

ADDENDUM TO DR. CAILLOUET PEER REVIEW COMMENTS AND RESPONSES: DRAFT BI-NATIONAL RECOVERY PLAN FOR THE KEMP'S RIDLEY SEA TURTLE

The Bi-national Kemp's Ridley Team (Team or we) sent the Draft Recovery Plan (Plan) to four peers for review, of which the following reviewed and submitted comments:

1. Dr. Charles W. Caillouet, Jr., NOAA Fisheries, retired
2. Dr. Jeffrey R. Schmid, Environmental Science Conservancy of Southwest Florida
3. Dr. Andre M. Landry, Jr., Texas A&M University at Galveston

The following addendum to Dr. Charles Caillouet comments and responses represent changes requested by Dr. Caillouet and agreed to be the Services. For the original summary as well as comments and responses to all peer reviewers see "Peer Review Comments" at: http://www.nmfs.noaa.gov/pr/pdfs/species/kempsridley_recovery_review.pdf.

Dr. Charles Caillouet

Part I. Introduction (Listing Status, Taxonomy, Species Description, Population

Distribution & Trends, Life History & Ecology, Demography, Conservation

Accomplishments, Threats)

Comment: Dr. Caillouet felt the age-based model should be run for several ages 8, 10, and 12 yr at maturity, and not just at 12-years. He felt the 12-year age at maturity was not justified. He also suggested that the model be updated with nests and hatchlings through 2007 and that we run simulations after updating several parameters.

Response: The Plan is not supposed to produce new data. After discussing the available information (see Section F.1), the Team determined that the best available point estimate of age to maturity is 12 years, based primarily on skeletochronology. We note that a model run using a different age at maturity would yield slightly different survival rates for pelagic immatures, large benthic immatures, and adults and would affect the post-1990 mortality multiplier (see Sections F.3. and F.4). The outcome with respect to predicted number of future nests would not be significantly impacted. Likewise, the reproductive values would differ slightly, but would not result in a significant difference in our conclusions and recommendations. Therefore, we chose

to run the model with just a single age at maturity (12 years). We have updated the model to include nesting data through 2009.

Comment: Dr. Caillouet questioned the statement that male-bias reproduction resulting from cooler weather may represent an important event in the reproductive ecology of sea turtles. He questioned how a rare event like a male-biased hatchling production season could affect the overall female-biased sex ratio, statistically speaking. Dr. Caillouet cited the theory that sex ratios tend to converge toward 1:1. Dr. Caillouet felt it important to explain why, even in the primary nesting region of Tamaulipas, the sex ratios are predominately female-biased. He questioned whether or not this was a natural characteristic of Kemp's ridley or a phenomenon of a depleted, but recovering, population.

Response: Female-biased sex ratios of hatchlings are common on many nesting beaches for a number of species and do not appear to be correlated with either depleted or robust populations. Recovery plans are not meant to theorize on different aspects of ecology, and the Team does not feel it appropriate to discuss this in the context of the recovery plan. We deleted the statement hypothesizing that cooler nesting seasons are an important aspect to the reproductive ecology of the Kemp's ridley.

Comment: Dr. Caillouet noted that total sea turtle strandings increased at a more rapid rate than Kemp's ridley strandings in Tamaulipas. He suggested tabulation of Kemp's Ridley strandings, strandings of other species combined, and total strandings. He provided a regression analysis of Kemp's ridley strandings versus total sea turtle strandings in Tamaulipas, indicating no significant relationship.

Response: The point of presenting the stranding data was to highlight the number of Kemp's ridley strandings reported along the Tamaulipas coast, not to compare it to other species.

Comment: In regards to the Seney (2003) study, Dr. Caillouet asked whether she had detected any impact of fishing pressure on less abundant food (i.e., prey other than blue crabs) on Kemp's ridleys, and suggested that this be explained.

Response: The Team agrees with Seney (2003) that a logical conclusion can be drawn between changes in the Kemp's ridley diet when the primary prey availability and abundance changes. The text was changed to state that Seney (2003) hypothesized an impact, as they did not specifically test for one.

Comment: Dr. Caillouet suggested that global warming effects might reduce the probability of cold stunning, at least in the areas where cold stunning episodes now occur.

