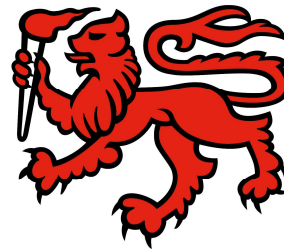


# Commonwealth Small Pelagic Fishery (SPF): Fishery Assessment Report 2022

Presentation to SPFRAG 15 December 2022  
(No confidential data)

Tim Ward, Barrett Wolfe, Gary Carlos and Peter Couslen

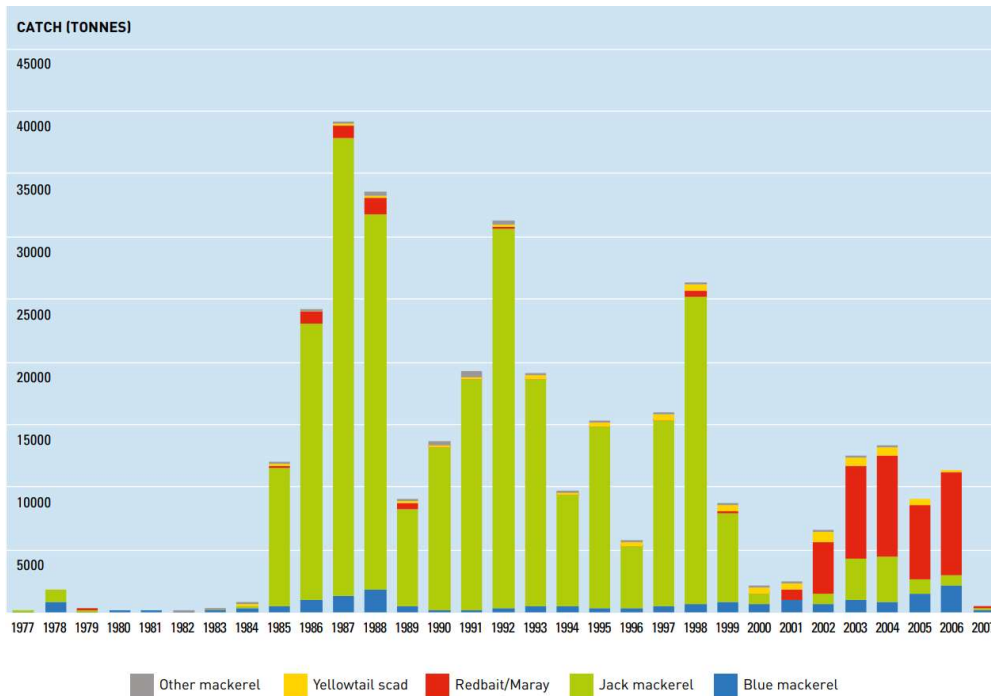


UNIVERSITY *of*  
TASMANIA

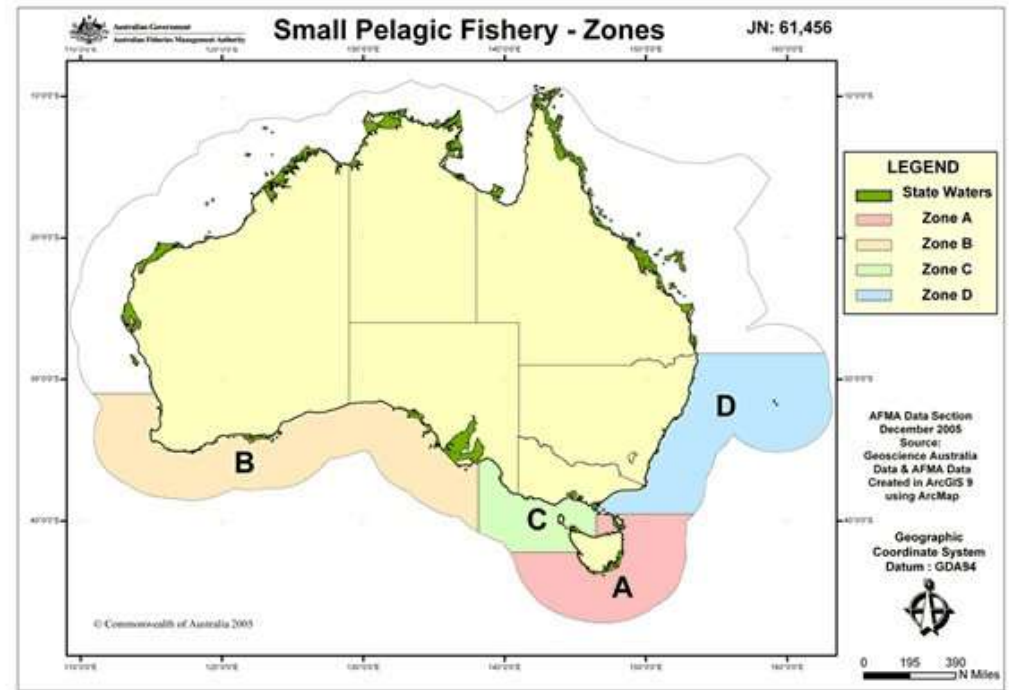


**IMAS**  
INSTITUTE FOR MARINE  
& ANTARCTIC STUDIES

# Jack Mackerel Fishery and SPF



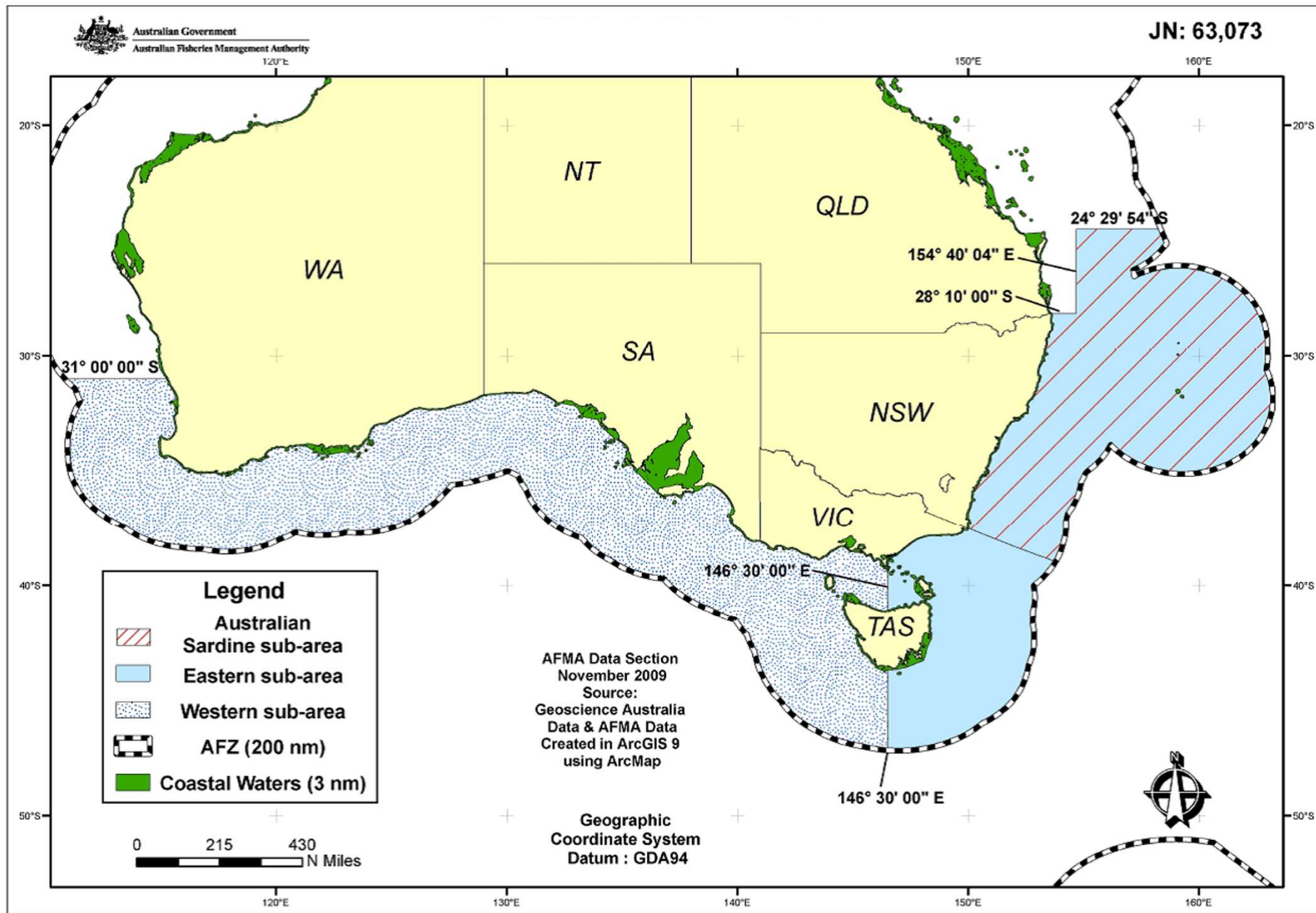
Source: Bulman et al. (2008), Expert Panel Report (2014)  
\*2007 data incomplete



Source: AFMA website 7 June (2007).

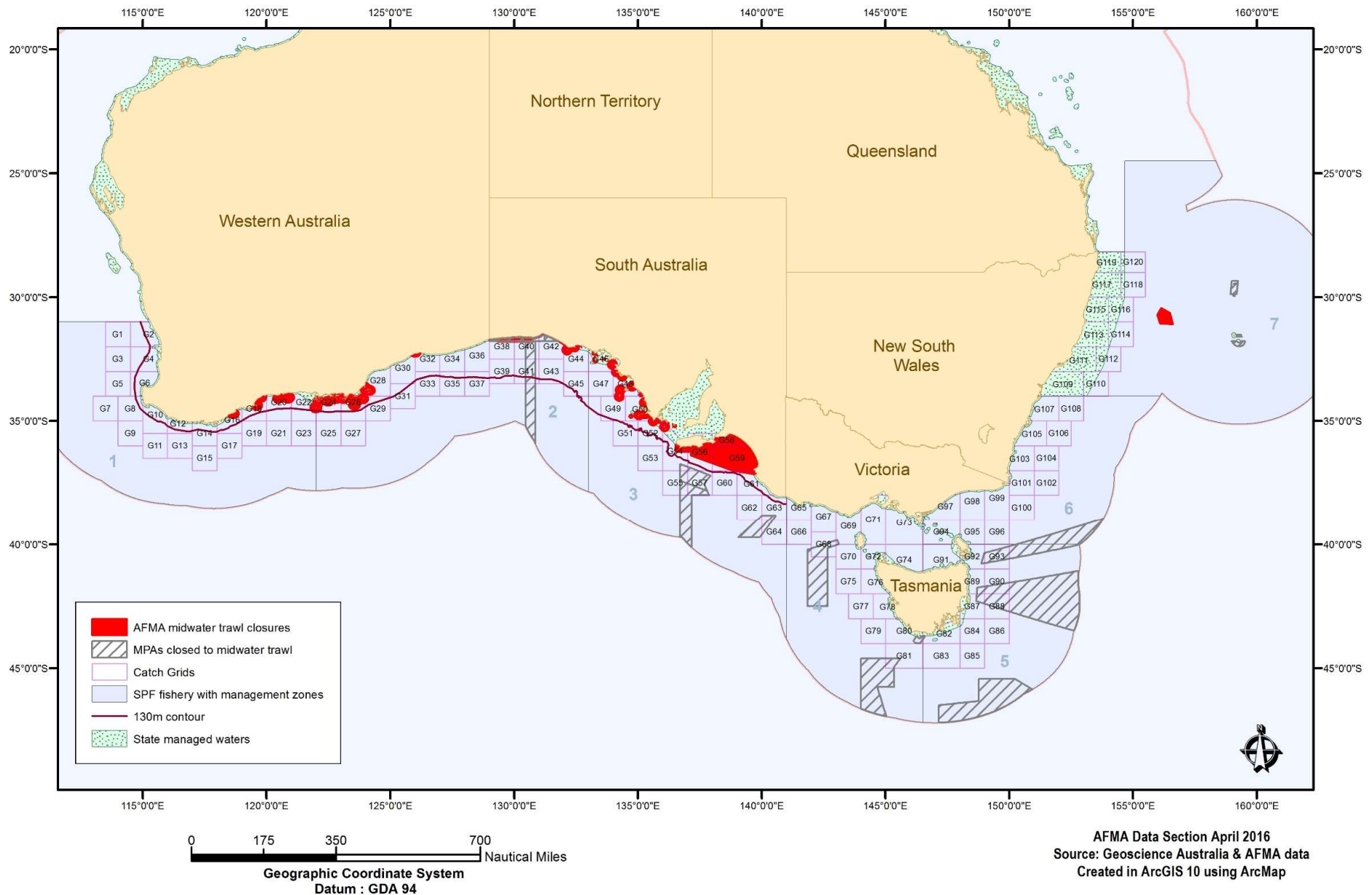
- Jack Mackerel Fishery (purse-seine) off Tasmania up to 2000
- Highest total catch of ~39,700 t in 1986/87
- SPF established in 2001
- JMK rules (TAC, zones, input controls, etc) up to 2008/09
- Mid-water trawling began in 2001/2002
- Harvest Strategy (2008, last revised 2017)
- Management Plan (2009)

# 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



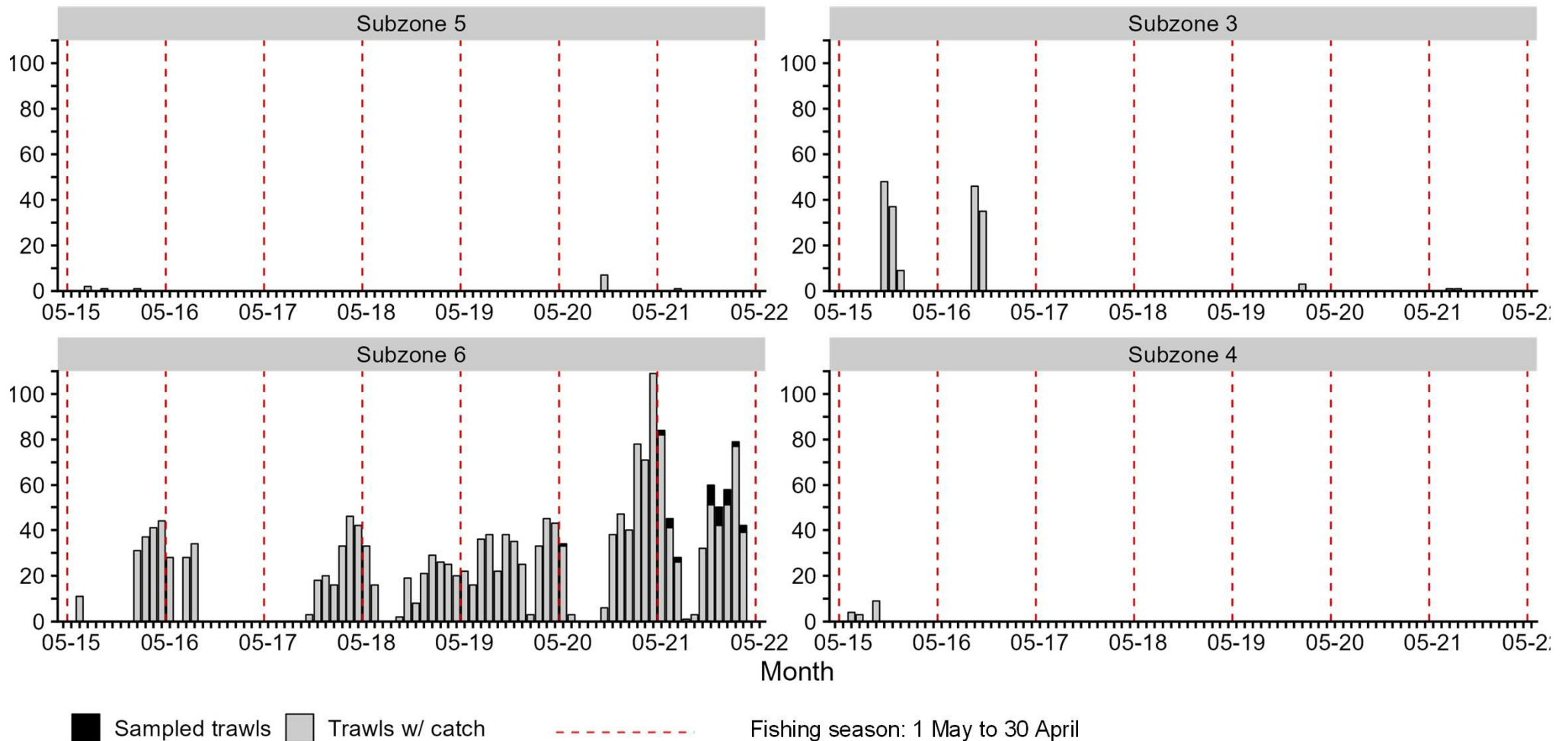
Catch grids established to control spatial/temporal concentration of effort

