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RECIP.NAME RECIPIENT AFFILIATION
EISENHUT,D.G. Division of Licensing

SUBJECT: Forwards Applied Biology,Inc Jan 1981 rept "Successful Relocation of Sea Turtle Nests Near St Lucie Plant, Hutchinson Island,FL."

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FLORIDA POWER & LIGHT COMPANY

April 22, 1981
L-81-175

Office of Nuclear Reactor Regulation
Attention: Mr. Darrell G. Eisenhut, Director
Division of Licensing
U. S. Nuclear Regulatory Commission
Washington, DC 20555

Dear Mr. Eisenhut:

Re: St. Lucie Units 1 and 2
Docket Nos. 50-335 and 50-389
Sea Turtle Nest Relocation

Attached for your information is a report prepared for Florida Power & Light Company by Applied Biology, Inc., Atlanta, Georgia, titled, "Successful Relocation of Sea Turtle Nests Near the St. Lucie Plant, Hutchinson Island, Florida", and dated January, 1981. The report describes a program implemented during construction work on the St. Lucie Unit No. 2 discharge pipeline in 1980.

Very truly yours,

Robert E. Uhrig
Vice President
Advanced Systems and Technology

REU/TCG/gw

Attachment

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ABI-317

SUCCESSFUL RELOCATION OF SEA TURTLE NESTS

NEAR THE ST. LUCIE PLANT

HUTCHINSON ISLAND, FLORIDA

JANUARY 1981

APPLIED BIOLOGY, INC.
ATLANTA, GEORGIA

CONTENTS

INTRODUCTION

Every year, from May to September, many Atlantic loggerhead turtles (Caretta caretta) use Hutchinson Island, Florida as a major nesting area (Gallagher et al., 1972). In addition, a small number of nests are made by Atlantic green turtles (Chelonia mydas) and leatherback turtles (Dermochelys coriacea). The extent and distribution of turtle nesting on the island has been monitored in alternate years since 1971 by Florida Power & Light Company to evaluate any potential influences from the construction and operation of the St. Lucie Plant. Maintaining the vitality of the Hutchinson Island rookery is important in view of the declining world populations of marine turtles (IUCN, 1969, 1971; NMFS, 1978).

The Florida Power & Light Company began construction of the cooling water discharge system for the St. Lucie Plant Unit 2 in 1980. This system utilizes a 5-meter diameter pipe buried under the beach and nearshore areas to carry the heated water to an offshore discharge. The installation of this pipe involves construction of a trench through the barrier dune and beach and the installation of a cofferdam from the beach to the end of the pipe. This construction is similar to that used in 1975 when the Unit 1 discharge pipe was installed.

The 1975 construction was shown to reduce nesting by sea turtles in the area of construction activity (ABI, 1977). After the construction was completed, sea turtle nesting returned to normal.

Florida Power & Light Company was concerned for the well being of the turtles and asked Applied Biology, Inc. (ABI), to monitor turtle nesting activity during the discharge pipe construction period. Additionally, to protect eggs incubating in nests in the construction area from possible destruction, a nest relocation program was implemented. Because the Atlantic loggerhead turtle has been the dominant species nesting on the island, discussions are based on this species unless otherwise noted.

MATERIALS AND METHODS

Four of the nine 1.25-kilometer-long segments of beach established as sample areas by Gallagher et al. (1972) were used for the nesting survey (Figure 1). These areas are located from 3 kilometers north of the power plant to 8 kilometers south of the plant and are numbered Area 3 through Area 6. The sample areas are approximately equidistant from each other along the island and are typical of nearby beach habitats. It was assumed that the distribution of turtle activity in the sample areas would be comparable to previous studies and, therefore, representative of nesting patterns established for Hutchinson Island (ABI, 1979). Any change in nesting trends observed in Sample Area 4 (the plant site) would be considered to be due to construction activity.

The four sample areas were surveyed each morning from 1 May through 15 September using small off-road motorcycles to locate and mark each new nest. Nests were marked with a stake, numbered, and dated to maintain accurate counts of the number and distribution of nests. Records were kept of raccoon nest predation and unsuccessful nesting attempts (false crawls) by turtles.

Sample Area 4 is adjacent to the power plant where construction was planned. Any nests made in the southern 0.8 kilometer of this area were considered to be potentially affected by construction activity and were relocated to a beach area 4.4 kilometers south of the power plant (Figure 1).

Limpus et al. (1979) found a significant decrease in hatching rates of loggerhead eggs that had been moved and inverted between 12 hours and 14 days after laying. To avoid this mortality, all eggs to be moved from the construction site vicinity were relocated within 12 hours of deposition. The eggs were counted, reburied and allowed to hatch under natural conditions.

