

PRESENT DISTRIBUTION OF THE DUGONG IN THE WORLD

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ABSTRACT

This is a result of hearing surveys on dugong distribution in the past 10 years. The species is distributed widely in the Indo-Pacific Ocean, between the longitude of 30°E and 170°E, and between the latitude of 30°N and 30°S. Although nothing is known on movement and seasonal migration of the species, discontinuity of distribution or of density suggests the presence of at least five populations. They are (1) east Australian and east Papua New Guinean group, (2) west Australia-Molucca-Philippine group, (3) Sumatra-Malaysia-Andaman group, (4) Indo-Sri Lanka group and (5) east African and Madagascar group. Their range might have been continuous before depletion by human activities, and the first three populations may still be continuous dispersely. The fourth and fifth group seems to be on the verge of extinction. The total population of 30,000 individuals is roughly presumed by Nishiwaki.

INTRODUCTION

Since the Human Environment Conference of the United Nations held at Stockholm in 1972, conservation of marine mammals has been called loudly. Particularly calls were concentrated on cetaceans. Then conservation on sirenians followed as a matter of concern. Studies on the dugong and the species of manatees have progressed at the same time (Bertram, 1976).

The first step needed for conservation is to clarify the habitat, range of dis-

tribution, and abundance. The present study will throw a light on the actual status of the distribution of *Dugong dugon* (Müller 1776) in the world.

HEARING SURVEY OVER THE INDO-PACIFIC REGION

Method and area covered

The data are collected from the information through the two expeditions to the Indo-Pacific region in 1977 and 1978, and of that collected by some of the authors individually in recent 10 years.

In 1977, Nishiwaki and Tobayama travelled to Indonesia, Sri Lanka, south India, Kenya, Tanzania, and Madagascar including the Comoro Islands. And in 1978, Nishiwaki, Kasuya, Miyazaki, and Kataoka surveyed Micronesia, Melanesia, Fiji, Indonesia, and Australia. The latter put stress on to know the eastern limit of distribution. Information was collected from local scientists, fishermen and other people who were expected to know the species. Our inquiry consisted of three questions by showing three photographs of dugong. They were, 1: "Have you ever seen or heard of the animals in this area?", if answer was "Yes", 2: "Where and when did you do it", and "How many?", and 3: "Do you think dugongs are still there?". If possible, our effort was made to confirm the fragments of skeleton, record in market, or hunting instruments. Palau Islands was not surveyed in the trip, because existence of dugong on the islands was known since long time before (Asano, 1935; Hirasaka, 1933; R. L. Brownell Jr, pers. comm.) and Nishiwaki investigated the islands in 1973 and 1974. In all through the surveys, our best effort was made to eliminate the confusion of other marine animals with dugong.

Result of hearing survey

The information of the dugong distribution obtained in the present study is as follows.

- (1) Absence of dugong was concluded on: Johnston I., Saipan, Caroline Islands (Truk Is., Ponape I., Ulithi Atoll, Ngulu Atoll, Nama I., Lukunor Atoll, Satawan Atoll), Marshall Islands (Majuro Atoll, Kusaie I.), Gilbert Islands, Nauru Island, Ellice Islands, Fiji, Surabaja (Java), Borneo (northern and eastern coast), Chon Buri (Bangkok Bay), Chittagong, Dacca, Khulna, Calcutta, Madras, Karachi, Bahrain, Seychelles.
- (2) Constant distribution was proven on: Palau Islands, Solomon Islands, New Hebrides, New Caledonia, Papua New Guinea (Lae, Port Moresby), Townsville, Thursday Island, Friday Island, Mulgrave Island, Philippines (Manila, Palawan, Iloilo, Cebu, Tacloban, Polillo Is., Zamboanga), Borneo (west coast), Sulawesi, Bali, Java (Denpasar, Banjuwangi, Serang), Bangka Island, east coast of Malay Peninsula (Songkhla, Surat Thani), west coast of Malay Peninsula (Pinang, Phuket), Rangoon, Ramree Island, Sri Lanka (Colombo, Jaffna), Adams Bridge, Trivandrum, Calicut, Bombay, Madagascar (Tananarive, Nossi-Be I., Majunga), Comoro Islands, Dar-es-Salaam,

