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Review of pre-1998 SESSF data

AFMA Project 2019-0801

Matt Koopman

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Contents

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Researcher Contact Details

Name:	Matt Koopman
Address:	Fishwell Consulting
	27A Hesse St Queenscliff, VIC 3225
Phone:	+61 3 5258 4399
Web:	www.fishwell.com.au

Executive summary

Onboard length frequency data are key inputs into stock assessments. Fisheries observers have been measuring fish caught by the Commonwealth Trawl Sector (CTS) of the Southern and Eastern Scalefish and Shark Fishery (SESSF) since 1992. The first coordinated SESSF observer program, the Scientific Monitoring Program (SMP) was run from 1993–1995 by a steering committee comprising representatives from Industry, the Australian Fisheries Management Authority (AFMA), Bureau of Rural Sciences (BRS), Commonwealth Scientific and Industrial Research Organisation (CSIRO), and State fisheries agencies (New South Wales, Victoria and Tasmania). This program recorded retained and discarded catches and length frequency measurements from trawl vessels in the then South East Fishery (SEF). At the same time, the New South Wales Fisheries Research Institute also collected length frequency data from SEF trawlers working out of the NSW ports of Eden, Ulladulla and Newcastle/Tuncurry. To improve efficiency in data collection from the SEF, a statistically rigorous sampling program (the Integrated Scientific Monitoring Program, ISMP) was designed in 1996 and 1997 and then implemented in 1998. During 1996 and 1997, an interim SMP was undertaken to maintain the time series of data. This program was managed by AFMA, with NSW and Victoria conducting the sampling and BRS managing the databases.

At some stage prior to 1998, observer data from the SMP, NSW sampling program and the interim SMP were combined into one database, presumably by BRS. For a number of reasons, the resulting onboard length frequency data contained many obvious errors. This project identified the main issues and corrected them where possible.

The main issues identified were: 1) the classification whether or not the catch was sorted before the length frequency sample was taken; 2) misclassification of retained lengths as discarded lengths; 3) missing proportion of catch weight sampled for length measurement; and, 4) missing catch and sample size information. Where possible, the misclassification errors were addressed using a logical algorithm that can be applied to the complete dataset. Missing information on the proportion of catch weight sampled was calculated from either the number of fish measured and number of fish retained or discarded, or from calculation of sample weights using length-weight relationships. Records with missing catch and sample size information were flagged to be deleted.

We searched through old Victorian Department of Primary Industry data (now Victorian Fisheries Authority - VFA) for onboard length frequency data not in the current database, but none was found. However, significant numbers of port-based length frequencies found in the VFA files were missing from the AFMA database. The addition of those data to the database is outside the scope of this project, but should be addressed.

Of the 319,311 onboard length records considered in this project, about 33% were incorrectly coded. 69,612 (22%) were re-coded from “discarded” to “retained”, 32 (0.01%) from “retained” to “discarded” to 36,246 (11%) from “discarded” to “fate unknown” and 66 (0.2%) from “retained” to “fate unknown”.

With these corrections in place, we believe that the length frequency data resulting from this project provides a more accurate dataset, and should be used for future stock assessments. If preferred, rather than apply these methods to the data stored in the AFMA database, the AFMA database could remain as is, and this process be either applied by AFMA when providing the CSIRO with an extract, or by the CSIRO after receiving the extract.

Introduction

Recommended Biological Catches (RBCs) for quota species in the Southern and Eastern Scalefish and Shark Fishery (SESSF) are calculated during stock assessments. One of the key inputs into Tier 1 stock assessments is length frequencies collected by observers sampling onboard commercial fishing activities. Due to the large amount of length frequency data collected, stock assessment results can be sensitive to the time series of length frequencies. Use of quality data not only provides for more accurate outputs, but also increases confidence in those assessments.

The Australian Fisheries Management Authority (AFMA) observer database contains onboard length frequency records dating back to 1992. Over time, the custodian of length frequency data for SESSF species has changed often, and the data has been warehoused in at least five different databases across as many different departments. Complicating the matter, the end users of the data for stock assessments, CSIRO, have multiple datasets that can't be reconciled due to different values of some fields, particularly those relating to discards. This is a particular issue for data from 1992 to 1997. CSIRO screen data for some fields they consider are mandatory, resulting in significantly reduced datasets for some species in some years. Based on a knowledge of how this data is collected and the other datasets that can be used to verify some fields, there are some missing and/or incorrect field records in the historical length dataset which may be able to be populated retrospectively. One example is the proportion of the catch sampled, which is used to weight-up the length frequency to the catch. Any data that can be corrected and populated back into datasets may improve assessments by maximising the amount of data used.

An example of issues with the data is demonstrated in Table 1 and Figure 1 showing duplicated datasets held by AFMA and the CSIRO. Table 1 shows the number of fish measured by fate: either retained, discarded or unknown. For the species and gear types shown, not one of numbers of fish measured match between datasets, but the total numbers – when fates are combined – are either identical or very similar. This is shown graphically in Figure 1 where the resulting length frequency distributions are very different.

Looking closer, there are many clear examples of errors in the assignment of retained and discarded catches in the original Victorian Fisheries Authority (VFA) dataset that have been translated into the AFMA dataset, and endeavours to correct many of those errors were attempted for the CSIRO dataset but introduced further errors. An example is shown in Table 2 and Table 3. The data in the VFA database (Table 2) for Jackass Morwong caught in shot 2 on 21/10/1993 by vessel S52 has two discarded fish (25 cm and 24 cm) and 47 retained fish (27 cm – 38 cm). With an LFDIS of 10 (10% of the discarded catch measured), that two fish of the 20 discarded were measured makes sense. Likewise, with an LFRET of 40.2, it makes sense that 47 retained fish of the 117 caught were measured. These data appear to be correct but in the CSIRO database, all fish measured from shot 2 are recorded as discarded, and the value for LFRET set to 0 (Table 3). This would mean that 49 fish were measured out of the 20 discarded, and that weighting it up by LFDIS would mean there was actually 490 fish discarded — more than three times the total catch of Jackass Morwong. LFRET for the following shot is the same as for shot 2, and perhaps it was assumed that the entry of LFRET in shot 2 was a duplication error. These errors are typical in the CSIRO dataset.

Where possible, this report resolves the issues in the pre-1998 data, and seeks to provide an agreed data set for use in future stock assessments.

Table 1. Sum of number of fish measured by gear type, year and species in the CSIRO and AFMA datasets (note that the CSIRO dataset contains decimals in the numbers of fish, and these have been rounded in this summary) for selected examples showing discrepancy between classification of retained and discarded fate. Numbers green are those that match between datasets. OT = Otter trawl, DS = Danish seine. A table (Table 10) containing the number of fish measured by gear type, year and species in the CSIRO and AFMA datasets for all species is shown in Appendix 0.

			Discarded		Retained		Unknown fate		Combined fate	
Year	Gear	Common Name	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA
1992	OT	Blue Grenadier	1	758	679	0	78	0	758	758
1993	OT	Blue Grenadier	9	2362	2,307	161	207	0	2523	2523
1994	OT	Blue Grenadier	0	2733	2,740	7			2740	2740
1995	OT	Blue Grenadier	58	7117	4,629	5	2,435	0	7122	7122
1996	OT	Blue Grenadier	4072	8323	854	829	4,226	0	9152	9152
1997	OT	Blue Grenadier	10637	8282	1,012	3,367			11649	11649
1993	OT	Blue Warehou	102	519	847	430			949	949
1994	OT	Blue Warehou	761	3137	2,996	1,124	503	0	4260	4261
1995	OT	Blue Warehou	332	2049	1,607	371	479	0	2418	2420
1996	OT	Blue Warehou	17	2534	2,393	94	218	0	2628	2628
1997	OT	Blue Warehou	375	217	1,130	1,288			1505	1505
1994	DS	Eastern School Whiting	150	8803	3,776	0	4,877	0	8803	8803
1995	DS	Eastern School Whiting	0	3900	3,701	0	199	0	3900	3900
1993	OT	Jackass Morwong	328	887	1,286	730			1614	1617
1994	OT	Jackass Morwong	1151	3199	2,268	1,332	1,111	0	4530	4531
1995	OT	Jackass Morwong	66	1035	488	205	686	0	1240	1240
1996	OT	Jackass Morwong	1256	1820	1,496	1,380	448	0	3200	3200
1997	OT	Jackass Morwong	4519	565	2,940	6,894			7459	7459
1996	OT	Blue Grenadier	4072	8323	854	829	4,226	0	9152	9152
1997	OT	Blue Grenadier	10637	8282	1,012	3,367			11649	11649
1993	OT	Blue Warehou	102	519	847	430			949	949
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1997	OT	Jackass Morwong	4519	565	2,940	6,894			7459	7459

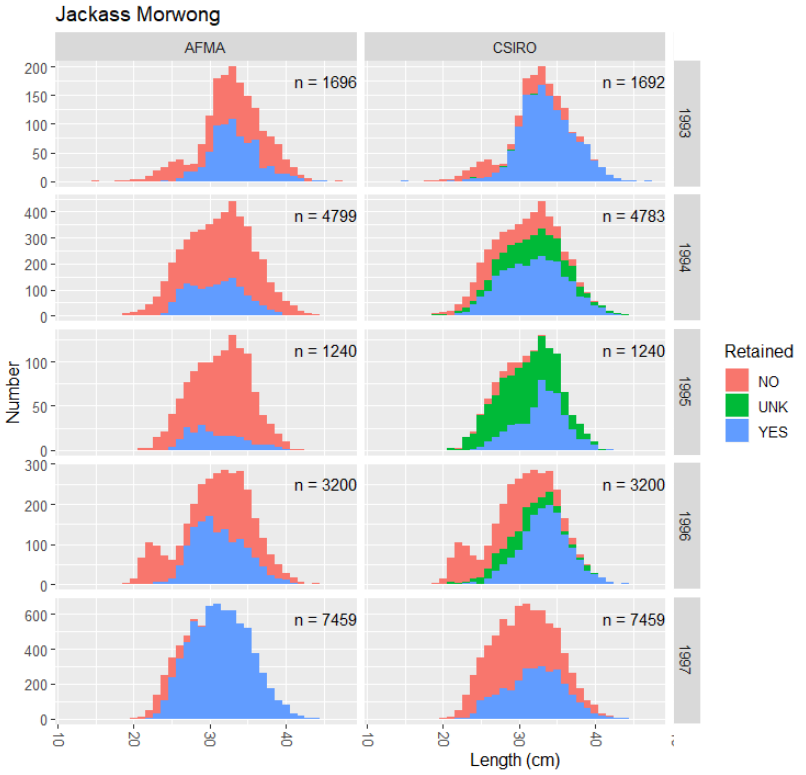

Figure 1. Resultant length frequency of Jackass Morwong from 1993 to 1997 from two different datasets.

Table 2. Example from the original VFA database where both retained and discarded fish from the one shot contained values of LFRET and LFDIS (SHOTNU 2). In this case the two smallest fish (in bold) are reported ad discarded (RETAINED = FALSE). Looking at the values of LFRET and LFDIS and comparing the numbers of fish measured and the number of fish reported retained and discarded, the recording of retained and discarded appear correct.

CALLSIGN	CSIROCODE	SHOTDATE	SHOTNU	LENGTH	NUWHATSEX	RETWHOLE	RETNO	DISWHOLE	DISNO	LFRET	LFDIS	RETAINED
S52	**377003**	**21/10/1993**	**2**	**25**	**1**	**81**	**117**	**5**	**20**	**40.2**	**10**	**FALSE**
S52	**377003**	**21/10/1993**	**2**	**24**	**1**	**81**	**117**	**5**	**20**	**40.2**	**10**	**FALSE**
S52	377003	21/10/1993	2	30	3	81	117	5	20	40.2	10	TRUE
S52	377003	21/10/1993	2	37	2	81	117	5	20	40.2	10	TRUE
S52	377003	21/10/1993	2	31	9	81	117	5	20	40.2	10	TRUE
S52	377003	21/10/1993	2	34	4	81	117	5	20	40.2	10	TRUE
S52	377003	21/10/1993	2	33	6	81	117	5	20	40.2	10	TRUE
S52	377003	21/10/1993	2	36	5	81	117	5	20	40.2	10	TRUE
S52	377003	21/10/1993	2	27	2	81	117	5	20	40.2	10	TRUE
S52	377003	21/10/1993	2	32	7	81	117	5	20	40.2	10	TRUE
S52	377003	21/10/1993	2	28	2	81	117	5	20	40.2	10	TRUE
S52	377003	21/10/1993	2	35	3	81	117	5	20	40.2	10	TRUE
S52	377003	21/10/1993	2	38	3	81	117	5	20	40.2	10	TRUE
S52	377003	21/10/1993	2	29	1	81	117	5	20	40.2	10	TRUE
S52	377003	21/10/1993	3	36	4	75	122	5	20	40.2	NA	TRUE
S52	377003	21/10/1993	3	33	6	75	122	5	20	40.2	NA	TRUE
S52	377003	21/10/1993	3	27	1	75	122	5	20	40.2	NA	TRUE
S52	377003	21/10/1993	3	29	5	75	122	5	20	40.2	NA	TRUE
S52	377003	21/10/1993	3	41	1	75	122	5	20	40.2	NA	TRUE
S52	377003	21/10/1993	3	34	5	75	122	5	20	40.2	NA	TRUE
S52	377003	21/10/1993	3	32	6	75	122	5	20	40.2	NA	TRUE
S52	377003	21/10/1993	3	28	4	75	122	5	20	40.2	NA	TRUE
S52	377003	21/10/1993	3	31	7	75	122	5	20	40.2	NA	TRUE
S52	377003	21/10/1993	3	39	1	75	122	5	20	40.2	NA	TRUE
S52	377003	21/10/1993	3	35	3	75	122	5	20	40.2	NA	TRUE
S52	377003	21/10/1993	3	30	6	75	122	5	20	40.2	NA	TRUE

Table 3. Example from the CSIRO database where an attempt was made to correct what was perceived as incorrectly recording discarded fish as retained (in bold). The value of LFRET has been changed to zero, and weighting up the number of fish measured (49 fish) by LFDis (10%) results in 490 fish, when only 117 fisher were reported as retained weighing 81 kg, and 20 fish 5 kg.

ID	CallSign	CAAB	Year	Month	Day	Len	NTot	LFRet	LFDis	Retained
568063	S52	37377003	1993	10	21	24	1	0	10	NO
568064	S52	37377003	1993	10	21	25	1	0	10	NO
568066	**S52**	**37377003**	**1993**	**10**	**21**	**27**	**2**	**0**	**10**	**NO**
568067	**S52**	**37377003**	**1993**	**10**	**21**	**28**	**2**	**0**	**10**	**NO**
568069	**S52**	**37377003**	**1993**	**10**	**21**	**29**	**1**	**0**	**10**	**NO**
568071	**S52**	**37377003**	**1993**	**10**	**21**	**30**	**3**	**0**	**10**	**NO**
568074	**S52**	**37377003**	**1993**	**10**	**21**	**31**	**9**	**0**	**10**	**NO**
568076	**S52**	**37377003**	**1993**	**10**	**21**	**32**	**7**	**0**	**10**	**NO**
568077	**S52**	**37377003**	**1993**	**10**	**21**	**33**	**6**	**0**	**10**	**NO**
568079	**S52**	**37377003**	**1993**	**10**	**21**	**34**	**4**	**0**	**10**	**NO**
568081	**S52**	**37377003**	**1993**	**10**	**21**	**35**	**3**	**0**	**10**	**NO**
568084	**S52**	**37377003**	**1993**	**10**	**21**	**36**	**5**	**0**	**10**	**NO**
568085	**S52**	**37377003**	**1993**	**10**	**21**	**37**	**2**	**0**	**10**	**NO**
568086	**S52**	**37377003**	**1993**	**10**	**21**	**38**	**3**	**0**	**10**	**NO**
568065	S52	37377003	1993	10	21	27	1	40.2	0	YES
568068	S52	37377003	1993	10	21	28	4	40.2	0	YES
568070	S52	37377003	1993	10	21	29	5	40.2	0	YES
568072	S52	37377003	1993	10	21	30	6	40.2	0	YES
568073	S52	37377003	1993	10	21	31	7	40.2	0	YES
568075	S52	37377003	1993	10	21	32	6	40.2	0	YES
568078	S52	37377003	1993	10	21	33	6	40.2	0	YES
568080	S52	37377003	1993	10	21	34	5	40.2	0	YES
568082	S52	37377003	1993	10	21	35	3	40.2	0	YES
568083	S52	37377003	1993	10	21	36	4	40.2	0	YES
568087	S52	37377003	1993	10	21	39	1	40.2	0	YES
568088	S52	37377003	1993	10	21	41	1	40.2	0	YES

Objectives

The objectives of the project were as follows:

1. Collate and compare length frequency datasets from CSIRO, AFMA and VFA.
2. Identify the most accurate length frequency dataset and describe the cause of the issue.
3. Fill in missing fields where possible.
4. Add length frequency data not currently in any database.
5. Obtain consensus on correct length frequency data to be used.

Methods

Historical onboard length frequency datasets were obtained from the CSIRO and an archived drive from the Victorian Fisheries Authority (VFA).

1.1 Data sources

The three main datasets examined are:

1. Onboard length frequency data from the **VFA** database copied from the archived VFA drive that included (ismpupdate2.mdb);
2. Onboard length frequency data from a recent extract from the AFMA to the CSIRO of the ISMP data that we will refer to as the **AFMA** database (RTonbl.txt, provided by Robin Thomson, CSIRO on 1/9/2017); and
3. Onboard length frequency data from an old extract from the VFA database to the CSIRO of the ISMP data that we will refer to as the **CSIRO** database (NKonbl_to1997.txt, provided by Robin Thomson, CSIRO on 1/9/2017).

While we name the datasets the **VFA**, **AFMA** and **CSIRO** datasets, they all derive from the same source, and they are named as such for simplicity rather than to imply ownership of the data or lay blame for issues that have arisen. These data sources cover the same pre-1998 time period.

The AFMA and CSIRO data both came from the VFA database which was used to warehouse observer data up until 2007. From the VFA database, the CSIRO received annual data dumps, while all data was provided to AFMA in 2007 as a handover as data custodian. The VFA database has been untouched since then, and is the less likely data source to have been compromised. In this report we take the approach of assuming the VFA database has the greatest integrity, and correct those data to what we believe is the most realistic representation of data that was collected. We use the AFMA and CSIRO data to identify errors, explain how they might have occurred, and to develop logical algorithms to correct the data. These are described in the results section.

1.2 Database fields

Field names in the various databases are usually referred to in this report by the field name. These are defined below as described in Thomson (2002)[1]:

- **Sorted** – Logical ('YES' or 'NO'), was the catch sorted into retained / discarded components before sampling?
- **TotNum** – Total number of fish measured
- **LFRET** – The percentage of the retained catch that was measured
- **LFDIS** – The percentage of the discarded catch that was measured
- **LFDATA** – The percentage of the retained catch that was measured
- **Retained** – Logical ('YES' or 'NO'), was the sample retained or discarded

[1] Thomson, R. (2002). South East Fishery data for stock assessment purposes. CSIRO Marine Research. Hobart, TAS.

The term “fate” refers to whether the fish measured was from the retained or discarded part of the catch.

1.3 Calculating sample weights from length-weight relationships

Where proportion of the catch sampled for length frequencies was missing, sample weights were calculated from length-weight relationship, fish length and the number of fish measured at each length. Length-weight parameters used for the main species are shown in Table 4, and resulting length-weight curves are shown in Figure 2.

Table 4. Parameters of the length-weight relationship used to calculate sample weights. Refer to references for units of measurements.

Common name	a	b	Source
Tiger Flathead	0.00588	3.31	[2]
Redfish	0.05515	2.7723	[3]
Blue Grenadier	0.01591	2.704	[4]
Silver Warehou	0.01531	3	[3]
Pink Ling	0.00293	3.129	[4]
Jackass Morwong	0.017	3.031	[5]
Orange Roughy	0.0367	2.956	[3]
Blue Warehou	0.03	2.9	[3]
Eastern School Whiting	0.00556	3.188	[3]
Gemfish	0.00143	3.39	[5]
Mirror Dory	0.0164	3	[5]
Bigeye Ocean Perch	0.0335	2.97	[6]
Reef Ocean Perch	0.0373	2.95	[6]
Velvet Leatherjacket	0.0556	2.9	[7]
Spikey Oreodory	0.02405	2.963	[6]
John Dory	0.0157	2.954	[6]
Silver Trevally	0.131	2.51	[6]
Spikey Dogfish	0.0068	2.94	[3]
King Dory	0.0263	2.974	[6]
Frostfish	0.0003	3.23	[6]
Barracouta	0.0074	2.94	[6]
Southern Sand Flathead	0.004235	3.1155	[6]
Grey Morwong	0.0012	3.35	[3]
Blue-Eye Trevalla	0.008657	3.1885	[3]

[2] https://www.afma.gov.au/sites/g/files/net5531/f/stock-assessment-for-the-southern-and-eastern-scalefish-and-shark-fishery-2016-and-2017-part-1-reduced-size2.pdf

[3] https://www.environment.gov.au/system/files/resources/c1a527fa-4007-4ebc-86d8-0773484c6457/files/se-fisheries.pdf

[4] Tuck, G.N. (ed.) 2014. Stock Assessment for the Southern and Eastern Scalefish and Shark Fishery 2013.

[5] Tuck, G.N. (ed.) 2011. Stock Assessment for the SESSF 2010. Part 1.

[6] https://www.fishbase.de/search.php

[7] https://media.nature.com/original/nature-assets/nclimate/journal/v3/n3/extref/nclimate1691-s1.pdf

Figure 2. Length-weight relationships used to calculate sample weights for LFRET and LFDIS calculations.

