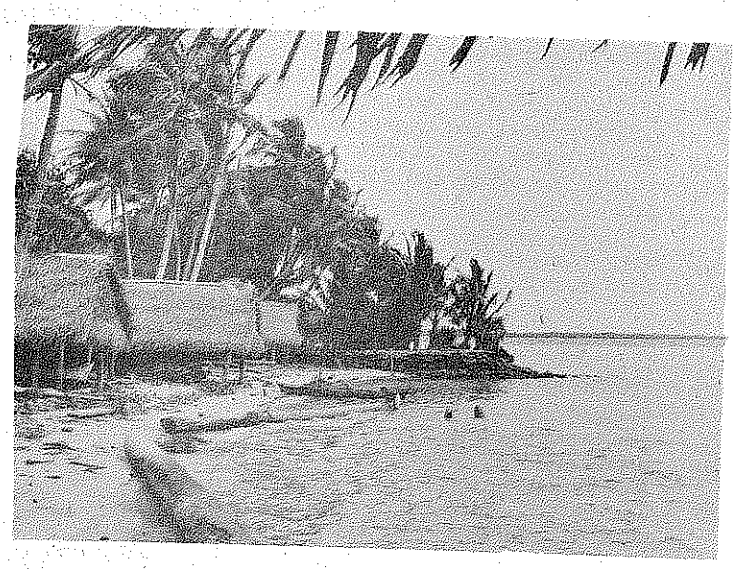

Figure 12...
Kapingamarangi.
Canoe houses, lagoon side.
August 1946.

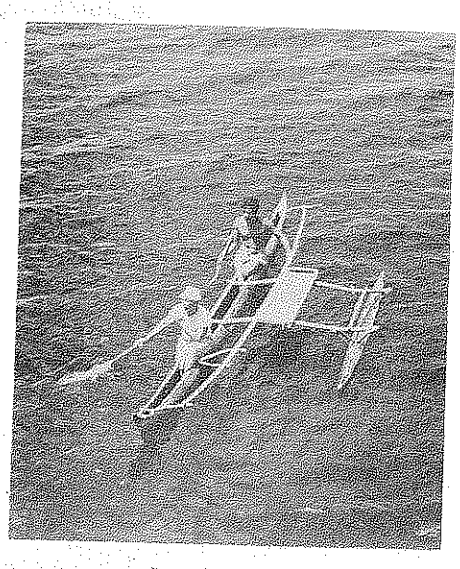

Figure 13...
Nukuoro
Paddling Canoe.
August 1946.

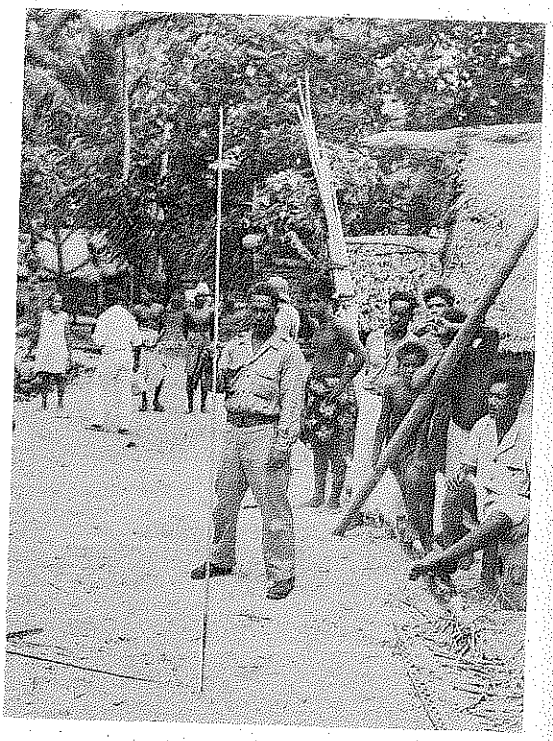

Figure 14...
Kapingamarangi.
Fish Spear.
August 1946.

side.

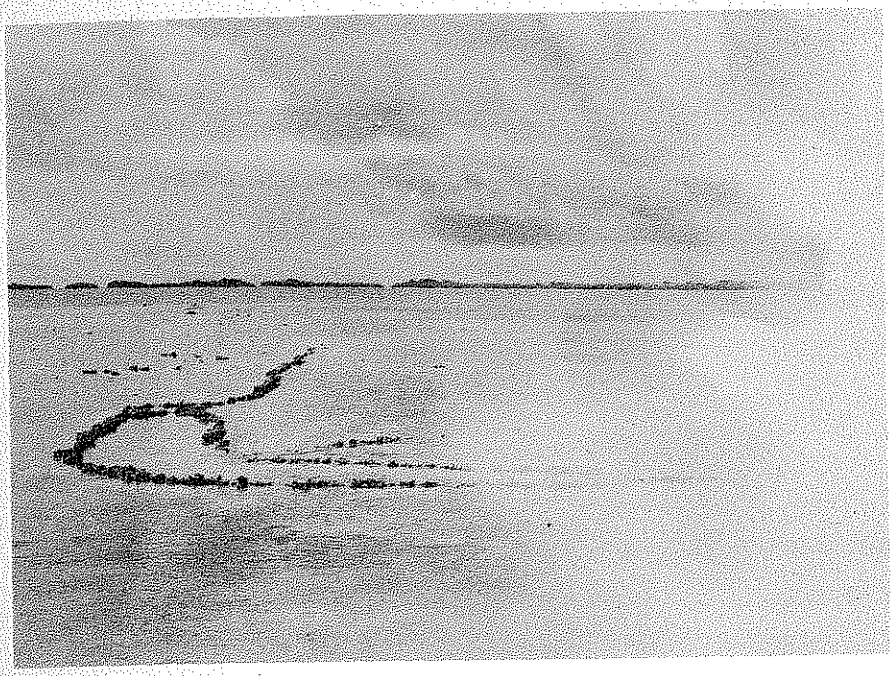

Figure 15... Kapingamarangi. Stone Fish Trap. Low tide. August 1946.

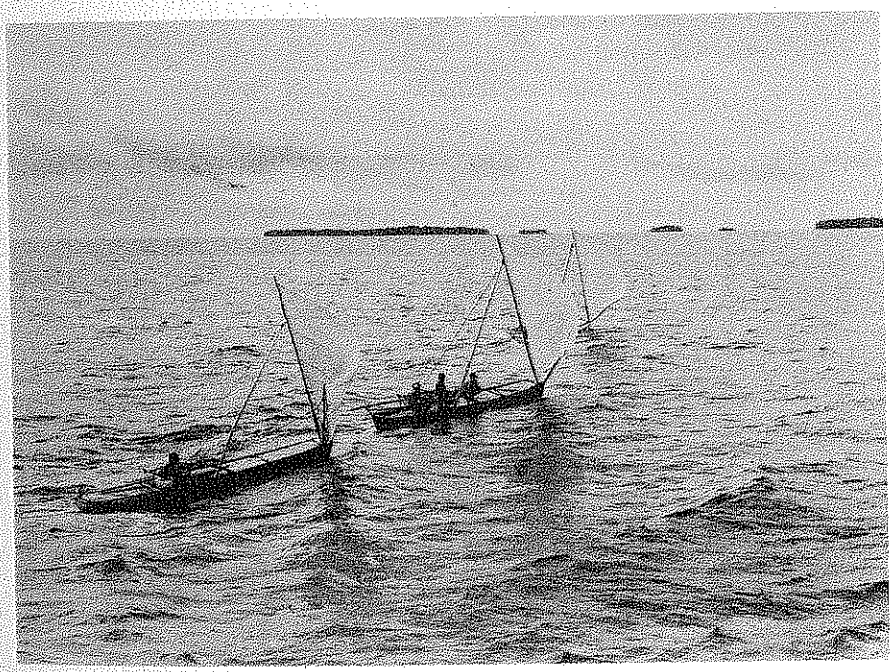

Figure 16... Kapingamarangi. Sailing Canoes. August 1946.

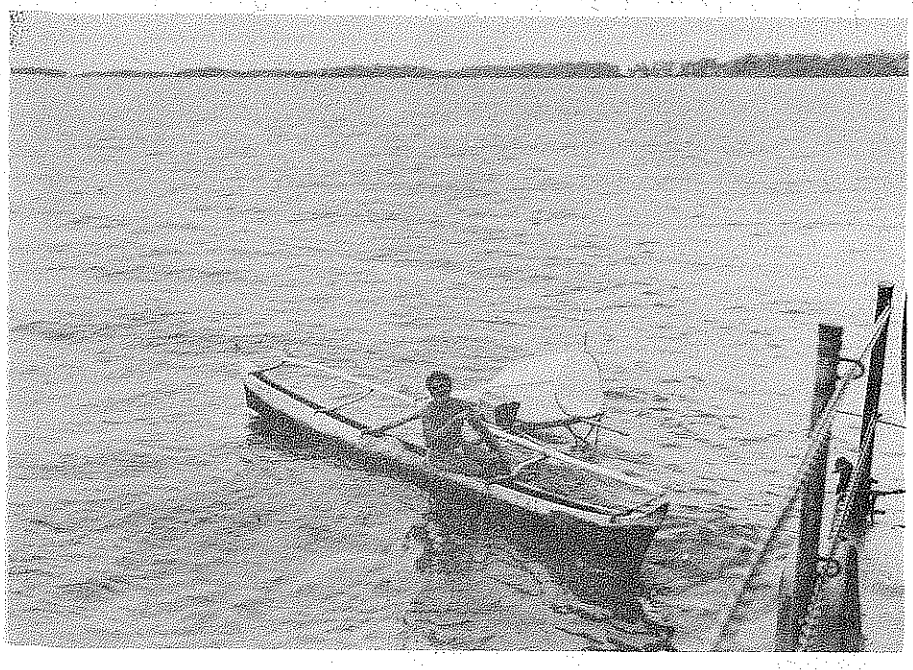

Figure 17... Kapingamarangi. Paddling canoe and scoop net for Flying Fish. August 1946.

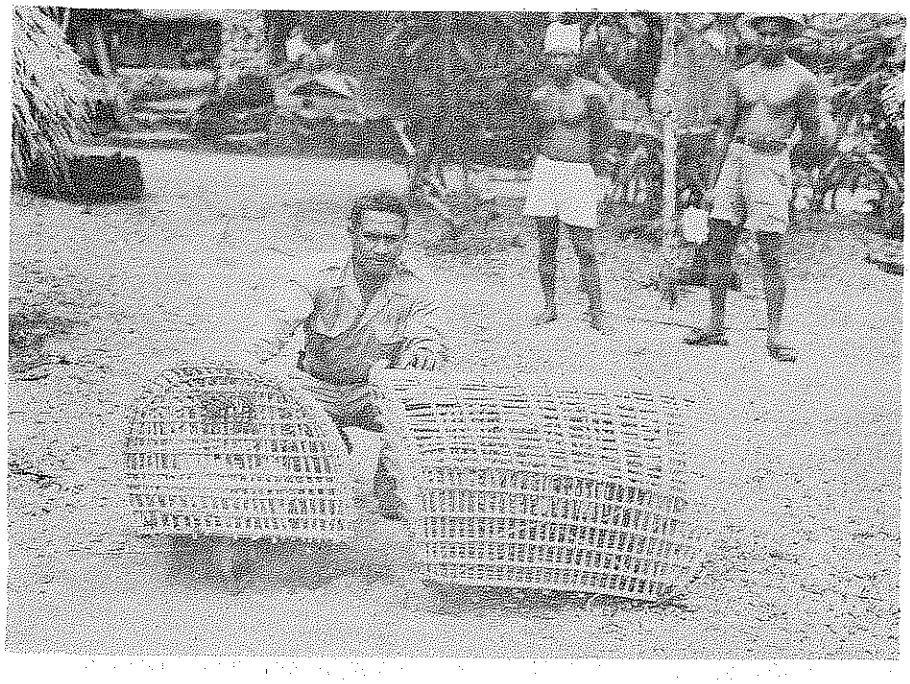

Figure 18... Kapingamarangi. Detail of fish traps. August 1946.

