

# Current Stock Assessment Methods and Open Science

Arni Magnusson  
Data & Assmt Professional Officer  
ICES Secretariat

IMR, Bergen  
6 March 2020



Science for sustainable seas

# Overview



## 1. Background

- Stock assessment, fisheries science
- Statistical computing

## 2. Current stock assessment methods

- Models and advisory tools
- Methods Working Group

## 3. Open science

- Online databases, online analysis
- Transparent Assessment Framework

## 1. Background

# Arni Magnusson



Data & Assessment Professional Officer  
ICES Secretariat, Copenhagen

## Background

M.S. and Ph.D., University of Washington  
Fish population dynamics      Fisheries management  
Statistical models              Software development  
National Fisheries Advisory Committee, Iceland

## Software

|                  |                         |
|------------------|-------------------------|
| AD Model Builder | Template Model Builder  |
| glmmTMB          | icesAdvice      icesTAF |

## Lecturer

|  |  |
|--|--|
| United Nations University<br>Tech University Denmark | University of Iceland<br>ICES Training Courses |
|--|--|

# Stock Assessments



- 2000 Icelandic cod
- 2001 Icelandic cod, NZ ling, NZ southern blue whiting
- 2002 Icelandic cod, NZ smooth oreo
- 2003 Icelandic cod, NZ smooth oreo
  
- 2010 Icelandic greater silver smelt
- 2011 Icelandic saithe, Icelandic herring
- 2012 Icelandic saithe, Greenland inshore cod
- 2013 Icelandic saithe, Greenland inshore cod, Icelandic slope redfish, NE Atlantic mackerel
- 2014 Icelandic saithe, Greenland inshore cod, Greenland halibut
- 2015 Icelandic saithe, Greenland inshore cod
- 2016 Icelandic saithe

# Reviewer



## Internal

- 2011–2016 Icelandic National Advisory Committee, 37 stocks
- 2016– Review of implementation of the ICES precautionary approach

## External

- 2010 ICES RGDEEP: alfonosinos, greater forkbeard, ling, orange roughy, red seabream
- 2012 ICES IBPNEW: North Sea turbot
- 2014 NOAA CIE: Gulf of Mexico king mackerel
- 2018 SPRFMO: Chilean jack mackerel
- 2019 ICES RGBFAS: Kattegat plaice
- ICES RGCSE: European seabass
- NAFO: Newfoundland 3Ps cod
- 2020 ICES WKGSS (Chair): greater silver smelt stocks

# Other Services



## Internal

- 2011–2015 Editor of MFRI annual report of assessments and advice for all stocks
- 2013 Review of research proposals and funding priorities at MFRI
- 2014–2016 Creator and maintainer of <https://data.hafro.is>, open science repository
- 2017– Contact between ICES and the RAM Legacy Database

## External

- 2009– Member of ADMB Foundation and Core Development Team
- 2017 Chair of stock assessment session at ICES ASC
- 2017– Chair of the ICES Methods Working Group
- 2018– Member of SPRFMO Scientific Committee

## Methods

What makes fisheries data informative for stock assessment (Magnusson and Hilborn 2007)

Performance of uncertainty methods in stock assessment (Magnusson et al. 2013)

## Iceland

Population genetics of Icelandic cod (Jakobsdottir et al. 2011)

Influence of cod abundance and temperature on shrimp recruitment (Jonsdottir et al. 2013)

Remote sensing of chlorophyll in Icelandic waters (Gudmundsson et al. 2016)

## Other regions

Estuarine influence on survival rates of Pacific salmon (Magnusson and Hilborn 2003)

State of the world's fisheries (Hilborn et al. 2003)

Population ecology of North Sea turbot and brill (van der Hammen et al. 2013)

Stock status of offshore shrimp stocks of Bangladesh (Barua et al. 2018)



## Peer-reviewed publications

Core developer and coauthor of AD Model Builder (Fournier et al. 2012)

Coauthor of general guidelines for fitting nonlinear models (Bolker et al. 2013)

Paper on literate programming and reproducible analysis (Magnusson and Jonsson 2014)

Coauthor of high-impact R package glmmTMB (Brooks et al. 2017)

## Other contributions

Significant contributions to base R since 2004 and TMB since 2013

First author of AD Studio, development environment for ADMB and TMB

Serve a key role in ICES Secretariat to assist all stock assessors with R coding

ICES training course instructor in ADMB and TMB model development

First author of 8 R packages on CRAN, including icesAdvice and icesTAF

## 2. Current Stock Assessment Methods

# Models Used in ICES Assessments



From the alphabetical list on <https://vocab.ices.dk/?ref=1525>

- ▶ Gadget
- ▶ SAM
- ▶ SMS
- ▶ SPiCT
- ▶ SS3
- ▶ XSA

As well as:

AartsPoos, ADAPT, AMISH, ASAP, ASPIC, DCAC, MYCC, TASACS, TSA, VPA, XSAM, ...

# Advisory Tools for Data-Limited Stocks



Based on the work of WKLIFE and other groups

- ▶ DLS3.2
- ▶ Length-based indicators
- ▶ MSY proxy methods

The ICES Methods Working Group focuses on **stock assessment methods**.

The objectives of the Methods WG are to improve existing assessment models and develop new ones, organize a collection of datasets, test the performance of new and existing models, and work on assessment-related techniques.

