Gulf of Mexico Science, 2005(2), pp. 186–191

Site Specificity and the Impact of Recreational Fishing Activity on Subadult Endangered Kemp's Ridley Sea Turtles in Estuarine Foraging Habitats in the Northeastern Gulf of Mexico

ANNE RUDLOE AND JACK RUDLOE

Eighty-nine subadult Kemp's ridley sea turtles, *Lepidochelys kempii*, captured incidentally to recreational or commercial fishing, were tagged and released between 1991 and 2003. Of 105 captures and recaptures, 74 were by recreational hook and line, 20 were by commercial trawling, and 11 were by other means. Captures ranged from 3 to 25 per year. Ten turtles were recaptured once and two were recaptured three times. Times from release to recapture ranged from 3 wk to 20 mo. Three head-started turtles from Padre Island, Texas were taken after being at large for 13 to 30 mo. Head-started turtles are hatched in captivity and released as juveniles. Evidence suggestive of site fidelity is presented. Turtles associated with heavily used fishing piers were most prone to recapture and showed little growth relative to turtles not associated with recreational fishing piers. Although hooks passed through the intestine successfully in most cases, seven turtles developed intestinal blockage that required surgery and extensive rehabilitation. Public fishing piers should have a plan for dealing with hooked turtles if they are located in estuarine areas used by Kemp's ridleys as foraging habitat.

Like all sea turtles, the endangered Kemp's ridley, *Lepidochelys kempii,* has been adversely impacted by human activities, particularly by harvest of eggs in past years (National Academy of Science, 1990) and by incidental take in commercial fisheries (McDaniel et al., 2000). The impact of recreational fishing on the species, both from swallowed hooks and entanglement in fishing line, as well as injury by boat propellers and ingestion of plastic debris was reported by Cannon et al. (1994) and Cannon (1998). As a result of such impacts and its restricted distribution, Kemp's ridley has experienced the steepest decline in population of any of the sea turtles and remains the most critically endangered of the seven species. This is despite extensive protection and recovery efforts by U.S. state and federal government agencies, the government of Mexico, and many other nongovernment individuals (National Academy of Sciences, 1990).

Although efforts to conserve Kemp's ridleys and other sea turtles are hampered by the difficulties inherent in studying any large and wide-ranging marine species, our knowledge of the species is slowly increasing. Population characterizations in the Gulf of Mexico have been reported by Rudloe et al. (1991), Rudloe and Rudloe (1995), Schmid (1995; 1998), Schmid and Witzell (1997), and Witzell and Schmid (2004) in Florida, and by Stabenau et al. (1996), Shaver (1991), Landry and Costa (1999), Coyne (2000) and Coyne et al. (2000), who have described populations in the northwestern Gulf off Texas and Louisiana. On the Atlantic coast, Burke et al. (1993, 1994) described populations in Long Island Sound and Lutcavage and Musick (1985) provided information on Kemp's ridleys in the Chesapeake Bay.

Movement patterns of radio- and satellite-tracked Kemp's ridleys include long-range movement over thousands of kilometers (Renaud, 1995), seasonal coastal migrations (Gitschlag, 1996), and tidally correlated foraging over ranges of 5–30 km with affinity for rocks, live bottoms, and macroalgae (Schmid et al., 2002, 2003).

In this paper, we report on turtles tagged and released from 1991–2003, with emphasis on the interactions of Kemp's ridley turtles with recreational fishers on heavily used piers in the study area.

METHODS

Kemp's ridleys taken incidentally to fishing activities were received from fishermen during the study period. In most cases, permit-holding staff from the Gulf Specimen Marine Laboratory were notified and staff members retrieved the turtle at the point of capture. Turtles were held in aquarium facilities at Gulf Specimen Marine Laboratory in Panacea, Florida where they were maintained in 1,000-liter tanks with filtered aerated seawater. At each capture or recapture, the turtle was weighed and straight-line carapace length and width were measured

with calipers. It was double-tagged with inconel flipper tags, and monitored until it was free of fishing hooks and able to capture and consume actively moving crabs, primarily blue crabs, *Callinectes sapidus,* and calico crabs, *Hepatus ellipticus.*

In cases of turtles caught on hook and line, if the hook could not be removed by staff, the turtle was transported to local veterinary clinics where it was X-rayed and the hook was removed by the veterinarian. In cases where the hook could not be reached, the animal was retained in the aquarium and monitored with metal detectors and periodic X-rays until it passed the hook naturally and was feeding on live crabs. If the hook appeared to be blocking the intestine, the turtle was transferred to specialized facilities in Florida at Sea World or the Clearwater Aquarium for surgery. Periods of captivity varied widely depending on how long it took the animal to resume capturing live crabs and feeding normally.

