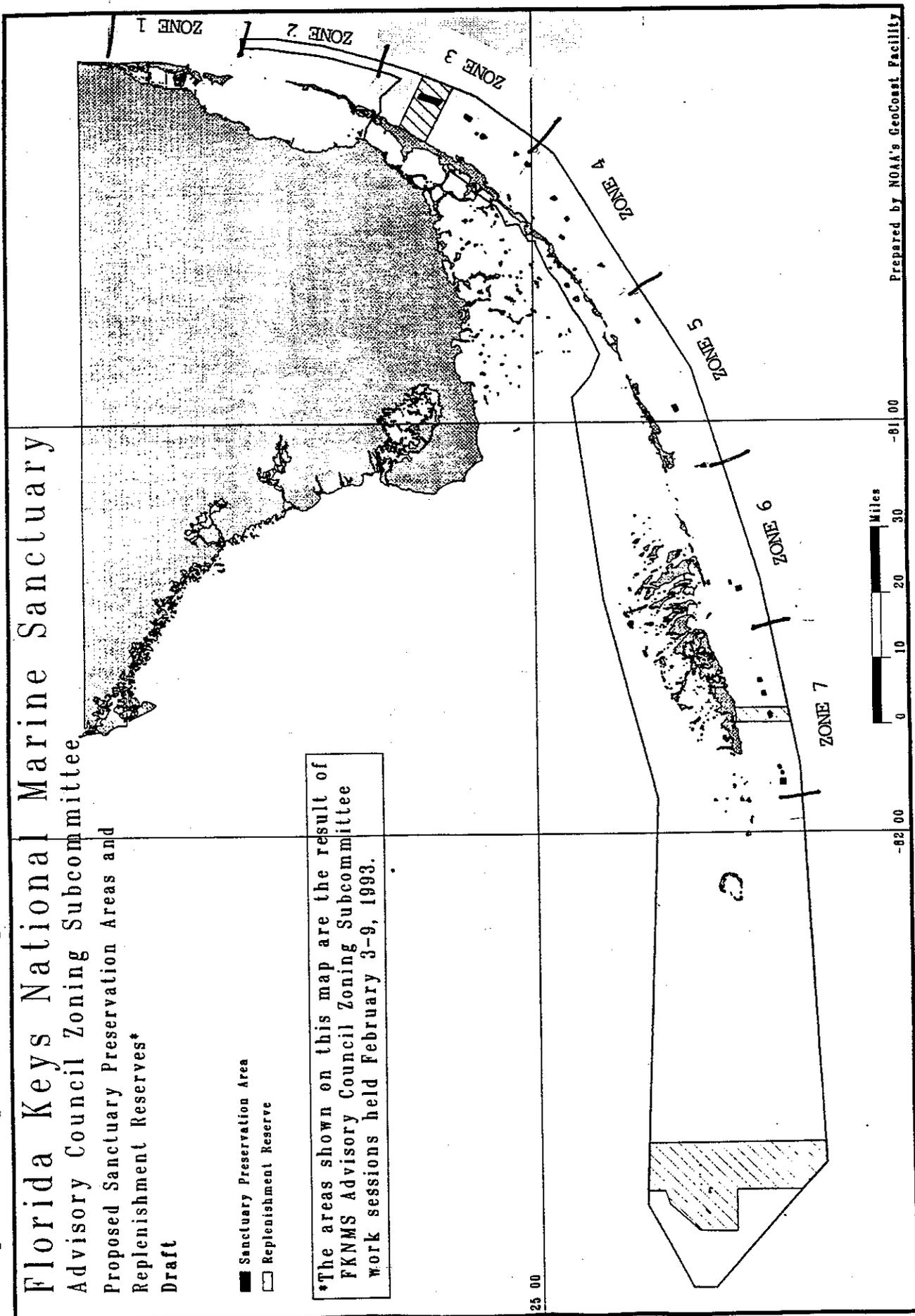
Proposed Sanctuary Preservation Areas and

Replenishment Reserves\*

Draft

- Sanctuary Preservation Area
- Replenishment Reserve

\*The areas shown on this map are the result of FKNMS Advisory Council Zoning Subcommittee work sessions held February 3-9, 1993.



Prepared by NOAA's GeoCoast Facility

- Key to Zones: 1 = Haulover Inlet to Fowey Light, 2 = Fowey Light to Red 4 buoy, 3 = Red 4 buoy to French Reef  
 4 = French Reef to Red 18 buoy, 5 = Red 18 buoy to Delta Shoals, 6 = Delta Shoals to American Shoals, 7 = American Shoals to Sand Key

Fig. 4. Number of turtles observed (bars) and turtles per minute seen (lines).

