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MEMORANDUM FOR: Roy E. Crabtree, Ph.D.

FROM: Bonnie Ponwith, Ph.D. Theo R. Brainerd

SUBJECT: Data Analysis Request: update of turtle bycatch in the Gulf of Mexico and southeastern Atlantic shrimp fisheries

Per your request, the Southeast Fisheries Science Center has updated Table 30 from the 2002 Technical Memorandum (Epperly et al. 2002) on the bycatch of sea turtles in the Gulf of Mexico and southeastern Atlantic shrimp fisheries. The updates were based on 2009 effort data. Estimation methods for turtle takes followed Epperly et al. (2002).

The narrative below provides background, describes potentially important sources of error, and provides methodology and an updated Table 30 formatted per Epperly et al. (2002). Table A1 in Appendix A provides injury and gear details for observed turtle takes in the Gulf of Mexico and southeast U.S. Atlantic shrimp fisheries in 2009. Details on the methods used to extract the final ACCSP shrimp effort are included in Appendix B. The Excel spreadsheet used to calculate values and the code used to extract the final ACCSP shrimp effort are attached.

If you have any questions, please do not hesitate to contact us.

Attachments

Cc:

F/SER3 – D. Bernhart
F/SER3 – J. Lee
F/SER24 – S. Branstetter
F/SER25 – J. McGovern
F/SER29 – A. Strelcheck
F/SEC3 – J. Bohnsack
F/SEC3 – S. Epperly
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F/SEC2 – S. Turner
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F/SEC – T. Brainerd
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F/SEC4 – J. Nance
F/SEC4 – E. Scott-Denton
F/SEC2 – D. Gloeckner

Background

The Southeast Regional Office (SERO) has reinitiated consultation on the shrimp fishery of the southeast U.S and the Gulf of Mexico. The Southeast Fisheries Science Center (SEFSC) was asked to provide current bycatch estimates of sea turtles in the southeast U.S. and Gulf of Mexico shrimp fisheries. The SEFSC informed SERO that although mandatory observer coverage of vessels with federal permits began in July 2007 in the Gulf of Mexico and in June 2008 in the Atlantic, the existing observer data (Appendix A) has an insufficient number of positive samples per strata (as defined in Epperly et al. 2002), to provide an unbiased statistical estimate. In addition any catch rate developed using future observer coverage would not be comparable to Epperly et al. 2002, or to prior updates the SEFSC has provided to SERO because the fishery currently uses TED's which render the vast majority of interaction unobservable. The commercial fleet is required to use TEDs. Hence, we assume that less than 3% of the interactions occurring in the main nets would be observed. Many of the interactions documented involved takes in try nets or small turtles passing through the bars of TEDs. SERO has a legal mandate to evaluate the effects of an action during a Section 7 consultation and, thus, needs some understanding of the level of takes likely to occur. The SEFSC was then asked by SERO to update the tables in NOAA Technical Memorandum NMFS-SEFSC-490 (Epperly et al. 2002) on the bycatch of sea turtles in the Gulf of Mexico and southeast U.S. Atlantic shrimp fisheries.

SEFSC updated the tables in Epperly et al. (2002) and followed the identical methodology except for the details of the estimation of Atlantic effort documented in Appendix B. The original report was based on 2001 effort data. This updated report used 2009 effort data. There are no new data comparable to Epperly et al. (2002) available from which to estimate catch rates of sea turtles in shrimp trawls. These data would include, interaction rates of sea turtles and shrimp trawls without TED's, comparable sea turtle density estimates, and mortalities of sea turtles as a function of tow time and water temperature. Using catch rate and aerial survey data that has not been updated in a decade is inappropriate because we expect sea turtle populations to have changed over the last decade. Efforts should be made to update this information or develop alternative survey methods to estimate bycatch.

There were numerous sources of variability and bias in the original analysis, and where possible the authors attempted to identify the direction of these biases. Please refer to the individual sections on *Sources of Error* throughout the original report (Epperly et al. 2002) as they are equally relevant to this updated analysis Foremost among the sources of error are the problems encountered with the sightability of Kemp's ridley and green turtles during aerial surveys. These problems render any estimates of adjusted catch rates suspect. Therefore, estimates of interactions and mortalities for these two species are especially inaccurate and are not provided here, consistent in how SERO used the 2002 report in their last Biological Opinion. Also, due to lack of CPUE for hawksbill turtles their bycatch could not be estimated; sightability of hawksbills suffers the same problems

as Kemp's ridleys and green turtles mentioned above. Due to these concerns regarding variability and bias, and the many sources of data with unquantified variability the SEFSC was unable to estimate confidence intervals about the estimates.

