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The Ikei Islanders: Fishing Practices in an Okinawan Coral Ecosystem

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Abstract

Many fishing villages, not only in the northeastern part of the main island of Okinawa but all along the Ryukyu Archipelago have to some extent been socio-economically influenced by the Itoman fishermen. There are individuals in many of these fishing societies who brought back fishing techniques which they gained from working as hired hands for the Itoman fishermen. Ikei Island, however, experienced none of that return, and unlike much of the rest of the archipelago, where pale imitations of Itoman-style fishing techniques exist, the Ikei fishing methods remain strongly traditional. In short, Ikei is fundamentally unlike other islands such as the Yaeyama islands that were basically settled by Itoman fishermen. This paper explores the extent to which pre-specialized fishing methods on Ikei were governed by the naturally occurring ecological constraints, and the extent to which these earlier habits have been preserved in what is today a predominantly fishing and farming village, relatively free of the influence of Itoman fishing techniques. Changes from the pre-war years to the present day and whether or not the traditional techniques are likely to survive are also discussed.

Key words: Ikei Islanders, Okinawan fishermen, Fishing-and-farming subsistence strategy, Traditional fishing practices, Coral reefs

Introduction

The three islands of Henza, Miyagi and Ikei are situated northeast of the Yokatsu Peninsula in such a way as to be the boundary between the bays of Nakagusaku and Kin (Fig. 1). A causeway (*kaichuudouro*) connecting Yakena (the peninsula side) and Henza Island was completed in 1971 and a bridge was built between Miyagi and Henza islands in 1975. In April of 1982 the Ikei Bridge was completed, linking all the islands to the peninsula. Ikei, the outermost of the three islands, was traditionally called Ichi or Ichihanari. It is a small island with a population of 400, and still has a strong sense of autonomy or geographical seclusion from the main island of Okinawa.

At present, there are 22 full-time members of the island's fishermen's union as well as 12-13 associate, part-time members. The latter are those who fish no more than 90 days of the year; they raise sugarcane and in the summer accompany others in squid fishing and so on.

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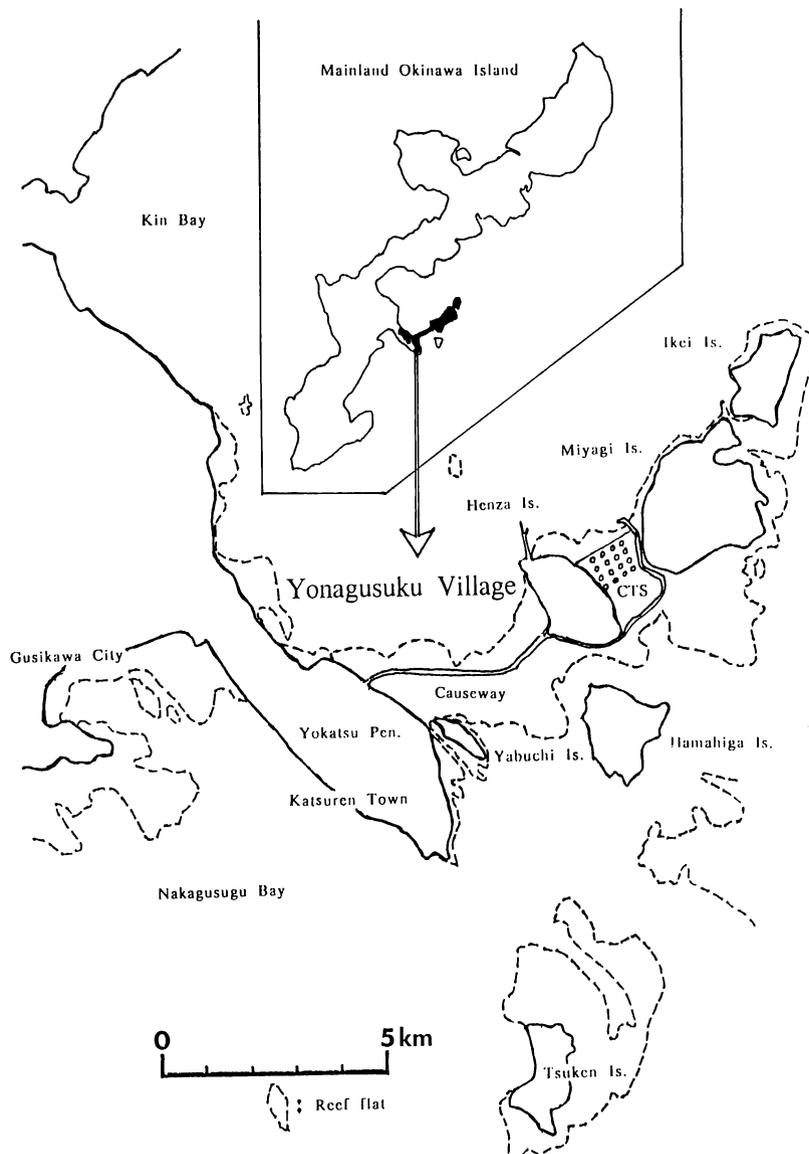


Fig. 1. Yonagusuku Village and the study site.

Before the war, fishermen from Itoman would camp out on the beaches of these islands and conduct large-scale net-fishing expeditions called *agya* for fusilier (*gurukun*). These fishermen also caught flying-fish (*tobuu*), using methods similar to those for catching fusilier in which the fish were frightened and driven into a bag net. As fusilier are surface water fish, the nets were floated on the surface of the water (TAKEDA, 1988, 1990, 1992b). In pre-war days, several groups of Itoman fishermen (*Ichimanaa*) would bid for the right to fish in these waters from August to the following April. The highest-bidding group would win the right to conduct this type of fishing off the island by paying the village a fee (*ukishin*) (see Note 1).

Among the fishing societies in the Ryukyu Archipelago, there are many villages with

individuals who brought back fishing techniques gained while working as hired hands for the *agya* net-fishing (FUKUCHI, 1983). However, Ikei Island experienced none of that return, and unlike much of the rest of the archipelago where pale imitations of Itoman-style fishing techniques exist, Ikei's own fishing methods remain strongly traditional. In short, Ikei is fundamentally unlike the other islands such as the Yaeyama islands which were basically settled by Itoman fishermen. The purpose of this paper is 1) to explore the extent to which pre-specialized fishing methods in Ikei were governed by the naturally occurring ecological constraints, 2) to explore to what extent these earlier habits have been preserved in what is today a predominantly fishing-and-farming village relatively free of influences of Itoman fishing techniques, and 3) to consider how likely these traditional techniques are to survive. The author has traced the changes in fishing techniques and in technology from the pre-war years to the present day in order to explore these phenomena from an ecological context.

The data were obtained from extensive and intensive field studies carried out from March, 1987 to March 1989 through interviews, direct observations and questionnaires.

Fishing practices and changes

Table 1 shows the past and present fishing methods on Ikei Island. The various categories of techniques are described here in detail.

I. Net Fishing

1. Techniques for driving fish into a bag net

1.1. *Anchikée*, a small-scale technique for driving fish into a bag net

This small-scale method for catching such fish as yellowscale parrotfish (*aagai-irabuchaa*) and bigfin reef squid (*shiro-ika*) was in use before the war but has since disappeared. This method was employed at Bise, in the northern part of the main island of Okinawa and was used on reef flats in shallow waters. However, the fish would leave for deeper water during the winter to escape the cold, so this fishing was not conducted during the winter months.

