Sea Turtle Stock Assessment: Loggerhead Case Study

NOAA FISHERIES

SEFSC

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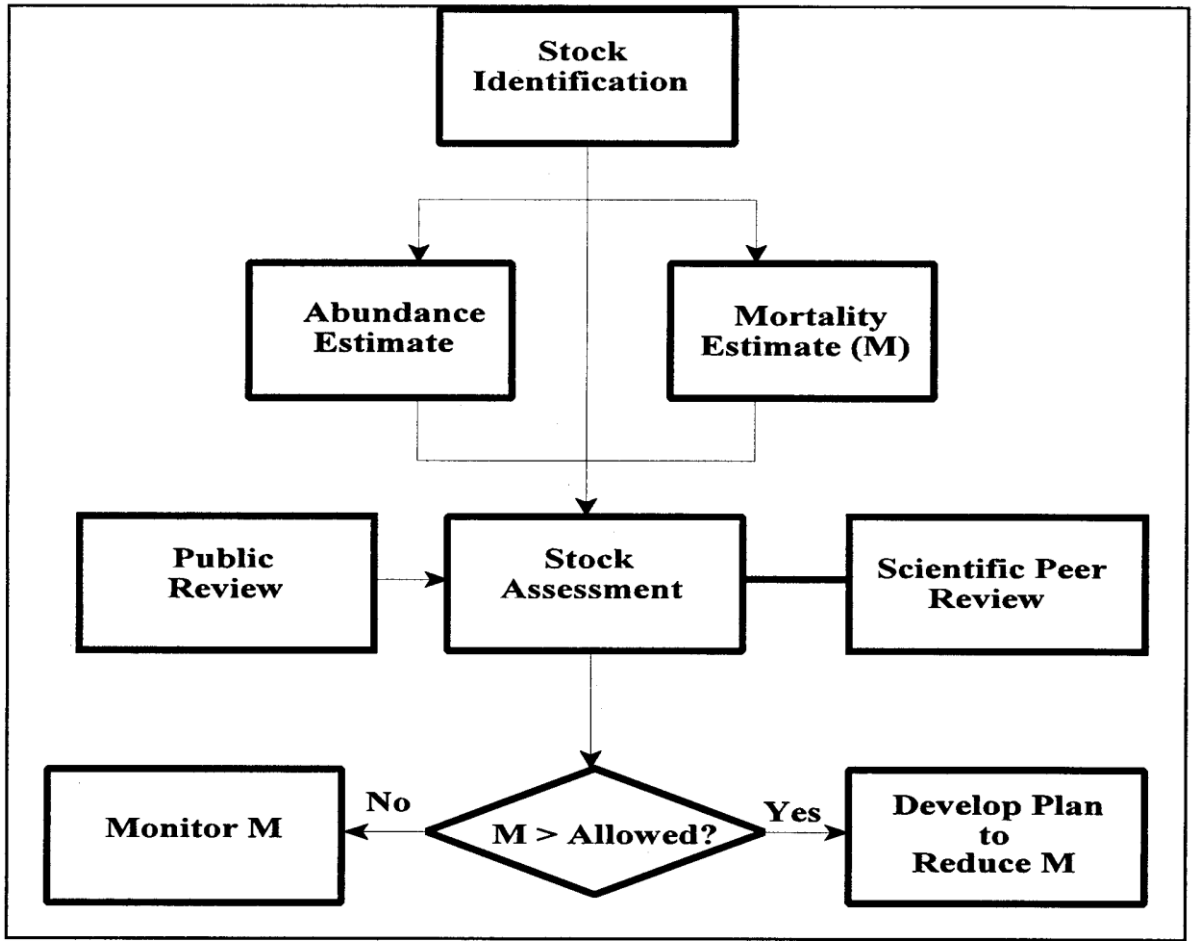
What is a Stock Assessment?

- "The most basic measure of protected species status is an estimate or index of the abundance at any given time" (SAIP 2004)
- No legislative mandate on how to assess status for turtles
  - ESA lacks provisions of MMPA about stock assessment
- All sea turtle species at Tier I
  - Basic but incomplete data on abundance and life history

