

**REVIEW OF “STOCK ASSESSMENTS OF LOGGERHEAD AND LEATHERBACK
SEA TURTLES AND AN ASSESSMENT OF THE IMPACT OF THE PELAGIC
LONGLINE FISHERY ON THE LOGGERHEAD AND LEATHERBACK SEA
TURTLES OF THE WESTERN NORTH ATLANTIC”. US DEPARTMENT OF
COMMERCE, NATIONAL MARINE FISHERIES SERVICE, MIAMI FLA.,
SEFSC CONTRIBUTION PRD-00/01-08,**

Ian Poiner

15 March 2001

Task:

On behalf of the *UM Independent System for Peer Reviews* undertake a review of: National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center. (2001). Stock assessments of loggerhead and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the Western North Atlantic. US Department of Commerce, National Marine Fisheries Service, Miami Fla., SEFSC Contribution PRD-00/01-08, 328 pages

Reviewer:

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1. Executive Summary

Marine turtles are declining globally and remain under threat in regions of the world. In 2000 National Marine Fisheries Service (NMFS) concluded that the pelagic longline fishery was likely to jeopardise the continued existence of loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) sea turtles and there was a need to determine more precisely the impact of the pelagic longline fishery on sea turtles. This required further analysis of observer data, and additional population modelling of loggerhead sea turtles. NMFS (2001) provides the scientific review and synthesis of new information and is the document under review. The focus of the review is the NMFS (20001) document.

The report represents a significant and comprehensive review and reanalysis of a large amount of published and unpublished reports and data. It is an important document and NMFS and its collaborators are to be commended for presenting the Report. The Report clearly highlights that the main impediment to determining more precisely the impact of the pelagic longline fishery on sea turtles is the lack of data about the turtles, the fishery and relative 'importance' of sea turtle long-line mortality, and the effectiveness of mitigation measure. However the reports does not systematically and formally prioritise the data needs required to provide the greatest reduction in uncertainty and outputs are not clearly linked to the required outcome ie sea turtle recovery.

The report provides an update of the status and condition of the loggerhead sea turtle stocks of the Western North Pacific and highlights the data needs to improve the assessment model. Of particular note is the lack of statistical power of the sea turtle and bycatch monitoring programs to detect trends. They should be reviewed and where appropriate redesigned. The validity of the deterministic modelling approach needs to be reviewed and the potential of alternative approaches for diagnosing population changes/declines especially where there are several mortality risks eg egg harvest, trawling and longline fisheries.

The evaluation of mitigation measures presents a good review of the current research into the impact of different hook styles on sea turtle bycatch survivorship and an analysis of the times and areas of high sea turtle/US longline fishery interactions. However the lack of

research into alternative gear, fishing strategies and the potential effectiveness of management actions is a significant gap.

The analysis, results and conclusions in the report represents the best scientific information on which to proceed with fishery management. The level of loggerhead and leatherback longline bycatch mortality should be reduced to acceptable levels. However the report provide little guidance on the conservation and fishery consequences of alternative management actions to achieve the required reduction in mortality.

There is a need to systematically and formally prioritise the data needs required to provide the greatest reduction in uncertainty about the status of sea turtle populations, assess competing mortality risks and to evaluate alternative management actions. The stock assessment models seem to be an appropriate tool to do this at least for loggerheads. For the leatherback turtle the data needs are even more acute compared to loggerheads. The priorities would seem to be improved understanding of stocks/management units, quantifying the sources of mortality causing the declines in the French Guiana and Suriname beaches, and for the US fleet improved understanding of what stocks/management units it is impacting.

2. Introduction

i) Background

Marine turtles are declining globally and remain under threat in regions of the world (IUCN 1995). The National Marine Fisheries Service (NMFS) has been concerned about the problem of turtle bycatch in longlines since 1994 (Williams *et al.* 1996). In 2000 NMFS concluded that the pelagic longline fishery was likely to jeopardise the continued existence of loggerhead (*Caretta caretta*) and leatherback (*Dermochelys coriacea*) sea turtles and there was a need to determine more precisely the impact of the pelagic longline fishery on sea turtles. This required further analysis of observer data, and additional population modelling of loggerhead sea turtles. NMFS (2001) provides the scientific review and synthesis of new information and is the document under review. It is in three parts with five appendices:

- Part I – Stock assessment of loggerhead sea turtles of the Western North Atlantic.
- Part II - Stock assessment of leatherback sea turtles of the Western North Atlantic.
- Part III – Assessment of the impact of the pelagic longline fishery on loggerhead and leatherback sea turtles of the Western North Atlantic.

ii) Review activities

My task (Appendix 2) was to review the stock assessments for loggerhead and leatherback sea turtles, focusing on the following:

- Assumptions in defining stock structure based on genetic information;
- Application of serious injury criteria;
- Estimation procedures for catch and mortality in the longline fishery;

- Conclusions on stock status and impacts of fishery relative to stock recovery.