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While examining this reef at 9:30 p.m. we saw six natives in a canoe catching flying fish (Cypselurus simus) in their traditional manner. Four of the natives paddled the canoe, while two men with long-handled scoop nets (Fig. 17) stood up in the canoe and caught the fish which were attracted by a torch made of dried coconut leaves. The natives paddled the canoe up and down along the outer edge of the reef, possibly 50 to 100 feet outside the surf. The torch was kept burning brightly and attracted the fish. The two men with the nets got them as they went by. The nets are 30 inches in diameter and the bag is four feet long and mounted on a frame so that the bag does not collapse. The handles are eight feet long. The flying fish were eight to ten inches in length.

On a sand reef exposed at low tide we saw two fish traps of coral rock made by the natives (Fig. 15). They are V-shape, with the point near shore and the opening away from shore. The sides of the V are 50 yards long. Fish entering the traps were bottled up at high tide by means of netting stretched across the opening of the V, and as the tide receded were chased to the foot of the V where they were taken at low tide.

There seemed to be no shortage of canoes. These are made locally from breadfruit logs hollowed out with an adze. The usual length is from 14 to 30 feet. Every family had at least one canoe (Fig. 16); some had more than one. As was the case elsewhere, the prospective owner of a canoe obtains the log and enlists the services of several of his friends to help with the construction. On Kapingamarangi the owner furnishes his helpers free lunch, but no money, as each man is repaid for service as needed. Most of the canoes 20 feet or longer carry a sail.

The chief methods of fishing include spears, throw nets, seines, traps as described above, and also small basket traps made of bamboo, which are roughly 18 inches square by 30 inches long. (See Fig. 18).

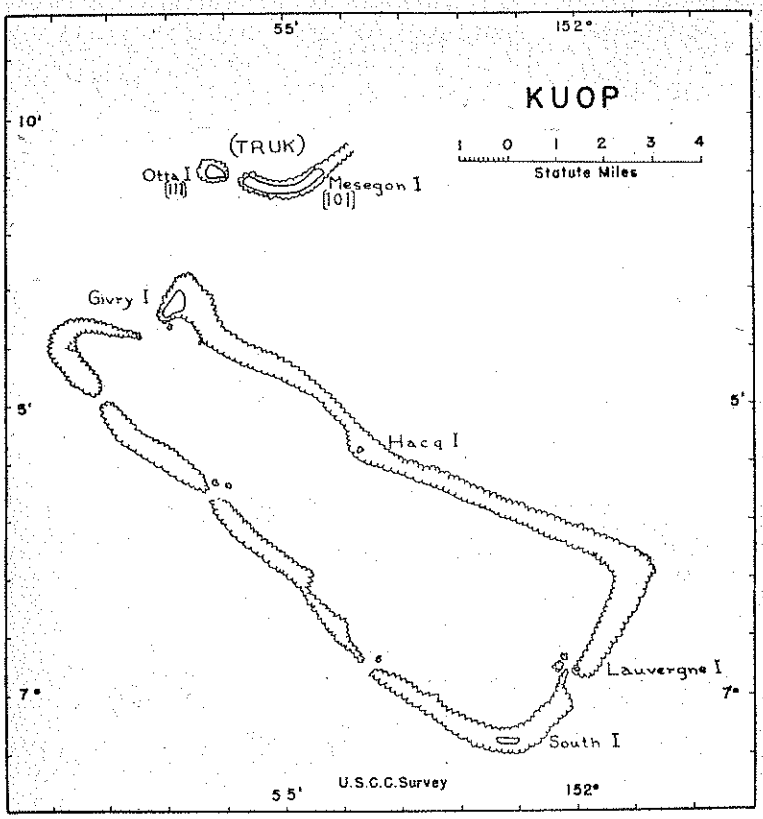
On the lagoon side of the island there are many individual coral heads sticking up from the bottom in from one to three fathoms of water. These coral heads frequently come within three feet of the surface. Around them there is an abundance of reef fishes and the natives say there has been no shortage.

Due to the isolated location of this island it is not regularly visited by trading ships and arrangements should be made to supply the natives with fish hooks, hand lines, seine twine for making nets and throw nets, and some steel rods, approximately 3/8 inches in diameter, for making spears.

To prevent depreciation from either checking in the sun or attack by marine worms, canoes are stored in sheds when not in use (Fig. 12). This practice is common throughout Micronesia.

E. TRUK ISLANDS (Population 9750 - 1946)
(May 23 - June 3)

From the fishery standpoint, the most striking feature of these islands is the general scarcity of fish. Toward the end of the war Japanese garrisons totaling as many as 40,000 men were isolated from home supplies and depended largely on sea food for meat. Since they were prevented by our bombing from using fishing vessels, it was obtained mostly by dynamiting. This was carried on so continuously and over such a wide area that there is at the present time a very great scarcity of fish of all kinds on the reefs and inside the lagoons. Since the native population is very short on protein, they have been forced to use very small fish and shell fish and it is expected that it will be from three to five years before the normal supply of fish is again present in the area. If other protein foods could be supplied, it would be desirable to restrict the taking of all immature fish, but under present circumstances it is not believed possible without great hardship to the native



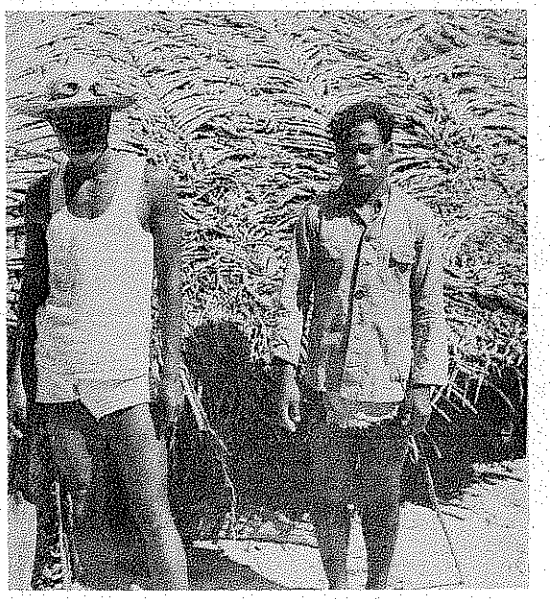


Fig. 19... Truk. Short Fish Spear. May 1946.

population. Using both hand lines and trolling, the only fish we were able to take in any quantity at all were remoras. Altogether we trolled both feather and spoon for 18-1/2 hours inside the lagoon and caught only one fish, a snapper (Aprion virescens) 18 inches long.

At Falas Island, the reefs were searched for fish and shellfish. Fish were very rare, only a few small striped surgeon fish and goat-fish under five inches were seen. None of these fish was in sufficient quantity to use a throw net. On the seaward side of this island there were many "gold ringer" shells under rocks in depths from three inches to two feet. "Monkey face" shells (Cypraea moneta) were also quite common, and there were some small tiger cowries, (Cypraea tigris) around two inches in length. Black sea-cucumbers, both smooth and rough types, were very common, but no yellow ones were seen. Outside the reef on the seaward side there were a few small crevalle (Caranx sp.) 12 to 14 inches long, but very wild. We were unable to get close enough for spearing. Small sand sharks, two to four feet long, were quite common.

On May 28 an examination was made of the outside reefs at Udot Island. The beach is sandy and slopes off very gradually approximately a hundred yards to the fringing reef. The depth over the flat area is approximately a foot at low tide. On this flat are many black sea cucumbers and under the rocks there are many small decorative shells, such as the monkey face and gold ringers used in handicraft. There were a few scattered schools of mullet, approximately eight inches long. Six were caught with one cast of the throw net. In general, however, all of the small fish here were very wild and difficult to approach. The fish caught were given to the natives, who took even the small finger mullet, two to three inches long. The chief on this island said that they have had no fish to speak of since the Japanese dynamited along the reefs near shore both day and night. A few trochus under three inches were also seen, but as we did not examine the outer face of the fringing reef, no large ones were found. A number of small blue parrot fish about six inches in length were seen, but could not be approached closely. We also saw several barracuda (Sphyraena sp.) 10 to 12 inches in length.

Outrigger canoes were very scarce and we were told that there were no breadfruit trees on the island large enough to make canoes. The Japanese had destroyed most of the canoes throughout the Truk group in order to prevent the natives from communicating with United States vessels.

We also trolled on the seaward side of Udot Island, looking for schools of bonito, but saw none, nor were there any flocks of birds hovering over the water as is the case when schools of fish are feeding. We trolled both a feather jig and a brass spoon for an hour and a half without obtaining any strikes.

The natives need many types of fishing implements, especially throw nets. Only a few are now available, as most of the nets they had under the Japanese have worn out and there is no twine from which to make new ones. Most of the fishing is done by women on the shallow reefs, using the small hand nets called epino with which they catch very small fish, crabs, and other shell fish.

At Fala-Beguets Island the natives are fairly well supplied with fishing implements. They have a few canoes and are able to do some hand-lining inside the reef. Usually three or four men fish together from one canoe. We found several schools of mullet eight to ten inches long and near shore, but very wild. There was an ample supply of epino nets and most of the natives had goggles and spears. In general fish are very scarce here, as two men came in from hand-lining with only four fish six inches long.

As indication of the scarcity of fish here is the fact that we spent one and a half hours searching the reefs for fish and shell fish and in addition to the mullet mentioned

above obtained only a few small goat fish (Mulloidichthys auriflamma) six inches in length, a parrot fish (Leptoscarus) 18 inches long, and a spiny lobster (Panulirus) of about one pound in weight. We saw several small schools of the anchovy (Anchoviella) used as a bait fish.

In view of the shortage of protein food the natives eat all kinds of shell fish available. Most of the shell fish are either eaten raw or roasted. Among their main sources are the trochus, both the commercial species imported by the Japanese and their own smaller native species and Cardium, called kitir and nitchik by the natives. They also eat three species of the giant clam (Tridacna gigas, crocea, elongata) and the mule foot (Hippoppus). Practically all of these shells are ruined for commercial purposes by roasting or by mutilation from cracking in order to get the animal out.

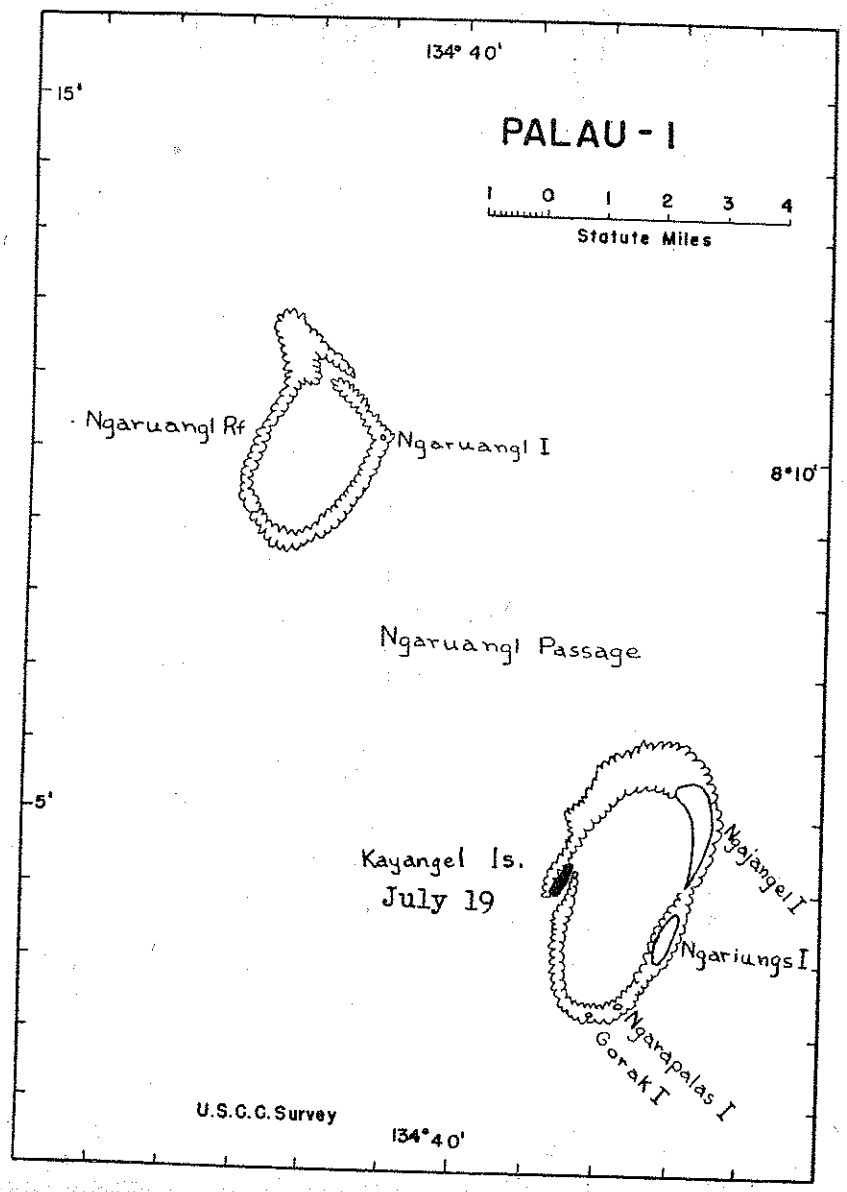
On June 3 an examination was made of the reefs around Pis Island. Probably because of its distance from the main Japanese base on Dublon Island this island has more fish than any of the others in the Truk group. Using spears we obtained several blue parrot fish (Leptoscarus) of small size ranging up to ten inches. These were very wild fish and difficutl to approach. There were also a number of schools of small goat fish six to seven inches in length. Also common were small crevalles (Caranx ignobilis) about ten inches in length, and the milk fish (Chanos chanos). Unfortunately the reef and the area between reef and shore are very rough around this island and there are no places where either seines or throw nets can be used. We also saw a number of schools of the bait fish (Anchoviella purpureus) which seemed to be plentiful enough to support a moderate commercial fishery except for the difficulty of catching them. There are plenty of spears and the women use the small hand net (epino). Training in the use of the spears begins at an early age as we saw a number of boys six to ten years of age using spears in shallow water inside the reef. Red striped crabs (Grapsus grapsus tenuicrustatus) are abundant. We also found three species of the giant clam (Tridacna gigas, crocea, and elongata). The so-called mule foot shell (Hippoppus hippoppus) is also abundant as were trochus, especially the small native type. One of the epino nets which we examined had a mesh one-half inch square.

