

BREEDING OF THE GREEN SEA TURTLE (Chelonia mydas)
AT SEA LIFE PARK, HAWAII

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Introduction

During the period from 1964 to 1973 Sea Life Park acquired 29 adult green sea turtles from various sources around the Hawaiian Islands. These turtles were kept on display in a large artificial pool along with four harbor seals and briefly, four sea lions. Eggs were deposited in the water on four occasions and unsuccessful attempts were made to incubate these eggs. In July 1974, a separate turtle pond with an adjacent artificial beach was built in hopes of initiating a successful breeding program, and eventually restocking natural populations (Ehrenfeld '74).

Facilities

The pond presently housing the adult turtles (5 male, 7 female) is a free-formed oval shape approximately 15 x 8m with a maximum depth of 1.5m. The surface is painted with a hard surface copper-based antifouling paint. Water flow is variable but averages several hundred gallons per minute. There is a bottom drain and a large scum drain. A 2m-wide ramp (3:1 slope) creates an access to the sand beach from the pond. The beach holds twenty cubic meters of crushed coral sand at an average depth of 65cm. This sand contains much more dust than normal beach sand and was very compact before the advent of nesting activities.

The adult turtle diet has consisted of 8kg. of fresh frozen smelt, herring and squid (4:4:1) daily with added multiple vitamins.

Nesting Activities

No nesting or laying activities were noted for the first twenty-three months from the date the turtles were introduced into the new pond. Attempted copulations, however, were occasionally observed.

Beginning 18 June 1976 one or more of the three female turtles presumably involved in the breeding began almost nightly excursions on the sand beach and often escaped into the park grounds. The first clutch of the 1976 season was laid in the water on 6 July. On 12 July a clutch of eggs was deposited in a nest on the beach and subsequently removed to an incubation chest.

Artificial Incubation

Eggs were obtained for artificial incubation by digging and removing them from the nest after the female had completed the nest and returned to the pond. In one instance, an unsuccessful attempt was made to incubate eggs laid in the water.

Incubation methods were modified from those given by Simon (1975). Eggs were placed in a styrofoam chest. The chests had a 5cm layer of damp washed silicone sand and holes in the bottom to drain any excess water. Up to 64 eggs were stacked in each container and covered with a layer of damp paper towels. The chests were stored at ambient room temperature (25-29°C). One clutch was kept on top of a warm incubator. This clutch, although fertile, did not survive, possibly due to overheating. Eggs were checked every 2-4 days and moisture added to prevent desiccation. Eggs were soft and usually dimpled on one side when laid. Fertile eggs became firm and turgid within 2 days. Care was taken not to move or rotate turgid eggs. Hatchlings were removed to a clean incubation chest for 3-5 days until their yolk was completely absorbed.

Natural Incubation

On four occasions "escape" adult turtles were led to a sand pile 50m away and behind a building in hopes that they would find this sand suitable for nesting, but on none of these occasions did the turtles lay eggs. However, an unchaperoned escape turtle evidently found this sand pile and laid a nest. This sand pile was in direct sunlight most of the day and was kept moist by a slight leak in an adjacent salt water holding tank. Only one hatchling was obtained from this clutch. The remaining hatchlings were destroyed by mongooses. This unexpected hatchling was the first indication of what was to come.

The majority of turtles hatched from 8 previously undetected nests in the artificial beach between 9 p.m. and midnight. All of these nests were in a 3.9m² section of the artificial beach farthest from the pond. Hatchlings appeared to crawl towards the brightest light source and were often discovered scrambling clustered around a footpath light.

Fertility of any unhatched eggs was determined by the presence of a blood spot or dead embryo.

Release of Hatchlings

After the first several successful clutches from the artificial beach, hatchlings were released, usually the same night as their emergence, on one of the two nearby isolated sandy beaches. Turtles were placed on the beach at the high-wave mark.

On all occasions they oriented immediately toward the brightest area in the sky, away from the dark cliffs, and scrambled toward the water. They were also attracted by the beam of a flashlight. Most of the hatchlings reached water in less than a minute (est.). Hatchlings kept for a greater length of time (up to 7 days) before their release were much slower entering the water. Being larger and more robust, they also had difficulties righting themselves when overturned by a wave.

Raising Hatchlings in Captivity

Forty-six hatchlings were kept in captivity. They were noted to accept food within 24 hours but did not actively feed until they were 2-4 days old. They were fed a diet of chopped smelt, squid, fresh frozen euphausiids, spinach, and trout chow four times daily. They were also noted to graze on the filamentous green algae growing on the sides and bottom of their tank. Weight gain is plotted in Figure 1. Length increased from 6cm at hatching to an average of 15cm at the date of their release. Twenty-four of these turtles were released on 29 April 1977 from a slowly moving boat (courtesy of SeaFlite, Hawaii) 200m offshore the island of Lanai near Kaunapali Harbor. The turtles were given a metal fore-flipper tag. Each was also injected with an antigen tag developed by Dr. Al Benedict, a research microbiologist with the University of Hawaii. Ten turtles from clutch #5 remain in captivity, four of them at Sea Life Park.