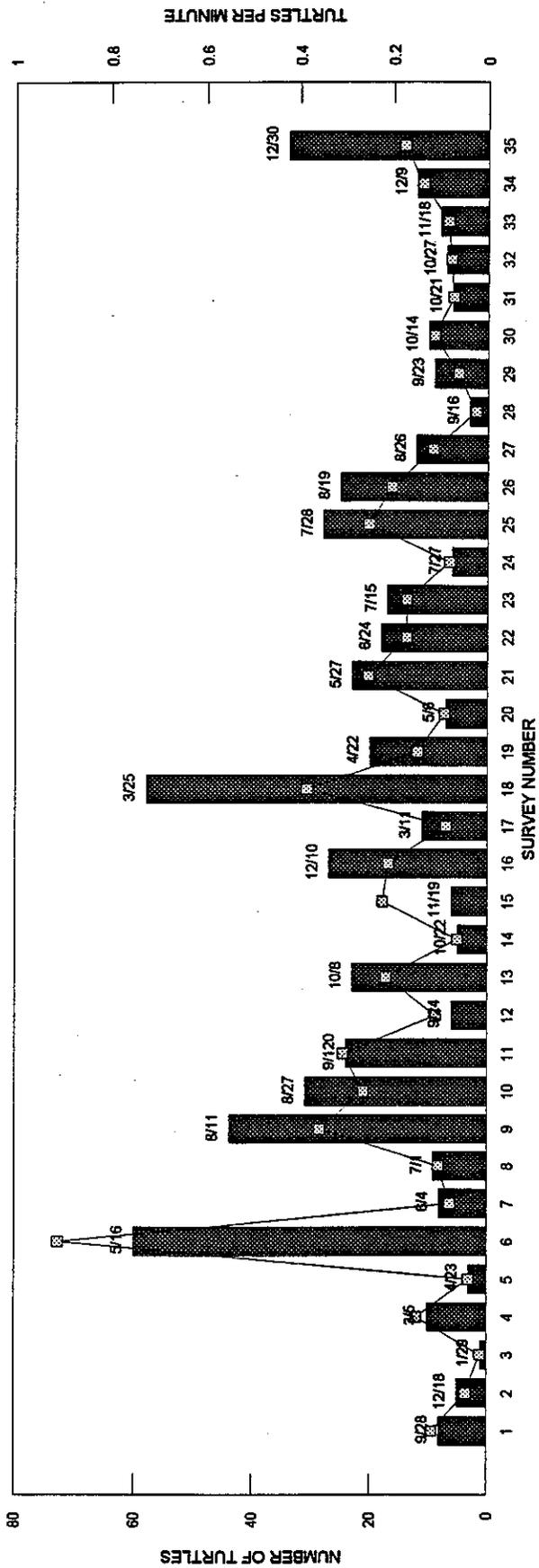


Fig. 4A. Average number of turtles observed (years pooled), confidence limits and high-low values.

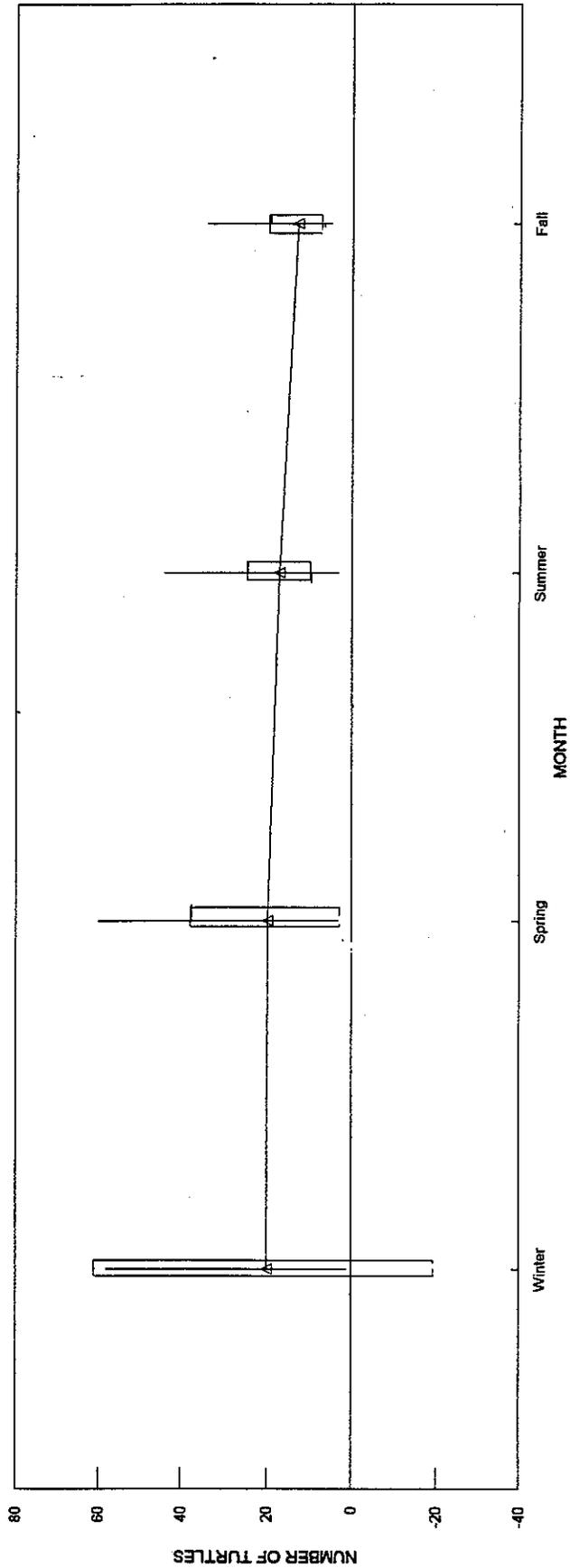
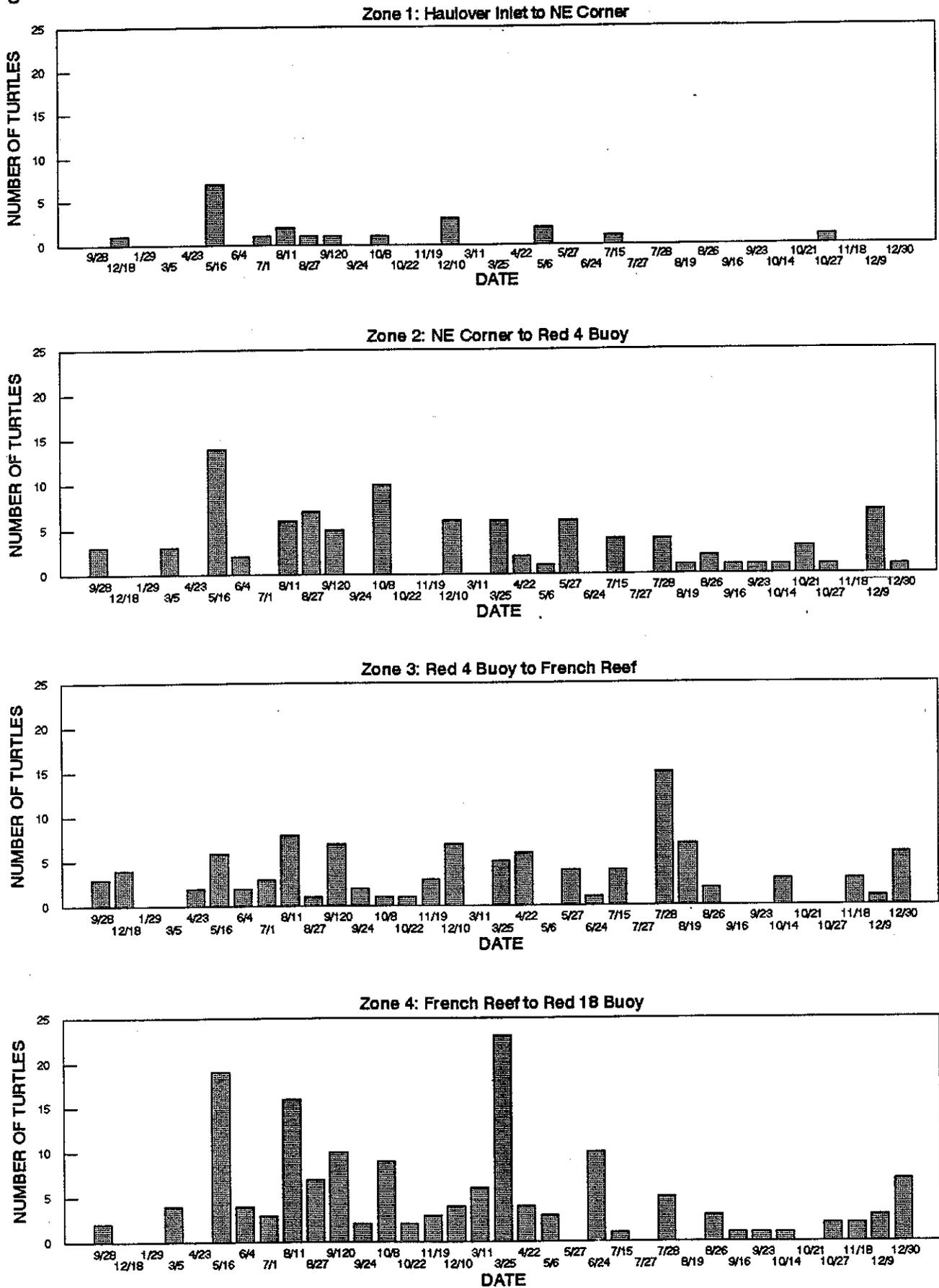