# Catch and effort data

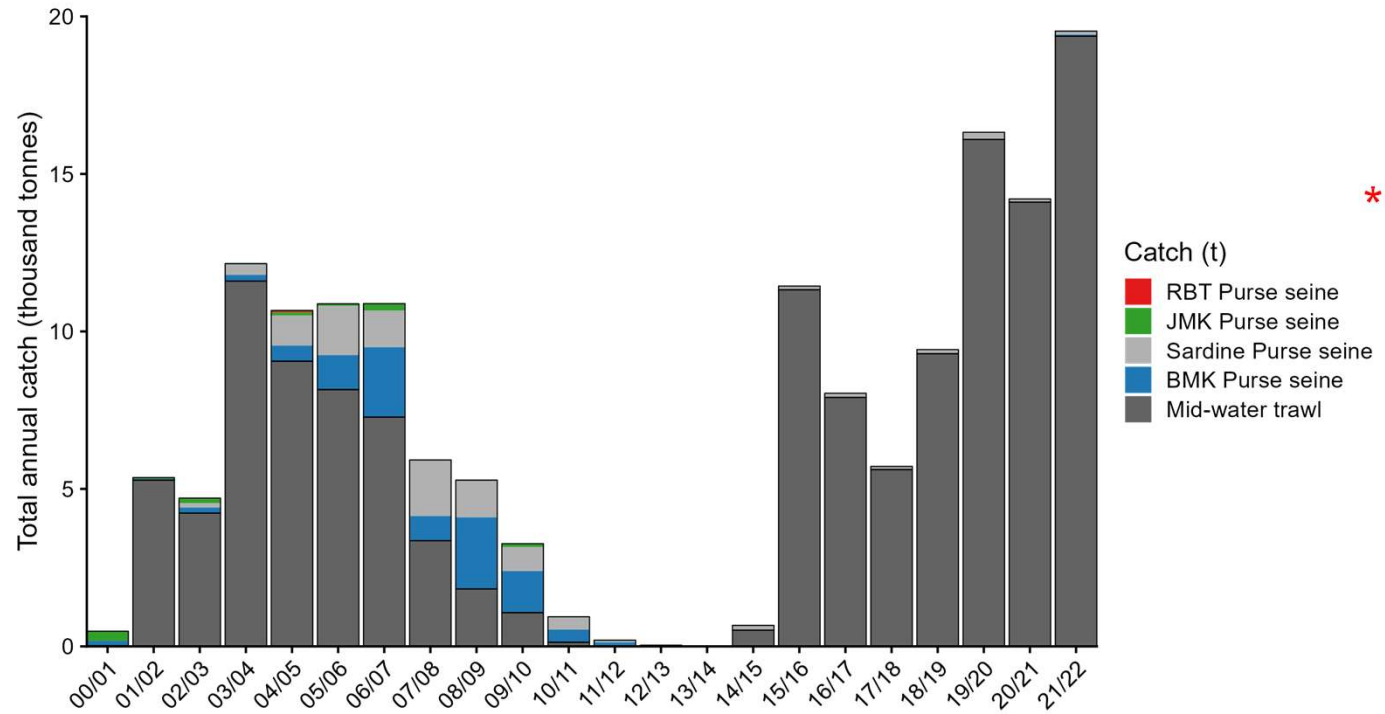
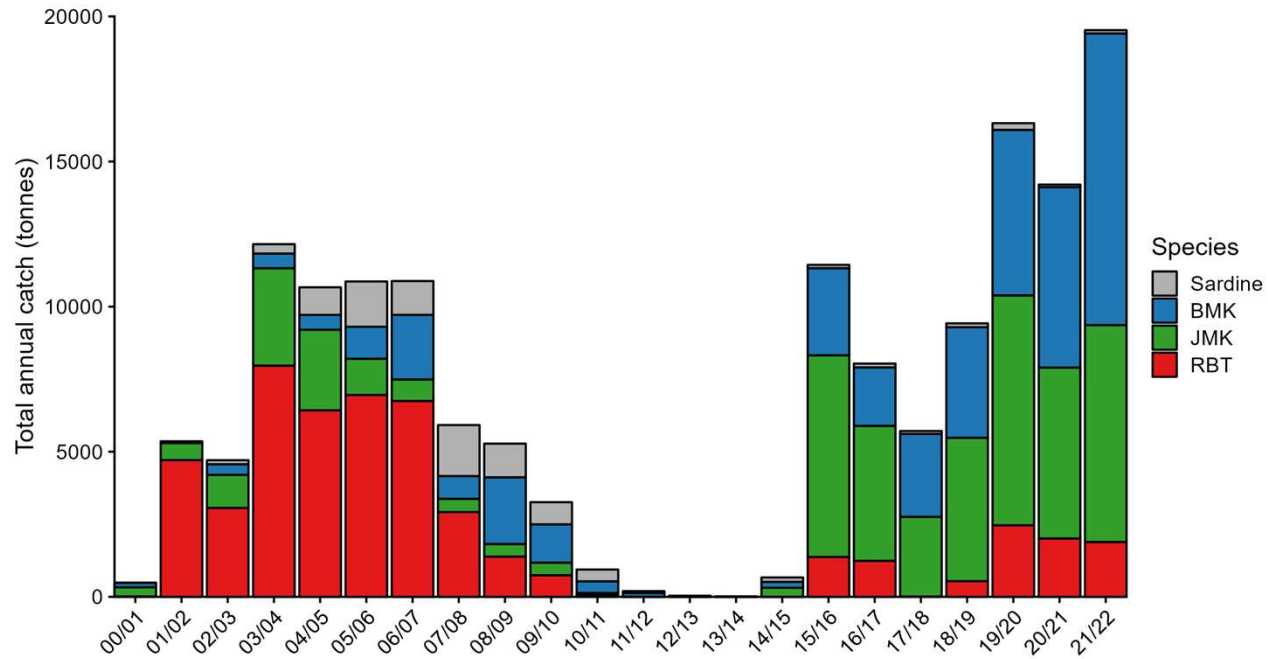
- SPF 2000/01 to 2021/22 (AFMA) – Blue Mackerel, Jack Mackerel, Redbait, Sardine
- NSW Purse-seine – Blue Mackerel, Sardine (Many thanks to John Stewart)

Not included in estimates of total catch: SESSF, WTBF, ETBF, state line-fisheries, recreational catches\*<sup>RBCs to TACs</sup>

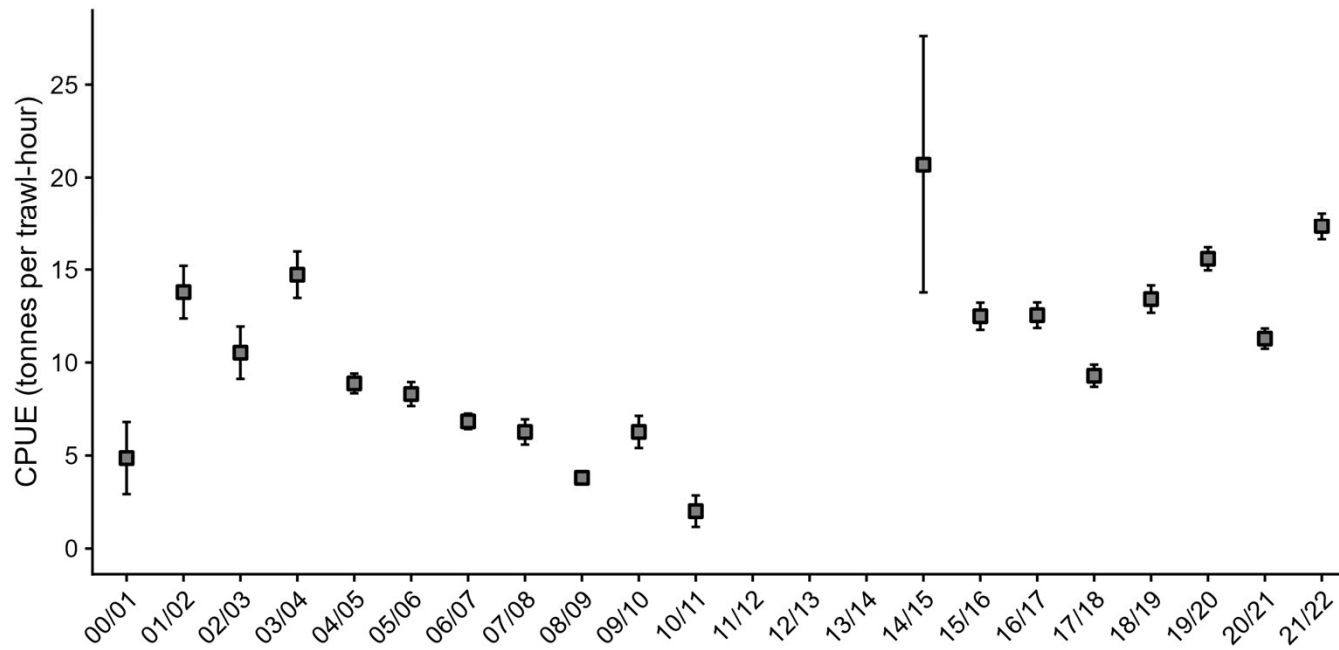
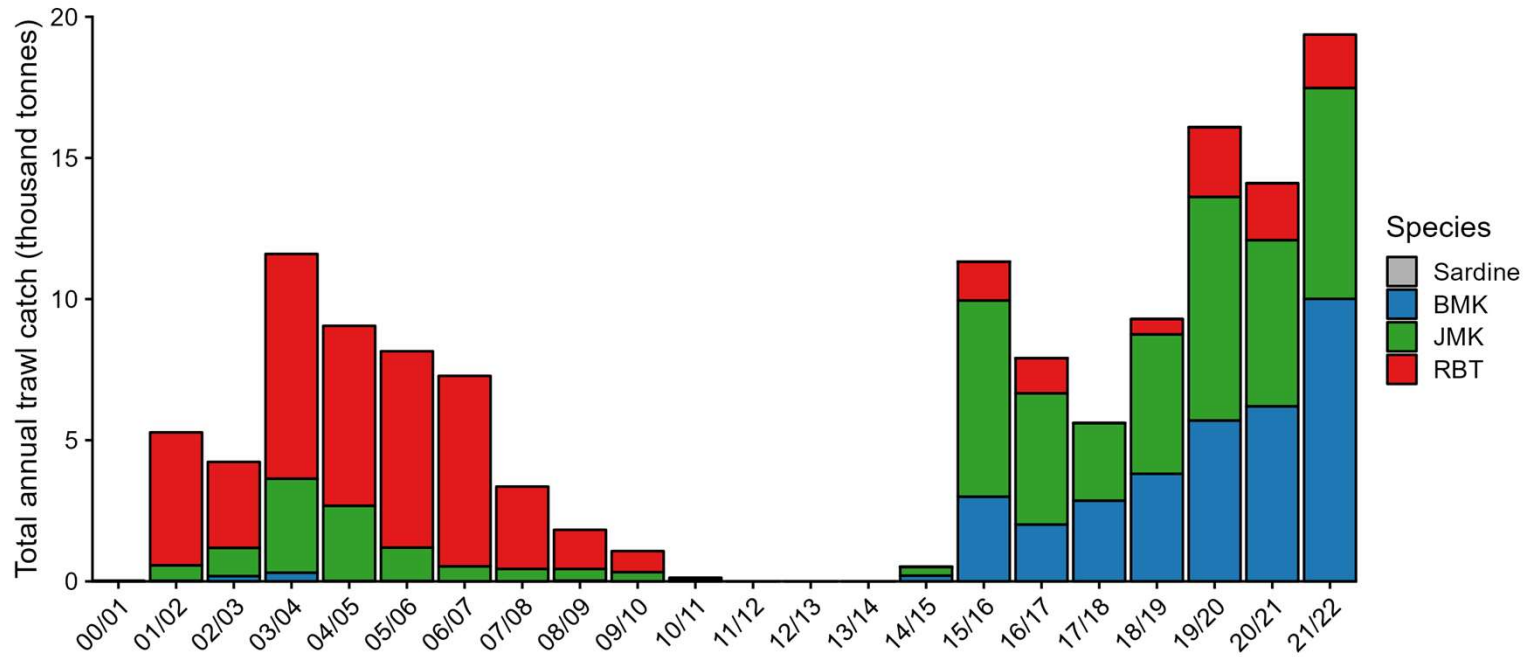
## Catch Sampling 2021/2022\*



# Total SPF Catch 2000/01 to 2021/22



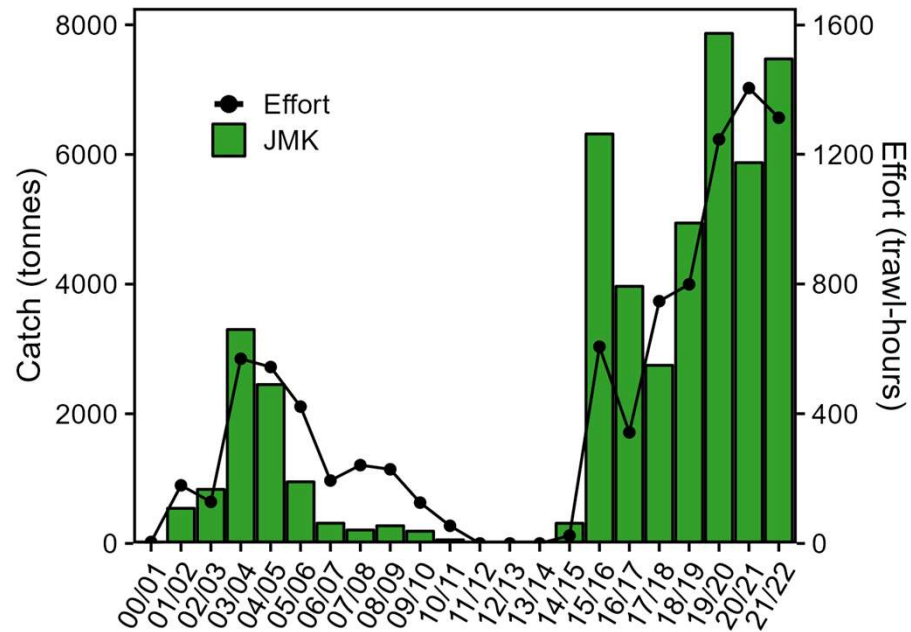
# Total SPF Trawl Catch, Effort and CPUE 2000/01 to 2021/22



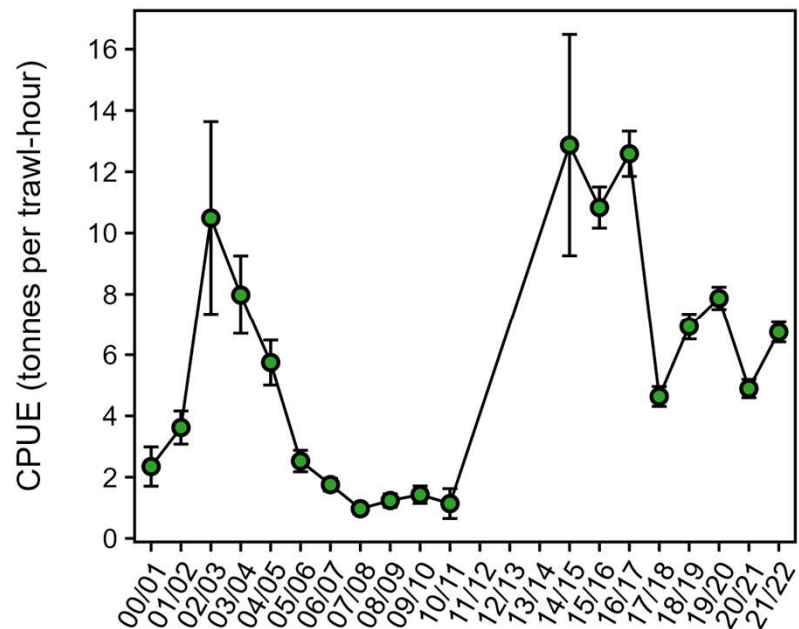
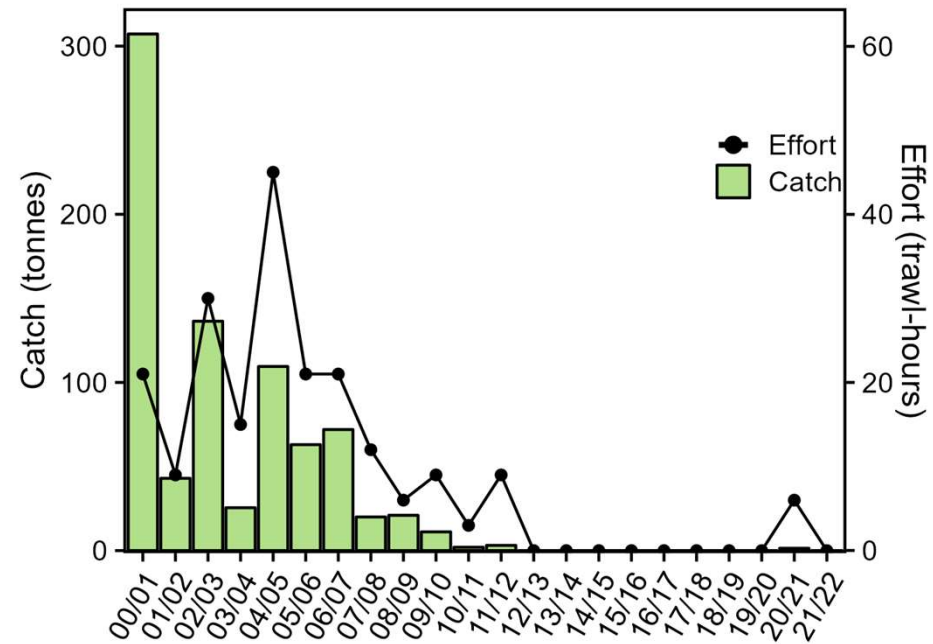
# Jack Mackerel: Eastern Sub-area



