Burney
2-25-92

our
copy

SEA TURTLE CONSERVATION
PROJECT
BROWARD COUNTY, FLORIDA
1991 REPORT

Submitted by:

Curtis Burney
Principal Investigator
and
Cathy Mattison
Project Manager

Nova University
Oceanographic Center
8000 North Ocean Drive
Dania, Florida 33004

For the:

BROWARD COUNTY BOARD OF COUNTY COMMISSIONERS
EROSION PREVENTION DISTRICT
OF THE
OFFICE OF NATURAL RESOURCE PROTECTION
609 B SW 1st Avenue
Fort Lauderdale, Florida 33301

TABLE OF CONTENTS

LIST OF TABLES ii

LIST OF FIGURES iii

ACKNOWLEDGEMENTS v

INTRODUCTION 1

MATERIALS AND METHODS 3

RESULTS 8

DISCUSSION 37

REFERENCES 45

APPENDICES
I. Summary of Hotline Calls 46
II.Summary of Educational Activities 47
III. Sea Turtle Summary Report Form 48

LIST OF TABLES

Table 1: Total *C. caretta* nests and nesting densities expressed as nests-per-kilometer for the 1991 season.......13

Table 2: Total *C. mydas* nests and nesting densities expressed as nests-per-kilometer for the 1991 season.......14

Table 3: Total nests, false crawls (FC) and percent nesting success (NS) for three sea turtle species in each of five Broward County beach areas during 1991.......17

Table 4: Total egg counts, released hatchlings and overall hatching successes for in situ and relocated nests of *C. caretta, C. mydas* and *D. coriacea*.......24

Table 5: Comparison of *C. caretta* hatching success at Hillsboro Beach by 1-way ANOVA and contingency table analyses.......26

Table 6: Comparison of *C. caretta* hatching success at John Lloyd State Recreation Area by 1-way ANOVA and contingency table analyses.......27

Table 7: Comparison of overall nest relocation and hatching results by beach for all species combined.......29

Table 8: Contingency table analyses of the effect of beach renourishment on nesting success in John Lloyd State Recreation Area.......34

Table 9: Contingency table analyses of the effect of beach renourishment on hatching success of natural (in situ) nests deposited in John Lloyd State Recreation Area.......36

LIST OF FIGURES

Figure 1: The historical pattern (A) and statistical trend (B) of total sea turtle nesting in Broward County since full surveys began in 1981 9

Figure 2: Historical nesting patterns for *C. caretta* (6A),*C. mydas*(B) and *D. coriacea*(B) in Broward County, 1981-1991 10

Figure 3: The seasonal pattern of daily *C. caretta* nest counts in Broward County, 1991 11

Figure 4: Comparison of the daily nesting patterns of *C. caretta, C. mydas* and *D. coriacea* at the five Broward Co. beaches during 1991. Hillsboro-Deerfield, A; Pompano, B; Fort Lauderdale, C; John Lloyd State Recreation Area, D; Hollywood-Hallandale, E 12

Figure 5: Locations of *C. caretta* (A), *C. mydas* (B) and *D. coriacea* (C) in Broward Co., 1991, listed by DNR locator number. 15

Figure 6: Comparison of the seasonal patterns of mean daily nesting success (nests/total crawls) for *C. caretta, C. mydas* and *D. coriacea* at the five Broward Co. beaches during 1991. Hillsboro-Deerfield, A; Pompano, B; Fort Lauderdale, C; John Lloyd State Recreation Area, D; Hollywood-Hallandale, E. 18

Figure 7: The horizontal distribution of average *C.caretta* nesting success on each beach segment identified by the DNR survey markers. 19

Figure 8: The number of *C. caretta* eggs per clutch plotted versus the Julian date of deposition in Broward Co. during 1991. 20

Figure 9: Seasonal patterns of *C. caretta* hatching success of in situ and relocated eggs deposited on the five Broward Co. beaches. Hillsboro-Deerfield, A; Pompano, B; Fort Lauderdale, C; John Lloyd State Recreation Area, D; Hollywood-Hallandale, E. 21

Figure 10: Comparison of the seasonal trends of the hatching success of relocated (A) and in situ (B) *C. caretta* nests deposited on Hillsboro-Deerfield beach during 1991. 22

Figure 11: The historical patterns of yearly hatching success in relocated and in situ (natural) nests since fenced beach hatcheries were first employed in 1981. 25

Figure 12: The mean hatching success of eggs from Pompano and Fort Lauderdale Beach which were relocated to Hillsboro Beach, shown by the location of their original deposition given by DNR locator numbers....28

Figure 13: Total yearly sea turtle nest counts in the four beach zones of John Lloyd State Recreation Area during 1991. 31

Figure 14: The Horizontal pattern of sea turtle nesting success in the four beach zones of John Lloyd State Recreation Area during 1991....32

Figure 15: The total numbers of sea turtle nests relocated and left in situ in the four beach zones of John Lloyd State Recreation Area during 1991. 33

Figure 16: Comparison of the seasonal patterns of mean daily sea turtle nesting success in zones 3 and 4 of John Lloyd State Recreation Area during 1991. 35

ACKNOWLEDGEMENTS

We thank the **Erosion Prevention District of the Broward County Office of Natural Resource Protection** and especially **Lou Fisher** who administered the project and solved several problems.

We gratefully acknowledge the dedicated efforts of **Michael Biggy, John Braker, Kevin Carter, Judith Hicklin, John Hocevar, Jenny Kappel, Bill Margolis, Chris Marshall, Dorothy Merrill, Bob Miller, Donny Norman, Barbara Maloney Prendergast, Connie Stephens, Denice Teeples, Terry Thompson, and Dale Vicha,** who helped with the field surveys, night releases, stranded turtles, and/or hatchery sand replacement. Their dedication and hard work has made the project a success. We gratefully thank the owner, Steve St.Clair, and Pat of **Competition Cycle, Dania, FL** who kept the all-terrain vehicles running and provided emergency repairs whenever a problem arose. We also acknowledge the park employees of the Broward County Park and Recreation Division at **Hollywood North Beach Park** and the Rangers at **John U. Lloyd S.R.A.** (especially **Ed Strickland**) who were always willing and able to offer assistance whenever we needed it. We would especially like to thank the following people for their assistance and cooperation:

Paul Eaton, Ed Lampert and the **Hollywood Beach Maint. Dept.**
John Dep and the **Hallandale Beach Maint. Dept.**
Fort Lauderdale Beach Maint. and **Public Works Dept.**
Beach Rakers of Pompano Beach, FL.
Mr. and Mrs. Bill Hall of the Malulani.
Pompano Beach Maint. Dept. and **Public Works Dept.**

We also acknowledge the following agencies and local governments for their cooperation in the completion of this project:

The Florida Department of Natural Resources, Division of Recreation and Parks

The Florida Marine Patrol

The Florida Department of Natural Resources, Institute of Marine Research

The Cities and Police Departments of Hallandale, Hollywood, Dania, Fort Lauderdale, Lauderdale-By-The-Sea, Pompano Beach, Deerfield Beach and the Town of Hillsboro Beach.

INTRODUCTION

Since 1978, the Broward County Erosion Prevention District (BCEPD) of the Broward County Office of Natural Resource Protection (formerly the Environmental Quality Control Board) has provided for the conservation of endangered and threatened sea turtle species within its area of responsibility, according to provisions of the dredge and fill permits issued to the District by the U.S. Army Corps of Engineers, the Florida Department of Environmental Regulation and the Florida Department of Natural Resources. Broward County is within the nesting areas of three species of sea turtles: *Caretta caretta* (the loggerhead sea turtle), *Chelonia mydas* (the green sea turtle) and *Dermochelys coriacea* (the leatherback sea turtle). *C. caretta* is listed as a threatened species, while *C. mydas* and *D. coriacea* are listed as endangered species under the U.S. Endangered Species Act and Florida Law Chapter 370.

Since these statutes strictly forbid any disturbance of sea turtles and their nests, conservation activities involving the relocation of nests from hazardous locations (especially necessary along heavily developed coasts) require permitting by the U.S. Fish and Wildlife Service (USFWS). In Florida, this permit is issued to the Florida Department of Natural Resources (FDNR), which subsequently issues permits to individuals, universities and government agencies. This project was administered by the BCEPD and conducted by the Nova University Oceanographic Center under Marine Turtle Permit #129, issued to the BCEPD by the FDNR Institute of Marine Research, St. Petersburg, Florida. The BCEPD is especially concerned with any environmental effects of intermittent beach renourishment projects on shorelines and the offshore reefs. As part of this concern, the District has maintained the sea turtle conservation program in non-renourishment years to provide a continuous data base.

The nesting survey and other program operations on Hollywood and Hallandale beaches during 1991 were conducted in partial compliance with specific monitoring requirements, as outlined in the dredge and fill permits issued to Broward County, for beach renourishment and construction, by the Florida Department of Environmental Regulation (# 061680189), the U.S. Army Corps of Engineers (#89IPG-90051) and the Florida Department of Natural Resources (#DBS89-245BO).

Operation of the program is competitively bid and a contract award is issued based on a selection committee review of submitted bids through a weighted point factor procedure. Nova University was awarded the contract to conduct the 1991 program.

In addition to fulfilling statutory requirements, the purposes of the project were:

1) to relocate eggs from nests deposited in sites threatened by natural processes or human activities and thus maximize hatchling recruitment,

2) to accurately survey sea turtle nesting patterns to determine any historical trends and assess natural and anthropogenic factors affecting nesting patterns and densities,

3) to assess the success of sea turtle recruitment and of hatchery operations in terms of nesting success, hatching success and total hatchlings released,

4) to dispose of turtle carcasses, respond to strandings and other emergencies and maintain a hot-line for reporting of turtle incidents, and

5) to inform and educate the public on sea turtles and their conservation.

MATERIALS AND METHODS

Beach Survey

Daily beach surveys commenced at sunrise, except at Fort Lauderdale where early beach cleaning required a slightly earlier start. For survey purposes the county was divided as follows:

BEACH	**LENGTH (km)**	**BOUNDARIES**	**DNR SURVEY MARKER #**
Hillsboro-Deerfield	7.0	Palm Beach Co. line to Hillsboro Inlet	1-24
Pompano	7.7	Hillsboro Inlet to Commercial Blvd.	25-50
Ft.Lauderdale	10.6	Commercial Blvd to Port Everglades Inlet	51-84
Lloyd Park	3.9	Port Everglades Inlet to Dania Beach fence	86-97
Hollywood-Hallandale	9.4	Dania Beach fence to Dade Co. Line	98-128

Daily patrols of Hollywood-Hallandale beach were started on March 1 because of a scheduled beach renourishment project. Surveys at the other Broward County beaches commenced on April 22. All beaches were patrolled through September 15th.

Except in John Lloyd Park, all nests were located by using DNR survey markers numbered consecutively from 1 to 128 in Broward County. Marker numbers corresponding to each beach area are listed above. Each nest was initially located relative to the nearest building, street, or other land mark. These locations where later cross referenced to the nearest survey marker.

The beach at John U. Lloyd State Recreation Area was surveyed by park personnel, who provided these data. Due to the relative lack of land marks in the park, four 1 km zones (Zone 1 farthest north) were used for recording nest locations. This was also done to provide continuity with the data collected during the previous three years, to assess the effects of a completed beach renourishment project on nesting patterns.

Surveyors used all-terrain vehicles that could carry four to eight turtle nests in plastic buckets. The usual method was to mark and record nests and false crawls on the first pass along the beach and then dig and transport endangered nests on the return pass. Due to early beach cleaning in Fort Lauderdale, nests were picked up on the first pass, with help from a second person who transported the eggs by car. When there were many nests requiring relocation, and no road support, additional trips were occasionally necessary. After recording, crawl marks were obliterated to avoid duplication.

Endangered nests were defined as follows:

1) a nest located within 20 feet of the mean high water line,

2) a nest located in an area with a high level of pedestrian traffic,

3) a nest located near a highway or artificially lighted area defined as a beach area where a worker can see his shadow on a clear night,

4) a nest located in an area subject to beach renourishment,

5) a nest deposited directly in existing, dense vegetation where roots might interfere with successful emergence of the hatchlings.

Especially due to definition 3, 100% of the nests at Pompano, and Fort Lauderdale were considered endangered and relocated to hatcheries or dark beach locations on Hillsboro beach. All nests on Hollywood and Hallandale beaches were relocated due to a beach renourishment project during the 1991 season. Nests to be relocated were carefully dug by hand, and transported in buckets containing sand from the nest chamber. Chamber depth was measured in order to accurately rebury nests at their original depth. They were then transferred to hand-dug artificial egg chambers of similar dimensions, which were lined with sand from the natural nest. Care was taken to maintain the natural orientation of each egg.

Lloyd

Nonendangered nests, mostly on Hillsboro beach, were marked and left in situ. After hatching, 186 of these nests (137 at Hillsboro, 49 at Lloyd Park) were excavated. Hatching (actual emergence) success for in situ nests was defined as the percentage of spent shells (assumed to have yielded live hatchlings) compared to the sum of spent shells, piped eggs, eggs with arrested or no visible development, and hatchlings found dead in the nest.

Hatchery Operations

As in previous years, eggs were relocated to three chain-link fenced hatcheries located (one each) at Pompano beach near Atlantic Blvd., at the South Beach municipal parking lot in Fort Lauderdale, and at North Beach Park in Hollywood. A self-releasing hatchery, located in Lloyd Park, was operated by park personnel. After hatching, all hatchery nests were dug, and counts of spent shells, hatchlings dead in the nest, piped eggs and eggs with arrested or no visible development were made.

Nests displaying a depression over the egg chamber, indicating eminent hatchling emergence, were covered with a screen cage or a bottomless plastic bucket to retain hatchlings, although the turtles sometimes escaped these enclosures by digging around them. Hatching success was defined as the percentage of relocated eggs resulting in live released turtles. After hatching commenced, the hatcheries were checked each night between 9 PM and midnight. After counting, hatchlings were released that same night in dark sections of Fort Lauderdale, Hillsboro or Lloyd Park beaches by allowing them to crawl through the intertidal zone into the surf. Hatchlings discovered at dawn in the hatcheries were collected and held indoors in dry styrofoam boxes in a cool, dark place until that night, when they were released as above.

Because of the high nesting density early in the season and the high percentage of relocated nests, the Pompano and Fort Lauderdale hatcheries quickly filled. After June 1, most nests from Fort Lauderdale and Pompano were relocated to Hillsboro Beach. Hatched nests in the hatcheries were completely dug out along with the surrounding sand and replaced with fresh sand before new egg chambers were dug. Old sand was spread outside the hatchery. Fresh sand was obtained elsewhere on the beach.

Data analysis

The data was compiled, analyzed and plotted primarily with Quattro Pro. County-wide yearly nesting densities from 1981 to 1991 for *C. caretta*, *C. mydas*, and *D. coriacea* were plotted and trends were assessed by linear regression and correlation analyses. Seasonal nesting patterns of *C. caretta* were plotted for each of the five beaches. Nesting densities for *C. caretta* and *C. mydas* were calculated per km for each beach and the *C. caretta* data were compared with 1-way analysis of variance (ANOVA) and Student-Newman-Keuls (SNK) tests (at the .05 significance level) (Zar, 1974). The total number of nests deposited by each species in the beach segments corresponding to each DNR survey marker was tabulated and plotted. Total nesting success (nests/total crawls) for each species at each beach was computed and the mean daily nesting success of *C. caretta* at each beach was compared by ANOVA and SNK analyses. Seasonal patterns of daily nesting success at each beach were plotted and analyzed for trends. The total nesting success in each beach segment was plotted versus its DNR survey number. The county-wide seasonal fecundity trend for *C. caretta* was analyzed by relating clutch size with the Julian date of clutch deposition with linear correlation analyses.

Seasonal patterns of mean daily hatching success rates for *C. caretta* eggs left in situ and relocated to each hatchery or to Hillsboro beach were plotted and compared for each beach. The mean hatching successes of eggs from Pompano and Fort Lauderdale which were relocated to Hillsboro Beach were plotted versus their deposition location (DNR locator number) to assess the effect of transport distance on hatching success.

