Fish recruitment indicators for the Gladstone Harbour Report Card using data derived from castnet sampling 2025

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Gladstone Healthy Harbour Partnership

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Bill Sawynok and Stefan Sawynok

Infofish Australia Pty Ltd

12 Mingoola Street Murarrie Qld 4172

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SUMMARY

The requirements of this project were to supply fish recruitment grades and scores for Yellowfin and Pikey Bream for the 2025 Gladstone Harbour Report Card, following the same methods used in the past 8 years so that results were comparable from year to year.

This year the sampling period was 3 months with surveys conducted in December, January and February. The number of sites surveyed remained at 26, the same as in previous years, however site 91 Iveragh was replaced due to access issues by site 147 Foreshores in close proximity. A survey involved 20 casts at each site in approximately the same area in each survey.

Prior to 2020-21 surveys, sampling was conducted monthly between December and March with a total of 104 surveys with 2,060 casts. From 2020-21 to 2024-25 surveys were undertaken from December to February with a total of 78 surveys and 1,540 casts except 2023-24 where there were 77 surveys as one site could not be surveyed in December due to pollution concern from rotting fish frames.

There was a total of 7,882 individuals recorded across the 78 surveys comprising 4,974 fish and 2,908 prawn with an overall catch rate of 5.1 individuals/cast. The highest catch rate was at Little Enfield Creek at 14.6 individuals/cast followed by Broadacres at 10.4 individuals/cast however this was boosted by 504 prawns in the January and February surveys. The lowest catch rate was 0.4 individuals/cast at Wappentake Creek. This is a site with tidal input only on the largest spring tides so there is limited opportunity for fish to reach the site, particularly when there is no or limited freshwater input as was the case this survey period.

Banana Prawn was the most recorded species at 2,908 (36.9%) followed by Mullet (all) at 1,742 (22.1%). Pikey Bream were the 3rd most recorded species at 461 (5.8%) and Yellowfin Bream the 6th at 383 (4.9%). Flattail Mullet were recorded at all 26 sites while Yellowfin Bream were at 24 sites and Pikey Bream at 23 sites.

This year data from December to February from 2016-17 to 2024-25 was used for analysis to improve the comparability of data from year to year. This was based on 78 surveys each year (except 2023-24 when there were 77 surveys).

The random effects model used previously was used again to determine scores and grades for each site, each zone and for all of harbour. The overall result for Gladstone Harbour was B with 1 zone recording an A, 8 zones a B and 3 zones a C.

The following table provides the scores averaged over sites within zones for the last 9 years from 2016-17 to 2024-25 (shown in the year of the relevant report card), along with the grade colours for the GHHP report card used to convert scores to grades in the 2025 Gladstone Harbour Report Card for each component of harbour health.

Recruitment of both Bream species has been variable which is likely related to environmental conditions however there does not appear to be any particular trend.

Zone	2025	*2024*	*2023*	*2022*	*2021*	*2020*	*2019*	*2018*	*2017*
1.Narrows	0.61	*0.44*	*0.37*	*0.65*	*0.54*	*0.62*	*0.20*	*0.59*	*0.76*
2.Graham Creek	0.69	*0.54*	*0.53*	*0.80*	*0.84*	*0.86*	*0.09*	*0.61*	*0.27*
3.Western Basin	0.98	*0.81*	*0.77*	*0.98*	*0.94*	*0.87*	*0.02*	*0.37*	*0.25*
4.Boat Creek	0.77	*0.61*	*0.57*	*0.35*	*0.35*	*0.35*	*0.43*	*0.62*	*0.31*
5.Inner Harbour	0.75	*0.76*	*0.56*	*0.69*	*0.61*	*0.51*	*0.11*	*0.56*	*0.41*
6.Calliope Estuary	0.66	*0.50*	*0.27*	*0.48*	*0.68*	*0.65*	*0.29*	*0.67*	*0.70*
7.Auckland Inlet	0.55	*0.36*	*0.36*	*0.61*	*0.63*	*0.80*	*0.57*	*0.83*	*0.82*
8.Mid Harbour	0.70	*0.54*	*0.49*	*0.58*	*0.78*	*0.56*	*0.06*	*0.53*	*0.59*
9.South Trees Inlet	0.63	*0.39*	*0.31*	*0.54*	*0.47*	*0.39*	*0.34*	*0.77*	*0.71*
10.Boyne Estuary	0.74	*0.63*	*0.37*	*0.64*	*0.53*	*0.46*	*0.34*	*0.45*	*0.71*
11.Outer Harbour	NS	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*	*NS*
12.Colosseum Inlet	0.73	*0.68*	*0.41*	*0.29*	*0.56*	*0.63*	*0.45*	*0.53*	*0.63*
13.Rodds Bay	0.73	*0.59*	*0.64*	*0.47*	*0.51*	*0.48*	*0.36*	*0.57*	*0.69*
ALL OF HARBOUR	0.70	*0.57*	*0.47*	*0.59*	*0.62*	*0.60*	*0.27*	*0.59*	*0.57*

