

# ICES Fisheries Advice

## Current Stock Assessment Methods and Open Science

Arni Magnusson  
Data & Assmt Professional Officer  
ICES Secretariat

FAO, Rome  
7 February 2020



Science for sustainable seas

# Overview



**ICES fisheries advice**

**Current stock assessment methods**

**Open science**

# Overview



## 1. ICES fisheries advice

- What is ICES
- Advisory process

## 2. Current stock assessment methods

- Models and advisory tools
- Methods Working Group

## 3. Open science

- Online databases, online analysis
- Transparent Assessment Framework

# 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 Tech University Denmark	University of Iceland ICES Training Courses
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# 1. ICES Fisheries Advice

# What is ICES



Organization that facilitates **international collaboration** in marine science, a network of more than 5000 scientists from over 700 marine institutes in our 20 member countries.

- ▶ Give scientific advice to management bodies
- ▶ Advice, Science, Data Centre
- ▶ Working Groups - Advice Drafting Groups - Advisory Committee
- ▶ Benchmark reviews
- ▶ Annual Science Conference, Journal, Training courses



CALL FOR ABSTRACTS FOR  
ICES ANNUAL SCIENCE  
CONFERENCE 2020

Photo: Astrid Maria Rasmussen

**JOIN**  
A TRAINING  
COURSE

**FOLLOW**  
OUR ADVISORY  
PROCESS

**EXPLORE**  
MARINE DATA

**GET**  
INVOLVED

## LATEST NEWS

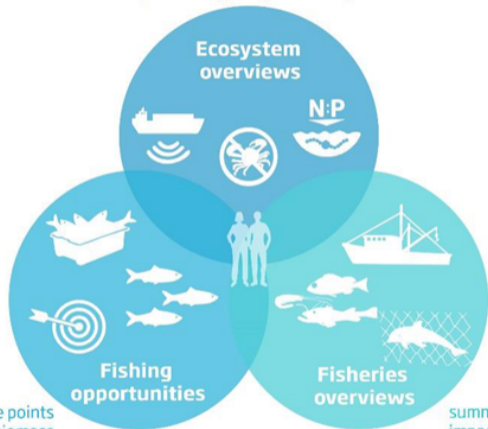
21 January 2020

Call for participants for workshop on model ensembles for stock assessment and advice



# ICES Overviews

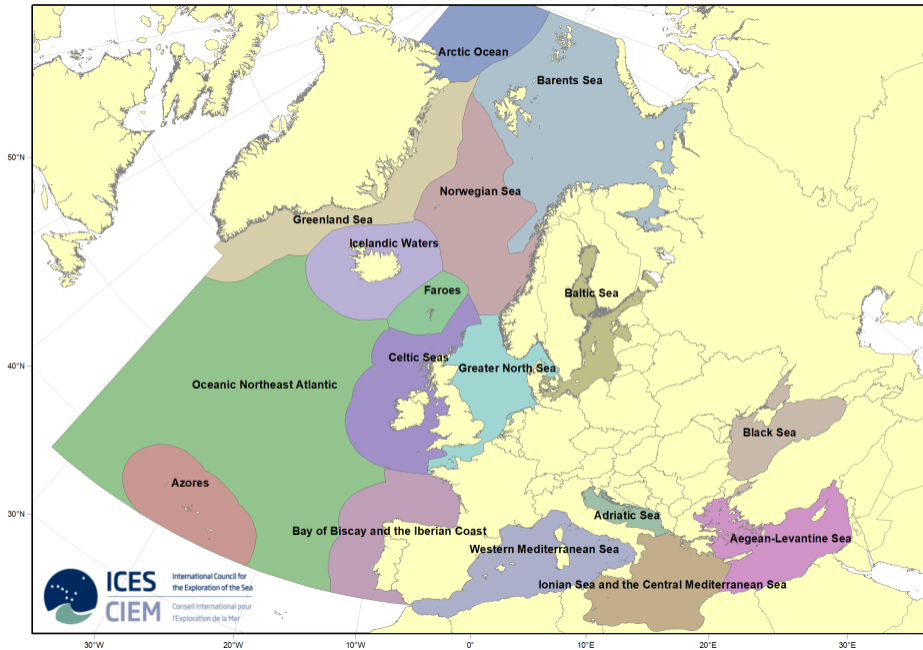
describe ecoregion context  
identify pressures & drivers  
impacts on key ecosystem components

