Fishery Data Guide

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Contents

1 Introduction

In this context, fishery data includes any information that can be used for one of three purposes:

1. to estimate the status of an exploited stock (e.g., stock assessment or a similar analysis),
2. to condition an operating model (OM) for evaluating the performance of alternative management approaches using closed-loop simulation testing (e.g., Management Strategy Evaluation; MSE)
3. to be used by a management procedure (MP) to provide management advice.

This document describes the standardized fishery data format for the DLMtool and MSEtool R packages, and the browser-based interface for these packages: *MERA*.

Using a standardized format for fishery data has the advantage that a the data can easily be applied for these three purposes without any requiring any re-organizing of the fishery data.

For example, the data file described in this document can be imported in MERA (or the R packages) and used to:

1. estimate stock status with the 10+ stock assessment methods,
2. condition an operating model for quantitative risk assessment or MSE,
3. provide management advice from the 100+ available management procedures.

1.1 Data Files

There are two input files for the fishery data: a data input file and a data documentation file.

Once imported into MERA, the two files are combined to provide a report document including the contents of the documentation file and graphical display of the quantitative data in the data input file.

1.1.1 Data Input File

The Data Input File is a standardized file format for fishery data that uses a standardized spreadsheet format: either a CSV (comma separated file; file extension .csv') or a MS Excel file (file extension .xlsx or .xls). Support for Google Sheets may be added later. Users enter all available fishery data into the data input file, which can then be imported into the R packages or MERA and used for the variety of purposes described above.

1.1.2 Data Documentation File

The Data Documentation File is a companion document that contains supporting information for the quantitative data in the input file. For example, the data documentation file can include a written description of the sources of the various data, the methods used to obtain the data, and relevant references to data sources or other information relating to the data preparation.

MORE INFO ON HEADERS ETC

1.2 Templates

Templates for the Data Input and Data Documentation files can be downloaded from an online repository.

- Data Input Excel File [1] (or Data Input CSV File [2])
- Data Documentation File [3]

Note that the links to the Data Input CSV File and Data Documentation File will open in the web browser. Save these files to your machine (usually by right-clicking in the browser) will file extensions '.csv' and '.md' respectively.

If using the DLMtool or MSEtool R packages in a R session, the template files can be generated by typing the following commands in the R console:

```
library(DLMtool)
# replace "MyDataFile" with the name of the data files you wish to create
DataInit("MyDataFile")
```

It is important to note that, in most cases, the data input file allows only one entry for each data type. For example, multiple catch-at-age data sets may be available (e.g., from a commercial fishery and from a fishery-independent survey). However, to be used in stock assessment or analysis, the two data sets must be combined in some way (or one data set ignored if it is not considered representative or reliable). Consequently, the data included in the Data Input file must represent the best available data. That is, the data sets must be combined in some manner (ideally described in the Data Documentation File) and the single data set entered into the data input file so it can be used in assessment or by management procedures.

This same principle applies to other data entered into the data input file. The only exception is for indices of abundance where multiple indices are allowed. This is explained in more detail in later sections of this guide.

2 Populating the Fishery Data File

This section of the guide describes how to enter data in the Data Input file and document the data in the Data Documentation file.

[1] https://raw.githubusercontent.com/DLMtool/DLMtool/master/inst/Data.xlsx
[2] https://raw.githubusercontent.com/DLMtool/DLMtool/master/inst/Data.csv
[3] https://raw.githubusercontent.com/DLMtool/DLMtool/master/inst/Rmd/Data/Data.md

	A	B
1	**Name**	**Data**
2	Name	Example Cobia Data
3	Common Name	Cobia
4	Species	*Rachycentron canadum*
5	Region	West Atlantic
6	Last Historical Year	2011
7	Previous TAC	
8	Units	1000 lbs
9	Previous TAE	
10	nareas	
11		

Figure 1: Example Metadata entries in the Data Input file

Important Note 1: It is important that the text in the first column of the input file (column A) is not modified at all. These names are used to import the data file into MERA or the R packages.