Rearing hatchlings in captivity brought problems of overcrowding and identification. As the hatchlings grew larger they required greater holding tank area. If overcrowded they would nip at one another causing wounds. This obviously could lead to a reduction of the victim's swimming ability. At least one hatchling died from the effects of severe bites, and several were noted to have lost weight during recovery. Of the twelve turtles that died in captivity, most were smaller than their tank mates and died during the first 2½ months. Identification of hatchlings by marking their shells with "indelible" ink was unsuccessful. The fading of the ink and the dark coloration of the turtles' shells necessitated remarking every three days, which became unfeasible. Four turtles of known parentage (clutch #5) were given small flipper tags when they were about 8cm shell length. These tags have worked quite well.

Discussion

Several problems have been encountered during this breeding season. Not the least of these was the awkward time (night) of both nesting and hatching. Female turtles were often not detected until they had wandered over a considerable territory after escaping the artificial beach. On at least eight occasions

turtles nested on the beach without being observed. Hatchling turtles emerging from the beach often spread out rapidly, necessitating flashlight search parties. On each of these occasions at least one hatchling was not found until the following morning, often up to 50m away from the nest.

A number of false nestings occurred, usually when the female dug through the sand to the hard substrate below. The females tended to dig their nests at the far end of the sand patch away from the pool. On one occasion a previously unknown clutch was dug up by a nesting turtle. Considering the number of unknown nests in the small beach, it is curious that this did not occur more than once.

Before the next breeding season the artificial beach will be reconstructed to eliminate some of the above problems. By lengthening the beach it will be possible to erect successive barriers as each clutch is laid. The depth of the sand is being increased to at least one meter. The rock border around the artificial beach will be fortified to prevent adult turtles from escaping. A baby turtle trap is being designed that will attract hatchlings to a lighted box into which they will hopefully crawl and be protected from predators. Other light sources are being eliminated from the view of the emerging hatchlings.

Survival of fertile eggs from the artificial incubators was low primarily due to predation by insects and mongoose. Temperature and humidity in the ambient temperature room could not be controlled to optimize hatching time. These problems should be eliminated with the construction of an appropriated chamber to control these variables.

SUMMARY

Seventeen clutches by no more than three female turtles produced 1,163 eggs, 455 of which were definitely fertile, to produce 398 hatchlings, 343 of which survived at least one day. Of these surviving turtles, 295 were released immediately into the ocean and 46 were kept. After six months, 12 turtles had died, 24 were tagged and released and 10 remain in captivity, four of these at Sea Life Park.


BIBLIOGRAPHY

- Benedict, A.A., 1977. "Three classes of immunoglobulins found in the sea turtle Chelonia mydas." Folia Microbiologica 17:75-78.
- Ehrenfeld, D.W., 1974. "Conserving the Edible Sea Turtle: Can Mariculture Help?" American Scientist, 62:23-31.
- Simon, 1975. "The Green Sea Turtle Chelonia mydas. Collecting, Hatching and Incubation of Eggs." Journal of Zoology, London, VI77 Part 3, pp 411, V176, pg 38-48.

DRUM AND CROAKER

Kowarsky, John 1977 "Cultural Trials of Young Green Sea Turtles -" 7
Aquaculture. 11 (77) 197-215

FIGURE I

>2000g 

GROWTH

1200

Wt.
(gm)