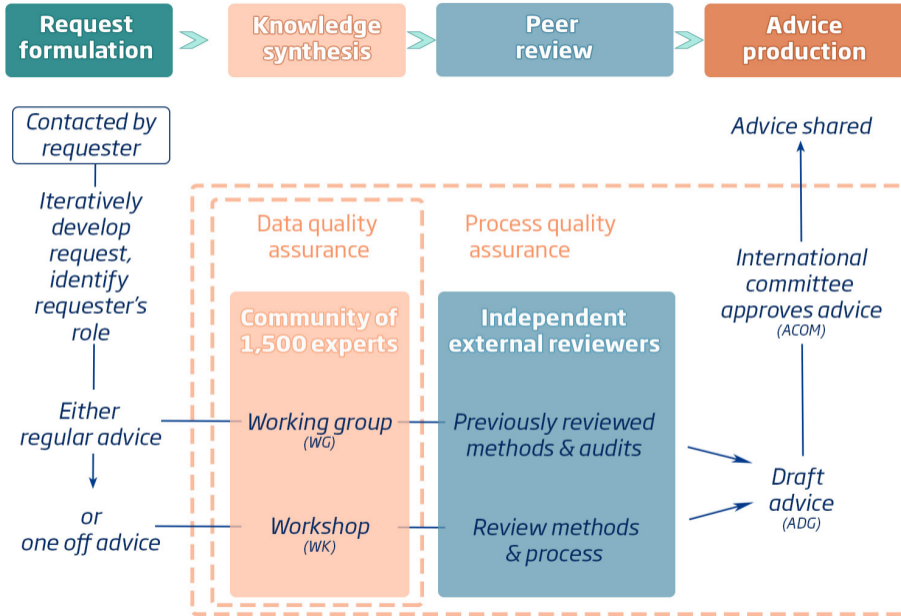


MSY options & reference points  
consequences of catch on biomass  
respond to changes in productivity

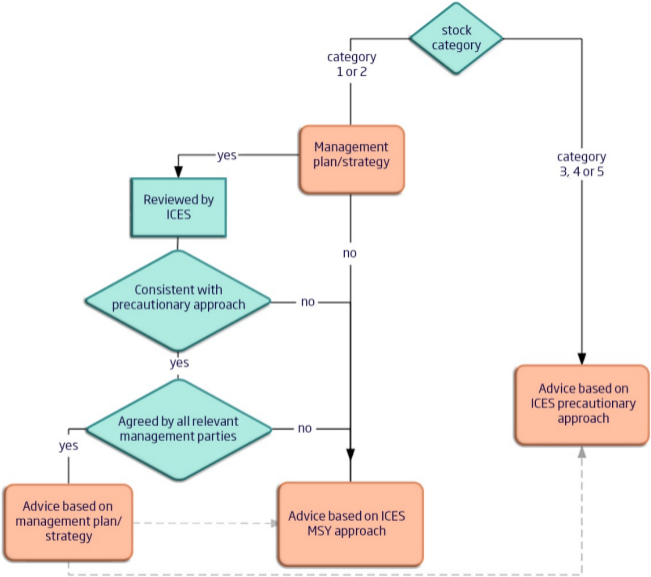
summarize fleet activity  
impacts of fishing & species  
trade-offs between fleets