The total number of relocated nests, eggs, lost or destroyed eggs and hatchlings released were tabulated for each beach. Lost eggs are those from nests left in situ or relocated outside a hatchery whose locations were lost due to unauthorized removal of the markers. Many of these eggs probably hatched normally. All eggs from predated nests were listed as destroyed, although many nests were only partially predated and some eggs hatched. All lost or destroyed eggs were not included in hatching success calculations.

Nesting, nesting success, and nest relocation patterns in John Lloyd State Recreation Area were plotted and compared to data collected before (1988), during (1989) and after (1990-91) a beach renourishment project. Nesting success and hatching success of in situ *C. caretta* were compared graphically and by contingency table analysis in beach zones 3 and 4. Beach zone 3 was renourished during the summer of 1989, while zone 4 was left in its natural condition.

RESULTS

A total of 2017 sea turtle nests were surveyed county-wide in 1991. This was the second highest recorded nest count, exceeded only by the previous years total. Figure 1A shows the nesting density pattern for the county over the past ten years. Figure 1B shows the trend line fit to the total nest counts. The increasing trend is significant at the 99.6 percent confidence level ($P = .004$). Figure 2 shows the yearly nesting density patterns for the three sea turtle species. The positive trend of *C. caretta* nesting (Fig.2A) is highly significant while *C. mydas* and *D. coriacea* nesting (Fig 2B) show no significant eleven-year trends. Only 11 *C. mydas* nests were found in 1991 compared to 106 in 1990.

Figure 3 shows the pattern of total nests laid in Broward County per day during the 1991 season, and Figure 4 compares these results for the five individual beaches. Table 1 gives the total number of *C. caretta* nests per kilometer of beach and the mean daily nesting per kilometer for each beach. One-way ANOVA indicated significant differences in mean daily nesting per km and SNK analysis showed that nesting densities were significantly lowest at Hollywood-Hallandale and highest at Hillsboro. Nesting on Lloyd Park and Fort Lauderdale beaches was not statistically different, but this level was significantly lower than on Pompano beach. Total nests and nests-per-km for *C. mydas* are shown in Table 2. The data were too few for meaningful statistical comparisons between beaches, but the total absence of *C. mydas* nesting at Hillsboro (where 76 nests were found in 1990) was completely unexpected. Figure 5 shows the spatial nesting distribution in Broward County for the three sea turtle species. The *C. caretta* pattern (Fig. 5A) is very similar to that from 1990. However, the *C. mydas* distribution was very different than in 1990 when they preferred Hillsboro and Lloyd Park beaches. In 1991, there seemed to be a slight prefer-

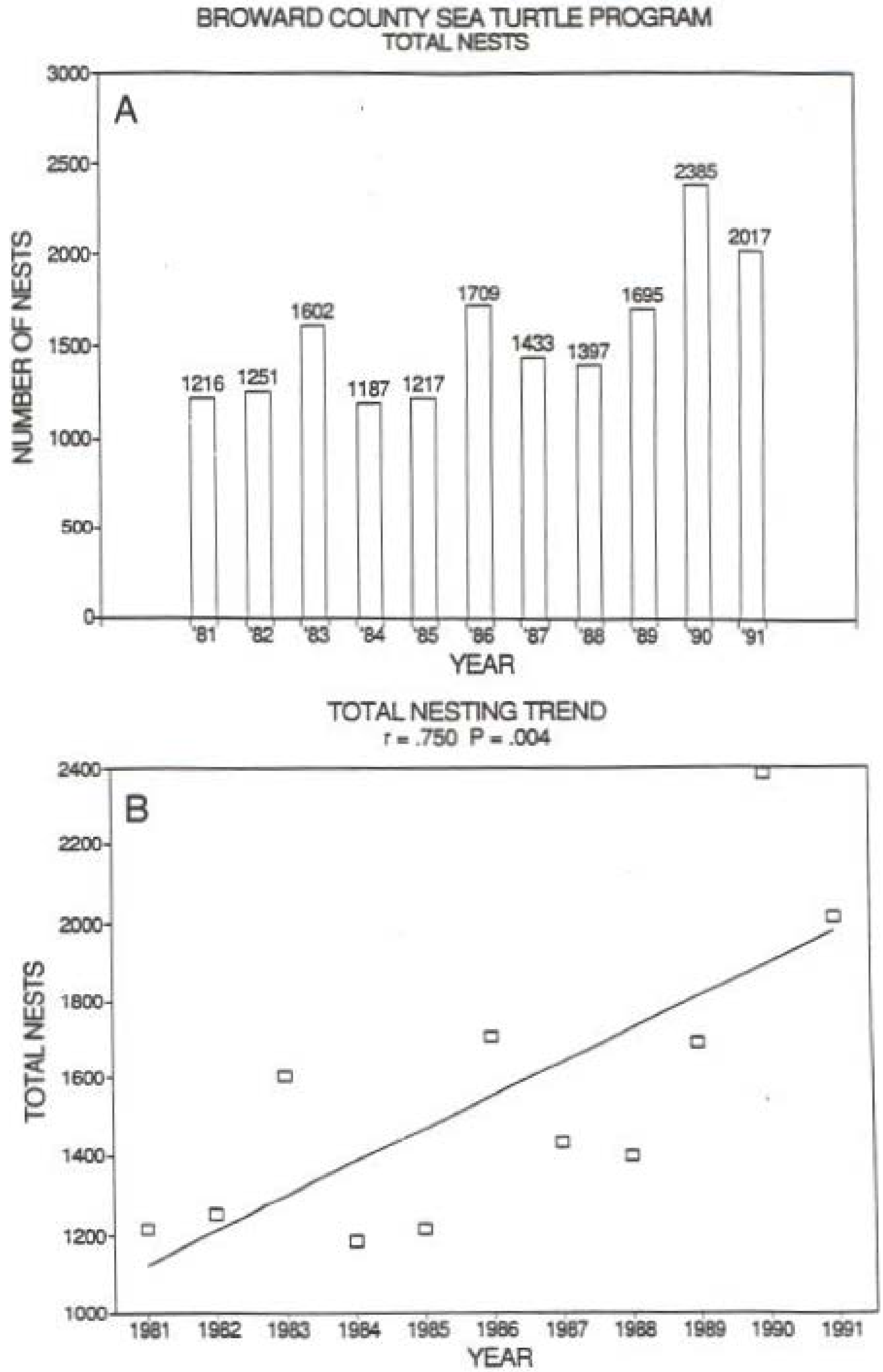


Figure 1: The historical pattern (A) and statistical trend (B) of total sea turtle nesting in Broward Co. since full surveys began in 1981.

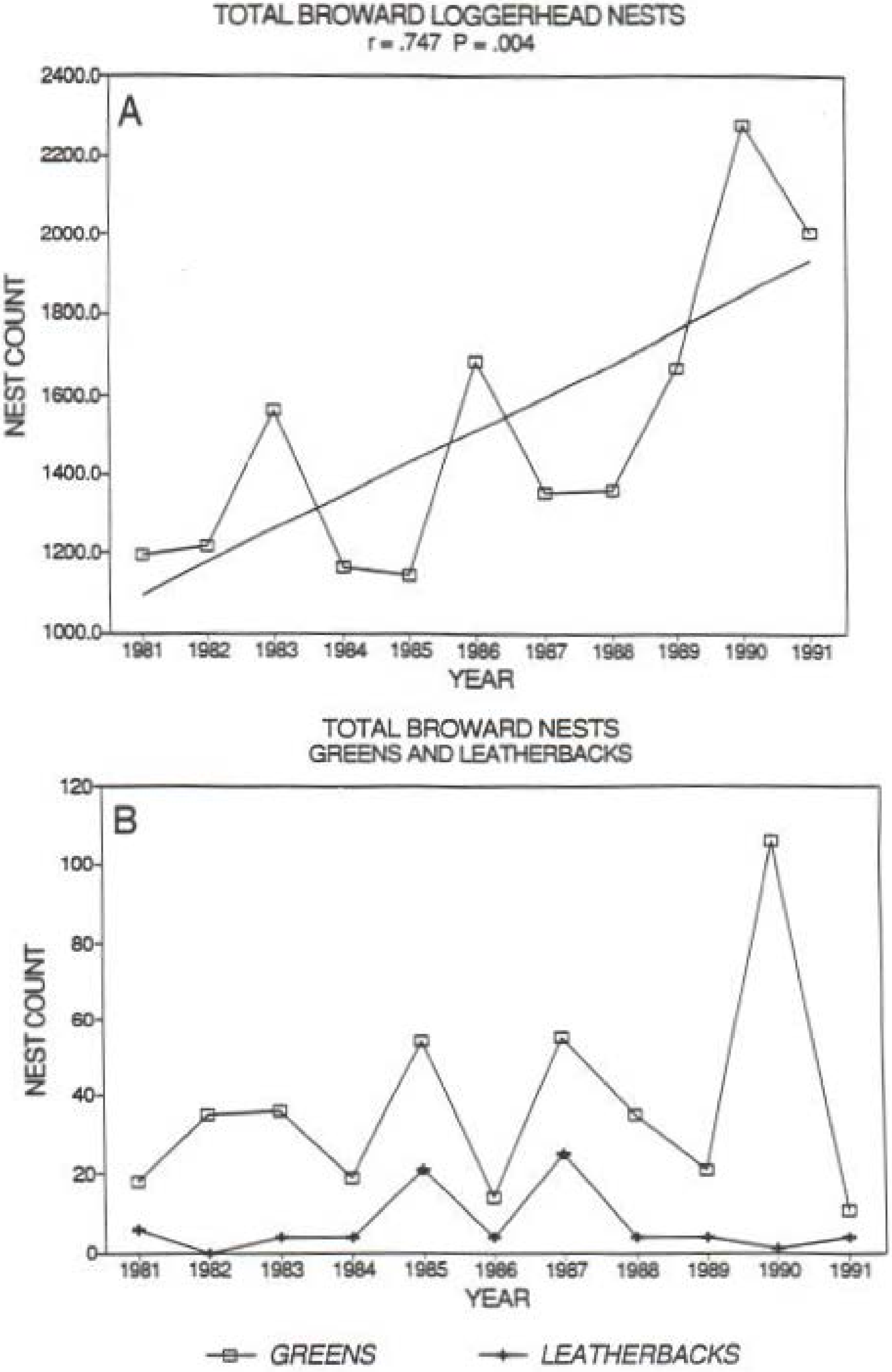


Figure 2: Historical nesting patterns for *C. caretta* (A) and *C. mydas* and *D. coriacea* (B) in Broward Co. since 1981.

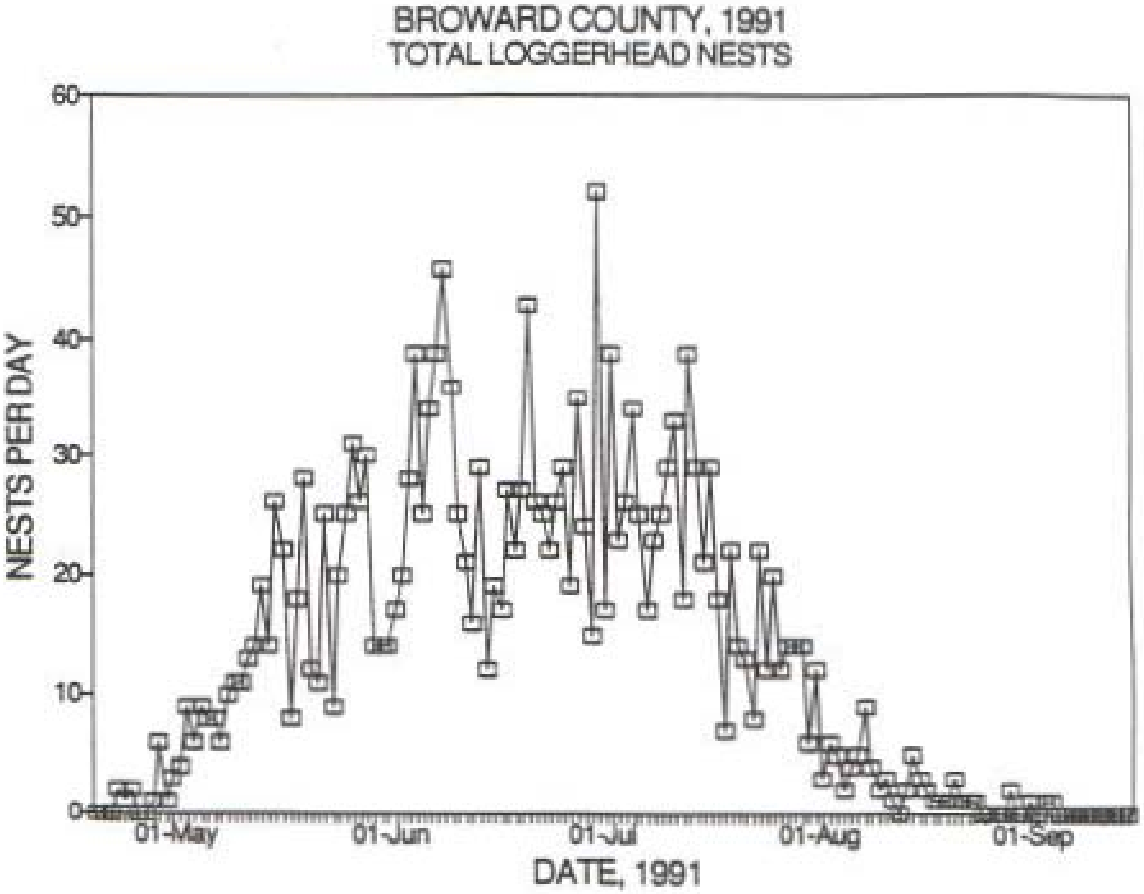


Figure 3: The seasonal pattern of daily *C. caretta* nest counts in Broward Co., 1991.

