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A Report on the Poisonous Fishes of the Line Islands.[1]

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This is the fifth of a series of epidemiological reports concerning the poisonous fishes of the tropical Pacific. The first report (HALSTEAD & BUNKER, 1954 a) dealt with the Phoenix Islands, the second (HALSTEAD & BUNKER, 1954 b) with Johnston Island, the third (HALSTEAD & SCHALL, 1955) with the Galápagos Islands, and the fourth (HALSTEAD & SCHALL, 1956) with Cocos Island. For a general résumé of the overall problem of poisonous fishes and ichthyosarcotoxism, the reader is referred to three earlier publications by HALSTEAD (1951, 1953) and HALSTEAD & LIVELY (1954).

A more complete discussion of the manner in which fishes are believed to become poisonous has been published elsewhere (HALSTEAD & BUNKER, 1954 a). There are probably a multiplicity of factors governing the degree of toxicity of a fish, such as abundance of certain types of food, the availability of certain types of organic chemical constituents in that food, and the physiology of the fish. A study on the stomach contents of poisonous fishes from Palmyra Island has been conducted by DAWSON, ALEEM, & HALSTEAD (1955).

The present study was stimulated by the reports of LEE & PANG (1945), and ROSS (1947), who first attracted attention to the problem of ichthyosarcotoxism in the northern Line Islands.

In addition to the support given by the Public Health Service and the Office of Naval Research, generous assistance was received from the Pacific Oceanic Fishery Investigations, U.S. Fish and Wildlife Service, the Civil Aeronautics Administration, the U.S. Coast Guard, the Division of Fish and Game, Board of Commissioners of Agriculture and Forestry, Territory of Hawaii, the Department of Health, Territory of Hawaii, the Pacific Science Association, the Pacific Science Board, National Research Council, the Bernice P. Bishop Museum, the Pacific Science Association, the Pan American World Airways, the Fanning Island Plantation, Ltd., and the Hawaiian Tuna Packers, Ltd. We are particularly

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indebted to the following individuals: Dr. Richard K. C. Lee, Dr. C. L. Wilbar, Jr., Mr. Vernon E. Brock, Mr. O. E. Sette, Mr. M. B. Schaefer, Dr. Harold J. Coolidge, Miss Ernestine Akers, Mr. Loring Hudson, Miss Brenda Bishop, Mr. Yoshio Yamaguchi, Mr. Edwin Bryan, Jr., Dr. James T. Kuninobu, Captain William A. Rice, Dr. S. R. Galler, Dr. James Enright, Mr. L. V. Fullard-Leo, Mr. Joseph King, Mr. George H. Akau, Mr. P. F. Palmer, Mr. Fred Cleaver, and Mr. J. Hogan.

Incidence of Fish Poisoning in the Northern Line Islands.

Poisonous fishes have been known to exist within the tropical Pacific since 1606 (FORSTER, 1778). Scores of subsequent references are to be found, in a literature of more than 1500 publications on poisonous marine animals, on the occurrence of ichthyosarcotoxism in various areas of the Pacific. However, the first reports to appear on poisonous fishes in the northern Line Islands are by LEE & PANG (1945), and ROSS (1947). A statement in ROSS' article is particularly noteworthy, viz. "No cases of fish poisoning had been recorded by previous medical officers or remembered by those people who had previously lived at Fanning. Because the number of cases has been steadily increasing, I have started an investigation . . ." The status of fish poisoning in the Pacific area is of concern because of its direct bearing upon public health and the utilization of fisheries resources.

During February, 1951, Mr. Kenneth E. Groves, of our staff, visited the northern Line Islands in conjunction with the field activities of the Pacific Oceanic Fishery Investigations in that region. A second expedition was sent to Palmyra Island during April and May, 1953. Members of the second expedition consisted of Messrs. Norman C. Bunker, Leonard S. Kuninobu, Robert L. Smith, F. Douglas Horton, Donald G. Ollis, and the senior author. As a result of these trips it was possible to collect many of the specimens and epidemiological data presented in this report.

Various officials of the Fanning Island Plantation, Ltd., were questioned as to the history of fish poisoning in the Line Islands. The statements of these workers were essentially in agreement with a letter written (1953) by Mr. P. F. D. Palmer, manager of the Plantation, part of which is quoted below:

> From personal experience going back to 1936, I can firmly state that the only poisonous fish in Fanning Island, in or out of the lagoon, up until the outbreak of the Pacific War in 1941, was

the *Tetraodon* and this could be eaten freely if the poison sack was first removed. There was never, in the history of the island, a fish with toxic matter in the musculature. This applies to all the other islands in this group. On my return from the war in 1946, I found cases of fish poisoning on Fanning Island from eating *Lutjanus vaigiensis.* The fish was not blamed at the time as fish poisoning was unknown. In the next four years, we had hundreds of cases of poisoning from *Lethrinus, Callyodon, Cephalopholis, Lutjanus flavipes, L. fulviflama, Ctenochaetus, Balistes, Serranus, Caranx, Sphyraena,* and *Gymnothorax.* No pelagic fish have ever been poisonous and no "schooling fish", such as mullet, garfish, etc. Also, strangely enough, no "white fish", or fish without color have ever been poisonous. We are of the firm opinion that the contamination is being washed away. Almost any *Caranx, Serranus,* and *Lutjanus flavipes* can now be eaten in safety (4 November 1953). We are still suspicious of *Callyodon, Lutjanus vaigiensis* and *Lethrinus,* but they may be quite safe now . . . No fish at Washington Island has ever been poisonous—even during the worst period of the 1940's. For this reason alone, we are firmly of the opinion that the poison was introduced by the Armed Forces—Washington Island being the only island in the group without a garrison. My own opinion is that either (or both) the coral polyp or the red or green algae have formed a poisonous chemical compound from the picric acid in flares, mortar refills, and other dumped ammunition. We expect the "period" to pass completely away from the islands within the next year or so when, we hope, any and all fish (with the exception of the badly prepared *Tetraodon*) can be eaten here, or in the Hawaiian market, in safety.

According to Plantation officials fish poisoning began in the Line Islands about 1943 and appeared first at Palmyra Island during the latter part of 1945. With the exception of plectognaths, Washington Island is still considered to be free of poisonous fishes. No cases of ichthyosarcotoxism have ever been reported from this island.

The statements of the Fanning Island Plantation officials regarding the development of ichthyosarcotoxism in the Line Islands are further substantiated by data provided by Mr. Vernon E. Brock, Director, Division of Fish and Game, and Dr. Richard K. C. Lee, President, Board of Health, both for the Territory of Hawaii. The following is a list of some of the more outstanding fish catches imported from the Line Islands and sold at the Aala Market and other independent fish dealers in Honolulu:

Date	Type of Fish	Poundage	Origin of Fish
23 Nov. 1930	Red snapper	9,820	Fanning, Christmas, Washington, Palmyra Islands
29 Apr. 1931	Ulua *(Caranx)*	11,066	Palmyra Island, Kingman Reef
	Red snapper	14,732	Kingman Reef
29 Apr. 1931	Lobster	600	Palmyra Island, Kingman Reef
	Misc. fishes	1,100	Kingman Reef
2 July 1931	Ulua	18,200	Christmas, Fanning Islands
	Red snapper	10,560	Christmas, Fanning Islands
	Lobster	1,106	Christmas, Fanning Islands
	Misc. fishes	4,605	Christmas, Fanning Islands

This data was submitted by Captain William G. Anderson, who was master of the vessel "M. V. Islander", upon which these fishes were shipped (Letter to Mr. Vernon E. Brock, dated June 6, 1953). Captain Anderson further states:

> Having been born on Washington Island and reared—one might say—on the reefs of all these islands, I can definitely say that poisonous fish were unknown up to and including 1937—the year in which the "Islander" made her last trip. No reports or complaints were received from sellers or consumers of any poisonous fish in these shipments or any other shipments by the "M. V. Lanikai" or the "M. V. Islander".

According to the Board of Health for the Territory of Hawaii, the first reported outbreak of ichthyosarcotoxism known to result from the ingestion of a Line Island fish in the Territory of Hawaii occurred in December, 1944, from eating a black seabass, *Epinephelus fuscoguttatus*, imported from Christmas Island. Table I gives a list of the outbreaks of fish poisoning caused by Line Island fishes.

Judging from the remarks of various public health officials, plantation workers, and military personnel formerly stationed in the Line Islands, the number of persons that have been actually intoxicated from the "food fishes" of this region is considerably higher than is indicated by the figures presented in Table I.

The frequency of outbreaks of ichthyosarcotoxism caused by reef fishes imported from the Line Islands and sold in the Territory of Hawaii has resulted in public health legislation prohibiting the sale of incriminated species (Public Health Regulations, Board of Health, Territory of Hawaii, Second Amendment to Chapter 4, Food and Food Products, Section 466, Revised Laws of Hawaii, April 2, 1954).

TABLE I.

A Summary of Reported Outbreaks of Ciguatera from Line Island Fishes.

Date	Locality	No. Cases	Deaths	Causative Fish	References
Feb. 1943	Palmyra	12	–	*Lutjanus vaigiensis*	TITCOMB (1945), HALSTEAD and LIVELY (1954)
Dec. 1944	Christmas	14	–	*Epinephelus fuscoguttatus*	LEE and PANG (1945ab)
Aug. 1944	Palmyra	6	–	*Lutjanus* sp.? "Red snapper"	HALSTEAD and LIVELY (1954), LEWIS (1952)
Jan. 1945	Palmyra	1		"Red snapper"	HALSTEAD and LIVELY (1954)
Feb. 1945	Palmyra	12		"Red snapper"	HALSTEAD and LIVELY (1954)
Nov. 1946	Palmyra	5		"Red snapper"	HALSTEAD and LIVELY (1954)
1945?	Christmas	3		*Variola louti*	TITCOMB (1945)
Feb. 1947	Palmyra	20	1	Species unknown	ZIESENHENNE (1952)
Feb. 1946	Fanning	95	–	"Grey rock cod, red rock cod, black jack, bonefish, reef fish, schnapper, greenfish, mullet, red schnapper, bream"	ROSS (1947)
Spring 1947	Fanning	1	–	*Lutjanus* sp.	HALSTEAD (unpublished data)
Sept. 1947	Christmas	16	–	*Lutjanus vaigiensis*	LEE (1950)
Dec. 1947	Christmas	17	–	*Lutjanus vaigiensis*	LEE (1950)
Nov. 1950	Kingman Reef	3	–	*Lutjanus vaigiensis*	REINTJES (1951)
? 1951	"Line Islands"	"Several"	–	*Lutjanus vaigiensis*	HALSTEAD (unpublished data)
Feb. 1951	Palmyra	26	–	*Acanthurus triostegus*	AKAU (1951)
March 1954	Palmyra	1	–	*Caranx ignobilis*	GOE and HALSTEAD (1955)

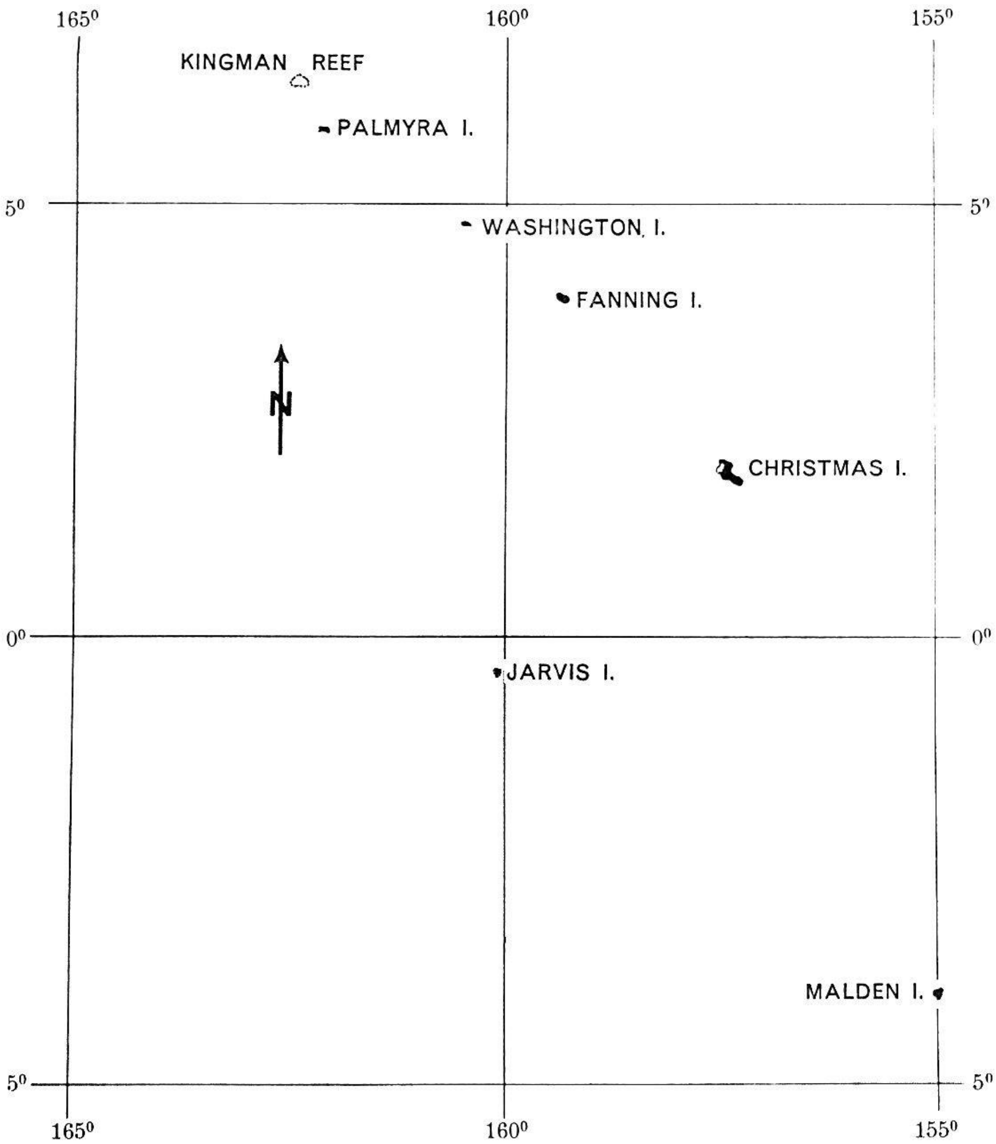

Fig. 1. Line Islands, showing the location of each island in relation to the others.

