The Comparative Ecology of Subsistence and Commercial Fishing in Southwestern Japan, with Special Reference to Maritime Institutions

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This paper first delineates the fishing system in Taira Island, located between Kyūshū and Okinawa. The inhabitants are not specialists but practise fishing fairly intensively to obtain the bulk of their animal protein requirements. Through data collecting by observation and measurement attention was paid to the relationship between fishing activities and the natural environment, human factors in fishing practises, and the distribution and consumption of the catch among individuals of the community. The findings include several characteristics of the type of subsistence fishing that might formerly have prevailed in Japan. First, various marine resources are exploited by different strategies throughout the year, regardless of productivity. Second, great inter-individual variations exist in fishing practise and in the catch; a strong or skillfull individual tends to do his favorite fishing more frequently and to obtain a larger catch. Third, social relations in the community profoundly affect fishing and the distribution of the catch; especially, the most productive methods, *i.e.*, trolling and hand-line fishing using a motorboat, are usually performed on the community work or feast days because of regulations at the community level, and the catch is distributed to all households and consumed at the feasts.

Taira Island subsistence fishing is then compared with the commercial fishing system in several fishing communities of Okinawa, specifically in Kudaka Island, Ōgami Island and Arakawa, where ecological investigations were carried out. Besides the differences in catch disposal, several subsystems, like the environment in which exploitation is conducted and the man-technology-resource complex, differ from each other. This comparison aims to contribute to an understanding of the nature of small-scale fishing in the region and of the human ecological implications of it, especially in the formation of systems of sea tenure.

INTRODUCTION

Our human ecological research on small communities has been based on the fundamental principle that human activity is a key link between human populations

and their environment (see, for example, [OHTSUKA 1970, 1972, 1983a, 1983b; WATANABE (ed.) 1977; ITANI and HARAKO (eds.) 1977]). Our observation and analysis has been focussed particularly on time allocation, use of space, work efficiency and work unit, to elucidate a human activity system which is ecosensitive to natural habitat conditions, the bio-social characteristics of individual members and the socio-cultural conditions of the communities.

In fishing communities maritime institutions are central to the socio-cultural condition of a human activity system. In our view their principal functions are: (1) to provide a mechanism for reaching inter-community agreements to avoid conflicts and to protect the fishing rights of each community; and (2) to provide a means of intra-community regulation to prevent over-exploitation of resources and to ensure the benefit of individual members.

In general terms maritime institutions have developed uniquely in Japan where they have been associated closely with the function of Fishery Cooperative Associations and the juridical system. Nonetheless, there exists considerable variation in the degree of development of maritime institutions among the thousands of Japanese coastal communities in which fishing plays an important economic role. Southwestern Japan, beyond Kyūshū, provides a good example of such variation since that area has been little influenced by Japanese fisheries laws, the first modern one among which was enacted in 1901. Inter-community variation in southwestern Japan largely depends on the local economic system; specifically on whether fishing is commercial or subsistence, and on the degree to which commercialization has intensified.

In this paper we compare subsistence and commercial fishing activity systems and then consider from an ecological perspective the "nature and nurture" of maritime institutions. Nowadays most Japanese fisheries are completely involved in the cash economy, although subsistence fishing has been carried out until recently in a few isolated communities, such as on remote islands, that are peripheral to the economic mainstream. Of the limited number of such communities, Taira Island, one of the Tokara Islands, located between Kyūshū and Okinawa (Fig. 1), was selected for study.[1] Subsistence fishing in Taira Island is compared with commercial fisheries in three Okinawan communities. Of a number of fishing communities in Okinawa Prefecture, Arakawa, in the Yaeyama Islands, Ōgami Island, in the Miyako Islands, and Kudaka Island, off Okinawa (main) Island, were selected for this analysis, since these three had been investigated intensively to understand their fishing activity systems.[2]

1) After a two-week reconnaissance survey, fieldwork was carried out three times; in October 1974, March–April 1976, and December 1977–January 1978. Each period of fieldwork was conducted for about three weeks and the number of observation days totalled 63 [OHTSUKA, KUCHIKURA and MOJI 1978; OHTSUKA and KUCHIKURA 1983].

2) Arakawa was studied by one of the authors (Y.K.) in 1972–73 [KUCHIKURA 1974, 1977], while Ōgami Island and Kudaka Island were separately studied by our colleagues, the former by Dr. M. Ichikawa, in 1971–72 [ICHIKAWA 1978] and the latter by Dr. H. Terashima, in 1973–75 [TERASHIMA 1977].