## Commonwealth: Trawl



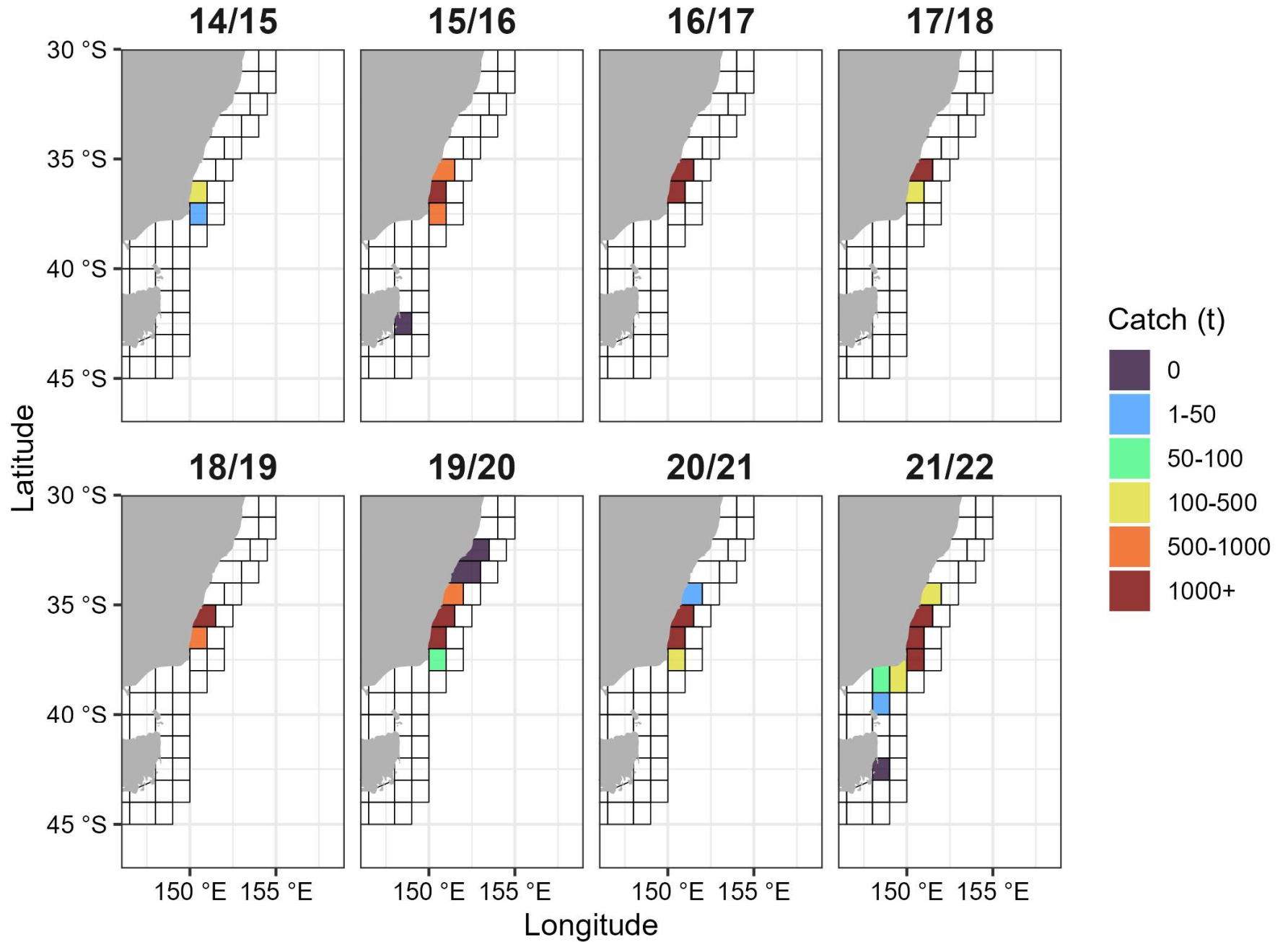
## Commonwealth: Purse-seine



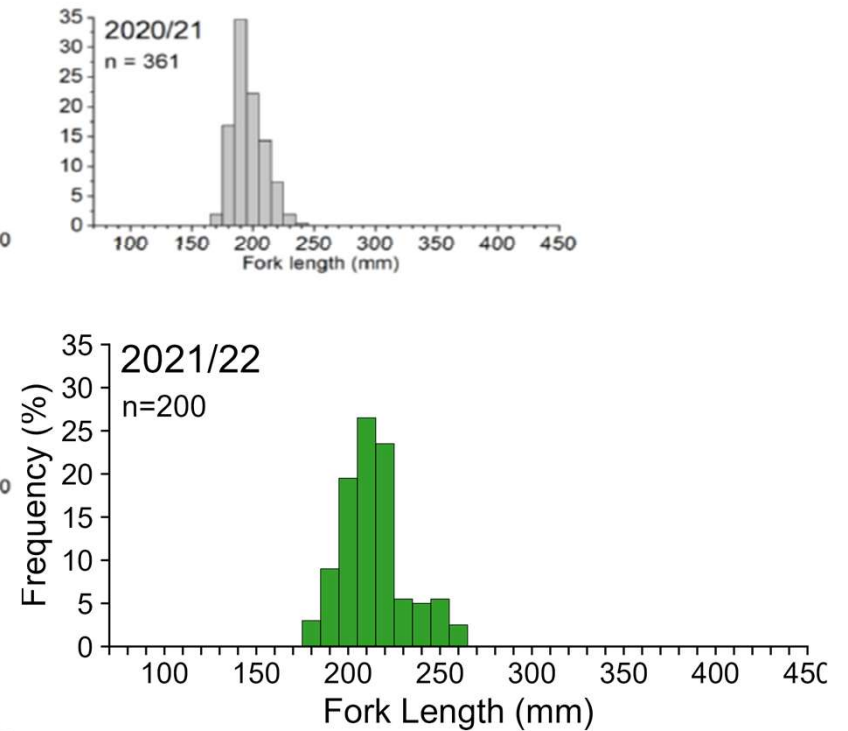
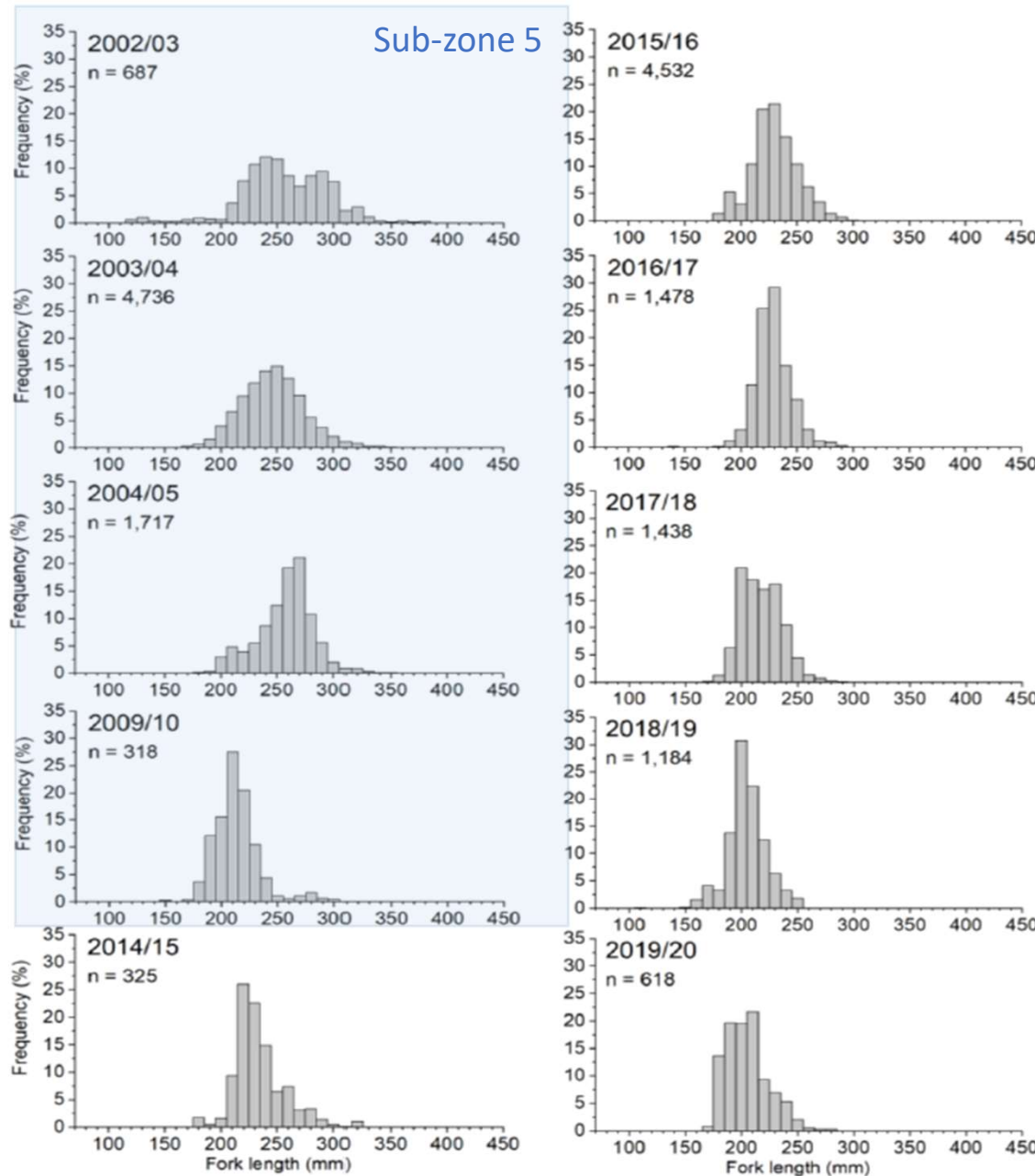
- Total trawl catch in 2021/22: 7,474 t
- Second highest in SPF history
- Highest in 2019/20: 7,922 t
- Decline in CPUE from 2003/04 to 2010/11
- High CPUE 2014/15 to 2016/17
- CPUE current operation: 5-8 t.trawl hr<sup>-1</sup>



# Jack Mackerel: Eastern Sub-area



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



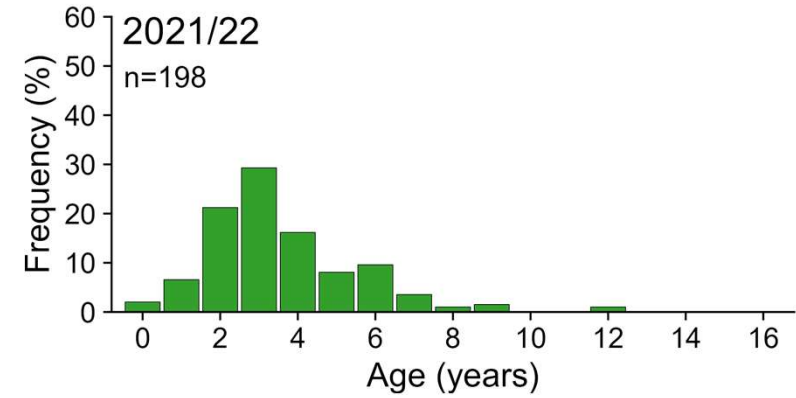
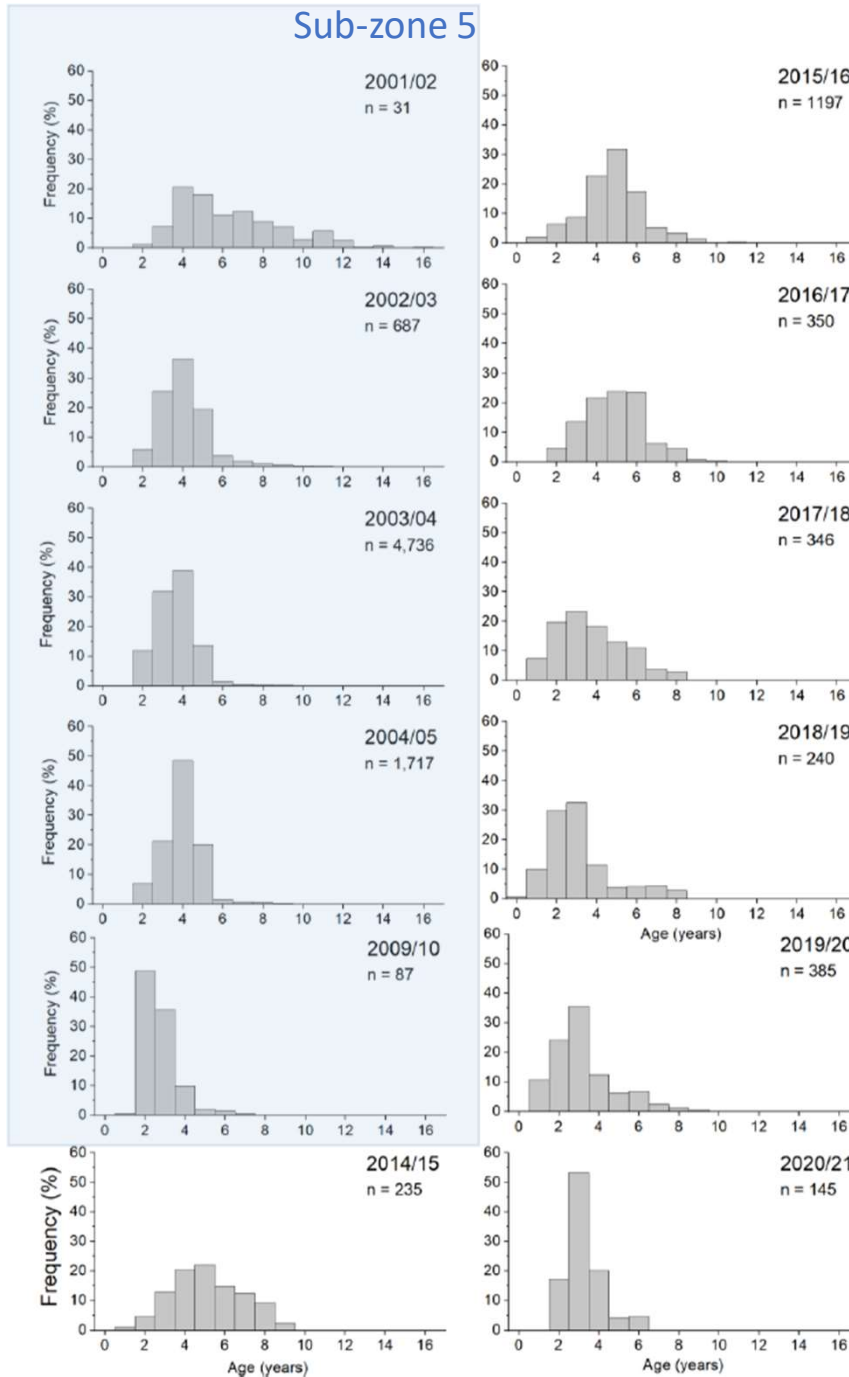
## Modal Fork Length

- 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)

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

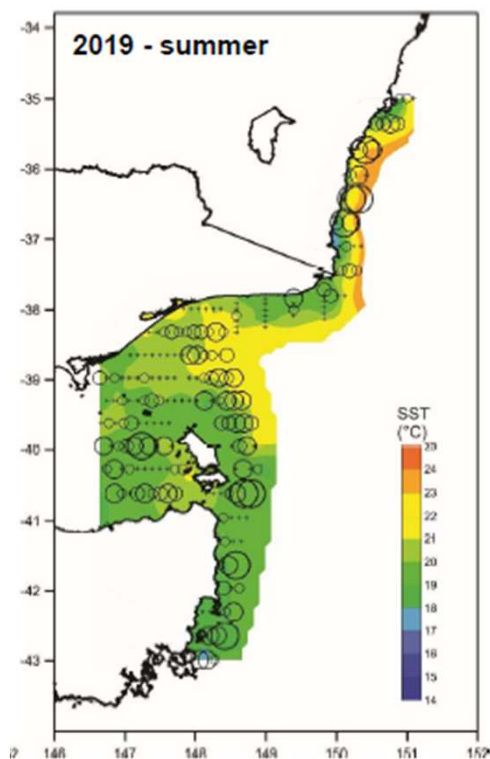
# Jack Mackerel: Eastern Sub-area (Sub-zone 6)



### 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

# 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:

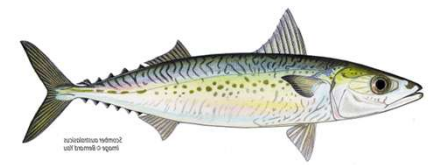
- Optimise timing of survey (start late December early January instead of mid January?)
- Improve adult sampling (faster trawler, other methods?)
- Obtain better estimates of spawning fraction and relative fecundity (alternative methods)
- Establish optimal model for estimating  $P_0$

RAG Recommendations		
Recommended Biological Catch (RBC)	2022-23	3 <sup>rd</sup> season at Tier 1 156,300 x 12% = <b>18,756 tonnes</b>

