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**Monitoring of Olive Ridley Sea Turtle Populations at Nancite Beach, Santa Rosa  
National Park, Costa Rica**



**Principle Investigator:** *Claudette Lee Mo*

**Research Period:** *June 10, 1996 - January 31, 1997*

**Report Prepared by:** *Scott Pankratz*

**Research Assistants:** *The following research assistants collected the data that is compiled in this report:*

*Scott Pankratz: September 10, 1996 - January 31, 1997*

*Kristin Caruso: October 10 - December 18, 1996*

*Jens Kiel: September 6 - September 22, 1996*

*Rachel Forsyth, David Bonnardeaux and Jennifer Hayward: July 20 - September 5, 1996*

*Shannon Donnelly and Don Dressler: June 10 - July 19, 1996*

## **ABSTRACT**

Nancite beach in the Guanacaste Conservation Area is of worldwide importance for the Olive Ridley sea turtle (*Lepidochelys olivacea*). Nesting at Nancite occurs not only individually, but also synchronously. Turtles emerge in groups of up to 100,000, over the course of 6-7 nights and days, in a phenomenon unique to the genus *Lepidochelys*, known as an *arribada*. Few beaches are known where *arribadas* for this species occur. These include Gahirmatha and Nadiakhia Muhana on the Pacific coast of India (Karr 1982); Escobilla on the Atlantic coast of Mexico (Cliffon et al 1982); and Nancite and Ostional on the Pacific coast of Costa Rica (Richard and Hughes 1972). Nancite is unique because it is a fully protected area where no harvesting of eggs is allowed.

*Arribadas* at Nancite were first discovered by Richard and Hughes in 1970 (Richard and Hughes 1972) and marking of Olive Ridelys was started by Hughes in 1971. In 1980 a systematic study monitoring abundance, distribution and migration of Olive Ridelys was undertaken by Cornelius and has been continued by Dr. Mo and the National University of Costa Rica.

## **OBJECTIVES**

1. To estimate the number of *arribadas* and the number of solitary turtles that nest throughout the year.
2. To compare the quadrat and the transect methods for estimating *arribada* sizes.
3. To estimate nest success in marked nests.
4. To continue marking and the reobservation program along with the Sea Turtle Center of the University of Costa Rica.
5. To register environmental parameters such as rainfall and temperature.



## RESULTS

The results section will cover the following: arribadas, solitary nesting, nest predation, neonate emergence, tagged turtles, turtle mortality, and environmental parameters.

### Arribadas

Two arribadas occurred during the time covered by this report, in the months of July and November. The first arribada occurred July 19, lasting only one night, and yielded 12,373 turtles by the transect method and 1882 turtles by the quadrat method. The second arribada began the morning of November 6 and ended November 8 for a total of three nights. The November arribada yielded 15,211 turtles by the transect method and 47,142 turtles by the quadrat method. See Table 1 below.

| <u>Dates</u>      | <u>Quadrat</u> | <u>Transect</u> |
|-------------------|----------------|-----------------|
| 19/7/96           | 1882           | 12,373          |
| 6/11/96 - 8/11/96 | 47,142         | 15,211          |

