Observed Sea Turtle Takes in the Skimmer Trawl Shrimp Fishery

Sheryan P. Epperly and Lesley W. Stokes
NOAA, National Marine Fisheries Service, Southeast Fisheries Science Center, Miami, FL

SEFSC Contribution PRBD-2012-05

August 15, 2012

Northern Gulf of Mexico, 2012

Species caught and locations

Observers reported the capture of 24 turtles in commercial skimmer trawls operating in shallow waters of the northern Gulf of Mexico, May-July 2012 (Table 1, Figure 1). Vessel selection was randomized and effort was concentrated in Louisiana, Mississippi, and Alabama where skimmer trawls operate in the Gulf of Mexico. All but one turtle was identified as Kemp's ridley, *Lepidochelys kempii*; the remaining turtle was identified as a hardshell turtle (e.g., not a leatherback). Two turtles, including the unidentified one, were thrown overboard immediately by the crew, and the observer did not sample these two turtles nor did they see one of them clearly enough to identify it. A third turtle escaped through a scupper hole before the observer could sample it.

Water depth and tow times

Turtles were captured in water depths of 4-17 ft. and nineteen turtles were captured in tows exceeding 55 minutes, defined as the minutes elapsed between the tailbag being deployed and the tailbag being removed from the water and then brought aboard the boat (Table 1). Tow times for all turtles ranged from 24-128 minutes. On skimmer trawl vessels, tailbags are periodically brought up to the surface to determine the size of the catch; the tailbags remain in the water and are not boarded unless the catch is sufficient to dump the tailbag. During this study, one vessel regularly brought the tailbags to the surface within 10 feet of the boat without bringing the tailbags onboard (e.g., the tailbag remained in the water). The observer noted this in the comments, however, the tow time was recorded as when the tailbag was deployed until removed from the water and then brought onboard the vessel, consistent with the program's definition of tow time.

Release condition and expected fate

The capture condition for 1 Kemp's ridley (tow time 55 min) was coded as comatose / unresponsive because it had no bilateral reflexes. The comatose turtle was not actively resuscitated by the crew (i.e., it was not placed on an inclined surface), but it did revive on its own within about 5 minutes of being boated, and began moving. The remaining 23 turtles were coded as alive at capture (Table 1). However, of those coded as alive at capture, 5 turtles (with

tow times ranging from 53-92 minutes) were reported to be lethargic, tired, or slow when boated, but were reported to be active on deck before release. All 24 turtles were released alive, and half were reported as actively swimming or diving upon release. Post-release behavior was not recorded by the observer in the other cases, but the lack of comment does not imply that the turtle's behavior was abnormal.

Turtles captured in trawls are likely to be forcibly submerged for lengths of time greater than their average dive times, which may result in the turtle becoming comatose and eventually drowning (Lutcavage and Lutz, 1997). During forced submergence turtles' heart rates sharply decline, blood lactate levels increase, and blood oxygen is depleted to very low levels (Lutcavage and Lutz 1997, Stabenau et al. 1991). Increases in blood lactate levels depend on several factors, including turtle size, duration of submergence, intensity of underwater struggle, and water temperature (Lutcavage and Lutz 1997). Recovery to pre-submergence blood lactate levels can take 180 minutes or more (Stabeneau and Vietti 2003), and others have suggested that at least 20 hours are required for full recovery (Lutz and Dunbar-Cooper 1987).

Mortality is positively correlated with tow time, and although mortality may be high on long tows, it will not always equal to 100% because a turtle caught shortly before the end of a long tow would likely survive. A logit regression of tow time on mortality explains up to 70% of the variance, but not all of it (Sasso and Epperly 2006). For hook-and-line interactions, experts have suggested that hardshell turtles hooked externally and released alive with no attached gear might suffer but a small post-release mortality (5%; Ryder et al. 2006). In contrast, that same group of experts opinioned that a resuscitated hardshell turtle released with no gear attached has a relatively low probability of surviving (40%) due to complications from the forced submergence and drowning. The National Research Council (1990) recommended that mortality estimates include both dead and comatose turtles. Therefore, we suggest that similar levels of mortality (at least 60%) could be expected in turtles that were comatose/resuscitated in a trawl encounter.

