



**NOAA
FISHERIES**

Supporting Analytical Tools

Office of Science & Technology
Stock Assessment Science Program Review
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Outline

- Objectives
- Analytical tools
 - NOAA Fisheries Toolbox
 - ADMB Project
 - Stock Synthesis
- Strengths, challenges, solutions

Objectives

Support National-scale technical activities important to maintaining & improving the stock assessment enterprise

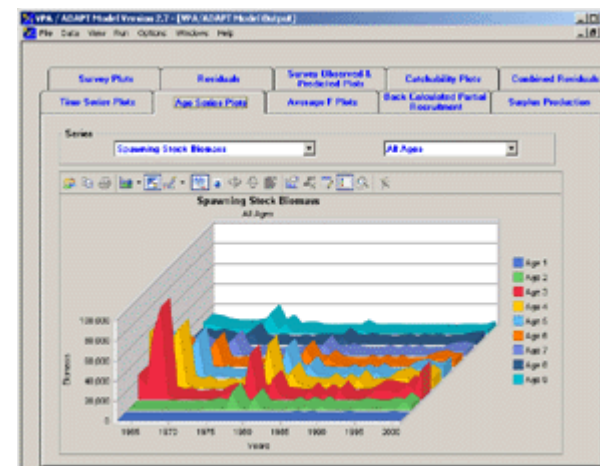
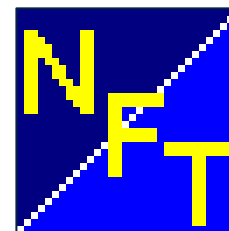
- Development, maintenance, availability, standardization, testing, and user support for stock assessment analytical tools

Analytical Tools

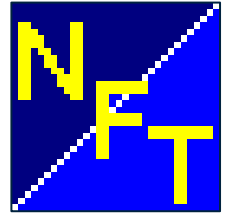
Assessment Methods Working Group

(Additional to the SAAM RFP)

- NOAA Fisheries Toolbox
- ADMB Project

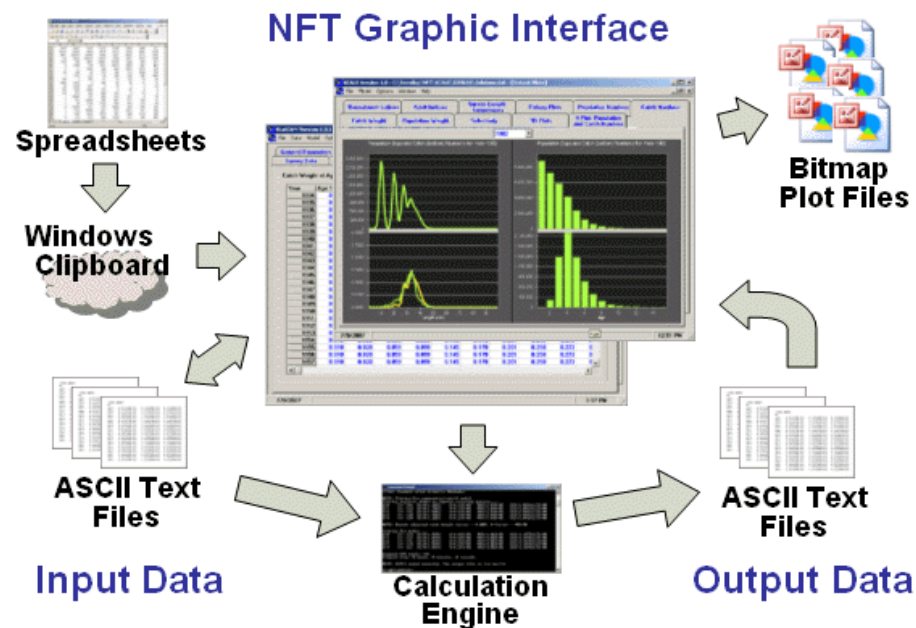


Analytical Tools

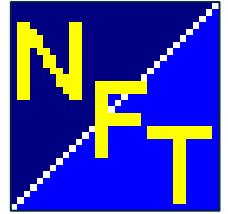


NOAA Fisheries Toolbox

- Software programs used in stock assessments
- Windows applications that combine consistent GUI with independent calculation engines