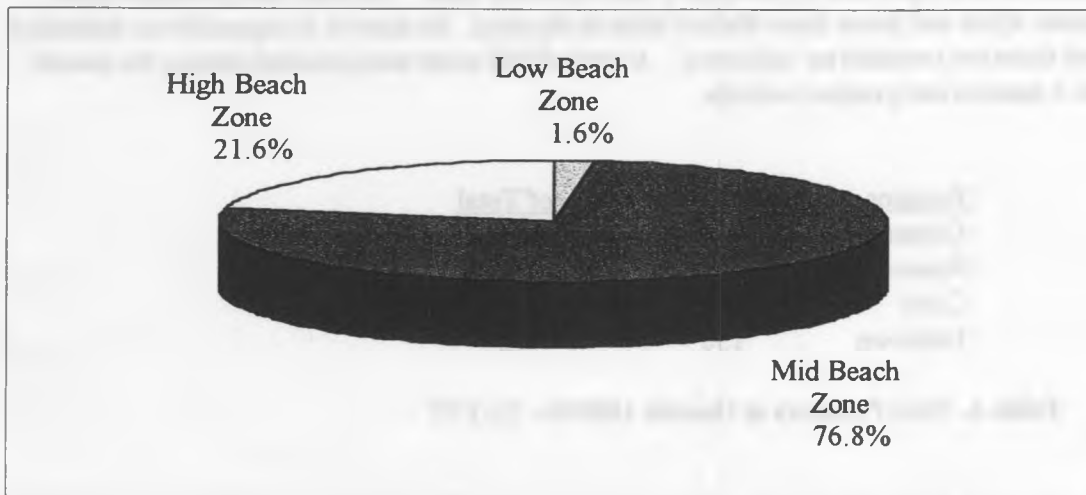
Table 1. Arribada Population Estimates

The July arribada was relatively small and lasted only one night. July 19 there was a waxing crescent moon with strong westerly winds and a clear sky. Though turtles were observed nesting on the beach as early as 5pm, there were not enough turtles to constitute an arribada until 11pm. During the low tide, over 200 turtles were counted on the beach and transect and quadrat counts began at 11:45pm lasting for five hours until 4:15am. There were no nests in Sectors 1 or 2 with the majority of the nesting activity occurring in Sectors 5 through 8. The transect method yielded 12,373 turtles with a 95% confidence interval ranging from 8687 to 16,058. The quadrat method yielded a total of 1882 turtles; creating a difference of 10,491 turtles.

The November arribada began on November 6 with a waning quarter moon, strong offshore winds from the north and clear skies. The turtles began arriving shortly after nightfall, with approximately forty turtles on Nancite at 10:00pm. Observation at midnight still did not show enough turtles to constitute an arribada, but at 2:00am, the arribada had begun. At this point, the tide was at an intermediate but declining stage. Transect and quadrat counts began at 2:45am. The first session included three sweeps, at 2:45am, 4:45am, and 6:45am. Nesting activity decreased rapidly at the light of dawn, but continued in waves throughout the entire day. At 12:45pm, the number of turtles on the beach warranted another sweep and so the population was sampled at this time. The beach was not sampled again until the evening of November 6 at 6:45pm. The final sweep of session #2 was begun at 4:45am. Session #3 began at 6:45pm and the final sweep on the morning of November 8 started at 2:45am. By 4:45am it was determined that less than 200 turtles remained on Nancite. The transect method yielded 15,211 turtles with a 95% confidence interval ranging from 12,513 to 17,910. The quadrat method yielded a total of 47,142 turtles.

## Solitary Nesting

During non-arribada periods, 2582 Olive Ridleys nested at Nancite. Of these, 479 were false crawls (18.5% of the total). When tracks indicated the zone of the beach where the nest was located, 247 of the solitary turtles nested in the high beach zone, 877 in the mid beach zone, and 18 in the low beach zone. See Figure 1. When turtle traffic exceeded 130 in a night, nest location became impossible to determine, and nest location data from June 10 - July 19 was not available for the compilation of these numbers. The beach 'zones' are altitudinal stratifications that run parallel to the ocean. The low beach zone is the area between the most recent high tide line and the ocean, the mid beach zone is between the most recent high tide line and the vegetation, the high beach zone is the area above where sand meets the vegetation.



**Figure 1.** Nest Locations of Solitary Nesting Turtles 20/7/96 - 31/1/97

In addition to the Olive Ridleys, 18 Black turtles or Pacific Green turtles (*Chelonia agassizzi*) nested and one Leatherback (*Dermochelys coriacea*) turtle nested at Nancite. Appendix 1 is a summary of the nesting activity of these species at Nancite from June through January.

At the end of the first week in October all the signs appeared for an impending arribada. During the night of October 5th, 105 turtles came ashore. The night of the 6th, 144 turtles came ashore. On October 7, turtles were easily visible off shore of Nancite from Sectors 5-8. The night of October 7, another 150 turtles came ashore. The rainfall during these days was substantial however, and this may account for the absence of an arribada. Table 2 is a summary of rainfall and turtle activity from October 4 - 9:

| <u>Date</u> | <u>Rainfall (cm.)</u> | <u># of Turtles (arriving that night)</u> |
|-------------|-----------------------|---|
| October 4th | .61                   | 34  |
| October 5th | 4.80                  | 105                                       |
| October 6th | 3.25                  | 144                                       |
| October 7th | 2.92                  | 150                                       |
| October 8th | 5.75                  | 30  |
| October 9th | 10.16                 | 4   |

**Table 2.** Rainfall and Turtle Activity October 4 - 9, 1996

The estuary in sector 7 broke through to the ocean at approximately noon on October 9. This substantial rainfall might account for the lack of an arribada even though the turtles appeared to be amassing offshore and increasing their activity on the beach from October 4-7.

