

## NEW SEA TURTLE TANK WITH NESTING-GROUND AND ITS EFFECT

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New sea turtle tanks were opened in Okinawa Expo Aquarium in April 1994. Size of main Tank is 16.8m × 10.5m × 2m H and volume is 336 m<sup>3</sup>. It has a sand nesting ground of 115 m<sup>2</sup> connected by a slope of 13° degree to the tank. Volume of sub-tanks are 4m<sup>3</sup>, 23m<sup>3</sup>, and 23m<sup>3</sup>. The smaller tank is for display of pups. Environmental parameters of the tank in average and range are as follows : Water temperature is 23.8°C and 19.4°C to 27.9°C, pH is 8.3 and 8.2 to 8.3, air temperature is 23.5°C and 16.1°C to 30.1°C, humidity is 78.4% and 70.8% to 94.7%. Eight green turtle (*Chelonia mydas*), three loggerhead turtle (*Caretta caretta*) and four hawksbill turtle (*Eretmochelys imbricata*) were kept in this main tank.

From June to July 1994, a female hawksbill turtle of 78cm CL laid eggs in the nesting ground three times. Number of eggs laid was 322 in total and 212 eggs were hatched. Hatching rate was 65.8% and hatching periods were from 51 to 59 days. Carapace length was 4.2cm ±SD 0.8 and body weight 14.2g ±SD 0.5 at hatch, and 16.7cm ±SD 1.51 and 563g ±SD 122.9 at one year old. Survival rate at one year old was 38.7%.

On 21 April 1995, mating of loggerhead turtle was observed and the female laid 625 eggs in five layings. Fertility was so low that only seven pups hatched and some of them showed malformation. All the pups hatched died within 87days.

Sea turtles are one of the friendly animals for Japanese people and they have been kept and exhibited in fifty five of sixty four aquariums in Japan.

Most of the aquarium display them in fish aquaria or simple sea turtle tanks. However, sea turtle tank with nesting ground is very rare.

Although, sea turtles different from land turtles, spend almost all of their life in the ocean, mother turtles land on the beach to lay eggs in their reproductive season. Therefore today's aquariums are required to have sea turtle tanks with a nesting ground to promote the reproduction in captivity and ecological display.

New sea turtle tanks were opened in Okinawa Expo Aquarium in April 1994 (Fig. 1, 2).

