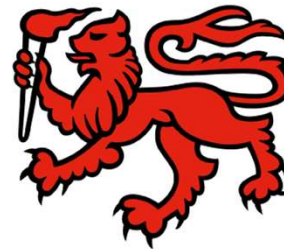


# Commonwealth Small Pelagic Fishery (SPF): Fishery Assessment Report 2023

Presentation to SPF RAG: **contains confidential information**

Tim Ward, Katerina Charitonidou, Gary Carlos and Tom Alderson

December 2023

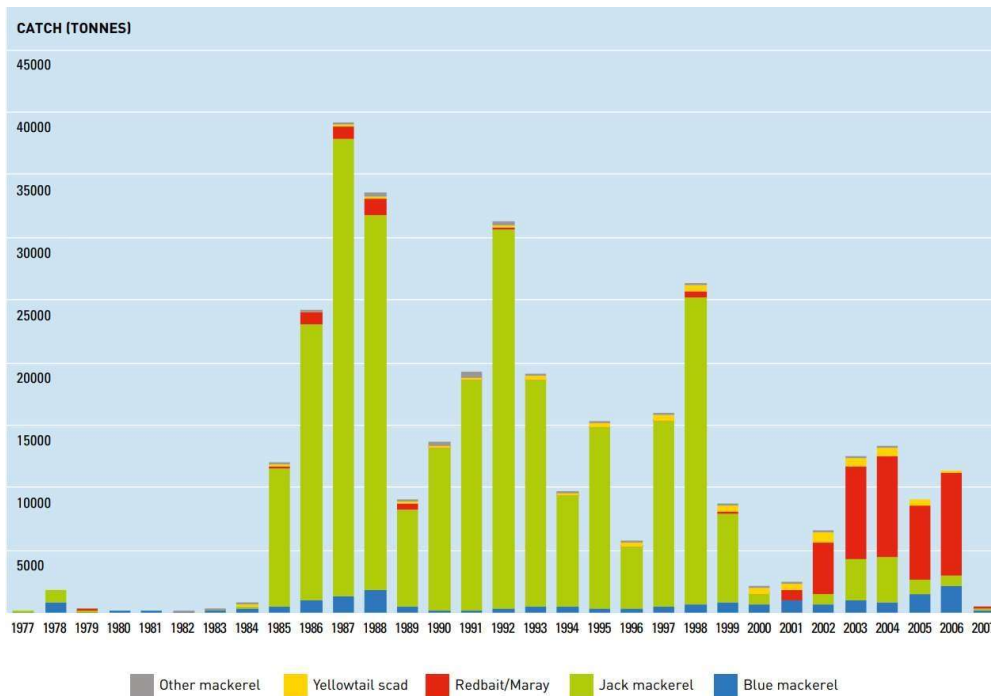


UNIVERSITY *of*  
TASMANIA

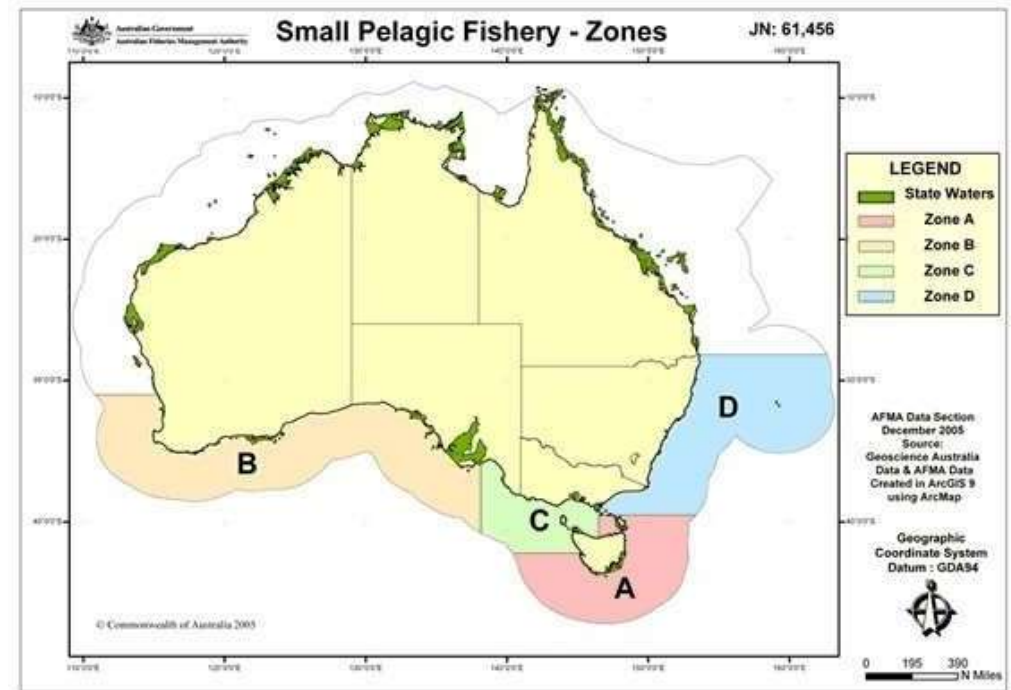


**IMAS**  
INSTITUTE FOR MARINE  
& ANTARCTIC STUDIES

# Jack Mackerel Fishery and SPF



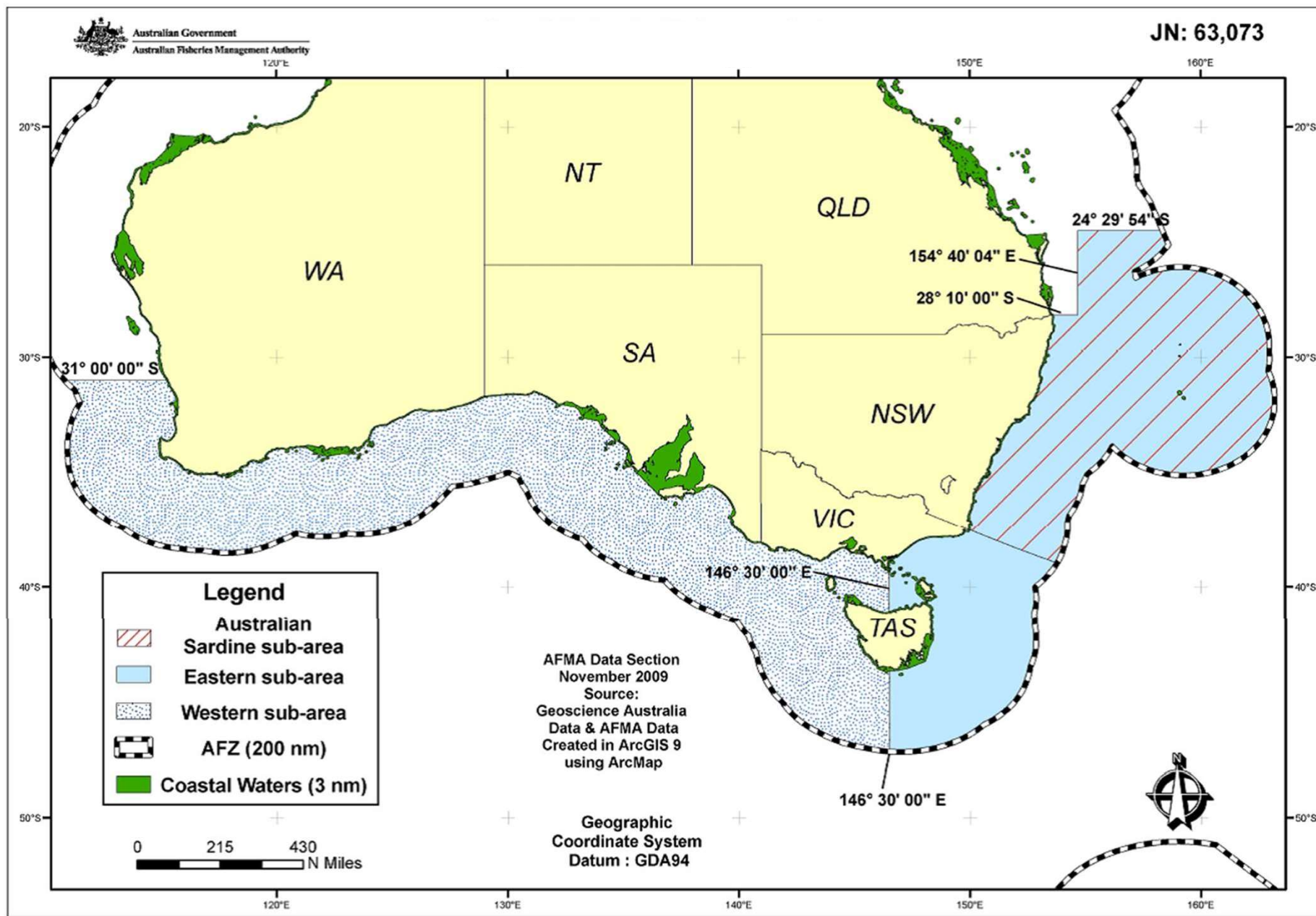
Source: Bulman et al. (2008), Expert Panel Report (2014)  
\*2007 data incomplete



Source: AFMA website 7 June (2007).

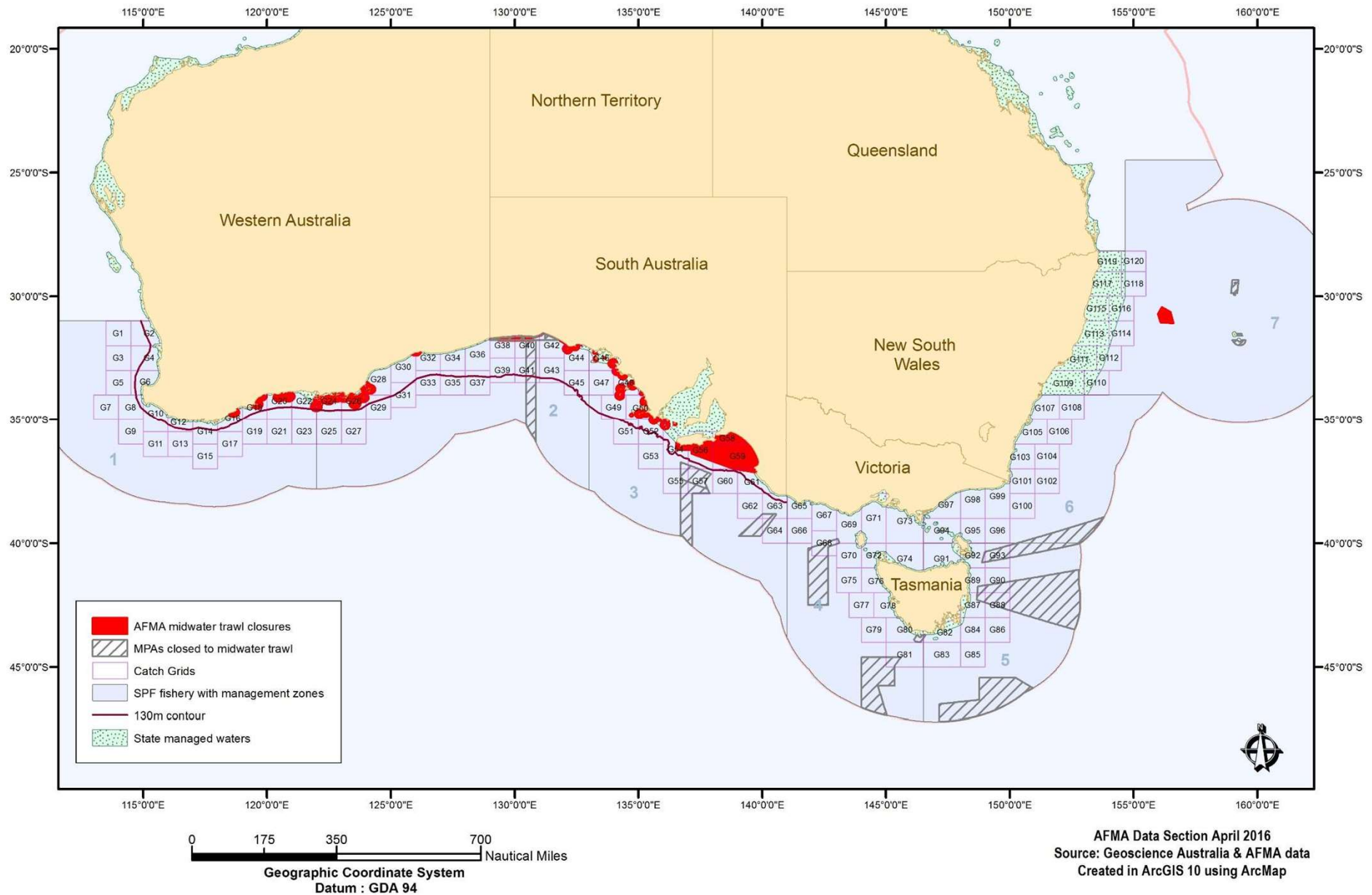
- Jack Mackerel Fishery (purse-seine) off Tasmania up to 2000
- Highest total catch of ~39,700 t in 1986/87
- SPF established in 2001
- JMK rules (TAC, zones, input controls, etc) up to 2008/09
- Mid-water trawling began in 2001/2002
- Harvest Strategy (2008, last revised 2017)
- Management Plan (2009)

# Three SPF sub-areas: Western, Eastern and Sardine



Target species: Jack Mackerel, Blue Mackerel, Redbait. Sardine in Sardine Sub-area only  
(Total Allowable Catches)

# Seven sub-zones, catch grids, trawl closures and MPAs



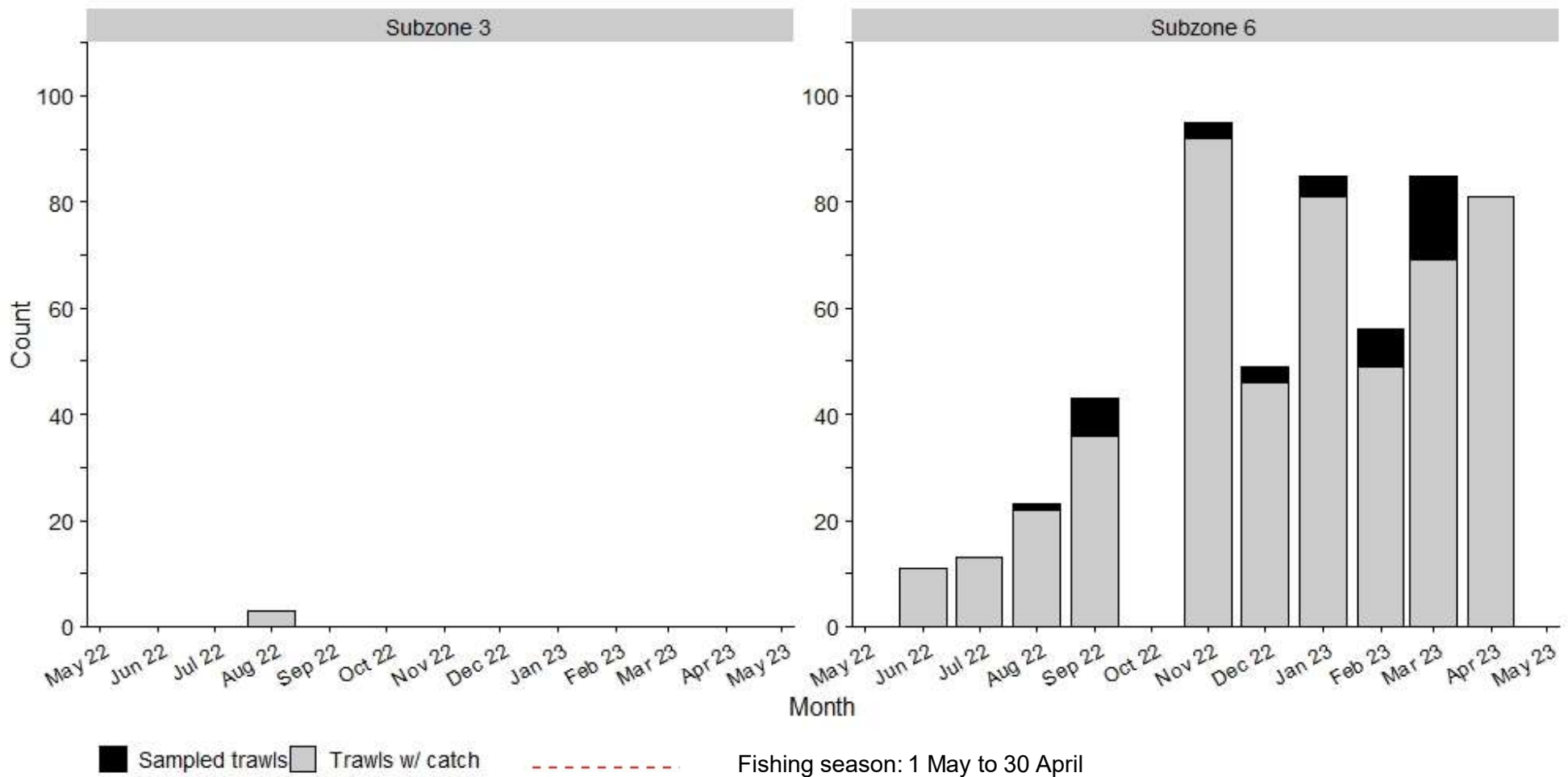
Catch grids established to control spatial/temporal concentration of effort

# Catch and effort data

- SPF 2000/01 to 2022/23 (AFMA) – Blue Mackerel, Jack Mackerel, Redbait, Sardine
- NSW Purse-seine – Blue Mackerel, Sardine (Many thanks to John Stewart)

Not included in estimates of total catch: SESSF, WTBF, ETBF, state line-fisheries, recreational catches\*RBCs to TACs (AFMA)

## Catch Sampling 2022/2023



# Catch Sampling Summary 2022/23

Species	SppCat	Samples	Fish	Otoliths Weighed	Otoliths Read
BMK	BMK	24	246	234	118
BMK	BMK Targeted large fish	8	121	115	59
JMK	JMK	25	288	287	120
RBT	RBT	20	237	234	95

Sampling targets and budgeted (Jack Mackerel and Blue Mackerel only, no RBT or Sardine)

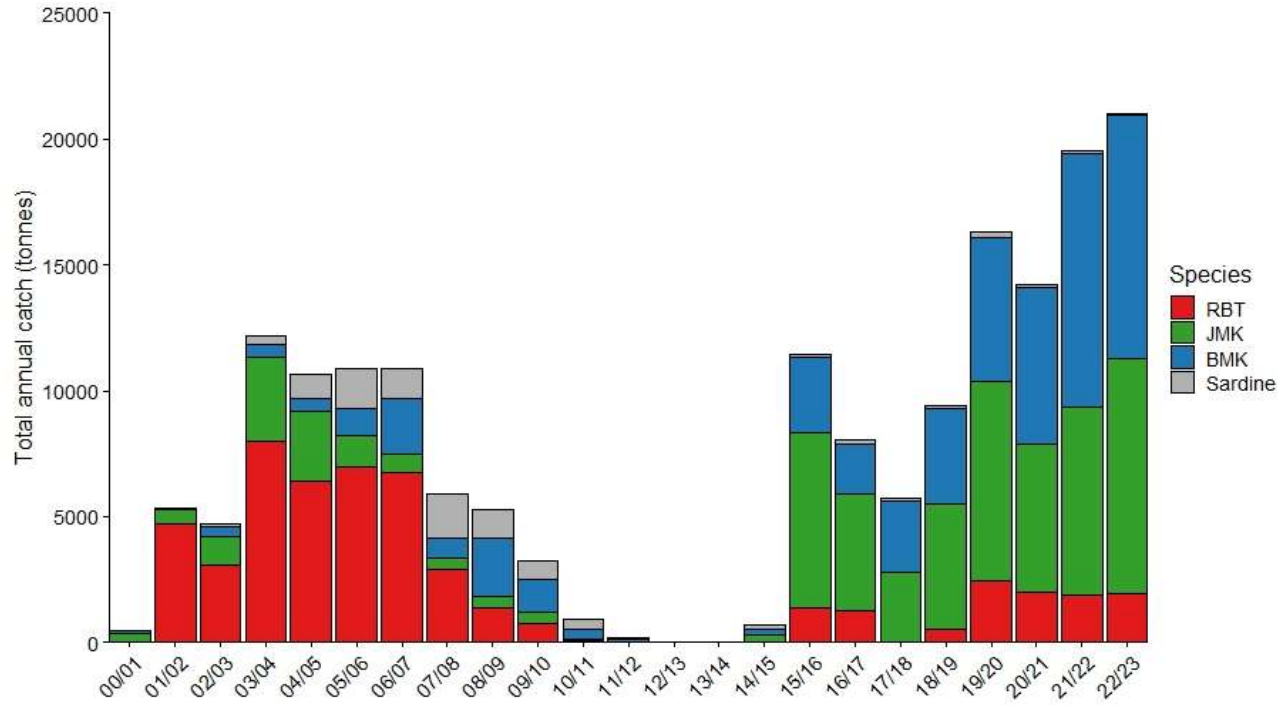
- 30 samples
- 10 lengths and otolith weights per sample (300 fish)
- 5 otoliths sectioned and read (150 otoliths)