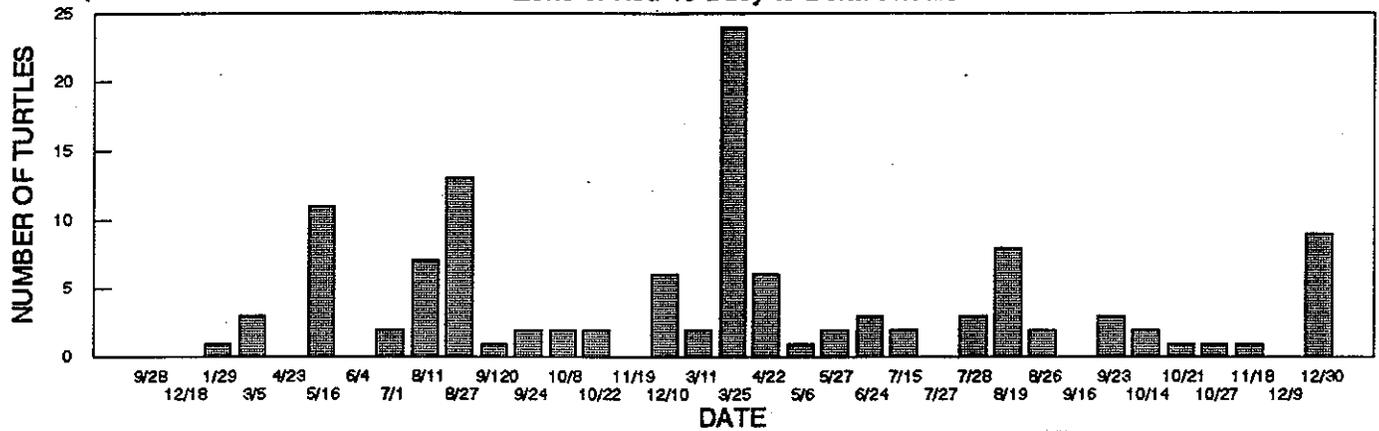
Figure 5. Number of marine turtles observed by zone and date of survey.



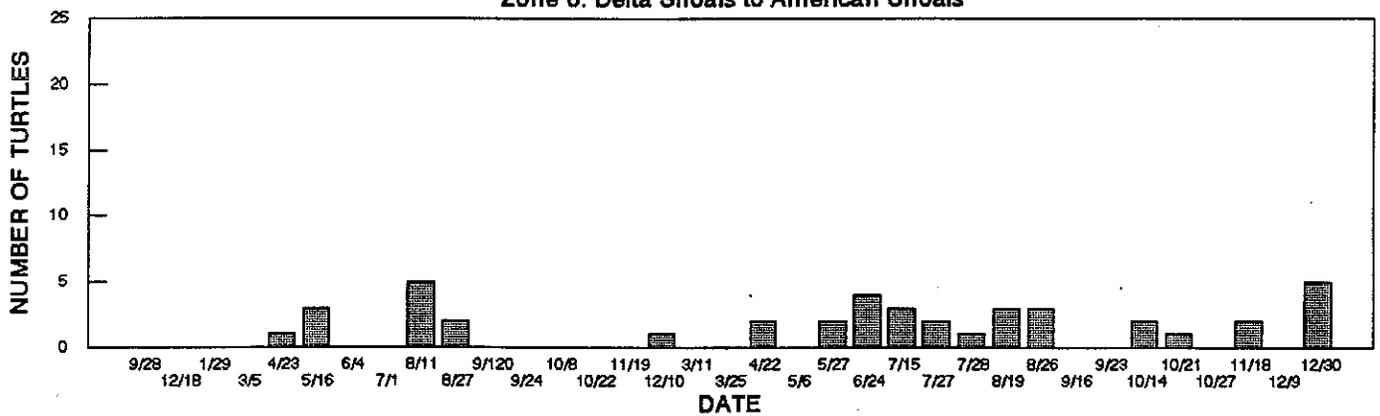
Incomplete or absent surveys occurred in some zones for some dates. See Table 1.

Figure 5 (cont.). Number of marine turtles observed by zone and date of survey.