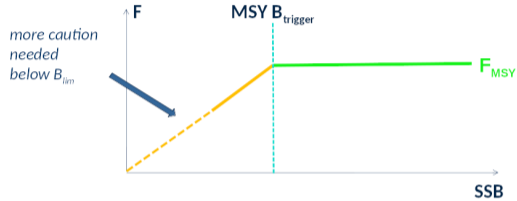


# Stock Categories

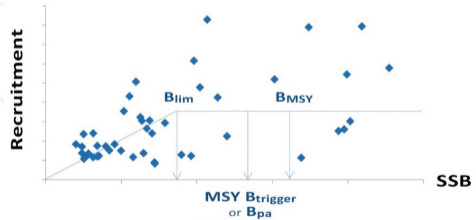


# Reference Points

Fmsy reference point



Blim and Btrigger reference points



## 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, ...

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 Working Group

Affiliation: HAPISG

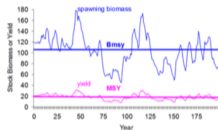
Chair: Christopher Legault, Arni Magnusson

The Methods Working Group (MGWG) focuses on stock assessment methods.

The objectives of MGWG 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.

MGWG's work is aligned in projects that are oriented to fit in the format of multi-authored journal papers. The group identifies topics that are of general relevance and high impact in stock assessment methods research. Project management is organized on the [MGWG GitHub site](#), where the research activities of the group can be followed.

Print it Send to f t in Share it



### LINKS

- [View all members of this group](#)
- [View MGWG Terms of Reference](#)
- [View latest MGWG Report](#)

GO TO SHAREPOINT SITE

GO TO GITHUB SITE

CONTACT US



# Methods WG on GitHub



The screenshot shows the GitHub repository page for 'ices-eg / wg\_MGWG'. The browser address bar shows the URL 'https://github.com/ices-eg/wg\_MGWG'. The repository name is 'ices-eg / wg\_MGWG' with 41 stars, 5 unstars, and 9 forks. The repository is owned by 'ICES Methods Working Group'. It has 1,039 commits, 1 branch, 5 releases, and 26 contributors. The current branch is 'master'. A list of recent commits is shown, including a merge by 'timjmiller' and several updates to files like '2017-woods-hole', '2018-Ispra', 'length-dist', 'model-complexity', 'selectivity', 'state-space', 'stock-recruitment', and 'time-varying'.

ICES Methods Working Group

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

# Methods WG Meetings



## Meeting agenda, Seattle 23-27 September 2019

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### Basic information

School of Aquatic and Fishery Sciences (SAFS), University of Washington. [Directions, parking, other visitor info](#). There are three SAFS buildings, this meeting will be in the *Fishery Sciences building* (FSH, [google maps link](#)).

### Schedule

*Note the different room for Monday vs. the rest of the week*

#### Mon, 9am-5pm, Room FSH 203

- Welcome
- Review of ongoing projects: [state-space](#), [stock-recruitment](#), [model-complexity](#), [selectivity](#)
- Status update
- Describe main challenges/obstacles in each project
- Consider whether to add/remove projects

