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Proceedings of the Zonal Science Advisory Process on Using Satellite Tracking Data to Define Important Habitat for Leatherback Sea Turtle (*Dermochelys coriacea*)

29 February – 1 March 2012
Dartmouth, Nova Scotia

Chairperson: Kent Smedbol
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Foreword

The purpose of these Proceedings is to document the activities and key discussions of the meeting. The Proceedings may include research recommendations, uncertainties, and the rationale for decisions made during the meeting. Proceedings may also document when data, analyses or interpretations were reviewed and rejected on scientific grounds, including the reason(s) for rejection. As such, interpretations and opinions presented in this report individually may be factually incorrect or misleading, but are included to record as faithfully as possible what was considered at the meeting. No statements are to be taken as reflecting the conclusions of the meeting unless they are clearly identified as such. Moreover, further review may result in a change of conclusions where additional information was identified as relevant to the topics being considered, but not available in the timeframe of the meeting. In the rare case when there are formal dissenting views, these are also archived as Annexes to the Proceedings.

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SUMMARY

Leatherback Sea Turtle (*Dermochelys coriacea*) was designated as Endangered by the Committee on the Status of Endangered Wildlife in Canada (COSEWIC) in April 1981 and reassessed as Endangered in May 2001. A Recovery Strategy for the Leatherback Sea Turtle in Atlantic Canada was published in February 2007. Critical habitat was not identified at that time, but a schedule of studies to identify critical habitat was provided. A Zonal meeting was held on 29 February – 1 March 2012 at the Bedford Institute of Oceanography, Dartmouth, NS, to review satellite telemetry data of tagged Leatherback Sea Turtles and determine if these data could be used to infer the location of important habitat for Leatherback Sea Turtle in Atlantic Canadian waters. The advice derived from this meeting could be used to inform identification of critical habitat in a *Species at Risk Act* (SARA)-compliant Action Plan for Leatherback Sea Turtle.

Compte rendu du processus zonal d'avis scientifique sur l'utilisation des données de repérage par satellite pour délimiter l'habitat important de la tortue luth (*Dermochelys coriacea*)

SOMMAIRE

La tortue luth (*Dermochelys coriacea*) a été désignée comme espèce en voie de disparition par le Comité sur la situation des espèces en péril au Canada (COSEPAC) en avril 1981 et réévaluée comme telle en mai 2001. Un programme de rétablissement concernant la tortue luth dans les eaux canadiennes de l'Atlantique a été publié en février 2007. L'habitat essentiel n'a pas été désigné à ce moment-là, mais le calendrier des études qui seront entreprises pour délimiter l'habitat essentiel a été fourni. Une réunion zonale a eu lieu le 29 février et le 1er mars 2012 à l'Institut océanographique de Bedford, à Dartmouth, en Nouvelle-Écosse, afin d'examiner les données de suivi télémétrique par satellite sur la tortue luth et de déterminer si ces données pourraient être utilisées pour déduire l'emplacement de l'habitat important de la tortue luth dans les eaux du Canada atlantique. Les conseils découlant de cette réunion pourraient être utilisés pour guider la détermination de l'habitat essentiel dans un plan d'action pour la tortue luth conforme à la *Loi sur les espèces en péril*.

INTRODUCTION

The meeting was chaired by Dr. Kent Smedbol (DFO Science/Habitat Management, Bedford Institute of Oceanography). The Chair welcomed participants to the meeting on 29 February 2012. Representatives from a number of organizations were in attendance including DFO, the US National Marine Fisheries Services, academic researchers, the fishing industry and other stakeholders. The Chair noted that this was a science peer-review and advisory meeting, which meant that the primary goal of the meeting was to review the information presented, determine if it was suitable for use in provision of science advice, and, if so, then advise DFO on likely areas of important habitat for Leatherback Sea Turtle in Atlantic Canadian waters. The information generated in this advisory process will be used by the Maritimes Species at Risk Office in the 5 year review of the Leatherback Sea Turtle Recovery Strategy, in the development of the Action Plan, and in the proposal of critical habitat for designation by the Minister of Fisheries and Oceans. The meeting Agenda, Terms of Reference and List of Participants can be found in Appendices 1-3.