At certain times, raccoon predation on the relocated nests required the setting of live traps to remove the predators. Additionally, some relocated nests were covered with poultry wire to prevent predation. All relocated loggerhead nests and a comparable number of undisturbed nests from Areas 3, 5 and 6 were examined after signs of hatchling emergence to determine hatch success. Records were kept of the incubation period, number of hatched and unhatched eggs, and live or dead hatchlings remaining in the nest. The hatching success of undisturbed nests was compared to relocated nests to detect any adverse effects from handling the eggs.

RESULTS AND DISCUSSION

Nesting Density

The total of 528 loggerhead nests observed within the four survey areas during 1980 is consistent with nest production in these areas during the five previous survey years (Figure 2). Maximum nesting occurred in June as it has in most previous years (Figure 3). Additionally, the percentage of nests deposited in Area 4 in 1980 was 25 percent of the total nests observed in Areas 3 through 6. This is consistent with previous surveys in which the Area 4 percentage of the total nest production in Areas 3 through 6 ranged from 21 to 27 percent. The one exception occurred in 1975 when construction activity and lights on the beach at night reduced the nesting in Area 4 to 11 percent of the total production in Areas 3 through 6.

In each survey since 1971, a gradient of nest density has been observed with the lowest densities being found on the northern portion of the island. Linear regression analysis of variance of nest density with respect to distance from the Ft. Pierce Inlet has been used to describe the gradient of nesting during previous surveys (ABI, 1979). The linear regression equation expressing nest density along the island in 1980 is $Y = 51.57 + 4.92X$; $r^2 = 0.68$;

where: $Y = a + bX$,

Y = Number of nests,

a = Y intercept,

b = Slope of the regression line,

X = Kilometers from Ft. Pierce Inlet.

While the regression equation for 1980 is based on values from four sample areas and past studies were based on nine areas, the slope of 4.92 is consistent with the values (range 1.57 to 7.71) representing the spatial distribution of turtle nests observed during previous surveys.

The total number of nests deposited on Hutchinson Island during each of the five previous survey years has been calculated using the area under the regression line that best describes nest density distribution along the island (Gallagher et al., manuscript in preparation). An estimate of 4168 loggerhead nests on the island was calculated for 1980 using the regression line calculated from the four areas. This number is within the range of 4000 to 5400 nests estimated on the island each survey year since 1971.

Previous turtle tagging studies suggest that it is reasonable to estimate that one turtle utilizes the Hutchinson Island survey beach for every two nests produced (ABI, 1979; Ehrhart, 1979). Using this estimate of two nests per female, a nesting population of 2084 turtles was calculated for the 1980 season. Population estimates from surveys since 1971 indicate the female population nesting on Hutchinson Island is fairly stable at over 2000 individuals.

Nesting Success

Turtles may crawl up on the beach and even begin nest excavation only to return to the sea without depositing eggs. The cause of these unsuccessful nesting attempts (false crawls) is not understood, but their fre-

quency may reflect the overall suitability of a beach for nesting. The index derived from false crawl data used in this and previous reports has been termed "nesting success" and is defined as:

$$S = \frac{N}{N + F} \times 100$$

where: S = Percent nesting success,

N = Number of nests,

F = Number of false crawls.

Nesting success has generally declined in each of the four survey areas since 1975 (Figure 4). The overall nesting success for the four areas has declined each year from a maximum of 54 in 1975 to a minimum of 45 in 1980. This is a continuation of the slight long-term decline in overall nesting success observed on Hutchinson Island since 1975 (ABI, 1979). The cause of this decline in nesting success is not known.

Turtle Nest Relocation

In all, 89 loggerhead turtle nests containing a total of 9948 eggs were removed from Area 4. In addition, one green turtle nest was removed and turned over to Mr. Ross Witham of the Florida DNR for the Head-Start Program.

The mean clutch size was 111 eggs with a range of 50 to 158 eggs per nest. Caldwell et al. (1959) reported a somewhat larger average clutch size of 126 eggs (range 64 to 198) for 71 nests on Cape Romain, South Carolina. He further observed that the number of eggs per clutch decreased as the nesting season progressed. For Hutchinson Island, a

linear regression analysis of clutch size in relation to time in the nesting season showed a relationship described by the equation:

$Y = 124.4 - 3.0X$; $r^2 = 0.70$;

where: $Y = a + bX$,

a = Y intercept,

X = Time of nesting season,

b = Slope.

The regression equation predicts a 17.3 percent reduction in clutch size of those nests deposited the last two weeks of the season compared to those deposited during the first two-week period (Figure 5).