Methods

The updates were based on 2009 effort data from the Gulf of Mexico, with methods described in Nance et al. (2008), and 2009 effort data from the southeastern U.S. Atlantic Ocean, taken from the state of Florida and the Atlantic Coastal Cooperative Statistics Program (ACCSP). Effort data were entered by season (Summer: March-November, and Winter: December-February), subregion (Western and Eastern Gulf of Mexico; and South, Central and North Atlantic), and depth (Inshore, Nearshore, and Offshore Gulf of Mexico; Inshore and Offshore Atlantic). Species' CPUE values were taken from Tables 15 and 16 (Epperly et al. 2002) and multiplied by effort in 2009 (hours fished for the Gulf of Mexico and days fished for the Atlantic) to estimate the number of interactions for each species. The number of interactions was multiplied by 0.03 to estimate the number of captures, as TEDs are assumed to be 97% effective in excluding turtles, resulting in a 3% capture rate. Mortality rates were taken from Table 24 (Epperly et al. 2002) and multiplied by the number of captures to estimate the number of mortalities per species. Summary tables of interactions, captures and mortalities by species, season, subregion and shore were generated using these data.

Results

Below is the updated Table 30 formatted per Epperly et al. (2002) representing the total number of estimated interactions and mortalities between loggerhead and leatherback sea turtles and shrimp otter trawls in the Gulf of Mexico and southeast U.S. Atlantic shrimp fisheries. The attached Excel spreadsheet provides the data used to generate this table. Appendix A provides injury and gear details for observed turtle takes in the Gulf of Mexico and southeast U.S. Atlantic shrimp fisheries 2009. Appendix B contains the methods used to extract the Atlantic data, and the code is attached.

Literature cited:

Epperly, S., Avens,L., Garrison, L., Henwood, T., Hoggard, W., Mitchell, J., Nance, J., Poffenberger, J., Sasso, C., Scott-Denton, E., and Yeung, C. 2002. Analysis of sea turtle bycatch in the commercial shrimp fisheries of Southeast U.S. waters and the Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-490, 88p.

Nance, James, Walter Keithly, Jr., Charles Caillouet, Jr., John Cole, Wilson Gaidry, Benny Gallaway, Wade Griffin, Rick Hart, and Mike Travis. 2008. Estimation of effort, maximum sustainable yield, and maximum economic yield in the shrimp fishery of the Gulf of Mexico. NOAA Technical Memorandum NMFS-SEFSC-570, 71P.

Updated Table 30 of Epperly et al. (2002). Estimated annual number of interactions and mortalities (in parentheses) in 2009 between leatherback and loggerhead sea turtles and shrimp trawls in the Gulf of Mexico (GOM) and southeast U.S. Atlantic (S. Atlantic) shrimp fishery and estimated mortalities. Note that these estimates are subject to many sources of error, many unquantified. Please refer to the individual sections on *Sources of Error* throughout Epperly et al. (2002).

Species	**GOM**	**S. Atlantic**
	Estimated Interactions/ (Mortalities)	**Estimated Interactions/ (Mortalities)**
Leatherback	623 (18)	378 (8)
Loggerhead	28095 (778)	33204 (673)

Appendix A: Detail information on observed interactions with sea turtles

Table A1. Injury and gear details for turtles captured in the Gulf of Mexico and southeast U.S. Atlantic shrimp fisheries in 2009.

#	Year	Month	Species	Gear	Interaction w/TED	Tow Time (min)	Region	Statistical Zone	Capture Condition	Final Disposition	CL est (ft)	CCL (cm)	CCW (cm)	SCL (cm)	
1	2009	2	loggerhead	try net	n/a	not avail.	Atlantic	30	alive, uninjured	released alive				59.7	
2	2009	7	loggerhead	try net	n/a	44	Atlantic	29	alive, uninjured	released alive		66	64		
3	2009	7	loggerhead	try net	n/a	68	Atlantic	29	alive, uninjured	released alive					
4	2009	1	loggerhead	TED/ BRD net	caught before TED	354	GOM	2	alive, uninjured	released alive					
5	2009	2	loggerhead	try net	n/a	not avail	GOM	20	alive, uninjured	released alive		76.7	74.9	73.4	
6	2009	3	Kemp's ridley	try net	n/a	not avail	GOM	20	alive, uninjured	released alive		32.2	32	30	
7	2009	3	loggerhead	try net	n/a	not avail	GOM	19	alive, uninjured	released alive		72.3	69.5	67.7	
8	2009	3	loggerhead	try net	n/a	not avail	GOM	19	alive, uninjured	released alive		66.9	65.7	65.9	
9	2009	3	Kemp's ridley	try net	n/a	not avail	GOM	19	alive, uninjured	released alive		35.1	36	33.7	
10	2009	3	loggerhead	TED/ BRD net	caught before TED	403	GOM	4	alive, uninjured	released alive					
11	2009	3	loggerhead	try net	n/a	not avail	GOM	2	previously dead	discarded marked dead/unrespon carcass		83	74.5	78	
12	2009	3	Kemp's ridley	try net	n/a	not avail	GOM	15	alive, uninjured	released alive		34.7	35.6	33.1	
13	2009	5	Kemp's ridley	TED/ BRD net	went through TED grid	373	GOM	14	comatose /unresponsive	released alive		21.6	21.5	20.2	