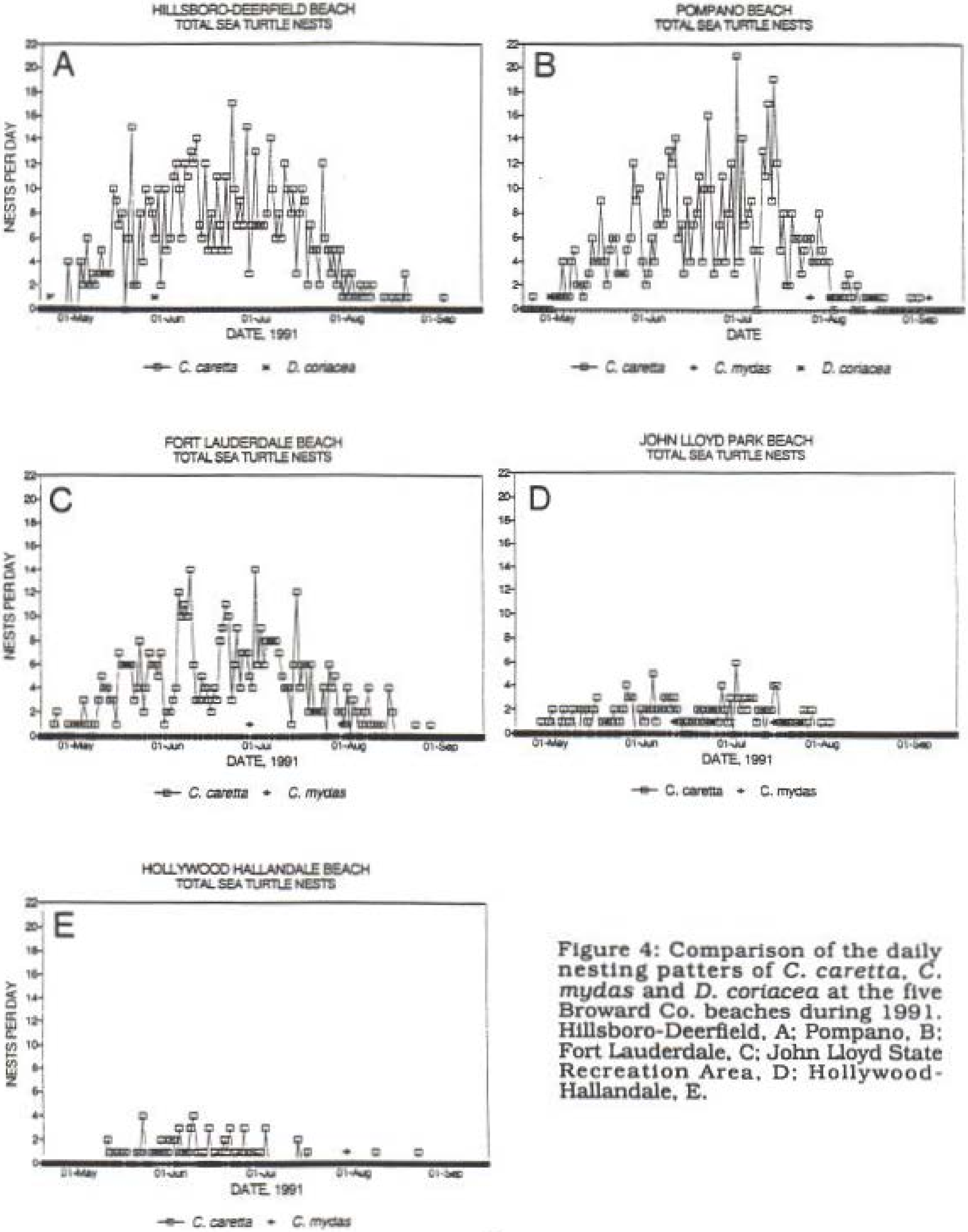


Figure 4: Comparison of the daily nesting patters of *C. caretta*, *C. mydas* and *D. coriacea* at the five Broward Co. beaches during 1991. Hillsboro-Deerfield, A; Pompano, B; Fort Lauderdale, C; John Lloyd State Recreation Area, D; Hollywood-Hallandale, E.

Table 1: Total *C.caretta* nests and nesting densities expressed as nests-per-kilometer for the 1991 season. Vertical lines at the right overlap groups where means were not distinguishable in a SNK test (alpha = .05) of mean daily nesting per km.

BEACH	TOTAL NESTS	BEACH LENGTH (km)	NESTS per km	DAILY MEAN NESTS/km
Hollywood-Hall.	65	9.4	6.9	0.05
Lloyd Park	147	3.9	37.6	0.26
Ft.Laud.	490	10.6	46.2	0.31
Pompano	624	7.7	81.0	0.55
Hillsboro	676	7.0	96.6	0.65
OVERALL	2002	38.6	51.9	0.35

Table 2: Total *C.mydas* nests and nesting densities expressed as nests-per-kilometer for the 1991 season. Data were too few for a SNK test of mean daily nesting densities.

BEACH	TOTAL NESTS	BEACH LENGTH (km)	NESTS per km
Hillsboro	0	7.0	0
Hollywood-Hall.	1	9.4	0.11
Ft.Laud.	2	10.6	0.19
Lloyd Park	5	3.9	1.28
Pompano	3	7.7	0.39
OVERALL	11	38.6	0.28

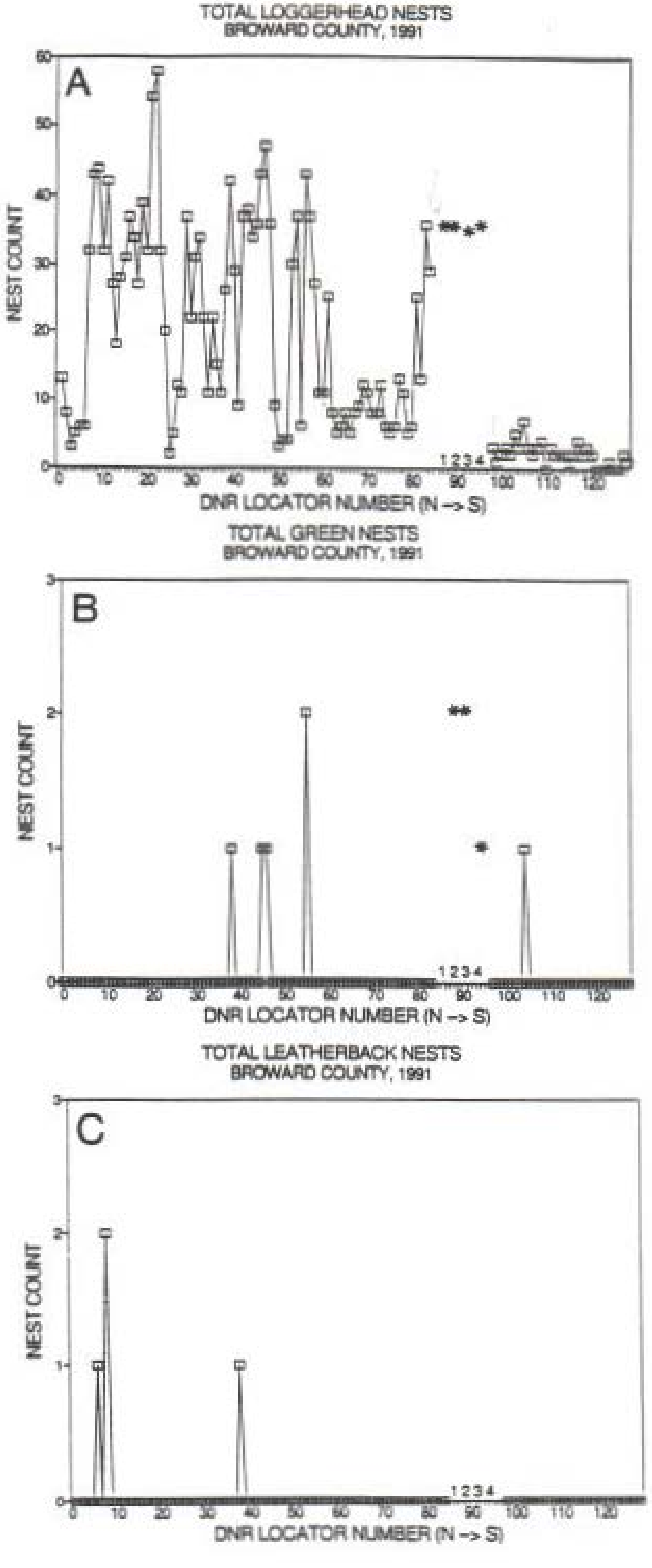


Figure 5: Locations of *C. caretta* (A), *C. mydas* (B) and *D. coriacea* (C) nests in Broward Co., 1991, listed by DNR locator number. Nest counts in the four zones of John Lloyd State Recreation Area are shown with asterisks.

ence for Lloyd Park, but nesting was nil at Hillsboro, and overall numbers of *C. mydas* nests were only 10 percent of the previous year. *D. coriacea* again nested early in the season with the first nest deposited on 1 April at Hillsboro beach (not shown in Fig. 4A).

Table 3 gives the total numbers of nests, false crawls and the nesting success of each species for each beach. Nesting success for *C. caretta*, was lowest on Lloyd Park and Hollywood-Hallandale beaches, which were statistically indistinguishable from each other, but were significantly lower than all other beaches. The highest nesting success occurred on Hillsboro and Fort Lauderdale beaches, which were also statistically equivalent. Figure 6 compares the seasonal patterns of mean daily nesting success of each species at each beach. There are no obvious seasonal patterns in these data. Figure 7 gives the average nesting success of *C. caretta* in the beach sections corresponding to each of the DNR survey monuments (or zones in Lloyd Park). The high variability of nesting success at Hollywood-Hallandale is due to the low turtle activity on this beach.

Figure 8 gives the seasonal relation of the number of eggs per *C. caretta* clutch and laying date. There was a small but highly significant decline ($r = -.152$, $P << .001$) in the number of eggs per clutch as the season progressed. Figure 9 shows the seasonal trends in hatching success for all relocated and investigated in situ nests of *C. caretta*. Figure 9A compares the hatching success of nests relocated to safer open beach locations on Hillsboro beach to those left in situ. Figures 9B and 9C compare the success of nests relocated to hatcheries at Fort Lauderdale or Pompano, or to the open beach at Hillsboro. Figure 9D shows the hatching results of nests at Lloyd Park that were relocated to either the hatchery or the open beach, or left in situ. All nests on Hollywood-Hallandale beach (Fig. 9E) were relocated to the hatchery. Figure 10 gives an expanded comparison of the hatching success of relocated (Fig. 10A) and in

Table 3: Total nests, false crawls (FC) and percent nesting success (NS) for three sea turtle species in each of five Broward County beach areas during 1991. Vertical lines for *C. caretta* overlap beaches where mean daily nesting successes were not distinguishable in a SNK test. Data for *C. mydas* and *D..coriacea* were too few for reliable statistical comparisons.

BEACH	*C.caretta*			*C.mydas*			*D.coriacea*		
	NESTS	FC	NS	NESTS	FC	NS	NESTS	FC	NS
Lloyd Park	147	367	28.6 |	5	18	21.7	0	2	0
Holly-Hall.	65	147	30.7 |	1	4	20.0	0	0	0
Pompano	624	674	48.1 |	3	1	75.0	1	0	100
Ft.Laud.	490	408	54.6 | |	2	3	40.0	0	0	0
Hillsboro	676	410	62.2 |	0	1	0	3	1	75.0
OVERALL	2002	2006	50.0	11	27	28.9	4	3	57.1
w/o Lloyd	1855	1639							

FC 4005

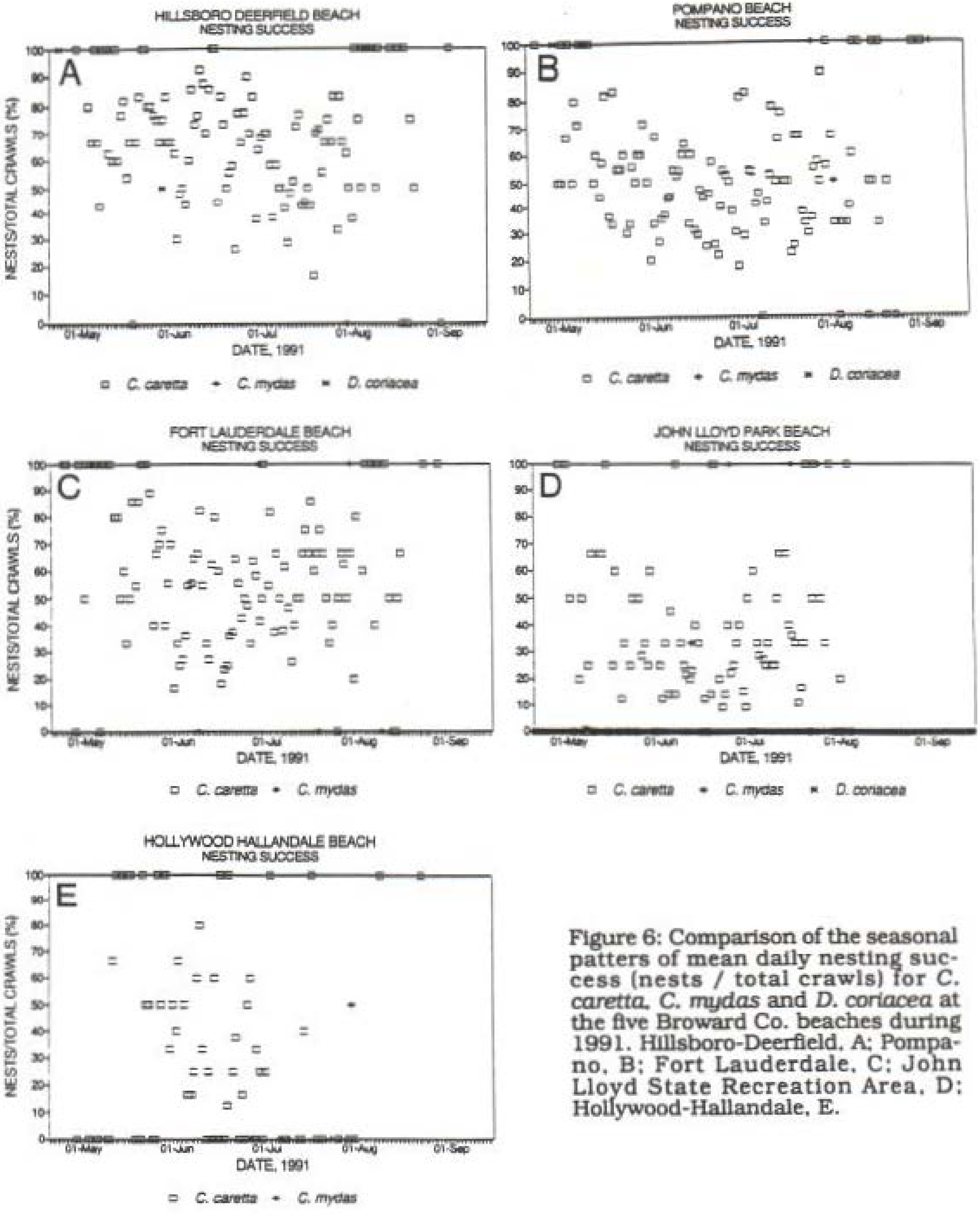


Figure 6: Comparison of the seasonal patters of mean daily nesting success (nests / total crawls) for *C. caretta*, *C. mydas* and *D. coriacea* at the five Broward Co. beaches during 1991. Hillsboro-Deerfield, A; Pompano, B; Fort Lauderdale, C; John Lloyd State Recreation Area, D; Hollywood-Hallandale, E.

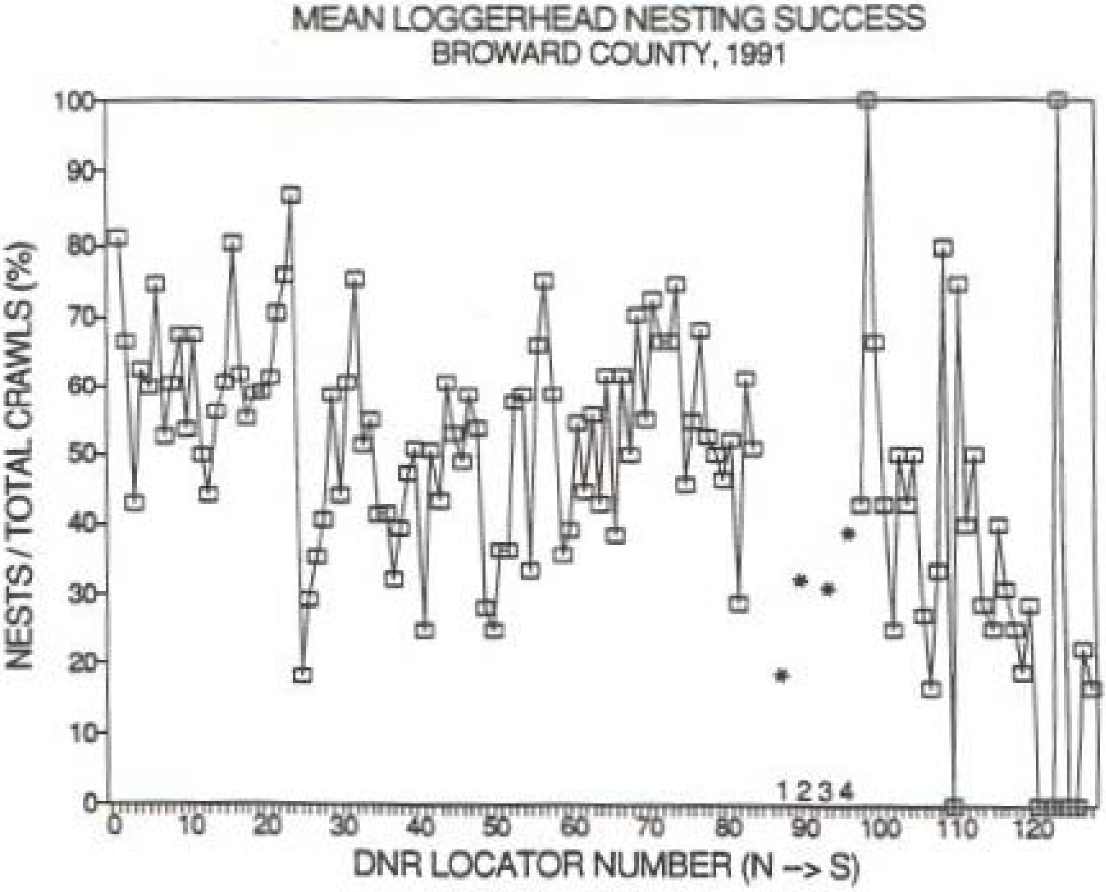


Figure 7: The horizontal distribution of average *C. caretta* nesting success on each beach segment identified by the DNR survey markers.