Incubation Period

Hirth (1971) has defined incubation period as the period between oviposition and emergence of the largest number of hatchlings on the surface. This qualification is necessary as emergence from a single nest may occur over several days. The incubation period for Hutchinson Island nests ranged from 46 to 60 days with a mean of 50.5 days for the relocated nests and from 46 to 61 days with a mean of 50.1 days for undisturbed nests. A t-test evaluation showed no significant difference ($P \leq 0.05$) in incubation periods for the two groups. A delay in the hatching of eggs from relocated green turtle nests reported by Prichard (1967) was not observed in the loggerhead nests relocated during this study.

Incubation periods for eggs deposited during the beginning of the nesting season and those deposited late in the nesting season were longer than the incubation periods for eggs deposited during mid-season (Figure 6). Caldwell et al. (1959) found a similar temporal pattern of incubation periods among loggerhead nests in South Carolina. He concluded that incubation periods shortened as the seasonally increasing temperature and amount of sunlight increased the total amount of heat received by the nests.

Hatch Success

Hatch success was determined by digging up nests after hatchling emergence and counting the number of hatched eggs, unhatched eggs and live or dead hatchlings still in the nest. Hatch success, the number of viable hatchlings reaching the surface, was calculated using the formula:

$$S = \frac{N-(U + D)}{E} \times 100$$

where: S = Hatch success,

N = Number of hatched eggs,

U = Number of unhatched eggs,

D = Number of dead hatchlings,

E = Total number of eggs.

Counting hatched eggs may introduce a source of counting error into this equation if the total number of eggs in the clutch is not known because many shells are reduced to fragments. For this study, the counting error in the field effort was determined by comparing the field count of hatched eggs with the actual clutch size. The mean counting error for

eggs in all relocated nests was 5.3 percent or only a 1 percent error in hatch success.

Hatch success of relocated nests averaged 80.9 percent while the hatch success of undisturbed nests averaged 84.5 percent. The mean hatch success for undisturbed nests may be artificially high because of the difficulty in locating unsuccessful and infertile nests after the normal incubation period. However, because hatch success rates for the two groups are not significantly different ($P \leq 0.05$), handling of the eggs during the relocation process did not reduce nest viability.

Green and Leatherback Turtles

Green and leatherback turtles nest on Hutchinson Island, but less commonly than the loggerhead. Since 1971, the number of green turtle nests has ranged between 5 and 37 per year, while leatherback nest numbers were between 1 and 7 (ABI, 1979). Although an entire island count is not available for 1980, the beach bounded by Areas 3 and 6 inclusive contained 14 green turtle nests and 4 leatherback nests. The majority of green turtle nests were observed between Areas 5 and 6, and for the first time, green turtle nests were observed adjacent to the St. Lucie Plant. This may be a continuation of the gradual northward shift in the preferred nesting location observed for green turtles since 1971 (ABI, 1979).

SUMMARY

Limited construction activity associated with installation of the Unit 2 discharge system during the summer of 1980 had no apparent adverse effect on marine turtles nesting on Hutchinson Island. Nest densities within the construction site and nearby areas were consistent with densities observed during previous surveys. Based on the 528 loggerhead nests observed in survey Areas 3 through 6, an estimate of 4168 nests was made for the island. This is consistent with the number of nests occurring on the island each year since 1971. The gradual decrease in nesting success observed since 1975 continued. Nesting success in the four survey areas combined was 45 percent in 1980.

In all, 89 loggerhead nests were relocated from the proposed construction site. Mean clutch size was 111 eggs. Relocating the nests did not significantly alter the hatch success as compared to undisturbed nests, nor did relocation affect the incubation period. In general, nests deposited early in the season contained more eggs than nests laid later in the season. The incubation period, however, was longer for eggs deposited either early or late in the season than eggs laid during mid-season.

The rate of raccoon predation on nests varied between areas but was similar to 1979 levels. Predation in the relocation area was reduced by trapping raccoons and covering nests with poultry wire.

The number and distribution of green and leatherback nests was similar to previous surveys, but for the first time since the surveys began green turtles nested adjacent to the power plant.