The specific tasks of the consultancy are provided in Appendix 2.

3. Summary and Findings

The report represents a significant and comprehensive review and reanalysis of a large amount of published and unpublished reports and data. It is an important document and NMFS and its collaborators are to be commended for presenting the Report. The Report clearly highlights that the main impediment to determining more precisely the impact of the pelagic longline fishery on sea turtles is the lack of data about the turtles, the fishery and relative ‘importance’ of sea turtle long-line mortality, and the effectiveness of mitigation measures.

Areas of uncertainty include,

Sea-turtles:

- Identification of stocks/management units using both demographics and genetics (Awise 1995). From the genetics the quantification of amount of male dominated gene flow (nDNA research).
- The lack of demographic data (eg. size- and age-specific growth and mortality rates, stock or management unit abundance estimates for both breeding and foraging areas) about sea turtles for both species but especially the leatherback.
- The response of sea-turtle stocks to food availability, changes in habitat (eg beach erosion) and changes in fishing gear or fishing strategy strategy.
- Sea turtle dispersal, recruitment and spatial population structure.
- The identification of the different sources of sea-turtle mortality, and their relative and cumulative impacts on sea turtle stocks.
- The relationship between trends in adult nesting females (measured at the nesting beach) and the overall population.
- Improved modelling tools to assess competing mortality risks and evaluate management strategies.

Fishery:

- Verification and improvement of the Pelagic Logbook Program (turtle catch recording component) and the NMFS Observer program to be able to detect trends.
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- Improved understanding of the longline sea-turtle catch and mortality of foreign fleets,
- Improved understanding of the impact of other fisheries and associated mitigation measures (especially trawling) on sea turtles.
- Improved understanding of post-capture mortality and the effects of potential mitigation measures.
- Improved understanding of the fishing effort and how it changes inter-annually in relation to the distribution of sea turtles.

Mitigation

- Identification and evaluation of mitigation measures (eg alternative hooks, spatial closures to reduce mortality).

However the report does not systematically and formally prioritise the data needs required to provide the greatest reduction in uncertainty. In reading the documents I got the impression the process for achieving a more precise understanding of the impact of the pelagic longline fishery (PLF) on sea turtles was reasonably well-resourced and producing significant scientific outputs. However the outputs of the different studies and monitoring activities could be better integrated to achieve the required outcome ie sea turtle recovery. This is possibly not true but a formal priority-setting process to identify the research/data required to reduce key areas of uncertainty would be of value.

a) General comments

Overall the report could be improved by:

- greater cross-referencing between the three parts and the appendices, and by having a consistency of style and layout across the three parts. As presented it is a compilation of reports of variable quality/detail (see below), different styles and is somewhat repetitious;
- standardising the reporting of the catch of turtles and where possible, and appropriate, include catch rate eg #/1000 hooks so data and results can be easily compared;
- standardising terminology across the three parts and the appendices eg stocks, management units, etc.
- Part 3 Chapter 3 – the last paragraph (p41) seems inconsistent with the rest of the Chapter;
- Part 3 Chapter 4 – the data presented in Tables 1 and 2 seem to be inconsistent with the text (see Entanglement section p54-55);
- Part 3 It may be useful to combine Chapters 2 and 5; and,
- many figures need more explanation in the legends and text eg Part 3 Chapter 5, Figures 1 and 2.

b) Part I. Stock assessment of Loggerhead Sea turtles of the Western Atlantic

The report provides an update of the status and condition of the loggerhead sea turtle stocks of the Western North Pacific. It highlights the need:

- to decrease mortality on juvenile stages;
- to improved identification of stocks/management units using both demographics and genetics, and from a genetics perspective the need to quantify the of amount of male dominated gene-gene-flow (nuclear DNA research); and,
- for sex-specific information on vital rates of sea turtles.