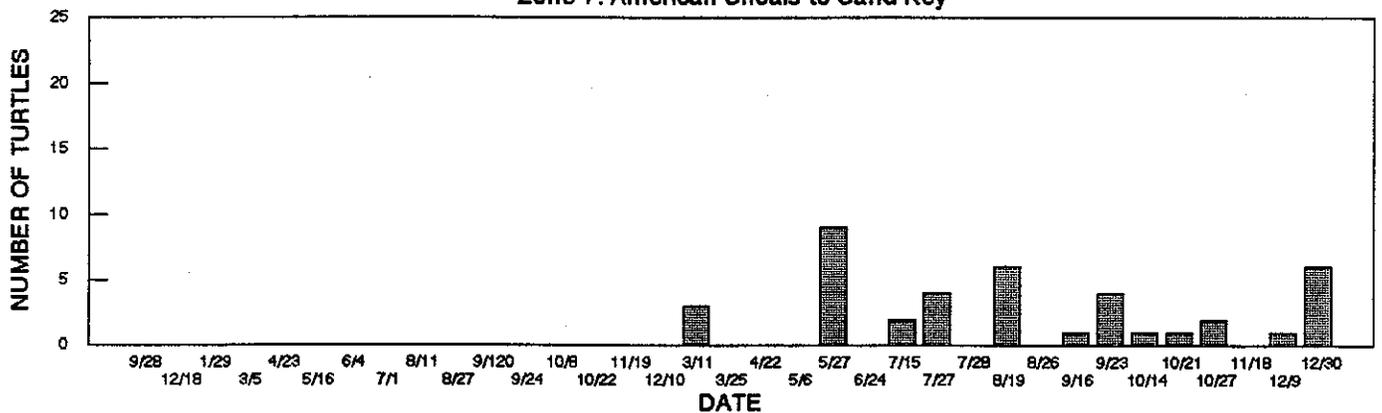
Zone 5: Red 18 Buoy to Delta Shoals



Zone 6: Delta Shoals to American Shoals



Zone 7: American Shoals to Sand Key



Incomplete or absent surveys occurred in some zones for some dates. See Table 1.

Figure 6. Total number of boats (fishing and dive) observed and survey time by survey number.