### **Nest Predation**

The main predators of Olive Ridley nests at Nancite are coyotes (*Canis latrans*), coati (*Nasau narica*), and raccoons (*Procyon lotor*). The nest predator is determined by visual observation of the predator, track identification at nest sight, and by analysis of the excavated sand. The three nest predators have distinct excavation styles and hence leave distinct holes in the sand. At times it is impossible to determine the predator and these are recorded as 'unknown'. A total of 808 nests were predated during the period of study. Table 3 summarizes predator activity.

| <u>Predator</u> | <u># of Nests</u> | <u>% of Total</u> |
|-----------------|-------------------|-------------------|
| Coyote          | 415               | 51%               |
| Raccoon         | 85                | 11%               |
| Coati           | 134               | 17%               |
| Unknown         | 156               | 19%               |

**Table 3.** Nest Predators at Nancite 10/6/96 - 31/1/97

Appendix 3 is a review of predator activity by month.

There is a question of accuracy regarding the determination of nest predation due to the fact that more than one predator may visit the same nest in the same night. In some cases the nests were initially predated by raccoons and coatis, and then by coyotes. This could have a bearing on the results, as the number of nests predated by coatis and raccoons will be underestimated and the predation by coyotes will be overestimated.

### **Neonate Emergence**

Two neonate emergences occurred during this period, corresponding to the two arribadas. The first emergence lasted from August 31 to September 5, the second emergence lasted from December 24 to December 31. During both periods of neonate emergence, predator activity on the beach increased. The following animals were seen eating neonates at Nancite during neonate emergences: black vulture, turkey vulture, crested caracara, common black hawk, magnificent frigatebird, crocodile, coyote, coati, ghost crab, and ctenosaur.

Hatchlings from the July arribada (July 19) began appearing on August 31 (43 days incubation) and neonates were still observed on the morning of September 5. The beach was in an eroding stage, the high tide and rains being the erosive agent, starting on August 29 and lasting through September 5. This exposed many of the nests, causing some neonates to emerge too soon. Many appeared undeveloped with

swollen abdomens, others bearing the resemblance of an umbilical cord. In sectors 8-10 the tide formed a small 30cm bank, exposing nests to vulture predation.

Hatchlings from the November arribada (November 6-8) began appearing on December 24 (46-48 days incubation) and were still observed on the morning of January 2 (54-56 days incubation). The greatest number of neonates were observed on December 25, 26, and 27. While predator activity on the beach was high, it is interesting to note that the number of nests excavated was very low. During the ten days of this emergence, only 18 nests were predated, an average of 1.8 per night; compared to an eight month average of 4.6 nest predations per night.

A total of 12 nest cages were placed during this study. Eight were lost or removed before day 45 of incubation, one produced no hatchlings, and three produced at least one hatchling. Table 4 summarizes nest cage activity:

| <u>Date</u> | <u>Cage #</u> | <u>Location</u> | <u># Eggs</u> | <u># Hatchlings</u> | <u>Comments</u>                 |
|-------------|---------------|-----------------|---------------|---------------------|---------------------------------|
| 19/9/96     | 2             | 8-M             | 101           | n/a                 | removed during arribada         |
| 19/9/96     | 1             | 8-M             | 121           | n/a                 | removed during arribada         |
| 21/9/96     | 3             | 5-M             | 119           | n/a                 | Lost                            |
| 21/9/96     | 4             | 7-M             | 115           | n/a                 | washed out by high tide         |
| 3/11/96     | 101           | 5-M             | 83            | 1                   |                                 |
| 3/11/96     | 102           | 3-M             | 102           | 0                   |                                 |
| 8/11/96     | 102           | 8-M             | 107           | 3                   |                                 |
| 8/11/96     | 103           | 8-M             | 124           | n/a                 | Lost                            |
| 8/11/96     | 104           | 8-M             | 130           | n/a                 | Lost                            |
| 8/11/96     | test          | 7-M             | 88            | n/a                 | washed out with estuary opening |
| 8/11/96     | 105           | 7-M             | n/a           | n/a                 | washed out with estuary opening |
| 9/11/96     | 201           | 5-M             | n/a           | 1                   |                                 |

**Table 4.** Nest Cage Usage and Results

The Leatherback nest laid in sector 2 on the morning of October 13 was presumed to be successful. On December 12, 23 neonate tracks led from the nest location to the sea. The hatchling tracks were considerably larger than those of Olive Ridley hatchlings with the distinctive track of a turtle who moves both front flippers forward together. The incubation time of eight weeks is also indicative of the Leatherback.

