Nesting Success of Kemp's Ridley Sea Turtles, *Lepidochelys kempi*, at Rancho Nuevo, Tamaulipas, Mexico, 1982–2004

W. N. WITZELL, P. M. BURCHFIELD, L. J. PEÑA, R. MARQUEZ-M., and G. RUIZ-M.

Introduction

The Kemp's ridley sea turtle, *Lepidochelys kempi* (Fig. 1) is the most endangered sea turtle in the world with a dramatic decline attributed to egg exploitation and incidental capture in commercial shrimp trawls (NRC, 1990). Its population had been declining at an alarming rate since at least 1947, when an amateur filmmaker revealed an estimated 40,000 female Kemp's ridleys nesting on the beach in a single day (Carr, 1963).

This species is unusual and endangered because 1) it nests primarily on a single stretch of beach with it's epicenter at Rancho Nuevo, Tamaulipas, Mexico, (Fig. 2), 2) it nests primarily during the daytime and often in large aggregations called arribadas (Fig. 3), which makes it easier for egg collectors, and 3) the Kemp's ridley also has a coastal distribution that makes it particularly vulnerable to incidental capture in commercial fishing trawls.

Massive egg exploitation on the beach during the 1940's and 1950's severely curtailed recruitment of new turtles into the population, and, combined with an increasing mortality of adult and subadult turtles in commercial fishing trawls starting in the early 1960's, the population was dealt a devastating blow and reduced to a total of 706 nests by 1985 (Burchfield and Foley[1]). A description and review of the shrimp trawl mortality on sea turtles is presented by the NRC (1990). NOAA's National Marine Fisheries Service (NMFS) addressed the problem of incidental turtle bycatch (Fig. 4, 5) with the development of turtle excluder devices (TED's) to reduce incidental mortality of turtles in commercial fishing trawls. A TED is basically a mesh grid inserted in a trawl that expels turtles from the net through a trap door (Fig. 6). A comprehensive review of TED development is provided by Watson et al. (1986).

In 1966, the Mexican Government (Instituto Nacional de Pesca) initiated a Kemp's ridley recovery program and began a research and conservation program near Rancho Nuevo. These efforts have concentrated on nest protection and increased hatchling production. In 1978, a collaborative program between Mexico and the United States (U.S. Fish and Wildlife Service) was developed to restore this species' population to a self sustainable level with the conservation efforts centered at Rancho Nuevo. Because this is the only place in the world where the large Kemp's ridley nesting aggregations occurred, it was declared the first National Reserve for the Management and Conservation of Sea Turtles in Mexico on 4 July 1977, when 13.2 miles (21.3 km) of beach were set aside (3.2 miles (5.1 km) north to 10 miles (16.2 km) south of Barra Coma). The Rancho Nuevo sanctuary was further expanded 10.6 miles (17 km) to the north (Barra Carrizo) in 2005. In 1981, the U.S. Fish and Wildlife Service contracted with the Gladys Porter Zoo in Brownsville, Tex., to administer the United States' field portion of the joint Mexico/U.S. effort to protect and increase the production of Kemp's ridley sea turtles at their natal beaches in the State of Tamaulipas, Mexico.

It is probable that the Kemp's ridley historically nested along the entire Gulf coast from Veracruz to Texas to some extent, and the early (1978–86) annual project reports support this with reports

Wayne N. Witzell, retired, was with the National Marine Fisheries Service, Southeast Fisheries Science Center, NOAA , 75 Virginia Beach Drive, Miami, FL, 33149: Present address: 5255 Singer Road, Las Cruces, NM, 88007. P. M. Burchfield and L. J. Peña are with the Gladys Porter Zoo, 500 Ringgold Street, Brownsville, TX, 78520. R. Marquez-M. is at Avenida Lázaro Cárdenas 1312, Colonia Morelos (AP 695), Manzanillo, Colima, México 28217. G. Ruiz-M. is with the Comisión Nacional de Areas Naturales, Protegidas – CONANP, Camino al Ajusco #200, Colonia Jardines en la Montaña, Delegación Tlalpán, México, Distrito Federal, México 14210.

