FRENCH FRIGATE SHOALS MARINE FISH SURVEY

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This survey was conducted in August, 1969, with the Hawaii division of the USBSFW on French Frigate Shoals, Hawaii. The purposes of the survey were to: 1) Establish underwater transects over a variety of habitats that can be sampled repeatedly by snorkel divers. 2) Provide an initial sample of the abundance of fishes per family on these transects. 3) Note the general ecotype in terms of other animals and topography, particularly lobsters and turtles. 4) Advise as to the research potential of this area as a marine refuge and its potential commercial value as a fishing ground. 5) Survey the area for Acanthaster plancii in cooperation with the Pacific Acanthaster Control Survey (WORL).

METHODS

Transects were chosen to include a variety of habitat types within each sample. This method was chosen to gather information on the diversity and abundance of fishes throughout the atoll for comparison with the windward islands and not for comparison between areas on French Frigate Shoals. The transect locations are indicated approximately by landmarks on the islands and major underwater topographic features (see aerial photos and appendix 1).

Samples were taken by swimming on the surface at a speed of about 20 m per minute. Approximate numbers of fishes seen within 3 to 4 m on either side of the diver were recorded as to family and size class on a underwater tape recorder with a microphone-shorkel (modified from Hydro Products, San Diego). Supplementary samples were made with snorkel and Scuba gear in the vicinity of the transects and in other locations (indicated in aerial photos and on HO chart by letters, A, B, etc.). Inclimate weather prevented the sampling of the more southerly islands and exposed areas.

RESULTS

FISHES * (see table 1)
Elasmobranchii. Small grey sharks (Carcharhinus sp.) were observed in all areas that were deeper than about 5 m. One area was never observed to have more than one shark. One large tiger shark (Galeocerdo cuvier) was observed crossing a sand bar just south of transect Trig #1.

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* Groups receive special mention below if they were found only outside of the transects, or if they appeared markedly different from the windward Hawaiian Islands.

Actinopterygii.
Anguilliformes. Only two eels were seen; one Gymnothorax meleagris near transect Trig #3, and one Gymnothorax sp.? near Tern I.

Beloniformes. While no belonids were sighted on any of the transects, numerous needle fish (Belone platyura) were seen in shallow water, usually in the lee of every island visited.

Beryciformes. Nocturnal holocentrids were not noted during the transects since they could only rarely be seen from the surface so no realistic estimate of abundance could be made. Many were seen in holes, during the supplemental observations, in all but the shallowest areas (< 2 m).

Perciformes.
Priacanthidae, Apogonidae. Big eyes (Priacanthus cruentatus) and cardinal fish, like the holocentrids, were not sampled but they were frequently sighted during the supplemental observations.

Carangidae. Jacks are notably more abundant than in the windward islands. Schools of 5 to 10 individuals up to 600 mm in length are not uncommon. Particularly large individuals of Carangoides ajax (white ulua) up to 1.5 m in total length were seen in the deeper areas with usually only one individual per "basin" of deeper water (e.g., transects East #1, Trig #3, and Tern-Trig #1).

Mullidae. Various species of goat fish are found, but apparently only Parupeneus samoensis occurs in large numbers.

Kyphosidae. Nenue (Kyphosus cinerascens) occur in not uncommonly large numbers. Occasional yellow individuals were observed on a deep reef (area __ on HO chart).

Chaetodontidae. Butterfly fishes are notably lacking in both numbers and species. Only Chaetodon miliaris was found with regularity, and C. ornatissimus (the only other common species) was common only at Tern-Trig #1.

Pomacentridae. Damselfishes were also poorly represented. Pomacentrus jenkinsi was the only species found regularly, and Dascyllus albisella was plentiful only at Tern-Trig #1.

Labridae. The wrasses are fairly well represented. Notably abundant are large Bodianus bilunulatus, Coris flavovittata, ~~and~~ C. ballieui, and Thallosoma ballieui.