### **Tagged Turtles**

During the period of this report, a total of 82 Olive Ridleys were tagged by researchers and volunteers. In addition, two Pacific Green turtles were tagged. These numbers will be sent to the Sea Turtle Program at the University of Costa Rica in San Pedro.

## **Turtle Mortality**

A total of thirty dead turtles were found on Nancite from June 1996 to January 1997. Sixteen appeared to be killed by predators, six appeared to have drowned, one was too weak to return to the sea from nesting, and the remaining five deaths were undeterminable.

On the morning of November 2 a turtle was taken from sector 6 after it layed its eggs, by either a Jaguar or Puma. The turtle was found the same day, approximately 50 meters in the back beach vegetation, its entire front half missing, with many teeth marks in the carapace. On the beach the tracks were obviously felid, but due to the substrate (sand), species identification was impossible.

On December 7, the fishing boat 'Zilvapol' was observed pulling in fishing nets within 100 meters offshore of Nancite. In this net were trapped three turtles that were pulled in motionless and dropped back into the ocean.

Appendix 4 has a summary of the turtle mortality.

## **Environmental Parameters**

Parameters measured daily at Nancite include ambient temperature, rainfall, and sand temperature. The sand temperatures were taken twice a day in sectors 6, 7, and 8 at mid and high zones of the beach. The summary of sand temperature records is not included in this report.

The mean ambient maximum temperature during the research period was 30.8 degrees Celsius. The mean minimum temperature during this time was 22.1 degrees Celsius. The ambient temperature ranged from 39 to 18 degrees Celsius. Total rainfall amounted to 184.81 centimeters. 184.76 centimeters of this rainfall was before December 1, and .05 centimeters of rain fell in December and January. Temperature and rainfall data is summarized in Appendix 5.

## **ENVIRONMENTAL EDUCATION AND VISITATION**

Information regarding visitation to Nancite is only available for the periods from June 10 - July 19 and from September 5 - January 31. During this time, a total of 174 people visited Nancite, this included 43 ACG affiliated researchers, 55 students and supporting staff from two classes held in Nancite, and 76 tourists. Total visitation to Nancite was 559 user-days. A user-day is equal to one person in Nancite for one day. It is the length of stay multiplied by the number of people staying. Of 559 user days in Nancite, 296 user-days or 53% were from the two student groups.

Tourists were normally taught proper beach etiquette, Nancite research history and given a tour of the beach by one of the research assistants. Tourists were encouraged to assist the researchers with any projects in progress and help to remove garbage from the beach. Research assistants often accompanied tourists at night on beach walks to look for turtles. The tourists represented ten different countries and were frequently students or biologists.

Two classes came to Nancite, a turtle ecology course on November 2 with 17 participants and a dry forest ecology class on January 17 with 28 participants.

Two filmmakers were at Nancite from October 5, 1996 to January 13, 1997. Jens Westphalen and Thoralf Gropitz from the NDR in Northern Germany stayed at the research station to make a nature documentary about Nancite and the Olive Ridley.

## **ADDITIONAL WORK**

- Over 400 kilograms of garbage was carried from Nancite to Estero Real during the months of December and January. This was trash left at the research station and in the neighboring forest by previous visitors to Nancite. More trash remains in the near vicinity of the station.
- A manual was compiled by Scott Pankratz and Kristin Caruso to standardize and educate new research assistants about the methodology used on the Olive Ridley Sea Turtle Monitoring Project at Nancite.
- This report has been distributed to the National University of Costa Rica (UNA) and the Guanacaste Conservation Area (ACG).

## **RECOMMENDATIONS**

- Class groups at Nancite MUST take out all the garbage that they bring into the Nancite Valley. Leaving batteries, plastics and tins in the forest sets a poor example and ruins the scientific and spiritual value we find here.
- New assistants must have an overlap period with veteran assistants in order to learn the ropes in-situ.
- Communication between the principle investigator, the principle investigator's assistants and the research assistants needs to be clear and complementary. Often times conflicting information was transmitted to research assistants from Claudette Mo and Jorge Quesada.
- To improve consistency, modifications in methodology and analysis need to be written down and made accessible to research assistants.
- The current method of using nest cages to determine hatchling success could be improved. It is imperative to use a fixed object as a reference point to buried nest cages. Buried cages can be lost if the leash holding the wood breaks. The current cages expose the neonates to environmental exposure and predation.

Suggestions for further study at Nancite:

- Neonate orientation at emergence
- Success rate of nests in newly deposited sand of the sector 7 estuary opening
- Crocodile movements and activity at Nancite
- Effects of woody debris on nesting turtles and neonates



## ACKNOWLEDGEMENTS

All information in this report from 10/6/96 - 19/7/96 was taken directly from the report compiled by Donnelly and Dressler.

