

Western Australian Marine Stewardship Council Report Series

West Coast Estuarine Managed Fishery (Area 2: Peel-Harvey Estuary) & Peel-Harvey Estuary Blue Swimmer Crab Recreational Fishery

Addendum 2

May 2018

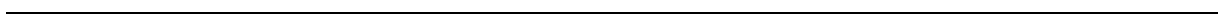


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Background

The West Coast Estuarine Managed Fishery (WCEMF) Area 2 (Peel-Harvey Estuary) uses haul and gillnets to target predominantly sea mullet (*Mugil cephalus*), and crab traps to target blue swimmer crabs (*Portunus armatus*). The recreational crab fishers in the Peel-Harvey Estuary primarily use drop and scoop nets for catching blue swimmer crabs.

The fisheries achieved Marine Stewardship Council (MSC) certification in 2016 and the assessment was based on information presented in Johnston et al. (2015):

http://www.fish.wa.gov.au/Documents/wamsc_reports/wamsc_report_no_3.pdf

This report is the second addendum to Johnston et al. (2015) and provides catch and effort information for the 2016 fishing season in the Peel-Harvey Estuary. It also provides updates on progress made to date to address the MSC conditions placed on the fisheries for the criteria where the standard was not quite achieved.

MSC Principle 1

1. Current Stock Status

The sea mullet and blue swimmer crab stocks targeted by fishers in the Peel-Harvey Estuary are assessed annually using a weight-of-evidence approach that considers all available information (see Wise et al. 2007). This approach is primarily based on evaluating standardised commercial catch rates (primary performance indicator) and catches (secondary performance indicator) of both species in the WCEMF Area 2, relative to reference points calculated based on a reference period in which these indicators have been stable (see Department of Fisheries 2015a, b). Overall weight-of-evidence assessments also consider any additional fishery-independent and fishery-dependent information where available.

1.1 Sea Mullet

After concerns that the original catch rate standardisation for sea mullet (based on “100 m netting hours” as the measure of fishing effort) could be inaccurate, both the original and an updated time series of catch rates (based on fishing days) are now simultaneously monitored against their respective reference levels (Table 1.1). This will continue until the first version of the harvest strategy for the Peel-Harvey finfish resource (2015-2020) is formally reviewed and the indicators can be updated. The review will also take into account the results of a mortality-based assessment of the sea mullet stock, for which age composition samples are currently being collected (see below).

Table 1.1. Catch rate reference points for sea mullet in the Peel-Harvey Estuary based on original catch rate standardisation (kg/100 m netting hour) and the updated standardised catch rate (kg/fishing day).

Reference point	Original catch rate	Updated catch rate
Target	3.4 kg/100 m netting hour	103 kg/day
Upper Threshold	4.6 kg/100 m netting hour	136 kg/day
Lower Threshold	2.2 kg/100 m netting hour	69 kg/day
Limit	1.6 kg/100 m netting hour	49 kg/day

The two time series of standardised catch rates for sea mullet both show a recent increase to above their respective upper threshold level (Figure 1.1-Figure 1.2). The updated 2016 catch rate of 141 kg/day was only slightly above the upper threshold of 136 kg/day, whilst the old catch rate of 8.9 kg/100 m netting hour was well above the 4.6 kg/100 m netting hour threshold level. The commercial sea mullet catch also shows an increasing trend and although the 2016 catch of 86 t was a slight reduction from the previous year, it was well above the upper threshold value of 70 t (Figure 1.3). This follows an increase in haul netting effort over recent years (Figure 1.4), likely reflecting an increased targeting of sea mullet following the MSC certification of the fishery.

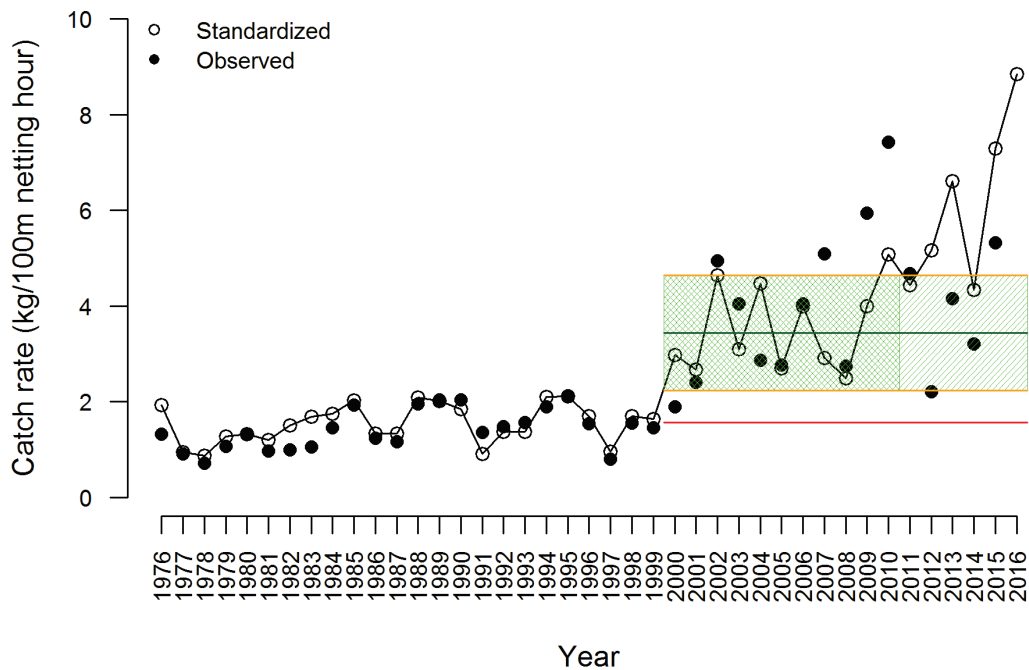


Figure 1.1. Time series of annual standardised commercial catch rate (kg/100 m netting hour) for sea mullet in the Peel-Harvey Estuary net fishery, based on original catch rate standardisation, relative to the original target (green range), threshold (orange line) and limit (red line) reference levels outlined in the Finfish Resources of the Peel-Harvey Estuary Harvest Strategy 2015-2020 (see Table 1.1).

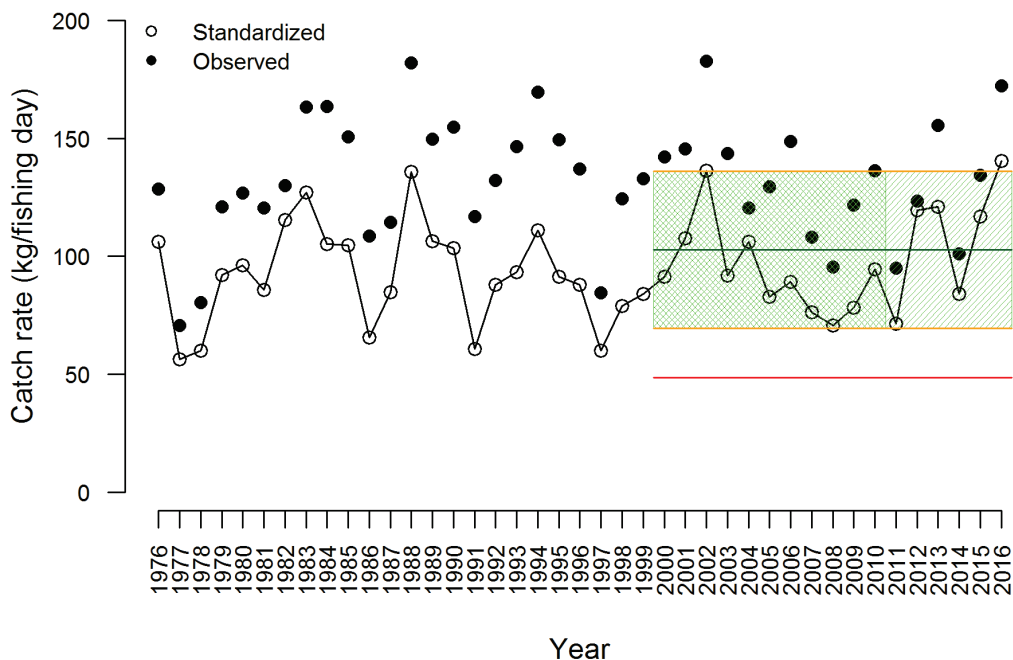


Figure 1.2. Time series of annual standardised commercial catch rate (kg/day) for sea mullet in the Peel-Harvey Estuary net fishery, based on an updated catch rate standardisation, relative to the new target (green range), threshold (orange line) and limit (red line) reference levels (see Table 1.1).

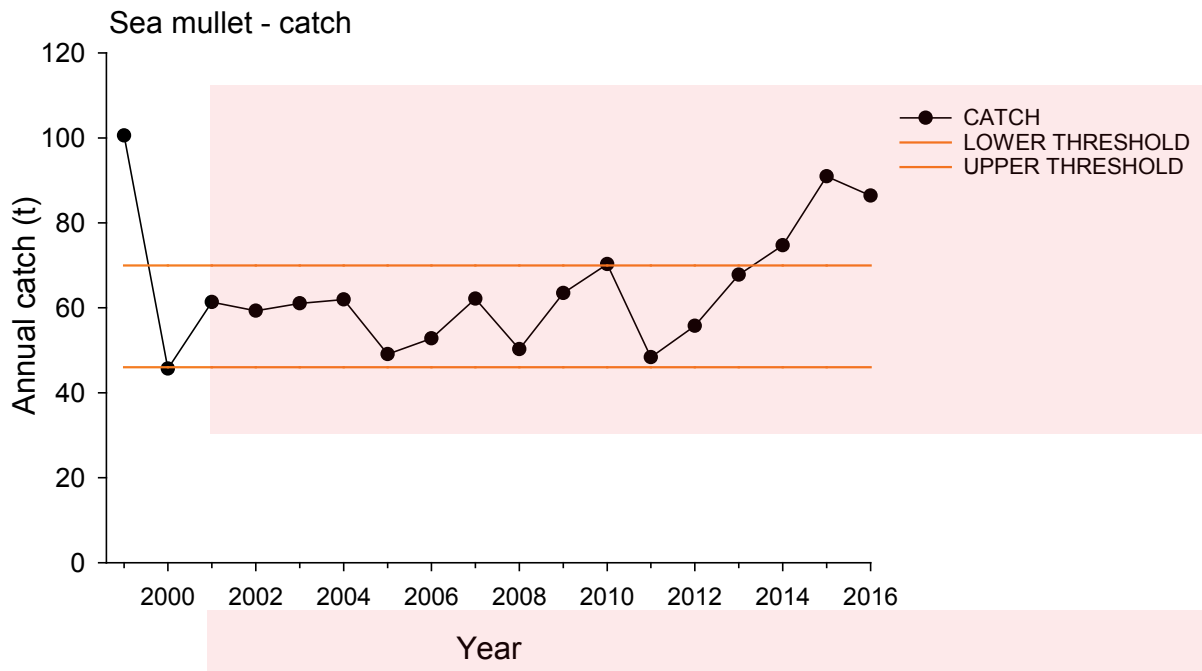


Figure 1.3. Annual commercial catch (tonnes) of sea mullet in the Peel-Harvey Estuary haul and gillnet fishery relative to the associated harvest strategy reference points.

