PRELIMINARY REPORT ON THE HAWKSBILL TURTLE (ERETMOCHELYS IMBRICATA) IN INDONESIA, PHILIPPINES, MALAYSIA AND SINGAPORE

JAPANESE TORTOISE SHELL ASSOCIATION
AUGUST 1973

ENGLISH VERSION
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MARCH 1978

Preface

The following translation of a report published by the Japanese Tortoise Shell Association has been prepared in order to gain insight into factors which influence the conservation of hawksbill and other sea turtles in the Pacific region. Japan is known to be the world's largest consumer of hawksbills, both for tortoise shell and whole stuffed curios. However, information on this trade and its sources of supply has generally been lacking.

The original report written in Japanese, as well as the English abstract of an abridged version (Appendix I), were first brought to my attention by Dr. Itaru Uchida in March 1976 during a visit he made to Hawaii. At that time I was also told of the Japanese Tortoise Shell Association and its newsletter which periodically provides importation statistics for tortoise shell. Some of these data have been republished in the *IUCN/SSC Marine Turtle Newsletter* (January 1977) thereby focusing attention on the continuing high level of trade (Appendix II).

In carrying out this translation I was fortunate to obtain the services of Miss Mae Nozoe who devoted many hours of work for the low level of financial compensation available. I am grateful to Miss Nozoe for her interest and conscientious work at all stages of the project.

Copies of this translation will be distributed initially to Drs. Archie Carr and Nicholas Mrosovsky, Co-chairmen of the IUCN Marine Turtle Group, and to other colleagues who have expressed concern for this problem. It is anticipated that the Japanese hawksbill industry will be a major topic of discussion at the IUCN marine turtle meeting scheduled for 15-19 May 1978 in Toronto, Canada. Additional copies of the translation will eventually be made available at cost to any interested individual or organization.

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I. INTRODUCTORY STATEMENTS

In February 1973 a conference was held in Washington D. C. on the conservation of endangered wildlife. This resulted in passage of the Convention on International Trade in Endangered Species. As a result, the hawksbill turtle industry in the Atlantic Ocean area was virtually stopped, and trade in the Pacific could be carried out only after obtaining permission. Due to the fact that the Convention has not been ratified by all of the countries, it has not yet been put into effect for Japan which depends totally on imports of tortoise shell. This greatly narrows the source of supply of raw material, and the tortoise shell industry which supports the traditional Japanese craft industry will greatly suffer.

We who are related to the tortoise shell industry have considered the seriousness of the situation and have come together with other individuals in the industry, from all parts of Japan, to form the Japanese Tortoise Shell Association (JTSA). We have taken it upon ourselves to investigate the ecology of the hawksbill turtle living in the waters of Southeast Asia, and to develop countermeasures. Fortunately we received the understanding and financial support of the Ministry of International Trade and Industry, as part of a project to assist in the promotion of buying domestic products. We were therefore able to conduct a preliminary investigation of the ecology and trade of the hawksbill in the Philippines, Malaysia, Singapore and Indonesia. This report contains the results of the investigation.

On behalf of the Association, we would like to express our deepest thanks to those who gave us advice and suggestions throughout the whole project

including: the Ministry of International Trade and Industry of the Nagasaki Prefecture; Professor Masaharu Nishiwaki, Chairman of the Oceanography Department of Tokyo University; the Japanese Embassies in the countries visited; companies involved in the industry; and the authors of this report, Assistant Professor Takeshi Kajihara (Oceanography Department, Tokyo University) and Itaru Uchida (Director, Himeji City Aquarium).

Tadao Kakidachi*
Chairman
Japanese Tortoise Shell Association
November 1973

The investigation committee consisted of six members. Two were industry members of the Japanese Tortoise Shell Association, three were specialists of sea turtles, and one was an Indonesian interpreter and public relations specialist. Three other individuals also participated using their own money.

The committee left Tokyo on August 10, 1973 for 25 days to study the ecology, resources and trade of turtles in four countries, the Philippines, Malaysia, Singapore and Indonesia. During this time we were able to interact with people in governmental organizations, laboratories, and researchers at Universities. We were also able to exchange information with technical cooperative groups in the various countries, and the specialists and workers of the Japanese Commerce Promotion Group.

The investigation helped us acquire material on which to make firm plans. This included: 1) data on the ecology of sea turtles; 2) information useful to the governments of the various countries for setting policies; and 3) information as to how our country should direct itself in the future.

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The investigation was made possible by the great cooperation of the Japanese embassies in each of the countries and the governmental agencies.

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Investigation Committee Chairman
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Biographical information for the participants of the investigation is presented in Table 1. The travel schedules of the participants are shown in Figure 1.

II. SITUATION OF THE HAWKSBILL TURTLE

The common element in all of the countries investigated was the scarcity of biological data and resource materials on sea turtles. In this booklet we first intend to describe the biological conditions of sea turtles in general in each of the investigated countries, and to follow this with a description of the hawksbill in the whole of Southeast Asia. The differing names of the species are listed in Table 2 along with their areas of inhabitation.

A. The Philippines

Green turtles, hawksbills, Pacific ridleys and leatherbacks inhabit the waters around the Philippines. Not much is known about the size of the leatherback population, nor the locations of their habitats. Although few in number, Pacific ridleys live scattered around the Philippines. Dense populations of green turtles and hawksbills exist in the Sulu Sea not far from the southern end of Mindanao Island and near Palawan.

1. Green turtles

No nesting grounds have been found north of Mindanao Island in the Sulu Sea. There is, however, a large colony in the Turtle Islands located in the southern portion of the Sulu Sea (Figure 2). Although a considerable number of green turtles live in the waters off Palawan, no breeding grounds are thought to be located there. This is because much of the shoreline is rough with few sandy beaches suitable as hatching grounds. The nesting season in the Sulu Sea lasts throughout the year, the peak being from May through September, and August the extreme height.

According to Domantay (1951), who reported on research conducted on nesting during a 35-day period between August 8 and September 11, 1951, a

total of 1,352 (39.5 per night*) turtles landed on Taganak, one of the Turtle Islands, to nest. According to this figure, the report assumes that 3,000 green turtles besides the nesting females exist in this locality. This figure shows an overwhelming decline as compared to the 20,000-25,000 in existence during the war before being exploited by the Japanese Army. No research has been carried out in this area since 1951. The natives here depend on the eggs and meat of the green turtle for their source of protein.

Since green turtles are very high in economic value (Table 3) fishermen depend on them for their livelihood, which in turn means that they are in danger of being overexploited. However, this booklet makes no reference to governmental policies as it was unable to obtain permission to conduct research in the Sulu Sea due to political unrest.

2. Hawksbills

Hawksbill habitats are limited to the Sulu Sea and around Palawan Island; they are not hunted north of Mindanao. The farther south one ventures, especially as one approaches the Turtle Islands, the denser the population becomes. Fishing boats are unable to approach the shore of Palawan as it is too rugged. The exact conditions in this area are therefore unknown although it is known that the population at the southern end of the island is higher than that on the Turtle Islands.

Nesting grounds exist on the Turtle Islands. These areas are scattered and mixed with that of the green turtle. Unlike green turtles, the hawksbills do not breed in large colonies. Hawksbills nest the year round, however their peak period is unknown. There is an 8:1:1 ratio of green turtles to hawksbills and to other species that climb ashore to nest. Based on this

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* "per month" appeared in the original version, however this would seem to be an error - ed.

ratio and yet unexperienced fishing, it can be concluded that the hawksbills amount to 1/10 the population of green turtles in the Sulu Sea.

Turtle fishermen usually look for green turtles, but also capture hawksbills when they are found. Moreover, the hawksbill fishing ground is practically the same as that of the green turtle, extending mainly between the Sulu Sea and the Turtle Islands. When on the lookout for hawksbills (due to merchants' orders) they travel as far as to the southern tip of Palawan. Figure 3 reveals the turtle fishing grounds in the Philippines.

Like green turtle hunting, two methods can be employed in hawksbill turtling. One is to flip the female turtles on their backs when they come ashore at night to nest, then to come back in the morning to collect them. The other is to cruise around the shoreline during the day and spear those that come up for air. This is the method most commonly used.

3. Yearly hawksbill catch

There are no records of the number of green turtles caught per year. There are, however, statistics on the volume of exported tortoise shell and its value. A law regarding the capture of sea turtles was passed in parts in 1962, and for five years since 1967 a moratorium against the capture of turtles was put into effect. Revision of the law in 1964 made it necessary to obtain permission to hunt the turtles. It also became necessary to obtain permission to export the shells.

Recorded in Table 4 are the amounts of tortoise shell exported according to the statistics given and their worth (1,000 pesos per unit, 1 kg per unit). Also recorded is the percentage of the value of the exported shells as compared to the value of exported marine products. These products include sea shells,

seaweed, sponge, shark fins, sea cucumbers, crocodile skins and tortoise shells. As stated, there has been a ban on sea turtle poaching since 1967. It can be assumed that at that time it was under the condition that permission be granted otherwise. The sudden increase in 1967 can be interpreted to mean that businessmen who had expected the moratorium were letting their stocks go. The export which took place during 1968-1969 comes from this old stock.

The amount of import from the Philippines to Japan (unknown before 1967) has continued since 1970 even if not recorded in the Philippine export statistics. Perhaps this can be considered unauthorized export from the Philippine viewpoint. In Table 5, the total export volume during the four year span between 1966-1969 is 38,900 lbs. The total import volume in Japan equals 3,800 lbs. From the Southeast Asian region or even worldwide vantage point, Japan imports the most tortoise shells, purchasing over 90% of the world's supply. Taking this into consideration, the 35,100 lbs difference between the export volume from the Philippines and that brought into Japan can be thought to have found its way into the storehouses of tortoise shell dealers (Chinese merchants) of Hong Kong, Malaysia and Singapore where the goods were then re-exported to Japan. In addition, it becomes necessary to consider whether the yearly fluctuation in export in the Philippines reflects the fluctuation in the number of turtles captured. This can be examined directly by taking into consideration the number of turtles captured and indirectly by considering the effort made to hunt them (number of boats used, power of the boats, number of fishermen, days in operation and amount of tools used). However, these figures have not been reported in the Philippines. According to a poll taken in the area, the effort of catching has not changed since the beginning of World War II.

The investigation resulted in considering the total number of turtles caught between 1963-1969 as equal to the total number exported from the Philippines and imported into Japan, and computing the average capture per year from that. In other words, 52,890 lbs divided by 7 equals 7,500 lbs. If one hawksbill produces 1.5 lbs of tortoise shell (assumed by Japanese Tortoise Shell Association), the yearly average will be 5,000 turtles.

B. Malaysia

Malaysia can be divided into three area, the Malay Peninsula, Sabah and Sarawak. Green turtles, leatherbacks and Pacific ridleys are most commonly spotted around the Malay Peninsula. Their hatching sites are located on the eastern coast (Figure 4). However, there are no reports of nesting in these regions. It seems that the period lasts throughout the year, although the exact details are not known. The nesting grounds of the ridley are widely distributed over that of the green turtle, but fewer come ashore than the green turtle. The leatherback habitats are concentrated on the Trengganu coast, where a world famous breeding ground is located. The nesting period is between Spring and September, the peak being from July until the beginning of August. A government nesting sanctuary is also located in Trengganu where hatchlings are released.

The same kinds of turtles that inhabit the Malay Peninsula are also found in Sarawak. Nesting takes place throughout the year, with the peak extending from June to August. Tables 6 and 7 indicate the number of turtles hatched on the main breeding grounds in Sarawak and then released.

Exact details of the Sabah region are unknown, but it has been reported that a nesting place of hawksbills is located in this area. According to

Japanese statistics, though in small amounts, tortoise shells are imported from this area during certain years. The native Malaysians use the eggs as food, while the Chinese use the meat.

C. Singapore

There is apparently a small number of sea turtles in Singapore. However, it is uncertain as to what species occupy the area. The main concern in this region is the hawksbill which is used for stuffing purposes. The turtles to be stuffed are about one to two years old with shells ranging from 20 to 35 cm in length. They are captured opposite the Sumatra coast where dealers for the taxidermists collect and ship them to Singapore. Within one week, the turtles are delivered to the taxidermist. The turtles die and become worthless thereafter. Putting this period into consideration, the area the turtles can be caught is limited to the Sumatra coastline. The hawksbills are then transported to processing plants (one or two) where they are placed in concrete tanks (2 by 2 by 0.7 m), filled with fresh water, and fed. They are then stuffed one at a time. The general process followed by the companies is explained as follows. While still alive the muscles, internal organs and brain are taken out and sold as food to the Chinese. The hollowed out turtle is soaked for two weeks in 5% formalin. After rinsing it in water for several days, it is taken out and dried for one day. The turtle is then stuffed with wood and sewn up as it is being shaped. Impurities are scraped off the shell with glass fragments and polished. The daily pay per worker amounts to 4.5-10 Singapore dollars (480-1,075 yen*) during the peak seasons. The temporary help (which sometimes includes children) receive 4.5-5.0 Singapore dollars (480-540 yen).

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* In 1973, approximately 271 yen = US$1.00 - ed.

About 60% of the turtles stuffed in Singapore are shipped to Japan while the remaining 40% are sold in Singapore to Japanese tourists. The Chinese and Malay residents do not show an interest in the turtles. The Chinese especially believe them to bring bad luck and are surprised at the Japanese interest. Very few tourists, other than the Japanese, purchase the turtles.

The biological significance of the stuffed hawksbills is that it is putting more pressure on the resource than the loss of adult hawksbills which are taken for their shell. In other words, the adult turtles at least play a role in perpetuating the species by laying eggs (female) and mating (male) before they are killed for their shell. But because the turtles which are stuffed have not yet reached maturity, the resources are affected in two ways - the individual turtle count is decreased, and the possibility of perpetuating the species is denied.

The figures dealing with the stuffed hawksbills which will be presented here were obtained verbally from the companies. About four or five processing plants are located in Singapore, each producing 3,000-4,000 stuffed turtles a year. The annual production therefore amounts to 15,000-20,000. Because Singapore also imports stuffed turtles from South Vietnam, the number handled per year is greater than the figures presented.

The area from which these turtles are taken, judging from the power of the boats and the number of days a captured turtle can be kept alive, probably lies between the Riau Islands in the Malacca Strait to the Islands of Bangka and Belitung.

It has been stated that the increase of Japanese tourists since 1972 has boosted the demand for the stuffed turtles. As stated elsewhere, the

pressure to obtain the young hawksbills is so high that those involved in the business claim that there are signs of their extinction.

Tortoise shell in Singapore is imported solely from Indonesia and re-shipped to Japan. Our investigations in August 1973 found that heavy orders from Japan had cleaned out Singapore's stock of shells.

D. Indonesia

1. Biology and use of sea turtles

The territory of Indonesia covers a wide area and includes a great number of islands. It stretches from 90° to 140° on the East longitude, 5° on the North latitude and 10° on the South latitude, ending up on both sides of the equator. Moreover, it includes the inland seas which Indonesia itself separates from the Pacific and Indian Oceans, and the South China Sea. The investigation confirmed that the coral reefs scattered in the inland sea serve as habitats for the hawksbills. Table 8 shows that, according to the 1969 research, the habitats of the hawksbill and green turtles span a wide area.

The sea turtles in Indonesia provide eggs, meat, and are also processed. Eggs of all species are consumed by people living over a vast area (see Table 9). The meat of mainly green turtles is eaten. The Moslems eat only the eggs and not the meat. Although the Chinese are the meateaters, they must rely on their purchases from the market because none of them are turtle fishermen. Residents of Bali place great value on turtle meat. Sea turtles are never left out of any ceremonial occasion; their heads are placed in coffins of the dead. Green turtles are raised in Bali for such purposes (refer to section on breeding). The volume of turtles handled in Bali in 1971 totalled 48,020 kg, which is worth 12,495,700 Rp (250 Rp or 160 yen per kg, the approximate equivalent of

the Philippine value shown in Table 3). If mature green turtles weigh on the average of 100 kg, the meat of approximately 500 turtles was sold in 1971. However, as stated below, the annual catch in Bali amounts to over 5,000 turtles. This means that most of the meat is consumed by the households and very little reaches the market.

Table 10 indicates the purposes for which the turtles are used, which was revealed by our research in Ambon (in the Moluccas at 3°41'S, 128°10'E - ed.), a great distance from Java. Very little eggs and meat are consumed in this region, the Chinese being the only meat eaters. Although it is not certain, apparently the capture of some kinds of sea turtles is prohibited. Besides relying on turtles (mainly green turtles) for their eggs and meat, the capture of hawksbills (young ones for taxidermy and mature ones for their shells) has sharply increased.

2. Methods of capture

Most of the fishermen in Indonesia's inland sea (Java Sea, Flores Sea, Banda Sea, and the Malacca Strait) are said to belong to the Buji tribe which commands the southern part of Celebes. They do not speak Indonesian. Being the only seafaring people in this country, they travel great distances on sailboats and are involved in the fishing and trade industries. Because they deal in the fishing trade and are thus mainly concerned with fishes, they capture turtles only upon coming across them. The turtles are either caught by seizing the females that come ashore to nest or by spearing them in water, which is the method employed most. Figure 5 presents the types of spears and methods used. The turtles are harpooned in the shell and pulled on board after they weaken. The hawksbills are speared in the neck, as any damage to

the shell will decrease its market value. Small and medium-sized hawksbills are scooped from the water with bare hands while they are swimming. Those under water are drawn up by hooks. Hawksbills in the Tonimbar Islands (east of Timor) are captured when they indulge in their habit of resting in the shade of rocks after foraging.

3. Areas of hawksbill habitation

We were unable to observe the places of habitation during the investigation. However, the consensus of opinion is that hawksbills dwell on coral reefs. The hatching place for those hawksbills used for taxidermy (the handling done by merchants, the processing by Indonesians) and areas which tortoise shell suppliers frequent are places where numerous coral beds are scattered.

Indonesians refer to sea turtles as "penyu." Looking at a detailed map of this area, one finds that there are many islands named Kep Penyu (or Penju, Kep stands for island) or Turtle Island. From long ago, the islands were known to be breeding places for turtles and reports state that they are utilized by green turtles as well as hawksbills. There are, in addition, small islands which do not have the word "penyu" in their name but are commonly called "Turtle Island." For instance, the little island of Serangan (in the Celebes at 5°30'N, 125°40'E - ed.) is commonly referred to as Turtle Island by those in that area. The name reflects the fact that nesting places are located there, or that the area is densely populated by turtles.