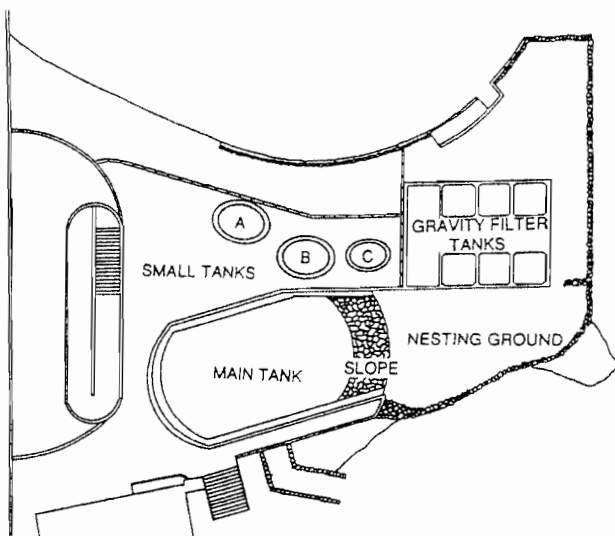


Fig. 1 Floor plan of sea turtle tank

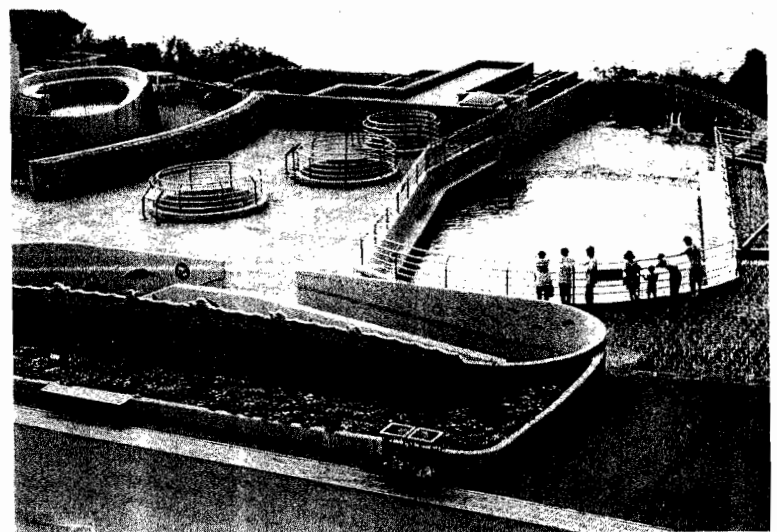


Fig. 2 Sea turtle tank in Okinawa Expo Aquarium

Size of main tank is 16.8m×10.5m×2m H and volume is 336 m<sup>3</sup>. It has a 115 m<sup>2</sup> sand nesting ground with 1.5m deep sand layer connected by a slope of 13° degree to the water of the tank (Fig. 3).

Three sub tanks are adjacent to the main tank. Size and capacity are shown in Table 1. Tank C is for display of pups.

From the underwater viewing room, turtles in main tank are observed through an acrylite panel (10m×1.5m H, 90mm in thickness) (Fig.4). Two sub tanks also have curved acrylite panel windows.

Ecological explanations of the sea turtle, one of the endangered animals, are described with many panels in three language, Japanese, English and Chinese.

Water of the tank is circulated through six sand gravity filter at 150 mt/hr, with making up sea water being supplied at 50 mt/hr. Turn over rate is nearly ten times/day.

Environmental parameters of the tank in

Table 1 Dimensional parameters of Turtle Tanks

Tank	Length	Width	Depth	Vol.
	m	m	m	m <sup>3</sup>
Main Tank	16.8	10.5	2.0	336
A	3.8	3.4	2.2	23
B	3.8	3.4	2.2	23
C	3.3	2.9	0.5	4
Total				386

Nesting Ground	Length	Width	Thickness	Squre
	m	m	m	m <sup>2</sup>
	13	10.5	1.5 (Sand)	115

average and range are as follows : Water temperature is 23.8°C and 19.4°C to 27.9°C, pH is 8.3 and 8.2 to 8.3, air temperatures is 23.5°C and 16.1°C to 30.1°C, humidity is 78.4% and 70.8% to 94.7%. Eight green turtles (*Chelonia mydas* ), three Loggerhead turtles (*Caretta caretta* ) and four Hawksbill turtles

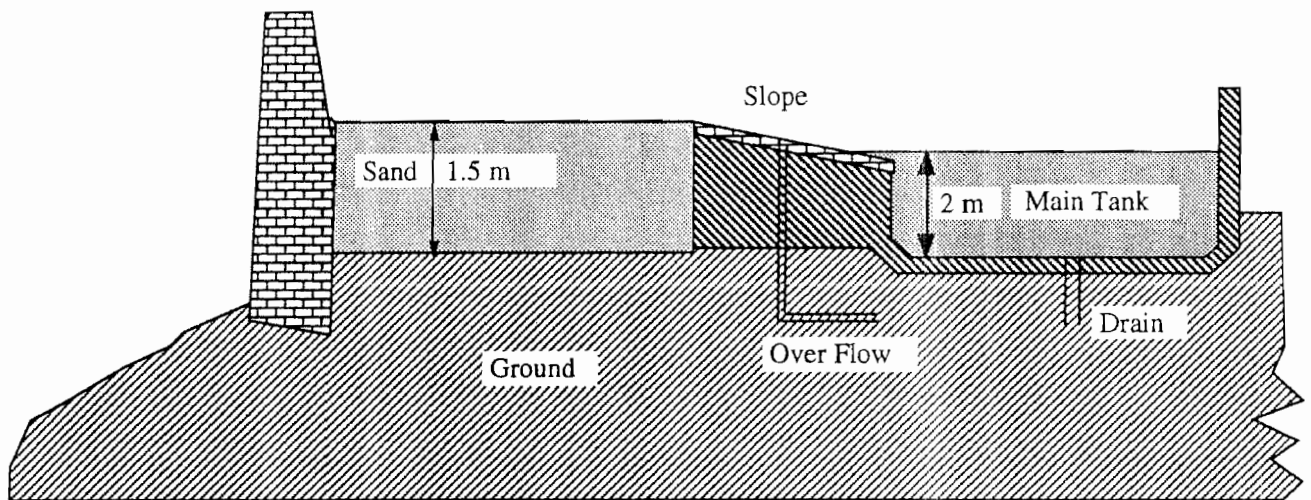


Fig. 3 Cross section of sea turtle main tank and nesting ground.