Results and discussion

1.4 Corrections to the VFA database

1.4.1 Read in the VFA database

Each relevant table of the VFA database (ISMPupdate2.mdb) was saved as a .csv file, read into R and merged as follows:

```
library(openxlsx)

OBlength <-  read.csv("/ismpupdate2LENGTHBACKUP.csv", header=TRUE, sep=",")

OBcatch <-  read.csv("/ismpupdate2CCDATABACKUP.csv", header=TRUE, sep=",")

OBCSIRO <-  read.csv("/ismpupdate2CAABSPECIESLIST.csv", header=TRUE, sep=",")

OBCCruise <-  read.csv("/ismpupdate2CRUISEBACKUP.csv", header=TRUE, sep=",")

OBCTrawl <-  read.csv("/ismpupdate2TRAWLBACKUP.csv", header=TRUE, sep=",")

OBCCruise<-OBCCruise[,c(1,2,24)]    #"CALLSIGN"   "CRUISEDATE" "TYPE"

OBlengthMerge<-merge(OBlength, OBcatch, by=c("CALLSIGN", "CRUISEDATE", "SHOTDATE", "SHOTNU",
"CSIROCODE"), all.x=TRUE,all.y=FALSE)

OBlengthMerge<-merge(OBlengthMerge, OBCSIRO, by.x="CSIROCODE", by.y="SETF..GAB.Code",
all.x=TRUE,all.y=FALSE)

OBlengthMerge<-merge(OBlengthMerge,OBCCruise, by=c("CALLSIGN", "CRUISEDATE"), all.x=TRUE,all.y=FALSE)

RDate<-as.POSIXlt(strptime(OBlengthMerge$SHOTDATE,"%d/%m/%Y"))

OBlengthMerge$Day<- RDate$mday

OBlengthMerge$Year<- RDate$year+1900

OBlengthMerge$Month<- RDate$mon+1

OBlengthMerge<-subset(OBlengthMerge, Year<1998)

OBlengthMerge$RETWHOLE[is.na(OBlengthMerge$RETWHOLE)] <- -99

OBlengthMerge$DISWHOLE[is.na(OBlengthMerge$DISWHOLE)] <- -99

OBlengthMerge$RETNO[is.na(OBlengthMerge$RETNO)] <- -99

OBlengthMerge$DISNO[is.na(OBlengthMerge$DISNO)] <- -99

OBlengthMerge$NTot<-with(OBlengthMerge, NUMALES +NUFEMALES +NUWHATSEX)
```

1.4.2 Sorted

The field “Sorted” refers to whether the catch was sorted into retained / discarded components before sampling. There are clear errors in recording of “sorted” made obvious when only either retained or discarded catch of that species was recorded in a shot. Those 72,914 records have been recoded as Sorted = true (Table 5). There were two records in which the retained weight and discarded number were both greater than 0, but the discarded weight was 0 and there was no LFDATA, LFRET or LFDIS. For those records, Sorted was recoded as unknown. A total of 9,063 records with Sorted = false remained as such, and nearly all of those records were flagged for deletion as described below.

Table 5. Summary of number of fish assigned as sorted = true, false or unknown in original ISMP database after running the code below. Outcomes that resulted in a change in the corrected dataset are highlighted orange.

Sorted	Original dataset	
Corrected dataset	False	True
False	9,063	0
True	72,914	200,094
Unknown	36,067	245

```
AllLFs<-(OBlengthMerge[,c(1:25,28:30,37:39,41)])
[1] "CALLSIGN” “CRUISEDATE” “CSIROCODE” “SHOTDATE” “SHOTNU" "LENGTH" "LENCODE" "NUMALES"
[9] "NUFEMALES” “NUWHATSEX” “SORTED" "RETAINED” “MEASCODE” “Discard" "Retained2” “RETWHOLE"
[17] "RETNO" "DISWHOLE” “DISNO" "LFDATA" "BIOLDATA” “COMMENTS” “LFRET" "LFDIS"
[25] "PROCESS" "CAAB.CODE” “COMMON.NAME" "SCIENTIFIC.NAME" "TYPE" "Day" "Year" "NTot"

AllLFs$Sorted_2<-with(AllLFs,ifelse(DISWHOLE<=0 & DISNO<=0  &RETWHOLE>0, "TRUE

          ifelse(DISWHOLE<=0 & DISNO>0 &RETNO>0 &RETWHOLE>0 &is.na(LFDIS)&is.na(LFRET), "UKN_",

          ifelse(DISWHOLE<=0 & DISNO>0 &RETWHOLE<=0 &is.na(LFDIS)&is.na(LFRET), "TRUE_",

           ifelse(DISWHOLE<=0 & RETWHOLE>0 &is.na(LFDIS)&is.na(LFRET), "TRUE_",

           ifelse(DISWHOLE>0 & RETWHOLE<=0&is.na(LFDIS)&is.na(LFRET), "TRUE_",

           ifelse(DISWHOLE>0 & RETWHOLE>0 &is.na(LFDIS)&is.na(LFRET), "UKN_",

          SORTED)))))))
```

1.4.3 Retained

The original dataset contained many records that were coded as Retained = false. It is uncertain how this happened, but it occurred before the old data was brought into the new access database build for the ISMP, as evidenced by the errors being in .dbf files that were last modified in August 1996 (Figure 3). It is likely that these .dbf files were created by the BRS while they managed the observer data collected during the interim SMP during 1995 and 1996. Where possible Retained was recoded as either true (69,612 fish) or false (32 fish) if either Retained or Discarded weight (but not both) were greater than 0. Where both were greater than zero, retained was recoded to unknown (36,312 fish).

The old VFA database has three different fields to indicate percentage of the catch sampled for length measurement:

1. LFRET – percent of the retained catch measured;
2. LFDIS – percent of the discarded catch measured;
3. LFDATA – percentage of the catch measured, fate unspecified.

There are no cases where if LFDATA is present in a record, either LFRET or LFDIS is also present. So, the only way to assign a record with LFDATA present is if there is either retained or discarded catch recorded, but not both. If both are recorded, there is no way to know if the measured fish were from the retained or discarded portion of the catch without making assumptions such as, for example, that fish length is the only determinant of fate. This is the case for 7,628 records representing 35,719 fish. These should be assigned “Unknown”. For those where only retained or discarded catch was recorded, LFDATA was assigned to either LFRET or LFDIS respectively.

Additional effort was put into resolving cases where Retained was classified as unknown using Tiger Flathead measured in 1994 as the case study (Table 7). The fate of these fish was classified as discarded in the original VFA database. Measurement from some shots could fairly safely be classified as retained because LFDATA is the same for all records from each catch, that fish are of a size that would generally be considered retained and that the sample weight is much larger than DISWHOLE (e.g. LED010 on 7/07/1994 in shot 1). However, in other shots, the very small size of some of the fish measured casted significant doubt that all fish measured from each of those shots were either all retained or all discarded (e.g. LET002 on 24/03/1994 in shot 9). Given this doubt, we consider that the risk of erroneously recoding fish of unknown fate as either retained or discarded based on catch weights compared to sample weights outweighs the benefits, and that those records should remain classified as “unknown”.

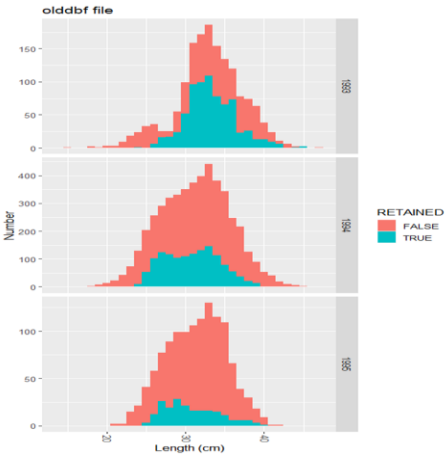

Figure 3. Length frequency of Jackass Morwong from the 1996 . dbf file. It is identical to the length frequency from the AFMA data in Figure 1.

Table 6. Summary of number of fish assigned as retained = true, false, unknown or missing in the original ISMP database and after running the code below. Outcomes that resulted in a change in the corrected dataset are highlighted orange.

Retained	Original dataset	
Corrected dataset	False	True
False	97,879	32
True	69,612	115,476
Unknown	36,246	66

```
AllLFs$Retained_2<-with(AllLFs,ifelse(DISWHOLE<=0 & DISNO<=0  &RETWHOLE>0, "TRUE_", ##Changes an extra 65 fish from False to True

                ifelse(DISWHOLE<=0 & DISNO>0 &RETNO>0 &RETWHOLE>0 &is.na(LFDIS)&is.na(LFRET), "UKN_",##Changes an extra 2 fish from True to Ukn

                ifelse(DISWHOLE<=0 & DISNO>0 &RETWHOLE<=0 &is.na(LFDIS)&is.na(LFRET), "FALSE_", ##effects an extra 28 fish

                ifelse(DISWHOLE<=0 & RETWHOLE>0 &is.na(LFDIS)&is.na(LFRET), "TRUE_",##Changes an extra 51 fish from False to True

                ifelse(DISWHOLE>0 & RETWHOLE<=0&is.na(LFDIS)&is.na(LFRET), "FALSE_",  ###Reclassifies 3 gummy sharks as discarded because there is no retained weight or number

                ifelse(DISWHOLE>0 & RETWHOLE<=0&is.na(LFDIS)&is.na(LFRET), "FALSE_",

                ifelse(DISWHOLE>0 & RETWHOLE<=0&RETNO<=0 , "FALSE_",

               ifelse(DISWHOLE>0 & RETWHOLE>0 &is.na(LFDIS)&is.na(LFRET), "UKN_",   ##Changes 36310 fish from True (66) or False (the rest)

                RETAINED))))))))##153990 fish (60468 RETAINED, 93522 DISCARDED)

AllLFs$LFRET_Add<-with(AllLFs, ifelse(Retained_2 %in% c("TRUE", "TRUE_","UKN_") & is.na(LFRET) & LFDATA>0,LFDATA,LFRET))

AllLFs$LFDIS_Add<-with(AllLFs, ifelse(Retained_2 %in% c("FALSE", "FALSE_","UKN_") & is.na(LFDIS) & LFDATA>0,LFDATA,LFDIS))
```

Table 7. Summary of data and outcome of attempt to resolve records with fate unknown for Tiger Flathead measured in 1994

Vessel	Shot date	Shot No.	Outcome
SRD001	08/03/1994	1	18 x 15–30 cm fish measured. LFDATA = 100. RETWHOLE = 2 kg, DISWHOLE = 2 kg. Sum of calculated sample weight = 3.4 kg. Impossible to distinguish retained from discarded.
SRD001	16/10/1994	2	99 x 24–40 cm fish measured. LFDATA = 45. RETWHOLE = 60 kg, DISWHOLE = 2 kg. Sum of calculated sample weight = 42 kg. Given that all LFDATA is the same for all records from this catch, and that the sample weight is much larger than DISWHOLE, it is most likely that the fish are from the retained catch, but it is we can't be 100% certain.
LED010	7/07/1994	1	128 x 26–52 cm fish measured. LFDATA = 20. RETWHOLE = 200 kg, DISWHOLE = 20 kg. Sum of calculated sample weight = 121 kg. Given that all LFDATA is the same for all records from this catch, the size of the fish, and that the sample weight is much larger than DISWHOLE, it is most likely that the fish are from the retained catch, but it is we can't be 100% certain.
LED010	7/07/1994	2	91 x 26–52 cm fish measured. LFDATA = 20. RETWHOLE = 185 kg, DISWHOLE = 15 kg. Sum of calculated sample weight = 84.6 kg. Given that all LFDATA is the same for all records from this catch, the size of the fish, and that the sample weight is much larger than DISWHOLE, it is most likely that the fish are from the retained catch, but it is we can't be 100% certain.
LED010	18/01/1994	1	97 x 28–58 cm fish measured. LFDATA = 60. RETWHOLE = 80 kg, DISWHOLE = 8 kg. Sum of calculated sample weight = 112.7 kg. Given that all LFDATA is the same for all records from this catch, the size of the fish, and that the sample weight is much larger than DISWHOLE, it is most likely that the fish are from the retained catch, but it is we can't be 100% certain.
LET002	25/03/1994	11	128 x 25–44 cm fish measured. LFDATA = 15. RETWHOLE = 345 kg, DISWHOLE = 20 kg. Sum of calculated sample weight = 78.4 kg. Given that all LFDATA is the same for all records from this catch, the size of the fish, and that the sample weight is much larger than DISWHOLE, it is most likely that the fish are from the retained catch, but it is we can't be 100% certain.
LET002	25/03/1994	12	125 x 23–54 cm fish measured. LFDATA = 8. RETWHOLE = 435 kg, DISWHOLE = 22 kg. Sum of calculated sample weight = 83.8 kg. Given that all LFDATA is the same for all records from this catch, the size of the fish, and that the sample weight is much larger than DISWHOLE, it is most likely that the fish are from the retained catch, but it is we can't be 100% certain.
LET002	24/03/1994	8	125 x 24–54 cm fish measured. LFDATA = 8. RETWHOLE = 510 kg, DISWHOLE = 8 kg. Sum of calculated sample weight = 118 kg. Given that all LFDATA is the same for all records from this catch, the size of the fish, and that the sample weight is much larger than DISWHOLE, it is most likely that the fish are from the retained catch, but it is we can't be 100% certain.
LET002	24/03/1994	9	133 x 17–49 cm fish measured. LFDATA = 12. RETWHOLE = 510 kg, DISWHOLE = 8 kg. Sum of calculated sample weight = 118 kg. The inclusion of very small fish (17–19 cm) casts doubt over the ability to resolve this issue. It is known that at times in the past, small flathead called "hackers" were retained and not sold commercially, but it is unlikely that 17 cm were big enough to be retained as hackers.
LET002	23/03/1994	5	162 x 18–49 cm fish measured. LFDATA = 5. RETWHOLE = 315 kg, DISWHOLE = 250 kg. Sum of calculated sample weight = 87.6 kg. The inclusion of very small fish (17–18 cm) casts doubt over the ability to resolve this issue. It is known that at times in the past, small flathead called "hackers" were retained and not sold commercially, but it is unlikely that 17 cm were big enough to be retained as hackers.
LET002	17/09/1994	8	95 x 29–61 cm fish measured. LFDATA = 15. RETWHOLE = 230 kg, DISWHOLE = 25 kg. Sum of calculated sample weight = 88.6 kg. Given that all LFDATA is the same for all records from this catch, the size of the fish, and that the sample weight is much larger than DISWHOLE, it is most likely that the fish are from the retained catch, but it is we can't be 100% certain.
LET002	15/09/1994	6	95 x 23–48 cm fish measured. LFDATA = 15. RETWHOLE = 110 kg, DISWHOLE = 25 kg. Sum of calculated sample weight = 59.6 kg. Given that all LFDATA is the same for all records from this catch, the size of the fish, and that the sample weight is much larger than DISWHOLE, it is most likely that the fish are from the retained catch, but it is we can't be 100% certain.
LET009	12/01/1994	2	75 x 30–57 cm fish measured. LFDATA = 50. RETWHOLE = 80 kg, DISWHOLE = 3 kg. Sum of calculated sample weight = 130.2 kg. Given that all LFDATA is the same for all records from this catch, the size of the fish, and that the sample weight is much larger than DISWHOLE, it is most likely that the fish are from the retained catch, but it is we can't be 100% certain.

1.4.4 Missing data

There were 3,540 records (9,989 fish) for which there was no retained or discarded weight or number and no or zero LFRET and LFDIS. These records were flagged to be deleted as it is impossible to tell if they were retained or discarded, and sample weights cannot be calculated from a combination of length frequencies and length weight relationships.

There was one record of a very large Gummy Shark (greater than 600 cm) that was flagged to delete.

```
###Flag records with no catch of measured proportion or when NTot=0

AllLFs$DeleteorNot<-with(AllLFs,ifelse(DISWHOLE<=0 & DISNO<=0 &RETNO<=0 &RETWHOLE<=0
&(LFDIS==0|is.na(LFDIS))&(LFRET==0|is.na(LFRET)), "Delete",

            ifelse(NTot==0, "Delete",

           ifelse(LENGTH>500, "Delete","Keep"))))
```

Proportion of the catch sampled was missing in 360 other records (1465 fish) of retained lengths and 81 other records (193) of discarded lengths from the data not flagged to be deleted (the numbers were much higher in the data flagged to be deleted). There were two ways to reconstruct proportion sampled:

1. Catch number – some records contained catch number. From of the number of fish measured the fraction of the catch in number can be calculated.
2. Length-weight relationships – sample weights for retained or discarded species in a shot can be estimated by summing the calculating weights at length using length weight relationships.

There is then the choice of which of the two methods above takes priority where both are present. We chose to prioritise use of the catch number method because we consider that counts are more accurate than length-weight relationships. The number of catches where each method was applied is as follows:

- LFRET = catch number ratio – 18
- LFRET = Length weight relationships ratio - 24
- LFDIS = catch number ratio – 5,528
- LFDIS = Length weight relationships ratio - 6

There are 21 retained catches (not filtered for deletion) where LFRET was greater than 100. There are 11 discarded catches (not filtered for deletion) where LFDIS was greater than 100 (Figure 8 and Figure 9). In all of these cases, the number of fish discarded and retained is recorded alongside weight. The LFDIS (percent of the discarded catch measured) and LFRET (percent of the retained catch measured) fields were calculated from the number of fish measured divided by the number of fish recorded as being caught (either retained or discarded). This is shown in Table 8 and Table 9 where the values in the 7th and 8th columns match exactly.

It is uncertain exactly how these errors occurred, but the two possibilities are that either:

- There was an error in the number recorded as being caught; or
- There was an error in the number of fish recorded for one or more lengths.

If it the former, and the actual number of fish caught is the same as the number of fish measured then LFDIS or LFRET should be 100. If the later, apart from not making sense, catch weighting the length frequency is exacerbating an error. The most sensible approach is to assume that there was an error in the number recorded as being caught and change LFDIS or LFRET for these records to 100. LFRET and LFDIS in these cases was reduced to 100.

Table 8. Summary of number of fish measured, number of fish recorded as discarded, LFDIS and the calculated percentage of fish measured from number of fish discarded.

Callsign	CSIRO code	Shot date	Shot number	Number of fish measured	Number of fish recorded as discarded	LFDIS (% of discarded catch measured)	No. fish measured / No. fish recorded as discarded x 100
S17	37264001	28/02/1996	1	11	10	110	110
S36	37296001	7/05/1993	2	38	34	112	112
S36	37377003	22/10/1993	2	9	4	225	225
S38	37020007	9/01/1993	4	22	21	105	105
S38	37287001	20/03/1993	7	20	17	118	118
S38	37287093	9/01/1993	5	27	22	123	123
S44	37287093	2/12/1992	6	8	5	160	160
S44	37439002	21/05/1993	1	6	3	200	200
S49	37255009	27/11/1992	3	5	4	125	125
S50	37020006	16/11/1993	2	2	1	200	200
S56	37264003	19/02/1997	2	23	20	115	115

Table 9. Summary of number of fish measured, number of fish recorded as retained, LFRET and the calculated percentage of fish measured from number of fish retained.

Callsign	CSIRO code	Shot date	Shot number	Number of fish measured	Number of fish recorded as retained	LFRET (% of retained catch measured)	No. of fish measured / No. of fish recorded as retained x 100
S36	296001	8/05/1993	2	50	29	172.4	172.4
S36	377003	8/05/1993	2	30	28	107.1	107.1
S44	020006	24/04/1993	6	46	22	209.1	209.1
S44	228002	21/05/1993	1	77	75	102.7	102.7
S44	264002	17/04/1993	7	38	32	118.8	118.8
S44	264002	17/04/1993	8	26	25	104.0	104.0
S44	264002	23/04/1993	1	22	21	104.8	104.8
S44	264002	23/04/1993	4	5	3	166.7	166.7
S44	264004	16/04/1993	5	35	21	166.7	166.7
S44	287001	23/04/1993	4	26	25	104.0	104.0
S44	287093	13/12/1993	1	30	25	120.0	120.0
S44	287093	20/07/1993	1	39	38	102.6	102.6
S44	287093	25/04/1993	10	53	50	106.0	106.0
S44	337002	23/04/1993	1	3	2	150.0	150.0
S44	337062	25/04/1993	8	22	19	115.8	115.8
S44	377003	16/04/1993	3	30	29	103.4	103.4
S47	020006	9/03/1993	1	67	30	223.3	223.3
S47	228002	21/04/1993	1	43	39	110.3	110.3
S47	258003	21/04/1993	1	88	70	125.7	125.7
S50	439002	14/11/1994	2	18	16	112.5	112.5
S56	296001	12/03/1997	1	75	74	101.4	101.4

```
###Calculate LFRET and LFDIS for all samples from length weight relationships

###Decide which one to use later

L_Wparams <-  read.csv("LengthWeightRelationships.csv", header=TRUE, sep=",")

AllLFs<-merge(AllLFs, L_Wparams[,c(4,10,11)], by="CAAB.CODE",all.x=TRUE)

AllLFs$WeightAtLength<-with(AllLFs,a_Both*LENGTH^b_Both)/1000    ####weight at length in kg

AllLFs$SampleWeight<-AllLFs$NTot *  AllLFs$WeightAtLength

###Calculate LFRET and LFDIS for all samples from retained and discarded numbers

###Calculate LFRET and LFDIS for all samples from calculated sample weights

###Decide which one to use later

AllLFsSumNTot<-ddply(AllLFs,.(CALLSIGN, SHOTDATE, SHOTNU, CSIROCODE, Retained_2,
DeleteorNot),summarise,

          SumNTot=sum(NTot, na.rm=TRUE),

         SumSampleWeight=sum(SampleWeight, na.rm=TRUE),

          LFRet=max(as.numeric(LFRET_Add), na.rm=TRUE),

          LFDis=max(as.numeric(LFDIS_Add), na.rm=TRUE),

          MaxNUMRET=max(RETNO, na.rm=TRUE),   ##max is only used to get the value, they should be the same in
each group

          MaxNUMDIS=max(DISNO, na.rm=TRUE),

          MaxCatchWeightRET=max(RETWHOLE , na.rm=TRUE),   ##max is only used to get the value, they should be the
same in each group

          MaxCatchWeightDIS=max(DISWHOLE , na.rm=TRUE))

###This assumes that LFRet and LFDis are right, and will use them if present

AllLFsSumNTot$LFRET_<-with(AllLFsSumNTot, ifelse(Retained_2 %in% c("TRUE",
"TRUE_")&LFRet<=0&MaxNUMRET>0, SumNTot /MaxNUMRET*100, LFRet))

AllLFsSumNTot$LFDIS_<-with(AllLFsSumNTot, ifelse(Retained_2 %in% c("FALSE",
"FALSE_")&LFDis<=0&MaxNUMDIS>0, SumNTot /MaxNUMDIS*100, LFDis))

AllLFsSumNTot$LFRET_LW<-with(AllLFsSumNTot, ifelse(Retained_2 %in% c("TRUE",
"TRUE_")&LFRet<=0&MaxCatchWeightRET>0, SumSampleWeight /MaxCatchWeightRET*100, LFRet))

AllLFsSumNTot$LFDIS_LW<-with(AllLFsSumNTot, ifelse(Retained_2 %in% c("FALSE",
"FALSE_")&LFDis<=0&MaxCatchWeightDIS>0, SumSampleWeight /MaxCatchWeightDIS*100, LFDis))

##This uses the following as preferences: LFRet and LFDis, then by number, then by weight

AllLFsSumNTot$LFRET_Final<-with(AllLFsSumNTot, ifelse(LFRET_>0, LFRET_, LFRET_LW))

AllLFsSumNTot$LFDIS_Final<-with(AllLFsSumNTot, ifelse(LFDIS_>0, LFDIS_, LFDIS_LW))
```

```
#Limit to maximum 100

AllLFsSumNTot$LFRET_Final<-with(AllLFsSumNTot, ifelse(LFRET_Final>100, 100, LFRET_Final))

AllLFsSumNTot$LFDIS_Final<-with(AllLFsSumNTot, ifelse(LFDIS_Final>100, 100, LFDIS_Final))

###Get rid of stuff I don't want to merge

AllLFsSumNTotM<-AllLFsSumNTot[,c(1,2,3,4,5,6,19,20)]

AllLFs<-merge(AllLFs, AllLFsSumNTotM, by=c("CALLSIGN", "SHOTDATE", "SHOTNU", "CSIROCODE", "Retained_2",
"DeleteorNot"),  all=TRUE)   ##merge summary table with raw data
```

1.5 Resulting data

Final length frequencies for the corrected VFA data are shown in Figure 4 to Figure 13.