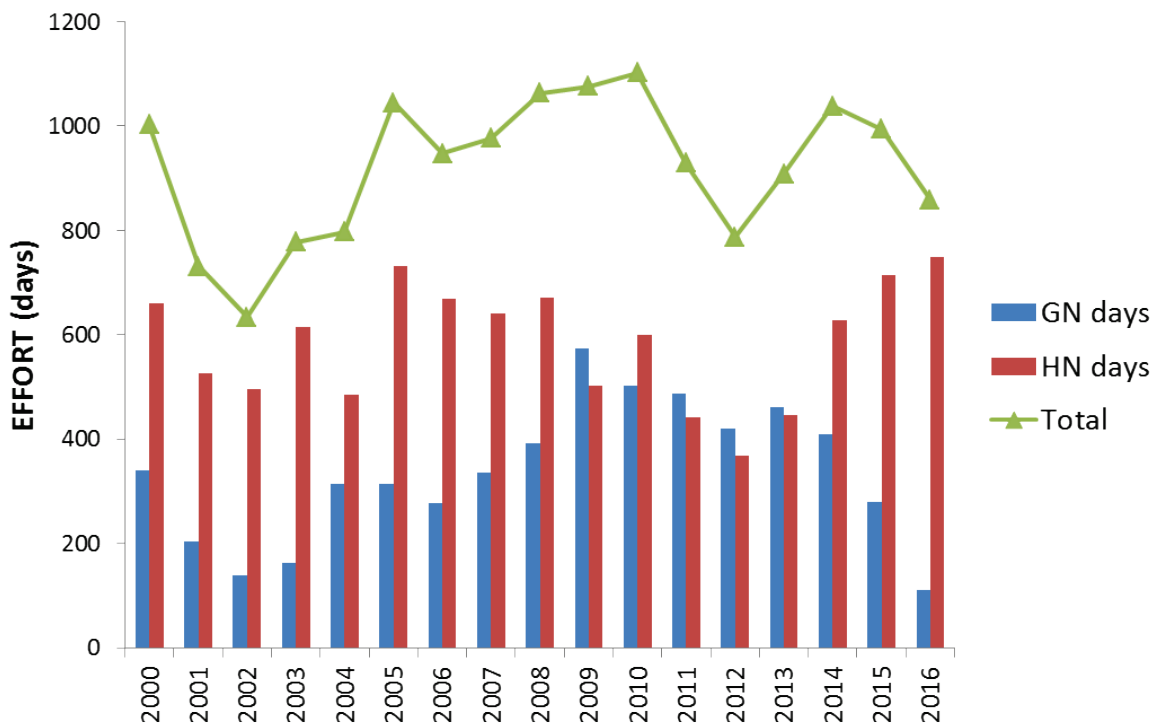


Figure 1.4. Annual nominal commercial netting effort (haul net and gill net days) in the Peel-Harvey Estuary fishery between 2000 and 2016.

Although the increasing trends in both sea mullet catch rates and catches indicate that the stock level is currently adequate, the recent breaches of the upper threshold levels have triggered a review of the risk to the sustainability of the stock. A Level 3 (catch curve and per-recruit) assessment is expected to be completed in 2019, with the first year of age composition samples from both estuarine and oceanic waters now collected. The outputs from this assessment will be used to inform sustainable harvest levels of this species for the next version of the harvest strategy.

1.2 Blue Swimmer Crab

The standardised commercial catch rate for blue swimmer crabs during the 2016/17 fishing season (1 November 2016 to 31 August 2017) of 0.9 kg/traplift was a slight increase from the previous year¹. This is above the harvest strategy threshold of 0.7 kg/traplift (Figure 1.5a), which indicates that the stock has been fished at sustainable levels. The annual commercial crab catch declined slightly from 58 t in 2015/16 to 55 t in 2016/17 but remained within the target range of 45-104 t (Figure 1.5b). As both performance indicators have remained within their respective target ranges, no changes to management were required for the 2017/18 season.

The estimated boat-based recreational catch of blue swimmer crabs in the West Coast Bioregion in 2015/16 (95% CI 36-50 t) was lower than the 2013/14 survey estimate of 50-68 t and the 2011/12 estimate of 75-97 t (Ryan et al. 2017). Finer-scale boat-based catch estimates for the Peel-Harvey Estuary from the 2015/16 data are currently being explored but are not yet available. From the total Statewide catch of blue swimmer crabs by recreational boat-based fishers (95% CI 38-56 t in 2015/16), around 50-70% is typically taken in the Peel-Harvey Estuary. Although shore-based catch information is more limited, the survey since 2015/16 allows for some data on shore-based fishing undertaken by (licensed) boat-based recreational fishers to be obtained.

Additional data collected by fishery-dependent and fishery-independent monitoring in the Peel-Harvey Estuary indicate that the recent below-average commercial catch and catch rates of blue swimmer crabs have been driven mainly by environmental conditions, including extreme rainfall events and subsequent cold water temperatures observed during autumn and winter (Figure 1.6). As was also evident in 2015/16, a high abundance of sub-legal crabs in the estuary (see below) suggests growth of crabs may also have been negatively affected by the cooler water temperatures.

¹ Note that the 2015/16 catch rate value presented last year has been revised after correcting a small error in the data analysis. The correct value for the 2015/16 fishing season is 0.85 kg/traplift.

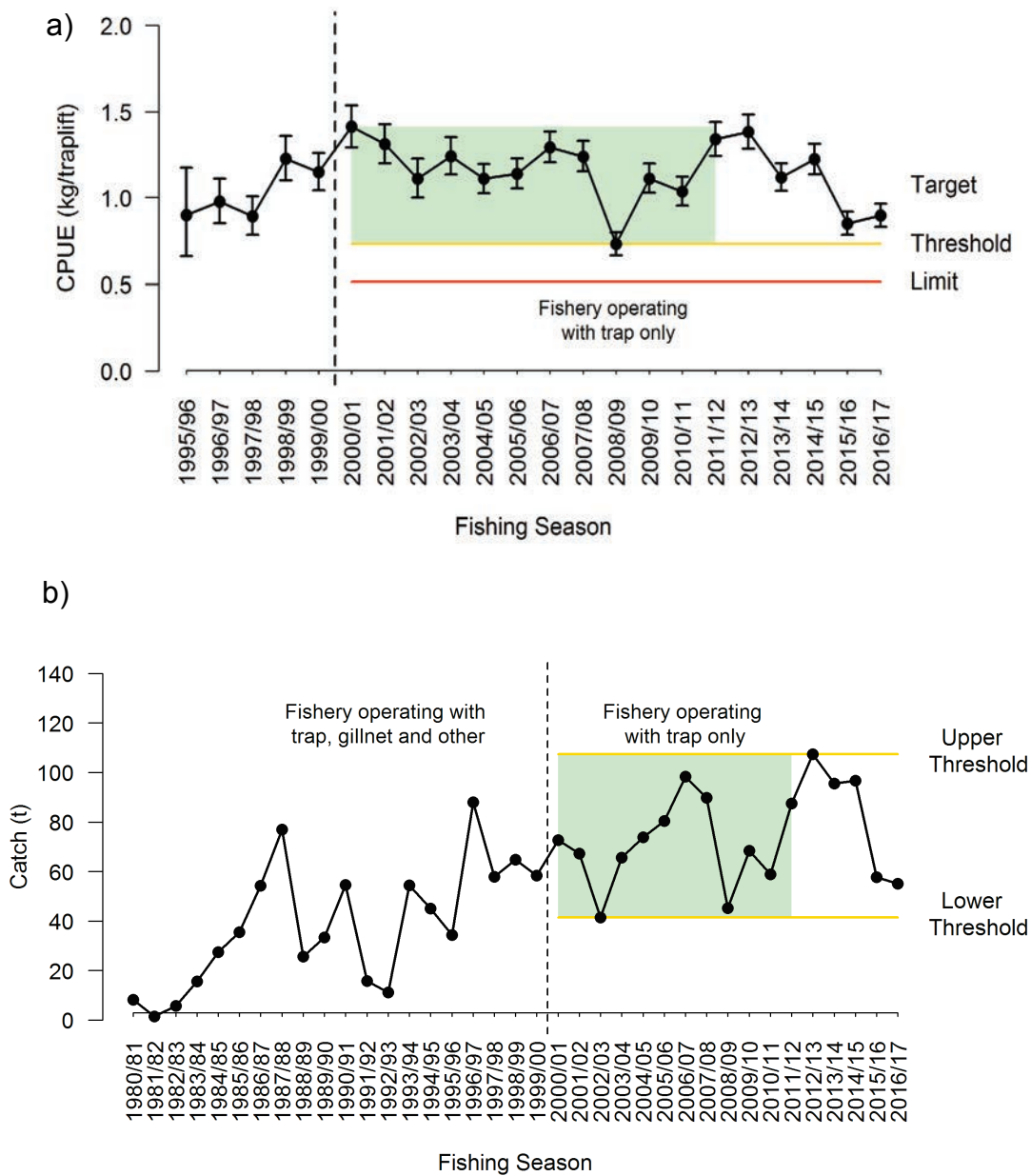


Figure 1.5. Annual (a) standardised commercial catch rate (kg/traplift, $\pm 95\%$ CIs) and (b) commercial catch (t) of blue swimmer crabs in the Peel-Harvey Estuary fishery relative to target (green range), threshold (orange line) and limit (red line) reference levels. The reference period from 2000/01 to 2011/12 is defined as the period where the fishery was operating with traps only and for which the fishery was operating normally following the transition from gillnets in the late 1990s.

