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Cover: Author Ken King, foreground, checks machine that registers ground transmission and attenuation of energy inputs typifying conditions at Chaco Culture National Historical Park. Story begins on page 3.

Editorial

The extremely untimely death of Thomas Lucke on February 28th of this year left the *Park Science* editorial board with a gaping hole. Tom had been a volunteer – offering to share the fruits of his careful reading of law journals as they apply to park matters. He read these journals voraciously; he extracted their Parks-related meat; he translated it into words we all could understand.

Your editor chose not to rush out and attempt to fill the board's vacancy. She has always found that volunteers tend to work harder and to add a personal cachet that gives a little different spin to the whole operation.

Sure enough. The lilies-of-the-field syndrome proved itself again. Within two weeks the phone rang and it was Harvey Fleet, Chief, Digital Cartography Branch, GIS Division at the NPS Denver Service Center, asking if he might have a little corner of *Park Science* with its own standing head for dealing with Geographic Information Systems (GIS) matters. (The response to his article in the Spring 1987 issue had encouraged him to make his bid.)

Not wishing to offend the gods by looking a gift lily in the mouth, we accepted forthwith. So Harvey Fleet is our new board member, and he welcomes both questions and information in his area of expertise.

WILLIAM PENN MOTT, JR., Director
National Park Service
U.S. Department of the Interior

Editorial Board:

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Roland H. Wauer, NPS Cooperative Extension Service, College of the Virgin Islands, St. Croix, USVI

Harvey Fleet, Chief, Digital Cartography, Denver Service Center

Jean Matthews, Editor: Oregon State University NPS/CPSU, Room 110 Forestry Sciences Lab,
3200 Jefferson Way, Corvallis, OR 97331 (503) 757-4579; 8-420-4579

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Regional Chief Scientists

Anderson, William H.
NATIONAL CAPITAL REGION
1100 Ohio Drive, S.W.
Washington, D.C. 20242
8(202)342-1443

Dottavio, Dominic
SOUTHEAST REGION
75 Spring St. S.W.
Atlanta, GA 30303
8-242-4916 (404) 221-4916

Karish, John R.
MID ATLANTIC REGION
Ferguson Bldg. Room 209-B
Pennsylvania State University
University Park, PA 16802
8(814)865-7974

Kilgore, Bruce
WESTERN REGION
450 Golden Gate Ave.
P.O. Box 36063
San Francisco, CA 94102
8-556-4968 (415) 556-4968

Ruggiero, Michael
MIDWEST REGION
1709 Jackson St.
Omaha, NE 68102
8-864-3438 (402) 221-3438

Huff, Dan
ROCKY MOUNTAIN REGION
P.O. Box 25827
Denver, CO 80225
8-776-9425 (303) 236-9425

Larson, James W.
PACIFIC NORTHWEST REGION
83 S. King St.
Suite 212
Seattle, WA 98104
8-399-4176 (206) 442-4176

Soukup, Michael
NORTH ATLANTIC REGION
15 State Street
Boston, MA 02109
8-835-8805 (617) 565-8805

Fletcher, Milford
SOUTHWEST REGION
P.O. Box 728
Santa Fe, NM 87501
8-476-6412 (505) 988-6412

Lovaas, Allan L.
ALASKA REGION
2525 Gambell St., Room 107
Anchorage, AK 99503-2892
8 (907) 271-2612

Please address requests for information to appropriate Regional Chief Scientist.

Padre Island Kemp's Ridley Sea Turtle Project Update

By Donna Shaver

Park-wide involvement, cooperation and enthusiasm in a single natural resources project is rare – but it happened at Padre Island in 1986. For the ninth year, Padre Island National Seashore (PAIS) participated in the international program to expand the population of the endangered Kemp's ridley sea turtle (*Lepidochelys kempi*). It was a year characterized by project expansion and advancement. As in the past, Kemp's ridley eggs were incubated and imprinted at Padre Island NS. However, this year, park personnel were also heavily involved in efforts to educate the public about the Kemp's ridley project, beach patrols to look for nesting turtles, and biological studies designed to gather further information needed to direct procedures and future actions.

In 1978 the Kemp's Ridley Sea Turtle Restoration and Enhancement Project was undertaken by the Instituto Nacional de Pesca of Mexico, U.S. Fish and Wildlife Service (USFWS), National Marine Fisheries Service (NMFS), National Park Service (NPS) and Texas Parks and Wildlife Department in accordance with Section II of the Endangered Species Act. One of the goals of the project was to establish a secondary breeding population of this species at Padre Island. Padre Island NS was chosen because the species had been known to nest there historically and because the NPS would be able to provide some protection in the event that a new breeding population became established.

Nesting

The Kemp's ridley is the most endangered and restricted sea turtle species. Virtually the entire population nests on a single 14 mile stretch of beach near the village of Rancho Nuevo, Tamaulipas, Mexico. Only sporadic nesting has been reported in other areas, ranging from Padre Island, Texas in the north to Veracruz, Mexico in the south.