Targeted sampling of large Blue Mackerel to address uncertainties in age, growth and reproduction

Tom Alderson M.Sc. thesis – also using samples from Blue Mackerel Spawning Fraction Stage 1 and 2

Historical data from SARDI (all species for Harvest Control Rule Project funded by SPFIA)

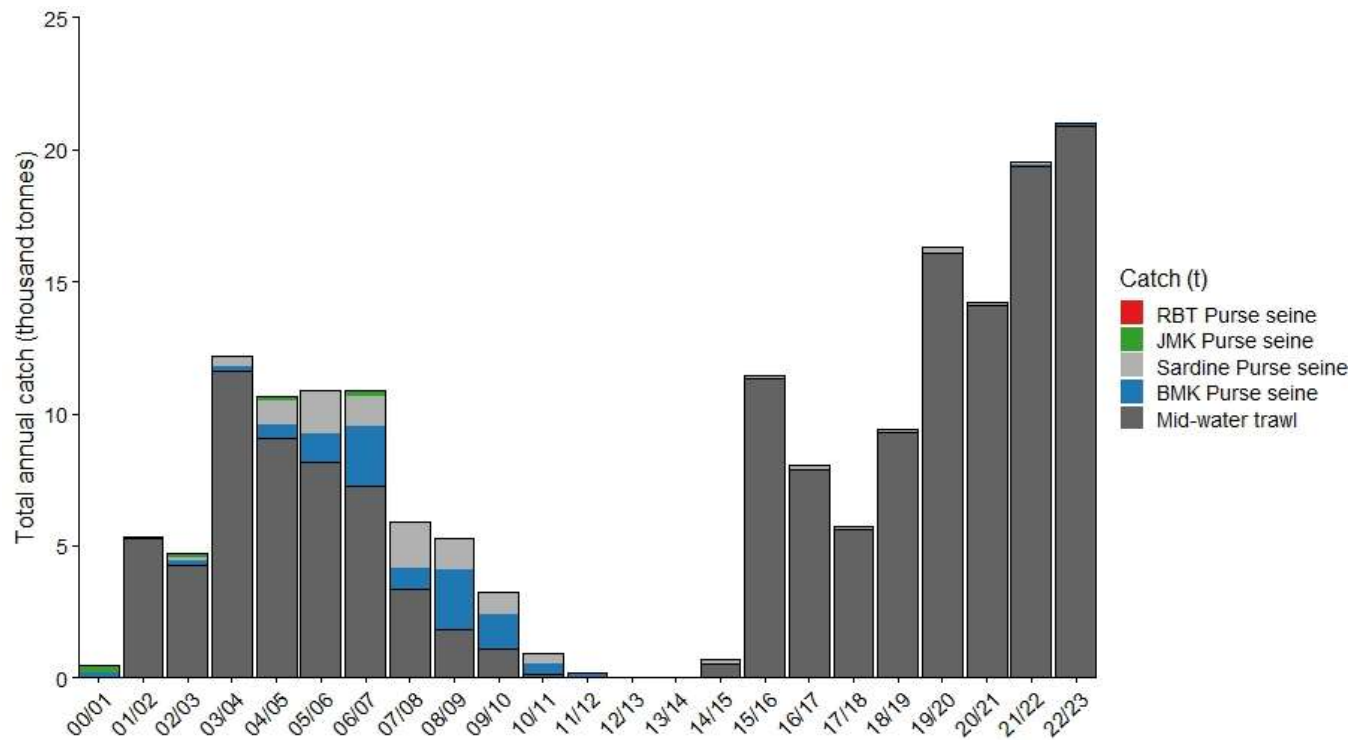
# Total SPF Catch 2000/01 to 2022/23



Total: 21,009 t

East: 20,969 t

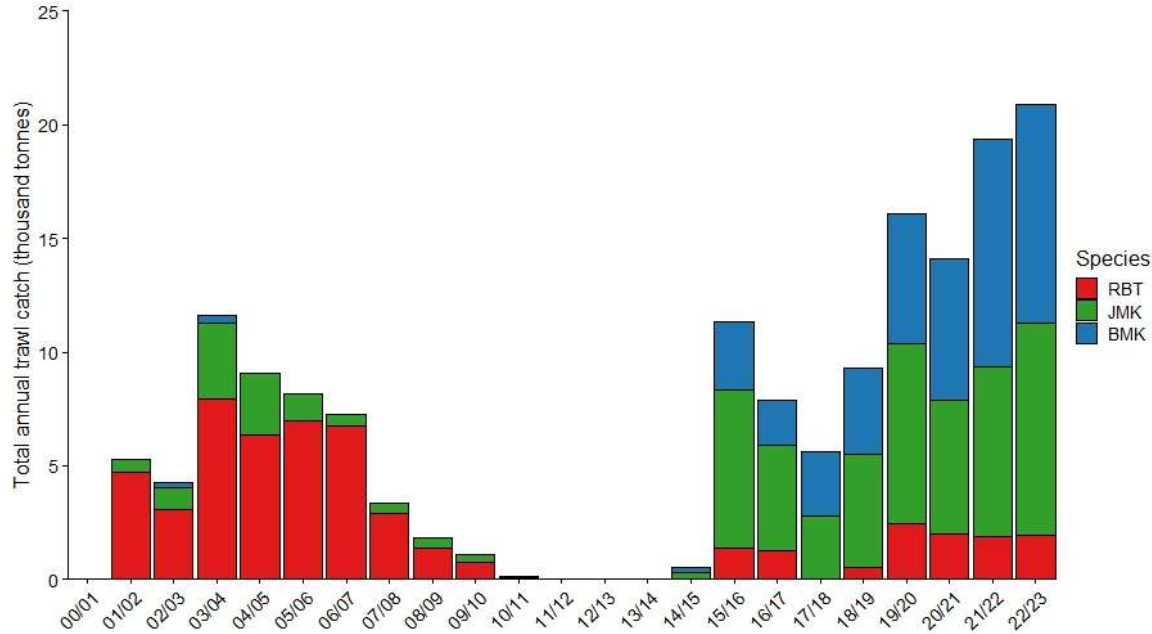
West: 40 t



Trawl: 20,901 t

Purse : 108 t

# Total SPF Trawl Catch, Effort and CPUE 2000/01 to 2022/23



Trawl: 20,901 t

East: 20,861 t

West: 40 t

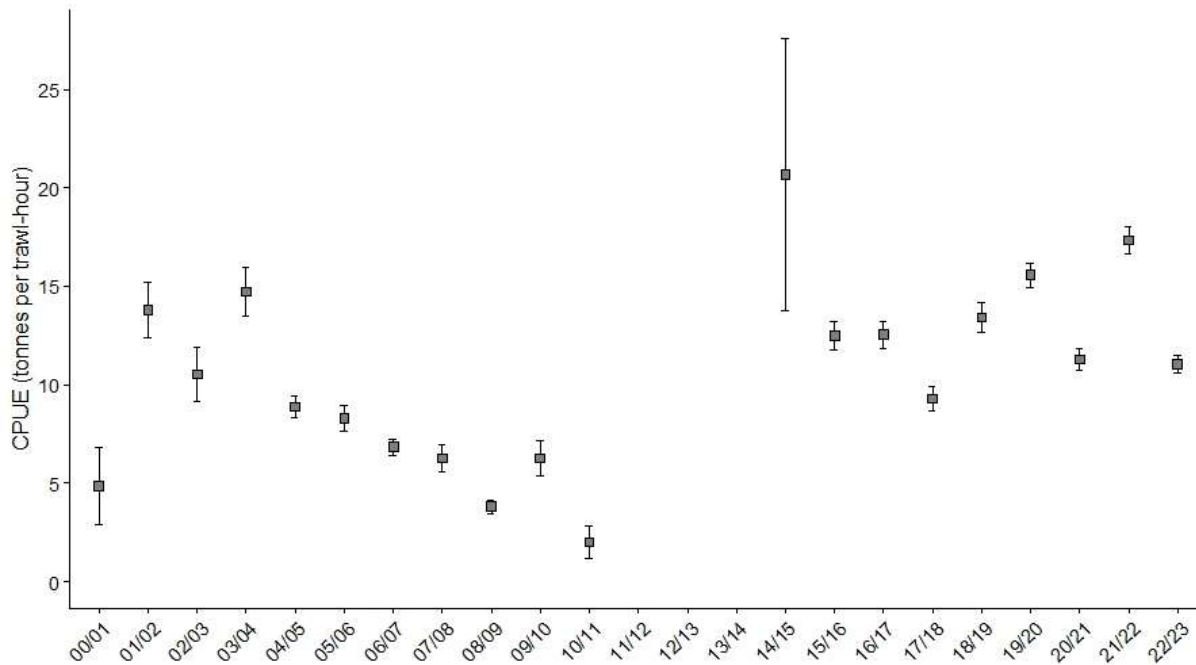
Trawl by Species

JMK: 9,342 t

BMK: 9,599 t

RBT: 1,946 t

SAR: 14 t

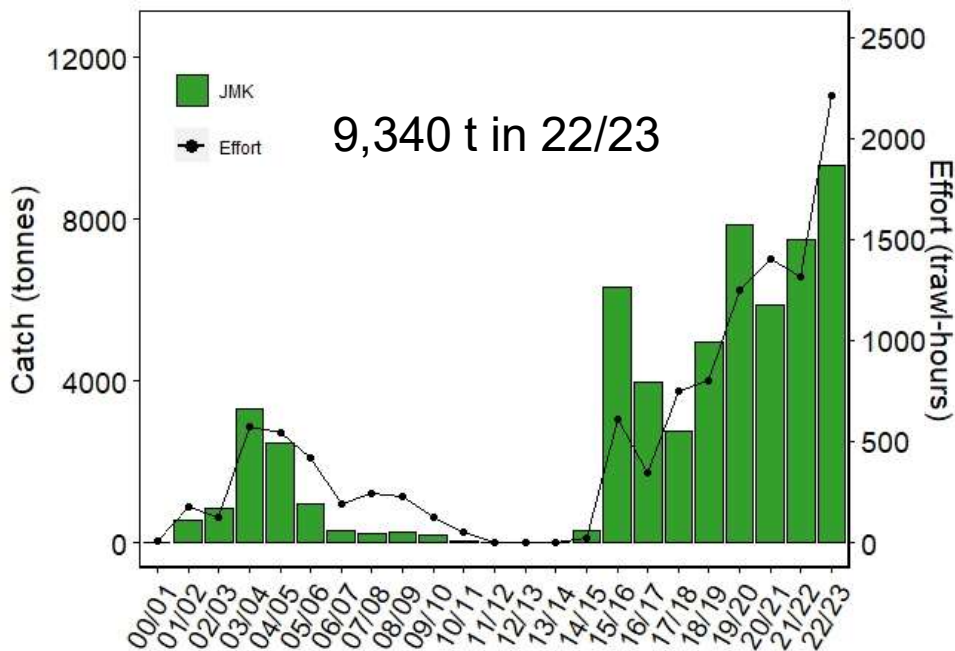




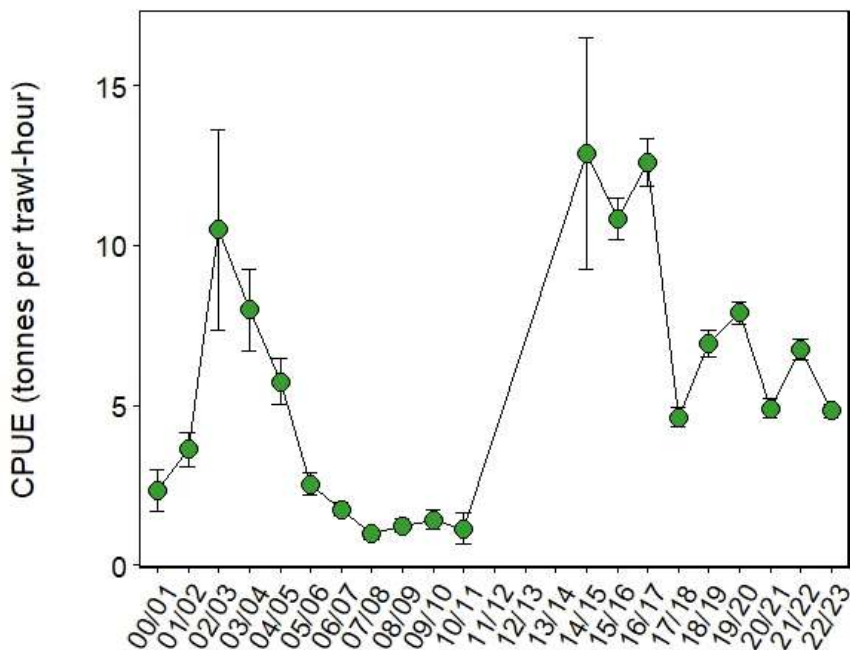
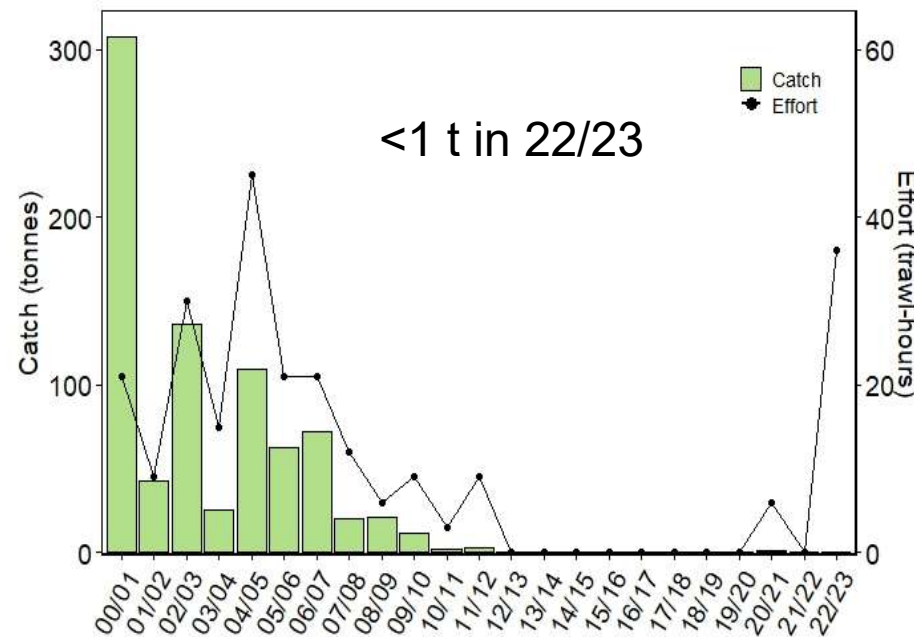
# Jack Mackerel: Eastern Sub-area



## Commonwealth: Trawl



## Commonwealth: Purse-seine



Total trawl catch in 2022/23 highest in SPF history

Second highest 2019/20: 7,868 t

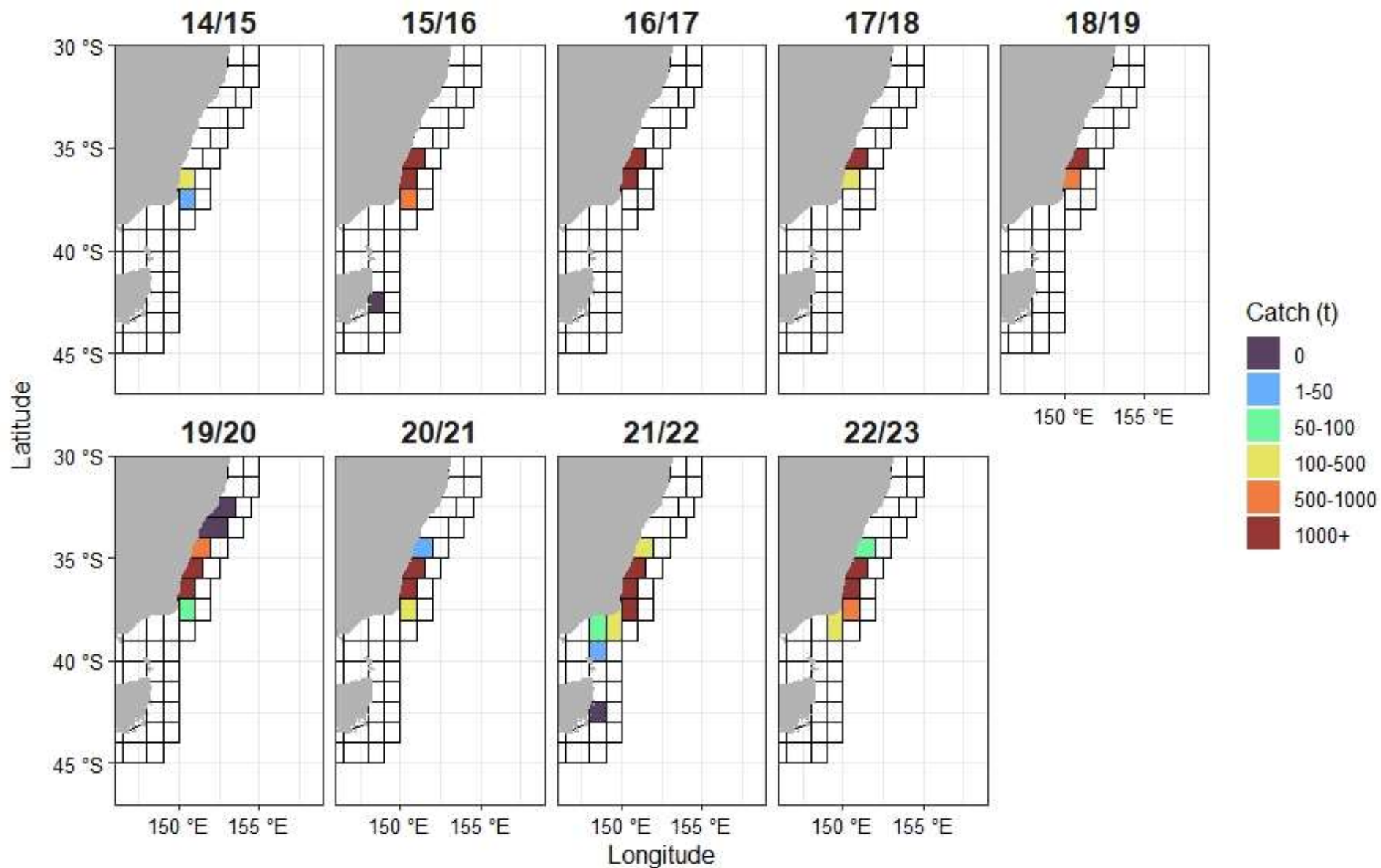
Decline in CPUE from 2003/04 to 2010/11 (Tas RBT)