The annual capture of turtles in the area surrounding Serangan (including 400 m inland) totals 7,000-8,000. Only green turtles are included, disregarding hawksbills.

A wildlife sanctuary is located in the Sukamade region which faces the Indian Ocean, east of Java. A nesting beach for turtles is located there, where the researchers of this investigation spent two nights for observations. According to their findings and that of the watchmen, green turtles and leatherbacks frequent this place, the majority of which are the green turtles. Nesting at this location takes place throughout the year, but the height of the season is unknown. Table 11 presents information on nesting in the Sukamade region. The position and shape of the beach are shown in Figure 6. The beach directly faces the Indian Ocean and not much coral is found in the offshore waters.

Coral reefs can be found in the inland sea close to the various islands. The hatching grounds of the hawksbills are located on sandy beaches near the coral reefs or on little islands with beaches near the coral reefs.

The above reveals that very few hawksbills dwell in the areas facing the Indonesian Sea and where there is a lack of coral reefs. As Figure 7 indicates, the hawksbill fishing grounds are located in the areas inhabited by the turtles.

4. Statistics on hawksbills captured for shell

As mentioned previously, there are no hawksbill fishermen in Indonesia. The low demand for green turtle meat in all areas except Bali is another reason for the lack of turtle fishermen. Hawksbill shells are handled mainly by Chinese merchants in Ambon and Makassar (in the Celebes at 5°26'S, 122°38'E; Makassar has been renamed Ujung Pandanga - ed.). Turtles captured in the areas indicated in Figure 7 are collected frequently throughout the year. However, since the people have no other means for exchanging their catch for food or

money except with the Chinese merchants, their main concentration is on fishing, which is more directly related to their lives. Turtles are caught only when spotted or during certain seasons.

Very little data are available to help us estimate the number of hawksbills killed per year in Indonesia. The country does not possess any records on the number of hawksbills exported. The only existing records come from Japan's log of imports. However, like data on the Philippines, there are instances of the goods traveling roundabout from Indonesia to Hong Kong or Singapore, and from there to Japan. The following information was gathered from Chinese merchants in Makassar and Ambon during the investigation. One of the firms in Ambon, run by a Chinese, receives approximately a ton (2,000 lbs) shipment per year and forwards it to Makassar. A company in Makassar which receives that shipment, plus others from different areas, reports that approximately 0.5 ton is brought in during a 3 month period. The Chinese merchants who handle virtually all shipping within the country either send them from local areas to Ambon and then to Makassar or from the local areas straight to Makassar and out of the country. Reports say that an estimated 40,000-50,000 lbs of cargo were handled since last year in Makassar.

Indonesia and the Philippines are the two Southeast Asian countries with the greatest volume of tortoise shell exports. Products imported into Japan from Hong Kong, Singapore and Malaysia can be considered to be re-exports originating from the first two countries. But if we assume, as stated earlier, that the annual catch in the Philippines is 7,500 lbs, with the amount of export from January to September of both 1972 and 1973 being 7,000-8,000 lbs, then we can safely say that the product was not circulated to other Southeast Asian countries.

The total volume of shells imported into Japan from Southeast Asia between 1966-1973 (Jan-Sept of 1973) is listed in Table 12. The total import of Hong Kong, Singapore, Malaysia, and Indonesia combined is presented under the column, "Indonesian group." Table 5 shows that it may be possible that from 1966 to 1969 the Philippine figures were added into the Indonesian group. Thus we can estimate the volume to have been 34,800 lbs. With this as our basis, the average yield for the Indonesian group during these past four years amounts to 6,800 lbs. If for the two years between 1970 and 1971 we assume that the Philippines yield (7,500 lbs equals amount exported to Japan) was included with the Indonesian group, the yearly average would come to 7,500 lbs. An inspection of the figures in the Indonesian group reveals an unusual increase from 1972. It was explained that, particularly in 1973, buyers from Japanese firms purchased huge amounts from the Singapore and Makassar markets. This consequently resulted in the Chinese merchants of Makassar handling 40,000-50,000 lbs. This increase comes close to the maximum number of hawksbills that can be caught in those countries. To increase the capture further would mean locating more fishing grounds and expending greater time and effort. It can be noted here that, based on the 40,000-50,000 lbs maximum yield, 30,000 adult hawksbills are killed each year in Indonesia.

5. Statistics on hawksbills captured for stuffing

Virtually all of the hawksbills caught for this purpose are stuffed in Makassar and sent to Djakarta, Ambon and Bali. The sole buyers are tourists and fishermen from Japan. Other foreigners, as well as the Indonesians themselves, are not among the purchasers.

Turtles stuffed in Singapore are said to be superior to those stuffed in Indonesia because factories in Makassar began to pick up on the technique only after the demand boomed in 1972. The skills involved in cleaning out the animal, glossing it, and positioning its limbs are yet to be refined. Another apparent distinction is that the neck of the Makassan product sits on a more acute angle than the Singapore version. Incidentally, we did not find any Singapore products during our stay in Indonesia.

Four or five taxidermy firms have been set up in Makassar since 1972, sub-contracted by Chinese merchants. A single company is able to produce an average of 2,000 stuffed turtles per year. This figure falls in proportion to the 10,000 turtles handled by Makassar merchants every year.

E. Distribution of Hawksbills in Southeast Asia and Usage of Sea Turtles

1. Distribution of hawksbills

Our research has identified the Sulu Sea and inland seas of Indonesia as the chief habitats of hawksbills. Although Hatien, located in the southern section of South Vietnam, was not visited during this investigation, feeding grounds are said to be present in the coral islands nearby. It is also known that hawksbills are stuffed there. Hatien and the Philippine island of Palawan are situated 10° North latitude, and the string of islands east of Java remain within the 10° South latitude. To restate, the hawksbills in Southeast Asia live within a zone 10° North and South of the equator on coral reefs in the area, the Flores and Banda Seas both serve as central locations. The habitats for Southeast Asian hawksbills therefore rest in the Sulu Sea.

2. Usage of sea turtles in Southeast Asia

As shown in Table 13, we have concluded from our investigations that hawksbills have the widest diversity of usage. This leads us to believe that

it is the species most persecuted. It should also be noted here that the capture of young turtles to be stuffed affects the reproduction ratio of the species greater than the slaughter of adult turtles for their shells.

Table 14 provides approximations on the total number of hawksbill and green turtles killed. The figures were derived by setting the weight of one shell at 1.5 lbs and by assuming that the number of green turtles captured in the Philippines was ten times that of the hawksbills.

III. LIFE OF THE HAWKSBILL TURTLE

This investigation placed importance on the gathering of information concerning the resources and raising of turtles. However, like the rest of the topics that were studied, the little time allowed made it impossible to bring to light all of the details for each subject. For instance, although it may seem a simple enough task to find out about the nesting seasons, a large number of areas must be observed over a certain number of years. While much previous research has been done on green turtles, very little has been done on hawksbills and, unfortunately, there are a great many areas still unclear.

Green turtle meat has long been prized for soup stock in Europe. Having also meant food for many tropical communities, this species has long undergone the scrutiny of natural historians as well as that of the local natives. Yet on the other hand, there are very few hawksbill consumers. Because efforts to hunt them increased only after World War II, the short period of interest has resulted in an equally short history of formal research and local observation. Combined with the problem of human observation is the biological issue which differs between green turtles and hawksbills. Unlike green turtles which nest in concentrated colonies, hawksbills breed diffusely over a wide area. One could hardly expect to carry out a successful experiment on hawksbills under such conditions. Our investigation this time centered on the growth of the hawksbill and its hatching period.

A. Growth

1. Relative growth of each section of the shell

Our desire was to find out the proportional growth for each part of the body. Before our departure, we were able to measure the total shell

(carapace) length and width, as well as the length and width of the first central plate, of 17 stuffed hawksbills (probably from Singapore) on display in several Tokyo stores. When sold commercially, the shell length of the stuffed tortoises are measured in inches along the curve. For biological purposes, the shell is measured in a straight line in centimeters. Figure 8 labels each shell section and Table 15 provides measurements. The terminologies employed in Figure 8 are those used by the Japanese Tortoise Shell Association. Figure 9 illustrates the underside of the shell (plastron). In comparing the shells of hawksbills between 30-60 cm long found in Tokyo with those found in Singapore between 20-40 cm long (Table 16; Figure 10), it was discovered that the ones in Tokyo were slightly wider. However, because of the different people and instruments used to measure them, no significant reason can be proposed for the discrepancy. A variation of no more than 20 cm occurs in shell length when comparing the topside (carapace) to the underside (plastron).

2. Color changes of the plastron

The plastron of young hawksbills is originally black. Areas of yellow appear as the turtle matures until finally very little black remains. We were able to follow the various stages of color change by studying a number of stuffed hawksbills in Makassar. Our findings are indicated in Table 17. Formalin apparently does not change the color of the shells. The stuffed turtles found in Singapore also proved that the bellies of turtles over 25 cm long are light yellow in color and no different from that of mature turtles. Turtles exceed 20 cm in length by the time they are a year old. The exact age of a turtle at 12 cm is unknown. According to Table 17 the underside of the hawksbill begins to turn from black to yellow during the latter half of the first year.

In most cases, the color of an animal's coat changes with respect to its life cycle or habitat. Even turtles as small as 12.5 cm show traces of barnacles adhering to them. This proves that by then, they have already begun to establish their lives around the coastal waters. Carr *et al.* (1966) claim that, from their observations, hatchlings between 13-15 cm in length cannot be found in the waters surrounding hawksbill nesting beaches in Costa Rica. They conjecture that the turtles are spending this period of their life floating along with the currents in the ocean. We therefore concluded that the 12.5 cm yearling that we came across must have been one that had fairly recently moved into its home among the coral, having given up life as a drifter. It can thus be conjectured that the underside color of young turtles changes rapidly after they settle into residency.

3. Growth of young turtles and ratio of decrease

Figure 11 was drawn up from the measurements in Table 16 for the length of the shell of stuffed hawksbills on hand in a store in Singapore. This store has a subcontracted factory that sells, wholesale and directly, merchandise brought in from the factory on payment. Measured shells with good coloring and of relatively large size were set aside from the good years and stocked. The composition of Figure 11 exhibits very well the range of the length of stuffed hawksbills made in Singapore. According to the owner of the store, turtles larger than 40 cm and smaller than 18 cm are rarely caught. Figure 12 shows the length of hawksbill shells measured at the time of their polishing before shipping from the processing plant. We can also see from this Figure that few turtles have been captured larger than 40 cm and smaller than 18 cm. Furthermore, there are sharp rises at 22 and 32 cm. It can be assumed that these are yearly peaks. Turtles one year old can grow to an average of 22.5 cm

(Bustard, personal communcation). Looking at Figure 12 from this standpoint, the peaks between 18-27 cm would be year-old turtles. Likewise the peaks between 28-36 cm can be assumed to be turtles two years old. Since both groups were captured at the same time, the space between the two peaks can be regarded as a difference of one year. If the peak at the first year is 22 cm, and the second year is 32 cm, the shell growth for one year would be 10 cm.

There were very few opportunities to measure the hawksbills waiting to be stuffed. Only two turtles were weighed in Singapore. One of them was 24 cm long and weighed 1.6 kg, while the other was 29 cm in length and 2.2 kg in weight. Shells of Ceylon hawksbills are between 3.9 and 4.2 cm in length soon after birth (Carr, 1966). If the turtles in Singapore waters are of the same length, it can be said that they grow five times their length after a full year and weigh more than 150 times their weight at birth. Between the first year and the second year they grow 1.5 times in length and 1.4 times in weight. Mature hawksbills have a shell length of approximately 80 cm (Atlantic turtles, Carr, 1966). Therefore the parents of turtles a year and two years old are, respectively, 3.6 and 2.5 times larger. Judging only by the growth of shell length, it can be said that the ratio or growth at these ages is the largest.

The growth of shell length in Figure 12 is based on turtles caught between March and May of 1973. If we pose these data as a random sampling of the turtles in the fishing grounds, we can calculate the ratio or decrease in turtles between one and two years of age. This ratio of decrease includes natural death, exploitation, and movement away from the fishing grounds. There were 43 year old turtles 16-27 cm in length, and 28 two year old turtles, 28 to 35 cm in length. The ratio of decrease there is, $\frac{43-15}{43} = 0.65$ and those living are 0.35.

Not much is known about the ratio of survival of sea turtles. The survival ratio of loggerheads that come up on the coast to nest, from the time they are eggs to when they reach adulthood is 0.013-0.02% (Kajihara, forthcoming). The average ratio of survival of green turtles in Mexico from sub-adult (5 years old) until adulthood is 0.8 (Marquez, 1973). The time of the highest death ratio in the life of the turtle is right after birth.

There exist no other data that we can refer to determine whether the 0.65 ratio of decrease of young hawksbills is high or low. However, if approximately 20,000 turtles a year are killed to be stuffed (see Table 14), compared with other areas of inhabitation where there are not exploitation pressures, this death rate is very high.

If the shell length of hawksbills to be stuffed is over 40 cm compared to shells 35 cm in length, their numbers are considerably smaller. It seems that this phenomenon does not occur only in Singapore but in Makassar as well. A Makassar plant at one time nurtured 500 turtles. The majority were killed from March through May, and thereafter a new supply was received a few each month. Fourteen out of fifty turtles were selected from a pond that was raising turtles to be killed from March through May, and their measurements were recorded in Table 18. Many of the turtles with these shell lengths fall between the ages of one and two years as recorded in Figure 12. There was also a turtle measuring 42 cm that had been feeding in the tank (pond) for one year.

Perhaps the reason there are almost no hawksbills smaller than 18 cm is that the turtles have not been found, or very few have reached the area (Carr, 1966). Concerning turtles over 40 cm long: 1) their death ratio rises sharply in their third year; 2) capture becomes difficult when they reach their third year; or 3) they scatter off into distant places. Regarding no. 1, the

ratio of natural death is higher in the third year than the second year. Concerning their capture, turtles over 40 cm are scarce even in Makassar where new facilities were built in 1972 when the demand for stuffed turtles increased. Hence, it can be safely assumed that turtles over 40 cm in the breeding grounds are also scarce. Our records up till now contradict no. 3. Figure 13 shows the length of the turtles caught in Japanese waters (Nishimura, 1967). This Figure does not reflect all the turtles caught but reflects the size of turtles that normally venture into Japanese waters. These hawksbills were swept from the tropical zone into Japanese waters by the warm current. If we assume that after they reach 40 cm they begin to venture farther out, we can also assume that the bigger they get the greater numbers of them will be killed. However, according to Figure 13, a large number of turtles between one and two years old venture forth, and after reaching 40 cm, like those in Singapore and Makassar waters, the numbers diminish. It can be thought that the assumption in no. 3 has a very low degree of probability. Regarding the second point on their difficulty of being captured, turtles over 40 cm are either inhabiting areas that make them difficult to catch, or they are able to travel farther and, although they can be spotted just as frequently as the smaller turtles, their ratio of being capture is lower. We were not able to collect data on this matter.

According to the manufacturers in both Singapore and Makassar, a great number of hawksbills are caught between March and May, with a small number the rest of the year.

B. Breeding Grounds and Season of the Hawksbills

Breeding grounds are widely scattered around the Sulu Sea, the waters of North Borneo, and the interior waters of Indonesia. The breeding grounds

in Indonesia are on the beaches of large islands and also on the coral or small islands. According to the fishermen around Makassar, turtles do not come on land to nest except at night on beaches heavily populated with people, but do land even in broad daylight where there are no human inhabitants. Regarding the breeding season in Indian waters, it is from November to February in Ceylon and from September to November in Seychelles (Carr, 1966). The present investigation was unable to bring to light the breeding seasons in Southeast Asia.

In regards to the Sulu Sea off the Philippines, the breeding season lasts throughout the year with no set peak period (Domantay, personal communication). According to fisherman in Southern Celebes in Indonesia, although turtles land to nest throughout the year, their peak is from February to April, with few eggs being laid the rest of the year. Also, in that country's University of Bogor, five turtles were being kept in fresh water. They were collected on the Seribu Island in the Jakarta Sea, hatched from the end of July to the end of August. If the hatching period is two months (Carr, 1966), it can therefore be said that these turtles came from eggs laid between the end of May to the end of June.

The turtle stuffers in Singapore and Makassar say that the slaughter of turtles whose shells measure about 20 cm occurs a lot between March and May. These come from eggs laid during the peak laying season. If at the killing they are exactly one year old, the laying season around Singapore and Makassar is, as the Southern Celebes fisherman say, from February to April. Information on Southeast Asian breeding grounds and seasons gained from this investigation are presented in Table 19. Table 20 gives information of the other egg laying in Pacific for reference purposes.

IV. POSSIBILITIES OF COMMERCIAL TURTLE FARMING

A. Farming of Different Species

Although there are man-made hatcheries and temporary rearing facilities in Southeast Asia, turtles are not raised for long periods in captivity. Man-made turtle hatcheries are like the fish hatcheries on the coast of Japan. The sea turtle hatcheries now in operation in Southeast Asia are presently run solely by the Malaysian government. As noted earlier, there is a leatherback hatchery in the village of Abang in Trengganu State on the southern coast of the Malay Peninsula, and a green turtle hatchery in Sarawak. None of the Southeast Asian countries have a hawksbill hatchery, nor does any plan to establish one.

1. Man-made hatcheries

The significance of man-made hatcheries is to protect the eggs from natural enemies (including man), from bad weather, and from the parent turtles in extremely dense nesting grounds. Hatcheries are not expected to increase the population, but rather are expected to maintain the present number of turtles. It is apparent that if hatchling turtles are not protected, the number of parent turtles will decrease.

The leatherback hatchery in Malaysia and the green turtle hatchery in Sarawak, both run by the state government, have a system of buying eggs from the general public or certain fishermen. The eggs are bought as soon as they are laid and made to hatch in man-made nests in the protected areas. The hatchling turtles are let loose at night. This system of purchasing is, at the same time, used with the system of collecting eggs. It establishes a certain number of overseers to guard a certain number of nests. At the end

of the hatching season when conditions become bad, eggs are used for food. The actual records for the leatherback hatchery in the State of Trengganu in Malaysia show that 60,000 eggs were collected in 1972 (10%), and 72,000 eggs from January to August 1973. Sixty percent of the eggs collected were hatched at the hatcheries. This is the same amount that hatches in the natural environment. The state government claims that if 1% of the hatchling turtles stocked (turned loose) become parents, the resource will be well-protected. However, it is believed that more than a 1% survival rate occurs. Data on the stocking of green turtles in Sarawak are listed in Table 7.