Scaridae. Parrot fish are also well represented, particularly the large individuals.

Zanclidae. Moorish idols are scarce and are usually seen only as isolated individuals.

Acanthuridae. The surgeon fishes are commonly the most plentiful large fishes on the reefs. Acanthurus sandvicensis, A. xanthopterus and A. nigroris are by far the most plentiful, but large Naso unicornis (Kala) are notably more abundant than in the windward islands.

Scombridae. Kawakawa (Euthynnus yaito) were seen only on the coral reef at transect Trig #1. Several individuals were seen feeding on the numerous nehu (Stolephorus purpureus).

Gobiidae, Blenniidae. These families were not sampled by the methods employed, but were seen during supplemental observations.

Mugilidae. Young mullet (probably Neomyxus chaptalii) were seen in shallow water in the lee of Whale-Skate I.

Balistidae. The humus are notable scarce. Only a few individuals of Melichthys buniva were seen.

Diodontidae. Spiney puffers were rarely seen in any location.

DISCUSSION

The sampling method employed in this study has the advantages of speed, simplicity, and of providing a quick estimation of th numbers of many types of reef fishes in a wide range of habitats. These advantages will facilitate the comparison of French Frigate Shoals with the other Hawaiian Islands, and the possible value of the island for research or commercial exploitation. The disadvantages of these methods include inaccurate estimation of numbers due to "herding", variable swimming speed, changes in visibility, and estimation of numbers of large groups. It must be stressed that these counts include only those fishes that are active during the day and are easily seen from the surface. Many other fishes such as holocentrids, apogonids, blenniids, gobiids, chirritids, etc. should be sampled by poisoning. These transects are not useful for comparison of different habitats on French Frigate Shoals since each includes several different habitat types.

When compared with the large windward islands of Hawaii, the ichthyofauna of the portions of French Frigate Shoals studied must be considered depauperate both in terms of numbers of and diversity of species. The relative scarcity of pomacentrid and chaetodontid fishes is perhaps the most striking difference. Some groups are however notably abundant with many large individuals. These latter groups are all subject to heavy commercial and sport fisheries exploitation such as the carangids and large labrids and scarids. The abundance of these groups is probably due to the lack of human predation for the large part. The presence of these fishes, especially the large predatory uluas, may well have a profound effect on the ecosystem.

Very few turtles were seen underwater, and only one adult was found on the beach. This was unexpected in view of past observations by Dr. J. Maciolek, and evidence that active egg laying was taking place on the beaches.

Lobsters were notable scarce. The greatest abundance was found in shallow water under ledges over algae covered rubble bottom, but even here they were usually found as isolated individuals. Judging from the areas sampled, it must be concluded that lobsters are far more scarce on French Frigate Shoals than in the windward Hawaiian Islands, and that the population is certainly not capable of supporting a commercial fishery.

The coral growth on French Frigate Shoals is similar to that found in the windward Hawaiian Islands. The predominant genera are Porites and Pocillopora, while Montipora appears less abundant.

The research potential of the atoll that is obvious to this investigator lies in the comparison of the area with the other Hawaiian Islands, both in terms of small vs. large island ecology, and as an area that is relatively free from human predation and pollution. Only one species of fish (Epibulus sp.) was sighted that is not reported from the Hawaiian Islands. The monk seal and turtle populations of course provide a valuable research potential. The preservation of this area as a natural refuge would greatly enhance its research potential if this would not negate the possibility of specimen collection and limited experimental ecological manipulation.