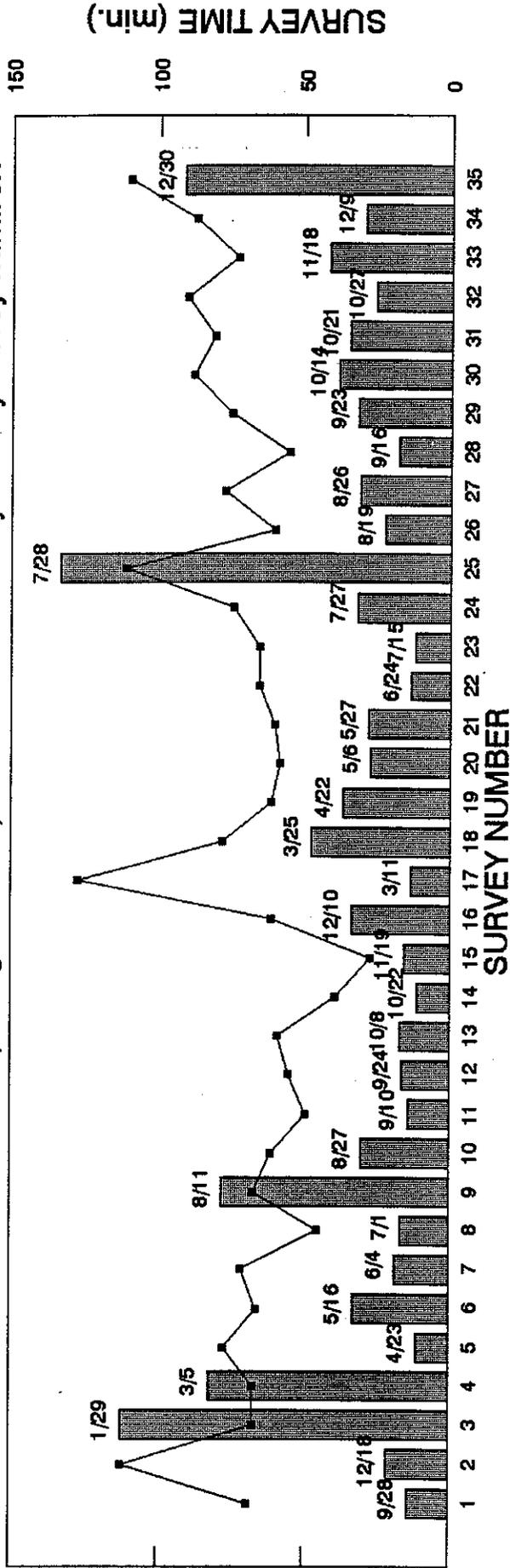


Figure 7. Fishing versus Dive Vessels by Date

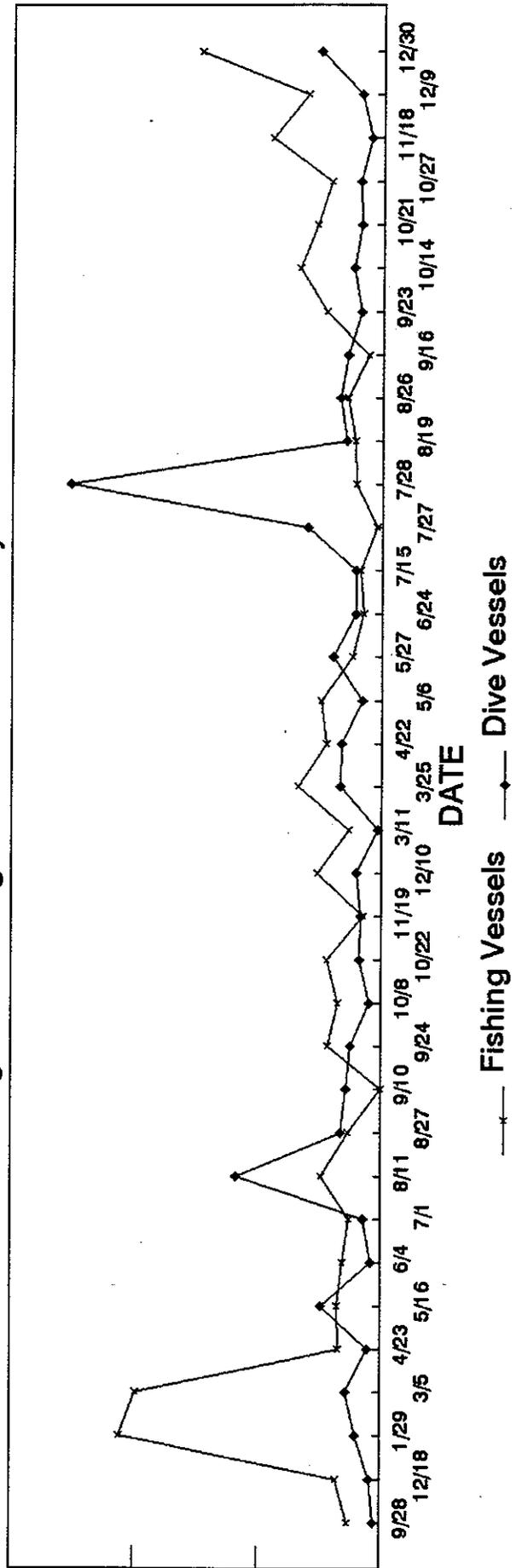
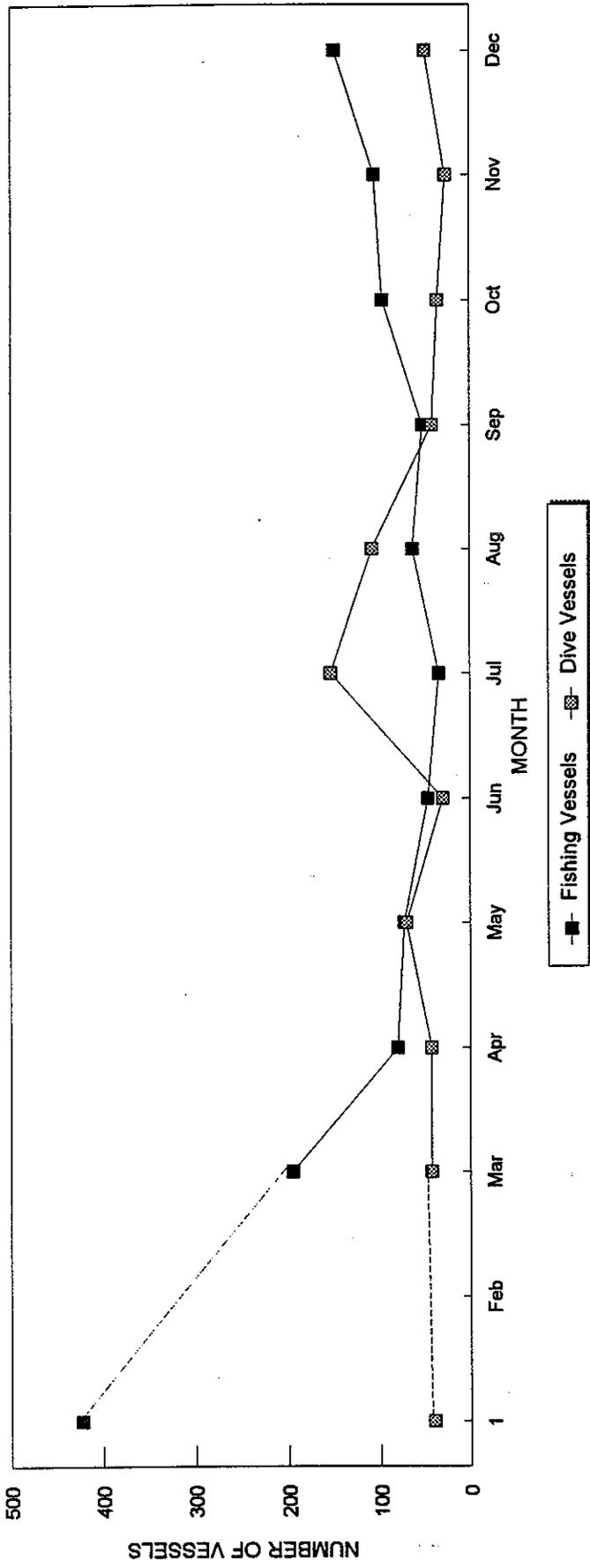


Fig. 7B. Average number of vessels observed by month and year (pooled).



Dashed line indicate no February samples.

Figure 8. Number of Fishing Boats by Classification and Zone.