During the summer (April-August), two small wooden boats (*sabani*) each with four crew members, were used in this type of fishing. Two of the crew would dive to set two bag-like nets (not a complete bag net) stretched between the boats in a large semicircle; the nets were tied together with Formosan sugar palm (*Arenga tremula*, Palmae), fountain palm (*Livistona chinensis*, Palmae) or screw-pine (*Pandanus tectorius*, Pandanaceae). Once the nets were in place, only the two skippers remained in the boats and the rest of the party were into the water. The two skippers pulled and manipulated the nets to keep them open while the others beat on the water's surface with their hands or banged against rocks or coral on the sea bottom with poles (*suruchikaa*, usually tied with several pieces of white cloth) in order to frighten and thereby drive the fishes into the nets. At the wings of the nets, the fishermen hung leaves of fountain palm or screw-pine to close them; these leaves also frightened the

Table 1. Fishing methods on Ikei Island

Fishing methods	No. of operators	Fishing season	Fishing time
Fish-driving into a bag net (<i>oikomi</i>)			
<i>Anchikee</i>	8	Summer	Daytime
<i>Pantatakaa</i>	5~6	All year round (esp., summer)	Daytime
<i>Kusukudaraki</i>	2~3	Summer	Daytime
<i>Enjagashii</i> , beach seining	5~6	Winter	Evening to night
<i>Hakamaa-ami</i>	3~4	Early in April to May 20	Evening to early morning
<i>Sashi-ami</i> , entangling net	1~2	All year round (except June 1~September 30)	Evening
<i>Suku-ami</i>	4	Around June 1 & 15; July 1 & 15	Daytime
<i>Ebi-ami</i>	1~2	July 1~31	Daytime
<i>Teichi-ami</i> , set net			
<i>Ooshiki-ami</i>	3~4	September~April	Daytime
<i>Oogata-teichi-ami</i>	4~5	All year round	Daytime
<i>Kogata-teichi-ami</i>	2	All year round	Daytime
<i>Ambushi</i>	1~2	All year round (esp., October~May)	Daytime
<i>Ika-ami</i>	1~2	All year round	Daytime
Handline-fishing			
<i>Tatanaa</i>	1	All year round	Daytime to evening
<i>Heinaa</i>	1	All year round	Daytime to evening
<i>Hikinawa</i> , trolling			
<i>Ika-biki</i> for bigfin reef squid	1	July~March (7~10th day of the lunar calendar)	Evening to night
<i>Ika-biki</i> for mitre squid	1	May~June	Evening to night
<i>Payaw</i>	1	All year round	Daytime
<i>Dentou-moguri</i> , night diving	1	All year round	Night
Trapping	1	All year round	Daytime
Octopus fishing	1	Summer	Daytime
Gathering			
Sea urchins	1	Summer	Daytime
Seaweeds	1	Summer	Daytime
<i>Njai</i> , gathering at low tide	1	All year round	Daytime to evening
<i>Sasa</i> , fish-stupefying poisons	3~4	Summer	Daytime

fish. The skippers would also strike rocks or coral outcrops on the sea bottom to drive the fish.

Because both old and young people could participate, this method was larger in scale and thus employed more people than the *pantatakaa* (see 1.2.).

1.2. *Pantatakaa*, a small-scale fish-driving into a bag net

Groups of 5~6 members use common nylon nets to catch small fish such as rabbitfish (*eigua*), parrotfish (*irabuchi*) and surgeonfish (*kusuku*) in the vicinity of the reef (waters 3 meters deep at the most) when the tide is high. Although it is conducted throughout the year in Kin Bay, this fishing is most popular in the summer month of July of the old lunar calendar. It is now possible to use the traditional technique with just 2~3 people, and may be done by some husband-and-wife teams on the island. In general, however, fish caught inside the reef suffice only for local consumption and do not constitute a cash catch. For this

reason, the people there say that the method is used mainly by those whose basic subsistence is farming. In recent years, a day's catch of 20 kilograms would be considered a major haul.

1.3. *Kusukudaraki*, a small-scale version of the *anchikee* fish-driving

This fishing method is a type of *pantatakaa*, conducted to catch surgeonfish in shallow waters where no boat is needed at all. As this method is begun from the beach, it is not employed by professional fishermen but rather by those seeking a dietary supplement. It is possible for women to participate, and the technique can also be carried out by only 2–3 persons. The team waits for the tide to go out and they then carry a 10-meter-long net on their shoulders into the sea. After localizing a surgeonfish school, they find a place where the tide runs strong, as between two rocks, and then stretch their nets accordingly. The bottoms of the nets are fixed in place with stones or outcrops of rock. The fish are driven shoreward into the nets by beating the surface of the water with their hands.

2. *Enjagashii*, beach seining

Night fishing using a beach seine of fine-mesh netting such as that used for a mosquito net, was popular as a pastime in an age when there was no entertainment such as television. It was conducted after suppertime in winter. Several men and women (six at the most) participate, in order to catch *shiragwa* (an unidentified flat-shaped fish which is said to be very tasty when salted), squid and octopi. The men stood in the shallow waters and drove the fish into the seine nets, which the women then pulled ashore. The women scooped up the fish with baskets in ankle-deep water so that fish would not be covered with sand.

The fish are salted like juvenile rabbitfish, without the heads and guts removed. Salted, these fish are highly prized for their taste and are higher priced than rabbitfish, which accounts for the two groups which continue this traditional seine fishing even today.

3. *Hakamaa-ami*

This fishing net is used for catching squirrelfish (*honbakamaa*: *Adioryx* spp., Holocentridae) which appear in schools in the lee of the island during period of mid-April to May 20 of the lunar calendar. A single net with mesh of about 3 cm and which is about 20 meters long is set straight to catch these migrating fish that stay in the area for approximately two months only. This fishing period is called *hakamaa-jibun*.

The net is set at night and hauled in the next morning. Now, only 3–4 people use this kind of net.

The fish caught in this net have no commercial value and are usually shared with the people on the island. It is mainly a means of procuring a little variety in the diet. The fish is not gutted but simply has its scales removed when caught so that it can be cooked; the fish is especially prized when cooked. The smaller ones, with their fatty stomachs, are also said to be tasty.

A net of larger, 6 to 7.5 cm mesh is used to catch the large big-eyed soldierfish (*akamintamaa*: *Myripristis* sp., Holocentridae), which are available throughout the year.

4. *Suku-ami*, driving-into net for young rabbitfish

A method of driving young rabbitfish (*suku*) into 5 mm mesh size bag nets set on the reef flats is conducted in the months of June and July of the lunar calendar by a group of four people. There are three types of *suku* fish determined by size. The fish also are distributed among the people as a gift (*yuimun*) from the god (*nirai-kanai*) just as the *honbakamaa* fish are.

The season for catching these fish is marked by strong waves (*suku-are*) that are believed to bring the fish into the reef flats. The fishermen try to catch the fish which feed on a kind of seaweed (*kusa*: unidentified). The fish that have already eaten the seaweed, called *kusamaa* or *kusahamaa*, are not abandoned or released because they are suitable for salting if the stomach has been removed. Among the *suku* fish, only middle- and small-sized young rabbitfish are salted while the larger ones are usually eaten raw or cooked with oil. If salted and the stomach is removed, cooking turns the flesh red. However, if the stomach is not removed, cooking causes the fish to split open from the belly, turning the flesh black and ruining the taste.

5. *Sashi-ami*, entangling net

Sashi-ami is made of nylon monofilament netting and is employed by 1–2 persons. It is said to catch mainly jack (*gaara*) and longspine emperor (*muruu*) on corals in shallow areas, so this type of fishing is done in the waters on the west side of the island. However, these nets catch even very small fish, because the nylon monofilament is hard for the fish to detect. *Sashi-ami* made of cotton, which was used before the introduction of nylon netting, was too easily detected by fish.

The net is double- or triple-walled. The triple-walled net has a trammelnet, and inner 8 cm-mesh net and two outer larger-mesh nets. Due to this constitution fish are caught indiscriminately, and thus the net called *jigoku-ami*, which literally means hell's net. For this reason, the use of trammelnet during the spawning season of June-September (inclusive) is strictly prohibited. However, single-walled nets and doubled-walled net that catch fewer fish than triple-walled are used all year round. None of the fishermen use this method with single- or double-walled nets in the summer as the fish thus caught spoil too easily; the hot weather also keeps fish from moving into shallow waters.

The trammelnet is set at night and hauled in the next morning. The fish caught during the hot season are said to be extremely soft and flexible because of the higher concentrations of salt in the water. For this reason the fishermen normally haul in their nets 2–3 hours after setting.

Before the war, the people of Okinawa used nets made of cotton, which had to be dried in the sun after each use to prevent from rotting (see Note 2). The nylon netting that came into use after the war does not need to be dried in this way. Also, nylon netting is lighter than cotton netting; however, the former is weakened with prolonged exposure to sunlight and so it needs to be covered during the day.

