# REVIEW OF TEWG 2008 NORTHWESTERN ATLANTIC LOGGERHEAD POPULATION ASSESSMENT

Report to the Center for Independent Experts

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September 30, 2008

**INTRODUCTION**

This is a review of:

TEWG. 2008. An Assessment of the Loggerhead Turtle Population in the Northwestern Atlantic Ocean. NMFS-SEFC-xxx.

In preparation for this review, I also read the following material:

Frazer, N.B. 1986. Survival from egg to adulthood in a declining population of loggerhead turtles, Caretta caretta. Herpetologica 42:47-57.

Heppell, S.S., L.B. Crowder, D.T. Crouse, S.P. Epperly, and N.B. Frazer. 2003. Population models for Atlantic loggerheads: past, present, and future. Ch 16. pp 55-274 in A.B. Bolten and B.E. Witherington, eds. "Loggerhead Sea Turtles." Smithsonian, Washington, DC.

TEWG. 1998. An Assessment of the Kemp's Ridley (Lepidochelys kempii) and Loggerhead (Caretta caretta) Sea Turtle Populations in the Western North Atlantic. NMFS-SEFC-409

TEWG. 2000. Assessment Update for the Kemp's Ridley and Loggerhead Sea Turtle Populations in the Western North Atlantic. NMFS-SEFC-444

TEWG. 2007. An Assessment of the Leatherback Turtle Population in the Atlantic Ocean. NMFS-SEFC-555

Hedges, M.E. 2007. Development and Application of a Multistate Model to the Northern Subpopulation of Loggerhead Sea Turtles (Caretta caretta). MS Thesis, Virginia Polytechnic

I also consulted an undated document from the NOAA website:

"Part I. Stock Assessment of Loggerhead Sea Turtles of the Western North Atlantic" by S.P. Epperly, M.L. Snover, J. Braun-McNeill, W.N. Witzel, C.A. Brown, L.A. Cszudi, W.G. Teas, L.B. Crowder, and R.A. Myers. (this document uses data through 2000, and cites references through 2001).

The CIE charge to the reviewers is to evaluate the TEWG 2008 document as an "assessment of status and trends of the population" and to evaluate the document's research recommendations. This is consistent with the document's title, as "an assessment of the...population," but the actual content of the document is considerably narrower than that. The executive summary of the document is narrower yet in its focus.

So, I will provide three levels of review:

(a) An appraisal of the assertions made in the executive summary of TEWG 2008.
(b) An appraisal of the other assertions made in the main text of TEWG 2008.
(c) An appraisal of TEWG 2008 as a stock status assessment.

Along the way I will comment on the adequacy and appropriateness of the data and the methods of analysis for each of the three levels.

My recommendations, at the end, will address specific shortcomings of the present document and will also consider from a programmatic perspective the needs for a comprehensive assessment of the Northwestern Atlantic loggerhead sea turtle population.

**EXECUTIVE SUMMARY OF TEWG 2008**

The key message of the executive summary of TEWG 2008, stated up front in its first paragraph, is that current evidence is not consistent with the conclusion from TEWG 1998 that the main northwestern Atlantic population is "showing signs of recovery." This message is well supported by the evident decline in the annual nest count from the Florida nesting areas, which make up the bulk of the nesting and hatchling production of the Atlantic population (and a substantial fraction of the world population).

A further seven pertinent points made in the executive summary are, in my own words, that:

1. The recent numbers of loggerheads nesting in Florida are lower than when standardized surveys began in 1989.

2. The annual numbers of loggerheads nesting in Florida show a strong declining trend since 1998.

3. Six stated hypotheses are worth considering to account for the decline in nest counts and to interpret its implications for the status of the population.

4. The available data do not allow "testing" of most of the six hypotheses, and so do not discriminate among them.

5. The analyses do conclude that adult female annual survival rates have not changed.

6. The role of pelagic longline bycatch in the decline is rendered less likely by the observation that rates of decline differ among the nesting assemblages.

7. More research is needed.

Points 1, 2 and 4 are well supported by the information presented in the body of the document. The six stated hypotheses which form the content of point 3 are relevant and reasonable enough, but the set of hypotheses, and their discussion, leaves out the important and obvious conclusion (perhaps this should be Hypothesis H_7) that the decline in nest counts does directly imply a declining trend in reproductive output of the population. All other things being equal, this decline in population reproduction will lead to declines in recruitment and to further declines in nest counts when the births from the current era reach reproductive age two or three decades in the future.