Geography and Ecology.

The 19 scattered islands which lie near the equator and the meridian of 160° west are commonly referred to as the Line Islands (BRYAN, 1942; ROBSON, 1950; U.S. Hydrographic Office, 1940). The islands included in this report are Malden, Jarvis, Christmas, Fanning, Washington, Palmyra and Kingman Reef. This particular group lies between latitudes 4°03′S. to 6°25′N. and longitudes 154°59′W. to 162°24′W. The islands are all small low-lying coral atolls. Malden, Christmas, Fanning, and Washington are under British rule, whereas Jarvis, Palmyra and Kingman Reef are administered by the United States.

MALDEN (lat. 4°3′S., long. 154°59′W., Fig. 1): Malden is a low, flat, triangular-shaped, coral island with a total land area of 29.14 sq. kilometers. The land rim encloses several saltwater lagoons which are located near the center of the island. Malden is surrounded by reefs which extend 400 to 600 meters out from the

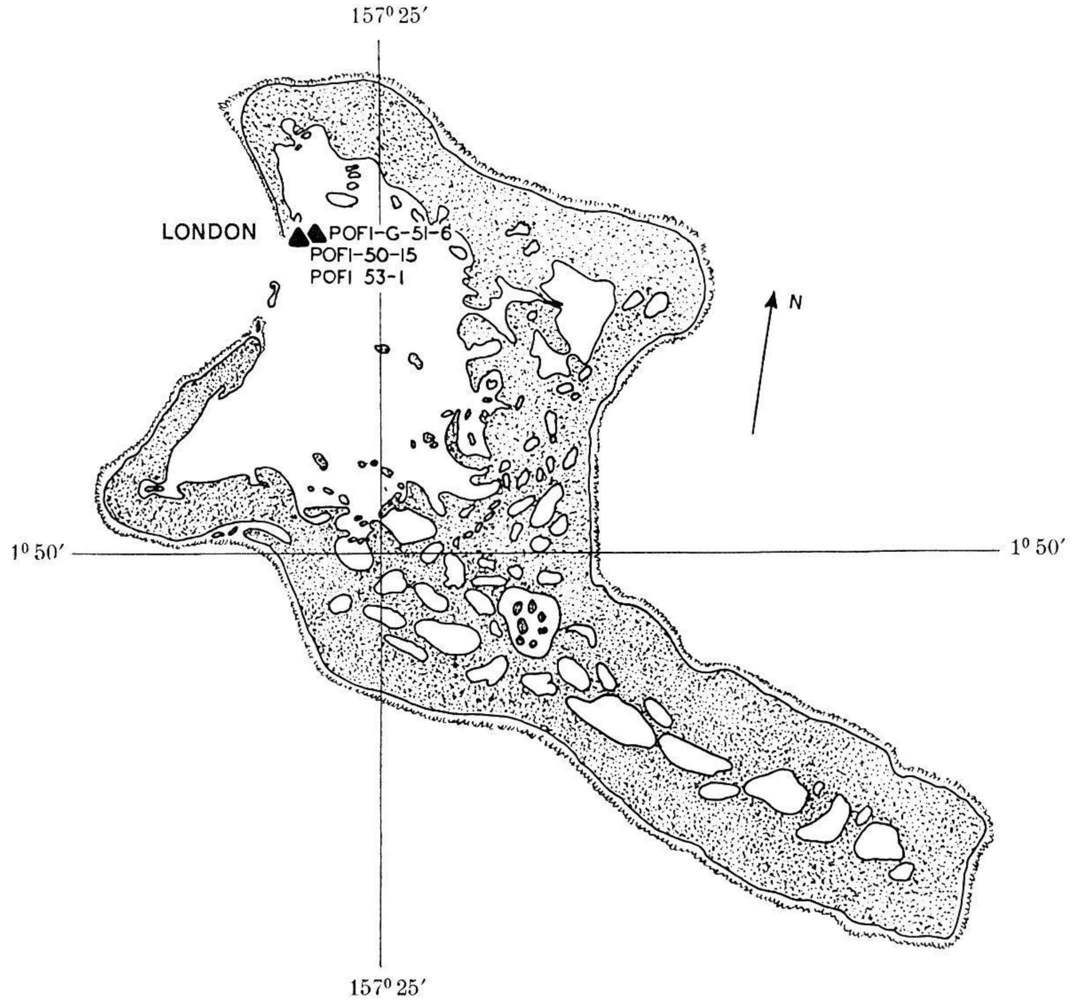

Fig. 2. Christmas Island.

island. The bottom drops off rapidly. The prevailing winds are from the east and northeast. The average annual rainfall is about 71 cm. but varies considerably from year to year. The mean climatic temperature is 27.7° C. Surface water temperature 26.0° C. In the past, freshwater wells were found to be non-productive. Ocean currents about Malden vary considerably as to direction and rate of flow. The island is dry and barren. Vegetation consists merely of a few shrubs and littoral plants. Malden maintains a large oceanic bird population, but no human beings. An abandoned settlement is located on the western extremity of the island. There are no data available regarding the incidence of ichthyosarcotoxism for this island.

Field number POFI 51-1. Malden Island, specific location not given. Bottom is comprised of coral and sand. Specimens consisted of *Acanthurus, Caranx, Ctenochaetus, Epinephelus, Kuhlia, Lutjanus, Myripristis,* and *Pseudobalistes,* captured at depth of 3 meters, by spear. January 27, 1951. J. E. King.

JARVIS (lat. 0°23′S., long. 160°02′W., Fig. 1): Jarvis is a saucer-shaped island consisting of coral and sand with a total land area of 4.5 sq. kilometers. The beaches surrounding the island slope steeply to a ridge having an elevation of about 7 meters. The interior of the island shows evidence of having been under water at one time, but is flat, dry and above sea level at present. A narrow fringing reef containing many deep potholes surronds the island. The reefs on the northern and eastern sides of the island are covered with large coral knolls and boulders. On the eastern side of the Island is an expansive shoal which extends out about 1,500 meters from the island. The ocean floor surrounding the remainder of the island begins to drop off rapidly within 200 meters of the shore. Water temperature 25.4° C. Vegetation consists of scattered herbs and grass. Brown fruiting algae were found to be in abundance. Jarvis supports a large population of oceanic birds, turtles and cats. Fishes were found to be very abundant. No data are available regarding the edibility of the fishes of this region.

Field number POFI-G 51-5 (lat. 00°22′34″N., long. 160°01′40″ W.): Taken on west leeward side of Jarvis Island about 73 meters from shore. Bottom is comprised of coral and sand. Coralline algae abundant. Surface water temperature 25.4° C. Fishes, consisting of *Abudefduf, Epinephelus, Kuhlia, Rhinecanthus,* and *Scarus,* were captured by night light, spear and net. February 10, 1951. K. E. Groves.

CHRISTMAS ISLAND (lat. 01°55′N., long. 157°20′W., Figs. 1 + 2): Christmas is a large, boot-shaped coral island having a total area of about 574.98 sq. kilometers. The island is about 21 kilometers wide in the northern and western parts. The toe of the boot extends as a long slender neck for about 22.5 kilometers in an east-southeasterly direction. The average elevation is about 4.5 meters, but there are several hills 10-12 meters high. Located in the western part of the island is a large, saltwater lagoon which contains many small islets. A number of small, saltwater marshes and lakes are scattered over the remainder of the island. A narrow, fringing reef, interrupted only by the lagoon entrance and extending out about 200 meters from shore, surrounds the island. There is a strong, northwest current along the north coast of the island which forms tide rips northward of the northwest point. Currents on the western side of the island set strongly toward the shore. Prevailing winds are from the east. Rainfall varies greatly from year to year. Vegetation consists of scrubby trees, pandanus, and coconut palms. Approximately 486 hectares are under cultivation with coconuts. Wildlife consists of the usual array of oceanic birds, turtles, crabs, etc. The settlement of London is located on the northern side of the lagoon entrance and a smaller one, known as Paris, is situated on the southern side. The natives are Gilbertese and number about

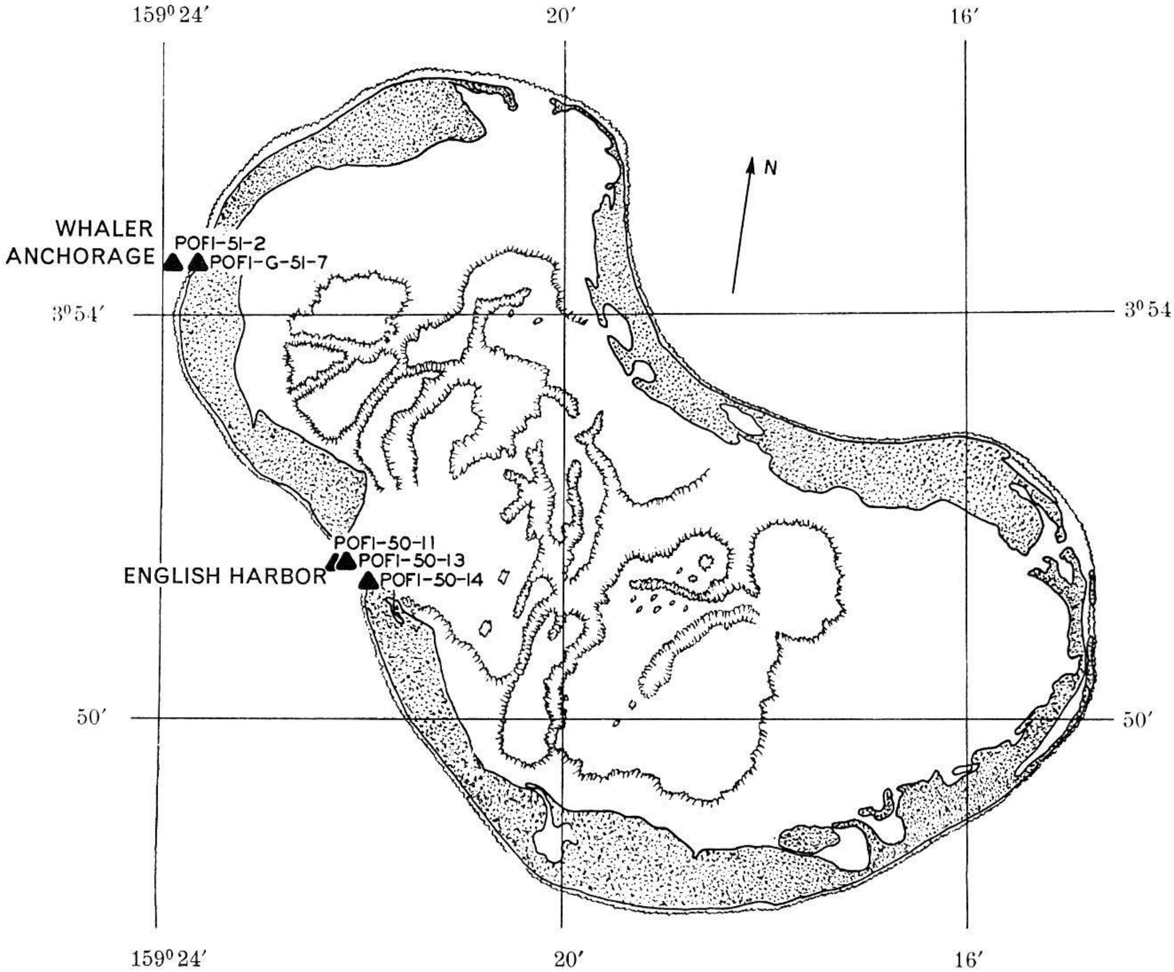

Fig. 3. Fanning Island.

220. Copra is the main product of the island. Reported outbreaks of fish poisoning at Christmas are listed in Table I.

Field number POFI 50-15 (lat. 01°58′10″N., long. 157°27′40″W.): North side of lagoon entrance, Christmas Island. Bottom comprised of coral and sand. Fishes, consisting of *Abudefduf, Acanthurus, Epinephelus, Lutjanus, Myripristis,* and *Scombroides,* captured at depth of 3 meters by spear. October 31, 1950. F. Cleaver.

Field number POFI-G 51-6 (lat. 01°58′30″N., long. 157°27′ 00″W.): Inside lagoon, near north side of lagoon entrance, Christmas Island. Bottom comprised of coral and sand. Fishes, consisting of *Acanthurus, Arothron, Bothus, Epinephelus, Lutjanus,* and *Mulloidichthys,* captured at depth of 2 meters by spear, and hook and line. February 15, 1951. K. E. Groves.

FANNING ISLAND (lat. 3°54′N., long. 159°24′W., Figs. 1 + 3): Fanning is a kidney-shaped coral atoll with a total land area of 32.12 sq. kilometers. The land rim is quite irregular, varying in width from about 100 to 1,500 meters. There are entrances on the eastern and northeastern sides of the island, but the only adequate passage for vessels is at English Harbor, on the western side. Except for the area about English Harbor, the lagoon is choked with coral bars and passages and has a maximum depth of about 18 meters. The island is steep-to on all sides and the 200 meter curve is reached about 500 meters from the shore except on the northern and northwestern sides where it is about 1,000 meters offshore. Ocean currents in the vicinity of Fanning Island are strong and variable. The mean climatic temperature is 27.7° C. Average annual rainfall is about 251 cm. Prevailing winds are from the southeast and east. Fanning is densely covered with coconut trees, pandanus, mango, bananas and a large variety of other tropical plants. The usual array of oceanic birds, crabs, etc. are also present. Brown fruiting algae were observed growing in the vicinity of the cable station. The cable station of the Pacific Cable Board is located on the northern side of the island at Napari and there is another settlement located on the southern side of the main lagoon entrance. The population of Fanning consists of about 250 Gilbertese natives and 20 European families. According to residents at Fanning most intoxications have occurred from eating fishes taken in the vicinity of Whaler Anchorage, especially within an 800 meter radius of the cable station on the ocean side, the main channel into the lagoon, and in the vicinity of English Harbor. A list of the reported outbreaks of ichthyosarcotoxism at Fanning are given in Table I.