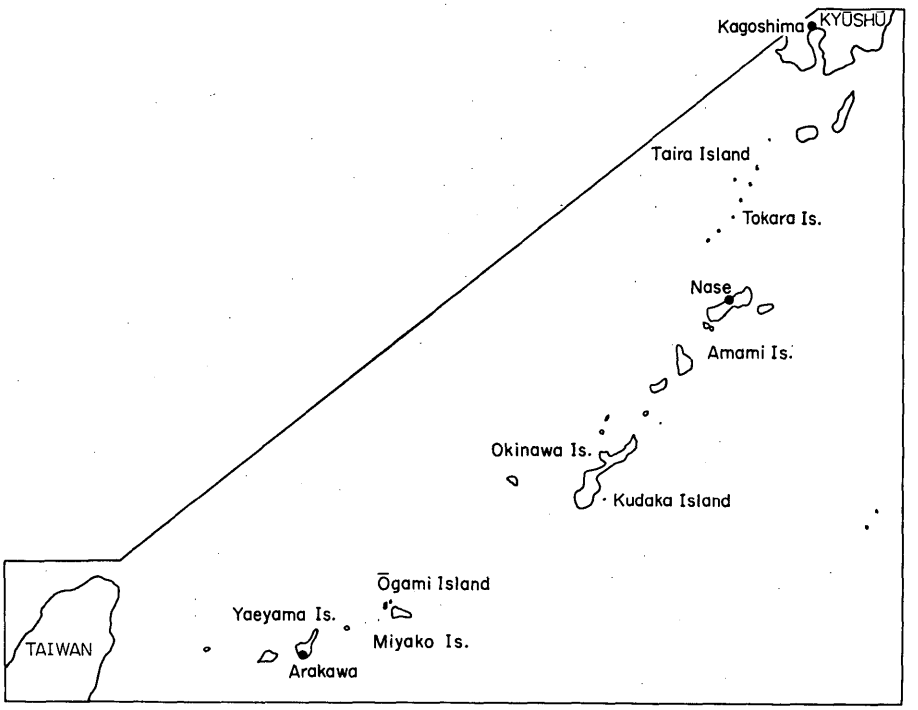


Figure 1. Generalized Location of the Communities Studied

TAIRA ISLAND

Taira Island, 1.99 km² in area, is surrounded by a coral reef. Between 1974 and 1978 it was inhabited by about 80 persons.[3] Taira Island together with another six inhabited islands of the Tokara group administratively form Toshima Village, which belongs to Kagoshima Prefecture. Because of the scattered distribution of the seven islands and their small population, the Tokara group is one of the most isolated areas in Japan.[4] Consequently, the economy is fairly self-sufficient. The bulk of daily foods are local products and almost all animal proteins are provided by the islanders' fishing efforts.

Owing to physical isolation Taira Island inhabitants have tended to retain a traditional rural lifestyle. Their lifestyle has been well-documented [KAKEYA 1972; OHTSUKA, KUCHIKURA and MOJI 1978; OHTSUKA and KUCHIKURA 1983], hence it is described only briefly here.

First, a traditional cooperative association still functions to maintain social solidarity and public welfare. Every islander aged between 15 and 65 or 70 belongs to

3) Except for school teachers, each of whom usually stays on the island for a period of three years.

4) A 499 ton cargo-passenger ship, which sails between Kagoshima, in Kyūshū, and Nase, in the Amami Archipelago, visits the Tokara Islands about five times a month. It is their sole means of transport to the outside world.

this association and is regarded as an authentic member of the community. Second, various traditional religious ceremonies are still observed, even if their functional significance has gradually weakened. Every ceremony is associated with a communal feast. The households of Taira Island have been divided into four groups, each of which is responsible in turn for the ceremony. The men's principal task is to catch fish for the feast and the women's is to prepare the dishes for it. Third, their traditional cooperative activities include making or repairing such common properties as roads, piers and shrines, as well as mutual aid for house-building and house-repair. In these activities all male members or all male and female members of the cooperative association take part, according to the nature of the activity. In many cases, a banquet follows a cooperative activity. Raw fish and sweet potato wine are preferably served at such banquets, for which several male members go fishing while the others perform the cooperative activity.