These Proceedings are meant to serve as a consensus summary of the meeting's principle discussions and conclusions and is not intended to be a chronological transcript. This Proceedings document complements the Science Advisory Report (SAR) and is not intended to be used in isolation. The SAR captures the conclusions of the meeting; the Proceedings document expands somewhat on how those conclusions were reached and the major discussion points.

During the Chair's welcome and introduction, he was asked to clarify the difference between "important habitat", of which identification was one of the terms of reference, and "critical habitat" in relation to the *Species at Risk Act* (SARA). Critical habitat is a legal requirement of SARA, and its identification for threatened or endangered species is obligatory if available information is sufficient for identification. Critical habitat is defined in SARA as "...the habitat that is necessary for the survival or recovery of a listed wildlife species and that is identified as the species' critical habitat in a recovery strategy or in an action plan for the species". Critical habitat is identified based on its functional capacity to support one or more life processes. Therefore, the identification of Critical Habitat is based on the features within a defined geographic area/location of the ecosystem that support a function necessary for the species survival or recovery. Important habitat does not have a specific definition, but it can be thought of as science-based advice for the identification of a species' critical habitat under SARA.

Introduction is not mandatory, but when available, it begins on page 1 and may include instructions given to meeting participants, initial discussions regarding the goal of the meeting (referring to the Terms of Reference) and the agenda, and reference to key meeting material.

USING SATELLITE TRACKING DATA TO DEFINE IMPORTANT HABITAT FOR LEATHERBACK SEA TURTLES IN ATLANTIC CANADIAN WATERS

Working Paper: James, M.C. and Jonsen, I.D. 2012. Using Satellite Tracking Data to Define Important Habitat for Leatherback Sea Turtles in Atlantic Canada. CSA Working Paper 2012/28.

Presenter: M. James
Rapporteurs: C. Whelan, J. Porter, and T. Worcester

PRESENTATION SUMMARY (PREPARED BY CHAIR)

This paper addresses six terms of reference for the meeting. Satellite telemetry data from 70 leatherbacks tracked in Atlantic Canadian waters were presented and used to recommend important habitat for the species. A state-space model was used to estimate the most probable locations for each turtle at regular time intervals, and to infer the behavioural state (resident or transient) in which the turtles were engaged in at each estimated location. The relative probability of residency (i.e., being in the resident behavioural state) associated with each turtle location was mapped to visualize the spatial distribution of the relative probability of residency for the Leatherback Sea Turtles tracked in Atlantic Canadian waters. The movements of satellite tagged turtles were widely distributed throughout Canadian waters, with turtles occurring in habitat across most of the Exclusive Economic Zone (EEZ) up to six months of the year (spring-autumn). Turtle movements in most of the EEZ were consistent with transiting (fast, directed movements, which are indicative of transit between foraging sites or migration) behaviour, with residency behaviour (slow, tortuous movements, which are often indicative of intensive searching and foraging activity) principally restricted to four general areas. These four areas were proposed as important habitat, wherein the relative probability of residency ≥ 0.5. These areas corresponded to waters east and southeast of Georges Bank, including the Northeast Channel near the southwestern boundary of the 200 mile limit, waters off eastern Cape Breton Island, including Sydney Bight and the Cabot Strait, waters south and east of the Burin Peninsula, Newfoundland, including parts of Placentia Bay, and the southern Gulf of St. Lawrence, including portions of the Magdalen Shallows and adjacent portions of the Laurentian Channel. Seasonal maps of relative probability of residency indicated peak occupancy of the proposed habitat areas in August and September.

DISCUSSION

Reviewers stated that the quality and quantity of data tabled during the review meeting were among the best for all populations in the world for Leatherback Sea Turtles.