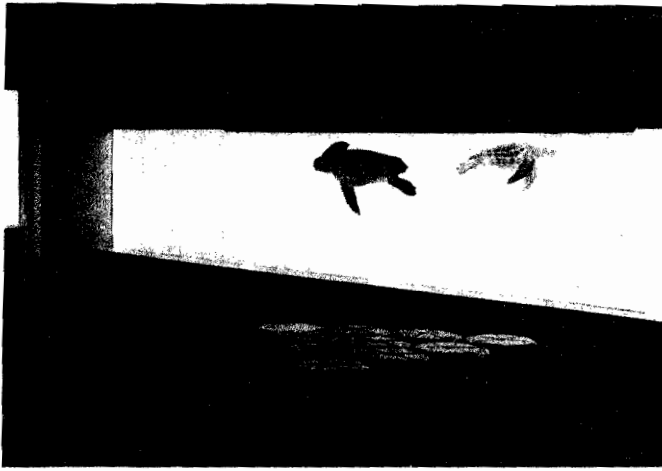


Fig. 4 Underwater viewing room of sea turtle tank

Table 2 Sea Turtles Being Kept in Turtle Tank

	Tank	Number		
		Male	Female	Total
<i>Chelonia mydas</i>	Main	1	7	8
<i>Caretta caretta</i>	Main	1	2	3
<i>Eretmochelys imbricata</i>	Main	1	3	4
<i>Lepidochelys olivacea</i>	A	Unknown		1
Hybrid?( <i>C.m.</i> × <i>E.i.</i> )	B	Unknown		1
Pups	C	Unknown		3-10

(*Eretmochelys imbricata*) were kept in this main tank. Some pups for display were kept in the smallest tank C (Table 2).

A Hawksbill turtle in 1994 and Loggerhead turtle in 1995 laid eggs at the nesting ground of the turtle tank.

The northern limit of nesting ground for the

Hawksbill turtle in Japan has been confirmed to be Okinawa Island by our research.

A female Hawksbill turtle (78 cm CL, 58 cm CW, 69 kg BW), captured in the west coast of Okinawa by set net on May 30, 1994, laid eggs on June 19, 1994, July 5, 1994 and July 18, 1994 at the nesting ground (Table 3).

Table 3 Laying and incubation of *Eretmochelys imbricata* in captivity

Laying		Incubation			
Date	Number	Date	Number	Rate (%)	Periods (Days)
19 Jun 94	110	17 Aug 94	68	61.8	59
5 Jul 94	104	25 Aug 94	85	81.7	51
18 Jul 94	108	10 Sep 94	59	54.6	54
Total	322		212		
Average	107		77	65.8	55

Nest Site Temperature

Periods	Temperature(°C)
20 Jun 94 - 30 Jun 94	27-30
1 Jul 94 - 31 Jul 94	27-32
10 Aug 94 - 10 Sep 94	27-31