Response: Fewer cold stunning events due to global warming is possible but unlikely on a decadal scale. We anticipate a period (decades) of more extreme weather patterns as global warming proceeds. Hurricanes and winter fronts are expected to move all the way into the subtropics. Thus, the Team feels fewer cold stunning events, on the timeframe for the Plan, cannot be predicted.

Comment: Dr. Caillouet commented that if the Team is concerned that alteration of sex ratios by global climate change (i.e., warming) is a threat to Kemp's ridley, then the Plan should emphasize the development of nesting colonies in Texas, other U.S. coastal states in the Gulf of Mexico, and perhaps the eastern seaboard. Otherwise, there is increasing potential for beaches in Mexico and south Texas to produce only females in the future, if indeed these beaches survive sea level rise associated with global warming.

Response: The Team discussed this point and felt it supported encouraging nesting by Kemp's ridleys in Texas and the northern Gulf of Mexico. Given the time frame for global warming to influence sex ratios, the Team believes recovery tasks 113 and 2152 that address the importance

of monitoring sex ratios will allow managers to respond in time to ensure suitable nesting sites and hatchling sex ratios are maintained.

Comment: Dr. Caillouet asked whether genetic and demographic studies to date have shown that feminization of Kemp's ridley sex ratios has jeopardized the existence of this species. He noted that feminization of the sex ratio appears to have benefited recovery. Availability of males has been adequate; i.e., it does not appear to be a bottleneck. He asked whether research has shown that past global warming trends have shifted the Kemp's ridley sex ratio in favor of females. As an alternative to global warming, he asked whether the shift in sex ratios could be a result of (a) the peculiarities of beach corral hatchery operations, or (b) a natural population response to recovery from the extreme low population level reached by Kemp's ridley in the past.

Response: The Team believes feminization of Kemp's ridley sex ratios may severely impact Kemp's ridleys based on data from other species of sea turtles. There are models (Davenport 1997, Hulin and Guillon 2007, Hawkes *et al.* 2007 see Draft Plan for citations) which predict very long-term reductions in fertility, but due to the relatively long life cycle of sea turtles, effects may not be seen 30 to 50 years in the future. Kichler *et al.* (1999) showed high levels of multiple paternity in Kemp's ridleys from Rancho Nuevo under the prevailing conditions of recovery in the 1990s where we know many more females were being produced than males.

Additional discussion was added to the text.

Comment: Dr. Caillouet suggested that the model projections for number of nests based on the demographic data be incorporated into the plan.

Response: We agree. See Figure 4 in the draft plan.

Comment: Dr. Caillouet suggested that the scientific justification for quantifying threats based on products of RRVs and arithmetic mid-points of logarithmically scaled mortality class

intervals needs to be examined further, to determine its validity. He suggested further that the justification, if there is one, needs to be explained in the plan. He suggested consultation between the Team and professional statisticians in this regard.

Response: Reproductive values are approximate and based on our current estimates of survival and reproductive rates, which are fit to observed nest numbers that have been increasing since the mid-1990s. Because reproductive values used here are based on a deterministic model, they assume a stable age distribution – a constant proportion of individuals in each life stage of the growing population. The growth rate observed on the nesting beach and the egg survival in corrals has been relatively constant for over a generation time, suggesting that the current population could be in a state that is close to a stable age distribution; however, natural populations do not remain at constant proportions due to variability in the vital rates and productivity from year to year. As the population growth rate slows, in response to density and limitations to nest protection, the reproductive value of juveniles will change as the population shifts to a new average age distribution. If the population growth rate slows due to a decrease in the reproductive rate, the value of juveniles will increase relative to the value of adults. Because of the potential volatility of reproductive value as a scalar, the threat tables presented here should be viewed qualitatively rather than quantitatively, and be updated with new monitoring data on a regular basis.

Comment: Dr. Caillouet suggested that size (and age) distributions of strandings and nesters be examined and applied to age-based modeling, with alternative and more realistic assumptions of increasing population size and an age distribution that may be shifting toward dominance by smaller sizes (younger ages).

Response: In the case of sea turtles (and many species) as animals grow, the range of ages associated with a given size increases leading to increasingly high variability in age estimates derived from size data. Furthermore, because sea turtles apparently almost stop growing in size once mature, the adults would be the most difficult and the most unreliable group to apply this type of conversion (size to age). There are other indicators of neophyte nesters that should be explored and perhaps determine if the proportion of neophyte nesters are increasing in the population. However, these data were unavailable for the Team to consider.