We speculate that virtually all these turtles probably survived the interactions, except the comatose/resuscitated turtle, because the time turtles were retained on deck (mean 69 minutes, range 13-162 minutes for all but the prematurely released turtles) allowed the turtles to hyperventilate and at least partially recover from acidosis. It is difficult to predict the outcome for the two turtles discarded immediately by the crew or the one that escaped, as the turtles were given no opportunity to recover from acidosis before being put back into the water. The tow times associated with those 3 turtles were 59-73 minutes.

Turtle sizes and a comparison with TED bar spacing and escape openings

All but 3 of the turtles were measured. Curved carapace lengths measured ranged from 19.4 - 48.3 cm (Table 1). Body depth can be estimated for the 21 measured Kemp's ridleys to evaluate what proportion might be able to pass through TED bars with 4 inch spacing (10.16 cm), the maximum spacing currently allowed (equation 1). We note that many TEDs are manufactured with closer spacing (NMFS unpubl. data). Turtles that pass through the bars of the TED and into the tailbag no longer can access the TED opening to escape and are subject to drowning, depending on the amount of time they are forcibly submerged.

(1) $\ln BD = -0.6283 + (0.9075 \times \ln SCL)$, [n=631, r^2=0.989] (Epperly and Teas 2002)

Kemp's ridley turtles ≥25.72 cm SCL (≥27.21 cm CCL, based on equation of Teas 1993 to convert between SCL and CCL) are predicted to be too large to pass through the bars. Thus, we estimate that 14 of the measured turtles - more than half - potentially could have passed through the bars of a TED, had there been one installed in the nets. The 3 turtles with estimated lengths all were large enough to be stopped by the bars of a TED. We also can use carapace widths and body depths to evaluate whether turtles could have escaped through the TED openings. Based on the sizes reported, either measured or estimated, all turtles captured were small enough to escape through a TED opening as required for inshore waters (see 68 FR 8456 February 21, 2003; Epperly and Teas 2002).

Skimmer Trawl Research, 2010-2012

Commercial boats were chartered for skimmer trawl research in North Carolina (Price and Gearhart 2011, NMFS unpubl. data) and more recently, in the Northern Gulf of Mexico (NMFS unpubl data); the latter work is ongoing. To date, 4 Kemp's ridleys were observed during North Carolina sampling (3 in 2010 and 1 in 2011) and 1 green turtle, *Chelonia mydas*, was observed during Louisiana sampling in 2011 (Figure 2, Table 2). All but one was taken in the control (naked) nets. The one Kemp's ridley captured in a TED-equipped net was caught in the flap over the escape opening, but it was not entangled in the mesh. One Kemp's ridley was boated comatose/unresponsive after a 55 minute tow, but was revived by the observer. It was held on deck for 3.6 h; the other Kemp's ridleys were held on deck for 22-75 minutes and the green turtle was not retained on deck. All turtles were released alive. Tow times associated with the North Carolina turtles ranged from 30-55 minutes, and the tow time associated with the green turtle captured in Louisiana was 57 minutes (in November). Tow times were defined as tailbag deployed to tailbag removed from the water and then brought aboard the boat, consistent with Scott-Denton et al. (2006) and the observer program described above. All five turtles were captured in shallow waters (4-6 ft.). Only one turtle, a Kemp's ridley, is predicted to have a body depth less than 4 inches, and all were small enough to have escaped through TED openings required for inshore waters. The equation (2) to estimate body depth for green turtles is

(2) $\ln BD = -1.0115 + (1.0023 \times \ln SCL)$, [n=176, r^2=0.977] (Epperly and Teas 2002)

Literature Cited

Epperly, S.P. and Teas, W.G. 2002. Turtle excluder devices - Are the escape opening large enough? Fishery Bulletin 100: 466-474.