Important Note 2: The data input file requires both character string (i.e., text) and numeric inputs. The data format for each entry is described below. It is important that no text is entered into the entries that require numeric inputs. For example, "Previous TAC" is a numeric input. A value of '1000' (without the quotations) is acceptable, while an input of 'about 1000' is not.

Important Note 3: Do not use any thousands separators. For example 1 000 000 and 1,000,000 may introduce errors during the data import. Entries like 1000000 are preferable.

The fishery data are grouped into 7 categories:

1. Metadata
2. Biological parameters
3. Selectivity parameters
4. Time-series information
5. Catch-at-age data
6. Catch-at-length data
7. Reference points and other metrics

The following sub-sections describe the data inputs for each of these categories.

2.1 Metadata

The metadata section has 9 entries (see Figure 1 for example). All entries must go in the second column (column B if using a spreadsheet program such as MS Excel).

DOCUMENTATION

2.1.1 Name

Text entry. A unique name for this data file.

2.1.2 Common Name

Text entry. The common name of the species.

The example data file is for data from a fishery for cobia.

2.1.3 Species

Text entry. The scientific name of the species.

The example data file includes the species name for cobia.

2.1.4 Region

Text entry. The region of the fishery.

The example data file assumes the fishery is in the Western Atlantic.

2.1.5 Last Historical Year

Numeric entry. The calendar year of either:

1. when the most recent time-series data was collected, or
2. in cases where an MSE has already been conducted for this species and new data has been collected since, the last historical year when the MSE was run. For example, if an MSE was conducted for this fishery in 2016 and new data has been collected since then, the last historical year is 2016.

The last historical year was 2011 in the example (Figure 1).

2.1.6 Previous TAC

Numeric entry. The most recent total allowable catch (TAC). Leave blank if no TAC exists.

There was no existing TAC for the example cobia fishery.

2.1.7 Units

Text entry. The units of the TAC and catch data, e.g., 'thousand tonnes'. Leave blank if no TAC or catch data exists.

The catch data in the example fishery is in units of '1000 lbs'.

2.1.8 Previous TAE

Numeric entry. The most recent total allowable effort limit (TAE). Leave blank if no TAE exists.

There was no existing TAE for the example cobia fishery.

2.1.9 nareas

Numeric entry. The number of spatial areas used in management. Only used for management procedures that set spatial closures. Leave blank if no spatial management is used or proposed.

There is no spatial management for the example cobia fishery.

12	**Biology**	
13	Maximum age	16
14	M	0.26
15	CV M	0.3
16	Von Bertalanffy Linf parameter	1324.4
17	CV von B. Linf parameter	0.23
18	Von Bertalanffy K parameter	0.27
19	CV von B. K parameter	0.07
20	Von Bertalanffy t0 parameter	-0.47
21	CV von B. t0 parameter	0.05
22	Length-weight parameter a	
23	CV Length-weight parameter a	
24	Length-weight parameter b	
25	CV Length-weight parameter b	
26	Steepness	
27	CV Steepness	
28	sigmaR	
29	CV sigmaR	
30	Length at 50% maturity	644
31	CV Length at 50% maturity	0.05
32	Length at 95% maturity	850
33	CV of length-at-age	0.1

Figure 2: Example Biology entries in the Data Input file

2.2 Biology

The next section contains mean and uncertainty values for the biological parameters of the species. Leave any entry blank if the parameter is unknown.

DOCUMENTATION

2.2.1 Maximum age

Numeric entry. The maximum age of the species. The catch-at-age data entries must match this value (see the Catch-at-Age section for more details).

The cobia example has a maximum age of 16 (Figure 2).

2.2.2 M and CV M

Numeric entries. A point estimate for the (adult) natural mortality rate (M) and a coefficient of variation (CV) associated with this estimate (assuming a log-normal distribution).