Field number POFI 50-11 (lat. 03°51′30″N., long. 159°22′25″W.): .8 km. offshore, northwest of English Harbor, Fanning Island. Bottom comprised of coral and sand. Two specimens of *Trachinotus* captured by spear at surface. November 14, 1950. F. Cleaver.

Field number POFI 50-13 (lat. 03°51′30″N., long. 159°22′15″W.): .4 km. northwest of English Harbor, Fanning Island. Bottom comprised of coral and sand. Fishes, consisting of *Acanthurus, Caranx, Decapterus, Gnathodentex,* and *Lutjanus,* captured by hook and line at depth of 22 meters. November 14, 1950. F. Cleaver.

Field number POFI 50-14 (lat. 03°51′20″N., long. 159°22′01″W.): Ocean side, south side, English Harbor entrance, Fanning Island. Bottom is comprised of coral and sand. Fishes, consisting of *Acanthurus, Cephalopholis, Chaetodon, Ctenochaetus, Gomphosus, Paracirrhites,* and *Scarus* captured at depth of 1 to 3 meters by spear. November 14, 1950. F. Cleaver.

Field number POFI 51-2 (lat. 03°54′30″N., long. 159°24′00″W.): 300 meters off northwest shore of Whaler Anchorage, Fanning Island. Bottom comprised of coral and sand. One specimen of *Caranx* captured near surface by hook and line. February 4, 1951. J. E. King.

Field number POFI-G 51-7 (lat. 03°54′30″N., long. 159°23′ 34″W.): Whaler anchorage, over Pacific Cable, Fanning Island. Coral reef. Abundance of brown fruiting algae present. Fishes,

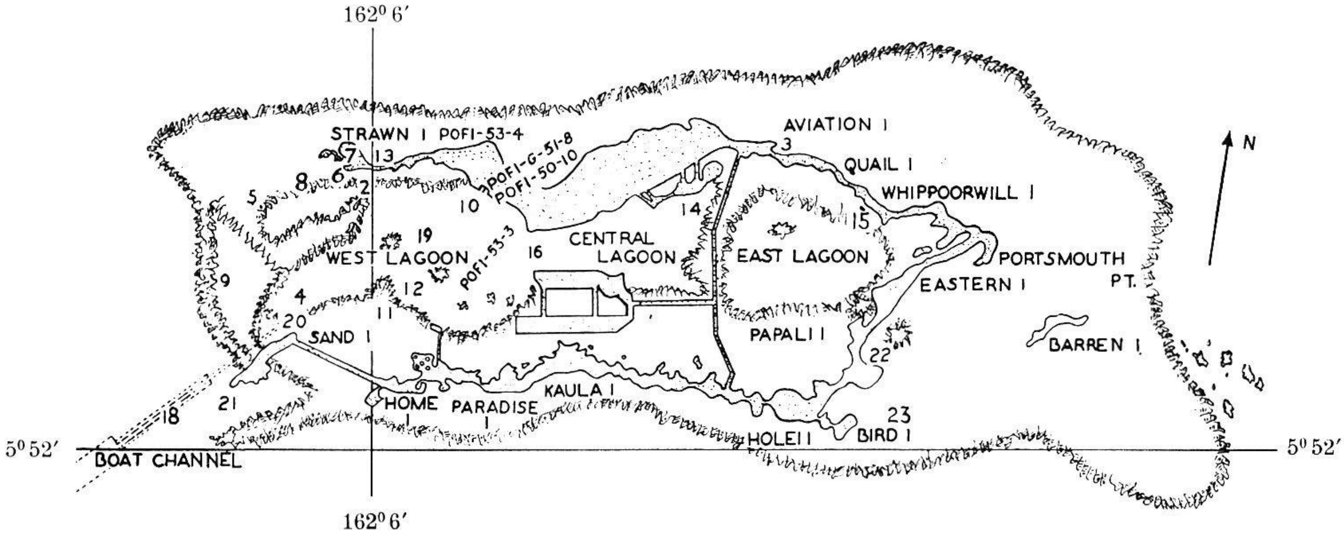

Fig. 4. Palmyra Island. Numbers 1-23 represent the A53 expedition numbers.

consisting of *Epinephelus, Gymnothorax, Lutjanus, Lethrinus,* and *Scarus* were collected by spear, hook and line within a maximum depth of 18 meters. February 18, 1951. K. E. Groves.

WASHINGTON ISLAND (lat. 4°40′N., long. 160°20′W., Fig. 1): Washington is about 1.6 km. in width and 6.4 km in length. There is said to be a freshwater lake on the east end of the island. A fringing reef extends for about 1,000 meters off the eastern tip of the island and at some distance off the northern side. Two projections of coral reef extend from 600 to 800 meters from the western end, but the remaining shore reef surrounding the island is quite narrow. Because of difficult landing conditions, Washington is not readily accessible. There is a coconut plantation on the island that is operated by the Fanning Island Plantation, and they maintain a population of about 200 Gilbertese workmen. No cases of fish poisoning have ever been reported from this island.

Field number POFI 54-3: Washington Island. Specific location not given. Specimens consisted of four epinephelids. May 24, 1954. J. E. King.

PALMYRA ISLAND (lat. 05°52′N., long. 162°06′W., Figs. 1 + 4): The atoll consists of many small islets lying on a barrier reef in an east and west direction. Originally the atoll consisted of about 50 small islets, having a total area of about 101.25 hectares, in a horse shoe surrounding three lagoons which are known as West, Center and East lagoons. During the occupation by the U.S. Navy most of the islets were connected by causeways. The islets stand at an elevation of about 2 meters above sea level and are densely covered by vegetation. The islets are scattered over an area of about 8.85 km. east and west by 2.41 km. north and south. The largest islet is Cooper Islet, which has an area of about 18.6 hectares and is located on the northern side of the atoll. The west lagoon is deep, up to about 70 meters in places, providing large anchorage areas and an adequate turning basin. A dredged channel that leads through the barrier reef on the southwestern side of the atoll is the only ship entrance to the lagoon. The depth at the entrance to the channel is about 7 meters. Along the southern shore of Cooper Island, in the west lagoon is a boat house, a dock for large vessels, a refueling pier and a seaplane ramp. A 1,830 meter aircraft landing strip and numerous buildings which are in various stages of deterioration are also located on Cooper Islet. The remaining perimeter of the west lagoon is comprised largely of shoal reef area which in some places is completely out of water during low tide. The west lagoon is connected to the central lagoon by a shallow channel, about 3 meters in depth, which has been dredged between the two lagoons. The central lagoon is adequate for small boat navigation, attaining a maximum depth of about 5 meters. The central lagoon is separated from the east lagoon by a narrow causeway which serves as a road between the northern and southern sides of the island. The east lagoon has a maximum depth of about 7 meters but for the most part is surrounded by shallow reef areas. There are several small openings to the ocean along the northern and eastern ends of the east lagoon.

The barrier reef is about 12.8 km. long in the east and west direction, extending about 2.4 km. eastward of Portsmouth Point. Extending eastward for a distance of about 5.4 km. from Portsmouth Point is a coral bank with depth of about 2 meters. A sunken reef extends about 1.6 km. westward of the western extremity of the barrier reef at the western end of the atoll. On the northern and southern sides the atoll is almost steep-to, the 200 meter curve generally being within 1,000 meters of the barrier reef. From the air it will be seen that the barrier reef is interrupted along its entire perimeter with innumerable small surge channels.

The weather at Palmyra is very unfavorable. Rain squalls are sudden and frequent. The average annual rainfall varies from about 254-457 cm. The uncertainty of the weather presents a difficult problem in attempting to develop a collecting schedule. The humidity is high but not to the extent of being disagreeable. The temperature at the time we were at the island hovered around 30° C. during the warmer part of the day. Since the northeast trades prevail with an average velocity of about 18.5 to 22.2 km., living at Palmyra is quite comfortable. A tropical front hovers in the vicinity of the island because of the meeting of the northeast and southeast trades.

The vegetation at Palmyra is dense. Most of the coconut palms were introduced, but are now growing abundantly and propagating themselves. Puka, tree heliotrope, pandanus, naupaka, hoeli, ferns, herbs and vines flourish. The island has a unique fauna. Hermit crabs and large land crabs are very numerous. Coconut crabs are present, but their population has been reduced. The usual variety of oceanic birds is present.

The turbidity of the water within the lagoon at Palmyra varies considerably, depending upon the general climatic conditions at the time. Usually, however, the water within the lagoon is murky and undesirable for aqualung work. The least turbid areas were found to be at the western end of the atoll. The area immediately southwest of Sand Island was excellent for making underwater observations. The surface water temperature averaged about 28° C. The tides are at high water, full and change at 5 hours 03 minutes. Spring tides rise to a height of .72 meter. Most of the fish specimens mentioned in the following section were captured during the period from April 19 to 29, 1953, by B. W. Halstead, L. Kuninobu, R. Smith, F. D. Horton, and N. C. Bunker.

Reef biochore and collecting stations at Palmyra Island: The reef biochore of Palmyra Island, for the purpose of this discussion, may be divided into the following biotopes:

Lagoon.

Coral: Coral patch reefs and knolls were found to be relatively sparse, and comprised largely of dead corals. Interspersed between the stands of coral were areas of coral sand and rubble. Green and brown algae were present. The water was somewhat turbid even during periods of calm. The maximum depth seldom exceeded 3 meters. Fishes commonly taken in this biotope consisted of *Gymnothorax, Arothron, Lutjanus, Ctenochaetus, Acanthurus, Chaetodon, Upeneus, Scomberoides, Epinephelus, Balistapus,* and *Mulloidichthys*. Specimens were collected with the use of blasting gelatin, spear, and hook and line. *Field numbers:* POFI 50-10, 12; POFIG 51-8; A 53-2, 9. 11. 12.

Sand: This biotope is comprised of flat sandy areas having occasional clumps of coral boulders or rubble. In some places the grain size is very fine, like that of an ooze. Algae are sparse or completely absent. Water generally turbid and shallow, maximum depth 4 meters. Fishes most commonly collected in this biotope consisted of *Caranx, Gymnothorax, Arothron, Lutjanus, Epinephelus, Mugil, Rhinecanthus, Chaetodon, Cephalopholis, Carangoides, Holocentrus, Priacanthus, Mulloidichthys, Hemirhamphus,* and

Eulamia. Specimens were collected by spear, hook and line, trolling, and blasting gelatin. The best collecting in the sand biotope proved to be along the reef margin southwest of Strawn Islet (A 53-8). *Field numbers:* POFI 53-3; A 53-4, 6, 8, 14, 15, 16, 20.

Tidepool: This biotope consisted of a single site, a tidal pool about 3 meters in diameter, having a depth of one meter. Bottom comprised of thick ooze and organic debris. Minimal amount of algal growth present. Surface water temperature at low tide was 32° C., the highest recorded for any area. Water rather clear. Specimens collected were limited to a single small species of *Gymnothorax.* Specimens collected by spear. *Field number:* A 53-7.

Wreckage: Although this can hardly be considered a natural biotope it is herein listed separately because of the influence that wreckage is reputed to have upon the toxicity of fishes. This zone is located by the old boathouse slip where old metal pilings and a conglomeration of metal scraps and debris had been dumped. Moderate algal growth was found to be growing on metal pilings. Acanthurids were especially numerous and observed feeding on algal growths. Water clear. Bottom predominantly sand. Specimens consisted of *Caranx, Acanthurus, Lutjanus, Arothron,* and *Abudefduf. Field number:* A 53-10.

Ocean.

Reef Flat: Extending out for a variable distance from the seaward beach around the island are broad flattened areas comprised largely of dead coral, occasional boulders, patches of sand, and rubble of organic derivation. During periods of low water most of the inner reef flat is exposed, but the outer reef flat may remain covered with a layer of water which seldom exceeds a depth of 1.5 meters. Large areas of the reef flat are covered by a thick algal turf. Acanthurids may frequently be observed feeding on the turf during periods of high water. Fishes most frequently taken in this biotope were *Arothron, Lutjanus, Mugil, Abudefduf, Upeneus, Epinephelus, Holocentrus, Gymnothorax, Belone, Acanthurus,* and *Mulloidichthys.* Specimens were collected by dip net, rotenone and spear. *Field numbers:* POFI 53-4; A 53-3, 5, 13, 22, 23.

Coral: Extending outward for about 1,000 meters from the seaward reef margin of the west end of Palmyra Island is a gradually sloping shoal area which attains a maximum depth of about 60 meters, and then drops off rather precipitously to much greater depths as the outer slope of the atoll. The shoal area within this 1,000 meter zone, and particularly southwest of Sand Islet, proved to be an excellent collecting area for the large reef fishes. Scattered about in this region are patch reefs, pinnacles, and knolls, which provide coverage for an abundance of fishes. Living corals were found to be common. Algae were present, consisting largely of microscopic forms. Bottom comprised of patchy areas of coral sand, boulders, live coral, and in some places, rubble. The water during calm periods is generally clear. Fishes most frequently taken in this biotope consisted of *Lutjanus, Epinephelus, Scomberoides, Sphyraena, Caranx, Acanthurus, Ctenochaetus, Variola, Pempheris, Epibulus, Cephalopholis, Chaetodon, Balistapus, Holocentrus, Myripristis,* and *Lethrinus.* Specimens were captured by spear and blasting gelatin. *Field numbers:* A 53-18, 21.

Open water: Open unprotected water about 1.6 km. southwest of Sand Islet. Water depth at site specimens were collected about 20 meters. Specimens collected by hook and line, consisting of *Lutjanus, Epinephelus,* and *Cephalopholis. Field numbers:* POFI 53-2; GV 51-41; A 53-1, 17.

Miscellaneous Field numbers: Palmyra Island. Ecological data unknown. POFI 54-1, 2; H 55-1, 2, 4.

Materials and Methods.

Specimens were collected with the use of rotenone, spear, blasting gelatin, dipnet, and hook and line. Soon after capture fish specimens were sorted, labeled, placed in plastic bags and quick frozen in a portable deep freeze unit. All specimens remained frozen until tested in the laboratory at Loma Linda, California.