The Kemp's ridley population has undergone one of the most dramatic declines ever experienced by any endangered species. It is estimated that 40,000 females nested in a daytime aggregation (arribada) filmed in 1947. By 1966, when biologists finally learned the location of the nesting beach and began protection, only 3,000 to 5,000 females nested in the largest arribadas. Despite conservation efforts, the adult population now is thought to consist of only 1,000 to 2,000 individuals. Causes for this sharp decline include the harvest of adults for meat and leather and of eggs for use as a supposed aphrodisiac. Incidental capture of these turtles in fishing and shrimping trawls is also thought to have reduced their numbers.

L. kempi is the only sea turtle species in which the adults nest during the day. Females require approximately 45 minutes to complete the terrestrial nesting process. They emerge from the sea, lumber up the beach, excavate a nest cavity about 1.5 feet deep, deposit about 100 eggs (one clutch), cover the nest and return to the sea. Eggs incubating in an undisturbed, natural nest are heated only by the warmth of the surrounding sand and the metabolic heat generated by their own embryonic development.

Hatching and Imprinting

About 20 clutches of Kemp's ridley eggs are collected in Rancho Nuevo and shipped to Padre Island each year. The eggs are caught in plastic bags as the female lays them and hence they never touch Rancho



YCC workers assist with catching the hatchlings released in the surf at Padre Island.



Hatchling Kemp's Ridley turtles are released mid-beach at Padre Island. As sun warms the turtles they become active and rush to the surf.

Nuevo sand. They are then packed into styrofoam boxes containing Padre Island sand and are transported via aircraft to the national seashore. The styrofoam boxes are placed in an outdoor predator-proof, screen enclosed incubation shed. Incubation temperatures of the eggs are recorded hourly with a recording thermograph.

After the eggs hatch the hatchlings are released on a beach area closed to vehicular traffic. They are allowed to enter the water and swim about 10 yards and are then recaptured using aquarium dip nets. It is thought that this exposure of eggs and hatchlings to Padre Island sand and of hatchlings to Padre Island sea water may act to "imprint" them, much the way a salmon is imprinted to its natal stream.

The recaptured hatchlings are transported to the

NMFS laboratory in Galveston, Texas, where they are held in captivity for about one year of "head starting." This allows them to grow to a size large enough to avoid most predators and to be tagged for future recognition. The yearling turtles are released offshore from Padre Island.

Two thousand and eleven Kemp's ridley eggs were transported to PAIS from Rancho Nuevo on June 12, 1986. A total of 1,776 of the eggs hatched. The overall hatching rate of 88.3 percent was the second highest achieved during the nine project years (Table 1). Only one hatchling died in its incubation box prior to beach release and hence the 1986 year-class had the highest survival rate at Padre Island to date. Rough and murky water conditions made hatchling recapture difficult during several morning releases and a total of

16 hatchlings were lost in the surf. The remaining 1,759 hatchlings were recaptured and transported to the NMFS laboratory for head starting.

Sex Determination

The importance of the temperature of sea turtle eggs while they incubate was not known when the Kemp's ridley project began in 1978. It has recently been found that four other species, including the olive ridley (*L. olivacea*), possess temperature dependent sex determination; that is, the temperature at which the eggs incubate determines the sex of the embryos. In these species, lower egg temperatures during the middle third of incubation produce primarily males and higher temperatures produce primarily females. Unfortunately, the extremely low numbers of Kemp's ridleys remaining in the population has prohibited embryo and hatchling sacrificing necessary to systematically study this question in this species. However, it is likely that incubation temperatures do, indeed, influence gender in *L. kemp*.

The implications of such a phenomenon are profound in a project designed to increase the numbers of an endangered species. Although natural sex ratios for this species are unknown, the Kemp's ridley recovery team believes that our conservation efforts for this endangered species should favor a production of a 1:1 sex ratio or slightly more females. Our practice of incubating Kemp's ridley eggs in styrofoam boxes is a technique used in many other sea turtle recovery projects. However, this technique has been found to subject incubating eggs to cooler than normal temperatures and hence results in an over-production of males.

In 1984 a study was undertaken to determine the sex ratio of *L. kemp* transported to, and incubated at Padre Island NS. Gonads were dissected from several year-classes of dead hatchlings and late-staged embryos for histological sex determination by Dr. David Owens (Texas A&M University). Owens found a preponderance of males, indicating that temperatures in the incubation shed were slightly too low. As a result, it was decided to increase 1985 and 1986 incubation temperatures. Gonads were removed from dead 1985 and 1986 year-class embryos and hatchlings. Subsequent histological analysis of the gonads revealed almost equal proportions of males and females in the 1985 year-class and 75 percent females in the 1986 year-class. This indicated that the elevated temperatures were successful in producing more females and provided the first evidence that *L. kemp* possesses temperature dependent sex determination. The matching of clutch incubation temperatures and sex ratios for several year-classes of eggs has allowed us to further define the incubation temperatures at which the eggs should be maintained in order to produce a 1:1 sex ratio or slightly more females.