This island seemed to have more seafood around it than all the others put together. In addition several flocks of birds were working along north pass which generally indicates feeding fish underneath. We were unable to do any trolling outside ourselves, as the vessel assigned to us was not allowed to go outside the reefs.

Unlike most of the other islanders, the people at Truk do not use the small decorative shells such as "monkey face" and "gold ringers" to make handicraft items such as headbands, necklaces, and bracelets. A few are used as fastenings on baskets.

Note on Bonito Industry on Truk

Although the Japanese produced considerable quantities of dried bonito sticks at Truk, operated a number of boats, and had refrigeration and other shore facilities on Dublon Island, our best information is that natives were very seldom employed in the industry. Their only employment was that women were used to a limited extent in the processing plants, but in the matter of catching fish the crews were entirely of Okinawans or Japanese. Sampans ranged in size from 40 to 55 feet and carried crews of over 20 men. The fishing was limited by the amount of live bait which could be obtained. Although some fishing was carried on throughout the year, the supply of live bait made it necessary to curtail operations during the period from March through June. The largest catch was, therefore, during the period from July through February. Two types of live bait were used, the first being a small anchovy (Anchoviella purpurea) one to two inches long called seribu by the natives of Truk; the second species was a small red or pink species, from two to three inches long, called tiribu by Trukese and takabe by the Japanese. As none was obtained, scientific identification can not be made. (For further reference, see Part II-I Bonito Industry.)


134° 40'
15'
PALAU - I
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Gorak I
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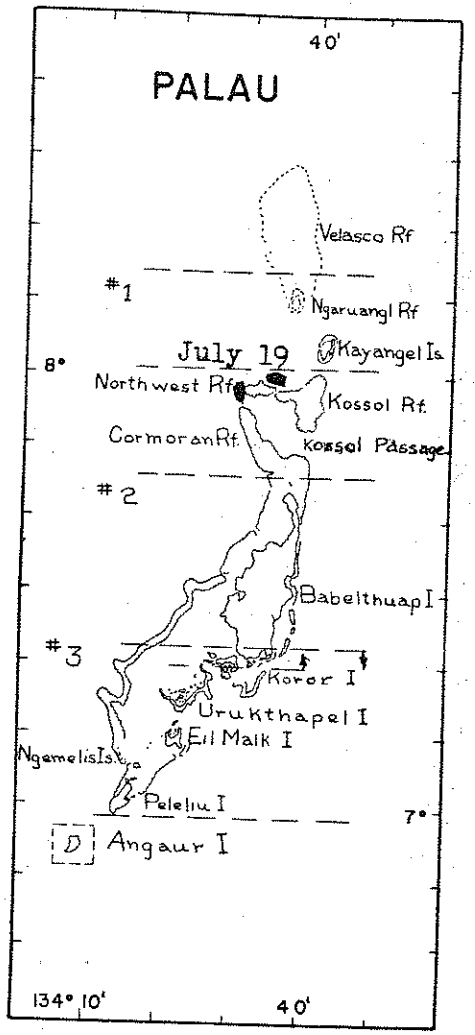
U.S.C.G. Survey
134°40'


40'
PALAU
Velasco Rf
#1
Ngaruangl Rf
July 19
Kayangel Is.
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Northwest Rf
Kossol Rf.
Cormoran Rf.
Kossol Passage
#2
Babelthuap I
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Urukthapel I
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Ngemelis Is.
Peleliu I
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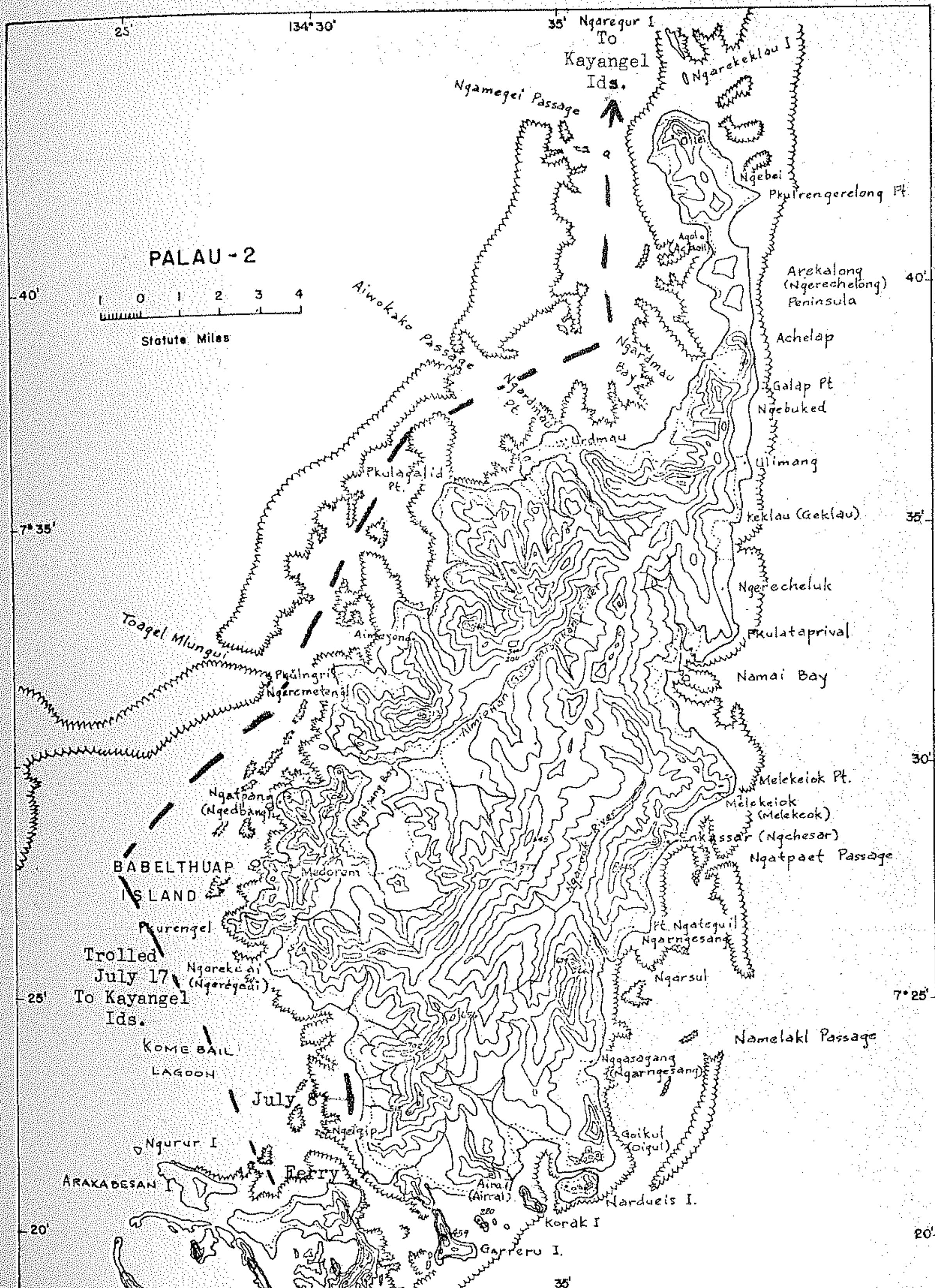
PALAU - 2
1 0 1 2 3 4
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40'
7°35'
30'
7°25'
20'
Ngaregur I
To Kayangel Ids.
Ngarekeklau I
Ngamegei Passage
Ngebei
Pkulrengerelong Pt
Arekalong (Ngerechelong) Peninsula
Achelap
Galap Pt
Ngebuked
Ulimang
Keklau (Geklau)
Ngerecheluk
Pkulataprival
Namai Bay
Aiwokako Passage
Ngardmau Bay
Ngardmau Pt
Urdmau
Pkulagalid Pt.
Toagel Mlungui
Pkulngril
Ngaremetengl
Ngatpang (Ngedbangl)
Melekeiok Pt.
Melekeiok (Melekeok)
Ngkassar (Ngchesar)
Ngatpaet Passage
BABELTHUAP ISLAND
Medorem
Pkurengel
Pt. Ngateguil
Ngarngesang
Ngarsul
Trolled July 17 To Kayangel Ids.
Ngarekeai (Ngeregeai)
Namelakl Passage
KOMEBAIL LAGOON
July 8
Ngasagang (Ngarngesang)
Ngeiqip
Goikul (Oigul)
Ngurur I
ARAKABESAN I
Ferry
Airai (Airrai)
Nardueis I.
Korak I
Garreru I.