ABSTRACT—The Kemp's ridley sea turtle, Lepidochelys kempi*, was on the edge of extinction owing to a combination of intense egg harvesting and incidental capture in commercial fishing trawls. Results from a cooperative conservation strategy initiated in 1978 between Mexico and the United States to protect and restore the Kemp's ridley turtle at the main nesting beach at Rancho Nuevo, Tamaulipas, Mexico are assessed. This strategy appears to be working as there are signs that the species is starting to make a recovery. Recovery indicators include: 1) increased numbers of nesting turtles, 2) increased numbers of 100+ turtle nesting aggregations (arribadas), 3) an expanding nesting season now extending from March to August, and 4) significant nighttime nesting since 2003. The population low point at Rancho Nuevo was in 1985 (706 nests) and the population began to significantly increase in 1997 (1,514 nests), growing to over 4,000 nests in 2004. The size and numbers of arribadas have increased each year since 1983 but have yet to exceed the 1,000+ mark; most arribadas are still 200–800+ turtles.*

[1]Burchfield, P. M., and F. J. Foley. 1985. Report on Republic of Mexico/United States of America conservation effort on behalf of Kemp's ridley sea turtles at Playa de Rancho Nuevo, Tamaulipas, Mexico, 1985. Available from the Gladys Porter Zoo, 500 Ringgold Street, Brownsville, TX 78520.

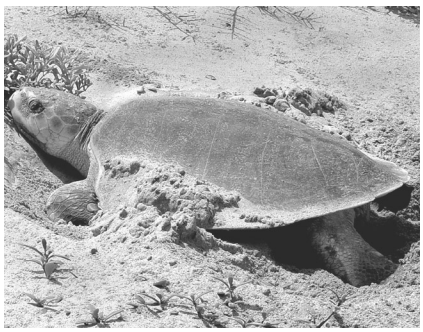

Figure 1.—A Kemp's ridley turtle laying eggs during the day at Rancho Nuevo, Tamaulipas, Mexico. Photo by W. N. Witzell.

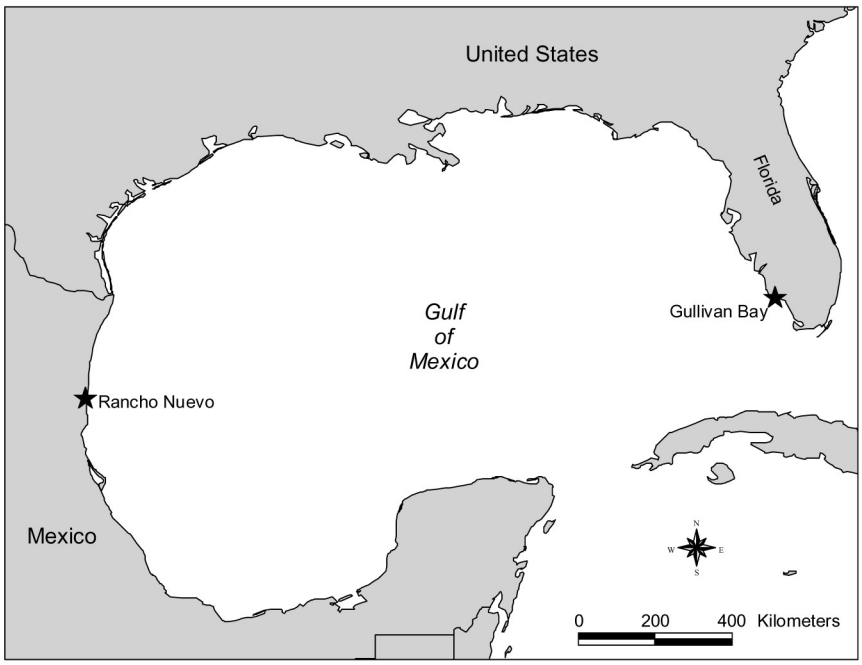

Figure 2.—The location of the main nesting beach at Rancho Nuevo, Tamaulipas, Mexico

of sporadic nesting along the entire Tamaulipas coast (Burchfield et al.[2]). As the turtle population began to increase, the number of turtle camps also increased and spread along the Tamaulipas coast to protect nesting activities (Fig. 7). The changes and development of the turtle camps is documented in a series of unpublished annual reports archived at the Gladys Porter Zoo, in Brownsville, Tex. (Burchfield et al.[2]).