Once the animal was free of obstructions and feeding normally, it was released. When possible, turtles were released at the point of capture. When that was not possible, they were released in Dickerson Bay, Wakulla County, Florida, an area frequented by Kemp's ridleys and the site of many of the captures reported herein.

Results

Number collected and means of capture.—During the study period, a total of 89 turtles were captured, tagged, and released. The time held in captivity for all turtles, except two that were recaptured three times each, ranged from same-day capture and release to 93 d in captivity. The mean duration of captivity was 16 d. Fifteen (16%) were held in excess of 30 d. The two animals that were recaptured three times were initially held for 7 mo in one case and 4 d in the other case. Of 105 captures and recaptures, 74 involved hook and line, 20 were from commercial shrimp trawlers, and the remaining 11 were caught by the following methods: two with cast nets, one by monofilament entanglement, one with a gill net, two by stranding, one tied up with a lead weight, and four delivered to the aquarium anonymously with no information (Table 1).

Table 1. Kemp's ridley landings by year and gear type.

Year	Hook and line	Trawl	Other	Total
1991	2	2	1	5
1992	0	5	2	7
1993	1	2	2	5
1994	1	1	3	5
1995	0	3	0	3
1996	1	2	0	3
1997	2	2	0	4
1998	6	1	1	8
1999	4	0	1	5
2000	4	0	1	5
2001	26	1	0	27
2002	23	0	0	23
2003	4	1	0	5
Total	74	20	11	105

Average size of all animals was 31.2 cm straight-line carapace length and 4.3 kg in weight. These turtles were smaller than the stranded Kemp's ridleys reported to the Florida Fish and Wildlife Conservation Commission for the same period, which had an average curved carapace length of 41 cm (R. Trindall, pers. comm.). Fifty (48%) of the captures were in the months of May and June and 88 (83%) were in the warm months of April–Oct.

Tag recoveries and movement patterns.—Of 12 turtles recaptured, 10 were recovered once and two were recovered three times each for a total of 16 recaptures. Time elapsed between release and recapture varied from 3 wk to 20 mo.

Of 19 turtles released away from the site of their initial capture, three (16%) were recovered once after periods of 1 month, 10 mo, and 20 mo. All three were recaptured near the site of their first capture at distances of 1–32 km from the release point. These animals were taken both initially and subsequently in trawls.

Of 38 turtles initially captured and released at the point of initial capture, seven were recovered once and two were recovered three times each. Twelve of these 13 recaptures were at or within a few hundred meters of the point of the last release. Thus 11 of the 12 recovered turtles and 15 of 16 recaptures were retaken at or near the point of first capture. The seven turtles recaptured once were taken after times ranging from 1 to 12 mo, with a mean time at large of 7.6 mo. The two animals recaptured multiple times were at large for periods ranging from 6 to 41 d with a mean of 23 d.

Three National Marine Fisheries Service head-started turtles released from Padre Island, Texas, were recovered after periods of 13, 15, and 30 mo at large. Head-started turtles are hatched in captivity and released as juveniles. One turtle grew 4 cm in carapace length after 15 mo. One was not landed and the initial size

of the third was not available so no growth data could be obtained on them.

Affinity for fishing piers.—Seventy-four of 105 captures or recaptures were from recreational fishing with hook and line. Nine of the 12 animals that were recaptured and 12 of the 16 recoveries were from publicly used fishing piers with cut bait. Fifty-one of the fishing-pier captures came from a single closely monitored pier in Panacea, Florida, which functioned as a public fishing site for virtually anyone requesting permission to fish. Fishing effort on that pier was steady throughout the study period and was estimated to be approximately 60 man-hr per week from April to Oct. based on daily personal observations and interviews with individuals who used the pier on a regular basis.

Only three turtles were taken on that pier from 1992–1997. From 1998–2000, an average of four turtles per year were landed. In 2001 the number of captures on the pier jumped to 20. In 2002, the total for that pier was 11. In 2003, the number dropped back to five.

The two turtles that were recaptured multiple times remained in the vicinity of that fishing pier for over 4 mo and 10 mo respectively and were taken repeatedly by hook and line. Although one had an initial captivity period of 7 mo and may have become conditioned to being fed during that time, the other was held for only 4 d prior to its first release. One was released at the pier where it was initially caught; the other was relocated 6.4 km away from the pier and returned to it repeatedly. Both turtles with multiple recoveries were visually observed to remain in the vicinity of the pier. A third animal initially caught at the same pier was released elsewhere but returned to the pier and was recaptured there once. A fourth animal that was not recaptured was originally taken from a different fishing pier and was reported by the owner of the pier to have been hooked and released several times prior to being brought to the aquarium. Of the four piers where turtles were recovered, three were public or semipublic in nature and received heavy use. The fourth was at a private residence. Turtles were taken during day and night.