Part II. RECOVERY (Strategy, Goal, & Criteria)

Comment: Regarding the A.1 Downlisting Criterion no. 1, Dr. Caillouet questioned why the current revision limited this downlisting criterion to three nesting beaches in Mexico. He pointed out that nestings in Texas are increasing exponentially too. He also pointed out that the 1992 recovery plan (USFWS and NMFS 1992) did not limit the downlisting criterion in this way, and it was published at a time when the population seemed to be in decline. Now the population is expanding exponentially, and he felt this downlisting criterion is more restrictive.

Response: The Team discussed this at length. The Team did not include the U.S. beaches in the downlisting criteria (as opposed to the delisting criteria) because a specific level of nesting in Texas would be superfluous for the threatened category, given the significantly larger level specified in Mexico. Also, the Team expects migrants from the nesting in Mexico to continue towards the northern periphery of its nesting range in Texas since the nesting population is one contiguous nesting population and not separated by artificial political boundaries between the U.S. and Mexico.

Comment: Dr. Caillouet questioned the need for the A.1 Downlisting Criterion no. 2 of 286,000 hatchlings, given the current exponential population growth. He wondered if it was intended to assure the corral hatchery operations continue at this level through downlisting. He felt the Plan should clarify the rationale behind the criterion.

Response: The Team felt that the recruitment of at least 286,000 hatchlings was necessary to ensure a minimum level of known production either through *in situ* or corrals or a combination of both. Clarifying text was added.

Part II RECOVERY (Step down & Narrative)

Comment: Regarding Recovery tasks 2131, Dr. Caillouet noted that long-term monitoring of annual number of nesting females may become exceedingly difficult to achieve. He noted that statistical sampling surveys could be designed to estimate number of females, but such surveys would still be exceedingly difficult and possibly expensive to implement. Counting nests and sampling to estimate nests per female per season are probably more cost effective for estimating annual numbers of females. If counting nesting females is going to be required, then this should be clarified in the Plan. If this is not the intent, then efforts should continue to count nests. Additional efforts should be directed at improving the estimation of number of nests per female for each year, its frequency distribution, its central tendency, its arithmetic average if its distribution is normal, or some other estimator if it is skewed.

Response: The Plan was changed to clarify that different monitoring methods may need to be developed.

Comment: In response to the statement under recovery tasks 2291—“The Kemp’s ridley population has experienced reduced abundance over decades, increasing the probability of

hybridization,” Dr. Caillouet responded that it is remarkable that more hybrids have not been seen alive or found stranded dead. He noted that the population has declined over decades followed with an increase over time. He wondered whether the probability of hybridization tracked the population trend. Dr. Caillouet noted the probability of hybridization would also be affected by whether population trends of other species most likely to hybridize with Kemp's ridleys are in phase with the trends in the Kemp's ridley population. Dr. Caillouet also questioned whether hybridization was really important to Kemp's ridley recovery, or any sea turtle species' recovery. He asked whether hybrids are fértil and capable of passing on the hybrid genes to future generations

Response: Hybridization is indeed rare and thus very little is known about them. From what is known, the Team felt it would be more likely that hybridization probabilities would go up as the Kemp's abundance dropped, as long as potential hybrid species occur in the same area and during the breeding season of the Kemp's ridley. The loggerhead sea turtle overlaps with the Kemp's ridley nesting season, although its nesting is very sparse in Tamaulipas. The green sea turtle may nest later in the season, but they nests in greater abundance. The text was changed to reflect the possibility of overlap of other species that may interbreed with the Kemp's ridley. Since neither genetics nor visual examinations have suggested hybrids to be significantly represented in the breeding population, it is unlikely to be important to the recovery of the Kemp's ridley. The better studied and most extreme case of hybridization is that of the hawksbill rookery in the Brazilian state of Bahia. At this rookery, 90% of the country's hawksbill nesting occurs, yet 42% of the nests are from hawksbill and loggerhead hybrids. This case indicates that the hybrids are indeed fértil, can lead to F2+ generations, introgressing extraneous genes into the population which will have profound conservation implications (Ruiz *et al.* 2006). The

presence of phenotypically detected hybrids involving loggerheads and green sea turtles amongst the assemblages nesting in Tamaulipas, albeit at very low levels, does suggest that in the case of the Kemp's ridley, hybrids can be fertile too. Again, though unlikely to be significant for our species, the example of Bahia, Brazil does suggest that adequate genetic monitoring is warranted to quantify the extent. The text was modified to indicate the importance of monitoring.