TABLE 1 Number of fish sighted per minute on the transects
- = not seen
+ = seen off transect but in general area

DATE	8/22	8/22	8/23	8/27	8/24	8/24	8/24	8/25	8/26	
TIME OF DAY										
TRANSECT	East	#1East#2	Trig#1	Trig#2	Trig#3	W-S#1	W-S#2	R#1	T-T#1	GREATEST
SWIM TIME (min.)	21	8	9	7	15	12	5	11	15	ABUNDANCE
DISTANCE (m)	500	225	200	200	300	250	100	200	250	
FAMILY										
Carcharhinid	0.1	-	0.1	-	+	0.1	-	+	+	0.1
Engraulid	50.0	130.0	-	2.9	1.3	-	20.0	13.7	3.3	130.0
Carangid >1ft.	0.0.2	0.1	-	-	+	0.4	0.2	+	+	0.4
<1ft.	2.5	0.1	1.6	0.4	+	+	-	+	0.1	2.5
Scombrid >1ft.	0.3	-	-	-	-	-	-	-	-	0.3
<1ft.	0.1	-	-	-	-	-	0.1	-	-	0.1
Labrid >6in.	0.7	1.6	1.7	0.8	1.4	1.1	0.1	1.3	1.1	1.7
<6in.	5.0	9.8	9.0	27.2	20.1	5.1	11.8	6.6	14.1	20.1
Mullid	0.7	0.4	0.3	1.4	0.9	18.6	0.8	12.2	1.7	18.6
Acanthurid >1ft.	0.2	0.7	0.6	-	0.4	0.9	-	0.3	0.3	0.9
<1ft.	16.8	10.3	15.1	5.1	16.7	8.9	2.2	11.4	11.7	16.8
Zanclid	0.2	-	0.3	+	0.1	-	-	0.3	0.2	0.3
Scarid >18in.	2.9	2.0	1.1	0.6	1.6	-	-	3.3	1.9	3.3
>10in.	0.9	3.0	0.1	0.9	0.6	2.0	-	1.5	3.3	3.3
<10in.	1.8	1.4	11.0	30.9	7.6	16.8	+	8.2	6.4	30.9
Pomacentrid	0 0.6	1.0	3.1	2.0	6.5	1.6	0.2	3.2	7.9	7.9
Chaetodontid	0.1	0.4	1.6	2.4	1.9	0.7	1.4	0.8	2.1	2.4
Kyphosid	4.7	-	-	-	+	+	-	1.0	3.5	4.7
Balsitid	0.4	-	-	-	+	-	-	0.1	+	0.4
Diodontid	0.1	---	-	-	-	-	-	-	-	0.1
Myliobatid	-	-	0.1	-	-	1.0	-	-	-	1.0
Canthigasterid	-	-	-	0.1	0.1	+	+	+	0.3	0.3
Chirritid	-	-	-	+	+	-	+	+	+	+
Sparid	-	-	-	-	-	-	-	-	0.1	0.1
Synodontid	-	-	-	-	+	+	+	+	+	+
Kuhliid	-	-	-	-	-	+	-	-	-	+
Belonid	-	-	-	-	+	-	+	+	-	+
Atherinid	-	-	-	-	-	-	+	-	-	+
Lobster	-	-	-	-	+(2)	-	-	+(7)	+(2)	+
Turtle >2ft.	0.1	-	-	-	+(1)	-	-	-	-	0.1
<2ft.	0.1	-	-	-	-	-	-	-	-	0.1

W-S = Whale-Skate ; R = Round ; T-T = Tern-Trig (N) = total number found off transect