In recent years Kagoshima Prefecture and Toshima Village have required the islanders to undertake such public works as constructing piers and paved roads and repairing school buildings in order to improve living conditions and, at the same time, to furnish them with a cash income. Owing to only a negligible cash income from local production, most of the islanders' earnings are derived from participation in public works. Apart from being a means of obtaining cash, public works labor appears to have the same social function as traditional cooperative activities, since it is a basic rule that, according to the nature of the work, all male members or all male and female members of the association participate in all such works. Similarly, too, completion of public works labor is frequently followed by a banquet.

Occupational specialization has barely developed on Taira Island. In households with a male head and his wife both persons usually perform small-scale rice and vegetable cultivation and the man does subsistence fishing. They both participate in public works. Our investigation for all adult males' major half-daily (*i.e.*, morning and afternoon) activities for 63 days during the three study periods revealed that 40–50 percent of half-days were spent in public or community work, 10 percent for fishing, 5–10 percent for farming and 10 percent for personal activities, such as maintenance of dwellings or huts and the like.[5)]

Three Okinawan Communities

Although each Okinawan community discussed here has its own distinct history and human ecological system, there exist three common features of direct relevance to the comparison with the Taira Island fishing system. First, each community either faces toward or is surrounded by a coral reef. This is basically identical with Taira Island, and natural environmental conditions, at least, produce no profound differences in the marine resources that may be exploited or in possible fishing strategies between Taira Island and the three Okinawan communities. Second, it is a rule that only commercial fishing is conducted by specialists or "proper"

5) This accords fairly well with Kakeya's (1972) survey of Taira Island adult males, conducted for 11 months in 1969.

fishermen. Every fisherman of the three Okinawan communities owns a motorboat. This differs from Taira Island where only three motorboats were available, two of which were community property to provide a ferry service and one, with a small engine, was a proper fishing boat co-owned by four persons. However, the degree of fisheries development varies among the three Okinawan communities (*vide infra*). Third, each community has a Fisheries Cooperative Association (FCA), which is responsible for most decision-making with respect to fishing as well as for marketing the catch. Taira Island has no FCA.

HISTORICAL SETTINGS

Fragmented descriptions of the fishing activities of the Tokara Islanders appear in several documents dating from the late-1800s and the early-1900s. In the Tokugawa (Edo) Period, the sea around the Tokara Islands was known as a good bonito fishing ground. Dried bonito was paid as a tax to the feudal lord at Kagoshima. During the late-Tokugawa Period and early-Meiji Period (in the 1860s, approximately), fishermen from Kyūshū began bonito fishing in the Tokara Sea. Group trolling by several crew members was the only technique employed to take bonito, although Tokara fishermen used lures whereas those from Kyūshū used *kibinago* (perhaps, round herring; *Spratelloides gracilis*) as live bait. Trolling with bait was more effective than that with a lure. Owing to a scarcity of *kibinago* in the Tokara Sea, and because of a shortage of capital, the traditional bonito fishery of the Tokara Islanders declined, and early in the Taishō Period (the 1910s) their large-scale group fishing for bonito disappeared entirely [TORIGOE 1977]. Since that time Tokara Islanders, at least those of Taira, have fished only for subsistence purposes.

In addition to the decline of bonito fishing it should be noted that the islanders' traditional fishing grounds were easily invaded by outsiders. It is reasonable to assume that this arose mainly because of an absence of a concept of sea tenure among the Tokara Island communities and that this lack was associated with the absence of a cash economy. There is no history, either written or oral, of sea ownership in the Tokara Islands.

In Okinawa, the renowned Itoman fishermen took the initiative in the elaboration of fishing strategies and organizations. The Itoman fishermen, who inhabit Itoman City, near Naha, on Okinawa Island, trained apprentices from many Okinawan communities. They also migrated and formed fishing communities throughout Okinawa Prefecture. Their main development took place at the beginning of the 18th Century as a consequence of increased benefits derived from the trade in marine resources with China. Historical documents show that in the 1890s 70 percent of Okinawan fishermen were regarded as Itoman men [UEDA 1979].

The influence of the Itoman group has varied among the three Okinawan communities discussed in this paper. Arakawa and its adjacent settlement, Tonoshiro, are located in Ishigaki City, the center of the Yaeyama District. Both settlements are typical of those established when Itoman fishermen migrated to the

outer islands of Okinawa. Thus, Arakawa fishermen are regarded as Itoman people and at present some 200 adult males among them are full-time fishermen.