From 1966 to 1978, conservation efforts focused on the area of Rancho Nuevo with the camp located first at Barra Calabazas and then at Barra Coma where it presently exists. In 1988, the program expanded to the south to Barra del Tordo with a camp at Playa Dos. In 1989 a third camp was established to the north at Barra Ostionales on Rancho Los Pericos in cooperation with the Tamaulipas State Government. The north camp's location was moved 6.2 miles (10 km) north of its original location, near to the town of Tepehuajes in 1996 for logistical reasons. In 1996, in coordination with the Tamaulipas' State Government, a camp was established in La Pesca. Additional camps have also expanded the project to the south to include the beaches of Ciudad Madero, Altamira, and, in 1997, the area of Lechuguillas, municipality of Vega de Alatorre, Veracruz.

The main strategy of these camps has always been to locate every nest and protect them in fenced corrals (Fig. 8). This controls egg predation from rac-

Figure 3.—An Arribada of several thousand Kemp's ridley turtles at Rancho Nuevo taken in the mid 1960's. Photo by R. Marquez-M.

[2]Burchfield, P. M. and various authors. 1978–2004. Published and unpublished annual reports on the Mexico/United States of America population restoration project for the Kemp's ridley sea turtle, *Lepidochelys kempi*, on the coasts of Tamaulipas and Veracruz, Mexico, var. pagin. Available from the Gladys Porter Zoo, 500 Ringgold Street, Brownsville, TX 78520.

coons, *Procyon lotor*; skunks, *Spilogale* sp. and *Mephitis* sp.; coyotes *Canis latrans*; ghost crabs *Ocypoda albicans*; and humans. Virtually all nests left in situ on the beach are depredated unless protected by wire enclosures. Egg harvest by local villagers was minimal until about 1997, when a combination of new roads and ranches were constructed that made beach access easier. Recent increases in arribadas have led to increased egg poaching as beach workers are often too busy to effectively cover the entire beach at once (Burchfield et al.[2]). The thieves wait in the dunes until the patrol has passed, and then intercept any turtles coming ashore to nest. Fortunately, these impacts remain minimal (e.g. 8 of 4,406 nests in 2004 were poached at Rancho Nuevo).

Figure 4. —A large Kemp's ridley turtle (locally called a white turtle) on the deck of a Louisiana shrimp boat in the early 1920's. Photo from La. Dept. Fish. Wildl., provided by C. Caillouet.

Figure 5.—A sea turtle on the deck of a trawler with the usual finfish bycatch. Photo by L. Ogren.

In this paper we document the apparent success of these conservation strategies using nesting data from the main camp at Rancho Nuevo collected from 1982 to 2004.

Material and Methods

The nesting data reported here were recorded at the main sea turtle Camp at Rancho Nuevo, Tamaulipas, Mex. Typically, there were three beach patrols a day where workers rode the entire length of the beach on four wheel all terrain vehicles. The first patrol was usually at sunrise, the second patrol at 1100 h, and the third patrol at 1500 h. More patrols were sent out if ridleys were expected and all camp personnel and vehicles were dispatched if there was an arribada. Patrol times and nesting beach protocols have varied between seasons and within seasons depending on turtle density, staffing, status of vehicles, and policies of the camp managers.

Turtles that were encountered were checked for flipper and passive integrated transponder (PIT) tags. If there were none, the appropriate tags were then applied if the equipment was available, the turtle measured over the carapace from the tip of the left first marginal scute to the tip of the right post central scute, and the nests marked for relocation to a protected corral. Nests were then collected in woven plastic bags as soon as possible, counted, and transferred to the corral area for reburial (Fig. 8). This entire process from nesting to reburial took between 1 to 12 hr, depending on the number of turtle nests and the staffing at the camp. Data sheets were filled out for each nest and they recorded date

and time, location of nest on beach, and number of eggs.

Holes were dug in the corrals to a depth of 17.8 inches (45 cm) with post-hole diggers and a bell-shaped nest cavity was carved by hand to resemble a natural nest in terms of depth, shape, and size (Witzell, 2005). The eggs were deposited into the resulting hole and the data sheet further recorded time of reburial. The nests were then surrounded with a circular mesh enclosure to capture the hatchlings when they emerged.