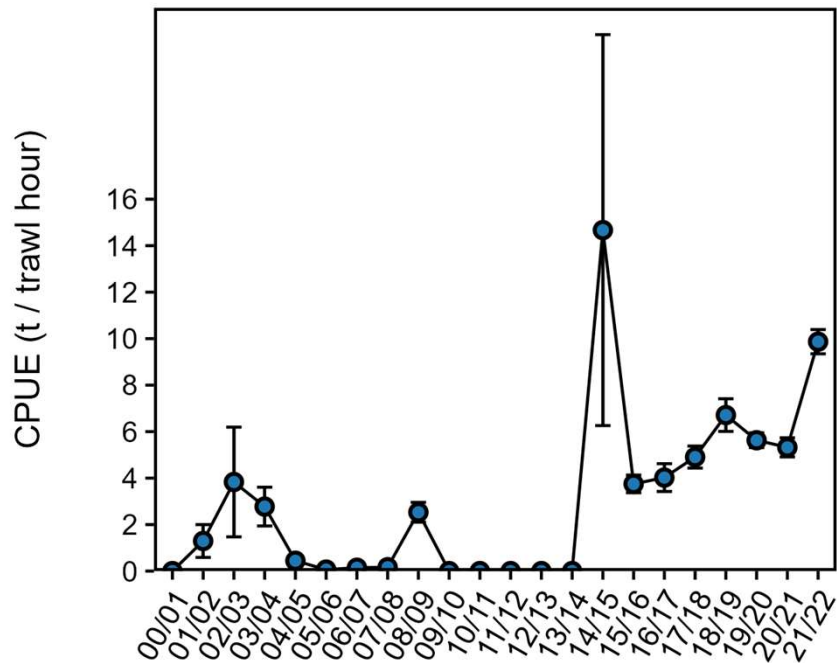
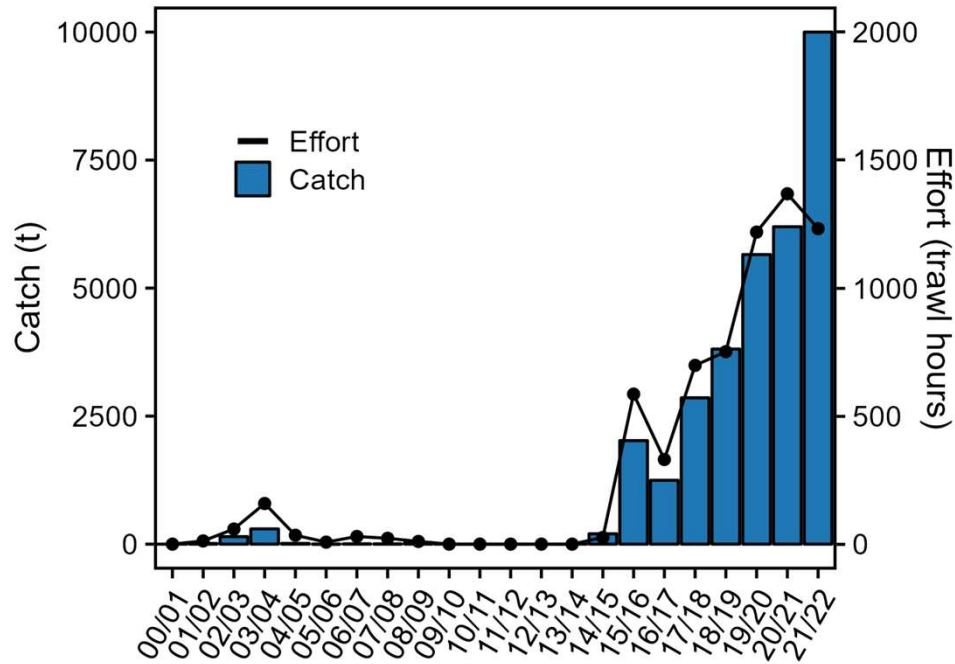
Source: AFMA SPF Species Summary 2022

Year (Source)	DEPM Spawning Biomass (95% CI)	2021/22 RBC (t)	2021/22 TAC (t)	2021/22 SPF Catch (t)	SPF Catch % Spawning Biomass	SPF Catch % RBC	SPF Catch % TAC
2019 (Jan) (Ward et al. 2020)	156,292 t (49,120–263,496 t)	18,756 t	18,630	7,474	4.8%	39.9	40.1

# Blue Mackerel: Eastern Sub-area



## Commonwealth: Trawl

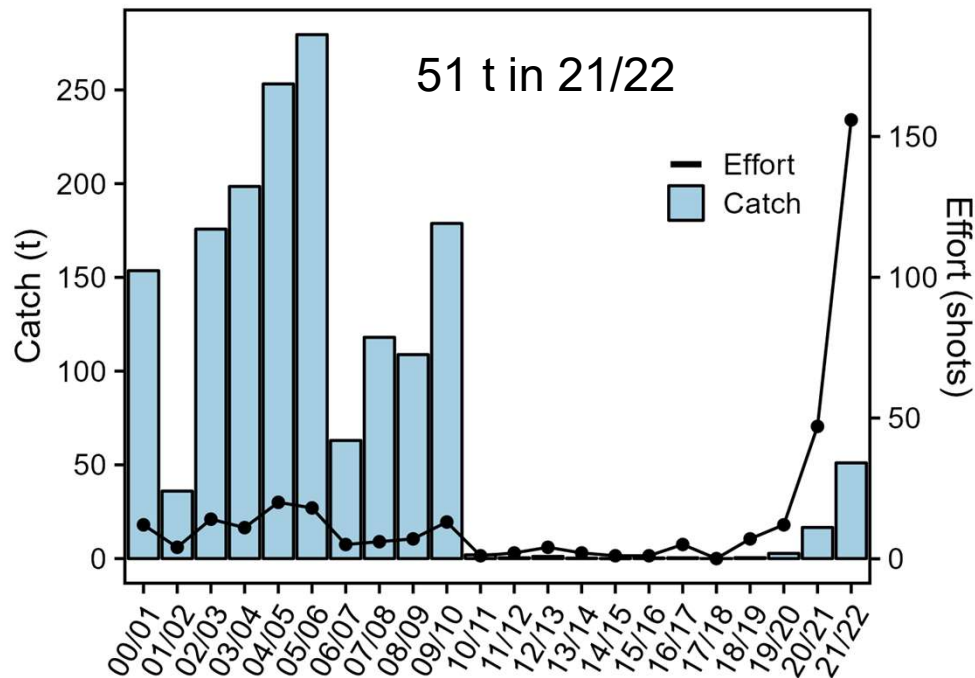


- Historically taken as by-catch off Tasmania
- Catch first increased in 2014/15 to 2016/17 (factory-trawler)
- Increased rapidly since 2017/18
- Previous highest catch ~6,219 t in 2020/21
- Total trawl catch in 2021/22 was 10,007t
- CPUE reached ~10 t.trawl hr<sup>-1</sup> in 2021/22

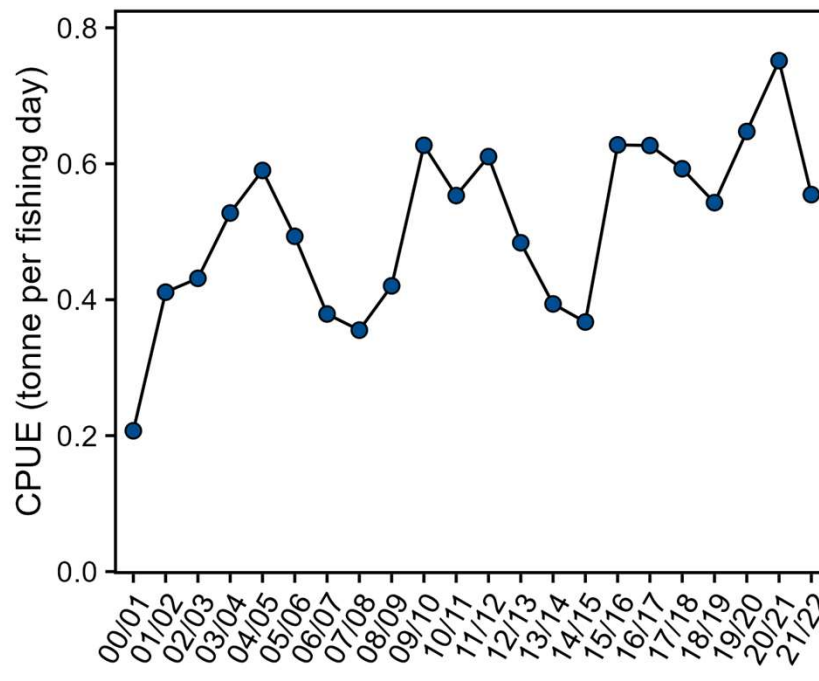
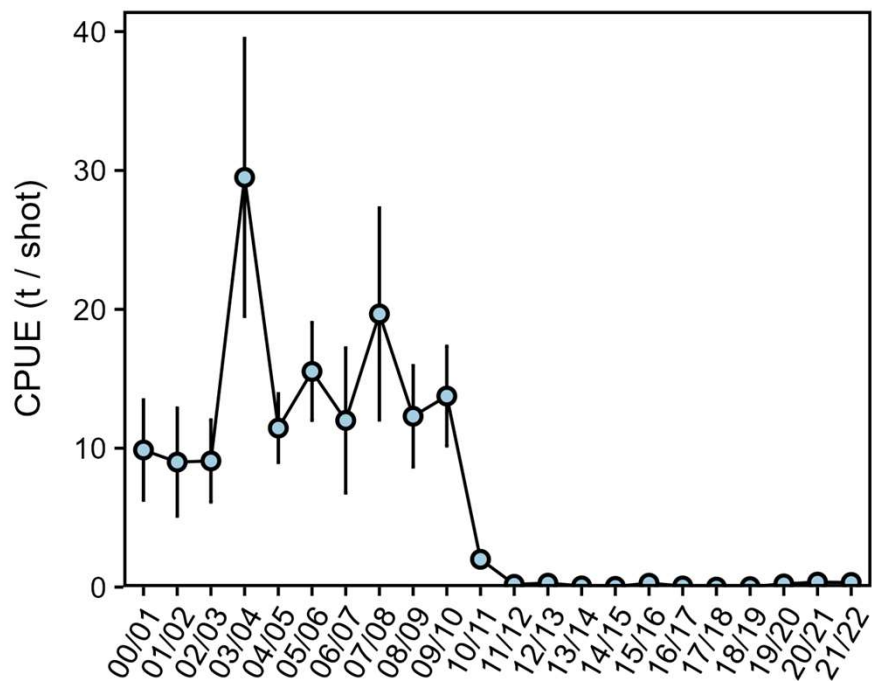
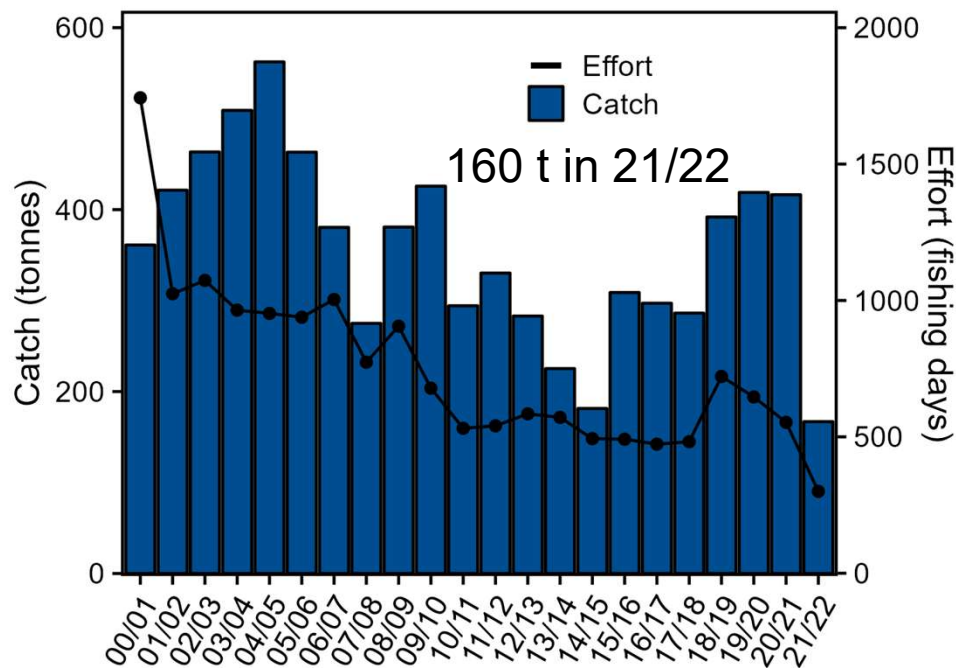
# Blue Mackerel: Eastern Sub-area



## Commonwealth: Purse Seine

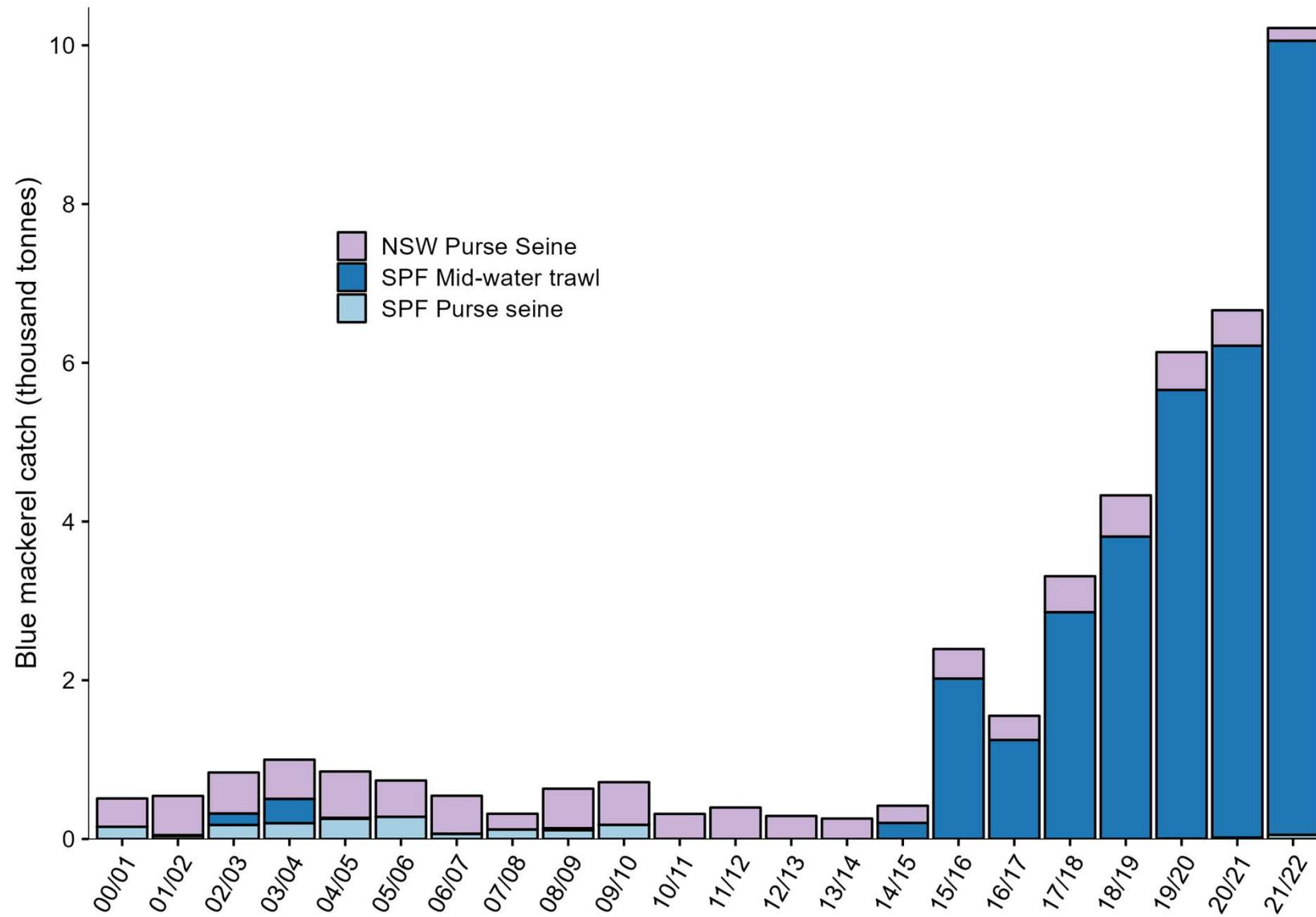
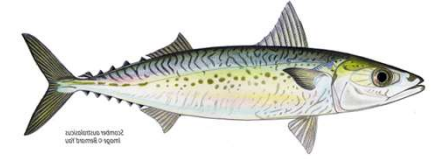