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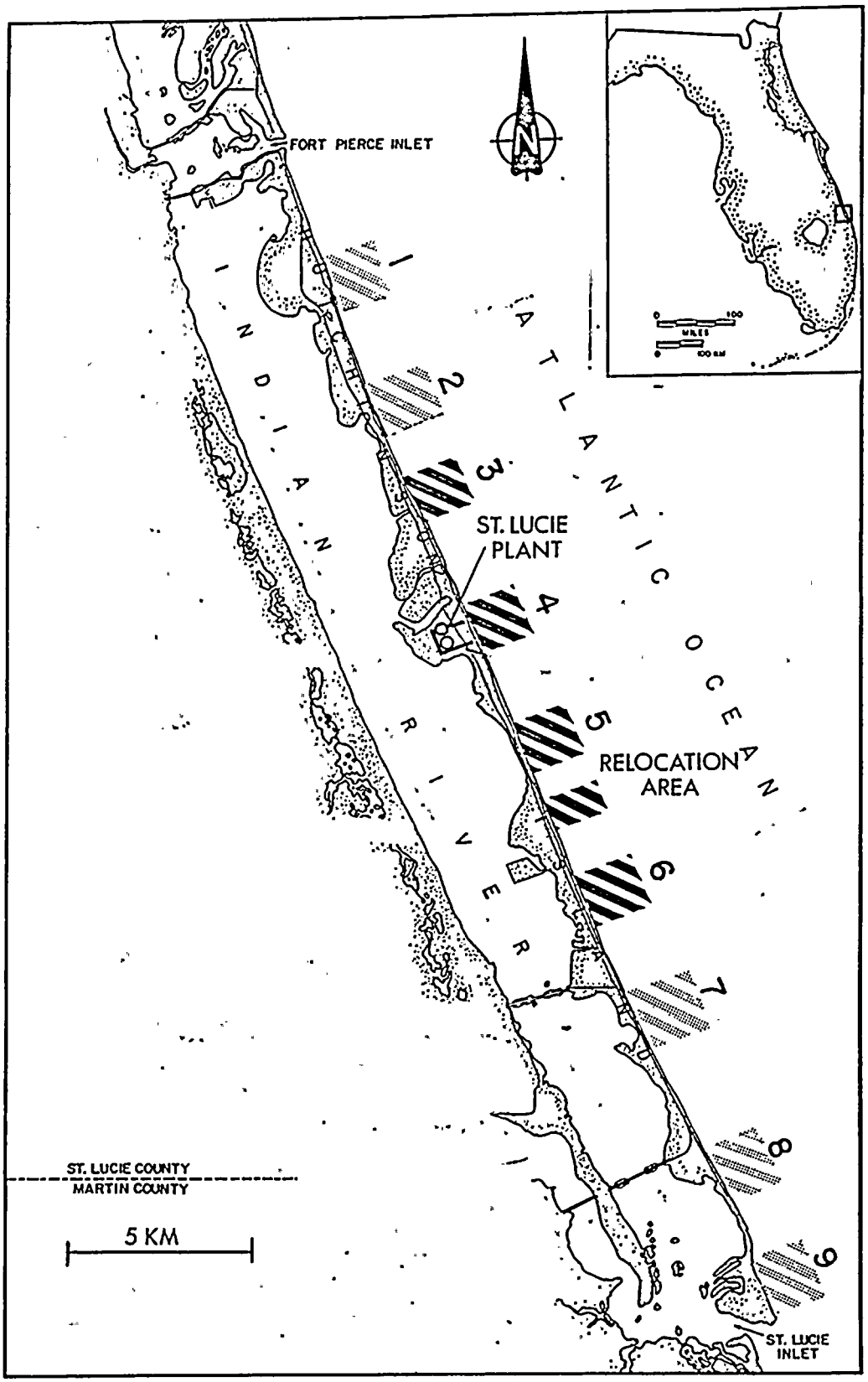

Figure 1. Location of four survey areas (3-6) used to monitor turtle nesting activities, Hutchinson Island, Florida, 1980.

