FIGURES 7 - MISSING

Preliminary Observations of the Inshore Marine Ecosystem in the Leeward Hawaiian Islands

Leighton R. Taylor, Jr.

Hawaii Cooperative Fishery Unit

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INTRODUCTION

Research in the marine environment of the Hawaiian Leeward Islands has been notably scant but not non-existent. A series of early papers records fishes from various localities; these are summarized in Brock, 1973. Galtsoff's (1933) report on Pearl and Hermes Reef is the most complete marine study accomplished to date in the Leeward Islands. Gosline (1955, 1965) reports peripherally on fishes of certain Leeward localities in his discussions of the fish fauna of the Hawaiian region. More recently Maciolek and Wass (1967) and Losey (1969) have recorded brief notes on the fish and invertebrate fauna of French Frigate Shoals, Laysan Island, Lisianski Island, and Pearl and Hermes Reef. Gross et al. (1969) describe the marine geology of Kure and Midway Atolls, and Dana (1971) reports on the reef corals of Kure.

This report results from two brief visits to certain Leeward localities during eleven days in May, June and July, 1973, in concert with biologists of the Hawaiian Islands National Wildlife Refuge.[1] Pressures of time prevented extensive survey of the marine ecosystem and only brief observations and limited collections were possible. It should be noted here that all observations are preliminary and non-quantitative. Abundance of certain species (as noted in Table 2) are subjective and tentative. My primary objective on these two visits was preliminary reconnaissance of the Leeward marine environment for future, more intensive research on the Leeward fish fauna.

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[1]Acknowledgment is made to Eugene Kridler, Wildlife Administrator, for his encouragement and cooperation and to David Olsen, Assistant Wildlife Administrator, for his support on the July expedition.

METHODS

Observations and collections were made while snorkeling or SCUBA diving. Collections of fish and marine invertebrates were made by hand, with sling spear, or with 5% powered rotenone (Chevron Wettable). Still photography was accomplished with a 35 mm Nikonos and movie footage was made with a 16mm Kodak K-100 in a Giddings aluminum housing.

Total in-water observation time totalled 11.5 hours. Location of dives and collections appear in Figs. 1-6; duration, type and depth of all dives are summarized in Table 1.

RESULTS AND OBSERVATIONS

Fish Fauna:

A check-list of those fish species observed, photographed, or collected appears in Table 2. The abundance terms in Column 6 are arbitrary: very common = >10/dive, common = >5/dive, uncommon = 2-4/dive, and rare = 1/dive. For secretive species such as eels, only numbers are given for those species collected in rotenone station 73-126. Numbers of shark species were counted during a single dive at the area indicated.

Three major generalizations can be made about the Leeward fish fauna which will be tested in future research. There appear to be differences in abundance of certain species in the Leeward fauna in comparison to that of the southeast high islands (Kauai-Hawaii). This is most noticeable in the Labridae, Chaetodontidae, and Acanthuridae. For example, Coris ballieui and Thalassoma purpureum are common in the Leewards but rare in the high islands. Gosline and Brock (1960) state that the taxonomy of the

Table 1

Summary of Leeward Island Dives
May, June, July 1973

Location	Date	Type	Max. Depth (ft)	Duration (Min.)	Collection	Photos
Midway Island						
1. PMR Reef	28 May	Snorkel	15	80		35mm
2. 1/2 way to Reef Hotel	1 June	SCUBA	30	60		35mm
3. Willis Harbor S. end	2 June	SCUBA	45	60	HCFU73-130	
4. Reef Hotel Area	2 June	Snorkel	10	60		35mm
Pearl & Hermes Reef						
5. E. Island, S. side	31 May	Snorkel	30	60		35mm
Lisianski Island						
6. S.E. side	29 May	Snorkel	30	40	HCFU73-131	
7. E. side off beach-rock terrace	30 May	Snorkel	20	40		35&16mm
8. Lisianski Is.	30 May	SCUBA	30	30	monk seal incident	
9. Off Refuge Sign, W. side	24 July	Snorkel	10	30		35mm
Laysan Island						
10. Off Refuge Sign, W. side	26 July	SCUBA	30	70	73-126	
11. "	27 July	Snorkel	15	30	73-127	
12. Laysan Lagoon	27 July	Snorkel	15	15		35mm
French Frigate Shoals						
13. Trig Is.	29 July	Snorkel	15	15	73-128	
14. Whale-Skate	"	"	15	20		35mm
15. East Is.	"	"	30	30		35mm
16. La Perouse Pinn.	"	"	35	30		
Necker Island						
17. W. Cove	30 July	SCUBA	45	50		35mm

latter species is in need of clarification due to the confusion of this form with T. fuscum and T. umbrostigma. Additional material from French Frigate Shoals would be helpful in solving this problem.

Only four species of Chaetodontidae were observed; the abundant species commonly seen in the high islands were notably absent. Reese (1973) has pointed out that certain Chaetodon species are highly specific in their food habits. Perhaps differences in availablility and abundance of certain coral species (upon which these fishes feed) are critical factors here.

Also apparently missing or at least rare in the Leeward fauna are many of the acanthurid species common in the south Hawaiian Islands. It is possible that a paucity of certain algae on which these acanthurids feed is a limiting factor.

Although quantitative differences do appear to exist between north and south, qualitative differences are slight. One observed difference, however, is the presence of the labrid, Epibulus insidiator. This species is common in the Indo-Pacific but has never been recorded from the high Hawaiian Isalnds (although it does occur at Johnston Island).

A significant find at Laysan Island was a single specimen of the serranid, Liopropoma n. sp. Randall and Taylor; the only other specimen taken was collected in Kaneohe Bay, Oahu.