The colonization by Itoman of Arakawa and Tonoshiro took place in approximately 1900. Before that small-scale fishing, using relatively crude methods, had been sporadically conducted by farmer-fishermen along the Yaeyama Sea. Gradually those former local fishing activities disappeared and the vast sea area of the Yaeyama has been exploited exclusively by the Itoman group [KISHABA 1934]. Few sea tenure conflicts have occurred within the Itoman group in the Yaeyama Sea, nor have there been many between the Itoman fishermen and other groups. The lack of intra-group conflict among the Itoman fishermen derives from their identity as the Itoman, and a similar absence of trouble between them and other groups from the fact that only the Itoman group has employed a highly developed technology.

Neither the people of Ōgami Island nor those of Kudaka Island are descended from Itoman fishermen. In the past both communities depended for their livelihood on farming and fishing. Because of the increased economic value of fish and other aquatic resources, and owing to the development of a transportation system, both communities developed a fishing-based economy several decades ago. Nonetheless, the scale and specialization of their fishing have lagged far behind those of Arakawa fishermen, largely as a consequence of remoteness from big markets, small populations (at present, about 160 in Ōgami and 350 in Kudaka) and a relative lack of capital [TERASHIMA 1977; ICHIKAWA 1978]. During the period when commercial fishing intensified, both communities were either directly or indirectly influenced by Itoman, although Itoman fishermen did not establish permanent settlements in either of the two areas.

Since both Ōgami and Kudaka are located close to neighboring communities that have a similar economic dependence on fishing they traditionally divided the sea, even if only vaguely, based on the projection of the village's land boundaries. It would appear that few intrusions were made into the sea territories of these two islands, especially by Itoman fishermen, not only because of unfavorable socio-economic conditions but also because of the existence of traditional marine territoriality already established by the villages of the islands and their neighbors.

ECOLOGICAL COMPARISON

Place of Fishing in the Community

Taira Islanders fish exclusively for subsistence, and on the average only 10 percent of an adult male's time is spent fishing. At the opposite extreme is Arakawa, where the fishermen do nothing but fish and their wives' major job is to sell the catch in the adjacent non-fishing communities or in the urban markets. On Ōgami and Kudaka Islands, where commercial fishing has intensified in the last several decades, fishermen have tended to divide into two groups; full-time specialists and seasonal fishermen who fish only in summer. The women of these two communities are mainly engaged in farming.

Table 1. Age Distribution of Fishermen (Number and Percent)

	<19	20-29	30-39	40-49	50-59	>60	Total
Taira Island[1)]	0	4 (14.8)	2 (7.4)	8 (29.6)	5 (18.5)	8 (29.6)	27
Ōgami Island	0	0	0	15 (78.9)	2 (10.5)	2 (10.5)	19
Kudaka Island	0	0	5 (17.9)	14 (50.0)	4 (14.3)	5 (17.9)	28
Arakawa	14 (7.2)	23 (11.9)	65 (33.5)	62 (31.9)	19 (9.8)	11 (5.7)	194

Table Note: [1)] All adult males who have not completely retired from fishing.

These characteristics of each community are reflected in the age structure of fishermen (Table 1). On Taira Island all adult males are part-time fishermen, and owing to out-migration to urban areas of the younger males [KASHIWAZAKI 1972], the age distribution of fishermen is skewed. A similar population movement occurred in the three Okinawan communities, but the different age structure of fishermen in Arakawa compared with the other two is a consequence of the different scale and productivity of fishing. The proportion of young fishermen is higher in Arakawa where fishing is an important economic sector, whereas in Ōgami and Kudaka most younger people have taken jobs in the secondary and tertiary sectors. This difference is also reflected in the size of the different sea territories. Arakawa fishermen, together with their neighboring Itoman group, established ownership over a very wide sea area, whereas the other two communities retained their traditional, small sea areas.

In terms of fishing effort and catch treatment a clear difference naturally emerges between the two kinds of economies. In the three Okinawan communities each fisherman acts according to cost-benefit rules and all his catch is marketed. On Taira Island, in contrast, fishing is solely to satisfy community requirements. About 80 percent of the total catch of Taira Island comes from the two most productive fishing methods using a motorboat (here referred to as boat-fishing), *i.e.*, trolling with a lure for bonito (*Euthynnus pelamis*) and tuna (*Parathummus sibi*), among other species, and deep hand line fishing for demersal species such as *Balistes* spp., *Xanthichthys* spp. and *Gymnocranius japonicus*, among others. More than 80 percent of boat-fishing was performed primarily for communal feasts or banquets (Fig. 2). This clearly implies that boat-fishing on Taira Island is strictly regulated by the community for contributing to the social solidarity in an important way. Also important is that only 40 percent of the boat-fishing catch was actually used for the feasts and banquets and that the balance was distributed to all households, even though each household's share was not identical.