With the exception of some of the Palmyra Island fishes which were identified by Mr. Vernon E. Brock, most of the identifications were made by the authors. Dr. Leonard P. Schultz of the U.S. National Museum kindly identified the scarids. We are further indebted to Dr. Schultz for having supplied us with a representative collection of identified reef fishes from the tropical Pacific which proved to be useful for comparative purposes. Reference works which proved to be of value in identifying Line Island fishes are by DE BEAUFORT (1940), DE BEAUFORT and CHAPMAN (1951), BLEEKER (1844-1880), CLARK (1949), DAY (1878-1888), FOWLER (1925, 1927, 1928, 1931 a + b, 1933, 1934, 1941), FOWLER and BALL (1925), FOWLER and BEAN (1928, 1929, 1930), FRASER-BRUNNER (1935, 1943), GÜNTHER (1873-1910), JORDAN and EVERMANN (1905), JORDAN and SEALE (1906), RANDALL (1955 a + b, 1956), SCHULTZ (1943), SCHULTZ et al. (1953), SMITH (1950), WEBER & DE BEAUFORT (1911-1936), and WEBER, DE BEAUFORT & KOUMANS (1953). Whenever possible we have followed the nomenclature as proposed by SCHULTZ. Representative specimens of all toxic species are preserved in the fish collection of the School of Tropical and Preventive Medicine.

The reader is referred to a previous report (HALSTEAD and BUNKER, 1954 a) on the poisonous fishes of the Phoenix Islands for a résumé of the screening techniques of earlier workers. The technique described here has been adopted as the routine screening procedure for this laboratory and is a modification of one originally suggested by Doctors Karl F. Meyer and Hermann Sommer of the University of California.

Samples were removed, when possible, from the muscle (M), liver (L), intestines (I), and gonads (G), from each fish to be tested. With small specimens it was sometimes necessary to remove the entire viscera (V) as a single sample, and in rare instances the entire fish was used in order to obtain sufficient material for extraction purposes. An effort was made to secure about 7 gm. of flesh for each sample. Two ml. of distilled water were added for each gram of flesh. The material was then homogenized in a Waring Blendor and the homogenate centrifuged at 2,000 r.p.m. for 25 minutes. One ml. of the clear supernatant fluid was injected intraperitoneally in each of four weanling white laboratory mice of the California Caviary Strain (CC_1) weighing 15 to 25 gm. Their reactions were observed and recorded for a period of 36 hours.

The classification used here is an arbitrary one which does give some idea as to degree of toxicity of a fish species within a particular geographical area. This method makes no attempt to differentiate between virulence and concentration. An earlier work by GOE and HALSTEAD (1955) discusses the sensitivity of the mouse screening test.

Negative (—), if the mouse continues to remain asymptomatic during the maximum test period of 36 hours, or dies after that time.

Weakly Positive (W), if the mouse shows definite symptoms, such as lacrimation, diarrhea, ruffling of the hair, hypoactivity, ataxia, etc., but the *animal recovers.*

Moderately Positive (M), if the mouse develops hypoactivity, ruffling of the hair, lacrimation, diarrhea, paralysis, etc., and *dies within a period of 1 to 36 hours.*

Strongly Positive (S), if the mouse develops hypoactivity, ataxia, and paralysis, usually followed by clonic or tonic convulsions of varying degrees, paradoxical respiration, respiratory paralysis and *death occurs within a few seconds to one hour.*

TABLE II.

An Analysis of Line Island Fishes with Reference to Their Toxicity.

Family and Species	Locality	Extracts Tested: Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
ACANTHURIDAE — Surgeonfish									
Acanthurus achilles Shaw	Fanning POFI-50-1	—							
Acanthurus achilles	Malden POFI-51-1	—							
Acanthurus gahhm (Forskål)	Palmyra A-53-9	—				—			
Acanthurus gahhm	Palmyra A-53-12	—			—		—		
Acanthurus gahhm	Palmyra A-53-15	—				M	M		
Acanthurus glaucopareius (Bloch)	Palmyra A-53-21	M				—	M		
Acanthurus glaucopareius	Palmyra A-53-21	—				—	M		
Acanthurus glaucopareius	Palmyra A-53-21	—		—		—	—		
Acanthurus glaucopareius	Palmyra A-53-21	—		—		—	—		
Acanthurus glaucopareius	Palmyra A-53-21	—				M			
Acanthurus glaucopareius	Palmyra A-53-21	—				W	W		
Acanthurus glaucopareius	Palmyra A-53-21	—				M			
Acanthurus glaucopareius	Palmyra A-53-21	—				M	—		
Acanthurus lineatus (Linnaeus)	Fanning POFI-50-14	—							
Acanthurus nigroris Valenciennes	Palmyra A-53-21	—				—	M		
Acanthurus triostegus (Linnaeus)	Fanning POFI-50-14	—							
Acanthurus triostegus	Christmas POFI-50-15	—		—		M			
Acanthurus triostegus	Palmyra POFIG-51-8	M							
Acanthurus triostegus	Palmyra A-53-5	—				W			
Acanthurus triostegus	Palmyra A-53-5	—		—		—			
Acanthurus triostegus	Palmyra A-53-5	—		—		W			
Acanthurus triostegus	Palmyra A-53-5	—				—			
Acanthurus triostegus	Palmyra A-53-8	—				M			
Acanthurus triostegus	Palmyra A-53-8	—				—			
Acanthurus triostegus	Palmyra A-53-9	—	W		—				
Acanthurus triostegus	Palmyra A-53-9	—	—		—				
Acanthurus triostegus	Palmyra A-53-9	—				—			
Acanthurus triostegus	Palmyra A-53-9	—				M			
Acanthurus triostegus	Palmyra A-53-9	—				—			
Acanthurus triostegus	Palmyra A-53-9	—				M			
Acanthurus triostegus	Palmyra A-53-9	—				M			
Acanthurus triostegus	Palmyra A-53-9	—				M			
Acanthurus triostegus	Palmyra A-53-9	—				—			
Acanthurus triostegus	Palmyra A-53-11	—		—	W		M		
Acanthurus triostegus	Palmyra A-53-11	—		—		—			
Acanthurus triostegus	Palmyra A-53-12	—				—			
Acanthurus triostegus	Palmyra A-53-12	—				M			
Acanthurus triostegus	Palmyra A-53-12	—				M			
Acanthurus triostegus	Palmyra A-53-13	—				—			
Acanthurus triostegus	Palmyra A-53-13	—				M			
Acanthurus triostegus	Palmyra A-53-13	—				M			
Acanthurus triostegus	Palmyra A-53-13	—				—			
Acanthurus triostegus	Palmyra A-53-13	W				M			
Acanthurus triostegus	Palmyra A-53-13	—				W	M		

TABLE II. (Continued.)

Family and Species	Locality	Extracts Tested: Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
Acanthurus triostegus (Linnaeus)	Palmyra A-53-13	—				M			
Acanthurus triostegus	Palmyra A-53-16	—		—	—				
Acanthurus triostegus	Palmyra A-53-16	—				—			
Acanthurus triostegus	Palmyra A-53-16	—				—			
Acanthurus triostegus	Palmyra A-53-21	—				—	M		
Acanthurus triostegus	Palmyra A-53-21	—				—	M		
Acanthurus triostegus	Palmyra A-53-21	—				W	W		
Acanthurus triostegus	Palmyra A-53-21	—				—	—		
Acanthurus triostegus	Palmyra A-53-21	M				M			
Acanthurus triostegus	Palmyra A-53-21	—				M			
Acanthurus triostegus	Palmyra A-53-21	—				M			
Acanthurus triostegus	Palmyra A-53-21	—				—			
Acanthurus triostegus	Palmyra A-53-21	—				—			
Acanthurus triostegus	Palmyra A-53-21	—				W			
Acanthurus triostegus	Palmyra A-53-21	M				W			
Acanthurus triostegus	Palmyra A-53-21	—				—			
Acanthurus triostegus	Palmyra A-53-21	—				—			
Acanthurus triostegus	Palmyra A-53-21	—				—			
Acanthurus triostegus	Palmyra A-53-21	—				—			
Acanthurus triostegus	Palmyra A-53-21	—				M			
Acanthurus triostegus	Palmyra A-53-21	—				W	—		
Acanthurus triostegus	Palmyra A-53-21	—				M			
Acanthurus triostegus	Palmyra A-53-21	—				—			
Acanthurus triostegus	Palmyra A-53-21	—				—			
Acanthurus triostegus	Palmyra A-53-21	—				—			
Acanthurus triostegus	Palmyra A-53-22	S		S		S			
Acanthurus triostegus	Palmyra A-53-?	—				W			
Acanthurus triostegus	Palmyra A-53-?	—				W			
Acanthurus triostegus	Palmyra A-53-?	—				—			
Acanthurus triostegus	Palmyra A-53-?	—				W			
Acanthurus triostegus	Palmyra A-53-?	—				—			
Acanthurus triostegus	Palmyra A-53-?	—		—		—			
Acanthurus triostegus	Palmyra A-53-?	—				—			
Acanthurus triostegus	Palmyra A-53-?	—				—			
Acanthurus triostegus	Palmyra POFI-53-4	—				—			
Acanthurus triostegus	Palmyra POFI-53-4	—				—			
Acanthurus triostegus	Palmyra POFI-53-4	—				—			
Acanthurus xanthopterus Valenciennes	Palmyra POFI-50-12	M			—				
Acanthurus xanthopterus	Palmyra POFI-50-12	—			—				
Acanthurus xanthopterus	Palmyra POFI-50-12	—			—				
Acanthurus xanthopterus	Palmyra POFI-50-12	—			—				
Acanthurus xanthopterus	Palmyra POFI-50-12	—	M		M				
Acanthurus xanthopterus	Palmyra POFI-50-12	—			M				
Acanthurus xanthopterus	Fanning POFI-50-13	—			—				
Acanthurus xanthopterus	Fanning POFI-50-13	M			M				
Acanthurus xanthopterus	Christmas POFIG-51-6	—	M		M				

TABLE II. (Continued.)

Family and Species	Locality	Extracts Tested: Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
Acanthurus xanthopterus Valenciennes	Christmas POFIG-51-6	—			—				
Acanthurus xanthopterus	Christmas POFIG-51-6	M	—		—				
Acanthurus xanthopterus	Palmyra POFIG-51-8	—							
Acanthurus xanthopterus	Palmyra A-53-5	—			—		—		
Acanthurus xanthopterus	Palmyra A-53-5	—	M			—			
Acanthurus xanthopterus	Palmyra A-53-8	—				—	M		
Acanthurus xanthopterus	Palmyra A-53-8	—				—	W		
Acanthurus xanthopterus	Palmyra A-53-8	—	M		—				
Acanthurus xanthopterus	Palmyra A-53-9	—	M	—	—		—		
Acanthurus xanthopterus	Palmyra A-53-9	—	—		—		—		
Acanthurus xanthopterus	Palmyra A-53-9	W	—		—		—		
Acanthurus xanthopterus	Palmyra A-53-9	—	—		—				
Acanthurus xanthopterus	Palmyra A-53-9	—			M		—		
Acanthurus xanthopterus	Palmyra A-53-9	—	S		—				
Acanthurus xanthopterus	Palmyra A-53-10	—				—	W		
Acanthurus xanthopterus	Palmyra A-53-10	—				—			
Acanthurus xanthopterus	Palmyra A-53-10	—	M		—		—		
Acanthurus xanthopterus	Palmyra A-53-10	—	—	—	—		—		
Acanthurus xanthopterus	Palmyra A-53-10	—	—		—		—		
Acanthurus xanthopterus	Palmyra A-53-10	—	M		—		—		
Acanthurus xanthopterus	Palmyra A-53-10	—	M		—		W		
Acanthurus xanthopterus	Palmyra A-53-10	—	M		—				
Acanthurus xanthopterus	Palmyra A-53-10	—	M		—		S		
Acanthurus xanthopterus	Palmyra A-53-10	—	—		—		—		
Acanthurus xanthopterus	Palmyra A-53-10	—	—		—		—		
Acanthurus xanthopterus	Palmyra A-53-10	—	—		—		—		
Acanthurus xanthopterus	Palmyra A-53-10	—	—		—		—		
Acanthurus xanthopterus	Palmyra A-53-12	—	M		—		—		
Acanthurus xanthopterus	Palmyra A-53-12	—	M		—		M		
Acanthurus xanthopterus	Palmyra A-53-12	M	M		—		—		
Acanthurus xanthopterus	Palmyra A-53-12	M				M			
Acanthurus xanthopterus	Palmyra A-53-12	M					—		
Acanthurus xanthopterus	Palmyra A-53-12	—				—			
Acanthurus xanthopterus	Palmyra A-53-12	W	—			—			
Acanthurus xanthopterus	Palmyra A-53-12	—	—		—		W		
Acanthurus xanthopterus	Palmyra A-53-12	—	—		—		—		
Acanthurus xanthopterus	Palmyra A-53-12	—	M		—		—		
Acanthurus xanthopterus	Palmyra A-53-12	—	—		—		—		
Acanthurus xanthopterus	Palmyra A-53-12	M	M		M		M		
Acanthurus xanthopterus	Palmyra A-53-12	—	M		—		W		
Acanthurus xanthopterus	Palmyra A-53-12	—	—		—		M		
Acanthurus xanthopterus	Palmyra A-53-13	—				—			
Acanthurus xanthopterus	Palmyra A-53-13	M				—	—		
Acanthurus xanthopterus	Palmyra A-53-13	—	—			W	W		
Acanthurus xanthopterus	Palmyra A-53-13	—	M			—	W		
Acanthurus xanthopterus	Palmyra A-53-13	—				—	—		

TABLE II. (Continued.)