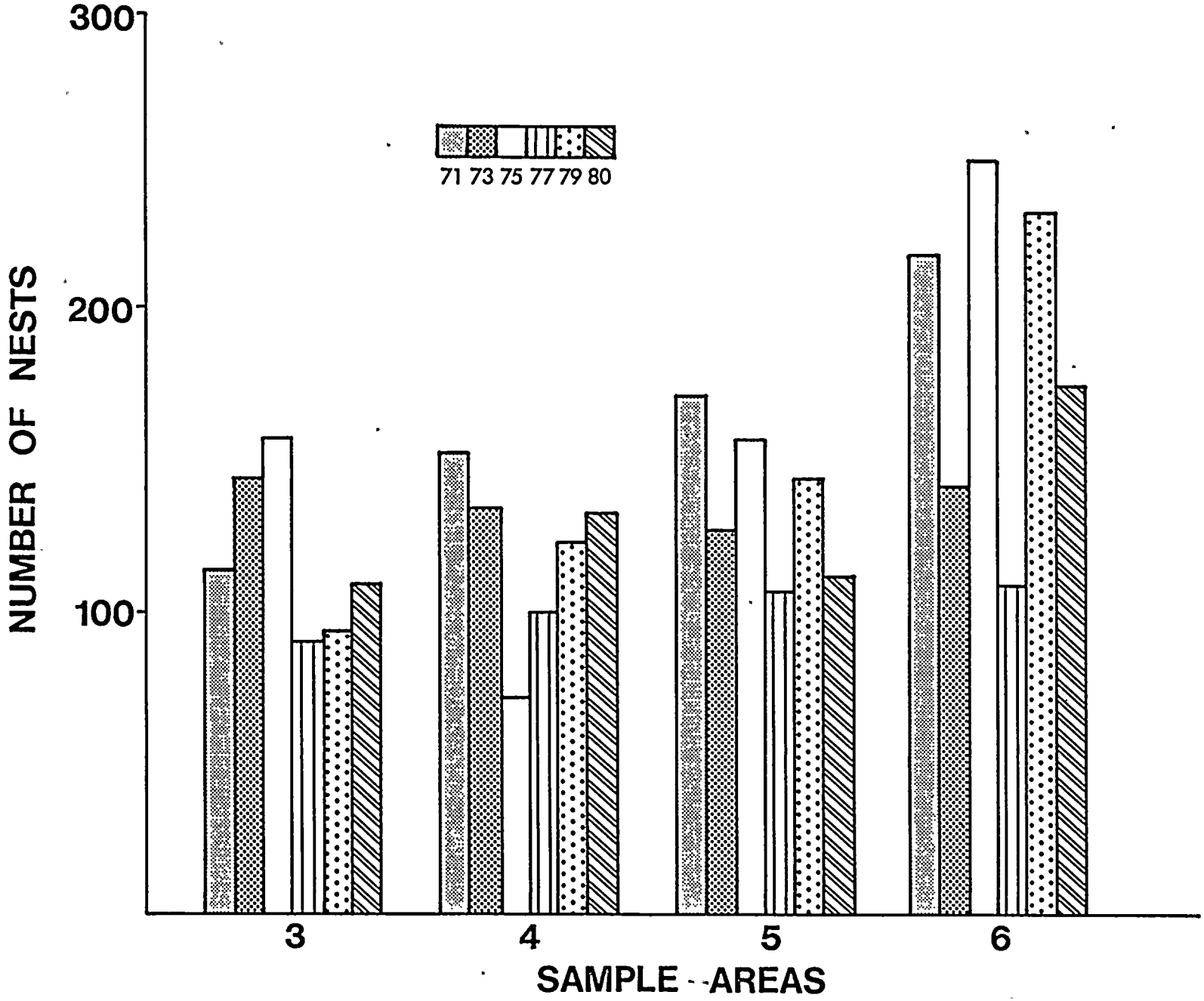

Figure 2. Number of loggerhead turtle nests found on Hutchinson Island by sample area and year.