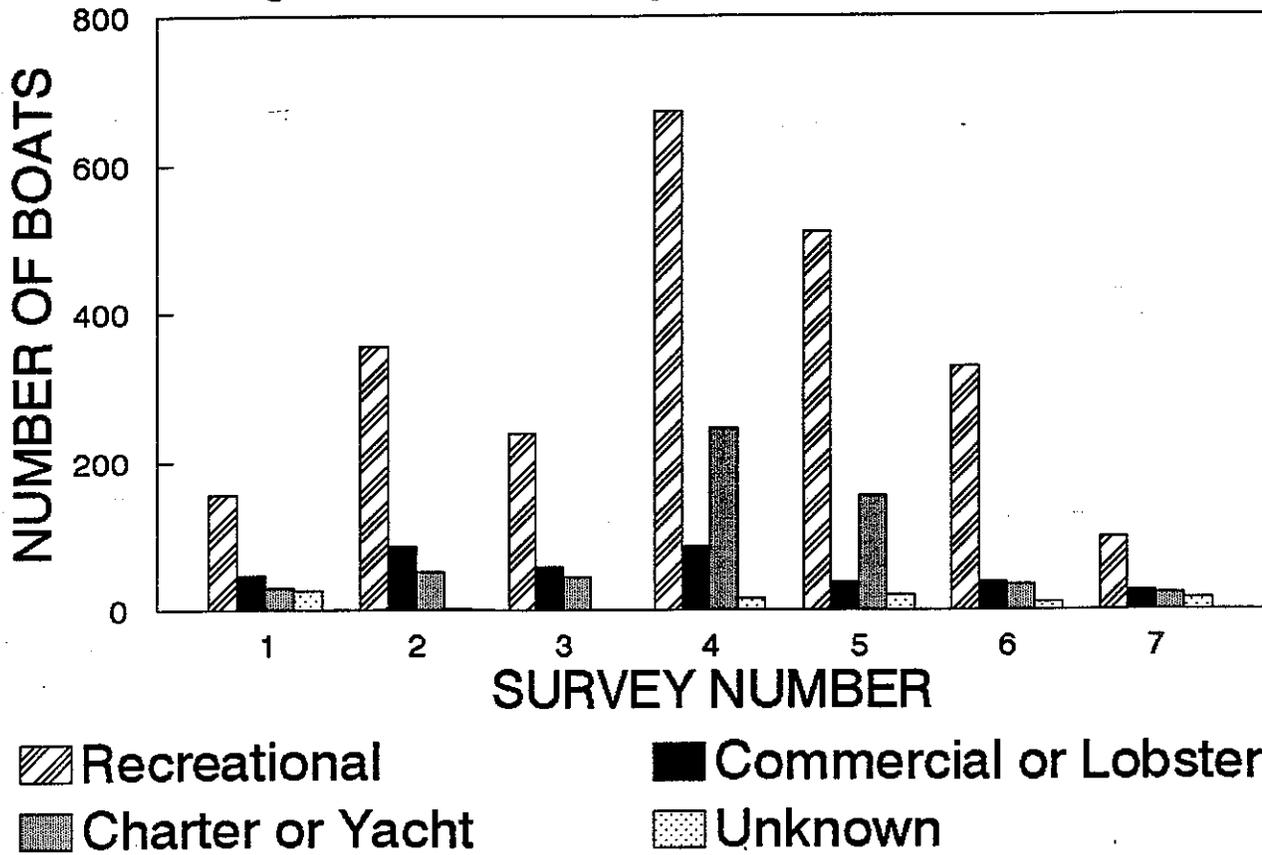


Figure 9. Number of Dive Boats by Classification and Zone.