Hatchlings typically emerged after 45–55 days (usually at night) and were immediately collected, counted and taken to the beach at random sites located 0.5–1.8 mile (1–3 km) north and south of the hatchery, for release on the beach front (Fig. 9). These release sites were arbitrarily selected by the persons releasing the hatchlings and no effort was made to spread the hatchlings over the entire beach or the area where the nests were actually collected. The hatchlings were attended until they have traversed the sand and have successfully reached the water. Those hatchlings that emerged during daylight were held in a cool dark room and released that night.

Results and Discussion

The Kemps ridley sea turtle is primarily a diurnal nesting species, with most nesting taking place during the late morning or afternoon hours, and basic reproductive information has recently been collected on the beach at Rancho Nuevo. These data, published by Witzell et al. (2005), were compared to data collected in the 1960's and the results of the recent study are summarized here. It is interesting to note that the sizes of the nesting turtles, eggs, and egg clutches were smaller than originally recorded in the 1960's, suggesting that there is now a younger nesting population. The mean length and weight of recent nesting females was 25.8 inches (65.5 cm) and 77.6 lb (35.2 kg), the mean clutch size was 100.7 eggs, the mean incubation period was 50 days, and the mean internesting interval is 24.4 days. The turtles are capable of nesting three times per season, with an average of 1.8 years between nesting seasons.

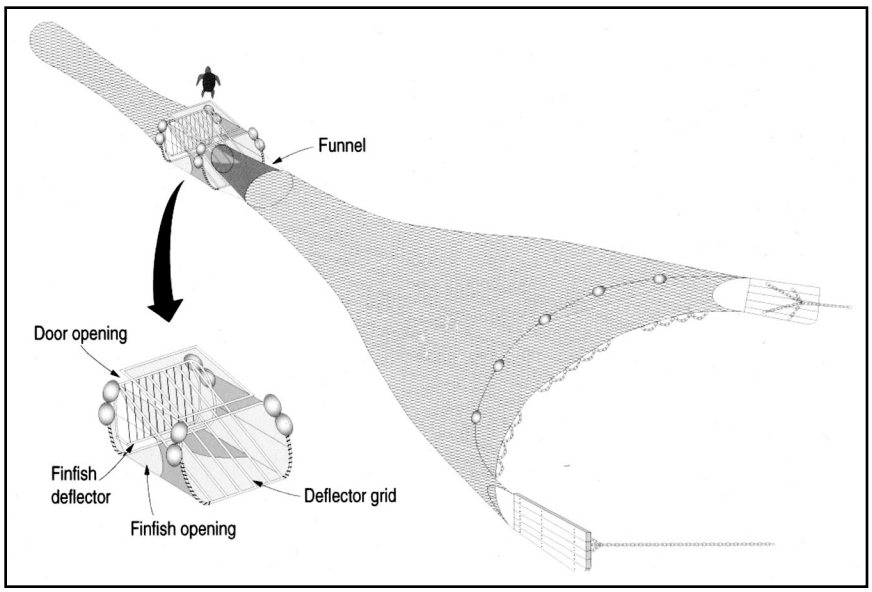

Figure 6. —Schematic diagram showing how a turtle excluder device (TED) works. Illustration provided by J. Watson.