6. *Ebi-ami*, net fishing for lobster

This method was in use before the war and was conducted by four different groups of people. Usage continued in the post-war years as well, although now it is conducted by only one group. It can even be used by one person, but it is more commonly done by two persons because the nets have to be set in the reef margin, where the waves are rough. The technique is used to catch lobster which move into shallow water during the night. The net is set at high tide and left overnight. The large-mesh nets are best to use since lobster will avoid small-meshed nets. There is not set length suitable for the nets, although the most a man can comfortably carry on his shoulders is a net of 200 meters in length and 1.2 meters or so in width which is usually an adequate size. The nets have to be wide enough to be used when the tide is high, but the nets work better when they have a wide hanging ratio; the floats are generally less buoyant than those needed to keep the nets perfectly afloat. Cotton nets are said to catch lobster better than nylon nets which tend to easily get hung up on coral outcrops and which are also more visible to the lobster.

The season for such fishing is legally limited to the month of July, although the fishermen prefer to begin fishing with the onset of the soft breezes that herald the beginning of summer (*kaachiibee*), so that in reality the season may last no more than two weeks at most. Furthermore, the lobster nets are expensive; because the fishing tends to be done in areas with a lot of rocks and coral, with the result that the nets tend to get damaged easily (in part because they are nylon). For this reason, this fishing is considered expensive.

7. *Teichi-ami*, set net

Taking advantage of the natural environment of the island's southeast coast, the villagers in that area have used a stationary net since the Meiji era; for the past 30 years, however, nothing has remained of the net but the floats. The persons who would operate such a net would take 70% of the catch but give the rest to the villagers as a fee in a custom called *ukishin* (see also Note 1). With good catches of such fish as bonito, they would leave as a gift, one fish for each villager distributed on the island (*yuimun*). The fish would also be given to each villager in the case of *suku* fish which are caught with the driving-into net for young rabbitfish or *honbakamaa* fish caught with a *hakamaa-ami* net.

These days, the people use durable black polyethylene nets. In a large net, sand bags of ten tons or more are used to anchor it.

Typhoons occasionally strike, of course, but they do not pull up these nets, as they are located on the leeward side of the island making them comparatively safe; and they will also hold fish seeking shelter there. Winds from the north rather than the south bring in more fish because the fish seek shelter on the leeward side of the island, away from the heavy wave action.

Squids and broadclub cuttlefish do not move into the nets to which mud or debris are attached. But it is likely that rabbitfish and bonito will not avoid the nets even if such debris is attached to these nets. However, clean nets which have no mud or shells attached catch more fish.

7.1. *Ooshiki-ami*

This fishing method is peculiar to the Yokatsu Peninsula where it originated in about 1894. It has been said that these nets are used to take migratory fish such as bonito and tuna, and even shark. However, with the establishment of the causeway together with a CTS (Crude Oil Transshipment Station), the currents have changed and the catch has become very poor. As SHOKITA (1988) has pointed out, the schools of fish that formerly sought shelter on the leeward side of the island stay away from the shallow waters surrounding the island when the water temperature rises, especially during the summer. So now the villagers get permission from the prefectural government to put out these set nets from September through April (the winter season) to catch chiefly broadclub cuttlefish (*kobushime*). At present, there is no such net in use on Henza Island, but there are seven in use off Miyagi, and two off Ikei. Currently 3–4 people on the island tend to the nets, at a cost of some 10 million yen.

These nets are positioned at depths of 25–30 meters in a channel through which large ships pass. The configuration is similar to the large-scale set nets (see 7.2.), but are one and a half times the size of the large set nets.

All fish caught in the bag nets of these nets must be retrieved by diving. The net is checked morning and night. If there are fish in the bag net it is replaced with a fresh one. Fish in the net can be retrieved by one person alone. However, siblings help in positioning the net. One person remains on board the ship to supply the diver in the water with air. Twice a month the net is pulled up and cleaned with a hydraulic pump spray. The net is so large that it must be taken in by a machine. And the nets will often become three times as heavy as when the nets were set because of the weight of mud or debris which has become attached to them, so the boat itself must be large enough (at least 6 tons) to maintain stability. Formerly, ten people hauled the nets, utilizing three boats. Accordingly, they haul bag nets, impounding nets and fence nets separately.

The fishermen are often busy repairing the nets during the day, so many people fish at night with a torch (*dentou-moguri*; see III).

7.2. *Oogata-teichi-ami*, large-scale set nets

This type of fishing began in 1983. There are 11 such nets in the area of Yonagusuku village. There were two groups, of 6 people each, operating such nets in November of 1983. Now there is only one group. Two people of the defunct group stopped fishing and now practice night fishing with electric lights (*dentou-moguri*) to retrieve the catch.

This net is set in waters 20 meters deep. Once every ten days, the nets—which can cost four million yen apiece—must be hauled up by hydraulic equipment, which can cost as much as 400,000 yen, and cleaned of all the mud and debris clinging to it. A spare net is set while the original is being cleaned, and the fishermen normally have to keep at least two such spare nets on hand because the repairs take so long. The method is thought to be a taxing one. Usually two people will suffice to bring on board any fish caught, but cleaning and repairing the nets requires four to five people. Now, the nets can catch up to 4000 kilograms of schools of barracuda (*kamasaa*) and other fish a day. It would seem a profitable operation, considering that only three people operate the net. In fact, there are times when it does not

bring in the 40 kilograms per person, per day catch that would be possible for a skillful octopus-fishermen.

7.3. *Kogata-teichi-ami*, small-scale set nets

There are two such nets in use on the island, and are set at depths of 10 meters to catch bonito, tuna, etc. The operation can be maintained even by one parent-child team, but three people are needed in net-settling and net-hauling.

7.4. *Ambushi*, fixed-net

Several people on the island use this fishing technique. Although two people working as a team do this, one person alone can also do it. The nets are set on reef flats in waters of a max. depth of 3 meters. When the tide recedes and the fish are on the move, a fence net set vertically to the surface guides the fish into three or four bag nets. Although conducted all year round, it is most popular in spring and summer. Unlike other set nets, this net must be hauled in before the onset of a typhoon because it is not secured. The fish do not come into the shallow water during the summer, so, like the *ooshiki-ami*, not many fish can be caught with this technique during the summer. It is used to catch rabbitfish, goatfish, bigfin reef squid, etc.

It is legally prohibited to leave the nets in the water for three months in the same place, as this hinders from the safe cruising of other boats. It requires ten sand bags of at least 60 kilograms to fix the bottom of the bag nets. It is also necessary to erect wooden sticks or iron poles several times, which fix the nets while they are set in the water. Furthermore, these nets cannot be left in place long because the mud and debris that attach to the nets draws the attention of the fish, which then avoid them. Therefore, the fishermen take up these nets once every ten days and clean them on the beach; they usually have two spare nets to use while the other is being cleaned. Recently, because of larger amounts of debris from soil erosion, the fishermen must clean these nets more frequently.

7.5. *Ika-ami*, fixed-net for bigfin reef squid

The *ika-ami* method has been in use since before the war. It is a kind of small-scale set net which is set on the reef flat at a depth of 4–5 meters. It is operated by 1–2 persons. Schools of bigfin reef squid are mainly targeted, although broadclub cuttlefish and other small fish come into the net. Conducted all year round, the peak activity is from October when the typhoon season is over, to June when the typhoon season starts. The net is pulled up when typhoons strike.

The bigfin reef squid caught by *iegi* (a fish-shaped lure made of wood; see II.3.) do not congregate during the months of September and October; these fish are otherwise caught by the nets when they gather before September. Bigfin reef squid caught in July through August are especially preferred, because they are all eaten raw without entrails removed.

II. Line fishing

1. *Tatenaa*, offshore handline fishing

The *tatenaa* method is used inside and outside the reef flats. About five people engage in this type of fishing now, but, as the fishermen of the island say, it imitates the pre-war method and so has not changed at all. It can be conducted all year round throughout Kin Bay. During the day, the method is used to fish for goatfish (*katakashi*), longspine emperor (*muruu*), a kind of goatfish (*akamuejii*), threadfin bream (*ijukin*) and jack; at night, it is used to catch bigeye scad (*gatsun*). However, no one uses the method to fish all night anymore, because recently the fishermen usually stop fishing in time to be back in port by 8 pm or so, in order to watch television, congregate socially with other villagers, and so on.