The effect of the above described changes to the length frequency distributions varies from species to species and year to year. These are discussed separately for each species.

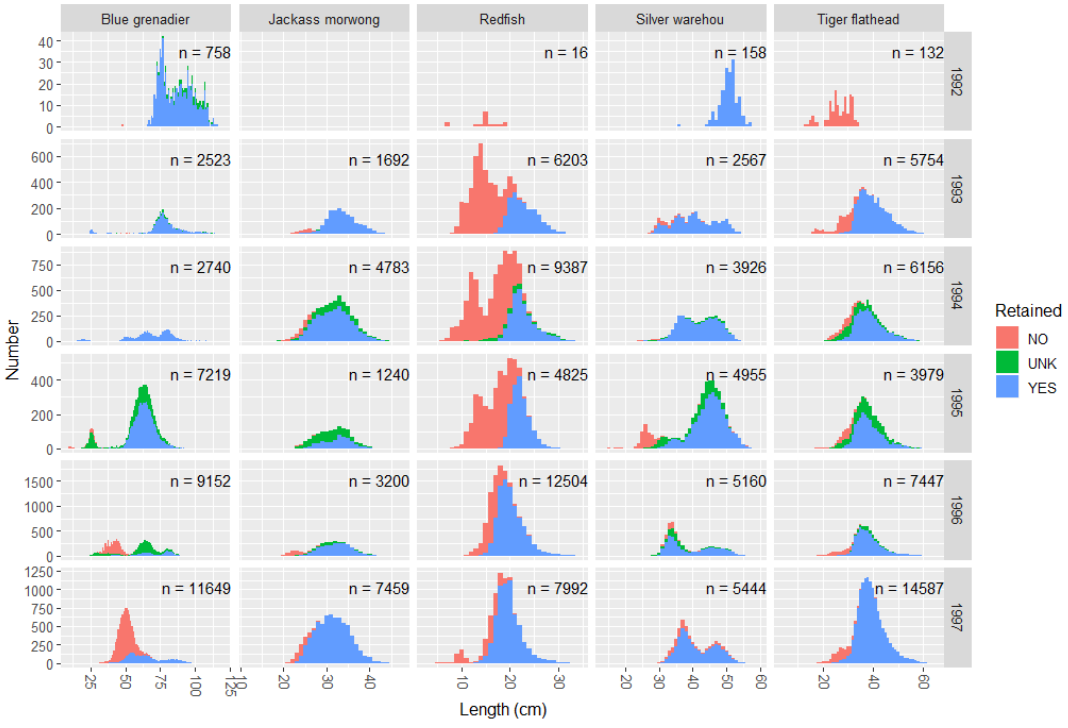

Figure 4. Final length frequency data for Blue Grenadier, Jackass Morwong, Redfish, Silver Warehou and Tiger Flathead. Number of fish measured is annotated.

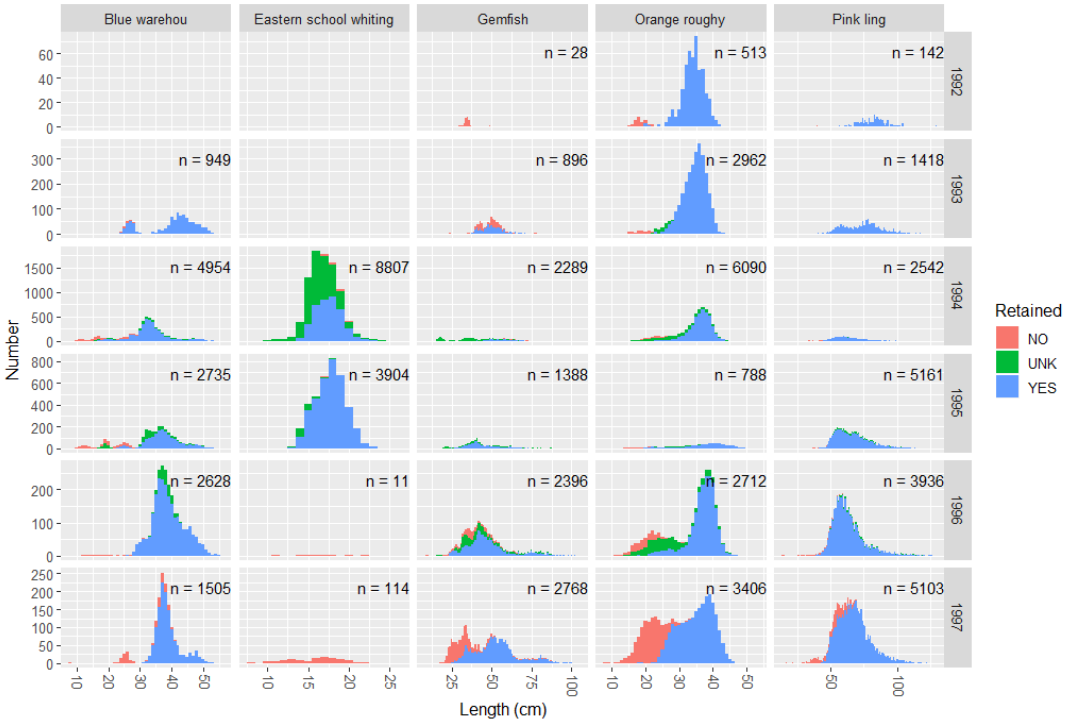

Figure 5. Final length frequency data for Blue Warehou, Eastern School Whiting, Gemfish, Orange Roughy and Pink Ling. Number of fish measured is annotated.

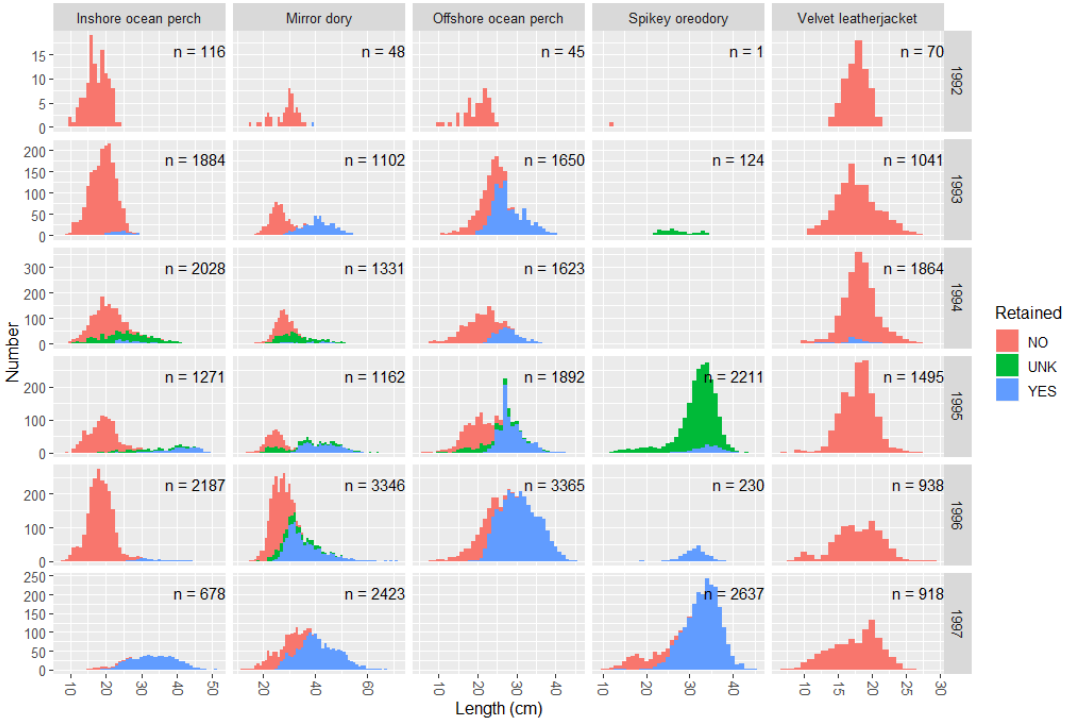

Figure 6. Final length frequency data for Inshore Ocean Perch, Mirror Dory, Offshore Ocean Perch, Spikey Oreodory and Velvet Leatherjacket. Number of fish measured is annotated.

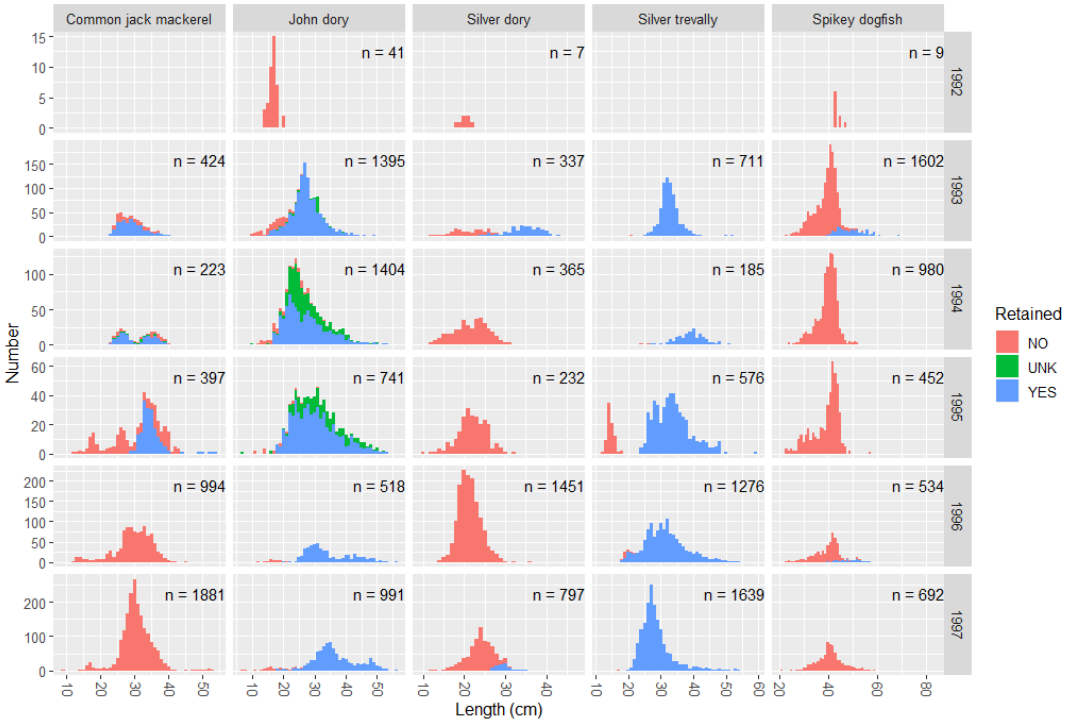

Figure 7. Final length frequency data for Common Jack Mackerel, John Dory, Silver Dory, Silver Trevally and Spikey Dogfish. Number of fish measured is annotated.

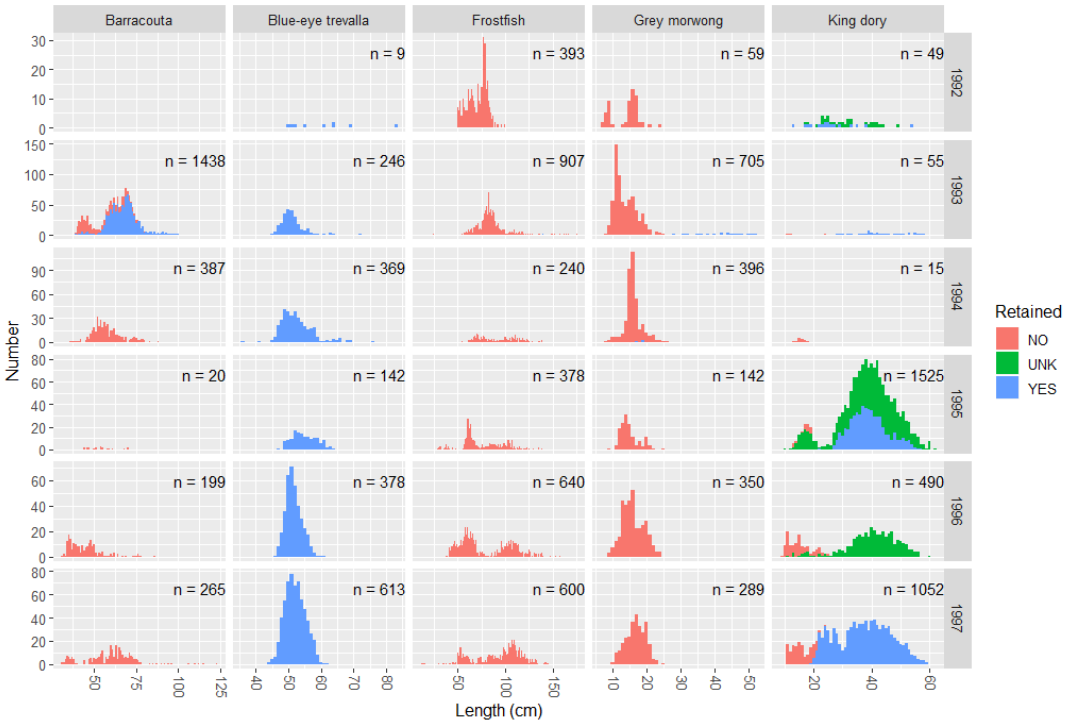

Figure 8. Final length frequency data for Barracouta, Blue-eye Trevalla, Frostfish, Grey Morwong and King Dory. Number of fish measured is annotated.

Figure 9. Final length frequency data for Black Oreodory, Gummy Shark, Latchet, Smooth Oreodory and Southern Sand Flathead. Number of fish measured is annotated.

Figure 10. Final length frequency data for Deepwater Flathead, Ocean Jacket, School Shark, Snapper and Warty Oreodory. Number of fish measured is annotated.

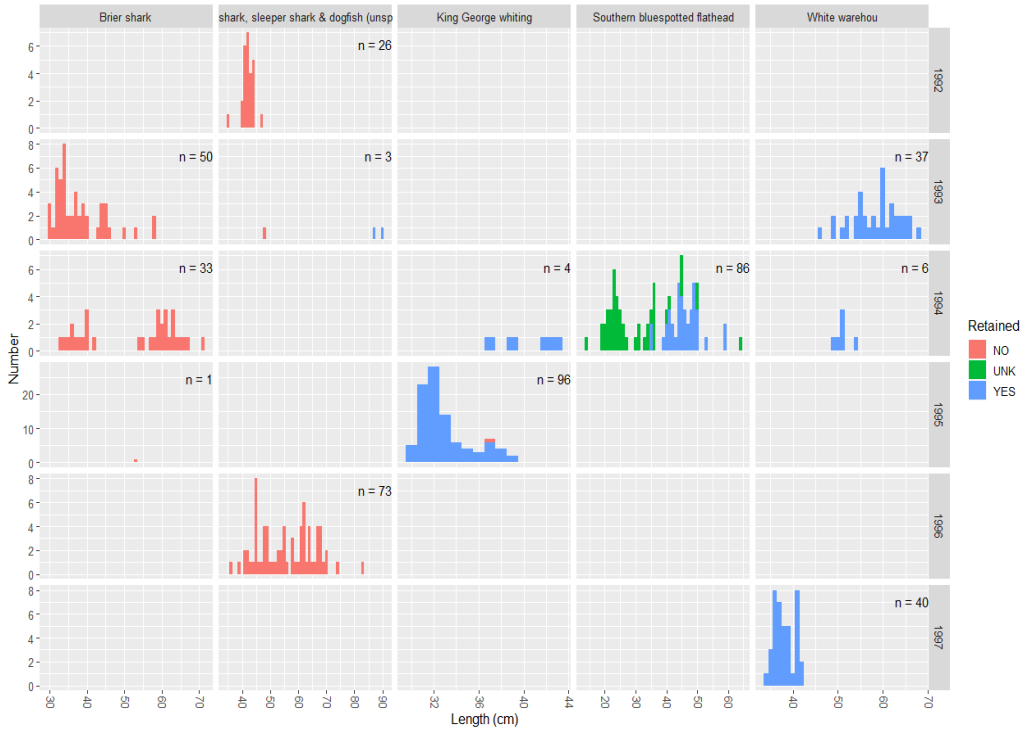

Figure 11. Final length frequency data for Brier Shark, Gulper Sharks, King George Whiting, Southern Bluespot Flathead and White Warehou. Number of fish measured is annotated.

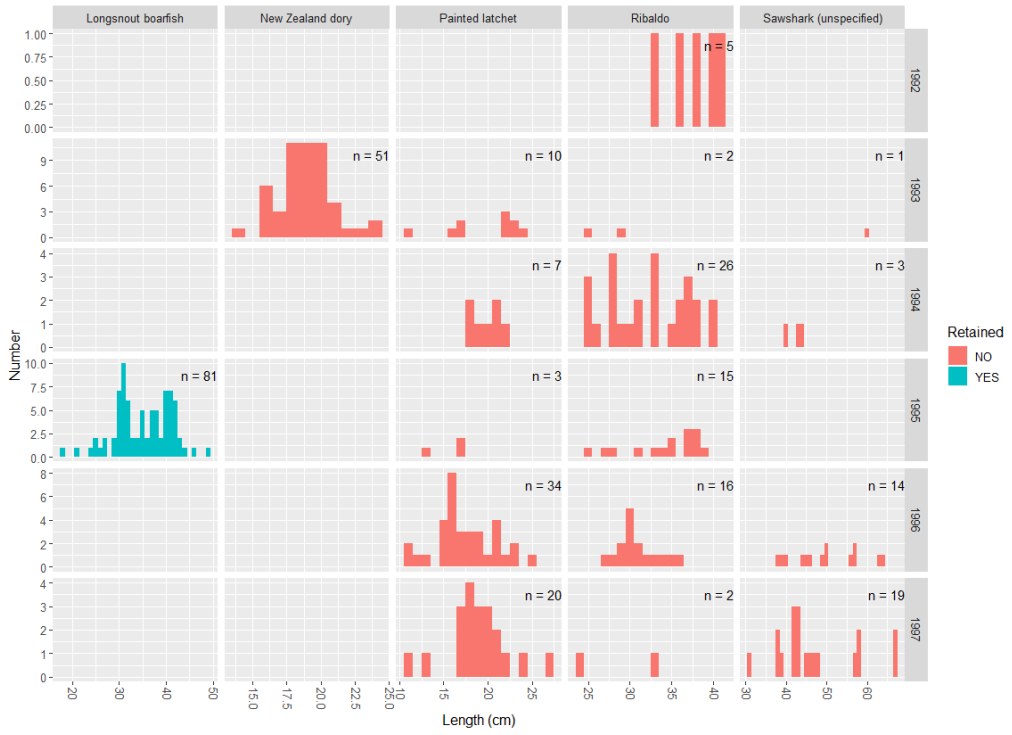

Figure 12. Final length frequency data for Longsnout Boarfish, New Zealand Dory, Painted Latchet, Ribaldo and Sawshark. Number of fish measured is annotated.