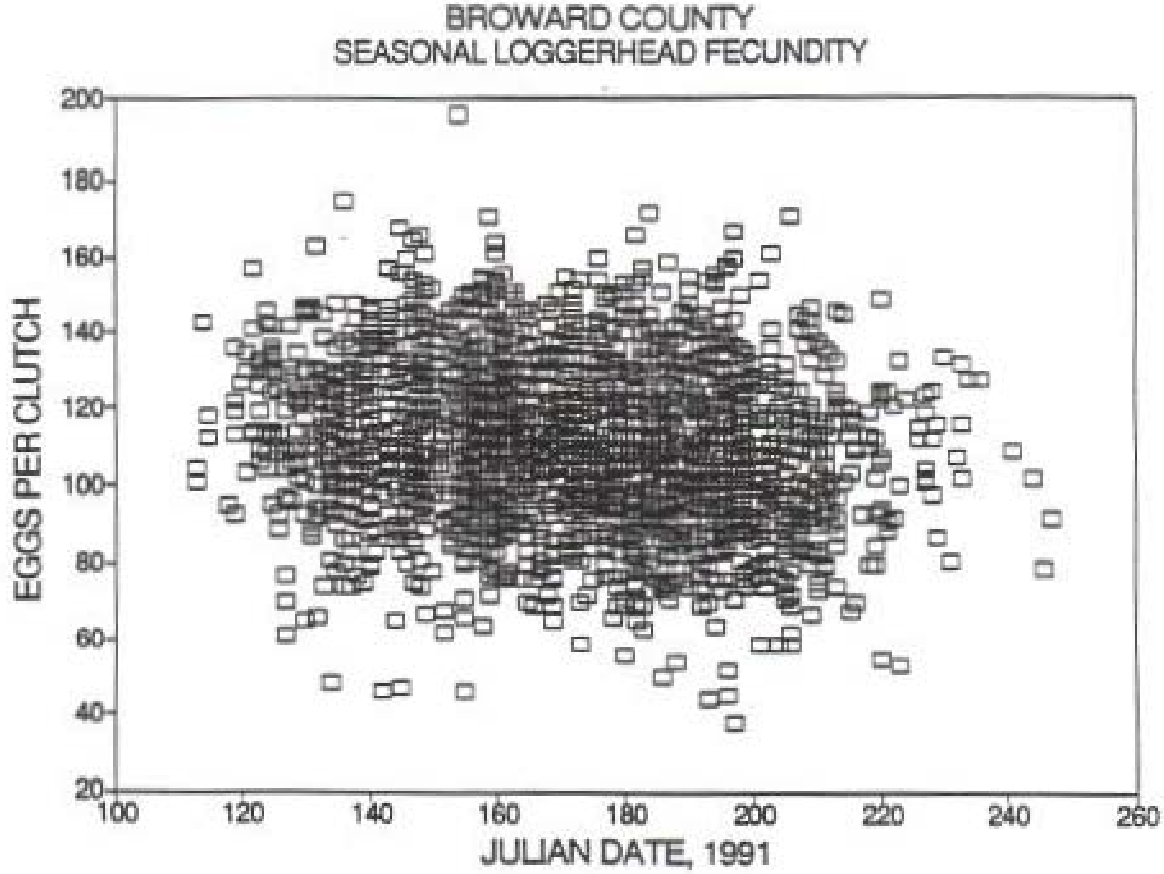
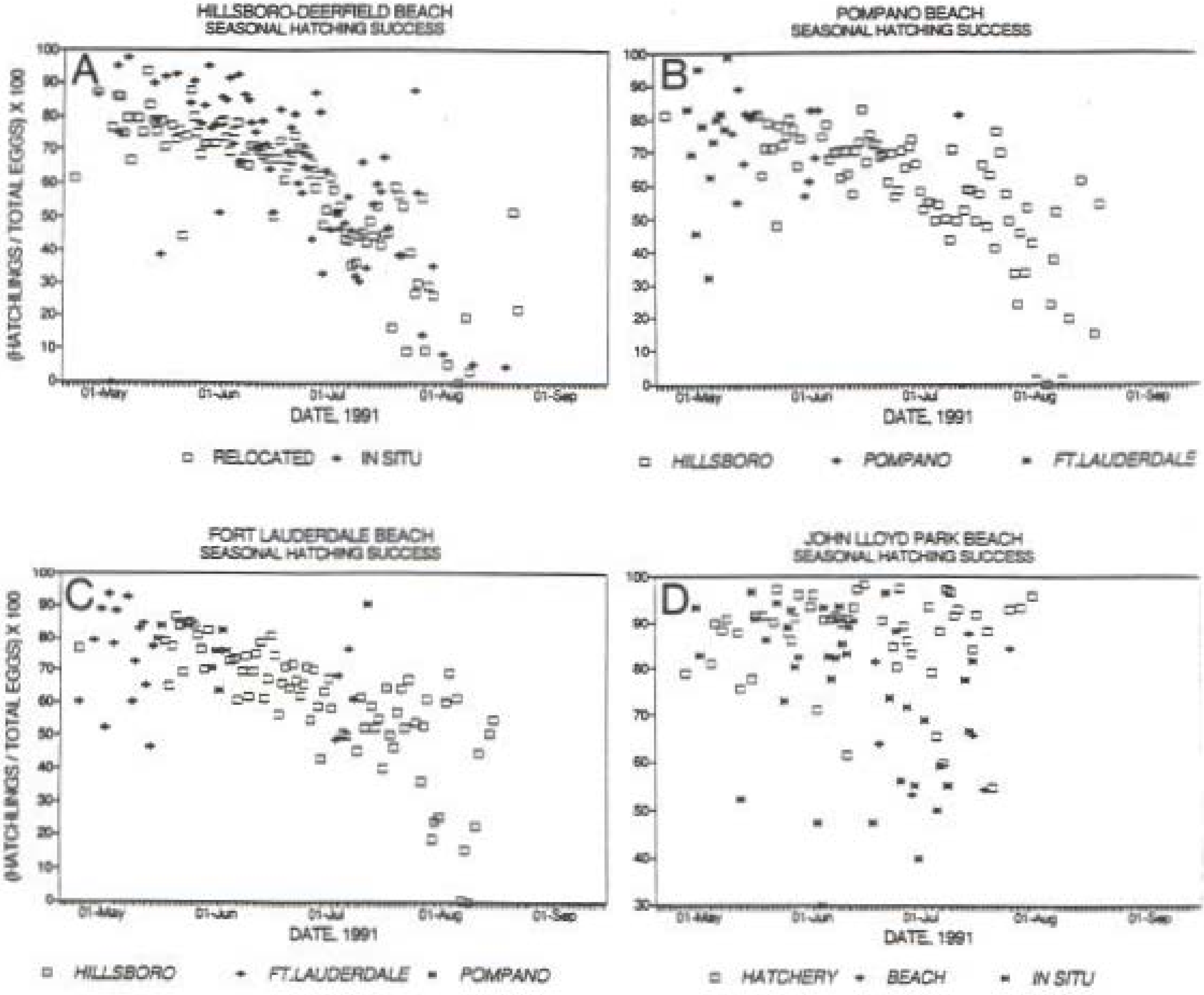


Figure 8: The number of *C. caretta* eggs-per-clutch plotted versus the Julian date of deposition in Broward Co. during 1991.

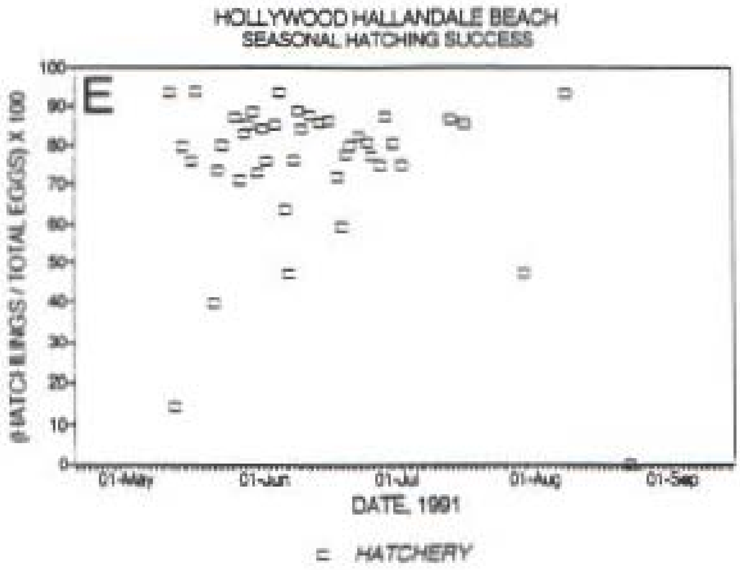


HILLSBORO-DEERFIELD BEACH
SEASONAL HATCHING SUCCESS

POMPANO BEACH
SEASONAL HATCHING SUCCESS

FORT LAUDERDALE BEACH
SEASONAL HATCHING SUCCESS

JOHN LLOYD PARK BEACH
SEASONAL HATCHING SUCCESS



HOLLYWOOD HALLANDALE BEACH
SEASONAL HATCHING SUCCESS

Figure 9: Seasonal patterns of *C. caretta* hatching success of in situ and relocated eggs deposited on the five Broward Co. beaches. Hillsboro-Deerfield, A; Pompano, B; Fort Lauderdale, C; John Lloyd State Recreation Area, D; Hollywood-Hallandale, E. Legends for individual figures indicate egg disposition. City names indicate eggs relocated to the hatchery in that location.

91

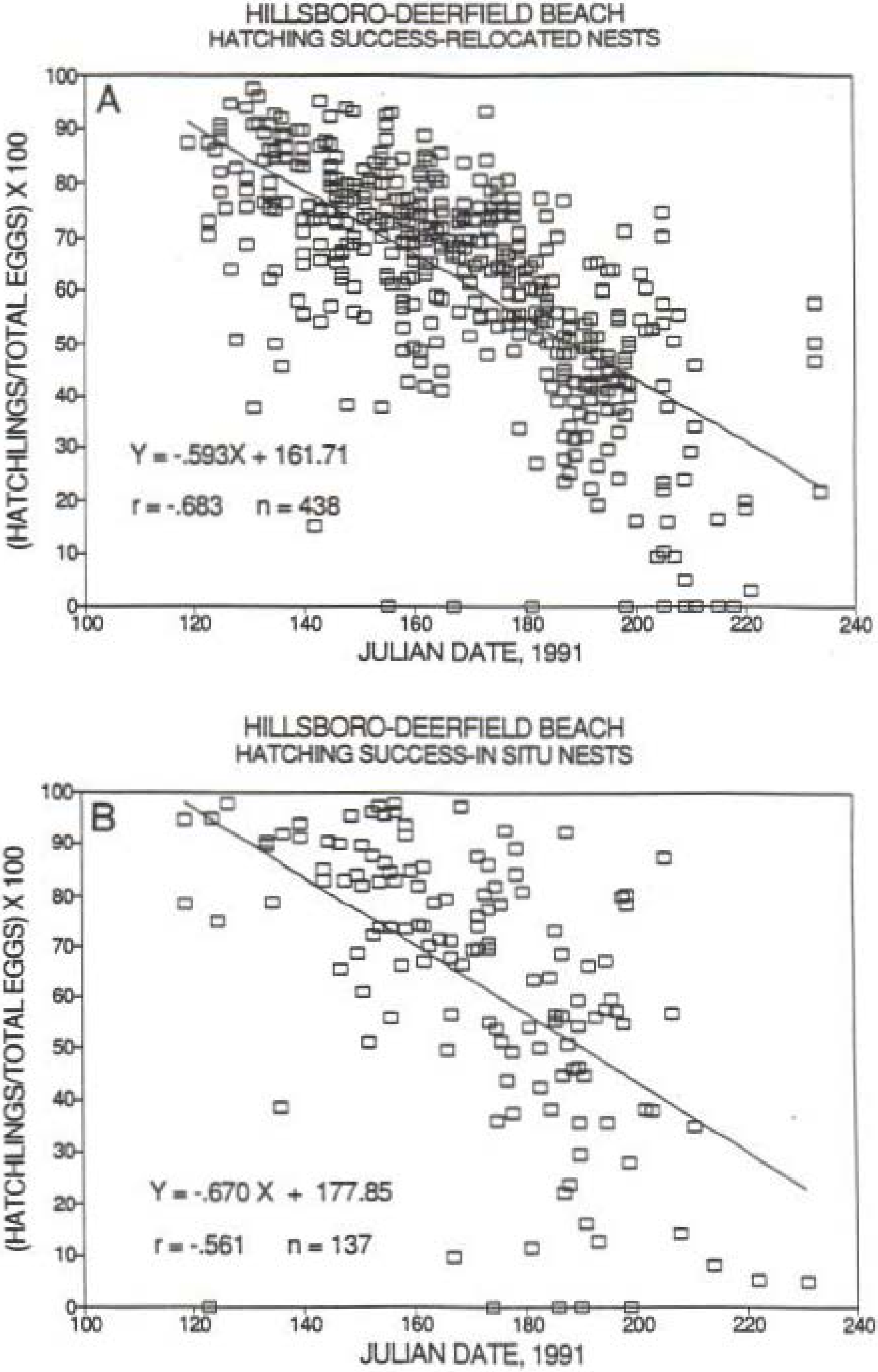


Figure 10: Comparison of the seasonal trends of the hatching success of relocated (A) and in situ (B) *C. caretta* nests deposited on Hillsboro-Deerfield beach during 1991.

situ (Fig. 10B) *C. caretta* nests at Hillsboro beach. Both seasonal patterns showed steep seasonal declines, but the slopes were not significantly different (P = .15) (Edwards, 1973). Table 4 gives an accounting of all eggs from relocated (hatchery and beach) and investigated in situ nests, as well as the number of live hatchlings produced and the overall hatching percent for each species. *C. caretta* eggs hatched with an overall success of 66.0 and 64.4 percent in relocated and in situ nests, respectively. Figure 11 shows overall sea turtle hatching success since 1981. Table 5 gives ANOVA and contingency table comparisons of *C. caretta* hatching success from in situ and beach-relocated nests at Hillsboro beach. One-way ANOVA comparing the individual hatching successes of all in situ and relocated nests showed no significant effect of relocation (F = 0.25, P = 0.615). The average hatching success of the 137 investigated in situ nests from Hillsboro beach was 63.2 percent, while the mean from 437 relocated nests was 62.1 percent. Although these mean hatching successes were very close, and the difference between the expected and observed frequencies in the contingency table analysis (Table 5) was less than ± 166 eggs, the contingency table did indicate a statistically significant (P < .002) effect of egg relocation on hatching success.

Table 6 shows the same ANOVA and contingency table comparisons of the hatching success of *C. caretta* from in situ and relocated nests at John Lloyd State Recreation Area. Both analyses showed highly significant differences between groups, but the average hatching success was significantly higher in relocated (85.5%) than in situ (74.9%) nests.