A further difference in the Leeward fauna is the abundance of larger fishes in shallower water and their boldness toward man. This may be explained by the lack of fishing in the area. Carangoides ajax (white ulua) up to 1 m long are common in water as shallow as 3 m. These animals are aggressive to the point of inconvenience to divers. During a SCUBA

dive at Lisianski Island, an individual judged to be about 75 cm in length was shot with a McNair bangstick. The fish was immediately attacked by the four other members of the group in which it had been swimming. After 30-60 seconds of frenzied feeding, a large male monk seal (~2.25 m) entered the group, seized the dying ulua and swam off with it clenched in his teeth pursued by the other large fish.

Large schools of Kuhlia sandvicensis (aholehole), Neomyxus chaptalii (mullet), and Kyphosus cinerascens (nenue) are very abundant in water as shallow as 50 cm.

Sharks

Sharks did not present a problem to divers although numerous specimens were seen. Caution is advised while diving in the Leeward chain due to the presence of large numbers of sharks in relatively shallow waters.

Small specimens (>1.5 m) of Carcharhinus menissorah (gray reef shark) were observed at Midway Island and became quite curious but not aggressive in areas where small fish were being speared.

At Pearl and Hermes Reef, numerous sharks (unidentified) were visible in shallow waters viewed from a Navy helicopter. An approximately 2.5 m specimen judged to be Carcharhinus galapagensis was observed in shallow water from the beach (Fig. 7) but no sharks were seen by divers at Pearl and Hermes Reef.

No sharks were seen by divers at Lisianski Island although several were sighted from the air.

Several 1-1.5 m C. menissorah were observed at Laysan Island but did not become aggressive during an hour-long rotenone station.

No sharks were seen at French Frigate Shoals but a 3 m specimen of Galeocerdo cuvieri (tiger shark) was recently collected near Trig Island in 2 m of water by David Olsen of the Hawaiian Islands National Wildlife Refuge.

The greatest number of sharks was seen at Necker Island. More than 15 individuals (unidentified but likely C. menissorah) were seen in Shark Bay from the top of the western peak. SCUBA divers in West Cove counted 15 C. menissorah during one dive (Fig. 8); these sharks were curious but non-aggressive. Also briefly sighted during this dive was a single Galeocerdo cuvieri (about 2.5-3.0 m). Two monk seals and the small gray sharks in the area did not appear to react to the large shark's presence, and the shark did not appear aggressive despite stridulations from captive specimens of Panulirus japonicus (lobster) in one diver's handbag.

Several results of apparent shark attack were observed in individual monk seals which bore obvious bite marks (Fig. 9) and in one case the complete loss of hind flippers (Fig. 10). A large male Chelonia mydas (green sea turtle) was found moribund on Lisianski Island apparently due to loss of his tail by a shark (Fig. 11).

"being in a dying condition"

Invertebrate Fauna

Because my major focus during these two trips was on the fish fauna, collections of invertebrates were limited and opportunistic. Those specimens collected are listed below. I wish to thank Drs. Julie Brock, Robert Kinzie, and Sidney Townsley for assistance in identification.

Coelenterata (Anthozoa, Madreporaria, "stony corals"):

Collections of corals were made at two localities and photographs were made of colonies from which samples were taken.

Midway Island Lagoon

Montipora verrucosa	Fig.
Montipora? sp.	
Pavona varians	
P. meandrina	Fig.
Porites compressa	Fig.
P. pokuensis	Fig.

Lisianski Island, S.E. side

Montipora verrucosa
Pavona explanulata
Pocillopora damicornis
P. meandrina
Porites compressa

Annelida (Polychaeta, Amphinomidae):

Notopygos gregoryi: Large fire worm, 2 specimens 150 mm; washed ashore at Lisianski Island

Arthropoda (Crustacea):

Amphipoda: Specimens from Laysan Island Lagoon shore sent to Dr. E. L. Bousfield, National Museum of Natural Science, Ottawa, Canada.

Decapoda: Rhynchocinetus ringens: Small pink shrimps from HCFU73-126, Laysan Island.
Panulirus japonicus: Lobster, 2 specimens, Necker Island.

Table 2

Check-list of fishes of the Hawaiian Leeward Islands
Observed during 2 expeditions in 1973

FAMILY and Species	Common Name	Island	Number, or Relative Abundance	Photo (+, -)	Coll. No.
CARCHARHINIDAE	Gray Sharks				
Carcharhinus galapagensis	Galapagos shark	P&H*	1	+	
C. menissorah	Grey reef shark	Mi,Ne	6,12+	+	
Galeocerdo cuvieri	Tiger shark	Ne	1	-	
MYLIOBATIDAE	Eagle Rays				
Aetobatis narinari	Eagle ray	FF	8+	+	
SYNODONTIDAE	Lizard Fishes				
Synodus binotatus	2-spotted lizard fish	La	1	-	73-126
MURAENIDAE	Moray Eels				
Gymnothorax eurostus	Common moray	La	13	-	73-126
CONGRIDAE	Conger Eels				
Conger oligoporus	" "	La	1		73-126
AULOSTOMIDAE	Trumpet Fishes				
Aulostomus chinensis	Trumpet fishes	Mi,La,Li	uncommon	-	
SYNGNATHIDAE	Pipe Fishes and Sea Horses				
Doryrhamphus melanopleura	Pipe fish	La	1	-	73-126

*Island Abbreviations: Mi, Midway; P&H, Pearl and Hermes Reef; Li, Lisianski; La, Laysan; Ne, Necker