#	Year	Month	Species	Gear	Interaction w/TED	Tow Time (min)	Region	Statistical Zone	Capture Condition	Final Disposition	CL est (ft)	CCL (cm)	CCW (cm)	SCL (cm)	
14	2009	5	Kemp's ridley	TED/ BRD net	went through TED grid	300	GOM	16	comatose /unresponsive	released alive		21.2	20.7	20.2	
15	2009	5	Kemp's ridley	TED/ BRD net	went through TED grid	408	GOM	16	alive, uninjured	released alive		23.1	23.6	21.3	
16	2009	5	unidentified hardshell	TED/ BRD net	caught before TED	330	GOM	21	alive, uninjured	released alive	2.5				
17	2009	5	Kemp's ridley	TED/ BRD net	went through TED grid	325	GOM	14	alive, uninjured	released alive		21.1	20.7	20.8	
18	2009	5	Kemp's ridley	TED/ BRD net	went through TED grid	420	GOM	15	alive, uninjured	released alive		23.4	23.4	20.2	
19	2009	5	Kemp's ridley	TED/ BRD net	went through TED grid	256	GOM	17	alive, uninjured	released alive		22.5	22	21.4	
20	2009	5	Hawksbill	TED/ BRD net	went through TED grid	223	GOM	17	alive, uninjured	released alive		23.5	20.2	22.6	
21	2009	5	loggerhead	TED/ BRD net	went through TED grid	274	GOM	13	fresh dead	discarded unmarked dead/unrespons carcass	not avail.				
22	2009	6	unidentified hardshell	TED/ BRD net	went through TED grid	261	GOM	2	fresh dead	discarded unmarked dead/unrespons carcass	1.3				
23	2009	6	loggerhead	TED/ BRD net	went through TED grid	246	GOM	13	alive, uninjured	released alive	not avail.				
24	2009	6	Green	TED/ BRD net	went through TED grid	192	GOM	17	fresh dead	discarded unmarked dead/unrespons carcass		20.9		19.8	
25	2009	11	loggerhead	try net	n/a	72	GOM	18	alive, uninjured	released alive	3.0				

#	Year	Month	Species	Gear	Interaction w/TED	Tow Time (min)	Region	Statistical Zone	Capture Condition	Final Disposition	CL est (ft)	CCL (cm)	CCW (cm)	SCL (cm)	
26	2009	12	green	TED/ BRD net	went through TED grid	336	GOM	11	comatose /unresponsive	released alive		25	21.2	24.1	
27	2009	12	Kemp's ridley	TED/ BRD net	caught before TED	294	GOM	11	alive, uninjured	released alive		30.8	31.9	30.1	
28	2009	12	Kemp's ridley	try net	n/a	65	GOM	14	alive, uninjured	released alive				60.4	

Appendix B: Methods and code used to calculate the Atlantic effort data 2001-2009.

Input data sets used:

FL 2001-2009 - Florida Trip Ticket (FTT) data housed in the FTT database at SEFSC.
NC 2001-2009 - NC trip ticket data housed at Atlantic Coastal Cooperative Statistics Program (ACCSP) data warehouse.
SC 2001-2005 – SC detailed shrimp data housed in the South Atlantic Shrimp (SAS) database.
SC 2006-2009 – SC trip ticket data housed at Atlantic Coastal Cooperative Statistics Program (ACCSP) data warehouse.
GA 2001-2005 – SC detailed shrimp data housed in the South Atlantic Shrimp (SAS) database.
GA 2006-2009 – SC trip ticket data housed at Atlantic Coastal Cooperative Statistics Program (ACCSP) data warehouse.
AL, MS, LA, TX 2001-2009 –Trip ticket data housed in the GulfFIN database.

Data from ACCSP require joining data from multiple tables. The DEALER REPORTS table has information on vessel, dealer, port of landing, date of landing and area fished. The LANDINGS table has information on species, condition, market category, pounds landed and value. For those trip ticket programs that collect detailed effort information above what is collected in the dealer report table, these data reside in the TRIPS, EFFORTS and CATCHES tables. The TRIPS table has data on the date sailed, number of trips, split trip or not, days at sea, number of crew and port of landing. The EFFORTS table records information on the fishing area, distance from shore, gear used, gear quantity, gear sets, fishing hours and soak time. The CATCHES table records data species caught, landed pounds, disposition, unit of measurement (pounds, numbers, bushels, etc.), market, grade and value.