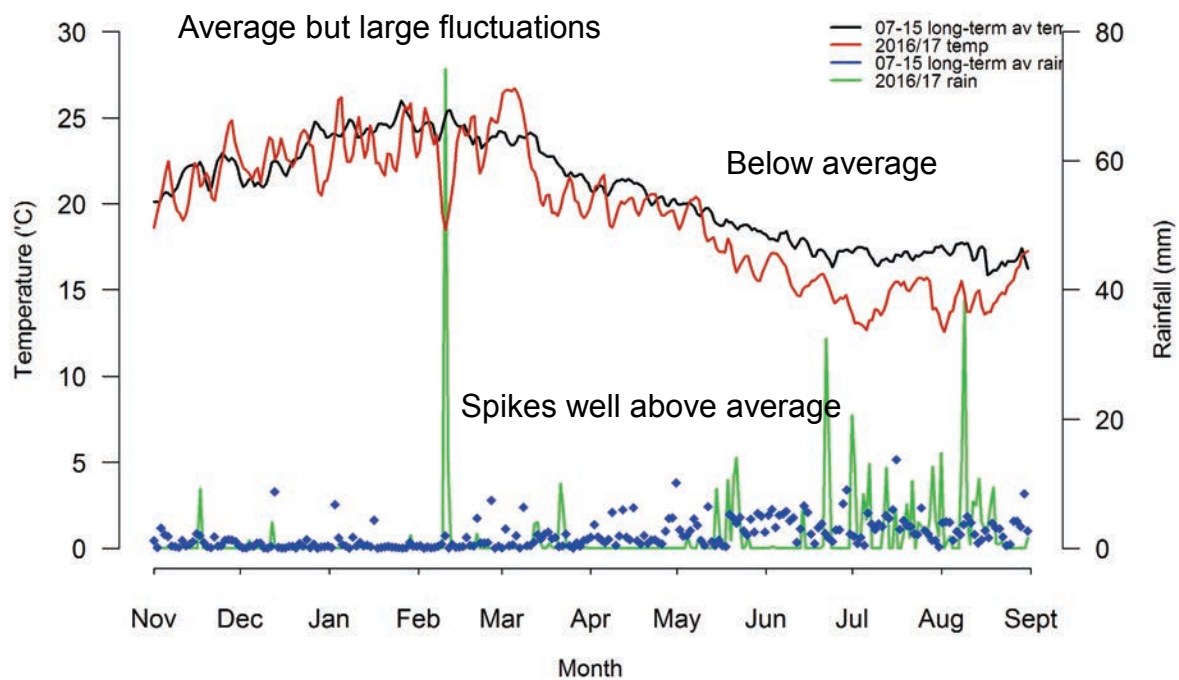


Figure 1.6. Patterns of water temperature and rainfall in the Peel-Harvey Estuary in 2016/17 relative to the long-term (2007-2015) average trends. Rainfall Sourced from Bureau of Meteorology Mandurah Station.

Monthly commercial trap monitoring of blue swimmer crab length frequencies in 2016/17 shows that males dominate the catch between November and April (Figure 1.7). Large females dominated catches in May but were only caught in lower numbers over the winter months due to rain flushing crabs out of the estuary. Fishery-independent surveys using research traps (without the escape gaps used in commercial trap to minimise captures of undersize crabs) show a dominance of sub-legal crabs between June and November (Figure 1.8). The large proportion of sub-legal crabs in the Peel-Harvey Estuary is also evident from trawl surveys undertaken in 2017 (Figure 1.9).

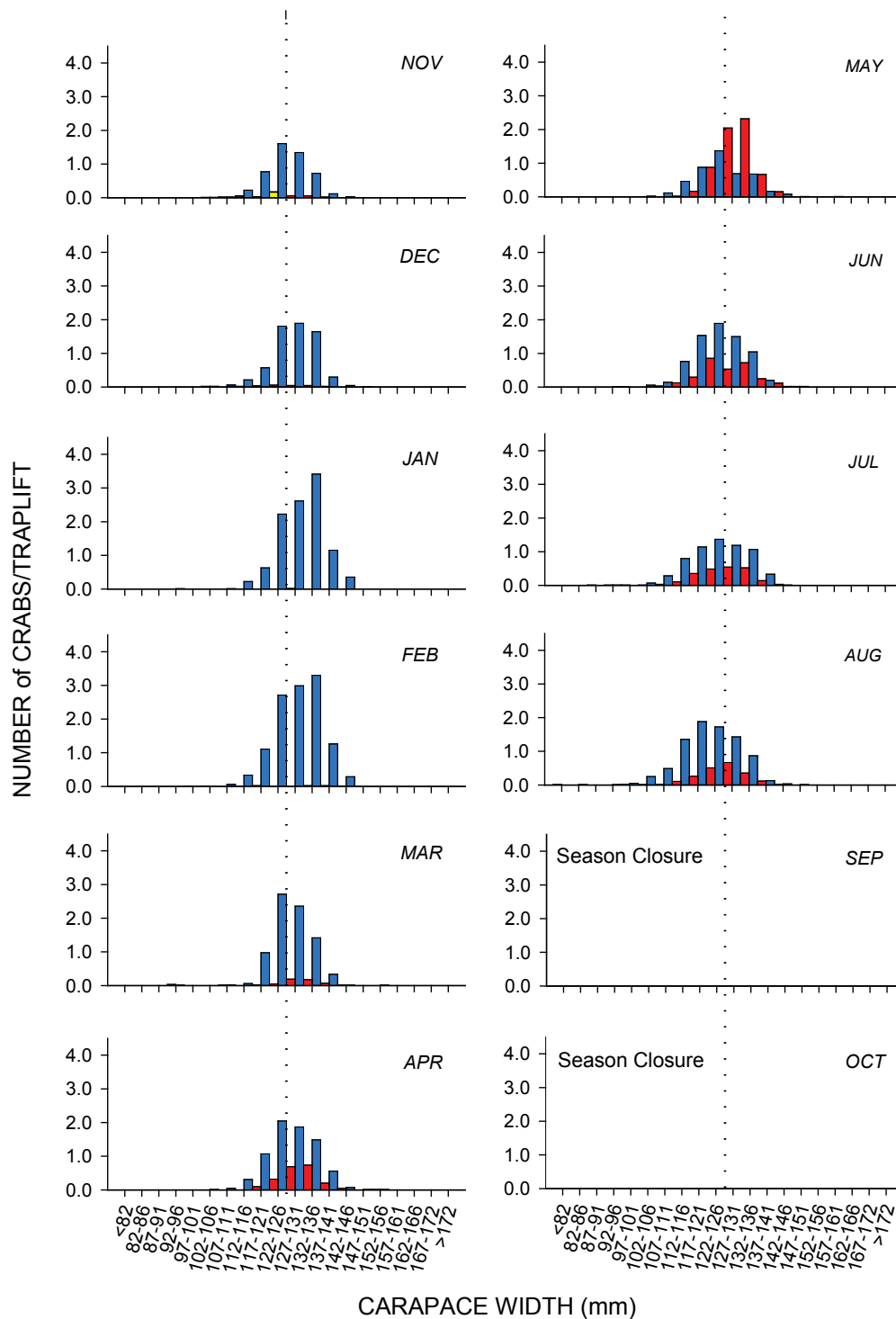


Figure 1.7. Monthly length frequencies of commercial trap catches of male (blue), female (red) and juvenile (yellow) blue swimmer crabs in the Peel-Harvey Estuary during the 2016/17 fishing season (1 November – 31 August). The minimum commercial size limit of 127 mm carapace width is indicated by the vertical dashed lines.

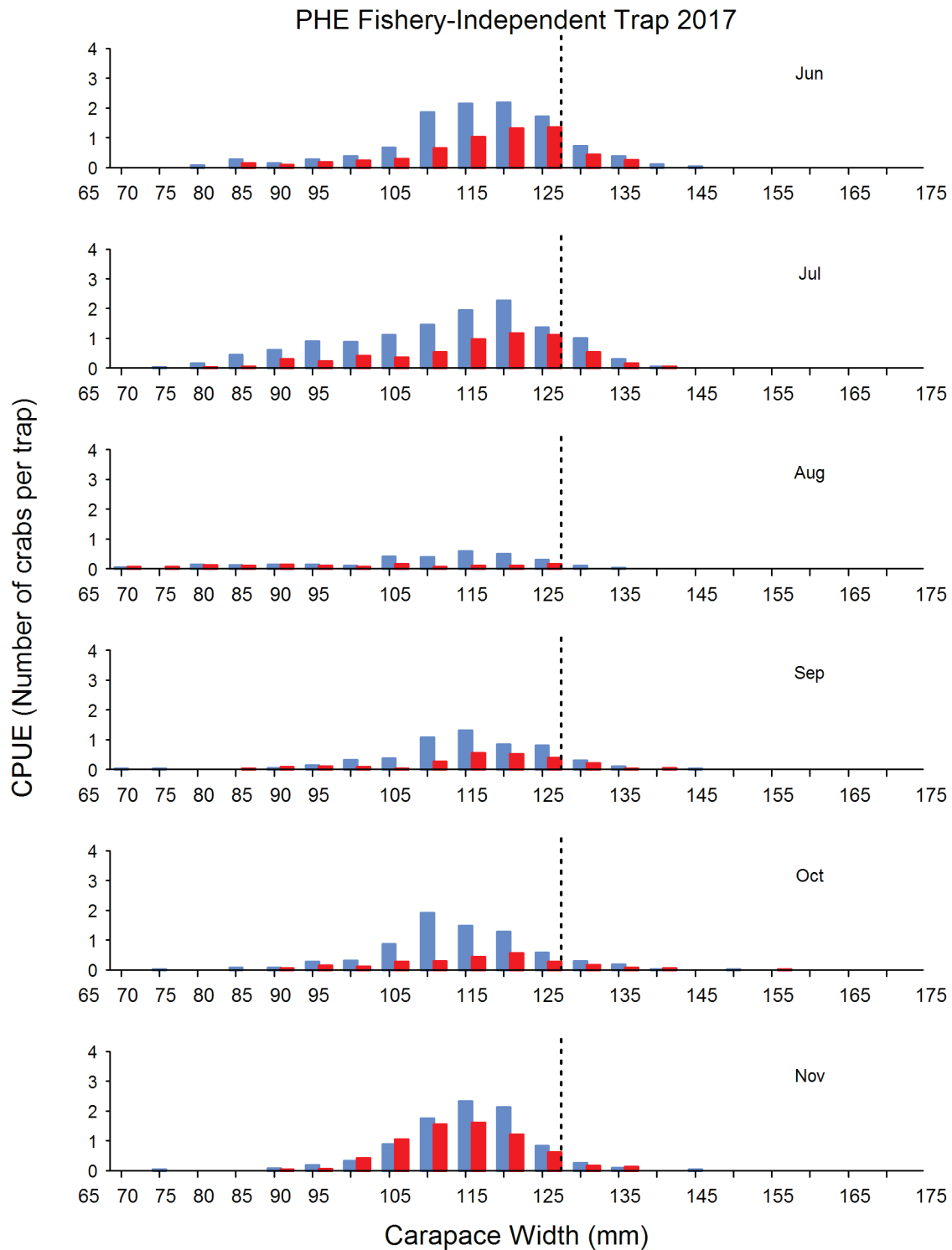


Figure 1.8. Monthly length frequencies of fishery-independent trap catches of male (blue), female (red) and berried (yellow) blue swimmer crabs in the Peel-Harvey Estuary between June and November 2017. The minimum commercial size limit of 127 mm carapace width is indicated by the vertical dashed lines.