Point 5 is not supported by the information presented in the body of the document. The mark recapture survival estimates discussed on pages 84-85 do not specifically compare estimates from the period pre-1998 and post-1998 with consistent models on strictly comparable data; nor is there any indication that the survival estimates from the mark recapture analysis have the statistical power to resolve survival differences of the minimal magnitude which could account for the declining nest counts. Overall, the mark recapture survival estimation is poorly documented, and I am concerned that the models used are over-complicated relative to the information content of the data.

The logic of point 6 is flawed. The conclusion that pelagic longline bycatch is unlikely to be a major factor in the decline, because the rate of decline differs among the different nesting assemblages, assumes that the different nesting assemblages all have the same exposure to the pelagic longline fisheries, and all suffer the same mortality rates from other causes. This assumption is obviously undermined by the possibility that turtles from the different nesting assemblages could have different foraging distributions in time and space. And it is also undermined by the possibility that other mortality factors could operate at different intensities among the respective nesting assemblages. The available information on nest site philopatry, genetic differentiation, and the general observation that, at least in the short term, locally exterminated subpopulations do not recolonize, all leave room for the possibility of spatial differences between nesting assemblages with respect to at sea exposures.

Point 7 is undeniable, and is a corollary of point 4. But the executive summary is a little vague about exactly what "research" is needed, or what critical "data" that research would provide. The main body of the text is a bit better in this respect, but still stops short of prioritizing the research needs or explaining exactly which data are needed to test which hypothesis adequately. In particular, the report fails to state explicitly that a considerable expansion and enhancement of observer programs will be needed to resolve the role of bycatch in affecting the status of the stock. In fact the word "observer" does not appear anywhere in the executive summary or the main body of the document, though there is an oblique reference to "observed fisheries" in the "Bycatch" section of the document (but not in the "Research Needs and Recommendations" section).

## OTHER POINTS IN THE MAIN TEXT OF TEWG 2008

In addition to discussion of evidence bearing on the main points asserted in the executive summary, the main text presents a statistical analysis of the trend in the nesting count data and a population viability analysis. Neither is very well done, but neither is essential to the points made in the executive summary.

*Statistical Trend Analysis*

The "frequentist" trend analysis for the Florida nesting count data was done by log regression. No details are given, and the document cites Witheringtgon, *et al*., in press, which is not provided. Likewise, the description of the survey methodology for the "Statewide Nesting Beach Survey" and the "Index Nesting Beach Survey" is not provided, so the reviewer has to take it on faith that there

are no artifacts owing to the survey method or the method of standardizing or the definition of the 28 "core nesting beaches."

The "Bayesian state space" analysis method is referenced to TEWG 2007, where it emerges that the likelihood function is not really a likelihood at all, but rather a vague prior on the probability that an adult female will nest and be sighted in any given year. This is not a satisfactory model.

Regardless of these shortcomings of the statistical analyses, it is clear on the face of it, from Figure 1 (p. 22), that there is a decline in the Florida nest counts and that the nature of the trajectory has changed midway. Again, only this figure is provided in the document, not a table of numbers, and the reference is to "Florida Fish and Wildlife Conservation Commission unpubl. data."

On inspection, the figure shows, for the interval 1989-1997, two obvious 4-yr cycles of an amplitude of about 15,000 and a slight increasing trend. On inspection, the figure shows for the interval 1998-2007 a strong and very consistent declining trend with numbers in 2004-200y consistently below the 1989 starting number (and the starting value itself was a "low" in the apparent cycle). The numbers since 2001 have been consistently below the first cycle's peak. Actually, it is ambiguous when the "change point" occurred: The downward trend is quite consistent starting from 1998, but note that 1987-2001 could equally well be viewed as a third 4-yr cycle, in which case the first real departure from the previous pattern would be 2002. The downward trend looks linear enough in the original space, without log transforming.

*Population Viability Analysis*

The population viability analysis is not well explained in the document, with a reference only to "Snover and Heppell, in review," which is not provided. The basic model, the diffusion model of Dennis et al (1991), is not a good approximation to the stochastic mechanisms actually at work in a population with an age at maturity of something like 30 yrs, and hence a generation time of probably more than 30 yrs. The choice to smooth the raw nest count time series with a 3-year running mean does not address this issue, but it may cancel out some observation error variation (if that variation is primarily high frequency). The bootstrap approach of Morris and Doak (2002) is a little bit clumsy, and definitely not state of the art. If the loggerhead turtle program wants to invest in some Bayesian analysis, the PVA modeling (as distinct from the particular attempt at "state space modeling" to estimate the population trend) would be a good place. A Bayesian framework offers a much more natural way to merge parameter uncertainty with estimates of real process variation in a PVA.