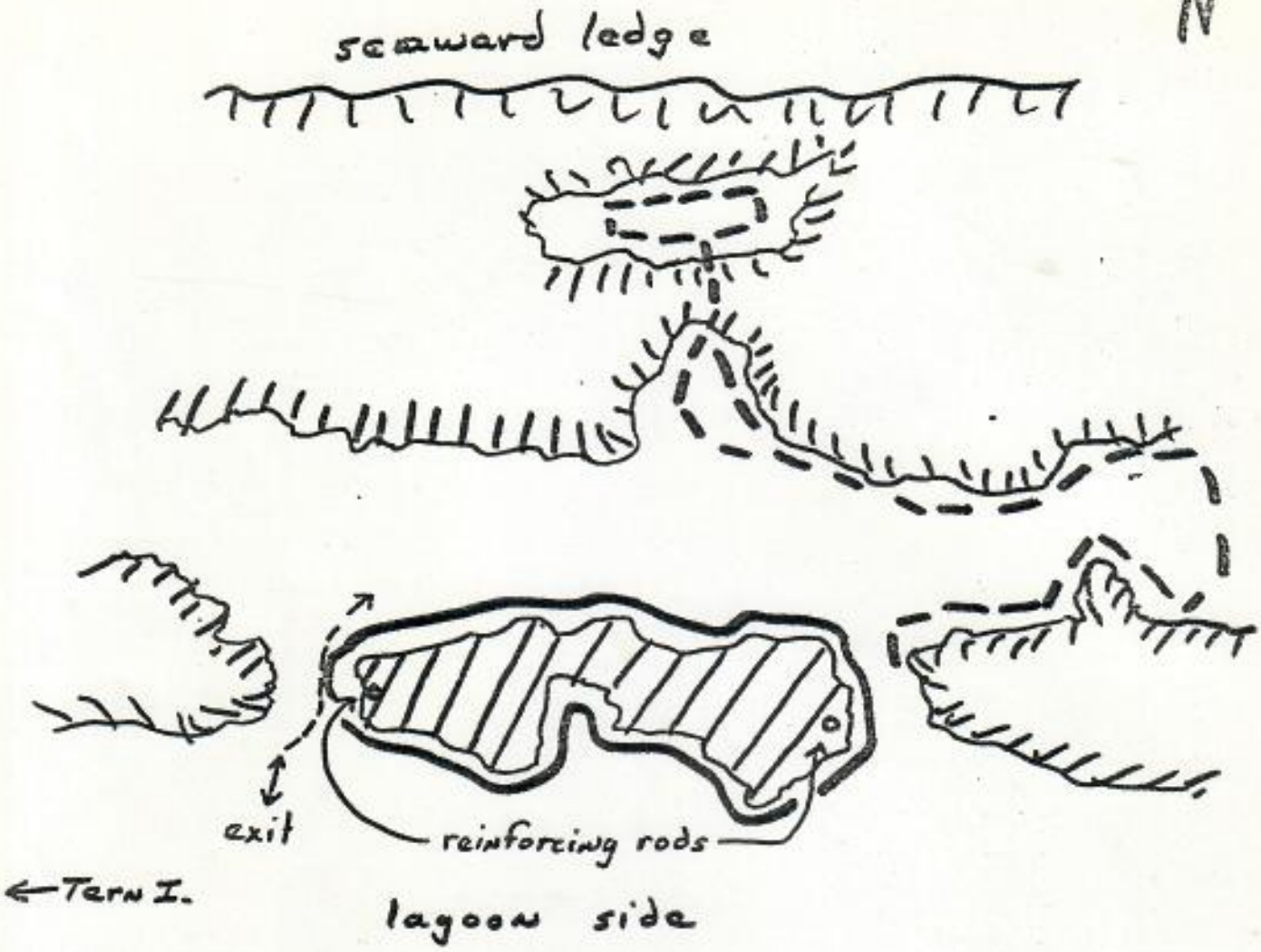

Figure 1: Crude ~~seeri~~ descriptive sketch of the area of transect(—) Tern-Trig #1 and the nearby areas that were looked at(- -)

APPENDIX I

Transect descriptions (see aerial photos).

Trig #1: (200m*, about 9 minutes swimming time, should be slack tide.) This transect, on the SE point of Trig I., is marked by one reinforcing rod on the beach and the underwater topography. Swim from beach over 2 large coral heads on sand bottom to 3 m deep, in a line to a shallow rubble ledge (about 75 m). Turn right (west) and swim along a mostly dead coral ledge until it deepens to about 4 m, and then ends in a sand rubble trough. Turn right and swim to the reinforcing rod on the beach over a sand-rubble bottom with few small coral heads (Pocillopora).