Of the 74 hook and line captures, 26 (36%) required treatment by a veterinarian to X-ray and/or to remove a hook that had passed beyond the mouth into the throat, stomach or intestine. One turtle had two hooks at the time of first capture whereas all the others had a single hook. Hooks were generally 2–5 cm in length. Hooks in the mouth or throat could be manually removed but those animals with hooks in the stomach were monitored with X-rays and metal detectors until the hook passed through the intestine.

Hooks that appeared to be in an upright position in X-rays so that the point of the hook was trailing as it moved through the gut tended to pass to the outside and produce little permanent damage. Hooks that appeared on an X-ray to be inverted so that the point of the hook could embed itself into the wall of the intestine appeared to be associated with blockages that required surgical intervention. Seven such cases that could not be handled by general practice veterinarians required transfer to larger, more specialized facilities. Stainless steel hooks showed no sign of rusting away while in the gut; nonstainless hooks showed significant corrosion and therefore had less chance of causing a fatal obstruction.

Growth of recaptured turtles varied, depending on whether the turtle remained in the vicinity of a fishing pier (Table 1). Nine recoveries of animals that remained around fishing piers showed a mean growth of 0.10 cm/mo in carapace length after a mean interval of 4.2 mo between release and recapture. Three recoveries of animals caught at a fishing pier and released 5–8 km away who returned and were recaptured at the pier showed mean growth of 0.14 cm/mo in carapace length after a mean interval of 4.7 mo between release and recapture. In contrast, four animals that were tagged and recovered away from piers showed a mean growth of 0.32 cm/mo in carapace length after a mean interval of 9.5 mo between release and recapture (Table 2).

Discussion

Some coastal waters of the Gulf of Mexico and the U.S. Atlantic seaboard are significant habitat for juvenile and subadult Kemp's ridley sea turtles (Burke et al., 1994; Rudloe and Rudloe, 1995; Schmid et al., 2003). In the study area, subadult Kemp's ridleys appeared to remain in localized areas while foraging in estuaries during warm months. Turtles released at the point of first capture tended to remain in the area and were subsequently recaptured in the same vicinity. The attractiveness of fishing piers strongly influenced this pattern in turtles taken by hook and line. However, three turtles taken in trawls and released away from the point of first capture were recovered in trawls back at that original capture point over distances of up to 32 km, suggesting

TABLE 2. Growth of recovered turtles at and away from fishing piers.

Locality	No. of recoveries	Carapace length gain (cm/mo)	Mean time elapsed
Caught, released, and recaptured at pier	9	0.10	4.2 mo
Caught at pier, relocated, returned to pier	3	0.14	4.7 mo
Caught, released, recaptured away from pier	4	0.32	9.5 mo

some degree of site fidelity. Detailed telemetry studies would be desirable to resolve this question.

Some individuals are attracted to frequently used fishing piers and are repeatedly hooked over prolonged periods. These animals often swallow the hooks. Although some hooks are passed naturally, such turtles are at risk of becoming physiologically impaired as a result of intestinal obstructions. Animals cut lose with hooks embedded in the mouth or throat will be at high risk of starvation. If relocated, they may return to the pier.

Turtles that remain in the vicinity of fishing piers may not grow as rapidly as animals that are not in the vicinity of piers, although the small sample size and short recapture intervals preclude certainty. In addition, the stress of repeated handling and time in captivity might artificially depress growth rates. Schmid (1998) and Witzell and Schmid (2004) reported growth rates of approximately 6 cm/yr, which were greater than those observed in this study.

The fact that turtles were taken on hook and line at multiple piers would suggest that this issue is of wide concern. The extent to which any specific pier will attract Kemp's ridleys may be influenced by several factors. Public piers with heavy fishing pressure and the consistent presence of bait in the water would be of more concern than more lightly used private piers. Rudloe and Rudloe (1995) suggested that ridleys travel along tidal channels to forage on intertidal flats at high tide, and Schmid et al. (2002) confirmed this behavior with telemetry studies. The presence of such tidal channels near a pier may add to its attractiveness to turtles. In addition, adjacent oyster bars or floating docks that may harbor crabs and other suitable prey might also increase the attractiveness of a given pier and the likelihood of turtles remaining in the area and being caught.

