

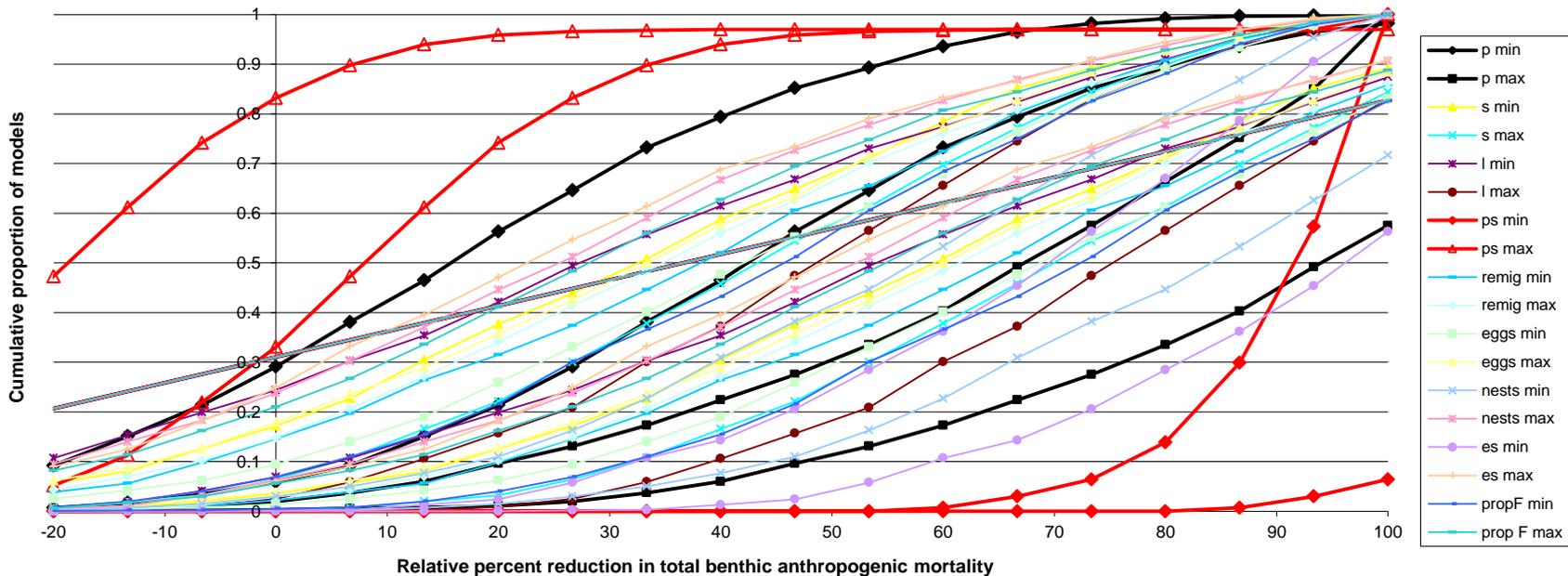


NOAA
FISHERIES

SEFSC

Research for Conservation:

Quantitative Stock Assessments for Sea Turtles



Review: Sea turtle Stock Assessment Projects

Currently:

SEFSC Historic Information collection and monitoring programs

- Fishery dependent (Observer program)
- Strandings

SAIP funded research projects (current)