Mombassa, Zanzibar, Juddah

(3) Places of rare occurrences or of doubtful information taken:

(a) On Guam Island, we met five fishermen or sport divers. A friend of one of the divers, who was also a sport diver, told his encounter under water an animal looks like a sea lion. The sea lion is not distributed in the island. Another information was obtained from a fisherman. He told that he had observed, from a boat, a large animal submerged under water near the southern tip of Guam Island. In the next day he found a long grazing traces in the sea grass at that position. Though the two information may possibly be a dugong, we consider that further confirmation is necessary before its conclusion.

(b) Among 20 people we met at Yap Island in 1978, only 9 persons knew the dugong. One dugong was captured by a turtle hunter about 15 years ago, and the animal was sold at the market. This information was confirmed individually by eight persons including the hunter and a manager of the market. Another individual was sighted in 1977 while staying at the bottom by the turtle hunter who witnessed the previous catch at the market. The information suggests that the species occurs in Yap coast very seldom.

The above information are summarized in Fig. 1, together with various past records of the species. Among the descriptions on dugong distribution ever published, that of Husar (1975) is closest to the present result. The important differences are as follows.

In her map, this species occurs in Marshall Is., Gilbert Is., and Ellice Is. Only one doubtfully supported it was a steward of a hotel at Majuro Island. He told us that he had seen an animal looked like dugong in Maloelap Island. However no other information in this region agreed the presence of the species, and we concluded that the species does not inhabit the islands. This conclusion fit to the opinion of Mr B. Puleloa, a District Fisheries Officer of Marshall Islands. The distribution of the species in Micronesia seems to be limited geographically. All information obtained by us certainly deny the distribution of the species in Micronesia except Palau, Yap and Guam Is., and constant inhabitation was only in the Palau Islands.

Dugong does not seem to be distributed in the Laccadive and Maldiv Islands (S. Jones, pers. comm.). Though our survey denied the presence of the dugong at Bahrain, it was recently documented by Gallagher (1976).

Although there has been no study on the diving depth of dugongs, they do not seem to dive so deep as cetaceans do. It may be safe to say that dugongs inhabit the waters not far from shore, namely limited usually within the depth of about 20 meters, however, they will be able to stray or to migrate across the open sea. Distribution of the dugong is parallel to that of the sea grasses, genera *Zostera*, *Cymodocea*, *Thalassia*, or *Thlassodendron* (Heinsohn *et al.*, 1977), though these grasses do not always invite dugongs. At Ponape and Truk Islands in Micronesia, there are abundant sea grasses but people said without exception that they had never seen dugong there. Another example is in the southern districts of Japan