Figure 12 shows the hatching success of individual nests laid on Pompano and Fort Lauderdale beaches (locations indicated by DNR locator numbers) which were relocated to a site at Hillsboro beach near DNR monument #24. There is no evidence of a significant decline in hatching success with increasing distance of egg transport. Table 7 summarizes the egg relocation data from

Table 4: Total egg counts, released hatchlings and overall hatching successes for in situ and relocated nests of *C.caretta*, *C.mydas* and *D.coriacea*.

Species	NUMBER OF EGGS	EGGS LOST/ DEST.	n*	NUMBER TURTLES RELEASED	HATCH SUCCESS PERCENT
In Situ Nests					
C. caretta	20280	178	184	13277	66.0
C. mydas	276	0	2	244	88.4
D. coriacea	0	0	0	0	0
Total	20556	178	186	13521	66.3
Relocated Nests					
C. caretta	197997	9418	1688	121425	64.4
C. mydas	1082	416	6	241	36.2
D. coriacea	421	0	4	241	57.2
Total	199500	9834	1698	121907	64.3
Overall					
C. caretta	218277	9551	1872	134702	64.5
C. mydas	1358	416	8	485	51.5
D. coriacea	421	0	4	241	57.2

* n = The number of nests actually investigated for hatching success percent.

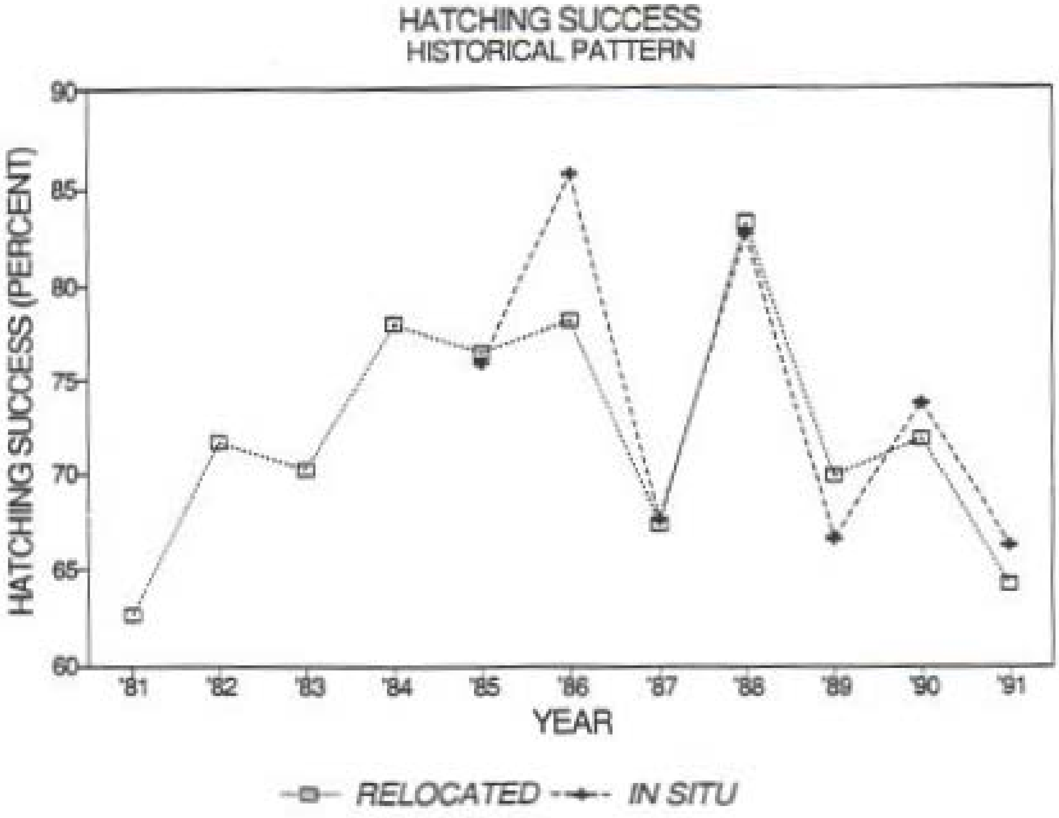


Figure 11: The historical patterns of yearly hatching success in relocated and in situ (natural) nests since fenced beach hatcheries were first employed in 1981.

Table 5: Comparison of *C. caretta* hatching success at Hillsboro Beach by 1-way ANOVA and contingency table analyses. The expected frequencies in the contingency table are given in parentheses below the observed frequencies.

ANOVA Table

SOURCE	DF	SS	MS	F	P
FACTOR	1	124	124	0.25	0.615
ERROR	572	281315	492		
TOTAL	573	281439			

LEVEL	N	HATCH% MEAN	STD
RELOCATED	437	62.11	20.56
INSITU	137	63.20	26.71

CONTINGENCY Table

	RELOCATED	IN SITU	TOTAL
EGGS HATCHED	30,311 (30476.8)	9,363 (9197.2)	39,674
EGGS NOT HATCHED	19,378 (19212.2)	5,632 (5797.8)	25,010
TOTALS	49,689	14,995	64,684

$X^2 = 10.06$, d.f. = 1, $P < .002$

Table 6: Comparison of *C. caretta* hatching success at John Lloyd State Recreation Area by 1-way ANOVA and contingency table analyses. The expected frequencies in the contingency table are given in parentheses below the observed frequencies.

ANOVA Table

SOURCE	DF	SS	MS	F	P
FACTOR	1	3315	3315	13.91	<<.001
ERROR	126	30034	238		
TOTAL	127	33348			

LEVEL	N	HATCH% MEAN	STD
INSITU	47	74.91	19.80
RELOCATED	81	85.46	12.25

CONTINGENCY Table

	RELOCATED	IN SITU	TOTAL
EGGS HATCHED	7,395 (7107.1)	3,914 (4201.9)	11,309
EGGS NOT HATCHED	942 (1229.9)	1,015 (727.1)	1,957
TOTALS	8,337	4,929	13,266

$X^2 = 212.7$, d.f. = 1, P << .001

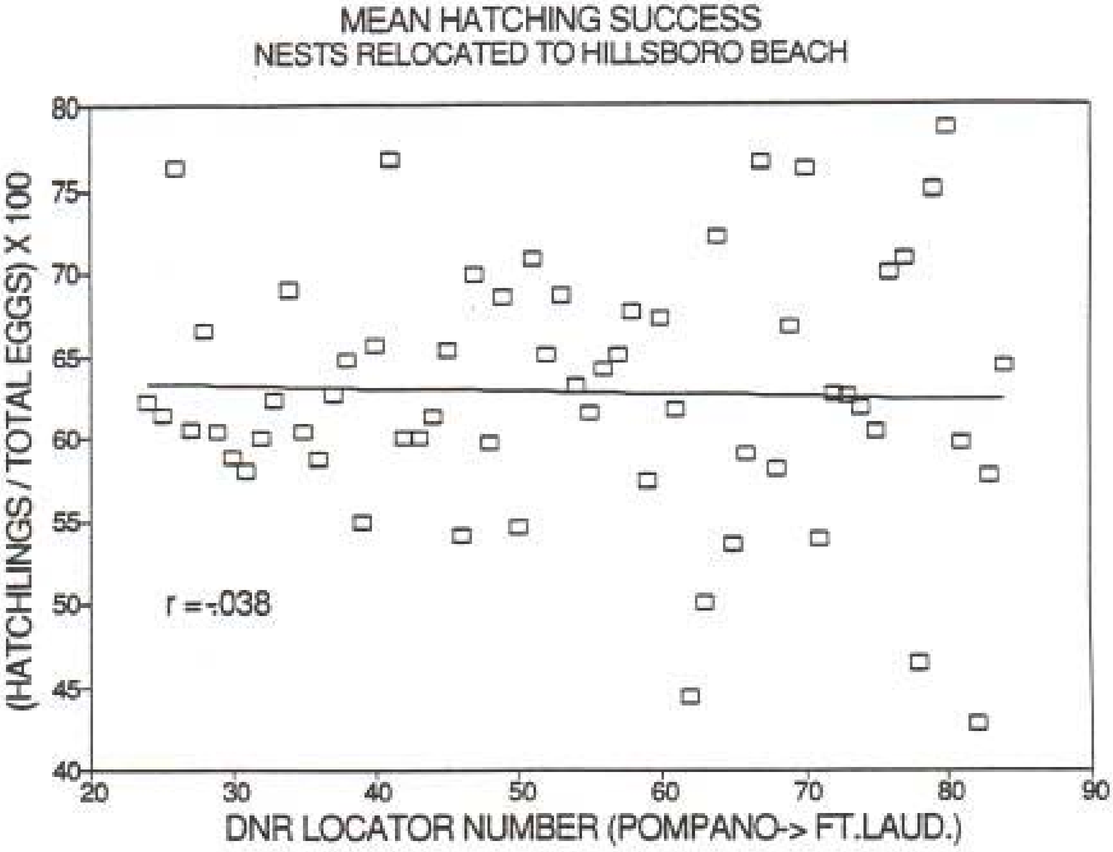


Figure 12: The mean hatching success of eggs from Pompano and Fort Lauderdale Beach which were relocated to Hillsboro Beach, shown by the location of their original deposition given by DNR locator number.

Table 7: Comparison of overall nest relocation and hatching results by beach for all species combined

Beach	Nests Moved	Total Eggs Moved	Eggs Lost/ Dest.*	Hatchlings Released	Overall Hatch Percent#
Hillsboro	518	57868	7880[1]	30451	60.9
Pompano	628	70011	722[2]	43465	62.7
Ft.Laud.	490	54571	463[3]	34804	64.3
Lloyd Park	94	9718	769[4]	7470	83.5
Hollywood-Hall	66	7332	0[5]	5717	78.0
Overall	1796	199500	9834	121907	64.3

* Eggs from nests which were relocated outside of hatcheries and could not be found because of removal of the markers are termed "lost". Many of these probably hatched normally. Eggs from partially predated nests are termed "destroyed", although some eggs hatched successfully.

\# Hatchlings released / (Total eggs moved - Lost or Destroyed)

[1] 1946 eggs lost (14 nests), 5934 eggs destroyed (53 nests)

[2] 420 eggs lost (4 nests), 302 eggs destroyed (3 nests)

[3] 320 eggs lost (3 nests), 2 nests given to Discovery Center (143 eggs + 122 hatchlings, and 1 unknown nest)

[4] 295 eggs lost (3 nests;1 uncounted), 474 eggs destroyed (7 nests;3 uncounted)

[5] 0 eggs lost or destroyed

each beach, for all sea turtle species combined.

Figure 13 compares total sea turtle nesting densities in the four zones of John Lloyd State Recreation Area before (1988), during (1989) and for two years after the renourishment of zones 1-3. Nesting seems to have improved in zone 1 (the most eroded section of the beach) since renourishment. Figure 14 shows the nesting success pattern in the four beach zones in 1991. Nesting success was much lower in zone 1 due to a high eroded cliff which denied most turtles access to the upper beach. Figure 15 gives the number of nests relocated and left in situ in 1990 and 1991. Virtually all nests in zones 1 and 2 were relocated, primarily because they were deposited below the beach cliff and were subject to inundation. Table 8 shows results of contingency table analyses relating the proportions of nesting and false crawls in zones 3 and 4 during 1990 and 1991. Renourishment seems to have had a significant effect on nesting success in 1990, but no significant effect was found in 1991. Figure 16 shows the seasonal nesting success pattern in zones 3 and 4 for 1991. Table 9 gives results of contingency table comparisons of the hatching success (number of nests hatching and failing to hatch) for in situ nests in zones 3 and 4 during 1990 and 1991. In 1990 there was a highly significant apparent effect of renourishment on hatching success (based on limited data), but no significant difference in hatching success on the renourished and unrenourished beach zones was found in 1991.

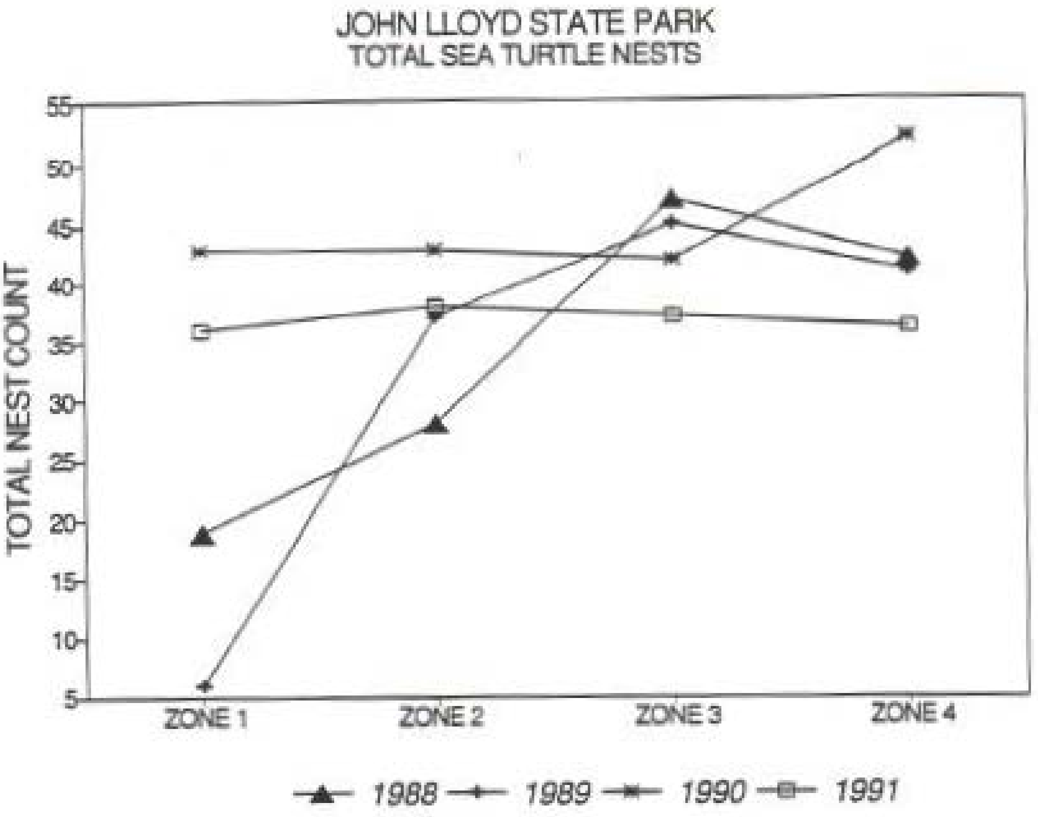


Figure 13: Total yearly sea turtle nest counts in the four beach zones of John Lloyd State Recreation Area since 1988. Zones 1-3 were renourished in 1989.