The cause of the increased catch rate in 2001 and to a lesser extent in 2002 on the closely monitored pier was not conclusively established, but could possibly be correlated with a precipitous decline in the area of a major prey item, the blue crab, *C. sapidus*. After 3 yr of severe drought in 1998–2000 (U.S. Weather Bureau), commercial landings of blue crabs in Wakulla County declined in 2001 to less than 50% of their 1999 levels (Florida Fish and Wildlife Conservation Commission, 2004). Then, after 3 yr of near normal rainfall from 2001–2003, blue crab landings in 2003 recovered to approximately 1999 levels and the number of Kemp's ridleys taken by hook and line on cut bait in that year also declined to the range seen in the 1990s. Whether the other piers in the area, which were not closely monitored, also experienced a higher rate of unreported captures in those years is not known but anecdotal reports suggested a similar pattern for at least one pier. The relative scarcity of blue crabs may have forced turtles to scavenge.

Other possible explanations for the high numbers of turtles in 2001 and 2002 might include oceanographic conditions that moved larger than normal numbers of animals inshore. However, the animals were not any smaller than in other years as would be expected if they were recruiting from offshore habitats.

A similar brief spike in numbers of subadult ridleys was recorded in 1998 at the intake canal of the power plant in Crystal River, Florida. From 1994–1997, an average of 1 turtle/yr was recorded there. In 1998, 40 were captured and from 1999–2003, the numbers dropped back to a mean of 7.6 turtles/yr. These turtles, like those in the present study, were within a size range of 25–55 cm carapace length, which is typical of benthic inshore animals (A. Foley, pers. comm.).

Although commercial fishermen using trawls and gill nets captured 20 turtles, the majority of the turtles were taken by recreational hook and line. As the population of this species recovers and as human population growth

continues in southeastern U.S. coastal counties, an increased incidence of such encounters is inevitable. The potential for these relatively small turtles to be detrimentally impacted by human recreational fishing is significant. Between 1992 and 2001, the Sea Turtle Stranding and Salvage Network maintained by the Florida Fish and Wildlife Conservation Commission reported 530 sea turtle fatalities in Florida coastal counties associated with recreational fish hooks or monofilament entanglement (R. Trindell, pers. comm.).

Legal restrictions on commercial fishermen that reduce incidental take of sea turtles, such as requirements for turtle-excluder devices and a ban in Florida on gill nets, are currently in place. However, there are no comparable rules to reduce the impact of recreational fishing on this endangered species. Public fishing piers in estuarine areas where Kemp's ridleys forage should have a plan for dealing with hooked turtles. The use of nonstainless-steel hooks or circle hooks should be encouraged in such localities during warm-weather months and signage should direct users to the proper local contacts for rehabilitation of hooked animals. Although tagged animals should generally be released at or near the point of capture, Kemp's ridley turtles recovered from such piers should be relocated as far as possible away from the point of capture but still remaining in appropriate habitat.

Literature Cited

Burke, V. J., S. J. Morreale, and A. G. J. Rhodin. 1993. Life history notes: *Lepidochelys kempii* (Kemp's ridley sea turtle) and *Caretta caretta* (loggerhead sea turtle). Diet. Herpetol. Rev. 24: 31–32.

———, ———, and E. A. Standora. 1994. Diet of the Kemp's ridley sea turtle, *Lepidochelys kempii,* in New York waters. U.S. National Marine Fisheries Service Fish. Bull. 92(1): 26–32.

Cannon, A. C. 1998. Gross necropsy results of sea turtles stranded on the upper Texas and western Louisiana coasts, 1 January–31 December 1994, p. 81–85. *In:* Characteristics and causes of Texas marine strandings. R. Zimmerman (ed.). NOAA Technical Report NMFS 143. U.S. Department of Commerce, Washington, D.C.

———, C. T. Fontaine, T. D. Williams, D. B. Rivera, and C. W. Caillouet, Jr. 1994. Incidental catch of Kemp's ridley sea turtles (*Lepidochelys kempii*), by hook and line, along the Texas coast, 1980–1992, p. 40–42. *In:* Proceedings of the Thirteenth Annual Symposium on Sea Turtle Biology and Conservation. B. A. Schroeder and B. E. Witherington (compilers). NOAA Technical Memorandum NMFS-SEFSC 341, U.S. Department of Commerce, Washington, D.C.

Coyne, M. S. 2000. Population sex ratio of the Kemp's ridley sea turtle (*Lepidochelys kempii*): problems in population monitoring. Ph.D. diss., Texas A & M Univ., College Station, Texas.