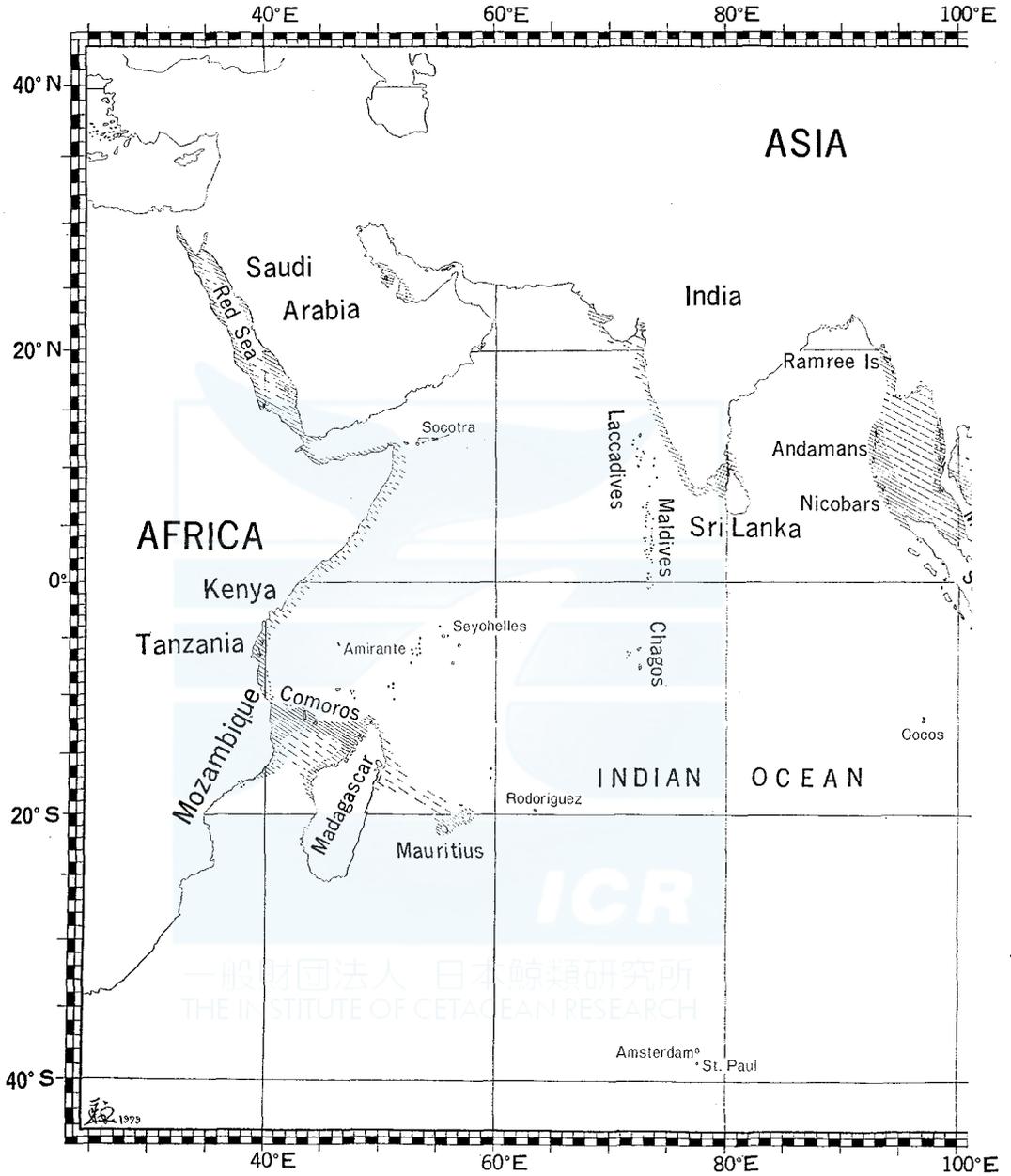
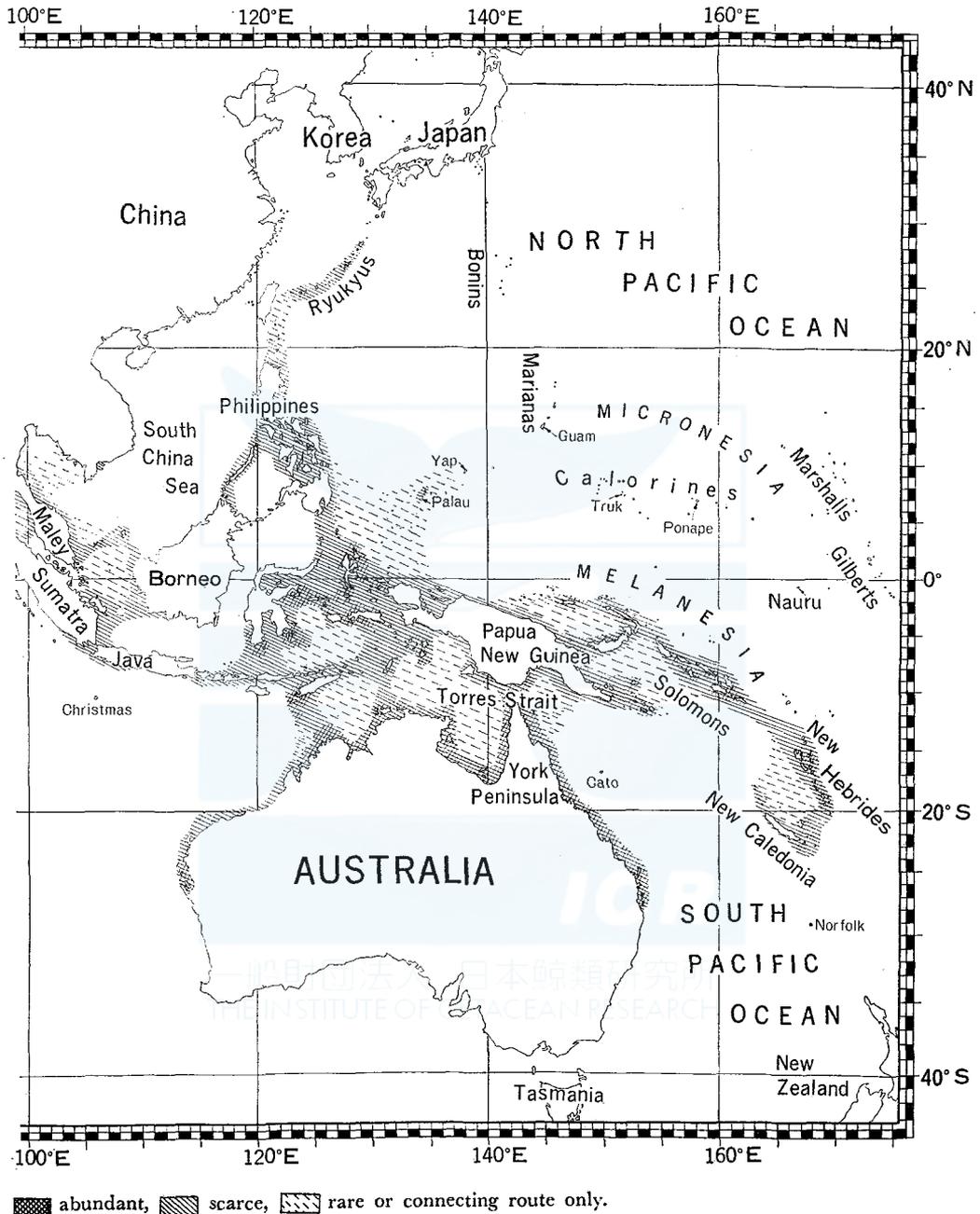