On Taira Island the performance of fishing and the treatment of the catch are closely associated with the concept that the island's marine resources are the common property of the entire community. From this it may be concluded, at least in the area discussed, that in pre-commercialized fishing the notion that marine resources are the common property of the community was commonplace, even if its members

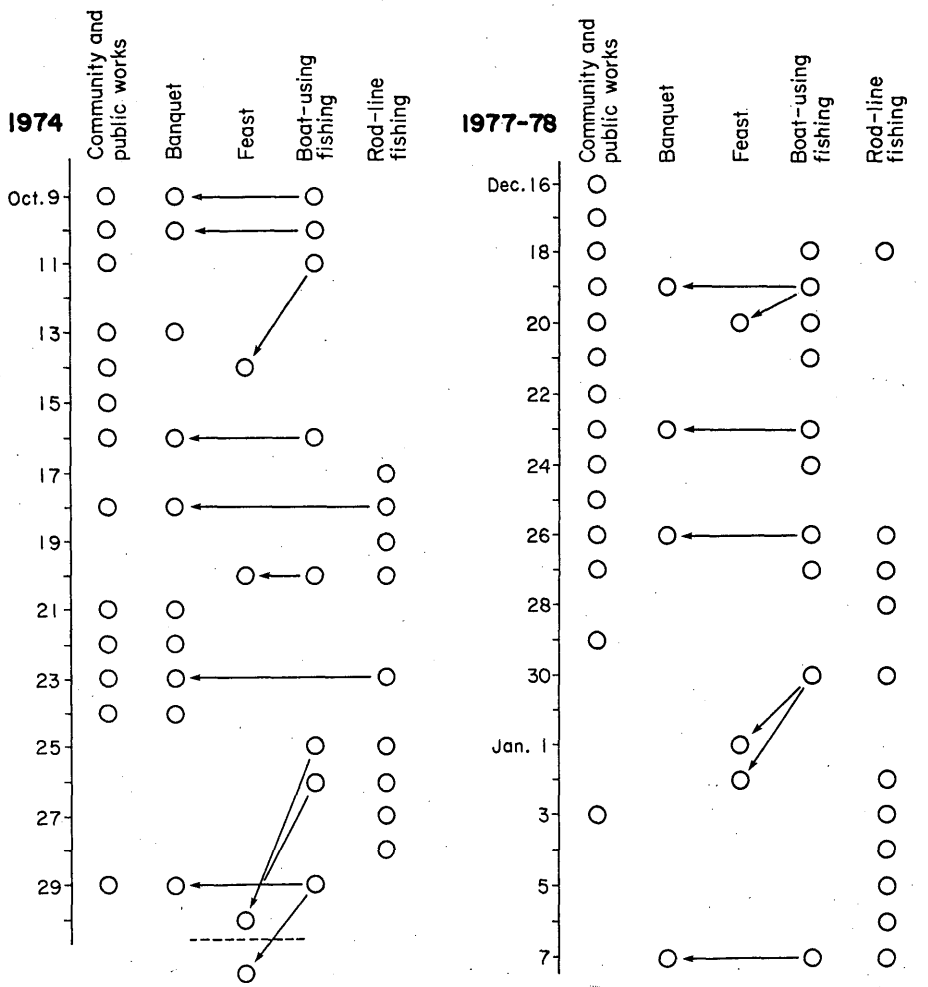
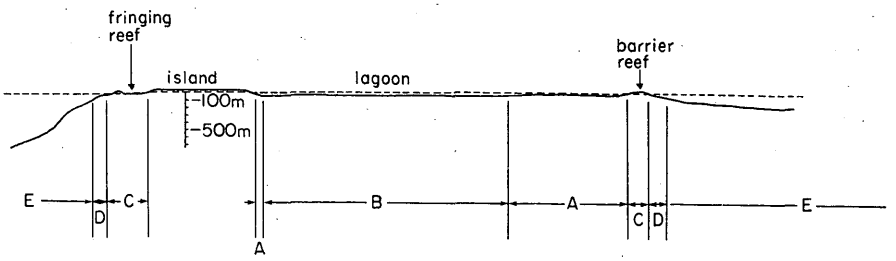


Figure 2. Occurrence of Events on Taira Island and Performance of Fishing (Arrow Indicates Use of the Catch)

did not protect them from outsiders. This, in turn, is suggestive of the condition required for the emergence of sea tenure in the commercial fishing community.