2. *Heinaa*, bottom longline fishing

There were fishermen on the island who used this technique until just before Okinawa reverted to Japan in 1972. However, the water is so polluted now that turning over rocks in the water yields none of the clam worms (*gokai*) and shrimps (*ebi*) used as bait in this method. So a few people may fish this way in their spare time, but no one does so for a living.

If the bait is good, they can catch spangled emperor (*taman*) and redmouth emperor (*kuchinagii*). The traps are put into the water at night and pulled up in the morning. Sometimes, however, the fishermen lose not only the fish they have caught but the traps themselves owing to shark attacks, so they take care to pull traps up as soon as possible.

3. *Hikinawa*, trolling

3.1. *Ika-biki*, trolling for squid

This method was in use before the war and is still in use today. Six fishermen on the island now use this technique. According to the old lunar calendar, nights of the seventh to the tenth are considered best for this type of fishing; the catch is poor during the full moon. Fishing can begin as early as 5 pm, before the sun sets, and is supposed to continue all night. However, these days the fishermen usually quit at 8–9 pm owing to the same reasons stated for the offshore handline fishing (*tatenaa*).

Bigfin reef squid can be caught with a small fixed net (*ambushi*) set on the reef flats, but *ika-biki* is the main method used. The fishing season can start as early as July or August, but at that point one might fish all night and catch only 8–10 fish at most and these might weigh no more than a kilogram total. Still, squid caught at this time can fetch prices of 3,000 yen per kilogram. Starting around September, the fishing season begins in earnest, and the squid taken are also larger. The fishing will continue until the following March. Beyond that, in May to June, they fish for mitre squid (*aka-ika*) around the reef margin (*hishi* or *pui*: refer to TAKEDA, 1992a) at distances of an hour or so by boat off the island.

Bigfin reef squid and mitre squid are caught by line using lures (*iegi*) made from the wood of the camphor tree (*Cinnamomum camphora*, Lauraceae). As the season continues, larger

lures are used. In the case of the mitre squid, a flat fish-shaped lure is used. The two poles to which the lures are attached are hung over each side of the boat at lengths of 8–9 meters and trolled behind as the boat moves through the water at the slowest speed. Boats equipped with diesel-fuel engines work best at this slow-speed trolling, because the spark plugs do not burn out the way they do with gasoline engines. Boats travel at the slowest speed because the squid will not hit the lures if the boat is moving too fast. Sometimes the fishermen motor to the head of the current and then drift with it. They move faster when trolling for mitre squid than for bigfin reef squid. When fishing for bigfin reef squid and mitre squid, the fishermen use only navigation lights.

Spear squid (*teppou-ika*) are fished for around the oil tanks of the Persian Gulf Petroleum Co., Ltd., which are located 30–40 meters off the island. The squid are fished all year round, and the waxing and waning of the moon has no effect. This fishing, however, requires an electric torch and a generator which supplies light of ten thousands watts which is necessary to attract the squid. This torch is lit one meter deep in the water, not on board. Around one hour after the light is turned on, the squid are pulled up with a kind of fishhook (*jigokubari*).

Flying-squid (*tobi-ika*) are fished for in deep seas at great distances from the island (1–2.5 hours by boat). It is said that in the old days, before boats were equipped with compasses and engines, the fishermen would leave port at 3 am, using the stars or cross-transit (a kind of traditional locality-finding methods among fishermen: *yama-ate*, locally called *san-tin*: IGARASHI, 1977) to guide them to the fishing grounds and returning home at 9 in the morning.

When fishing for flying-squid, they use no lures but do use lamps in order to attract the schools of squid. They bait the area with other squid. The squid attract in this manner are then brought aboard one at a time with a gaff (*gakija* or *gijizao*: TAKEDA, 1988). In order to slow the speed of the boats when fishing, the fishermen use a special kite-shaped anchor (*fuu-anaka*), made of cloth, and dragged along under the water with a rope of 70–100 meters in length. The length is adjusted according to the current: shortened when the currents run swift, but lengthened when the currents are sluggish in order to give the boat more speed.

3.2. *Payaw*, trolling around floating fish aggregation devices (*payao*)

This type of fishing began about 3–4 years ago in Okinawa. These floating fish aggregation devices (FADs) attract migratory fish such as bonito, tuna, swordfish, dolphin and Spanish mackerel, which are then caught (TAKEDA, 1988, 1992b). The Yokatsu Fishermen's Cooperative has set up three such *payaw* installations by 1988, at locations outside the reef in waters 1,000 meters deep, and 1–2 hours away from the island by rapid engine-powered boats. At Minatogawa, Gushikami-son, these *payaw* devices have yielded spectacular catches (TAKEDA, 1988, 1992b). However, because the Ikei islanders have no tradition of this type of trolling, by and large they have no interest in it now.

3.3. Trolling for needlefish

The rule of thumb for a type of trolling for needlefish (*shija*), is that the fish should be allowed to snap at the bait three times in order to be able to remove the hook easily. There

are about 5–6 different varieties of needlefish that can be caught around the island. Fish caught on reef flats on the eastern side of the island can be cooked and eaten in any way because they contain no harmful parasites. However, fish caught from the west side of the island, where there are no reef flats, cannot be eaten raw and must be eaten salted. Needlefish fished from the eastern side, called *ufu-chiburaa* (literally meaning big-headed) are a prize catch bringing a good price, with *hira-shija* needlefish caught from the eastern side being the most highly prized.

III. *Dentou-moguri*, night-diving with an electric torch

This method started soon after the war and is mainly conducted on the reef flats on the eastern side of the island. At present, nine islanders are engaged in this type of fishing, four of whom specialize in the method exclusively and fish both day and night. No self-contained underwater breathing apparatus (in short, scuba: OHYAMA et al, 1980) gear is used, but the standard diving method or *sumoguri* (breath-holding diving or skin diving) is done with only snorkels and electric lamps (at night). In the years before the war the fishermen were also involved in spearfishing, with spears called *iigun* equipped with a barb (used mainly for spearing octopi) and an *ukijiki* (sharpened for penetrating the flesh of fish). Now they use spearguns with virtually flawless accuracy—tools which the islanders call simply *teppou* (gun). Although they also target octopus and broadclub cuttlefish, they especially seek highly-prized fish such as yellowscale parrotfish, bluespine unicornfish (*tsunoman*) and bigfin reef squid at night. These fish are easily caught because they tend to sleep at night on their sides. However, the very success of these methods has called for restriction on this island as well as in other areas. Restrictions must be set also because there is no protection against theft, by the lamp-carrying night divers, of valuable fish caught in others' traps or nets. Not only are fish stolen but property is damaged, as knives are used to cut fish free of nets.

IV. Trapping

Trapping, a form of fishing common in the pre-war era, reached its peak 50–60 years ago. Since no one now makes the baskets used in the method, it is no longer practiced. In earlier days, those who fished this way made their own baskets of the *baakidake* bamboo (*Hoorai-chiku*: *Bambusa glaucescens*).

The baskets were of two types. One was used to catch yellowscale parrotfish, and a crushed sea urchin was used to attract fish into the trap. The other, called *eederu*, was used to mainly catch rabbitfish; cooked and peeled sweet potato was used as bait.

This method was used among the part-time fishermen on Ikei, while on Ishigaki Island there are several trapping specialists who own as many as 50 basket traps. Wire traps (*kane-teeru*), which are very common on Ishigaki Island (KUCHIKURA, 1975), have never been

used on Ikei.

Usually, trappers did not put any marker or buoy to help spot the underwater traps underwater. It is said, however, that these traps were often raided by divers.

V. Octopus fishing

In the vicinity of the reef flats, a single individual will fish for octopus. Currently, four islanders are engaged in such fishing. Those with boats go to the uninhabited island of Uchibaru, which has a large, well-developed reef.