The TRIPS table was updated with information from EFFORTS and CATCHES table to assign the predominant area fished and distance from shore based on the pounds landed from each area within a trip. Predominant gear used was then assigned, also using pounds landed. Gear quantity, gear sets and fishing hours were then updated using the maximum values for each trip. Disposition was then used to determine the primary disposition (Food or Bait) for the catch from that trip based on the pounds landed. The predominant species in the catch was then assigned based on the pounds landed. A base table was created with data from the DEALER REPORTS and LANDINGS tables, including: trip identifier, data supplier (state agency), unload date, state of landing, county of landing, dealer, vessel, gear, area fished, distance from shore, pounds landed and value. This table was then updated from the TRIPS table with the highest recorded number of trips and predominant species from the trip table for each dealer report (trip id).

Florida trip ticket data were coded to FIN standard codes and inserted into the base table from the FTT_TYPE1 table, which includes the trip data (dealer, vessel, date sailed, date

landed, gear, area fished, time fished) joined to the FTT_TYPE3 table and FTT_TYPE3_FIXED tables, which include the detailed information on gear, area fished county landed, disposition, grade, pounds landed and value for each species. The FTT data was then updated with the predominant gear, species, disposition, county of landing and fishing area.

Data from the SAS system were then extracted to a temporary table and individual records identified by dealer, vessel, date of landing, state, county and schedule number. This was necessary because the SAS_MAIN_DATA table is a flat file, with a record for each species caught during the trip, creating multiple lines of data from each trip. Predominant species, disposition, gear and fishing area where assigned based on pounds landed and the number of trips was assigned based on the maximum number of trips for each record. These data were then coded to match the code structure from ACCSP and added to the base table holding the ACCSP and FTT data. This may be different than previous method used; resulting in more accurate estimate of trips (previous report may have overestimated trips).

Data from GulfFIN for AL, MS, LA and TX, where shrimp trips were identified as fishing in the Atlantic were then added to the base table from the DEALER_REPORTS and LANDINGS tables at GulfFIN.

All data was then reformatted to ensure all the formats in each variable are consistent for each dataset added to the base table. Gears, trips, disposition, distance from shore, start date and areas fished were then updated from the ACCSP TRIPS table and shrimp season and shrimp area were assigned. Data were then summarized by state, county, vessel, start data, unload date, gear, area, trips, days fished, pounds landed and value.

Days fished were then calculated by state:

FL:

- If TIME_UNITS indicated hours, but TIME_FISHED was less than UNLOAD DATE-START DATE the TIME_FISHED was treated as days, while if the TIME_UNIT indicated days but TIME_FISHED was greater than UNLOAD DATE-START DATE, TIME_FISHED was treated as hours.

- If TIME_UNITS was hours, DAYS_FISHED was recalculated as 1+trunc((TIME_FISHED - 12)/12). (Note that an error was found in the original code that was used to generate effort in the 2002 report. The bias was to underestimate days fished by 1 day in a proportion of the trips.)

- If TIME_UNITS was in days, DAYS_FISHED was set = TIME_FISHED.

GA:

- DAYS_FISHED was set equal to DAYS_FISHED recorded in the data. Where DAYS_FISHED was missing, it was set equal to number of trips x UNLOAD

DATE-START DATE (i.e., a trip is one day) if UNLOAD DATE=START DATE then DAYS_FISHED = trips.

NC:

- Where DAYS_FISHED was missing, it was set equal to number of trips x UNLOAD DATE-START DATE (i.e., a trip is one day) if UNLOAD DATE=START DATE then DAYS_FISHED = trips.

SC:

- If season was "SUMMER" and fishing location was in the ocean then DAYS_FISHED = 2.5x trips.

- If season was "WINTER" and fishing location was in the ocean then DAYS_FISHED = 2.3x trips.

- If the location was inshore then DAYS_FISHED was set equal to the number of trips.

  Note that in the original 2002 report, days fished was based on reported trips in 2001 and trip duration information from 1989-1990.

ALL STATES:

For all trips greater than 45 days fishing, the DAYS_FISHED were considered erroneous and the DAYS_FISHED was set to missing. Any trips still missing DAYS_FISHED because days fishing were not recorded or START DATE was not recorded or DAYS_FISHED was greater than 45 days where estimated from the average DAYS_FISHED for the same year, season, distance from shore and data supplier. AL had no average (data did not include days fishing or date sailed), so the DAYS_FISHED was set equal to the number of trips.