600

100

Nov
0
8

30

Jan
62

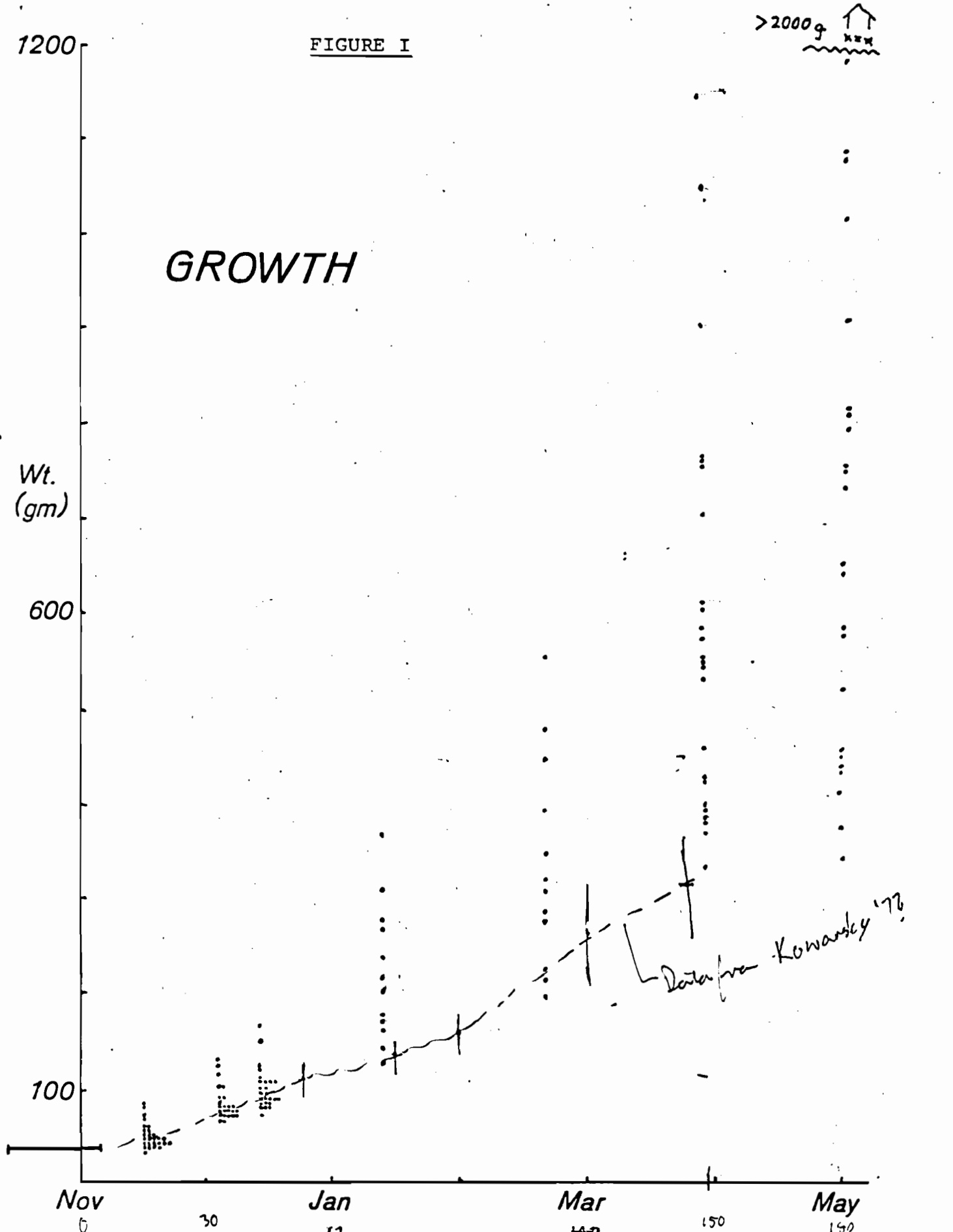
Mar
120
120

150

May
180

OCTOBER 1977

Data from Kowarsky '78



1976 TURTLE HATCHINGS

Clutch #	Date Laid	Date Hatched	Total Eggs	Nonfertile	Fertile	Hatchings Produced	Hatchlings Obtained	Artificial Incubation	Nest in Beach	Eggs in Pond	& Prod.
1	6 July		35	35	0	0	0	X		X	0
2	12 July		64	44	20	0	0	X			0
3	26 July		17	?	?	0	0			X	0
4	28 July		107	107	0	0	0	X			0
5	10 Aug.	3 Nov.	67	≥5	≥20	20	20	X		33	P<80
6		20 Sept	45	9	36	36	1		X		80
7	20 Sept		80	80	0	0	0			X	0
8	30 Sept		114	114	0	0	0	X			0
9		25 Oct	41	24	12	9	0	X			22
10		15 Oct	79	29	50	43	43		X		54
11		30 Oct	73	45	28	25	14		X		34
12		2 Nov	78	14	54	49	49		X		72
13		5 Nov	89	30	59	47	47		X		53
14		24 Nov	81	21	60	57	57		X		70
15		30 Nov	77	4	73	72	72		X		94
16		19 Dec	60	17	43	40	40		X		67
17		21 Dec	85	85	0	0	0		X		0
TOTALS			1163	653	455	398	343				29.3

- (2) Incubated on top of heat source.
- (4) Clutch divided in two. One incubator in a constant T° room. *hatchlings*
- (5) Unknown number of eggs destroyed by mongoose. Eggs laid by female #2009. Four hatchlings sent to Vancouver, four to Waikiki, four kept at SLP.
- (6) Hatched from sand pile behind Reef Tank building.
- (9) Excavated during nesting of clutch # Destroyed by mongoose.
- (10) Insect destruction in nest.
- (13) Three hatchlings found still in nest.
- (17) Found when beach excavated.