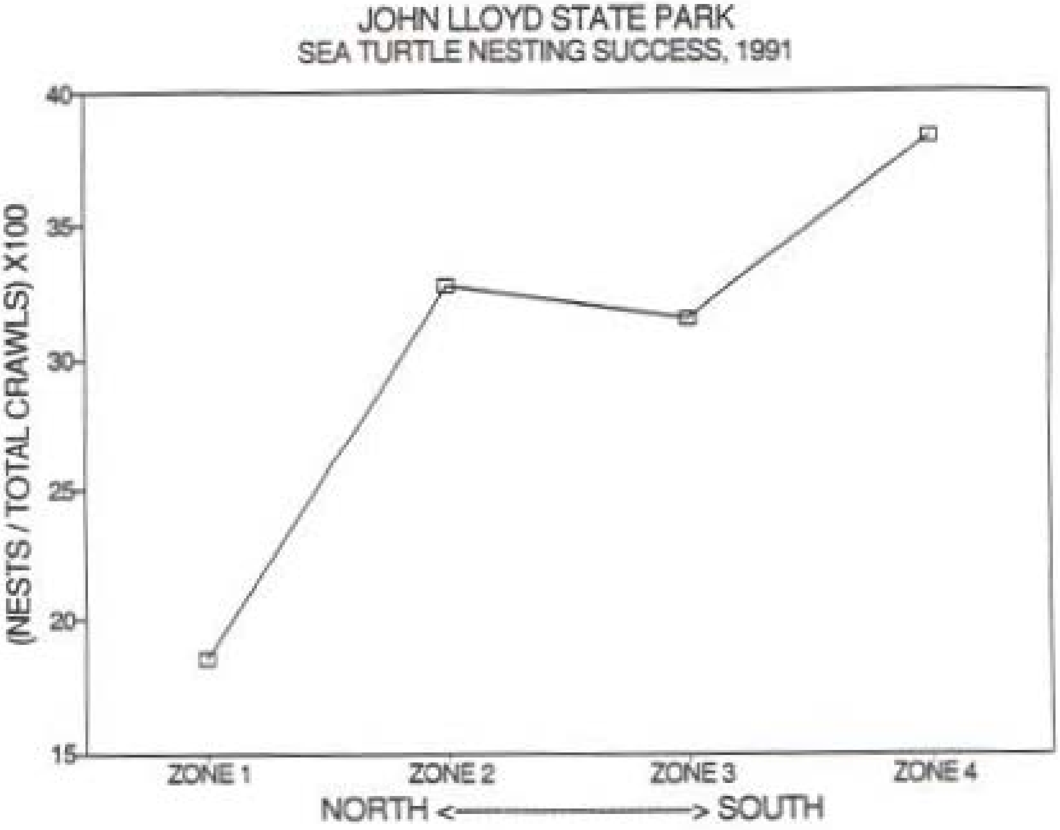


Figure 14: The horizontal pattern of sea turtle nesting success in the four beach zones of John Lloyd State Recreation Area during 1991.

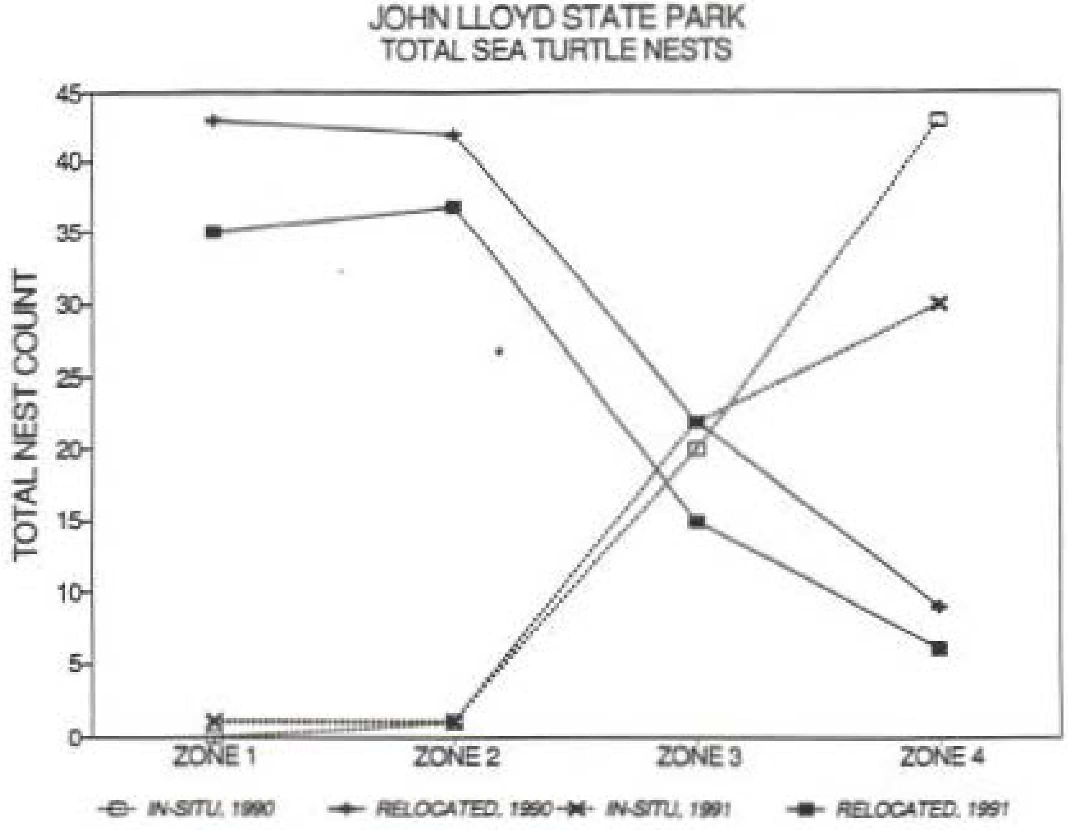


Figure 15: The total numbers of sea turtle nests relocated and left in situ in the four beach zones of John Lloyd State Recreation Area during 1991.

Table 8: Contingency table analyses of the effect of beach renourishment on nesting success in John Lloyd State Recreation Area. Zone 3 was renourished in 1989 while Zone 4 was not renourished. The expected frequencies are given in parentheses below the observed frequencies.

1990	Renourished **Zone 3**	Not Renourished **Zone 4**	Totals
Nesting Crawls	36 (46.9)	45 (34.1)	81
False Crawls	82 (71.1)	41 (51.9)	123
Totals	118	86	204
Nest Success	30.5%	52.3%	

$X^2 = 9.89$, d.f. = 1, $P < .002$

Nesting success is not independent of beach zone.

1991	Renourished **Zone 3**	Not Renourished **Zone 4**	Totals
Nesting Crawls	35 (38.4)	36 (32.6)	71
False Crawls	76 (72.6)	58 (61.4)	134
Totals	111	94	205
Nest Success	31.5%	38.3%	

$X^2 = 1.03$, d.f. = 1, $P = .310$

Nesting success is independent of beach zone.

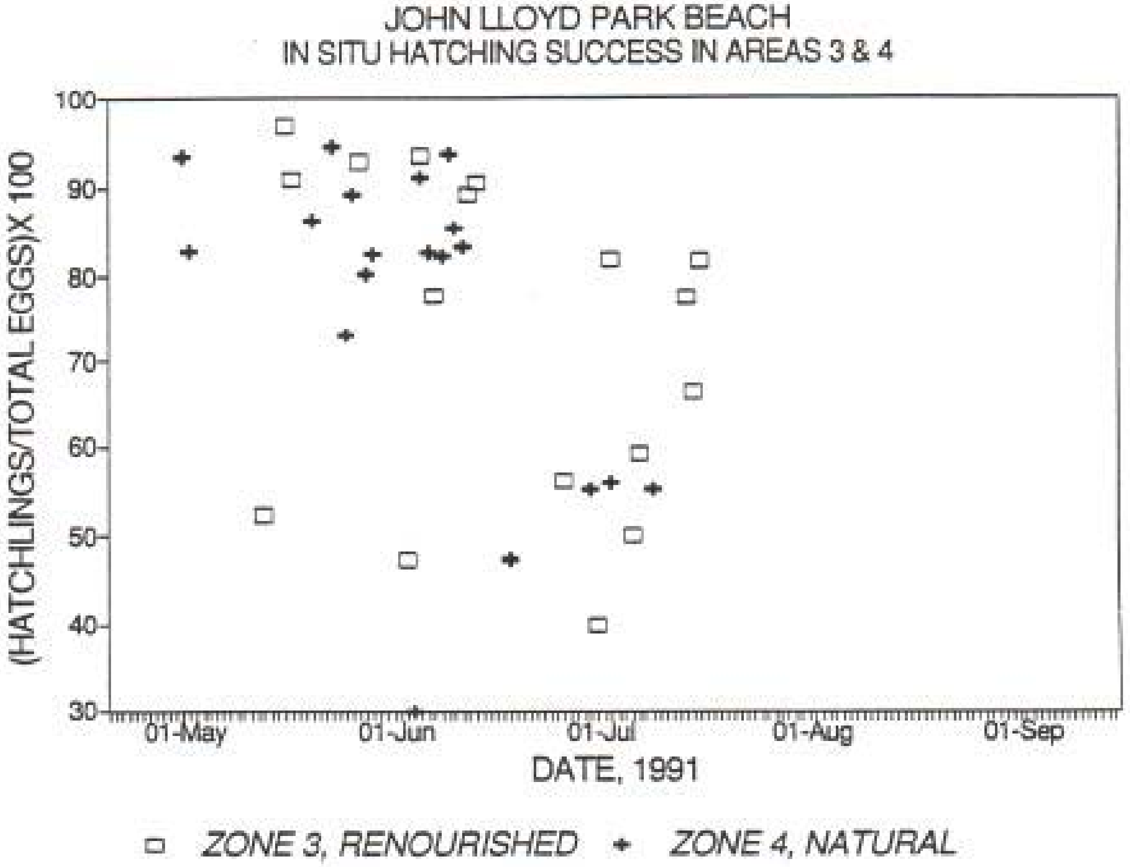


Figure 16: Comparison of the seasonal patterns of mean daily sea turtle nesting success in zones 3 and 4 of John Lloyd State Recreation Area during 1991. Zone 3 was renourished in 1989 and zone 4 was left in its natural condition.

Table 9: Contingency table analyses of the effect of beach renourishment on hatching success of natural (in-situ) nests deposited in John Lloyd State Recreation Area. Zone 3 was renourished in 1989 while Zone 4 was not renourished. All nests were relocated from Zone 3 in 1989. The expected frequencies are given in parentheses below the observed frequencies.

1990		Renourished **Zone 3**	Not Renourished **Zone 4**	Totals
	Hatch	240 (214.2)	257 (282.8)	497
	No Hatch	47 (72.8)	122 (96.2)	169
	Totals	287	379	666
	Hatch Success	83.6%	67.8%	

$X^2 = 21.6$, d.f. = 1, $P \ll .001$

Hatching success was not independent of nesting zone.

1991		Renourished **Zone 3**	Not Renourished **Zone 4**	Totals
	Hatch	1601 (1613.6)	2028 (2015.4)	3629
	No Hatch	519 (506.4)	620 (632.6)	1139
	Totals	2120	2648	4768
	Hatch Success	75.5%	76.6%	

$X^2 = 0.740$, d.f. = 1, $P = .390$

Hatching success is independent of nesting zone.

DISCUSSION

This years relatively high nest count (Fig. 1A) continues and strengthens the significant positive trends of total sea turtle (Fig. 1B) and *C. caretta* (Fig. 2B) nesting densities over the eleven years since total county nesting surveys were begun. Burney and Mattison (1990) discussed several possible explanations for the increased *C. caretta* nesting activity in 1990. Higher nesting densities could have been caused by a greater number of first-time nesting females indicating an increasing population size, perhaps due to past conservation projects or natural circumstances having a positive effect on recruitment or survival. This would be very encouraging. However, since individual females do not usually nest every year (Ehrhart, 1981), there was the possibility that the nesting peak in 1990 may have resulted from the chance coincidence of their individual nesting patterns, causing an abnormally large proportion of the female population to nest in the same year. This might have produced increased nesting without an increase in the number of adult females in the local population. However, the high *C. caretta* nest count in 1991 (second only to the 1990 total) decreases the likelihood of the second explanation. If most of the adult females nested in 1990, much lower nesting densities should have occurred in 1991, because this would have been a non-nesting year for most of the population. Therefore, the fact that nesting densities remained high for two consecutive years decreases the likelihood of the chance coincidence hypothesis. There is the possibility that increased food availability may have increased the nesting frequency of the population (Wood and Wood, 1980), but this in itself would also be encouraging for the survival of the species. There is also the possibility that the local *C. caretta* population was augmented by adults which previously nested at another location. This cannot be directly addressed, but the likelihood of such augmentation occurring two years in a row seems unlikely.

Unfortunately, the highly encouraging level of *C. mydas* nesting activity in 1990 was not continued in 1991 (Fig. 2B, Table 2). It is possible that the 1990 result was caused by either a chance coincidence of nesting patterns (as discussed above) or by augmentation from another population. The fact that there was no *C. mydas* nesting at Hillsboro beach, where their nesting density is normally the highest, may suggest that virtually the entire population nested in 1990 and therefore did not nest in 1991. The possibility that actual *C. mydas* nests at Hillsboro beach in 1991 may have been misidentified as *C. caretta* is not plausible because this beach was surveyed by the same highly experienced worker as in 1990.

D. coriacea nesting was again low and the eleven years of data show no trends (Fig. 2B). Since the first known nest was deposited well before the start of the daily beach surveys (April 1), it is possible that a few other early nest may have gone uncounted.

The timing of the seasonal pattern of daily *C. caretta* nesting was similar to last year, as was its shape in the initial month of the season (Fig. 3). The rate of increase of nesting per day in May was very similar to that in 1990 and peak daily nesting densities in the two years were comparable, but nesting activity declined more rapidly during the last half of the 1991 season, producing the slightly lower yearly total than for 1990.

C. caretta nesting densities (Fig. 4, Table 1) were highest in Hillsboro, followed by Pompano and then by Fort Lauderdale and Lloyd Park, which were not statistically different. As in previous years, nesting densities were lowest at Hollywood-Hallandale, but 1991 nesting activity was less than half that of 1990. This may have been due to the renourishment project in progress on Hollywood-Hallandale beach in 1991. As in previous years, *C. caretta* nesting patterns (Fig. 4A-C) contain periodic variations (more evident when data smoothing is employed) which appear to be related to the lunar and tidal timing and phase. These relationships are being analyzed and will be reported separately (Margolis, in prep).

The *C. caretta* nest location pattern for 1991 (Fig. 5A) is very similar to the pattern in 1990 (Burney and Mattison, 1990), with minima at the locations of the Deerfield town pier, the Hillsboro Inlet, the Commercial Boulevard pier (locator #3, 25 and 50, respectively) and on the section of Fort Lauderdale beach that is directly adjacent to Highway A1A (locator #63-80). Clearly, these patterns are not random and must be related to the degree of development, lighting, pedestrian traffic or moving lights visible from the beach. This effect is also under more intensive review including correlation with past years (ie. Fletemeyer, 1985), and will be reported separately (Mattison, in prep.). The historically low nesting on the Dania, Hollywood, and Hallandale beaches (Hollywood-Hallandale) is difficult to explain in terms of the degree of beachfront development. The Dania beach section, directly south of Lloyd Park, is relatively dark, with established dunes and no high rise development. The Dania pier has been closed. Qualitatively, much of Hollywood-Hallandale beach front appears no more developed than parts of Fort Lauderdale or Pompano beaches, which had much higher nesting densities. A hypothesis is that possible differences in offshore bottom contours, reef structure or ecology may account for the abrupt decline in nesting activity south of Lloyd Park, but this speculation has yet to be rigorously tested.

The nesting success of *C. caretta* at the individual beaches (Table 4) was not significantly different ($P > .05$) from the previous year (Burney and Mattison, 1990) at Hillsboro, Fort Lauderdale or Lloyd Park beaches (contingency table analyses). For Pompano, the difference between years was significant

(P=.002) but not very large (53.4%, 1990; 48.1%, 1991). However, nesting success at Hollywood-Hallandale declined greatly (P << .001) from 58.7% in 1990 to 30.7% in 1990. This decrease could have been due to the beach renourishment project, because of its commotion and the pipe along the beach which many turtles could not surmount. During 1991, nesting success at Hollywood-Hallandale was not statistically different than at Lloyd Park, where nesting success was reduced by an often insurmountable beach cliff. The nesting successes of *C. mydas* and *D. coriacea* are listed in Table 3, but the low activity of these species in 1991 makes comparisons between beaches or previous years inappropriate. Seasonal patterns of nesting success (Fig. 6) show no patterns during 1991, unlike previous years when there were seasonal declines at Fort Lauderdale in 1990 (Burney and Mattison, 1990) and at Hillsboro in 1989 (Burney and Mattison, 1989). We have no explanation for the cause of these decreases, but they do not appear to be consistent patterns characteristic of particular beaches. The horizontal distribution of *C. caretta* nesting successes (Fig. 7) shows little relationship with the nesting density pattern (Fig. 5A). Although the locations of the piers (see above) show minima in Figure 7, other sites had equivalent or lower nesting success. The beach immediately south of Hillsboro Inlet (with a substantial offshore shoal visible at low tide) was characterized by both low nesting and the lowest nesting success of any beach area north of Lloyd Park. The section of Fort Lauderdale beach adjacent to Highway A1A had lower nesting (Fig. 5A), but not lower nesting success relative to the rest of Fort Lauderdale and Pompano beaches. Moving lights (Mortimer, 1981) may deter *C. caretta* emergence in this location, but this does not seem to discourage them once they have begun to crawl.