I did not understand the logic of the "SQE index" and its relation to critical values and "Type I" and "Type II" classification errors. No doubt a Bayesian alternative would help here as well.

## TEWG 2008 AS A STOCK STATUS ASSESSMENT

The preface to TEWG 1998 states that the TEWG originated during the course of the 1995 Consultation requiring NMFS to form a team of experts to "compile and examine [in]formation on the status of sea turtle species....attempt to identify a) the maximum number of individual sea

turtles of each species that can be taken incidentally to commercial fishing activities without preventing the recovery of the species, b) the maximum number of individuals that can be taken incidentally to commercial fishing activities without jeopardizing the continued existence of any listed sea turtle species, and c) the number of stranded sea turtles occurring in statistical zone that indicate incidental takes are occurring at levels beyond those authorized." None of (a), (b) or (c) has been accomplished yet. TEWG 1998 and TEWG 2000 proposed provisional numbers for (c), called Interim Stranding Limits, and assessed whether these were being exceeded. TEWG 2000 considered, but did not endorse, PBR as an approach to estimating (a) and (b). None of this is mentioned in the present document.

In this respect, and in some others, both TEWG 1998 and TEWG 2000 are more comprehensive assessments than the current document, TEWG 2008. TEWG 1998 and TEWG 2000, for example, presented some rough quantitative estimates of bycatch. TEWG 2008 declines to do so, but it does not explicitly disavow the previous estimates either.

Now, the current document does present an important new finding--a declining trend in nest counts--and states an important new conclusion-- that there is no longer an appearance of progress toward recovery. What is missing from the present document is a statement of what other conclusions from TEWG 1998 and TEWG 2000 have been superceded, and what conclusions still stand. So it is not clear whether TEWG 2008 is intended as a stand alone stock status assessment, or whether TEWG 1998 and TEWG 2000 and TEWG 2008 are to be understood together to constitute "the stock assessment."

None of the three TEWG assessments has really done a synthesis, integrating all the data, or considering the combined effects of all the factors (including quantification of nesting beach protection and hatchery operations and TED adoption) operating over the past 30 years since listing. I doubt that such a synthesis will be very conclusive given the limitations of the data, but it should still be tried.

## REVIEWER'S RECOMMENDATIONS

*Short Term*

To bring the present document up to a reasonable standard:

* Explain carefully the relationship between the present document TEWG 2008, and the former assessments in TEWG 1998 and TEWG 2000.

* Better assess the implications of the decline in nest counts for the future of the population over the next 30 years.

* Prioritize the Research Needs and be more explicit about what data are needed to answer what question, and be more explicit about how those data are to be obtained, and what sample sizes and precision are required to deliver an adequate answer.

* Specifically explain what is needed to resolve the question of the role of bycatch, and be sure that this point makes it into the Executive Summary.

* Better document the nest count data.

* Better document the trend analysis of the nest count data.

* Drop the Bayesian state space analysis (or if a more reasonable likelihood model, supported by actual data, is ready for use, then redo that analysis).

* Better document the population viability analysis and explain its real usability (or perhaps just drop it).

* Better document the data used for the adult female survival rate analysis, and make those data accessible for reviewability.

* Better document the adult female survival analysis, provide meaningful diagnostics, and revisit the claim (now in the Executive Summary) that the adult female survival rate has not changed.

*Long Term*

For the longer term, the program needs to:

* Greatly intensify marking operations.

* Design and implement a mark resighting and carcass recovery system appropriate to the estimation of survival rates, reproductive rates, and population size.

* Compile a well documented data base of all the data.

* Initiate an integrated modeling and statistical analysis effort to synthesize all the information for a more comprehensive assessment.

Finally, from my reading of TEWG 2008 and background material, I get the impression that the turtle program might benefit from a programmatic review.

**REVIEWER'S SUMMARY**

The new and central finding of TEWG 2008 is that, based on evidence since 1989, the main northwestern Atlantic loggerhead population is not showing signs of recovery, and the trend in nest counts is declining. This important claim is fully justified by the information presented.