High CPUE 2014/15 to 2016/17

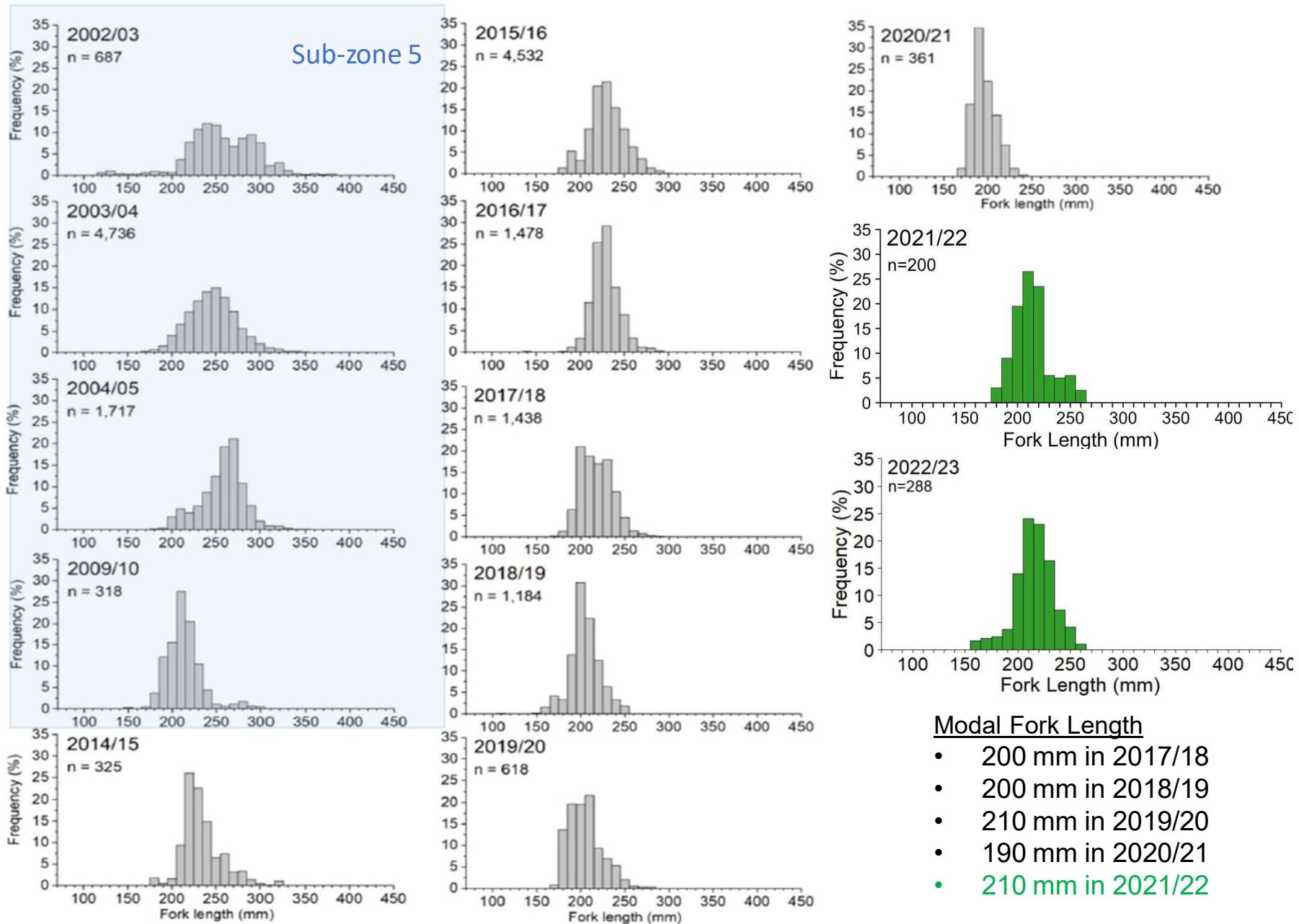
Current operation: 4.6-7.9 t.trawl hr<sup>-1</sup>

5.8 t.trawl hr<sup>-1</sup> in 2022/23

# Jack Mackerel: Eastern Sub-area



# Jack Mackerel: Eastern Sub-area (Sub-zone 6)



## Modal Fork Length

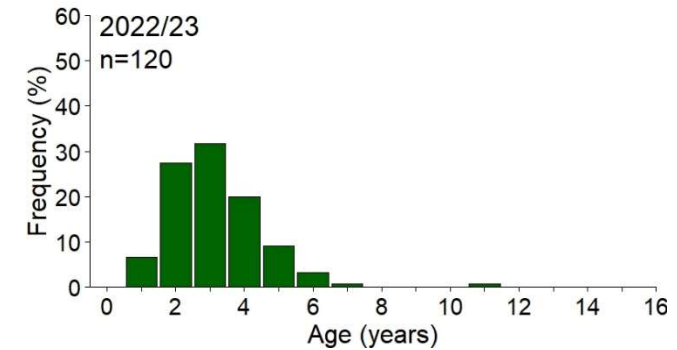
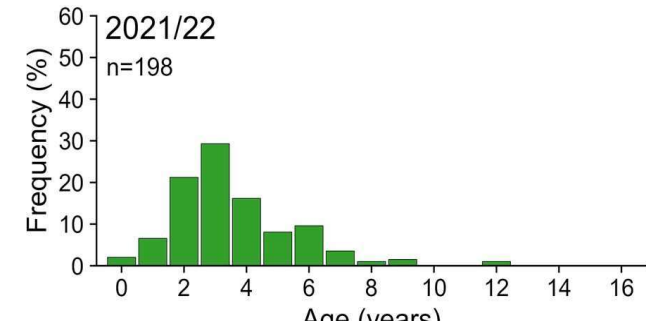
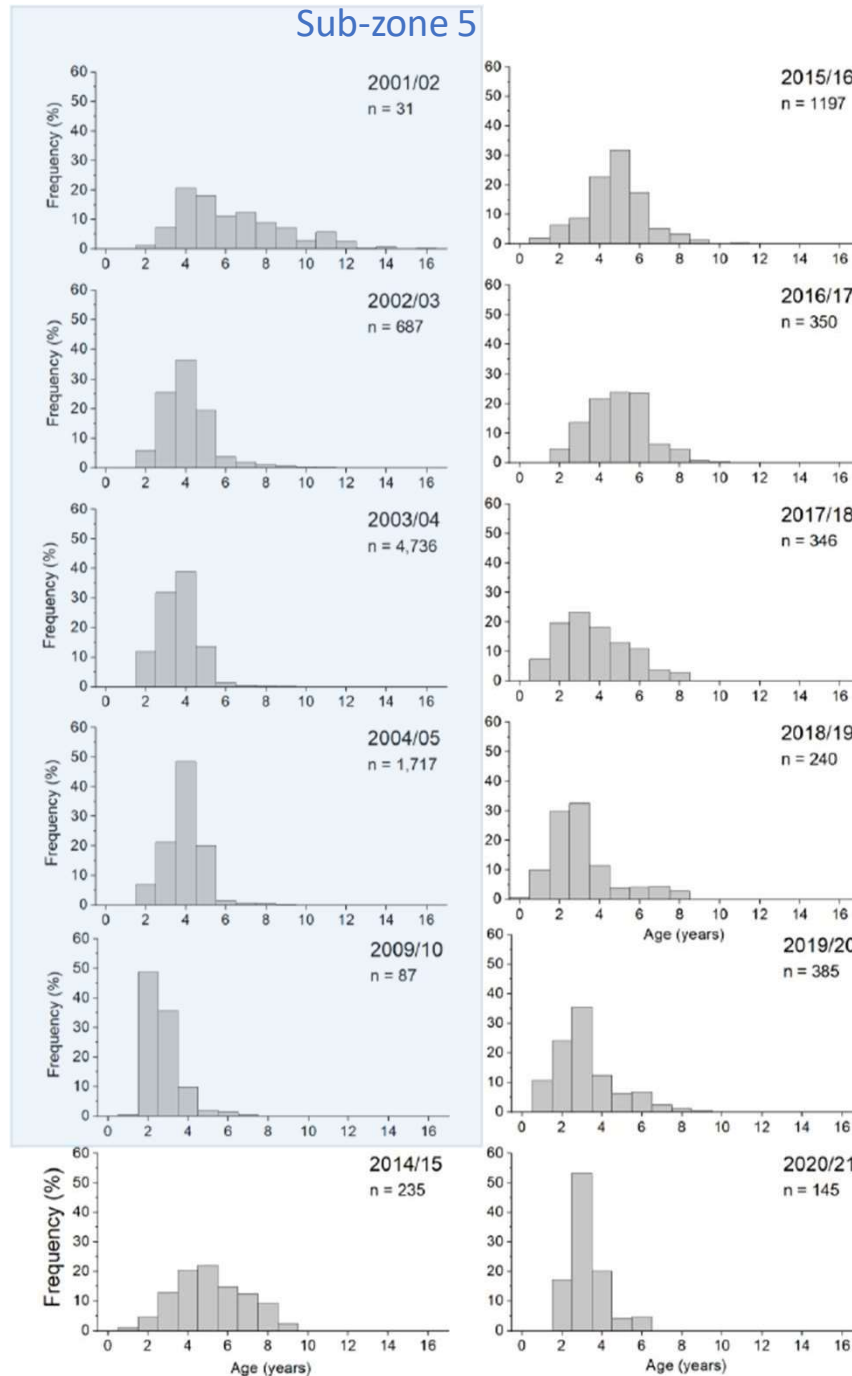
- 200 mm in 2017/18
- 200 mm in 2018/19
- 210 mm in 2019/20
- 190 mm in 2020/21
- 210 mm in 2021/22

50% Maturity ~270 mm (Grammer et al. 2022)

Length frequency distributions for mid-water trawl from Grammer et al. (2022)

**Majority of the catch less than size of 50% maturity and not part of the spawning biomass**

# Jack Mackerel: Eastern Sub-area (Sub-zone 6)



## Modal Ages

- 3 years in 2017/18
- 3 years in 2018/19
- 3 years in 2019/20
- 3 years in 2020/21
- 3 years in 2021/22
- 3 years in 2022/23

Consolidate data for final report.  
Establish SPF database?

# Jack Mackerel: Eastern Sub-area

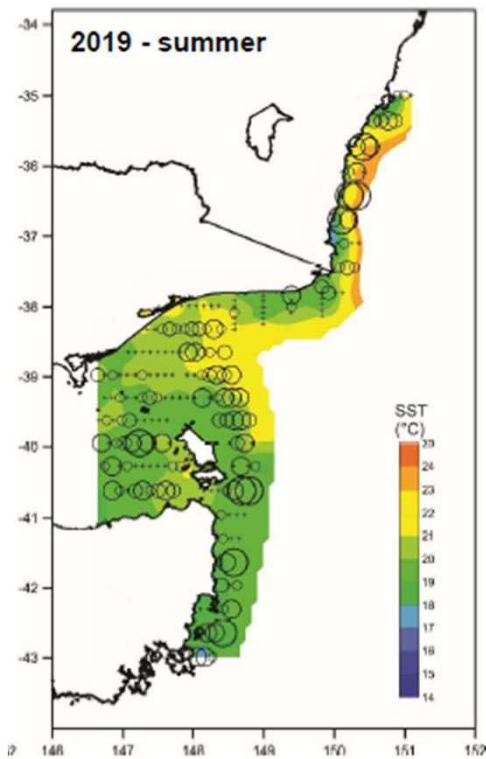


## Key Findings of DEPM

- Eggs widespread between Jervis Bay and south-eastern Tasmania, especially in Bass Strait
- Survey area refined in 2019 compared to 2014 (extended into Bass Strait)
- New spawning habitat discovered in Bass Strait
- Egg densities and mean daily egg production lower in 2019 than 2014
- Spawning fraction also lower in 2019 and than 2014
- Peak of spawning season may have occurred prior to 2019 survey (especially in the north)
- Likely mixing of Eastern and Western “stocks” in Bass Strait

## Need to:

- Optimise timing of survey (start late December early January instead of mid January?)
- Improve adult sampling (faster trawler, other methods?)
- Obtain better estimates of spawning fraction and relative fecundity (alternative methods)
- Establish optimal model for estimating  $P_0$

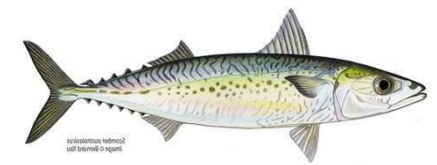


Recommendations		
Recommended Biological Catch (RBC)	2023-24	4 <sup>th</sup> season at Tier 1 156,292 x 12% = <b>18,755 tonnes</b>

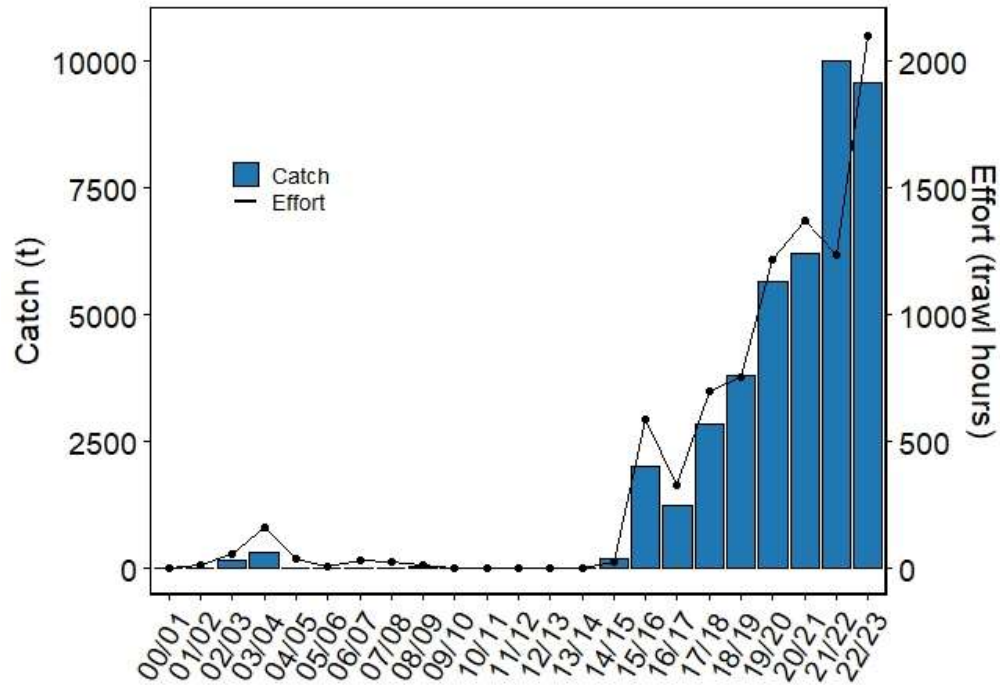
Source: AFMA SPF Species Summary 2023

Year (Source)	DEPM Spawning Biomass (95% CI)	2021/22 RBC (t)	2021/22 TAC (t)	2022/23 SPF Catch (t)	SPF Catch % Spawning Biomass	SPF Catch % RBC	SPF Catch % TAC
2019 (Jan)	156,292 t	18,755 t	18,720	SPF 9,341	6.0%	49.8%	49.8%
(Ward et al. 2020)	(49,120–263,496 t)						

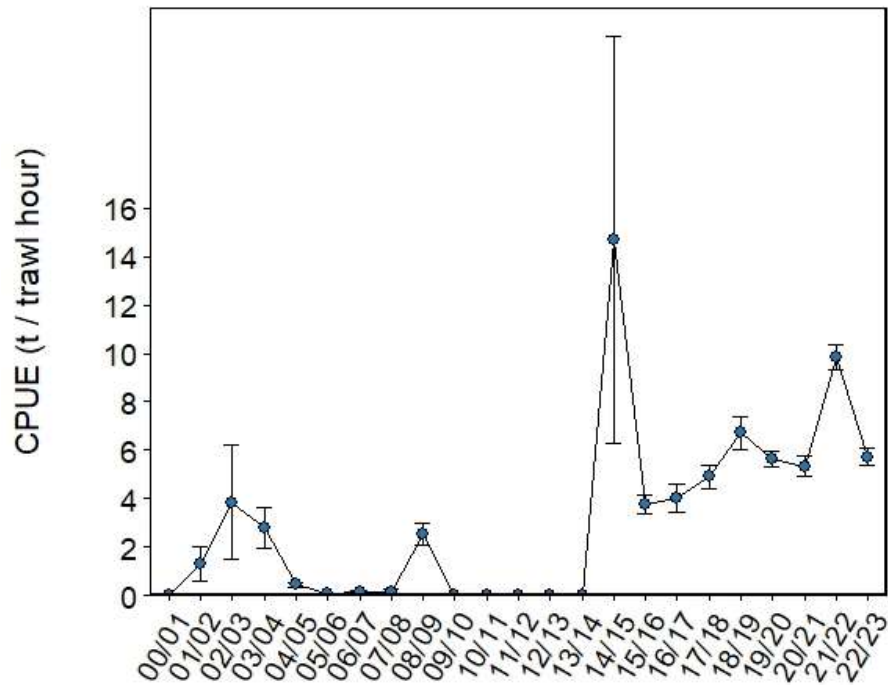
# Blue Mackerel: Eastern Sub-area



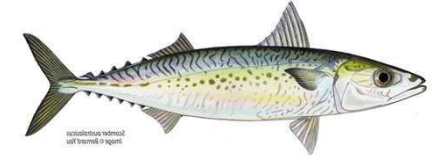
## Commonwealth: Trawl



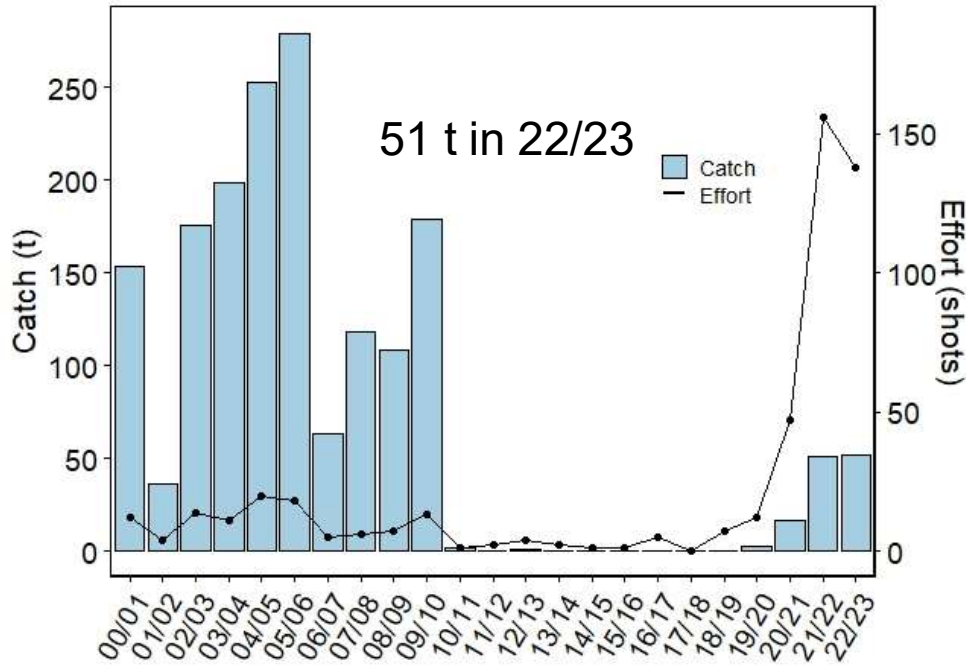
- Historically taken as by-catch off Tasmania
- Catch first increased in 2014/15 to 2016/17 (factory-trawler)
- Increased rapidly since 2017/18
- Highest catch ~10,007 t in 2021/22
- Total trawl catch in 2022/23 was 9,586 t
- CPUE of ~5.7 t.trawl hr<sup>-1</sup> in 2022/23