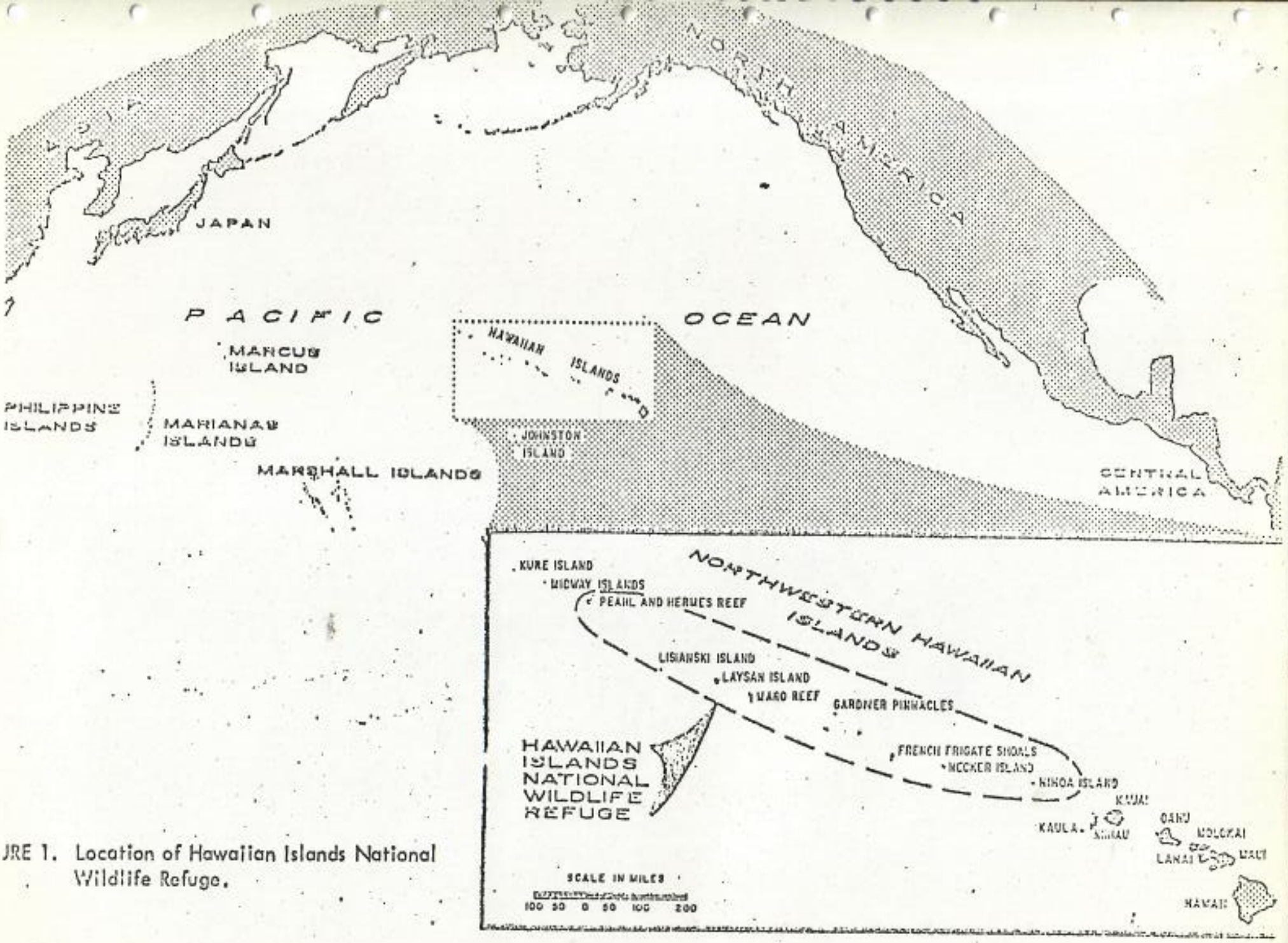
FAMILY and Species	Common Name	Island	Number, or Relative Abundance	Photo (+, -)	Coll. No.
HOLOCENTRIDAE	Squirrelfishes				
Plectrypops lima	Squirrelfish	La	3	-	73-126
Adioryx lacteoguttatus	Spot-bellied sq'fish	Mi,Li,La,FF,Ne	Common	-	73-126
ATHERINIDAE	Silversides				
Pranesus insularum	Iao	La	Common	-	73-126
MUGILIDAE	Mullets				
Neomyxus chaptalii	Mullet	P&H,Li,La	Common	+	
SERRANIDAE	Sea-basses				
Liopropoma n.sp.	Wrassassedbass	La	Rare	-	73-126
KUHLIIDAE	Aholeholes				
Kuhlia sandvicensis	Aholehole	Mi,P&H,Li,La,FF,Ne	Common	+	
PRIACANTHIDAE	Bigeyes				
Priacanthus cruentatus	Aweoweo	La	Rare	-	
APOGONIDAE	Cardinal Fish				
Apogon snyderi	Cardinal fish	Mi,La	Rare	-	
A. erythrinus	"	La	10	-	73-126
CIRRHITIDAE	Hawkfishes				
Paracirrhites arcatus	Piliko'a	Mi	Rare	-	

FAMILY and Species	Common Name	Island	Number, or Relative Abundance	Photo (+, -)	Coll. No.
CARANGIDAE	Jacks, Uluas				
Caranx melampygus	Omilu	Mi,Li,La,FF,Ne	Common	+	
C. ignobilis	Ulua	La,FF	Common	-	
C. ajax	White ulua	Li,La,FF	Common	+	
MULLIDAE	Goatfishes				
Mulloidichthys samoensis	Weke	Mi,P&H,Li,La,FF	Common	+	
Parupeneus multifasciatus	Moano	Li	Rare		
P. bifasciatus	Munu	Li	Rare	-	
KYPHOSIDAE	Rudder Fishes				
Kyphosus cinerascens	Nenue	Mi,P&H,Li,La,FF,Ne	Common	+	
CHAETODONTIDAE	Butterfly Fishes				
Chaetodon miliaris	Butterfly fish	Mi,Li,La,FF	Common,3	+	73-126
Ch. fremblii	"	Mi,Li,La,FF	Common,3		
Ch. auriga	"	Mi,Li	Uncommon	-	
Ch. quadrimaculatus	"	Mi,Li	Uncommon	-	
Ch. trifasciatus	"	Mi	Uncommon	-	
Forcipiger flavissimus	"	Mi	Uncommon	-	
POMACENTRIDAE	Damselfishes				
Abudefduf sordidus	Kupipi	Mi,Li,La,FF	Common	-	
Dascyllus albisella	White-spot damsel	Mi,FF	Uncommon	-	
Pomacentrus jenkinsi	Damselfish	Mi,Li,FF	Common		
Chromis ovalis?	"	Mi,Li	Uncommon	-	