There are no man-made hatcheries run by the government in Indonesia. However, egg poaching is prohibited in a natural sanctuary located in Sukamade, on the east of Java. Most of the turtles that come up to nest are green turtles. The watchmen dig holes for the hatchlings and measure hatched and unhatched eggs. They found that the percentage of naturally hatched eggs was more than 90% (Table 11), indeed a high ratio. Iguanas and a species of cat prey on the eggs.

Large numbers of green turtles land on a single beach to nest. Hawksbills and green turtles nest on the same beaches in many places in Southeast Asia. Nesting grounds of the former are scattered within the nesting grounds of the latter. As adult turtles continue to land, they sometimes manage to dig up the nests of turtles who occupied the space earlier. Although hawksbills do not land all at once to nest, when they do land on nesting grounds for green turtles, green turtles can be assumed to destroy the nests made by the hawksbills. Although the laying season differs in Southeast Asia from place to place for the two types of turtles, since both have long nesting periods (Table 19), the rate of destruction is not high but could possibly be.

Figure 14 shows the number of green turtles that come up to nest and the percentage of nests destroyed. According to this, it can be thought that in the Sulu Sea, North Borneo and Indonesian waters a number of hawksbill nests are destroyed by green turtles.

2. Farming of green turtles

Green turtles are held in captivity on the island of Bali in Indonesia because live ones are used for weddings and funerals. The research team found about 20 huts used for this purpose in Benoa, on the Southern part of Bali, and on the shores of the island called Serangan. The size of the huts is about 4-7 m by 15 m by 6 m (in height). Shelves built from the bottom of the ocean serve as the main pillar to keep the walls of the hut standing. The walls and roof are made of coconut leaves. In Figure 15 a hut is shown with two shelves. One shelf can be used by several people. Adult turtles that are harpooned are held in the racks and raised for a short period. The shells of the turtles themselves are from 60-80 cm and one rack holds anywhere from 3-20 individuals. They are fed once in three days. Thirty kilograms of seaweed is divided among 20 turtles (the local word for this is "sanguur" and its seeds look like those of *Zostera*). The rearing period is less than one month. It is said that the price for a turtle 80 cm long is 10,000-15,000 rupiah (RP) (6,400-9,600 yen).

3. Farming of hawksbills

Stuffers in Singapore and Makassar temporarily hold live hawksbills. Because good stuffed turtles cannot be made from dead turtles, they hold turtles obtained from fishermen. The holding in both regions is done in fresh water. Because the captivity in Singapore is only for one week, the turtles are not fed. There are four or five places in Makassar that put 30-50 one year old hawksbills into a 2 by 2 m concrete tank filled with 0.5 m of

fresh water for a year. There was one place that put 500 one year old turtles into a pond 10 by 10 m. In the concrete tank, the range of turtles was 25-30 cm in length. About 10 kg of キビナゴ kibinago*(5-6 cm long, 500 RP, about 320 yen) are fed once a day and the water is changed once every two days. Seventy new turtles were added in March and by August 30% had died because of a white disease in the eyes and cannibalism. When the turtles were measured during the study (Table 18) it was found that, assuming the average length was 23 cm in March, those raised in captivity differed little in growth when compared to the turtles growing naturally. Because the turtles in captivity are stuffed when they are smaller than 30 cm, they are in captivity for half a year at the most. The turtles kept in the pond have a lot of black areas on their shells. Those in the pond are said to be poor stuffed products. Fifteen kilograms of kibinago were fed daily to 500 turtles. From March to May, turtles to be shipped are held and stuffed. Stuffing also is carried out throughout the year. What caught our interest here is that, according to the people, fresh water tends to bring out the shell coloring more (there are many sections with unusual hues). The turtles are bought from the fishermen in Makassar for 500 yen each. The total cost of keeping the turtles for five months, including the cost of the feed as stated above and 500 yen in wages per caretaker, is 221,000 yen. If there is a 30% death rate, the cost of caring for a turtle for five months is 3,160 yen.

B. The Possibilities of a Farming Industry

There are many issues to take into consideration and here we would like to discuss the farming of turtles for their shells, the locations suitable for farming, where to obtain turtles, feeding them, the densities for raising them, and the cost of the operation.

*_Spratelloides japonicus_ (family Dussmieridae) - ed.

1. Location for farming

The suitable places for raising turtles throughout the year are the Sulu Sea and Indonesian waters which lie 10° North and South of the equator, where hawksbills live throughout the year. It might be possible to set up huts with shelves like those at Bali in places that do not suffer much wind and wave damage. It would be more suitable to make the racks standing in water out of local waterproof wood rather than metal, as they will not corrode and will minimize the damage caused by tiny animals that attach themselves to the racks. A more extensive manner is to use the atolls instead of making racks. However, this may not be practical.

2. Obtaining turtles for farming

It would be difficult to hatch many eggs at once or to obtain a lot of young turtles because the nesting places are scattered and many eggs cannot be hatched in one place in the Sulu Sea and the Indonesian waters. It might be easier to obtain one to two year old turtles in this area. The rearing of 20,000-30,000 young turtles that are captured to be stuffed can be considered. However, if adult turtles raised for their shell are placed in fresh water like turtles temporarily held, the death rate will be high and the turtles themselves will not grow well. If turtles could be obtained outside of Southeast Asia, another method would be to purchase those bred in Australia.

3. Feed and density

These two points become very important when it comes to long-term raising. Since turtles are omnivorous creatures, a continued diet of meat (mainly fish) will either hinder their growth or cause a large amount of sickness. Southeast Asia is regarded as having a poor source of fish protein now, as well as into the future. Therefore, it is thought to be difficult to feed

fish to the turtles at a constant rate. It is probably necessary to think of using seaweed or sea animals not used by man. Then it will also be necessary to choose a spot where great bulks of these can always be obtained. If they are collected from the coral it will be important to take the preservation of the coral itself into consideration.

One essential element in deciding on the density of the raising will be the amount of feed provided. In high density, the turtles will eat each other unless enough feed is offered to them. High density may be suitable for young turtles. However, their value increases as they mature and, in order to prevent costly deaths, lower densities will be needed as they become bigger. Then of course it becomes necessary to select out the young turtles and either stuff them or let them loose. But because money would have been wasted on the turtles removed, it is necessary to decide on an aim of how many large turtles can be accommodated. We will later discuss the issue of releasing the turtles into the wild.

4. Farming expenses

We will make general statements based on our recent investigation. The expenses necessary in raising turtles have been recorded above in the example of the raising in Makassar. That is, the cost of keeping one yearling hawksbill for five months was 300 yen. As the turtles get bigger the amount of feed needed rises sharply. Ten kilograms of feed are offered to 50 turtles every day in Makassar. If we consider the consumption of one turtle to be on the average of 0.2 kg per day, then 10% of its weight is feed. If fed at this rate, a 50 kg turtle (hawksbills used for their shells weigh more than 50 kg) would have to consume 5 kg of food per day. The price of kibinago which is used as feed in Makassar is 58,000 yen per year and this is worth 25 times more than a year old turtle.

Turtles one to two years old are easy to obtain in Southeast Asia, but suppose that: 1) we raised them for ten years until they became the size suitable for tortoise shell; 2) that they weighted 2 kg at the time they were bought; and 3) that they weighed 70 kg at the end of ten years. We will also suppose that during this time there was an increase in weight comparable to the green turtles (Figure 16), the amount of feed would be 10% of the weight, and feed costing 30 yen per kilogram, including 10 yen per day per turtle for the caretaker. The total expenses for the year would be as indicated in Table 21. These calculations were based on the relatively cheap wages and cost of feed in Makassar. It can therefore be assumed that the cost will increase in the future or if a different location is used. Because of unusual buying of tortoise shell in Japan in 1973 the price of raw material increased considerably (Table 22). However, even if compared to Table 22, the cost of raising turtles as indicated in Table 21 is still very high. According to this, it is possible to find proper locations and to obtain hawksbills for farming. However, one cannot count on profits if tortoise shell from the raised turtles were to be imported.

5. Significance of stocking

As mentioned earlier, if the eggs were hatched and the hatchlings released, there would be no significant increase in the supply. Next, we can consider raising them past the one year danger stage before turning them loose. As our records as well as our investigations have shown, the lives of the hawksbills are tied closely to the coral. Moreover, their residence is more stable than other turtles. Taking this into consideration, there is a danger that the turtles will prey excessively on the sea life that live around the coral if too many turtles are let loose at the same spot. It is not known to

what extent turtles can live side by side with the other sea life. Therefore, what can be stated now is that the sea around Singapore and Makassar can be stocked with the same number of turtles taken away to be stuffed. There is also great significance in looking at it from the standpoint of maintaining the supply of parent turtles. In addition, if in the areas where adult turtles are captured for their shell allow inhabitation because of diminished supply, it would be effective to stock the areas. According to the assumed number of turtles in Indonesia since 1972 (Table 14), perhaps stocking with young turtles would start to restore the supply quickly. However, a large area would have to be stocked if it were to be taken up. Forty thousand turtles would be necessary per year according to our rough estimates. If turtles one year old would be kept in captivity for one year, the calculations in our chart show that the cost would approach 4,000,000 yen.

V. SUBSTITUTES FOR TORTOISE SHELL

What comes to mind as a substitute for tortoise shell is the shell of green turtles, more specifically the plastron. As stated before, the population of green turtles surpasses by far that of the hawksbills. However, green turtles are caught only for their meat, and also have religious restrictions on them, which limit their capture to the Sulu Sea near the Philippines and Bali in Indonesia. The annual catch in these places is estimated at 60,000 (Table 14). They are caught solely for their meat and internal organs and the shells are not used. Green turtles are sold at 6,000-10,000 yen each (over 80 kg) in Bali. However, because the shells are not used, they could probably be purchased at a very low price. With a suitable way to ship them, large amounts of green turtle shells could be shipped at an extremely low price.

The members of the research team were able to come in contact with a good many local shell dealers (Chinese merchants) during this investigation. They claimed that a large number of Japanese buyers came directly to the manufacturers and bought the raw materials at high prices, which in turn raised the prices of the materials. The Chinese merchants who reside there have been able to live together with the local people because they have been able to maintain their small profits. They are afraid that the high prices for the shells will trigger exploitation of the hawksbills and the shells will be speculated upon. The large Japanese businesses will in turn buy out the market. The fact that the high price of the tortoise shell this year has increased the fishermen's efforts to capture the turtles is of grave concern to us. If the underside of green turtle shells were to be imported from Southeast Asia into Japan, it should perhaps be done first by importing a small amount as a trial and then gradually increase the amount. Their shipping should follow the route established in Southeast Asia.

VI. GOVERNMENTAL POLICIES FOR HAWKSBILLS

The governmental policies concerning the supply of hawksbill in each of the producing countries should be viewed from the perspective of the policies regarding all sea turtles. The policies concerning green turtles in particular should be seriously considered. The countries of Southeast Asia, in addition, have more wildlife than our country (Japan) and much is being done to protect them. All of the countries have categorized sea turtles as wildlife instead of animals belonging to the fishing industry. There is perhaps no one, even in our country, who places the green turtles which land seasonally on shores south of the Kanoo area to lay eggs, as part of the fishing industry. In other words, this stems from the fact that nationally their economic use is low. The use of green turtles holds a low economic status even in Southeast Asia. Moreover, the use of sea turtle meat as a source of protein does not hold wide interest due to religious reasons in Malaysia and Indonesia where there are large populations of Moslems (there is a sizeable number of Buddhists only on Bali). This perhaps is the basis for sea turtles being regarded as wildlife rather than a part of the fishery.

A. Regulations on the Capture of Sea Turtles

1. The Philippines

The regulations on the capture of sea turtles in this country are based on research done by Professor J. S. Domantay (presently retired from the University of Manila). In his thesis, Professor Domantay states that the greatest cause of the rapid decline of the green turtle population in Sulu Sea after the war is the exploitation by the Japanese Army during the war (20,000-25,000 egg laying turtles). Although we were unable to obtain any firm evidence,

it is believed that the first ordinances concerning sea turtles were issued in 1950. The ordinances issued in 1962 were a revision of the earlier laws. The following excerpts from the ordinances of 1962:

August 2, 1962, Regulation No. 68, The Ministry of Agricultural and Natural Resources, Department of Fisheries (Revision No. 36) - 1) It is prohibited to possess or buy and sell tortoise shells or eggs during the period of November 1 to January 15; 2) It is unlawful to capture spawning green turtles and loggerheads and hawksbills no bigger than 18" during that time.

April 1, 1964, Regulation No. 76, The Ministry of Agricultural and Natural Resources, Department of Fisheries - 1) Limitations on the capture of sea turtles, namely green turtles, hawksbills, loggerheads and leatherbacks, including their eggs and shell; 2) permission must be obtained in regard to their capture, collection and transfer; 3) Records of their capture and collection must be submitted; 4) Items of prohibition: unlawful to seize turtles whose shell measurements are not more than 12 inches and unlawful to skin dive for turtles; 5) Violators will receive not more than six months imprisonment with hard labor.

June 9, 1967, Regulation No. 88, Ministry of Agricultural and Natural Resources, Department of Fisheries - 1) Complete prohibition in catching green turtles, hawksbills, ridleys and loggerheads, in addition to their eggs and shells; 2) Prohibition period, 5 years; 3) exemptions from the Ministry are possible if for the purpose of publicity for scientific, educational and statute aims; 4) Violators will be fined not more than 200 pesos or sentenced to no more than six months of hard labor.

March 28, 1972, Ordinance from the Ministry of Agricultural and Natural Resource - 1) Responsibilities for taking care of the sea turtles will be turned over to the Department of Public Parks and Wildlife from the Department of Fisheries.

According to the above, the country has turned over the handling of sea turtles from sea life to wildlife. Tighter controls have been established gradually. This in turn seems to point out that the laws were not being fully obeyed. Statistics on hand in Japan do show that tortoise shells were being imported from the Philippines even after the moratorium in 1967. Furthermore, meat from green turtles taken from the Sulu Sea was being sold in markets in the southern part of the Island of Mindanao during the recent investigation. It is reported that disputes have been going on between the residents around the Sulu Sea, which is turtling grounds, and the government. However, according to the conditions in the country, although the government does not fully enforce the laws, it is difficult to think that the regulations will become more lenient. Rather, the fact that the Department of Public Parks and Wildlife has taken over the handling of sea turtles from the Department of Fisheries indicates that the government is planning to take a hard stand on the protection of sea turtles in the future by establishing the Turtle Islands (breeding grounds for turtles) as a natural sanctuary.

2. Malaysia

Turtle meat is not eaten in Malaysia. In a country with a large population of Moslems, religious sanctions are placed against consuming turtle meat. The capture of turtles is also legally prohibited. State regulations in Trengganu, a State on the east coast of the Malay Peninsula, require the protection of leatherback breeding grounds and the collection of

eggs. There is also a State hatchery. There are also plans to establish a sanctuary for green turtle nesting grounds and places of inhabitation (feeding grounds). The government has not held much interest in hawksbills as not much can be seen on the Malay Peninsula. There is a State hatchery in Sarawak on the Island of Borneo. There are, however, no regulations concerning the accumulation of eggs. We were unable to visit the hawksbill laying grounds on Northern Borneo. Malaysia's policy on sea turtles is based on research done between 1950 and 1960 by Professors Hendrickson and Harrison, on mainly leatherbacks and green turtles. It is believed that the government's protection of breeding turtles and establishment of hatcheries are based on advice from these individuals. According to Harrison (1955, 1956) one of the causes of the diminishing number of green turtles in Sarawak is the exploitation of turtles by the Japanese army during the war. There is little interest in hawksbills in Malaysia because they are scarce in places other than the State of Sabah. However, the government is keenly interested in continuing to stock and maintain the source by breeding leatherbacks and green turtles.

3. Singapore

Because there are virtually no breeding grounds or places of inhabitation for sea turtles in Singapore, the government and research agencies possess no reports or data on sea turtles.

4. Indonesia

We heard that the capture of certain sea turtles was prohibited in Northern Mark District (area near Ambon), but were unable to obtain any data. A natural sanctuary, however, exists in East Java where breeding grounds of green turtles and leatherbacks are protected and where egg poaching is strictly prohibited. We were unable to obtain any information from the central government

and other research agencies concerning sea turtles in places other than this sanctuary. We found one young researcher in the Fishery Department of the Bogor Agricultural University who is interested in sea turtles. However, because of a lack of the right conditions for research, particularly the lack of funds, he has been unable to carry on any real studies.

B. Policy for Maintaining the Source of Hawksbills

1. Increase of imports into Japan

The two Southeast Asian countries that produce hawksbills are the Philippines and Indonesia. The hawksbills from these countries are used to produce tortoise shell and for stuffing. Furthermore, the consumers are limited to the Japanese Tortoise Shell Association and Japanese tourists. In other words, Japan is the consumer of Southeast Asian hawksbills. There are various reasons why the governments of countries that produce these turtles do not have a grasp of the actual situation. The population of hawksbills as compared to other turtles, especially green turtles, is low, although hawksbills are not consumed locally. They are also caught across a wide area far from the central government, and the dealers of the shells and stuffed turtles are Chinese merchants. There are no researchers of sea turtles in these countries.

The most direct method for estimating the number of sea turtles in existence is to count the number that come ashore to lay eggs. This method is especially effective for green turtles, leatherbacks and ridleys which come up together on certain beaches to nest. Most of the research has been done on green turtles. One successful result from the research is that the number of green turtles, which had been diminishing because of exploitation, has recovered because countries have adopted regulations pertaining to their capture (Table 23).

The population of hawksbills is smaller than that of green turtles. Calculating the distribution of breeding grounds and places of inhabitation, the population of hawksbills is less than one-tenth that of green turtles. The fact that there is a scarcity of hawksbills and their inhabitants are also few indicates that they have diminished more strikingly in number than green turtles because of seizure.