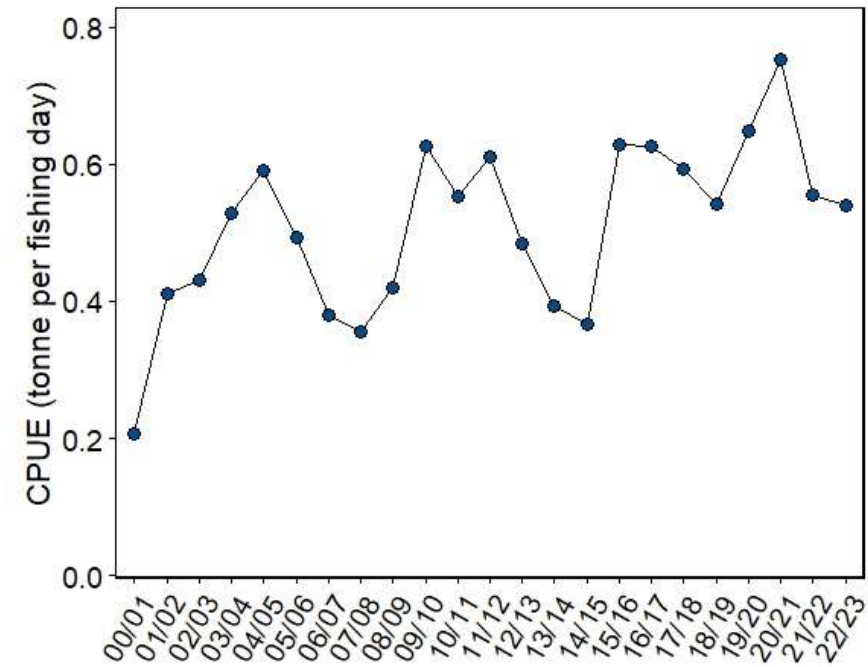
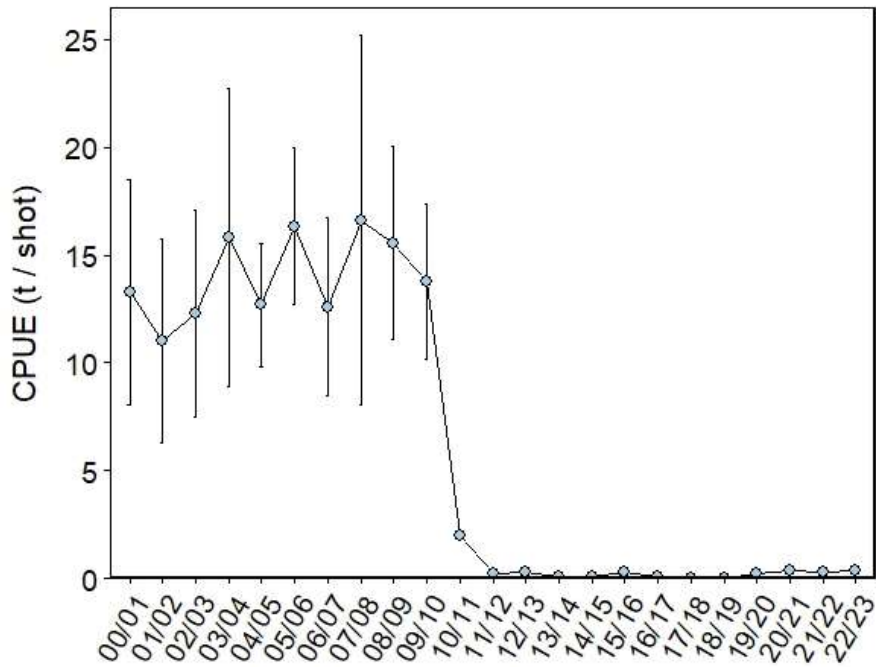
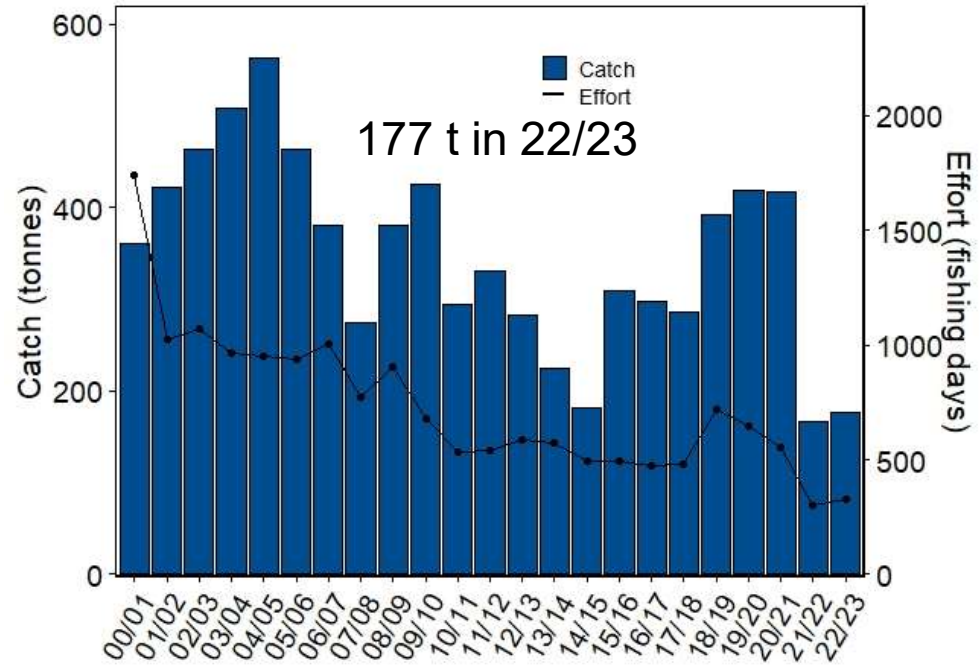
# Blue Mackerel: Eastern Sub-area



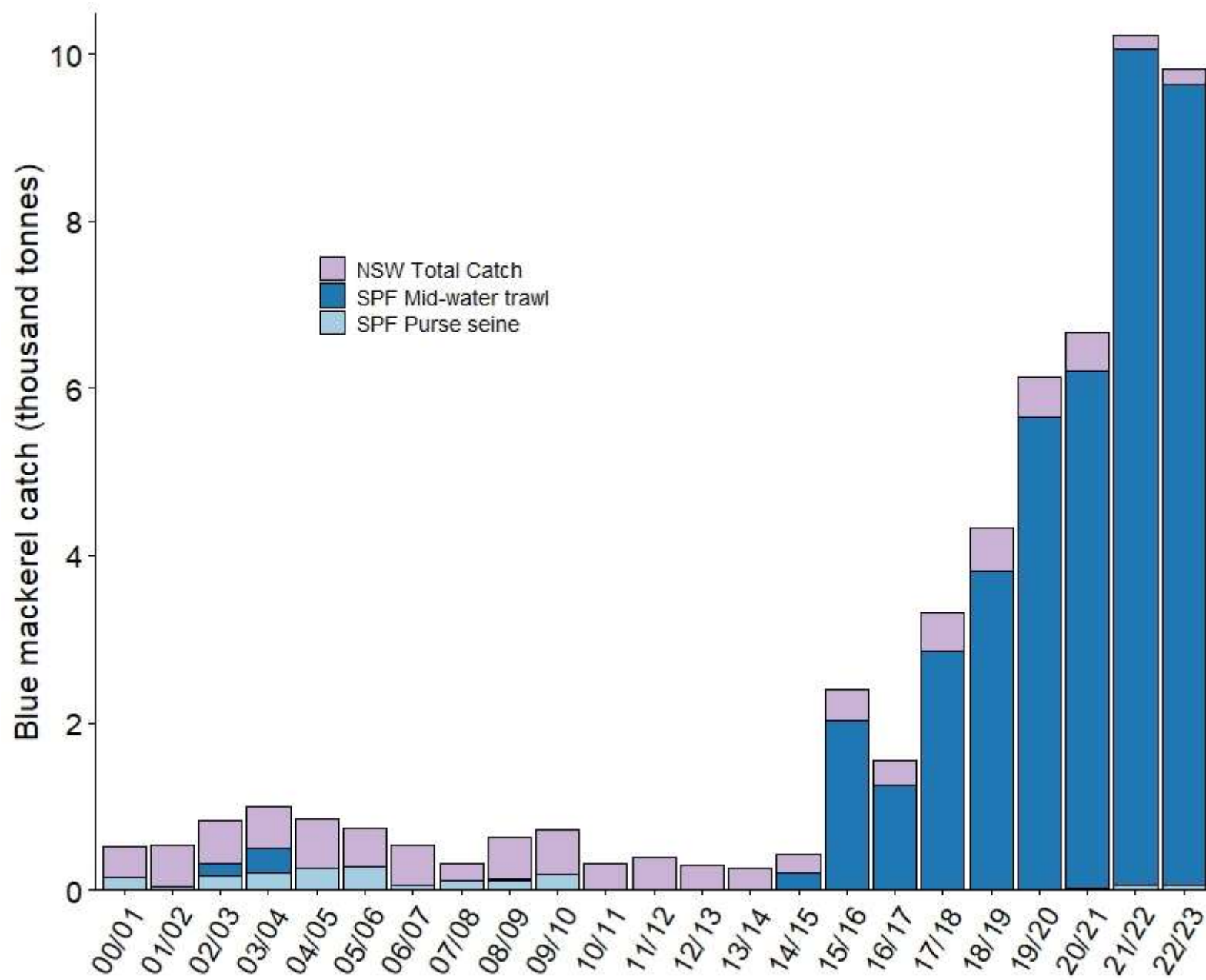
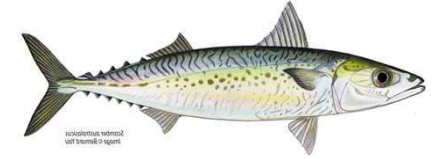
## Commonwealth: Purse Seine



## NSW: Purse Seine



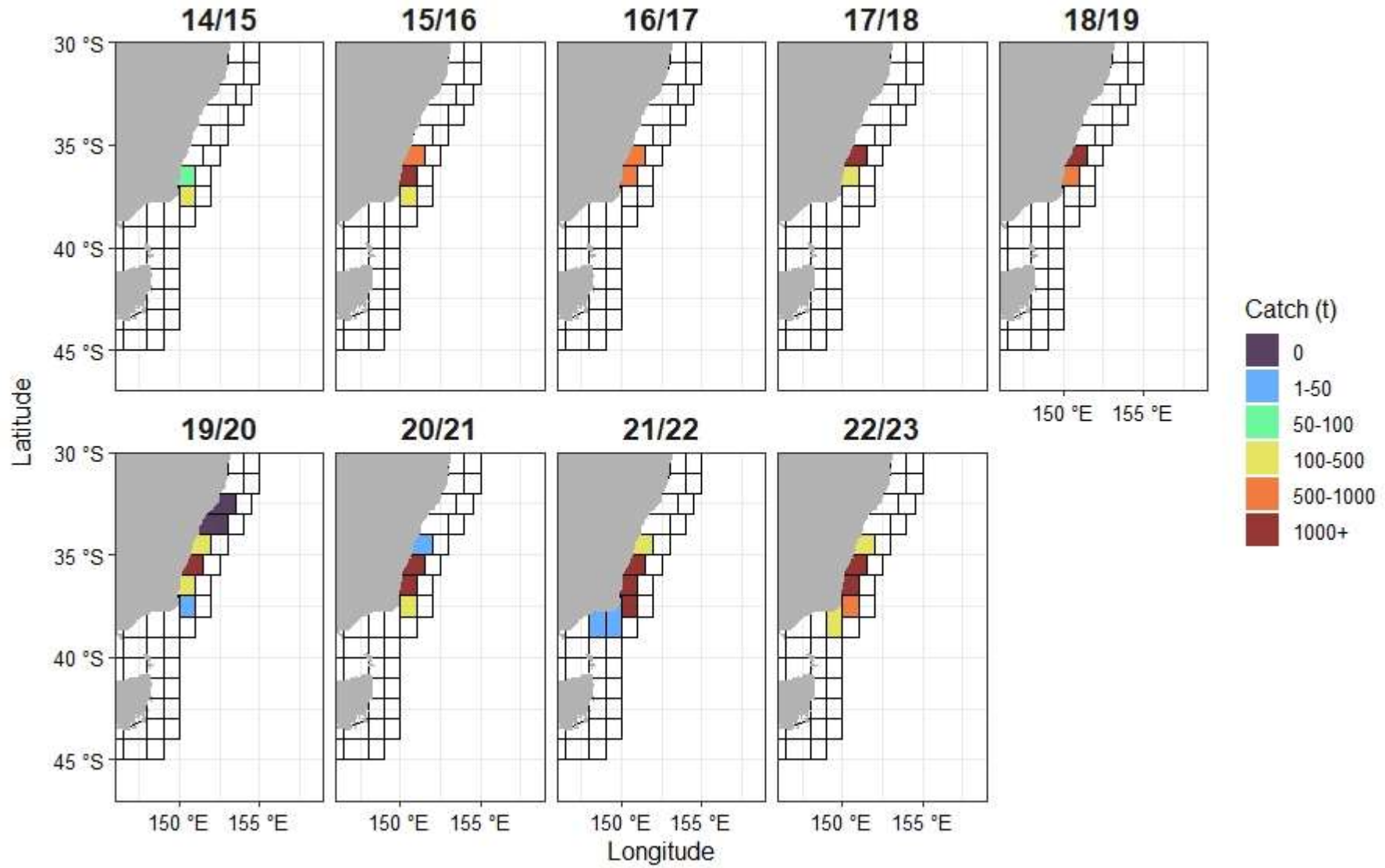
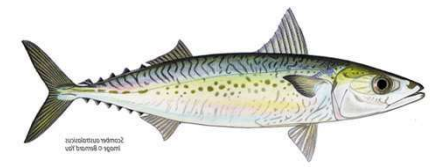
# Blue Mackerel: Eastern Sub-area



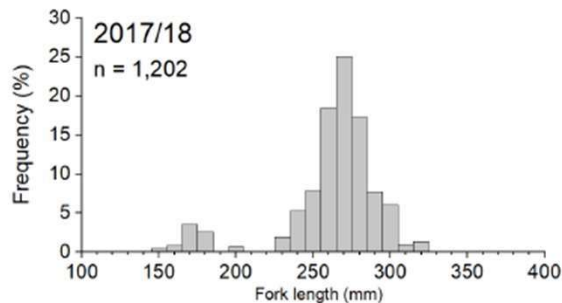
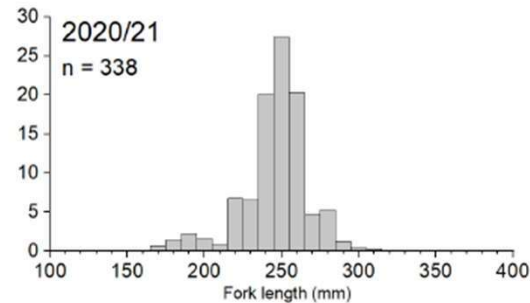
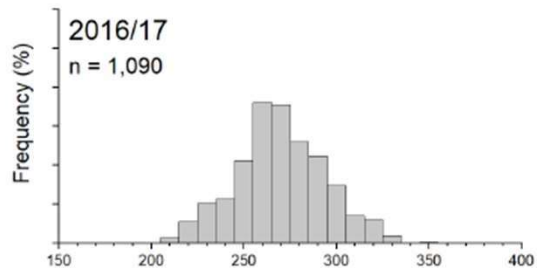
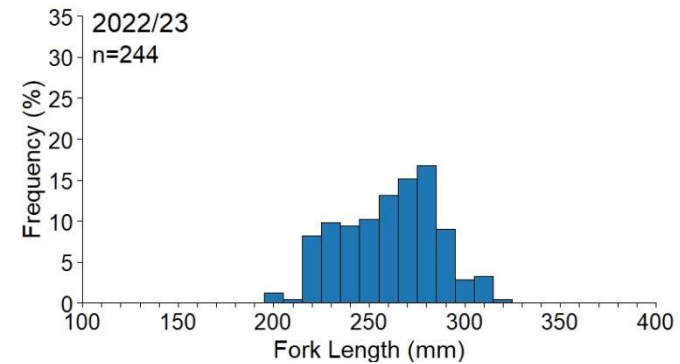
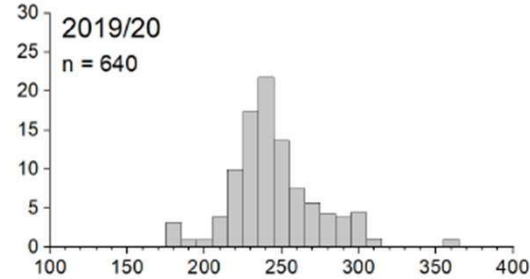
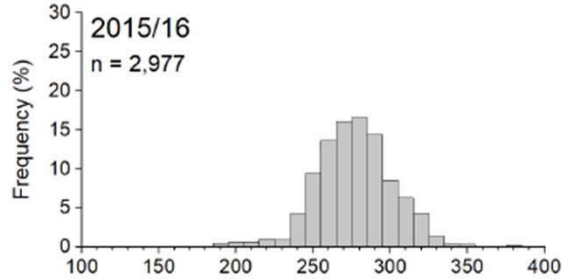
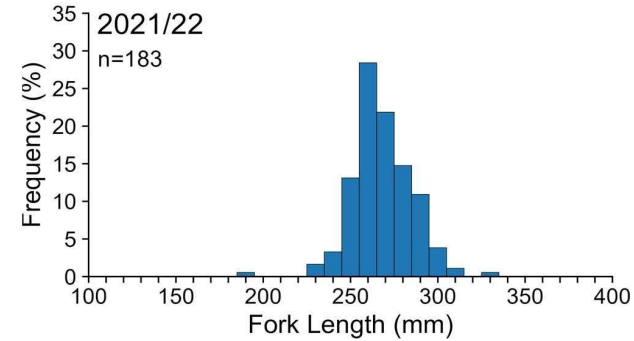
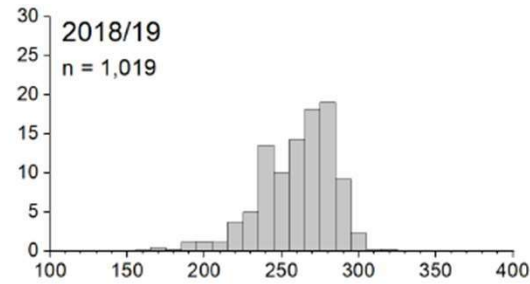
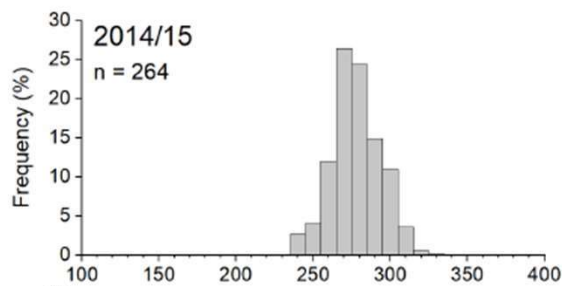
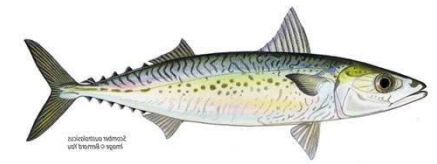
Total catch 2022/23: ~9,814 t