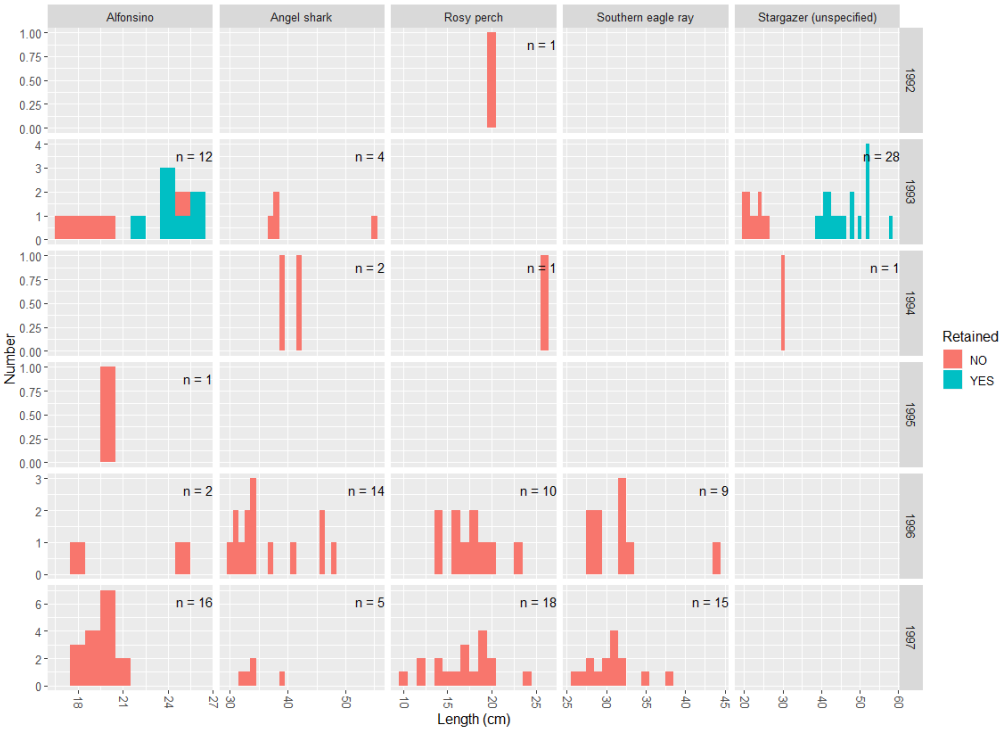

Figure 13. Final length frequency data for Alfonsino, Angel Shark, Rosy Perch, Southern Eagle Ray and Stargazer. Number of fish measured is annotated.

1.5.1 Tiger Flathead

Length frequencies for Tiger Flathead were identical in the three data sources for 1992 (Figure 14). For 1993, the corrected VFA data was similar in shape to the AFMA data, but contained about 550 less records and recoding of discarded fish as retained fish increased the numbers of fish greater than the mode classified as retained. Removal of fish flagged for deletion removed nearly 4000 fish from the 1994 data present in the CSIRO and corrected VFA data. The overall shapes of the CSIRO and corrected VFA data are identical, but reclassification of many discarded fish to retained changes the length frequency to show smaller fish being discarded and larger fish retained, as would be expected. A similar pattern is observed for 1995 data, however only about 1,600 fish were removed from the dataset. 1996 length frequencies were improved from the AFMA data by reclassifying large discarded fish as of unknown fate, while most of the fish greater than 32 cm classified as discarded in the CSIRO data are now classified as retained. Similarly, for the 1997 data, the AFMA and corrected VFA length frequencies are similar, and both appear more realistic than the CSIRO data in which the proportion of discards was similar to retained fish for fish greater than 32 cm.

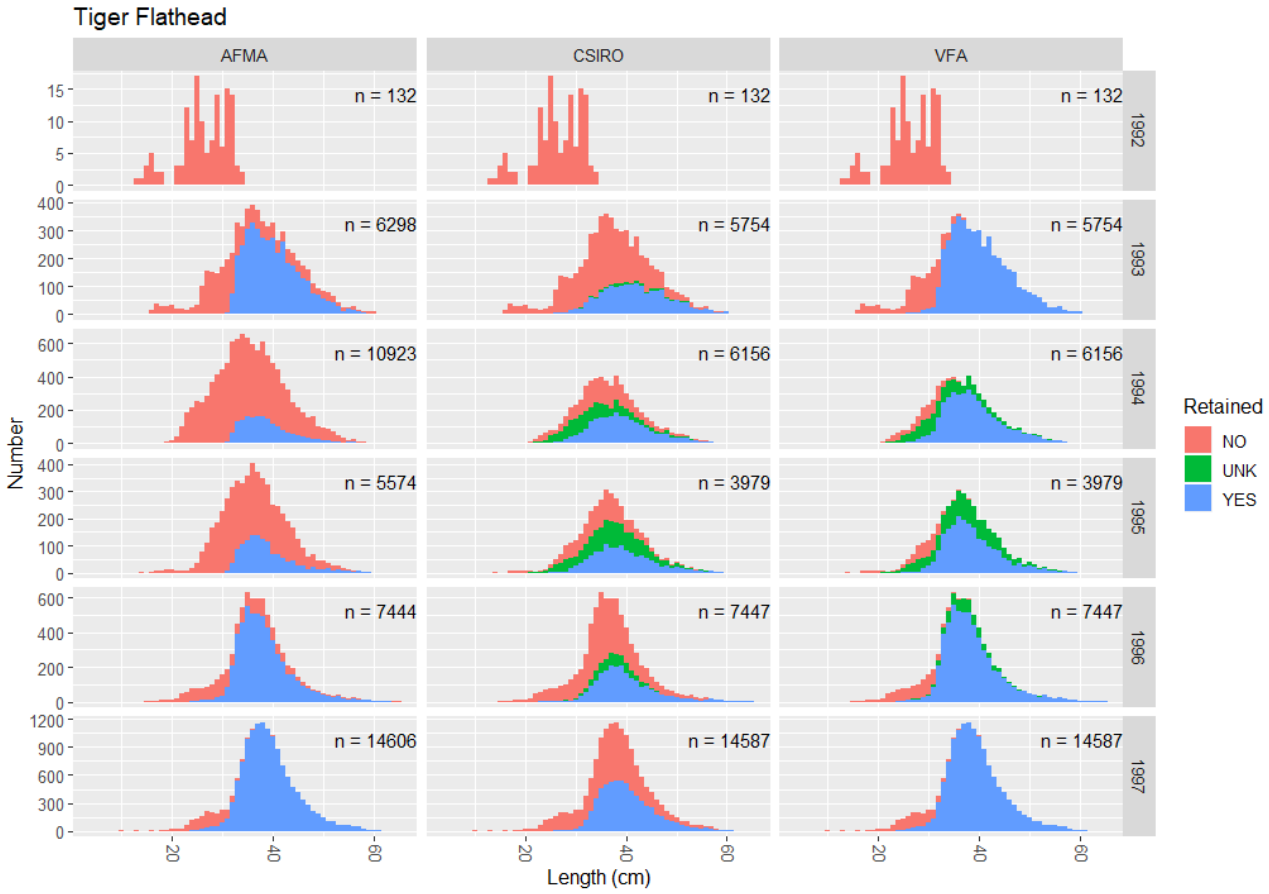

Figure 14. Comparison of length frequency data for Tiger Flathead from the AFMA, CSIRO and VFA databases.

1.5.2 Blue Grenadier

AFMA length frequencies for Blue Grenadier in 1992 (Figure 15) comprised entirely of discarded fish, and apart from small numbers of retained small (25 –35 cm) and large (85–90 cm) fish in 1993, nearly all fish up to and including 1995 were discarded. In the 1996 data both the retained and discarded catches comprised three apparent cohorts, but the discards by far dominated all three. From 1992 to 1995, the corrected VFA data classifies these fish as being retained and is nearly identical to the CSIRO data, and differs 1996 only by some 40–50 cm and 60–75 cm fish classified as discarded in the CSIRO data, but changed to retained in the corrected VFA data. The 1997 AFMA data appears identical to the corrected VFA data.

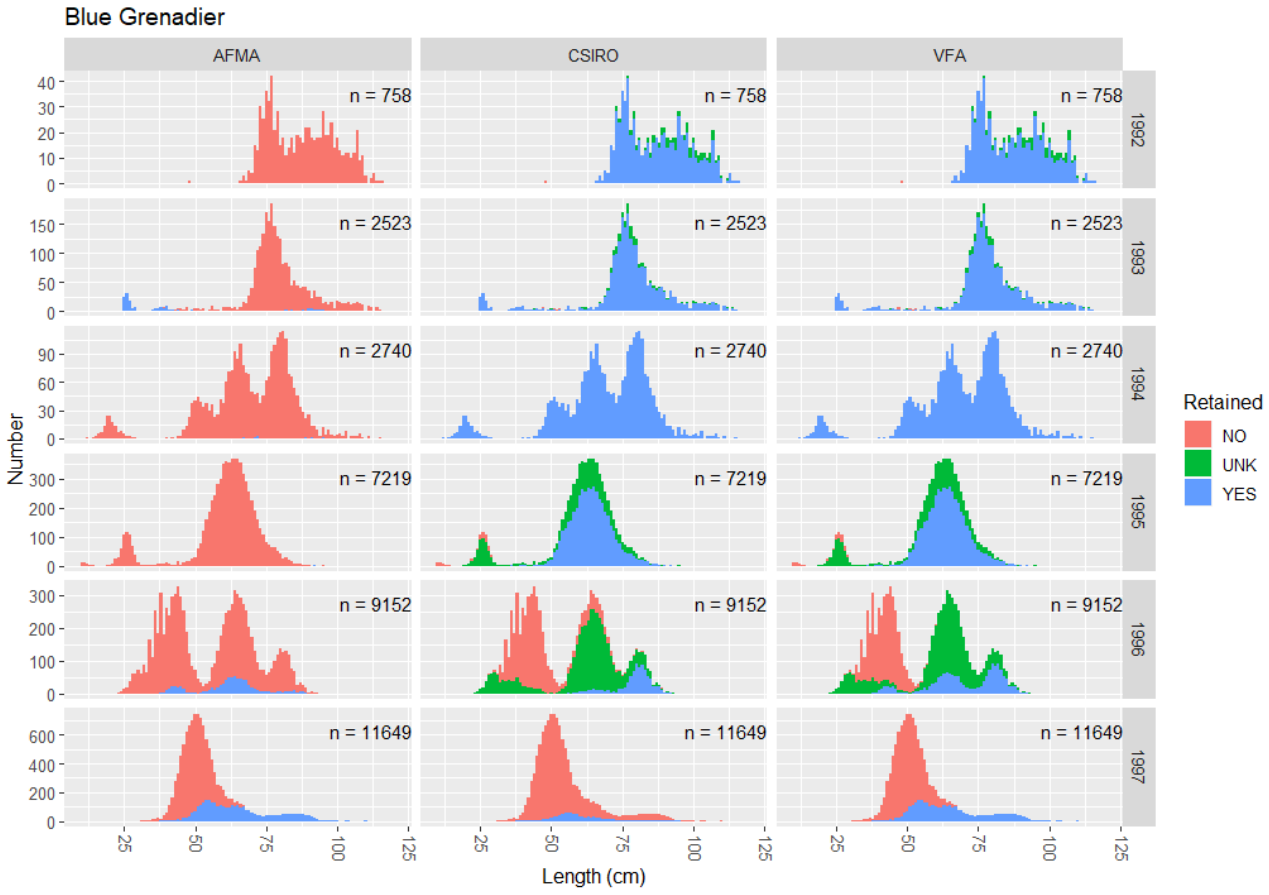

Figure 15. Comparison of length frequency data for Blue Grenadier from the AFMA, CSIRO and VFA databases.

1.5.3 Pink Ling

Pink Ling length frequencies in the AFMA data from 1992–1995 look as if the retained and discarded categories have been reversed, with mostly the largest fish discarded (Figure 16). This issues appears to have largely been resolved in the CSIRO data, but with some discarding of large fish, particularly in 1997. The corrected VFA data is similar to the CSIRO data but with fewer large fish discarded, particularly in 1997.

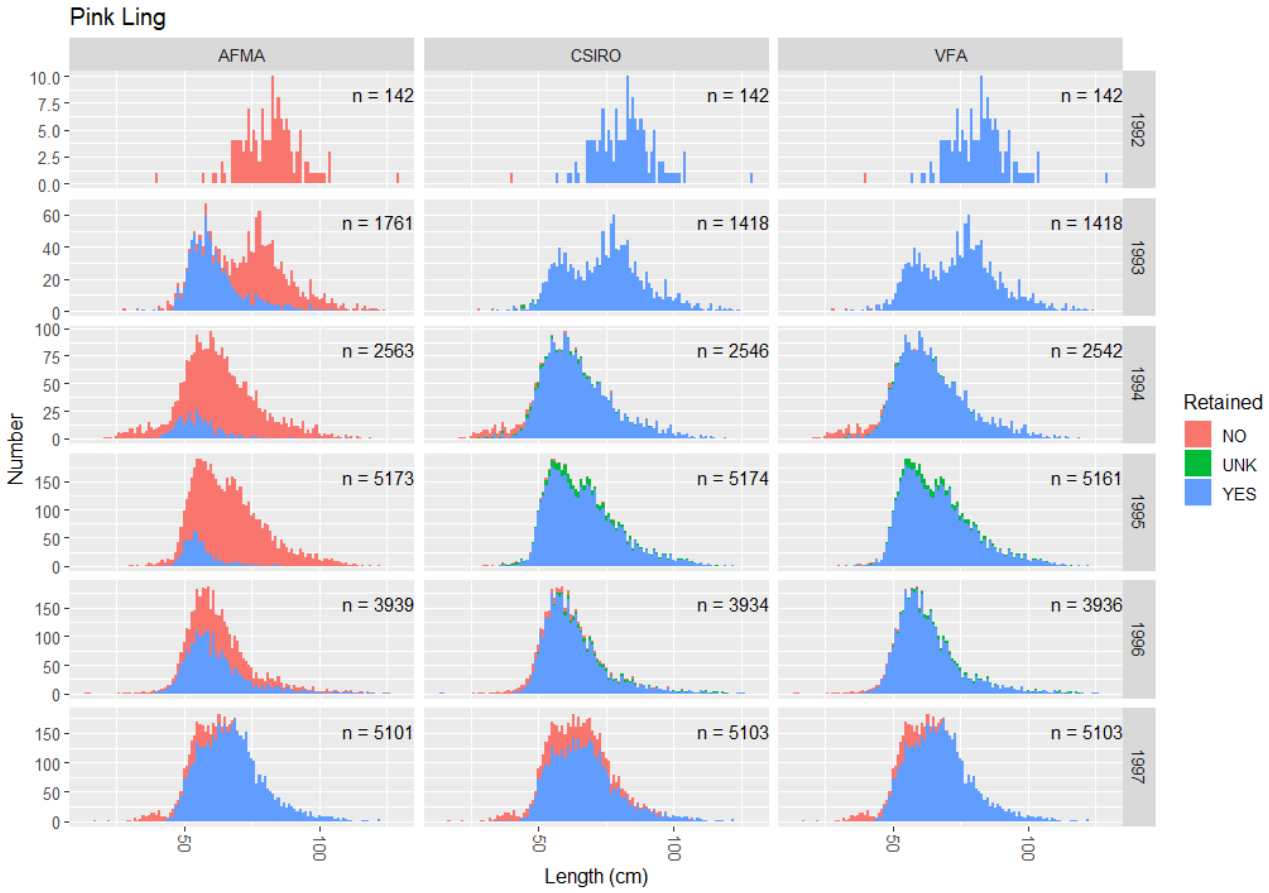

Figure 16. Comparison of length frequency data for Pink Ling from the AFMA, CSIRO and VFA databases.

1.5.4 Orange Roughy

The overall shape of the length frequencies for Orange Roughy are nearly identical across datasets except for in 1993 where the AFMA dataset has 43 more fish, however, the AFMA data classifies most samples from 1992-1996 as discarded while the CSIRO and VFA classify them as retained (Figure 17). The CSIRO data set presents a more likely length frequency with most fish above 30 cm retained. The corrected VFA data is very similar to the CSIRO data up until 1995 where some of the smaller fish (20–25 cm) were not reassigned as discarded as was done in the CSIRO data. Those data are from two shots, one in which there no discarded catch was recorded, and for the other shot where both retained and discarded catches were recorded in the one shot, but both retained and discarded lengths were reported including fish of the same length.

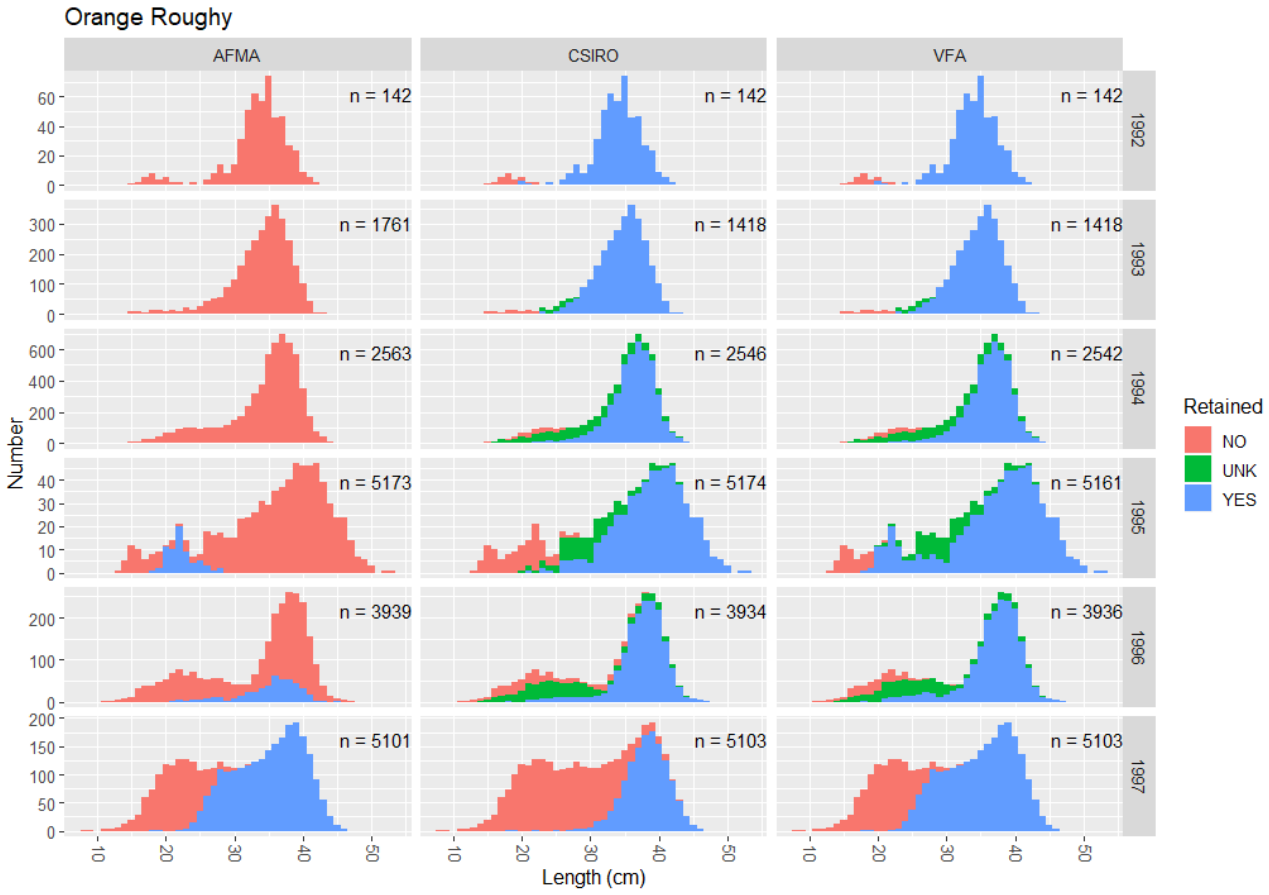

Figure 17. Comparison of length frequency data for Orange Roughy from the AFMA, CSIRO and VFA databases.

1.5.5 Redfish

Length frequency distributions for Redfish are very similar between the AFMA and corrected VFA datasets (Figure 18). The main differences are small differences in sample numbers and the addition of some fate unknown in the 1994 VFA data. The CSIRO data contained much less retained catch.

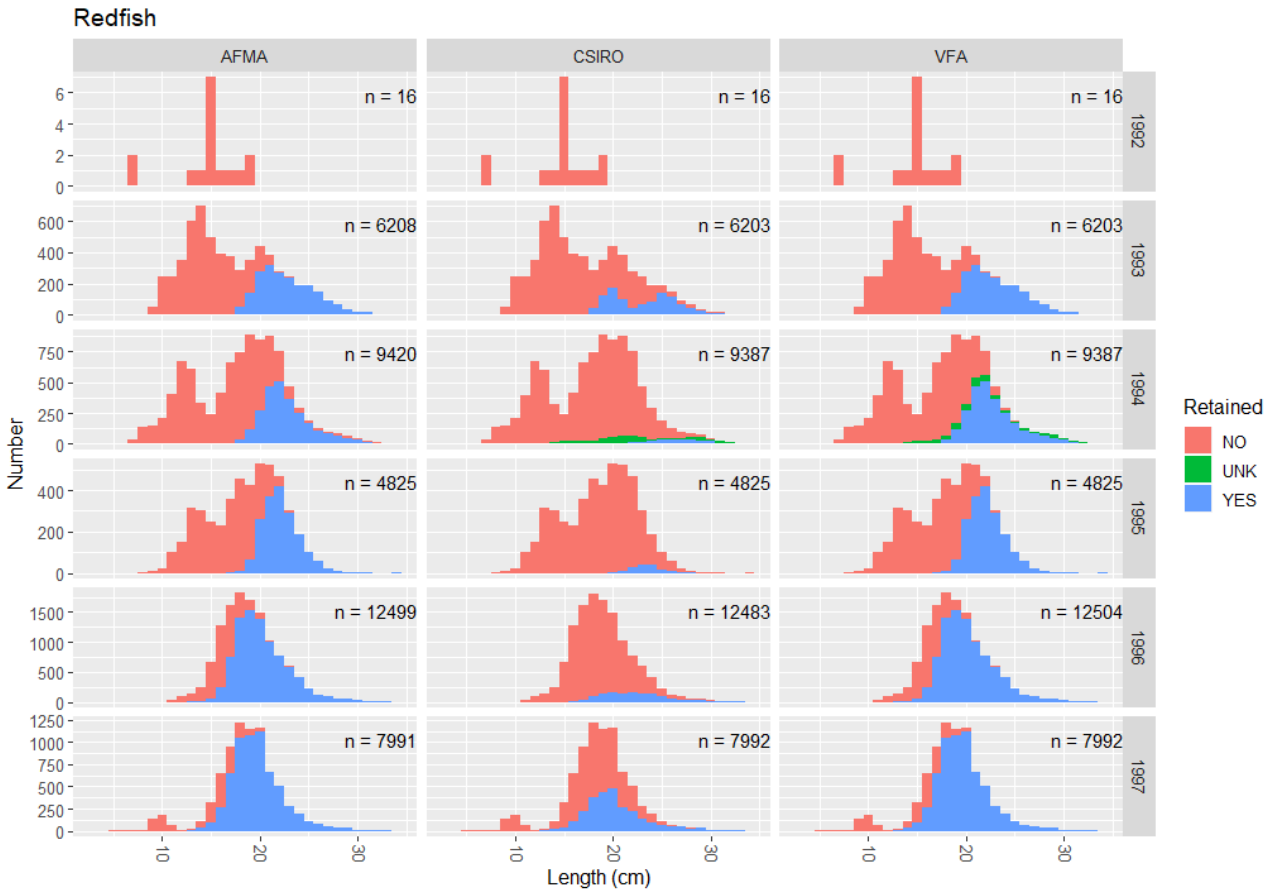

Figure 18. Comparison of length frequency data for Redfish from the AFMA, CSIRO and VFA databases.