One line of questioning concerned potential effects of tagging on ensuing movement patterns of tagged turtles. The researchers had reported “capture effects” from turtles that had been tagged using a harness attachment. This is one reason why the first seven days of data post-capture are omitted from analyses. In recent years the tags have been attached directly to the shell, which minimizes potential short-term behavioural effects associated with tagging. Research has demonstrated that when the objectives of satellite tagging include the study of subsequent habitat use in Canadian waters, it is unwise to tag leatherback sea turtles near the end of the typical foraging period; turtles tagged with harnesses late in the year may initiate southward migration from foraging areas sooner than those turtles tagged earlier in the foraging period.

The first deployment of a satellite tag on a live-captured leatherback occurred in 1999, with additional deployments occurring until the present. At-sea tagging includes both sexes and all size classes that are known to use temperate waters. Tags were applied as early in the season as possible. As a result, in some years all tags may have been deployed opportunistically off

mainland Nova Scotia and, thus, there may be no satellite tagging later in the season off Cape Breton Island. This occurred in 2001 and 2003, and the resultant residency patterns were different from other years – these turtles were all equipped with harnesses early in the season and subsequently foraged mainly in the vicinity of Georges Bank, rather than further north. Nevertheless, based on data from all years, there does not appear to be a general artifact in residency derived from the tagging location. For instance, turtles tagged off southwest Nova Scotia do not exhibit evidence of local residency behaviour whether data from the first seven days post-tagging are included or excluded from analysis. Some tagged animals were tracked for over 12 months, which included a full migratory cycle.

The potential that observed behaviour patterns might be more variable as additional tagging areas were included was discussed. The presenters acknowledged this possibility; for instance, future tagging of Leatherback Sea Turtles in Placentia Bay, NF, might indicate a higher degree of residency in that area than based on the currently available data. Other areas of interest for tagging include the southwest portion of the EEZ, which the researchers identified as gap in tagging coverage, as well as tracking information that begins before the turtles enter Canadian waters.

Much discussion centered on the selection of probability 0.5 as the threshold for identifying cells as important habitat. This value was chosen arbitrarily by the science team overseeing the analysis, but was selected following in-depth discussion. It was noted that changing the threshold would not alter the general location of areas of higher turtle-days, but it would alter the size of the areas denoted as “important”. It was agreed that 0.4 would be used for the final analysis.

Participants asked how uncertainty in accuracy of location returns might impact the results. Explicit treatment of uncertainty was the main reason for using a state spaced modeling approach. Satellite telemetry tends to be more precise than location data gathered using photoperiod geo-referencing technologies. The model does account for uncertainty in measurements and carries this uncertainty through into the behavioural state estimates. Poor position estimates are down-weighted in the analysis.

Working Paper: Mosnier, A., Gosselin, J-F., Lawson, J.W., and Lesage, V. 2012. Complementary Sources of Information on Leatherback Sea Turtle Habitat use in Canadian Waters. CSA Working Paper 2012/27.

Presenter: Arnaud Mosnier
Rapporteurs: C. Whelan, J. Porter, and T. Worcester

PRESENTATION ABSTRACT

An overview of the results obtained on Leatherback Sea Turtle habitat use through the analysis of two different databases was presented. In spite of spatial biases and lack of systematic measure of effort in a large portion of the data, opportunistic sightings collected by DFO Newfoundland and Labrador from 1946 to 2011 show a seasonal change in number of leatherback sightings consistent with other sources of information such as satellite telemetry data. Leatherback Sea Turtle observations occurred in Newfoundland waters from June to November with a peak of occurrence in August, and highlight the importance of the region around the Burin peninsula. Leatherback Sea Turtle spatial densities were also obtained from a systematic line-transect aerial survey of the Labrador, Newfoundland, Scotian Shelf and Gulf of St Lawrence waters conducted in July-August 2007. This survey was part of the Trans North Atlantic Sighting Survey (TNASS) and targeted all marine megafauna, including sea turtles. In total, 60 leatherbacks were observed along transects. A simple density analysis highlighted Placentia Bay (in the Burin peninsula area) as a region of high leatherback density,