In some other respects, however, the TEWG 2008 document is rather weak as a "stock status assessment."

# Appendix I: Statement of Work for Dr. Dan Goodman

### External Independent Peer Review by the Center for Independent Experts

### Loggerhead Turtle Expert Working Group Report

**TEWG Project Overview**

The National Marine Fisheries Service's (NMFS) Southeast Fisheries Science Center (SEFSC) convened a Loggerhead Turtle Expert Working Group (TEWG) to assess the status of loggerhead turtles in the North Atlantic Ocean. Scientists from NMFS, NGOs, and academia with expertise in loggerhead biology and data analysis comprised this group. All members contributed their expertise to the group, with the goal of producing a draft report that assesses loggerhead status in the Atlantic.

The TEWG concept was established by the SEFSC at the behest of NMFS in 1995 to assess the status of turtle species in the Atlantic. Previous TEWG reports addressed loggerhead turtle status in 1998 (TEWG 1998) and 2000 (TEWG 2000). The current loggerhead TEWG was initiated to address the recent declines in loggerhead nest in the U.S. The TEWG met in December 2006, April 2007, and September 2007. The SEFSC has the lead for conducting stock assessments on Atlantic sea turtles, and assembled an international group of government scientists, academics, and NGOs to assess the status of loggerheads.

**Overview of CIE Peer Review Process:**

The Office of Science and Technology implements measures to strengthen the NMFS Science Quality Assurance Program (SQAP) to ensure the best available high quality science for fisheries management. For this reason, the NMFS Office of Science and Technology coordinates and manages a contract for obtaining external expertise through the Center for Independent Experts (CIE) to conduct independent peer reviews of stock assessments and various scientific research projects. The primary objective of the CIE peer review is to provide an impartial review, evaluation, and recommendations in accordance to the Statement of Work (SoW), including the Terms of Reference (ToR) herein, to ensure the best available science is utilized for the National Marine Fisheries Service management decisions.

The NMFS Office of Science and Technology serves as the liaison with the NMFS Project Contact to establish the SoW which includes the expertise requirements, ToR, statement of tasks for the CIE reviewers, and description of deliverable milestones with dates. The CIE, comprised of a Coordination Team and Steering Committee, reviews the SoW to ensure it meets the CIE standards and selects the most qualified CIE reviewers according to the expertise requirements in the SoW. The CIE selection process also requires that CIE reviewers can conduct an impartial and unbiased peer review without the influence from government managers, the fishing industry, or any other interest group resulting in conflict of interest concerns. Each CIE reviewer is required by the CIE selection process to complete a Lack of Conflict of Interest Statement ensuring no advocacy or funding concerns exist that may adversely affect the perception of impartiality of the CIE peer review. The CIE reviewers conduct the peer review, often participating as a member in a panel

review or as a desk review, in accordance with the ToR producing a CIE independent peer review report as a deliverable. The Office of Science and Technology serves as the COTR for the CIE contract with the responsibilities to review and approve the deliverables for compliance with the SoW and ToR. When the deliverables are approved by the COTR, the Office of Science and Technology has the responsibility for the distribution of the CIE reports to the Project Contact.

**Requirements for CIE Reviewers:**

Three CIE reviewers are required to conduct a desk review (no travel is required) of a Loggerhead TEWG draft report (approximate length 120 pages), and each reviewer's duties shall occupy a maximum of 5 days to conduct the peer review and produce a CIE independent peer review report.

The CIE reviewers shall have expertise with current quantitative skill as it relates to an understanding of life histories and stock assessment of large, long-lived, highly migratory marine vertebrates. CIE reviewers shall expertise and experience with generating stock assessments in a data poor situation and in the use of count data as proxies for population size (e.g., number of nests for this report) and population growth rates. The CIE reviewers shall have the requested expertise necessary to complete an impartial peer review and produce the deliverables in accordance with the SoW and ToR herein.

**Statement of Tasks for CIE Reviewers:**

The CIE reviewers shall conduct an independent peer review of the TEWG loggerhead stock assessments to determine whether the best possible assessment was utilized through the TEWG process. The CIE reviewers shall conduct preparations prior to the peer review, conduct the peer review, and complete the deliverables in accordance with the ToR and deliverable dates as specified.