1.5.6 Mirror Dory

Corrected VFA length frequency data are more like the CSIRO data for Mirror Dory from 1992–1995 (Figure 19), while for those years the AFMA data contains more discards records than the other two databases. For 1996 and 1997, the corrected VFA length frequency data more closely resemble the AFMA data with the exception of fate unknown records in 1996.

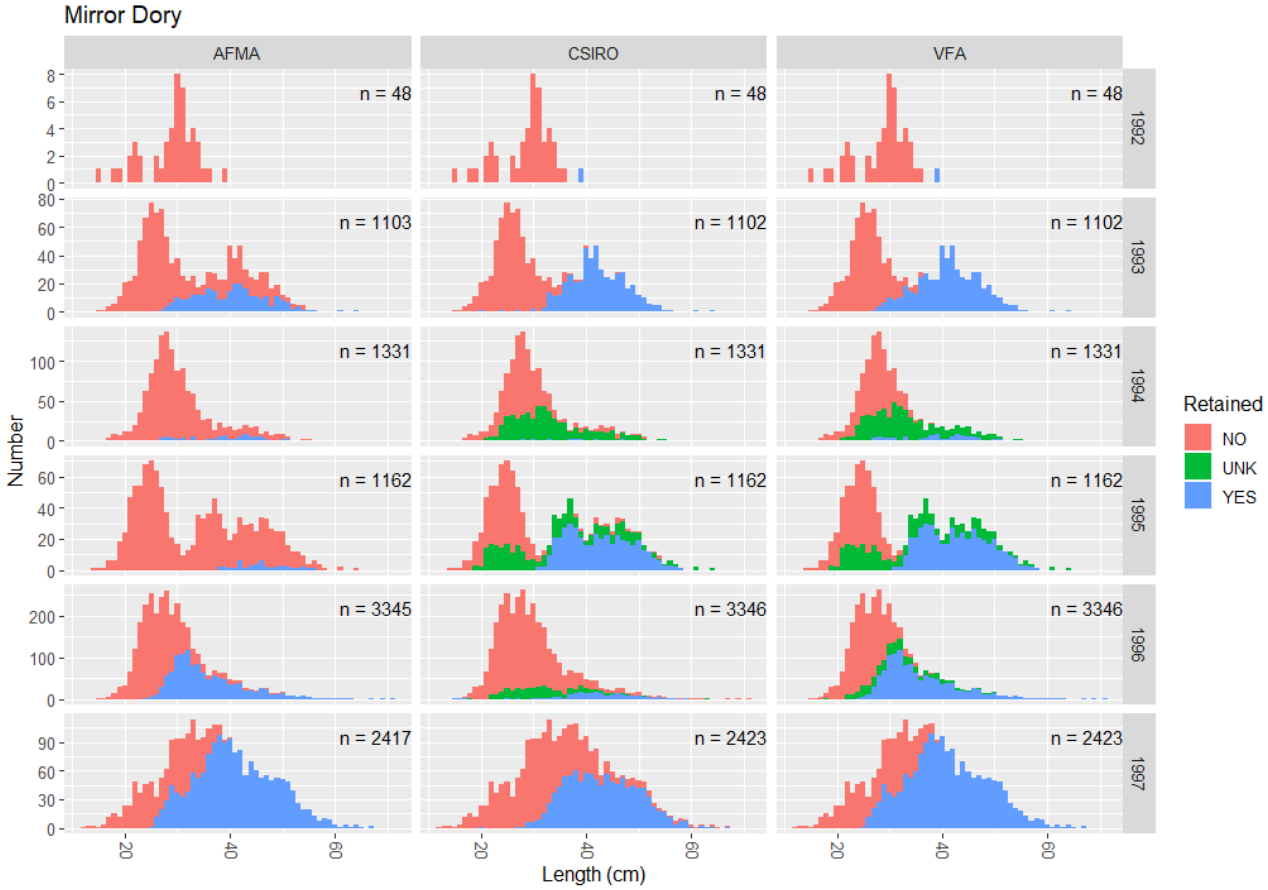

Figure 19. Comparison of length frequency data for Mirror Dory from the AFMA, CSIRO and VFA databases.

1.5.7 John Dory

Length frequencies of John Dory are similar between the three datasets from 1992–1995 apart from the inclusion of fate “unknown” in the CSIRO and corrected VFA datasets (Figure 20). 1996 and 1997 length frequencies are identical between the AFMA and corrected VFA datasets, with the CSIRO data containing more medium sized discards than the other two databases.

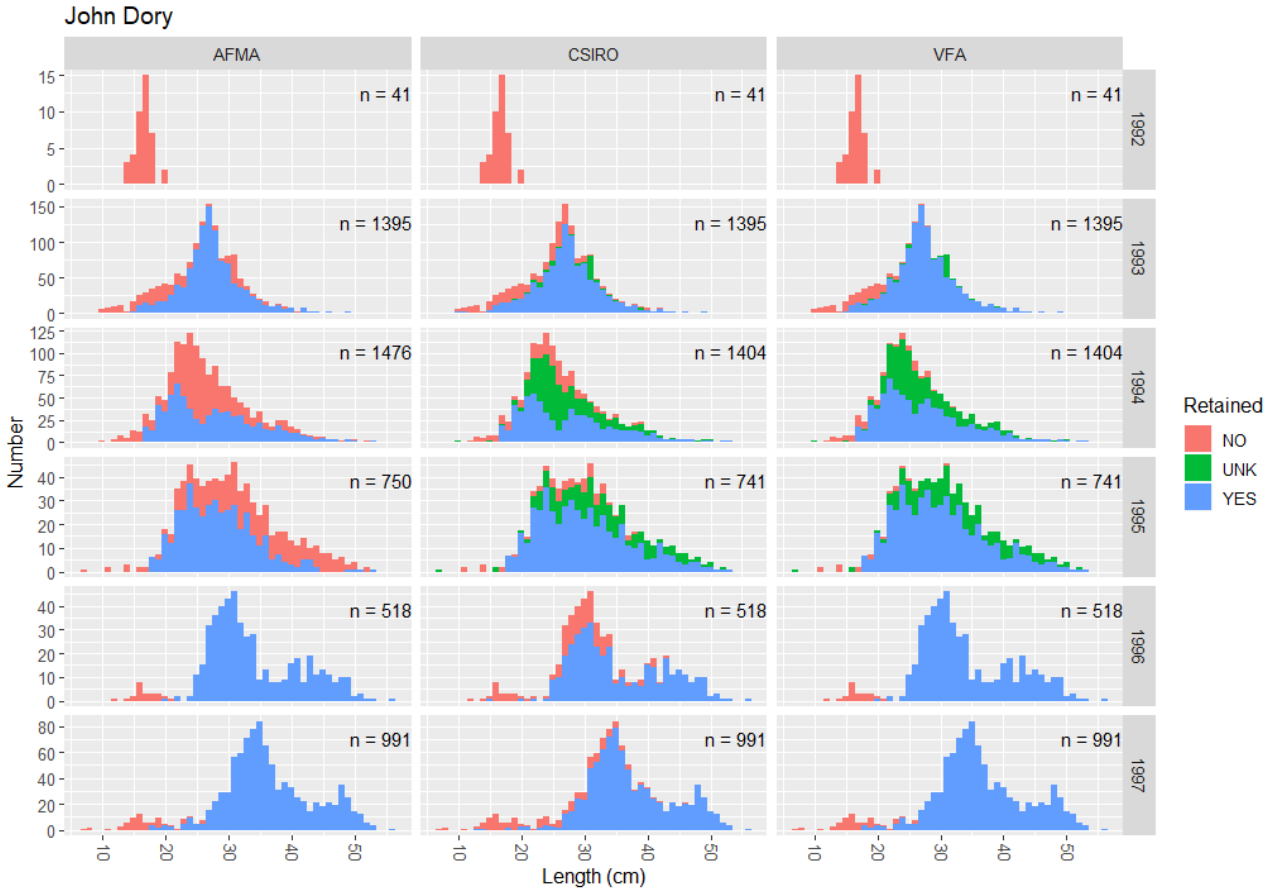

Figure 20. Comparison of length frequency data for John Dory from the AFMA, CSIRO and VFA databases.

1.5.8 Offshore Ocean Perch (Bigeye Ocean Perch)

Length frequencies of Offshore Ocean Perch are very similar between the AFMA and corrected VFA datasets from 1992–1997 there being less samples in some years and unknown fate in 1995 in the corrected VFA data (Figure 21). Apart from the inclusion of fate unknown in the CSIRO and corrected VFA datasets (Figure 20). The CSIRO data has much less retained catch in most years.

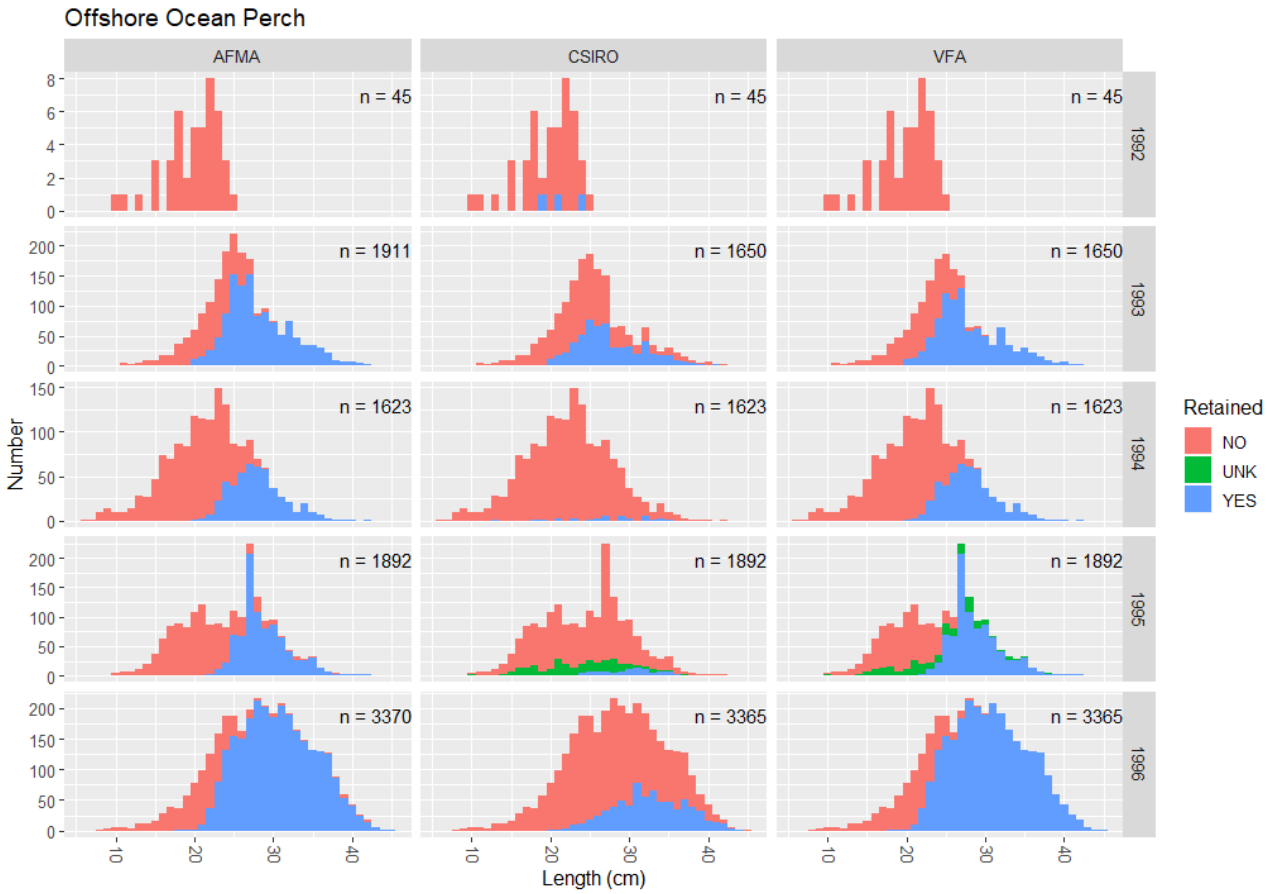

Figure 21. Comparison of length frequency data for Offshore Ocean Perch from the AFMA, CSIRO and VFA databases.

1.5.9 Reef Ocean Perch

Length frequencies of Reef Ocean Perch are identical among datasets for 1992, and very similar for 1993 and 1996 with the exception that the CSIRO data has no retained fish (Figure 22). While the AFMA data for 1994 and 1995 has nearly no retained length measurements, the CSIRO and corrected VFA data are very similar in that they have small amounts of retained measurements, and records classified as unknown across most of the length frequency distribution. The AFMA and corrected VFA data are identical for 1997, while the CSIRO data has more discards of lengths greater than 23 cm than the other two datasets.

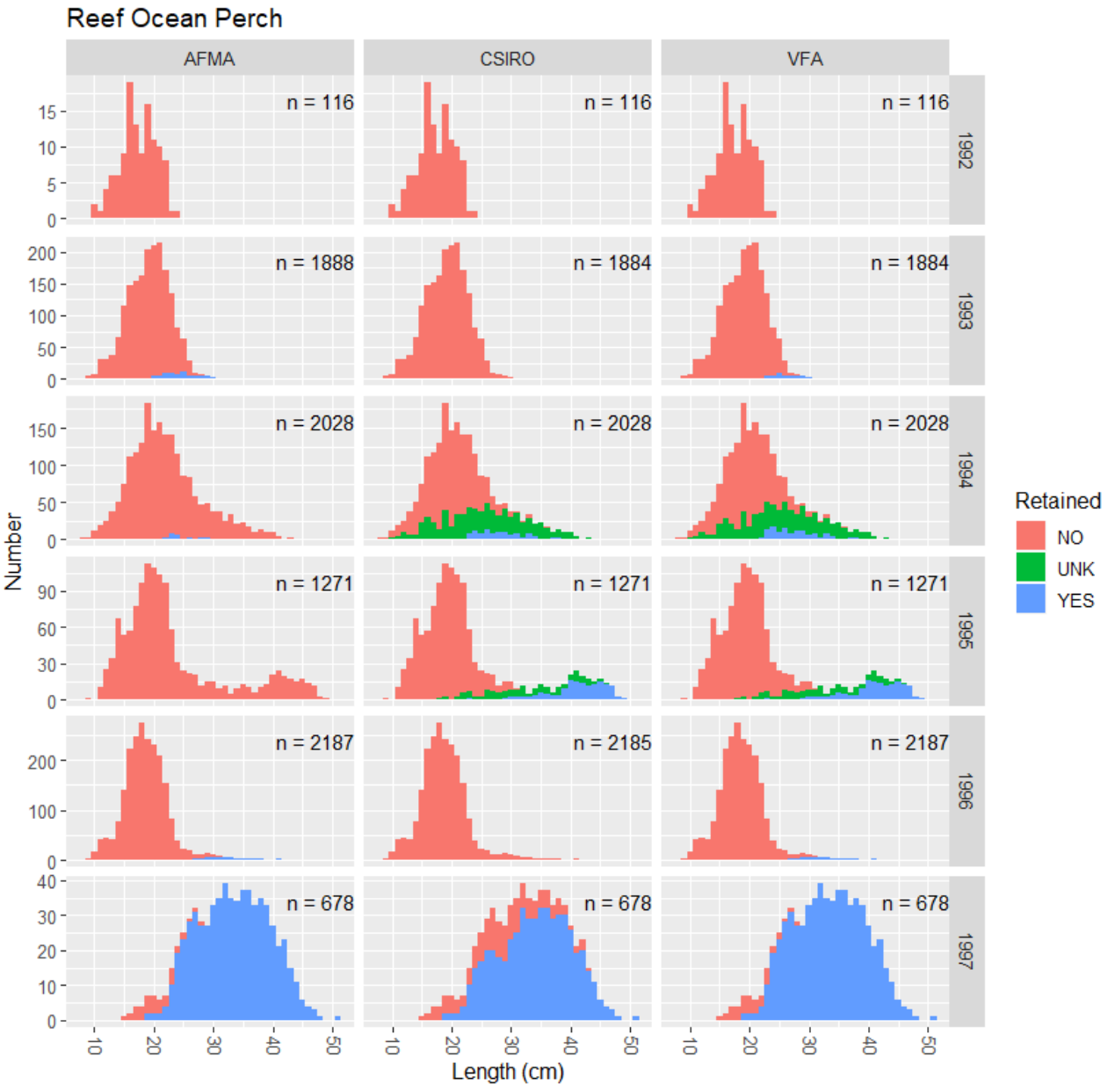

Figure 22. Comparison of length frequency data for Reef Ocean Perch from the AFMA, CSIRO and VFA databases.

1.5.10 Eastern School Whiting

The lack of retained Eastern School Whiting measured in 1996 and 1997 was looked at closely, in particular the samples classified as retained in the CSIRO dataset, but the discarded samples in the AFMA and corrected VFA datasets (Figure 23). This difference resulted from fish from three shots that were classified as discarded in the AFMA dataset being changed to retained because the value of "DISWHOLE" is 0 in both, but for which the values of "DISNO" match the number of fish measured. Together with "LFDIS" of 100 it is most likely that those fish measured are from the discarded catch, and that is was reclassified for the CSIRO data because of the 0 value of "DISWHOLE". These fish should therefore be classified as discarded.

Corrected VFA and CSIRO length frequencies for 1994 and 1995 are very similar, however there are some differences in classification between "Unknown" and "Retained". In the CSIRO dataset there are some records where only no discarded catch weight or number are recorded, "RETWHOLE" is positive, but proportion of the catch sampled is not recorded. The "Retained" field in these datasets is clearly untrustworthy, and so with no other indication that the measured samples were discarded, it is likely that those fish were retained, **however this needs to be agreed by the appropriate RAG**.

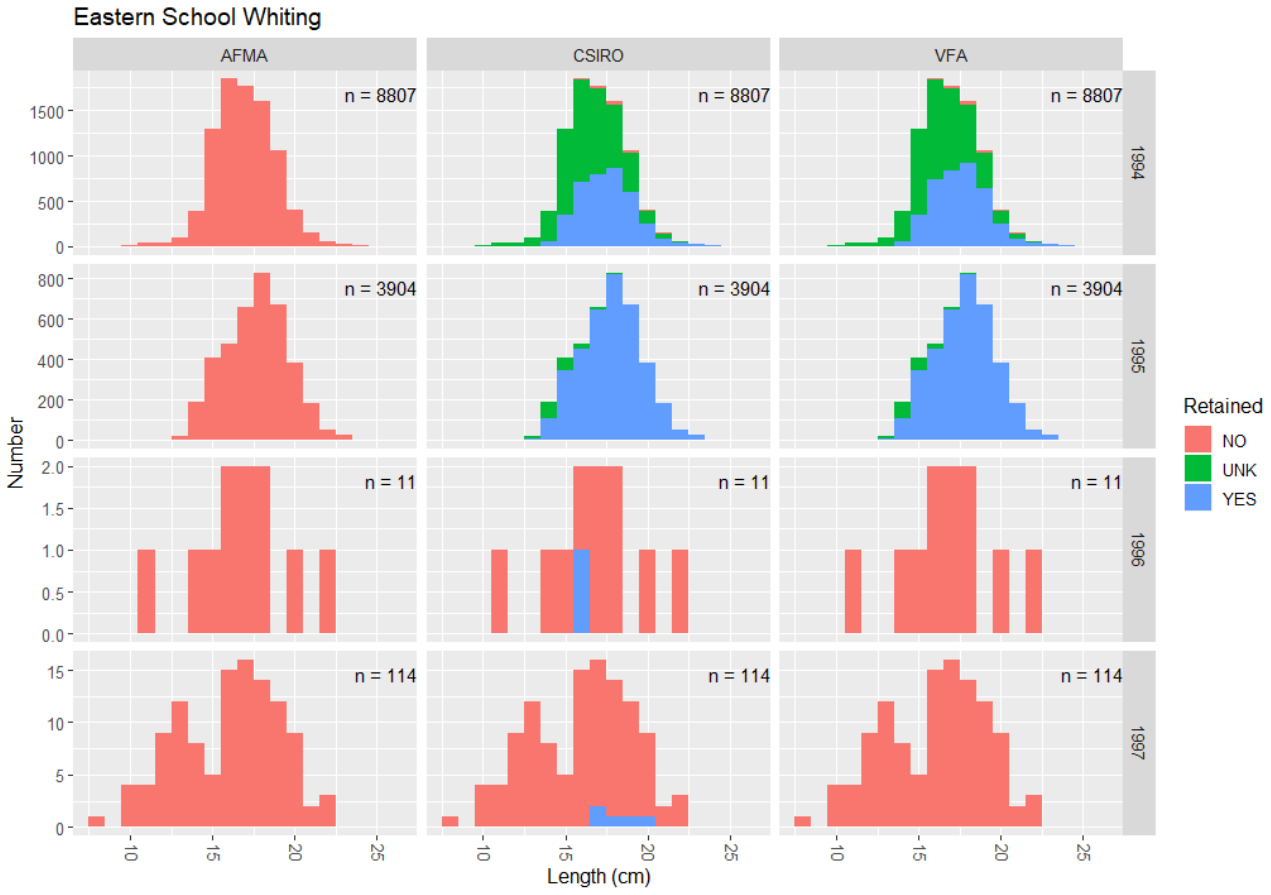

Figure 23. Comparison of length frequency data for Eastern School Whiting from the AFMA, CSIRO and VFA databases.