Citation: Lara-Ruiz, P., G. G. Lopez, F. R. Santos & L. S. Soares. 2006. Extensive hybridization in hawksbill turtles (*Eretmochelys imbricata*) nesting in Brazil revealed by mtDNA analyses. Conservation Genetics. DOI 10.1007/s10592-005-9102-9

Comment: Dr. Caillouet questioned why the Team did not recommend release of captive reared animals.

Response: We clarified the text to read that the recommendation was limited to release of turtles with disease symptoms.

Comment: Regarding Recovery tasks 214, the Team identified that guidelines will need to be identified on the critical proportion or number of nests to be moved to hatcheries to guarantee recovery goals. Dr. Caillouet felt that these guidelines should be simulated by the Team and put in the recovery plan.

Response: The Team feels the development of guidelines for the proportion or number of nests to be moved to hatcheries is a function of the long-established Kemp's ridley working group, because this group coordinates the on-the-ground conservation and monitoring program.

Comment: Regarding Recovery task 2151, Dr. Caillouet noted that a female-biased hatchling sex ratios would clearly accelerate recovery as compared to a 1:1 M:F sex ratio or a male bias.

Response: We strengthened the discussion on the effects a female bias would have on the recovery rate.

Part III IMPLEMENTATION SCHEDULE

Comment: Dr. Caillouet questioned why Texas nesting beaches and habitats were mentioned only once in the Implementation Schedule. He felt that Texas should get priority status for protection of nesting turtles, eggs, and hatchlings, as well as protection of foraging areas, migratory corridors, etc. for Kemp's ridleys. Also, some research priorities should include Texas.

Response: The Texas coast nesting is considered the northern periphery of the main nesting beaches of State of Tamaulipas, Mexico, with the majority of its nesting in Texas occurring within extensive stretches of protected beaches on Padre Island National Seashore and several National Wildlife Refuges. The Team believes the recovery actions and implementation schedule appropriately reflect the importance and priority for this part of the Kemp's nesting range. See also response to Dr. Landry comment on Upper Texas Coast nesting.

LITERATURE CITATIONS

Comment: Dr. Caillouet felt the plan does not adequately cover the literature on Kemp's ridley health, and he provided Caillouet (1997) as a source.

Response: Recovery plans are not meant to be exhaustive presentations of current research results. We feel the information provided is sufficient to identify and support priorities for recovery. We added the Caillouet (1997) citation as a reference source for health assessments.

Appendix A Threats Matrix

Comment: Dr. Caillouet questioned the Team's use of arithmetic sums and means in the threats analysis table and requested additional clarification on the methods and justification for the procedure.:-

Response: We have added text to better explain the methods used. The basic concept of using reproductive values to scale threats, employing a common currency to compare threats affecting different life stages was recently applied to loggerhead sea turtles (Wallace et al. 2008, NMFS & USFWS 2008) and we do the same here for Kemp's ridleys. The pattern of reproductive value versus age always increases to age at maturity, then decreases through time for humans (and some other mammals) because fecundity is fixed; each year individuals get closer to maximum age (end of their lifespan and hence, contribution) so the relative contribution has to decline. The model we used has adults grouped into a single stage, so that decline with age doesn't happen. Essentially, the reproductive values are scaled to the maximum value, which is that of that adult stage. The current model does not discount the importance of hatchling production, nor males. It simply uses adult females as a scalar by which to compare the threats.

The threats are categorized by orders of magnitude, e.g., they are logarithmically scaled class intervals. The team decided to calculate a measure of the classes' central tendency (i.e., their mid-point) to replace each mortality class interval instead of using the limits of each class interval themselves to represent the importance of each mortality cause (threat). Originally, the team used the arithmetic mean of the class limits rather than the geometric mean, in part because they believed the former was more conservative. In doing so, the team made implicit if not explicit assumptions about the probability distribution of mortality within each class. Further

scrutiny of the mathematics and statistical literature has suggested that the team's original decision was in error. Because the team categorized the mortalities on a log scale, inherently the distribution of mortalities within each class also is log normal, even though there currently may be little or no information on the actual distribution. Thus, it is more appropriate that the geometric means be used to represent the midpoints in each class and the threats analysis was revised accordingly.