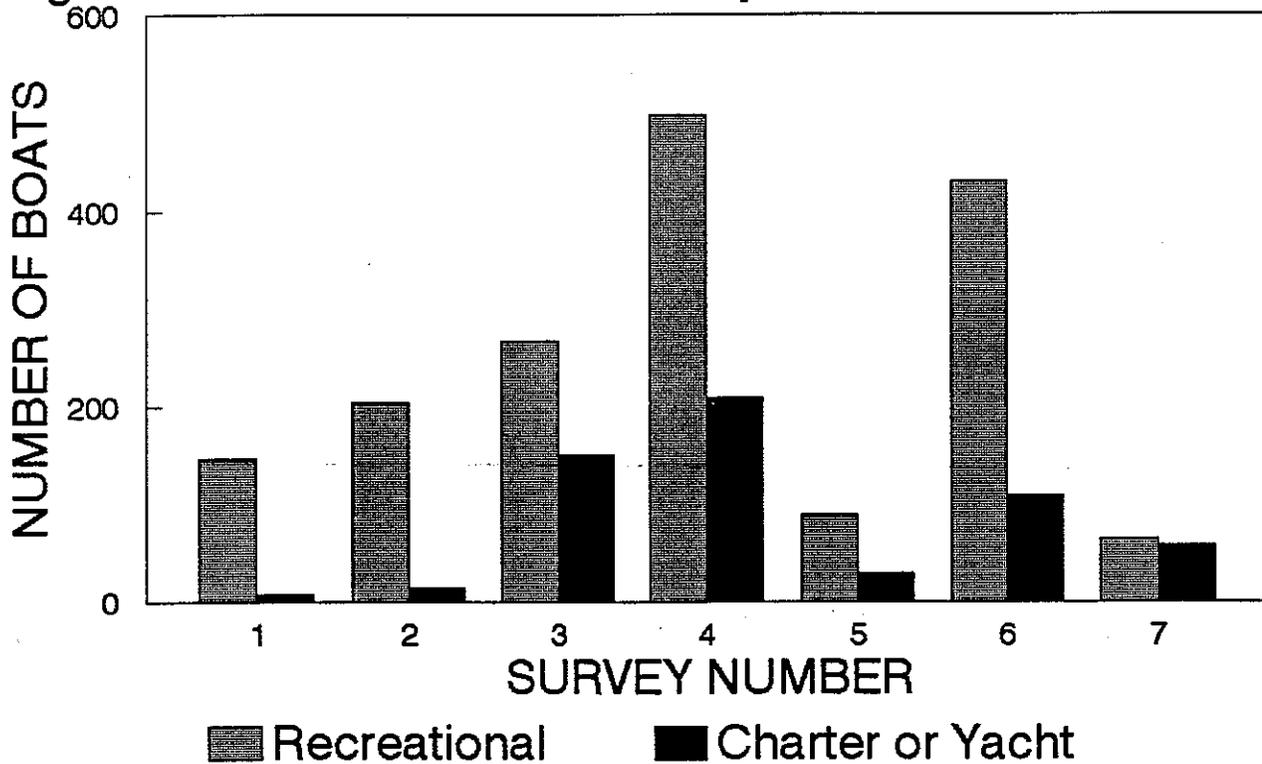
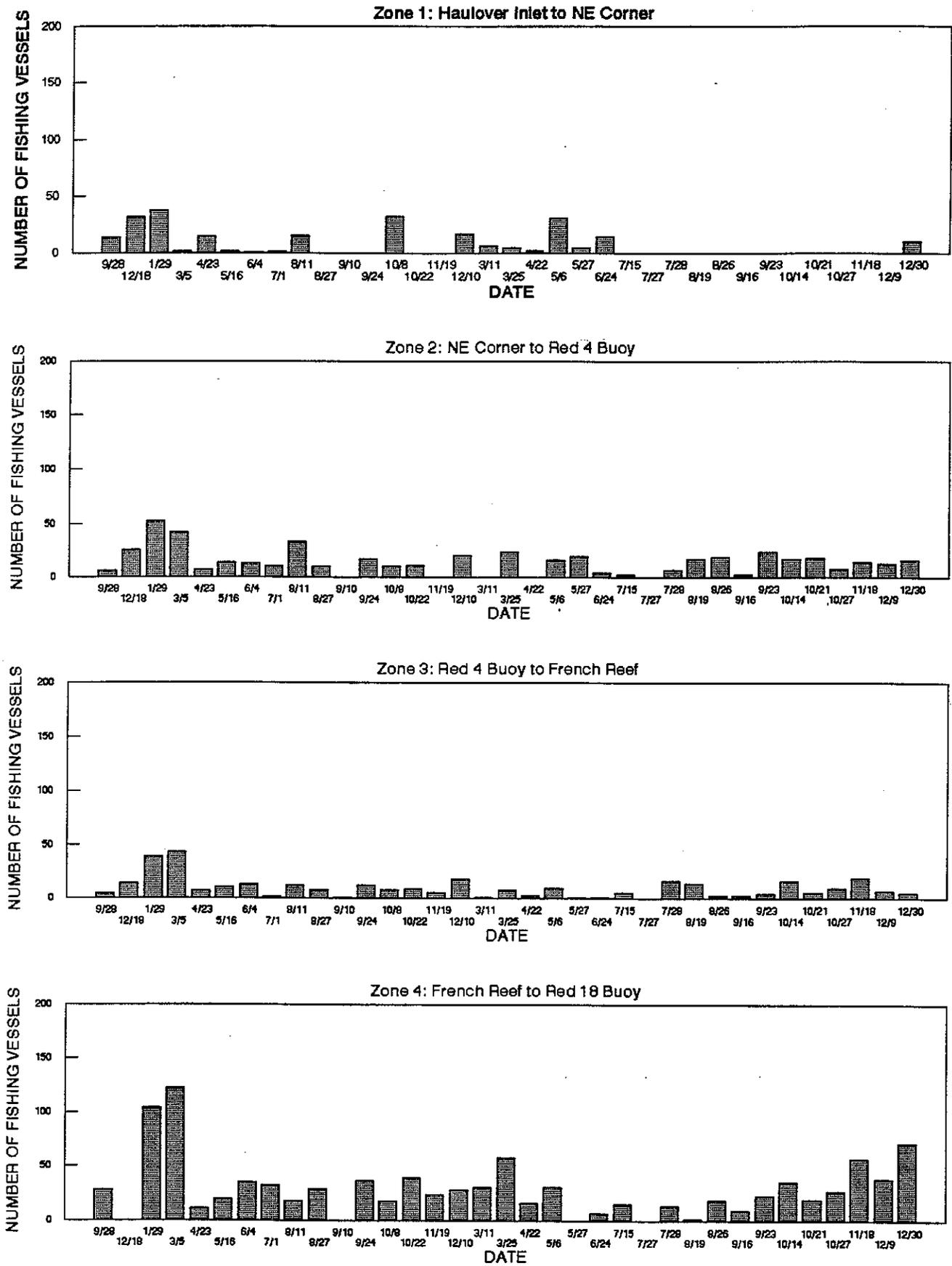
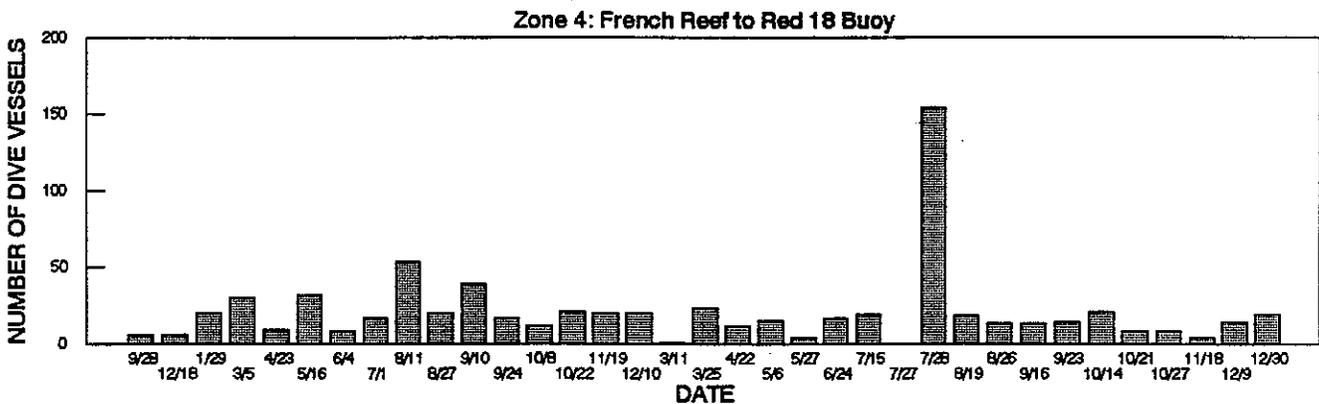
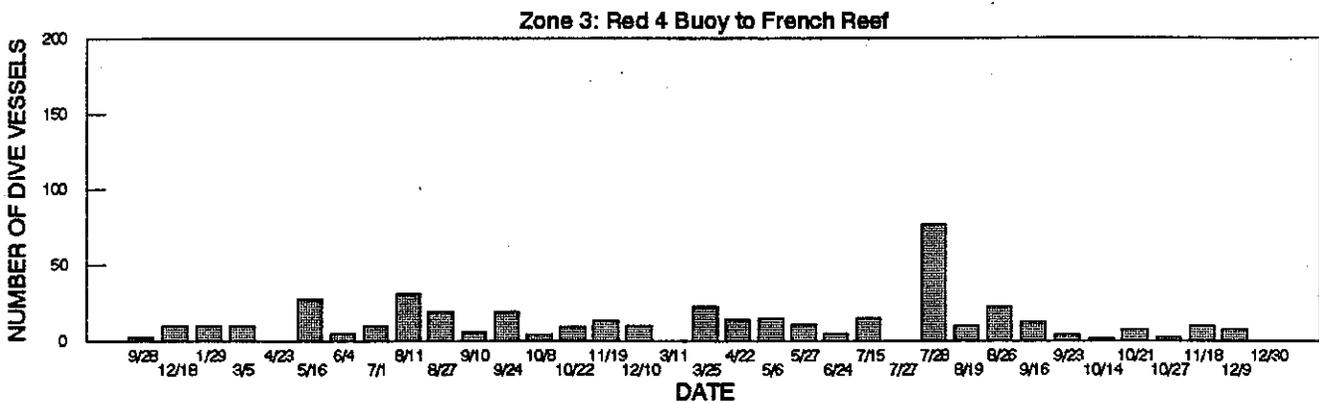
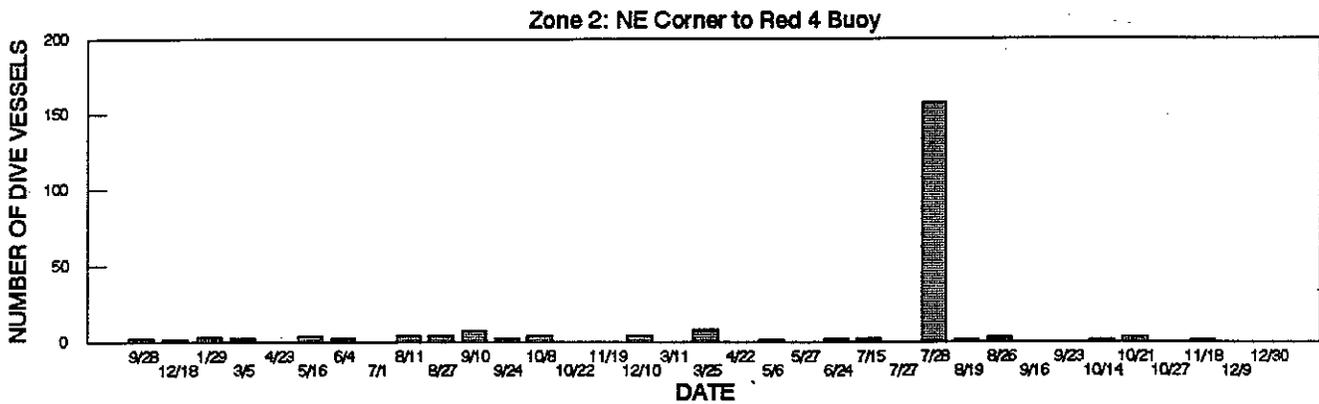
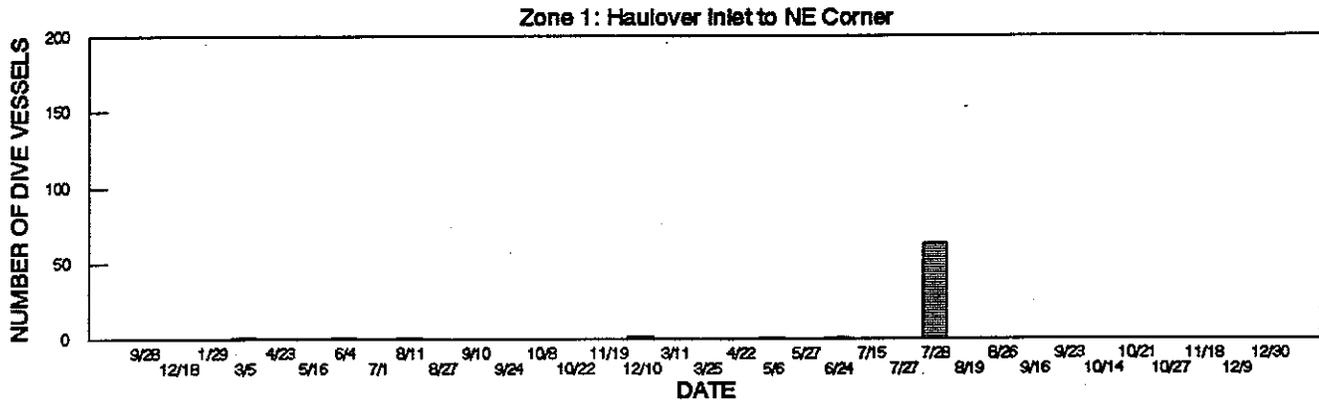