1.5.11 Silver Trevally

Length frequencies for Silver Trevally are very similar between datasets, particularly from 1993 and 1995 (Figure 24). AFMA data from 1994 shows discarding of all but the very largest fish, while CSIRO and corrected VFA data are almost identical for that year. The 1996 AFMA data contains large (32–50 cm) discarded fish that were largely recoded as retained in the CSIRO data, however the latter recoded some retained fish (23–31 cm) as discarded, while the largest discarded fish in the corrected VFA data in that year is 22 cm. The 23–31 cm discarded fish in the CSIRO data appear to be an error caused by lack of "shot number" in the CSIRO onboard data format. Where multiple fish of the same species, size and fate were recorded by the observer program on the same day from multiple shots, one of the records was change from retained to discarded. The following is an example of where that has occurred:

- Silver Trevally were measured from three shots (shots 1, 2 and 3) on vessel S23 on 22/05/1996
- 25 cm fish were recorded in both shots 2 and 3, and were listed as retained in the original data, but both retained and discarded fish were recorded from shot 2. LFRET from shot 3 was 6.2, while RFRET and LFDIS from shot 2 were 7.7 and 50 respectively.
- Seemingly to address the conflict of having two records of the same length of fish on the same day, it was assumed that the record that included a value of LFDIS greater than 0 was discarded.
- That this assumption is incorrect by comparing the number of fish measured against the number of fish caught and RFRET and LFDIS. In shot 2, a total of 14 fish measured were recorded as discarded in the original VFA dataset, while 28 fish were reported as discarded (DISNO). With LFDIS of 50 (50% of discarded fish measured), this makes sense. However, in the CSIRO data, there are 40 discarded fish measured, and the 33 fish for which there are retained and discard lengths of the same length category are combined by length category and assigned an LFDIS of 100.

A similar issue resulted in small–medium sized fish being recoded as discarded in the 1997 data.

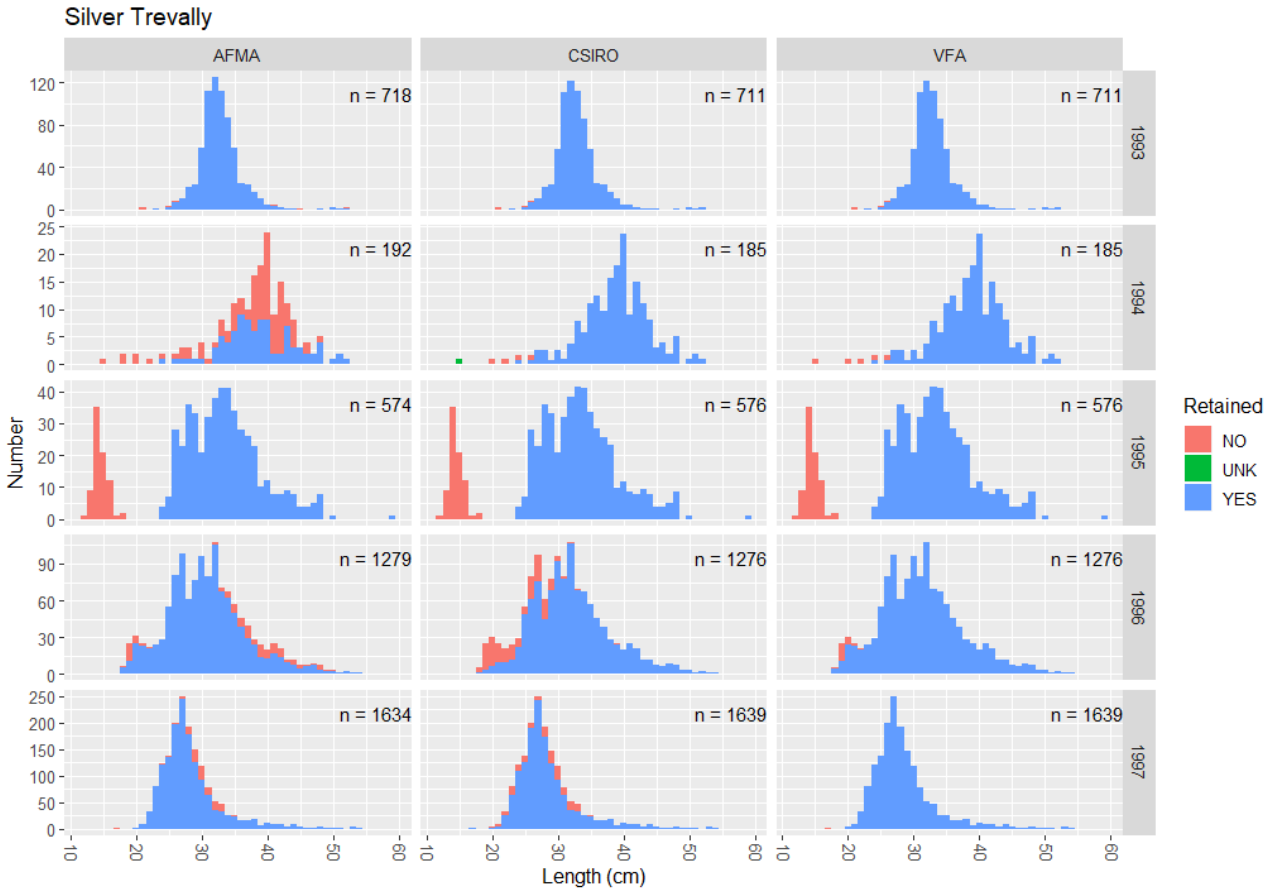

Figure 24. Comparison of length frequency data for Silver Trevally from the AFMA, CSIRO and VFA databases.

1.5.12 Jackass Morwong

The corrected VFA dataset reclassified most of the medium to large discarded length frequencies of Jackass Morwong to either retained or unknown (for 1994, 1995 and 1996) (Figure 25). AFMA data from 1993 to 1996 shows discarding across all length classes and in 1995 and 1996 in particular, with the discarded fish generally bigger than the retained fish. The CSIRO dataset largely addressed the issues of wrongly assigned discards except for in 1997 where it appears to have introduced many errors across all lengths.

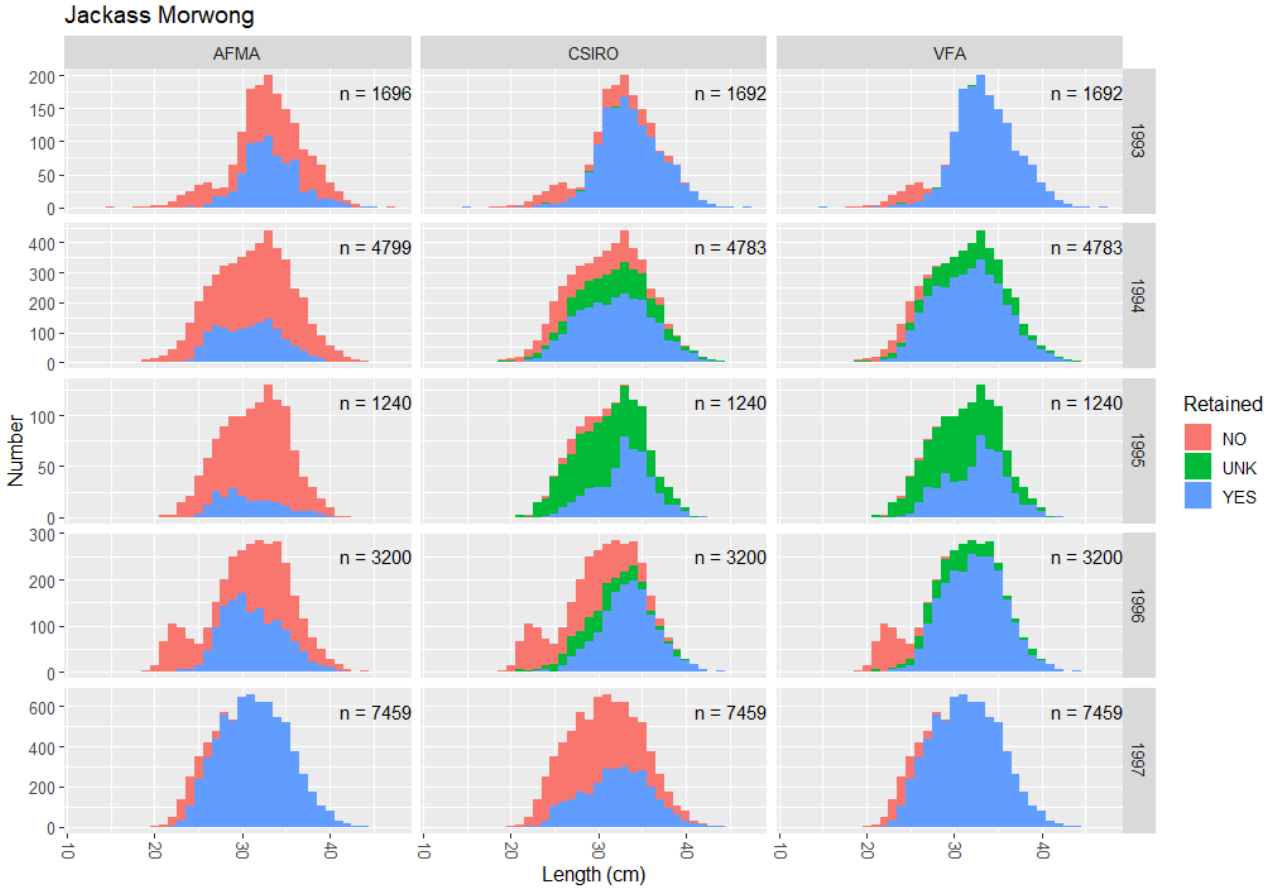

Figure 25. Comparison of length frequency data for Jackass Morwong from the AFMA, CSIRO and VFA databases.

1.5.13 Gemfish

Length frequencies for 1992, 1993 and 1997 are similar across datasets (Figure 26). The CSIRO and corrected VFA datasets largely corrected the misclassification as discarded during 1994 to 1996, however the CSIRO dataset has more medium to large discarded fish, particularly in 1996 for 45–60 cm fish. The CSIRO data also has more 75–85 cm discarded fish than the corrected VFA dataset.

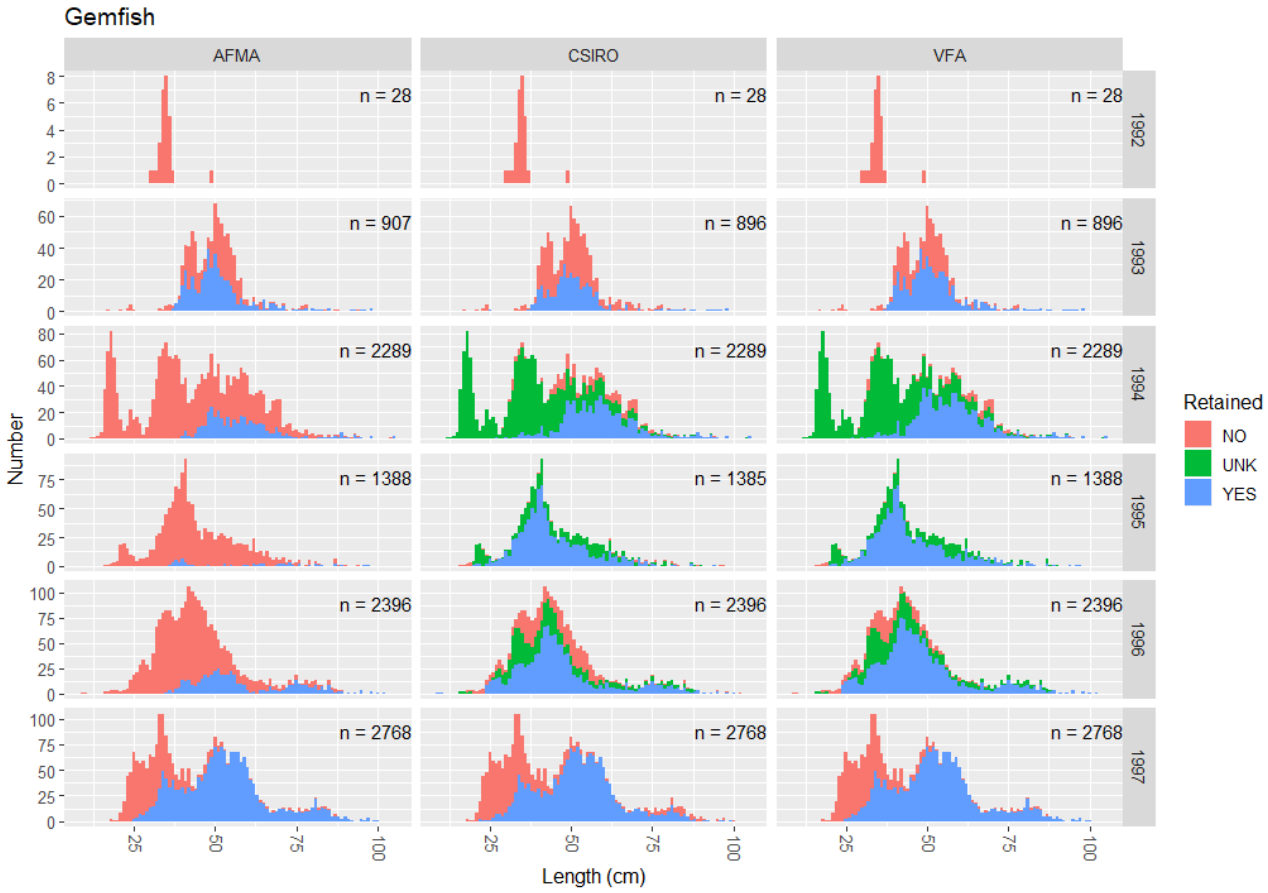

Figure 26. Comparison of length frequency data for Gemfish from the AFMA, CSIRO and VFA databases.

1.5.14 Blue-eye Trevalla

In the AFMA data, the vast majority of Blue-eye Trevalla length frequencies were misclassified as discarded from 1992 to 1996 (Figure 27). Both the CSIRO and corrected VFA datasets corrected all of those misclassifications from discarded to retained in those years, with the resulting data identical. All three datasets are identical in 1997.

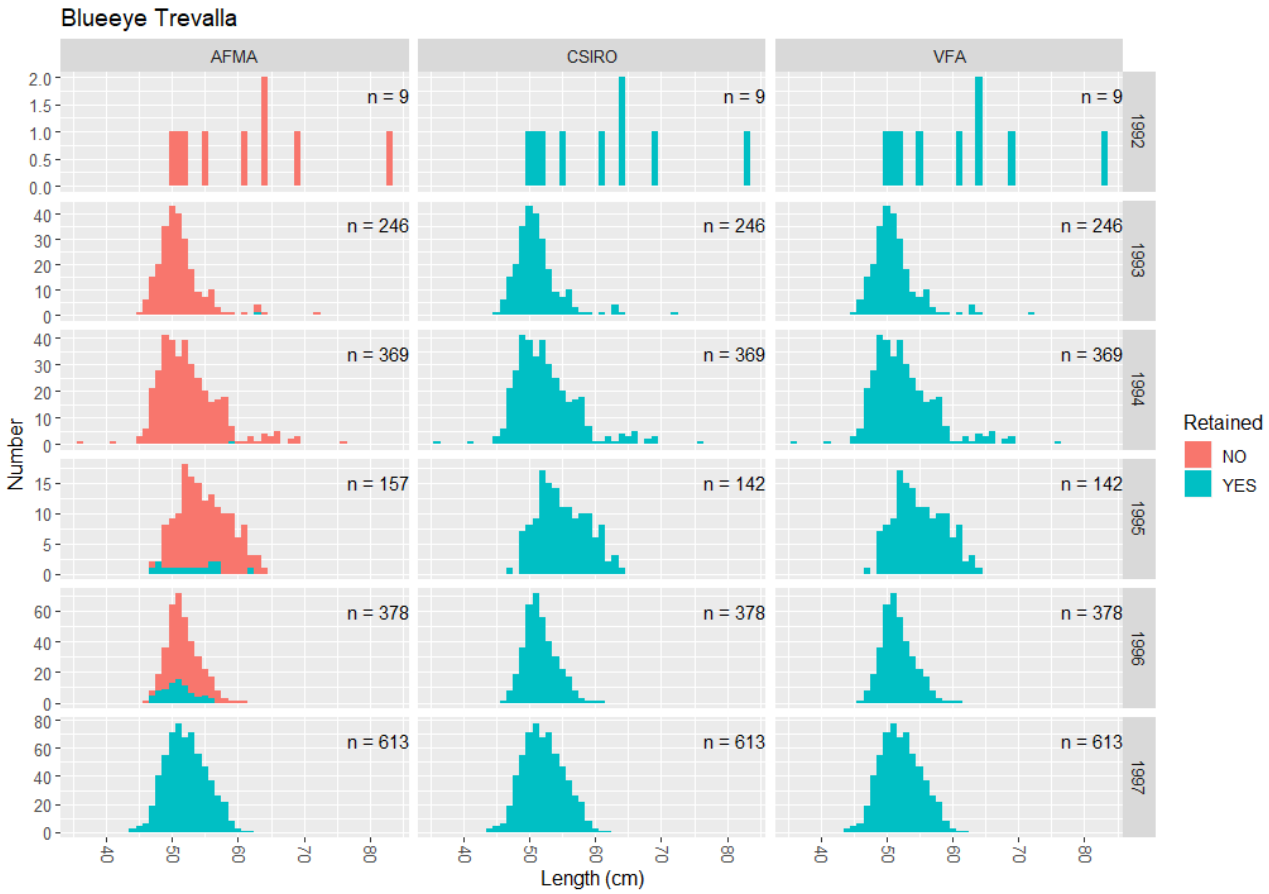

Figure 27. Comparison of length frequency data for Blue-eye Trevalla from the AFMA, CSIRO and VFA databases.

1.5.15 Blue Warehou

In the AFMA data, most Blue Warehou length frequencies were misclassified as discarded from 1992 to 1996 (Figure 28), with discarded fish represented right across the length frequency distributions. This was particularly a problem in 1996 when almost all fish were recorded as discarded. Corrections made in the CSIRO data largely resolved the issue however discarding of some medium to large fish remained from 1993 to 1995. This was corrected in the VFA data. Length frequencies are similar across all three datasets for 1997, however discarding of large Blue Warehou was erroneously introduced in the CSIRO dataset. The discarded fish greater than 40 cm length are from one particular vessel from one date. Fish from this vessel on this day differed from most other catches sampled in 1997 only in that both LFRET and LFDIS are greater than 0. Length records from one particular vessel from one date also had both LFRET and LFDIS greater than 0, and these retained fish from that catch were also changed to discarded. The fate of fish from these two shots should be as they were in the original VFA database.

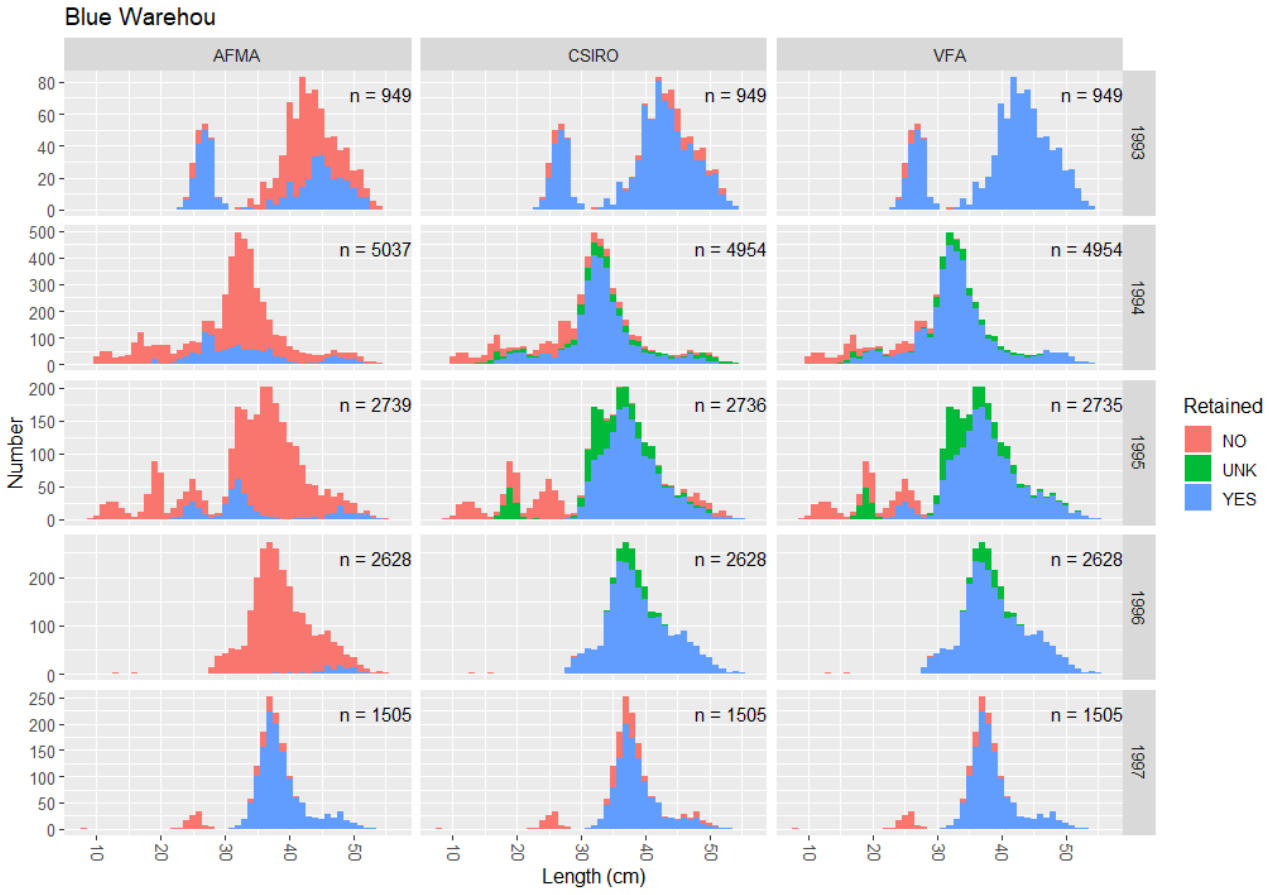

Figure 28. Comparison of length frequency data for Blue Warehou from the AFMA, CSIRO and VFA databases.