- N. GOMx Mortality
- GOMx Leatherback habitat
- Turtle habitat Use Cape Lookout

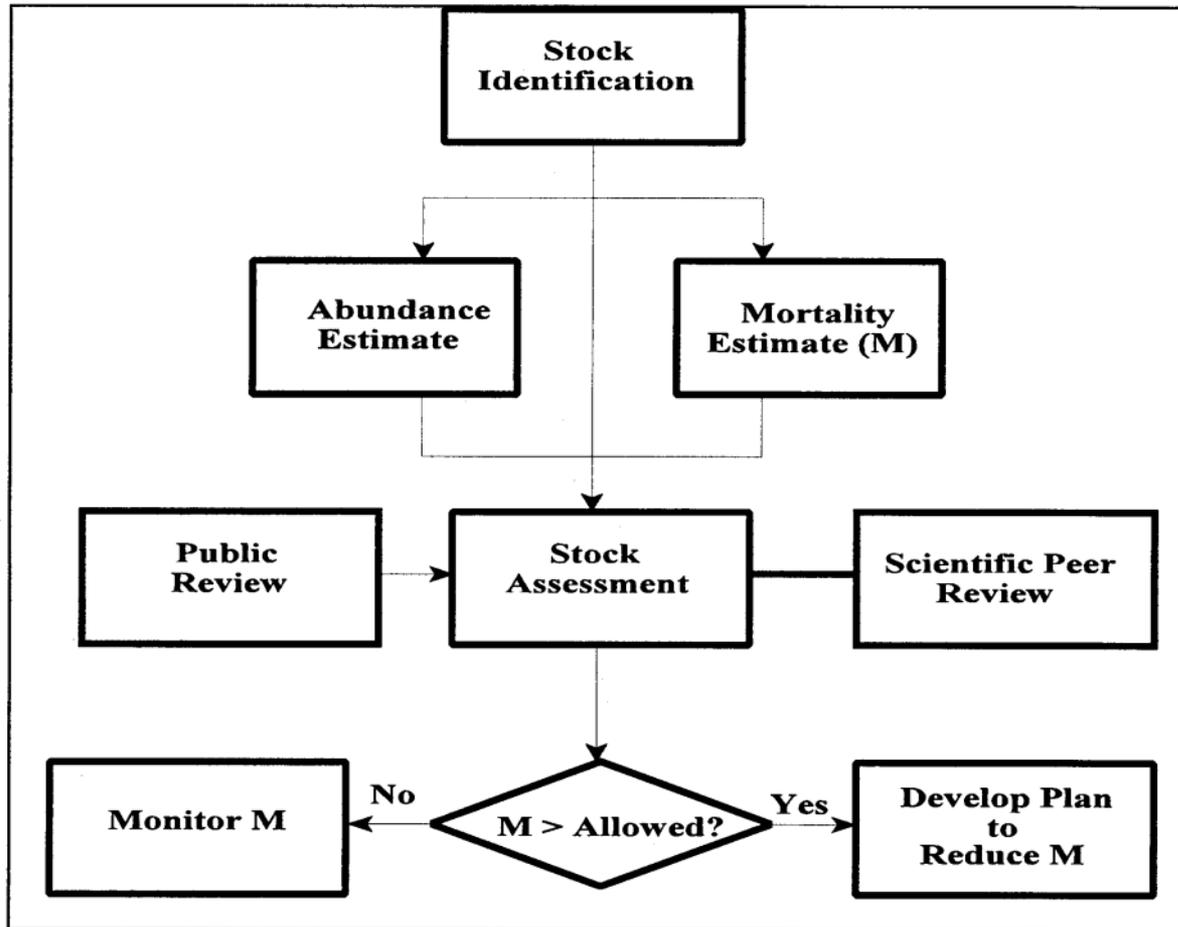
Other Projects

- AMAPPS – aerial and shipboard surveys
- In-water index sites
- **Quantitative assessment - toolbox project**

Future and long term vision:

- Protected species quantitative assessment framework

NMFS Protected Species Toolbox Initiative



NMFS 2004. Report of the NOAA Fisheries National Task Force for Improving Marine Mammal and Turtle Stock Assessments. NOAA Tech. Mem. NMFS-F/SPO-63, 112p.

Management Needs

“Bycatch estimates need to be combined with quantitative stock assessments to provide improved understanding of how listed species are adversely affected by estimated bycatch levels.”

- SERO Biological Opinion, Reef Fish Fishery 2011.

Mandates

Endangered Species Act (section 7) requires federal agencies to ensure that any authorized action is not likely to jeopardize the continued existence of listed species:

NMFS defines “jeopardize the continued existence of”:
“to engage in an action that reasonably would be expected, directly or indirectly, to reduce appreciably the likelihood of both the survival and recovery of a listed species.....”

- 50 CFR §402.02.

Toolbox project – National initiative

2013-2014: Six Projects

- SEFSC, NEFSC, SWFSC, PIFSC – 4 Sea Turtle Tools
- NWFSC – R-shiny server project
- AFSC – Tracking map tool

2015-2018: One National Initiative – 3 themes

- Coral Demographics
- Spatial Analysis
- Population Assessment

Sea turtle Toolbox Project 1: Spatial Tools (SEFSC lead)