All information in this report from 20/7/96 - 5/9/96 was taken directly from the report compiled by Forsyth, Bonnardeaux, and Hayward.

Thanks to Roger Blanco for passion and dedication to the special resources of the Guanacaste Conservation Area.

Thanks to Kristin Caruso who helped compile a portion of this report.



## APPENDIX 1

### Green and Leatherback Turtle Activity at Nancite 10/7/96 - 31/1/97

| <u>Date</u> | <u>Spp.</u> | <u>Location</u> | <u>Comments</u>                          |
|-------------|-------------|-----------------|--|
| 20/7-5/9    | C.A.        | n/a             | <u>Eight</u> in total during this period |
| 4/10/96     | C.A.        | Sector 1/M      | Nested                                   |
| 13/10/96    | D.C.        | Sector 2/M      | Nested & Successful                      |
| 16/10/96    | C.A.        | Sector 1/A      | Nested                                   |
| 3/11/96     | C.A.        | Sector 4/M      | Nested & Tagged                          |
| 17/12/96    | C.A.        | Sector 6        | False Crawl                              |
|             | C.A.        | Sector 5/M      | Nested                                   |
| 18/12/96    | C.A.        | Sector 5/M      | Nested                                   |
| 30/12/96    | C.A.        | Sector 2/M      | Nested                                   |
| 7/1/97      | C.A.        | Sector 10/M     | Nested                                   |
| 12/1/97     | C.A.        | Sector 4/M      | Nested                                   |
| 28/1/97     | C.A.        | Sector 10/A     | Nested & Tagged                          |

**Spp.** - C.A - *Chelonia agasazzi*

D.C. - *Dermochelys coriacea*

**Location** - refers sector and zone on beach

n/a - this information was not available from the report of Forsyth, et. al.

## APPENDIX 2

### Monthly Summary of Solitary Nesting Turtles at Nancite

| Month | Dates       | # Days | Nesters | FC  | IND. | Total | Avg./Day |
|-------|-------------|--------|---------|-----|------|-------|----------|
| June  | 10/6-25/6   | 16     | 65      | 27  | 0    | 92    | 5.75     |
| July  | 5/7-19/7    | 15     | 150     | 34  | 0    | 184   | 12.27*   |
| Aug   | 20/7-5/9    | N/A    | 240     | 29  | 0    | 269   | N/A      |
| Sept  | 6/9-22/9    | 16     | 179     | 24  | 0    | 203   | 12.69    |
| Oct   | 1/10-22/10  | 21     | 282     | 138 | 140  | 560   | 26.67    |
| Nov   | 31/10-30/11 | 20     | 103     | 5   | 211  | 319   | 12.76*   |
| Dec   | 1/12-31/12  | 25     | 398     | 29  | 0    | 427   | 17.08    |
| Jan   | 1/1-31/1    | 22     | 41      | 44  | 454  | 539   | 24.5     |

**# Days** - Number of days of data collection in the time period

**Nesters** - Number of turtles that nested

**FC** - False Crawl

**IND.** - Number of turtles that came ashore, but whose activity was indeterminable

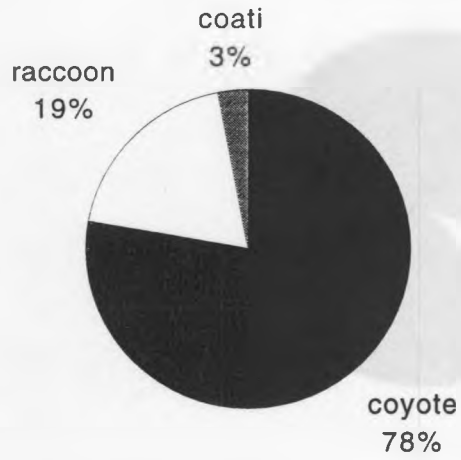
**N/A** - This information was not available from the report of Forsyth, et. al