Fig. 1. A map indicating the present distribution of the dugong (*Dugong dugon*) in the world.



proper. There are abundant *Zostera* spp. to form a good shelter for various fishes, but no dugong has ever been found in the waters north of 30°N.

Another factor influences the dugong distribution may be the water temperature. The northern limit of the species is at Amami Oshima Islands in the southern Japan or at the latitude of about 29°N. These range nearly coincides with the mean surface water temperature of 23°C. The dugong seems to be sedentary and may not make long seasonal migration affected by the seasonal change of the water temperature. Accordingly, if there is any record of the occurrence of the dugong in the waters below the above mentioned temperature, we shall investigate most carefully whether or not the animal belongs to species of cetacean genera *Orcaella* or *Neophocaena*. In March 1979, an animal belonging to the latter genus was misidentified by local people in western Kyushu as a dead dugong.

The third factor influences dugong distribution may be the ocean current. In the wide area of Micronesia, the Palau Islands situated at the western part, is the only place of constant dugong inhabitation. Though, as mentioned above, Ponape and Truk Islands can be a good habitat of the dugong, there is no evidence of dugong distribution. The North Equatorial Current may be a reason of this distribution pattern. If there found some strayed individuals migrating from Melanesia to Micronesia in the north, they were drifted to the west by the current and eventually, unable to reach to central or eastern Micronesia, but arrived at Palau or other nearby islands. This hypothesis suggests that the dugong population in Palau Islands recruited from the population of Melanesia and Papua New Guinea.

Discreteness of the populations

Little have been known about the discreteness of the dugong population. Following is a tentative separation of populations based on geographical differences in density or hiatus of distribution. It is reasonable to consider that there are smaller local breeding units in each population as it is already indicated in the presence of geographical differences in growth rate observed between the populations on the eastern and northern coasts of Australia (Marsh, in press).