Fishing Strategies

Coralline environments provide human communities with several kinds of fishing activity fields, each of which is usually distinguished and named. This is the case among the communities treated here [KUCHIKURA 1974; TERASHIMA 1977; ICHIKAWA 1978]. In broad terms, the sea is horizontally divided into reef flat (and lagoon, if developed), a seaward slope zone and a deep water zone (Fig. 3). Moreover, there are important differences in the vertical use of the reef flat and seaward slope zone [KUCHIKURA 1977]. For convenience in comparing the activity fields



Zone	I			II	III
Activity field	A	B	C	D	E
	lagoon and outer reef shallow water region	lagoon floor	reef flat: lagoon reef margin; seaward reef margin	seaward slope zone	deep water zone
	"inō"		"hishi"	"hishinkuchi"	
Local name	("hishi") "inō-hāgai"	"inō" "inō-chibu"	"hishi-bata" "hishi-nu-kēri guwa" "araba"	"ashi"	"dal-kai"

Figure 3. Zonation of Fishing Activity Fields (Based on the Sea Environment of Arakawa)

among the fishing communities considered, however, they are divided here into four categories, taking the kinds of resources into account: (1) obtaining fish just offshore without using a boat; (2) obtaining fish at the reef flat or in the lagoon; (3) obtaining fish in the open sea (seaward slope zone and deep water zone); and (4) obtaining aquatic resources other than fish on the reef flat or in the lagoon. The major resources taken (Appendix 1) correspond to these four resource-environment complexes.

The major fishing methods of each community are classified according to the four resource-environment complexes (Table 2). This classification reveals three important points. First, the two fishing methods used by Taira Islanders are

Table 2. Major Fishing Methods of the Four Communities

	Seashore (without boat): fishes	Reef flat and lagoon: fishes	Open sea: fishes	Reef flat and lagoon: other aquatic resources
Taira Island	Rod-line Small gill net	Hand line	Hand line Trolling	Spearing
Ōgami Island		Hand line Trapping Gill net Spearing	Hand line Long line Trolling	Trolling Spearing Gathering shellfish Gathering seaweed
Kudaka Island		Hand line Small drive-in net Trapping Gill net Spearing	Hand line Long line Trolling	Trolling Spearing Gathering shellfish Gathering sea urchin Gathering seaweed
Arakawa		Hand line Drive-in net Trapping Gill net Fixed net Lift net Spearing	Hand line Long line Trolling	Trolling Spearing Hunting turtle Gathering shellfish Gathering seaweed

employed just offshore. Naturally they are relatively unproductive. Our 63-day records demonstrate that the average labor efficiency in terms of catch (kg/work hour) was about 0.3 kg/hr for rod-line fishing and about 1.4 kg/hr for boat-fishing. Rod-line fishing is common, despite its poor labor efficiency, because it can be done when sea conditions do not permit boat-fishing. Further, because it is a simple technique it can be performed by persons who have little opportunity to participate in boat-fishing, and consequently whose share of boat-fishing catches is relatively small. This contrasts with conditions in the three Okinawan communities. In Arakawa, for example, *per capita* daily income ranges only between 3,500 and 5,400 ¥ for all fishermen and for all technologies.

Second, Taira Islanders use only three fishing methods, except for the two methods employed to exploit the seashore area. This contrasts with the large number of methods used by the three Okinawan communities. Table 3 compares the efforts for different fishing methods on Taira Island with those in Arakawa. Clearly demonstrated is the uneven effort for exploitation of different resources by Taira Islanders. While the biomass of each resource in the Taira Island sea environment has not been studied, doubtless their efforts are not proportionate to available resources. In contrast, Arakawa fishermen tend to exploit all resources as far as possible, each man specializing in one or several techniques. Thus, the Arakawa fishing system has resulted in competition among its different technologies for the exploitation of the same resources. Especially, drive-in netting, spearing, trapping and hand line fishing all aim at lethrinids and serranids, among other fishes on the reef flat or in the lagoon. This kind of competitive relationship had led to intra-community agreements on resource exploitation.