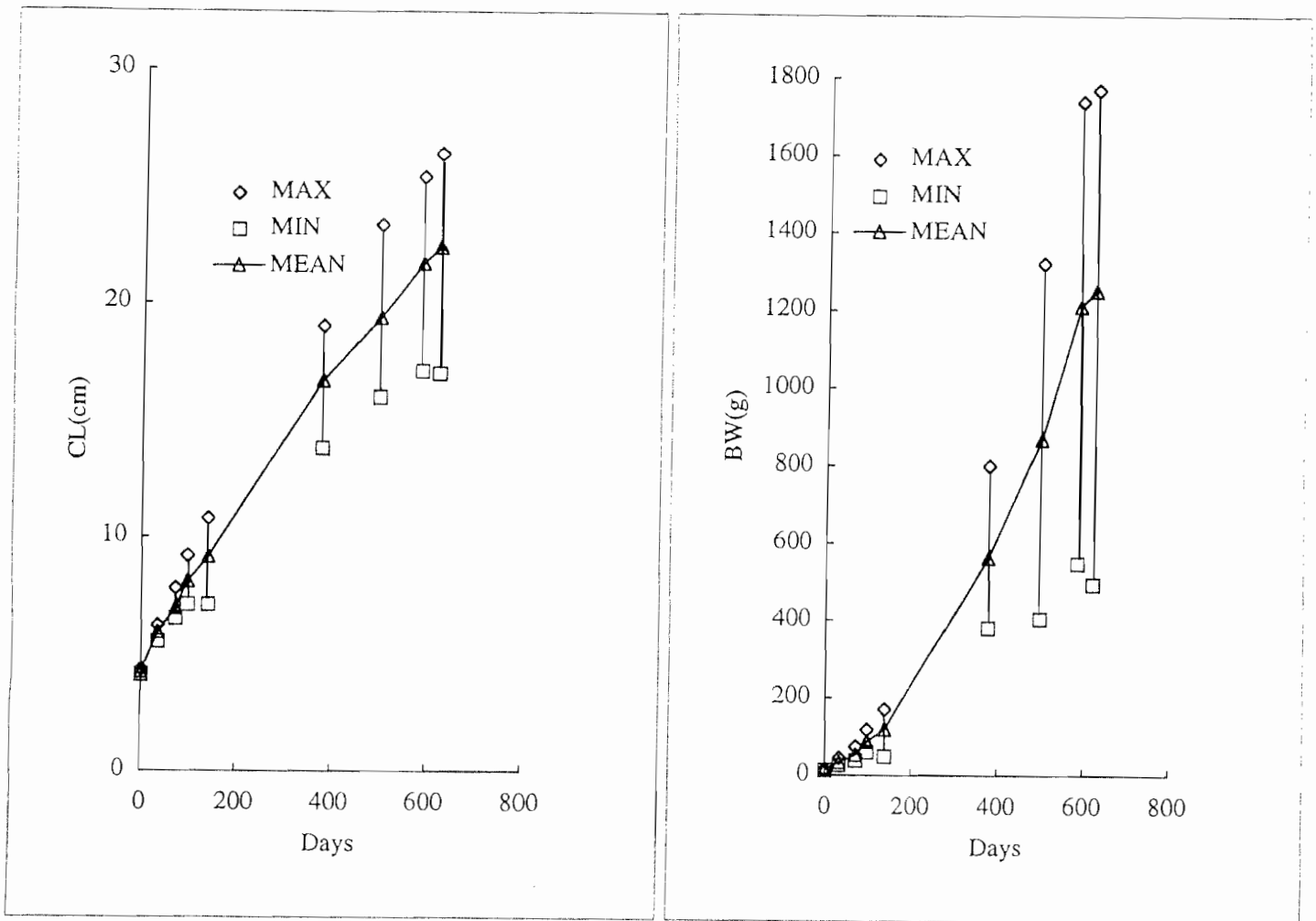


Fig. 6 Growth in carapace length and body weight of tank-hatched hawksbill turtles.

In these three layings, this Hawksbill turtles laid 322 eggs (average 107 eggs) and 212 pups hatched out after 51-59 days (hatchability

65.9%).

Range of sand temperature of nesting ground is as follows, June 20-30 : 27-30°C, July 1-31 : 27-32°C and August 1-Sept. 10 : 27-31 °C.

Hatching began after sun set. In case of Aug. 24, hatched pups got out from the nest at 20:00 and stayed there until the last hatchling came out. At 20:55 they started to run all at once toward the tank water.

It is reported that each pup begins to run as soon as if gets out from the sand.

Just hatching Hawksbill turtles, their mean size and weight were 8.1 cm CL and 86.6 g BW (Fig. 5), after one year 16.7 cm CL and 562.5 g BW, the survival ratio was 38.7 % (Fig. 6).