Population 1 seems to be distributed widely and densely along the east coast of Australia from about 30°S to Papua New Guinea. It ranges from west of 170°E, and includes the islands of Melanesia, Solomon Is., New Hebrides and New Caledonia. The southern limit of distribution is at Moreton Bay on the east coast of Australia, or at about 30°S. The western boundary of this population, may presumably be at around 140°E.

Population 2 is considered to range from northwest coast of Australia to Amami Oshima at 29°N which is the northern limit in the Pacific, through west coast of Papua New Guinea and the Philippines. The boundary between the populations 1 and 2, especially on the northern coast of Australia, is not distinct. They are possibly of one continued population.

Population 3 is distributed from the west coast of Borneo and west Java to

the both coasts of Malay Peninsula, and from the northern coast of Sumatra Island to the Nicobar and the Andaman Islands, and as north as to Ramree Island. There is no distribution of the species in the Bangkok Bay, which may possibly be related to the muddy bottom and poor sea grass. However the occasional catch along the coast of the Gulf of Thailand was reported by Thiemmedh (1961). Although the distribution along the coast of Cambodia and Viet Nam is unknown, we have heard that some marine mammals were in the lagoon of Cotin China (Viet Name and Cambodia). Presumably they were *Neophocaena* or *Orcaella*. Further investigation in the area is desirable. This population is separated from population 2 by a dispersed distribution area near Borneo and Java or along the longitude of 110°E (Nishiwaki, 1977).

Population 4 ranges from Sri Lanka to the northwest coast of India. The boundary between populations 3 and 4 may be along the longitude of 90°E. This population seems to have had wider distribution in the past, but is apparently decreasing (Bertram and Bertram, 1970; Jones, 1976).

Population 5 ranges from the Red Sea (Gohar, 1957), through east coast of Africa, and Madagascar, to Mauritius. Though dugongs were abundant in former days in the area, they have decreased drastically through the long history of hunting (Gallagher, 1976; Bertram pers. comm., 1979). It was heard that there had been few recent sightings along the coasts of Kenya, Tanzania and the northwest Madagascar (Ligon, 1976), and hunting seems to be still continued. At the Seychelles Islands, a scientist said that there had been some dugongs at the Praslin Islands group in the past but there is no sighting now. At Mauritius, they told us that they seldom saw dugongs. It was told that the species was most abundant, among the east African and Madagascar region, at the Comoro Islands. In the Museum of Tananarive, there was a series of whole skeletons of the dugong collected at the northwest coast of Madagascar. The western limit of the distribution is at the northern part of Red Sea and the northern limit is in the Indian Ocean region is also there.

A presumption on abundance

Following comment on the population abundance was made by M. Nishiwaki.

For conservation of marine mammals, it is necessary to study status of population as well as distribution of them. Because it is nearly impossible to count precise number of marine mammals in the water, estimation of number of animals has to be done based on biological knowledge and statistical records of animal catch. Nishiwaki heard that about 500 animals are killed annually in Torres Strait and York Peninsula area, but there is no statistical record, only scarce data have been collected from the remains of dugong carcasses. In many places protection laws on paper spread, but local people continue to catch dugongs secretly. Secret catch can do nothing for collection of data.

Heinsohn *et al.* (1976), Heinsohn (1978), and Ligon (1976) reported about their aerial countings but they have not published on the population number yet. Some of the present authors were able to join in aerial survey by the thoughtful

cooperation of Dr Heinsohn. We counted dugongs as ten individuals per hour from 900 feet altitude and speed of 100 miles per hour at Halifax Bay area. Though data was scarce and accumulation of experiences were little, Nishiwaki dared to make rough presumption over the five populations. His presumption is merely a milestone to future estimations, but he would like to invite opinions and corrections on this presumption. He estimates the number of dugongs as 5,000 in the east coast of Australia, 6,000 for the Torres Strait and York Peninsula area, and 7,000 in Melanesia. This lead to the total of 18,000 in population 1. Number of dogongs in population 2 is 4,000 in the southern latitude area and 3,000 in the northern latitude area. The population size will be about 2,500 in population 3, 1,000 in population 4, 1,000 in population 5 north of equator, and 500 in the same population south of equator. The number of dugongs all over the Indo-Pacific region may be roughly 30,000 animals. populations 4 and 5 seem to be near to desperation.

