

# Package ‘datalimited2’

January 20, 2018

**Type** Package

**Title** More Stock Assessment Methods for Data-limited Fisheries

**Version** 0.0.0.9000

**Date** 2018-01-05

**Description** Methods for estimating B/BMSY from fisheries catch time series.

**URL** <https://github.com/cfree14/datalimited2>

**Depends** R (>= 3.4.2)

**License** GPL-3

**Encoding** UTF-8

**LazyData** true

**Imports** plyr, segmented, gbm, dismo, fGarch, R2jags, coda, parallel, foreach, doParallel, gplots

**RoxygenNote** 6.0.1

## R topics documented:

|                           |           |
|---------------------------|-----------|
| bbmsy2s . . . . .         | 2         |
| bsm . . . . .             | 2         |
| cmsy2 . . . . .           | 3         |
| ocom . . . . .            | 4         |
| plot_cmsy2 . . . . .      | 5         |
| plot_cmsy2_mgmt . . . . . | 6         |
| plot_dlm . . . . .        | 7         |
| plot_ocom . . . . .       | 7         |
| plot_zbrt . . . . .       | 8         |
| rores . . . . .           | 8         |
| s2bbmsy . . . . .         | 9         |
| SOLIRIS . . . . .         | 9         |
| TIGERFLAT . . . . .       | 10        |
| YELLSNEMATL . . . . .     | 10        |
| zbrt . . . . .            | 11        |
| <b>Index</b>              | <b>12</b> |

---

|         |                                     |
|---------|-------------------------------------|
| bbmsy2s | <i>Convert saturation to B/BMSY</i> |
|---------|-------------------------------------|

---

### Description

Converts saturation ( $S = B/K$ ) to B/BMSY

### Usage

```
bbmsy2s(bbmsy)
```

### Arguments

|       |                  |
|-------|------------------|
| bbmsy | B/BMSY values(s) |
|-------|------------------|

### Details

$$S = 1 - \text{depletion} = B / K = B/BMSY / 2 B/BMSY = S * 2$$

### Value

Saturation (B/K) value(s)

---

|     |  |
|-----|--|
| bsm | <i>Bayesian state-space surplus production model</i> |
|-----|--|

---

### Description

Estimates B/BMSY time series and other biological quantities (e.g.,  $r$ ,  $k$ , MSY) from a time series of catch and a resilience estimate using the Bayesian surplus production model from Froese et al. (2017).

### Usage

```
bsm(year, catch, biomass, btype, resilience = NA, r.low = NA, r.hi = NA,
     stb.low = NA, stb.hi = NA, int.yr = NA, intb.low = NA, intb.hi = NA,
     endb.low = NA, endb.hi = NA, q.start = NA, q.end = NA, verbose = T)
```

### Arguments

|                 |   |
|-----------------|---|
| year            | A time series of years  |
| catch           | A time series of catch  |
| biomass         | A time series of biomass or CPUE (type is designated in btype)  |
| btype           | Biomass time series type: "None", "biomass", or "CPUE"  |
| resilience      | Resilience of the stock: "High", "Medium", "Low", "Very low"  |
| r.low, r.hi     | A user-specified prior on the species intrinsic growth rate, $r$ (optional)   |
| stb.low, stb.hi | A user-specified prior on biomass relative to unfished biomass at the beginning of the catch time series (optional) |

|                   |   |
|-------------------|---|
| int.yr            | A user-specified year of intermediate biomass (optional)  |
| intb.low, intb.hi | A user-specified prior on biomass relative to unfished biomass in the intermediate year (optional)                  |
| endb.low, endb.hi | A user-specified prior on biomass relative to unfished biomass at the end of the catch time series (optional)       |
| q.start, q.end    | A user-specified start and end year for estimating the catchability coefficient (optional; default is last 5 years) |
| verbose           | Set to FALSE to suppress printed updates on CMSY/BSM progress (default=TRUE)  |

### Value

A time series of B/BSMY estimates and other stuff

### References

Froese R, Demirel N, Coro G, Kleisner KM, Winker H (2017) Estimating fisheries reference points from catch and resilience. *Fish and Fisheries* 18(3): 506-526. <http://onlinelibrary.wiley.com/doi/10.1111/faf.12190/abstract>

### Examples

```
output <- bsm(year=SOLIRIS$yr, catch=SOLIRIS$ct, biomass=SOLIRIS$bt, btype="CPUE", r.low=0.18, r.hi=1.02)
plot_dlm(output)
```

---

cmsy2

*cMSY catch-only stock assessment model*


---

### Description

Estimates B/BSMY time series and other biological quantities (e.g., r, k, MSY) from a time series of catch and a resilience estimate using cMSY from Froese et al. (2017).