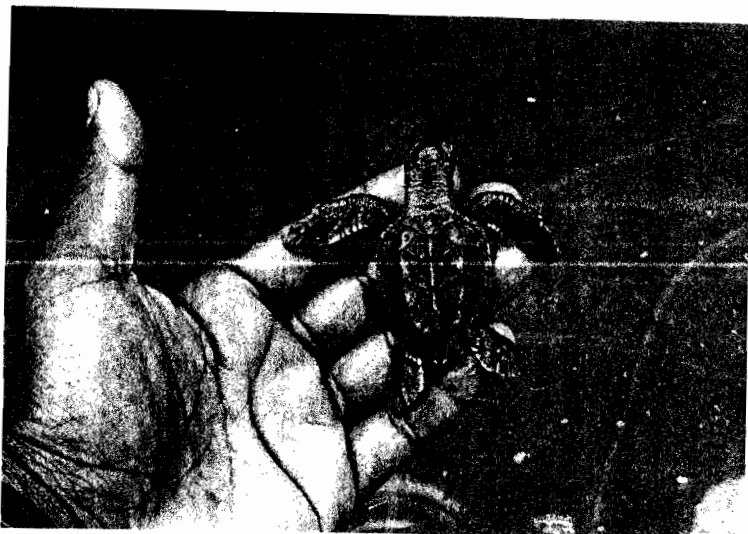


Fig. 5 A just hatching Hawksbill turtle



Fig.7 Mating Loggerhead turtle in sea turtle tank

The more turtles were kept long, the more difference was observed in their growing. Just after hatching, carapace and plastron side showed pale brown in Hawksbill pups and that was similar to Loggerhead pups, but there was difference in the number of lateral scutes and

prefrontal scale between two species.

Four month after hatching, the body color became darker and with the growth pale yellow lines appeared in the part of carapace, and the black part of carapace changed to pale yellow.

One years after hatching, carapace patterns changed into irregular yellow and black.

On April 21, 1995, mating of Loggerhead turtle was observed. The male held the female with his flippers hooking over her carapace for two hours half (Fig.7). They had been caught by set net in the east coast of Okinawa and kept for two years in Okinawa Expo Aquarium.

After the mating the female laid 625 eggs in five depositings. Her five clutches are shown in Table 4.

There were no sign to hatch in eggs laid on May 10, 75 days after hatching. We dug up them

Table 4 Laying and incubation of *Caretta caretta* in captivity

Laying		Incubation			
Date	Number	Date	Number	Rate (%)	Periods (Days)
10 May 95	118	31 Jul 95	6	5.1%	82
25 May 95	96	—	0	0.0%	—
3 Jun 95	141	—	0	0.0%	—
13 Jun 95	133	—	0	0.0%	—
26 Jun 95	137	1 Sep 95	1	0.7%	67
Total	625		7		
Average	125		1.40	1.2%	75

Nest Site Temperature

Periods		Temperature(°C)
18 May 95 -	30 Jun 95	20-25
1 Jul 95 -	31 Jul 95	25-30
1 Aug 95 -	1 Sep 95	27-30

and found only 18 eggs showing embryonic growth, therefore we decided to conduct artificial incubation.

As the result, after 82 days, on July 31, 6 turtles were hatched. But some of them were observed to be malformed with the carapace carved. Among the eggs laid on June 26, only one hatched after 67 days on September 1.

The eggs of May 25, June 3 and June 13 showed no embryonic growth.

Only seven pups hatched in total and all of them died within 87days.

Two causes of this failed breeding were estimated. The first was very low fertilization cause of which was unknown. The second was lower temperature in the nest than that of the average year. Especially in May and June it was 20°C to 25°C while it was 27°C to 29°C in the normal year (Table 4). The normal development and successful hatching is usually expected between 24°C to 33°C in sea turtles.

According to the Red-data book published by IUCN, the sea turtles are endangered species and Washington Convention strictly controls international transactions of turtles. In the Hawksbill case, mother turtle carried eggs fertilized in the sea, so it was not exact reproduction in captivity.

It may be, however, the first successful hatching and growing in captive settings for the hawksbill and proved the tank with nesting ground was of great use for breeding.

We would like to realize successful hatching of this species and other sea turtles as the result of mating in the tank taking advantage of this new

facilities.