SAIP Conceptual Model of Stock Assessment Process



NOAA Fisheries Office of Science and Technology Website

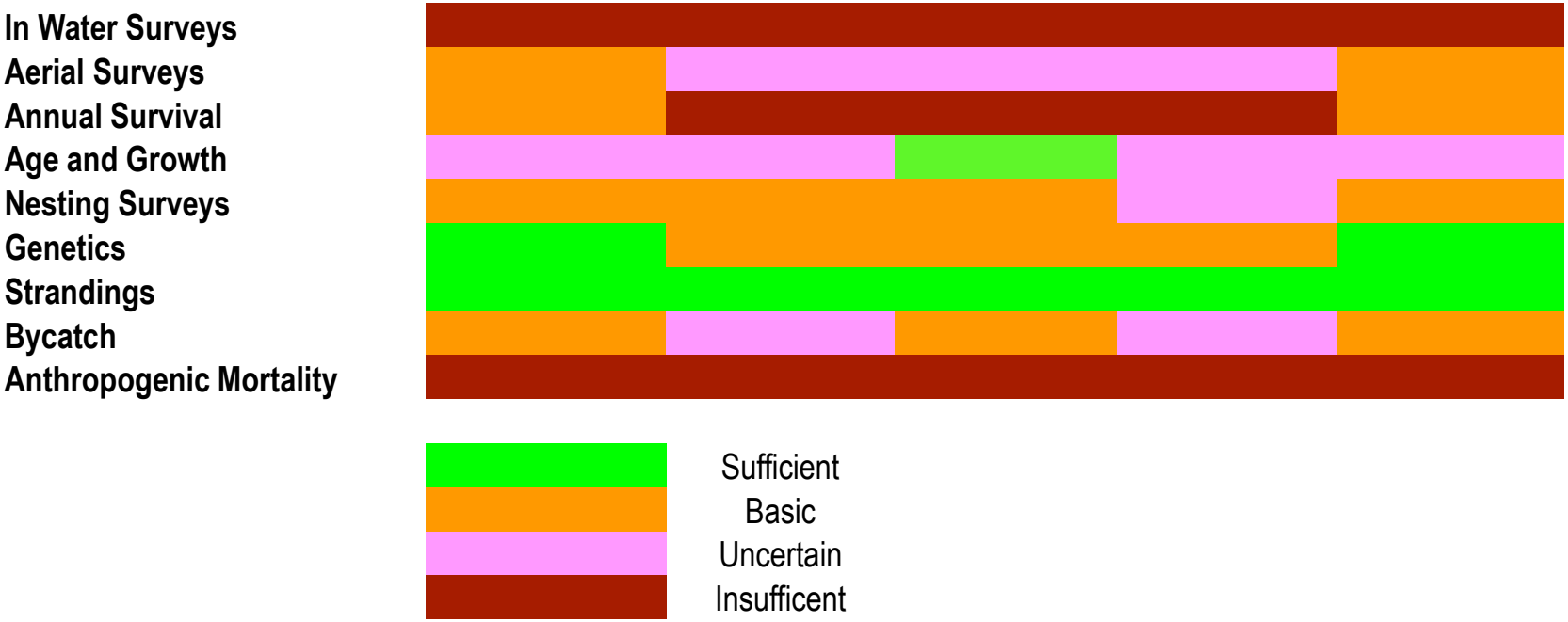
- NOAA Fisheries' stock assessments are key to marine resource management
  - What is the current status of a stock relative to established targets?
  - How much catch is sustainable while maintaining a healthy stock?
  - If a stock becomes depleted, what steps are required to rebuild it to healthy abundance levels?

Where does science play a role in the Endangered Species Act?

- Data driven population assessments to assess population trends and status
- Identifying data gaps
- Science Centers are in the unique position to perform these assessments with their role in NOAA Fisheries and expertise

The Data

	Loggerhead	Green	Kemp's ridley	Hawksbill	Leatherback
Current Status (Endangered or Threatened)	T	E (proposed T)	E	E	E
Tier Level	1	1	1	1	1
Most Recent Quantitative Assessment	2009				2007
Most Recent Status Review	2009	2015	2007	2013	2013



SEFSC Turtle Assessments

- Turtle Expert Working Group
- Quantitative assessments
- ESA recovery plans and status reviews

Turtle Expert Working Group

- 1995 Shrimp Biological Opinion required NMFS to "select a team of population biologists, sea turtle scientists, and life history specialists to compile and examine formation [*sic*] on the status of sea turtle species"
- Established by SEFSC 1995

Turtle Expert Working Group

- Members from NMFS, USFWS, State Agencies, Academia, NGOs and Industry
- Collaborative effort among data owners
- Assessments were a mix of qualitative “expert opinion” and quantitative approaches
- Peer reviewed by the Center for Independent Experts

Turtle Expert Working Group

- Management focused
  - Kemp's and Loggerheads (1998)
  - Update for Kemp's and Loggerheads (2000)
- Broad Stock Assessment
  - Leatherbacks (2007)
  - Loggerheads (2009)

1998 Turtle Expert Working Group: Kemp's and loggerhead assessments

- Identify maximum take by commercial fisheries without preventing recovery of the species
- Identify maximum take by fisheries without jeopardizing continued existence the species
- Identify number of stranded turtles by statistical zone indicating take levels beyond authorized

Leatherback TEWG (2007)

- Life History
- Stock Status
- Trends of nesting females
- Population Size
- In-water data
- Aerial Surveys
- Strandings
- Threats

2009 SEFSC GOMx Loggerhead Assessment

- Bottom Longline Reef Fish Fishery effect
  - Not addressed in 2009 TEWG
- What is the effect of management actions that would decrease annual anthropogenic mortality rates of benthic loggerhead sea turtles on expected benthic female population size and trajectory?
- Used NMFS SEFSC 2001 loggerhead model demographic model based for consistency