There are three major points in the overall conclusion of our study on the present usage of Southeast Asian hawksbills in Japan. Namely, our first point is that the usage of Southeast Asian hawksbills takes advantage of blind spots in the laws of each country and, furthermore, is sometime able to get around the law. The second point is that the huge number of young hawksbills that are used for stuffing has a greater effect of diminishing the population than usage of adult turtles. The third point is that increasingly large numbers of adult turtles are being killed for their shells.

At the end of our investigation we were able to obtain records of the volume of tortoise shell imported into Japan from January to September of 1973 (Figure 17). According to these data, by September 1973 the volume of import had greatly exceeded that of the entire year before. Countries doing the exporting also increased. This can also be interpreted as a regional ignoring of sea turtle preservation policies, and moreover a defiance of them. The wrong usage of natural resources will quickly lead to self destruction.

2. Japan's policy toward hawksbills

Not only has Japan affected the hawksbill population in Southeast Asia, effects are also being felt all over the world. If Japan lowers its volume of imports, countries doing the exporting would automatically lower their export and the rate of decrease in the hawksbill populations would fall. In other

words, instead of waiting for the countries producing the turtles to develop their own policies, appropriate policies adopted in Japan would prove to be the shortcut to the preservation of the species. The policy facing us at this moment is therefore the curbing of imports. It is necessary to curtail the import of both stuffed hawksbills and tortoise shells.

It is felt that an all out prohibition on the capture of hawksbills for stuffing purposes is best. Under certain circumstances the eggs could be obtained for hatching and young turtles raised in captivity. But for the present, limits should be placed on the number of stuffed turtles imported and the number brought into Japan by tourists. The smaller the number, the more the contribution will be toward the preservation of hawksbills.

Because the proper volume of catch for tortoise shell is unclear, we can only make a guess as to the volume of import of tortoise shells. First of all we should lower the standard to what it was before 1971, that is, to less than 15,000 lbs. This standard would at least not place the sales route of Southeast Asia into disorder. It would also be a volume that would enable fishermen to make this a side business. A more constructive policy would be for each country to support research dealing with hawksbills and sea turtles and subsidize hatcheries and farming and the preservation of the species.

VII. SUMMARY

The scope of habitats for hawksbills in Southeast Asia is 10° North and South of the equator. Most of their habitats are located in the Sulu Sea of the Philippines, off the coast of Northern Borneo, and in the waters between the islands of Indonesia. Hawksbills live close to the coral. However, the population density is one-tenth that of green turtles in the Sulu Sea.

The residents of Southeast Asia mainly prey on the eggs of sea turtles. Areas where turtle meat is consumed are around the Sulu Sea in the Philippines and Bali, in Indonesia (green turtle). The yearly capture in both places is estimated at a total of 60,000.

Although hawksbill eggs are used as food, their consumption, compared to green turtles and leatherbacks, is low. However, young hawksbills are killed to be stuffed and adults are killed for their shell. It is estimated that the yearly capture for the former is 30,000, and 35,000 for the latter. The killing of young turtles is concentrated in the waters of Sumatra near Singapore and the southern portion of the Celebes. It is believed that the 5,000 young turtles which pressure the resource of hawksbills in the Sulu Sea of the Philippines, the 30,000 adult turtles killed in Indonesian territory, and the numbers killed in the various waters are far to the excess. Virtually all of the stuffed hawksbills and tortoise shells are exported and sold to Japan.

When the shells of baby hawksbills reach 12-18 cm in length they settle themselves into the coral. At a full one year of age they become 23 cm and grow to 32 cm at two years. Among the young turtles, those between one and

two years old are the easiest to catch. The turtles become difficult to catch when they grow beyond 40 cm.

The nesting grounds of hawksbills are on beaches near the coral. The nesting grounds are also scattered over a wide area. Hawksbills do not land, like green turtles, in large numbers on one area of land. The nesting season is very long and their periods are not clear. Although we are not entirely certain, it seems that the peak on the southern portion of the Celebes and Eastern Sumatra is between February and April.

It is realistic that we look for breeding grounds and habitats for hawksbills. However, because the nesting grounds are scattered in Southeast Asia, it is difficult to obtain eggs. Instead it is probably easier to obtain turtles one to two years old. The main portion of expenses will go to feed if long term raising were taken up. The cost of raising turtles for their shells will amount to five to ten times the cost of simply killing them in the wild. Hatching the eggs and raising turtles until they are about one or two years old is an effective measure.

If the undersides of shells of green turtles were used as a substitute, it would be easy to obtain a large supply at a low price in Southeast Asia. However, the purchase of these should be approached with caution.

There are no regulations concerning the capture of sea turtles other than in the Philippines. There is only slight interest in turtles in the various countries. When it comes to the preservation of turtles, the matter will be approached through policies concerning preservation of wildlife rather than fisheries.

Japan, the sole consumer of hawksbills, should develop policies for their maintenance. It is necessary to consider limits on the killing of young turtles which are used for stuffing, which are imported into Japan, and it is also necessary to place restrictions on the import of tortoise shells (not more than 15,000 lbs*).

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* This recommendation appears to refer exclusively to tortoise shell imported from Southeast Asia (see Table 12, Figure 17). - ed.

資格 Title	氏名 Name	略歴 Background	分担 Responsibilities
団長 Chairman	かじはら たけし 梶原 武 Takeshi Kajihara	born March 6, 1927 昭和 2 年 3 月 6 日生 Oceanography Dept. 東京大学海洋研究所助教授 Tokyo University 日本たいまい協会嘱託 commissioned by JTSA	team leader 調査団の統卒 たいまい資源生態、養殖の調査 報告書作成 investigate hawksbill lifecycle and raising; compile report
副団長 Vice-Chairman	うち だ いたる 内田 至 Itaru Uchida	昭和 7 年 8 月 31 日生 born August 31, 1932 姫路市立水族館長 Director, Himeji City Aquarium 日本たいまい協会嘱託 commissioned by JTSA	たいまい資源生態、養殖の調査 investigate hawksbill lifecycle and raising
団員 Team Member	さくま とおる 佐久間 微 Toru Sakuma	born February 19, 1949 昭和24年 2 月19日生 Indonesian Dept. 東京外国語大学 インドネシア科 Tokyo Univ. of Foreign Languages 日本たいまい協会嘱託 commissioned by JTSA	渉外 通訳 interpreter and public relations
〃 Team Member	たかせ やすお 高瀬 康夫 Yasuo Takase	born July 11, 1950 昭和25年 7 月11日生 Dept. Fisheries College of Agriculture 東京大学農学部 水産学科 Tokyo University 日本たいまい協会嘱託 commissioned by JTSA	たいまい資源生態、養殖の調査 investigate hawksbill lifecycle and raising
〃 Team Member	たなか しげお 田中 重男 Shigeo Tanaka	born September 23, 1933 昭和 8 年 9 月23日生 owner of Tanaka Tortoise Shell Factory 田中べっ甲製作所経営 representative of JTSA 日本たいまい協会代議員	たいまい資源調査 庶務会計 investigate hawksbill resources; finance; general affairs

Table 1. Biographical information for participants of the investigation.

資格	氏名	略歴	分担
団員 Team Member	よしむらまさみ 吉村正美 Masami Yoshimura	born January 3, 1939 昭和14年1月3日生 Chief 長崎たいまい協会事務局長 Nagasaki Bureau of Trade 日本たいまい協会嘱託 commissioned by JTSA	general affairs 庶務 会計 たいまい資源調査 業者連絡 investigate hawksbill resources; finance; contact with companies
自費参加 Independent	わたなべこうじ 渡辺剛志 Koki Watanabe	昭和26年3月24日生 born March 24, 1951 長崎大学水産学部水産学研究科修士課程 Master's candidate 日本たいまい協会嘱託 Fisheries; commissioned by JTSA	たいまい資源調査 養殖、生態の調査 investigate hawksbill resources; raising; habitat
〃 Independent	やまぐちようへい 山口洋平 Yohei Yamaguchi	昭和12年1月1日生 born January 1, 1937 長崎県観光課物産係長 日本たいまい協会嘱託 commissioned by JTSA	たいまい資源調査 渉外 investigate hawksbill resources; public relations
〃 Independent	ふじきてつお 藤木哲夫 Tetsuo Fujiki	born October 2, 1935 昭和10年10月2日生 Fisheries Testing Div. Nagasaki 長崎県水産試験場 増養殖研究所飼料病害課技師 日本たいまい協会嘱託 commissioned by JTSA	たいまい資源養殖の調査 investigate hawksbill raising

Table 1. Biographic information (continued)

	和名 Japanese	種名 Scientific Names	英名 English	フィリピン Filipino	マレーシア Malay	シンガポール (中国福南語) Singapore (min-nan dialect)	インドネシア Indonesian
Ao umigame	アオウミガメ	Chelonia mydas Chelonia depressa	Green turtle Flatback t.	Pundo Turtuga 又は	Penyu Penyu Agar Penyu Pulau	Lek Ku	Penyu ikan
Taimai	タイマイ	Ertmochelys imbricata	Hawksbill t.	Sisikan Payukan 又は		Tai Mo	Penyu sisir Penyu sisik 又は or
Aka umigame	アカウミガメ	Caretta caretta	Loggerhead t.				
Hime umigame	ヒメウミガメ (太平洋)	Lepidochelys olivacea	Pacific ridley		Penyu Rantau Penyu Lipas		
Hime umigame	ヒメウミガメ (大西洋)	Lepidochelys kempii	Atlantic ridley				
Osa game	オサガメ	Dermochelys coriacea	Leatherback t.		Ibu Kamba Ibu Belimbig		

Table 2. Names of sea turtles in various languages

	Product 品名	Unit 単位	Unit price in Yen 単価(円)
green turtle meat	アオウミガメの肉	1kg	150～160
green turtle egg	アオウミガメの卵	1個	13
hawksbill shell	タイマイの甲羅	1kg	350～450

Table 3. Retail price of sea turtles found in Zamboanga, Mindanao.

フィリピンにおけるタイマイ甲の輸出高　　shell in kg (甲羅, kg)　　capital (1000 pesos)　　Unit: 1000 yen per kg

Mo.月 / Year 年	1	2	3	4	5	6	7	8	9	10	11	12	計	金額 千ペソ	単価 (1kg当たり) 千円	Λ %
1961	—	—	—	—	—	—	—	—	—	—	—	—	—			
62	—	—	—	—	—	—	—	—	—	—	—	—	—			
63	—	—	390	10	—	16	—	—	—	64	120	—	600	49.6	3.7	0.1
64	1	—	—	—	100	—	7	—	5	—	—	580	693	54.6	3.4	0.1
65	1560	—	1750	—	20	90	—	—	—	—	—	—	3420	314.8	4.1	0.5
66	—	—	—	—	—	130	—	—	—	4	25	18	177	121.8	3 2	0.1
67	184	2025	—	—	—	—	200	—	145	—	170	10625	13348	408.6	1.3	0.2
68	—	—	190	1340	—	496	—	—	—	130	—	—	2156	1,050.0	21.9	0.4
69	25	280	—	—	—	—	—	—	1685	—	—	—	1990	1,742.3	39.2	2.1
70	—	—	—	—	—	—	—	—	—	—	—	—	—			
71	—	—	—	—	—	—	—	—	—	—	—	—	—			
72	—	—	—	—	—	—	—	—	—	—	—	—	—			

(注)　Λ　タイマイ甲輸出金額／フィリピン水産物輸出総金額

Table 4. Monthly volume of tortoise shell exported from the Philippines

Unit: 1,000 lbs

べっ甲のフィリピン輸出量とフィリピンから日本への輸入量　　単位：千ポンド

Year 年	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973 (1～9月分)
Export from Philippines フィリピン輸出量	11.8	1.5	7.5	0.4	29.4	4.7	4.4	—	—	—	
Import to Japan フィリピンより日本輸入量				—	0.4	1.0	2.8	2.1	1.3	7.2	8.4

(注)　空欄は不明

Table 5. Volume of tortoise shell exported from the Philippines versus the volume imported into Japan. (blank spaces represent missing data)

Nesting grounds 主要産卵場	Year 年	No. turtles 主要産卵場の産卵頭数	No. eggs 産卵数	Avg. per turtle 1巣平均の卵数
Talang Talang Besan	1967	4,671	478,607	104
Talang Talang Kechie	1968	1,861		
Satang Besar				

Table 6. Chief nesting grounds in Malaysia and Sarawak

No. eggs laid	産卵数	478,608卵
Income	卵販売金額	42,370$
Eggs bought by Gov.	州政府購入卵数	1,016卵(10巣分)
No. hatchlings stocked	州政府のふ化放流稚ガメ数	979頭

Table 7. Number of green turtle eggs laid in Sarawak (1967)

島	E.imb タイマイ タイマイ	Caretta アカウミガメ	C.my アオウミガメ	Dermo オサガメ
Sumatra	+	−	+	−
Belitou	−	−	+	−
Natuna	+	?	+	−
Borneo	+	+	+	−
Djawa	+	+	+	−
Madara	+	+	+	−
Sumba	+	−	−	−
Flores	+	−	+	−
Solor	−	+	−	+
Sulavesi	+	+	+	−
Ambou	+	+	+	−
Banda	+	−	+	−
Obi	−	−	+	−
Ternate	+	−	−	−
Kei	+	−	−	−
Abu	+	+	+	−
Irian	+	+	+	+

+ 生息確認 - known to exist
− 生息未確認 - existence not known

Table 8. Distribution of sea turtles in Indonesia (1969)

District 地方名 (郡の名)	採集場所	
Barru 郡	Takalasi 地区の砂浜	-beach
Palauro 〃	Panakiang 島 Dutungan 〃 Bakki 〃	-islands
Pulueas 〃	Buleu 地区の砂浜	-beach
Benuang 〃	Battra 島 Salawa 〃 Taiwaule 〃	-islands
Lumpue 〃	砂浜	-beach

Table 9. Major areas in the Celebes where sea turtle eggs are collected

(語) ○: 利用可 -used
×: 利用不可 -not used

	種類 Species	甲 Shell	肉 Meat		
green turtle	Penyu ikan (アオウミガメ)	×	○	中国人のみ	- Chinese only
hawksbill	Penyu sisir (タイマイ)	○	○	西イリアンの特定種族のみ。心臓は有毒とされている。	- tribe in W. Irian considers meat poisonous
	Penyu posir	×	○	心臓は有毒として食べない	- heart considered poisonous
probably leatherback	Penyu botang (多分オサガメ)	×	○		

Table 10. Utilization of sea turtles in the Moluccas

Year 年	Mo. 月	No. nests 産卵巣数	No. turtles hatched ふ化頭数（匹）	No. eggs unhatched 未ふ化頭数（匹）	% hatched ふ化率（%）
1969	8	20	2,128	187	91.9
	9	35	3,916	226	94.5
	10	17	1,828	115	94.0
	11	17	1,957	98	95.2
	12	32	3,727	166	95.7
1970	1	29	3,321	186	94.6
	2	52	5,890	341	94.5
	3	32	3,825	149	96.2
	4	34	4,007	165	96.0
	5	24	2,559	257	99.5
	6	25	2,838	108	96.3
	7	25	2,833	130	95.4
	8	14	1,354	116	92.1
	9	11	1,171	74	94.0
	10	1	117	5	95.9
	11	—	—	—	
	12	—	—	—	
1971	7	31	3,612	287	92.6
	8	46	5,249	359	93.5
	9	56	4,417	498	89.8
	10	45	5,408	416	92.8
	11	54	6,324	402	94.0
	12	27	3,128	253	92.5
1972	1	33	3,866	356	91.5
	2	15	1,728	160	91.9
	3	10	1,092	111	90.7
	4	37	4,333	382	91.8
	5	15	1,695	149	91.9
	6	12	1,436	118	92.4
	7	10	906	65	93.3
	8	19	1,694	163	91.2
	9	17	1,596	126	92.6
	10	4	376	36	91.2
	11	3	257	22	92.1
	12	4	370	36	91.1
1973	1	42	3,556	356	90.8
	2	7	663	54	92.4
	3	20	1,875	188	90.8
	4	25	2,387	207	92.0
	5	7	678	50	93.1
	6	18	1,738	147	92.2
	7	9	969	79	92.4

Table 11. Nesting in the Sukamade region (1969-1973)

Unit: 1,000 lbs

国 / 年	① 香港 Hong Kong	② シンガポール Singapore	③ マレーシア Malaysia	④ インドネシア Indonesia	⑤ フィリピン Philippines	①~④の計(インドネシア系) Total* (1-4)	インドネシア系 年平均量 Avg. vol/yr*
1966		6.8	3.0	4.3	—	14.1	6.8
1967		9.5	1.4	1.2	0.4	12.1	
1968		13.1	1.4	1.8	1.0	16.4	
1969		12.5	2.9	2.0	2.3	17.4	
1970		10.7	2.3	1.6	2.1	14.6	7.5
1971	0.1	2.8	2.4	6.6	1.3	11.9	
1972	2.1	7.3	0.2	15.5	7.2	25.1	40~50
1973 (1~9月) Jan-Sept	4.4	15.1	—	37.5	8.4	57.0	

Table 12. Volume of tortoise shell imported into Japan from Southeast Asia. (* Indonesian group)

東南アジア地域の海ガメの利用状態 ○：利用している - used
×：利用していない - not used

	Species 種類	Eggs 卵	Sub-adults 未成熟ガメ	Adults 親	
				Meat	Shell
hawksbill	タイマイ	○	○	○	○
green turtle	アオウミガメ	○	×	○	×
ridley	ヒメウミガメ	○	×	×	×
loggerhead	アカウミガメ	○	×	×	×
leatherback	オサガメ	○	×	×	×

Table 13. Utilization of sea turtles in Southeast Asia

	種 / 国	Adult greens アオウミガメ (親)	Hawksbills タイマイ Yearlings 未成熟	Hawksbills タイマイ Adults 親	
Philippines	フィリピン	50,000 (スル海) Sulu Sea	—	5,000 (スル海)	Sulu Sea
Indonesia	インドネシア	10,000 (バリ島) Bali	10,000 (マカッサル近海) near Makassar	〔1971年以前 5,000〕 1972年以後 30,000 (インドネシア内海)	before 1971 after 1972 inland waters of Indonesia
Singapore	シンガポール	—	15,000～20,000 Sumatra	—	
Total	合 計	60,000	25,000～30,000	35,000	