An octopus that has been caught is tied around the neck and trolled behind the boat. Other octopi approach it, thinking it is a female or another male seeking to invade their territory, and these octopi are hooked up with a gaff and brought on board. This method is akin to a fishing technique (*tomo-zuri*) used for ayu fish (*ayu*). However, it differs from the one in use on Yaeyama and other areas: these islanders know each octopi nest; they search for them with glasses framed with wood (*tamauki* or *tamauuki*) and catch them by sticking two *iigun* spears into known octopus crevices (TAKEDA, 1988, 1992b).

Especially in June, some fishermen have been known to catch 40 kilograms in a single day.

VI. Gathering

Although men will sometimes help out with large-scale gathering expeditions for the commercial base in other areas, this is usually carried out on a small scale and involves only women and children at Ikei. Not much diving is required, and nothing very large is taken. Sandals must be worn when in gathering on the reef flats because there is the danger of unexpectedly treading on a harmful *anafuku* shell (unidentified), which can seriously injure an individual. Searching for seashells and fish is usually done when work in the fields is complete or when the tide falls during the working hours. At the present, however, this is not frequently carried out. Because the coral ecosystem supplies food-sufficiency and food-availability all year round, the gathering activities have been important to the survival of people living on the Okinawan coral island ecosystem, especially since terrestrial food plant availability is poor (TAKEDA, 1992a, in press a, b). This method has been carried on by women, children and even the aged on a daily basis. Gathering has also been used in conjunction with non-specialized fishing techniques; this method is important in non-specialized societies such as fishing-and-farming communities, but is not the case in commercialized fishing or specialized fishing societies. When we think the role of gathering activities in terms of the survival or strategy of a coastal society, we can see its importance. Specialized fishing technology or commercialized technology, as seen in the Itoman fishermen or Minatogawa fishermen, has evolved quite differently (TAKEDA, 1988, 1992b).

1. Sea urchins

Natural sea urchins (*shirahige-uni*: *Tripneustes gratilla*) grow on the reef flats (*inoh*) and reef margins (*hishi*) surrounding the island. They cannot live in low salt concentrations but thrive in salt water (SHIMABUKURO, 1988). Although runoff due to heavy rains as well as pollution have mostly destroyed their habitat, it is likely that the main reason for their disappearance is overfishing. In the reef margins, where the tides run strong, they practically carpet the area. After seasonal restrictions on urchin gathering were lifted, it is said that they must be continually gathered over a period of six weeks in order to make the effort economically worthwhile. Recently, the villagers gathered together and tried cultivating urchins by making the seaweeds which they feed on available to them on the reef flats. In 1987 the effort worked out well, mainly because limestone rocks (*yama-ishi*) was chosen as the site for the experiment. The general supposition was that the rocks of the Motobu area, Kunigami-son, in the northern part of the main island of Okinawa, somehow provided a firm base for growing the seaweeds. Since sea urchins depend greatly on seaweed for food (KAMURA, 1988), the key for survival is an abundance of seaweed in the sea. Hard stones from the Palaeozoic Era naturally occur in Motobu where cements are now mass-produced. These stones are so hard that sea water can not penetrate for seaweed growth (OHYAMA, Seiho; personal communication, 1992/2/19). It is more likely that that success depends on the basic characteristics of the chosen environment rather than on the type of rocks. The optimum conditions that made such cultivation possible may well be threatened in the future by pollution.

2. Seaweed

2.1. *Mozuku* (*Cladosiphon okamuranus*)

In the fishing communities of Okinawa, cultivating Okinawa *mozuku* is a widespread activity (ITANI, 1990).

In addition, *mozuku* which grows naturally on the reef flats is also available around Ikei. However, this year the people were unable to harvest the seaweed due to heavy red-soil pollution (*akatsuchi-osen*) in 1988.

2.2. Other seaweeds

Nachoraa (*Digenea simplex*) seaweed grows on the reef flats, sometimes on stationary nets. This seaweed has been made into a drink and used drunk as a vermifuge, so was very common in daily life. Cooking it with a species of *irabuu* sea snake (*erabu-umihebi*: *Laticauda semifasciata*) is highly valued. *Tsunomata* (*Eucheuma* sp.) and *ibaranori* (*Hypnea charoides*) seaweed are also available, which are often cooked with soy bean paste (*mooi-doofu*). *Nkuku* seaweed (*Caulerpa racemosa*), *tategusa* (unidentified), *miru* (*Codium fragile*), *aasa* (*Monostroma nitidum*) and so on are also gathered on the reef flats and eaten. Refer to TAKEDA (1992a) for the detailed list of seaweeds used as foods.

3. *Njai* or *izai*, gathering at low tide

Shells are mainly gathered in the daytime because they are very heavy to carry. Shells

gathered in the daytime are *kinajyuaa* (unidentified), giant spider conch (*ushibeebee*), top shell (*takasegai*), mussel (*kujyakugai*) and so on. Species of cone shells (*imogai*), however, are avoided because it is laborious work to cut them open and because of the danger from cracking away during hammering. In particular, large-sized shells of the *imogai* species, have shells so hard that they are not gathered.

On the other hand, octopi (*Octopus* spp.), crabs and fish are targeted at night, along with parrotfish, rabbitfish and striped eel catfish (*kugaa*). Most fish which sleep at night are easily caught.

4. *Sasa*, fish-stupefying poisons

The leaves of wartweed (*sasagusa*: *Euphorbia heliscopia*, Euphorbiaceae) have been used as fish poison on Ikei. The leaves gathered in summer are still poisonous in other seasons even if they are dried. The greener the leaves are, the more powerful their effect. Thus, this fishing method is generally done in summer by one person. However, when this is done in large tide pools with netting, three to four persons are needed. It takes two days to carry this out, since one day is for preparation. Preparation involves gathering the leaves and pounding them on a stone mortar. On the following day, when the tide is low, the pounded leaves are scattered by hand in the tide pools (*kumui*). A net is set around the tide pool to prevent the stupefied fish from floating away outside the pool. In the case of this type of fishing, persons who come to the spot are also allowed to openly steal fish.

On Kudaka Island, the people used crushed seeds and fruits of the *akou* fig tree (*Ficus superba*, Moraceae) as fish poison and used them to catch assorted varieties of fish in tide pools (TERASHIMA, 1977). This tree also grows on Ikei, but the people do not use this plant for stupefying fish at all. Leaves of the *ijyu* tree (*Schima wallichii*, Theaceae) are usually used for this purpose on Okinawa, along with China laurestine (*sangojyu*; *Viburnum odoratissimum*, Caprifoliaceae), velvetleaf (*monpanoki*; *Messerschmidia argentea*, Rosaceae) and so on. Refer to TAKEDA (1992a, in press a, b) for a detailed general list of poisonous Okinawan plants.

Discussion

Before the war, the fishermen of Okinawa, the Itoman fishermen in particular, fished not only in Okinawa but off the mainland of Japan and as far away as the South Seas (NAKAMATSU, 1977; SAKURADA, 1981; UEDA, 1974, 1979). In those days, the Itoman fishermen caught grunt (*isaki*), flying-fish and needlefish by driving the fish into bag nets (this method is called *agyaa*) in such distant places as the Gotou Archipelago, Nagasaki Prefecture. It is said that they caught so many fish with this method that they sparked resentment among the local people and clashed with them. After the war, until around the time Okinawa reverted to Japan in 1972, fishermen especially from Yaeyama sailed as far as the South Seas in search of top shells (*takasegai*) and pyramid shells (*hirosegai*) from which buttons were made. Such efforts ceased after it became possible to make buttons in