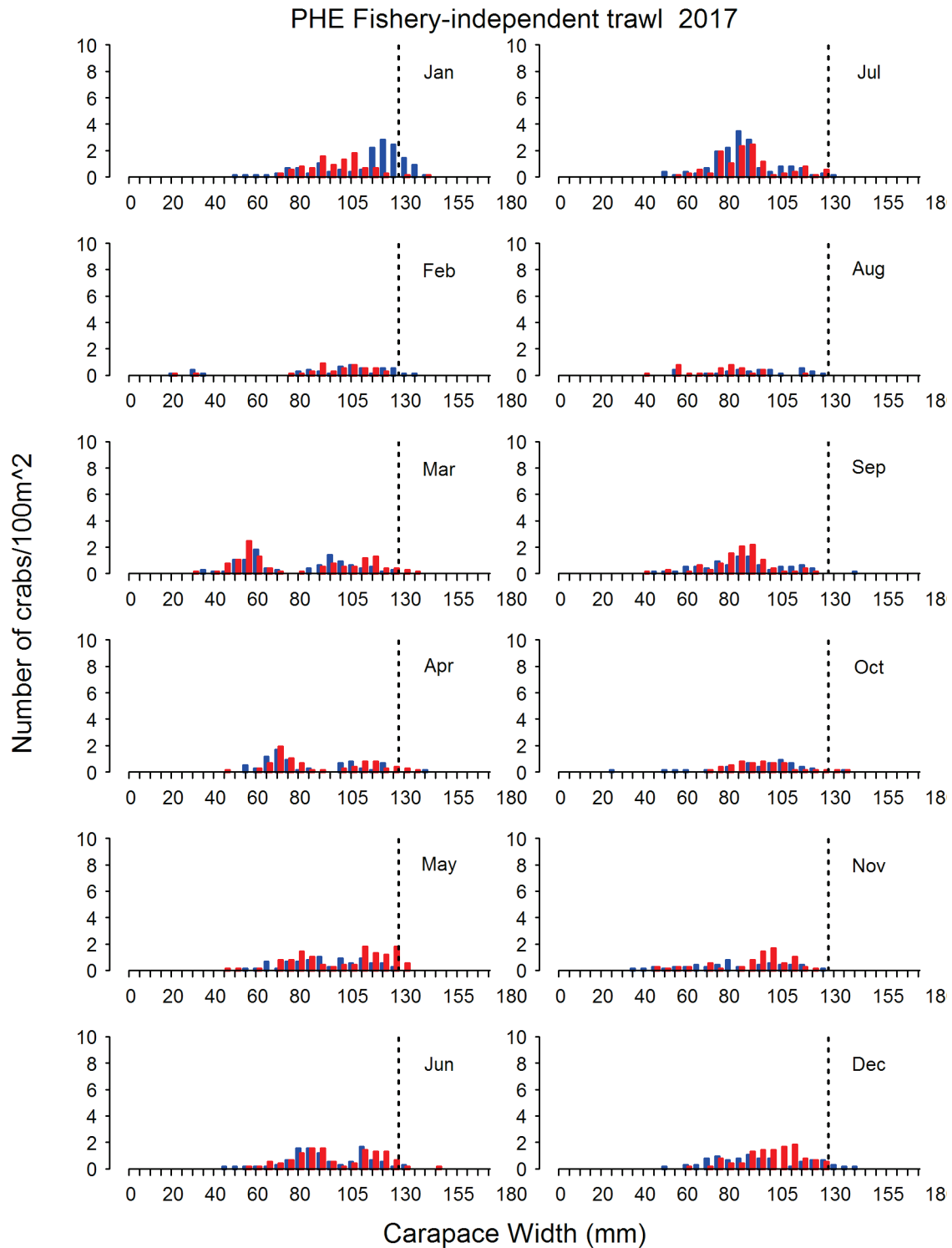


Figure 1.9. Monthly length frequencies of fishery-independent trawl survey catches of male (blue), female (red) and juvenile (yellow) blue swimmer crabs in the Peel-Harvey Estuary in 2017. The minimum commercial size limit of 127 mm carapace width is indicated by the vertical dashed lines.

The fishery-independent trap survey data used to develop an index of November legal crab abundance was the lowest on record in 2016 (0.54 crabs/traplift; Figure 1.10) but increased to 1.18 crabs/traplift in 2017. Based on the relationship established between this index and the commercial catches in the following fishing season, the predicted catch for 2016/17 was 58 t (Figure 1.10), which is very similar to the actual recorded catch of 55 t. Together with an index of recruitment that will be developed from the trawl survey data, this fishery-independent information will continue to be considered in addition to the current harvest strategy performance indicators in an overall weight of evidence approach to stock assessment in this fishery.

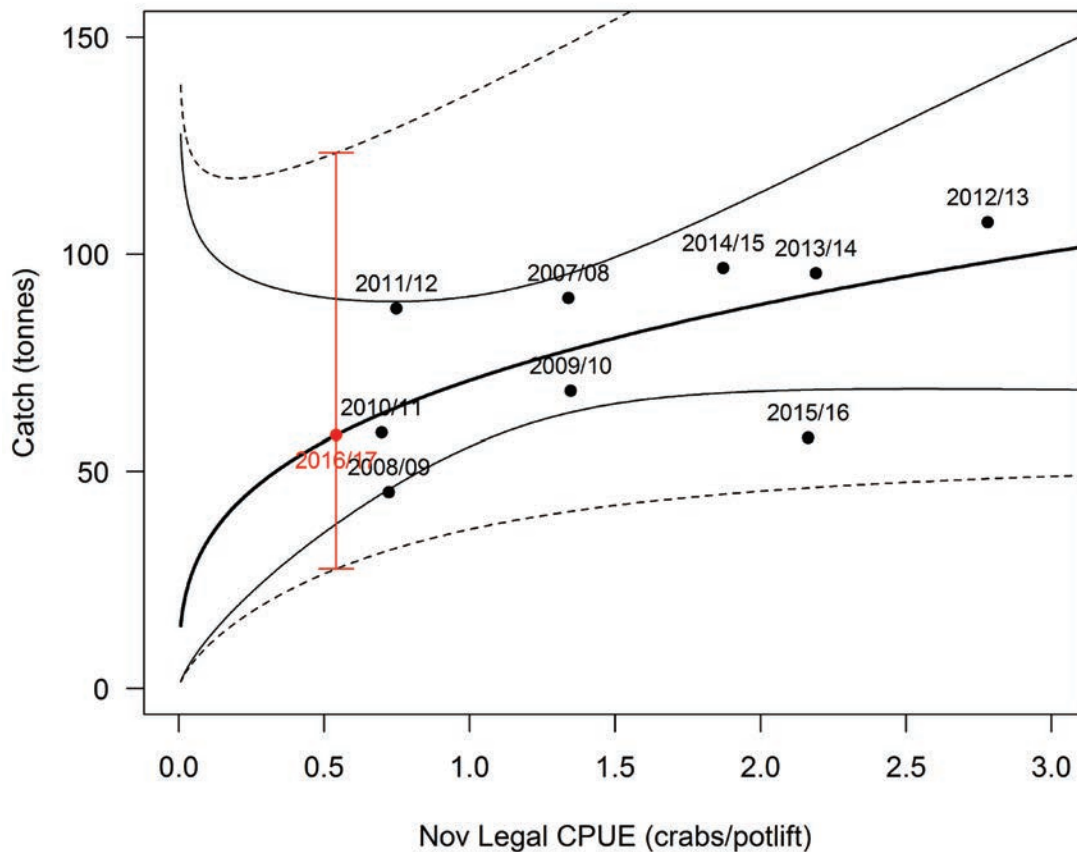


Figure 1.10. Catch prediction model using the fishery-independent November trap catch rates of legal sized blue swimmer crabs (year t) as predictor of commercial catch for the following (November-August) fishing season (year t+1) (power relationship). The solid black line indicates the fitted regression line (bias corrected for estimation in log space), and the 95% confidence limits are indicated by the black line. The dotted line indicates the 95% prediction limits. The predicted catch and its prediction limits for 2016/17 are shown in red, noting that the actual catch for this fishing season was 55 t.

MSC Principle 2

2. Other Retained Species

This section reports available information on species other than the ‘target’ (P1) species that are retained by commercial fishers in the commercial WCEMF (Area 2) and recreational blue swimmer crab fishers in the Peel-Harvey Estuary.

2.1 Commercial Net Fishery

In addition to sea mullet, the commercial haul and gillnet fishery also retains a number of other nearshore and estuarine finfish species (Table 2.1). Catch data shows a substantial further reduction in gillnet catches in 2016 (Table 2.1), which follows a continued decline in gillnetting effort over the past three years (Figure 1.4).