FAMILY and Species	Common Name	Island	Number, or Relative Abundance	Photo (+, -)	Coll. No.
LABRIDAE	Wrasses				
Anampses cuvieri	Opule	Mi,La	Uncommon,3	-	73-126
Bodianus bilunulatus	A'awa	Mi,Li,La,FF	Common	+	
Coris ballieui	Wrasse	Mi,Li,La	Common,1	+	73-130
C. flavovittata	Hilu	Mi,P&H,Li,La,FF	Common,1	+	73-130
C. venusta	Wrasse	La	Uncommon,1	-	73-126, 73-130
Epibulus insidiator	Long-jawed wrasse	Mi,La,FF	Rare	?	
Gomphosus varius	Turkey wrasses	Mi,La	Uncommon	-	
Labroides phthirophagus	Cleaner wrasse	Mi,P&H,Li,La,FF,Ne	Common,3	-	73-130
Macropharyngodon geoffroyi	Hinalea	Mi,Li,La,FF	Common,1	-	73-130
Pseudocheilinus octotaenia	"	Mi,FF	Uncommon,	-	
Stethojulis balteata	Omaka	Mi,Li,La,FF	Common,11	-	73-126
Thalassoma ballieui	Hinalea luahine	Mi,P&H,Li,La,FF,Ne	v. common,16	+	73-126
T. duperreyi	Hinalea lauwili	Mi,P&H,Li,La,FF,Ne	v. common,14	-	73-126, 73-130
T. purpureum	Olani	Mi,Li,La,FF	v. common,2	-	73-127
T. umbrostigma	Hinalea	P&H,Mi,Li,La,FF	v. common,1	+	73-127
SCARIDAE	Parrot Fishes				
Scarus perspicillatus	Uhu	Mi,P&H,Li,La,FF,Ne	v. common	+	
TRICHONOTIDAE					
Crystallodytes cookei		La	Common?,12	-	73-126
ZANCLIDAE	Moorish Idols				
Zanchus canescens	Moorish idol	Mi,Li,La,FF	Common	+?	

FAMILY and Species	Common Name	Island	Number, or Relative Abundance	Photo (+, -)	Coll. No.
ACANTHURIDAE	Surgeonfishes				
Acanthurus nigrofuscus	Surgeonfish	Mi,P&H,Li,La,FF	Common	+	73-126
A. nigroris	Maiko	Mi,P&H,Li,La,FF			73-127
A. triostegus	Manini	Mi,P&H,Li,La,FF,Ne	Common	+	73-126
Naso spp.	Unicorn fish	Mi,Li,La			
ELEOTRIDAE	Gobies				
Eviota distigma	Goby	La	Common,10	-	73-126
GOBIIDAE	Gobies				
Quisquilius eugenius	Goby	La	Common?,1	-	73-126
BLENNIIDAE	Blennies				
Cirripectus lineopunctatus	Blenny	La	1	-	73-126
C. obscurus	"	La	2	-	73-126
C. variolosus	"	La	Common,57	-	
Exallias brevis	O'opu pao'o	Mi,Li,La	Common	-	
Plagiotrema ewaensis	Sabretooth blenny	Mi,Li,La	Common	-	
SCORPAENIDAE	Scorpionfishes				
Scorpaena coniorta	Scorpionfish	La	2	-	73-126
PEGASIDAE	Pegasusfishes				
Pegasus papilio	Pegasusfish	La	Rare	-	

FAMILY and Species	Common Name	Island	Number, or Relative Abundance	Photo (+, -)	Coll. No.
BALISTIDAE	Triggerfishes				
Melichthys niger	Humuhumu	Mi,Li,La,FF	Common	+	
M. vidua	"	Mi,La	Uncommon	-	
MONACANTHIDAE					
Pervagor spilosoma	O'ili uwiwi	Mi,Li,La,FF	v. common	+	
CANTHIGASTERIDAE	Sharpbacked Puffers				
Canthigaster jactator	Sharpbacked puffer	Mi,Li,La,FF	Common	-	
DIODONTIDAE	Spring Puffers				
Diodon hystrix	O'opu kawa	Mi,La	Uncommon	-	
ANTENNARIIDAE	Anglerfishes				
Antennarius bigibbus	Anglerfish	La	Rare?	-	73-126
A. drombus	"	La	Rare?	-	73-126



JRE 1. Location of Hawaiian Islands National Wildlife Refuge.