The Problem

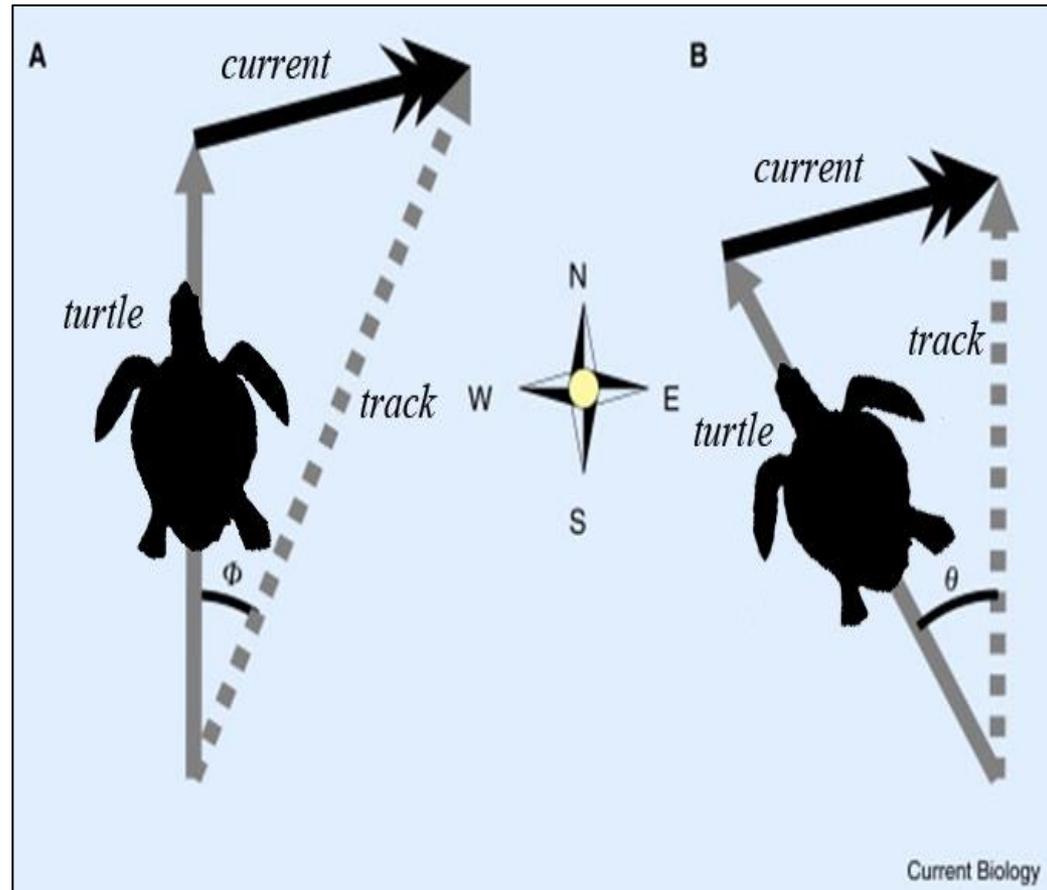
- Limited data on oceanic distribution and abundance
- Need spatiotemporal estimates for:
 - Critical Habitat
 - Hot spots for anthropogenic interactions

Proposed Solution

- Predict the distribution by a combination of:
 - physical ocean circulation processes (e.g., ocean currents)
 - biological processes (e.g., swimming behavior)
- Link these spatiotemporally predictions to demographic estimates