As outlined in the harvest strategy for the finfish resources of the PHE (Department of Fisheries 2015a), catch and catch rate-based reference levels have been developed for these species as indicators of change in fish abundance and/or the level of targeting by fishers. The target catch / catch rate levels are:

- Yelloweye mullet: annual commercial catch is < 46 tonnes;
- Yellowfin whiting: annual commercial catch is < 12 tonnes;
- Australian herring: annual commercial catch is < 9 tonnes;
- Tailor: annual commercial catch is < 9 tonnes;
- Cobbler: annual catch rate of cobbler is > 6 kg / fishing day and annual commercial catch is < 9 tonnes;
- Perth herring: annual commercial catch of Perth herring is < 2.7 tonnes; and
- All other retained species: annual commercial catch of each other retained species is < 5 % of the total retained catch.

Overall catch trends for the individual key retained species other than sea mullet, relative to harvest strategy reference levels, are briefly summarised below.

Table 2.1. Retained species catches (kg) for the commercial Peel-Harvey Estuary haul net (HN) and gillnet (GN) sectors between 2014 and 2016. Dark blue shading indicates target (P1) species and light blue shading indicates main retained species (i.e. > 5% of total retained catch).

Common Name	Annual Catch (kg)					
	2014		2015		2016	
	GN	HN	GN	HN	GN	HN
Mullet, Sea	17854	56876	11064	79892	1831	84591
Mullet, Yelloweye	6174	10243	883	4928	313	11054
Whiting, Yellowfin	8489	16105	3178	26432		19048
Herring, Australian	986	2151	113	2580		3080
Tailor	2321	5837	125	6154		1331
Cobbler	193		901	356	853	326
Herring, Perth	1298	1225		2529		
Whiting, King George	14	7	7	397		784
Trevallies, General	89	1176	5	1059		823
Whiting, General/Sand		550		112		778
Trevally, Skipjack/Silver				75		
Garfish, Southern Sea				5		
Bream, Black	41	2	7			24
Flatheads, General	28			8		9
Common Silverbiddy		30		18		70
Flounders, General		2				
Pilchard				150		90
Herrings, Giant		5				
Trumpeters/ Grunters, General		20				
Squids, General				3		
Total (kg)	37487	94229	16283	124698	2997	124762
Annual Total (kg)	131716		140981		127759	

2.1.1 Yelloweye mullet

The catch of yelloweye mullet in the Peel-Harvey Estuary reached a historical low of 6 t in 2015 but increased slightly to 11.4 t in 2016 (Table 2.1). As the catch was still well below the threshold level of 46 t, no harvest strategy response has been required.

2.1.2 Yellowfin whiting

After above-average yellowfin whiting catches were observed in the Peel-Harvey Estuary in 2014 and 2015, a Level 3 (catch curve and per-recruit) assessment of the yellowfin whiting stock was triggered by the harvest strategy. The assessment, based on two consecutive years of age composition data from 2015 and 2016, confirmed that the stock is in a healthy state and that a very strong recruitment by the 2010/11 year class had contributed to the recent high catches.

The results of the yellowfin whiting assessment were presented in the 2017 addendum to the Johnston et al. (2015) MSC report², and summaries were communicated by the Department through emails to key stakeholders and also to the broader public via their website and social media³. As expected, catches in 2016 declined to 19 t (Table 2.1) and preliminary data for 2017 indicate that this trend has continued down to below the threshold level for this species of 13.8 t.

2.1.3 Australian herring

The catch of Australian herring in the Peel-Harvey Estuary has been stable at around 3 t since 2012 and was 3.1 t in 2016 (Table 2.1). This is a very small component of the total Statewide catch from the overall stock, which is in a recovery phase after management changes were implemented in March 2015 to reduce fishing pressure.

2.1.4 Tailor

Following a peak in catches of tailor in the Peel-Harvey Estuary in 2013 corresponding to a period of strong recruitment, annual catches have returned to a low level of 1.3 t in 2016 (Table 2.1). Hence there are no concerns about the current status of the stock.

2.1.5 Cobbler

Commercial catch rates of cobbler in the Peel-Harvey Estuary have fluctuated largely in response to catches over time, with both indicators remaining at low levels between 2013 and 2015. While cobbler catches in 2016 (1.2 t) remained similar to the previous year (1.3 t), the catch rate calculated for the July to September winter period when this species is mainly targeted increased markedly to 66 kg/day from 14 kg/day. This was due to the substantial reduction in gillnetting effort observed between 2015 and 2016, from 64 to 13 gillnetting days between July and September. As both indicators remained within their target reference levels, no changes to management were required.

2.1.6 Perth herring

The catch of Perth herring in the Peel-Harvey Estuary show an increasing trend between 2010 and 2014 to around 2.5 t and further increased slightly to just over the harvest strategy target of 2.7 t in 2016 (Figure 2.1; Table 2.1). As data for 2017 indicate that this trend has continued to above the threshold level, a review will be triggered by the harvest strategy to evaluate the risk of the current catch levels to the overall sustainability of the stock. This review will incorporate all available data for Perth herring, which includes an age composition data sample recently collected by Departmental staff.

² http://www.fish.wa.gov.au/Documents/wamsc_reports/wamsc_report_no_4_addendum.pdf

³ See <http://www.fish.wa.gov.au/About-Us/News/Pages/Yellowfin-whiting-population-in-the-black.aspx>, http://www.fish.wa.gov.au/Documents/other/yellowfin_info_sheet.pdf and <https://twitter.com/FisheriesWA/status/922640613513859072>

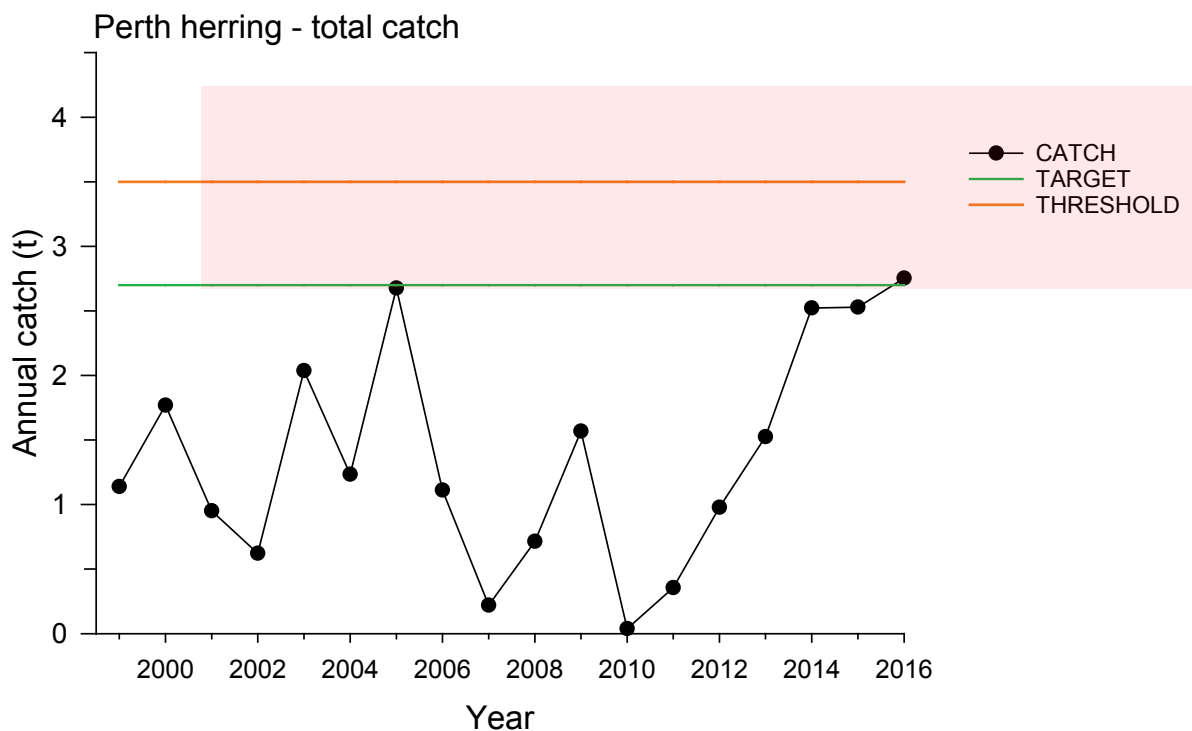


Figure 2.1. Annual commercial catch (tonnes) of Perth herring in the Peel-Harvey Estuary haul and gillnet fishery relative to the associated harvest strategy reference points.

2.1.7 Other finfish species

The combined annual commercial catch of all other species retained in the Peel-Harvey Estuary net fishery has remained low at around 2% of the total catch in the fishery, which is well below the catch threshold level of 5%.

2.2 Commercial Trap Fishery

2.2.1 Octopus

The only other species retained in the commercial trap fishery for blue swimmer crabs has been octopus, with a catch of 32 kg reported for the 2016/17 fishing season.

2.2.2 Bait Usage

As in recent years, commercial monitoring of the trap fishery for blue swimmer crabs shows no change in the use of bait, with around 300 g of locally-caught sea mullet and yelloweye mullet typically used per trap. Conversion rates (kg bait used per kg of blue swimmer crab caught) for the 2016/17 fishing seasons have remained the same as those previously reported in the range of 0.22-0.29 (Table 2.2).

Table 2.2. Summary of bait usage in the Peel-Harvey Estuary commercial trap fishery in 2014/15 to 2016/17

Year	Total No. of trap lifts	Total crab Catch (kg)	Bait Type	Amount of Bait used per Trap (g)	Total Bait used (kg)	Conversion Rate
2014/15	69,888	96,753	Sea mullet Yelloweye mullet	300	20,966	0.22
2015/16	56,746	57,702	Sea mullet Yelloweye mullet	300	17,024	0.29
2016/17	52,874	55,095	Sea mullet Yelloweye mullet	300	15,862	0.29

2.3 Recreational Drop and Scoop Net Fishery

There has been no further information collected on non-target retained catches (or bait) in the recreational drop and scoop net fishery for blue swimmer crabs since that reported in Johnston et al. (2015).

3. Bycatch

3.1 Commercial Net Fishery

Since the implementation of a bycatch reporting and validation program for the haul and gillnet fishery in the Peel-Harvey Estuary in 2017, commercial fishers have been submitting monthly logsheets to the Department to report on their discarded as well as retained catches from each net shot conducted. To verify these data, bi-monthly observation trips have been undertaken by Departmental research staff on board the commercial fishing vessels.

The sections below provide summaries of the bycatch data reported by fishers and observers during the first 11 months of this monitoring program, from April 2017 to February 2018. All licence holders that have been active in the net fishery during this time have participated in the program, noting that a few fishers focus only on crab trapping and some net for finfish only very occasionally.