Henwood, T.A. and Stuntz, W.E. 1987. Analysis of sea turtle captures and mortalities during commercial shrimp trawling. Fishery Bulletin 85(4): 813-817.

Lutcavage, M.E., Lutz, P.L., 1997. Diving physiology. In: Lutz, P.L., Musick, J.A. (Eds.), The Biology of Sea Turtles. CRC Press, Boca Raton, FL, pp. 277–296.

Lutz, P.L., Dunbar-Cooper, A., 1987. Variations in the blood chemistry of the loggerhead sea turtle, *Caretta caretta*. Fishery Bulletin 85, 37–43.

Price, B. and Gearhart, J. 2011. Evaluations of turtle excluder device (TED) performance in U.S. southeast Atlantic and Gulf of Mexico skimmer trawl fisheries. NOAA Technical Memorandum NMFS-SEFSC-615, 22pp.

National Research Council, 1990. Decline of the Sea Turtles: Causes and Prevention. National Academy Press, Washington, DC, 355 pp.

Ryder, C.E., Conant, T.A., and Schroeder, B.A. 2006. Report of the workshop on marine turtle longline post-interaction mortality. Bethesda, Maryland, USA, 15-16 January 2004. U.S. Dept. Commerce, NOAA Technical Memorandum NMFS-OPR-29, 40 p.

Sasso, C.R. and Epperly, S.P. 2006. Seasonal sea turtle mortality risk from forced submergence in bottom trawls. Fisheries Research 81: 86-88.

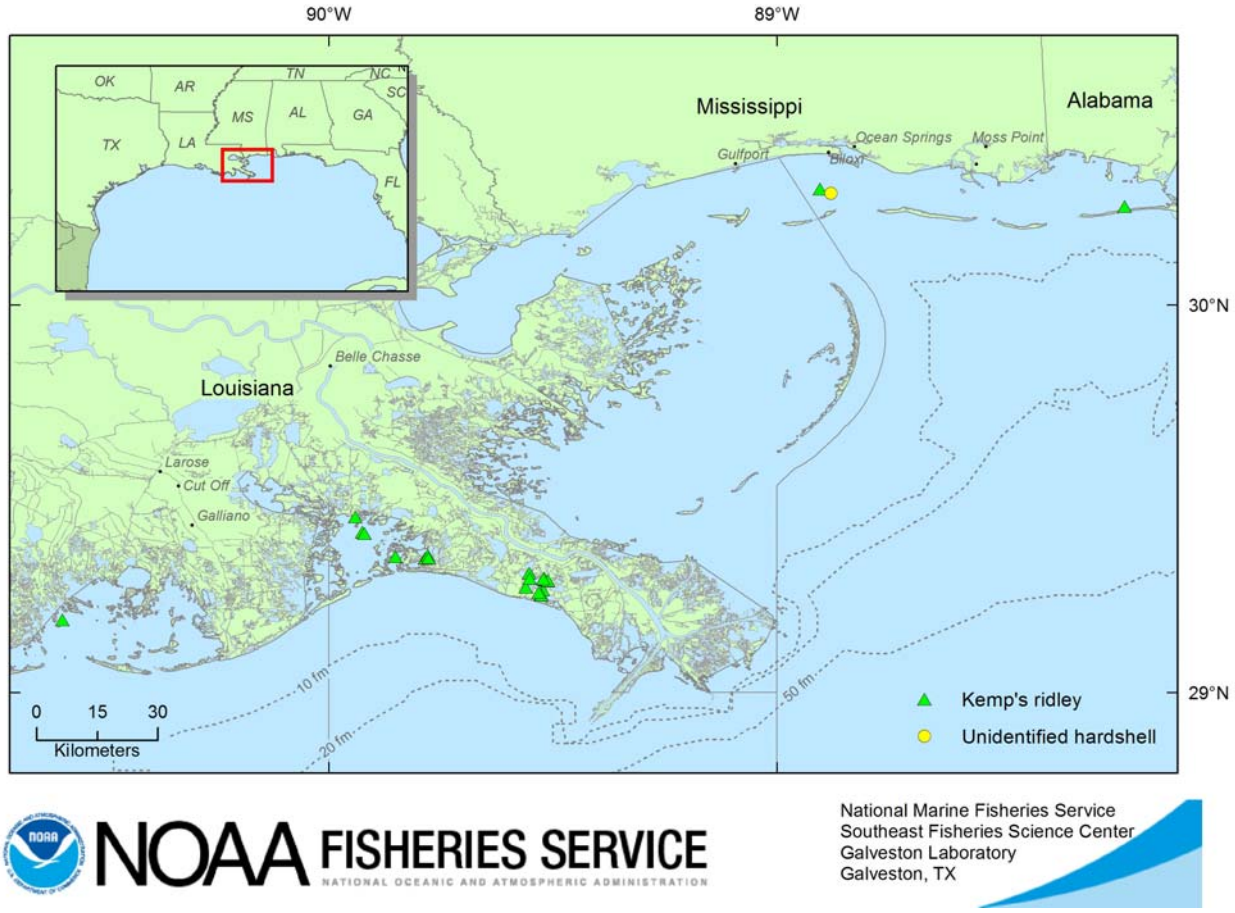
Scott-Denton, E., Cryer, P., Gocke, J., Harrelson, M., Jones, K., Nance, J., Pulver, J., Smith, R., and Williams, J.A. 2006. Skimmer trawl fishery catch evaluations in coastal Louisiana, 2004 and 2005. Marine Fisheries Review 68(1-4): 30-35.