Figure 1

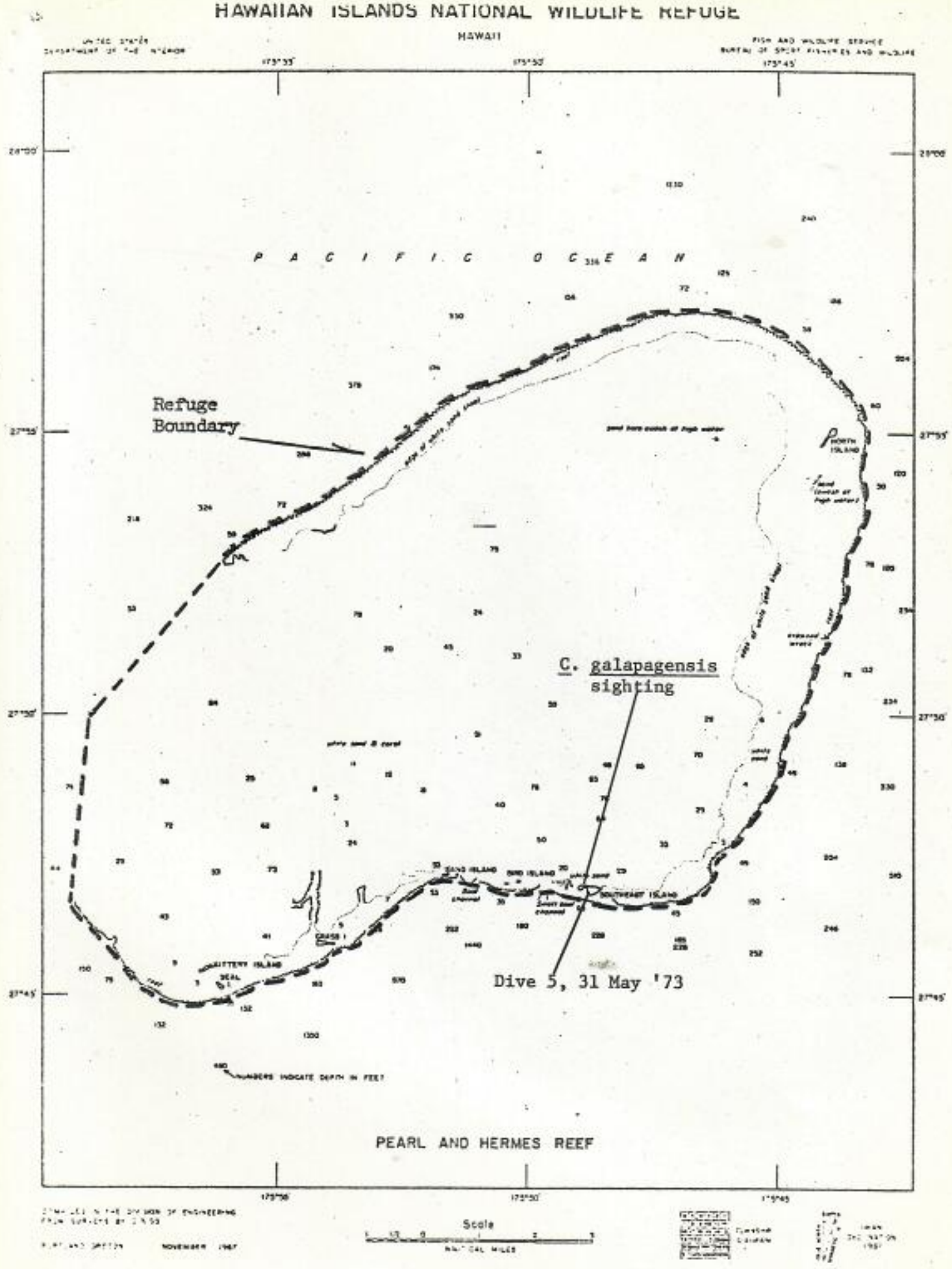

HAWAIIAN ISLANDS NATIONAL WILDLIFE REFUGE
HAWAII
P A C I F I C O C E A N
Refuge Boundary
C. galapagensis sighting
Dive 5, 31 May '73
PEARL AND HERMES REEF
Scale