# Blue Mackerel: Eastern Sub-area



# Blue Mackerel: Eastern Sub-area (Sub-zone 6)

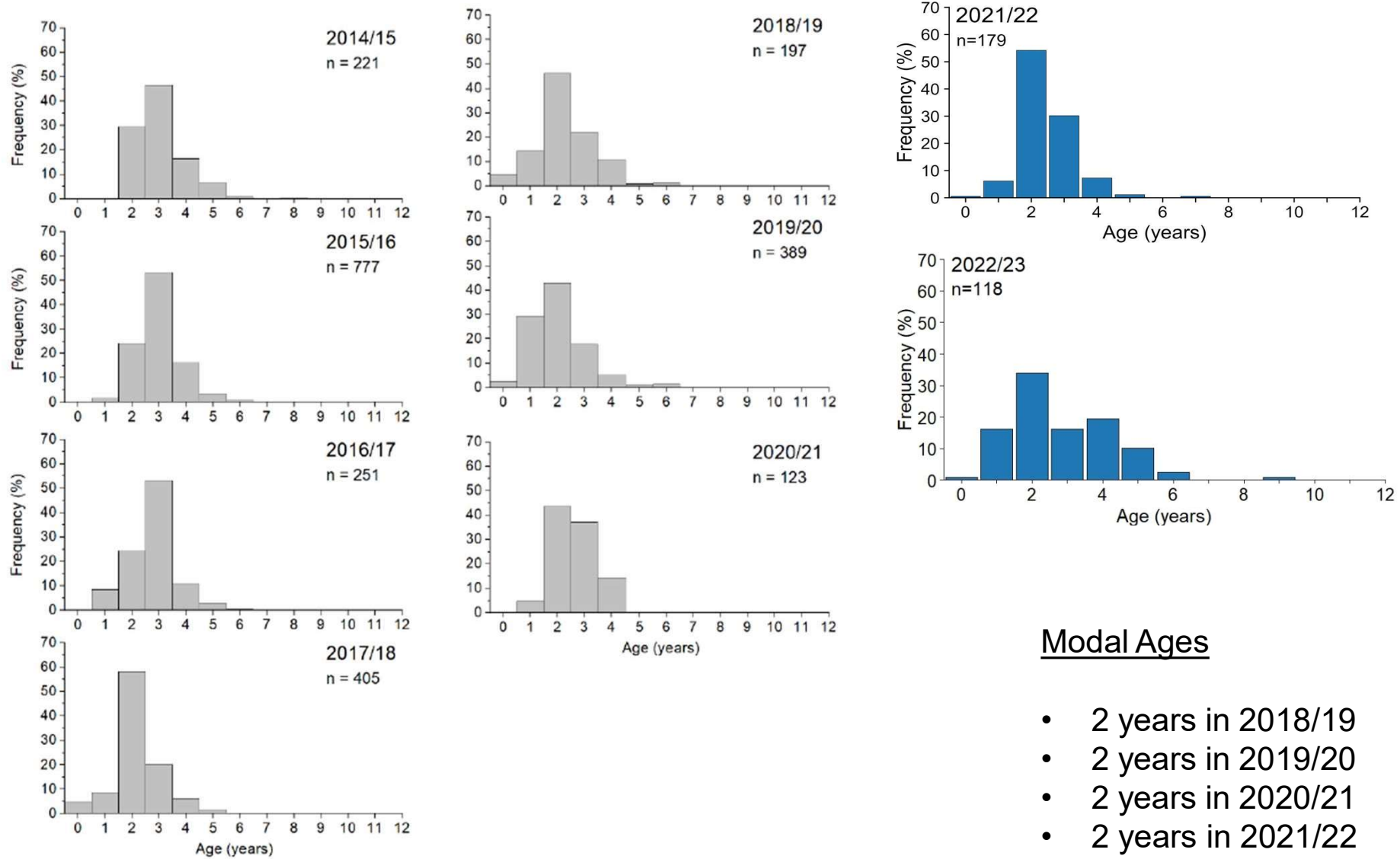
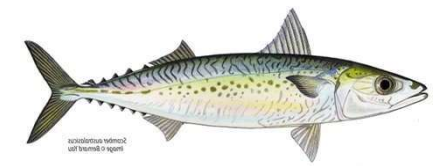


## Modal Fork Length

- 280 mm in 2018/19
- 240 mm in 2019/20
- 250 mm in 2020/21
- 260 mm in 2021/22
- 280 mm in 2022/23
  
- 50% Maturity ~287 mm (Grammer et al. 2022)
  
- **Majority of the catch less than size 50% maturity and not part of the spawning biomass**

Length frequency distributions for mid-water trawl from Grammer et al. (2022)

# Blue Mackerel: Eastern Sub-area (Sub-zone 6)



## Modal Ages

- 2 years in 2018/19
- 2 years in 2019/20
- 2 years in 2020/21
- 2 years in 2021/22
- 2 years in 2022/23

Age frequency distributions from mid-water trawl Grammer et al. (2022)

# Targeted sampling large Blue Mackerel

Tom Alderson's M.Sc.

*Age, growth and reproductive maturity of Blue Mackerel off eastern Australia*

Samples:

BMK Spawning Fraction 1 and 2

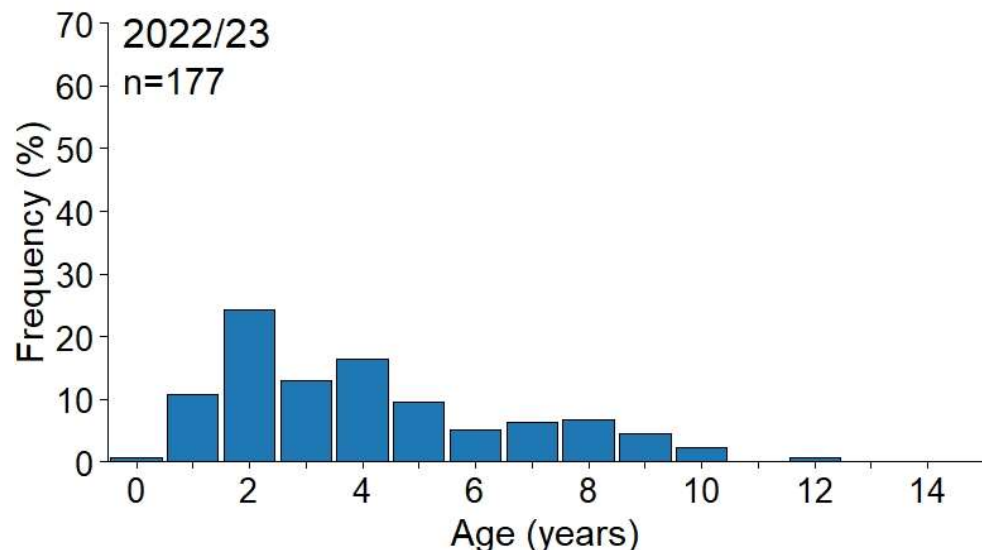
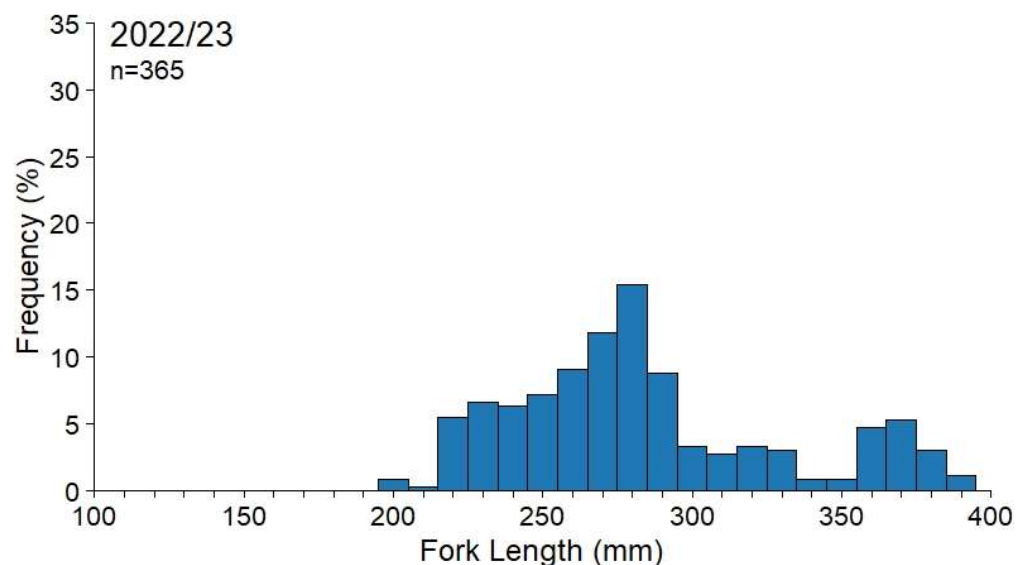
Reanalysis:

Harvest Control Rules (SPFIA)

Re-run MSE (Smith et al 2015) using recent fishery data

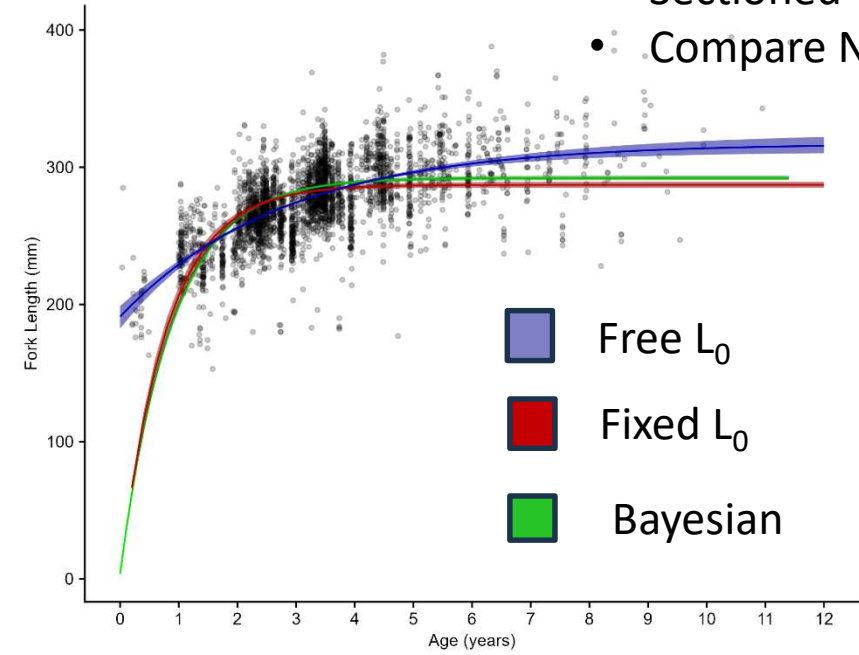
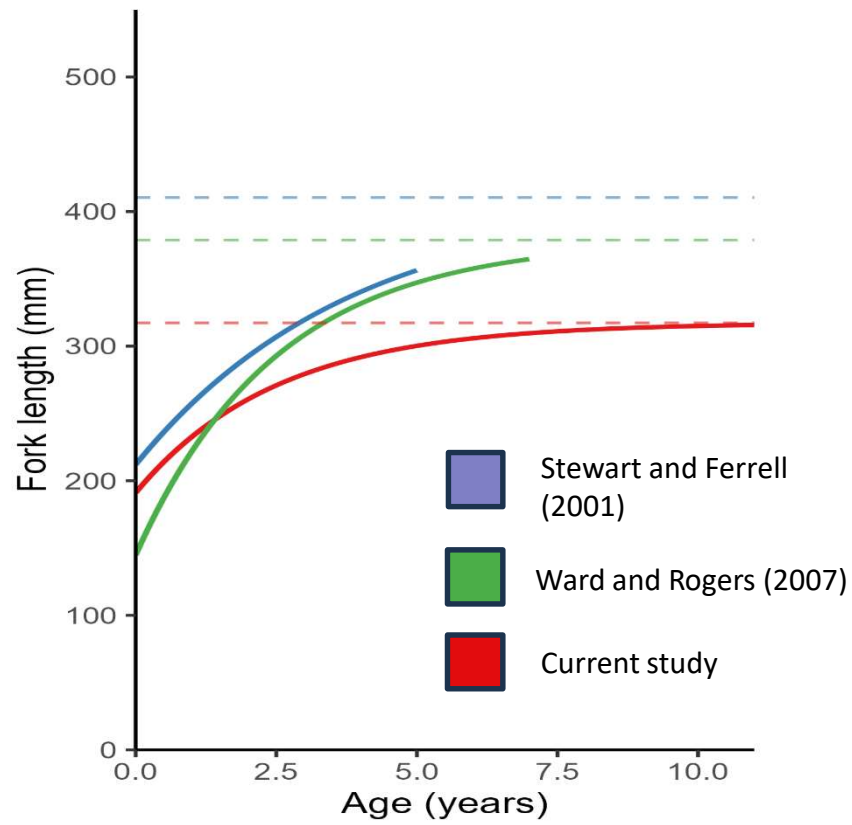
All species: especially Blue Mackerel

ER in HS: 23% reduced to 15% (RAG)

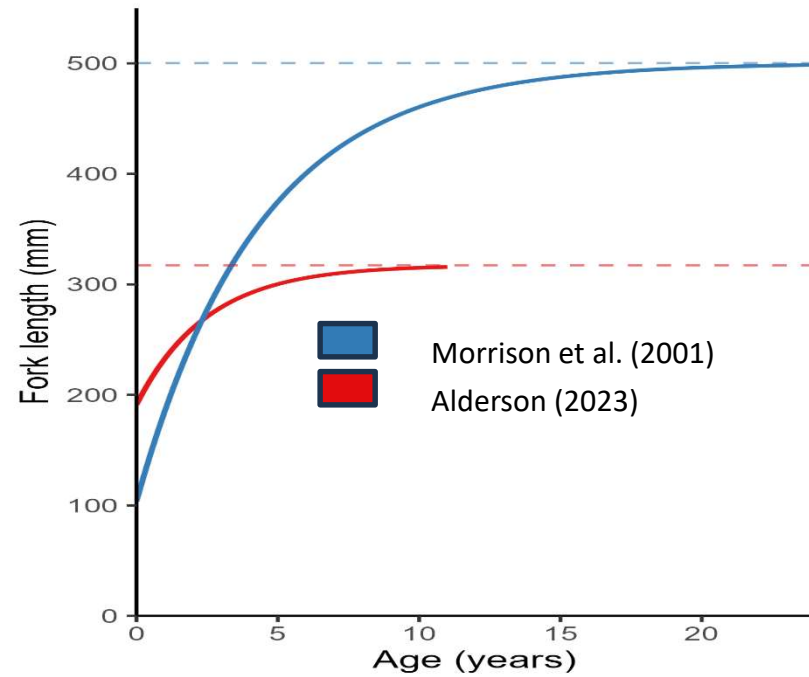


# Key issues

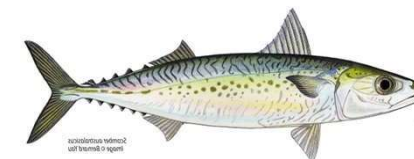
- Large fish
- Small fish
- Sectioned vs whole
- Compare NZ



Alderson et al. (2023), M.Sc. thesis



# Blue Mackerel: Eastern Sub-area

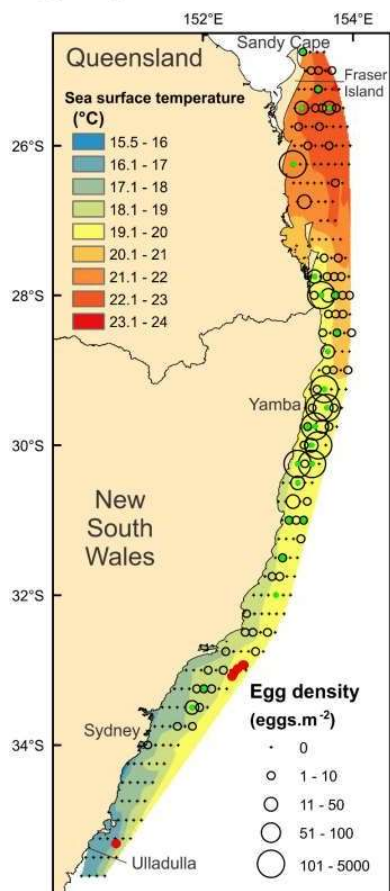


## Key Findings of DEPM

- Similar egg distributions in 2014 and 2019
- Eggs widespread and abundant off northern NSW and southern Queensland
- Few eggs south of Sydney where fishery is located
- Spawning area 14% larger in 2019 than 2014
- Egg densities and mean daily egg production similar in 2014 and 2019 (data combined)
- Spawning fraction and other adult parameters estimated from South Australian samples

## Need to:

- Estimate adult parameters of Blue Mackerel off east coast, especially spawning fraction
- Investigate potential latitudinal gradient in timing of spawning season
- Understand why no eggs collected off southern NSW? Does spawning occur later there?
- Establish optimal model for estimating  $P_0$

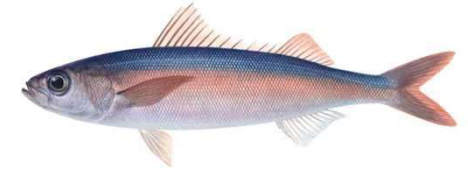


Recommendations		
Recommended Biological Catch (RBC)	2023-24	3 <sup>rd</sup> Season at Tier 1 (2019-20 DEPM) 80,000 x 15% = <b>12,000 tonnes</b>

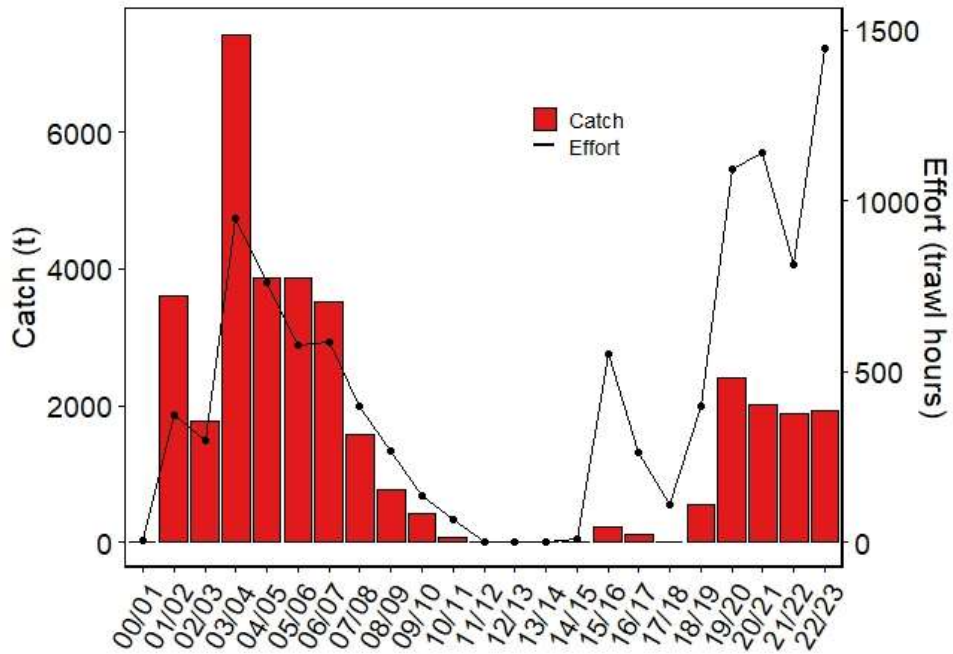
Source: AFMA SPF Species Summary 2023

Year (Source)	DEPM Spawning Biomass (95% CI)	2021/22 RBC (t)	2021/22 TAC (t)	2022/23 Catch (t)	Catch % Spawning Biomass	Catch % RBC	Catch % TAC
2019 (Sept)	80,000	12,000 t	11,600	SPF E Trawl: 9,586 t SPF E Total: 9,637 t	12.0%	79.9%	82.6%
(Ward et al. 2021)	88,265 t (33,320-143,209 t)			E Total: 9,814 t	12.0%	81.8%	84.6%