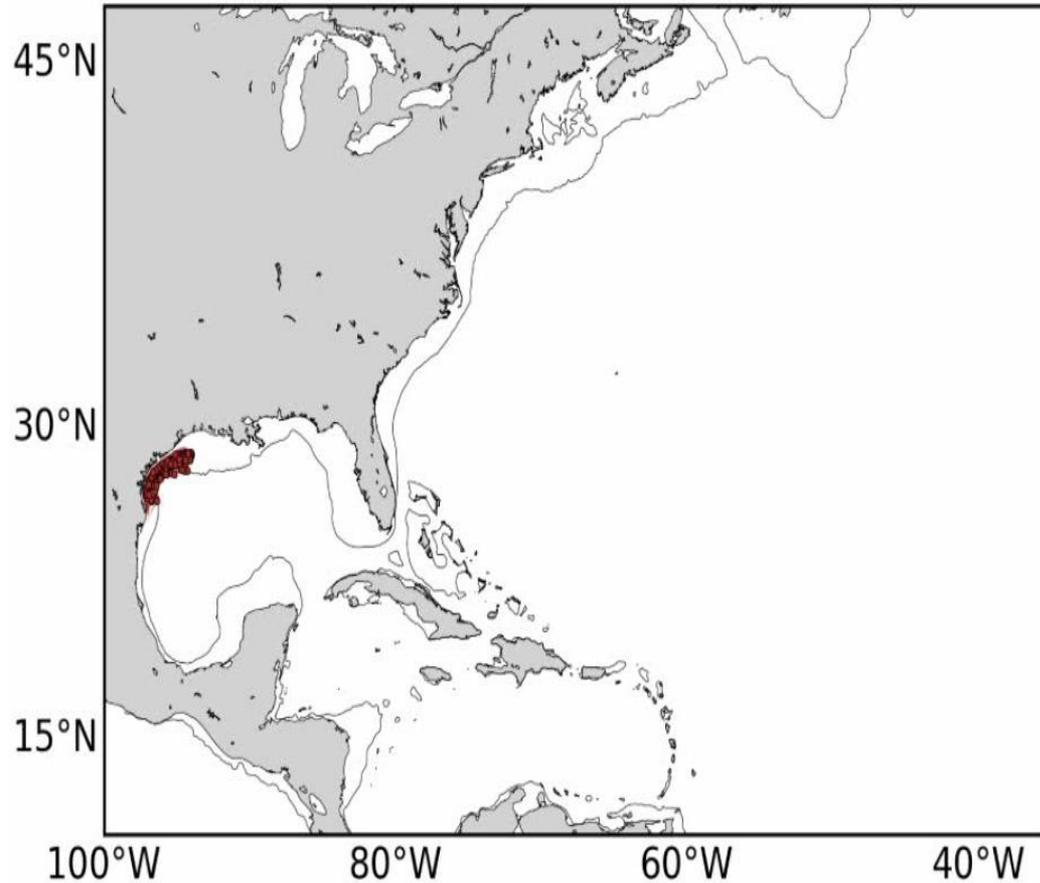
Movement of animals in the ocean

The path of a marine animal is a combination of its swimming velocity and that of the ocean currents.



Modified from Chapman et al. 2011

Simulating movements of oceanic-stage turtles with ocean circulation models



HYCOM

- Hindcast velocity fields
- 0.08° grid resolution
- Daily snap shots at 0 m
- Data assimilation from satellite and *in situ* measurements

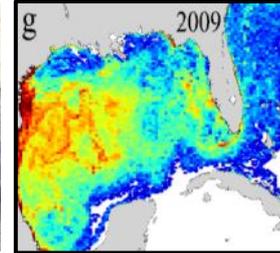


ICHTHYOP

- Release particles at specific locations and times
- Track particles through virtual ocean
- Compute probability of particles entering certain areas

Estimating distribution and abundance from nesting forward

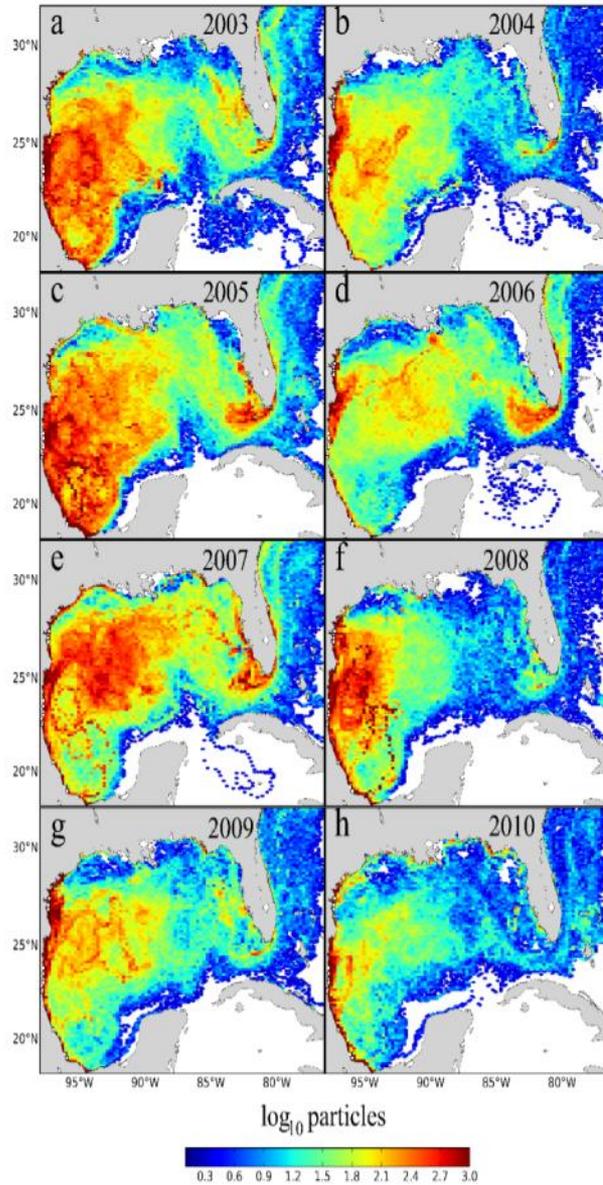
Coupling physical transport models with demographic information