Overall, the bycatch data demonstrate that there is a very low level of discarding in the commercial net fishery, with observation trips confirming that the majority of discarded catches are released alive and expected to survive. A review of the full first year of the monitoring program and a more comprehensive exploration of data will be completed during the second half of 2018. This will include consideration of changes to the logsheet design and reducing the frequency of observation trips.

3.1.1 Fishery-Dependent Reporting

From a total of 482 net shots reported by eight commercial fishers operating between April 2017 and February 2018, 95% (457) targeted finfish through active haul netting and 5% (25) used gillnets set overnight. All the gillnet shots were conducted during winter between July and September and mainly targeted cobbler or yellowfin whiting. In contrast, the majority of haul net shots retained sea mullet as the main target species.

Thirty percent of the reported haul net shots had no discards, compared to 16% of the gillnet shots. The two most commonly discarded species from haul nets were blue swimmer crabs and silver bream (*Rhabdosargus sarba*), which occurred in 46% and 32% of reported shots, respectively (Table 3.1). Less common species in the haul net shots included the weeping toadfish (*Torquigener pleurogramma*) and yelloweye mullet (*Aldrichetta forsteri*). Over the 11 months sampled, the average number of each bycatch species recorded in each haul net shot was low, around one (individual) per shot or less (Table 3.1). This compares to an average retained catch (in weight) of 143 kg recorded for the same net shots.

Despite a much lower number of reported gillnet shots compared to haul net shots, data suggest some slight differences in the composition and quantity of discards between the two fishing methods. Just over half (52%) of the gillnet shots reported discarding of yelloweye mullet, followed by 40% and 36% occurrence of silver bream and weeping toadfish, respectively (Table 3.1). Blue swimmer crabs were discarded from only 12% of reported gillnet shots. The average numbers of discard species released from each gillnet shot were slightly greater than haul net shots (Table 3.1), which would be expected given that gillnets are typically set overnight and thus remain in the water for longer.

Fishers reported that the main reasons for not retaining discarded species were not being permitted to (e.g. blue swimmer crabs, rays), due to the catch being below the minimum legal size (e.g. silver bream, tailor), or from being of no economic value (e.g. weeping toadfish, yelloweye mullet), or of poor quality from predation whilst in the net.

Table 3.1. Bycatch species reported by commercial net fishers in the Peel-Harvey Estuary from 457 haul net shots and 25 gillnet shots between April 2017 and February 2018.

Species	Haul net		Gillnet	
	% occurrence in shots	Average number per shot	% occurrence in shots	Average number per shot
Blue swimmer crab (<i>Portunus armatus</i>)	46%	1.14	12%	0.2
Silver bream (<i>Rhabdosargus sarba</i>)	32%	1.02	40%	2.64
Weeping toadfish (<i>Torquigener pleurogramma</i>)	9%	0.95	36%	5.28
Yelloweye mullet (<i>Aldrichetta forsteri</i>)	8%	0.40	52%	2.96
Roach (<i>Gerres subfasciatus</i>)	2%	0.06	-	-
West Australian salmon (<i>Arripis truttaceus</i>)	2%	0.04	-	-
Leatherjacket (Monacanthidae)	2%	0.03	12%	0.16
Tailor (<i>Pomatomus saltatrix</i>)	1%	0.04	4%	0.04
Black bream (<i>Acanthopagrus butcheri</i>)	1%	0.03	-	-
Yellowtail grunter (<i>Amniataba caudavittata</i>)	<1%	<0.01	-	-
Western striped trumpeter (<i>Pelates octolineatus</i>)	<1%	<0.01	-	-
Australian herring (<i>Arripis georgianus</i>)	<1%	<0.01	-	-
Smooth ray (<i>Dasyatis</i> sp.)	<1%	<0.01	-	-
King George whiting (<i>Sillaginodes punctatus</i>)	-	-	4%	0.4
Cobbler (<i>Cnidoglanis macrocephalus</i>)			4%	0.04
Mulloway (<i>Argyrosomus japonicus</i>)			4%	0.04

3.1.2 Fishery-Independent Verification

Observation trips were undertaken with seven of the licence holders in the Peel-Harvey Estuary between April 2017 and February 2018, with most effort focused on the vessels that operate more frequently throughout the year. Only during two of the observation trips were no nets shot due to poor weather conditions and visibility. A total of 29 net shots were observed during the first 11 months of the monitoring program, of which 93% (27) used haul nets and 7% (2) used set gillnets overnight. A summary of the bycatch data from these trips is provided in Table 3.2. Due to the low number of gillnet shots observed, the data have been summarised together.

Overall, the type and quantity of discarding observed in net shots reflected that reported by the fishers on their logsheets. There were no discards in 24% of observed net shots, compared to 30% and 16% of haulnet and gillnet shots, respectively, that were reported by the fishers. The four most commonly observed discard species were the same as those reported by fishers in haul and gillnet shots (cf. Table 3.1 and Table 3.2). Blue swimmer crabs, silver bream, weeping toadfish and yelloweye mullet were observed in 41%, 38%, 21% and 17% of the observed net shots, respectively.

Table 3.2. Bycatch species caught and discarded by commercial net fishers in the Peel-Harvey Estuary from 27 haul net shots and two gillnet shots during observer trips between April 2017 and February 2018.

Species	Haul and gillnets	
	% occurrence in shots	Average number per shot
Blue swimmer crab (<i>Portunus armatus</i>)	41%	1.66
Silver bream (<i>Rhabdosargus sarba</i>)	38%	1.17
Weeping toadfish (<i>Torquigener pleurogramma</i>)	21%	1.48
Yelloweye mullet (<i>Aldrichetta forsteri</i>)	17%	0.45
Roach (<i>Gerres subfasciatus</i>)	7%	0.14
Australian herring (<i>Arripis georgianus</i>)	7%	0.14
Western striped trumpeter (<i>Pelates octolineatus</i>)	7%	0.07
Tailor (<i>Pomatomus saltatrix</i>)	7%	0.07
King George whiting (<i>Sillaginodes punctatus</i>)	3%	0.34
Soldierfish (<i>Gymnapistes marmoratus</i>)	3%	0.03
West Australian salmon (<i>Arripis truttaceus</i>)	3%	0.03
Yellowtail grunter (<i>Amniataba caudavittata</i>)	3%	0.03
Leatherjacket (Monacanthidae)	3%	0.03
Cobbler (<i>Cnidoglanis macrocephalus</i>)	3%	0.03
Mulloway (<i>Argyrosomus japonicus</i>)	3%	0.03

3.2 Commercial Trap Fishery

Monthly commercial trap monitoring in the commercial trap fishery in the Peel-Harvey Estuary has not indicated any marked change in the species composition or quantity of bycatch in the traps. Three species of the species observed to be discarded from crab traps since the beginning of the monitoring program in 2007 (Table 3.3), weeping toadfish, western striped trumpeter and cobbler, have also been recorded as bycatch in the net fishery for finfish species in the estuary.

Table 3.3. Bycatch species observed in the Peel-Harvey Estuary (commercial trap) fishery for blue swimmer crabs during on-board catch monitoring conducted between 2007 and 2016.

Common name	Species name
Weeping toadfish	<i>Torquigener pleurogramma</i>
Western striped trumpeter	<i>Pelates octolineatus</i>
Octopus	<i>Octopus cf. tetricus</i>
Cobbler	<i>Cnidoglanis macrocephalus</i>
Four-lobed swimming crab	<i>Thalamita sima</i>
Mud crab	<i>Scylla sp.</i>

3.3 Recreational Drop and Scoop Net Fishery

No new information on other retained catches (or bait) in the recreational drop and scoop net fishery for blue swimmer crabs has been collected since that reported in Johnston et al. 2015.

4. ETP Species

There have been no reported interactions in the commercial WCEMF (Area 2) with Endangered, Threatened or Protected (ETP) species in 2016 or 2017.

5. Habitats

As part of a 3-year project that commenced in 2017 to address the MSC condition on the recreational scoop net fishery for blue swimmer crabs, an assessment of the impact of this fishery on habitats in the Peel-Harvey Estuary is currently being undertaken. The project is comprised of three separate components, the results of which will subsequently be used with any other relevant information to undertake a risk assessment. The project's components include (1) a survey of scoop netting effort across broader areas of the estuary, (2) mapping of benthic habitats within the estuary, and (3) an exploration of shorebird data to identify areas/habitats of particular importance.

The section below provides progress updates for the first and third component of the project, with work to collate imagery and bathymetric data on habitats just about to commence.

5.1 Scoop-net survey

The Department commenced a 12-month survey to determine areas of high-, medium- and low-intensity recreational scoop-netting within the estuary on 1 March 2018 (Figure 5.1). The survey is designed to meet the first stage of the proposed project plan.

5.1.1 Survey design

A modified roving survey design is being used whereby counts of recreational fishers are conducted using the progressive count method (Hoenig et al. 1993; Pollock et al. 1994). The location of each fisher identified during the progressive count is being georeferenced to assist in linking the scoop netting footprint to habitat. Each recreational fisher is classified by their method of fishing because the condition relates to scoop netting only. Thermographic cameras are a key component of the design and extend the coverage of the survey to include daylight, crepuscular and nocturnal periods.

The scope and design components are summarised in Table 5.1 and have been informed by the analysis of data from the three remote thermal camera sites within the estuary (Herron Point, Coodanup, Novara; Figure 5.1). More sampling effort is being focussed on expected periods of high activity (Nov to Feb; Table 5.2).

The primary sampling unit (PSU) is each survey day (Table 5.1), from which a 6-hour shift is randomly selected. Survey days are stratified by season (high [Nov-Feb], mid [Mar-Apr],

low [May-Oct]), time of day (a.m. [05:00-10:59], midday [11:00-16:59], p.m. [17:00-22:59]) and region according to the secondary sampling units (SSU): day type (weekday, weekend/public holiday).

The estuary has been grouped into North, East and West regions (Figure 5.1). These regions differ from that of Johnston et al. (2014) and Malseed & Sumner (2001) to take advantage of natural barriers to scoop-net fishers (e.g. Dawesville Cut) and out of scope areas (e.g. Serpentine/Murray Rivers, southern Harvey Estuary). The changes reduce the potential for the fishers from adjoining regions being included in the region being surveyed.