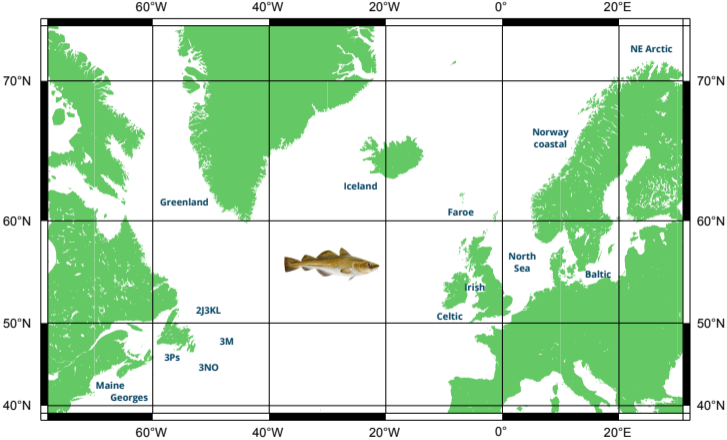
#### Tue, 9am-5pm, Rooms FSH 314 & 329

- Work on projects
- Introduce new members to tasks and workflow

#### Wed, 9am-5pm, Rooms FSH 314 & 329

- Work on projects

# 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>

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

basis of advice

any other analyses

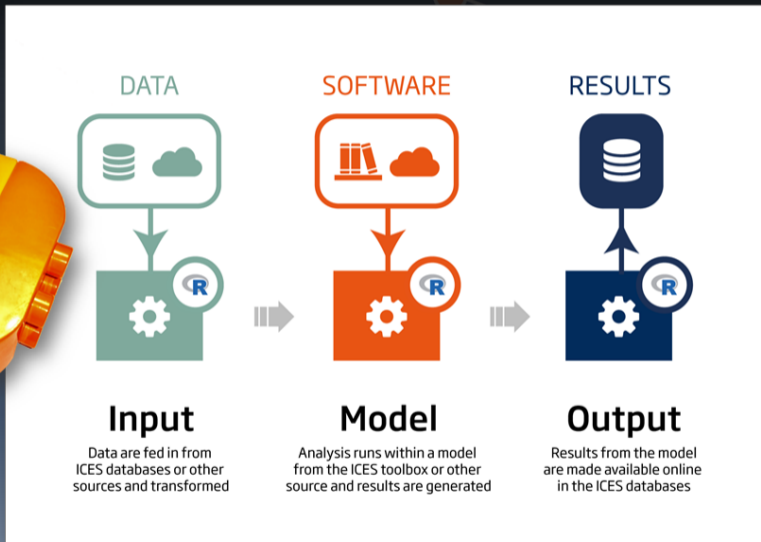
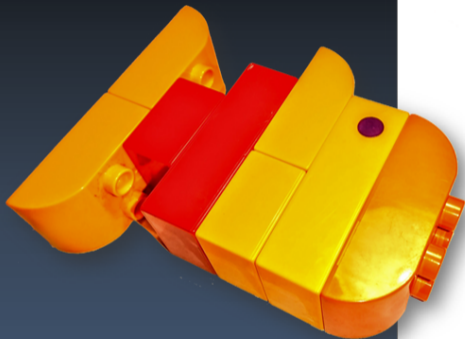
# Transparent Assessment Framework (TAF)



## *Aim*

Assure quality, improve efficiency, and ensure transparency of **data** and **analysis** 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**



# TAF History



## 2016–2018

- ▶ Design
  - ✓ *Scientists write standard R scripts that prepare data and run analysis*
- ▶ Implementation
  - ✓ *R packages: work with ICES databases, core TAF functions*
  - ✓ *Web interface where users can browse and download assessments*
  - ✓ *Example stocks demonstrate workflow: data, model, output*

## 2018–2020

- ▶ Training
  - ✓ *2-day workshops, user documentation, video tutorials, working group support*
- ▶ Deployment
  - ✓ *ICES assessments moving to TAF, 50 stocks fully implemented, 41 partially*

# TAF Workflow



## Core

- data.R** - Preprocess data, write TAF data tables
- model.R** - Run analysis, write model results
- output.R** - Extract results of interest, write TAF output tables

## Also

- report.R** - Prepare plots and tables for report

# TAF Workflow

fetch

data



data

software



model



output



report

scripts

*Now used in a variety of ICES analyses, not only stock assessments*

# Fisheries advice



## At home institutes

- ▶ *Scientists*: analyze **data**, finalize **model**, tabulate and plot **results**

## At ICES

- ▶ *Expert group*: review results, write **report** and draft **advice**
- ▶ *Advice drafting group*: review the **advice**
- ▶ *Advisory committee* finalize and release **advice**

# Fisheries advice

## Icelandic haddock



*Iceland Sea and Greenland Sea Ecoregions*

*Published 12 June 2015*

### **2.3.12 Haddock (*Melanogrammus aeglefinus*) in Division Va (Iceland grounds)**

#### **ICES stock advice**

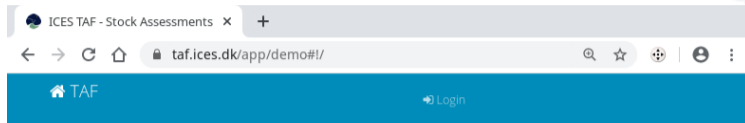
ICES advises that when the Icelandic management plan is applied, catches in the fishing year 2015/2016 should be no more than 36 400 t.