\* Months in which an arribada occurred

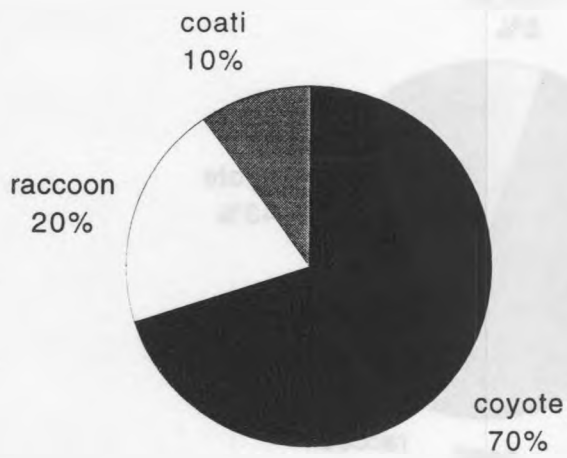
### APPENDIX 3

#### Nest Predation at Nancite June 6, 1996 - January 31, 1997

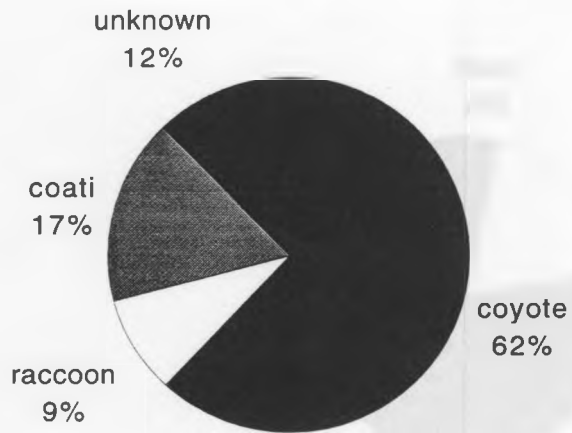
June (54 Nests)



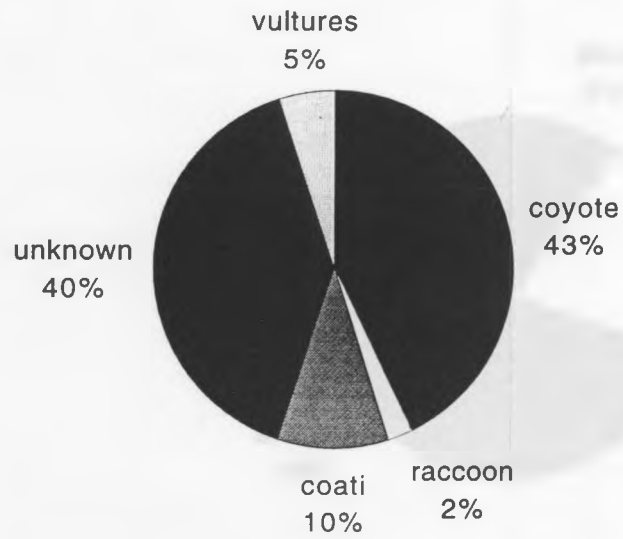
July (50 Nests)



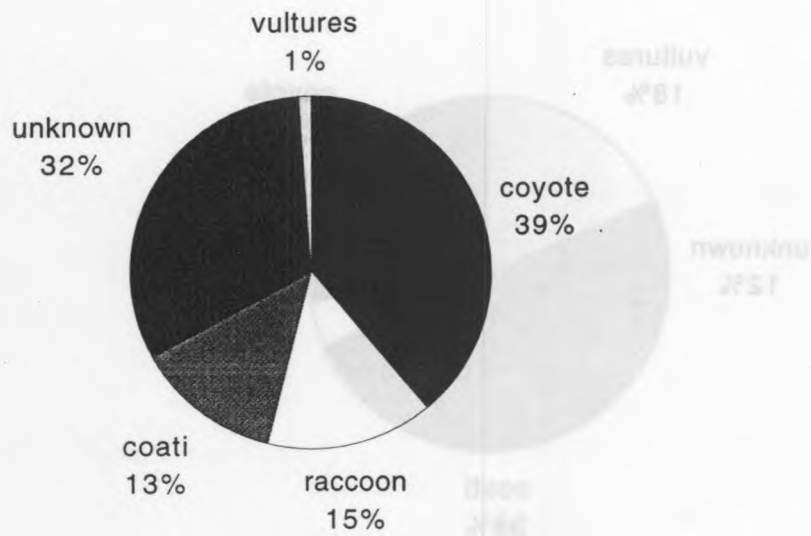
### August (245 Nests)