Family and Species	Locality	Extracts Tested: Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
Acanthurus xanthopterus Valenciennes	Palmyra A-53-16	—				M			
Acanthurus xanthopterus	Palmyra A-53-16	—				—			
Acanthurus xanthopterus	Palmyra A-53-22	M	M		W		—		
Acanthurus xanthopterus	Palmyra A-53-22	—	—		W		M		
Acanthurus xanthopterus	Palmyra POFI-53-4	—	—		—		—		
Ctenochaetus magnus Randall	Malden POFI-51-1	—							
Ctenochaetus striatus (Quoy and Gaimard)	Fanning POFI-50-14	—							
Ctenochaetus striatus	Palmyra POFIG-51-8	—							
Ctenochaetus striatus	Palmyra A-53-9	—				—			
Ctenochaetus striatus	Palmyra A-53-21	—				—			
Ctenochaetus striatus	Palmyra A-53-21	—				—			
Ctenochaetus striatus	Palmyra A-53-21								M
Ctenochaetus striatus	Palmyra A-53-21	—				—			
Ctenochaetus striatus	Palmyra A-53-21	—				—			
Ctenochaetus striatus	Palmyra A-53-21	W				M			
Ctenochaetus striatus	Palmyra A-53-21	—				M			
Ctenochaetus striatus	Palmyra A-53-21	—				M			
Ctenochaetus striatus	Palmyra A-53-21	—				M			
Ctenochaetus striatus	Palmyra A-53-21	W				M			
Ctenochaetus striatus	Palmyra A-53-21	—				M			
Zebrasoma rostratum (Günther)	Palmyra A-53-21	—				M	W		
ALBULIDAE — Bonefish									
Albula vulpes (Linnaeus)	Palmyra A-53-?	—				M	M		
Albula vulpes	Palmyra A-53-?	—				—			
BALISTIDAE — Triggerfish									
Balistapus undulatus (Mungo Park)	Palmyra A-53-9	—	M			—			
Balistapus undulatus	Palmyra A-53-21	—	W		—		—		
Balistapus undulatus	Palmyra A-53-21	—				—			
Pseudobalistes flavimarginatus (Rüppell)	Malden POFI-51-1	—							
Rhinecanthus aculeatus (Linnaeus)	Palmyra A-53-3	—	—	—	—				
Rhinecanthus aculeatus	Palmyra A-53-5	S		—		—			
Rhinecanthus aculeatus	Palmyra A-53-8	—	—	W	—				
Rhinecanthus aculeatus	Palmyra A-53-12	W	M			—			
Rhinecanthus aculeatus	Palmyra A-53-21	—	—			W			
Rhinecanthus aculeatus	Palmyra POFI-53-4	—	—			W			
Rhinecanthus aculeatus	Palmyra POFI-53-4	—	—	—	—				
Rhinecanthus rectangulatus (Bloch and Schneider)	Jarvis POFIG-51-5	W				—			
Sufflamen chrysoptera (Bloch)	Palmyra A-53-12	—	—			W			

TABLE II. (Continued.)

Family and Species	Locality	Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
		Extracts Tested							
BELONIDAE — Needlefish									
Belone platyura Bennett	Palmyra A-53-13								S
Belone platyura	Palmyra A-53-13								S
CARANGIDAE — Jacks									
Carangoides ferdau jordani Nichols	Palmyra A-53-8	—				—			
Caranx ignobilis (Forskål)	Palmyra A-53-4	—	M		—		—		
Caranx ignobilis	Palmyra A-53-10	—	—	—	—		M		
Caranx ignobilis	Christmas POFI-53-1	W	—			—			
Caranx ignobilis	Palmyra POFI-53-4	—	—			—			
Caranx lugubris Poey	Fanning POFI-50-13	—	W		—				
Caranx lugubris	Fanning POFI-51-2	—							
Caranx melampygus Cuvier	Malden POFI-51-1	—							
Caranx melampygus	Palmyra A-53-4		W	S			M		
Caranx melampygus	Palmyra A-53-4	W	M		—		—		
Caranx melampygus	Palmyra A-53-5	—	M	M	—		–		
Caranx melampygus	Palmyra A-53-9	—	—		—				
Caranx melampygus	Palmyra A-53-9	—	—		—				
Caranx melampygus	Palmyra A-53-12	—				—			
Caranx melampygus	Palmyra A-53-?	W	M	—	—				
Caranx sexfasciatus Quoy and Gaimard	Palmyra A-53-4	—	—		—		—		
Decapterus sanctaehelenae (Quoy and Gaimard)	Fanning POFI-50-13	—				—			
Decapterus sanctaehelenae	Christmas POFI-54-5	—	—	—	—				
Elagatis bipinnulatus (Quoy and Gaimard)	Christmas POFI-54-5	—	—		—				
Scomberoides sanctipetri (Cuvier)	Christmas POFI-50-15	—				—			
Scomberoides sanctipetri	Palmyra A-53-9	—		—	—				
Scomberoides sanctipetri	Palmyra A-53-9	—				M			
Scomberoides sanctipetri	Palmyra A-53-18	—				W			
Scomberoides sanctipetri	Palmyra A-53-18	—		—		—	—		
Trachinotus bailloni (Lacépède)	Fanning POFI-50-11	—							
Trachinotus bailloni	Christmas POFI-54-5	—				S			
CARCHARHINIDAE — Gray sharks									
Carcharhinus menisorrah (Müller and Henle)	Palmyra A-53-20	—	W		—				
Carcharhinus menisorrah	Palmyra A-53-20	—	—	M					
Carcharhinus menisorrah	Palmyra A-53-20	—	—		—				
CHAETODONTIDAE — Butterflyfish									
Chaetodon auriga Forskål	Palmyra A-53-3	—				W	M		
Chaetodon auriga	Palmyra A-53-5	—				M			
Chaetodon auriga	Palmyra A-53-5	—				—			
Chaetodon auriga	Palmyra A-53-5	S				S			

TABLE II. (Continued.)

Family and Species	Locality	Extracts Tested: Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
Chaetodon auriga Forskål	Palmyra A-53-5	—				—			
Chaetodon auriga	Palmyra A-53-8	—				M			
Chaetodon auriga	Palmyra A-53-8	—		—		M			
Chaetodon auriga	Palmyra A-53-8	—				—			
Chaetodon auriga	Palmyra A-53-9	—				M			
Chaetodon auriga	Palmyra A-53-9	—		W		M			
Chaetodon auriga	Palmyra A-53-9	—			M				
Chaetodon auriga	Palmyra A-53-9	—				—			
Chaetodon auriga	Palmyra A-53-9	—				W			
Chaetodon auriga	Palmyra A-53-9	—				—			
Chaetodon auriga	Palmyra A-53-10	—				—			
Chaetodon auriga	Palmyra A-53-10	—				—			
Chaetodon auriga	Palmyra A-53-12	—				M			
Chaetodon auriga	Palmyra A-53-12	W				M			
Chaetodon auriga	Palmyra A-53-12	—				W			
Chaetodon auriga	Palmyra A-53-12	—				—			
Chaetodon auriga	Palmyra A-53-12	—				M			
Chaetodon auriga	Palmyra A-53-12	—				—			
Chaetodon auriga	Palmyra A-53-12	—				M			
Chaetodon auriga	Palmyra A-53-20	—				S			
Chaetodon auriga	Palmyra A-53-20	—				—			
Chaetodon auriga	Palmyra POFI-53-4	—		—		—			
Chaetodon auriga	Palmyra POFI-53-4	—		—		—			
Chaetodon ephippium Cuvier	Fanning POFI-50-14	—							
Chaetodon ephippium	Palmyra A-53-8	—				M			
Chaetodon ephippium	Palmyra A-53-8	—				M			
Chaetodon ephippium	Palmyra A-53-8	—				M			
Chaetodon ephippium	Palmyra A-53-9	—				W	—		
Chaetodon ephippium	Palmyra A-53-12	—				M			
Chaetodon ephippium	Palmyra A-53-12	—				M			
Chaetodon ephippium	Palmyra A-53-12	—				M			
Chaetodon lunula (Lacépède)	Palmyra A-53-5	—				—			
Chaetodon lunula	Palmyra A-53-5	—				—			
Chaetodon lunula	Palmyra A-53-5	—				—			
Chaetodon lunula	Palmyra A-53-8	—				—			
Chaetodon lunula	Palmyra A-53-12	—				M			
Chaetodon lunula	Palmyra A-53-16	—				—			
Chaetodon lunula	Palmyra A-53-21	—				M			
Chaetodon lunula	Palmyra A-53-21	—		—		—			
Chaetodon lunula	Palmyra A-53-21	—				M			
Chaetodon lunula	Palmyra A-53-21	—				W			
Chaetodon trifasciatus Mungo Park	Palmyra A-53-21	—				—			
Chaetodon trifasciatus	Palmyra A-53-21	—				—			
Chaetodon trifasciatus	Palmyra A-53-21	—				—			
ECHELIDAE — Worm Eel									
Kaupichthys diodontus Schultz	Christmas POFI-54-5								—

TABLE II. (Continued.)

Family and Species	Locality	Extracts Tested: Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
HEMIRAMPHIDAE — Halfbeaks									
Hyporhamphus dussumieri (Valenciennes)	Palmyra A-53-15								S
HOLOCENTRIDAE — Squirrelfish									
Holocentrus microstomus Günther	Palmyra A-53-21	—				W			
Holocentrus opercularis Valenciennes	Palmyra A-53-21	—				—			
Holocentrus spinifer (Forskål)	Palmyra A-53-5	S				M			
Holocentrus spinifer	Palmyra A-53-5	—				W			
Holocentrus spinifer	Palmyra A-53-8	—	W		W				
Holocentrus spinifer	Palmyra A-53-12	—				—			
Holocentrus spinifer	Palmyra A-53-21	—				—			
Holocentrus spinifer	Palmyra A-53-21	—				—			
Holocentrus spinifer	Palmyra A-53-21	—				—			
Holocentrus spinifer	Palmyra A-53-21	—				—			
Holocentrus spinifer	Palmyra A-53-21	—				—			
Myripristis argyromus Jordan and Evermann	Palmyra A-53-21	—				—			
Myripristis argyromus	Palmyra A-53-21	—		M		—			
Myripristis argyromus	Palmyra A-53-21	—				—			
Myripristis berndti Jordan and Evermann	Palmyra A-53-21	—				M			
Myripristis berndti	Palmyra A-53-21	—				W			
Myripristis berndti	Palmyra A-53-21	—				—			
Myripristis murdjan (Forskål)	Christmas POFI-50-15	—							
Myripristis murdjan	Malden POFI-51-1	—							
Myripristis murdjan	Palmyra A-53-13	—		—		—			
Myripristis murdjan	Palmyra A-53-21	—				M			
Myripristis murdjan	Palmyra A-53-21	—				—			
Myripristis murdjan	Palmyra A-53-21	—				—			
Myripristis pralinius Cuvier	Palmyra A-53-21	—				M			
KUHLIDAE — Mountain Bass									
Kuhlia petiti Schultz	Jarvis POFIG-51-5	—		—	—				
KYPHOSIDAE — Pilotfish									
Kyphosus bigibbus Lacépède	Palmyra POFI-50-12	—							
LABRIDAE — Wrasses									
Epibulus insidiator (Pallas)	Palmyra A-53-21	—				—			
Epibulus insidiator	Palmyra A-53-21	—				—			
Gomphosus tricolor Quoy and Gaimard	Fanning POFI-50-14	—							

TABLE II. (Continued.)

Family and Species	Locality	Extracts Tested							
		Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
LUTJANIDAE — Snappers									
Gnathodentex aureolineatus (Lacépède)	Fanning POFI-50-13	—							
Lethrinus variegatus Cuvier and Valenciennes	Fanning POFIG-51-7	—							
Lethrinus variegatus	Palmyra A-53-16	—				—			
Lethrinus variegatus	Palmyra A-53-20	—	M		—				
Lethrinus variegatus	Palmyra A-53-21	—	M	—	—		—		
Lethrinus variegatus	Palmyra A-53-21	—	W		W		W		
Lethrinus variegatus	Palmyra A-53-21	—	—		M				
Lethrinus variegatus	Palmyra A-53-21	—		—	—		—		
Lethrinus variegatus	Palmyra A-53-21	—		—	—		—		
Lethrinus variegatus	Palmyra POFI-54-2	—				—			
Lutjanus bohar (Forskål)	Fanning POFI-50-13	—	—		—				
Lutjanus bohar	Fanning POFI-50-13	—	—		—				
Lutjanus bohar	Fanning POFI-50-13	—	—		—				
Lutjanus bohar	Fanning POFI-50-13	—			—				
Lutjanus bohar	Christmas POFIG-51-6	—							
Lutjanus bohar	Christmas POFIG-51-6	M	—		—				
Lutjanus bohar	Fanning POFIG-51-7	—							
Lutjanus bohar	Fanning POFIG-51-7	W	W						
Lutjanus bohar	Palmyra GV-51-41	—	M		—				
Lutjanus bohar	Palmyra GV-51-41	—	M		—				
Lutjanus bohar	Palmyra GV-51-41	—	—	—	—				
Lutjanus bohar	Palmyra GV-51-41	—	M						
Lutjanus bohar	Palmyra GV-51-41	—		—		—			
Lutjanus bohar	Palmyra GV-51-41	—	—	—	—				
Lutjanus bohar	Palmyra GV-51-41	—		—		—			
Lutjanus bohar	Palmyra GV-51-41	—	—		—				
Lutjanus bohar	Palmyra GV-51-41	—		—		—			
Lutjanus bohar	Palmyra GV-51-41	—		—	—				
Lutjanus bohar	Palmyra GV-51-41	—				—			
Lutjanus bohar	Palmyra GV-51-41	—		—		—			
Lutjanus bohar	Palmyra GV-51-41	—		—		—			
Lutjanus bohar	Palmyra GV-51-41	—		—		—			
Lutjanus bohar	Palmyra GV-51-41	—		—		—			
Lutjanus bohar	Palmyra GV-51-41	—				—			
Lutjanus bohar	Palmyra A-53-1	—	M	—	—		—		
Lutjanus bohar	Palmyra A-53-1	W	W	M	W				
Lutjanus bohar	Palmyra A-53-1	W	W	M	W				
Lutjanus bohar	Palmyra A-53-1	W	M	M	M				
Lutjanus bohar	Palmyra A-53-1	M	—	—	—				
Lutjanus bohar	Palmyra A-53-1	—	—	—	—				
Lutjanus bohar	Palmyra A-53-1	—	M		—				
Lutjanus bohar	Palmyra A-53-1	—	W	M	—				
Lutjanus bohar	Palmyra A-53-1	—	—	—	—				
Lutjanus bohar	Palmyra A-53-1	—	—	—	—				

TABLE II. (Continued.)