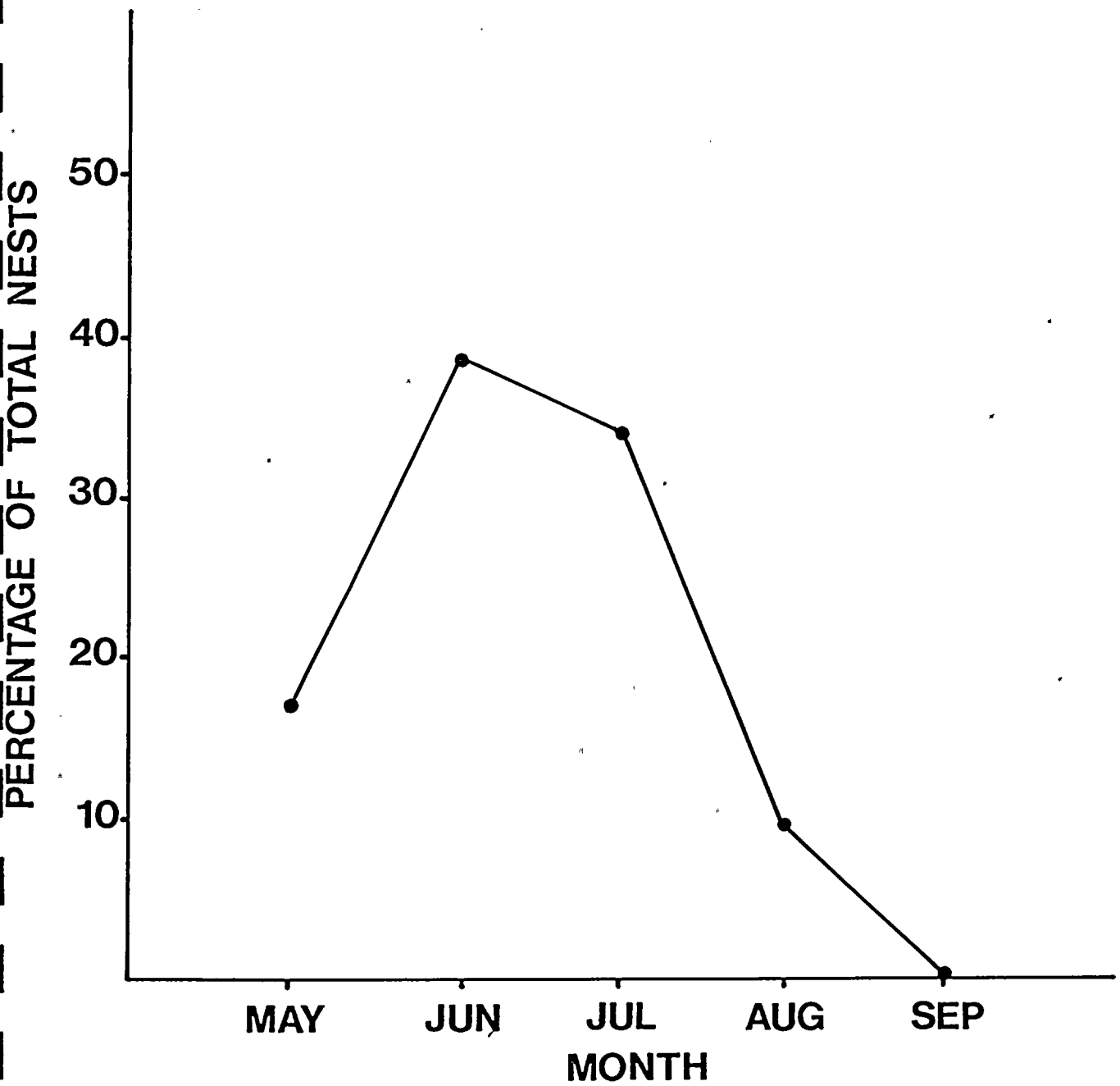

Figure 3. Percentage of total loggerhead nests deposited on Hutchinson Island by month, 1980.