# Methods WG on GitHub



GitHub, Inc. (US) | https://github.com/ices-eg/wg\_MGWG

Pull requests Issues Marketplace Explore

ices-eg / wg\_MGWG

Unwatch 41 Unstar 5 Fork 9

Code Issues 0 Pull requests 1 Projects 0 Wiki Security Insights Settings

ICES Methods Working Group Edit

Manage topics

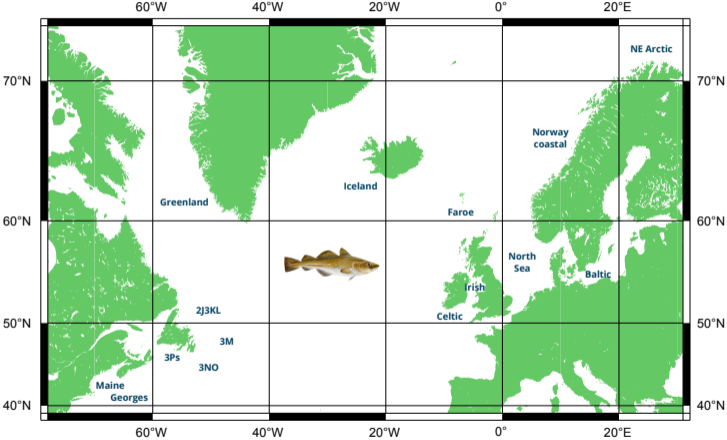
1,039 commits 1 branch 5 releases 26 contributors

Branch: master New pull request Create new file Upload files Find File Clone or download

timjmiller Merge branch 'master' of https://github.com/ices-eg/MGWG Latest commit bd374dc 32 minutes ago

|                   |   |                |
|-------------------|---|----------------|
| 2017-woods-hole   | Thursday Dinner Directions                          | 2 years ago    |
| 2018-Ispra        | Add files via upload                                | last year      |
| length-dist       | Update README.md                                    | 2 hours ago    |
| model-complexity  | on hold until 2020                                  | 2 hours ago    |
| selectivity       | Initial manuscript, based on poster                 | 20 hours ago   |
| state-space       | remove a mistakenly added file                      | 32 minutes ago |
| stock-recruitment | Merge branch 'master' of github.com:ices-eg/wg_MGWG | 28 days ago    |
| time-varying      | 2 slides on time-varying                            | 3 hours ago    |

# Atlantic Cod Selectivity



### 3. Open Science



# Open Science at ICES



## Open Data

ICES databases can be accessed online, via **web services**

## Open Source

Software maintained by the ICES Secretariat is hosted on

<https://github.com/ices-tools-prod>

**icesAdvice**, **icesDatras**, **icesTAF**, **icesVocab**

## Open and Reproducible Research

ICES working groups make their analytical **scripts** available on

<https://github.com/ices-taf>

basis of advice

<https://github.com/ices-eg>

any other analyses

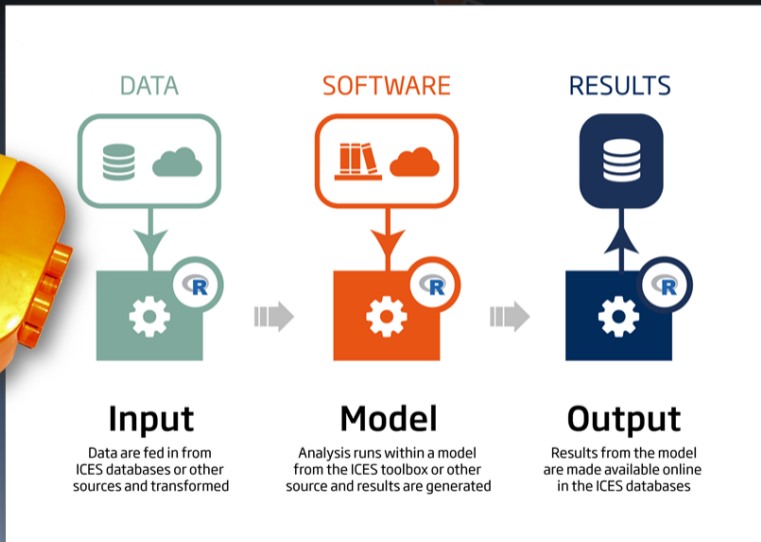
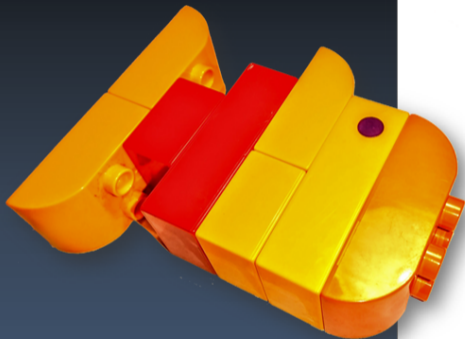
# Transparent Assessment Framework (TAF)



## *Aim*

Assure quality, improve efficiency, and ensure transparency of **data** and **analyses** used in the ICES advisory processes.

# taf.ices.dk



Science for sustainable seas

# TAF Overview



- ▶ ICES gives advice for over 200 stock assessments every year:  
**data preparation** → analysis → peer review → advice
- ▶ Open: data files, model scripts, and results available **online**
- ▶ Reproducible: anyone can browse, download, and **run** the assessment, on their own computer or on the ICES TAF **server** (final run)
- ▶ Assessment repository is private, but the analysis becomes **public** after the peer review and advice is released
- ▶ Easy to see exactly **what has changed** in the data or model setup between years
- ▶ Standard sequence of scripts (data, model, output, report) facilitates **quality checks** and **peer review**

# Overview



## 1. Background

- Stock assessment, fisheries science
- Statistical computing

## 2. Current stock assessment methods

- Models and advisory tools
- Methods Working Group

## 3. Open science

- Online databases, online analysis
- Transparent Assessment Framework