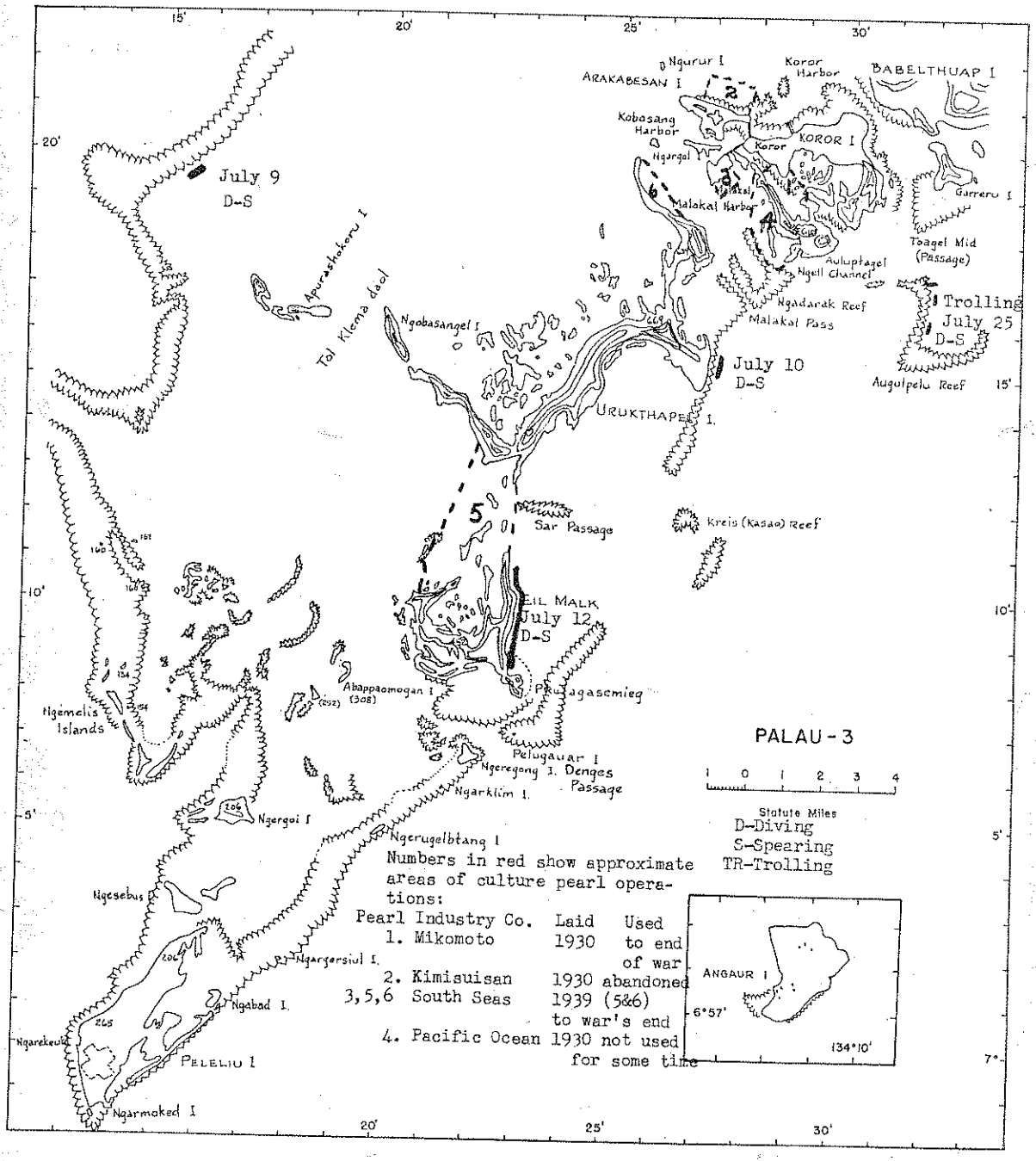

PALAU - 3
Statute Miles
D-Diving
S-Spearing
TR-Trolling
Numbers in red show approximate areas of culture pearl operations:
Pearl Industry Co. Laid Used
1. Mikomoto 1930 to end of war
2. Kimisuisan 1930 abandoned
3,5,6 South Seas 1939 (5&6) to war's end
4. Pacific Ocean 1930 not used for some time
July 9 D-S
July 10 D-S
July 12 D-S
Trolling July 25 D-S
ARAKABESAN I
BABELTHUAP I
KOROR I
URUKTHAPEL I.
PELELIU I
ANGAUR I
Ngurur I
Koror Harbor
Kobasang Harbor
Ngargol
Koror
Malakal Harbor
Garreru I
Toagel Mid (Passage)
Auluptagel
Ngell Channel
Ngadarak Reef
Malakal Pass
Augulpelu Reef
Apurashokoru I
Tol Klema deol
Ngobasangel I
Sar Passage
Kreis (Kasao) Reef
EIL MALK
Abappaomogan I
Ngemelis Islands
Pelugauar I
Ngeregong I.
Denges Passage
Ngarklim I.
Ngergoi I
Ngerugelbtang I
Ngesebus
Ngargersiul I.
Ngabad I.
Ngarekeuk
Ngarmaked I
6°57'
134°10'

Figure 20... Palaus. Terrain between Koror and Peleliu. July 1946.

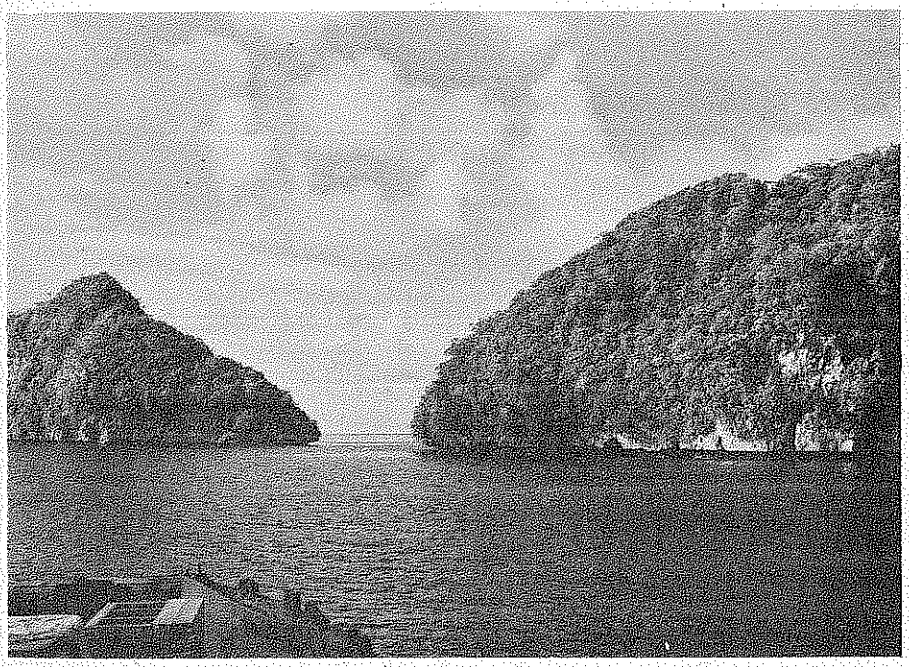


Figure 21... Palaus. Typical undercut cliffs on islands between Koror and Peleliu. July 1946.

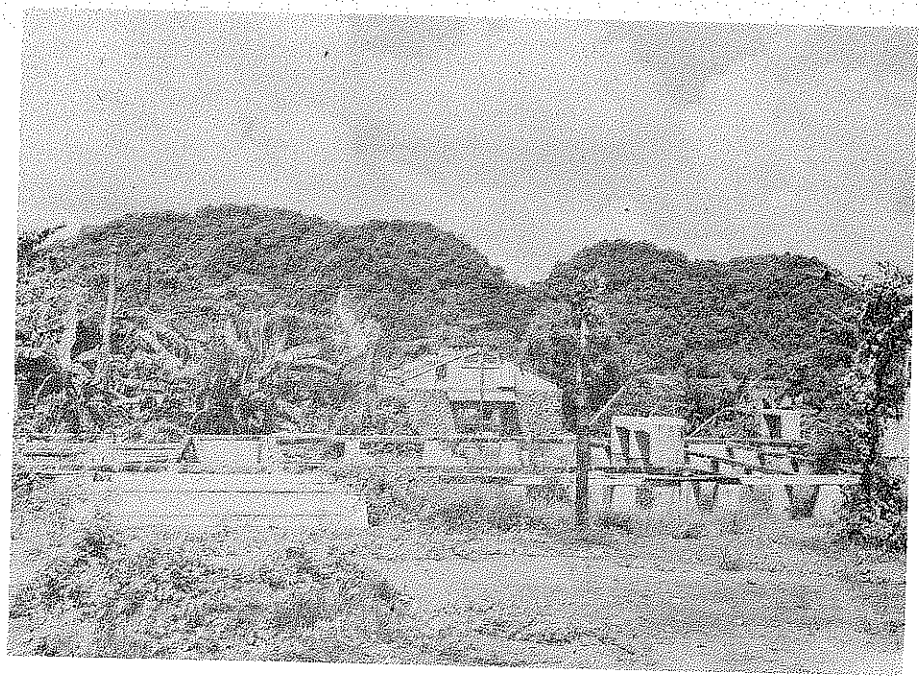


Figure 22... Palaus — Koror. Site of Japanese Marine Fisheries Experiment Station. July 1946.

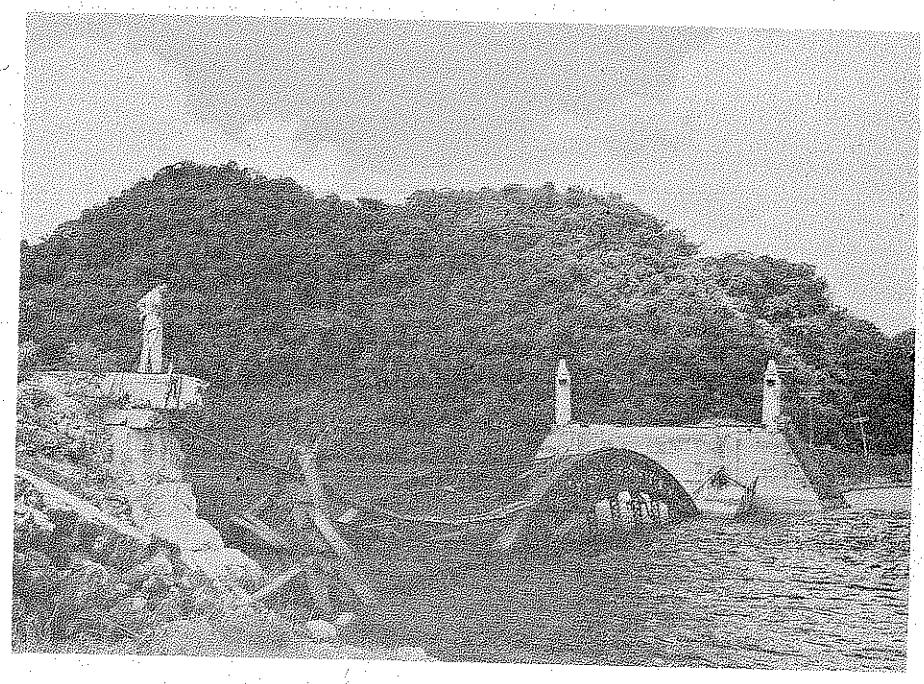


Figure 23... Palaus — Koror. Bombed bridge blocking navigation. July 1946

F. PALAU ISLANDS (Population 6018 - 1946)

1. Peleliu
(July 6)

Lack of time prevented a survey of the fisheries in this section. On the east side of the island the fringing reef is close inshore, while on the west side itis in some places several hundred yards offshore. There is a considerable area suitable for fishing. Because of the shortage of throw nets and other types of gear, the natives obtain most of their fishery products by spearing and diving. Shell fish are taken mainly by women and children by picking them up by hand on the reefs at low tide.

Peleliu cannot be considered of any importance as a base for offshore fishing operations, both because of lack of water, and port facilities are not sufficient for the handling of large vessels. As long as the island is devoted chiefly to a military establishment and large numbers of natives are employed on military projects, there can be only limited subsistence fishing. It is not considered necessary to make a thorough study of the fishery resources in the Peleliu area.

2. Koror
(July 8-25)

Koror was the most important Japanese fishing base for offshore operations and the site of their marine experiment station (Fig.22), which operated from 1933 until the war began. Four Japanese companies were engaged in the growing of culture pearls and a number of pearl shell luggers used this as a base of operations for their fishing in the Arafera Sea. Large quantities of trochus shells for perarl buttons, and dried sea cucumbers (trepang or beche-de-mer—Fig. 31), were exported to Japan. Decking facilities were constructed for loading and unloading large freighters, and utilities such as water and electricity were provided for the population of 25,000. Marine railways and repair yards were capable of handling ships up to a hundred feet. A paved causeway to Arakabesan Island and a bridge to Malakal Island were capable of carrying heavy vehicular traffic. All of these installations were either destroyed or damaged beyond repair by bombing and strafing (Fig.23). Regardless of the damage to buildings and installations ashore, Koror must still be considered the most important site for rehabilitation of the fisheries of the former mandated area.

One resource not duplicated elsewhere is the large number of native fishermen who are accustomed to diving and spear fishing outside the reefs and who are anxious to undertake at least a limited amount of offshore fishing, especially for bonito. Although they had a comparatively small part in the former Japanese operations, they are essentially skilled fishermen and it is believed that it would not take more than six months of expert training in order to make them capable of taking complete charge of the fishing operations. It would be necessary to bring in technical personnel--probably from Japan or Okinawa--to give training, both in actual fishing methods and in preparation of the dried bonito sticks which would be the main source of income.