Figure 10. Number of Fishing Vessels Observed by Zone and Date of Survey



Incomplete or absent surveys occurred in some zones for some dates (See Table 1.)

Figure 11. Number of Dive Vessels by Zone and Date.



Incomplete or absent surveys occurred in some zones for some dates (See Table 1.)



## Florida Keys National Marine Sanctuary Advisory Council Zoning Proposal, March 1993

These materials represent the recommendations on Sanctuary Preservation Areas and Replenishment Reserves provided to NOAA by the Florida Keys National Marine Sanctuary Advisory Council. These zones will be included as part of the proposal for Alternative III of the Draft Environmental Impact Statement for the Sanctuary. The table identifies the amount of the Sanctuary included at each site. Alternative III will also include Existing Management Areas and the Wildlife Management Zones developed by the U.S. Fish and Wildlife Service as part of their Backcountry Management Plan. For more information on these zones, please contact the Florida Keys National Marine Sanctuary Planning Office at (305) 743-2437.

Area Calculations*				
Name	Acres	Square Nautical Miles	Square Miles	Percent of Sanctuary
Florida Keys NMS**	2,351,322	2,774	3,674	100%
<b>Sanctuary Preservation Areas</b>				
Carysfort/South Carysfort Reef	808	0.954	1.263	0.03%
The Elbow	223	0.263	0.348	0.01%
Dry Rocks	38	0.045	0.060	>.01%
Grecian Rocks	265	0.313	0.415	0.01%
French Reef	91	0.107	0.142	>.01%
Molasses Reef	219	0.258	0.342	0.01%
Conch Reef	58	0.068	0.090	>.01%
Conch Reef (Research Only)	177	0.209	0.277	0.01%
Davis Reef	143	0.168	0.223	0.01%
Hen and Chickens	149	0.175	0.232	0.01%
Cheeca Rocks	38	0.045	0.060	>.01%
Alligator Reef	148	0.174	0.231	0.01%
Tennessee Reef (Research Only)	131	0.155	0.205	0.01%
Coffins Patch	363	0.428	0.567	0.02%
Sombrero Key	181	0.214	0.284	0.01%
Looe Key	283	0.334	0.443	0.01%
Looe Key (Research Only)	83	0.098	0.129	>.01%
Pelican Shoal (Research Only)	68	0.081	0.107	>.01%
Newfound Harbor Key	105	0.124	0.165	>.01%
Western Sambo	227	0.268	0.355	0.01%
Eastern Dry Rocks	68	0.080	0.106	>.01%
Rock Key	62	0.073	0.097	>.01%
Sand Key	373	0.440	0.583	0.02%
<b>Total</b>	<b>4,302</b>	<b>5.075</b>	<b>6.722</b>	<b>0.18%</b>
<b>Replenishment Reserves</b>				
Key Largo (Special Use)	19,179	23	30	0.82%
Sambos	7,394	9	12	0.31%
Dry Tortugas***	158,016	186	247	6.72%
<b>Total</b>	<b>184,568</b>	<b>218</b>	<b>288</b>	<b>7.85%</b>

\*All data are preliminary pending "ground truthing" of boundaries

\*\*Excludes land area and Dry Tortugas National Park

\*\*\*Includes 64,570 acres within National Park Boundary