The cobia example has an estimate of M of 0.26 and an associated CV of 0.3 (Figure 2).

2.2.3 von Bertalanffy Linf parameter and CV

Numeric entries. The estimated mean asymptotic length from a fitted von Bertalanffy growth model and the associated CV.

The units of the *Linf* parameter are not important, but all length parameters and data (e.g., length-at-maturity and catch-at-length) must be in the same units.

The cobia example has an estimate of *Linf* of 1324.4 and an associated CV of 0.23 (Figure 2).

2.2.4 von Bertalanffy K parameter and CV

Numeric entries. The estimated von Bertalanffy growth parameter (K) and the associated CV.

The K parameter must be in the same units as M, usually year^{-1}.

The cobia example has an estimate of K of 0.27 and an associated CV of 0.07 (Figure 2).

2.2.5 von Bertalanffy t0 parameter and CV

Numeric entries. The estimated age when mean length is zero (*t0*) and the associated CV.

The *t0* parameter must be in the same units as "Maximum age" (usually years).

The cobia example has an estimate of *t0* of -0.47 and an associated CV of 0.05 (Figure 2).

2.2.6 Length-weight parameters

Numeric entries. Estimates of the a and b parameters (and associated CVs) from a fitted length-weight model of the form:

$$W = aL^b$$

This data is not available for the example cobia data (Figure 2).

2.2.7 Recruitment parameters

Numeric entries. Mean estimates and associated CVs.

The *steepness* parameter is the expected fraction of virgin recruitment when the spawning biomass has been reduced to 20% of the unfished level. This is an important parameter for determining the productivity of the stock, especially at low levels of spawning biomass. However, the parameter is difficult to estimate and not well known for many species.

The *sigmaR* parameter describes the variance around the expected stock-recruitment relationship.

This data is not available for the example cobia data (Figure 2).

2.2.8 Length-at-Maturity parameters

Numeric entries. Mean estimates and associated CVs.

The *Length at 50% maturity* and *Length at 95% maturity* parameters are estimated by fitting a logistic model to maturity-at-length data. The parameters refer to the expected length where 50% and 95% respectively

35	**Selectivity**		
36	Length at first capture	130	
37	CV Length at first capture	0.2	
38	Length at full selection		
39	CV Length at full selection		
40	Vulnerability at asymptotic length	1	

Figure 3: Example Selectivity entries in the Data Input file

of the population are mature. The CV of length at 95% maturity is assumed to be the same as the CV of length at 50% maturity.

The example cobia data has estimates of the length at 50% and 95% maturity of 644 and 850 mm respectively, and a CV of 0.05.

2.2.9 Variability of length-at-age

Numeric entry. The expected variability of length-at-age; that is, the distribution of length-at-age around the mean growth curve described by the von Bertalanffy growth model.

The example cobia data assumed a coefficient of variability of length-at-age of 0.1.

2.3 Selectivity

There are five parameters relating to selectivity at length. Leave any entry blank if the parameter is unknown.

2.3.1 Length at first capture

Numeric entries.

The *Length at first capture* is an estimate of first length class that is vulnerable to the fishery (and the associated CV).

The example cobia data file assumes a length of first capture of 130 and a CV of 0.2 (Figure 3).

2.3.2 Length at full selection

Numeric entries.