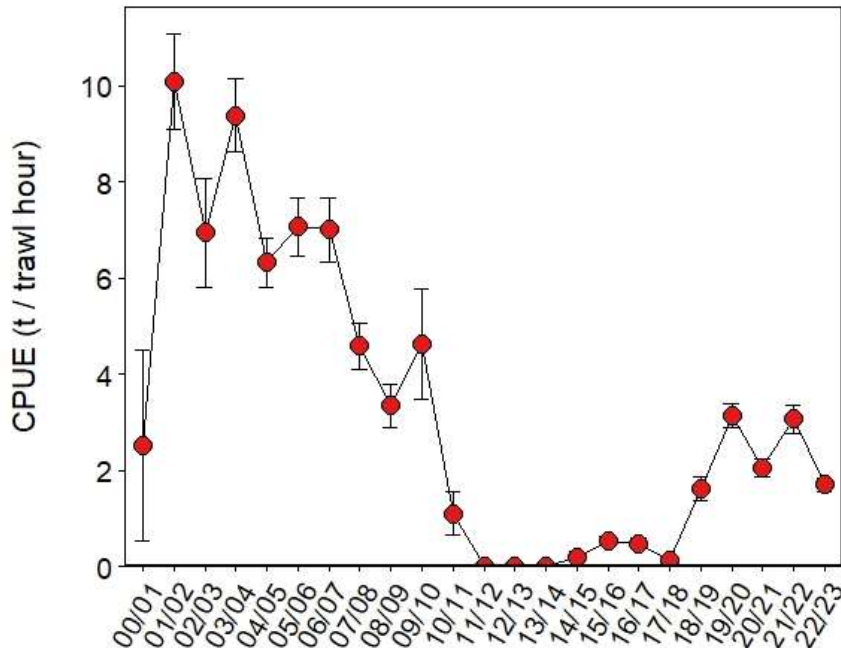
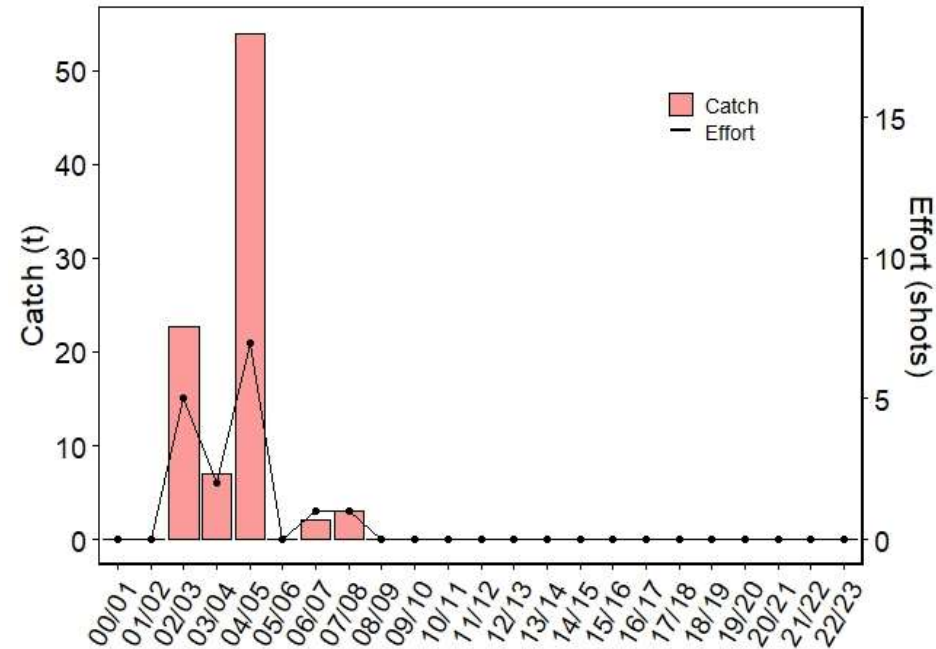
# Redbait: Eastern Sub-area



## Commonwealth: Trawl

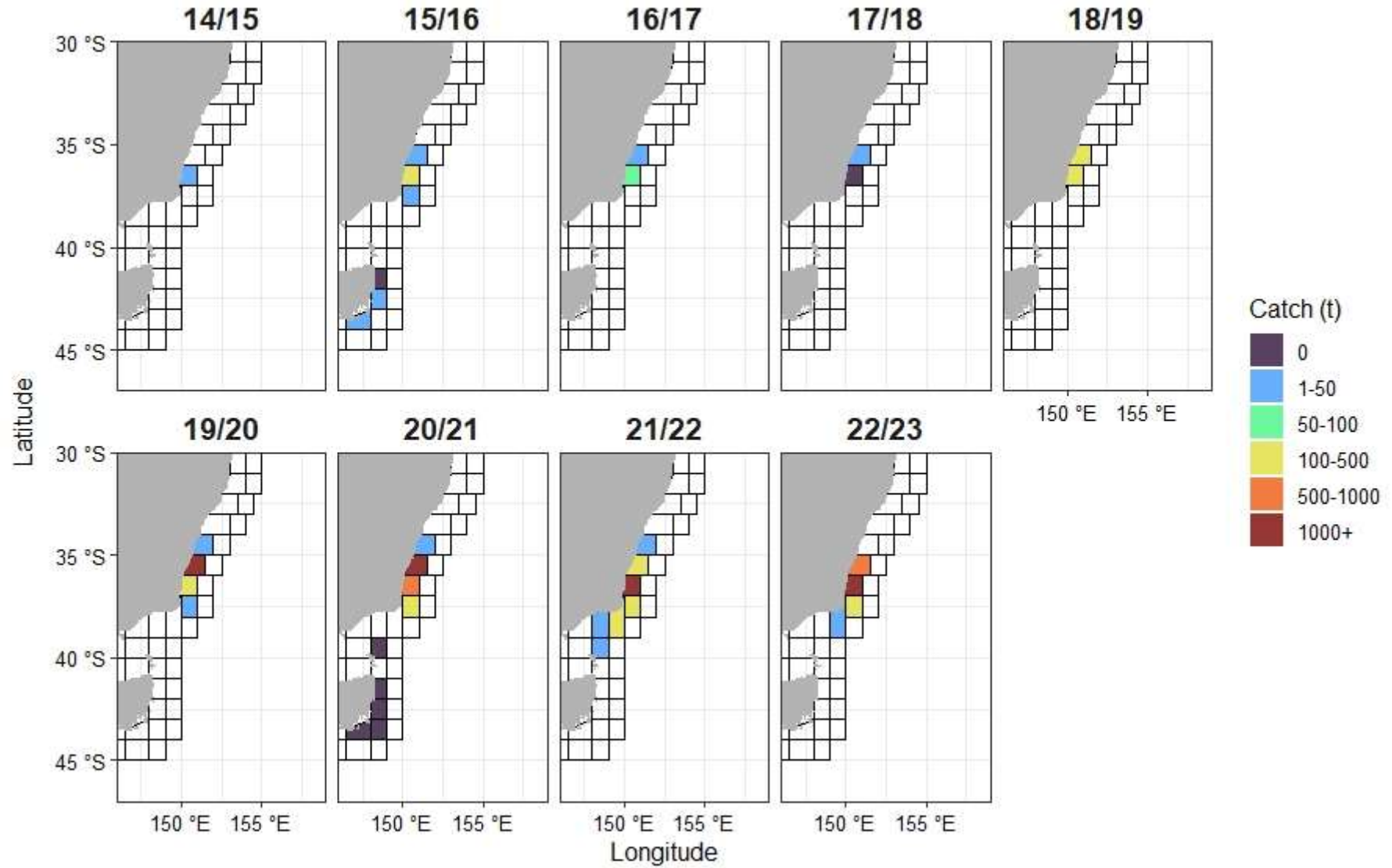
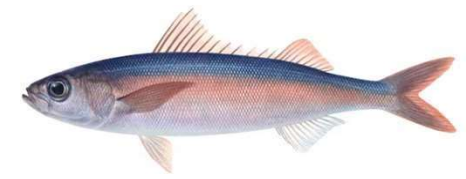


## Commonwealth: Purse-seine



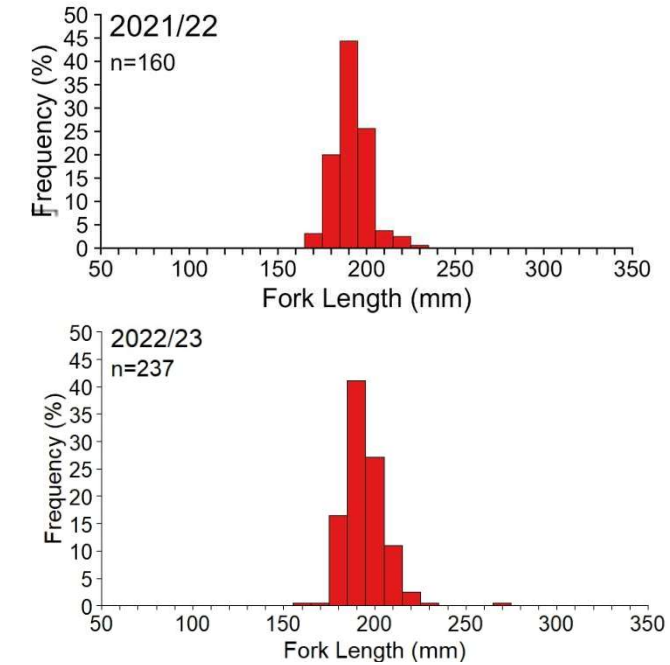
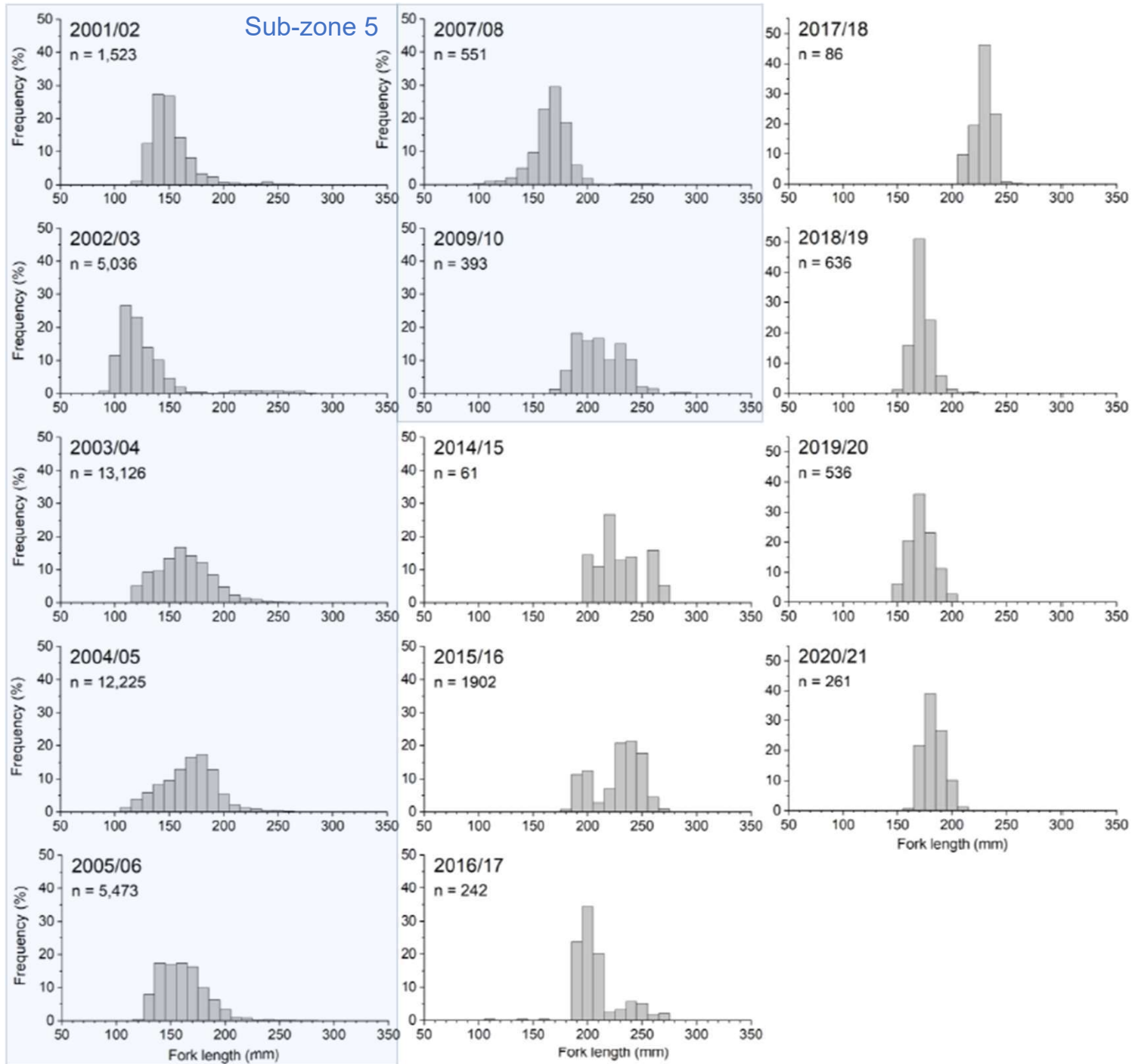
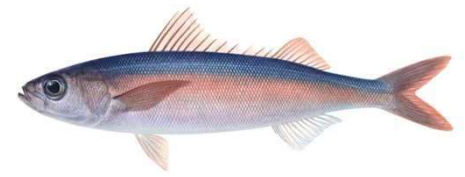
- Trawl catch peak of 7,733 t in 2003/04
- 2019/20: 2,412 t
- 2021/22: 1,890 t
- 2022/23: 1,921 t
- CPUE ~10 t.trawl hour<sup>-1</sup> in 2001/02
- CPUE in last six years ~1.7–3.5 t.trawl hour<sup>-1</sup>

# Redbait: Eastern Sub-area





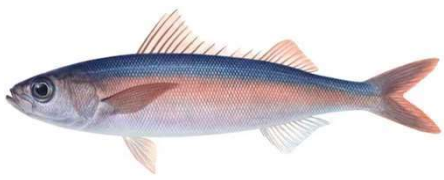
# Redbait: Eastern Sub-area (Sub-zone 6)



## Modal Fork Length

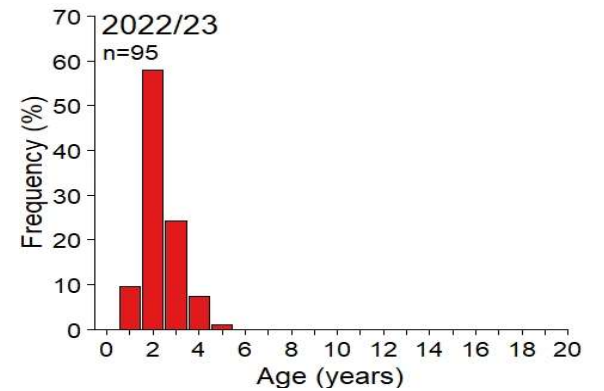
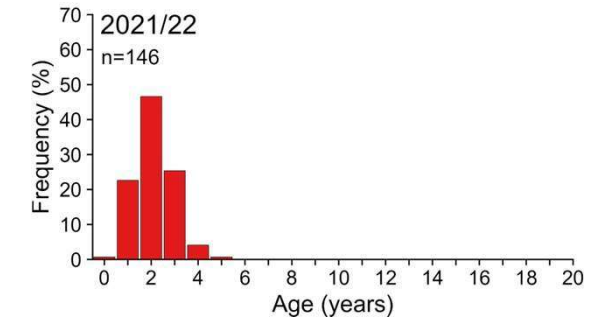
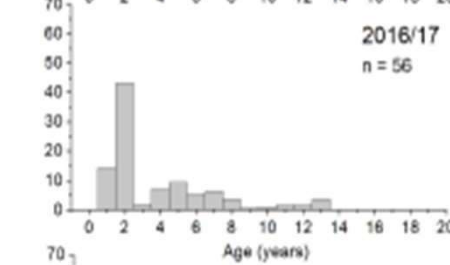
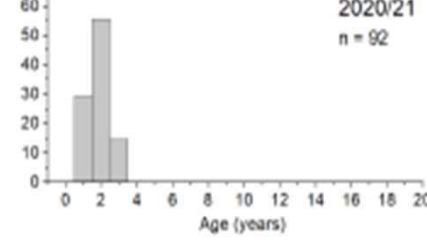
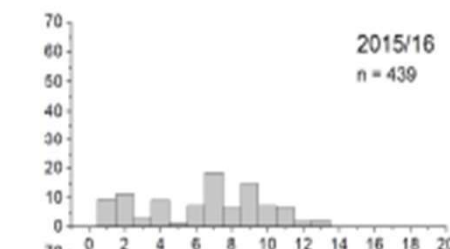
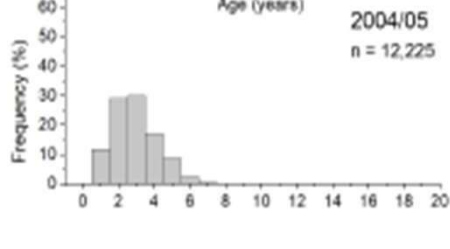
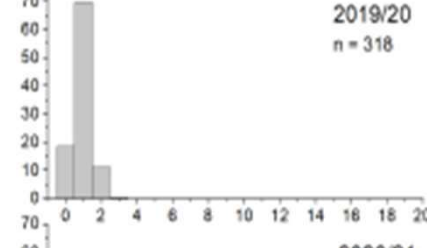
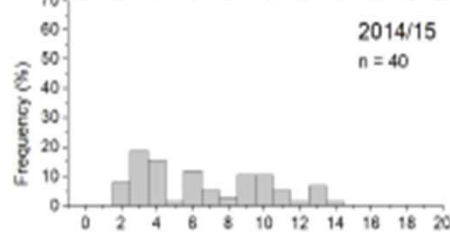
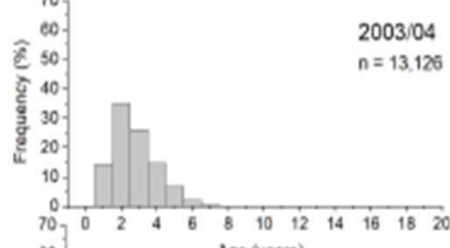
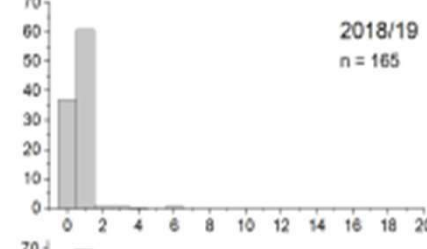
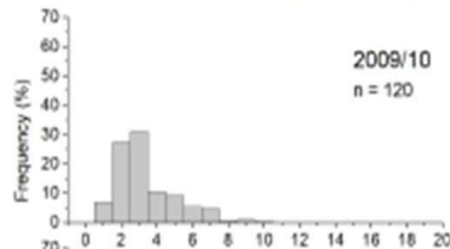
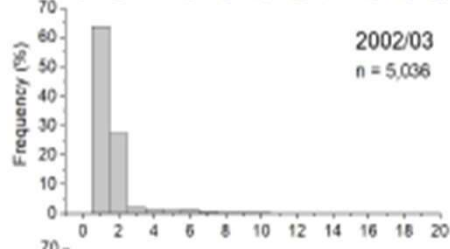
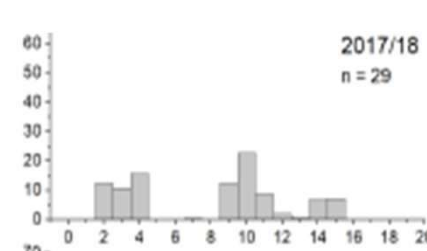
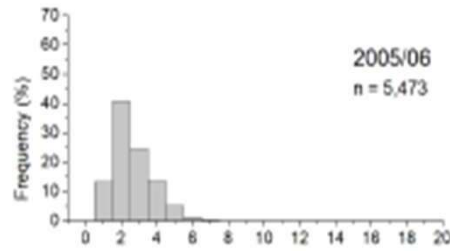
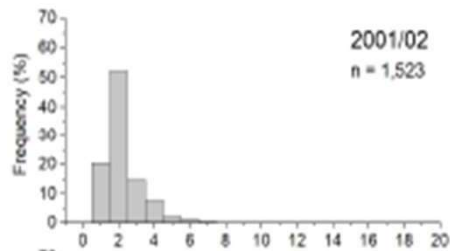
- 170 mm in 2018/19
- 170 mm in 2019/20
- 180 mm in 2020/21
- 200 mm in 2021/22
- 190 mm in 2022/23