Table 14. Number of hawksbills and green turtles captured in Southeast Asia

	Length 甲長	Width 甲幅	Length-first central plate 鱗甲長	Width-first central plate 鱗甲幅		Length 甲長	Width 甲幅	Length-first central plate 鱗甲長	Width-first central plate 鱗甲幅
①	60.9*	50.2	8.7	21.3	⑩	41.7	34.7	5.4	12.8
	(63.0)	(57.9)		(23.2)		(43.1)	(40.0)		(14.0)
②	56.9	45.4	7.6	17.7	⑪	40.9	31.1	7.1	12.6
	(59.0)	(56.5)		(19.8)		(42.8)	(36.8)		(14.5)
③	47.6	40.3	6.1	14.4	⑫	39.7	32.8	5.3	11.8
	(50.6)	(45.3)		(15.7)		(41.5)	(38.8)		(13.0)
④	45.0	38.9	6.7	13.9	⑬	37.1	32.0	4.8	11.6
	(46.7)	(45.6)		(15.6)		(38.2)	(38.0)		(13.5)
⑤	44.9	37.4	5.9	14.5	⑭	34.2	30.0	4.2	10.9
	(46.7)	(43.2)		(15.9)		(35.7)	(35.3)		(12.4)
⑥	44.6	38.5	5.6	13.2	⑮	33.7	29.8	4.6	10.0
	(46.1)	(45.0)		(14.3)		(34.8)	(39.6)		(11.0)
⑦	43.3	38.9	6.1	12.7	⑯	32.5	27.4	4.9	10.0
	(44.2)	(44.9)		(14.1)		(34.0)	(31.2)		(11.1)
⑧	43.0	35.8	5.7	12.4	⑰	30.0	27.6	4.8	9.1
	(44.8)	(39.5)		(—)		(31.5)	(30.7)		(10.4)
⑨	42.0	37.9	6.2	13.2					
	(43.1)	(44.8)		(14.7)					

Table 15. Measurements of stuffed hawksbills in Tokyo (1973).
* ( ) - curved measurement; all units centimeters

No.	Length (直)甲長 (cm)	欠刻甲長 (cm)	Width 甲幅 (cm)	Plastron length 腹甲長 (cm)	No.	Length (直)甲長 (cm)	欠刻甲長 (cm)	Width 甲幅 (cm)	Plastron length 腹甲長 (cm)
1	20.0	20.5	15.0	16.5	43	26.5	25.5	19.5	20.5
2	20.0	19.2	14.5	15.0	44	30.0	28.5	23.5	23.0
3	20.0	19.5	15.5	16.0	45	31.0	30.0	22.5	22.5
4	22.0	21.0	16.0	17.5	46	30.5	29.5	22.0	22.5
5	19.5	19.0	14.5	15.5	47	29.5	28.5	23.0	21.0
6	22.5	21.5	16.5	17.5	48	19.0	18.5	15.0	15.0
7	20.5	20.0	15.0	16.5	49	31.5	29.5	23.5	24.0
8	19.5	18.5	13.5	15.5	50	32.0	30.5	25.5	28.5
9	22.5	22.0	17.0	17.5	51	25.0	24.5	19.0	19.5
10	25.0	24.0	18.5	19.0	52	31.0	29.5	24.0	23.5
11	27.5	26.0	21.5	21.5	53	34.5	32.5	27.0	26.0
12	25.0	24.0	18.5	20.0	54	19.5	19.0	15.0	15.0
13	23.0	21.5	17.5	17.5	55	35.0	33.5	26.0	26.5
14	21.5	20.5	15.5	16.5	56	32.0	30.5	25.5	24.0
15	20.0	19.5	15.0	15.0	57	29.5	28.5	22.5	23.0
16	18.0	17.0	13.0	15.0	58	29.0	28.0	22.0	21.0
17	21.0	19.5	16.5	16.5	59	29.5	28.5	22.5	22.5
18	22.5	21.0	17.0	17.0	60	40.5	38.0	29.5	30.5
19	26.0	24.0	17.5	19.0	61	29.5	27.5	20.5	22.5
20	24.5	23.5	18.0	18.5	62	33.0	32.0	24.5	24.5
21	26.5	25.5	19.5	20.0	63	32.5	31.5	26.5	24.0
22	31.0	29.5	23.0	24.5	64	26.0	25.5	17.0	18.5
23	34.0	32.0	24.0	24.0	65	23.5	23.0	18.5	18.5
24	34.5	33.0	26.5	27.0	66	33.0	31.5	24.5	25.0
25	36.0	34.5	30.5	27.5	67	27.5	27.0	22.0	20.5
26	37.5	36.0	28.5	27.5	68	30.0	29.0	23.0	23.0
27	35.5	33.5	28.0	28.0	69	27.0	26.0	20.5	20.5
28	38.0	36.5	30.5	28.5	70	32.5	30.5	24.0	24.5
29	27.0	26.0	20.5	20.5	71	33.0	31.5	26.0	25.0
30	27.5	26.5	21.5	21.5	72	30.5	29.0	24.0	22.0
31	27.5	26.5	21.0	20.5	73	31.0	30.0	23.0	23.5
32	29.0	27.5	23.0	22.5	74	31.5	30.5	24.0	24.0
33	32.5	31.5	25.0	23.5	75	33.0	31.5	26.0	25.0
34	33.0	31.0	25.5	26.0	76	28.0	27.0	19.5	21.0
35	30.0	29.0	23.0	23.0	77	31.0	30.0	24.0	23.0
36	27.5	26.5	20.5	20.5	78	29.0	27.5	24.0	20.0
37	29.0	27.5	23.5	23.0	79	34.5	32.0	26.5	26.5
38	30.5	29.5	23.5	24.0	80	29.5	28.0	22.0	20.5
39	31.5	29.5	23.5	25.0	81	31.0	29.5	25.0	23.5
40	32.0	31.0	24.5	24.5	82	34.5	33.0	26.5	26.0
41	30.5	29.0	23.5	23.0	83	68.0	65.5	51.0	51.0
42	30.5	29.5	23.5	23.0	84	58.5	56.5	58.5	58.0

Table 16. Measurements of stuffed hawksbills in Singapore (1973) (owned by businessman Mr. L.)

No.	Length 甲長 cm	欠刻甲長 cm	Width 甲幅長 cm	Plastron length 腹甲長 cm	Plastron color 腹甲の色	Date killed 殺した時期
1	12.5	12.2	9.3	10.0	4/5が黒色 black 甲板接合部うすい黄色	Mar.-May 1973, 3～5月
2	16.2	15.5	12.5	12.8	1/2が黒色 black 1/2 yellow	〃
3	20.8	20.4	16.0	16.0	1/5が黒色 black 4/5 yellow	〃
4	25.0	24.5	20.0	19.2	全面がうすい黄色 甲板接合部にわずかに 黒色が残っている。*	〃

Table 17. Color changes in hawksbill turtles used for stuffing. (* overall light color; very little black remaining where sections touch each other)

No.	Length 甲長 cm	Width 甲幅 cm	Remarks 備考
1	42	31	1年間飼育 — raised one year
2	27		3ヶ月間飼育 — raised three months
3	26		〃
4	28		〃
5	25		〃
6	26		〃
7	24		〃
8	27		〃
9	26		〃
10	23	17.5	〃
11	27	20.5	〃
12	23.5	18	〃
13	27	21	〃
14	28.5	23	〃

Table 18. Measurements of hawksbills held in Makassar

国 ＼ 種類		タイマイ hawksbills	アオウミガメ green turtles	ヒメウミガメ ridleys	オサガメ leatherbacks	アカウミガメ loggerheads
Philippines フィリピン	生息 a	++ スル海 パラワン島	++ スル海 パラワン島	++ 少数	+ 少数	++ ?
	b	++〔周年?〕(殊になし)同上	++〔周年〕(5–9)同上	?	−	+ ?
	産卵					
Malaysia マレーシア	生息 a	++ 北ボルネオ	++ マレー半島東部 サラワク	++ アオウミガメと同じ	+ マレー東部(多) サラワク (少)	+ ?
	b	+ 〔?〕同上	++〔周年〕(6–8)同上	+ 〔?〕	++〔3–9〕(7–8)同上	+ 〔?〕
	産卵					
Singapore シンガポール	生息 a		?		−	
	b	?		?		?
	産卵		+ 〔?〕		−	
Indonesia インドネシア	生息 a	++ インドネシア内海のサンゴ礁	++ タイマイより分布域大	++	+	++ ?
	b	++〔周年?〕同上 (2–4?)	++〔周年〕(9–5)ジャバ島東部 (4–7)セレベス			
	産卵			++〔?〕	+〔?〕	++〔?〕

Table 19. Habitats and egg laying seasons of sea turtles in Southeast Asia

a) Feeding habitat: − does not come seasonally
+ comes seasonally
++ year round

b) Nesting: − none
+ few
++ many
[] egg laying months
() peak months

種類 / 項目	アオウミガメ green turtles	タイマイ hawksbills	アカウミガメ loggerheads	ヒメウミガメ ridleys	オサガメ leatherbacks
Adult shell length 成体の甲長 cm	60～100，♂＞♀	50～80，♂＞♀	70～100，♂＞♀	60～80，♂＞♀	150~250，♂＞♂
Hatchling shell length ふ化稚ガメの甲長cm	4.6	4.0～4.6	4.0～5.0	4.0～4.6	5.8～6.0
Egg laying months 産卵期，月	ボルネオ 5～9（盛期） マラッカ海峡 Borneo Malacca Strait 12~1（〃）	セイロン Ceylon 11~2（盛期） セイセレス Celebes 9~11（〃）	日本 Japan 6～8	セイロン Ceylon 9～1 東部太平洋 E. Pacific 8~11	マレー半島 Malay Peninsula 7～8（盛期）
Diameter No. eggs 卵径mm，卵数／回	45～50，75~200卵	30～40，150~200卵	40～45，70~150卵	35～45，70~135卵	50～60，※ 50~130卵（平均75）
Nestings per season 一産卵季の産卵回数	2～5回	2～3回	2～3回		※ 3～4回
Incubation period ふ化日数日	40～70日	平均 60日	30～65日	50～60日	※ 50～60日（平均55）
食性 Food	草食 herbivore	雑食 omnivore	肉食 carnivore	草食 herbivore	雑食 omnivore

Table 20. Other sea turtle egg laying in the Pacific (Carr, 1966; Kajihara and Uchida, forthcoming)

No.years 飼育年数	タイマイの体重 Weight kg	購入価格 Retail Value	Yearly cost 年間経費 Personnel 管理費	Feed 餌代 (1kg30円)	Yearly Cost 年間経費合計 yen	Total Cost 経費累計 yen
1 年目	2	500	3,650	2,190	6,340	6,340
2 〃	5		3,650	5,475	9,125	15,465
3 〃	10		3,650	10,950	14,600	30,065
4 〃	15		3,650	16,425	20,075	50,140
5 〃	20		3,650	21,900	25,550	75,690
6 〃	30		3,650	32,850	36,500	112,190
7 〃	40		3,650	43,800	47,450	159,640
8 〃	50		3,650	53,750	57,400	217,040
9 〃	60		3,650	65,700	69,350	286,390
10 〃	70		3,650	76,650	80,300	366,690

Table 21. Cost of raising one hawksbill in captivity

	Month 月 / 地域	1	2	3	4	5	6
Southeast Asia	東南アジア	2～7*	5～6	4～8	4～6	7～24	8～12
Indonesia	(インドネシア)	2	—	8	6	14	12
Oceania	大洋州	14	3～16	11～22	12～21	5～23	22
U.S.A.	アフリカ	—	6	4～6	7	5～8	4～6
South & Central America	中南米(大西洋)	10～21	11～30	6～22	6～31	7～57	6～77

Table 22. Tortoise shell purchased by Japan in 1973
(*price range for 1 kg in 1,000 yen)

Location	Regulation
	Pacific Ocean and adjaoent areas
Hawaiian Leewards	complete protection for all marino turtles and eggs (Anon, 1968b; Hendrickson, 1969; Laycock, 1970).
Midway Island	protection for turtles less than 60 om in carapace length.
Trust Territory of the Pacific	full protection for turtles and eggs on shore; and in the water for turtles wlth carapace length less than 61 om (wilson, 1969).
Kingdom of Tonga	following regulations now waiting approval by Government complete year-around protection for eggs and for turtles with carapace length more than 87.5 cm; protection for all turtles of all sizes from 1 November to 28 February; ban on the salo or export of any turtle shell greater than 87.5 om; complete proteotion for the leatherbaok of all sizes at all times.
Fiji Islands	same regulations as for Tonga, awaiting Government approval.
Rose Atoll, American Samoa	complete proteotion for turtles and eggs.
Malaysia	complete protection for nesting turtles; Government controls harvesting of eggs (about one million annually); March is closed season for eggs in Sabah (Harrisson 1950–1969; Hendrickson, 1958; de Silva, 1968, 1969b).
Queensland, Australia	full protection for all marine turtles and eggs (Bustard, 1969d).
	Atlantio Ocean and adjaoent areas
※ Mexico	full protection for eggs; permit required to take turtles during open season; on Pacific coast closed season generally extends from 1 June through 31 October; on Gulf coast closed season extends from 1 May through 31 August.
Costa Rica	adults and eggs fully protected on nesting beaches; and protection for turtles Within 4.8 km of nesting beaches (but harpooners can operate beyond this limit).
Panama	full protection for the green turtle (Myers, 1970).
Suriram	complete protection for nesting turtles and eggs on some of the major nesting beaches (see text).
French Cuiana	protection for adults and eggs during May, June, July (Anon 1969i; Pritchard, 1969).
Trinidad and Tobago	protection for turtles and eggs from 1 June through 30 September.
Ascension Island	full protection for turtles and eggs.
	Indian Ocean and adjacent areas
Britiah Indian Ocean Territory and Seychelles Islands	complete protection for turtles and eggs