The clutch size of *C. caretta* nests again showed a relatively slight but highly significant seasonal decline. This has been observed by others (Lebuff and Beatty, 1971; Caldwell, 1959) and there has been no detectable change in this pattern in Broward County since 1989 (Burney and Mattison, 1989,1990).

The seasonal pattern of hatching success of *C. caretta* (Fig. 14) declined much more steeply in 1991 than in the two previous years. The cause of this is unknown, but the similarity of slopes of the regression lines (Fig. 10A-B) for in situ and relocated nests indicates that the cause was environmental or physiological rather than due to egg relocation. The strong seasonal downtrend invalidates direct comparisons of the hatching success of nests relocated to hatcheries with those relocated to the open beach or left in situ. For example, Figure 9B shows that the hatching success of Pompano nests relocated to the Fort Lauderdale hatchery averaged much higher than those relocated to Hillsboro beach. Such a comparison is deceptive because nests laid early in the season (with higher hatching success) were relocated to the hatcheries. After the hatcheries filled, the later nests were relocated to Hillsboro. Such a comparison is valid only if eggs are relocated to the various sites over the entire season, and in roughly equivalent numbers.

The overall hatching successes of relocated and in situ nests (Table 4, Fig. 11) were quite similar at 64.3 and 66.3 percent, respectively. These were some of the lowest values in the eleven years of the project, but they are not unprecedented. It is possible that adverse weather conditions may have resulted in the lower hatching rates, although 1991 did not seem unusual. One large storm in mid season caused extremely high tides and may have inundated and reduced the viability of some nests, but this is speculation. A careful analysis of past years air and water temperatures, rainfall amounts and storm patterns may help explain the yearly fluctuations in hatching success, but this large task has not been completed (Mattison, in prep.). It is also possible that these variations may result from differences in the physiological condition of the nesting females that could affect the viability of their eggs.

Comparison of the hatching success of in situ and relocated *C. caretta* nests at Hillsboro beach by 1-way ANOVA (Table 5) indicated no difference between groups. However, a 2X2 contingency table analysis, of the total numbers of in situ and relocated eggs that hatched or failed to hatch, did indicate that the two classifications were not independent (ie. a significant effect of relocation on hatching success). The difference in mean hatching success, however, was quite small (relocated, 62.1%; in situ, 63.2%) and the difference between the observed and estimated frequencies in each cell of the table was less than 166 eggs. This means that if an additional 166 of the 49,689 relocated eggs would have hatched and 166 more of the in situ eggs (out of 14,995) would have failed to hatch, the hatching percentages would have been equal ($X^2 = 0$). This small difference is probably more than offset by the increased egg survival provided by moving the nests from their hazardous initial locations. Furthermore, if only an additional 64 eggs had hatched in relocated nests and failed to hatch in in situ nests, X^2 would have been non-significant at the .05 level, leading to the conclusion that relocation had no significant effect on hatching success. Therefore, our finding that nest relocation has a significant negative effect on hatching success could depend entirely on a difference of one or two infertile nests out of the 437 relocated and 137 in situ nests investigated at Hillsboro beach. Statistical significance does not always indicate biological significance.

Conversely, both ANOVA and contingency table analyses showed that the hatching success of relocated nests at Lloyd Park was significantly higher for relocated than for in situ nests (Table 6). Here, the difference in estimated and observed frequencies in the contingency table is 288 eggs, which represent a greater fraction of the total, but the conclusion could still depend on a difference of a few infertile nests. Higher hatching success in relocated nests than in those left in situ has been reported previously (Wyneken et al.,1988).

There seemed to be no systematic reduction in the hatching success with increasing distance of nest transport (Fig. 12). If the amount of agitation and vibration experienced by transported nests increases with distance of transport, this would suggest that the degree of disturbance experienced by the eggs during transportation was not an important factor in determining their survivability.

We now have two years of post-renourishment data with which to assess the effect of the 1989 renourishment of the beach in the Lloyd Park on sea turtle nesting, nesting success and hatching success. Figure 13 shows that nesting densities in the four zones (including zone 4 which was not renourished) have been roughly equivalent in the two post-renourishment years and have been enhanced in zone 1 which was severely eroded prior to the project. Nesting densities at Lloyd Park and Fort Lauderdale were not significantly different in 1991 (Table 1). Although nesting densities were similar in the four zones in 1991, nesting success was vastly reduced in zone 1 (Fig. 14) due to the high eroded cliff that necessitated the relocation of virtually all nests in zones 1 and 2 (Fig. 15). This was also the case in 1990. Lloyd beach was not maintained by daily beach raking and cleaning operations, as on the municipal beaches, which would prevent such a cliff from developing.

Comparison of zones 3 and 4 at Lloyd Park is interesting because zone 3 is minimally affected by erosion and zone 4 was not renourished, and serves as a control site. Contingency table analysis of nesting success in 1990 indicated significantly higher success in the unrenourished section (Table 8), however, analysis of 1991 data indicated that there was no difference. If the reduced nesting success in 1990 was due to the characteristics of the sand or something else related to the renourishment, its effects seem to have vanished within two years. Likewise, the analysis of hatching success in zones 3 and 4

(Table 9) indicate a significant effect of nesting zone on the hatching success of in situ nests in 1990 (based on limited data). This suggests, but certainly does not confirm (difference between estimated and observed frequencies < 26 eggs), an adverse influence of the dredged sand on hatching success. However, results from 1991 (with a much larger sample size) indicate that there was no dependence of beach zone on hatching success, suggesting that any adverse effect of the renourishment project on hatching success was no longer observable.

Our experience with the Lloyd Park and Hollywood-Hallandale renourishment projects have lead to the following conclusions. Beach renourishment is not inherently detrimental to sea turtles if the projects are properly conducted and maintained. In fact, such projects may enhance nesting densities in areas of extreme erosion. At Lloyd Park, no significant differences in nesting and hatching success on adjacent renourished and unrenourished sections could be found two years after the renourishment project. After renourishment, beach maintenance (preventing cliff formation and sand hardening) and nest relocation can reduce or eliminate detrimental effects to sea turtle nesting. For example, without nest relocation, almost all the nests in northern Lloyd Park would have been lost due to inundation. If formation of the eroded cliff had been prevented by regular maintenance (as was done after the previous Lloyd Park renourishment) nesting success would have been improved and the proportion of nests requiring relocation may have been reduced.

REFERENCES

/ Burney, C.M. and C. Mattison. 1989. Sea Turtle Conservation Project, Broward County, Florida. 1989 Report. Broward County Erosion Prevention District, Environmental Quality Control Board. Fort Lauderdale, Florida. 58 pp

✓ Burney, C.M. and C. Mattison. 1990. Sea Turtle Conservation Project, Broward County, Florida. 1990 Report. Broward County Erosion Prevention District, Environmental Quality Control Board. Fort Lauderdale, Florida. 46 pp

91 No Caldwell, D. 1959. The loggerhead turtles of Cape Romain, South Carolina. *Bull. Fla. State Mus., Biol. Sci.* **4:** 319-348.

No Edwards, A.L. 1973. Statistical Methods, Third Ed., Holt, Rinehart and Winston, New York.

yes Ehrhart, L.M. 1981. A review of sea turtle reproduction, p. 29-38. In: Proceedings of the World Conference on Sea Turtle Conservation. K.A. Bjorndal (ed.). Smithsonian Institution Press, Washington D.C.

Y No Fletemeyer, J.R. 1985. Sea Turtle Conservation Project, Broward County, Florida. 1985 Report. Broward County Erosion Prevention District, Environmental Quality Control Board. Fort Lauderdale, Florida. 23 pp

No Lebuff, C.R. and R.W. Beatty. 1971. Some aspects of nesting of the loggerhead turtle, *Caretta caretta caretta* (Linne) on the Gulf coast of Florida. *Herpetologica.* **30:** 29-31.

No Mortimer, J.A. 1981. Factors influencing beach selection by nesting sea turtles, p. 45-51. In: Proceedings of the World Conference on Sea Turtle Conservation. K.A. Bjorndal (ed.). Smithsonian Institution Press, Washington D.C.

yes Wood, J.R. and F.E. Wood. 1980. Reproductive biology of captive green sea turtles, *Chelonia mydas. Am. Zool.* **20:**499-505.

No Wyneken, J., T. J. Burke, M. Salmon and D.K. Pedersen. 1988. Egg failure in natural and relocated sea turtle nests. J. Herpetology 22: 88-96.

yes Zar, J.H. 1974. Biostatistical Analysis. Prentice-Hall, Inc., Englewood Cliffs, N.J. 620 pp.

APPENDIX 1: SUMMARY OF SEA TURTLE HOT-LINE, BEEPER & NOVA CALLS

MAY 1 - SEPTEMBER 30, 1991

SUBJECT	HOT-LINE	BEEPER	NOVA
EMERGENCES:			
Nesting	18	16	0
Hatchlings	2	2	0
NEST LOCATIONS	44	12	11
STRANDINGS	3	2	1
POACHING	0	0	0
VOLUNTEERS	156	0	84
OTHER **	172	23	49
OVERALL	395	55	145

** Including calls from the media, injured land turtles, and all other unclassified, requests for information, and multi reason calls.

APPENDIX 2: **Summary of Educational/Public Information Activities**

~~One thousand turtle flyers~~ Flyers were distributed in a timely manner along the beach, mostly to people who approached workers with questions and at the night turtle releases at Pompano and Fort Lauderdale, which usually attracted crowds. ~~On at least four occasions, night releases were observed by groups such as the Boy Scouts and various school groups.~~ Flyers were also placed in beach-front business establishments and some were distributed to people touring the Oceanographic Center. ~~The project manager gave several turtle talks at elementary schools.~~

During July through mid-August a weekly sea turtle release and informational seminar was given at Hollywood North Beach Park.

Hatchlings were also provided for JUL's bi-weekly sea turtle walk, where they were released as discussed previously.

FLORIDA DEPARTMENT OF NATURAL RESOURCES
MARINE TURTLE NESTING SUMMARY QUESTIONNAIRE FOR 1991

Instructions: Please type or print legibly in ink. Please be sure completed form is signed by the principle permit holder. Attach additional sheets if necessary.

1. PRINCIPLE PERMIT HOLDER INFORMATION

Principal Permit Holder: Lou Fisher

Permit #: TP 129

Organization: Broward County Office of Natural Resource Protection

Address: 609 B SW 1st Ave
Ft. Lauderdale, Florida 33301

County: Broward

Day Telephone (include area code): 305 765 4013

Night Telephone (include area code): 305 429 9248

Beach Name: Entire County Beaches except John U Lloyd Beach SRA

2. GENERAL SURVEY INFORMATION

Survey Boundary Information: Please describe survey boundaries geographically. Be specific and use known landmarks that can be found on a map (or include a marked map). For example - North Boundary; 1.5 miles south of the Martin/St. Lucie County Line; South Boundary: St. Lucie Inlet.

North Survey Boundary: Border of Palm Beach County and Broward County (Deerfield Beach)

South Survey Boundary: Border of Dade County and Broward County (Hallandale Beach)

Beach Length: 21.8 km / [✓ mi] (circle unit)

Is beach length [✓ ESTIMATED] or MEASURED ? (circle one)

Was this the **exact** same survey area as your 1990 survey area? (circle one): [✓ YES] NO

If NO, please explain the specific differences:

Start Date of Survey (include month/day): 4/1/91

End Date of Survey (include month/day): 9/15/91

Time of Day Surveyed: START 0600hrs AM / PM (circle one); FINISH 1000hrs AM / PM (circle one)

Number of Days Per Week Surveyed: 7 ; If you did **not** survey seven (7) days per week, describe how nests are counted on the day(s) surveys are resumed:

Was there any variation in the number of days surveyed per week or was the entire beach surveyed the same number of times every week of the nesting season? (circle one): [✓ SAME] VARIABLE

If VARIABLE, please explain the specific variation:

Were non-nesting crawls (false crawls) counted during your survey? (circle one): [✓ YES] NO

How many people were involved in surveying the nesting beach during 1991?: 23

COMPLETE THE BACK OF THIS FORM ALSO

3. NESTING BEACH MANAGEMENT INFORMATION: Please respond to all of the following questions regarding management techniques (SEE ATTACHED NEST SUCCESS REPORTING FORM FOR SPECIFIC DEFINITIONS OF IN SITU NESTS, BEACH RELOCATED NESTS, ETC.)

Did you leave nests *in situ*? (circle one): [✓ YES] NO

Did you cover *in situ* nests with flat screen? (circle one): YES [✓ NO] N/A (not applicable)
If YES, was the screen SELF-RELEASING or RESTRAINING ? (circle one)

Did you cover *in situ* nests with an above-ground cage (not a hatchery)? (circle one): YES [✓ NO] N/A
If YES, was the cage SELF-RELEASING or RESTRAINING ? (circle one)

Did you beach relocate nests (not to a hatchery)? (circle one): [✓ YES] NO
If YES, did you relocate nests INDIVIDUALLY (e.g., simply moving the nest directly landward of the *in situ* location or otherwise maintaining natural nest spacing) or reburied them in [✓ GROUP] with other beach relocated nests? (circle one)

If you did beach relocate nests, please give reasons: Hatchery facilities were filled to capacity.

Did you cover beach relocated nests with flat screen? (circle one): YES [✓ NO] N/A (not applicable)
If YES, was the screen SELF-RELEASING or RESTRAINING ? (circle one)

Did you cover beach relocated nests with an above-ground cage (not a hatchery)? (circle one): YES [✓ NO] N/A
If YES, was the cage SELF-RELEASING or RESTRAINING ? (circle one)

Did you use a hatchery? (circle one): YES NO
If YES, was the hatchery SELF-RELEASING or [✓ RESTRAINING] ? (circle one)

If a hatchery was used, please give reasons: Secure and controlled location for relocated nests.

If a hatchery was used, please give specific location: One each at: Pompano Beach (Atlantic Blvd):
Ft. Lauderdale (A-1-A and Sea Breeze Blvd), and at Hollywood Beach (North Beach Park)

If predator control methods other than the screening describe above were employed, please describe: None Used

List all non-human predators documented depredating nests in 1991: Foxes in Hillsboro Beach

Were hatchling disorientation events documented during 1991? (circle one): YES [✓ NO]
If YES, have all disorientation reports been submitted to DNR? (circle one): YES NO

I certify the above information to be true and accurate to the best of my knowledge.