quantity from oil-based plastics. Now only large, modernized fishing boats in search of tuna on the high seas make these journeys (TAKEDA, 1989). Upon reversion, the Okinawa fishing industry became subject to a variety of domestic and international laws, such as local fishing rights and the 200-mile EEZ. Fishermen possessing the financial and organizational resources switched to deep-sea fishing for tuna and bonito, but most others remained subject to legal restrictions of one sort or another that forced them to take up coastal fishing with the methods at hand. The loss of access to resources such as *mozuku* seaweed and sea urchins from areas that are now off limits caused fishermen to turn to other fishing methods and to introduce new ones, and to search for off-shore fishing methods and to introduce new ones, and to search for off-shore fishing grounds. At the same time, as fishing gear and vessels became more and more innovated, the fishermen were forced to modify their methods in order to take maximum advantage of the new technologies. In short, they were forced into modernization. Although some methods such as trapping remained unchanged, newly introduced methods such as floating fish aggregation devices (FADs) called *payaw* (traditional ones are now used in the waters of Southeast Asia or other areas), have had a major impact (TAKEDA, 1988). First introduced in 1983, these installations spread to other areas and now the number of *payaw* devices is 145 in Okinawa Prefecture [refer to TAKEDA, 1992b for the *payaw* sites installed in Okinawa]. As indicated elsewhere in the text, the *payaw* devices are not yet a major factor in the lives of the fishermen of Ikei Island, but the large and steady catch from this fishing method has often attracted younger people to become fishermen and thus help the communities to prosper. At one point, large fishing vessels, with mainly Miyazaki Prefecture registrations, raided the *payaw* devices set up by each Fishermen's Cooperative of Okinawa in open waters. The local people, with their livelihood at stake, sought to ban boats from other prefectures and resulted in incidents of violence. The Ministry of Agriculture, Forestry and Fisheries then intervened and secured an agreement whereby out-of-prefecture boats would stay away from locally operated *payaw* devices and confine their fishing to specific *payaw* devices installed in designated fishing grounds. The agreement put an end to the violence (see also Note 3).

The fishermen of the island have been forced to adopt new, previously unheard of fishing techniques, due to technological advances in fishing gear and boats. However, as the fishermen themselves are well aware, those changes are driven by an intense spirit of competition to catch more fish, taking as much as possible and as quickly as possible. Of course this type of response to the opportunities afforded by technology to directly affect one's income is not unique to the island, and is apparent in any fishing community. Also, the rush to upgrade engines and equipment does serve to help the fishermen get back to port quickly in the event of a typhoon or other disturbance.

There are examples of changes in fishing technology engendering a shift away from collective fishing techniques and toward more solitary methods. The older fishing methods relied, to some extent, on mobilizing fairly large numbers of people in order to be effective. However, more importantly the fishermen did not have the money to acquire their own boats and nets, so several had to gather together in the same boat in order to fish. Now, however, they have the financial resources to possess such gear by loans through fishermen's coopera-

tives or banks on an individual basis. Also, in the old days the nets were made of cotton, which were easily spotted by fishes. In order to prevent the fish from escaping the nets, the fishermen had to mobilize as many people as possible to seal off the fishes' escape routes.

After nylon (which is difficult for the fish to see in the water), replaced cotton netting, it became possible for even a single person with the right equipment to handle the nylon netting quite efficiently. Moreover, as fishing modernized and the newer techniques supplanted the older ones, individuals could possess the high-technological equipment that allowed them to easily handle the entire process by themselves. For this reason, it is a fact that fishing methods once transmitted to individuals through their participation in traditional group fishing activities, are dying out. The shift in fishing methods away from group or communal activities is related to a social phenomenon whereby there is an increase in occupational fishing engaged in by household units or small family outfits. It has become easier for such groups to obtain financial and other loans from local governments and fishermen's cooperatives, so another recent trend is for several people to pool money and set up large-scale fishing facilities, which they then maintain and manage cooperatively. However, as in the example above of the *ooshiki-ami* set net, it is not always the case that such joint efforts run smoothly.

It is often said among the Ikei Islanders and other fishing villages that if the fishermen could use modern gear to exploit the plentiful fish resources of the past, they would all be rich. The hard environmental factors of the present, in which they work, including the fish stock at their disposal, clearly suggest that technological advances will not suffice to solve the problem of declining catches. On Ishigaki Island, for example, over-exploitation of the boring clam (*shakogai*) and sea urchin has made them almost extinct. Also, the use of scuba gear and air compressor kits (locally called *puuka*) now allows the fishermen to dive at night and easily catch large numbers of sleeping fish [see the text of III. Lamp-diving (*dentou-moguri*)], although there have been some casualties caused by needlefish (*datu*) and shark recently. One Ishigaki fisherman said: "I really feel sorry for the fish. They are harassed by driving-into netting (*agyaa*) during the day and by lamp-divers at night. Now there is no place for fish to hide and no time to sleep." This one statement contains all the laments of the fishermen, who have turned the sea into a factory in such a way that sooner or later they are bound to destroy their own livelihood. Moreover, the spirit of competition among fishermen, which holds that "a fish that is not caught now will be caught by someone else later on", has accelerated the depletion of these resources. Thus the fishermen are driven to catch undersized fish of little commercial value. In a case of porcupinefish (*abasaa*), for example, which bring the same price regardless of their size, the fishermen keep the larger, tastier ones for their families' consumption and sell the smaller ones on the market. In short, the competition to secure viable catches has escalated to the point that size no longer matters. Yet even without resorting to this extreme example, it can be seen that catches among the fishing communities of Okinawa have declined. Only very recently have the islanders awakened to the fact that the rapacious overfishing caused by conventional fishing methods has depleted stocks and now requires some sort of legal regulation. An awareness of that need has grown gradually among the fishermen throughout the archipelago.

That is the reason why they have shortened the season for driving-in net on the Yaeyama Islands in an effort to preserve the resources of fusilier (*gurukun*). They were very wise to put a temporary halt to fishing around Ishigaki Island in 1988 and move activity to far-off Yonaguni Island (see Note 4). One cannot escape the feeling that these actions are too little and too late, but two experiences of the author with the steadfast, foresighted habits of the fishermen of mainland Japan leave room for hope. First, for more than 20 years, the fishermen of Boosou Peninsula, Chiba Prefecture dived for abalone (*awabi*). After collecting catch, they returned to their boats and checked the shells with a simple measuring tool to see that they were of regulation size. Undersized specimens were then released into the sea, allowing a chance for the population to regenerate. As a subsequent experience, the author noticed they stopped using nylon netting when fishing for spiny lobsters (*ise-ebi*). Nets made from nylon monofilament tear easily on the rocks, are practically indissoluble and hard for the fish to see, and therefore cause a kind of ghost fishing. This means that the scattered pieces of nets catch and kill fish indiscriminately for many years after they have been lost in the water. Although cotton nets can be abandoned in the water, they are less harmful because they rot. Seeing the fishermen search for lobster with the conventional cotton netting was truly an impressive sight. It is hoped that each fisherman will keep in mind that each and every other fisherman has weighed the benefits of using cotton nets for himself, although they may be hard to obtain these days.

It is beyond dispute that there are fishermen who steal fish from other people's nets or traps and, worse, do not bother to open the nets but simply cut the fish out. Since the Ikei fishermen say that Americans who come to dive in these waters around Ikei Island do not such things, it seems that such immoral deeds of the fishermen have indeed come back to hurt them. While it is important that the fishermen take notice of their own deeds and improve it, a more urgent issue is motivating them to act aggressively to preserve the marine resources and the natural environment. The author has, on countless occasions, seen fishermen, who use the sea as their own fields so to speak and simply dump into the ocean used mercury batteries and unrecyclable styrofoam and plastics. The fishermen, however, are not solely responsible for the diminution and depletion of fish stocks. Leisure fishermen equipped with the latest gear are also responsible. Meanwhile, the large catches obtained by using frozen krill (*okiami*) as a chum bait for line-fishing (*sabiki-zuri*) are an example of the deleterious effects of such leisure fishing. The fish ignore the chum bait which sinks to the sea bottom, so such attention to and development of water activities have several negative consequences and no advantages from this perspective. Though not in Okinawa, it is reported that so much krill chum has been left in the ocean that, in some places, it covers the seafloor to a depth of ten centimeters or more. From a global perspective, the time has probably come for more aggressive and concrete action to take place rather than self-restraint, in order to not only protect the environment but also to preserve and nurture the resources of the future. To that end, it will be necessary to implement ordinances designating no-fishing areas and seasons soon, as well as to implement procedures for insuring compliance with such regulations.