5.1.2 Out-of-scope areas

There are several ‘out-of-scope’ areas within Peel-Harvey Estuary where it is not possible or practical to conduct roving surveys during the day and night (Figure 5.1). For example, private property along parts of the foreshore restricts direct access to the fishery and in other locations 4WD tracks provide seasonal access to the foreshore. Remotely piloted aircraft (RPA), otherwise known as drones, have been trialled to assess the level of fishing activity in these areas⁴. While no published study to date has used RPAs to monitor recreational fishers, there appear to be several advantages of this technique. These include: (i) providing counts of fishers from all locations, including inaccessible areas by car or boat; and (ii) an overhead view of fishers that reduces the background noise from other heat signatures. The results of the RPA trials are currently being evaluated. However, the intention is for RPAs to compliment and not replace the roving survey.

⁴ See <http://www.fish.wa.gov.au/About-Us/News/Pages/An-eye-in-the-sky-for-crabbing-survey.aspx> and <https://twitter.com/FisheriesWA/status/975598732489080834>

Table 5.1. Design components of the modified roving method.

Specification	Item	Method
Persons in scope	Residency status	All
	Age	All
	Sampling frame	Spatio-temporal
Activities	Platform	Shore-based wading activity
	Methods	All recreational fishing methods (e.g. scoop-net, drop-net, drag-net, gill-net, rod and line) Any wading activity (e.g. walking a dog, playing children)
Geographical scope	Fishing activity	All publicly accessible areas from the shore around the Peel-Harvey Estuary Sampling limited to estuary waters only (i.e. rivers, inlets and tributaries are excluded)
Timeframe	Survey dates	1/3/2018–28/2/2019
	Time of sampling	05:00-22:59
Sampling Units	Primary sampling unit	Survey day
	Strata	Season - High [Nov-Feb]; - Mid [Mar-Apr]; - Low [May-Oct] Day type - Weekday; - Weekend/Public Holiday Region - North [Wannanup-Coodanup]; - East [Yunderup-Herron Point]; - West [Island Point-Caddadup]
		Secondary sampling unit

Table 5.2. The number of days in each stratum, sampling proportion for each stratum and proportion of fishing effort (fisher hours) at the three remote thermal camera sites, individually and combined, between March 2015 and February 2016. Data for the site fishing effort are based on 5 randomly selected days for each day type per month of the year for each site between March 2015 and February 2016.

Season	Day type	No. days in strata	Proprn of all days available	Sampling Effort			All camera sites fishing effort	
				n	Proprn of total n	Sampling fraction	Proprn (Season)	Proprn (Day type)
Mid-season (Mar - Apr 2018)	WD	39	0.639	4	0.133	0.103	0.149	0.085
	WE/PH	22	0.361	4		0.182		0.179
Low-season (May - Aug 2018)	WD	88	0.715	4	0.133	0.045	0.016	0.028
	WE/PH	35	0.285	4		0.114		0.011
Closed-season (Sep - Oct 2018)	WD	42	0.689	2	0.065	0.048	0.029	0.035
	WE/PH	19	0.311	2		0.105		0.026
High-season (Nov 2018-Feb 2019)	WD	82	0.683	20	0.667	0.244	0.806	0.852
	WE/PH	38	0.317	20		0.526		0.784
Total	WD	251	0.688	30	0.500	0.120	0.321	
	WE/PH	114	0.312	30	0.500	0.263	0.679	
	All	365	1.000	60	1.000	0.164	1.000	

^a values take into account a Departmental close-down between 21/12/18-1/1/19

^b proportion of the total available days before the close-down days were removed from the selection sample

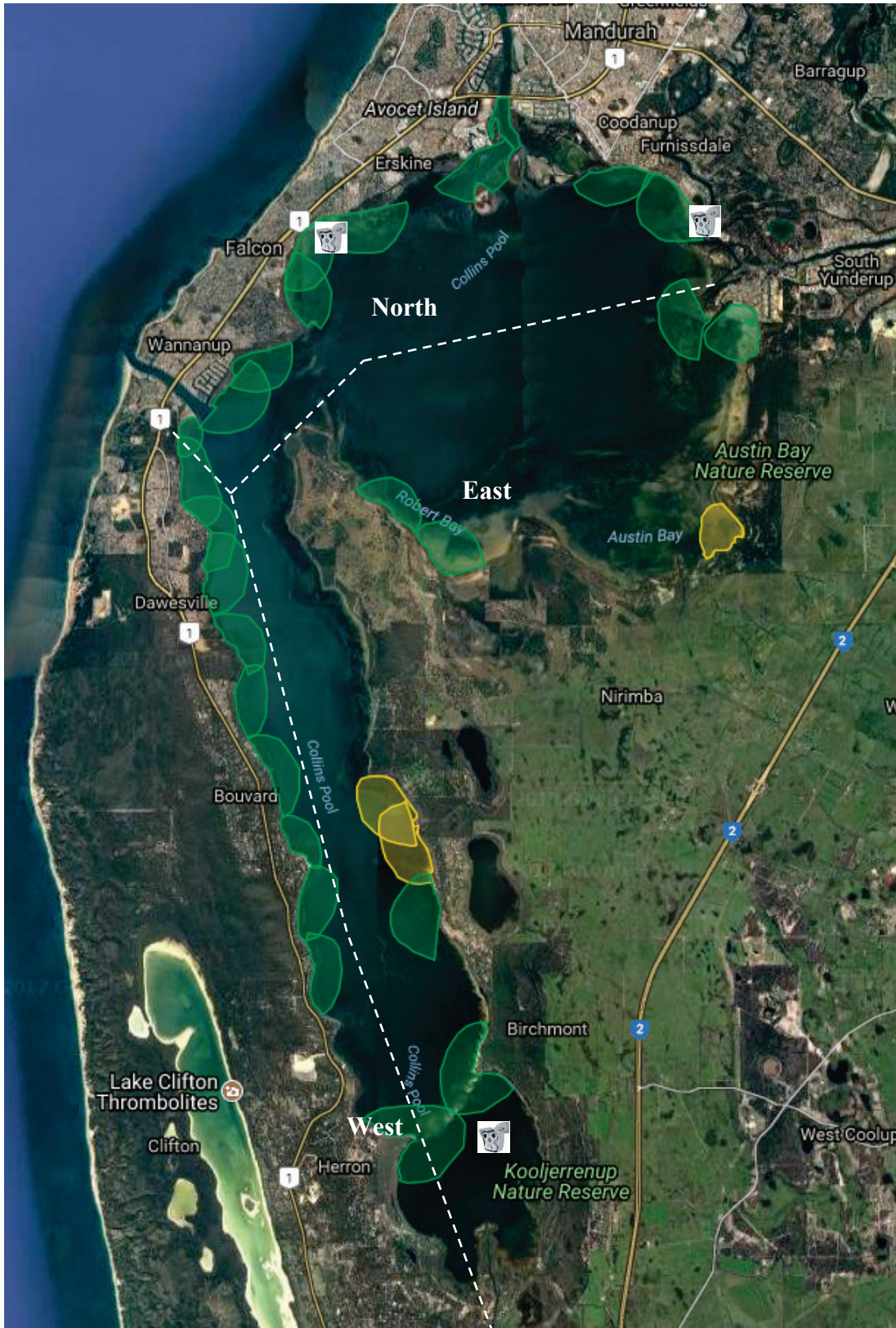


Figure 5.1. Survey sites showing the field of view from sites in the North, East and West regions along the roving survey route. Green shading indicates sites accessible throughout the year. Yellow sites indicate sites with potential access issues depending on the quality of the track. Unshaded areas are out of scope due to limited public access by road. Camera icons represent the locations of DPIRD remote thermal cameras.

5.2 Shorebird data exploration

5.2.1 Background

The Peel-Yalgorup system is listed as a Ramsar wetland of international importance and supports a large number of waterbirds, including many migratory species that visit the region during summer (Hale and Butcher 2007). It is during this time that recreational scoop netting activity in the estuary is believed to be at its highest. As part of the broader study to assess impacts of recreational scoop netting for blue swimmer crabs on habitats in the Peel-Harvey Estuary, an exploration of available shorebird data will be undertaken to identify any areas of particular importance to the birds.

Shorebird data for the broader Peel-Yalgorup system were acquired from Birdlife Western Australia's Peel Branch. The data comprise annual counts of shorebirds between 2008 and 2017, typically undertaken in January or February at a number of fixed sites (count areas) within the system. Counts are undertaken by groups of volunteers during high tide, when the mudflats used for foraging are inundated and the shorebirds congregate together. As counts in most areas are undertaken on the same day, the data for each year are considered to provide a reasonable representation of the number of birds present at that time.

The different count areas within the Peel-Harvey Estuary (see Figure 5.2) have broadly remained the same over the years, although some had not been surveyed annually. In cases where count areas have recently been separated into smaller sub-areas (e.g. 6 a, b and 7 a, b), the annual count data from the smaller sub-areas were first merged into the broader count area prior to this exploratory analysis (noting that finer-scale data from the more recent years will also be subsequently examined).

The total counts of each of the 85 waterbird species recorded in the Peel-Yalgorup system since 2008 were first explored to obtain a broad overview of which are most commonly observed in the Peel-Yalgorup wetlands. Secondly, the relative abundance of species in the individual count areas were evaluated by calculating, for each area, the average number of birds present in each year during which counts had been undertaken.

As it is not feasible to describe in detail the spatial abundance patterns of each species recorded in the data set, it is necessary to identify key species. Based on the criteria used by the Ramsar Convention when classifying wetlands as internationally important (see Hansen et al. 2016), it is proposed that these explorations will be based on the 14 species of both migratory and resident waterbirds of which at least 1% of the total population is supported by the Peel-Yalgorup system (Table 5.3). This draft list of key species will be reviewed and amended to include any additional species of interest to this study.



Figure 5.2. Approximate location and boundaries of individual count areas in the Peel-Harvey Estuary and adjacent lakes within the northern part of the broader Peel-Yalgorup wetlands system. Note that areas 12, 13 and 14 are lakes and wetlands located to the south, outside the extent of this map.

Table 5.3. Key waterbird species for which the Peel-Yalgorup system supports at least 1% of each total population, and their current global and Australian conservation status.