Family and Species	Locality	Extracts Tested: Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
Lutjanus bohar (Forskål)	Palmyra A-53-1	—	M	—	—				
Lutjanus bohar	Palmyra A-53-1	—	—	—	—				
Lutjanus bohar	Palmyra A-53-1	—	W	—	—				
Lutjanus bohar	Palmyra A-53-1	—	M	—	—		—		
Lutjanus bohar	Palmyra A-53-1	—	—	—	—				
Lutjanus bohar	Palmyra A-53-1	—	—	—	—		M		
Lutjanus bohar	Palmyra A-53-1	—	M	W	—				
Lutjanus bohar	Palmyra A-53-1	M				M			
Lutjanus bohar	Palmyra A-53-1	—	M	M	—				
Lutjanus bohar	Palmyra A-53-21	—				—			
Lutjanus bohar	Palmyra A-53-21	—				M			
Lutjanus bohar	Palmyra A-53-21	—				—	—		
Lutjanus bohar	Palmyra A-53-21	—	M	—	—				
Lutjanus bohar	Palmyra A-53-21	—	—	—	—				
Lutjanus bohar	Palmyra A-53-21	—	—	—	—				
Lutjanus bohar	Palmyra A-53-21	—				M			
Lutjanus bohar	Palmyra A-53-21	—		—	—		—		
Lutjanus bohar	Christmas POFI-53-1	—				—			
Lutjanus bohar	Christmas POFI-53-1	—	M			—			
Lutjanus bohar	Palmyra POFI-53-2	—	M	—	—				
Lutjanus bohar	Palmyra POFI-53-2	—				—			
Lutjanus bohar	Palmyra POFI-53-2	—				—			
Lutjanus bohar	Palmyra USCG-53-1	—	—	—	—				
Lutjanus bohar	Palmyra POFI-54-2	—				—			
Lutjanus bohar	Palmyra POFI-54-1	—	S		—		—		
Lutjanus bohar	Palmyra POFI-54-1	—	—		—				
Lutjanus bohar	Fanning POFI-54-4	—				—			
Lutjanus bohar	Christmas POFI-54-5	—	W		—				
Lutjanus bohar	Christmas POFI-54-5	—	S		—				
Lutjanus bohar	Palmyra H-55-1	—	M		—		W		
Lutjanus bohar	Palmyra H-55-1	—		—					
Lutjanus bohar	Palmyra H-55-1	—							
Lutjanus bohar	Palmyra H-55-2	—							
Lutjanus bohar	Palmyra H-55-2	—							
Lutjanus bohar	Palmyra H-55-2	—							
Lutjanus bohar	Palmyra H-55-2	—							
Lutjanus bohar	Palmyra H-55-2	—							
Lutjanus bohar	Palmyra H-55-2	—							
Lutjanus bohar	Fanning H-55-3	—							
Lutjanus bohar	Fanning H-55-3	—							
Lutjanus bohar	Fanning H-55-3	—							
Lutjanus bohar	Fanning H-55-3	—							
Lutjanus bohar	Fanning H-55-3	—							
Lutjanus bohar	Palmyra H-55-4	—	—		—		—		
Lutjanus bohar	Palmyra H-55-4	—	—		—		—		
Lutjanus bohar	Palmyra H-55-4	—	M	—	—		M		
Lutjanus bohar	Palmyra H-55-4	—	—	—			—		

TABLE II. (Continued.)

Family and Species	Locality	Extracts Tested: Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
Lutjanus bohar (Forskål)	Palmyra H-55-4	—	—	—	—		—		
Lutjanus bohar	Palmyra H-55-4	—	W		W		M		
Lutjanus bohar	Palmyra H-55-4	—	M	—	—		—		
Lutjanus bohar	Palmyra H-55-4	—	—		—		—		
Lutjanus bohar	Palmyra H-55-4	—	M		M		—		
Lutjanus bohar	Palmyra H-55-4	—	M		—		W		
Lutjanus bohar	Palmyra H-55-4	—	M		—		—		
Lutjanus bohar	Christmas H-55-5	—	—		—				
Lutjanus bohar	Christmas H-55-5	—	—	—	—				
Lutjanus bohar	Christmas H-55-5	W	W		W		M		
Lutjanus bohar	Christmas H-55-5	W	W		—		—		
Lutjanus bohar	Christmas H-55-5	—	—	W	W		—		
Lutjanus bohar	Christmas H-55-5	—	W		—				
Lutjanus bohar	Christmas H-55-5	—	M		W				
Lutjanus bohar	Christmas H-55-5	—	—		W				
Lutjanus bohar	Christmas H-55-5	W	M		—		—		
Lutjanus bohar	Christmas H-55-5	—	—		—		—		
Lutjanus bohar	Christmas H-55-5		—		—				
Lutjanus bohar	Christmas H-55-5	—	M		—		—		
Lutjanus bohar	Christmas H-55-5	—	—		—				
Lutjanus bohar	Christmas H-55-5	—	W		—				
Lutjanus bohar	Christmas H-55-5	—	M		W		—		
Lutjanus bohar	Christmas H-55-5	—	—		—				
Lutjanus bohar	Christmas H-55-5	—	—	—			—		
Lutjanus bohar	Christmas H-55-5	—	M		—				
Lutjanus bohar	Christmas H-55-5		—		—				
Lutjanus bohar	Christmas H-55-5	—	M		—		—		
Lutjanus bohar	Christmas H-55-5	—	W		—				
Lutjanus bohar	Christmas H-55-5	—	—		—				
Lutjanus bohar	Christmas H-55-5	—	—		—				
Lutjanus bohar	Christmas H-55-5	—	—		—				
Lutjanus bohar	Christmas H-55-5	—	W		—				
Lutjanus bohar	Christmas H-55-5	—	—		—				
Lutjanus bohar	Christmas H-55-5	—	—		—				
Lutjanus bohar	Christmas H-55-5	W	M		W		—		
Lutjanus bohar	Christmas H-55-5	—	—		—				
Lutjanus bohar	Christmas H-55-5	—	W		—				
Lutjanus bohar	Christmas H-55-5	—	—		—		—		
Lutjanus bohar	Christmas H-55-5	—	—		—		—		
Lutjanus bohar	Christmas H-55-5	—	—		—				
Lutjanus bohar	Christmas H-55-5	—	—		—				
Lutjanus bohar	Christmas H-55-5	—	W		W				
Lutjanus bohar	Christmas H-55-5	—	—		—				
Lutjanus bohar	Christmas H-55-5	—	—		—				
Lutjanus bohar	Christmas H-55-5	M	—		M				
Lutjanus bohar	Christmas H-55-5	—	M		—				
Lutjanus bohar	Christmas H-55-5	—	W		—				

TABLE II. (Continued.)

Family and Species	Locality	Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
		Extracts Tested							
Lutjanus gibbus (Forskål)	Palmyra POFI-50-12	—				—			
Lutjanus gibbus	Palmyra GV-51-41	—	M	M					
Lutjanus gibbus	Palmyra GV-51-41	—	—	—	—				
Lutjanus gibbus	Palmyra GV-51-41	—	—	—	—				
Lutjanus gibbus	Palmyra GV-51-41	—				—			
Lutjanus gibbus	Palmyra GV-51-41	—		—	—				
Lutjanus gibbus	Palmyra GV-51-41	—	—		—				
Lutjanus gibbus	Palmyra GV-51-41	—	—	—	—				
Lutjanus gibbus	Palmyra GV-51-41	—				—			
Lutjanus gibbus	Palmyra GV-51-41	—				—			
Lutjanus gibbus	Palmyra GV-51-41	—				—			
Lutjanus gibbus	Palmyra A-53-1	—	—	—	—				
Lutjanus gibbus	Palmyra A-53-8	—				—	—		
Lutjanus gibbus	Palmyra A-53-8	—				—	—		
Lutjanus gibbus	Palmyra A-53-8	—				—			
Lutjanus gibbus	Palmyra A-53-8	—				—			
Lutjanus gibbus	Palmyra A-53-10	—	—		—		M		
Lutjanus gibbus	Palmyra A-53-12	—	—	—	—		—		
Lutjanus gibbus	Palmyra A-53-21	—				—			
Lutjanus gibbus	Christmas POFI-53-1	—		—		W			
Lutjanus gibbus	Fanning H-55-3	—	M		—		—		
Lutjanus monostigmus (Cuvier and Valenciennes)	Palmyra POFIG-51-8	—							
Lutjanus monostigmus	Palmyra A-53-3	—	—	—	—				
Lutjanus monostigmus	Palmyra A-53-8	—				—			
Lutjanus monostigmus	Palmyra A-53-10	M		M		M			
Lutjanus monostigmus	Palmyra A-53-20	—				—	—		
Lutjanus monostigmus	Palmyra POFI-53-3	—				—			
Lutjanus monostigmus	Palmyra POFI-53-3	—				—			
Lutjanus monostigmus	Palmyra POFI-53-4	—				—			
Lutjanus monostigmus	Palmyra A-53-?	—				W			
Lutjanus vaigiensis (Quoy and Gaimard)	Christmas POFI-50-15	M				—			
Lutjanus vaigiensis	Palmyra POFIG-51-8	—							
Lutjanus vaigiensis	Palmyra POFIG-51-8	—			—				
Lutjanus vaigiensis	Palmyra POFIG-51-8	M		M	M				
Lutjanus vaigiensis	Palmyra GV-51-41	—		—	—				
Lutjanus vaigiensis	Palmyra GV-51-41	—				—			
Lutjanus vaigiensis	Palmyra A-53-2	W	M	W					
Lutjanus vaigiensis	Palmyra A-53-3								—
Lutjanus vaigiensis	Palmyra A-53-3	—				—			
Lutjanus vaigiensis	Palmyra A-53-3	—		—		W			
Lutjanus vaigiensis	Palmyra A-53-5	—		—	—				
Lutjanus vaigiensis	Palmyra A-53-5	—		—		—			
Lutjanus vaigiensis	Palmyra A-53-8	—				—			
Lutjanus vaigiensis	Palmyra A-53-8	—				—			
Lutjanus vaigiensis	Palmyra A-53-8	—				—			

TABLE II. (Continued.)

Family and Species	Locality	Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
		Extracts Tested							
Lutjanus vaigiensis (Quoy and Gaimard)	Palmyra A-53-8	—				—			
Lutjanus vaigiensis	Palmyra A-53-8	M		—	—				
Lutjanus vaigiensis	Palmyra A-53-8	—				M			
Lutjanus vaigiensis	Palmyra A-53-8	—		—		—			
Lutjanus vaigiensis	Palmyra A-53-8	—		—		—			
Lutjanus vaigiensis	Palmyra A-53-8	—				—			
Lutjanus vaigiensis	Palmyra A-53-8	M				W			
Lutjanus vaigiensis	Palmyra A-53-8	—				—			
Lutjanus vaigiensis	Palmyra A-53-8	—				—			
Lutjanus vaigiensis	Palmyra A-53-8	—				—			
Lutjanus vaigiensis	Palmyra A-53-8	—				M			
Lutjanus vaigiensis	Palmyra A-53-8	—				M			
Lutjanus vaigiensis	Palmyra A-53-8	—				M			
Lutjanus vaigiensis	Palmyra A-53-8	—				M			
Lutjanus vaigiensis	Palmyra A-53-8	—		—	—				
Lutjanus vaigiensis	Palmyra A-53-9	—		—		M			
Lutjanus vaigiensis	Palmyra A-53-9	—				W			
Lutjanus vaigiensis	Palmyra A-53-9	—				W			
Lutjanus vaigiensis	Palmyra A-53-9	—				—			
Lutjanus vaigiensis	Palmyra A-53-9	—				W			
Lutjanus vaigiensis	Palmyra A-53-9	—				—			
Lutjanus vaigiensis	Palmyra A-53-9	—				—			
Lutjanus vaigiensis	Palmyra A-53-9	M				S			
Lutjanus vaigiensis	Palmyra A-53-9	M				—			
Lutjanus vaigiensis	Palmyra A-53-9	—				M			
Lutjanus vaigiensis	Palmyra A-53-9	M				—			
Lutjanus vaigiensis	Palmyra A-53-9	—		W	W				
Lutjanus vaigiensis	Palmyra A-53-9	—				—			
Lutjanus vaigiensis	Palmyra A-53-9	—				—			
Lutjanus vaigiensis	Palmyra A-53-9	—		—	—				
Lutjanus vaigiensis	Palmyra A-53-9	—				—			
Lutjanus vaigiensis	Palmyra A-53-9	—		—	—				
Lutjanus vaigiensis	Palmyra A-53-10	—				—			
Lutjanus vaigiensis	Palmyra A-53-10	—				—			
Lutjanus vaigiensis	Palmyra A-53-10	W				—	M		
Lutjanus vaigiensis	Palmyra A-53-10	—				—			
Lutjanus vaigiensis	Palmyra A-53-10	—				—			
Lutjanus vaigiensis	Palmyra A-53-10	—		—	W		W		
Lutjanus vaigiensis	Palmyra A-53-10	—		—		—			
Lutjanus vaigiensis	Palmyra A-53-10	—		—		—			
Lutjanus vaigiensis	Palmyra A-53-10	W		M	M		—		
Lutjanus vaigiensis	Palmyra A-53-10	—				—	—		
Lutjanus vaigiensis	Palmyra A-53-10	—				—			
Lutjanus vaigiensis	Palmyra A-53-10	M		W		W			
Lutjanus vaigiensis	Palmyra A-53-10	—				M			
Lutjanus vaigiensis	Palmyra A-53-10	—				W			
Lutjanus vaigiensis	Palmyra A-53-10	—				—			

TABLE II. (Continued.)