Figure 2

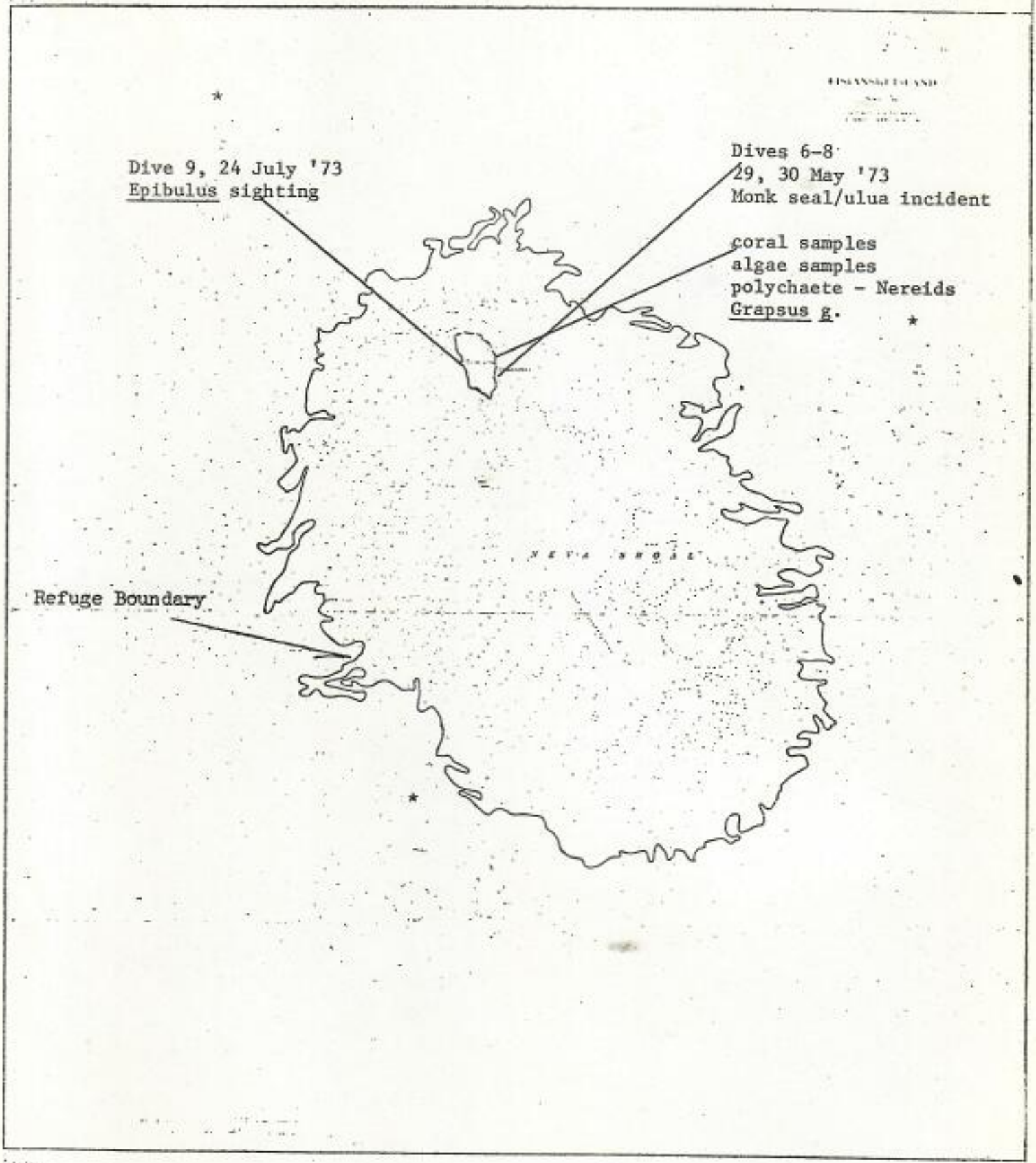

Dive 9, 24 July '73
Epibulus sighting
Dives 6-8
29, 30 May '73
Monk seal/ulua incident
coral samples
algae samples
polychaete - Nereids
Grapsus g.
Refuge Boundary

Figure 3

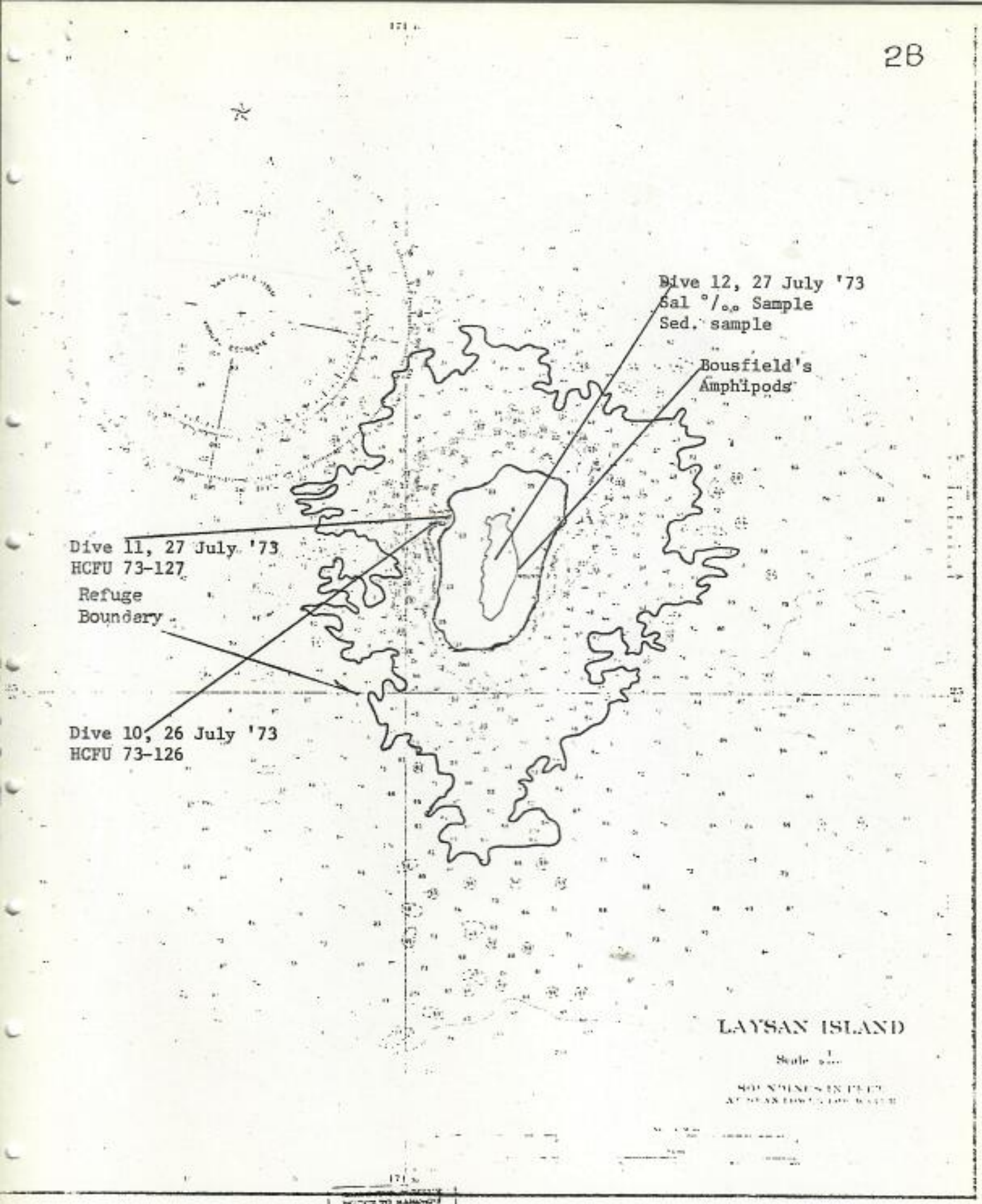

Dive 12, 27 July '73
Sal °/₀₀ Sample
Sed. sample
Bousfield's
Amphipods
Dive 11, 27 July '73
HCFU 73-127
Refuge
Boundary
Dive 10, 26 July '73
HCFU 73-126
LAYSAN ISLAND