50% Maturity ~147 mm for males and 157 for females (Grammer et al. 2022)



# Redbait (East)

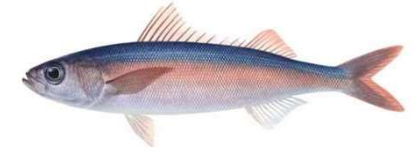
## Age frequency: mid-water trawl catch samples



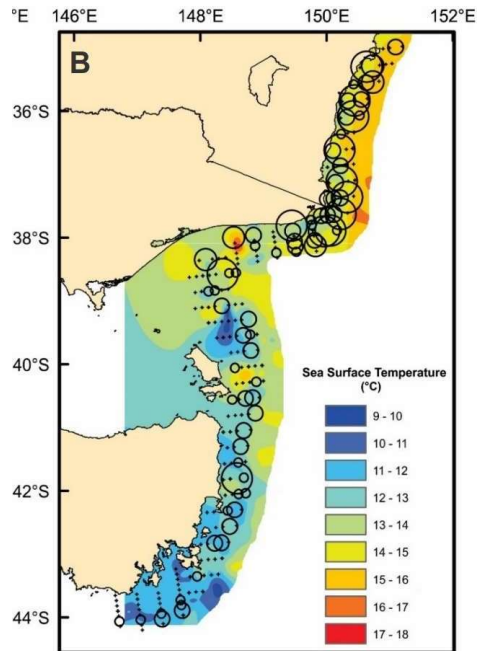
### Modal Ages

- 1 years in 2018/19
- 1 years in 2019/20
- 2 years in 2020/21
- 2 years in 2021/22
- 2 years in 2022/23

# Redbait: Eastern Sub-area



October 2020



## Key Findings of DEPM

- Eggs on mid to outer shelf between Jervis Bay and south-eastern Tasmania
- Larger survey and spawning area in 2020 than in 2005 and 2006
- Improved estimates of adult parameters compared to previous surveys
- Estimating egg production is key challenge due to long duration of egg development (~4 days)
- Peak of spawning season may have ended soon after the egg survey was completed
- Adult samples collected after the egg survey had low spawning fractions
- Population likely continuous around southern Tasmania

## Need to:

- Optimise timing of egg and adult surveys
- Ideally conduct egg and adult sampling concurrently from two separate vessels
- Investigate spatial and temporal variation in spawning season and spawning fraction
- Establish optimal methods for estimating P0 that account for slow egg development rate

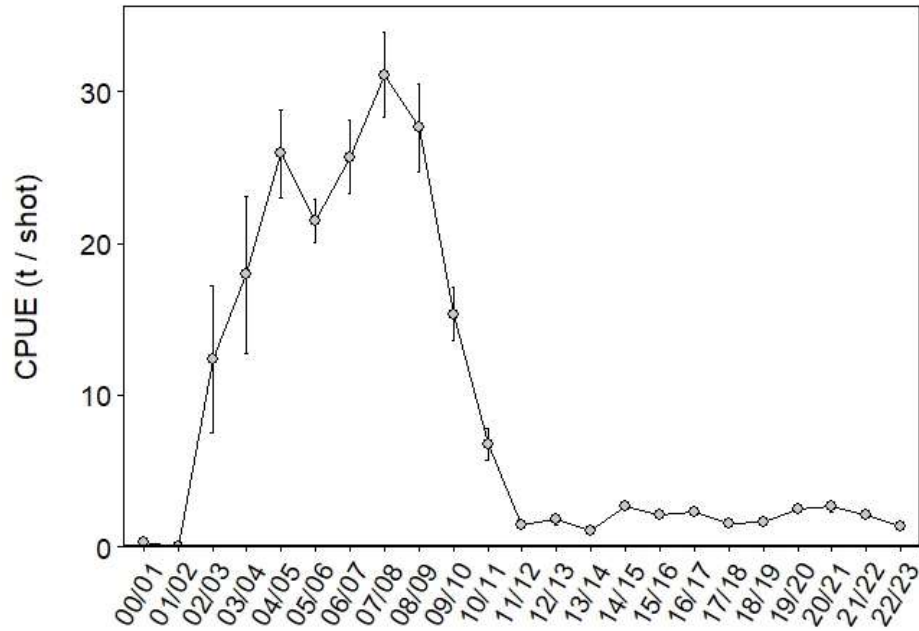
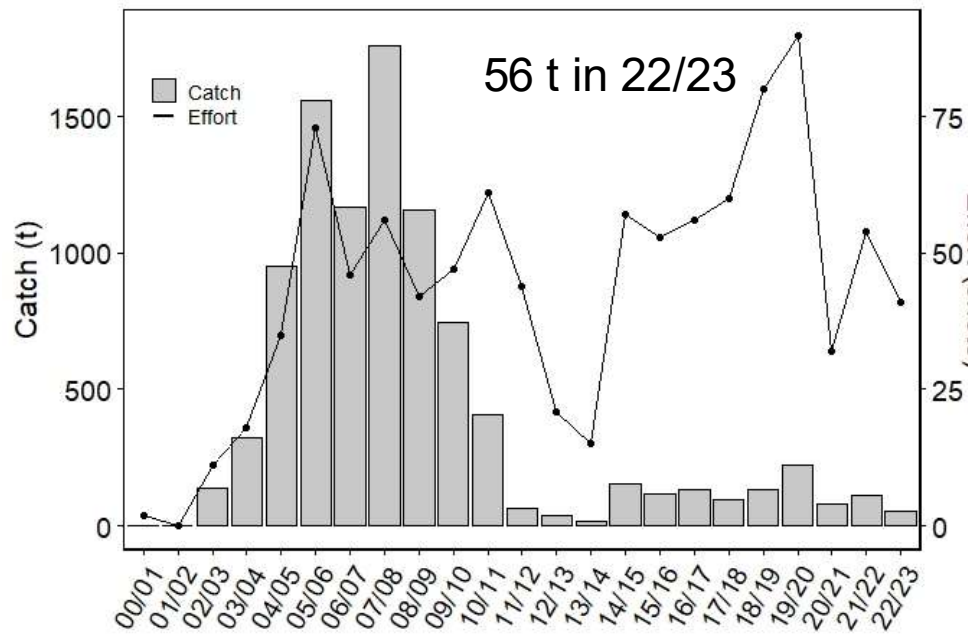
Recommendations		
Recommended Biological Catch (RBC)	2023-24	2 <sup>nd</sup> Season at Tier 1 54,000 x 10% = 5,400 tonnes

Source: AFMA SPF Species Summary 2023

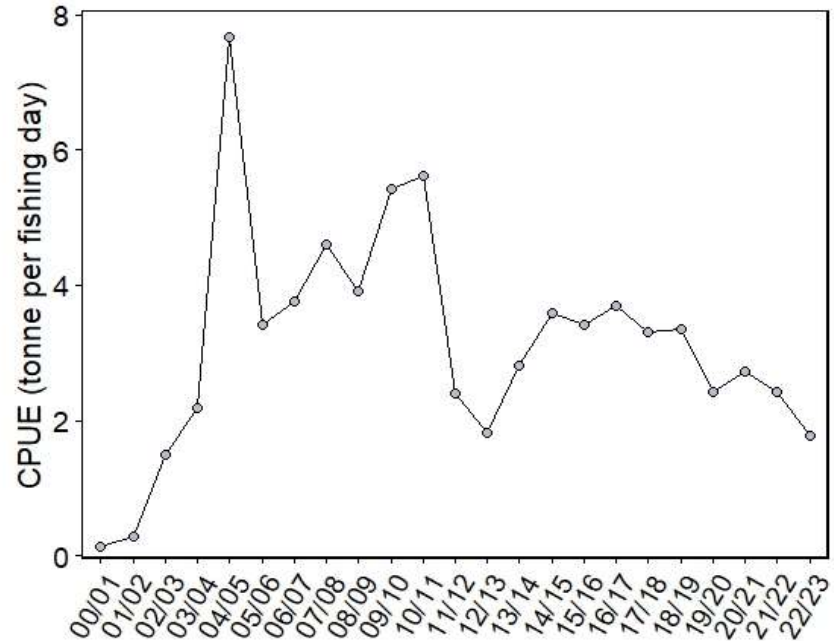
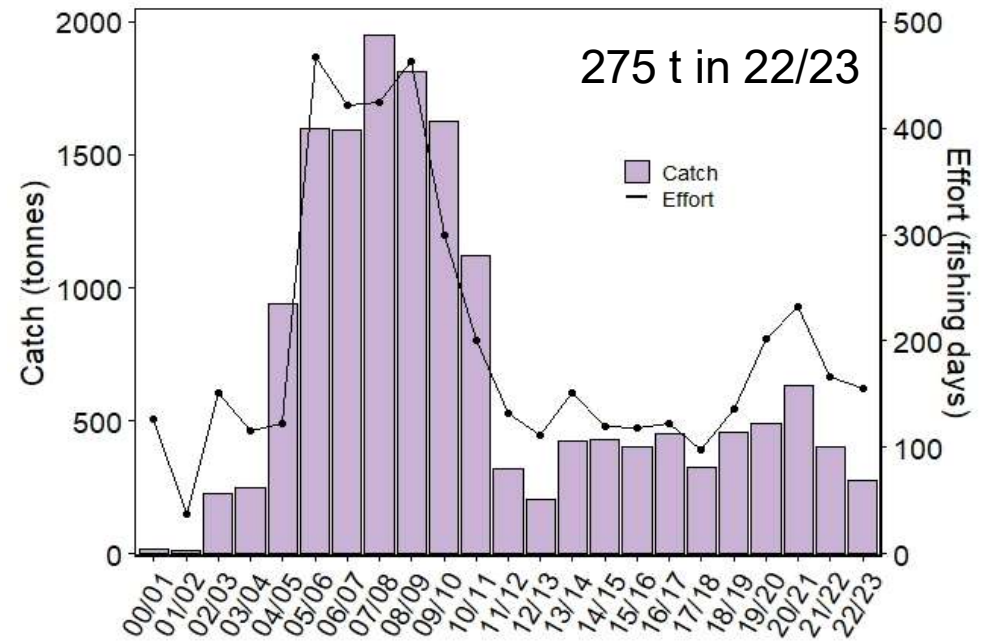
Year (Source)	DEPM Spawning Biomass (95% CI)	2021/22 RBC (t)	2021/22 TAC (t)	2022/23 SPF Catch (t)	SPF Catch % Spawning Biomass	SPF Catch % RBC	SPF Catch % TAC
2020 (Oct)	52,629 t	5,400 t	5,380 t	1,921 t	3.7%	35.6%	35.7%
Grammer et al. (2022)	(13,937–91.321 t)						

# Sardine: Sardine Sub-area

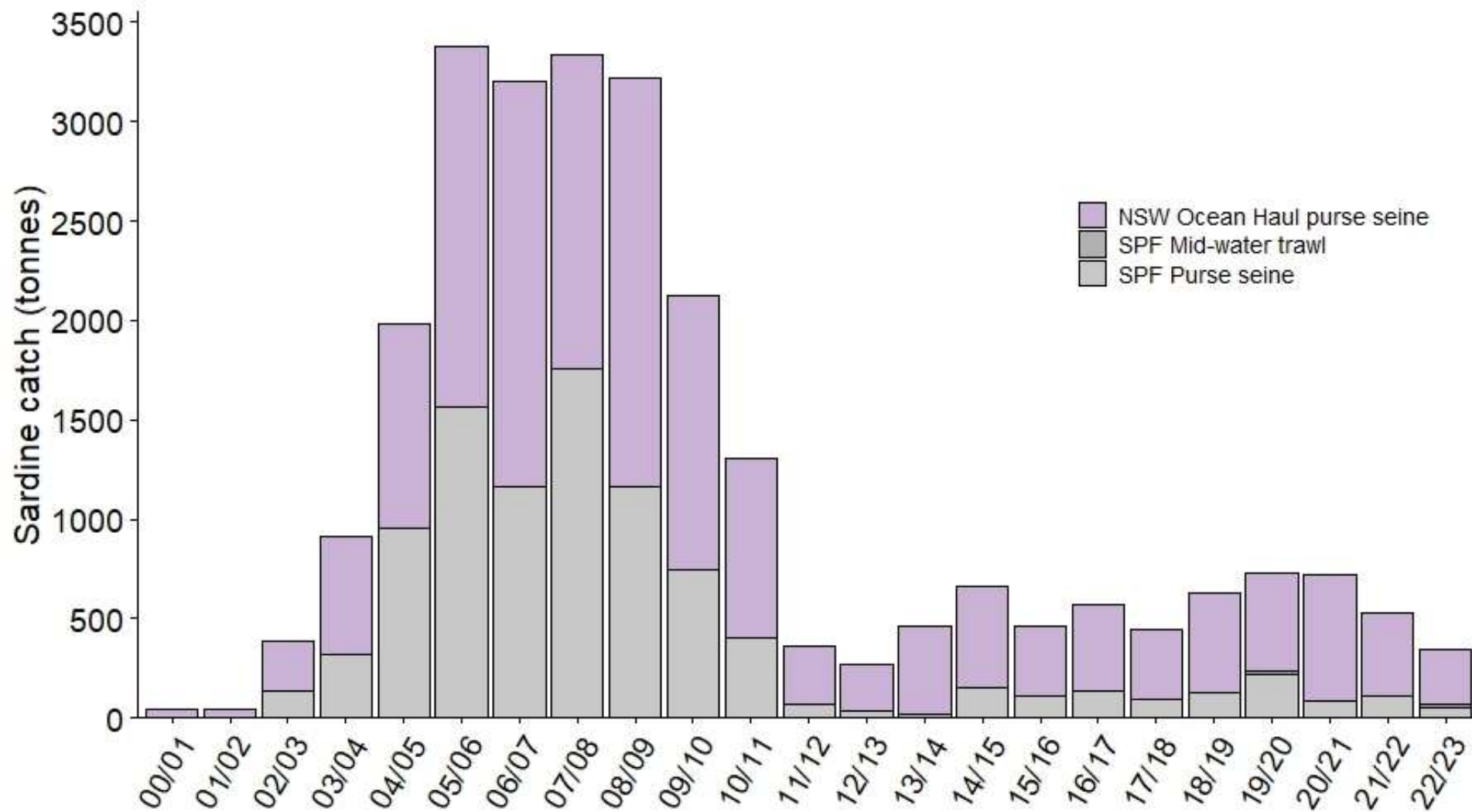
## Commonwealth: Purse-seine



## NSW: Purse-seine



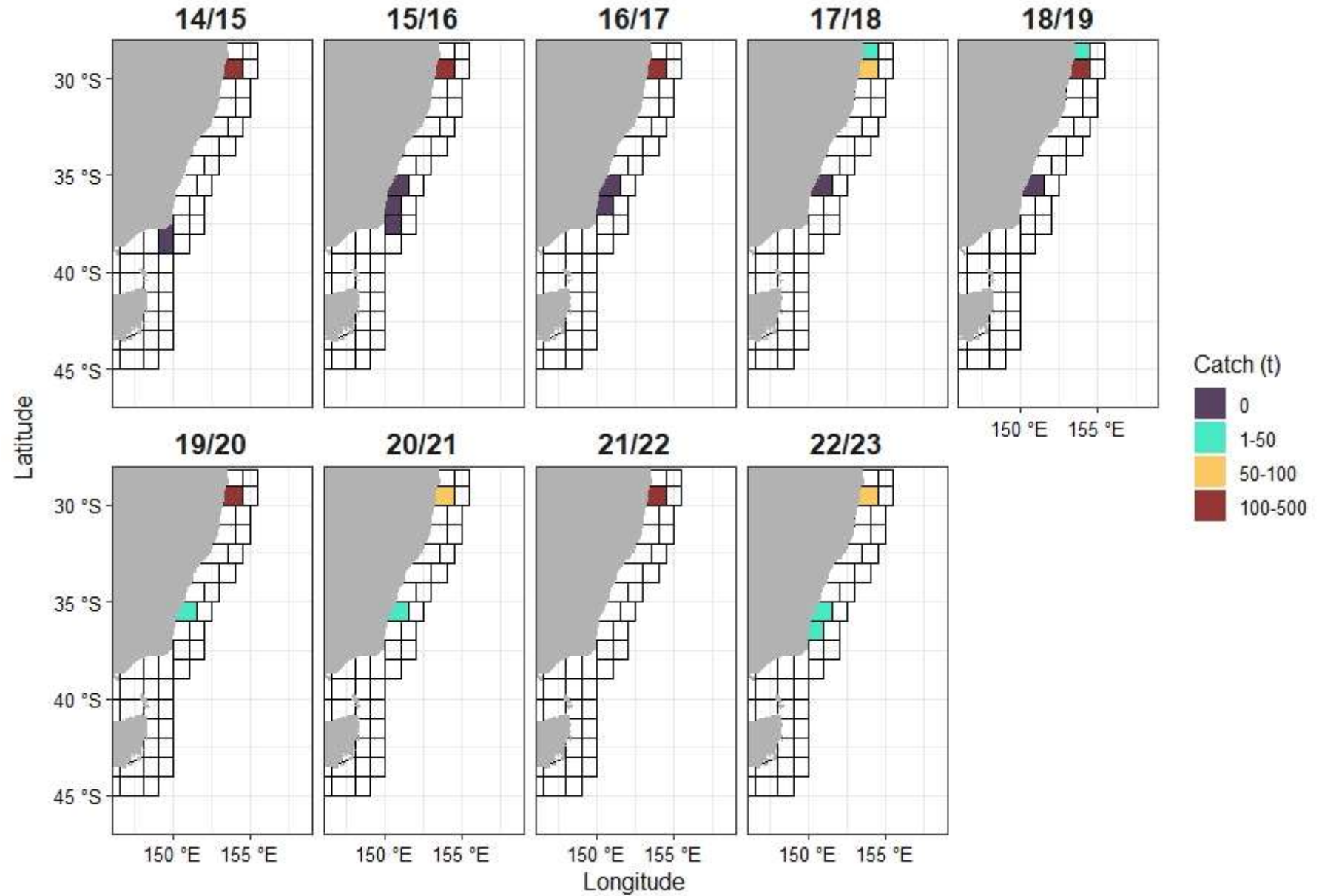
# Sardine: Sardine Sub-area



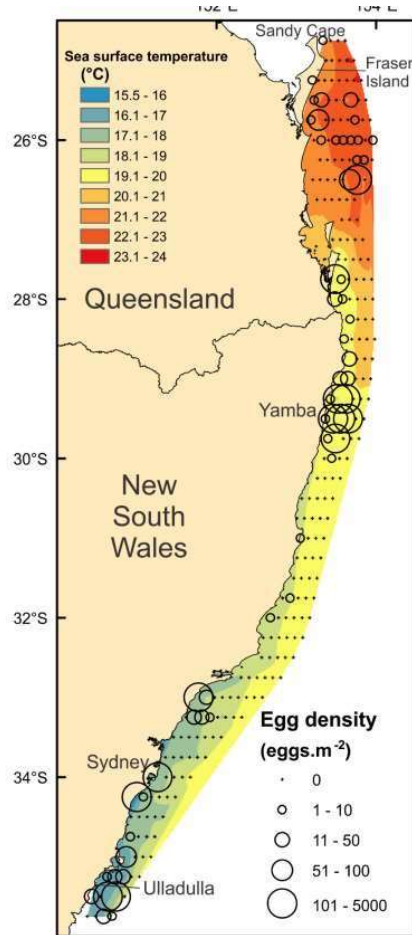
Total catch in 2022/23: 345 t

Includes 14 t in SPF trawl

# Sardine: Sardine Sub-area



# Sardine: Sardine Sub-area



## Key Findings of DEPM

- Eggs patchily distributed along the east coast
- Patches off southern Queensland, northern NSW and southern NSW
- Few eggs collected between 30°S (Coffs Harbour) and 33°S (Newcastle)
- Spawning area fell from 22,400 km<sup>2</sup> in 2014 to 14,281 km<sup>2</sup> in 2019
- Driven by reduction in eggs between Coffs Harbour and Newcastle
- Spawning biomass fell from 49,575 t to 42,724 t