### Basis of the assessment

**Table 2.3.12.6** Haddock in Division Va. The basis of the assessment.

ICES stock data category	1 (ICES, 2015b).
Assessment type	Adapt-type model (in ADMB) that uses catches in the model and in the forecast.
Input data	Landings-at-age and two survey indices (Icelandic spring and autumn groundfish surveys).
Discards and bycatch	Haddock is caught in mixed demersal fisheries, sometimes as a large proportion of the catch, sometime as bycatch. Discarding due to high-grading was up to 20% by weight in the late 1990s, but has been less than 2% in recent years.
Indicators	None.
Other information	The stock was benchmarked in February 2013 (ICES, 2013a) and a harvest control rule evaluated in April 2013 (ICES, 2013b).
Working group	North-Western Working Group ( <a href="#">NWWG</a> ).

# Browse TAF Analysis Online



Select a stock assessment

Year	Stock Code	Species	Expert Group	Data Category	Assessment Type	Public
2015	rjm-347d	Raja montagui	WGEF	3.2	Survey-based trends	✓
2015	had-iceg	Melanogrammus aeglefinus	NWWG	1	Adapt-type model (in ADMB)	✓
2016	cod-347d	Gadus morhua	WGNSSK	1	Age-structured model (SAM)	✓
2016	ple-eche	Pleuronectes platessa	WGNSSK	1	Age-structured model (Aarts and Poos)	✓

# Browse TAF Analysis Online



## Haddock (Melanogrammus aeglefinus) in Division Va (Iceland grounds)

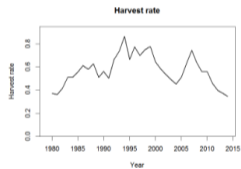
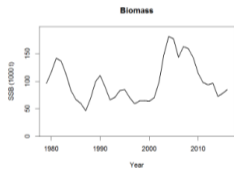


<b>Stock Description</b>	<a href="#">Haddock (Melanogrammus aeglefinus) In Division Va (Iceland grounds)</a>
<b>Active Year</b>	2015
<b>Stock Code</b>	<a href="#">had-iceg</a>
<b>Stock Data Category</b>	1
<b>Assessment Type</b>	Adapt-type model (In ADMB)
<b>Ecoregion</b>	Greenland Sea Ecoregion, Iceland Sea Ecoregion
<b>Expert Group</b>	<a href="#">North-Western Working Group (NWWG)</a>
<b>Expert Group Report</b>	<a href="#">NWWG 2015 Report</a>
<b>GitHub Repo</b>	<a href="#">ices-taf/2015_had-iceg</a>



# Browse TAF Analysis Online

```
55 natage <- rnd(natage, as.character(6:10), 2)
56 write.taf(natage, dir="report")
57
58 ## fatage (trim year and age)
59 fatage <- read.taf("output/fatage.csv")
60 fatage <- head(fatage, -2)[c("Year", as.character(2:10))]
61 fatage <- round(fatage, 3)
62 write.taf(fatage, dir="report")
63
```



[report/catage.csv](#)

	Year	2	3	4	5	6	7	8	9	10+
1	1979	149	1908	3762	6057	9022	1743	438	56	112
2	1980	595	1385	11481	4298	3798	3732	544	91	37
3	1981	10	514	4911	16900	5999	7875	1802	168	57