Third, commercial fishing tends to exploit several marine resources of little subsistence use but which are commercially valuable. As shown in Table 2, a typical example is sea urchin collection in Kudaka Island, which has developed only recently. Shellfish and seaweed gathering are similar in this sense. Since these three resources are sedentary they are vulnerable to over-exploitation leading to rapid extinction. Thus their exploitation must be regulated to ensure sustained yields.

Table 3. Comparison of Efforts for Different Fishing Methods Classified by the Resource-Environment Complex* (Percent in Parentheses)

	A	B	C	D	Total
Taira Island	5.3 (27.7)	2.5 (13.1)	10.1 (52.9)	1.2 (6.3)	19.1
Arakawa[a]	0	140.7 (40.0)	92.7 (26.3)	118.8 (33.7)	352.2

Table Note: The unit of comparison differs among the communities; per-day man-hour is used for Taira Island whereas per-day number of fishermen is used for Arakawa.

* The categorization of the resource-environment complex follows Table 2. A—Seashore (without boat): fishes, B—Reef flat and lagoon: fishes, C—Open sea: fishes, and D—Reef flat and lagoon: other aquatics.

[a] The figures include the fishermen of Arakawa and those of Tonoshiro, a neighboring community, who exploit the identical sea area; Tonoshiro possesses almost the same number of fishermen as Arakawa.

Individuals and Groups in Fishing Activities

Most fishing methods in the four communities are, as a rule, employed by individual fishermen. Exceptions are drive-in netting in Arakawa and Kudaka Island and boat-fishing on Taira Island. Drive-in netting requires the cooperative efforts of several fishermen. The drive-in netting technique used in Arakawa needs at least four fishermen, who divide their labor. The team leader selects the fishing spot and time of fishing and operates one boat. A sub-leader operates another boat. A diver or divers work in the water throughout, setting the nets, removing the ropes or nets from rocks or corals, and lifting the full net into the boat. One or more probationers help the divers to operate the rope.

Taira Island boat-fishing is done by four fishermen, but sometimes fewer and occasionally more. One acts as the operator who decides the trolling course or selects spots for hand line fishing. In this he depends on his knowledge of the marine environment, especially location-finding (*ate*) [IGARASHI 1974], fish ecology and the habits of sea birds which congregate around shoals of such targets as bonito and the tuna. Yet in Okinawan communities, despite the use of the same fishing method the and boats of same size, trolling and hand line fishing are usually done by a single fisherman. This difference can be explained largely by the difference in economic systems.

Figure 4 shows the time that each Taira Island fisherman spends for each fishing method as a cumulative rate among all individuals, arranged in increasing order of age. It reveals great individual differences in time for spearing (associated with diving), although the three other activities, none of which requires physical strength,

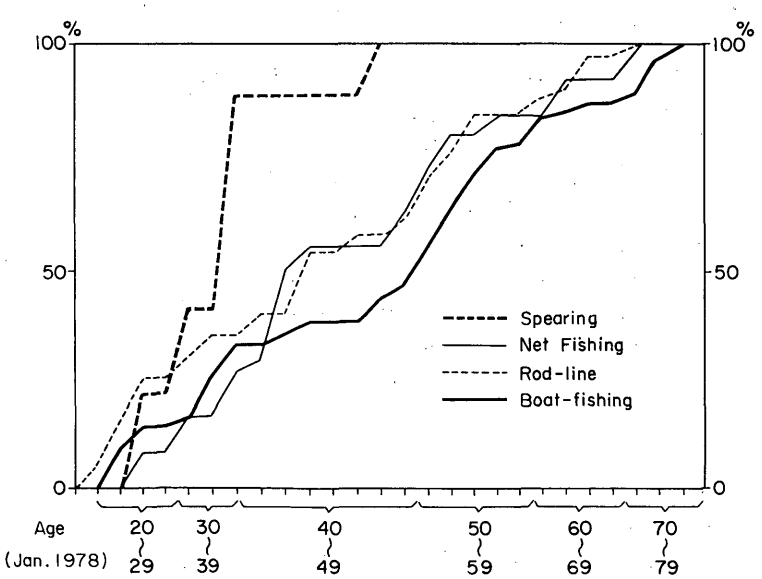


Figure 4. Cumulative Rate of an Individual's Time Spent in Each Fishing Method on Taira Island

Table 4. Relationship between Fishermen's Work Type and Age in Kudaka Island[1)]

Age	Work type			
	I	II	III	IV
30-39	5	0	0	0
40-49	6	5	2	1
50-59	0	3	1	0
60+	0	0	1	4