For many years after the end of the war, the fishing communities of Okinawa suffered

harm to their environment by the ravages of soil erosion and by the destruction of the coral reefs by crown-of-thorns (*onihitode*). Even if these specific ills are remedied it is doubtful that Okinawa can remain free of such environmental damage in the future.

The fishermen are being forced to change their methods and meanwhile the environment within which they work is undergoing profound and multiple changes at all levels. The changes that have the most direct effect on the Ikei fishermen are land reclamation for the construction of CTS sites by the Persian Gulf Petroleum Co. Ltd., etc. and the landfill operations for the causeway (*kaichuudouro*), which combined, has cut off the currents from their fishing areas. The causeway has virtually sealed off Nakagusuku and Kin Bays from the open sea, so no new fish stocks replenish these areas and they have become practically lifeless. The floors of the bay are covered with heavy amounts of mud and deposits of ooze, which become particularly excessive when typhoons strike. This is also clear from the following story: Fishermen say that, when hauled up, their nets are covered with so much ooze they look as if they have been kept in a paddy field. They also say that they have difficulty in pulling up anchors because buried in the ooze so deeply; they have begun attaching a buoy to the anchor line and moving the boat forward in order to use the combined force of buoy and engine to free the anchor from the mud. At present, a plan is underway in Okinawa Prefecture to build a bridge linking Hamahiga Island and Henza Island. Construction is scheduled to begin in 1995. As a condition of that construction, the Yonagusuku fishermen's cooperative has requested three bridges of 50 or 100 meters on the present causeway. It is quite a rational demand that roundly censures the prefectural office's thoughtlessness in attempting to ignore the ecological conditions of the area. At the same time, the islanders themselves deserve some of the blame in the matter because of their haste and the ease with which they endorsed the project. Still, it is perhaps an encouraging sign that the local people and offices concerned have begun to take a hand in designing ecologically sound bridges and roads, with accurate assessments done for the evaluation of environmental factors.

According to TOKUYAMA (1986), the filtering effects of the beach sands, which keep out mud but allows nutrition-rich land water into the reef flats, is one reason why the reef flats are so productive. This explanation likely holds true for sandy Ikei Island as well, for the sands keep the mud from killing off the reef flats by preventing their inflow in all but the heaviest rains. However after reversion to Japan and the subsequent increase in use of land for roads and farm lands, waste water containing detergents, as well as soil runoff from the cultivated fields (including agricultural pesticides and chemicals) and red soil (*akatsuchi*) from housing developments, began to flow directly into the sea via concrete drainage pipes. The crown-of-thorns (*onihitode*) that ravage the coral have not extinguished the coral reefs by themselves because they too are dying out. It is also evident that the survival of the coral reefs allows for crown-of-thorns by themselves to have a chance to live in the area. In the end, however, the accumulation of pollutants brought to the water from sewage and waste water drainage is probably the single biggest factor in the destruction of the reef. On reef flats where such polluted water accumulates, it is a recognized and pitiable fact that no fresh water gets in to replenish the area except when a major typhoon hits. At present, some

attempts are being made to prevent the red-soil from spilling into the water by constructing coastal and riverine barricades made of rocks and stones. However, some method is urgently needed to hold such runoff from construction sites to a bare minimum and must be implemented on a massive scale as quickly as possible.

It is empirically known among the fishermen that fish gather in the lee of the island (SHOKITA, 1988; HIDAHA, 1985). Fish also tend to move from deep water to shallow water to search of food so the best fishing spots are those where trees and rocks hang over the surface of the water and create some shade. In this respect, it can be seen that the easy foresting and quarrying carried on land does not always rebound to the benefit of luring fish to an area.

Today, as marine pollution worsens and the earth's marine resources are no longer limitless, many fishing communities are turning to some form of aquaculture. This is true not only for Okinawa but of the coastal communities of the mainland of Japan as well, in an attempt to secure adequate catch and to maintain the economic viability of these communities. For example, in Okinawa there are enthusiastic efforts being made to cultivate *asahi-gani* crab and *kuruma-ebi* lobster as well as a variety of seaweeds such as *sunui*, *aasa* (*Monostroma nitidum*), *mooi* (*Hypnea charoides*), *moogusa* (*Hizikia fusiforme*), *ara-mooi* which have begun to be farmed recently, and *umi-budou* (*Caulerpa lentillifera*) which its natural distribution of which is limited to Miyako Island as a northern boundary. Now young sea bream (*chin*) and mangrove crab (*nokogiri-gazami*), blue manna crab (*taiwan-gazami*), babylon (*bai*) and sea urchins are also stocked. Moreover, boring clams (*shakogai*) are cultured with young shells buried in rocks. These movements have also in part motivated the switch to similar methods for catching deep-sea migratory fishes, as evidenced by the installation of the *payaw* devices and the use of set netting devices that operate similar to traps set in the hunting for terrestrial animals. The Itoman fishermen have even recently begun attempting to cultivate fish caught on their lines or in their nets. Although such efforts are in part stimulated by the rising prices paid for fish, the gourmet food fashions and heavy demand for fresh and costly fish are factors at work not only in Okinawa but in the rest of the country. However, it remains to be seen whether such demands will have a beneficial effect on environmental preservation through the careful cultivation of marine resources.

Notes

Note 1.

Usually, fee for fishing in other areas are locally called *umi-ganee*, which were paid in cash or with one-third of the fish caught. Mainly, two groups of Itoman fishermen called *useiguwaa* and *hangusaa* bid for the right to fish in the area for one year, for which they paid a total of 300 yen to the Ikei Islanders. The former group had the stronger influence in the area. They fished in the *agyaa* style using ten *sabani* boats.

Note 2.

Blood of pigs has usually been used for this purpose, with that of cattle rarely utilized.

The work of smearing the blood on the net and then steaming it in a kettle is troublesome, but this process strengthens the nets and prevents them from clinging to rocks or coral in the sea. Also it helps to attract fish.

Note 3.

This is not the end of the problems concerning the *payaw* devices. Fishermen from Miyazaki Prefecture were granted permission to install ten *payaw* devices in the waters off Okinawa and some agreements were reached, one of which limited the number of *payaw* devices the Okinawans could erect. On the basis of this agreement the Miyazaki fishermen did install ten *payaw* devices in December 1988, some of which were swept away by the currents. In fact, however, Miyazaki fishermen, who operate big 100-ton vessels, have repeatedly been seen fishing around Okinawan *payaw* devices during the night and on rainy days, when the fishermen from Okinawa, with their much smaller boat, cannot go out to fish. But this depletes the stock resources, leaving nothing for the local fishermen to catch.

Note 4.

Mr. TSUNEO IKEI, leader of the *agyaa* fishing team, began in the spring of 1990, engaging in this fishing technique in Indonesia after a few preliminary surveys of the fish population density and so on were conducted. This is directly induced by the fact that fusilier (*gurukun*) decreased in number on Yaeyama islands because of over-exploitation and other reasons. The prices became so high that they were not eaten frequently, although this fish has been most popular in the daily life of the Okinawans and is the most favored fish just as the Pacific saury (*sanma*) is the most favored in the mainland of Japan. Not only fish-consumers but fishermen themselves must take care that they do not over-exploit fish overseas, and should also become interested in the fish resources in conserving the overseas areas concerned.