corroborating the results from satellite telemetry data as important habitat for leatherbacks. A Generalized Additive Model, using TNASS data and four environmental variables (bathymetry, bottom slope, chlorophyll A concentration, sea surface temperature), was used to evaluate the seasonal change in potential Leatherback Sea Turtle habitat in the Canadian waters. This analysis assumed that relationships between environmental variables and turtle distribution for August 2007 also prevailed at other times of the year. The model predictions fit well with the temporal distribution, and to some extent, the spatial distribution of the Leatherback Sea Turtles. Several regions recognized as important by the satellite telemetry data were also predicted as important for turtles by the model.

DISCUSSION

The analysis is based on both opportunistic observations and an effort-weighted aerial survey. The results show overlap of high density areas in Placentia Bay from sightings data with high residency in the same area as estimated from the satellite telemetry data. The consensus interpretation was that this modeling work highlights similar patterns to those derived from the satellite telemetry work.

RECOMMENDATIONS

It was agreed that the telemetry data presented are considered suitable (as best currently available data) for provision of science advice concerning likely locations(s) of important habitat for Leatherback Sea Turtles in Atlantic Canada. As a caveat, it is important to note that these data serve as a proxy for direct sampling of important habitat, under the explicit assumption that the relative probability of leatherbacks exhibiting residency behaviour is indicative of successful foraging and feeding, and, thus, is positively correlated with the quality of foraging habitat.

It was recommended that the seasonal residency figure in Working Paper 2012/28 be standardized so that density panels are directly comparable. It was further recommended that some text be added to Working Paper 2012/28 concerning potential gaps in satellite telemetry data coverage in Grand Banks area.

As follow-up to the meeting, it was recommended that a literature review concerning potential location(s) of benthic polyp beds be undertaken. Note that polyp beds may not be coupled with distributions of foraging turtles, but are important when considering the importance of prey as a feature of critical habitat.

Although the Terms of Reference for the meeting specifically requested a review of areas of high use likely associated with intensive prey searching and foraging activity that could be considered important feeding habitat, locations of high transient behaviour may also be considered important habitat, and analyses to document these migratory pathways should be undertaken.

APPENDIX 1: TERMS OF REFERENCE

Using Satellite Tracking Data to Define Important Habitat for Leatherback Sea Turtle

Zonal Advisory Process – Maritimes, Gulf, Newfoundland and Labrador, Quebec
29 February – 1 March 2012
Dartmouth, NS

Chairperson: Kent Smedbol

Context

Leatherback Sea Turtle (*Dermochelys coriacea*) was designated as Endangered by COSEWIC in April 1981 and reassessed as Endangered in May 2001. A Recovery Strategy for the Leatherback Sea Turtle in Atlantic Canada was published in February 2007. Critical habitat was not identified at that time, but a schedule of studies to identify critical habitat was provided. The *Species at Risk Act* (SARA) requires that the competent minister report on the implementation of the Recovery Strategy and progress toward meeting its objectives within five years of when it is included in the public registry. This deadline for review is February 2012. An Action Plan for Leatherback Sea Turtles in Atlantic Canada is also being developed at this time, which would include a description of critical habitat if not included within the Recovery Strategy. Information that could be used to identify important habitat for Leatherback Sea Turtles in Atlantic Canadian waters was peer reviewed by the October 2010 National Marine Mammal Peer Review Committee (NMMPRC). Some additional information was requested. It is the intent of the current meeting to review the requested information.

The information generated in this advisory process will be used by the Maritimes Species at Risk Office in the 5 year review of the Leatherback Sea Turtle Recovery Strategy, in the development of the Action Plan, and in the proposal of critical habitat for designation by the Minister of Fisheries and Oceans.