Source: [TERASHIMA 1977]
Table note: [1)] For classification of work types see text

are conducted fairly equally by all fishermen. In the Okinawan communities fishermen's efforts tend to be associated with age. On Kudaka Island fishing methods were classified into two groups, one of which (A) does not require hard work and yet provides a stable catch, and the other (B) which demands physical strength but tends to be unstable in the amount of catch [TERASHIMA 1977]. Group A includes trolling and seaweed and sea urchin collection, whereas group B includes spearing, netting and hand line fishing. Most fishing methods used on Kudaka Island are seasonal. Those of group A are usually done in summer, so that each fisherman should undertake some group B methods to raise his yearly income. In this setting the 28 fishermen were classified into four types: Type I, who used both A and B technologies throughout the year; Type II, who used both in summer only and who were engaged in work other than fishing in winter; Type III, who used only group A throughout the year; and Type IV who used only group A and only in summer. Table 4, which relates fishermen's work type to age, suggests that the younger the individual the harder he worked. Similarly, in Arakawa the younger members tend to engage in more strenuous activities in individual work settings and to perform underwater tasks in group work settings [KUCHIKURA 1974].

These findings contrast with the equal participation in the various fishing employed by Taira Islanders, regardless of their age. Theoretically, any type of fishing except diving can be done by all individuals and especially by the younger ones. In commercial fishing communities the labor force has generally increased against the amount of resources, so that the different age groups are assigned to the appropriate fishing methods. Although usually informal, this intra-community regulation is universal.

CONCLUSIONS

This ecological comparison of subsistence and commercial fishing systems suggests several problems concerning maritime institutions. First, on Taira Island subsistence fishing is regulated largely by the social conditions of the community and, at the same time, is done for the benefit of the entire community. This practise conforms with the islanders' notion that the sea and its resources are the common

property of the community. However, this notion does not necessarily prevent the intrusion of outsiders, rather it only regulates the community members' activities. It is reasonable to assume that were commercialization to proceed this notion might transform into one of sea territoriality.

Inter-community sea tenure was established with the rise of commercial fishing. But it is noteworthy that commercial fishing faces several different problems: several fishing methods tend to exploit the same resources so that each fishing community or its FCA must establish a system to prevent inter-method conflicts; to assure all individuals, especially the elderly, of access to marine resources, younger fishermen, in particular, should forgo those technologies that can be operated without physical strength; and commercialization tends to exploit resources like sedentary shellfish, seaweeds and sea urchin that would quickly become extinct locally were exploitation not regulated. These problems make it apparent that fishing communities must limit individualistic activities, and that commercial fisheries, in particular, must stress intra-community regulations rather than those between or among communities.

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Appendix 1. Major Marine Resources (Family Name and Common Name for Fishes)[1)]

1. Fishes: seashore

Pomacentridae	Damselfish
Labridae	Wrasse
Kyphosidae	Seachub
Serranidae	Grouper and Seabass
Girellidae	Nibbler
Cirrhitidae	Hawkfish

2. Fishes: reef flat and lagoon

Sandy sea bottom	
Gerridae	Majarra
Sparidae	Porgy
Platycephalidae	Flathead
Hemiramphidae	Halfbeak
Mugilidae	Mullett
Dorosomatidae	Gizzard shad
Rocky sea bottom	
Holocentridae	Squirrelfish
Priacanthidae	Bigeye
Serranidae	Grouper and Seabass
Nemipteridae	——
Girellidae	Nibbler
Kyphosidae	Seachub
Bottom layer	
Mullidae	Goatfish
Lutjanidae	Snapper
Lethrinidae	——
Sparidae	Porgy
Mid-water layer	
Carangidae	Trevally

3. Fishes: open sea

Surface or mid-water layer	
Scombridae	Mackerel and Tuna
Sphyraenidae	Barracuda
Carangidae	Trevally
Coryphaenidae	Dolphinfish
Bottom layer	
Lutjanidae	Snapper
Sparidae	Porgy
Lethrinidae	——

4. Other aquatic resources: reef flat and lagoon
(common name, and genus name for main resources)

Squid (mainly, *Sepioteuthis, Sepia*)
Octopus
Shellfish (mainly, *Tridacna*)
Sea urchin
Seaweed (mainly, *Nemacystus*)
Turtle (mainly, *Eretmochelys, Chelonia*)

Appendix Note: [1)] Source for Common Name is [MASUDA, ARAGA and YOSHINO 1975]