Analytical Tools



NOAA Fisheries Toolbox

- Independent programmers (NMFS scientists) develop calculation engines
- NFT programmer
 - Coordinates and maintains versions
 - Develops GUIs (Visual Basic)
 - Responsible for website and user support
 - Was located at NEFSC (position currently vacant)

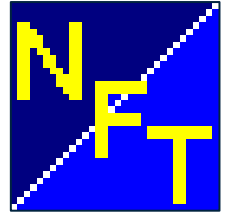
Analytical Tools

NOAA Fisheries Toolbox

List of programs

- Assessment Models
- Projection
- Reference Points
- Model Evaluation
- Tagging
- Other

<u>Estimation of Stock Size and Mortality</u>	<u>Acronym</u>	<u>Date Updated</u>
•A Stock Production Model Incorporating Covariates	(ASPIC)	2/08/2011
•Age Structured Assessment Program Model	(ASAP)	04/14/2014
•Collie-Sissenwine Analysis	(CSA)	01/13/2014
•Dual Zone Virtual Population Analysis	(VPA-2BOX)	8/4/2004
•Statistical Catch at Age Model	(STATCAM)	5/2/2008
•Statistical Catch at Length Model	(SCALE)	9/13/2013
•Stock Synthesis Version 3	(SS3)	10/18/2012
•Virtual Population Analysis	(VPA)	4/18/2014
<u>Management Scenario Projections</u>		
•Age Structured Projection Model	(AGEPRO)	9/17/2013
<u>Biological Reference Points</u>		
•Age Based Yield Per Recruit	(YPR)	9/17/2013
•An Index Method	(AIM)	1/31/2014
•Length Based Yield Per Recruit	(YPRLEN)	4/20/2012
•Stock Recruitment Fitting Model	(SRFIT)	3/18/2010
<u>Model Performance Evaluation</u>		
•Population Simulator - Age Based	(POPSIM-A)	12/12/2013
•Population Simulator - Length Based	(POPSIM-L)	12/12/2013
•Management Strategy Evaluation	(MSE)	12/23/2013
•Visual Report Designer	(VisRpt)	4/2/2008
<u>Models for Data Limited Situations</u>		
•Depletion Corrected Average Catch Model	(DCAC)	10/4/2012
•Survival Estimation in Non-Equilibrium situations	(SEINE)	9/15/2008
<u>Model for Analyzing Tagging Data</u>		
•Instantaneous Rates	(IRATE)	4/19/2013
<u>Additional Tools</u>		
•Kalman Filter	(KALMAN)	7/24/2009
•Model Compare	(MCOMP)	2/10/2014
•Productivity and Susceptibility Analysis	(PSA)	3/4/2010
•Rivard Weights Calculator	(RIVARD)	10/24/2008



Analytical Tools

NOAA Fisheries Toolbox

- NMFS ST: provides funding
- Assessment Methods WG: provides oversight

What's ahead?

- Encourage increased participation across regions
- Fill vacancy and evaluate direction
 - Is the GUI frequently used and is the current format ideal?
 - More formal testing and documentation?
 - Significant energy into MSE tool?
 - Keep at NEFSC?
 - Collaborate with Protected Species Toolbox?