Adult Sightings

The age at which Kemp's ridleys mature is unknown but estimates range from 8 to 15 years. Since females from the early project years may begin returning to Padre Island to nest, systematic beach patrols for nesting turtles were initiated this year. Many park staff members were issued permits and trained to detect and respond to turtle sightings and all were watchful while on the beach. Various members of the Resource Management, Interpretation, and Maintenance and Ranger Divisions conducted the turtle patrols and thus, the effort was park-wide. Although one adult female and one false crawl (an abandoned nesting attempt) were sighted during the patrols and one nesting adult and one false crawl were reported by visitors,

Table 1. General results of 1978-1986 Kemp's ridley incubation and imprinting at Padre Island National Seashore.

Year	Number eggs from Rancho Nuevo	Number (percent) eggs hatched	Number hatchlings died at Padre Island	Number hatchlings lost during release	Number hatchlings to Galveston
1978	2,191	1,931 (88.1)	64	19	1,848
1979	2,053	1,769 (85.7)	15	93	1,661
1980	2,976	2,502 (84.1)	14	65 ^a	1,611
1981	2,279	1,898 (83.3)	11	19	1,868
1982	2,017	1,563 (77.6)	5	34	1,524
1983	2,006	242 (12.1)	10	2	230
1984	1,976	1,792 (90.7)	239	9	1,544
1985	1,978	1,664 (84.1)	14	25	1,623 ^b
1986	2,011	1,776 (88.3)	1	16	1,759
Total	19,487	15,137 (77.7)	373	282	13,668

^aCalculated excluding 810 hatchlings from 11 clutches intentionally released into the Gulf of Mexico.

^bCalculated excluding 69 hatchlings from a Padre Island natural nest head started at the Galveston NMFS Laboratory.

no Kemp's ridley nests were found.

Since the national seashore is 68 miles long and extensive areas are often devoid of NPS personnel, it is imperative that park visitors assist with turtle detection and reporting. Increased efforts were made to educate the public about the Kemp's ridley project and urge visitors to report turtle sightings immediately. Interpretive programs were given at several hatchling releases and new handouts, posters and displays describing the project were made. Television and newspaper interest and coverage remained high, as in past years.

Beach Temperature Profiles

A beach temperature profile study was undertaken to determine temperatures at which Kemp's ridley eggs would incubate if laid in Padre Island sand. The study was conducted at three sites on Padre Island by contractor Dr. Allan Chaney (Texas A&I University) in conjunction with a simultaneous study at Rancho Nuevo. The results of these two studies were compared. It was found that Rancho Nuevo and Padre Island sand temperatures were comparable during the

summer months of heaviest nesting activity and egg incubation and that Padre Island sand temperatures should be warm enough to produce females.

Future Program Efforts

Padre Island NS has received 19,487 Kemp's ridley eggs and sent 13,668 hatchlings to Galveston for head starting during the nine years of the restoration and enhancement program. The Kemp's ridley recovery group members recently decided to extend the program through the summer of 1992. Important biological information on this poorly known endangered species has been gathered each year. Much of this information will have future implications and applications at Padre Island and Rancho Nuevo. Although no confirmed nestings of our Padre Island imprinted turtles have occurred, national seashore staff members and visitors will continue to look for returning females and be optimistic that such returns will occur and that a secondary breeding population of the Kemp's ridley will become established at PAIS.

Donna Shaver is a Natural Resource Management Trainee at Padre Island National Seashore.

Resource Management History Traced by Ranger's Thesis

From R. Gerald Wright at the NPS/CPSU at University of Idaho, Moscow, comes word of a thesis by Gordon C. Olsen of Slippery Rock University, entitled "A history of natural resources management within the National Park Service." Olsen is a Ranger at Antietam National Battlefield and limited copies of his M.S. thesis are available through Barry MacIntosh, NPS historian in Washington, DC. Wright's review follows:

The thesis is chronologically organized and traces the history of resource management activities, personnel and offices from the start of the NPS to present. It is a lengthy document, well researched in terms of its use of archival records, unpublished NPS memos, and Annual Reports of the Director, Chief Scientist, etc. The thesis is an excellent reference document for those who are interested in knowing more about the roots of the NPS in terms of personalities and offices involved in natural science and resource management. A major part of this discussion deals with the Washington Office. Producing an ordered chronology of the activities of this office is no small task.

The thesis is less strong in its discussion of actual

resource management activities. However, it must be realized that considering the breadth of NPS activities, writing such a history is far from easy. In part, the chronological thread which adds organization to the administrative history, makes the discussion of resource management activities disjointed. Overall some activities are treated better than others. The history of fire management is excellent, discussions of wildlife management had less detail than I would like to have seen.

Somewhat distracting was what I consider excessive use of lengthy direct quotes. I also feel there was a tendency for the author to except some historical accounts at face value. This results in NPS activities being portrayed in a consistently positive light even when this may not be warranted. A greater reliance on the discussion of NPS resource management activities available in refereed publications may have helped correct this situation. It is my perception that these materials often provide a more objective viewpoint.