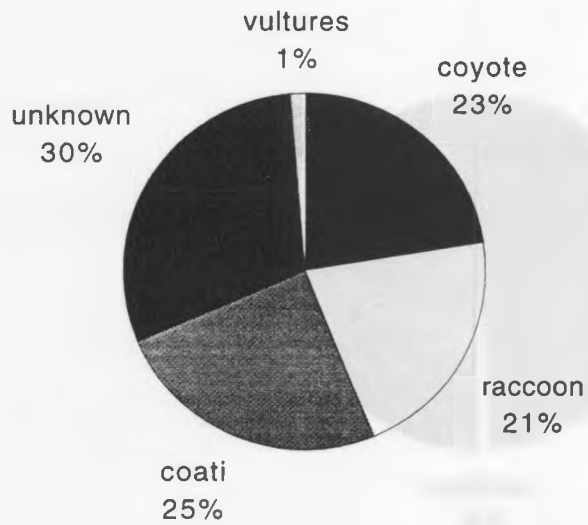
### September (129 Nests)



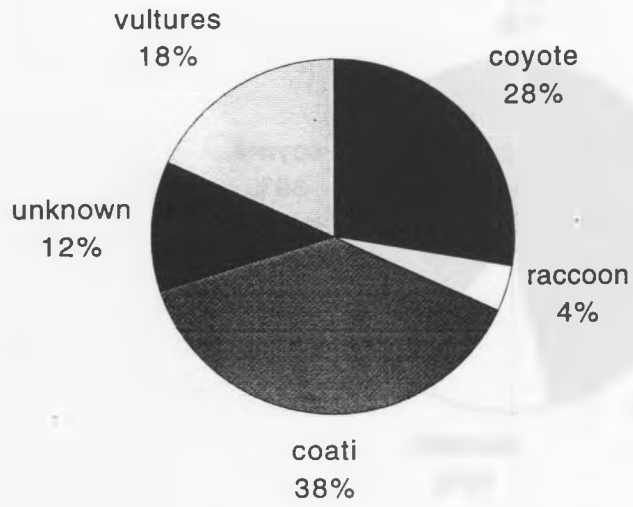
**October (129 Nests)**



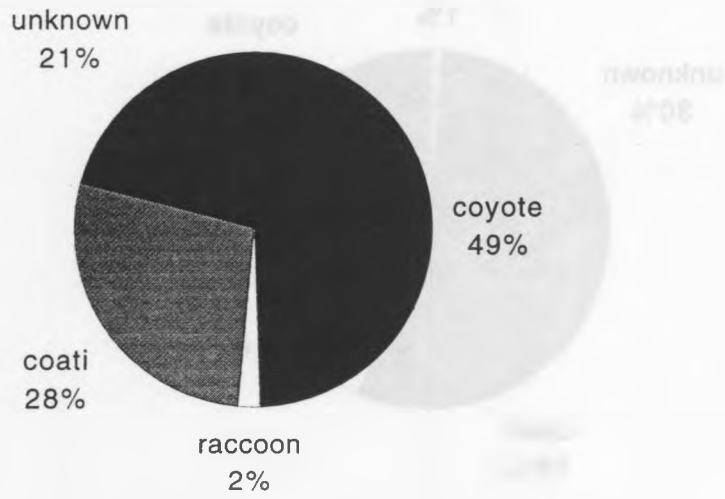
**November (103 Nests)**



**December (50 Nests)**



**January (58 Nests)**



## APPENDIX 4

### Adult Turtle Mortality at Nancite 10/6/96 - 31/1/97

| <u>Date</u> | <u>Spp.</u> | <u>Possible Cause of Death</u>                         |
|-------------|-------------|--|
| June        | L.O.        | Shark  |
| July        | L.O.        | Shark  |
| 20/7-5/9    | L.O.        | Four deaths by shark or Crocodile                      |
|             | L.O.        | Two deaths by drowning                                 |
|             | L.O.        | One death by unknown causes                            |
| 11/9/96     | L.O.        | Trauma - Shark or Crocodile                            |
| 13/9/96     | L.O.        | Drowning   |
| 13/9/96     | L.O.        | Drowning   |
| 15/9/96     | L.O.        | Unknown  |
| 16/9/96     | L.O.        | Shark  |
| 18/9/96     | L.O.        | Unknown  |
| 8/10/96     | L.O.        | Trauma - Shark or Crocodile                            |
| 16/10/96    | L.O.        | Trauma   |
| 18/10/96    | L.O.        | Trauma   |
| 31/10/96    | L.O.        | Trauma   |
| 2/11/96     | L.O.        | Jaguar or Puma   |
| 2/11/96     | L.O.        | Drowning   |
| 2/11/96     | L.O.        | Trauma - Shark   |
| 4/11/96     | L.O.        | Drowning   |
| 5/11/96     | L.O.        | Trauma   |
| 10/11/96    | L.O.        | Unknown  |
| 12/11/96    | L.O.        | Weakness - Unable to return to ocean after laying eggs |
| 15/11/96    | L.O.        | Drowning   |
| 16/11/96    | E.I.        | Unknown*   |
| 17/11/96    | C.A.        | Unknown**  |
| 9/12/96     | L.O.        | Crocodile  |