Figure 4

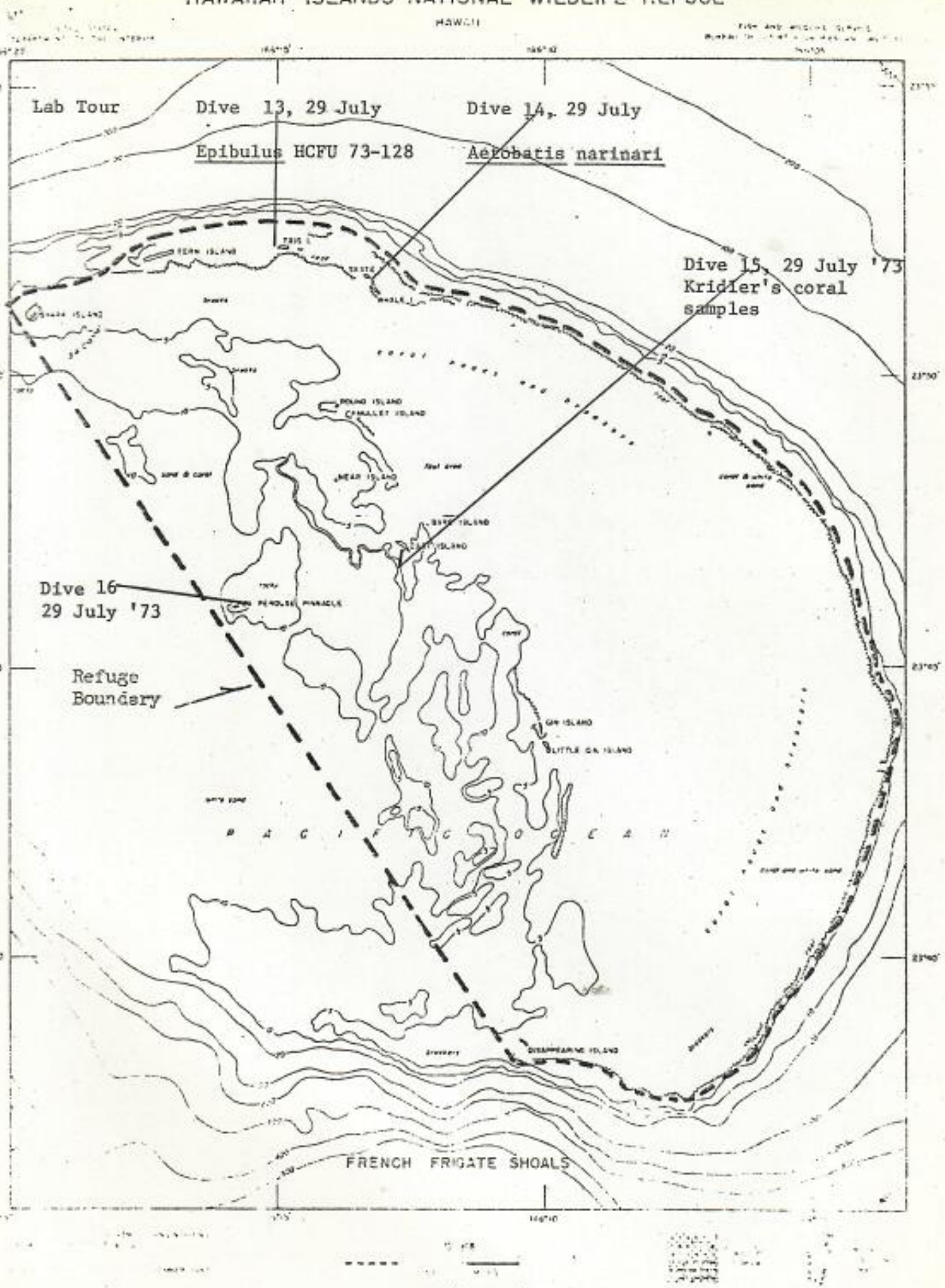
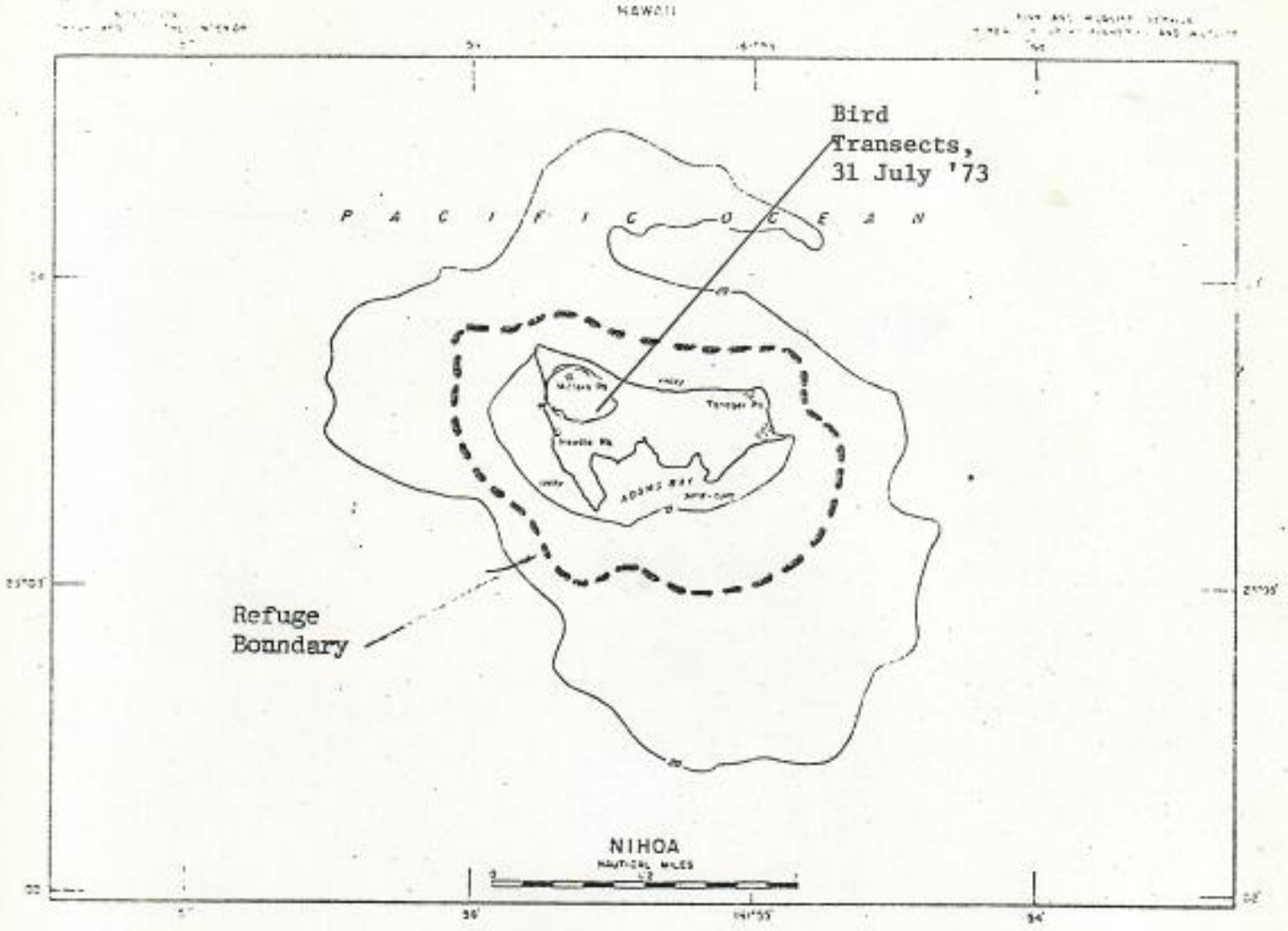