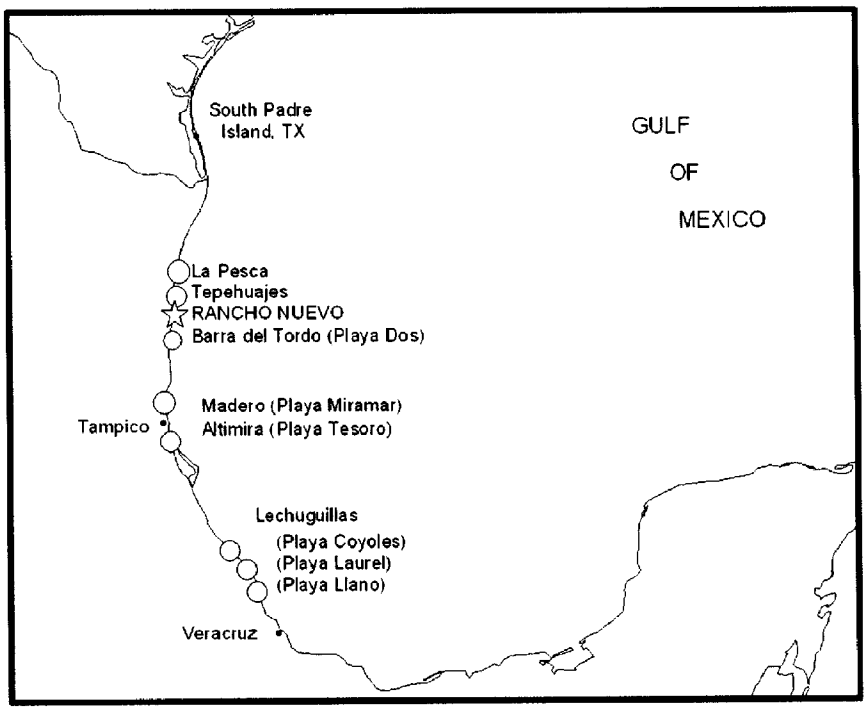

Figure 7.—Kemp's ridley sea turtle research and conservation camps along the Mexican coast.

Juvenile turtles spend up to two years in the pelagic environment before settling out into distinct coastal areas feeding on invertebrates (Witzell and Schmid, 2004; 2005) until they approach maturity. These are very specific

areas and are commonly referred to as developmental habitats. The turtles stay in these areas from about 7.8 inches (20 cm) to 21.6 inches (55 cm), when they move offshore into deeper water (Ogren, 1989; Collard and Ogren, 1990; Witzell and Schmid, 2004). Several minor coastal developmental habitats are located along the eastern coast of the United States from Cape Cod Bay, Mass., to Cape Canaveral Ship Channel, Fla., but the most important developmental habitats are in the in the Gulf of Mexico. The coastal waters of the Texas–Louisiana border and the Cedar Keys area of northwest Florida are two such developmental habitats, but the Ten Thousand Islands of southwest Florida is possibly the largest and most important developmental habitat in the Gulf of Mexico (Witzell and Schmid, 2004). The young turtles remain in these coastal habitats for about 8–10 years before maturing at approximately 11–15 years of age, 22 inches (56 cm) long (Schmid and Witzell, 1997) and returning to Tamaulipas to breed. Immature turtles from as far away as the U.S. middle Atlantic coast were once believed to have been 'lost' from the nesting population but tagging has shown that these turtles also return to Mexico to breed (Witzell, 1998). Nesting turtles may move considerable distances between nesting sites and have been recorded nesting at the Padre Island National Seashore in Texas and subsequently nesting at Rancho Nuevo within a nesting season (Witzell[3]).

Figure 8.—Eggs collected at Rancho Nuevo are transplanted into protected corrals. Photo by W. N. Witzell.

Figure 9.—Hatchling Kemp's ridley turtles released on the beach at Rancho Nuevo. Photo by J. M. Witzell.

The main nesting season at Rancho Nuevo typically occurs from April through June, with some nesting extending into July (Table 1). May is the month when most of the arribadas (defined here as at least 100 turtles per daily event) occur with April and June being second and third respectively (Fig. 10). The nesting season in two recent years (1998, 2001) began in March and extended into August. Additionally, significant numbers of turtles nested at night in 2003, and we believe that the extended nesting seasons and the night nesting might be indicators of an increasing population.

[3]Witzell, W. N. 2004. Observations of special interest. *In* Report on the Mexico/United States of America population restoration project for the Kemp's ridley sea turtle, *Lepidochelys kempi*, on the coasts of Tamaulipas and Veracruz, Mexico, p. 25. Available from the Gladys Porter Zoo, 500 Ringgold Street, Brownsville TX 78520.

The total number of nests and the numbers of arribadas at Rancho Nuevo can be used as indices of conservation success. Although these numbers are generally increasing (Fig. 11), there is one environmental parameter that can affect nesting density on this beach section. Nearshore currents can affect the nesting density and location of nesting activity on any section of the beach. For instance, there was a very strong (1–3 km/hr) northerly current during the 2000 nesting season (Witzell, personal observ.). This displaced the turtles to the northern section of Rancho Nuevo and a large portion of the Rancho Nuevo turtles to the Tepehuajes camp. This displacement could affect the nesting numbers recorded at Rancho Nuevo on any given year. Since nesting numbers have traditionally indicated to conservationists how successful recovery efforts were progressing, unnoticed lateral nesting displacement could give false impressions of recovery success between successive years.