Stabenau, E.K., Heming, T.A., and Mitchell, J.F. 1991. Respiratory, acid-base and ionic status of Kemp's ridley sea turtles (*Lepidochelys kempii*) subjected to trawling. Comparative Biochemistry and Physiology 99A(1/2): 107-111.

Stabenau, E.K., Vietti, K.R.N., 2003. The physiological effects of multiple forced submergences in loggerhead sea turtles (*Caretta caretta*). Fishery Bulletin 101, 889–899.

Teas, W.G. 1993. Species composition and size class distribution of marine turtles stranding on the Gulf of Mexico and Southeast United States coast 1985-91. NOAA Technical Memorandum NMFS-SEFSC-315, 43p.

Figure 1. Capture locations of 23 Kemp's ridleys and 1 unidentified cheloniid (unidentified hardshell) sea turtle in skimmer trawls observed May-July 2012 in the northern Gulf of Mexico.



NOAA FISHERIES SERVICE
NATIONAL OCEANIC AND ATMOSPHERIC ADMINISTRATION

National Marine Fisheries Service
Southeast Fisheries Science Center
Galveston Laboratory
Galveston, TX

Figure 2. Capture locations of 1 green turtle in Louisiana (top) and 4 Kemp's ridleys in North Carolina (bottom) during NMFS SEFSC skimmer trawl research studies, 2010-2012.