———, M. E. Monaco, and A. M. Landry, Jr. 2000. Kemp's ridley habitat suitability index model, p. 60. *In:* Proceedings of the Eighteenth International Sea Turtle Symposium. F. A. Abrea-Grobois, R. Briseno-Duenas, R. Marquez, and L. Sarti (compilers). NOAA Technical Memorandum MNFS-SEFSC 436. U.S. Dept. of Commerce, Washington, D.C.

Florida Fish and Wildlife Conservation Commission. 2004. Commercial Fisheries Landings in Florida. http://research.myfwc.com/features/view_article.asp?id=19224.

Gitschlag, G. R. 1996. Migration and diving behavior of Kemp's ridley (Garman) sea turtles along the U.S. southeastern Atlantic coast. J. Exp. Mar. Bio. Ecol. 205(1–2):115–135.

Landry, A. M., and D. Costa. 1999. Status of sea turtle stocks in the Gulf of Mexico with emphasis on the Kemp's ridley, p. 248–268 *In:* The Gulf of Mexico large marine ecosystem: assessment, sustainability and management. H. Kumpf, K. Steidinger, and K. Sherman (eds.). Blackwell Science, Malden, MA.

Lutcavage, M., and J. A. Musick. 1985. Aspects of the biology of sea turtles in Virginia USA. *Copeia* 1985(2):449–456.

McDaniel, C., L. Crowder, and J. Priddy. 2000. Spatial dynamics of sea turtle abundance and shrimping intensity in the U.S. Gulf of Mexico. Conserv. Ecol. 4:1–19.

National Academy of Science. 1990. Decline of the sea turtles: causes and prevention. National Academy Press, Washington, D.C.

National Oceanic and Atmospheric Administration. 2005. U. S. National Weather Service Forecast Office for Tallahassee, Florida. Available at: www.srh.noaa.gov/tae/climate. Accessed 28 Sept. 2005.

Renaud, M. L. 1995. Movements and submergence patterns of Kemp's ridley turtles (*Lepidochelys kempii*). J. of Herpetol. 29(3):370–374.

Rudloe, A., and J. Rudloe. 1995. Characterization of an inshore population of the Kemp's ridley sea turtle in the northeastern Gulf of Mexico. *In:* Proceedings of the 12th Annual Workshop on Sea Turtle Biology and Conservation. NOAA Technical Memorandum NMFS-SEFSC-361, U.S. Department of Commerce, Washington, D.C.

———, ———, and L. Ogren. 1991. Occurrence of immature Kemp's ridleys, *Lepidochelys kempii,* in coastal waters of northwest Florida. Northeast Gulf Science 12(1):49–53.

Schmid, J. 1995. Marine turtle populations on the east-central coast of Florida: results of tagging studies at Cape Canaveral, Florida, 1986–1991. Fish. Bull. 93(1):139–151.

———. 1998. Marine turtle populations on the west-central coast of Florida: results of tagged studies

at the Cedar Keys, Florida, 1986–1995. Fish. Bull. 96(3): 89–602.

———, AND W. WITZELL. 1997. Age and growth of wild Kemp's ridley turtles (*Lepidochelys kempii*): cumulative results of tagging studies in Florida. Chelon. Conserv. Biol. 2(4):532–537.

———, A. B. BOLTEN, K. BJORNDAL, AND W. J. LINDBERG. 2002. Activity patterns of Kemp's ridley turtles, *Lepidochelys kempii,* in the coastal waters of the Cedar Keys, Florida. Mar. Biol. 140(2):215–228.

———, A. B. BOLTEN, K. BJORNDAL, W. J. LINDBERG, H. F. PERCIVAL, AND P. D. ZWICK. 2003. Home range and habitat use by Kemp's ridley turtles in west-central Florida. J. Wildl. Manage. 67(1):196–206.

SHAVER, D. J. 1991. Feeding ecology of wild and head-started Kemp's ridley sea turtles in south Texas USA waters. J. Herpetol. 25(3):327–334.

STABENAU, E., K. STANLEY, AND A. LANDRY. 1996. Sex ratios from stranded sea turtles on the upper Texas coast. J. Herpetol. 30(3):427–430.

WITZELL, W. N., AND J. R. SCHMID. 2004. Immature sea turtles in Gullivan Bay, Ten Thousand Islands, southwest Florida. Gulf Mex. Sci. 22(1):54–61.

GULF SPECIMEN MARINE LABORATORY, P.O. BOX 237, PANACEA, FLORIDA 32346. Date accepted March 21, 2005.