NS = not surveyed

A **Very good** (0.85 – 1.00)

B **Good** (0.65 – 0.84)

C **Satisfactory** (0.50 – 0.64)

D **Poor** (0.25 – 0.49)

E **Very poor** (0.00 – 0.24)

1. INTRODUCTION

The Gladstone Healthy Harbour Partnership (GHHP) was established in 2013 to assess the health of Gladstone Harbour. The GHHP produces an annual report on the health of the harbour that includes environmental, social, cultural and economic indicators. Fish recruitment and health were identified as important environmental indicators.

Following trial surveys in 2014-15 Yellowfin Bream (*Acanthopagrus australis*) and Pikey Bream (*Acanthopagrus pacificus*)[1] were selected as appropriate species to be used as fish recruitment indicators (Sawynok et al. 2018) From 2015-16 to 2019-20 standardised surveys were undertaken from December-March at 26 sites in the 13 environmental reporting zones to assess recruitment and provide scores and grades for the report card. From 2020-21 to 2024-25 standardised surveys were undertaken from December-February using the same methodology as in previous years. This resulted in three sampling events rather than the four conducted in prior years.

2. OBJECTIVES

The requirements of this project were to:

1. Conduct a castnet sampling program based on the approved sampling design over the 2024-25 Bream recruitment season.
2. Provide Bream recruitment report card scores and grades for the 2025 Gladstone Harbour Report Card.

[1] Pikey Bream was previously known as *Acanthopagrus berda*

3. GLADSTONE HARBOUR MONITORING ZONES

The Gladstone Harbour has been divided into 13 environmental monitoring zones for the GHHP Report Card as shown in Figure 1. The area includes Gladstone Harbour, Calliope River, Boyne River, the Narrows, Outer Harbour and Rodds Bay.