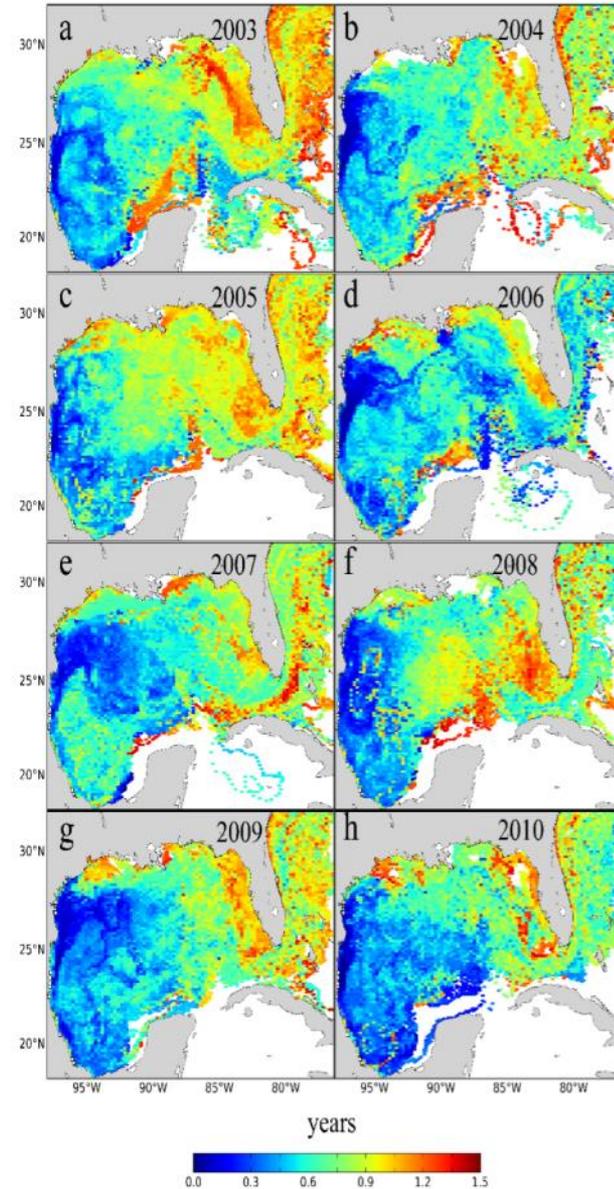
$$T_f = N \times C \times S_c \times P \times S_o^Y$$

Where N is the number of nests at the focal beach, C is the clutch size (number of eggs per nest), S_c is percent clutch survival, P is the percentage particles at a location and time of interest, S_o is annual percent oceanic survival, Y is the age class of turtles (in years), and T_f is the number of turtles at a location and time of interest from a focal beach.

Density Distribution



Age-structure

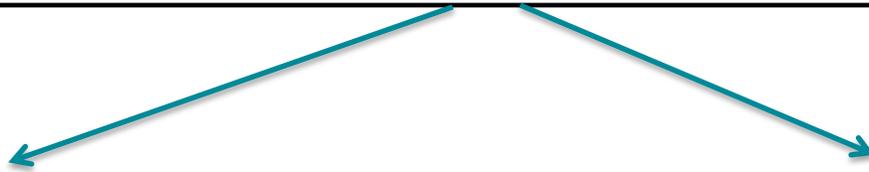


Challenges

- Variance estimates - not implemented
- Access to movement data
- Limited to oceanic size classes (< 3 years old)
- Limited analytic resources
 - SEFSC postdoc (50% time)

Sea Turtle Toolbox Project 2: Population Assessment (NEFSC lead)

Management Scenario



Population Simulation

Assessment models (tools)

- Nesting trends (e.g. TEWG 2007)
- Regional density estimates (e.g. AMAPPS)
- Reproductive value loss limit (Curtis and Moore 2013)
- PBR like ? / other _____