At the time of the survey, even subsistence fishing was on a restricted scale. During the war the natives were prevented from fishing on the outer reefs and as a further security measure the Japanese destroyed as many of the native canoes as they could find. Present estimates are that prior to the war the natives had in the Palaus approximately 1,500 sailing and paddling outrigger canoes (Fig. 26). At the present time there are less than a hundred.

Since the barrier reef is from three to ten miles offshore, most of the natives find it necessary to fish only on the fringing reef close to shore (Fig.25). Their main reliance is on shell fish. Crabs, especially the large Samoan crab (Scylla serrata) and spiny

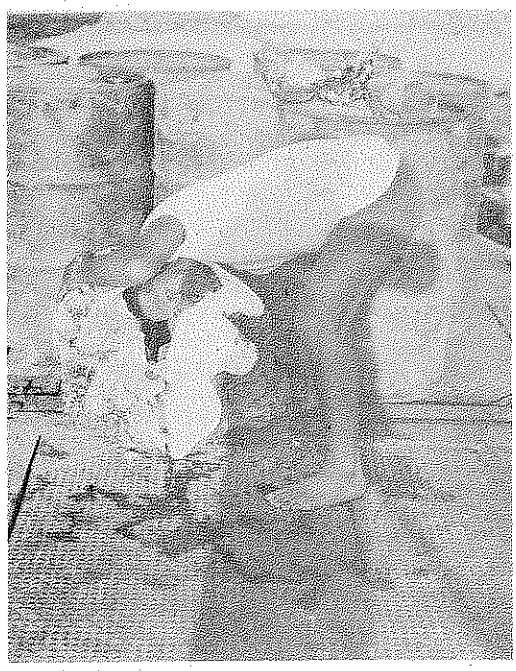


Fig. 24... Palaus - Koror.
Giant clam shell. July 1946.

Fig. 25... Palaus - Koror. July 1946
Spear fishing inside barrier reef.

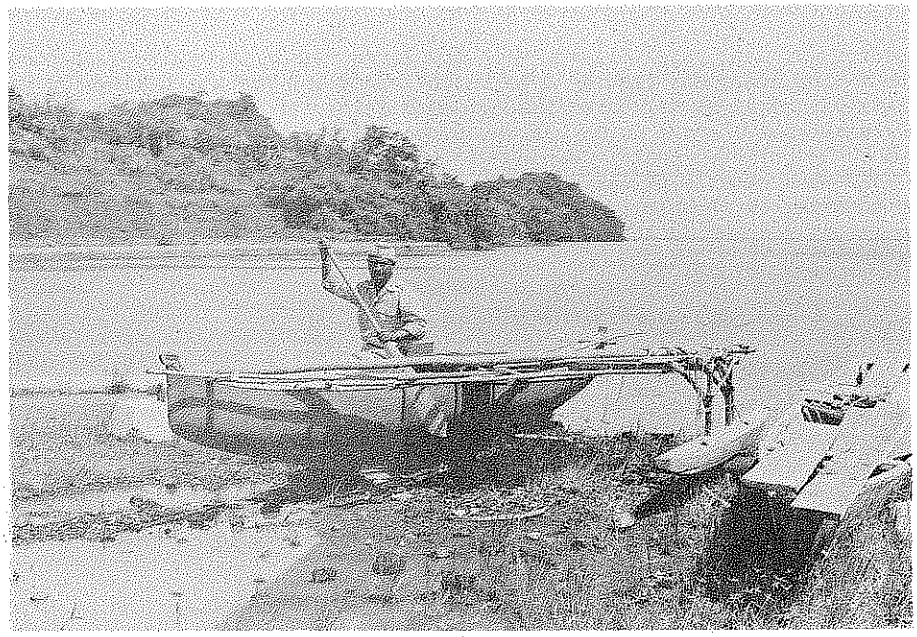


Fig. 26... Palaus - Koror. Paddling Canoe. July 1946.

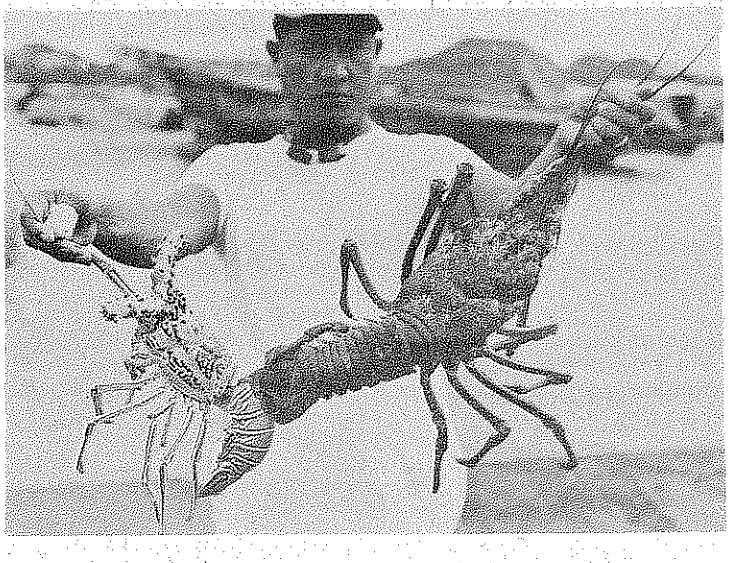


Fig. 27... Palaus - Koror. Spiny Lobsters. July 1946.

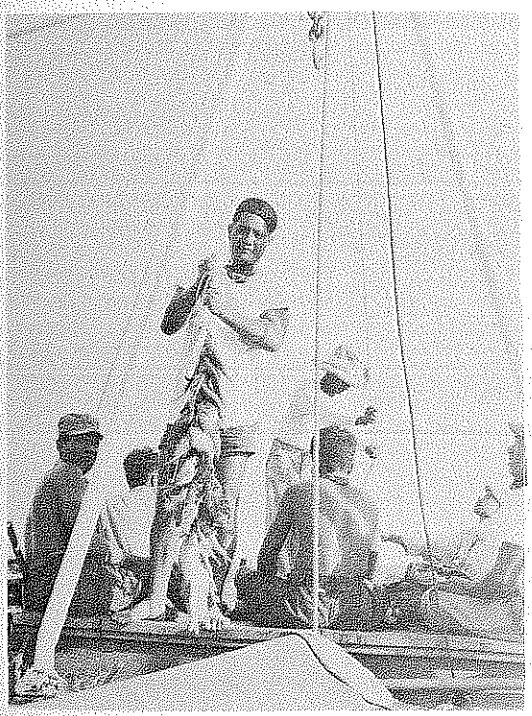


Fig. 28... Palaus - Koror. One man's catch, two hours of spearing. July 1946.

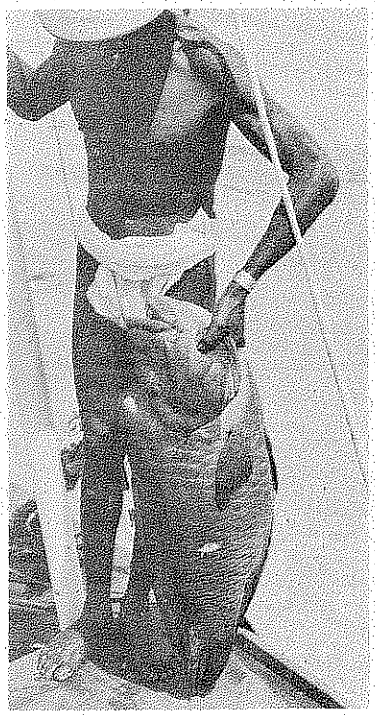


Fig. 29... Palaus - Koror. 25 pound Blue wrasse (Cheilinus undulatus) from outer reef. July 1946.

lobsters (Fig. 27) are abundant. Even so, the total catch of fish is well below requirements. So anxious were the fishermen for an opportunity to go to outer reefs that we always had more volunteers than could be used. Usually we took from 11 to 14 native fishermen with us. All of them had their own spears and goggles. In addition, each man carried a small purse-like basket woven of coconut fronds, and a piece of string or wire on which to string his fish. In the course of two hours of fishing on the outer reef the average catch per fisherman was around 25 pounds of fish and from two to ten pounds of shell fish (Fig. 28).

None of the fishes in the Palaus is regarded as poisonous, although several are not eaten because of taboos. Hence, most species contribute to the native diet. On the reefs the more important species are groupers, snappers, parrot fish, wrasse (Fig. 29) damsel fish, and goat-fish. The most important shell fish is the giant clam (Tridacna). Smaller sizes of these giant clams up to 12 inches are abundant. There are also a few of the larger ones up to 36 inches (Fig. 24). The information is to the effect that the Japanese shipped back to Japan approximately 1,000 pairs of shells from the larger size tridacna and these were found to be comparatively scarce. The natives do not bring in the shells, but sever the adductor muscle of the clam in its position on the bottom and simply extract and bring in the meat.

Trochus shells from three to five inches in diameter at the base are abundant as are the rough cat-eyes. Black lip pearl oysters were rather scarce. However, the native divers usually do not go below two fathoms and very few of them will go beyond four fathoms. There can be little doubt but that a large spawning reserve of both fish and shell fish exists below the four fathom mark.

Trolling also yielded good results. We always had a large white feather jig with a Sobey #11 hook and a brass #6½ or #7 spoon behind the boat while we were under way. The spoon caught approximately three fish to each one caught by the feather jig. The combined catch for both feather and spoon ranged from 10 to 25 pounds of fish per hour. The main species taken were crevalle, barracuda, bonito, and occasionally a snapper or grouper (Fig. 30). The crevalle, snapper, and grouper weighed from four to eight pounds; the bonito from five to ten pounds, and the barracuda from six to 25 pounds. All of this trolling was done inside the barrier reef.

Excluding the offshore fisheries, the development of which requires outside capital and shore facilities, there remain several local sources of income which can be developed immediately and without the necessity for outside financing. These include trochus, trepang, black lip pearl shells, giant clam shells, other decorative and curio shells, and possibly the culture of pearls.

A start has already been made in collecting and preparing trochus shells for marketing to pearl button manufacturers. Several thousand shells were collected during the present season, which, due to the special situation existing, ended on August 31. Normally, the pre-war regulations should be in effect, which required the taking of these shell fish only during the months of May and June, and usually only for a two-week period in one or the other of these months. The Palau chiefs have declared the Japanese regulations to be in force, but no supporting action has been taken by Military Government. The trochus is a large marine shell, reaching a width at the base of approximately six inches and a maximum height of five inches (Fig. 46). These animals are usually found on the sides and roofs, or in crevices, of the caverns at the outer edge of the barrier reefs, in depths ranging from one to three fathoms. In preparation for market, a part of the animal is removed with a small hook and the shells are then buried in dry sand for a period of a month or so, or may be left in sea water for a week or so until, in the former case, ants have eaten the remaining meat portion from the shell, or, in the latter case, decomposition has softened it so that it can be removed. The shells are then dried and a layer of encrusting coral which covers all of the shell is carefully knocked off. On most of the shells the

Fig. 30... Palaus - Koror.
Bonito and Crevalle taken on spoon. July 1946.

Fig. 31... Palaus - Koror.
Types of trepang produced by natives. July 1946.

Figure 32... Palaus - Koror. Equipment for culturing pearls. July 1946.

Figure 33... Palaus - Koror. Baskets holding black-lip oysters for pearl culture. July 1946.

tip of the spire has been riddled by marine boring worms. If the infestation has been extensive and appears in more than 10 percent of the shell area, the shells either bring a lower price of may be discarded entirely, as they are unsuitable for button making. As a conservation measure, the Japanese prohibited the taking of any shells less than three inches in diameter at the base and this regulation should be rigidly enforced in the future.

Sea cucumbers of many varieties are common throughout the Palaus, but are eaten to only a limited extent by the natives. The Japanese, however, not only used large quantities locally, but prepared trepang for export to Japan. Several natives at Koror are now engaged in preparation of trepang and with proper guidance in preparation of the desired qualities and with assistance in marketing, it should prove a good and steady source of income for a number of natives throughout the year. The process itself is a simple one and consists of boiling, eviscerating, and drying the sea cucumbers. The drying may be done in an easily constructed oven, but care must be taken to avoid spoilage while in warehouses awaiting transportation. The main types of trepang now being prepared at Koror are shown in Fig. 31.