There were few distinct arribadas consisting of 100+ turtles from 1982 to 1996, most turtles nested individually or in small groups. It is interesting to note that there were two 100+ turtle arribadas even in 1985, the year with the lowest recorded number of nests at Rancho Nuevo (706), and we cannot account for this. From 1978 to 1996 the number of 100+ turtle arribadas ranged from 0 to 4 (with 1987 having no arribadas) and there were 26.1 days between events (SD = 7.7). However, as the population started to increase (Fig. 11), the numbers of arribadas per year has increased from 5 in 1997 to 11 in 2004. Unlike the earlier events (1978–96) with a mean 26.1 days between events, the recent events are likely to occur less than 10 days apart and many 1–3 days apart. This indicates that either an arribada had taken place over a 1–3 day period and/or there were more than one group of turtles nesting (arribadas 3–10 days apart). It is difficult to discern individual arribada events after 1996 because of their frequency, and it appears that the turtles are beginning to form into different groups that produce multiple arribadas as the population continues to build. There is a tendency for mass nesting to occur on windy days (Witzell et al., 2005), but it is typically windy each day on the Tamaulipas coast during the nesting season. Arribadas were observed on both calm and windy days as well as during thunder storms.

The population was slowly building during this period (1982–96) but it was apparently incapable of forming large nesting aggregations with so few animals. The average number of 100+ turtle arribadas per season during this time period was 2.4. However, there were five arribadas in 1997, one of which was over 400 turtles. This was the first 400-turtle arribada since the Bi-National Program was initiated in 1978 and it marked the year that the ridley population started to increase. As the population increased, the average number of 100+

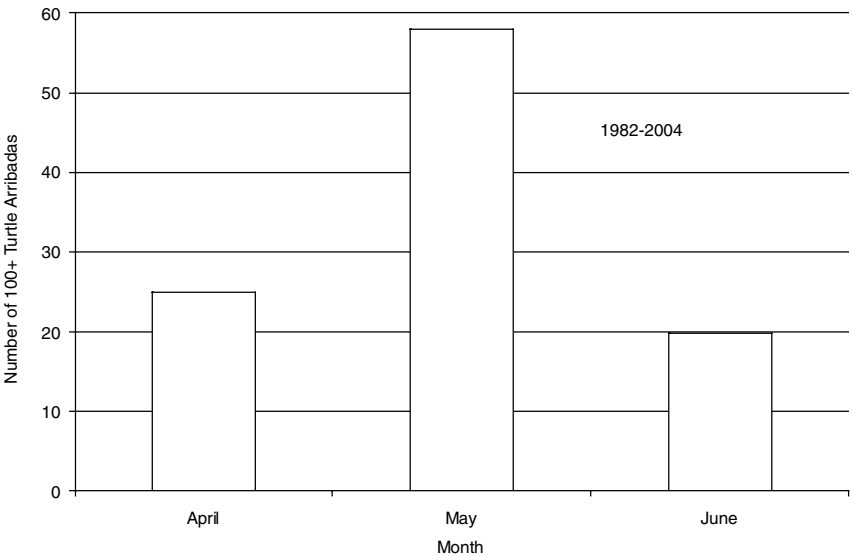

Figure 10.—Seasonal distribution of 100+ Kemp's ridley turtle arribadas.

Table 1.—Nesting season, by year, at Rancho Nuevo: X= 50+ nests, O= less than 50 nests.

Year	March	April	May	June	July	August	Total Nests
1982		X	X	X	X		792
1983		X	X	X	O		862
1984		X	X	X	O		924
1985		X	X	X	O		706
1986		X	X	X	O		742
1987		X	X	X	X		737
1988		X	X	X	O		854
1989		X	X	X	X		739
1990		X	X	X	O		780
1991		X	X	X	O		840
1992		X	X	X	O		899
1993		X	X	X	X		857
1994		X	X	X			1,153
1995		X	X	X	X		1,430
1996		X	X	X	X		1,288
1997		X	X	X	X		1,549
1998	O	X	X	X	O	O	2,413
1999	O	X	X	X	O		2,298
2000	O	X	X	X	O		3,778
2001	O	X	X	X	X	O	3,846
2002	O	X	X	X	X		4,194
2003	O	X	X	X	X		5,380
2004	O	X	X	X	X		4,463

turtle arribadas per season (1997–2004) increased from 2.4 to 8.6, and there was evidently more than one group of individuals forming the aggregations. It is also during this time (1997 to 2004) that 200+ turtle arribada*s* became more common, and we expect the first 1,000 turtle arribada soon.