Family and Species	Locality	Extracts Tested: Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
Lutjanus vaigiensis (Quoy and Gaimard)	Palmyra A-53-10	—				M	—		
Lutjanus vaigiensis	Palmyra A-53-10	—		—		M			
Lutjanus vaigiensis	Palmyra A-53-10	—		—		—			
Lutjanus vaigiensis	Palmyra A-53-10	—				W			
Lutjanus vaigiensis	Palmyra A-53-10	—			—		—		
Lutjanus vaigiensis	Palmyra A-53-10	—				M			
Lutjanus vaigiensis	Palmyra A-53-10	—				—			
Lutjanus vaigiensis	Palmyra A-53-10	M				—			
Lutjanus vaigiensis	Palmyra A-53-10	—				—			
Lutjanus vaigiensis	Palmyra A-53-10	—		—		—			
Lutjanus vaigiensis	Palmyra A-53-10	—		—		S			
Lutjanus vaigiensis	Palmyra A-53-10	—				M	—		
Lutjanus vaigiensis	Palmyra A-53-10	—				—			
Lutjanus vaigiensis	Palmyra A-53-10	—				—			
Lutjanus vaigiensis	Palmyra A-53-10	—				—			
Lutjanus vaigiensis	Palmyra A-53-10	—		—		—			
Lutjanus vaigiensis	Palmyra A-53-12	—		—		—			
Lutjanus vaigiensis	Palmyra A-53-12	—				—			
Lutjanus vaigiensis	Palmyra A-53-12	—				—			
Lutjanus vaigiensis	Palmyra A-53-12	W				M			
Lutjanus vaigiensis	Palmyra A-53-12	—				—	M		
Lutjanus vaigiensis	Palmyra A-53-13	M				M			
Lutjanus vaigiensis	Palmyra A-53-13	—		—	W				
Lutjanus vaigiensis	Palmyra A-53-13	—		M	M				
Lutjanus vaigiensis	Palmyra A-53-15	—				W			
Lutjanus vaigiensis	Palmyra A-53-15	—				—			
Lutjanus vaigiensis	Palmyra A-53-16	—		—	W				
Lutjanus vaigiensis	Palmyra A-53-16	—				W			
Lutjanus vaigiensis	Palmyra A-53-16	—		—		W			
Lutjanus vaigiensis	Palmyra A-53-16	—				—			
Lutjanus vaigiensis	Palmyra A-53-16	—		—		—	—		
Lutjanus vaigiensis	Palmyra A-53-16	—		—	—				
Lutjanus vaigiensis	Palmyra A-53-19	—		—	—				
Lutjanus vaigiensis	Palmyra A-53-19	—				—			
Lutjanus vaigiensis	Palmyra A-53-19	—				—			
Lutjanus vaigiensis	Palmyra A-53-20	—				M			
Lutjanus vaigiensis	Palmyra A-53-20	—				—			
Lutjanus vaigiensis	Palmyra A-53-23	—				M			
Lutjanus vaigiensis	Palmyra A-53-?	—				—			
Lutjanus vaigiensis	Palmyra A-53-?					M			
Lutjanus vaigiensis	Palmyra POFI-53-4	—		—	—				
Lutjanus vaigiensis	Palmyra POFI-53-4	—		—	—				
MUGILIDAE — Mullets									
Chelon engeli (Bleeker)	Palmyra A-53-13	—				M			
Chelon engeli	Palmyra POFI-53-4	—				—			

TABLE II. (Continued.)

Family and Species	Locality	Extracts Tested: Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
Chelon engeli	Palmyra POFI-53-4	—		—	—				
Chelon engeli	Palmyra POFI-53-4	—				—			
Chelon troscheli Bleeker	Palmyra POFIG-51-8	—		—		—			
Chelon vaigiensis (Quoy and Gaimard)	Palmyra A-53-3	—				—			
Chelon vaigiensis	Palmyra A-53-3	—		W	W				
Chelon vaigiensis	Palmyra A-53-3	—				—			
Chelon vaigiensis	Palmyra A-53-3	—		M		—			
Chelon vaigiensis	Palmyra A-53-3	—		—		M			
Chelon vaigiensis	Palmyra A-53-3	—				M			
Chelon vaigiensis	Palmyra A-53-3	—				—			
Chelon vaigiensis	Palmyra A-53-3	—		—	—				
Chelon vaigiensis	Palmyra A-53-8	—		M		M			
Chelon vaigiensis	Palmyra A-53-13	—				—	—		
Chelon vaigiensis	Palmyra A-53-13	—				—	—		
Chelon vaigiensis	Palmyra A-53-13	—				—			
Chelon vaigiensis	Palmyra A-53-15	—		—		—			
Chelon vaigiensis	Palmyra A-53-15	—				—			
Chelon vaigiensis	Palmyra POFI-53-4	—							
MULLIDAE — Goatfish									
Mulloidichthys auriflamma (Forskål)	Palmyra A-53-9	—	—	—			—		
Mulloidichthys auriflamma	Palmyra A-53-9	—	—	—	—				
Mulloidichthys auriflamma	Palmyra A-53-9	W	M	—	—				
Mulloidichthys auriflamma	Palmyra A-53-9	—				M			
Mulloidichthys auriflamma	Palmyra A-53-9	—				—			
Mulloidichthys auriflamma	Palmyra A-53-9	—				—			
Mulloidichthys auriflamma	Palmyra A-53-9	—				—			
Mulloidichthys auriflamma	Palmyra A-53-12	—		—		—			
Mulloidichthys auriflamma	Palmyra A-53-12	—		—		—			
Mulloidichthys auriflamma	Palmyra A-53-13								—
Mulloidichthys auriflamma	Palmyra A-53-13								—
Mulloidichthys auriflamma	Palmyra A-53-13								—
Mulloidichthys auriflamma	Palmyra A-53-15	—				—			
Mulloidichthys auriflamma	Palmyra A-53-20	—				M			
Mulloidichthys auriflamma	Palmyra A-53-20	—				M			
Mulloidichthys auriflamma	Palmyra A-53-20	—				—			
Mulloidichthys auriflamma	Palmyra A-53-20	—				—			
Mulloidichthys auriflamma	Palmyra A-53-20	—				—			
Mulloidichthys samoensis (Günther)	Palmyra POFIG-51-8	—			—				
Mulloidichthys samoensis	Palmyra A-53-9	—				—			
Mulloidichthys samoensis	Palmyra A-53-20	—				—			
Mulloidichthys samoensis	Palmyra A-53-20	—				—			
Parupeneus bifasciatus(Lacépède)	Palmyra A-53-21	—				W			

TABLE II. (Continued.)

Family and Species	Locality	Extracts Tested: Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
Upeneus arge Jordan and Evermann	Palmyra A-53-3	—		—		—	W		
Upeneus arge	Palmyra A-53-9	—				—			
Upeneus arge	Palmyra A-53-12	—				—			
MURAENIDAE — Moray Eels									
Gymnothorax javanicus (Bleeker)	Palmyra A-53-9	—	M		M		—		
Gymnothorax pictus (Ahl)	Fanning POFIG-51-7	—							
Gymnothorax pictus	Palmyra A-53-5	S	—		—				
Gymnothorax pictus	Palmyra A-53-5	—	—	—	—				
Gymnothorax pictus	Palmyra A-53-6	—	M		W				
Gymnothorax pictus	Palmyra A-53-6	—	M		M				
Gymnothorax pictus	Palmyra A-53-9	—		—		W			
Gymnothorax pictus	Palmyra A-53-9	—				—			
Gymnothorax pictus	Palmyra A-53-9	—				—			
Gymnothorax pictus	Palmyra A-53-9	—				M			
Gymnothorax pictus	Palmyra A-53-9	W				W			
Gymnothorax pictus	Palmyra A-53-12	—	M			M			
Gymnothorax pictus	Palmyra A-53-12	—				—			
Gymnothorax pictus	Palmyra A-53-13	M	M			M			
Gymnothorax pictus	Palmyra A-53-13	M	—			—			
Gymnothorax pictus	Palmyra A-53-13	—	—		—				
Gymnothorax pictus	Palmyra A-53-13	—	M		M				
Gymnothorax pictus	Palmyra A-53-13	—	M	—	M				
Gymnothorax pictus	Palmyra A-53-13	—	W		—				
Gymnothorax pictus	Palmyra A-53-13	—	M	M	M				
Gymnothorax pictus	Palmyra A-53-13	—	M	W	M				
Gymnothorax pictus	Palmyra A-53-13	—				M			
Gymnothorax pictus	Palmyra A-53-13	—				—			
Gymnothorax pictus	Palmyra A-53-13	—	M	M	—				
Gymnothorax pictus	Palmyra A-53-13	—				—	—		
Gymnothorax pictus	Palmyra A-53-13	—				—			
Gymnothorax pictus	Palmyra A-53-13	W	—		W				
Gymnothorax pictus	Palmyra A-53-13	—		W		—			
Gymnothorax pictus	Palmyra A-53-13	W	W	M	—				
Gymnothorax pictus	Palmyra A-53-13	—	M	W	—				
Gymnothorax pictus	Palmyra A-53-21	S	S		—				
Gymnothorax pictus	Palmyra POFI-53-4	—	—		—				
PEMPHERIDAE — Deep-water Catalufa									
Pempheris oualensis Cuvier	Palmyra A-53-21	—				W			
Pempheris oualensis	Palmyra A-53-21	—				W			
Pempheris oualensis	Palmyra A-53-21	—				—			

TABLE II. (Continued.)

Family and Species	Locality	Extracts Tested: Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
POMACENTRIDAE — Damselfish									
Abudefduf glaucus (Cuvier)	Palmyra A-53-5								S
Abudefduf septemfasciatus (Cuvier)	Palmyra A-53-5	—				—	—		
Abudefduf septemfasciatus	Palmyra A-53-5	—				—	—		
Abudefduf septemfasciatus	Palmyra A-53-10	—		—		—			
Abudefduf septemfasciatus	Palmyra A-53-12	—				—			
Abudefduf septemfasciatus	Palmyra A-53-13	—				—			
Abudefduf septemfasciatus	Palmyra A-53-13	—				—	M		
Abudefduf septemfasciatus	Palmyra A-53-13	—				M	—		
Abudefduf septemfasciatus	Palmyra A-53-20	—				M	M		
Abudefduf sordidus (Forskål)	Christmas POFI-50-15	M				—			
Abudefduf sordidus	Jarvis POFIG-51-5	—							
Abudefduf sordidus	Palmyra A-53-3	—				W	M		
Pomacentrus nigricans (Lacépède)	Palmyra A-53-5								—
PRIACANTHIDAE — Big Eyes									
Priacanthus hamrur (Forskål)	Palmyra A-53-8	—				—			
Priacanthus hamrur	Palmyra A-53-8	—	—		—				
SCARIDAE — Parrotfish									
Scarus brevifilis (Günther)	Fanning POFI-50-14	M				W			
Scarus brevifilis	Palmyra A-53-9	—		W	—				
Scarus dussumieri (Valenciennes)	Christmas POFIG-51-6	—	—						
Scarus globiceps Valenciennes	Fanning POFI-50-14	—				—			
Scarus jonesi (Streets)	Fanning POFIG-51-7	—	W						
Scarus jonesi	Palmyra A-53-5	—	W	S	M				
Scarus jonesi	Palmyra A-53-5	—	—	—	—				
Scarus jonesi	Palmyra A-53-5	—		—	—				
Scarus jonesi	Palmyra A-53-5	—	—	—	—				
Scarus jonesi	Palmyra A-53-21	—	M	—	—				
Scarus microrhinos Bleeker	Palmyra A-53-21	—	M		—				
Scarus randalli Schultz	Palmyra A-53-9	—	—	—	—				
Scarus rubroviolaceus Bleeker	Palmyra A-53-5	—	—	W	S				
Scarus rubroviolaceus	Palmyra A-53-5	—	S	M	—				
Scarus rubroviolaceus	Palmyra A-53-5	W	W	W	—				
Scarus rubroviolaceus	Palmyra A-53-5	—	W	W	—				
Scarus sordidus Forskål	Palmyra A-53-21	—				—			
Scarus sordidus	Palmyra A-53-21	—				—			
Scarus vermiculatus (Fowler and Bean)	Jarvis POFIG-51-5	W							
Scarus vermiculatus	Palmyra A-53-5	—	—	—	—				
Scarus vermiculatus	Palmyra A-53-9	—	—	—	—				

TABLE II. (Continued.)

Family and Species	Locality	Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
		Extracts Tested							
SERRANIDAE — Sea Basses									
Cephalopholis argus Bloch and Schneider	Palmyra POFI-50-10	—							
Cephalopholis argus	Palmyra A-53-2	—				M			
Cephalopholis argus	Palmyra A-53-4	—	W		—				
Cephalopholis argus	Palmyra A-53-8	W				M			
Cephalopholis argus	Palmyra A-53-8	—			M		—		
Cephalopholis argus	Palmyra A-53-18	—				—			
Cephalopholis argus	Palmyra A-53-21	—				—			
Cephalopholis argus	Palmyra A-53-21	—				—			
Cephalopholis argus	Palmyra A-53-21	—				—			
Cephalopholis argus	Palmyra A-53-21	—	W			M			
Cephalopholis argus	Palmyra A-53-21	—				—			
Cephalopholis argus	Palmyra A-53-21	—				M			
Cephalopholis argus	Palmyra A-53-21	—				—			
Cephalopholis argus	Palmyra A-53-21	—				—			
Cephalopholis argus	Palmyra A-53-21	—				—			
Cephalopholis argus	Palmyra A-53-21	—				—			
Cephalopholis argus	Palmyra A-53-21	—	W		—				
Cephalopholis argus	Palmyra A-53-21	—				—			
Cephalopholis argus	Palmyra A-53-21	—	—		—				
Cephalopholis argus	Palmyra A-53-21	—				—			
Cephalopholis argus	Palmyra POFI-53-4	—				—			
Cephalopholis urodelus (Bloch and Schneider)		—							
Cephalopholis urodelus	Palmyra A-53-21	—				—			
Epinephelus corallicola Valenciennes	Palmyra A-53-13	—				—			
Epinephelus corallicola	Palmyra A-53-21	W	—		—				
Epinephelus corallicola	Palmyra A-53-21	W	M		—				
Epinephelus corallicola	Palmyra A-53-21	—	—		—				
Epinephelus corallicola	Palmyra A-53-21	—				—			
Epinephelus corallicola	Palmyra A-53-23	—	M			M			
Epinephelus corallicola	Palmyra POFI-53-4	—				—	—		
Epinephelus corallicola	Palmyra POFI-53-4	—		—	—		—		
Epinephelus corallicola	Washington POFI-54-3	—	—		—				
Epinephelus elongatus Schultz	Palmyra A-53-1	—	—	—	—				
Epinephelus elongatus	Palmyra A-53-9	—				—			
Epinephelus fasciatus (Forskål)	Washington POFI-54-3	—				—			
Epinephelus fasciatus	Washington POFI-54-3	—				—			
Epinephelus fuscoguttatus (Forskål)	Kingman Reef POFI-50-9	—	M		—				
Epinephelus fuscoguttatus	Palmyra POFI-50-10	—	—						
Epinephelus fuscoguttatus	Fanning POFIG-51-7	—							
Epinephelus fuscoguttatus	Palmyra A-53-5	—	—			—			
Epinephelus fuscoguttatus	Palmyra A-53-8	—	—			—			
Epinephelus fuscoguttatus	Palmyra A-53-9	—	S		S		S		

TABLE II. (Continued.)