※１９７１年より海ガメ全種の全面捕獲禁止（ＭＡＲＱＵＥＺ他，１９７３）
（註） フィリピン １９６７年より５年間，海ガメ全種について捕獲採卵禁止

Table 23. Regulations regarding the harvesting of green turtles and their eggs

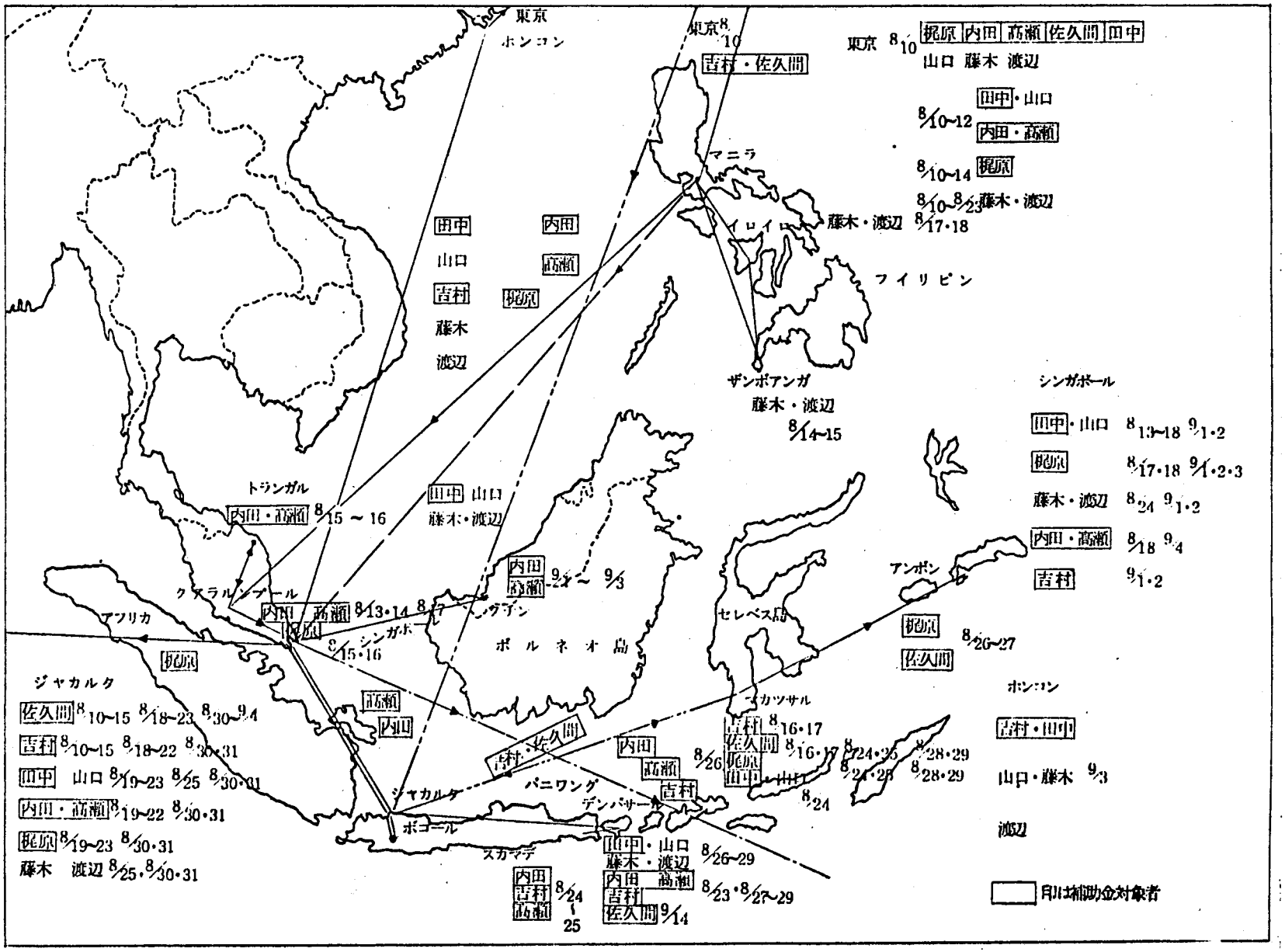

Figure 1. Travel schedules for participants of the investigation

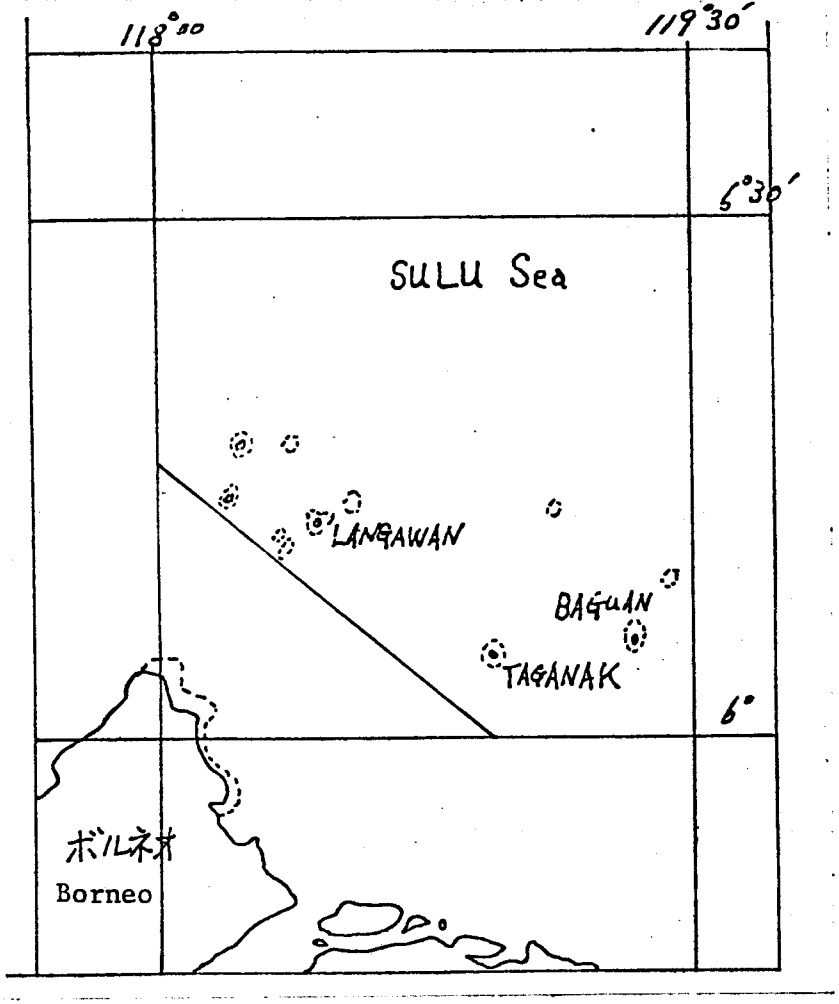

Figure 2. Southern portion of the Philippines, Sulu Sea and Turtle Islands

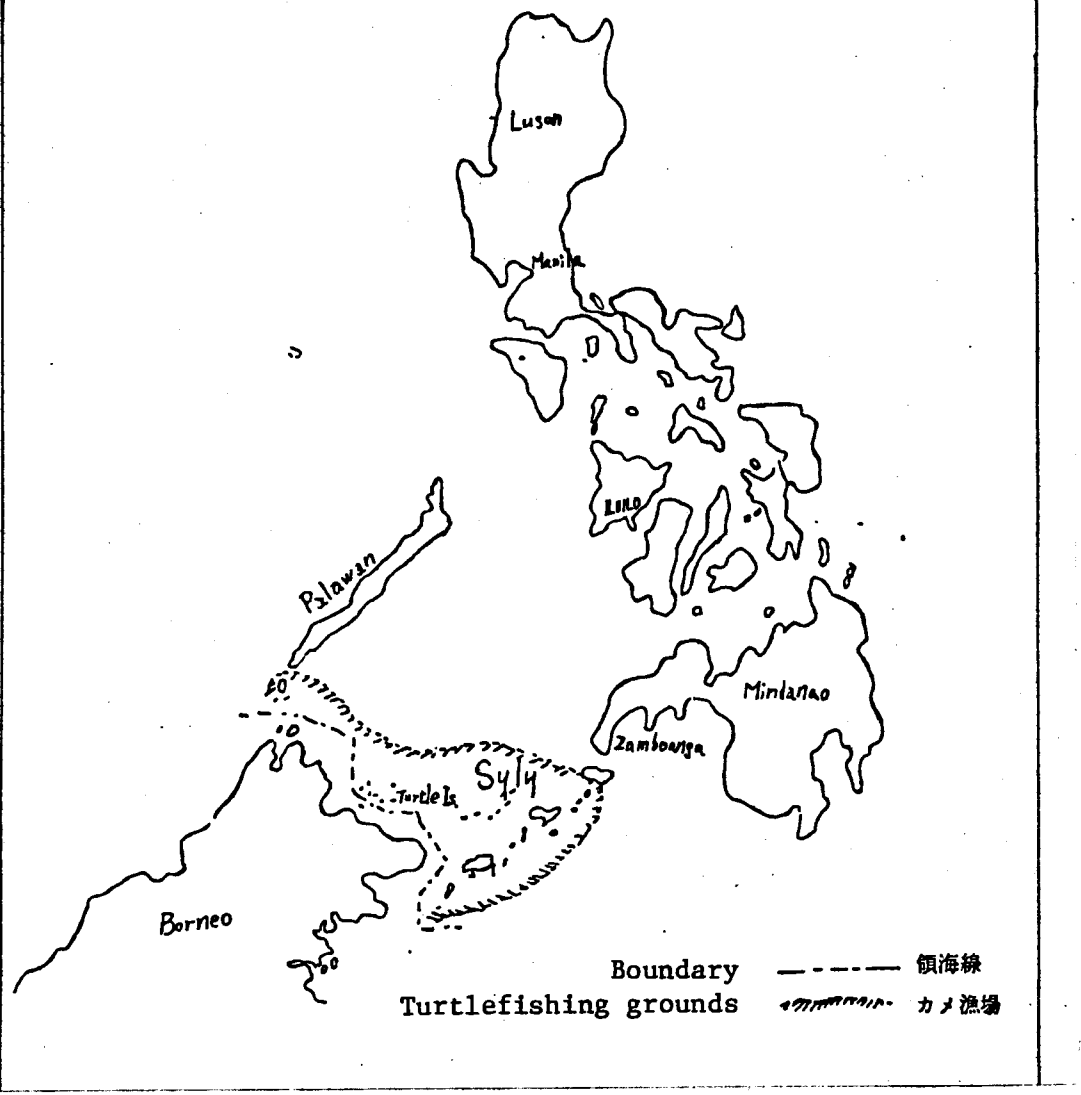

Figure 3. Turtle fishing grounds around the Philippines

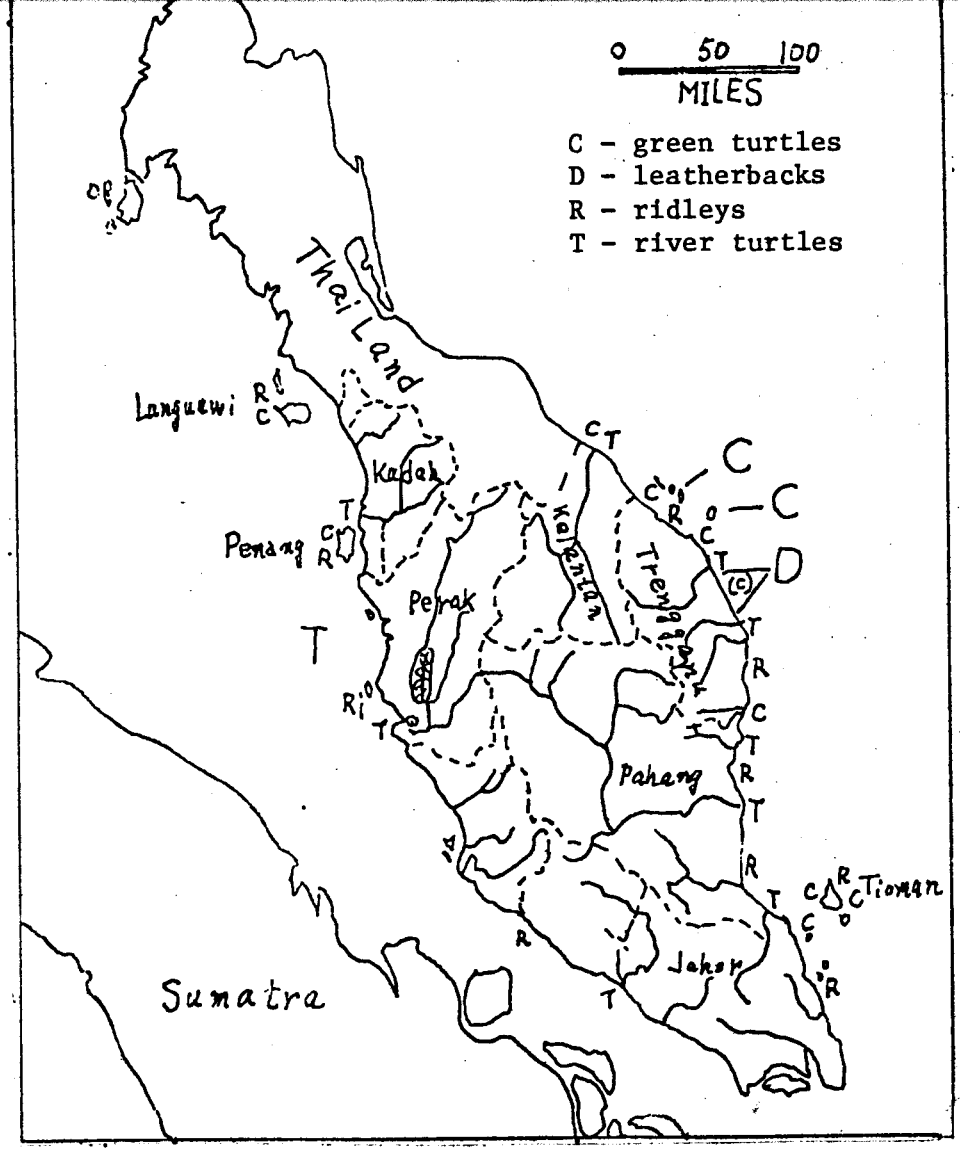

Figure 4. Turtle nesting grounds located in Malaysia (Hendrickson, 1961). (Capital letters = large breeding grounds; lower case = scattered or small breeding grounds)

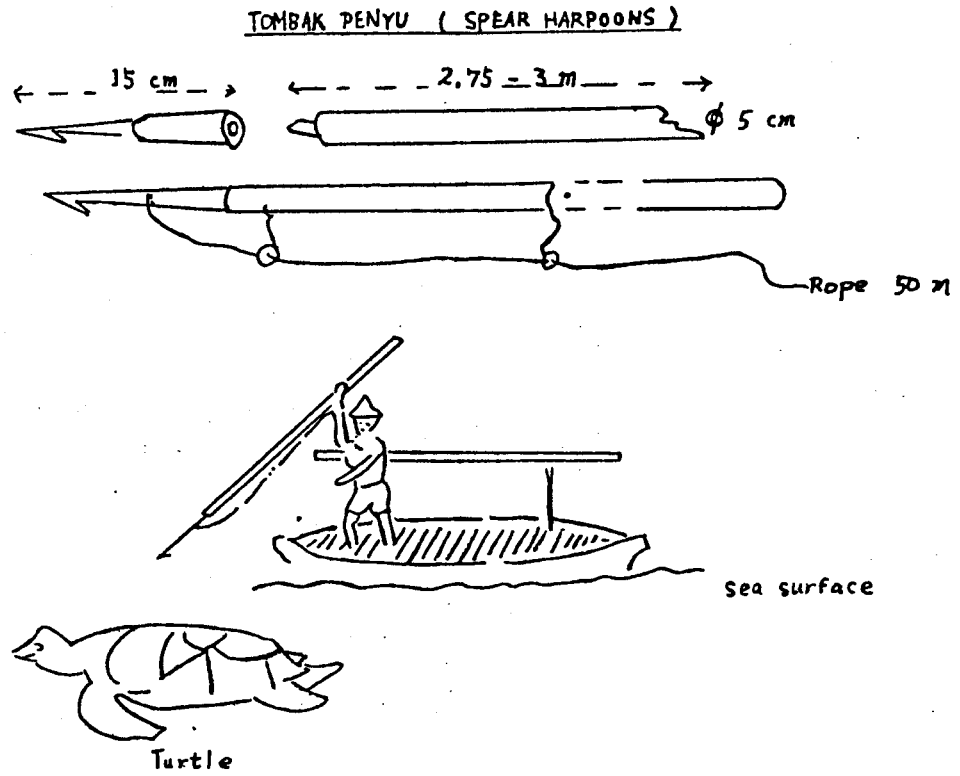

Figure 5. Turtle fishing method employed in areas around Bali

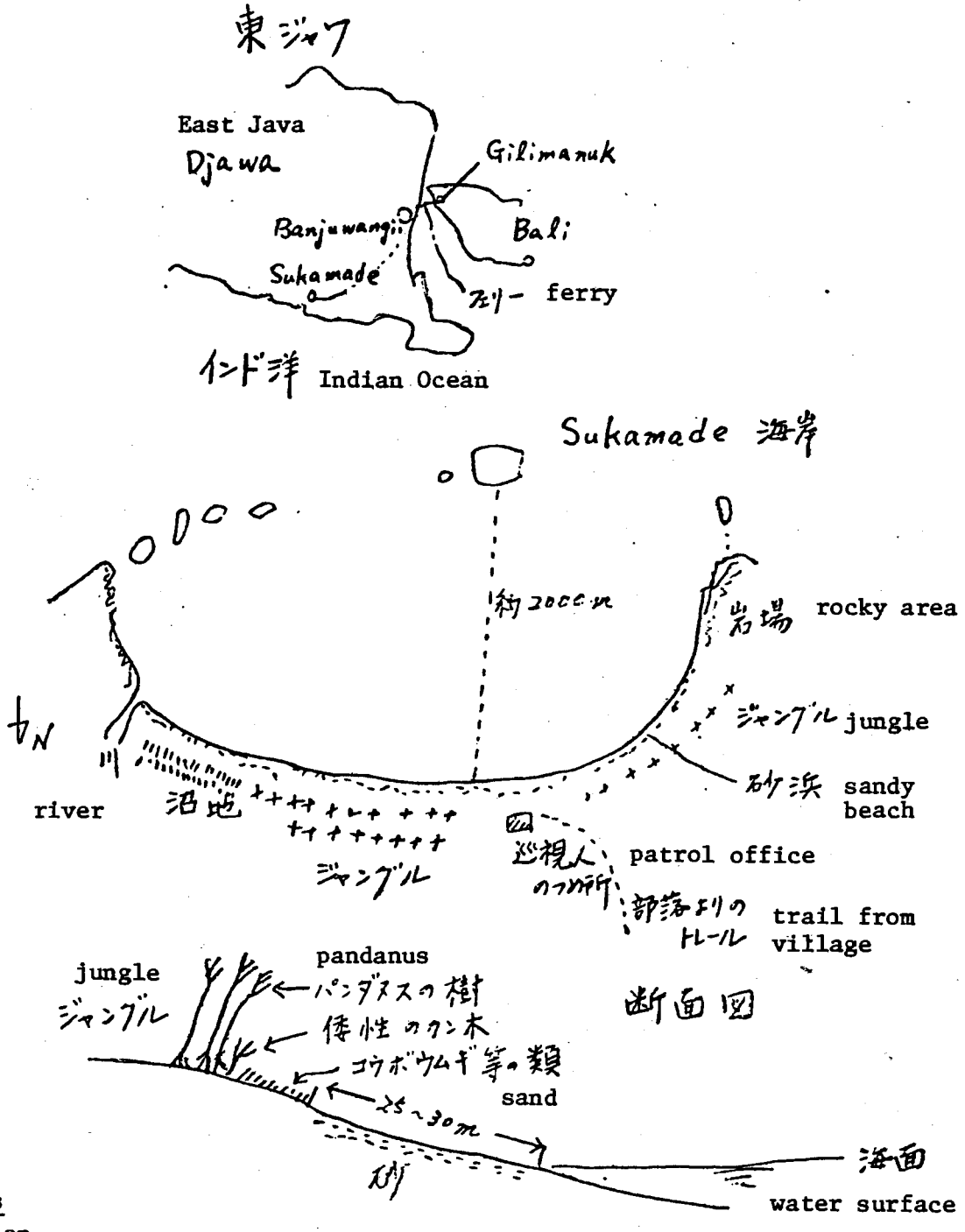

Figure 6. Location and shape of the beach at Sukamade (Indonesia)