## Need to:

- Estimate adult reproductive parameters robustly

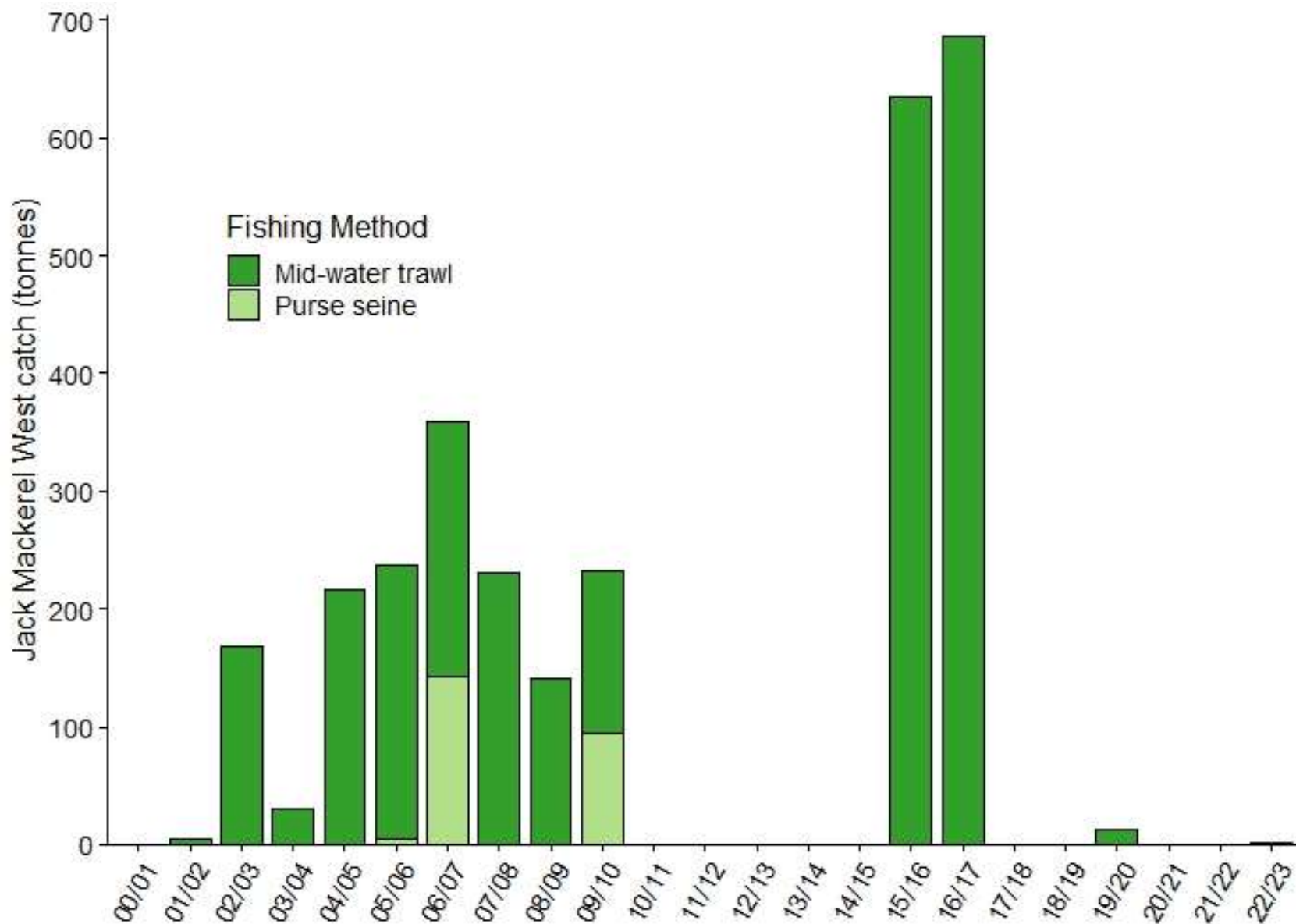
## Recommendations

<b>Recommended Biological Catch (RBC)</b>	2023-24	3 <sup>rd</sup> Season at Tier 1 (2019-20 DEPM estimate) 42,724 x 20% = <b>8,454 tonnes</b>
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Source: AFMA SPF Species Summary 2023

Year (Source)	DEPM Spawning Biomass (95% CI)	2021/22 RBC (t)	2021/22 TAC (t)	2022/23 Catch (t)	Catch % Spawning Biomass	Catch % RBC	Catch % TAC
2019 (Sep)	42,724 t	8,454t	7,970 t	SPF: 70 t	0.2%	0.8%	0.9%
Ward et al. (2021)				Total: 345 t	0.8%	4.1%	4.3%

# Jack Mackerel: Western Sub-area

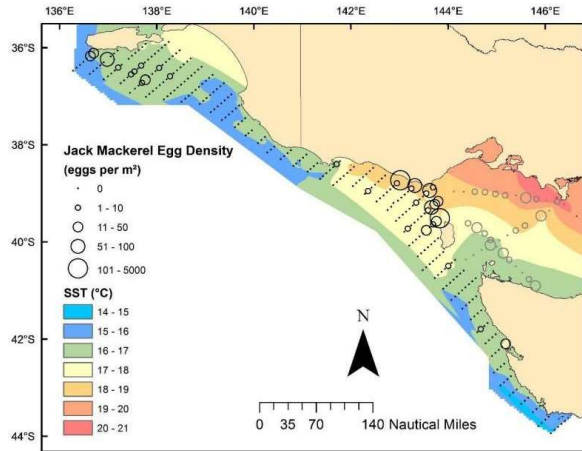




# Jack Mackerel: Western Sub-area

## Key Findings of DEPM

- Presence of Jack Mackerel eggs in Bass Strait established
- Jack Mackerel from Eastern and Western Sub-areas may mix in Bass Strait
- Discontinuity in egg distributions off Bonney Coast suggests potential separation between South-eastern Australia and Great Australian Bight
- Spawning biomass of south-western Tasmania and in western Bass Strait may be smaller than off south-eastern Australia
- Best estimate of biomass of 34,978 tonnes is 31,069 t plus Bass Strait



## Need to:

- Ensure future surveys include Bass Strait
- RAG recommended limiting catches off south-west coast of Kangaroo Island (G54, G55)

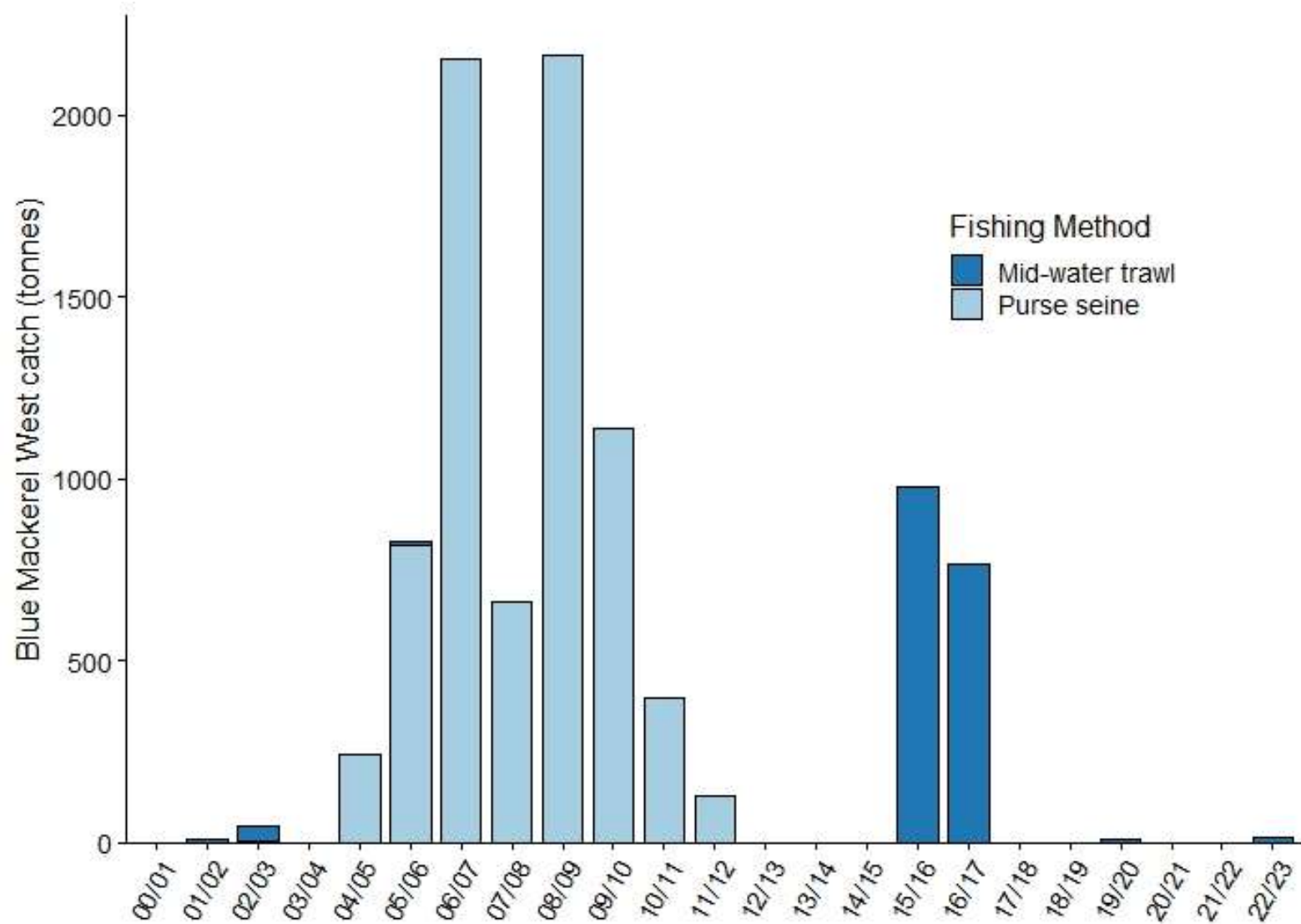
Recommendations		
Recommended Biological Catch (RBC)	2023-24	1 <sup>st</sup> Season at Tier 2 34,978 x 6% = 2,099 tonnes

Source: AFMA SPF Species Summary 2023

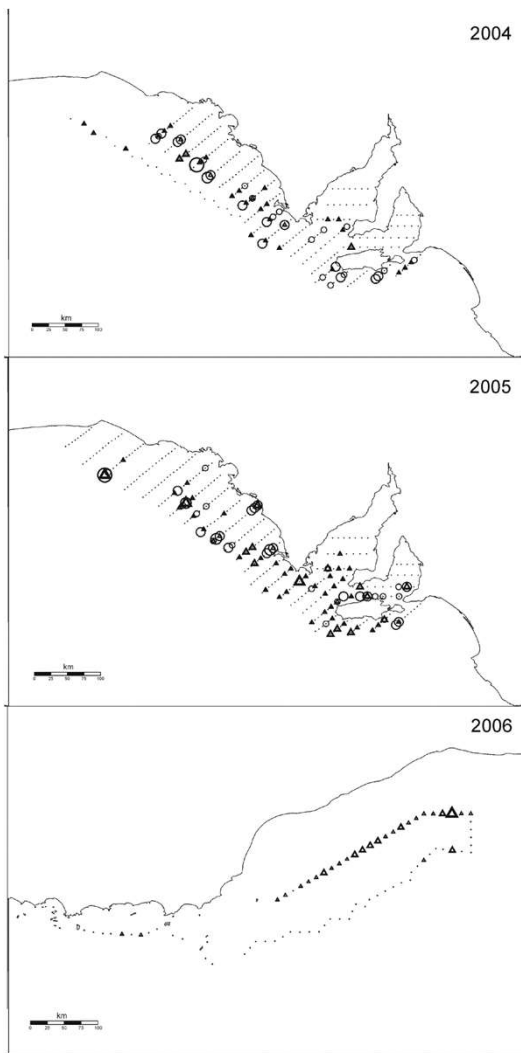
Year (Source)	DEPM Spawning Biomass (95% CI)	2021/22 RBC (t)	2021/22 TAC (t)	2022/23 SPF Catch (t)	SPF Catch % Spawning Biomass	SPF Catch % RBC	SPF Catch % TAC
2016/17 (Dec-Feb)	34,978 t	2,099 t	2,100 t	2 t	0.0%	0.1%	0.1%

Ward et al.  
(2018)

# Blue Mackerel: Western Sub-area



# Blue Mackerel: Western Sub-area



## Key Findings of DEPM

- Eggs found in eastern and western Great Australian Bight
- Few eggs found in eastern part of Western Sub-area
- Comprehensive survey of stock has not been conducted
- Potentially large unfished stock in western GAB and off southern WA

## Potential to:

- Coordinate DEPM survey off WA with DEPM survey for SA Sardine and Blue Mackerel

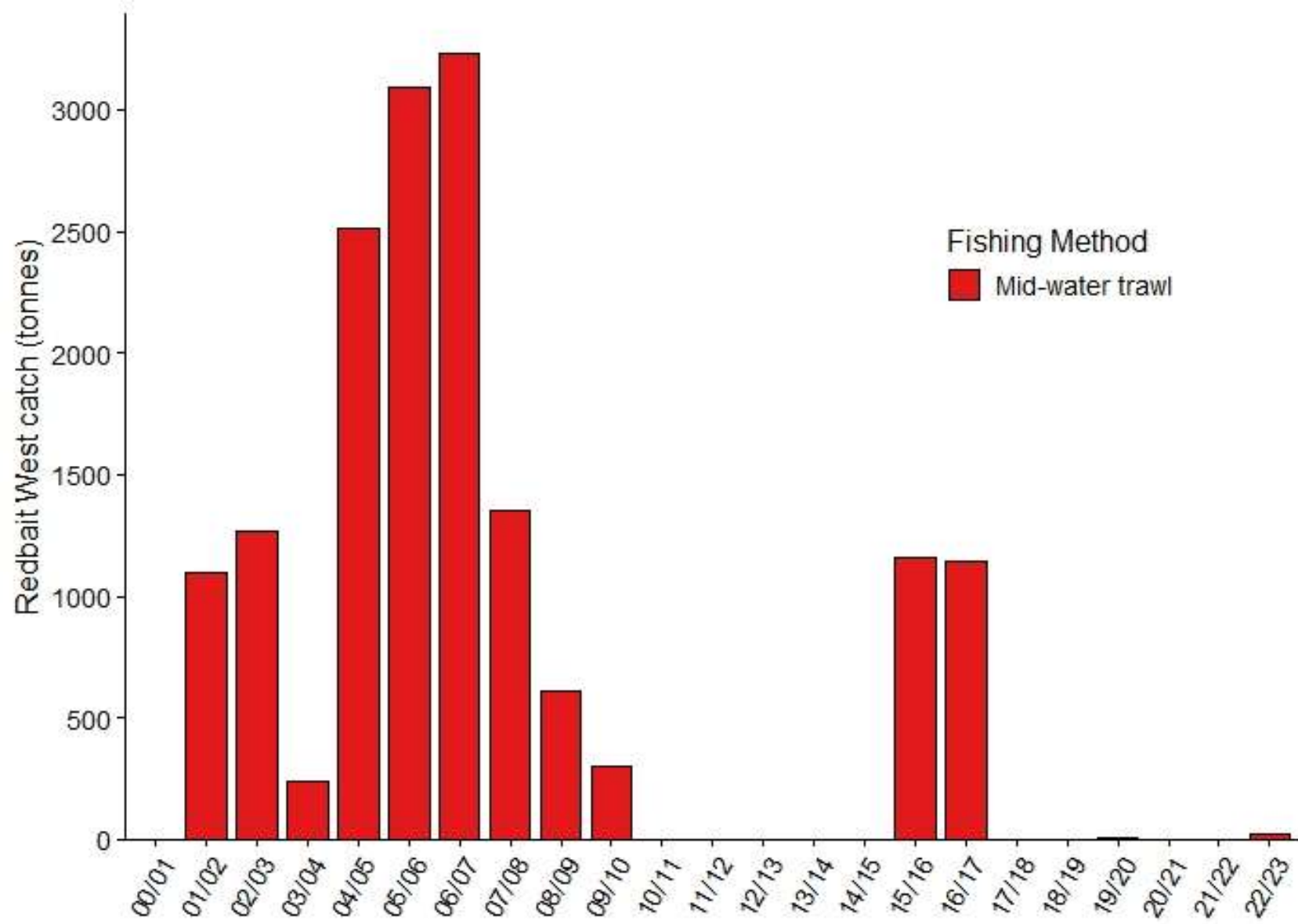
Recommendations		
Recommended Biological Catch (RBC)	2023-24	7 <sup>th</sup> Season at Tier 3 86,500 x 3.75% = <b>3,244 tonnes</b>

Source: AFMA SPF Species Summary 2023

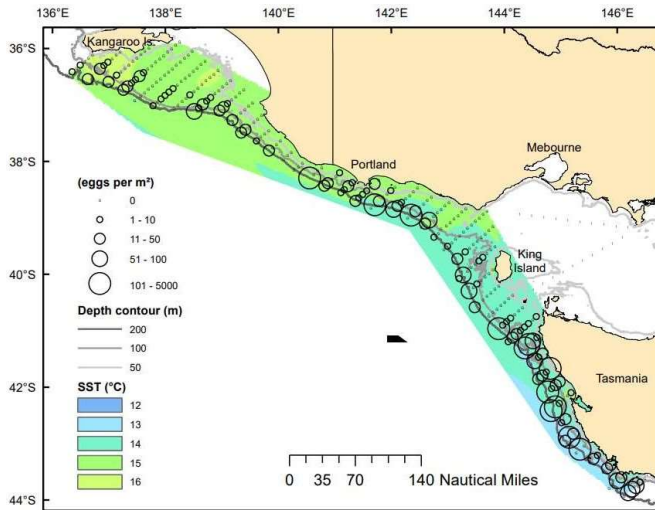
Year (Source)	DEPM Spawning Biomass (95% CI)	2021/22 RBC (t)	2021/22 TAC (t)	2022/23 SPF Catch (t)	SPF Catch % Spawning Biomass	SPF Catch % RBC	SPF Catch % TAC
2006	86,500 t	3,244t	3,240 t	13 t	0%	0.4%	0.4%

Ward et al.  
(2007, 2009)

# Redbait: Western Sub-area



# Redbait: Western Sub-area



## Key Findings of DEPM

- Eggs widespread and abundant on outer shelf and upper slope waters in the eastern portion of the Western Sub-area
- No eggs collected in Bass Strait
- Distribution appears to continuous around southern Tasmania
- Spawning area 28,365 km<sup>2</sup>
- Redbait also occur west of the survey area
- Robust estimates of adult parameters, especially spawning fraction
- Main challenge is estimating  $P_0$

## Need to:

- Establish reliable method for estimating  $P_0$
- Understand distribution and abundance west of the survey area

Recommendations		
Recommended Biological Catch (RBC)	2023-24	5 <sup>th</sup> season at Tier 1 66,787 x 10% = 6,678 tonnes

Source: AFMA SPF Species Summary 2023

Year (Source)	DEPM Spawning Biomass (95% CI)	2021/22 RBC (t)	2021/22 TAC (t)	2022/23 SPF Catch (t)	SPF Catch % Spawning Biomass	SPF Catch % RBC	SPF Catch % TAC
2017 (Oct)	66,678 t	6,678 t	6,680 t	25 t	0%	0.4%	0.4%

Ward et al.  
(2019)