2009 Loggerhead Assessment

Objectives

- Estimate current female loggerhead population sizes for the western North Atlantic, and for Management Units of interest to the US
- Predict future population trajectories given management designed to reduce anthropogenic mortality of benthic loggerhead sea turtles
- Examine uncertainty in the model due to changes in some parameters

2009 Loggerhead Assessment

Loggerhead Life History:
Stages in Straight Carapace Length (SCL)

- pelagic/oceanic (birth to 63cm SCL)
- small juvenile (41cm to 82cm SCL)
- large juvenile (63cm to 100cm SCL)
- adult (>82cm SCL)

All **benthic** stages are vulnerable to GOM reef fish fishery bottom longlines

2009 Loggerhead Assessment

Updated parameters
(minimum, nominal, maximum)

- Mortality by stage
- Stage duration (years in a stage)
- Fecundity parameters
  - Eggs per nest
  - Nests per nesting female
  - Hatchling emergence success
  - Sex ratio (proportion female)
  - Remigration interval (years between nesting for an adult female)

Examined 5 management units (nesting assemblages)

- Peninsular Florida
- Northern US
- Dry Tortugas
- Northern Gulf of Mexico
- Greater Caribbean

2009 Loggerhead Assessment

Sensitivity analysis: What parameters have the biggest effect on population trajectory?

Parameters in order of relative importance from 10K runs of the stochastic model based on simple regression of each parameter on asymptotic population growth rate. Order determined by the magnitude of the adjusted R^2 of the significant regressions.

Adj R^2	Parameter
0.673	pelagic survival
0.107	pelagic stage duration
0.066	small benthic survival
0.042	emergence success
0.038	adult survival
0.020	large benthic survival
0.019	large benthic stage duration
0.017	nests per female
0.004	eggs per nest
0.003	proportion female
n.s.	small benthic stage duration
n.s.	mean remigration interval

This result suggests a rank order of research priorities to help reduce our uncertainty in loggerhead population trajectories.

For example: Pelagic survival explains 67% of the variation in population growth rate, and small benthic survival explains about 6.6%.

2009 Loggerhead Assessment

- The loggerhead benthic female population in the western North Atlantic is fairly large with a large range of uncertainty in total population size (30,000 to 300,000 or more).
- Predicting future populations of loggerhead sea turtles is very uncertain due in part to large uncertainty in our knowledge of loggerhead life history.
- Fine-scale questions such as impacts of individual fisheries cannot be resolved by the model given the high degree of uncertainty in model parameters.
- Any reductions in mortality will improve the long term outlook for loggerhead sea turtles, but even 100% reduction in anthropogenic benthic mortality may be insufficient to reverse a population decline if it exists.

Ranked SEFSC Sea Turtle Science Prioritization from SEFSC Sea Turtle Strategic Plan Development (2014)

Sea turtle program themes in terms of overall priority from 1 (highest) to lowest (7)	Leadership	Scientists and Tech staff	Managers
Investigate temporal and spatial trends in abundance and distribution	1	1	2
Inform stock assessments with stock identification and life history parameters	2	2	5
Assess anthropogenic and natural mortality	4	3	1
Develop approaches to reduce sea turtle by-catch	5	5	2
Understand sea turtle habitat requirements and ecosystem interactions	6	4	6
Improve program coordination, focus, and efficiency	3	6	2
Conduct public outreach & education to support conservation	7	7	7

Data Collection Efforts for Better Stock Assessments

- In-water index sites
  - NC
  - Florida
- Abundance
  - Cape Lookout Bight
  - AMAPPS
- Mortality
  - Loggerheads with Canada DFO
  - Leatherbacks in Gulf of Mexico
  - LA/MS Kemp's ridley research

Strengths

- TEWG process
  - Expertise in performing collaborative assessments
- Capability to perform quantitative assessments
- Collaborative research and assessment efforts with NEFSC
- New and focused data collection efforts
- Broad vision to assess populations and identify data needs to answer specific management questions

Challenges

- Numerous data owners
  - Willingness to share data
- TEWG
  - Previous membership selection not focused on quantitative skills needed
- Data and tools not comprehensive enough to answer specific management questions
- ESA lacks provisions of MMPA for stock assessment
- No assessments since 2009
  - Limited resources for collaborative working group assessments
  - Focus on short term/specific questions

Future Assessments

- Perform question driven assessments mandated by ESA
  - NEFSC and SEFSC have the expertise and vision to provide broad population assessments and alternative methods to answer specific management questions
- Prioritize our limited resources to focus on quantitative methods and data to support them
- Recognition that management questions need broad assessments to answer their specific questions

Future Assessments

- SEFSC and NEFSC collaborative working groups
  - Smaller and more quantitative
  - Member selected for skill set not data ownership
  - Explore different methods such as “Adaptive Harvest Management”, PVA, and collaborative working groups as used for fishery management
  - Tool Box with NEFSC