Analytical Tools



ADMB Project

- Automatic Differentiation Model Builder
 - Dave Fournier (Otter Research)
 - Accurate, stable, efficient statistical software
 - Ideal for nonlinear models with $>\sim 5$ estimable parameters (e.g., stock assessment models)
 - Basis for large proportion ($>1/2$) of NMFS assessments (including many Toolbox programs)

Analytical Tools



History

- Initially, users (including NMFS) purchased individual licenses
- 2007: researchers formed ADMB Foundation with open source as a goal
- Moore Foundation provided funds to UC-NCEAS to acquire rights and create open source software
- Non-profit ADMB Foundation formed to oversee the open source/public domain ADMB Project
- NMFS expresses willingness to provide annual support, as available

Analytical Tools



Current status

- NMFS ST supports via grant to U Hawaii (JIMAR)
 - Full-time programmer, part-time admin, Fournier contract, travel, supplies, workshop (~\$250k/yr)
 - Proposal reviewed annually
- ADMB software is housed on U Hawaii server
- Assessment Methods WG provides oversight of NMFS grant
- ADMB Foundation also seeks additional support
- CIE review of this arrangement planned for early 2015

Analytical Tools



Main objectives

1. Improve and maintain software installation and manuals
2. Fix defects in source code and apply coding standards
3. Enhance software with new features to improve maintainability, efficiency, and model development
4. Improve long-term maintainability of source code so Core Team and external developers can understand and enhance software
5. Upgrade C++ coding to contemporary C++ coding standards

Analytical Tools



General thoughts

- ADMB is available and relatively popular worldwide
- Primarily funded by NMFS ST
- Maintained/upgraded regularly
- Sometimes challenging for new users – installation, documentation, and support issues can arise
- However, outreach and training activities are ongoing and available

Analytical Tools



Stock Synthesis

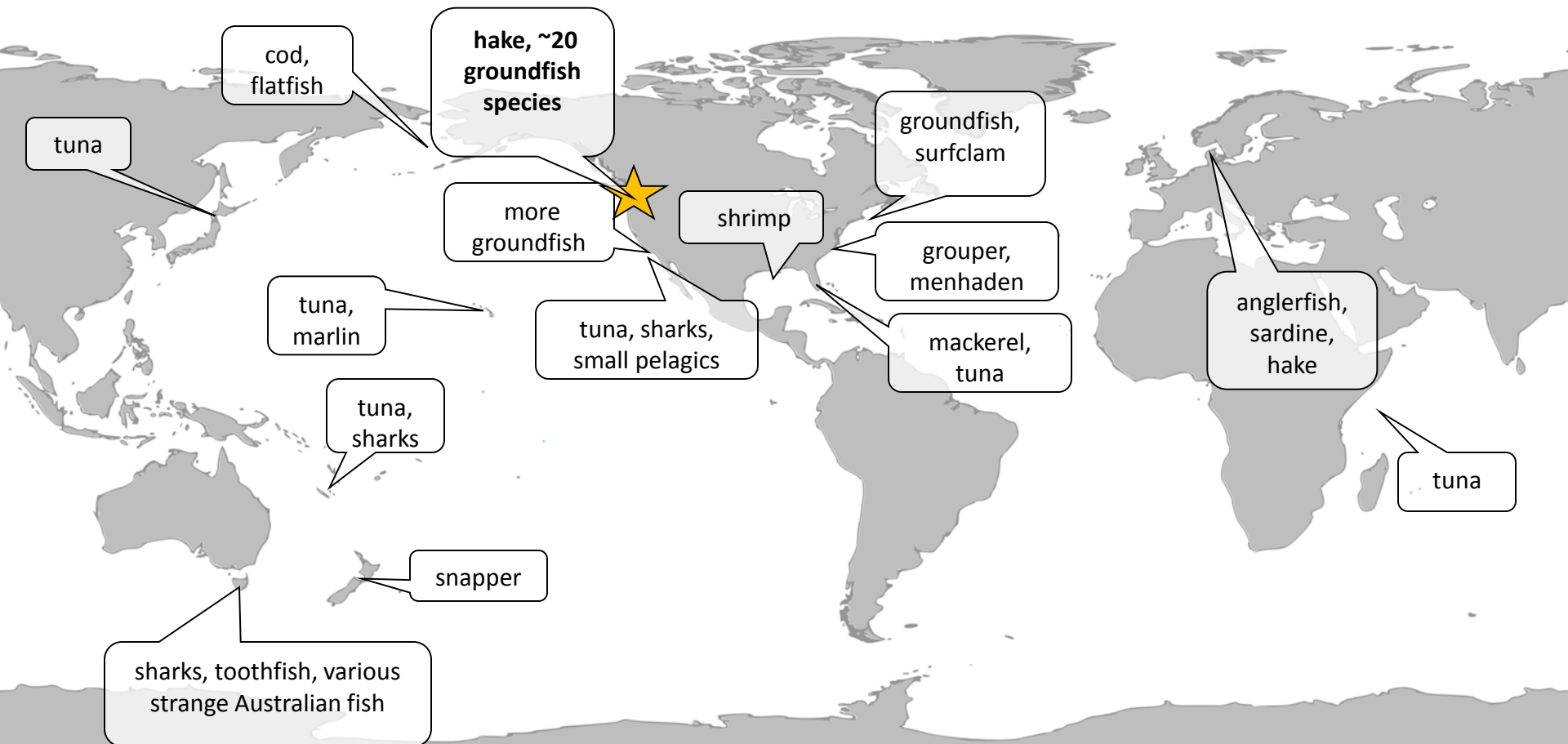
- General software program for stock assessment
 - Based on integrated analysis
 - Can accommodate a range of data types; thus a variety of assessment model classes can be configured
 - Utilizes ADMB and available for download via NOAA Fisheries Toolbox
 - Development by Methot began in late '80s