The status and trends analyses are comprehensive and the use of meta-analysis to summarise multiple, independent studies to detect general relationships and allow the analysis of overall trends in nesting beach numbers was effective. However the report (Appendix 1) could explain more fully the advantages and disadvantages of applying this approach generally and specifically to sea turtle studies (see Osenberg and St. Mary 1998 and Osenberg et al 1999). The lack of statistical power of the sea turtle monitoring programs and bycatch monitoring programs to detect trends eg SEAMAP monitoring

program (-0.24/year after 11 years) indicates the need to review and possibly redesign the programs taking into account such things as geographic and fisheries coverage, sampling stratification, allocation of sampling effort and current estimates of the turtle bycatch from different regions of the fishery. Furthermore, the monitoring programs should be designed to be able to be adaptively improved over time. If there were to be a review of observer programs some of the approaches being developed to measure sea-bird bycatch in longline fisheries would be worth investigating (eg Heinemann et al 1999).

The loggerhead stock assessment approach uses a deterministic modelling approach that assumes among other things that demographic rates are density independent, does not take into account the substantial temporal variability in demographic processes eg growth and breeding behaviour, and possibly lacks adequate model validation. The approach was to build on and update (eg vital rates) age-based models of Heppell et al. (in press). There is some debate in literature about the value of these models for diagnosing population changes/declines especially where there are several mortality risks (Chaloupka and Musick 1999; Chaloupka in press). Alternatives include stochastic simulation modelling that with appropriate demographic data and adequate model validation can be used to assess competing mortality risks (see Chaloupka in press). It would be appropriate for the review to address the validity of the deterministic modelling approach and assess whether there are better alternatives.

c) Part II. Stock assessment of Leatherback Sea turtles of the Western North Atlantic

This section is a comprehensive review of what is known about leatherback sea turtles in the Western North Atlantic and highlights that the main impediment to determining more precisely the impact of the pelagic longline fishery on leatherback is the lack of data about the turtles, interactions with the fishery, and the relative 'importance' of long-line mortality. The report identifies the data needs required to proceed with a quantitative stock assessment (see page 10) much of which could be achieved with long-term mark recapture programs. There is also a need for improved stock/management unit definition and given the lack of useful trend data (see page 11) the development of monitoring programs with the appropriate statistical power to measure specified changes in leatherback stocks/management units. The trend data presented in Table 2 p27 is too variable to indicate any within region trends despite the suggestions to the contrary in the text (p11).

d) Part III – Assessment of the Impact of the Pelagic Longline Fishery on Loggerhead and Leatherback Sea Turtles of the North Atlantic

The Western North Atlantic is a complex fishery with 24 nations involved. The US fishery effort (hooks) is relatively low but its relative efficiency is high. The evaluation of spatial closures needs more attention since the analysis of the sea-turtle bycatch by the US Atlantic Pelagic fleet highlights the importance of time-area factors in explaining bycatch rates. The methods used to analyse the observer data to estimate bycatch were rigorous but again highlighted the need for improved sample design to be able to detect trends especially in high bycatch areas.

The available data on loggerhead turtles makes it difficult to quantify impact of the Western North Atlantic longline fishery but the estimated mortality of the US fishery (147-1220/yr) and the likely mortality of the other fleets would indicate that a reduction in fishing mortality is warranted. Based on the data and analyses presented the goal should be to maximise the survivorship of all juvenile life history stages. However the report does not clearly present and evaluate management strategies to do this. For example what would be the effect of reduced mortalities by using alternative hooks or different spatial closures or a combination of both. The conclusion for leatherbacks is similar but less specific because of the lack of data. However the particular concerns about the declines in nesting in French Guiana, highlight the need for the data and modelling tools to assess competing mortality risks (eg longline, trawling and egg harvest) and evaluate management strategies (Chaloupka in press).

The evaluation of mitigation measures presents a good review of the current research into the impact of different hook styles on sea turtle bycatch survivorship and an analysis of the times and areas of high sea turtle/US longline fishery interactions. However the lack of research into alternative gear, fishing strategies and the potential effectiveness of management actions is a significant gap. The hook research is encouraging and should be continued but the analysis of times and areas of high interactions come to no conclusions or recommendations. This again highlights the need to assess competing mortality risks, to quantitatively investigate management scenarios, and to estimate the conservation and fishery consequences of alternative management actions. Simulation of management scenarios applied to a 'model' of the real world can be a very powerful step in the development of management strategies.