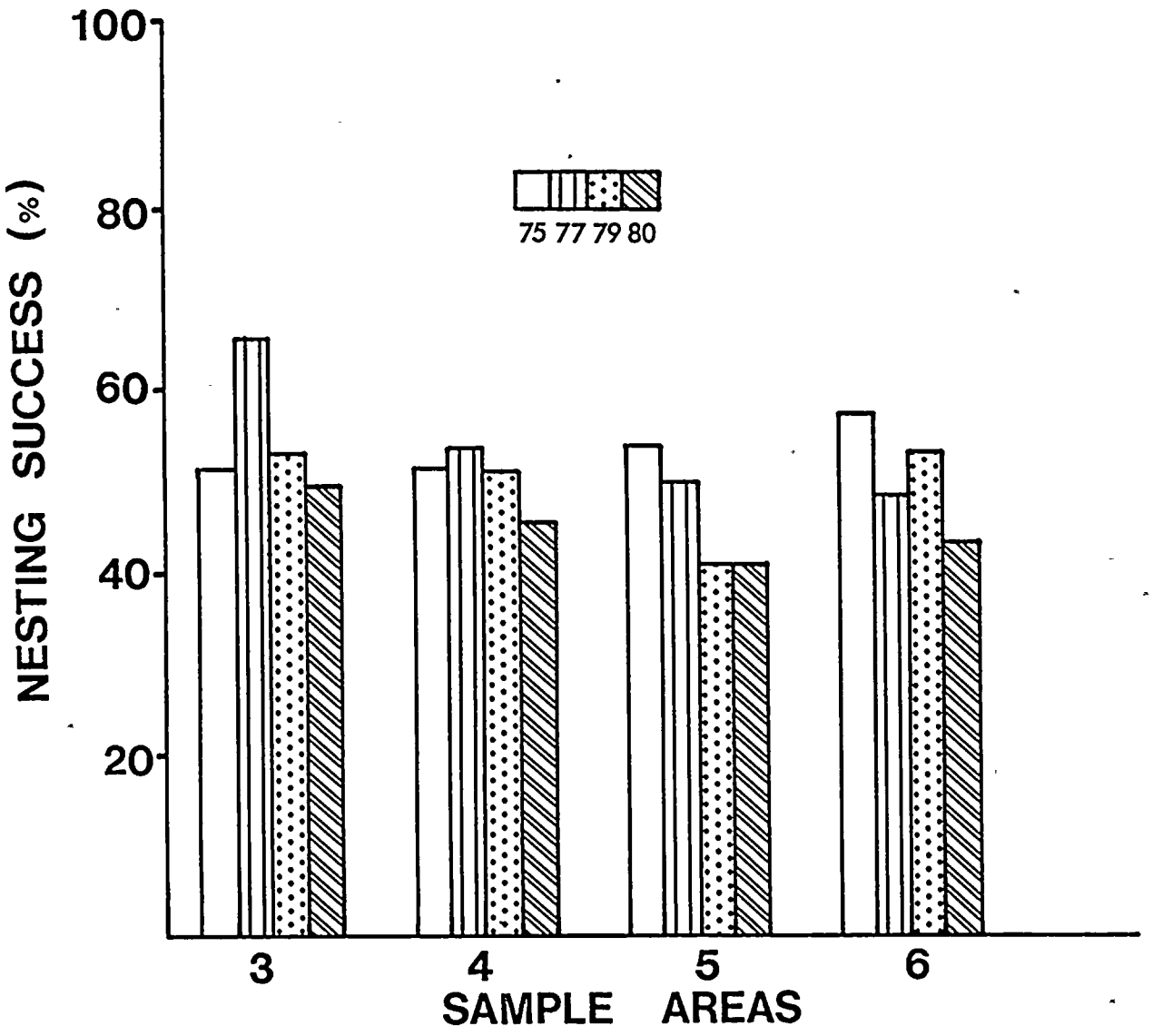

Figure 4. Percentage nesting success of loggerhead turtles by sample area and year.

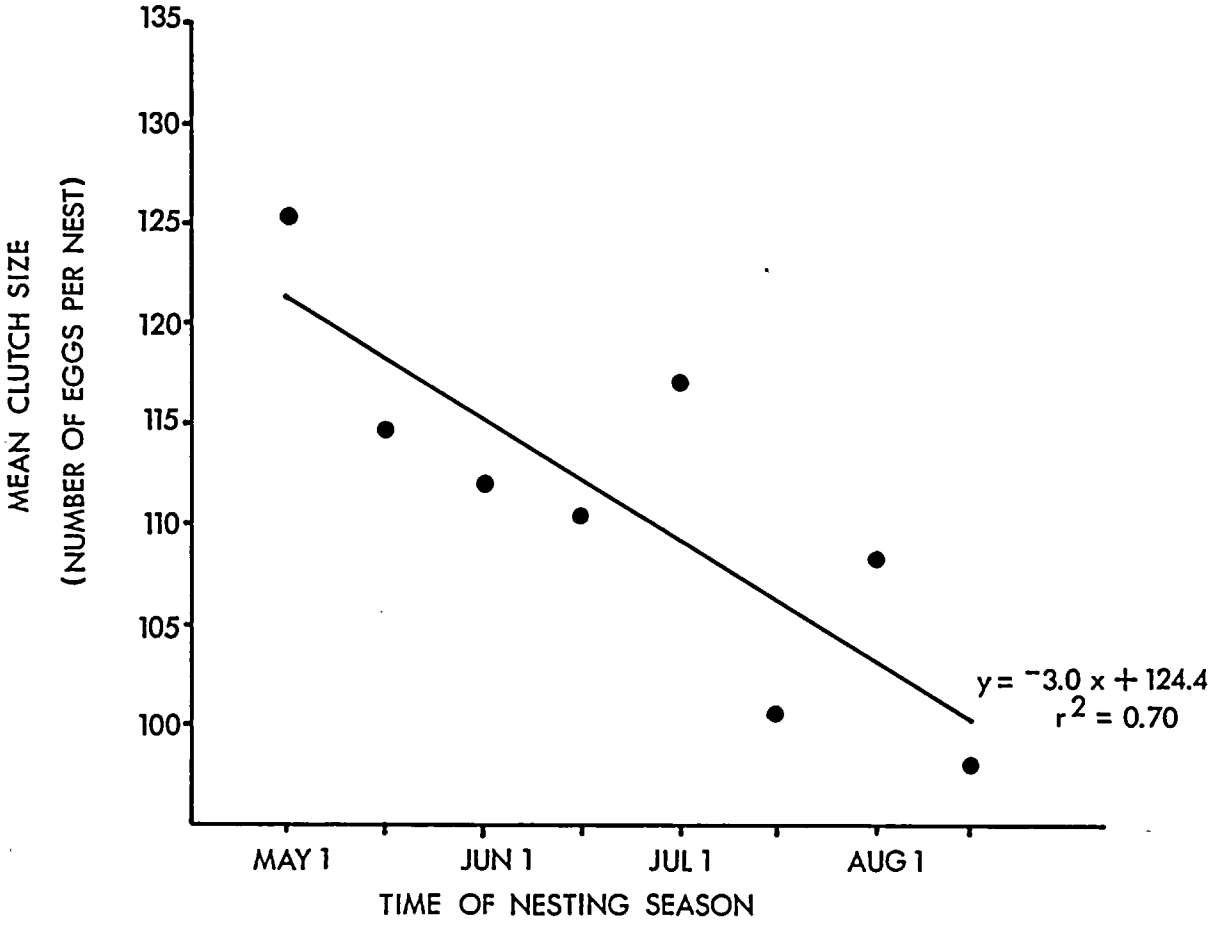

Figure 5. Mean clutch size and regression line of nests deposited on Hutchinson Island by month in 1980.