Signature of Principle Permit Holder

December 9, 1991
Date

DNR/DMR/FMRI 33-706, Revised 11/91

FLORIDA DEPARTMENT OF NATURAL RESOURCES
NESTING SURVEY REPORTING FORM FOR 1991

Principle Permit Holder: Lou Fisher

Permit Number: TP129

Beach Name: Broward County (less John U Lloyd Beach SRA)

	C. caretta (Loggerhead)	*C. mydas* (Green Turtle)	*D. coriacea* (Leatherback)
Total # of Nests	1855	6	4
Total # of Non-Nesting Emergences (False Crawls)	1639	9	1
Date of First Documented Nest	4/23/91	6/29/91	4/1/91
Date of Last Documented Nest	9/3/91	9/4/91	5/28/91
***In situ* Nest Data:** *In situ* nests are those left where the turtle deposited the clutch. *In situ* nests may be left without additional protection, screened with self-releasing or restraining flat screens, or covered with self-releasing or restraining above-ground cages. Record the number of nests by category and species.			
Total # of Nests Left *in situ*	163	0	0
# of *in situ* Nests without Additional Protection	163	0	0
# of *in situ* Nests with Self-Releasing Screen	0	0	0
# of *in situ* Nests with Restraining Screen	0	0	0
# of *in situ* Nests with Self-Releasing Cage	0	0	0
# of *in situ* Nests with Restraining Cage	0	0	0
Beach Relocated Nest Data: Beach relocated nests are those removed and reburied at a place on the beach (not in a fenced hatchery) other than where the turtle deposited the clutch. As with *in situ* nests, beach relocated nests may be left without additional protection, covered with self-releasing or restraining flat screens, or covered with self-releasing or restraining above-ground cages. Record the number of nests by category and species.			
Total # of Beach Relocated Nests	1451	5	3
# Beach Relocated without Additional Protection	1451	5	3
# Beach Relocated with Self-Releasing Screen	0	0	0
# Beach Relocated with Restraining Screen	0	0	0
# Beach Relocated with Self-Releasing Cage	0	0	0
# Beach Relocated with Restraining Cage	0	0	0
Hatchery Data: Hatcheries are permanent or semi-permanent fenced/caged areas where nests are re-buried. Hatcheries are either self-releasing (hatchlings escape on their own) or restraining (hatchlings cannot escape without human intervention).			
Total # of Nests in Self-Releasing Hatchery	0	0	0
Total # of Nests in Restraining Hatchery	239	1	1

NOTE: Two Loggerhead Nests were taken by The Discovery Center for educational display.

FLORIDA DEPARTMENT OF NATURAL RESOURCES - NEST SUCCESS REPORTING FORM FOR 1991
SPECIES: *Caretta caretta* (Loggerhead)

PRINCIPLE PERMIT HOLDER: Lou Fisher
BEACH NAME: Broward County (less John U. Lloyd Beach SRA)
PERMIT NUMBER: Tp12 9

	TOTAL # OF NESTS	# OF NESTS MARKED TO EVALUATE	# OF MARKED NESTS DEPREDATED	# OF NESTS ACTUALLY EVALUATED	# OF EGGS IN EVALUATED NESTS	# OF HATCHLINGS EMERGED	# OF LIVE HATCHLINGS IN NEST	# OF DEAD HATCHLINGS IN NEST	# OF PIPPED LIVE	# OF PIPPED DEAD	# OF UNHATCHED EGGS	DNR USE ONLY
IN SITU	163	163	n/a	137	14,995	9,305	n/a	294	n/a	846	4,504	
IN SITU (SCREENED)												
IN SITU (CAGED)												
BEACH RELOCATED	1,451	1,451	n/a	1,451	161,268	93,754	n/a	2,202	n/a	14,725	40,274	
BEACH RELOCATED (SCREENED)												
BEACH RELOCATED (CAGED)												
SELF-RELEASING HATCHERY												
RESTRAINING HATCHERY	239	239	n/a	239	26,802	20,118	n/a	397	n/a	1,342	4,858	
OTHER (EXPLAIN) Disc. Center	2											
DNR USE ONLY												

EXPLANATION OF ROW CATEGORIES:

NOTE: n/a - this information either was not observed or was not kept as a statistic durine the survey.
Fate of the two nests taken by the Discovery Center is unknown.

IN SITU: NATURAL NEST LEFT WHERE TURTLE DEPOSITED THE CLUTCH
IN SITU (SCREENED): IN SITU NEST COVERED WITH A SELF-RELEASING FLAT SCREEN
IN SITU (CAGED): IN SITU NEST COVERED WITH AN ABOVE-GROUND INDIVIDUAL CAGE
BEACH RELOCATED: NEST REMOVED AND REBURIED AT A PLACE ON THE BEACH OTHER THAN WHERE TURTLE DEPOSITED THE CLUTCH (NOT IN A FENCED/CAGED HATCHERY)
BEACH RELOCATED (SCREENED): BEACH RELOCATED NEST COVERED WITH A SELF-RELEASING FLAT SCREEN
BEACH RELOCATED (CAGED): BEACH RELOCATED NEST COVERED WITH AN ABOVE-GROUND INDIVIDUAL CAGE
SELF-RELEASING HATCHERY: PERMANENT OR SEMI-PERMANENT FENCED/CAGED AREA WHERE MANY NESTS ARE REBURIED, HATCHLINGS ESCAPE ON THEIR OWN
RESTRAINING HATCHERY: PERMANENT OR SEMI-PERMANENT FENCED/CAGED AREA WHERE MANY NESTS ARE REBURIED, HATCHLINGS CANNOT ESCAPE WITHOUT HUMAN INTERVENTION

EXPLANATION OF COLUMN HEADINGS:

TOTAL # OF NESTS: TOTAL NUMBER OF NESTS FOR EACH CATEGORY
OF NESTS MARKED TO EVALUATE: NESTS WHICH WERE MARKED TO TRACK THEIR FATE AND EVALUATE NEST SUCCESS
OF MARKED NESTS DEPREDATED: NUMBER OF MARKED NESTS DEPREDATED BY NON-HUMAN PREDATORS
OF NESTS ACTUALLY EVALUATED: NESTS IN WHICH NEST SUCCESS WAS EVALUATED
OF EGGS IN EVALUATED NESTS: TOTAL NUMBER OF EGGS IN EVALUATED NESTS (THIS MAY BE AN ESTIMATE DUE TO HATCHED EGG COUNTS)
OF HATCHLINGS EMERGED: NUMBER OF HATCHLINGS THAT EMERGED FROM THE NEST ON THEIR OWN, BEFORE THE NEST WAS EXCAVATED FOR EVALUATION
OF LIVE HATCHLINGS IN NEST: NUMBER OF LIVE HATCHLINGS FOUND IN THE NEST UPON EXCAVATION OF THE NEST FOR EVALUATION
OF DEAD HATCHLINGS IN NEST: NUMBER OF DEAD HATCHLINGS FOUND IN THE NEST UPON EXCAVATION OF THE NEST FOR EVALUATION
OF PIPPED LIVE: NUMBER OF LIVE HATCHLINGS FOUND PIPPED (BROKEN THROUGH EGGSHELL BUT NOT COMPLETELY FREE OF EGGSHELL) UPON EXCAVATION OF THE NEST FOR EVALUATION
OF PIPPED DEAD: NUMBER OF DEAD HATCHLINGS FOUND PIPPED (BROKEN THROUGH EGGSHELL BUT NOT COMPLETELY FREE OF EGGSHELL) UPON EXCAVATION OF THE NEST FOR EVALUATION
OF UNHATCHED EGGS: NUMBER OF UNHATCHED EGGS FOUND UPON EXCAVATION OF THE NEST FOR EVALUATION

FLORIDA DEPARTMENT OF NATURAL RESOURCES - NEST SUCCESS REPORTING FORM FOR 1991
SPECIES: *Chelonia mydas* (Green Turtle)

PRINCIPLE PERMIT HOLDER: Lou Fisher
BEACH NAME: Broward County (less John U Lloy-Beach SRA)
PERMIT NUMBER: TP129

	TOTAL # OF NESTS	# OF NESTS MARKED TO EVALUATE	# OF MARKED NESTS DEPREDATED	# OF NESTS ACTUALLY EVALUATED	# OF EGGS IN EVALUATED NESTS	# OF HATCHLINGS EMERGED	# OF LIVE HATCHLINGS IN NEST	# OF DEAD HATCHLINGS IN NEST	# OF PIPPED LIVE	# OF PIPPED DEAD	# OF UNHATCHED EGGS	DNR USE ONLY
IN SITU												
IN SITU (SCREENED)												
IN SITU (CAGED)												
BEACH RELOCATED	5	5	0	5	542	143	0	2	n/a	21	280	
BEACH RELOCATED (SCREENED)												
BEACH RELOCATED (CAGED)												
SELF-RELEASING HATCHERY												
RESTRAINING HATCHERY	1	1	0	1	49	23	0	0	n/a	0	26	
OTHER (EXPLAIN)												
DNR USE ONLY:												

EXPLANATION OF ROW CATEGORIES:

IN SITU: NATURAL NEST LEFT WHERE TURTLE DEPOSITED THE CLUTCH
IN SITU (SCREENED): IN SITU NEST COVERED WITH A SELF-RELEASING FLAT SCREEN
IN SITU (CAGED): IN SITU NEST COVERED WITH AN ABOVE-GROUND INDIVIDUAL CAGE
BEACH RELOCATED: NEST REMOVED AND REBURIED AT A PLACE ON THE BEACH OTHER THAN WHERE TURTLE DEPOSITED THE CLUTCH (NOT IN A FENCED/CAGED HATCHERY)
BEACH RELOCATED (SCREENED): BEACH RELOCATED NEST COVERED WITH A SELF-RELEASING FLAT SCREEN
BEACH RELOCATED (CAGED): BEACH RELOCATED NEST COVERED WITH AN ABOVE-GROUND INDIVIDUAL CAGE
SELF-RELEASING HATCHERY: PERMANENT OR SEMI-PERMANENT FENCED/CAGED AREA WHERE MANY NESTS ARE REBURIED, HATCHLINGS ESCAPE ON THEIR OWN
RESTRAINING HATCHERY: PERMANENT OR SEMI-PERMANENT FENCED/CAGED AREA WHERE MANY NESTS ARE REBURIED, HATCHLINGS CANNOT ESCAPE WITHOUT HUMAN INTERVENTION

EXPLANATION OF COLUMN HEADINGS:

TOTAL # OF NESTS: TOTAL NUMBER OF NESTS FOR EACH CATEGORY
OF NESTS MARKED TO EVALUATE: NESTS WHICH WERE MARKED TO TRACK THEIR FATE AND EVALUATE NEST SUCCESS
OF MARKED NESTS DEPREDATED: NUMBER OF MARKED NESTS DEPREDATED BY NON-HUMAN PREDATORS
OF NESTS ACTUALLY EVALUATED: NESTS IN WHICH NEST SUCCESS WAS EVALUATED
OF EGGS IN EVALUATED NESTS: TOTAL NUMBER OF EGGS IN EVALUATED NESTS (THIS MAY BE AN ESTIMATE DUE TO HATCHED EGG COUNTS)
OF HATCHLINGS EMERGED: NUMBER OF HATCHLINGS THAT EMERGED FROM THE NEST ON THEIR OWN, BEFORE THE NEST WAS EXCAVATED FOR EVALUATION
OF LIVE HATCHLINGS IN NEST: NUMBER OF LIVE HATCHLINGS FOUND IN THE NEST UPON EXCAVATION OF THE NEST FOR EVALUATION
OF DEAD HATCHLINGS IN NEST: NUMBER OF DEAD HATCHLINGS FOUND IN THE NEST UPON EXCAVATION OF THE NEST FOR EVALUATION
OF PIPPED LIVE: NUMBER OF LIVE HATCHLINGS FOUND PIPPED (BROKEN THROUGH EGGSHELL BUT NOT COMPLETELY FREE OF EGGSHELL) UPON EXCAVATION OF THE NEST FOR EVALUATION
OF PIPPED DEAD: NUMBER OF DEAD HATCHLINGS FOUND PIPPED (BROKEN THROUGH EGGSHELL BUT NOT COMPLETELY FREE OF EGGSHELL) UPON EXCAVATION OF THE NEST FOR EVALUATION
OF UNHATCHED EGGS: NUMBER OF UNHATCHED EGGS FOUND UPON EXCAVATION OF THE NEST FOR EVALUATION

FLORIDA DEPARTMENT OF NATURAL RESOURCES - NEST SUCCESS REPORTING FORM FOR 1991
SPECIES: *Dermochelys coriacea* (Leatherback)

PRINCIPLE PERMIT HOLDER: Lou Fisher
BEACH NAME: Broward County (less John U Lloyd Beach SRA)
PERMIT NUMBER: TP129

	TOTAL # OF NESTS	# OF NESTS MARKED TO EVALUATE	# OF MARKED NESTS DEPREDATED	# OF NESTS ACTUALLY EVALUATED	# OF EGGS IN EVALUATED NESTS	# OF HATCHLINGS EMERGED	# OF LIVE HATCHLINGS* IN NEST	# OF DEAD HATCHLINGS IN NEST	# OF PIPPED LIVE	# OF PIPPED DEAD	# OF UNHATCHED EGGS	DNR USE ONLY
IN SITU												
IN SITU (SCREENED)	–											
IN SITU (CAGED)												
BEACH RELOCATED	1	1	0	1	299	140	n/a	1	n/a	21	127	
BEACH RELOCATED (SCREENED)												
BEACH RELOCATED (CAGED)												
SELF-RELEASING HATCHERY												
RESTRAINING HATCHERY	1	1	0	1	122	101	n/a	0	n/a	1	18	
OTHER (EXPLAIN)												
DNR USE ONLY												

EXPLANATION OF ROW CATEGORIES:

IN SITU: NATURAL NEST LEFT WHERE TURTLE DEPOSITED THE CLUTCH
IN SITU (SCREENED): IN SITU NEST COVERED WITH A SELF-RELEASING FLAT SCREEN
IN SITU (CAGED): IN SITU NEST COVERED WITH AN ABOVE-GROUND INDIVIDUAL CAGE
BEACH RELOCATED: NEST REMOVED AND REBURIED AT A PLACE ON THE BEACH OTHER THAN WHERE TURTLE DEPOSITED THE CLUTCH (NOT IN A FENCED/CAGED HATCHERY)
BEACH RELOCATED (SCREENED): BEACH RELOCATED NEST COVERED WITH A SELF-RELEASING FLAT SCREEN
BEACH RELOCATED (CAGED): BEACH RELOCATED NEST COVERED WITH AN ABOVE-GROUND INDIVIDUAL CAGE
SELF-RELEASING HATCHERY: PERMANENT OR SEMI-PERMANENT FENCED/CAGED AREA WHERE MANY NESTS ARE REBURIED, HATCHLINGS ESCAPE ON THEIR OWN
RESTRAINING HATCHERY: PERMANENT OR SEMI-PERMANENT FENCED/CAGED AREA WHERE MANY NESTS ARE REBURIED, HATCHLINGS CANNOT ESCAPE WITHOUT HUMAN INTERVENTION

EXPLANATION OF COLUMN HEADINGS:

TOTAL # OF NESTS: TOTAL NUMBER OF NESTS FOR EACH CATEGORY
OF NESTS MARKED TO EVALUATE: NESTS WHICH WERE MARKED TO TRACK THEIR FATE AND EVALUATE NEST SUCCESS
OF MARKED NESTS DEPREDATED: NUMBER OF MARKED NESTS DEPREDATED BY NON-HUMAN PREDATORS
OF NESTS ACTUALLY EVALUATED: NESTS IN WHICH NEST SUCCESS WAS EVALUATED
OF EGGS IN EVALUATED NESTS: TOTAL NUMBER OF EGGS IN EVALUATED NESTS (THIS MAY BE AN ESTIMATE DUE TO HATCHED EGG COUNTS)
OF HATCHLINGS EMERGED: NUMBER OF HATCHLINGS THAT EMERGED FROM THE NEST ON THEIR OWN, BEFORE THE NEST WAS EXCAVATED FOR EVALUATION
OF LIVE HATCHLINGS IN NEST: NUMBER OF LIVE HATCHLINGS FOUND IN THE NEST UPON EXCAVATION OF THE NEST FOR EVALUATION
OF DEAD HATCHLINGS IN NEST: NUMBER OF DEAD HATCHLINGS FOUND IN THE NEST UPON EXCAVATION OF THE NEST FOR EVALUATION
OF PIPPED LIVE: NUMBER OF LIVE HATCHLINGS FOUND PIPPED (BROKEN THROUGH EGGSHELL BUT NOT COMPLETELY FREE OF EGGSHELL) UPON EXCAVATION OF THE NEST FOR EVALUATION
OF PIPPED DEAD: NUMBER OF DEAD HATCHLINGS FOUND PIPPED (BROKEN THROUGH EGGSHELL BUT NOT COMPLETELY FREE OF EGGSHELL) UPON EXCAVATION OF THE NEST FOR EVALUATION
OF UNHATCHED EGGS: NUMBER OF UNHATCHED EGGS FOUND UPON EXCAVATION OF THE NEST FOR EVALUATION