4. Conclusion and Recommendations

The analysis, results and conclusions in the report represents the best scientific information on which to proceed with fishery management. The level of loggerhead and leatherback longline bycatch mortality should be reduced to acceptable levels but the report provide little guidance on the conservation and fishery consequences of alternative management actions to achieve the required reduction in mortality.

There is a need to systematically and formally prioritise the data needs required to provide the greatest reduction in uncertainty about the status of sea turtle populations, assess competing mortality risks and to evaluate alternative management actions. The stock assessment models seem to be an appropriate tool to do this at least for loggerheads. If improved understanding of stocks/management units and the reduction in mortality in juvenile stages will have the greatest impact on maintaining or increasing current population growth rates, what are the priority data needs to achieve this from a sea turtle, fishery and mitigation measure perspective?

For the leatherback turtle the data needs are even more acute compared to loggerheads. The priorities would seem to be improved understanding of stocks/management units, quantifying the sources of mortality causing the declines in the French Guiana and

Suriname beaches, and for the US fleet improved understanding of what stocks/management units it is impacting.

Specific recommendations would include.

- Improved data about the turtles, the fishery and relative ‘importance’ of sea turtle long-line mortality, and the effectiveness of mitigation measure to reduce key uncertainties (see Section 3 a for details).
- Review the sea turtle monitoring programs and bycatch monitoring programs and possibly redesign them to be able to detect trends and be able to be adaptively improved over time.
- Loggerhead population modelling – investigate alternative modelling approaches that can be used to assess competing mortality risks and the validity of the deterministic modelling approach.
- Leatherbacks – As well as the data needs identified in the report there is also a need for improved stock/management unit definition and for the development of monitoring programs to detect trends in the populations.
- Evaluate the effectiveness of potential management actions including the adoption of improved gear, fishing strategy and spatial closures.

5. References

- a) Avise, J.C. (1995) Mitochondrial DNA polymorphism and the a connection between genetics and demography of relevance to conservation. *Conservation Biology* 9:686-690.
- b) Chaloupka, M.Y. (in press) Simulation modelling of loggerhead sea turtle population viability exposed to competing mortality risks in the southwestern Pacific region. In Bolten, A and Witherington, B (eds) *Synopsis of the Biology and Conservation of Loggerhead Sea Turtles*. Smithsonian Institution Press, Washington.
- c) Chaloupka, M.Y. and Musick, J.A. (1999) Age, growth, and population dynamics. Chapter 9 in Lutz, P.L. and Musick, J.A. (eds) *The Biology of Sea Turtles*, CRC Marine Sciences Series, p233-276.
- d) Heinemann, D., Farley, J., Clear, N., Gunn, J., Klaer, N. and Whitelaw, W. (1999). Pilot seabird bycatch observer program for Australian domestic longline fisheries: design, guidelines, options and recommendations. Report to Environment Australia and the Australian Fisheries Management Authority. 120p.
- e) Heppell, S.S., Crowder, L.B., Crouse, D.T., Epperly, S.P. and Fraxer, N.B. (in press). Population models for Atlantic loggerheads: past, present and future. In Bolten, A and Witherington, B (eds) *Synopsis of the Biology and Conservation of Loggerhead Sea Turtles*. Smithsonian Institution Press, Washington.

- f) IUCN/SSC Marine Turtle Specialist Group. (1995) *A Global Strategy for the Conservation of Marine Turtles*. International Union for Conservation of Nature and Natural Resources Species Survival Commission.
- g) National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center. (2001). Stock assessments of loggerhead and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the Western North Atlantic. US Department of Commerce, National Marine Fisheries Service, Miami Fla., SEFSC Contribution PRD-00/01-08, 328 pages
- h) Osenberg, C.W. and St. Mary, C.M. (1998). Meta-analysis synthesis or statistical subjugation? *Integrative Biology: Issues, News and Views*, 1:43-48.
- i) Osenberg, C.W., Sarnelle, O., Cooper, S.D. and Holt, R.D. (1999). Resolving ecological questions through meta-analysis: goals, metrics and models. *Ecology* 80: 1105-1117.
- j) Williams, P., Anninos, P.J., Plotkin, P.T. and Salvini, K. 1996. Pelagic longline fishery – sea turtle interactions. Proceedings of an industry, academic and government experts and stakeholders workshop held in Silver Spring, Maryland, 24-25 May 1994. *NOAA Technical Memorandum NMFS-OPR-7*. US Department of Commerce, National Oceanic and Atmospheric Administration and National Marine Fisheries Service.