図6. インドネシアにおけるタイマイ漁場

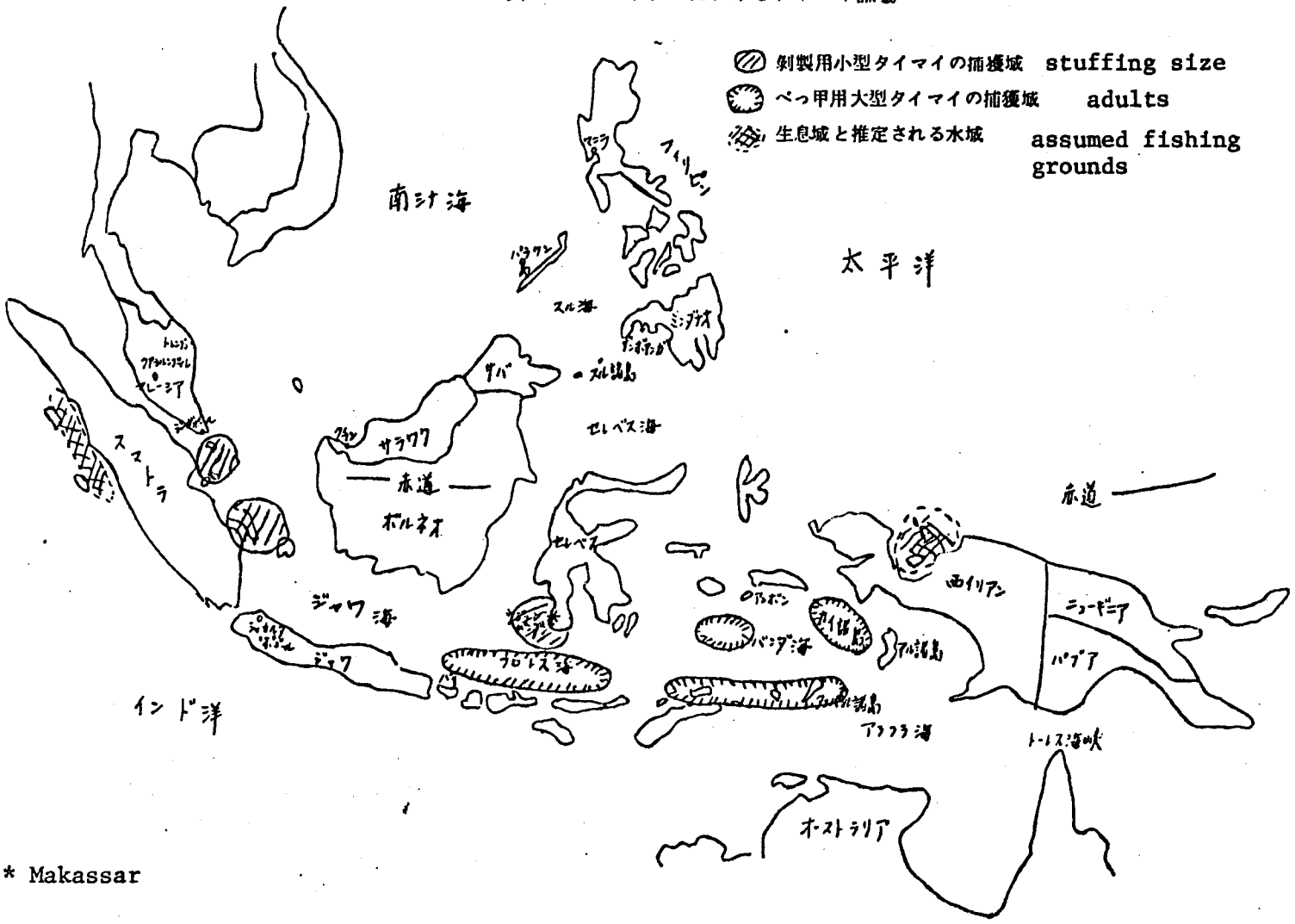

Figure 7. Hawksbill fishing grounds in Indonesia

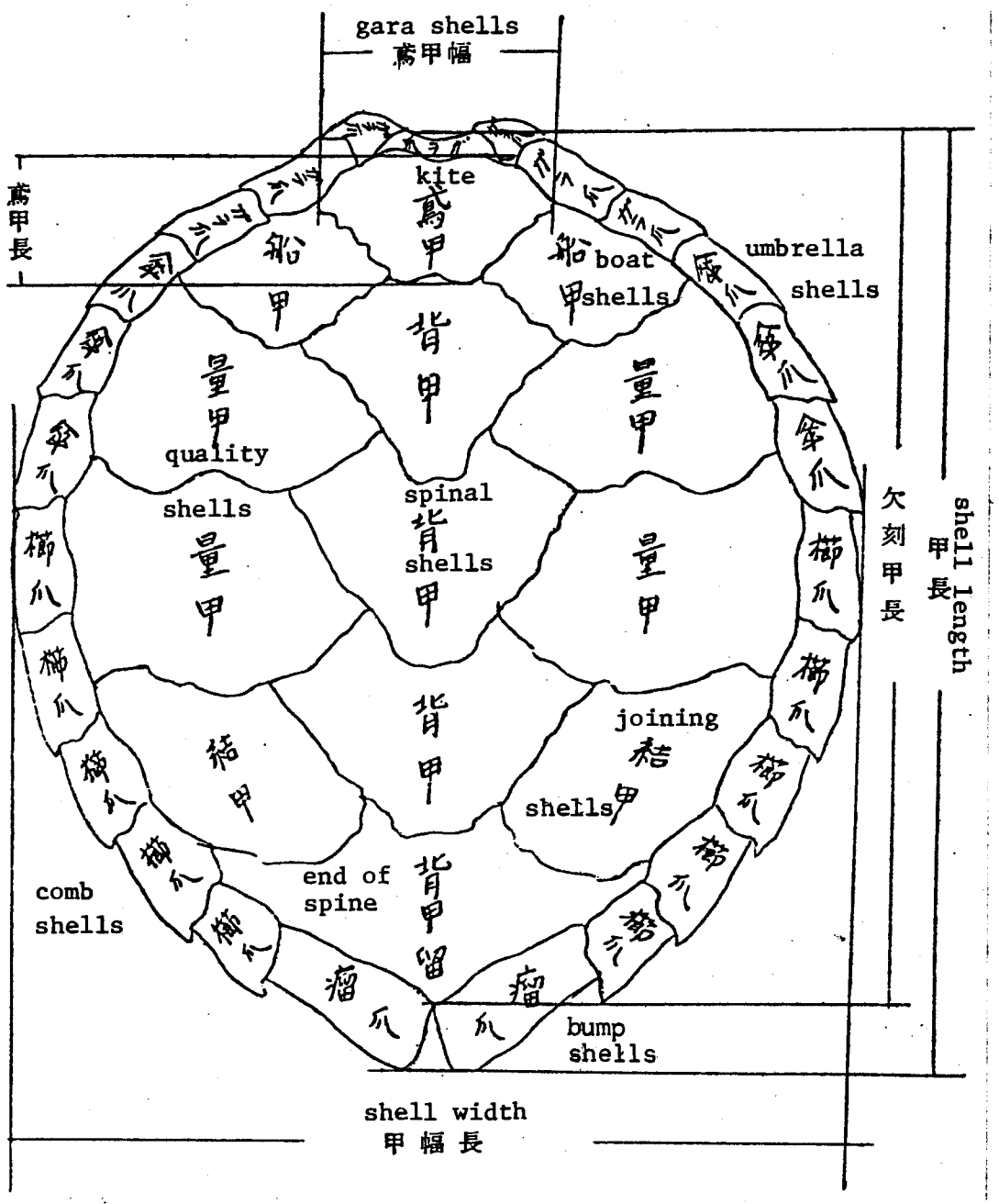

Figure 8. Measurements and terminologies of the hawksbill carapace used by the Japanese Tortoise Shell Association

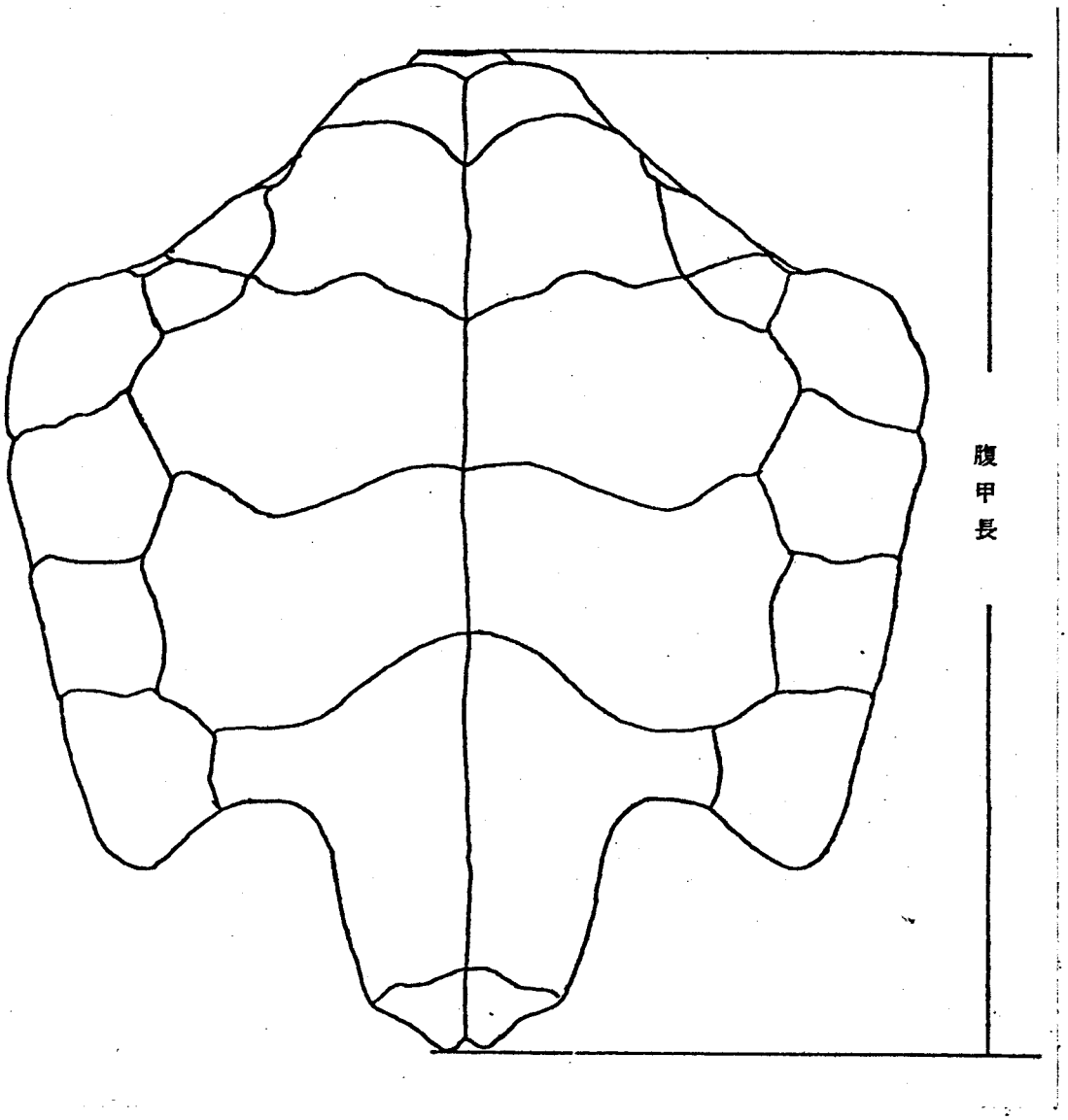

Figure 9. Measurement of the hawksbill plastron

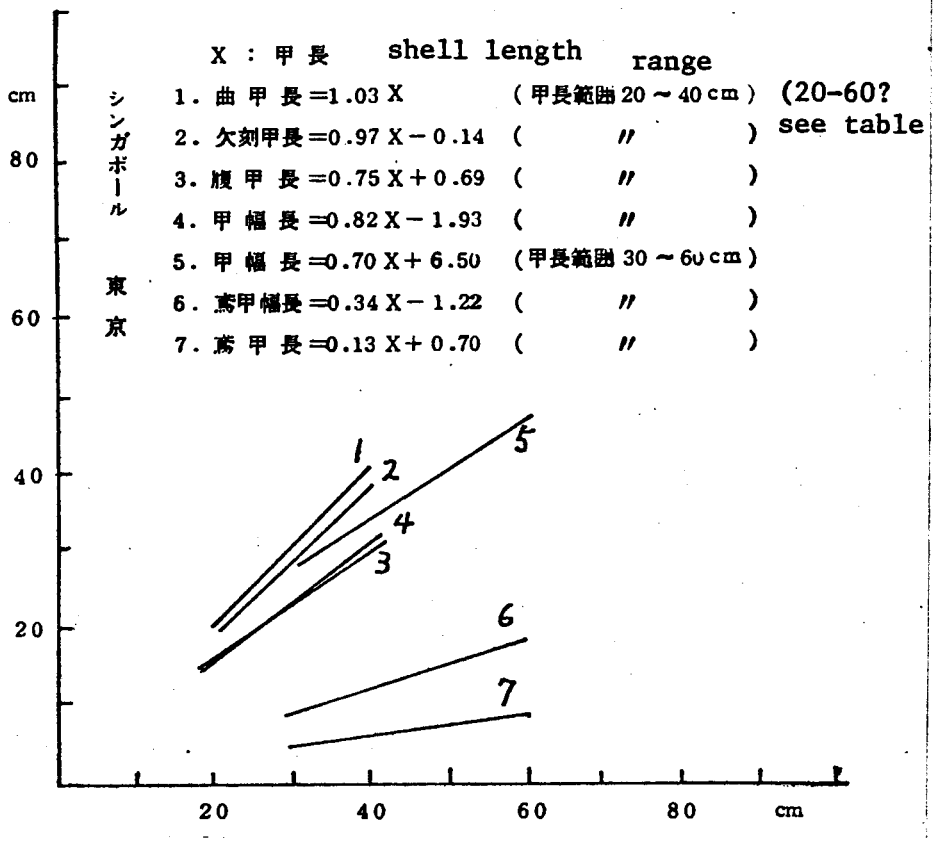

Figure 10. Comparison of stuffed hawksbills found in Tokyo and Singapore

1-4 Singapore
5-7 Tokyo
1 curved shell length
2 post central length
3 plastron length
4-5 shell width
6 first central width
7 first central length

Figure 11. Carapace length of stuffed hawksbills in Singapore business stock. (1973)

図11 剝製タイマイの甲長組成
（シンガポールのL氏商店内のstock. 1973. 8月）
(from the stock of Mr. L.)

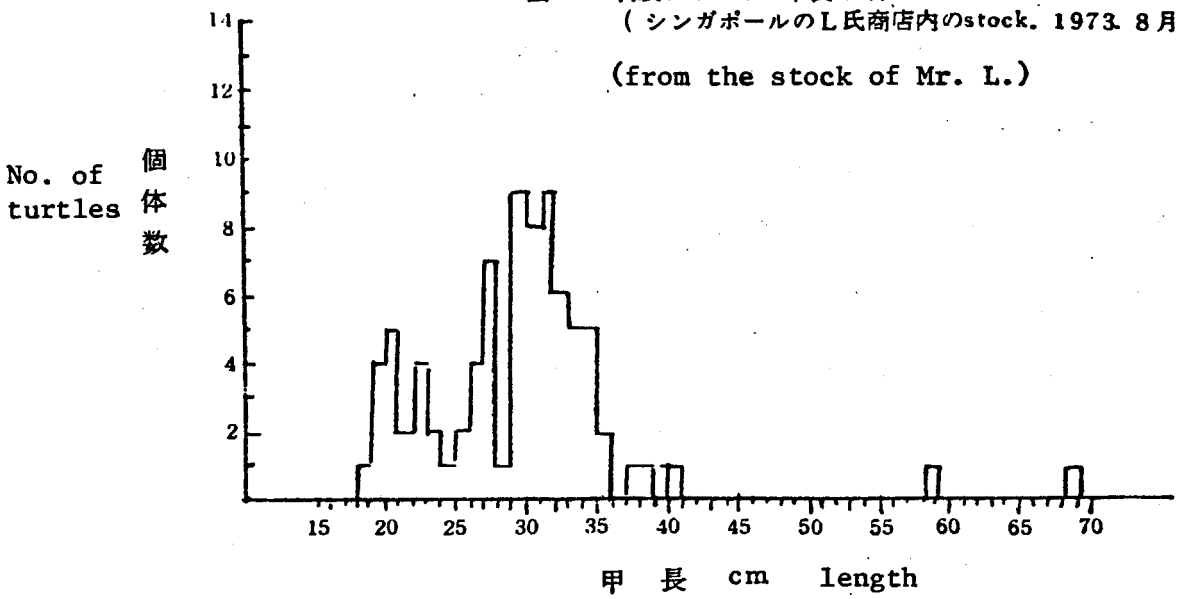

図12 剝製タイマイの甲長組成
（シンガポールL氏の剝製加工場所有. 1973. 8月）
(from the processing plant of Mr. L.)

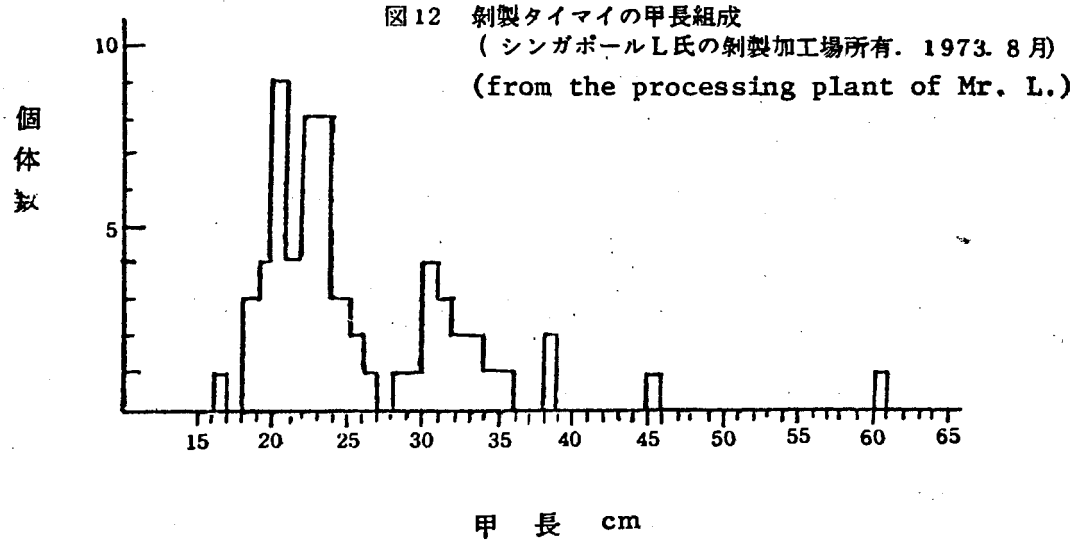

Figure 12. Carapace length of stuffed hawksbills in Singapore processing plant (1973)