It should be emphasized that the accumulation of statistical records of dugong catch and biological knowledge on the species are fundamental matter for conservation of the dugong population.

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REFERENCES

- ANDERSON, P. K. and G. E. HEINSOHN, 1978. The status of the dugong and dugong hunting in Australian waters; a survey of local perceptions. *Biol. Conserv.*, 13(1): 13-26.
- ASANO, N., 1935. On the dugong of Plau. *Botany and Zool.*, Tokyo, 6: 1047-1051, 1219-1228. (In Japanese)
- BERTRAM, G.C.L., 1976. Increased interest in Sirenia. *FAO/ACMRR/MM/SC/94*, 4 pp.
- BERTRAM, G.C.L. and C.K.R. BERTRAM., 1970. Dugongs in Ceylon. *Oryx*, 10(6): 362-364.
- GALLAGHER, M. D., 1976. The dugong *Dugong dugon*, Sirenia, at Bahrain Persian Araboab Gulf. *J. Bombay Nat. Soc.*, 73(1): 211-212.
- GOHAR, H.A.F., 1957. The Red Sea dugong. *Publ. Mar. Bio. St. Gardaga.*, 9: 3-49.
- HEINSOHN, G. E., 1975. The Dugong (*Dugong dugon* Müller); Ecosystem relations, species interactions, and effects of human activities. *FAO/ACMRR/MM/SC/WG/4-1*, 21 pp.
- HEINSOHN, G. E., 1978. Aerial surveys and dugong conservation an overview. *Bull. Australian Mammal. Soc.* 51: 36-37.
- HEINSOHN, G. E., A. V. SPAIN and P. K. ANDERSON, 1976. Population of dugongs (Mammalia: Sirenia): Aerial survey over the inshore waters of tropical Australia. *Biol. Conserv.* 9: 21-23
- HEINSOHN, G. E., J. WAKE, H. MARSH and A. V. SPAIN, 1977. The dugong (*Dugong dugon* (Müller)) in the seagrass system. *Aquaculture*, 12: 235-248.
- HIRASAKA, K., 1933. Dugong. pp. 1-22. *Rep. Survey Natl. Monuments, Animals Part 1*, Min. Edu., Tokyo. (in Japanese)
- HUSAR, S. L., 1975. The dugong: Endangered Siren of the South Seas. *Natl. Parks and Conserv. Mag.*, Feb. 1975. p. 15-18.
- JONES, S., 1976. The present status of the dugong, *Dugong dugon*, (Müller) in the Indo-Pacific and problems of its conservation. *FAO/ACMRR/MM/SC/26*, 47 pp.
- LIGON, S., 1976. Aerial survey of the dugong in Kenya. *FAO/ACMRR/MM/SC/107*, 2 pp.
- MARSH, H. in press. Age determination in the dugong (*Dugong dugon*). Growth of dolphins, porpoises, toothed whales and sirenians: IWC publication.
- NISHIWAKI, M., 1977. Ecology of the dugong and its management. *Mar. Res. Indonesia*, 10: 1-6.
- THIEMMEDH, J., 1961. Notes on the sea cow (*Halicore dugong* Erxleben) in the Gulf of Thailand. *Thai Fish. Gaz.*, 14(3): 213-222. (in Thai with English summary)

A NOTE ON STAMPS OF DUGONG

The government of the Ryukyus under occupation of U.S. issued a stamp of a dugong picture as a rare animal on 20th April 1966. According to Mr A. Isagawa who designed the picture, the motive of the issuance was to make a serial stamps of animals which were protected by the law in Okinawa at that time.

Another stamp of dugong picture was sold at Dar-es-Salaam, as a symbol of endangered species when the research project members visited there.



Stamps of dugong picture. Left: Issued by the Government of the Ryukyus.
Right: Issued by the Government of Tanzania.