Family and Species	Locality	Extracts Tested							
		Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
Epinephelus fuscoguttatus (Forskål)	Palmyra A-53-20	—	M			—			
Epinephelus fuscoguttatus	Palmyra A-53-21	—	M	—	W				
Epinephelus fuscoguttatus	Palmyra A-53-21	—	—			—			
Epinephelus fuscoguttatus	Palmyra H-55-1	—							
Epinephelus fuscoguttatus	Fanning H-55-3	—							
Epinephelus fuscoguttatus	Fanning H-55-3	W							
Epinephelus fuscoguttatus	Fanning H-55-3	—							
Epinephelus fuscoguttatus	Fanning H-55-3	—							
Epinephelus fuscoguttatus	Palmyra H-55-4	W	W		—				
Epinephelus fuscoguttatus	Palmyra H-55-4	W	—		—		W		
Epinephelus hexagonatus (Bloch and Schneider)	Christmas POFI-50-15	M				—			
Epinephelus hexagonatus	Palmyra A-53-1	—				—			
Epinephelus hexagonatus	Palmyra A-53-3	—				W			
Epinephelus hexagonatus	Palmyra A-53-13	W				—			
Epinephelus hexagonatus	Palmyra A-53-23	—		M		—			
Epinephelus hexagonatus	Washington POFI-54-3	—				W			
Epinephelus merra Bloch	Christmas POFI-50-15	M				—			
Epinephelus merra	Christmas POFIG-51-6					—			
Epinephelus merra	Palmyra A-53-5	—				—			
Epinephelus merra	Palmyra A-53-8								—
Epinephelus merra	Palmyra A-53-9	—				—			
Epinephelus merra	Palmyra A-53-10	—				—			
Epinephelus merra	Palmyra A-53-13	—				M			
Epinephelus merra	Palmyra A-53-13	—				W			
Epinephelus merra	Palmyra A-53-16	—				—			
Epinephelus socialis (Günther)	Malden POFI-51-1	—							
Epinephelus socialis	Malden POFI-51-1	W							
Epinephelus socialis	Jarvis POFIG-51-5	—	—		—				
Epinephelus socialis	Palmyra A-53-3	—				—			
Plectropomus leopardus (Lacépède)	Palmyra A-53-21	—	—		—				
Plectropomus truncatus (Fowler)	Fanning H-55-3	—	—		M				
Variola louti (Forskål)	Palmyra A-53-21	—				—	—		
Variola louti	Palmyra A-53-21	—				—			
SPHYRAENIDAE — Barracudas									
Sphyraena barracuda (Walbaum)	Palmyra A-53-18	—	M	—	—				
TETRAODONTIDAE — Puffers									
Arothron hispidus (Linnaeus)	Christmas POFIG-51-6	S							
Arothron hispidus	Palmyra A-53-3	S	—	S	S		M	S	
Arothron hispidus	Palmyra A-53-5	S	S	S	S		S	S	
Arothron hispidus	Palmyra A-53-5	S	S	S	S		S	S	
Arothron hispidus	Palmyra A-53-6	—	M	S	—		—	W	
Arothron hispidus	Palmyra A-53-6	—	W	S	W		M	M	

TABLE II. (Continued.)

Family and Species	Locality	Extracts Tested: Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
Arothron hispidus (Linnaeus)	Palmyra A-53-9	S	S	S	S		S	S	
Arothron hispidus	Palmyra A-53-9	S	S	M	S		S		
Arothron hispidus	Palmyra A-53-10	S	S		S		M	S	
Arothron hispidus	Palmyra A-53-10	S	S		S		S	S	
Arothron hispidus	Palmyra A-53-12	—	—	—	—		—	S	
Arothron hispidus	Palmyra A-53-12	—	—	S			—	M	
Arothron hispidus	Palmyra A-53-12	—	S		—			S	
Arothron hispidus	Palmyra A-53-12	W	—		W		—	S	
Arothron hispidus	Palmyra A-53-13	W	W	S	—		—	M	
Arothron hispidus	Palmyra A-53-13	S	—		—				
Arothron hispidus	Palmyra A-53-13	—	—	—	S			S	
Arothron hispidus	Palmyra A-53-14	S	S	S	S			S	
Arothron hispidus	Palmyra A-53-14	M	S	S	S		M	S	
Arothron hispidus	Palmyra A-53-14	S	M	S	S			S	
Arothron hispidus	Palmyra A-53-14	S	S	S	S		S	S	
Arothron hispidus	Palmyra A-53-22	S	S		S		S	S	
Arothron hispidus	Palmyra A-53-22	S	—	—	—		S	S	
Arothron hispidus	Palmyra A-53-22	S	S	S	S		S	S	
Arothron hispidus	Palmyra A-53-?	S	S	S	S		S	S	
Arothron hispidus	Palmyra POFI-53-4	W	S	W	M		M	—	
Arothron hispidus	Palmyra POFI-53-4	W	W	—	M		M	—	
Arothron meleagris (Lacépède)	Palmyra A-53-5	S	S		S			S	

TABLE III.

Results of a Survey of Poisonous Fishes on the Line Islands.

	Species	Specimens	Muscle	Liver	Gonads	Intestines	Viscera	Intestinal Content	Skin	Whole Fish
Total Tested	87	747	730	234	162	250	421	132		12
Total Found Toxic	58	337	77	115	38	48	147	45		5
Per cent Found Toxic	67	45	11	49	23	19	35	34		42

TABLE IV.

Distribution of the Toxin in Muscle and Viscera (Viscera, Whole or in Part), as Found in 680 Specimens Tested for Both Muscle and Viscera Toxicity.

	Muscle	Viscera	Muscle and Viscera
Number of Toxic Specimens	74	303	50
Per Cent Toxic of a Total of 680 Tested Specimens	11	45	7
Per Cent Toxic of a Total of 326 Toxic Specimens	23	93	15

Discussion and Summary.

The 89 fish species reported in Table II, a majority of which are shore inhabitants, are representative of those likely to be used as food in the Line Islands. The following families contain either valuable or potentially useful food species: Acanthuridae, Albulidae, Carangidae, Carcharhinidae, Holocentridae, Kuhlidae, Kyphosidae, Labridae, Lutjanidae, Mugilidae, Mullidae, Pempheridae, Pomacentridae, Priacanthidae, Scaridae, Serranidae, and Sphyraenidae. However, these are for the most part the same groups which have contributed the greatest number of causative agents of ichthyosarcotoxism among persons eating Line Island fishes.

A total of 24 families of marine fishes, containing a total of 89 species, was tested. Of the 87 species (excluding Tetraodontidae)[3] tested, 58 or 67% were found to be toxic. In this same group there was a total of 747 specimens (excluding tetraodontoid specimens) in which 337 specimens or about 45% were toxic. In most instances the viscera proved to be more toxic than the musculature. Of 680 specimens in which both musculature and viscera (including liver, intestines, gonads, etc.) were tested, 326 specimens or 48% were poisonous. The 326 toxic specimens showed a toxic distribution as follows: 74 specimens or 23% had toxic musculature, 303 or 93% had toxic viscera, and 50 or 15% had both. In general, if the musculature was poisonous, so were the viscera. These results show that there is a great deal of variation of toxicity within a given species. Moreover, the toxin content of the various organs of the fish varies from specimen to specimen. Too few specimens were collected of most of the species to permit a complete statistical analysis.

It should be noted that fishes were collected in the Line Islands during October and November, 1950; January, February, and August, 1951; January and April, 1953; May and June, 1954; and January through April, and September, 1955. However, further collections should be made at a single site on a year-round basis in order to determine any seasonal fluctuation.

Once again the reader is warned against arriving at hasty conclusions about the edibility of species listed as "weakly positive" as it is difficult to interpret these reactions. There is reason to believe, however, that if anything the test is not as sensitive as might be desired (GOE and HALSTEAD, 1955). If mistakes are being made it is most likely that poisonous specimens are being missed because of an inability to detect small quantities of the poison with present

[3] The tetraodontoid fishes are excluded since they are generally considered to be poisonous wherever they are found.

screening methods. Chromatographic procedures have recently been instituted and it is hoped that our screening program can be placed on a more exact basis. Specimens which have registered only "weakly positive" by the mouse screening method have been known to contain sufficient quantities of the poison to hospitalize the victim eating the fish, whereas in other instances the reaction has been of questionable significance.

The data provided in this report become very disturbing when considered from the viewpoint of utilizing new protein food sources from the sea. Dr. K. K. RAO (1957) of the United Nations Food and Agriculture Organization has noted that the world population is increasing at the rate of almost 100,000 persons per day. If we are to meet future food needs "fish supplies would have to be increased by nearly 90 per cent". If this expansion program is to be achieved it means that the shore fisheries resources of the tropical Pacific must be utilized to a much greater extent than they have to date. However, poisonous fish studies by German, Japanese, and American scientists in the tropical Pacific have shown that from about 30% to 50% of the reef fishes of large island areas are poisonous to eat. Also, more than 70% of the fish families studied were found to contain toxic species.

In evaluating an extensive literature on poisonous marine animals and compiling epidemiological reports, one gains the distinct impression that intoxications from marine products have rapidly increased in the Pacific area since 1943. Not a single clue has been found regarding outbreaks of ichthyosarcotoxism in the Line Islands prior to 1943, despite the fact that in numerous localities elsewhere in the Pacific fish poisonings were reported as far back as 1606. It is also interesting that the only island in the Line group where intoxications from fish have not occurred is Washington Island, even though it has maintained a native population of about 200 persons. The question as to whether we are merely becoming more conscious of the problem or whether there is an actual increase is one which has been under consideration for several years. A review of Japanese reports indicates that there has also been a marked increase in poisonings from marine animals since 1945 in the western Pacific. At present, marine products account for about 10% of the total food of Japan but contribute up to 70% of the food intoxications. Surprisingly, Japanese epidemiologists have been unable to determine the primary etiological agents in an unusually large percentage of the cases of intoxications from marine products in recent years (KAWABATA, 1957; KAWABATA, HALSTEAD, and JUDEFIND, 1957; KAWABATA, ISHIZAKA, and MIURA, 1955). The poisonous fish situation in the Pacific area carries grave public health implications and must be given more serious consideration than it has received to date.

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Résumé.

La plupart des 89 espèces de poissons énumérées dans le tableau II habitent les régions côtières et servent de nourriture dans les Line Islands.

24 familles de poissons marins, comprenant un total de 89 espèces, ont été testées quant à leur toxicité. De 87 espèces (à l'exception des Tetraodontidae dont la toxicité est prouvée), 58 (67 %) se sont révélées venimeuses. Dans le même groupe se trouvaient 747 exemplaires (exceptés les Tetraodontidae) dont 337 individus (45 %) étaient toxiques. Dans la plupart des cas, les organes internes étaient plus toxiques que la musculature. Parmi les 680 exemplaires dont on a examiné et la musculature et les organes internes (foie, intestins, organes génitaux, etc.), 326 animaux (48 %) étaient toxiques. Ces 326 exemplaires venimeux ont pu être groupés selon leur toxicité de la façon suivante : Chez 74 animaux (23 %), la musculature était toxique, chez 303 (93 %), le système nerveux, et chez 50 (15 %), la musculature et le système digestif. Lorsque la musculature était toxique, l'intestin l'était en général aussi. Ces résultats montrent que, dans une seule et même espèce, la toxicité est soumise à de très fortes fluctuations. Le degré de toxicité varie également d'individu à individu.

La présence de poissons venimeux dans la région du Pacifique est de la plus haute importance pour la santé publique et il serait temps de prêter plus d'attention à ce problème que cela n'a été fait jusqu'à présent.

Zusammenfassung.

Von den 89 in Tabelle II aufgezählten Fischarten sind die meisten Küstenbewohner und Vertreter jener Fische, die auf den Line Islands als Nahrung konsumiert werden.

Es wurden insgesamt 24 Familien mariner Fische, die total 89 Arten umfassen, geprüft. Von den 87 untersuchten Arten (ausgenommen die Tetraodontidae) [3], erwiesen sich 58 (67%) als toxisch. In derselben Gruppe befanden sich total 747 Exemplare (ausgenommen die Vertreter der Tetraodontidae), von welchen sich 337 Individuen (45%) als giftig erwiesen. In der Mehrzahl der Fälle waren die Eingeweide stärker toxisch als die Muskulatur. Von den 680 Exemplaren, bei denen sowohl die Muskulatur als auch die Eingeweide (Leber, Darmsystem, Geschlechtsorgane usw.) geprüft wurden, waren 326 Tiere (48%) giftig. Diese 326 toxischen Exemplare ließen sich, was ihre Giftigkeit betrifft, wie folgt aufteilen: Bei 74 Tieren (23%) war die Muskulatur toxisch, bei 303 (93%) war das Darmsystem toxisch, und bei 50 (15%) waren Muskulatur und Darmsystem giftig. Wenn sich die Muskulatur als giftig erwies, so war meist auch der Darm toxisch. Die vorliegenden Resultate zeigen, daß innerhalb einer bestimmten Art in bezug auf ihre Giftigkeit große Schwankungen auftreten können. Außerdem variiert der Toxingehalt der verschiedenen Organe von Tier zu Tier.

Das Vorkommen von Giftfischen in der pazifischen Region hat ernste Folgen für die Gesundheit der Bevölkerung; diesem Problem muß größere Beachtung geschenkt werden, als dies bis heute der Fall war.

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[3] Die Vertreter der Tetraodontidae wurden bei den Untersuchungen nicht berücksichtigt, da sie in allen Gebieten, wo sie vorkommen, als giftig betrachtet werden.