Appendix 1 – Bibliography of materials provided by the Center for Independent Experts

National Marine Fisheries Service (NMFS) Southeast Fisheries Science Center. (2001). Stock assessments of loggerhead and leatherback sea turtles and an assessment of the impact of the pelagic longline fishery on the loggerhead and leatherback sea turtles of the Western North Atlantic. US Department of Commerce, National Marine Fisheries Service, Miami Fla., SEFSC Contribution PRD-00/01-08, 328 pages

Appendix 2 – Statement of Work

Consulting Agreement Between the University of Miami and Reviewer

March 2001

General

Whether the interaction between the highly migratory species (HMS) longline fishery and sea turtles is impacting sea turtle populations, relative to achieving recovery, has not been determined. To this end, the analyses evaluating the status of sea turtle stocks in the Western North Atlantic Ocean and estimates of mortality from the HMS longline fishery need to be reviewed independently.

Separate status reports for the loggerhead and leatherback sea turtles will be developed based on current information on stock structure. Estimates of catch and mortality for these sea turtle stocks will be developed and included in the status reports. The impact of these mortality estimates will be evaluated and, if found to be affecting recovery trajectories and impeding recovery, reductions to these mortality estimates will be evaluated. Reductions in mortality will be developed as needed to insure recovery. Recovery will be based on the existing criteria included in the current Recovery Plans for these stocks.

This effort, as described above, will result in the development of mitigation plans by the SER and the effects of this plan on sea turtle recovery will be evaluated through a Biological Opinion. As the mitigation plan and Biological Opinion may recommend changes to the fishery, the consultant shall review the analyses on these two efforts to determine whether they represent the best available science/information.

The consultant shall analyze the review of stock assessments for loggerhead and leatherback sea turtles, focusing on the following:

1. Assumptions in defining stock structure based on genetic information;
2. Application of serious injury criteria;
3. Estimation procedures for catch and mortality in the longline fishery;
4. Conclusions on stock status and impacts of fishery relative to stock recovery.

The consultant shall conclude, in a written report, whether the analyses represent the best available information on which to proceed with fishery management.

Specific

The consultant's duties shall not exceed a maximum total of two weeks- several days for document review and several days to produce a written report of the findings. The consultant may perform all review, analysis, and writing duties out of the consultant's primary location, as no travel is required. Finally, no consensus report shall be required.

The itemized tasks of the consultant include:

1. Reading and analyzing following documents provided to the consultant:
 - a. Serious injury criteria with decision documentation (F/PR)
 - b. Report on catch and mortality of sea turtles in U.S. Atlantic longline fishery by area, year, and season (F/SEC)
 - c. Status of N. Atlantic loggerhead turtle and impact of fishery (F/SEC)
 - d. Status of Atlantic leatherback turtle and impact of fishery (F/SEC)
 - e. Workshop report on gear modifications for longline fishery to minimize impacts of turtle interactions (F/BSF)
2. No later than February 28, 2001, submitting a written report of findings, analysis, and conclusions. The report should be addressed to the "UM Independent System for Peer Reviews," and sent to Dr. David Die, UM/RSMAS, 4600 Rickenbacker Causeway, Miami, FL 33149 (or via email to ddie@rsmas.miami.edu).

Signed _____
Date _____

ANNEX I: REPORT GENERATION AND PROCEDURAL ITEMS

1. The report should be prefaced with an executive summary of findings and/or recommendations.
2. The main body of the report should consist of a background, description of review activities, summary of findings, and conclusions/recommendations.
3. The report should also include as separate appendices the bibliography of materials provided by the Center for Independent Experts and the center and a copy of the statement of work.

4. All material provided to the reviewer must be added to the bibliography that can be returned as an appendix to the final report.

Please refer to the following website for additional information on report generation:

http://www.rsmas.miami.edu/groups/cimas/Report_Standard_Format.html