Common Name	Species Name	Global conservation status (IUCN)	Australian Commonwealth status (EPBC)
Red-necked stint	<i>Calidris ruficollis</i>	Near Threatened	Not Assessed
Sharp-tailed sandpiper	<i>Calidris acuminata</i>	Least Concern	Not Assessed
Curlew sandpiper	<i>Calidris ferruginea</i>	Near Threatened	Critically Endangered
Red-necked avocet	<i>Recurvirostra novaehollandiae</i>	Least Concern	Not Assessed
Red-capped plover	<i>Charadrius ruficapillus</i>	Least Concern	Not Assessed
Hooded plover	<i>Thinornis rubricollis</i>	Vulnerable	Not Assessed
Black-winged stilt	<i>Himantopus himantopus</i>	Least Concern	Not Assessed
Banded stilt	<i>Cladorhynchus leucocephalus</i>	Least Concern	Not Assessed
Australian shelduck	<i>Tadorna tadornoides</i>	Least Concern	Not Assessed
Australasian shoveler	<i>Anas rhynchos</i>	Least Concern	Not Assessed
Grey teal	<i>Anas gracilis</i>	Least Concern	Not Assessed
Eurasian coot	<i>Fulica atra</i>	Least Concern	Not Assessed
Musk duck	<i>Biziura lobate</i>	Least Concern	Not Assessed
Fairy tern	<i>Sternula nereis</i>	Vulnerable	Vulnerable

5.2.2 Preliminary results

The data set includes counts of more than 430,000 waterbirds in the Peel-Yalgorup system between 2008 and 2017. Of the 85 different species recorded, around 50-60 are typically observed each year. Just under a third of the species are listed as migratory shorebirds, with the remainder including a wide range of resident shorebirds, ducks, grebes, pelicans, cormorants, herons, egrets, gulls and terns.

Based on the total number of birds counted in all areas and years, the six most commonly observed species have been the banded stilt, red-necked stint, Australian shelduck, black swan, grey teal and the silver gull (Table 5.4). Counts of these species have generally remained stable between years, with the exception of banded stilts which fluctuate from none observed in 2009 to over 39,000 birds in 2013. Most of the species recorded in the Peel-Yalgorup system have only been observed occasionally, with 68 of the 85 species collectively representing less than 5% of the total bird counts in the data set (Table 5.4).

Just over 50% of all birds counted were within the Peel-Harvey Estuary, with the remainder counted in the many inland freshwater and saline lakes surrounding the estuary. The data indicate that the areas with the highest abundance of birds within the Peel-Harvey Estuary are the eastern Peel Inlet, the southern Harvey Estuary, and the Mandurah Channel and nearby Estuary Islands.

Table 5.4. Total counts of the main waterbird species observed in the Peel-Yalgorup system between 2008 and 2017, and their relative contribution to the overall bird count.

Common name	Species name	Total number counted (2008-2017)	Percentage of total bird count
Banded stilt	<i>Cladorhynchus leucocephalus</i>	89262	20.4%
Red-necked stint	<i>Calidris ruficollis</i>	46699	10.7%
Black swan	<i>Cygnus atratus</i>	43109	9.9%
Australian shelduck	<i>Tadorna tadornoides</i>	42780	9.8%
Silver gull	<i>Chroicocephalus novaehollandiae</i>	41147	9.4%
Grey teal	<i>Anas gracilis</i>	38122	8.7%
Black-winged stilt	<i>Himantopus himantopus</i>	21610	4.9%
Sharp-tailed sandpiper	<i>Calidris acuminata</i>	18797	4.3%
Pacific black duck	<i>Anas superciliosa</i>	16193	3.7%
Little pied cormorant	<i>Microcarbo melanoleucos</i>	11046	2.5%
Australian pelican	<i>Pelecanus conspicillatus</i>	10413	2.4%
Little black cormorant	<i>Phalacrocorax sulcirostris</i>	9609	2.2%
Red-capped plover	<i>Charadrius ruficapillus</i>	9467	2.2%
Pied cormorant	<i>Phalacrocorax varius</i>	8637	2.0%
Red-necked avocet	<i>Recurvirostra novaehollandiae</i>	4180	1.0%
Australian white ibis	<i>Threskiornis moluccus</i>	2597	0.6%
Hoary-headed grebe	<i>Poliiocephalus poliocephalus</i>	2212	0.5%
Common greenshank	<i>Tringa nebularia</i>	2122	0.5%
White-faced heron	<i>Egretta novaehollandiae</i>	1936	0.4%
Eastern great egret	<i>Ardea modesta</i>	1634	0.4%
Caspian tern	<i>Hydroprogne caspia</i>	1535	0.4%
Crested tern	<i>Thalasseus bergii</i>	1430	0.3%
Australian wood duck	<i>Chenonetta jubata</i>	1177	0.3%
Fairy tern	<i>Sternula nereis</i>	1160	0.3%
Little egret	<i>Egretta garzetta</i>	917	0.2%
Australasian darter	<i>Anhinga novaehollandiae</i>	881	0.2%
Musk duck	<i>Biziura lobate</i>	785	0.2%
Yellow-billed spoonbill	<i>Platalea flavipes</i>	610	0.1%
Hooded plover (western)	<i>Thinornis rubricollis tregellasi</i>	596	0.1%
Eurasian coot	<i>Fulica atra</i>	576	0.1%
Red-kneed dotterel	<i>Erythronyctes alba</i>	555	0.1%
Australasian shoveler	<i>Anas rhynchotis</i>	539	0.1%
Grey plover	<i>Pluvialis squatarola</i>	512	0.1%
Bar-tailed godwit	<i>Limosa lapponica</i>	463	0.1%
Straw-necked ibis	<i>Threskiornis spinicollis</i>	307	0.1%
Wood sandpiper	<i>Tringa glareola</i>	302	0.1%
Other species		3072	<1% combined

Preliminary analyses of count data for each the 14 key species indicates that their spatial abundance patterns vary widely. For the hooded plover, Australasian shoveler and musk duck, more than 99% of observations have been outside the Peel-Harvey Estuary, from the many surrounding freshwater and saltwater lakes. Other species, including the curlew sandpiper, red-necked stint and the banded and black-winged stilts, show a more even distribution across the estuarine and lake habitats. For the sharp-tailed sandpiper and fairy tern, around 70% of observations of each species were from within the Peel-Harvey Estuary.

In general, the greatest number of sharp-tailed sandpiper within the Peel-Harvey Estuary was in the eastern part of Peel Inlet (Areas 6a and b, see Figure 5.2), with an average of more than 1000 birds observed each year in Austin Bay and Boggy Bay. Bird counts in this area also show high abundance of stilts, grey teals and red-necked stints. The latter species is also equally abundant at the mouth of the Harvey River in the southern part of the estuary. Although observed in much lower numbers, the highest numbers of fairy terns (average of around 60 birds per year) have been observed along the Mandurah Estuary Channel and the Creery Wetlands in northern Peel Inlet.

6. Ecosystem

A 3-year ARC Linkage Project (LP150100451) ⁵ titled “*Balancing estuarine and societal health in a changing environment*” was started in early 2016, led by scientists at Murdoch University. It is due for completion in 2019.

⁵ See <http://peel.science.uwa.edu.au> and <https://www.6mm.com.au/news/local-news/new-project-key-to-estuary-protection/>

MSC Principle 3

The section below provides updated fishery compliance statistics for the 2016/17 financial year.

7. Compliance and Enforcement

There have not been any offences detected in the commercial WCEMF in the Peel-Harvey Estuary during the 2016/17 fishing season. An updated summary of offences made by recreational fishers is provided in Table 7.1.

Although the data show that retention of undersized crabs and, to a lesser extent, breaching the bag limit, remains the main offence types in the recreational crab fishery, the number of prosecution briefs, infringement notices and warnings recorded in 2016/17 were all lower than the previous year (Table 7.1; Table 7.2). Compliance effort, both with regards to overall presence of Fisheries Officers and the number of contacts made with fishers, has remained very similar to 2015/16 (Table 7.2), indicating that the level of non-compliance in this fishery has declined. The compliance data for the Peel-Harvey Estuary have been examined as part of a broader review of the management of the blue swimmer crab fisheries in south-western WA.

Table 7.1. Summary of detected offences by recreational fishers in the Peel-Harvey Estuary between 2013/14 and 2016/17.

Offence Type	Prosecution Briefs				Infringement Notices				Infringement Warnings			
	13/14	14/15	15/16	16/17	13/14	14/15	15/16	16/17	13/14	14/15	15/16	16/17
Crabbing												
Closed Season	0	0	0	1	10	13	5	6	4	2	3	0
Closed Waters	0	0	0	1	0	2	0	0	0	0	0	0
Excess Bag	17	27	25	22	28	27	8	6	49	102	59	27
Excess Gear	0	0	0	0	0	1	0	1	0	1	0	0
Illegal Gear	2	2	3	4	12	14	11	2	5	10	16	21
Licensing	0	0	0	0	0	0	0	0	1	0	0	0
No Licence	0	0	0	0	19	18	8	2	1	4	0	1
Obstruction	1	8	14	5	0	0	0	0	0	0	0	0
Species	0	0	0	0	38	5	0	0	1	0	0	0
Undersize	17	27	44	28	312	286	256	173	541	450	319	127
Processing	0	3	0	4	0	0	2	0	0	0	0	0
Other	2	7	0	1	0	0	0	0	0	0	0	0
TOTAL	39	74	86	66	419	366	290	190	602	569	397	176
Netting												
Closed Season	2	0	1	3	2	0	2	0	1	1	0	0
Closed Waters	0	3	5	6	1	0	3	7	0	4	0	1
Excess Bag	0	0	3	0	0	0	1	0	2	7	0	0
Illegal Gear	2	2	7	3	1	4	3	1	0	7	0	3
No Licence	1	0	1	0	2	4	1	1	0	0	0	1
Undersize	1	0	2	0	0	5	0	0	0	1	0	0
Other	2	0	0	2	3	7	3	2	0	4	4	1
TOTAL	8	5	19	14	9	20	13	11	3	24	4	6

Table 7.2. A summary of offence data relative to the compliance effort in the broader Peel-Harvey Estuary area, noting that this also incorporates oceanic waters outside of the estuary

Financial year	Total Presence (Officer Hours) in area	Rec Crabbing Compliance Contacts in area	Rec Crabbing Offences in area
2012/13	3,562	5,854	514
2013/14	3,788	9,283	1,060
2014/15	4,497	10,930	1,009
2015/16	4,898	7,384	773
2016/17	4,676	7,007	432

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