Analytical Tools



Growing in popularity (DOC Gold Medal - 2008)

- As of 2012: used for 61 formal stock assessments (35 in US)



Analytical Tools



Benefits

- Flexible, but standardized
- Transferable: potential to increase efficiency
- Effective for propagating / characterizing uncertainty
- Well tested, minimal potential for bugs
- Complementary tools available (R)
- Facilitates collaboration, communication, and sharing of knowledge

Analytical Tools



ST Support

- While Methot was under ST
 - Development, maintenance, testing, and user support
- Now
 - Funding when needed (workshop, travel, etc.)
 - Low level of engagement from ST Stock Assessment Coordinator(s)

Analytical Tools



Planned activities

- Considering establishing a development team
 - Transition development, maintenance, and support
 - Establish online forum
 - Consider transition to structured programming and/or community development

Strengths

General

- ST supports key analytical tools for assessments

Toolbox

- Analytical tools are globally accessible
- Generic interface facilitates ease of use across tools
- Separate calculation engine facilitates contributions from many programmers
- Mainly production tools, but can be useful for research and testing

ADMB Project

- Fundamental to NMFS stock assessments
- NMFS support emphasizes stewardship

Stock Synthesis

- Wide use and growing popularity
 - Promotes Agency credibility
 - Promotes efficiency as NMFS scientists become experienced

Challenges

General

- All tools are regionally managed: could limit communication and National planning

Toolbox

- Most used by NEFSC
- Updating GUI versions when engines are regularly updated (also screen resolution fixed)
- Currently no Toolbox programmer and maintenance is a challenge
- No formal approach to testing

ADMB Project

- \$250k/yr >> cost of individual licenses
- Lack of full documentation of software

Stock Synthesis

- Senior Science Advisor responsible for all aspects
- No formal role established for ST

Solutions

General

- Centralize tools at HQ, or continue to rely on Assessment Methods WG for coordination

Toolbox

- Hire a new programmer
- Encourage broader use or move developer to HQ
- Perhaps abandon Visual Basic
- Create standardized testing protocol

ADMB Project

- Seek funding partners, or reduce scope of grant
- Emphasize importance of documentation, or create specific funding opportunity for improving user guide and documenting software

Stock Synthesis

- Transition management to a development team
- Formalize ST engagement, or allow more oversight by Assessment Methods WG of SS (and other tools)



Thank You!