## NSW: Purse Seine



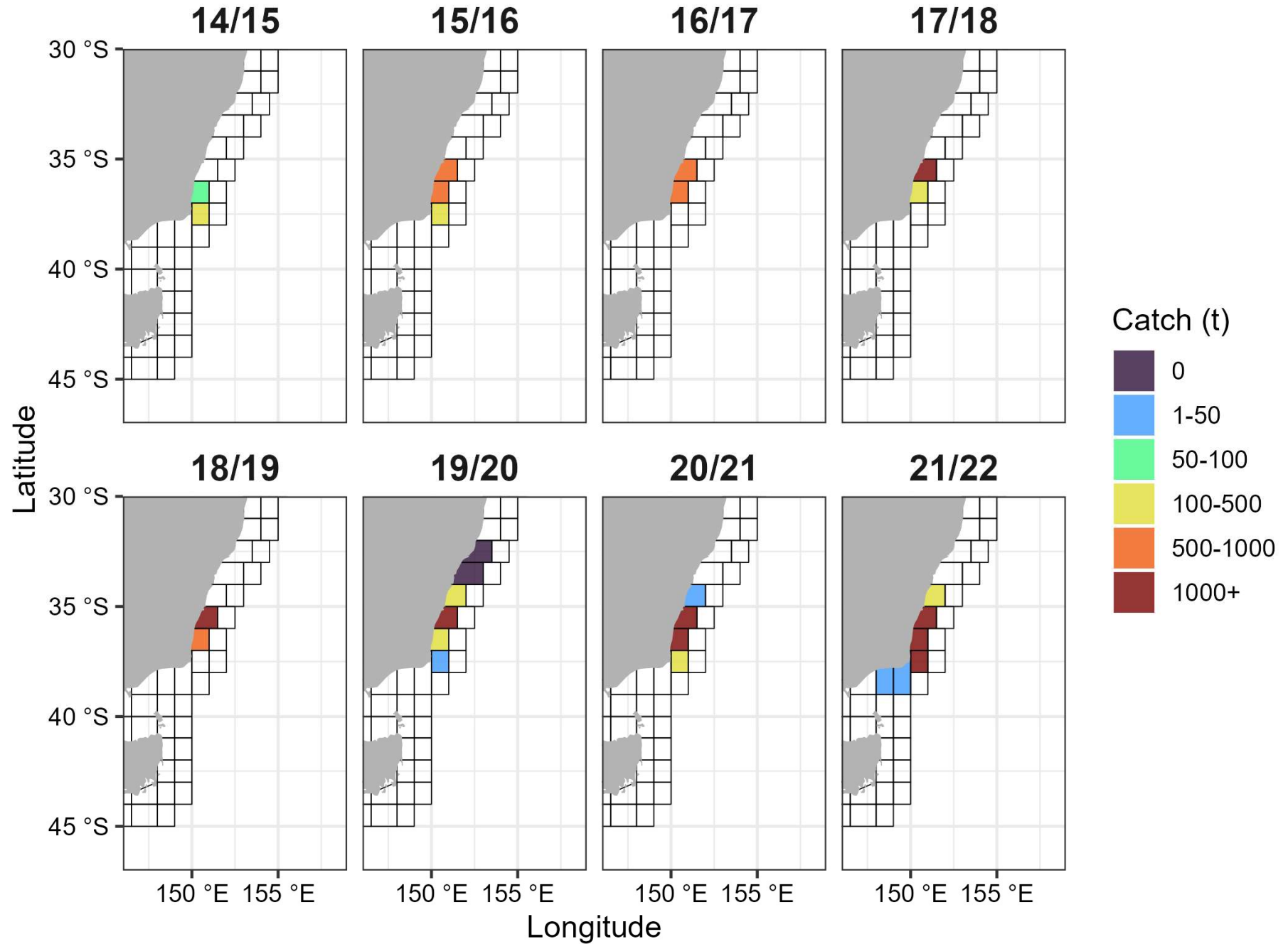
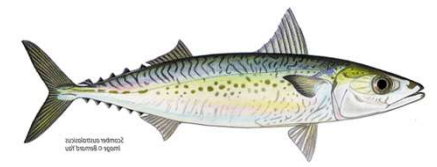
\*

# Blue Mackerel: Eastern Sub-area



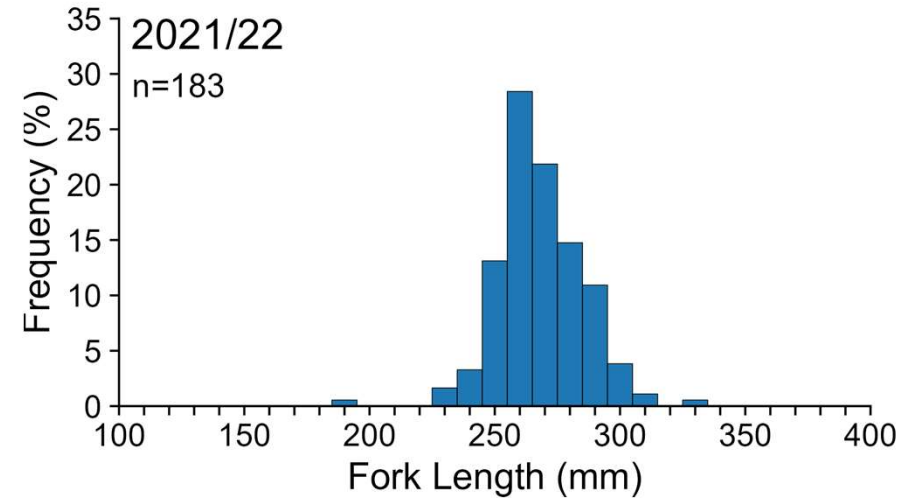
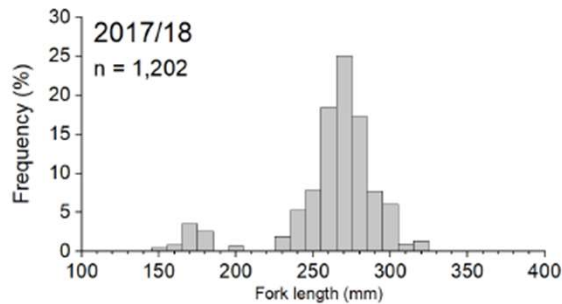
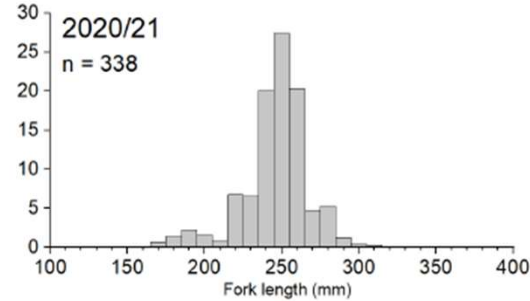
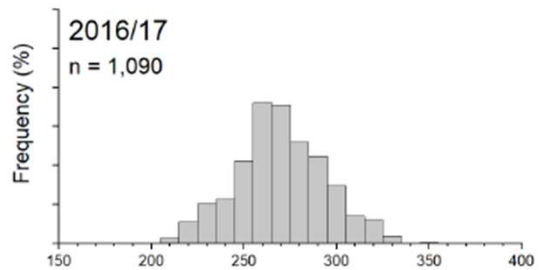
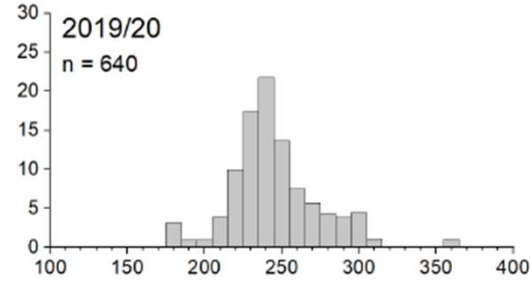
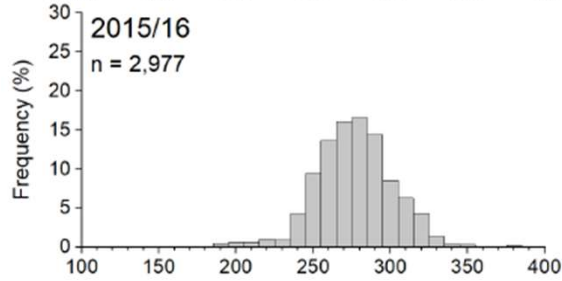
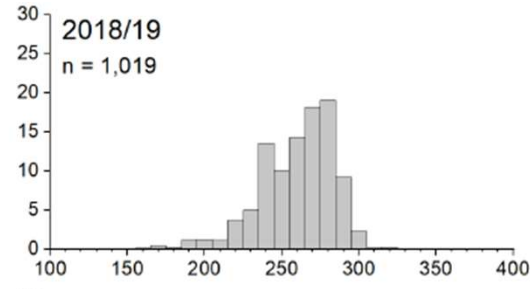
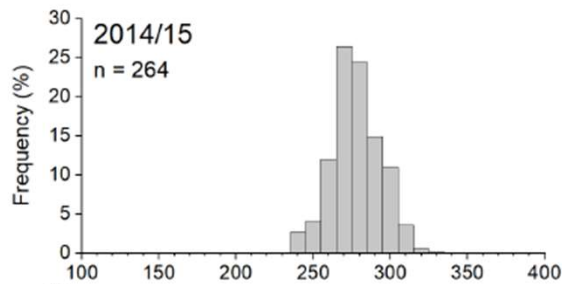
Total catch 2021/22: ~10,218 t

# Blue Mackerel: Eastern Sub-area





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

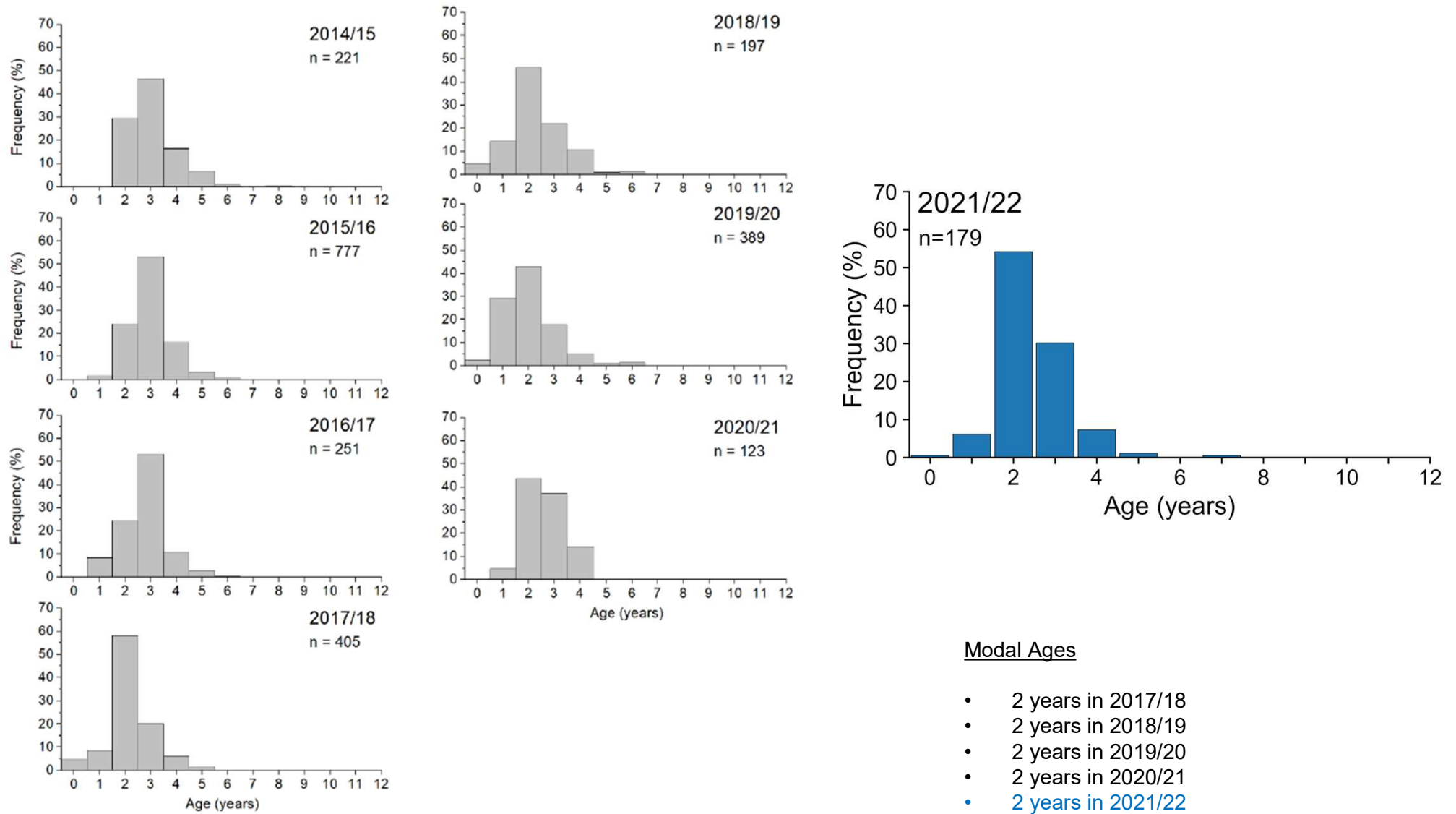
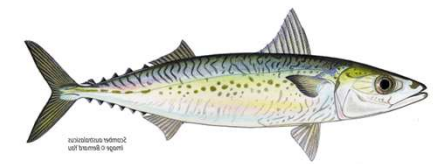


## Modal Fork Length

- 270 mm in 2017/18
- 280 mm in 2018/19
- 240 mm in 2019/20
- 250 mm in 2020/21
- 260 mm in 2021/22
- 50% Maturity ~287 mm (Grammer et al. 2022)
- **Majority of the catch less than size of 50% maturity and not part of the spawning biomass**

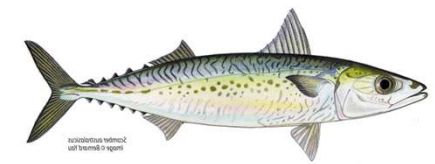
Length frequency distributions for mid-water trawl from Grammer et al. (2022)

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



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

# Blue Mackerel: Eastern Sub-area

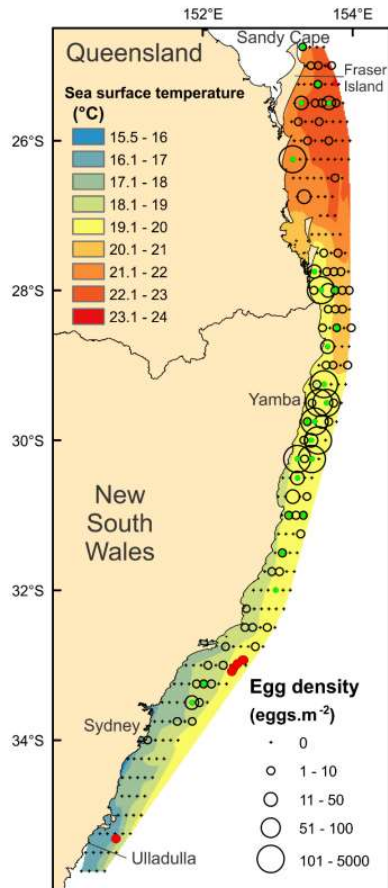


## Key Findings of DEPM

- 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  $P_0$



RAG Recommendations		
Recommended Biological Catch (RBC)	2022-23	2 <sup>nd</sup> Season at Tier 1 (2019 DEPM) 80,000 x 15% = <b>12,000 tonnes</b>

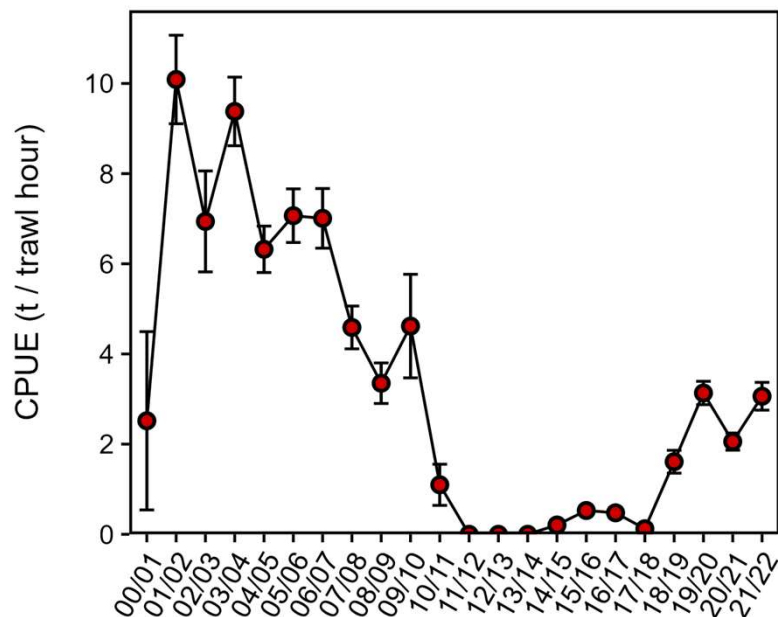
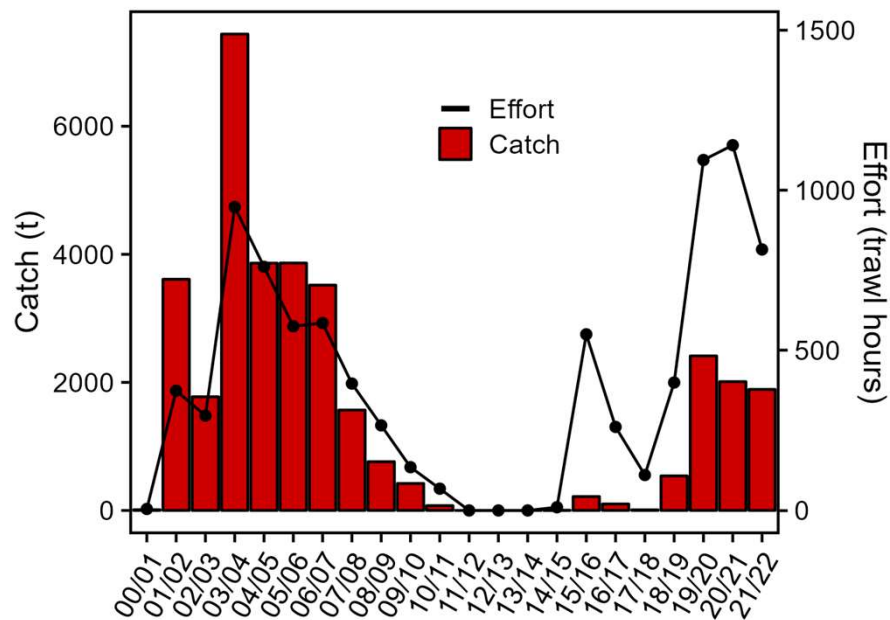
Source: AFMA SPF Species Summary 2021

Year (Source)	DEPM Spawning Biomass (95% CI)	2021/22 RBC (t)	2021/22 TAC (t)	2021/22 Catch (t)	Catch % Spawning Biomass	Catch % RBC	Catch % TAC
2019 (Sept)	80,000	12,000 t	11,400	SPF: 10,058	12.6%	83.8%	88.2%
(Ward et al. 2021)	88,265 t (33,320-143,209 t)			Total: 10,218 t	12.8%	85.2%	89.6%