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APPENDIX: Fish and marine species cited in the texts of South Pacific Study Vol. 13(1) and Vol. 13(2)

English name	Scientific name, Family name	Japanese name/Local name
Fish		
Ayu fish	<i>Plecoglossus altivelis</i> , Plecoglossidae	Ayu/Ryukyu-ayu
Barracuda	<i>Sphyraena</i> spp., Sphyraenidae	Kamasu/ <i>Kamasaa</i>
Bigeye scad	<i>Trachurops mauritianus</i> , Carangidae	Aji/ <i>Gatsun</i>
Billfish	<i>Tetrapturus audax</i> , Istiophoridae	Makajiki/
Bluespine unicornfish	<i>Naso unicornis</i> , Acanthuridae	Tenguhagi/ <i>Tsunoman</i>
Coral-trout	<i>Pleocropomus maculatus</i> , Serranidae	Sujihata/ <i>Akajin</i>
Damselfish	<i>Chromis natatus natatus</i> , Pomacentridae	Suzumedai/ <i>Hikaa</i>
Dogtooth tuna	<i>Gymnosarda unicolor</i> , Scombridae	Isomaguro/ <i>Tokakin</i>
Dolphin (Dorado)	<i>Coryphaena hippurus</i> , Coryphaenidae	Shiira/ <i>Manbikaa</i> , <i>Manbiki</i>
Flyingfish	<i>Cypselurus agoo agoo</i> , Exocoetidae	Tobiuo/ <i>Tobuu</i>
Fusilier (Banana fish)	<i>Caesio</i> spp., Lutjanidae	Takasago/ <i>Gurukun</i>
Goatfish	<i>Upeneus bensai</i> , Mullidae	Himeji/ <i>Katakashi</i>
Grouper	<i>Epinephelus</i> spp., Serranidae	Hata/ <i>Miibai</i>
Grunt	<i>Parapristipoma trilineatum</i> , Plectorhynchinae	Isaki
Grey large-eye bream	<i>Gymnocranius affinis</i> , Lethrinidae	Shirodai/ <i>Shiryuuu</i>
Halfbeak	<i>Hyporhamphus</i> spp., Hemiramphidae	Sayori/ <i>Haiyuu</i>
Heavybeak parrotfish	<i>Scarus gibbus</i> , Scaridae	Nanyoubudai/ <i>Irabucha</i> , <i>Irabuchi</i>
Humphead wrasse (Napoleon fish)	<i>Cheilinus undulatus</i> , Cheiliniinae	Meganenomochiuo/ <i>Hirosaa</i>
Indian mackerel	<i>Rastrelliger kanagurta</i> , Scombridae	Gurukuma/ <i>Gurukumaa</i>
Jack	<i>Caranx</i> spp., Carangidae	Hira-aji/ <i>Gaara</i>
Japanese snapper (Blue snapper)	<i>Paracaesio caeruleus</i> , Lutjanidae	Aodai/ <i>Shichuumachi</i>
Longspine emperor	<i>Lethrinus nematacanthus</i> , Lethrinidae	Itoufuefuki/ <i>Muruu</i>
Mackerel	<i>Auxis</i> spp., Scombridae	Saba
Mojarra	<i>Gerres oyena</i> , Gerreidae	Kurosagi/ <i>Amaiyu</i>
Northern bluefin tuna	<i>Thunnus thynnus</i> , Scombridae	Kuromaguro, Honmaguro/ <i>Ushishibi</i>
Needlefish	<i>Strongylura anastomella</i> , Belonidae	Datsu/ <i>Shija</i>
Parrotfish	<i>Calotomus japonicus</i> , Scaridae	Budai/ <i>Irabuchi</i> , <i>Irabuchaa</i>
Plotosid (Striped eel catfish)	<i>Plotosus lineatus</i> , Plotosidae	Gonzui/ <i>Kugaa</i>
Porcupinefish	<i>Caesio diagramma</i> , Caesioninae	Harisenbon/ <i>Abasaa</i>
Rabbitfish	<i>Siganus fuscescens</i> , Siganidae	Aigo/ <i>Eegwa</i>
Rabbitfish (young)	<i>Siganus fuscescens</i> , Siganidae	Aigo/ <i>Suku</i>
Red goatfish	<i>Mulloidichthys pflugeri</i> , Mullidae	Ryukyu-akahimeji/ <i>Akamueji</i>
Redmouth emperor	<i>Lethrinus nemataeanthus</i> , Lethrinidae	Isofuefuki/ <i>Kuchinagi</i>
Ruby snapper	<i>Etelis coruscaus</i> , Lutjanidae	Hamadai/ <i>Akamachi</i>
Saury	<i>Cololabis saira</i> , Belonidae	Sanma
Scad	<i>Decapterus muroadsi</i> , Carangidae	Muroaji
Seabream	<i>Acanthopagrus sivicolus</i> , Sparinae	Minamikurodai/ <i>Chinu</i> , <i>chin</i>
Skipjack tuna	<i>Katsuwonus pelamis</i> , Scombridae	Katsuo/ <i>Kachu</i>
Smoothbelly sardinella	<i>Amblygaster leiogaster</i> , Clupeidae	Yamatomizun/ <i>Yamatomojyun</i>
Snapper	<i>Lutjanus stellatus</i> , Lutjaninae	Fuedai/ <i>Machi</i>
Soldierfish	<i>Myripristis berndti</i> , Myripristinae	Akamatsukasa/ <i>Akamintamaa</i>
Spangled emperor	<i>Lethrinus nebulosus</i> , Lethrinidae	Hamafuefuki/ <i>Taman</i>
Spanish mackerel	<i>Scomberomorus niphonius</i> , Scombridae	Sawara/Saara
Squirrelfish	<i>Sargocentron spinosissimum</i> , Holocentridae	Ittodai/ <i>Honbakamaa</i>
Surgeonfish	<i>Prionurus scalprus</i> , Acanthuridae	Nizadai/ <i>Kusuku</i>
Threadfish bream	<i>Nemipterus</i> spp., Nemipteridae	Itoyoli/ <i>Ijugin</i>
Tuna	<i>Thunnus</i> spp., Scombridae	Maguro/ <i>Shibi</i>
Yellowfin tuna	<i>Thunnus albacares</i> , Scombridae	Kihadamaguro/ <i>Shibigwa</i>
Yellowscale parrotfish	<i>Scarus oviceps</i> , Scaridae	Hibudai/ <i>Aagai-irabuchaa</i>

Other marine species		
Bigfin reef squid	<i>Sepioteuthis lessoniana</i> , Loliginidae	Aori-ika/ <i>Shiru-ichaa</i>
Broadclub cuttlefish	<i>Sepia latimanus</i> , Sepiidae	Kobushime/ <i>Kubushime</i>
Diamondback squid	<i>Thysanoteuthis rhombus</i> , Thysanoteuthidae	Sode-ika/ <i>Sei-ika</i>
Flying squid	<i>Sthenoteuthis oualaniensis</i> , Ommastrephidae	Tobi-ika/ <i>Toobi-ichaa</i> , <i>Hingaa-ichaa</i>
Mitre squid	<i>Ommastrephes bartrami</i> , Ommastrephidae	Aka-ika/ <i>Aka-ichaa</i>
Spearg squid	<i>Loligo bleekeri</i> , Loliginidae	Yari-ika/ <i>Teppou-ika</i>
Octopus	<i>Octopus oliveri</i> , Octopodidae	Anadako/ <i>Nnuijigwa</i>
Octopus	<i>Octopus minor</i> , Octopodidae	Tenagadako/ <i>Shigai</i>
Octopus	<i>Octopus vulgaris</i> , Octopodidae	Madako/ <i>Taku</i>
Blue manna crab	<i>Portunus pelagicus</i> , Portunidae	Taiwan-gazami
Mangrove crab	<i>Scylla serrata</i> , Portunidae	Nokogiri-gazami
Spiny lobster	<i>Panulirus</i> sp., Palinuridae	Ise-ebi
Crown-of-thorns	<i>Acanthaster planci</i> , Acanthasteridae	Onihitode
Sea urchin	<i>Tripneustes gratilla</i> , Toxopneustidae	Shirahigeuni
Babylon	<i>Babylonia japonica</i> , Buccinidae	Bai
Boring clam	<i>Tridacna squamosa</i> , Tridacnidae	Hirejako/ <i>Ajikee</i>
Chiragra spider conch	<i>Harpago chiragra</i> , Strombiidae	Suijigai
Cone shell	<i>Lithoconus tessellatus</i> , Conidae	Harushagai (Imogai)/ <i>Buutoo</i>
Giant spider conch	<i>Lambis truncata</i> , Strombiidae	Rakudagai
Mussel	<i>Septifer bilocularis</i> , Mytilidae	Kujakugai
Pyramid top	<i>Tectus pyramis</i> , Trochidae	Hirosegai, Gintakahama/ <i>Hishiguu</i>
Top shell	<i>Tectus maximus</i> , Trochidae	Takasegai, Sarasabatei/ <i>Soomin</i>
Turban snail	<i>Turbo argyrostoma</i> , Turbinidae	Choosensazae/ <i>Mannaa</i>