There has always been a limited market for giant clam shells, due to use for bird baths and baptismal founts. If a definite outlet could be found for some of these shells, they could be taken in the course of other fishing. One of the main problems is that of packing and shipping, as each of the valves of the shell frequently weighs more than a hundred pounds.

Decorative and curio shells, such as the cowries, the helmet shell, and the trumpet shells, are abundant and are taken by the natives in the course of their regular fishing. Probably many more could be brought in than are at present. However, it is necessary to exercise considerable caution in encouraging this particular project for the reason that all of these shells are fragile. They require special packing and handling and it is believed that no attempt should be made to supply the American market from the Palaus. Whatever quantity can be sold, either locally in the Palaus or at Guam, could be handled. Under present conditions it is doubtful if it would be economically sound to attempt to ship such shells clear to the United States.

Black lip pearl oysters have always been in demand for the manufacture of buttons, shell inlay in wood, and for buckles and various carved pieces of ornamental jewelry. The supply of these oysters in the Palaus is believed to be considerable, although scattered over a wide area. As more canoes are constructed by the natives and they are able to travel more widely in their fishing operations, they should be able to obtain quantities of these shells in the course of their regular operations. No data are available on which to base estimated annual production. The rate of growth of this pearl oyster is not known, but it is thought to be comparatively slow and that from seven to twelve years may be required to reach maximum size of around eight or nine inches in diameter. Conservative measures are essential to prevent depletion, and until better information can be obtained it is recommended that no black lip pearl oysters be taken under four and a half inches in diameter. Individuals examined in Koror in July were full of ripe spawn at that time. Pending further knowledge, it is recommended that there be a closed season on the taking of these oysters during the period June 1 through August 31.

As early as 1930, four Japanese companies were engaged in experimental production of culture pearls from the black lip oyster in the vicinity of Koror (Palaus). These were the Mikimoto Pearl Industry Company, which was still in operation during the war; the Kimi Suisan Pearl Industry Company, whose holdings were in the harbor and were abandoned on account of harbor dredging; the Pacific Ocean Pearl Industry Company, who also began operations in 1930, but who had abandoned the work before the end of the war. The last was the South Seas Pearl Industry Company, which was in operation to the end of the war and known to have made plantings of pearl oysters as late as 1939. The extent and success attained by these companies is not known. At the time of our visit all of the oysters with culture pearls had been taken up, either by the Japanese, or by the natives subsequently. There were reports of one deep water planting in from 20 to 25 fathoms, which,

if it exists, could only be examined by the aid of deep sea diving equipment not available to us. The approximate location of each company's cultured pearl operations is indicated on chart Palau 3, page 36.

There is one native on Arakabesan Island who states that he learned from the Japanese the process of inserting pearl blanks into the oysters for pearl formation (Fig. 32). In partnership with another native he has already put out approximately 150 baskets of black lip oysters, each basket holding ten oysters (Fig. 33). None of the blanks had been inserted in oysters at the time of our visit. The progress of this enterprise is worthy of attention. No financial assistance will be required, as there are plenty of baskets left over from the Japanese operations and the natives will be able to obtain the necessary number of black lip oysters locally and mostly by their own efforts.

The process in principle is a simple one. The black lip pearl oyster, from four to six inches in diameter, is opened mechanically and a blank bead made of pearl shell is inserted in the mantle through a very small incision made with a small scalpel. The incision is then closed and the oyster is put in one of the baskets and left for three years, at the end of which time the blank bead is thoroughly covered with the nacre which gives the pearl its lustrous appearance. It has been the general impression that a very small particle was inserted, around which the oyster built the pearl. This is far from being the case. Actually, the blank beads are all approximately the final size of the pearl. They are graduated in size so that if 50 pearls are needed for a necklace, the appropriate sizes can be obtained from 50 different oysters. The actual thickness of the layer of nacre laid down by the oyster is quite thin. It was impossible to get any definite information as to whether or not the Japanese put more than one blank bead in each oyster. The natives intended to put only one blank in each oyster. Their plantings are in from two to five fathoms of water. One problem which will face this budding industry is that of obtaining additional pearl blanks when their present stock is exhausted. There were thousands of these blanks at Koror, but most of them have been damaged by fire. The blanks appear to have been made either from the large white pearl oyster shell, or from giant clam shells. Information is to the effect that glass beads cannot be used, as the nacre does not stick tight enough to the glass. Some of the instruments used for the operation of inserting blanks into the pearl oyster are shown in Fig. 32.

If the present native experiments are successful, there is ample space for expansion to produce thousands of pearls annually.

There is a sufficient supply of large trees in the Palaus to provide for the necessary number of new outrigger canoes, both sailing and paddling. There has not been very much boat building up to the present time because large numbers of the natives were left homeless and their first consideration has been to build a house for themselves and their families. It will certainly be another 12 months, possibly longer, before boat building can be undertaken on a large scale. In the meantime inter-island transportation of passengers and freight is completely dependent on the few Japanese motor boats of 30 to 40 feet and powered by single cylinder, semi-diesel engine with the blow torch starting. Most of these vessels are in very bad repair, both as to hull and engines. Unless some means can be found to repair or replace some of the hulls and to service the engines, there will be a complete breakdown of the local transportation system within 12 months. Another factor to be considered is that these semi-diesel engines have been operated on a lower grade of fuel oil from Japanese military stocks and will not operate on regular United States Navy fuel oil of 50 cetane. Most of the stocks of Japanese diesel oil are nearly exhausted and unless the engines can be modified to burn standard United States Navy fuel, these vessels will have to be tied up. Navy vessels cannot be used to replace the Japanese type for inter-island traffic unless operations are taken out of native hands and financed and operated by the Navy. Naval vessels are unsuitable in design for this type of service and their cost of maintenance, operation, and repairs are beyond the means of the natives. The best solution of the problem appears to be to modify the fuel system of the Japanese semi-diesels so that they will use U. S. Navy fuel.

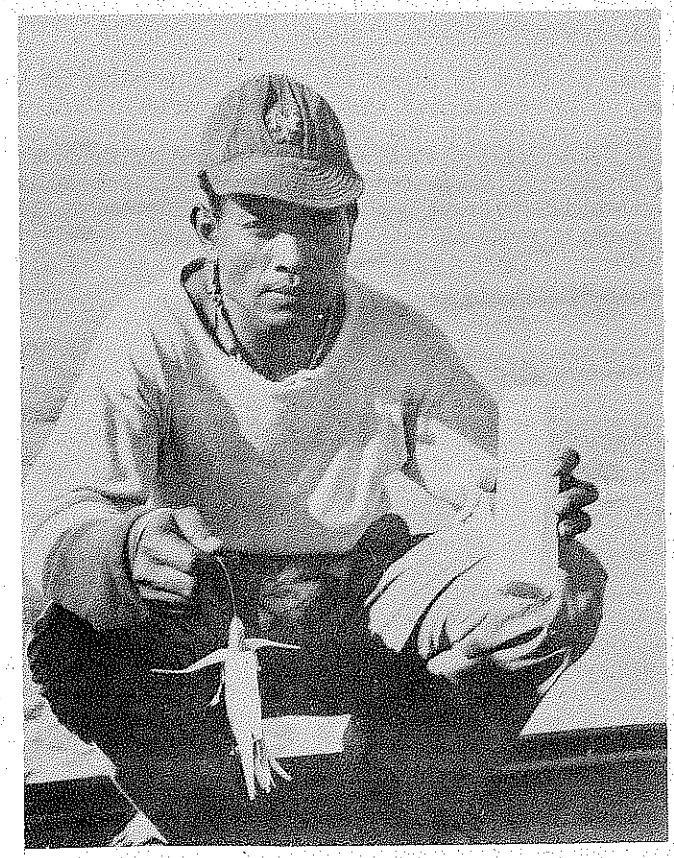


Fig. 34... Palaus - Kayangel Island jig made from inner stalk of Spider Lily (Crinum asiatica). July 1946.

Fig. 35... Rota. Area between shore and fringing reef. Low tide. June 1946.

Note on Marine Fisheries Experiment Station

If it should become possible to carry out biological studies of the fisheries in the former mandated areas, it is recommended that special consideration be given to Koror as a site for headquarters. Nothing but the foundations and parts of walls remain of the Japanese marine fisheries experiment station at Koror, and it is doubtful if even the foundations would be of material advantage in constructing a new station. The Japanese structures were of reinforced concrete and included, in addition to laboratory and office space, several large outdoor tanks filled with sea water, and fairly large refrigeration space amounting to probably 10,000 cubic feet. Attached to the station were various auxiliary shops, such as machine shop, carpenter shop, and storage and repair facilities for netting and other fishing equipment.

Schools of bait fish are abundant along the shores of many of the islands in the group.

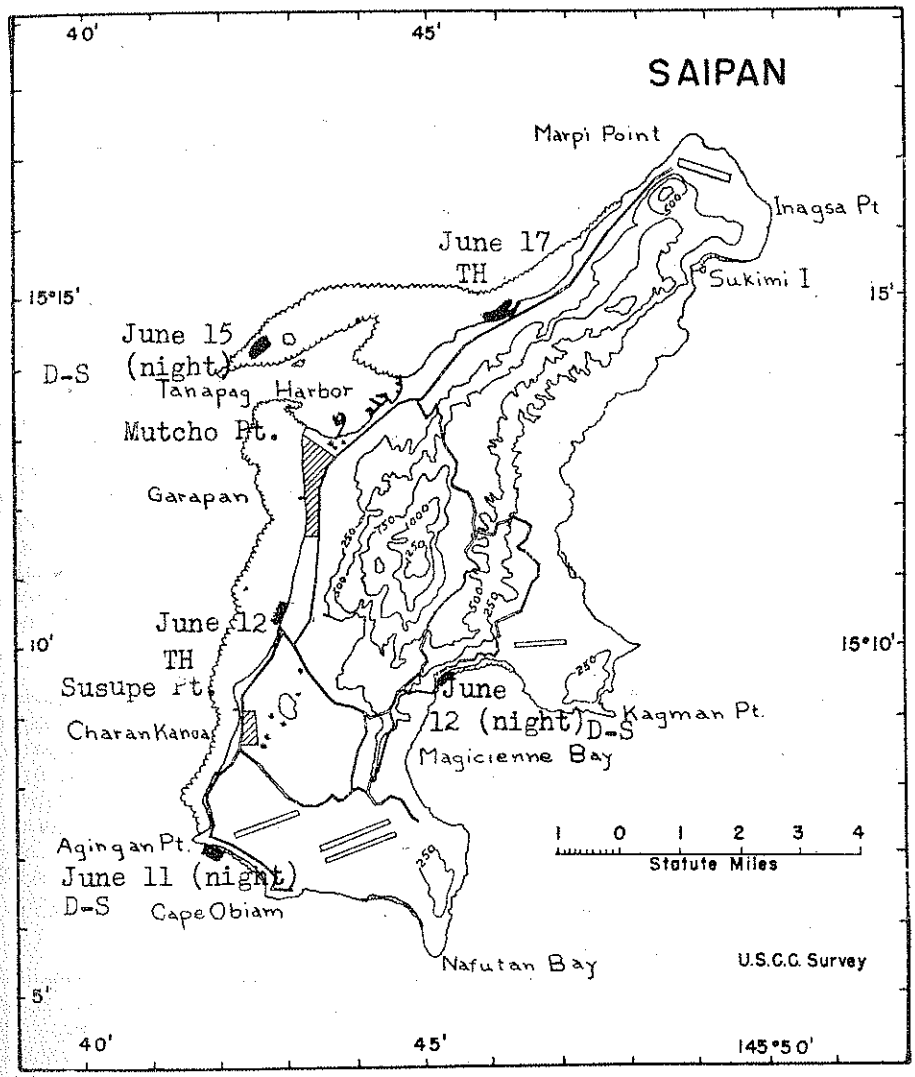
In 1939 the Japanese operated 45 motored fishing vessels of 30 to 45 feet in length in the Palau district. Practically all of these were engaged in the bonito drying industry.

