

Current Stock Assessment Methods and Open Science

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IMR, Bergen
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Science for sustainable seas

Overview



1. Background and skills

- 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 and skills

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	University of Iceland
Tech University Denmark	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

Internal

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

External

- 2010 ICES RGDEEP: alfonsinos, 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](#)

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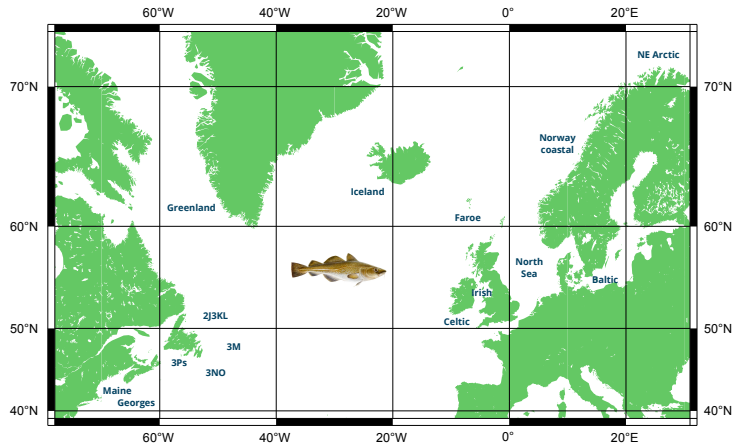
1,039 commits 1 branch 5 releases 26 contributors

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

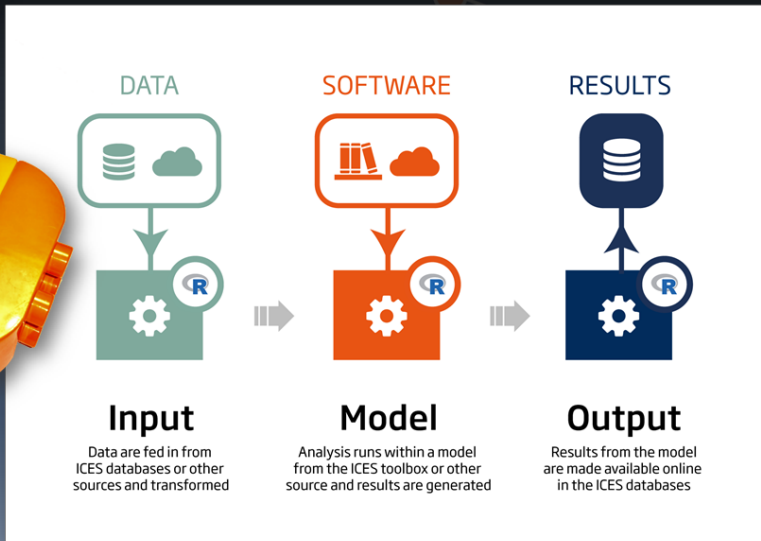
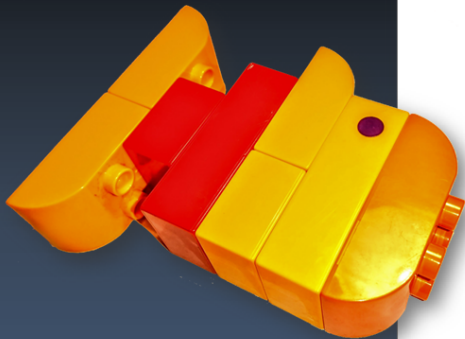
Transparent Assessment Framework (TAF)



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**

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