Sample



Output Metric

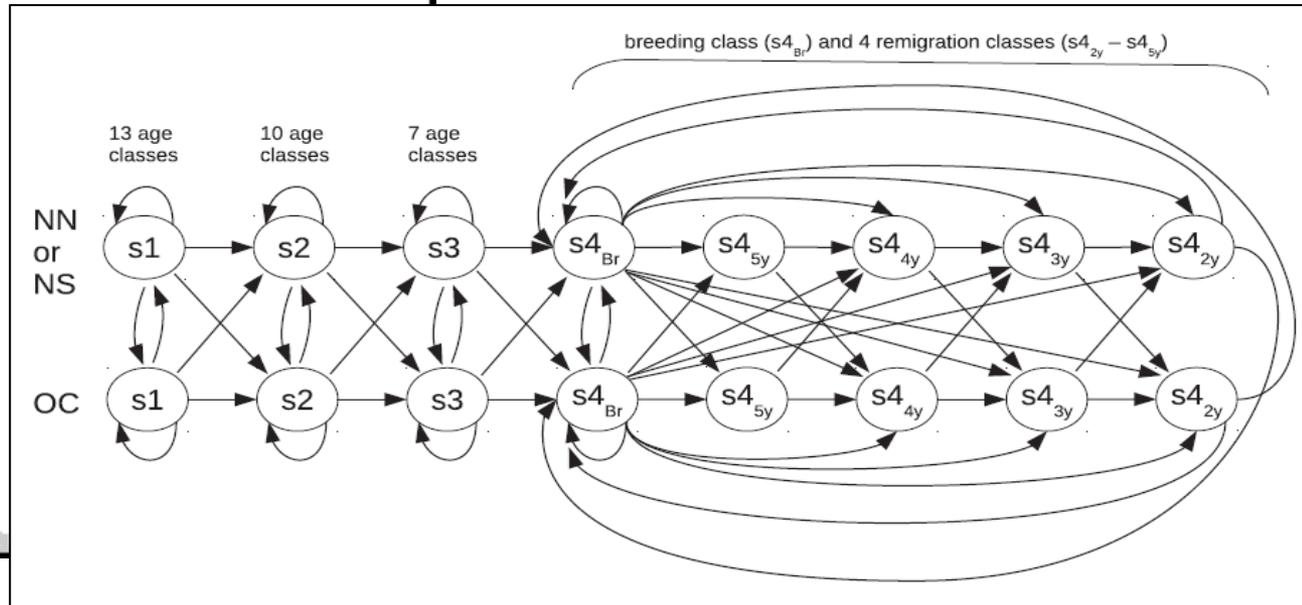
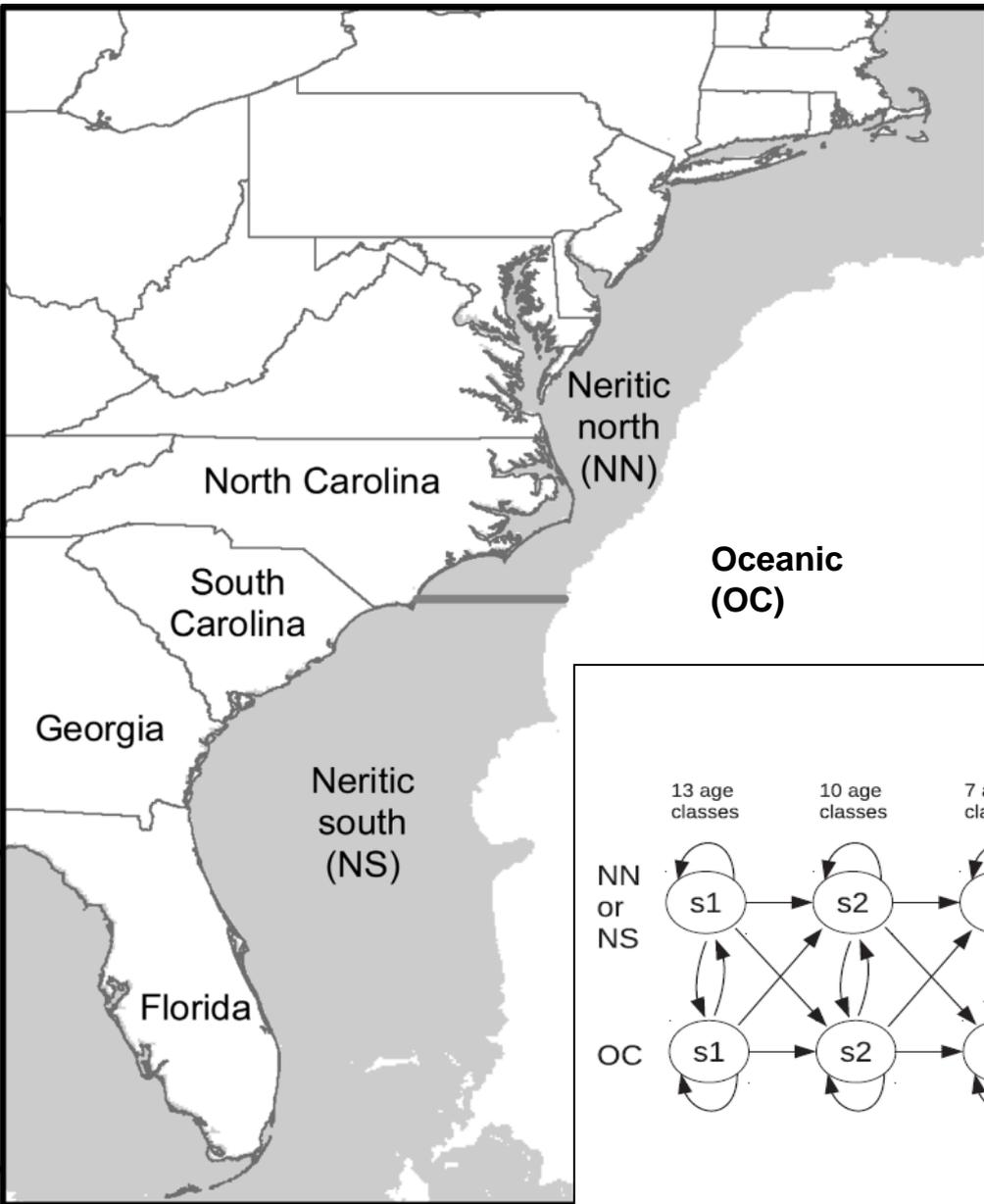
Output Metric