### Usage

```
cmsy2(year, catch, resilience = NA, r.low = NA, r.hi = NA, stb.low = NA,
      stb.hi = NA, int.yr = NA, intb.low = NA, intb.hi = NA,
      endb.low = NA, endb.hi = NA, q.start = NA, q.end = NA, verbose = T)
```

### Arguments

|                 |   |
|-----------------|---|
| year            | A time series of years  |
| catch           | A time series of catch  |
| resilience      | Resilience of the stock: "High", "Medium", "Low", "Very low"  |
| r.low, r.hi     | A user-specified prior on the species intrinsic growth rate, r (optional)   |
| stb.low, stb.hi | A user-specified prior on biomass relative to unfished biomass at the beginning of the catch time series (optional) |
| int.yr          | A user-specified year of intermediate biomass (optional)  |

|                   |   |
|-------------------|---|
| intb.low, intb.hi | A user-specified prior on biomass relative to unfished biomass in the intermediate year (optional)                  |
| endb.low, endb.hi | A user-specified prior on biomass relative to unfished biomass at the end of the catch time series (optional)       |
| q.start, q.end    | A user-specified start and end year for estimating the catchability coefficient (optional; default is last 5 years) |
| verbose           | Set to FALSE to suppress printed updates on CMSY/BSM progress (default=TRUE)  |

### Value

A list containing the following elements: (1) ref\_pts - A dataframe with biological quantity / reference point estimates with 95 (2) ref\_ts - A dataframe with B/BMSY and reference point time series with 95 (3) priors - A dataframe with the priors used in the CMSY analysis; (4) rv.all - A vector with the viable r values; (5) kv.all - A vector with the viable k values; (6) btv.all - A dataframe with the biomass trajectories produced by the viable r/k pairs.

### References

Froese R, Demirel N, Coro G, Kleisner KM, Winker H (2017) Estimating fisheries reference points from catch and resilience. *Fish and Fisheries* 18(3): 506-526. <http://onlinelibrary.wiley.com/doi/10.1111/faf.12190/abstract>

### Examples

```
output <- cmsy2(year=SOLIRIS$yr, catch=SOLIRIS$ct, r.low=0.18, r.hi=1.02)
plot_dlm(output)
```

---

ocom

*Optimized catch-only model*

---

### Description

Estimates saturation (B/K) and stock status (B/BMSY) time series and other biological quantities (i.e., r, k, MSY, final year saturation) from a time series of catch and natural mortality (M) estimate using the optimized catch-only model (OCOM) from Zhou et al. (2017).

### Usage

```
ocom(year, catch, m)
```

### Arguments

|       |                          |
|-------|--------------------------|
| year  | A time series of years   |
| catch | A time series of catch   |
| m     | Natural mortality (1/yr) |

**Value**

A list containing the following elements: (1) time series of B/BMSY estimates; (2) 1000 randomly selected biomass trajectories; (3) 1000 corresponding B/BMSY trajectories; (4) estimates of biological quantities  $r$ ,  $k$ ,  $MSY$ ,  $S$ ; and (5) the 10,000 draws underpinning these values.

**References**

Zhou S, Punt AE, Smith ADM, Ye Y, Haddon M, Dichmont CM, Smith DC (2017) An optimised catch-only assessment method for data poor fisheries. ICES Journal of Marine Science: doi:10.1093/icesjms/fsx226. <https://doi.org/10.1093/icesjms/fsx226>

**Examples**

```
output <- ocom(year=TIGERFLAT$yr, catch=TIGERFLAT$catch, m=0.27)
plot_dlm(output)
```

---

plot\_cmsy2

---

*Plot cMSY and BSM model results*


---

**Description**

Plots cMSY and BSM model results following the example of Froese et al. (2016). Produces the following six plots:

- A - Catch time series
- B - Finding viable r-k pairs
- C - Viable r-k pairs
- D - Saturation (B/k) time series
- E - Exploitation rate ( $F / (r/2)$ ) time series
- F - Surplus production curve

**Usage**

```
plot_cmsy2(output)
```

**Arguments**

output                      Output from the cMSY or BSM stock assessment models (see ?cmsy2 or ?bsm)

**Value**

Six plots: (1) catch time series; (2) r-k pair search; (3) viable r-k pairs; (4) saturation time series; (5) exploitation rate time series; (6) surplus production curve

**References**

Froese R, Demirel N, Coro G, Kleisner KM, Winker H (2016) A Simple User Guide for CMSY and BSM (version “q”). 27 October 2016. <http://oceanrep.geomar.de/33076/>