図13　日本海々岸でとられたタイマイの甲長組成
（S. NISHIMURA：1967より）

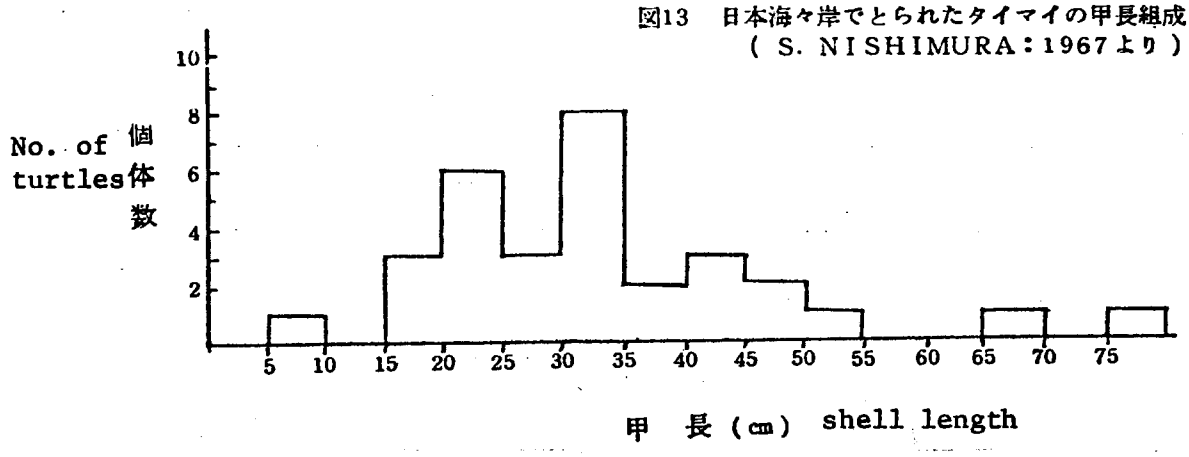

Figure 13. Carapace length of hawksbills taken on the shores of the Japan sea

図14. アオウミガメ産卵場における上陸個体数と巣の破壊率の関係（HIRTH, 1971より）

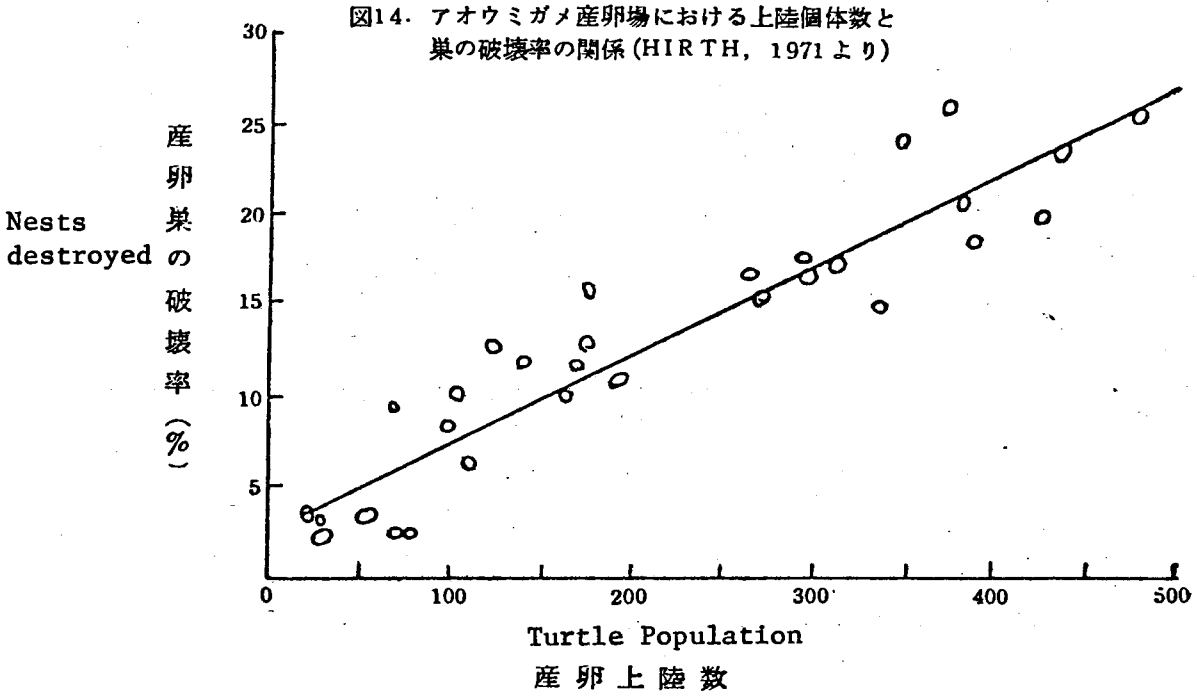

Figure 14. Correlation of nest destruction with size of turtle population (Hirth, 1971)

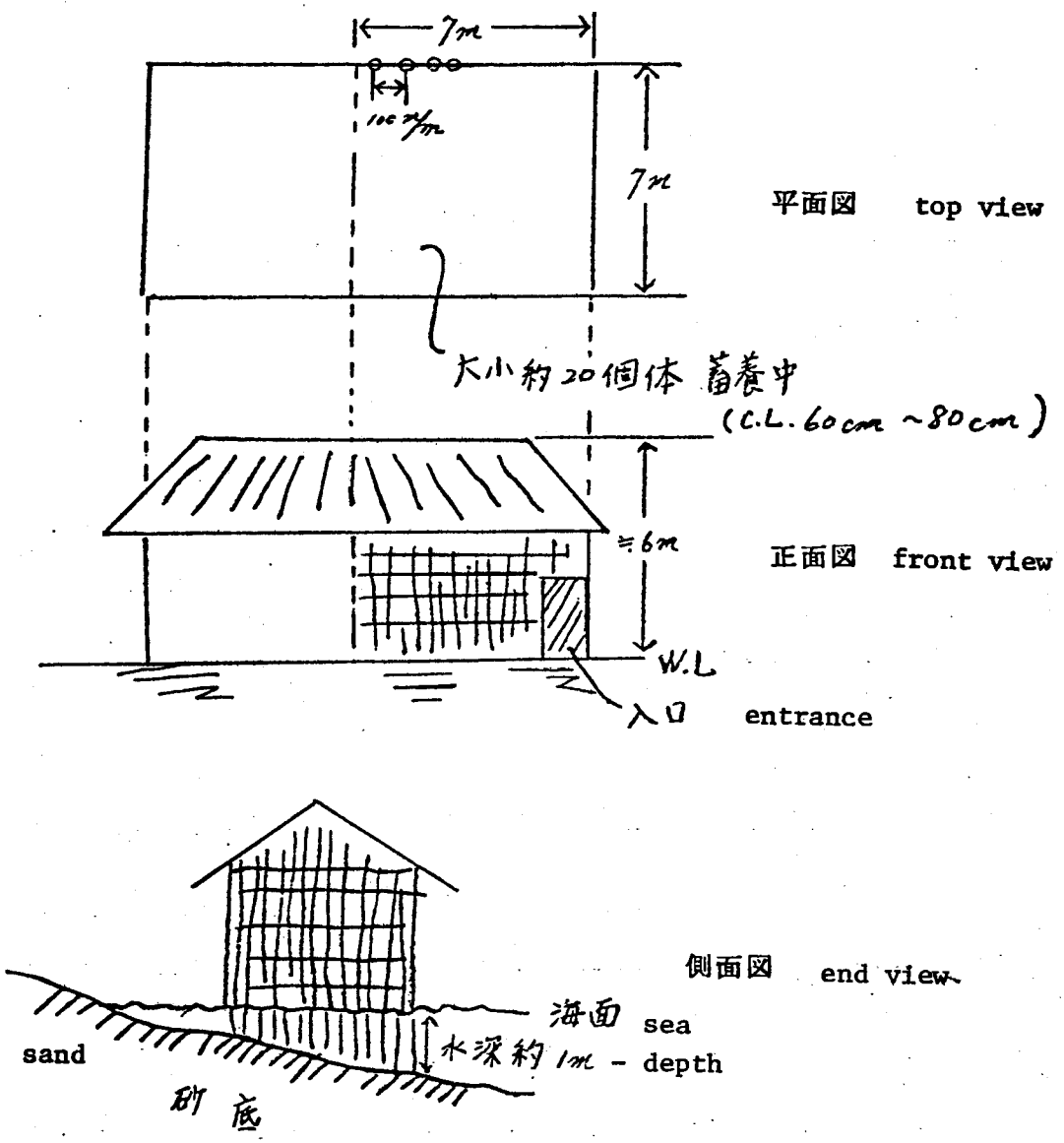

Figure 15. Hut used for raising turtles at Benoa (Bali)

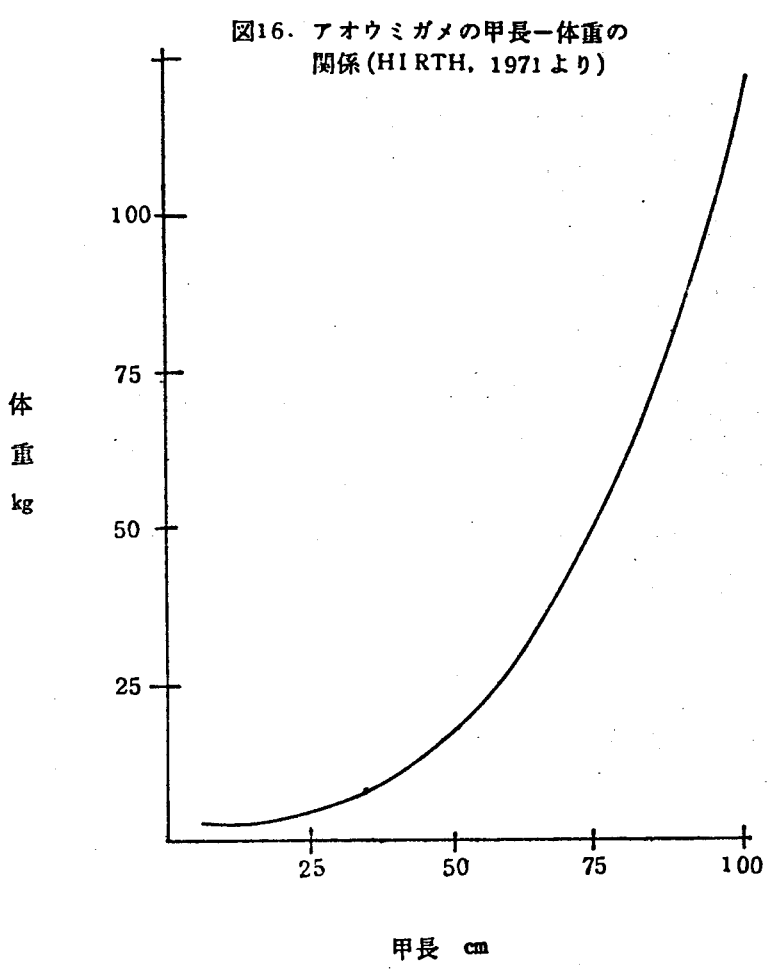

Figure 16. Model showing weight and carapace length of green turtles (Hirth, 1971)

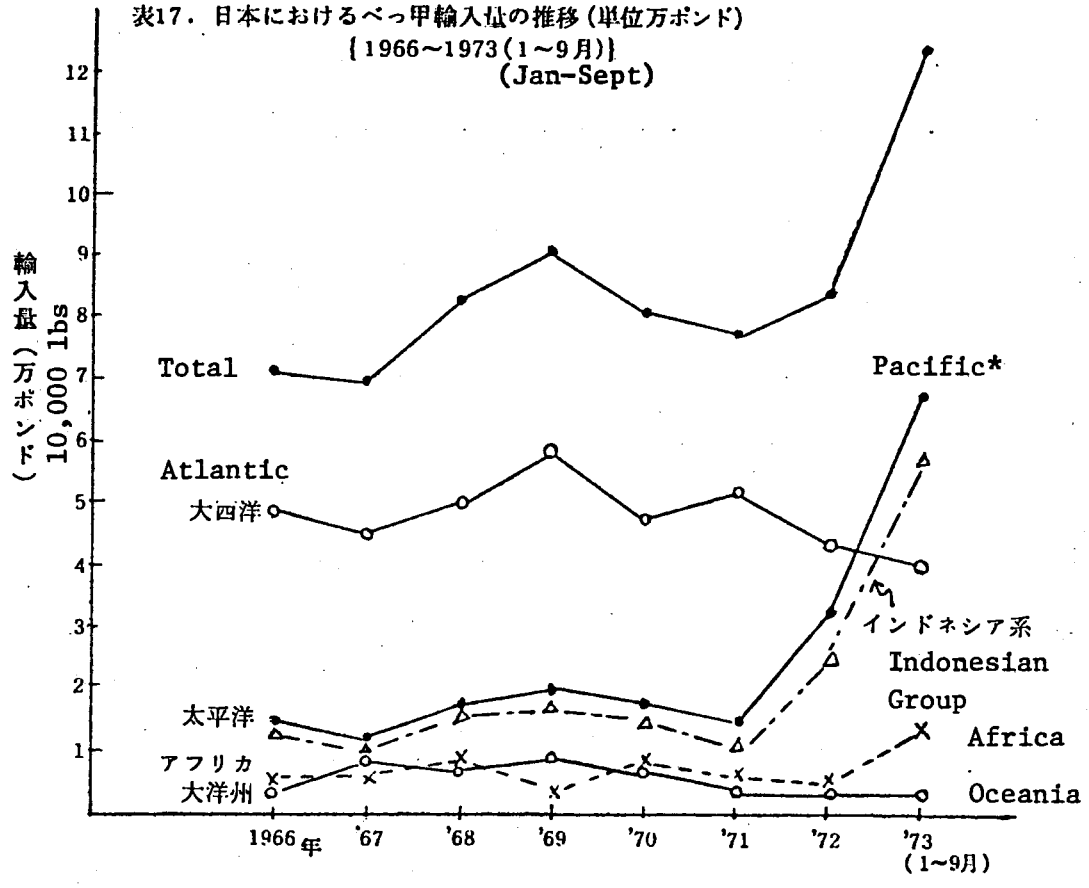

Figure 17. Annual change of tortoise shell imported into Japan (1966-1973)

* appears to include "Indonesian Group" and Philippines - ed.

東南アジアにおけるタイマイの生態と漁業

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The Ecology and Fisheries of the Hawksbill Turtle, *Eretmochelys imbricata*, in Southeast Asia

Takeshi KAJIHARA and Itaru UCHIDA (Ocean Res. Inst., Univ. Tokyo and Himeji City Aquarium)

Research on the hawksbill turtle was carried out in Southeast Asia during the period from August to September of 1973. Adult hawksbills used for tortoise shell are caught on a number of coral banks in the Sulu, Flores and Banda Seas, and juveniles (18—36cm in carapace length) for taxidermy are caught on the west coast of Sumatra and the south coast of Celebes. It is presumed that the hawksbill in the Java and Flores Seas nests from January through June, but the nesting months in the Sulu Sea are not clear. One- and two-year-old turtles grow to an average carapace size of 23cm and 33cm respectively. The color of the plastron rapidly changes from black to light-yellow during the yearling stage, especially during the period of growth from 12cm to 20cm in carapace length. The annual number of hawksbill turtles captured is roughly estimated at 5,000 adults in the Sulu Sea, 15,000 adults and 20,000—30,000 juveniles in the Indonesian territory.

Jap. J. Herp.. 5(3):48—56. 1974.

Appendix I.

地域	輸出国名 ＼ 月別	kg / 1000 yen	2		3		4		5		6		7		8		9		10		計	
			数量	金額	数量	金額	数量	金額	数量	金額	数量	金額	数量	金額	数量	金額	数量	金額	数量	金額	数量	金額
Formosa	台湾								16	144			9	228							25	372
Singapore	シンガポール	424	3366			36	1910	77	2012	579	6425	21	420	247	4011	449	4706	383	2902	342	3860	2558	29612
Philippines	フィリピン	166	930	447	1165	104	461	266	1753			96	465			393	2855	300	2754			1472	10383
Indonesia	インドネシア	205	2585	101	3643	50	413	24	253	552	10778	1829	17008	744	8884	28	284	370	5479	1020	16180	4923	65507
India	インド					26	165	45	693			79	1469			44	445					194	2772
Maldive	モルディヴ	40	269			50	341	40	263	40	263							115	1150			285	2286
Kenya	ケニア	507	3638	153	1147					395	3192	53	445	773	5764			699	5400			2580	19586
Tanganyika	タンザニア	320	4473					593	7214	151	1301	149	2513	544	7550	192	2442	203	3969			2152	29462
Mozambique	モザンビーク	277	2118																			277	2118
Somalia	ソマリヤ																						
Seychelles	セーシェルズ											77	1312									77	1312
Madagascar	マダガスカル											60	344									60	344
Australia	オーストラリア			269	1437			500	7433									147	2950			916	11820
Fiji	フィジー					49	899	18	381	9	179			22	377	22	338	25	440			145	2614
Solomon	ソロモン			283	933			157	1465			19	249			81	436	115	760	139	1064	794	4907
Others	その他							136	1248									377	2417	73	3071	586	6736
Sub Total	計	1939	17379	953	8325	315	4189	1856	22715	1742	22282	2383	24225	2339	26814	1209	11506	2734	28221	1574	24175	17044	165831
Holland	オランダ									319	7083			217	7420							536	14503
Honduras	ホンジュラス																						
British Honduras	英領ホンジュラス					12	167															12	167
Nicaragua	ニカラグ			207	2819	98	1660	268	3868									181	2912	38	927	792	12186
Costa Rica	コスタリカ	170	2467																			170	2467
Panama	パナマ	31	1234	453	7643	230	3311					45	1432	634	11468	231	6841	774	17477	79	2374	2477	51780
Havana	バハマ							315	14334					217	9413							532	23747
Jamaica	ジャマイカ			34	1334			140	2931					86	2465			8	118			268	6848
Cayman	ケイマン	219	4981	11	176	191	3657	249	4071	378	5886			692	13399			185	2985	431	6490	2356	41645
Barbados	バルバトス																						
Cuba	キューバ	1375	32133	1350	31724	700	17293									2000	59376			1550	39657	6975	180183
Haiti	ハイチ	186	6051	21	902							219	4784	79	2133	188	4966	108	3406			801	22242
Grenada	グレナダ																						
St. Lucia	セントルシア																						
Dominican Rep.	ドミニカ					29	603			90	3005							97	1721	23	351	239	5680
Puerto Rico	プエルトリコ					104	1725					45	974			45	976					194	3675
Colombia	コロンビア																						
St. Vincent	セントヴインセント											62	823	68	895							130	1718
West Indies (Fr)	仏領西インド	32	518			35	541					40	610									107	1669
Portugal	ポルトガル									10	104							45	375			55	479
	その他																						
Sub Total	計	2013	47384	2076	44598	1399	28957	972	25204	797	16078	411	8623	1993	47193	2464	72159	1398	28994	2121	49799	15664	368989
Total	合計	3952	64763	3029	52923	1714	33146	2828	47919	2539	38360	2794	32848	4332	74007	3673	83665	4132	57215	3695	73974	32688	558820

太平洋・印度洋

大西洋

Appendix II. Tortoise shell imported into Japan in 1976