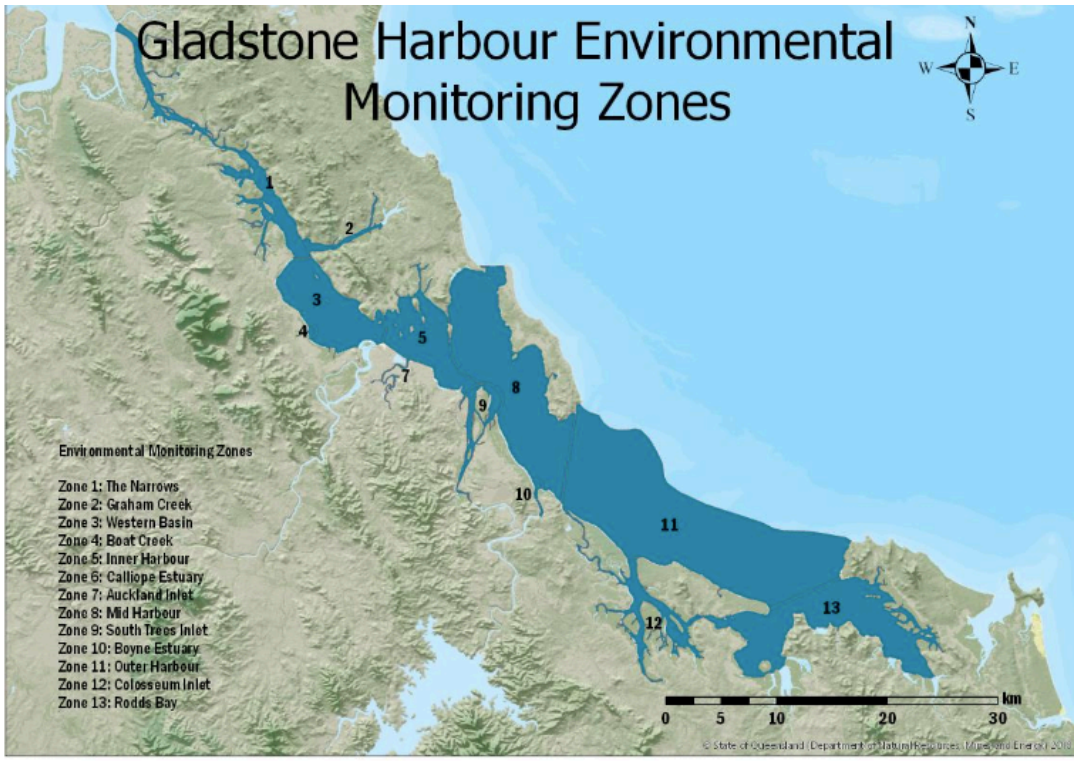


Figure 1: Gladstone reporting zones for the GHHP Report Card (from 2018 Report Card Technical Report.pdf at https://dims.ghhp.org.au/repo/public/79fdb7).

The 13 Gladstone Harbour reporting zones are:

1. The Narrows
2. Graham Creek
3. Western Basin
4. Boat Creek
5. Inner Harbour
6. Calliope Estuary
7. Auckland Creek
8. Mid Harbour
9. South Trees Inlet
10. Boyne Estuary
11. Outer Harbour
12. Colosseum Inlet
13. Rodds Bay

4. SITE LOCATIONS

There were 26 survey sites surveyed in 2024-25. Survey sites are shown in Figure 2. Sites were chosen where Bream recruits were likely to be encountered. Sites were also selected within the estuaries and at the upper tidal limit in some areas to determine the extent of distribution of recruits within the estuaries.

For the 2024-25 surveys one site was moved due to access issues. This was site 91 Iveragh and was moved 3.4km to the north-east to site 147 Foreshores (circled in Figure 2) and was still within the Colosseum Inlet sub-region. The site is at the Foreshores unformed public boat ramp so does not have any access issues. Figure 3 shows two views of the Foreshores site on Foreshores Creek.