3. Kayangel Islands
(July 18-19)

There are four islands in the group, lying about 30 miles north of Babelthuap. These are low islands and only the largest one is inhabited, the population being around 130 persons. The barrier reef is from one to four miles offshore. From a subsistence standpoint these islands are much better provided for than any others in the Palau region. The small population is insufficient to make any inroads on the marine resources and there was no dynamiting by enemy garrisons, nor was there bombing and strafing by our forces. There is no shortage of sailing or paddling outrigger canoes and breadfruit trees are available for the construction of replacements. Most of the fishing is done by diving and spearing, with a limited amount of trolling. There is practically no smooth bottom around the islands suitable for beach seining. Cast nets are rare, due to lack of twine for knitting them. The spears are made from either 1/4 inch or 3/8 inch steel rod, about 24 inches long, with a double barb on the point set into a bamboo shaft from six to ten feet in length. These spears float. Due to the abundance of fish and shell fish, there is no shortage of protein food. Sea cucumbers are sufficiently abundant to warrant a limited production of trepang. Large trochus are abundant on the outer reef and black lip oysters from four to six inches in diameter are common in from two to four fathoms inside the barrier reef. Decorative shells, such as the cat-eye and several species of cowries, are very abundant. Of the larger curio shells, the spider, helmet, and trumpet shells are occasionally taken. Spiny lobsters are also very common. Octopi are occasionally taken and greatly relished by the natives.

Excellent catches were made, both inside and outside the reef, by trolling. Close to 60 pounds of fish were taken per hour by trolling. These were mainly crevalle from four to 10 pounds in weight, wahoo from 10 to 12 pounds, and barracuda from 10 to 20 pounds in weight. The natives make their own jigs, similar to the white feather jig, from the white inner pulp of the so-called "spider lily", (Crinum asiatica) which is quite effective. The jig is illustrated in Fig. 34. It proved especially good for barracuda and for this species was almost as good as our brass #6½ and #7 spoons in total poundage taken.

At the time of the survey there was no actual shortage of fishing gear or supplies with which to maintain a subsistence diet. In order, however, that there may be no shortage in the future, it is essential that supplies of steel rods 1/4 inch and 3/8 inch diameter should be furnished for making spears and an assortment of hooks, swivels, leader wire, and seine twine for making throw nets, and larger size of cotton twine for hand lines; brass and silvered spoons of #6½ and #7 sizes, preferably of the types known as "Diamond" and "McMahon". A small assortment of these items could be sent to the trade store for use as required in replacements.



D-Diving
S-Spearing
TH-Throw Netting

III. THE MARIANA ISLANDS

A. SAIPAN ISLAND (Population +4600 - 1946) (June 12-17)

The fringing reef on Saipan is in some places over a mile offshore, forming a broad inshore area suitable for beach seining and throw netting. The native population on Saipan is somewhat in excess of 4,600 persons, and since they traditionally consume nearly a pound of fish per person per day, there is a steady market for fishery products. Due to the general shortage of labor, most of the natives are employed by the armed services in one capacity or another. Only 80 men are available for work in the fisheries. Approximately 50 of these are engaged in offshore fishing for bonito on two Japanese sampans.

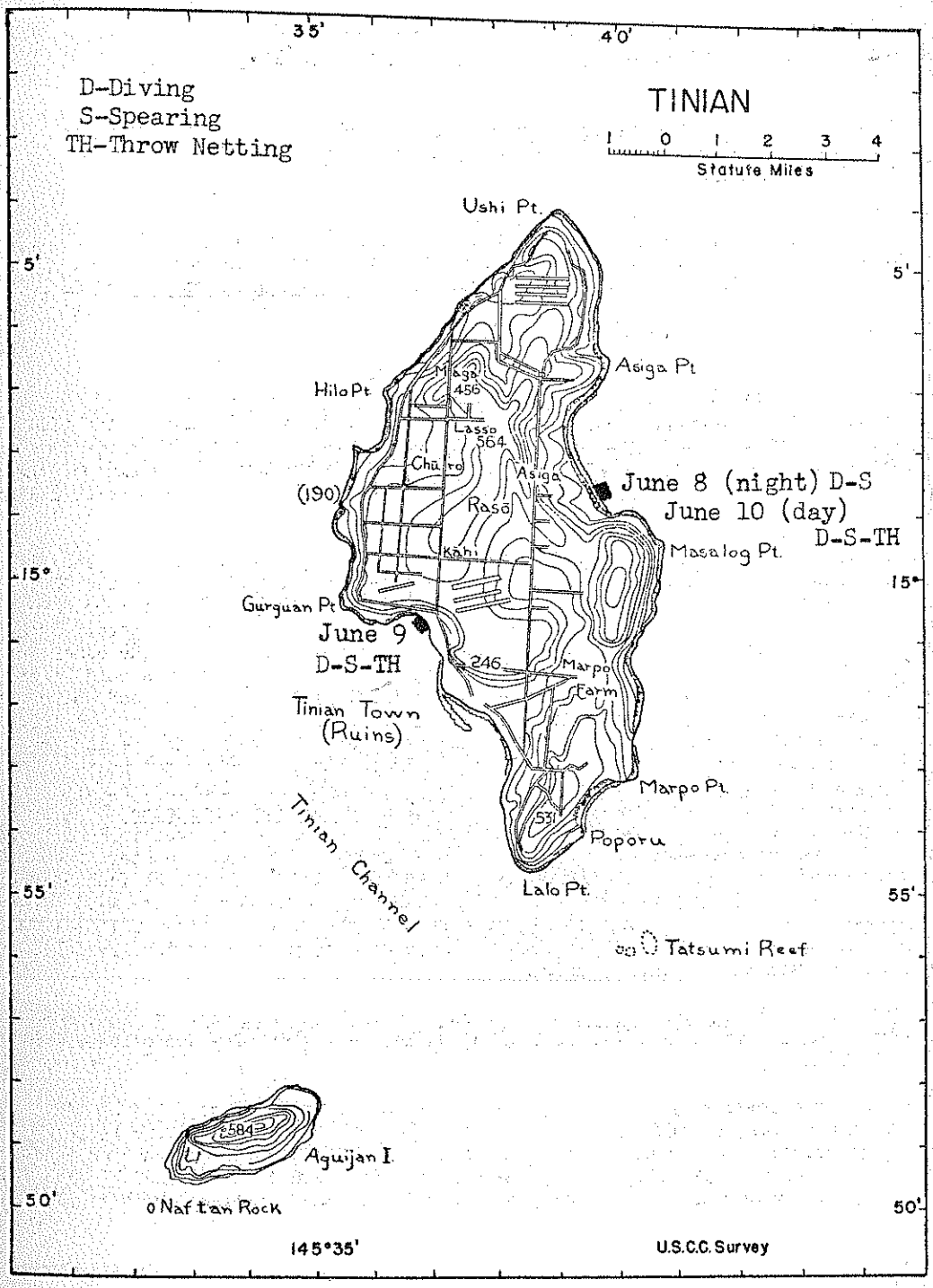
Under the Japanese, the bonito fishery was entirely in the hands of Okinawan or Japanese fishermen and no natives were allowed outside the reefs. When these experienced fishermen were repatriated, there remained available on Saipan four sampans from 55 to 65 feet in length, with necessary operating gear such as bait nets, poles, and hooks. Two of these vessels are nowin operation with all native crews. A thorough description of the methods used will be found in the Fisheries section (Part II-IC), since it may become an example for operations by natives in some of the other islands, particularly in the Carolines.

Several night surveys were made of reefs at various parts of the island, especially to determine the abundance of spiny lobsters, sea cucumbers, and trochus shells, all three of which are more easily located at night than during the day time. The local native method of hunting the spiny lobster is to use either a coconut frond torch or a Coleman gasoline lantern and walk along in shallow water not over three feet deep and when a lobster is located to pin it down with a forked stick. Two fishermen work together on this, one carrying the torch, the other the forked stick. A method which we found much more successful than the regulation torching was to swim with navy battle lanterns under water, as visibility is much better and the crawfish, being largely blinded by the glare of the light, can be caught by hand.

In contrast to the scarcity of fish inside the reef, we found the holes and caverns at the outer edge of the reef well populated with surgeon fish, red squirrel fish, crevalle and parrot fish. As long as there is the labor shortage on Saipan, these fish cannot be made available to the native population, as they can be taken only by spearing, or by the use of hand lines from outside the breakers. As the natives are employed daily by the armed services, they will have no opportunity of going to these reefs. Many Chamorros have spears, goggles, and seven-foot throwmets. The latter have a very small mesh, close to 1/8 inch square bar. They are used along the sandy beaches and the catch is generally small goat fish three to four inches in length and occasionally mullet up to 10 inches in length.

A night survey was made of the reef which lies off Maniagassa Island. With the assistance of four native divers, a strip 60 feet wide and half a mile long was covered on the inner side of the reef. The depth of water varied from two to five feet. Using diving goggles and navy battle lanterns carried under water, the section was carefully covered. Spiny lobsters were common, but we obtained only two which were large, weighing two and a half and three pounds and being 18 and 20 inches in length. Trochus were very abundant. Taking only the largest shells, at least four inches in diameter at the base, they were picked up at the rate of 25 an hour. There were many large trochus shells inhabited by hermit crabs, and it is reasonable to suppose that they had perished from old age.

Sea cucumbers were very abundant. The large yellow ones up to 14 inches in length were common, as were the large, black, smooth ones up to 24 inches in length. Fairly


D-Diving
S-Spearing
TH-Throw Netting
TINIAN
1 0 1 2 3 4
Statute Miles
35'
40'
5'
15°
55'
50'
Ushi Pt.
Asiga Pt.
Hilo Pt.
Masso
456
Lasso
564
Chūro
Asiga
Rasa
Kahi
(190)
June 8 (night) D-S
June 10 (day)
D-S-TH
Masalog Pt.
Gurguan Pt.
June 9
D-S-TH
246
Marpo
Farm
Tinian Town
(Ruins)
Marpo Pt.
531
Poporu
Lalo Pt.
Tinian Channel
Tatsumi Reef
584
Aguijan I.
Naftan Rock
145°35'
U.S.C.G. Survey

common were large, black, spiny ones up to 12 inches and smooth black ones to eight inches. Brown spotted groupers to 14 inches were abundant, and very common were two kinds of red squirrel fish, one solid red, Myripristis murdjan, and one with white longitudinal stripes, Holocentrus diadema. Both of these were about eight inches in length.

On the leeward side of the island, in the section from shore out to the reef, there are many patches of edible sea weeds of the branching type (Gracilaria sp.), about six inches high.

Giant clams of the species Tridacna elongata were common, but rarely exceeded six inches in length. Small decorative shells used in handicraft were rare, with the exception of Cypraea moneta.

A number of fish are considered poisonous. Among these are large crevalle (Caranx sp.) and most red fish; also all of the fish on the outside reef. On the inside of the reef it is considered that any black fish (presumably surgeon fish) are poisonous and, of course, all puffers are discarded. The black tipped sand shark, (Eulamia melanapterus) is not eaten.