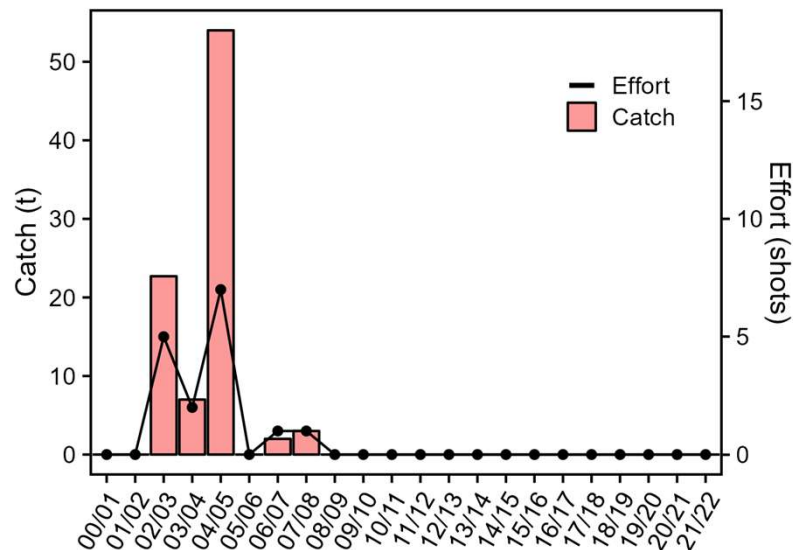
# Redbait: Eastern Sub-area



## Commonwealth: Trawl

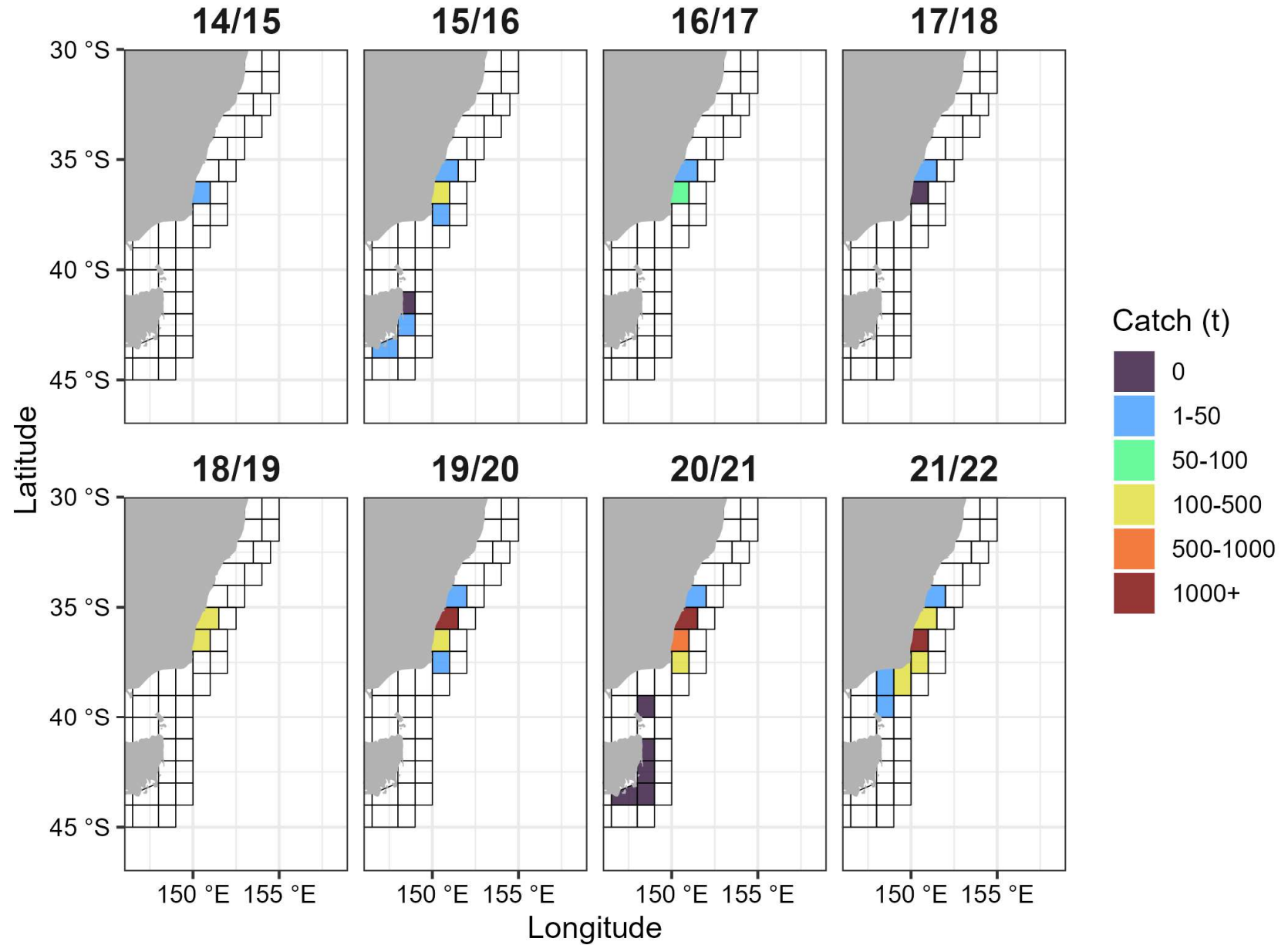
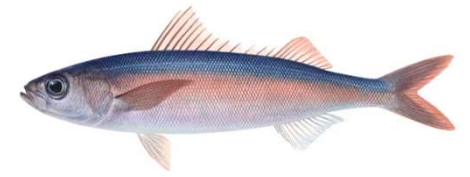


## Commonwealth: Purse-seine

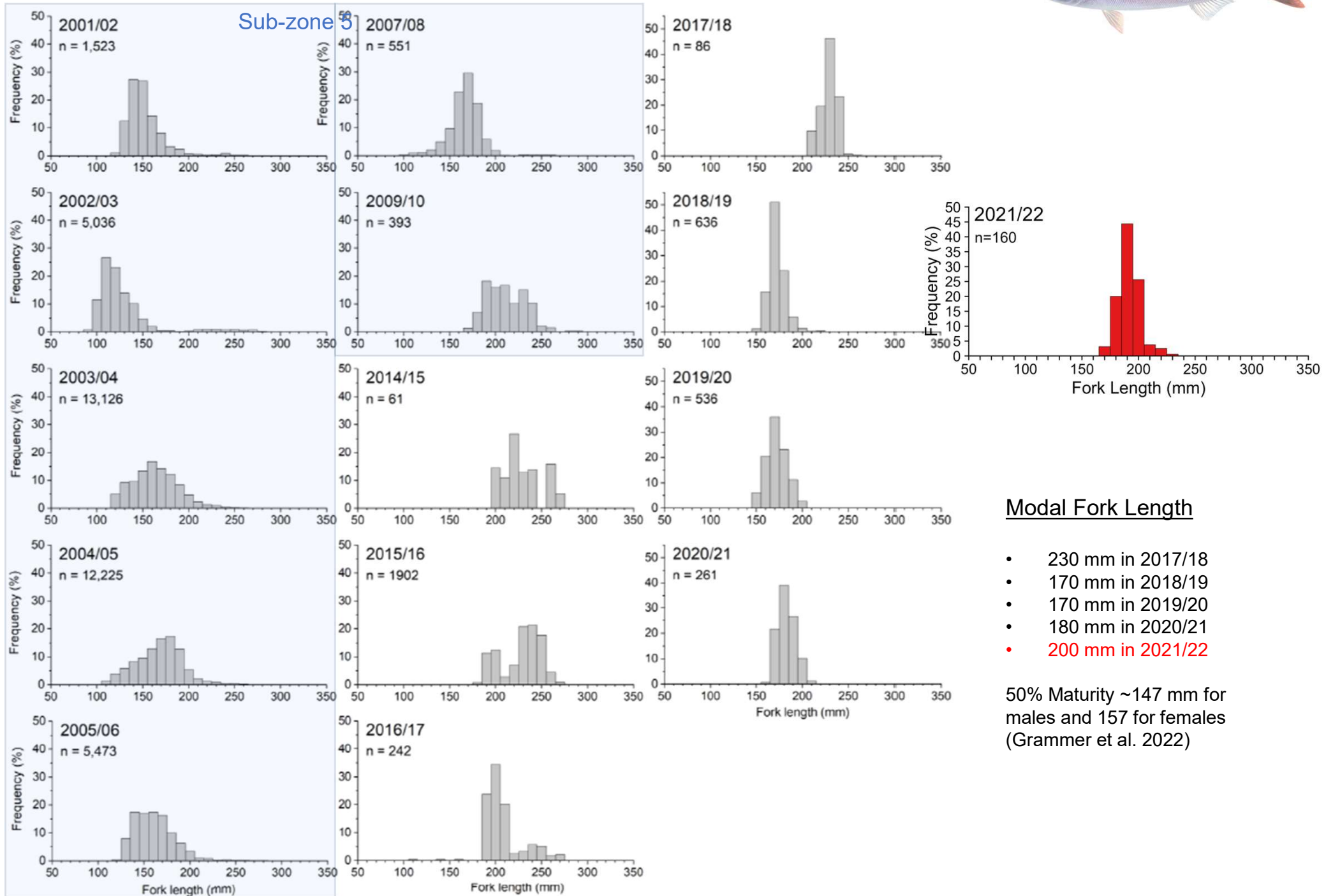
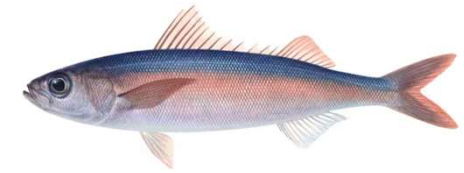


- Trawl catch peak of 7,733 t in 2003/04
- 2019/20: 2,457 t
- 2021/22: 1,890 t
- CPUE ~10 t.trawl hour<sup>-1</sup> in 2001/02
- CPUE in last three years ~2-3.5 t.trawl hour<sup>-1</sup>

# Redbait: Eastern Sub-area



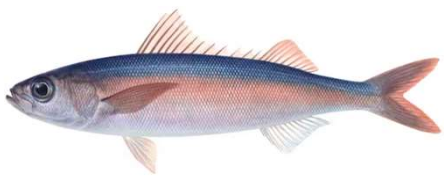
# Redbait: Eastern Sub-area (Sub-zone 6)



## Modal Fork Length

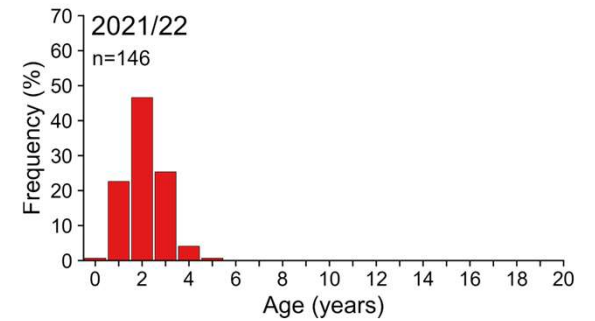
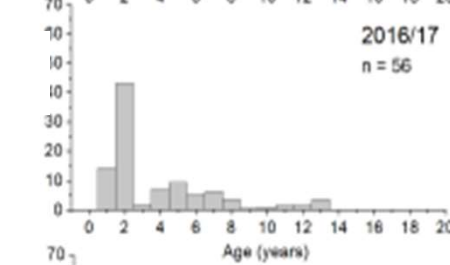
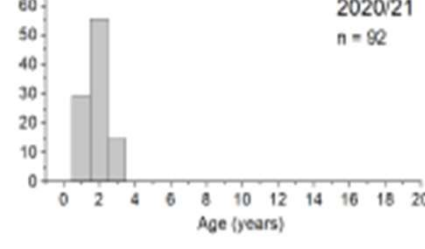
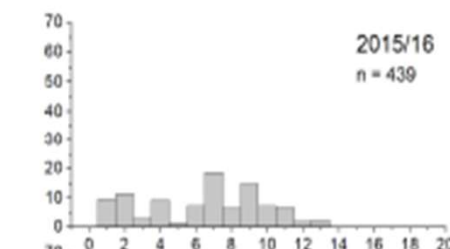
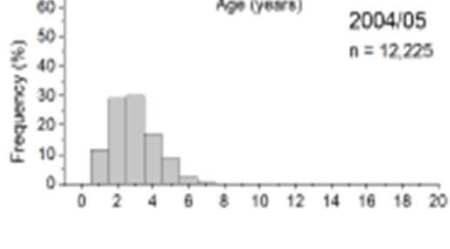
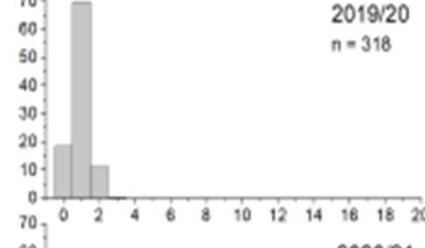
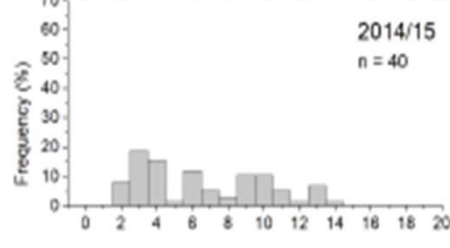
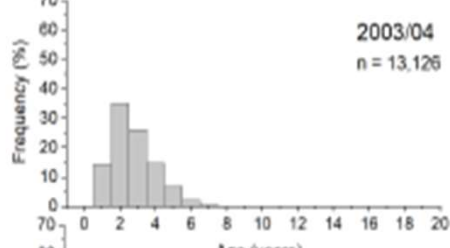
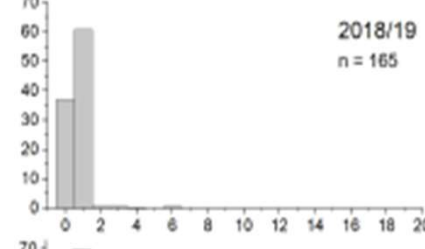
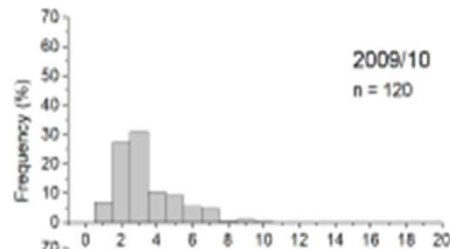
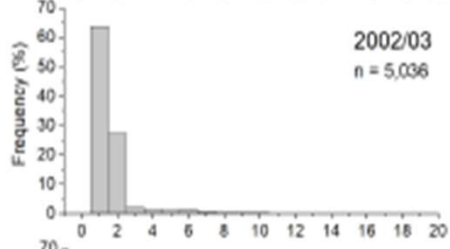
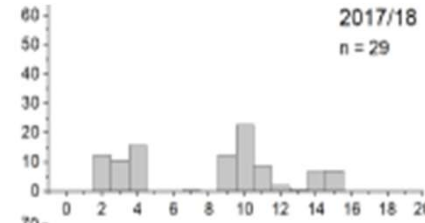
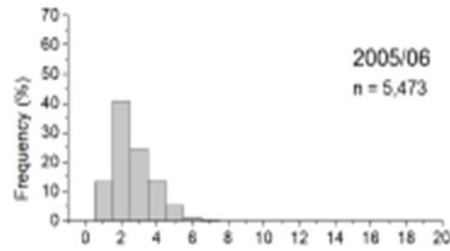
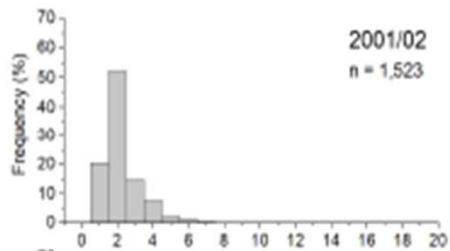
- 230 mm in 2017/18
- 170 mm in 2018/19
- 170 mm in 2019/20
- 180 mm in 2020/21
- 200 mm in 2021/22

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



# Redbait (East)

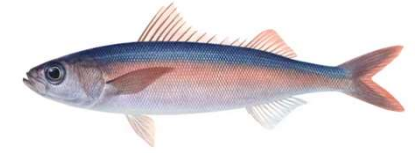
## Age frequency: mid-water trawl catch samples



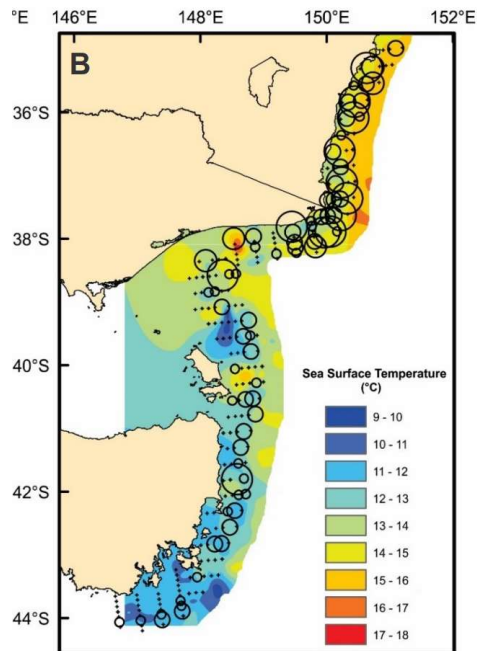
### Modal Ages

- 10 years in 2017/18
- 1 years in 2018/19
- 1 years in 2019/20
- 3 years in 2020/21
- 2 years in 2021/22