Spp. - L.O. - *Lepidochelys olivacea* (Olive Ridley)

E.I. - *Eretmochelys imbricata* (Hawksbill)

C.A. - *Chelonia agasazzi* (Pacific Green)

\* Juvenile turtle

\*\* Male turtle

More detailed notes on individual turtles can be found in the daily data sheets. Most of the dead turtles washed ashore showed major trauma, but few clues to the exact cause of the trauma.



## APPENDIX 5

### Temperature and Rainfall

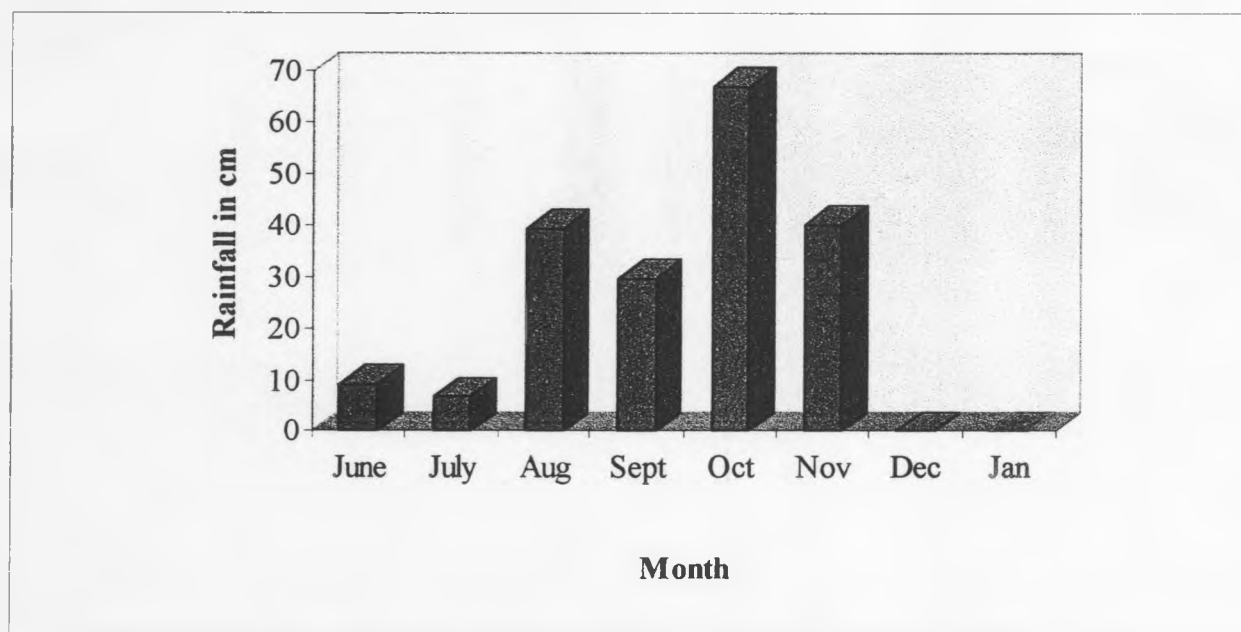
#### Monthly Temperature Summary - All temperatures in °C

| Month | Avg. High | Avg. Low | Highs Range | Lows Range |
|-------|-----------|----------|-------------|------------|
| June  | 31        | 22.5     | 29-37       | 22-25      |
| July  | 30        | 22       | 28-34       | 21-23      |
| Aug   | 31        | 22.1     | 18*         | 34.5*      |
| Sept  | 30.9      | 22       | 29-34       | 21-23      |
| Oct   | 28.5      | 22       | 26-33       | 21-23      |
| Nov   | 30.7      | 22.7     | 26-33       | 22-24      |
| Dec   | 31.5      | 22.1     | 30-33       | 19-25      |
| Jan   | 32.8      | 21.2     | 30-39       | 19-24      |



\*Only the highest and the lowest temperatures are available for the month of august

#### Monthly Rainfall Summary - All amounts in cm



| June | July | Aug   | Sept  | Oct   | Nov   | Dec | Jan  |
|------|------|-------|-------|-------|-------|-----|------|
| 9.22 | 6.71 | 39.27 | 29.49 | 67.03 | 39.94 | 0.1 | 0.05 |