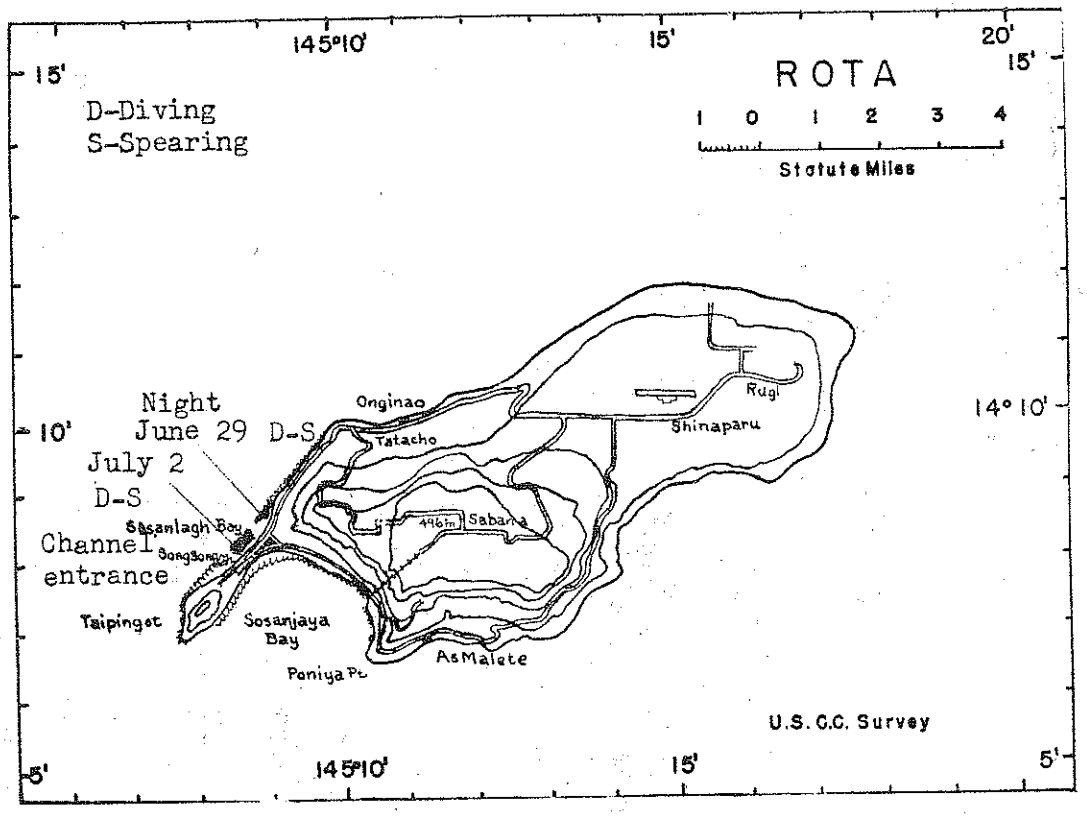
B. TINIAN ISLAND (No native population - 1946)
(June 8-10)

From a fishery standpoint, the most striking topographic feature of Tinian is the lack of barrier or fringing reefs, particularly along the east or weather side of the island. Here the surf breaks directly against rock cliffs of the island itself and there is no rocky plateau along the shore. This is in part true of the western or lee side of the island, except that the surf is not as high and there are sections where there is a limited fringing reef.

At the time of our visit there were no native families living on Tinian. The fishery was in the hands of Okinawans, but was not being actively prosecuted because the Okinawans were to be repatriated within 10 days. Since it might serve as a useful pattern elsewhere, it may be stated that the Okinawans conducted their fishery on a cooperative basis. One group, using a Japanese sampan, fished offshore for bonito and tuna. The other group, using two Okinawan canoes and a beach seine, fished inshore. The catch was sold at prices ranging from five to ten cents a pound, which was sufficient to provide a good source of income to the fishermen and still supply the remainder of the population with the protein food at prices which they could afford. Our only examination showed that the inshore areas were well populated with fish. Mullet 10 to 12 inches in length, and goat-fish (Mulloidichthys, Pseudupeneus) six to eight inches in length were abundant, although rather wild and difficult to approach. Spiny lobsters, Panulirus marginatus, were abundant on the reefs at night and can be taken by torching. These lobsters ranged in length from nine to 16 inches and averaged slightly over a pound each. The female lobsters were carrying bright orange eggs on their swimmerets. This species differs from that found along the southeastern United States coast in that the head and thorax portion are much larger in proportion to the total length than is the case with the United States variety. Consequently, the central Pacific lobster does not have as much meat in proportion to total length as the United States variety does.

Thread fish (Polydactylus sexfilis), are surgeon fish (Hepatua sp.) were abundant. The former ranged in size from 10 to 12 inches, while the latter were approximately eight inches in length.

The chief characteristic of the inshore area from the fringing reef to the high water line on shore is the lack of living coral. The bottom is of very fine white coral sand, with occasional dead coral heads protruding from the bottom. Such an area is well adapted to the use of throw nets and in some places beach seines can be used. This condition is characteristic of the Marianas as compared with the Carolines and Marshalls.


145°10'
15'
20'
15'
ROTA
D-Diving
S-Spearing
1 0 1 2 3 4
Statute Miles
Night
June 29 D-S
July 2
D-S
Channel
entrance
Onginao
Tatacho
Rugi
Shinaparu
14° 10'
10'
Sasanlagh Bay
Songsong
446m
Sabana
Taipingot
Sosanjaya
Bay
Poniya Pt.
As Malate
U.S.C.C. Survey
5'
145°10'
15'
5'

In both the latter groups there is a tremendous growing population of brain, mushroom, staghorn, and other branching corals. Around most of Tinian there is a bluff from 10 to 40 feet high, rising abruptly along the shore, and consequently there are no mangrove swamps. Small decorative shells which might be used for handicraft are rare.

Along the outer edge of the reef there is a large population of fish among which the most common are parrot fish (Callyodon sp.), mullet, goat-fish (Mulloidichthys and Pseudupenaus), and crevalle (Caranx sp.) to three feet in length; octopi are occasionally to be found, and yellow sea cucumbers are abundant. Schools of anchovies (Anchoviella purpureus), used as live bait for bonito, are abundant under the bluffs. Small flying fish from three to six inches in length are very abundant also.

All of our observations indicate that Tinian would prove to be a very good site for an extensive bonito fishing fleet. Probably as many as 10 or 12 fishing vessels could be accommodated there.

C. ROTA ISLAND (Population +800 - 1946)
(June 29-July 2)

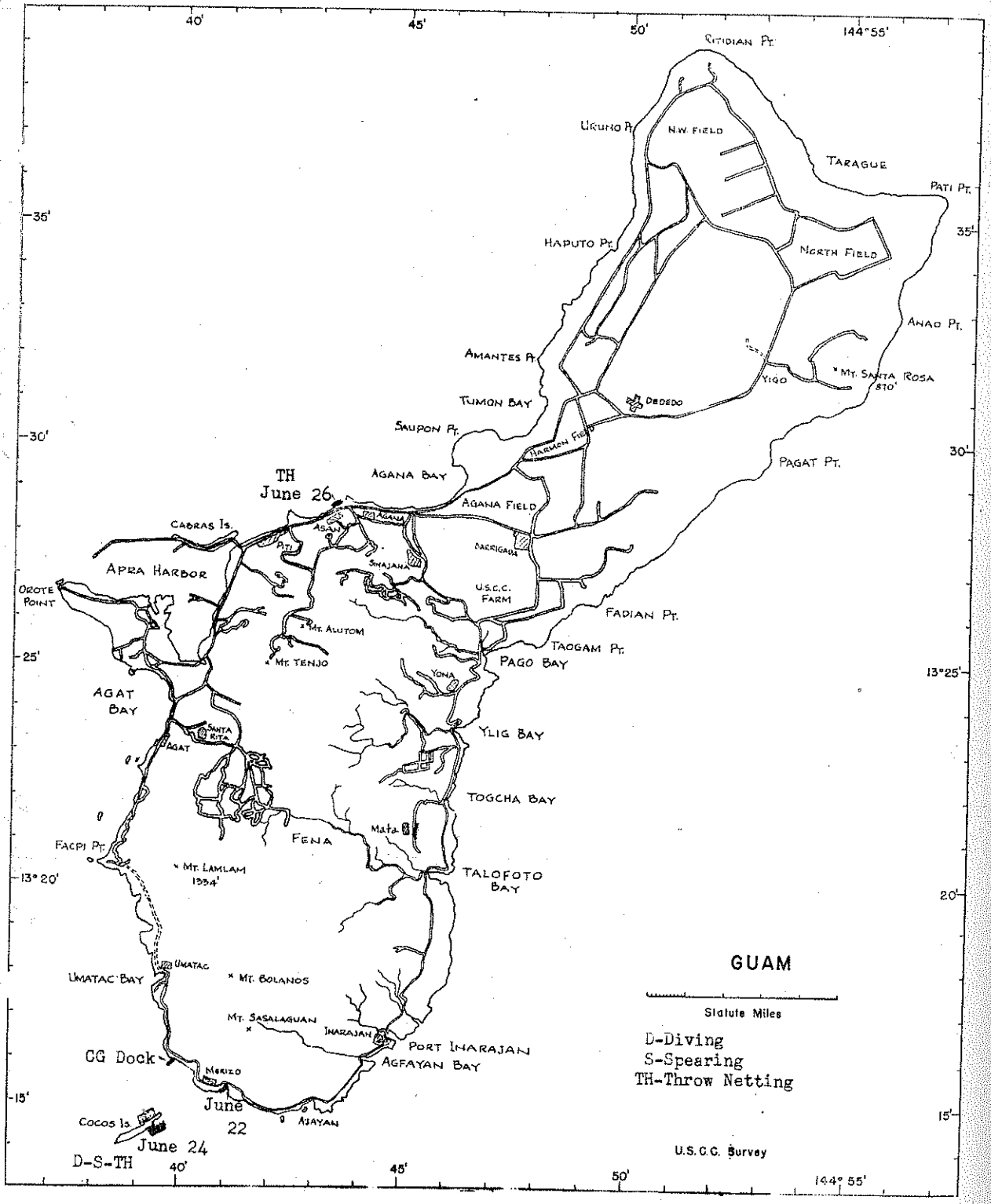
The fringing reefs around Rota are mostly only a few yards offshore (Fig. 35). Consequently, there is a comparatively small inshore area from which fish may easily be taken. The Japanese operated one sampan, which brought in fresh bonito to feed the garrison, Japanese civilian, and native population. Any surplus was dried. The natives were employed on the sugar plantations and were not allowed to go outside the reef, so that there is none experienced in offshore fishing. Only two fishermen expressed any desire to fish outside the reef and their operations were confined to hand-lining just outside the breakers. Since there is no local interest in developing an offshore fishery, it would be impractical to attempt to do so. Nevertheless, the 800 natives on Rota are not now able to obtain a sufficient quantity of protein food, and the most practical form of assistance would be to supply the fishing gear which they were accustomed to use under the Japanese. According to a report from the native commissioners of the two villages, their most urgent need is twine from which they can knit throw nets. They formerly had one to a family, but at present there are only eight left altogether. These nets were approximately 10 feet in diameter. An ample supply of twine for making throw nets should be kept on the island. Canoes or other small boats are not essential as few woulduse them, nor are hooks or lines especially needed. In the absense of throw nets, the natives do a small amount of spear fishing with goggles on the reefs, and women and children collect shell fish--mostly trochus, cat-eye, and spiny lobsters--from the reef. Outside of these the natives have a few chickens, and sometimes coconut crabs and fruit bats. Occasionally a deer is taken. According to the native commissioners, they were accustomed to having fish at least once a day and estimated that they used approximately a pound of fish per person. However, due to the lack of cast nets and nonavailability of fresh fish from the offshore fishery, they obtained fish only two or three times a week. The fish is mostly prepared by roasting, boiling with vinegar, or eaten raw.

A favorite method of cooking fish throughout the Marianas is to fry them in coconut oil. This was also done on Rota, but at the present time, the destruction of coconut trees has been so great that no oil is produced locally and none has been imported.

Sea cucumbers are not eaten and shark meat also is not used by the native population.

Barringtonia nuts are occasionally ground into a paste and used as a fish poison. Derris root, also, is sometimes used, although rarely.

During May and June large schools of a small silvery fish, two to three inches long, called manahag, believed to be young herring, are taken in large quantities by throw nets and are salted down for future use. These large schools appear annually, both at Rota and Guam, and stay only a few weeks.


40'
45'
50'
144°55'
Sitidian Pt.
Uruno Pt.
N.W. Field
Tarague
Pati Pt.
35'
Haputo Pt.
North Field
Anao Pt.
Amantes Pt.
Mt. Santa Rosa 870'
Yigo
Tumon Bay
Dededo
Saupon Pt.
30'
Harmon Field
Pagat Pt.
TH June 26
Agana Bay
Agana Field
Cabras Is.
Agana
Piti
Barrigada
Sinajana
Apra Harbor
U.S.C.C. Farm
Orote Point
Mt. Alutom
Fadian Pt.
Mt. Tenjo
Taogam Pt.
25'
Pago Bay
13°25'
Yona
Agat Bay
Santa Rita
Agat
Ylig Bay
Togcha Bay
Mata
Facpi Pt.
Fena
Mt. Lamlam 1334'
Talofoto Bay
13° 20'
20'
Umatac
Umatac Bay
Mt. Bolanos
Mt. Sasalaguan
Inarajan
Port Inarajan
Agfayan Bay
CG Dock
Merizo
15'
June 22
Cocos Is.
Asayan
June 24
D-S-TH
GUAM
Statute Miles
D-Diving
S-Spearing
TH-Throw Netting
U.S.C.G. Survey