The reviewers shall evaluate the draft North Atlantic assessment report of the Loggerhead TEWG. Their primary responsibility is to conduct an impartial peer review to ensure that assessment results are based on sound science, and the CIE reviewers shall not comment on management decisions. The reviews shall consider whether the input data, assessment methods, and results are adequate and support the conclusions. If a reviewer finds the assessment to be deficient, then he/she shall recommend remedial measures, including an appropriate approach for correcting and subsequently reviewing the assessment. The evaluation shall explicitly address the following Terms of Reference.

**Terms of Reference:**

1. Evaluate the adequacy, appropriateness, and application of data used in the assessment.

2. Evaluate the general adequacy, appropriateness, and application of methods used in the assessment.

3. Evaluate the adequacy, appropriateness, and application of the methods used to assess population status and trends.

4. Review research recommendations provided in the report and make any additional recommendations warranted.

5. Prepare a Peer Review Report as described in Annex 1, summarizing the CIE Reviewer's evaluation of the Loggerhead TEWG report and addressing each Term of Reference, including a statement on whether the assessment was based on sound science, appropriate methods, and appropriate data, with a copy each sent to Dr. David Sampson at david.sampson@oregonstate.edu and Mr. Manoj Shivlani at shivlanim@bellsouth.net.

**Schedule of Milestones and Deliverables:**

| | |
|---|---|
| 27 March 2008 | CIE shall provide the COTR with the CIE reviewer contact information, which shall then be sent to the Project Contact |
| 11 April 2008 | The Project Contact shall send the CIE Reviewers the Loggerhead TEWG report |
| 25 April 2008 | Each reviewer submit independent peer review report to CIE |
| 8 May 2008 | CIE shall submit draft CIE independent peer review reports to the COTRs |
| 22 May 2008 | CIE shall submit final CIE independent peer review reports to the COTRs |
| 28 May 2008 | The COTRs shall distribute the final CIE reports to the Project Contact |

**Background References:**

Turtle Expert Working Group. 1998. An Assessment of the Kemp's Ridley (Lepidochelys kempii) and Loggerhead (Caretta caretta) Sea Turtle Populations in the Western North Atlantic. NOAA Technical Memorandum. NMFS-SEFSC-409, 96 p.

Turtle Expert Working Group. 2000. Assessment Update for the Kemp's Ridley (Lepidochelys kempii) and Loggerhead (Caretta caretta) Sea Turtle Populations in the Western North Atlantic. NOAA Technical Memorandum. NMFS-SEFSC-444, 115 p.

**Acceptance of Deliverables:**

Upon review and acceptance of the CIE reports by the CIE Coordinator and Steering Committees, CIE shall send via e-mail the CIE reports to the COTRs (William Michaels William.Michaels@noaa.gov and Stephen K. Brown Stephen.K.Brown@noaa.gov) at the NMFS Office of Science and Technology by the date in the Schedule of Milestones and Deliverables. The COTRs will review the CIE reports to ensure compliance with the SoW and ToR herein, and have the responsibility of approval and acceptance of the deliverables. Upon notification of acceptance, CIE shall send via e-mail the final CIE reports in *.PDF format to the COTRs. The COTRs at the Office of Science and Technology have the responsibility to distribute the final CIE reports to the Project Contacts.

**Request for Changes:**

Requests for changes shall be submitted to the Contracting Officer at least 15 working days prior to making any permanent substitutions. The Contracting Officer will notify the Contractor within 10 working days after receipt of all required information of the decision on substitutions. The contract will be modified to reflect approved changes. The Terms of Reference (ToR) and list of pre-review documents herein may be updated without contract modification as long as the role and ability of the CIE reviewers to complete the SoW deliverable in accordance with the ToR are not adversely impacted.

**Key Personnel:**

Contracting Officer's Technical Representative (COTR):

William Michaels, COTR, NMFS Office of Science and Technology,
1315 East West Hwy, SSMC3, F/ST4, Silver Spring, MD 20910
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# ANNEX 1

## Format and Contents of CIE Independent Peer Review Report

1. The reviewer's report shall be prefaced with an executive summary of findings and/or recommendations.

2. The main body of the reviewer's report shall consist of a background, description of the review, summary of findings, and conclusions/recommendations. The summary of findings shall address each Term of Reference. Reviewers are also encouraged to provide any criticisms and suggestions for improvement of the TEWG process.

3. The reviewer's report shall include as separate appendices the bibliography of materials provided for the review of the Loggerhead TEWG draft report and a copy of the CIE Statement of Work.