1.5.16 Silver Warehou

Silver Warehou length frequencies from 1992 in the AFMA data are all classified as discarded (Figure 29). It is uncertain why these were recorded as discarded, but those fish were all from one shot for which no discard weight or number were recorded. The fate of these records should be classified as retained. The 1993 AFMA data has discarded fish right across the size distribution, and changes made to produce the CSIRO dataset reduced the discards of small fish (around 30 cm) and increased the number of medium to large fish (greater than 37 cm) discarded. The corrected VFA data resulted in similar retained and discarded length frequency of small fish to the CSIRO data, but changed discards of medium to large fish to retained. It is uncertain why they were classified as discarded in the AFMA data. This problem is much larger in the AFMA data from 1994 to 1996 where:

- 1994 – retained and discarded length frequencies are almost the opposite of what would be expected with the majority of 30–40 cm fish retained, and most fish greater than 40 cm discarded.
- 1995 – only a very small amount of medium sized fish is recorded as retained;
- 1996 – the length frequency distributions of retained and discarded fish are of similar shape, but the numbers of discarded fish are much greater than retained fish.

The CSIRO data greatly improved those data, recoding most of the medium to large sized fish to retained, and some as unknown. Some medium and large fish remained as discarded for 1995 and 1996. The corrected VFA data recoded most of those to either retained of unknown for 1994 and 1996, while some large fish remained as discarded for 1995. Those remaining discarded fish were from the same vessel (LET001) over two shots (1 and 17) on 10/8/1995 and 13/8/1995 during what appear to be one trip. Retained catch of Silver Warehou was not recorded for either shot, and there is no other indication that these records should be recoded as retained. Corrected VFA data from 1997 is identical to the AFMA data, while the CSIRO data included more discarded fish over most of the length frequency distribution.

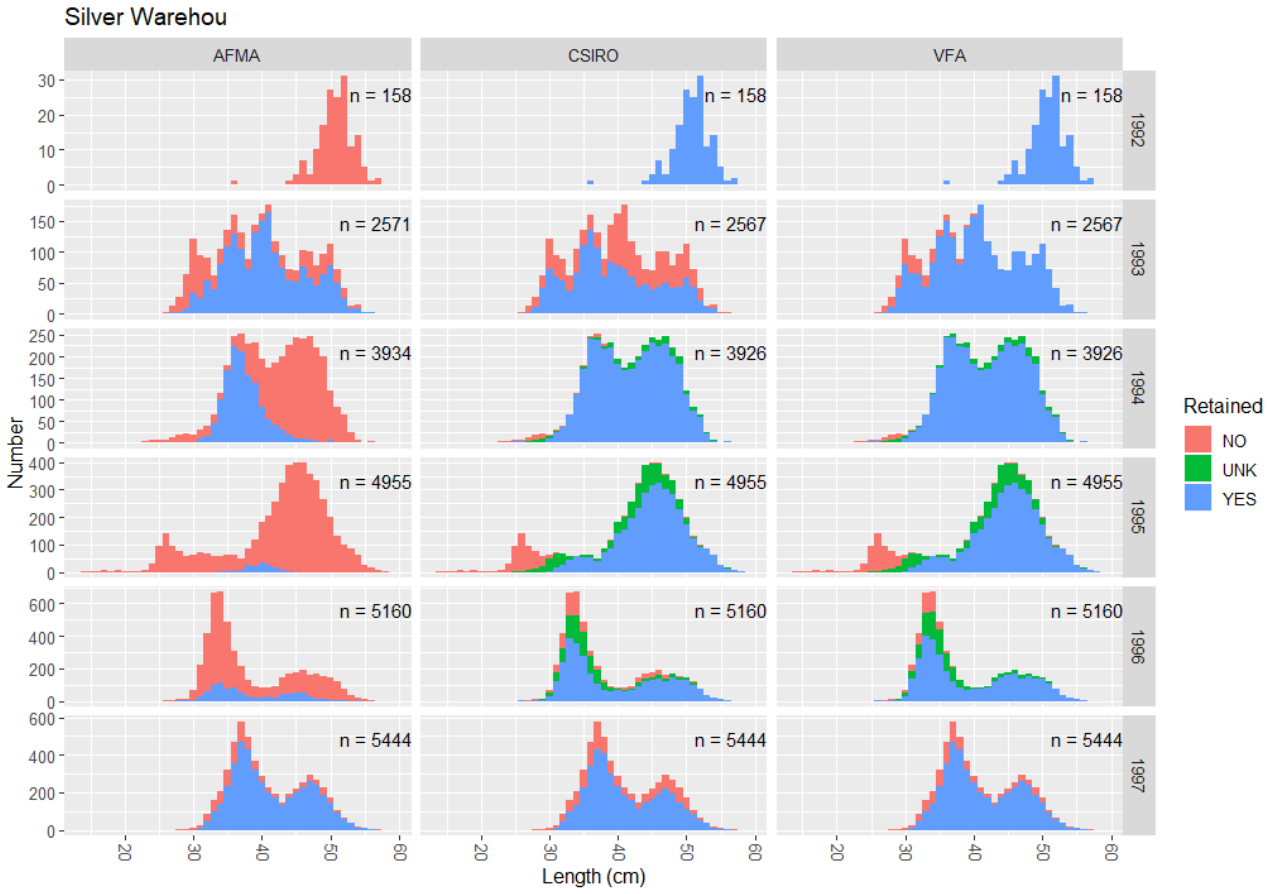

Figure 29. Comparison of length frequency data for Silver Warehou from the AFMA, CSIRO and VFA databases.

1.5.17 Spikey Oreo Dory

There is uncertainty as to the fate of the Spikey Oreo Dory measured during 1994 and 1995 with most fish classified as unknown (Figure 30) because LFDATA rather than LFRET or LFDIS is populated, however this can be resolved for at least some of these record by comparing number of fish measured to number of fish retained and discarded, particularly when LFDATA = 100. All length records were listed as discarded for 1996 in the AFMA data, and all of those were changed to retained in the CSIRO and corrected VFA data which are identical. The corrected VFA dataset for 1997 is very similar to the AFMA data, but differs slightly in that some small fish (13–20 cm) were reclassified as retained in the former as well as in the CSIRO data. Those fish were all from one shot (vessel PT003, 21/8/1997, shot 8) and were listed as discarded in the AFMA data. They were reclassified as retained in the corrected VFA data because no discarded weight was recorded. Given their very small size, that they were recorded as discarded and that LFDIS is greater than 0, these fish were most likely discarded, and this demonstrates a flaw in the methods applied.

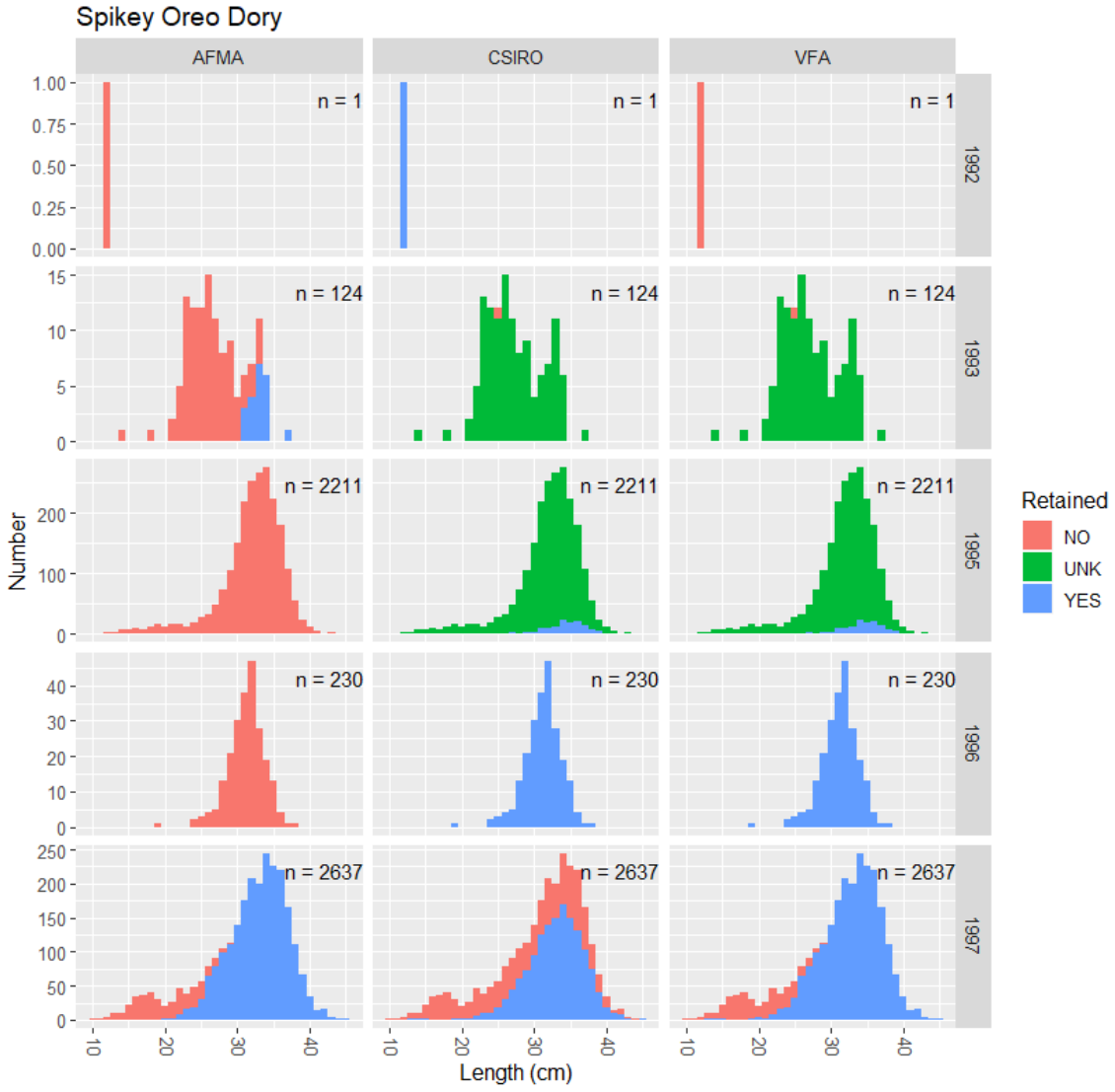

Figure 30. Comparison of length frequency data for Spikey Oreo Dory from the AFMA, CSIRO and VFA databases.

1.6 Additional onboard data not in database

The VFA hard drive was scanned for onboard length frequency data that was not in the database but none were found. However, significant numbers of port-based length frequencies found in files from the VFA are missing from the AFMA database. The addition of those data to the database is outside the scope of this project, but should be addressed. For example, there are nearly 5,000 port-based length measurements of Blue Grenadier from 1993 in an excel spreadsheet (226_93.xls) that are not in the AFMA database. The length frequency distributions are very different between the two datasets (Figure 31). Another example is for Eastern School Whiting. On page 10 of Day (2007[8]), the author described port length frequencies as being "available from port sampling for the period 1994–2005." The following files found on the VFA hard-drive contain port sampled length frequency data from 1991–1993: 924_91.xls (2026 fish), 524_92.xls (590 fish) and 542_93.xls (168 fish).

There are about 60 different Excel files containing these data and it is uncertain how extensive the issue above is. The variability in the layout of these files does not allow for simple compilation of these datasets for easy comparison with AFMA data. For example, "wide format" tables are used that have different ranges of lengths, and there are often calculated fields including weighted length frequencies and moving averages. For this reason, these data require significant processing time to compile into a format that would enable efficient comparison with the AFMA port-based data, and that this cannot be done within this project.

[8] Day, J. (2005). School whiting (Sillago flindersi) stock assessment based on data up to 2006. Updated 9 November 2007, following discussions held at Shelf RAG September 4-5 2007 and subsequently. CSIRO Marine and Atmospheric Research Castray Esp, Hobart, Tasmania 7000. http://www.cmar.csiro.au/e-print/internal/2007/dayjr_x.pdf

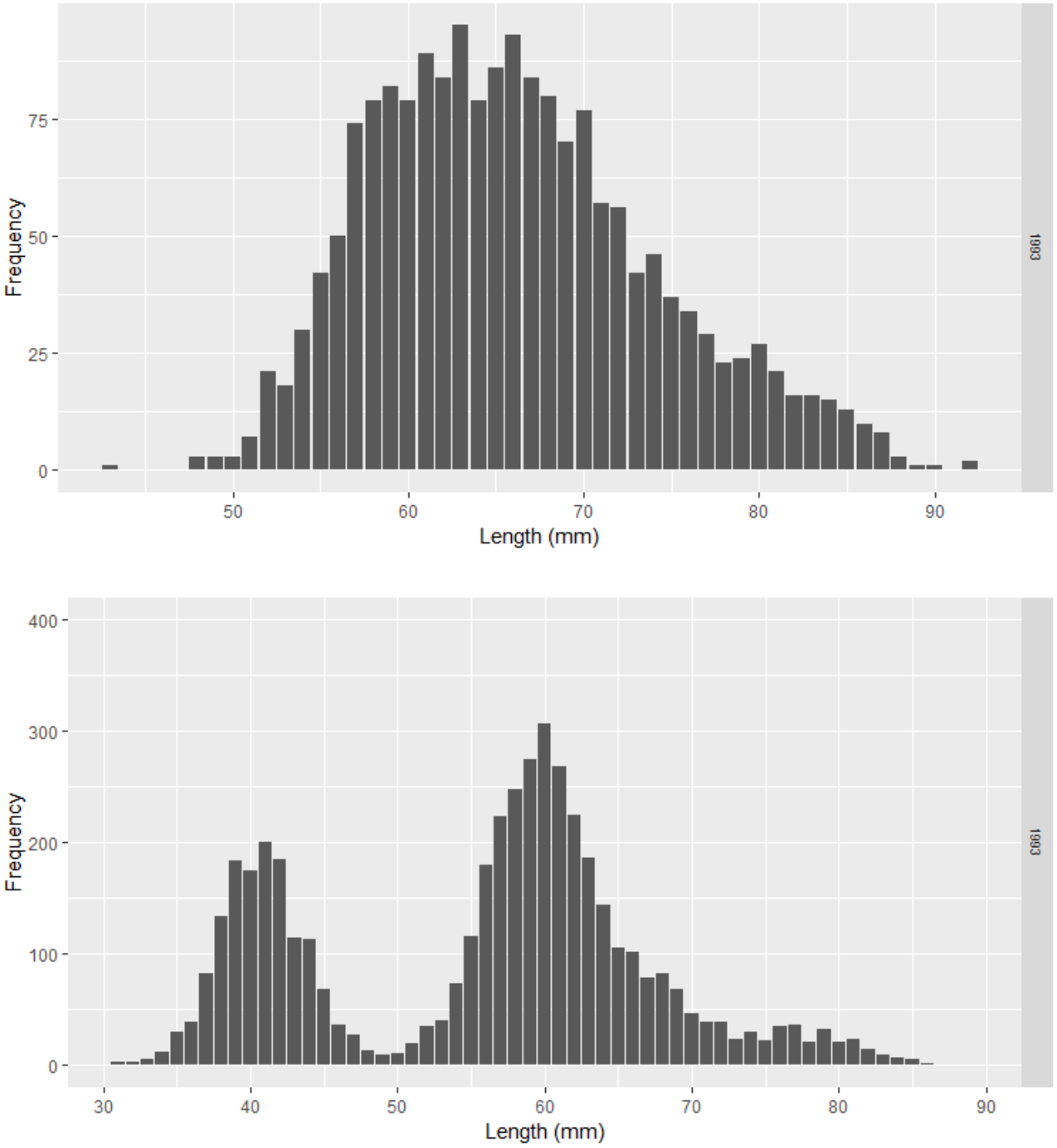

Figure 31. Raw length frequency of Blue Grenadier from port samples in 1993 in the database (top panel) compared to those found in VFA files that are missing from the AFMA data (bottom panel). Note that some of the data in the VFA files are also in the AFMA data.

Conclusions

CSIRO, AFMA and VFA datasets were obtained and compared to identify problems and develop a solution to correct those problems where possible, thereby providing the most accurate pre-1998 time series of onboard length frequency data possible. Issues identified were largely a result of changes in data custodians, and migration between databases, as well a previous attempts to correct erroneous data.

The mains issues identified were: 1) whether or not the catch was sorted prior to taking the length frequency sample; 2) misclassification of retained lengths as discarded lengths; 3) missing proportion of catch weight sampled for length measurement; and 4) missing catch and sample size information. Where possible, the misclassification errors were addressed using a logical algorithm that can be applied to the complete dataset. Missing proportion of catch weight sampled were calculated from either number of fish measured and number of fish retained or discarded, or from calculation of sample weights using length-weight relationships. Records with missing catch and sample size information were flagged to be deleted.

We believe that the length frequency data resulting from this project is a more accurate dataset, and should be used for future stock assessments. Rather than apply these methods to the data stored in the AFMA database, we propose that the AFMA database remains as is, but that this process is either applied by AFMA when providing the CSIRO with an extract, or by the CSIRO after receiving the extract.

While no new onboard length frequency data was found, significant numbers of port-based length frequency data was found in files on the VFA hard-drive that are not included in the AFMA database. The 60 Excel files containing these data are in a wide range of formats, and it will require considerable effort (about 5 days) to compile them into one data set to enable efficient comparison between datasets. We recommend that this issue is addressed in a separate project.

Outputs from this project were presented at the December 2019 SERAG. The RAG recommended this revised dataset should be considered as the default dataset, replacing the existing dataset, and should be added to the AFMA database by April 2020 in order to be used in stock assessments in 2020.

Appendix 1

Table 10. Sum of number of fish measured by gear type, year and species in the CSIRO and AFMA datasets (note that the CSIRO dataset contains decimals in the numbers of fish, and these have been rounded in this summary).

			Discarded		Retained		Unknown fate		Combined fate	
Year	Gear	Common Name	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA
1970	LL	Albacore	0	0	0	96	0	1	0	97
1993	OT	Alfonsino	5	12	7	0	0	0	12	12
1995	OT	Alfonsino	1	1	0	0	0	0	1	1
1996	OT	Alfonsino	2	2	0	0	0	0	2	2
1997	OT	Alfonsino	16	16	0	0	0	0	16	16
1993	OT	Angel Shark	3	4	1	0	0	0	4	4
1994	OT	Angel Shark	2	2	0	0	0	0	2	2
1996	OT	Angel Shark	13	14	1	0	0	0	14	14
1997	OT	Angel Shark	5	5	0	0	0	0	5	5
1993	OT	bar cod	0	10	0	23	0	0	0	33
1994	OT	bar cod	0	1	0	0	0	0	0	1
1993	OT	Barracouta	875	526	563	912	0	0	1438	1438
1994	OT	Barracouta	386	387	1	0	0	0	387	387
1995	OT	Barracouta	20	20	0	0	0	0	20	20
1996	OT	Barracouta	199	199	0	0	0	0	199	199
1997	OT	Barracouta	265	265	0	0	0	0	265	265
1992	OT	Bigeye Ocean Perch	42	45	3	0	0	0	45	45
1993	OT	Bigeye Ocean Perch	1058	718	592	1,193	0	0	1650	1911
1994	OT	Bigeye Ocean Perch	1590	1135	33	488	0	0	1623	1623
1995	OT	Bigeye Ocean Perch	1522	1020	105	872	265	0	1892	1892
1996	OT	Bigeye Ocean Perch	2642	711	723	2,659	0	0	3365	3370
1970	LL	Bigeye Tuna	0	1	0	25	0	4	0	30
1993	OT	Black Oreodory	128	732	364	0	153	0	645	732
1992	OT	Blue-eye Trevalla	0	9	9	0	0	0	9	9
1993	OT	Blue-eye Trevalla	0	245	246	1	0	0	246	246
1994	OT	Blue-eye Trevalla	0	368	369	1	0	0	369	369
1995	OT	Blue-eye Trevalla	0	142	142	15	0	0	142	157
1996	OT	Blue-eye Trevalla	0	299	378	79	0	0	378	378
1997	OT	Blue-eye Trevalla	0	0	613	613	0	0	613	613
1995	DS	Blue Grenadier	95	97	0	0	2	0	97	97
1992	OT	Blue Grenadier	1	758	679	0	78	0	758	758
1993	OT	Blue Grenadier	9	2362	2,307	161	207	0	2523	2523
1994	OT	Blue Grenadier	0	2733	2,740	7	0	0	2740	2740
1995	OT	Blue Grenadier	58	7117	4,629	5	2,435	0	7122	7122
1996	OT	Blue Grenadier	4072	8323	854	829	4,226	0	9152	9152