Evaluate

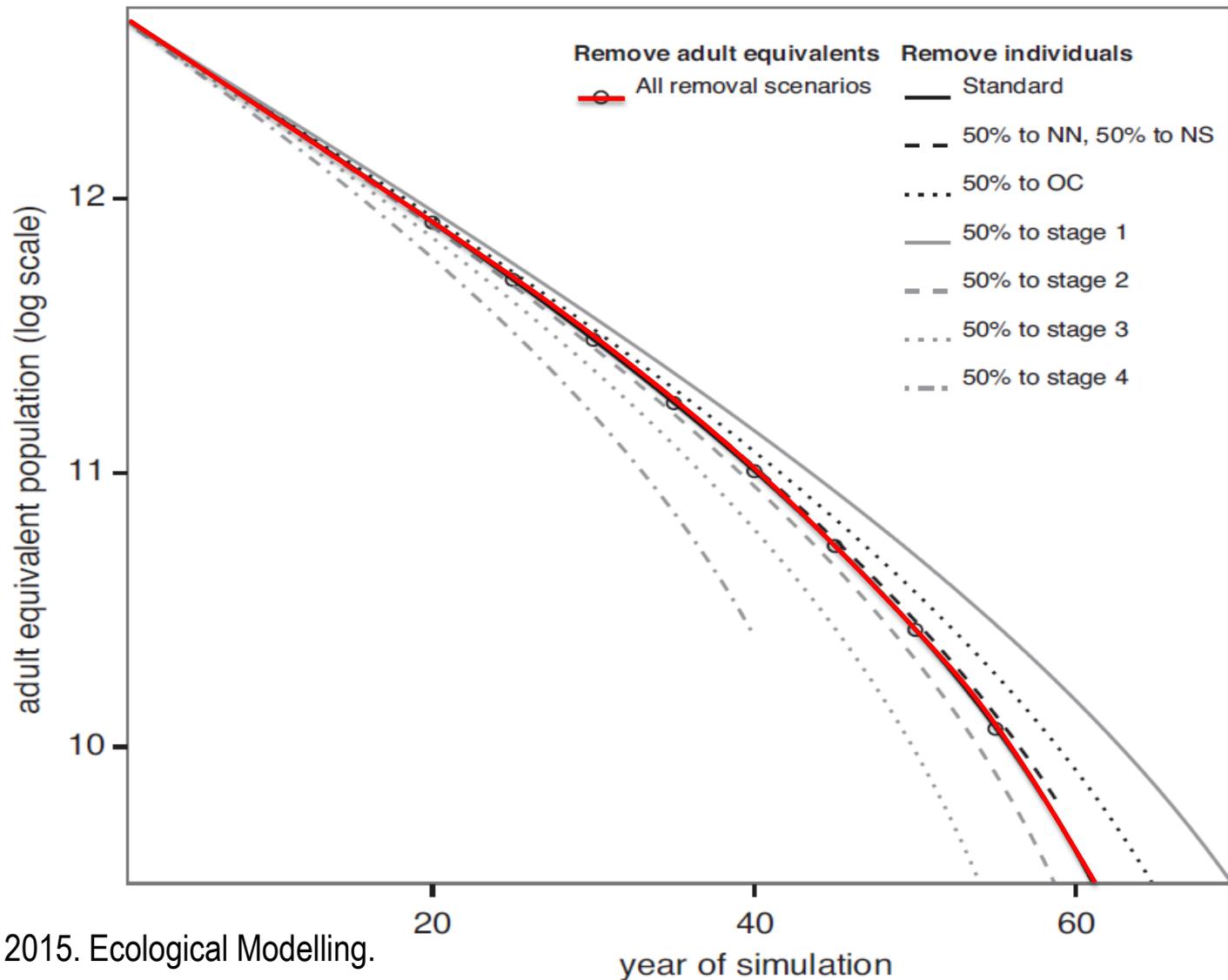


Building a better assessment toolbox starting with loggerhead turtles...

Warden et al. 2015. Ecological Modelling.



Monitoring removals by life stage is important.



Warden et al. 2015. Ecological Modelling.