**Examples**

```
# Fit cMSY and plot results
output <- cmsy2(year=SOLIRIS$yr, catch=SOLIRIS$ct, r.low=0.18, r.hi=1.02)
plot_cmsy2(output)
plot_cmsy2_mgmt(output)

# Fit BSM and plot results
output <- bsm(year=SOLIRIS$yr, catch=SOLIRIS$ct, biomass=SOLIRIS$bt, btype="CPUE", r.low=0.18, r.hi=1.02)
plot_cmsy2(output)
plot_cmsy2_mgmt(output)
```

---

|                 |   |
|-----------------|---|
| plot_cmsy2_mgmt | <i>Plot cMSY and BSM model results for management</i> |
|-----------------|---|

---

**Description**

Plots cMSY and BSM model results for management following the example of Froese et al. (2016). Produces the following four plots:

- A - Catch time series
- B - B/BMSY time series
- C - F/FMSY time series
- D - Kobe plot

**Usage**

```
plot_cmsy2_mgmt(output)
```

**Arguments**

|        |   |
|--------|---|
| output | Output from the cMSY or BSM stock assessment model (see ?cmsy2 or ?bsm) |
|--------|---|

**Value**

Four plots: (1) catch time series; (2) B/BMSY time series; (3) F/FMSY time serie; and (4) Kobe plot

**References**

Froese R, Demirel N, Coro G, Kleisner KM, Winker H (2016) A Simple User Guide for CMSY and BSM (version “q”). 27 October 2016. <http://oceanrep.geomar.de/33076/>

**Examples**

```
# Fit cMSY and plot results
output <- cmsy2(year=SOLIRIS$yr, catch=SOLIRIS$ct, r.low=0.18, r.hi=1.02)
plot_cmsy2(output)
plot_cmsy2_mgmt(output)

# Fit BSM and plot results
output <- bsm(year=SOLIRIS$yr, catch=SOLIRIS$ct, biomass=SOLIRIS$bt, btype="CPUE", r.low=0.18, r.hi=1.02)
plot_cmsy2(output)
plot_cmsy2_mgmt(output)
```

---

`plot_dlm`*Plot data-limited stock assessment output*

---

**Description**

Plots the results of data-limited stock assessment models.

**Usage**

```
plot_dlm(output)
```

**Arguments**

`output`                      Output from a datalimited2 model

**Details**

Produces different plots for each data-limited stock assessment model.

1. zBRT - Produces plots showing: (A) catch time series; (B) saturation time series; and (C) B/BMSY time series.
2. OCOM - Produces plots showing: (A) catch time series; (B) viable r/k pairs; (C) saturation time series; and (D) B/BMSY time series.
3. cMSY - Produces plots showing: (A) catch time series; (B) viable r/k pairs; (C) B/BMSY time series, (D) F/FMSY time series.
4. BSM - Produces plots showing: (A) catch time series; (B) viable r/k pairs; (C) B/BMSY time series, (D) F/FMSY time series.

**Examples**

```
output <- ocom(year=YELLSNEMATL$year, catch=YELLSNEMATL$tc, m=0.2)
plot_dlm(output)
```

---

`plot_ocom`*Plot OCOM results*

---

**Description**

Plot OCOM results

**Usage**

```
plot_ocom(output)
```

|   |  |
|---|--|
| plot_zbrt   | <i>Plot zBRT results</i>   |
| <b>Description</b><br>Plot zBRT results   |  |
| <b>Usage</b><br>plot_zbrt(output)   |  |
| rorcs   | <i>Refined ORCS approach</i>   |
| <b>Description</b><br>Estimates stock status (i.e., under, fully, or overexploited) from expert knowledge using the refined ORCS approach from Free et al. 2017.  |  |
| <b>Usage</b><br>rorcs(scores)   |  |
| <b>Arguments</b>  |  |
| scores  | A numeric vector of length twelve containing scores for the following "Table of Attributes" questions: <ul style="list-style-type: none"> <li>• TOA 1 - Status of assessed stocks in fishery</li> <li>• TOA 3 - Behavior affecting capture (2 or 3 only)</li> <li>• TOA 5 - Discard rate</li> <li>• TOA 6 - Targeting intensity</li> <li>• TOA 7 - M compared to dominant species</li> <li>• TOA 8 - Occurence in catch</li> <li>• TOA 9 - Value (US\$/lb) - continuous value</li> <li>• TOA 10 - Recent trends in catch</li> <li>• TOA 11 - Habitat loss</li> <li>• TOA 12 - Recent trend in effort</li> <li>• TOA 13 - Recent trend in abundance index</li> <li>• TOA 14 - Proportion of population protected</li> </ul> |
| <b>Value</b><br>Stock status (i.e., under, fully, or overexploited)   |  |
| <b>References</b><br>Free CM, Jensen OP, Wiedenmann J, Deroba JJ (2017) The refined ORCS approach: a catch-based method for estimating stock status and catch limits for data-poor fish stocks. <i>Fisheries Research</i> 193: 60-70. <a href="https://doi.org/10.1016/j.fishres.2017.03.017">https://doi.org/10.1016/j.fishres.2017.03.017</a> |  |



**Examples**

```
scores <- c(1, 2, NA, 2, 2, 3, 1.93, 2, 1, 2, 1, 3)
rorcs(scores)
```

s2bbmsy

*Convert B/BMSY to saturation***Description**

Converts B/BMSY to saturation ( $S = B/K$ ).