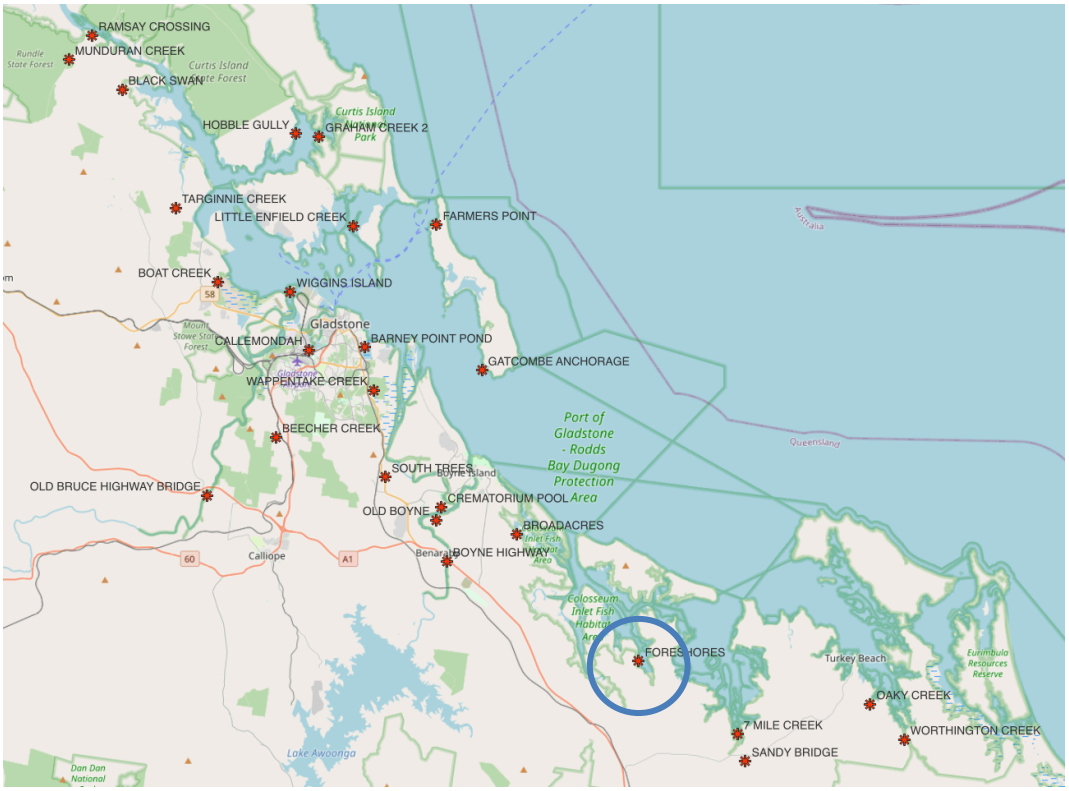


Figure 2: Site locations and site ID in the Gladstone area for Bream recruitment surveys.

Figure 3: New site 147 at Foreshores replacing site 91 at Iveragh.

5. TIMING OF SURVEYS

Yellowfin Bream spawn along foreshores near estuary entrances during winter with a peak in July-August and return to estuaries after spawning (Pollock et al 1982). Pikey Bream migrate to the lower reaches of estuaries from May-September to spawn with peak spawning during July-August (Bray, D.J. 2018).

Figure 4 shows the long term monthly mean rainfall at Gladstone Airport from March to February from http://www.bom.gov.au/. This shows that the spawning period is during winter when rainfall is low, and climatic conditions are generally stable. Rainfall then increases towards the end of the year and early in the next year. Rainfall around the monthly mean is likely to improve food supply for recruits.

The survey period was initially from December to March but was reduced to December to February from 2020-21 due to resource limitations. This allows recruits to distribute widely throughout the estuaries following spawning. Recruits are generally 30-70mm when first encountered in December. Surveys were initially conducted around or after full moon tides as these allow the recruits to distribute widely, including to the upper tidal limit and into freshwater under the right conditions. However, spring tides in October and November also allow recruits to access all areas allowing more flexibility in the timing of surveys.

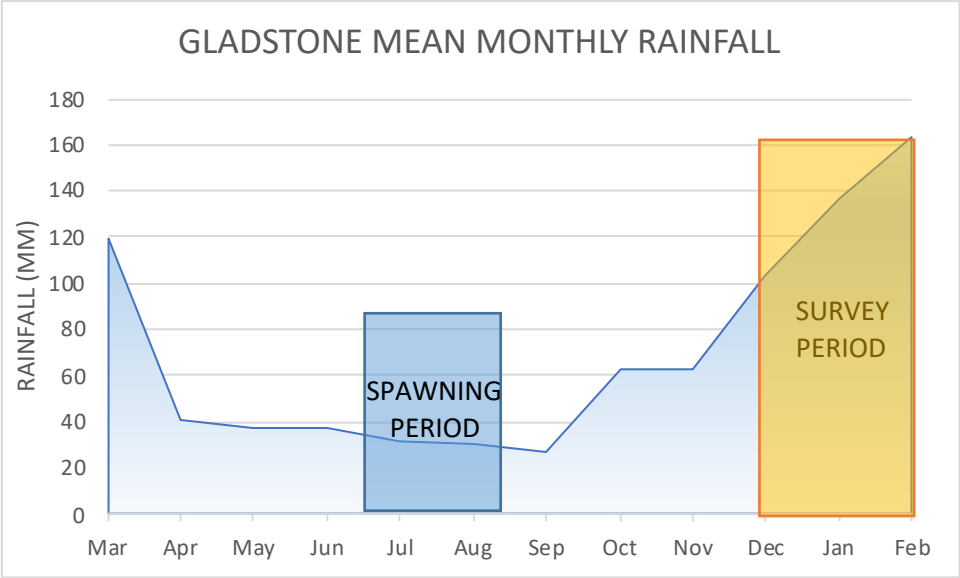


Figure 4: Gladstone long term mean monthly rainfall and Bream spawning and survey periods.

6. METHODS

Details of methods used were provided in "Fish recruitment indicators for the Gladstone Harbour Report Card using data derived from castnet sampling 2018" (Sawynok et al. 2018). There were no changes in 2024-25 to the methods used in the previous surveys (Sawynok and Venables 2017). In summary, each survey comprised 20 casts with a castnet at each site covering the same areas as previous surveys.