Trig #2: (200m*, about 7 minutes) Two reinforcing rods on the NE beach of Trig provide a range marker for this transect. Swim NNW on the range over a row of mostly living coral heads on white sand bottom. The depth shallows from about 7 m near the beach to about 1 m at the end of the transect. The transect ends at the beginning of the shallow fringing reef. The deeper coral heads are very large (up to 15 m in diameter) and are almost all living coral (Porites and Pocillopora). Many of the shallow heads are weathered dead coral.

Trig #3: (300m*, about 15 minutes) A pair of ranges, marked by two reinforcing rods lined up behind a refuge sign, describe this transect off the western shore of Trig. Swim out on the southern leg from the beach, on the north side of two large coral heads. This is shallow algae covered rubble. Swim across the shallow sand-rubble channel (to 3m depth) to a low ledge about ½ m deep. Turn right and follow the ledge until it ends in a sand-rubble bottom (1-4 m depth). Swim back on northern range over a sand bottom to 7 m deep.

Whale Skate #1: (250m*, about 12 minutes) A reinforcing rod on the beach denotes the approximate location of this transect on the eastern tip of Whale Skate I. Swim NE from the beach over 4 large coral heads (that can be seen from the beach) that span the channel to the eastern ledge. These are living Porites-Pocillopora heads over a sand bottom to 7 m depth. Turn right (south) at the sloping (30 to 50)rubble ledge with some living coral, and swim along the ledge until it turns west, toward the tip of the island. Swim across the channel to the beach over a sand bottom, 5-6 m deep.

Whale Skate #2: (100m*, about 5 minutes) Swim from the beach along the western intersection of the sand channel with the algae covered rubble reef that is easily seen just east of the wrecked barge off of the southern shore. Swim over 0.5 to 1.5 m deep bottom with sand-rubble and few small Pocillopora heads until even with the wrecked barge.

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*) Transect distances estimated from aerial photos to about ± 50 m.

Round #1: (200m, about 11 minutes) This transect covers the SE edge of the channel just north of Romd I. Begin at the coral "finger" that forms the NNW corner of the ledge. Swim west along the undercut ledge with some living Porites and Pocillopora over a sand bottom from 2 to 6m deep. As the water shallows and the ledge diminishes, swim in a straight line over 1 - 2m deep rubble bottom with some living coral. Continue over bottom to ½m deep until reaching the inside of the shallow fringing reef of predominantly living Pocillopora.

East #1: (500m, about 21 minutes, should be high tide) The inbound and outbound legs of this transect are marked by two reinforcing rods on the beach that are lined up on a range with the eastern most telephone pole. Swim out on the southern range over shallow rubble bottom (to 1 m deep) and swim through the surge channels of the fringing reef to the outer ledge (also the starting point for East #2). Turn left (east) and swim along a steep, undercut ledge to 6 m deep with moderate coral growth dominated by Pocillopora. On reaching the end of a reef "finger" that terminates in a large yellow Porites head, swim north, over a shallow (1m) pavement reef to the opposite ledge and swim along the ledge to the northern range. Return to the beach on this range.

East #2: (225m, about 8 minutes) This transect starts on the outer ledge (see East #1) on the southern range. Turn right (west) and swim along the ledge until reaching the large mound that leads seaward (south) and forms offshore breakers. Swim along the eastern face of this sloping mound with heavy Pocillopora growth over a sand rubble bottom to 6 m. until the mound ends seaward.

Tern-Trig #1: (250m, about 15 minutes, should be slack high tide) This transect is located in a small bay inside the fringing reef about ¼ mile east of Tern I. (see fig. 1). Two entrances to the bay are marked by reinforcing rods in the coral. (The western entrance is the preferred boat channel.) Swim around the submerged coral "island" that is marked on either end by reinforcing rods. This is an undercut ledge with many living Pocillopora heads. The bottom is sand with some rubble to 7m deep.