Challenges

- Complex model
 - Data Limited / Large Uncertainty
- Controversial
 - Adult equivalents
 - Reference Points
 - Jeopardy
- Limited analytic resources
 - NEFSC contractor (66% time)

Strengths

Partnerships

- Analytic support
 - All NMFS Science centers
 - Academic (UM, LSU, Duke, OSU, UCF)
- Data partners: USFWS, Navy, BOEM, academics

Accomplishments

- Loggerhead simulation model and estimation of adult equivalents
(Warden et al. 2015. Ecological Modelling)
- Adult Female population estimator
(Richards et al. 2011. Endangered Species Res.)
- Ocean circulation and small turtle demography
(Putman et al. submitted)

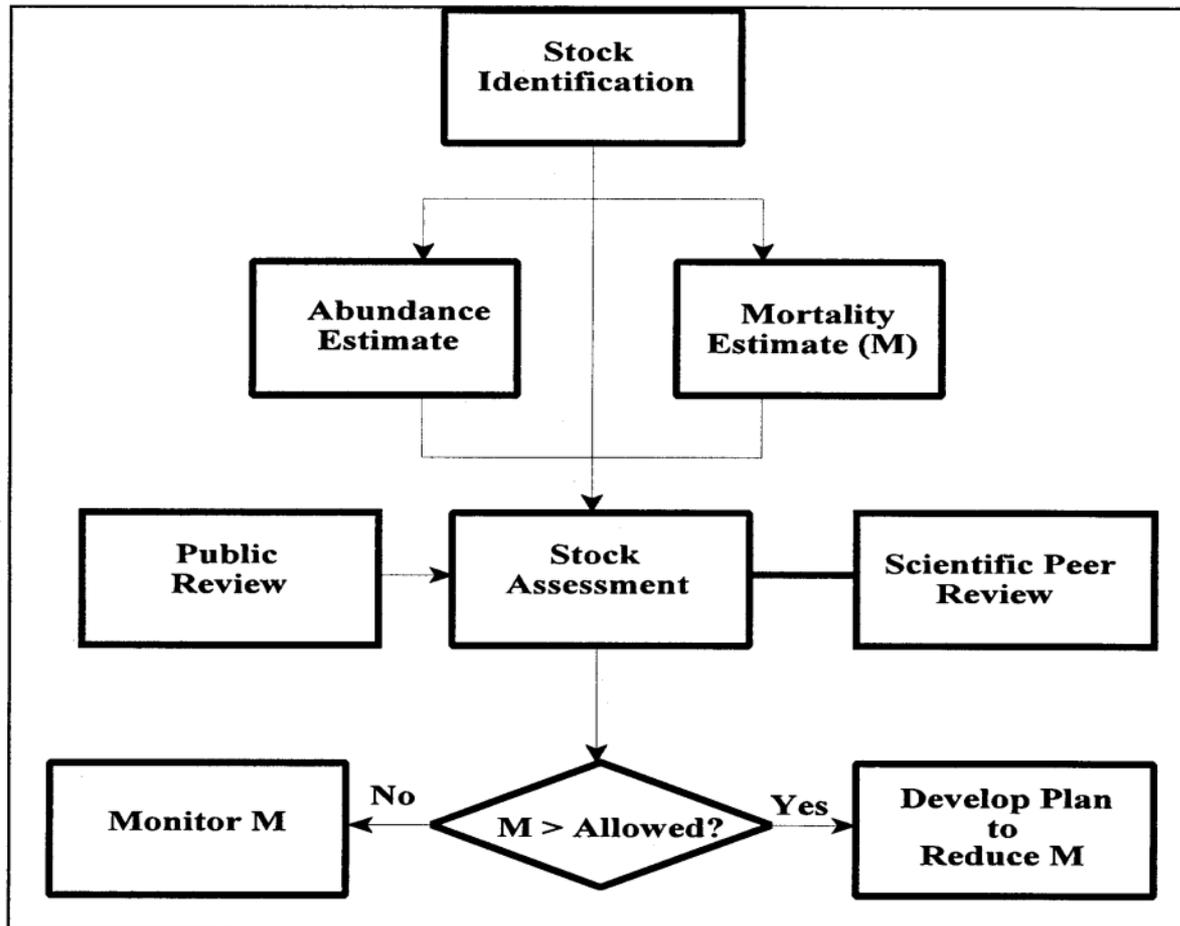
Analytic Challenges

- Framework construction and acceptability
- No clear legislative directive (e.g. PBR from MMPA)
- Rarity and small sample sizes
- Data access
- Aerial surveys limited analytical framework (e.g. Sea turtle surface availability)
- In water capture-recapture / sight-resight
- Strandings data
- Bycatch monitoring (sample sizes)
- Health studies
- Behavior studies

Future Directions

- Quantitative Framework Development
- Analytic tools for survey correction factors (e.g. turtle surfacing)
- Expand circulation model to be integrated with a population dynamical model
- Continue support for tool development and testing

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Discussion Topics

- Is the research we are conducting reflective of scientific best practices?
- Do you see an opportunity for SEFSC to shift resources from an existing activity to deal with an unmet need?