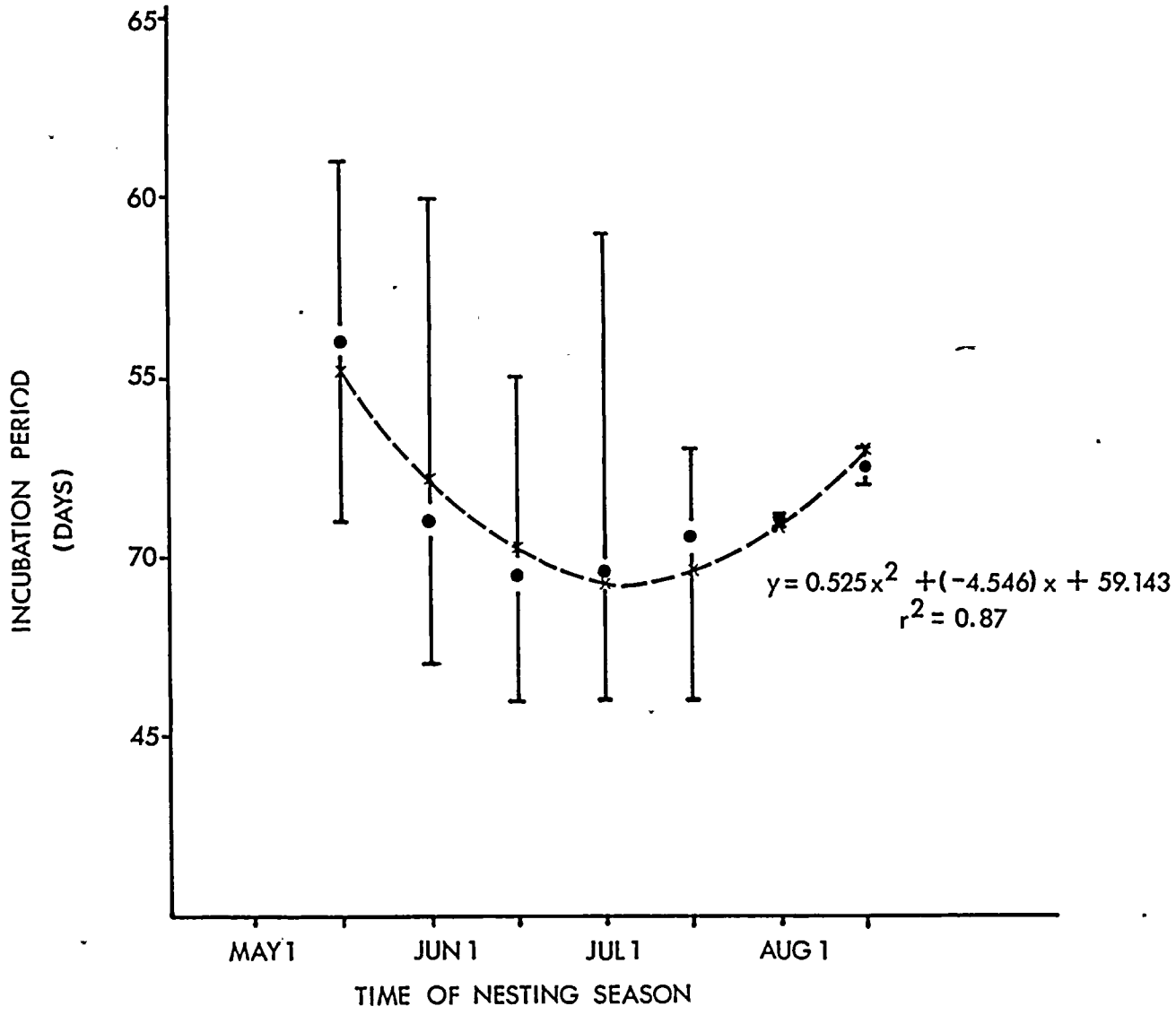

Figure 6. Incubation periods of loggerhead turtle nests by time of nest deposition.