			Discarded		Retained		Unknown fate		Combined fate	
Year	Gear	Common Name	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA
1997	OT	Blue Grenadier	10637	8282	1,012	3,367	0	0	11649	11649
1970	LL	Blue Shark	0	1	0	2	0	0	0	3
1994	DS	Blue Warehou	371	767	192	9	131	0	694	776
1995	DS	Blue Warehou	214	319	0	0	104	0	318	319
1993	OT	Blue Warehou	102	519	847	430	0	0	949	949
1994	OT	Blue Warehou	761	3137	2,996	1,124	503	0	4260	4261
1995	OT	Blue Warehou	332	2049	1,607	371	479	0	2418	2420
1996	OT	Blue Warehou	17	2534	2,393	94	218	0	2628	2628
1997	OT	Blue Warehou	375	217	1,130	1,288	0	0	1505	1505
1993	OT	Bluestriped Goatfish	1	1	0	0	0	0	1	1
1994	OT	Bluestriped Goatfish	5	5	0	0	0	0	5	5
1995	OT	Bluestriped Goatfish	4	4	0	0	0	0	4	4
1996	OT	Bluestriped Goatfish	2	2	0	0	0	0	2	2
1997	OT	Bluestriped Goatfish	0	3	3	0	0	0	3	3
1993	OT	Brier Shark	50	50	0	0	0	0	50	50
1994	OT	Brier Shark	33	33	0	0	0	0	33	33
1995	OT	Brier Shark	1	1	0	0	0	0	1	1
1997	OT	Butterfly Perch	11	11	0	0	0	0	11	11
1993	OT	Common Jack Mackerel	268	124	156	300	0	0	424	424
1994	OT	Common Jack Mackerel	150	125	50	98	23	0	223	223
1995	OT	Common Jack Mackerel	277	272	120	125	0	0	397	397
1996	OT	Common Jack Mackerel	989	994	1	0	0	0	990	994
1997	OT	Common Jack Mackerel	1879	1881	2	0	0	0	1881	1881
1992	OT	Common weedfish	2	2	0	0	0	0	2	2
1993	OT	Common weedfish	11	12	1	0	0	0	12	12
1997	OT	Common weedfish	1	1	0	0	0	0	1	1
1993	OT	deepwater burrfish	13	14	1	7	0	0	14	21
1994	OT	deepwater burrfish	4	4	0	0	0	0	4	4
1994	OT	Deepwater Flathead	0	86	52	0	34	0	86	86
1996	OT	Deepwater Flathead	0	221	112	0	109	0	221	221
1997	OT	Deepwater Flathead	0	0	158	158	0	0	158	158
1992	OT	Dogfishes	26	26	0	0	0	0	26	26
1993	OT	Dogfishes	1	1	2	2	0	0	3	3
1996	OT	Dogfishes	73	73	0	0	0	0	73	73
1997	OT	eastern fiddler ray	0	2	0	0	0	0	0	2
1993	OT	Eastern Orange Perch	13	13	0	0	0	0	13	13
1993	OT	Eastern Red Scorpionfish	0	0	0	2	0	0	0	2
1996	OT	Eastern Red Scorpionfish	1	1	0	0	0	0	1	1
1997	OT	Eastern Red Scorpionfish	1	2	1	0	0	0	2	2
1994	DS	Eastern School Whiting	150	8803	3,776	0	4,877	0	8803	8803
1995	DS	Eastern School Whiting	0	3900	3,701	0	199	0	3900	3900
1994	OT	Eastern School Whiting	4	4	0	0	0	0	4	4
1995	OT	Eastern School Whiting	4	4	0	0	0	0	4	4

			Discarded		Retained		Unknown fate		Combined fate	
Year	Gear	Common Name	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA
1996	OT	Eastern School Whiting	10	11	1	0	0	0	11	11
1997	OT	Eastern School Whiting	109	114	5	0	0	0	114	114
1970	LL	Escolar	0	0	0	22	0	0	0	22
1997	OT	Fish (mixed)	5295	3048	775	3,000	0	0	6070	6048
1996	OT	Freespine Flathead	1	1	0	0	0	0	1	1
1997	OT	Freespine Flathead	3	3	0	0	0	0	3	3
1992	OT	Frostfish	393	393	0	0	0	0	393	393
1993	OT	Frostfish	906	906	1	1	0	0	907	907
1994	OT	Frostfish	240	242	0	0	0	0	240	242
1995	OT	Frostfish	364	378	14	0	0	0	378	378
1996	OT	Frostfish	640	640	0	0	0	0	640	640
1997	OT	Frostfish	600	600	0	0	0	0	600	600
1994	DS	Gemfish	4	4	0	0	0	0	4	4
1992	OT	Gemfish	28	28	0	0	0	0	28	28
1993	OT	Gemfish	539	452	357	455	0	0	896	907
1994	OT	Gemfish	233	1916	622	369	1,430	0	2285	2285
1995	OT	Gemfish	38	1330	920	58	427	0	1385	1388
1996	OT	Gemfish	601	1920	1,168	476	627	0	2396	2396
1997	OT	Gemfish	1078	940	1,690	1,828	0	0	2768	2768
1996	OT	Giant Boarfish	5	6	1	0	0	0	6	6
1997	OT	Giant Boarfish	3	3	0	0	0	0	3	3
1996	OT	Gould's Squid	0	139	0	0	139	0	139	139
1970	UN	Gould's Squid	0	0	0	353	0	0	0	353
1993	OT	greenback flounder	10	10	0	0	0	0	10	10
1994	OT	greenback flounder	7	7	0	0	0	0	7	7
1995	OT	greenback flounder	3	3	0	0	0	0	3	3
1996	OT	greenback flounder	31	34	3	0	0	0	34	34
1997	OT	greenback flounder	20	20	0	0	0	0	20	20
1992	OT	Greeneye Dogfish	53	53	0	0	0	0	53	53
1993	OT	Greeneye Dogfish	63	111	0	22	0	0	63	133
1992	OT	Grey Morwong	59	59	0	0	0	0	59	59
1993	OT	Grey Morwong	705	680	0	25	0	0	705	705
1994	OT	Grey Morwong	394	396	2	0	0	0	396	396
1995	OT	Grey Morwong	142	142	0	0	0	0	142	142
1996	OT	Grey Morwong	343	350	7	0	0	0	350	350
1997	OT	Grey Morwong	287	289	2	0	0	0	289	289
1997	OT	Gulper sharks	2	2	0	0	0	0	2	2
1994	DS	Gummy Shark	64	146	32	16	64	0	160	162
1995	DS	Gummy Shark	216	532	58	32	289	0	563	564
1993	OT	Gummy Shark	24	27	4	1	0	0	28	28
1994	OT	Gummy Shark	9	154	58	19	105	0	172	173
1995	OT	Gummy Shark	1	405	43	24	385	0	429	429
1996	OT	Gummy Shark	8	30	3	1	20	0	31	31

			Discarded		Retained		Unknown fate		Combined fate	
Year	Gear	Common Name	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA
1997	OT	Gummy Shark	165	118	57	104	0	0	222	222
1993	OT	Hapuku	0	1	3	3	0	0	3	4
1997	OT	humboldt's lanternfish	1	1	0	0	0	0	1	1
1993	DS	Jackass Morwong	1	79	71	0	6	0	78	79
1994	DS	Jackass Morwong	5	265	247	3	1	0	253	268
1993	OT	Jackass Morwong	328	887	1,286	730	0	0	1614	1617
1994	OT	Jackass Morwong	1151	3199	2,268	1,332	1,111	0	4530	4531
1995	OT	Jackass Morwong	66	1035	488	205	686	0	1240	1240
1996	OT	Jackass Morwong	1256	1820	1,496	1,380	448	0	3200	3200
1997	OT	Jackass Morwong	4519	565	2,940	6,894	0	0	7459	7459
1993	DS	John Dory	0	144	68	0	76	0	144	144
1994	DS	John Dory	29	541	93	0	404	0	526	541
1995	DS	John Dory	6	116	14	0	87	0	107	116
1992	OT	John Dory	41	41	0	0	0	0	41	41
1993	OT	John Dory	303	175	948	1,076	0	0	1251	1251
1994	OT	John Dory	217	198	558	737	103	0	878	935
1995	OT	John Dory	53	198	478	436	103	0	634	634
1996	OT	John Dory	133	23	385	495	0	0	518	518
1997	OT	John Dory	147	58	844	933	0	0	991	991
1992	OT	King Dory	0	49	17	0	32	0	49	49
1993	OT	King Dory	3	55	52	0	0	0	55	55
1994	OT	King Dory	15	15	0	0	0	0	15	15
1995	OT	King Dory	21	1525	551	0	953	0	1525	1525
1996	OT	King Dory	103	490	0	0	387	0	490	490
1997	OT	King Dory	323	144	729	908	0	0	1052	1052
1994	DS	King George Whiting	0	1	4	3	0	0	4	4
1995	DS	King George Whiting	0	95	94	1	2	0	96	96
1993	OT	Latchet	3	75	72	11	0	0	75	86
1994	OT	Latchet	7	218	0	0	211	0	218	218
1995	OT	Latchet	1	1	0	0	0	0	1	1
1996	OT	Latchet	20	21	1	0	0	0	21	21
1997	OT	Latchet	8	9	239	238	0	0	247	247
1993	OT	Leathery turtle	0	0	1	1	0	0	1	1
1995	OT	Longsnout boarfish	0	81	81	0	0	0	81	81
1992	OT	Longsnout Dogfish	5	14	0	0	0	0	5	14
1993	OT	Longsnout Dogfish	0	0	0	27	0	0	0	27
1970	LL	Mahi Mahi	0	0	0	5	0	0	0	5
1992	OT	marble flathead	158	158	0	0	0	0	158	158
1993	OT	marble flathead	0	0	29	29	0	0	29	29
1992	OT	Mirror Dory	47	48	1	0	0	0	48	48
1993	OT	Mirror Dory	628	826	474	277	0	0	1102	1103
1994	OT	Mirror Dory	754	1237	26	94	551	0	1331	1331
1995	OT	Mirror Dory	442	1120	416	42	304	0	1162	1162

			Discarded		Retained		Unknown fate		Combined fate	
Year	Gear	Common Name	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA
1996	OT	Mirror Dory	2741	2118	215	1,227	390	0	3346	3345
1997	OT	Mirror Dory	1348	777	1,074	1,640	0	0	2422	2417
1994	OT	Mosaic leatherjacket	6	9	0	0	0	0	6	9
1995	OT	Mosaic leatherjacket	5	5	0	0	0	0	5	5
1992	OT	Ocean Jacket	64	64	0	0	0	0	64	64
1994	OT	Ocean Jacket	3	3	0	0	0	0	3	3
1995	OT	Ocean Jacket	2	2	0	0	0	0	2	2
1996	OT	Ocean Jacket	6	6	0	0	0	0	6	6
1997	OT	Ocean Jacket	134	134	0	0	0	0	134	134
1997	OT	ocean sunfishes	1	1	0	0	0	0	1	1
1970	LL	Oilfish	0	1	0	0	0	0	0	1
1992	OT	Orange Roughy	25	513	488	0	0	0	513	513
1993	OT	Orange Roughy	72	2962	2,801	0	89	0	2962	2962
1994	OT	Orange Roughy	243	6090	4,515	0	1,332	0	6090	6090
1995	OT	Orange Roughy	117	720	562	68	109	0	788	788
1996	OT	Orange Roughy	373	2260	1,736	452	603	0	2712	2712
1997	OT	Orange Roughy	2096	1079	1,310	2,327	0	0	3406	3406
1993	OT	pacific spookfish	55	55	0	0	0	0	55	55
1994	OT	pacific spookfish	4	4	0	0	0	0	4	4
1995	OT	pacific spookfish	2	2	0	0	0	0	2	2
1996	OT	pacific spookfish	19	19	0	0	0	0	19	19
1997	OT	pacific spookfish	41	41	0	0	0	0	41	41
1992	OT	Piked Spurdog	9	9	0	0	0	0	9	9
1993	OT	Piked Spurdog	1498	1398	104	216	0	0	1602	1614
1994	OT	Piked Spurdog	980	982	0	0	0	0	980	982
1995	OT	Piked Spurdog	452	455	0	0	0	0	452	455
1996	OT	Piked Spurdog	483	484	50	50	0	0	533	534
1997	OT	Piked Spurdog	690	692	2	0	0	0	692	692
1993	DS	Pink Ling	0	23	10	0	9	0	19	23
1994	DS	Pink Ling	115	236	63	0	37	0	215	236
1995	DS	Pink Ling	8	34	1	1	22	0	31	35
1992	OT	Pink Ling	1	142	141	0	0	0	142	142
1993	OT	Pink Ling	5	909	1,394	829	0	0	1399	1738
1994	OT	Pink Ling	36	2001	2,262	326	33	0	2331	2327
1995	OT	Pink Ling	39	4535	4,730	603	374	0	5143	5138
1996	OT	Pink Ling	313	1832	3,468	2,107	153	0	3934	3939
1997	OT	Pink Ling	1309	605	3,794	4,496	0	0	5103	5101
1992	OT	Port Phillip Pipefish	70	93	0	0	0	0	70	93
1993	OT	Port Phillip Pipefish	1041	1041	0	0	0	0	1041	1041
1994	OT	Port Phillip Pipefish	1863	1864	1	0	0	0	1864	1864
1995	OT	Port Phillip Pipefish	1494	1495	1	0	0	0	1495	1495
1996	OT	Port Phillip Pipefish	935	938	3	0	0	0	938	938
1997	OT	Port Phillip Pipefish	908	918	10	0	0	0	918	918

			Discarded		Retained		Unknown fate		Combined fate	
Year	Gear	Common Name	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA
1997	OT	Red Cod	1	1	0	0	0	0	1	1
1992	OT	Red Gurnard	1	1	0	0	0	0	1	1
1993	OT	Red Gurnard	25	27	24	22	0	0	49	49
1994	OT	Red Gurnard	22	22	0	0	0	0	22	22
1995	OT	Red Gurnard	3	4	1	0	0	0	4	4
1996	OT	Red Gurnard	26	29	3	0	0	0	29	29
1997	OT	Red Gurnard	46	53	7	0	0	0	53	53
1993	DS	Redfish	0	1	0	0	0	0	0	1
1994	DS	Redfish	399	556	2	0	120	0	521	556
1992	OT	Redfish	16	16	0	0	0	0	16	16
1993	OT	Redfish	5131	4133	1,072	2,074	0	0	6203	6207
1994	OT	Redfish	8212	6307	270	2,557	384	0	8866	8864
1995	OT	Redfish	4667	3017	158	1,808	0	0	4825	4825
1996	OT	Redfish	11153	3740	1,329	8,759	0	0	12482	12499
1997	OT	Redfish	5346	1711	2,646	6,280	0	0	7992	7991
1993	DS	Reef Ocean Perch	12	12	0	0	0	0	12	12
1994	DS	Reef Ocean Perch	27	37	0	0	10	0	37	37
1992	OT	Reef Ocean Perch	116	116	0	0	0	0	116	116
1993	OT	Reef Ocean Perch	1872	1803	0	73	0	0	1872	1876
1994	OT	Reef Ocean Perch	1241	1965	102	26	648	0	1991	1991
1995	OT	Reef Ocean Perch	983	1271	155	0	133	0	1271	1271
1996	OT	Reef Ocean Perch	2183	2129	2	58	0	0	2185	2187
1997	OT	Reef Ocean Perch	155	40	523	638	0	0	678	678
1992	OT	reticulate swell shark	1	1	0	0	0	0	1	1
1994	OT	reticulate swell shark	1	1	0	0	0	0	1	1
1996	OT	reticulate swell shark	9	10	1	0	0	0	10	10
1997	OT	reticulate swell shark	12	18	6	0	0	0	18	18
1992	OT	Ribaldo	5	5	0	0	0	0	5	5
1993	OT	Ribaldo	2	2	0	0	0	0	2	2
1994	OT	Ribaldo	26	26	0	0	0	0	26	26
1995	OT	Ribaldo	15	15	0	0	0	0	15	15
1996	OT	Ribaldo	16	16	0	0	0	0	16	16
1997	OT	Ribaldo	1	2	1	0	0	0	2	2
1994	DS	Rock ling	0	4	0	0	0	0	0	4
1996	OT	Rosy Dory	4	4	0	0	0	0	4	4
1997	OT	Rosy Dory	3	3	0	0	0	0	3	3
1994	OT	Rudderfish	0	1	1	0	0	0	1	1
1993	OT	sandy-backed stingaree	2	3	1	0	0	0	3	3
1993	OT	Sawsharks	1	1	0	0	0	0	1	1
1994	OT	Sawsharks	3	3	0	0	0	0	3	3
1996	OT	Sawsharks	11	14	3	0	0	0	14	14
1997	OT	Sawsharks	16	19	3	0	0	0	19	19
1994	DS	School Shark	0	1	0	0	1	0	1	1

			Discarded		Retained		Unknown fate		Combined fate	
Year	Gear	Common Name	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA
1995	DS	School Shark	1	1	0	0	0	0	1	1
1993	OT	School Shark	0	26	27	1	0	0	27	27
1994	OT	School Shark	4	103	52	1	43	0	99	104
1995	OT	School Shark	16	83	8	1	60	0	84	84
1996	OT	School Shark	0	21	5	0	16	0	21	21
1997	OT	School Shark	71	49	168	190	0	0	239	239
1970	LL	Shortfin Mako	0	0	0	5	0	1	0	6
1992	OT	Silver Dory	7	8	0	0	0	0	7	8
1993	OT	Silver Dory	151	129	186	212	0	0	337	341
1994	OT	Silver Dory	362	365	3	0	0	0	365	365
1995	OT	Silver Dory	232	232	0	0	0	0	232	232
1996	OT	Silver Dory	1443	1451	1	0	0	0	1444	1451
1997	OT	Silver Dory	790	723	7	74	0	0	797	797
1993	DS	Silver Trevally	0	3	3	0	0	0	3	3
1994	DS	Silver Trevally	0	5	0	0	1	0	1	5
1995	DS	Silver Trevally	81	81	0	0	0	0	81	81
1993	OT	Silver Trevally	4	4	704	711	0	0	708	715
1994	OT	Silver Trevally	4	95	180	92	0	0	184	187
1995	OT	Silver Trevally	0	0	495	493	0	0	495	493
1996	OT	Silver Trevally	179	115	1,097	1,164	0	0	1276	1279
1997	OT	Silver Trevally	183	120	1,456	1,514	0	0	1639	1634
1993	DS	Silver Warehou	0	1	1	0	0	0	1	1
1994	DS	Silver Warehou	13	30	12	0	0	0	25	30
1995	DS	Silver Warehou	23	23	0	0	0	0	23	23
1992	OT	Silver Warehou	0	158	158	0	0	0	158	158
1993	OT	Silver Warehou	1058	763	1,508	1,807	0	0	2566	2570
1994	OT	Silver Warehou	67	2557	3,610	1,347	224	0	3901	3904
1995	OT	Silver Warehou	520	4790	3,482	142	930	0	4932	4932
1996	OT	Silver Warehou	827	4271	3,251	889	1,082	0	5160	5160
1997	OT	Silver Warehou	1371	937	4,073	4,507	0	0	5444	5444
1997	OT	Slender Flounder	4	4	0	0	0	0	4	4
1997	OT	small-toothed flounder	3	4	1	0	0	0	4	4
1992	OT	Smooth Oreodory	3	270	0	0	267	0	270	270
1993	OT	Smooth Oreodory	146	404	203	0	55	0	404	404
1994	OT	Smooth Oreodory	0	89	0	0	89	0	89	89
1996	OT	Smooth Oreodory	2	2	0	0	0	0	2	2
1997	OT	smooth toadfish	4	4	0	0	0	0	4	4
1994	DS	Snapper	0	26	22	2	1	0	23	28
1995	DS	Snapper	0	1	1	1	1	0	2	2
1994	OT	Snapper	0	11	11	0	0	0	11	11
1995	OT	Snapper	0	98	98	0	0	0	98	98
1997	OT	Snapper	28	28	50	50	0	0	78	78
1970	LL	Southern Bluefin Tuna	0	0	0	1	0	0	0	1

			Discarded		Retained		Unknown fate		Combined fate	
Year	Gear	Common Name	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA	CSIRO	AFMA
1993	DS	Southern Bluespotted Flathead	0	10	0	0	0	0	0	10
1994	DS	Southern Bluespotted Flathead	0	388	39	0	47	0	86	388
1995	DS	Southern Bluespotted Flathead	0	173	0	0	0	0	0	173
1996	OT	Southern Eagle Ray	9	9	0	0	0	0	9	9
1997	OT	Southern Eagle Ray	15	15	0	0	0	0	15	15
1997	OT	southern fiddler ray	2	0	0	0	0	0	2	0
1993	DS	Southern Sand Flathead	0	478	3	0	472	0	475	478
1994	DS	Southern Sand Flathead	58	1219	108	0	445	0	611	1219
1995	DS	Southern Sand Flathead	3	296	5	0	220	0	228	296
1994	OT	Southern Sawshark	2	2	0	0	0	0	2	2
1992	OT	Spikey Oreodory	0	1	1	0	0	0	1	1
1993	OT	Spikey Oreodory	1	103	0	21	123	0	124	124
1995	OT	Spikey Oreodory	0	2211	135	0	2,076	0	2211	2211
1996	OT	Spikey Oreodory	0	230	230	0	0	0	230	230
1997	OT	Spikey Oreodory	1165	387	1,472	2,250	0	0	2637	2637
1993	OT	spotted flounder	51	51	0	0	0	0	51	51
1993	OT	Stargazers	10	0	18	0	0	0	28	0
1994	OT	Stargazers	1	0	0	0	0	0	1	0
1970	LL	Striped Marlin	0	0	0	18	0	0	0	18
1970	LL	Swordfish	0	0	0	51	0	0	0	51
1993	DS	Tiger Flathead	0	1020	356	0	133	0	489	1020
1994	DS	Tiger Flathead	0	7050	1,658	0	622	0	2280	7050
1995	DS	Tiger Flathead	0	2753	563	0	596	0	1159	2753
1992	OT	Tiger Flathead	132	132	0	0	0	0	132	132
1993	OT	Tiger Flathead	3816	1387	1,449	3,891	0	0	5265	5278
1994	OT	Tiger Flathead	2207	2058	800	1,815	869	0	3876	3873
1995	OT	Tiger Flathead	1316	1518	726	1,303	777	0	2819	2821
1996	OT	Tiger Flathead	4455	1915	2,279	5,529	713	0	7447	7444
1997	OT	Tiger Flathead	8140	1343	6,447	13,263	0	0	14587	14606
1993	OT	Toothed Whiptail	1	1	0	0	0	0	1	1
1993	DS	Toothy Flathead	0	99	0	0	0	0	0	99
1994	DS	Toothy Flathead	0	476	0	0	0	0	0	476
1995	DS	Toothy Flathead	0	113	0	0	0	0	0	113
1996	OT	Warty Oreodory	0	109	0	0	109	0	109	109
1997	OT	Warty Oreodory	432	296	0	136	0	0	432	432
1993	OT	White Warehou	0	37	37	0	0	0	37	37
1994	OT	White Warehou	0	6	6	0	0	0	6	6
1997	OT	White Warehou	0	0	40	40	0	0	40	40
1970	LL	Yellowfin Tuna	0	0	0	92	0	0	0	92
1970	LL	Unknown	0	0	0	1	0	0	0	1