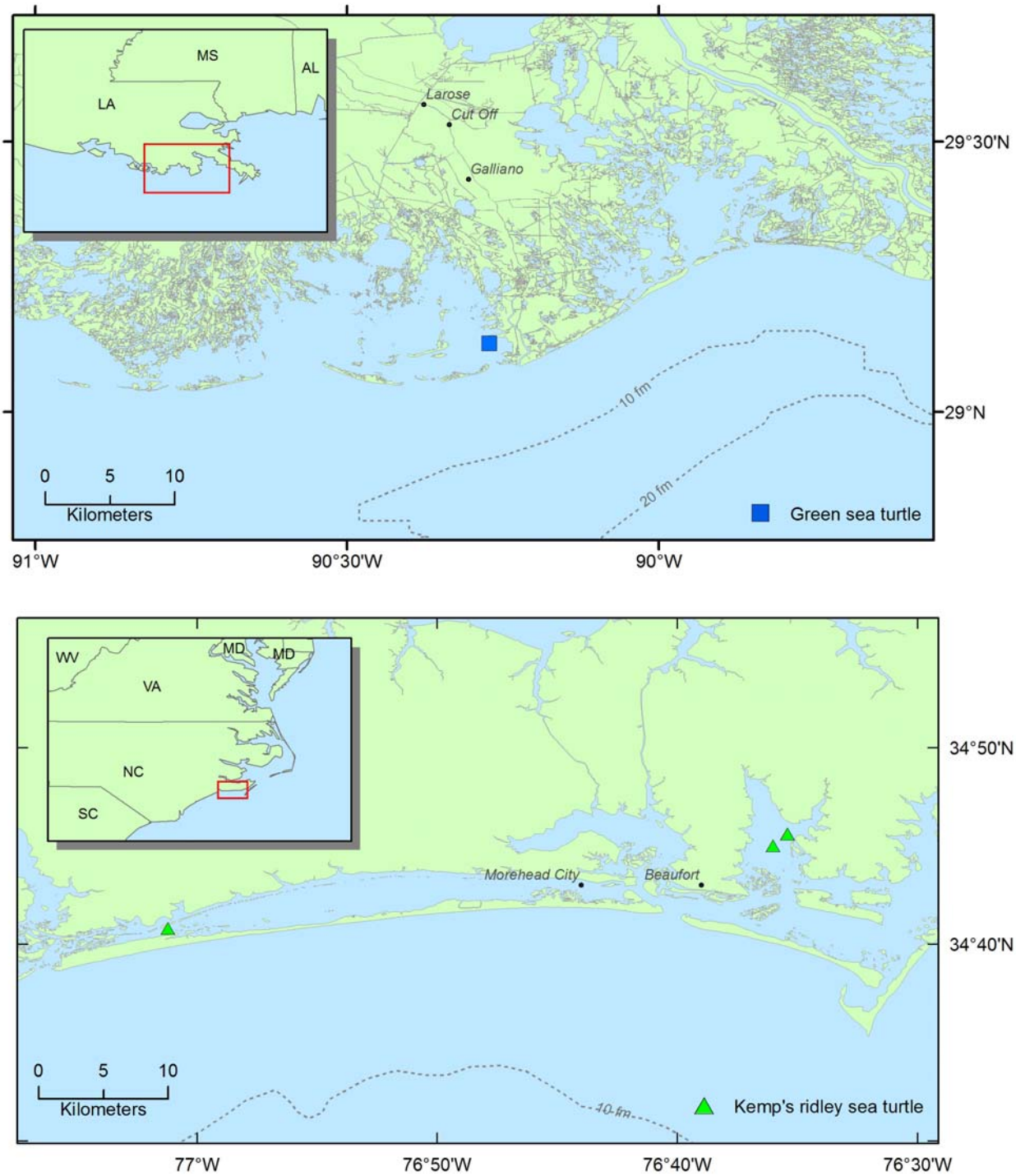


Table 1. Observed sea turtles captured in skimmer trawls in the Northern Gulf of Mexico, May-July 2012.