HAWAIIAN ISLANDS NATIONAL WILDLIFE REFUGE
HAWAII
Lab Tour
Dive 13, 29 July
Epibulus HCFU 73-128
Dive 14, 29 July
Aetobatis narinari
Dive 15, 29 July '73
Kridler's coral
samples
Dive 16
29 July '73
Refuge
Boundary
FRENCH FRIGATE SHOALS

Figure 5

HAWAIIAN ISLANDS NATIONAL WILDLIFE REFUGE



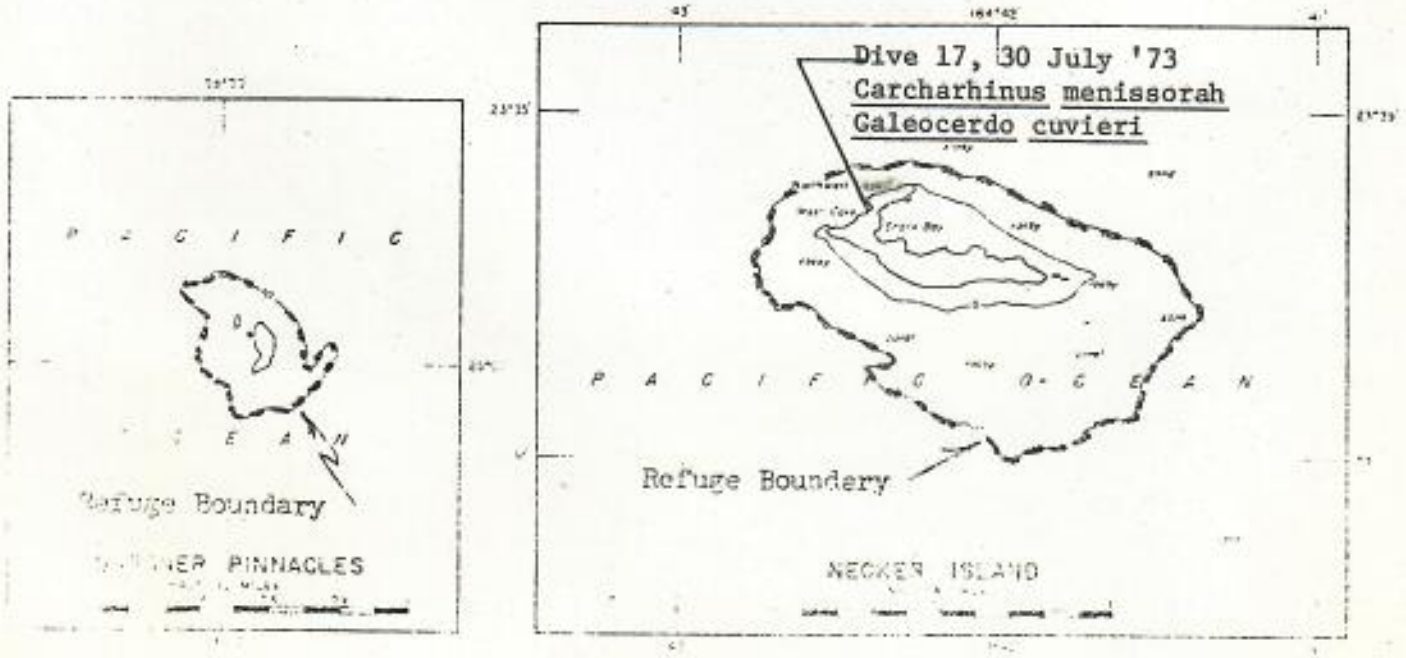


Figure 6

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