# 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

RAG Recommendations		
Recommended Biological Catch (RBC)	2022-23	1 <sup>st</sup> Season at Tier 1 54,000 x 10% = 5,400 tonnes

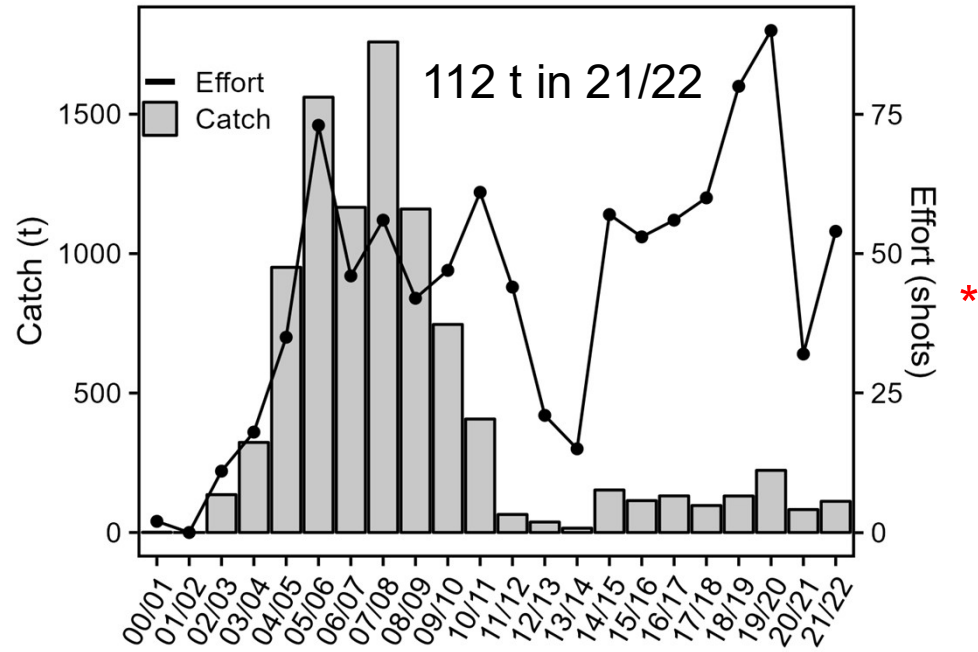
Source: AFMA SPF Species Summary 2022

Year (Source)	DEPM Spawning Biomass (95% CI)	2021/22 RBC (t)	2021/22 TAC (t)	2021/22 SPF Catch (t)	SPF Catch % Spawning Biomass	SPF Catch % RBC	SPF Catch % TAC
2020 (Oct)	52,629 t	5,400 t	5,370 t	1,890 t	3.6%	35.0%	35.2%
Grammer et al. (2022)	(13,937–91.321 t)						

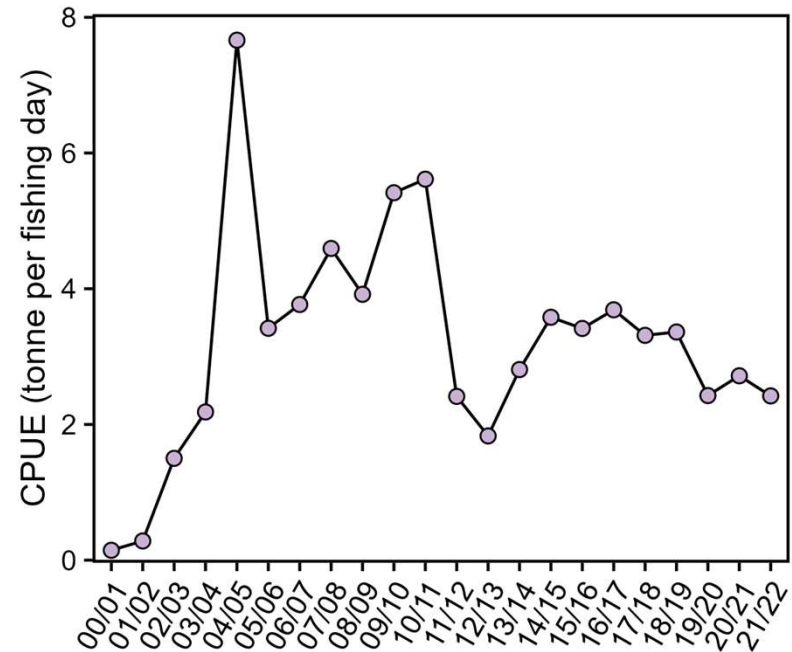
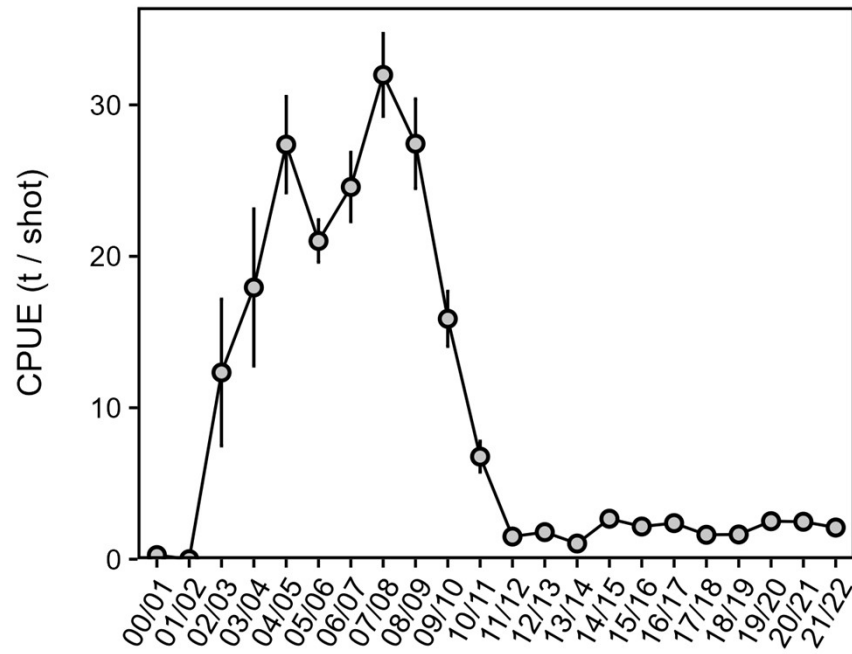
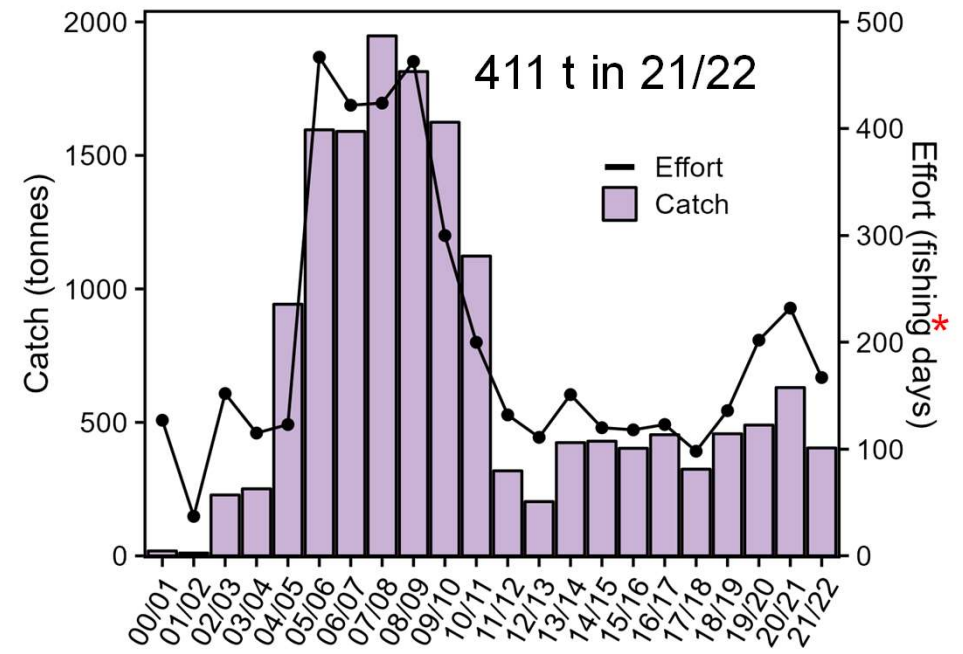