It is difficult to say how these nesting patterns will progress as the population continues to recover. Historically, there are no data available on daily nesting prior to the population crash so it is unknown whether the turtles will eventually join into one massive nesting aggregation, or stay separated into several groups, as appear to be happening now. The increase in yearly nesting of Kemp's ridley turtles since 1982 clearly shows the success of this Bi-National recovery project. The recovery continues to escalate as more turtles form multiple arribadas, which will hopefully soon be in the thousands. It is imperative that the beach conservation effort continues to protect every nest until the population can sustain natural depredation on eggs and hatchlings. It is also imperative that refinement and mandatory use of TED's for all commercial fishing trawls continues.

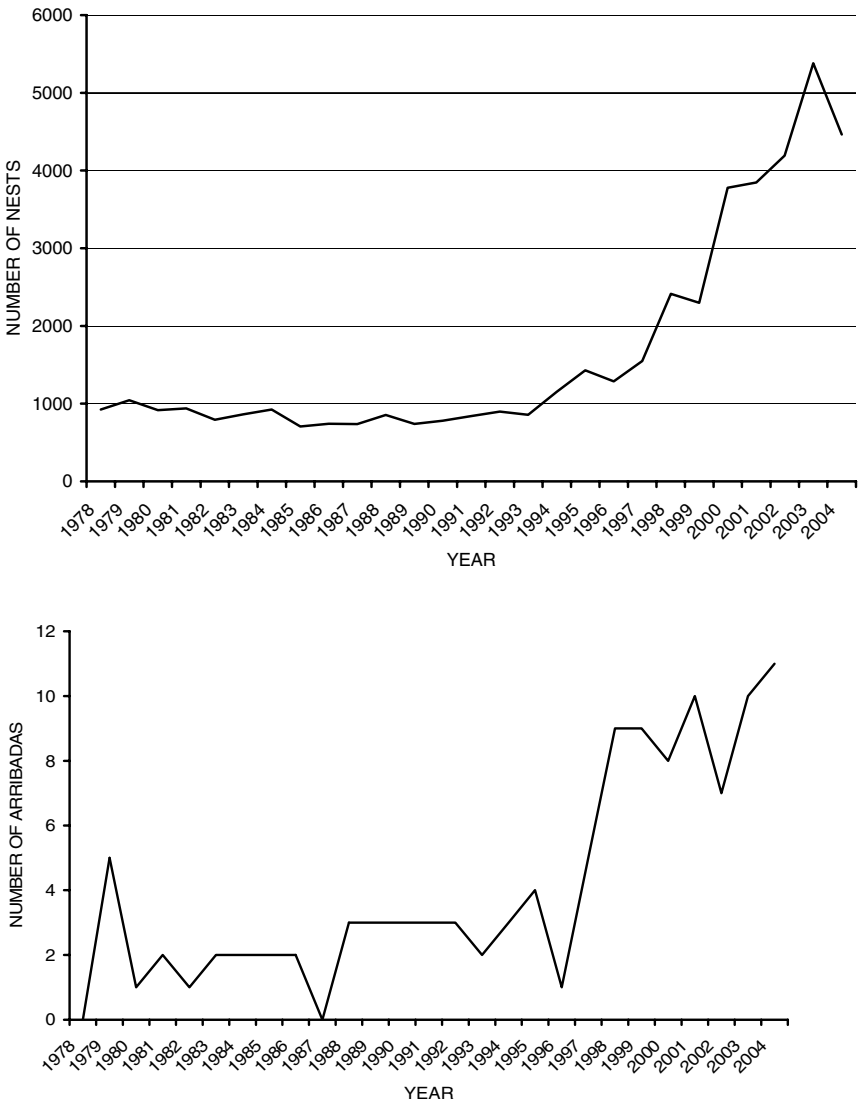

Figure 11.—The total number of nests recorded at Rancho Nuevo and the numbers of 100+ Kemp's ridley turtle arribadas, (1978–2004).

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