# View or Download Data and Results



ICES TAF - Stock Assessments x https://taf.ices.dk/fs/2015\_had x +

← → ↻ 🏠 🔒 taf.ices.dk/fs/2015\_had-iceg/report/summary.csv

Year	Rec	B3plus	SSB	Landings	YoverSSB	Fbar
1979	80923	162177	96072	55330	0.576	0.521
1980	37390	192244	116521	51110	0.439	0.398
1981	10426	206988	141628	63558	0.449	0.542
1982	42788	180380	136817	69428	0.507	0.444
1983	29306	148112	112589	65942	0.586	0.508
1984	20574	112797	82961	48282	0.582	0.515
1985	42788	102394	66652	51102	0.767	0.537
1986	86501	96480	59837	48859	0.817	0.739
1987	164036	105395	46298	40760	0.88	0.584
1988	48742	153708	69391	54204	0.781	0.675
1989	29778	168184	99537	62885	0.632	0.676
1990	27094	145507	110745	67198	0.607	0.611
1991	92280	122708	89825	54692	0.609	0.664
1992	175094	106310	66379	47121	0.71	0.728
1993	30437	130451	71000	48133	0.670	0.660

# Read Data and Results into R

```
RGui (64-bit) - [R Console]
File Edit View Misc Packages Windows Help
> read.csv("https://taf.ices.dk/fs/2015_had-iceg/report/summary.csv")
  Year  Rec B3plus  SSB Landings YoverSSB  Fbar
1  1979  80923 162177  96072   55330    0.576 0.521
2  1980  37390 192244 116521   51110    0.439 0.398
3  1981  10426 206988 141628   63558    0.449 0.542
4  1982  42788 180380 136817   69428    0.507 0.444
5  1983  29306 148112 112589   65942    0.586 0.508
6  1984  20574 112797  82961   48282    0.582 0.515
7  1985  42788 102394  66652   51102    0.767 0.537
8  1986  86501  96480  59837   48859    0.817 0.739
9  1987 164036 105395  46298   40760    0.880 0.584
10 1988  48742 153708  69391   54204    0.781 0.675
11 1989  29778 168184  99537   62885    0.632 0.676
12 1990  27094 145507 110745   67198    0.607 0.611
13 1991  92280 122708  89825   54692    0.609 0.664
14 1992 175094 106310  66379   47121    0.710 0.728
15 1993  38437 130461  71000   48123    0.678 0.669
```

# Analysis Stored on GitHub



ices-taf / 2015\_had-iceg Unwatch 4 Star 0 Fork 1

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

2015 - Haddock in Division Va (Icelandic haddock) - NWWG <https://taf.ices.dk/app/demo#!/2015/h...> Edit

Manage topics

109 commits 3 branches 0 packages 3 releases 2 contributors

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

**colinpmillar** add app links to readme [taf-skip] Latest commit df9c2ff on May 14, 2019

bootstrap	Make catageysa available as a directory	10 months ago
README.md	add app links to readme [taf-skip]	9 months ago
data.R	revert data change	13 months ago
model.R	Make catageysa available as a directory	10 months ago
output.R	Use write.taf(dir) notation	10 months ago
report.R	Plain source()	2 years ago
report_plots.R	all systems OK ;)	13 months ago
report_tables.R	Use write.taf(dir) notation	10 months ago
utilities.R	extractData(datafile) instead of extractInput(txt)	14 months ago

# List Code Changes Between Stages or Years



base: 2.2 compare: 2.3

2 commits 8 files changed 0 commit comments 1 contributor

Commits on Apr 16, 2019

- arni-magnusson Make catageysa available as a directory c000077
- arni-magnusson Use write.taf(dir) notation 188b7f8

Showing 8 changed files with 1,455 additions and 16 deletions.

Unified Split

```
2 bootstrap/SOFTWARE.bib
@@ -3,5 +3,5 @@Misc{catageysa
3 3 year = {2015},
4 4 title = {Age-structured model ({ADAPT}), in {ADMB}},
5 5 version = {2015, last modified 2015-05-05},
6 - source = {initial/software/catageysa.zip},
7 + source = {initial/software/catageysa},
8 }
```

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