**Usage**

```
s2bbmsy(s)
```

**Arguments**

**s** Saturation (B/K) value(s)

**Details**

$$S = 1 - \text{depletion} = B / K = B/BMSY / 2 B/BMSY = S * 2$$
**Value**

B/BMSY values(s)

SOLIRIS

*Irish Sea Common sole time series***Description**

A dataset containing the catch and biomass time series for Irish Sea Common sole (*Solea solea*) from 1970-2014. This stock was used as an example in the cMSY/BSM user manual and is used to validate this package's implementation of cMSY and BSM.

**Usage**

```
SOLIRIS
```

**Format**

A data frame with 45 rows (years) and 4 variables:

**Stock** stock id

**yr** year

**ct** catch, in metric tons

**bt** biomass, in metric tons

**Source**

Froese R, Demirel N, Coro G, Kleisner KM, Winker H (2017) Estimating fisheries reference points from catch and resilience. *Fish and Fisheries* 18(3): 506-526. <http://onlinelibrary.wiley.com/doi/10.1111/faf.12190/abstract>

TIGERFLAT

*SE Australia Tiger flathead time series***Description**

A dataset containing the catch time series for SE Australia Tiger flathead (*Neoplatycephalus richardsoni*) from 1915-2012. This stock was used as an example in the OCOM paper and is used to validate this package's implementation of zBRT and OCOM.

**Usage**

TIGERFLAT

**Format**

A data frame with 98 rows (years) and 3 variables:

**stock** stock id

**yr** year

**catch** catch, in metric tons

**Source**

Zhou S, Punt AE, Smith ADM, Ye Y, Haddon M, Dichmont CM, Smith DC (2017) An optimised catch-only assessment method for data poor fisheries. *ICES Journal of Marine Science*: doi:10.1093/icesjms/fsx226. <https://doi.org/10.1093/icesjms/fsx226>

YELLSNEMATL

*USA SNE/MA Yellowtail flounder time series***Description**

A dataset containing the catch time series for USA SNE/MA Yellowtail flounder (*Pleuronectes ferruginea*) from 1973-2014.

**Usage**

YELLSNEMATL

**Format**

A data frame with 42 rows (years) and XX variables:

**Stock** stock id

**yr** year

**ct** catch, in metric tons ...

---

zbrt*Zhou-BRT catch-only stock assessment model*

---

**Description**

Estimates saturation (B/k) and stock status (B/BMSY) time series from a time series of catch using the boosted regression tree (BRT) model from Zhou et al. (2017).

**Usage**

```
zbrt(year, catch)
```

**Arguments**

|       |                        |
|-------|------------------------|
| year  | A time series of years |
| catch | A time series of catch |

**Value**

A dataframe with a time series of saturation and B/BMSY estimates. S8 and S38 correspond to the saturation estimates from the 8- and 38-predictor models, respectively. S, the best estimate of saturation, is the mean of these two predictions. B/BMSY is this estimate doubled ( $B/BMSY = S * 2$ ). High and low values correspond to the upper and lower 95

**References**

Zhou S, Punt AE, Yimin Y, Ellis N, Dichmont CM, Haddon M, Smith DC, Smith ADM (2017) Estimating stock depletion level from patterns of catch history. *Fish and Fisheries*. <http://onlinelibrary.wiley.com/doi/10.1111/faf.12201/abstract>

**Examples**

```
output <- zbrt(year=TIGERFLAT$yr, catch=TIGERFLAT$catch)
plot_dlm(output)
```

# Index

## \*Topic **datasets**

SOLIRIS, [9](#)

TIGERFLAT, [10](#)

YELLSNEMATL, [10](#)

bbmsy2s, [2](#)

bsm, [2](#)

cmsy2, [3](#)

ocom, [4](#)

plot\_cmsy2, [5](#)

plot\_cmsy2\_mgmt, [6](#)

plot\_dlm, [7](#)

plot\_ocom, [7](#)

plot\_zbrt, [8](#)

rorcs, [8](#)

s2bbmsy, [9](#)

SOLIRIS, [9](#)

TIGERFLAT, [10](#)

YELLSNEMATL, [10](#)

zbrt, [11](#)