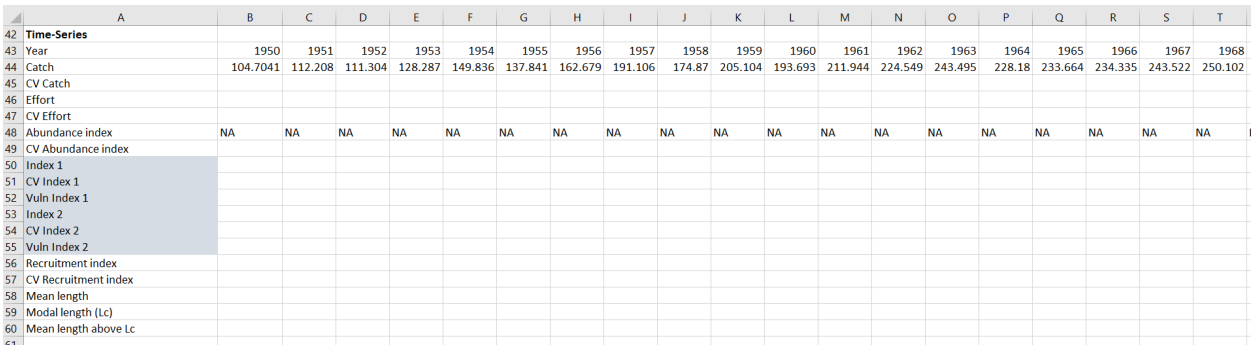
The *Length at full selection* is the first length class that is fully vulnerable to fishing (and the associated CV).

No information is available for the length at full selection for the example cobia data file (Figure 3).

2.3.3 Vulnerability at asymptotic length

Numeric entry.

The *Vulnerability at asymptotic length* describes that shape of the selectivity curve. Dome-shaped selectivity patterns (Vulnerability at asymptotic length < 1) occurs vulnerability to fishing begins to decrease after reaching a maximum value at some intermediate length.



	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T
42	**Time-Series**																			
43	Year	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	1960	1961	1962	1963	1964	1965	1966	1967	1968
44	Catch	104.7041	112.208	111.304	128.287	149.836	137.841	162.679	191.106	174.87	205.104	193.693	211.944	224.549	243.495	228.18	233.664	234.335	243.522	250.102
45	CV Catch																			
46	Effort																			
47	CV Effort																			
48	Abundance index	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
49	CV Abundance index																			
50	Index 1																			
51	CV Index 1																			
52	Vuln Index 1																			
53	Index 2																			
54	CV Index 2																			
55	Vuln Index 2																			
56	Recruitment index																			
57	CV Recruitment index																			
58	Mean length																			
59	Modal length (Lc)																			
60	Mean length above Lc																			

Figure 4: Example Time-series entries in the Data Input file

AO	AP	AQ	AR	AS	AT	AU	AV	AW	AX	AY	AZ	BA	BB	BC	BD	BE	BF	BG	BH	BI	BJ	BK
1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011
524.939	485.794	812.279	567.168	378.929	416.998	736.258	1025.7	694.553	549.759	593.751	639.593	549.412	415.301	1152.86	1196.39	1139.92	1272.44	832.809	609.65	1002.92	1081.08	508.243
0.81	0.55	1.72	1.34	1.05	1.19	1.32	0.56	0.94	0.86	0.9	1.28	1.34	0.9	1.11	1.08	1.08	0.94	1.54	1.96	0.93	0.88	0.94

Figure 5: Example time-series entries in the Data Input file showing the entries continuing to the last historical year (2011)

The example cobia data file assumes asymptotic selectivity (Vulnerability at asymptotic length = 1) (Figure 3).

2.4 Time-Series

The time-series section includes data sources such as annual catches, annual abundance indices, and other annual indices such as recruitment, and mean length.

Time-series data should be entered for all historical years of the fishery; that is, the first year the fishery began to the current year of data (Figures 4 and 5). Years where no data are available should either be left empty or populated with an 'NA' (no quotations).

2.4.1 Year

2.4.2 Annual Catch

2.4.3 Annual Effort

2.4.4 Abundance Index

2.4.5 Additional Indices

2.4.6 Recruitment Index

2.4.7 Mean Length

2.4.8 Modal Length (LC)

2.4.9 Mean Length above Lc

2.5 Catch-at-Age

2.6 Catch-at-Length

2.7 Reference Points

3 Importing the Fishery Data File

MERA

R Packages

4 The Fishery Data Object

slotnames

slot dimensions

4.1