Species	Capture condition	Release Condition	Attempt Resuscitation	Water Depth (ft)	Tow Time (min)	Time Onboard (min)	Estimated Carapace Length (ft)	SCL std (cm)	CCL (cm)	SCW (cm)	CCW (cm)
Kemp's ridley	Alive, uninjured	Released alive	N/A	7	73	0	1.0	-	-	-	-
Kemp's ridley	Alive, uninjured	Released alive	N/A	10	61	0	1.5	-	-	-	-
Kemp's ridley	Alive, uninjured *	Released alive	N/A	5	73	145	-	19.3	19.4	17.9	21.4
Kemp's ridley	Alive, uninjured	Released alive	N/A	8	59**	17	-	21.4	23.6	19.5	23.4
Kemp's ridley	Alive, uninjured *	Released alive	N/A	6	54	57	-	21.6	22.6	20.6	23.6
Kemp's ridley	Alive, uninjured *	Released alive	N/A	5	92	128	-	22.0	23.2	20.5	23.9
Kemp's ridley	Alive, uninjured	Released alive	N/A	5	66	93	-	22.4	22.3	20.1	23.7
Kemp's ridley	Alive, uninjured	Released alive	N/A	4	24	162	-	22.4	22.8	20.9	24.3
Kemp's ridley	Alive, uninjured *	Released alive	N/A	4	61	70	-	-	22.9	-	23.9
Kemp's ridley	Alive, uninjured	Released alive	N/A	8	75	13	-	22.5	24.1	20.4	24.5
Kemp's ridley	Alive, uninjured *	Released alive	N/A	6	53	160	-	23.1	24.1	22.2	25.4
Kemp's ridley	Comatose/unresponsive	Released alive	No	10	55	34	-	23.2	24.3	20.5	24.8
Kemp's ridley	Alive, uninjured	Released alive	N/A	6	90	54	-	24.0	23.8	21.7	25.2
Kemp's ridley	Alive, uninjured	Released alive	N/A	6	87	22	-	-	25.0	22.0	26.0
Kemp's ridley	Alive, uninjured	Released alive	N/A	6	60	79	-	24.8	25.7	23.2	26.4
Kemp's ridley	Alive, uninjured	Released alive	N/A	6	80	43	-	-	25.7	21.8	25.1
Kemp's ridley	Alive, uninjured	Released alive	N/A	4	84	112	-	29.3	30.1	26.5	30.7
Kemp's ridley	Alive, uninjured	Released alive	N/A	9	64	39	-	29.4	30.5	28.2	33.8
Kemp's ridley	Alive, uninjured	Released alive	N/A	12	69	65	-	29.4	33.1	29.8	30.6
Kemp's ridley	Alive, uninjured	Released alive	N/A	9	70	42	-	30.0	31.2	28.0	32.1
Kemp's ridley	Alive, uninjured	Released alive	N/A	6	128	19	-	35.4	37.6	33.5	39.0
Kemp's ridley	Alive, uninjured	Released alive	N/A	6	24	37	-	36.0	38.5	31.2	38.6
Kemp's ridley	Alive, uninjured	Released alive	N/A	17	62	66	-	45.6	48.3	44.9	50.2
Unidentified hardshell	Alive, unknown	Released alive	N/A	16	59	0	1.5	-	-	-	-

* Turtles that were lethargic or slow when boated.
** Tow time estimated based on tow time for sampled net.

Table 2. Observed sea turtles captured in skimmer trawls during research projects in the waters of the Southeast U.S. (4 Kemp's ridleys in North Carolina, 2010-2011) and the Northern Gulf of Mexico (1 green turtle in Louisiana, 2011).

Species	TED interaction	Capture condition	Release condition	Attempt Resuscitation	Water Depth (ft)	Tow Time (min)	Time Onboard (min)	SCL std (cm)	CCL (cm)	SCW (cm)	CCW (cm)
Kemp's ridley	N/A	Alive, uninjured	Released alive	N/A	4	30	32	24.0	25.4	21.0	25.4
Kemp's ridley	Stuck in flap of TED	Alive, uninjured	Released alive	N/A	5	31	15	27.3	27.5	25.3	28.4
Kemp's ridley	N/A	Comatose/unresponsive	Released alive	No*	6	55	219	28.5	29.9	26.0	30.0
Kemp's ridley	N/A	Alive, uninjured	Released alive	N/A	6	46	22	31.0	-	29.6	-
Green	N/A	Alive, uninjured	Released alive	N/A	4	57	0	33.5	-	27.7	-

* Turtle was resuscitated by observer, not crew.