Objective

The objective of this meeting is to review information available to assist in the identification of important habitat for Leatherback Sea Turtles in Atlantic Canada. Given that little is known about the biological, chemical, and physical features associated with important feeding habitat for Leatherback Sea Turtles, this RAP will review the data on the spatial distribution and behavioural patterns inferred from satellite tracking data to identify areas consistently used by Leatherback Sea Turtles in high densities year after year, i.e., inferring from the turtles' behaviour where the important habitat exists. Specifically, this meeting will:

- Briefly review the methodology of using satellite tracking data to define important habitat (reviewed previously at the 2010 NMMPRC meeting).
- Review areas of high use likely associated with intensive prey searching and foraging activity, that could be considered important feeding habitat.
- Identify seasonal habitat by month or season, and concatenate this information into a definition of important habitats.
- Review a table of tagging locations, duration and where turtles from different locations were tracked during their deployment.
- Provide clarity on where and when data was available spatially (i.e., a measure of effort).
- Provide details, where available, on habitat characteristics in the turtle high use areas (e.g., sea surface temperature, jellyfish densities, etc.).

If current information is incomplete, recommendations for research or analysis that is necessary in order to complete these Terms of Reference will be discussed.

In completing these objectives, it is expected that the recommendations provided by the National Marine Mammal Peer Review Committee during their October 2010 meeting will be addressed.

Expected Publications

- CSAS Science Advisory Report
- CSAS Research Document
- CSAS Proceedings

Participation

- DFO Science
- DFO Ecosystem Management
- DFO Fisheries Management
- Provincial government representatives
- Industry representatives
- Non-governmental organizations
- Aboriginal groups
- Academics
- International experts

References

Atlantic Leatherback Turtle Recovery Team, 2006. Recovery Strategy for Leatherback Turtle (*Dermochelys coriacea*) in Atlantic Canada. *Species at Risk Act* Recovery Strategy Series. Fisheries and Oceans Canada, Ottawa.

COSEWIC, 2001. COSEWIC Assessment and Update Status Report on the Leatherback Turtle *Dermochelys coriacea* in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa.

DFO, 2007. Documenting Habitat use of Species at Risk and Quantifying Habitat Quality. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2007/038.

DFO, 2011. Meeting of the National Marine Mammal Peer Review Committee; November 22-26, 2010. DFO Can. Sci. Advis. Sec. Proceed. Ser. 2011/003.

APPENDIX 2: AGENDA

Using Satellite Tracking Data to Define Important Habitat for Leatherback Sea Turtle

Zonal Peer Review – Maritimes, Gulf, Newfoundland and Labrador, Quebec

Lewis King Boardroom
BIO, Dartmouth, NS

29 February – 1 March 2012

Chairperson: Kent Smedbol

AGENDA

29 February 2012 – Wednesday

9:00 - 9:30	Introduction and Background (chair)
9:30 – 10:15	Using Satellite Tracking Data to Define Important Habitat for Leatherback Sea Turtles in Atlantic Canadian Waters
10:15 - 10:30	Break
10:30 - 12:00	Discussion
12:00 - 1:00	Lunch (not provided)
1:00 - 1:20	Progress to Date on 3D Modelling of Jellyfish Aggregations
1:20 - 3:00	Discussion (continued)
3:00 - 3:15	Break
3:45 - 4:15	Discussion (continued)
4:15 - 4:30	Day 1 Wrap Up

1 March 2012 – Thursday

9:00 – 9:15	Review of Day 1
9:15 –10:30	Review of SAR
10:30 –10:45	Break
10:45 –12:00	Review of SAR (continued)

APPENDIX 3: LIST OF PARTICIPANTS

Using Satellite Tracking Data to Define Important Habitat for Leatherback Sea Turtle

Zonal Advisory Process – Maritimes, Gulf, Newfoundland and Labrador, Quebec

Lewis King Boardroom
BIO, Dartmouth, NS

29 February – 1 March 2012

Chairperson: Kent Smedbol

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