# Sardine: Sardine Sub-area

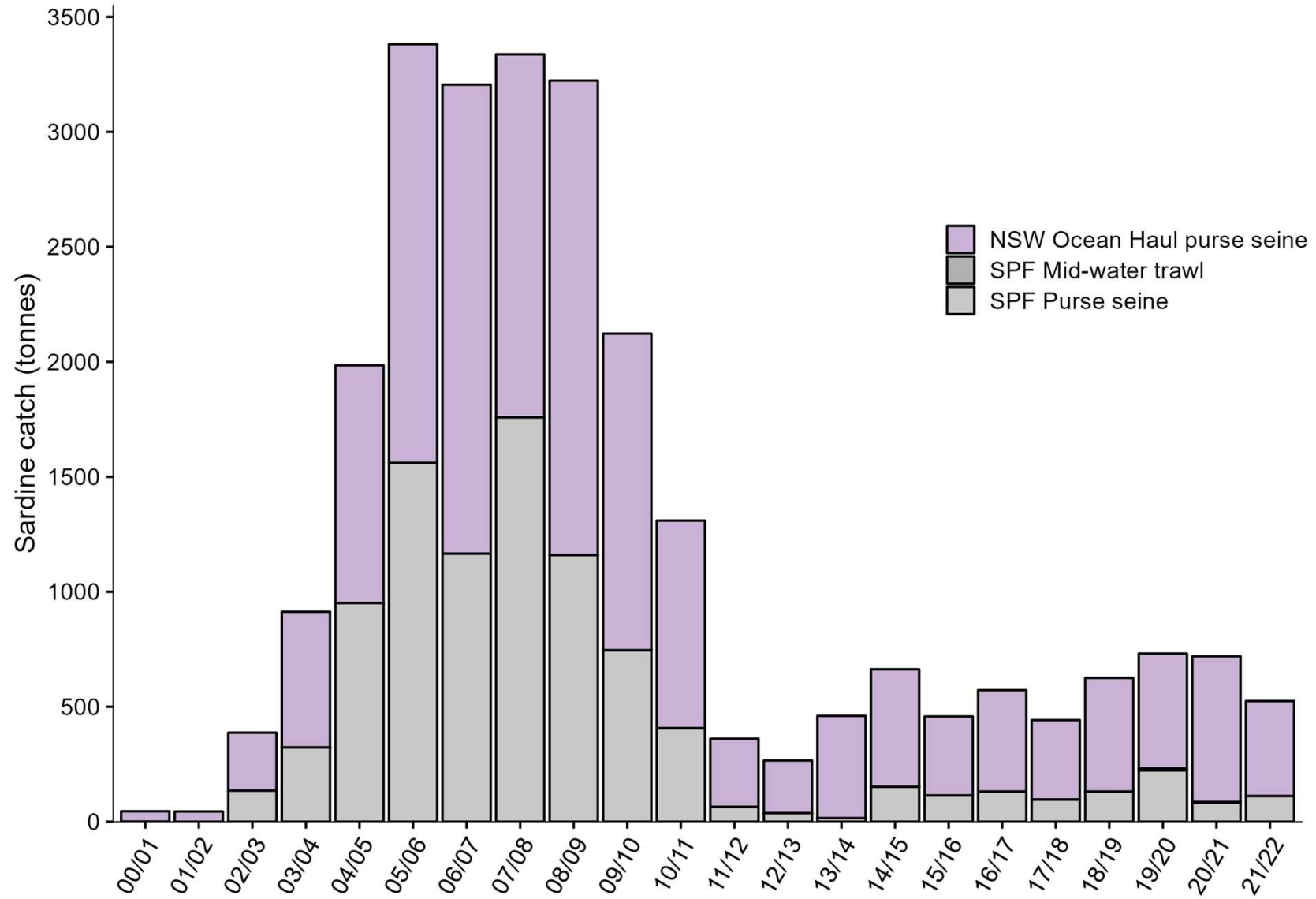
## Commonwealth: Purse-seine



## NSW: Purse-seine

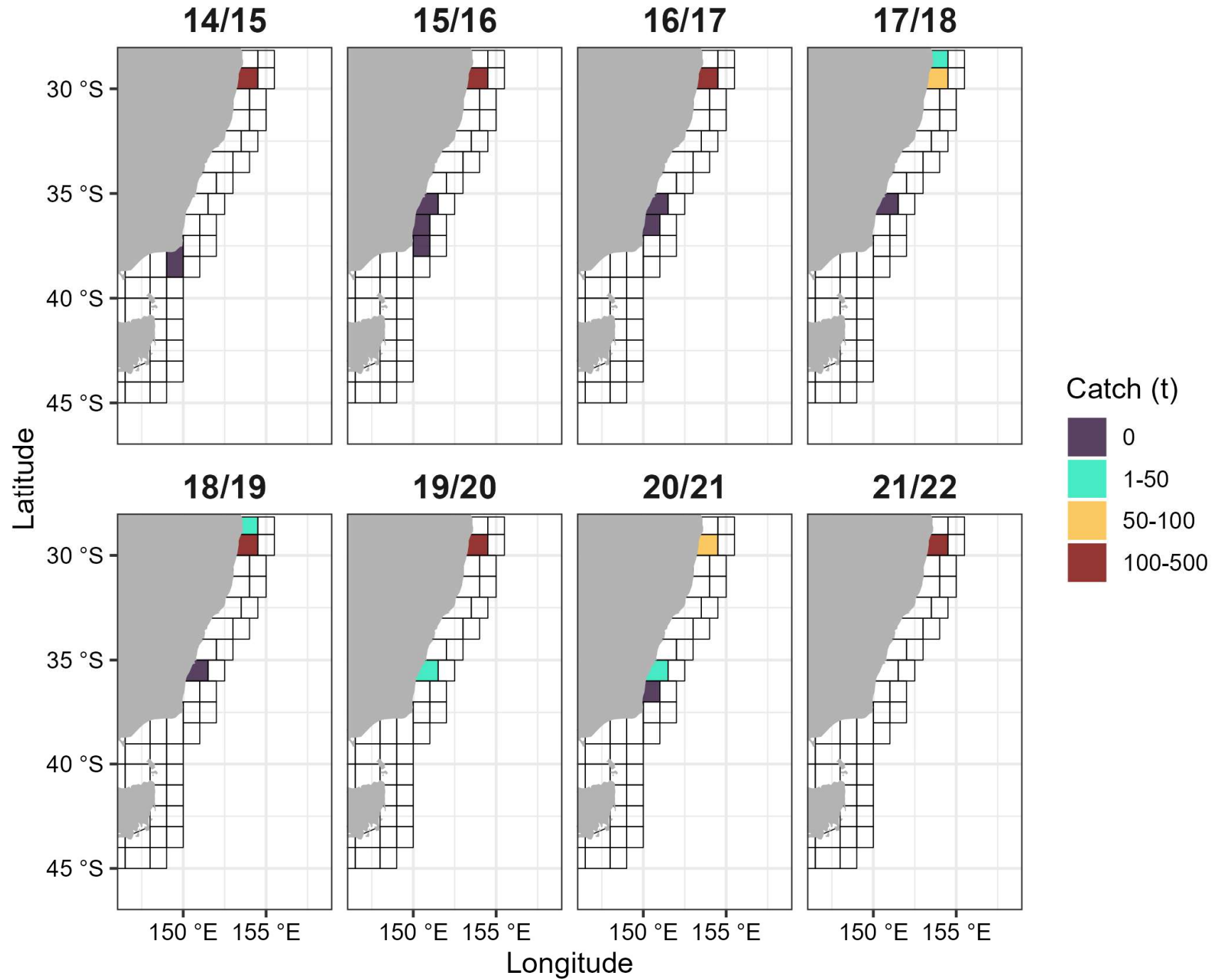


# Sardine: Sardine Sub-area

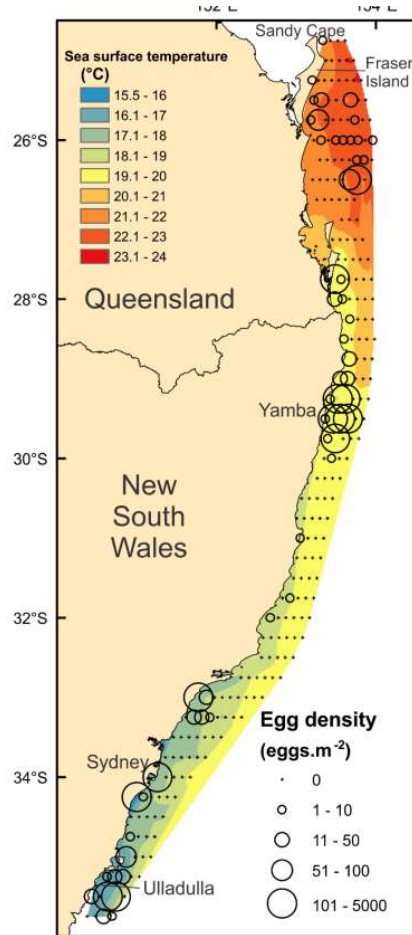


Total catch in 2021/22: 523 t

# 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:

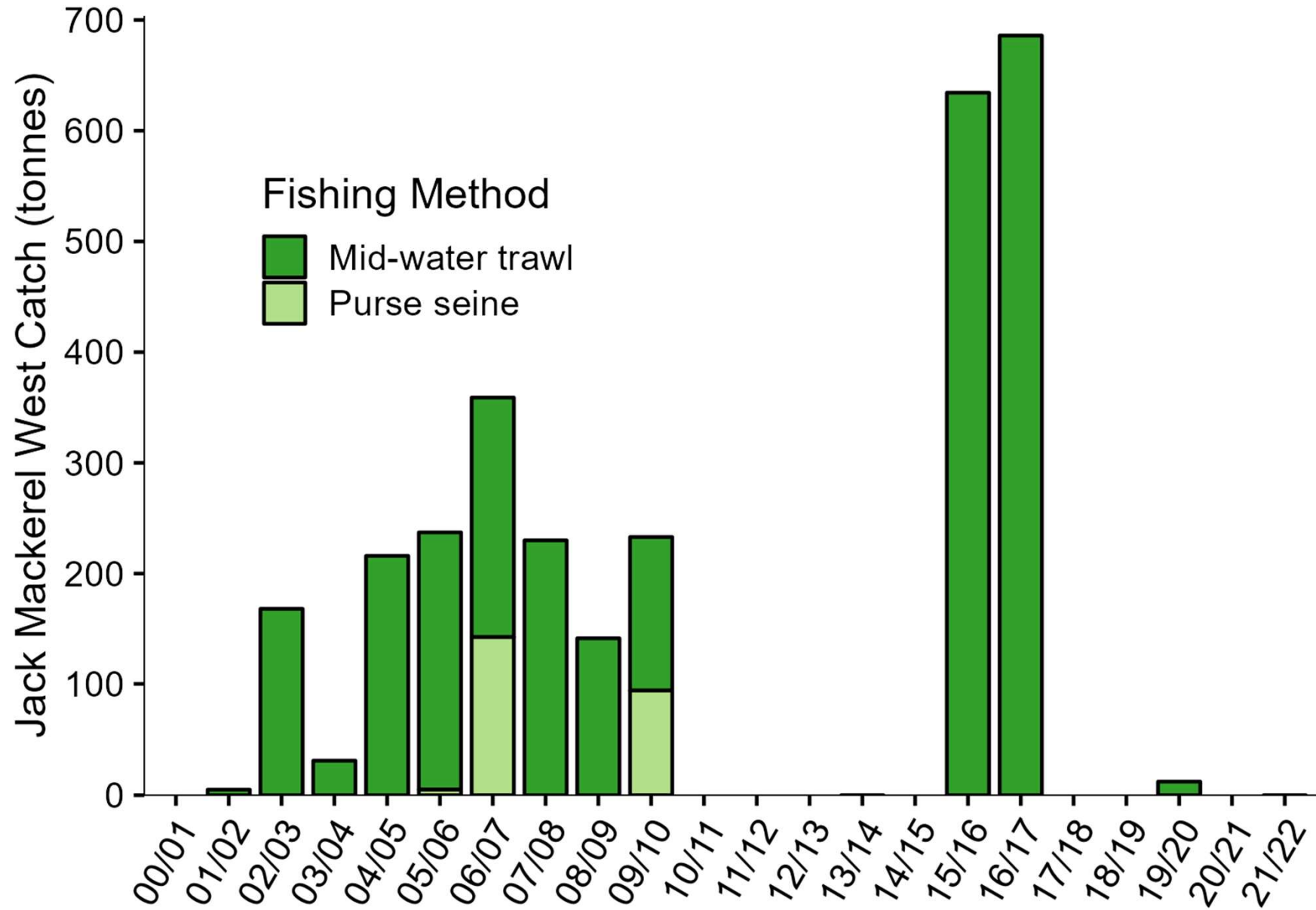
- Estimate adult reproductive parameters
- Understand lack of egg between 30°S and 33°S

RAG Recommendations		
Recommended Biological Catch (RBC)	2022-23	2 <sup>nd</sup> Season at Tier 1 (2019 DEPM estimate) 42,700 x 20% = <b>8,540 tonnes</b>

Source: AFMA SPF Species Summary 2022

Year (Source)	DEPM Spawning Biomass (95% CI)	2021/22 RBC (t)	2021/22 TAC (t)	2021/22 Catch (t)	Catch % Spawning Biomass	Catch % RBC	Catch % TAC
2019 (Sep)	42,724 t	8,540t	7,980 t	SPF: 112 t	0.3%	1.3%	1.4%
Ward et al. (2021)				Total: 523 t	1.2%	6.1%	6.6%

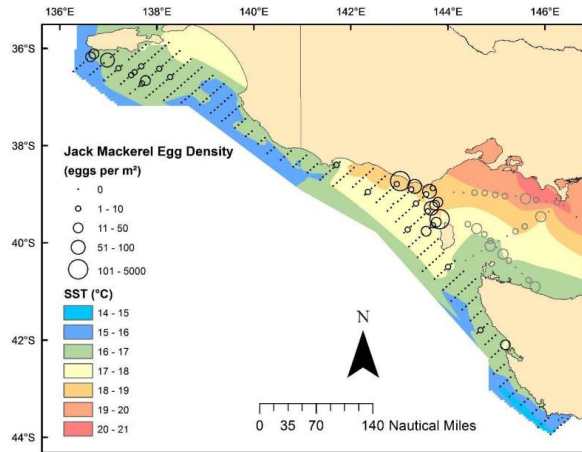
# Jack Mackerel: Western Sub-area



# 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:

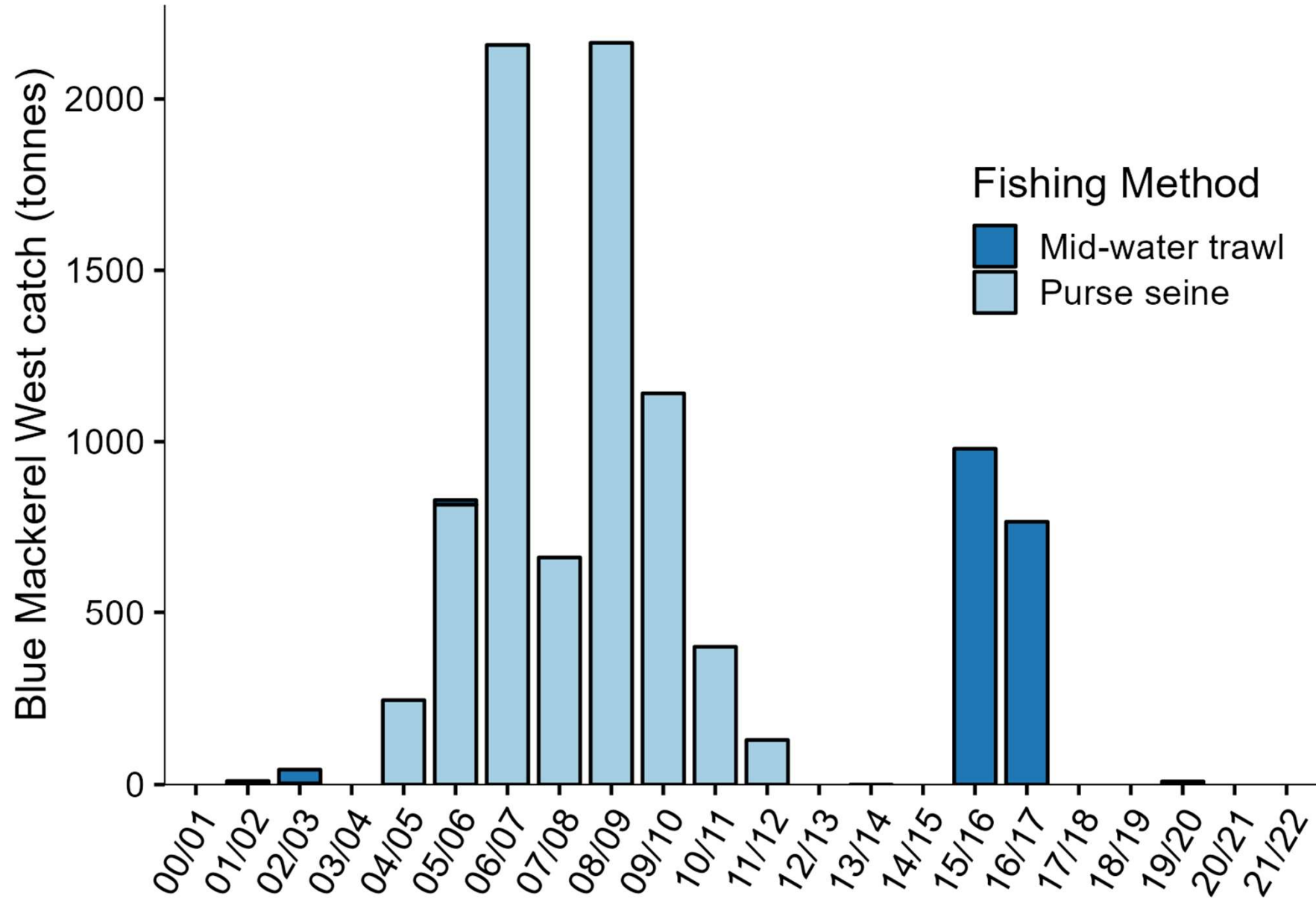
- Ensure future surveys include Bass Strait
- RAG recommended limiting catches off south-west coast of Kangaroo Island (G54, G55)

RAG Recommendations		
Recommended Biological Catch (RBC)	2022-23	5 <sup>th</sup> Season at Tier 1 35,000 x 12% = <b>4,200 tonnes</b>

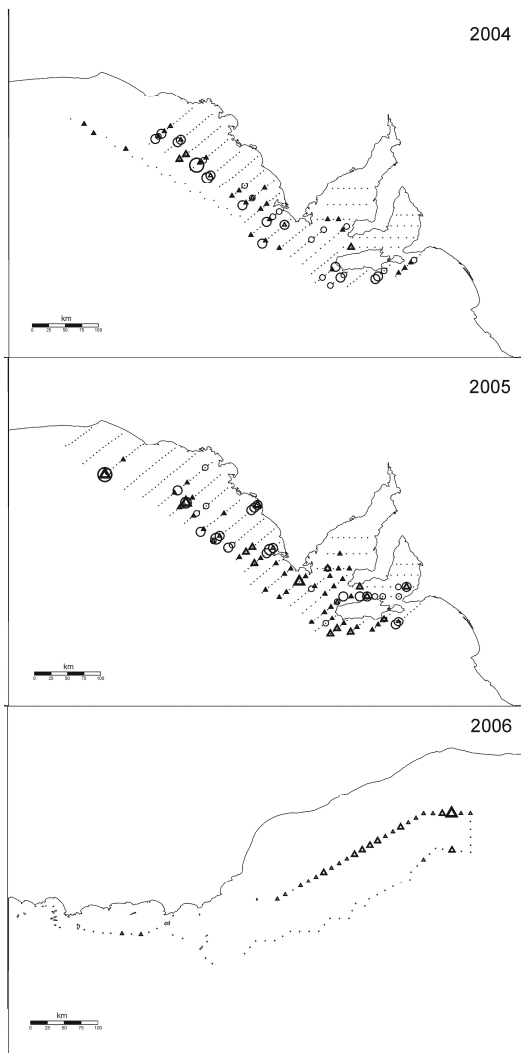
Source: AFMA SPF Species Summary 2022

Year (Source)	DEPM Spawning Biomass (95% CI)	2021/22 RBC (t)	2021/22 TAC (t)	2021/22 SPF Catch (t)	SPF Catch % Spawning Biomass	SPF Catch % RBC	SPF Catch % TAC
2016/17 (Dec-Feb)	34,978 t	4,200t	4,180 t	0 t	0%	0%	0%
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

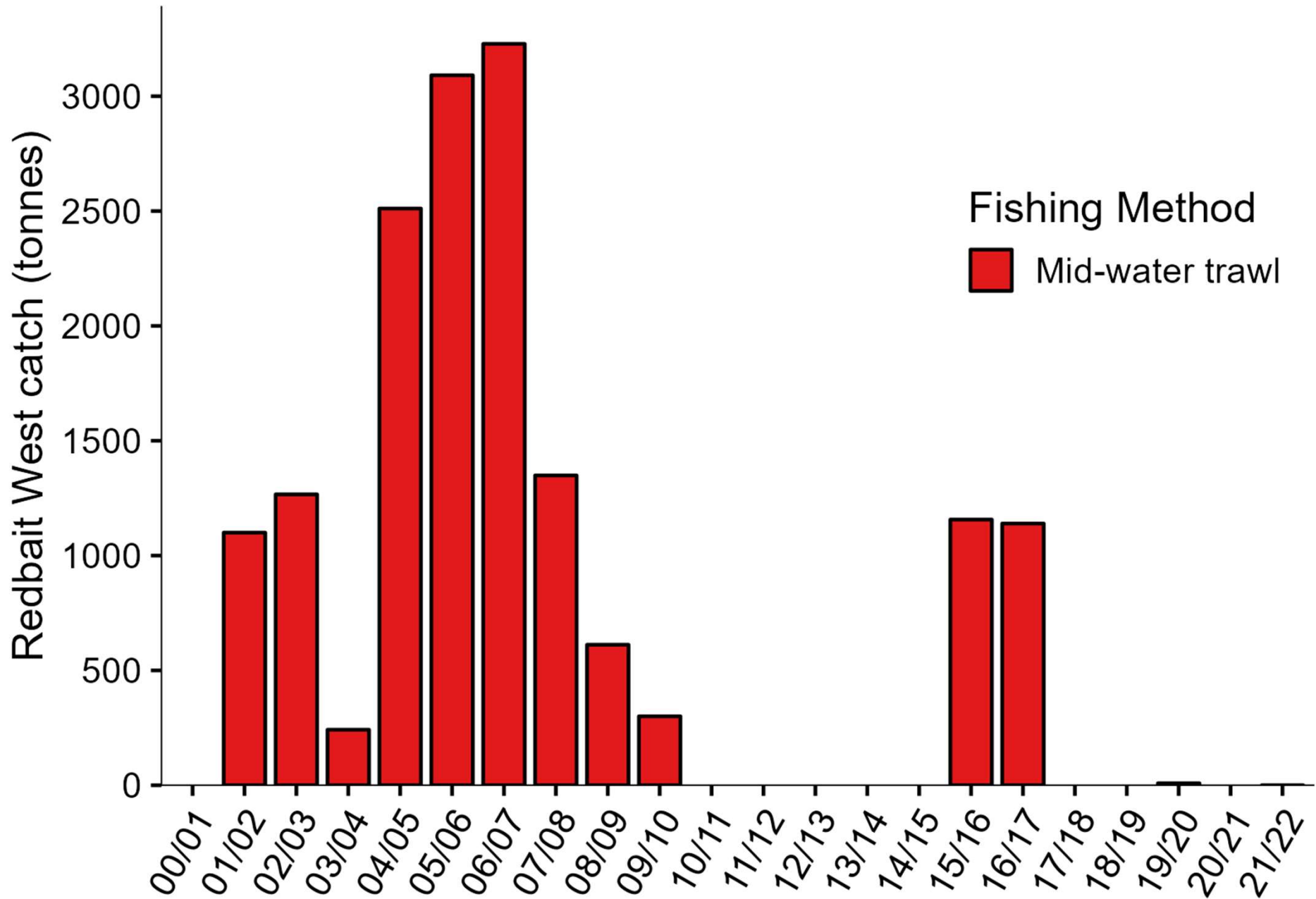
RAG Recommendations		
Recommended Biological Catch (RBC)	2022-23	6 <sup>th</sup> Season at Tier 3 86,500 x 3.75% = <b>3,243 tonnes</b>

Year (Source)	DEPM Spawning Biomass (95% CI)	2021/22 RBC (t)	2021/22 TAC (t)	2021/22 SPF Catch (t)	SPF Catch % Spawning Biomass	SPF Catch % RBC	SPF Catch % TAC
2006	86,500 t	3,243t	3,210 t	0 t	0%	0%	0%

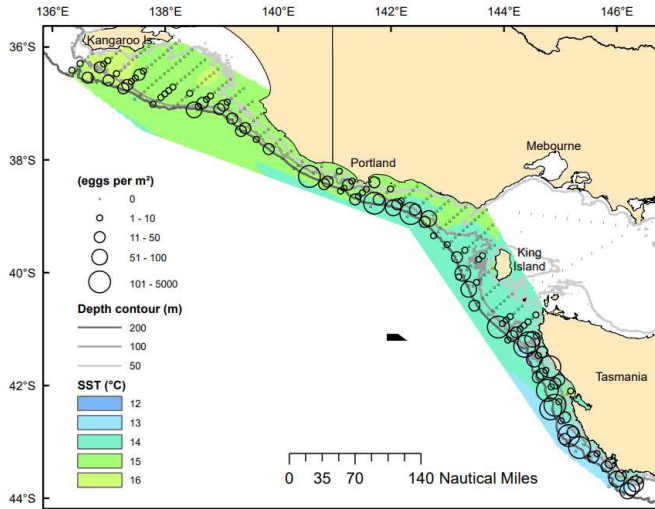
Ward et al.  
(2007, 2009)



# 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

RAG Recommendations		
Recommended Biological Catch (RBC)	2022-23	4 <sup>th</sup> season at Tier 1 66,800 x 10% = 6,680 tonnes

Year (Source)	DEPM Spawning Biomass (95% CI)	2021/22 RBC (t)	2021/22 TAC (t)	2021/22 SPF Catch (t)	SPF Catch % Spawning Biomass	SPF Catch % RBC	SPF Catch % TAC
2017 (Oct)	66,787 t	6,680t	6,680 t	0 t	0%	0%	0%

Ward et al.  
(2019)