Prior to 2020-21 surveys, sampling was conducted monthly between December and March with a total of four survey rounds with 104 surveys. From 2021-22 to 2024-25 sampling was conducted from December to February with three survey rounds and 78 surveys. Figure 5 shows the castnet method used and Figure 6 and Figure 7 show the target species of Bream.

The random effects statistical model used was the same as that described in the 2018 report (Sawynok et al 2018). In summary, the random effects model was used to generate scores on a 0-1 scale for each site. The scores for each site were then averaged to provide a zone score and then zone scores were averaged to give an all-of-harbour score. Scores were then converted to a grade based on the following scale:

E	D	C	B	A
0.00-0.24	0.25-0.49	0.50-0.64	0.65-0.84	0.85-1.00

Figure 5: Castnet method used for the recruitment surveys.

Figure 6: Pikey Bream recruit from Black Swan in February 2025.

Figure 7: Yellowfin Bream recruits from Graham Creek in February 2025.

7. RESULTS

7.1 Summary of 2024-25 Surveys

Surveys were undertaken each month from December-February. Dates for the surveys were:

- 1-18 December 2024
- 3-17 January 2025
- 5-16 February 2025

Table 1: Summary of the results of monthly surveys from December 2024-February 2025.

	SURVEYS	CASTS	FISH	PRAWN	CATCH	YELLOWFIN BREAM	PIKEY BREAM
DEC	26	520	1408	471	1879	164	154
JAN	26	520	1517	1248	2765	120	188
FEB	26	520	2049	1189	3238	99	119
TOTAL	78	1560	4974	2908	7882	383	461

Table 1 shows the number of individuals recorded at all sites from December 2024 - February 2025. There were 78 surveys with 1,560 casts resulting in a catch of 4,974 fish and 2,908 prawns for a total of 7,882 individuals. There were 383 Yellowfin Bream and 461 Pikey Bream recorded.

Figure 8 shows the number of fish and prawn in the catch each month while Figure 9 shows the percentage of fish and prawn in the catch each month. There was an increase of 72.3% in the number of individuals recorded from December-February with a 45.5% increase in the number of fish. There was a 165% increase in the number of prawns from December-January and a slight drop of 4.7% from January-February.

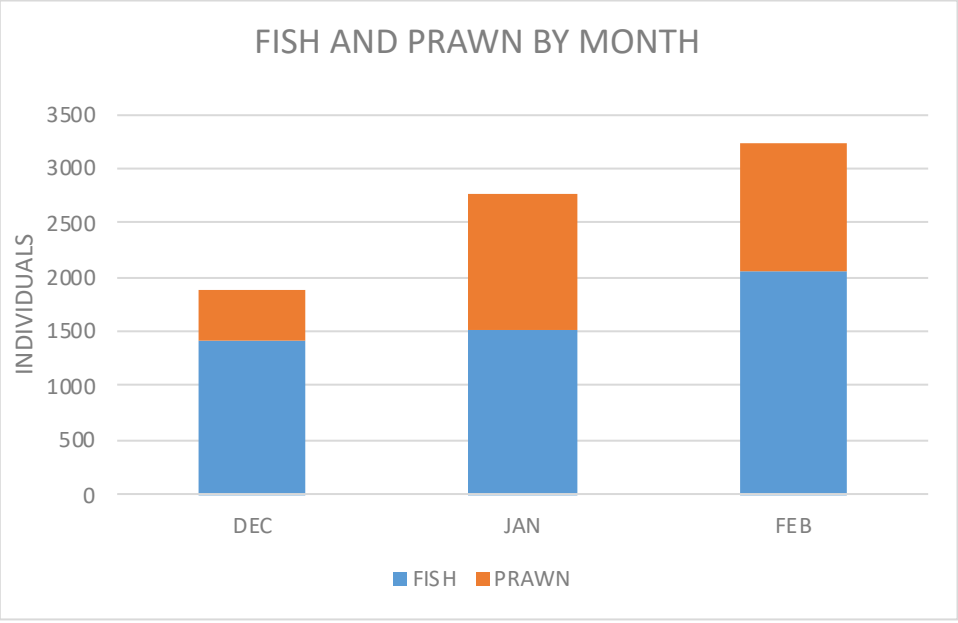


Figure 8: Numbers of fish and prawn recorded from December 2024 - February 2025.

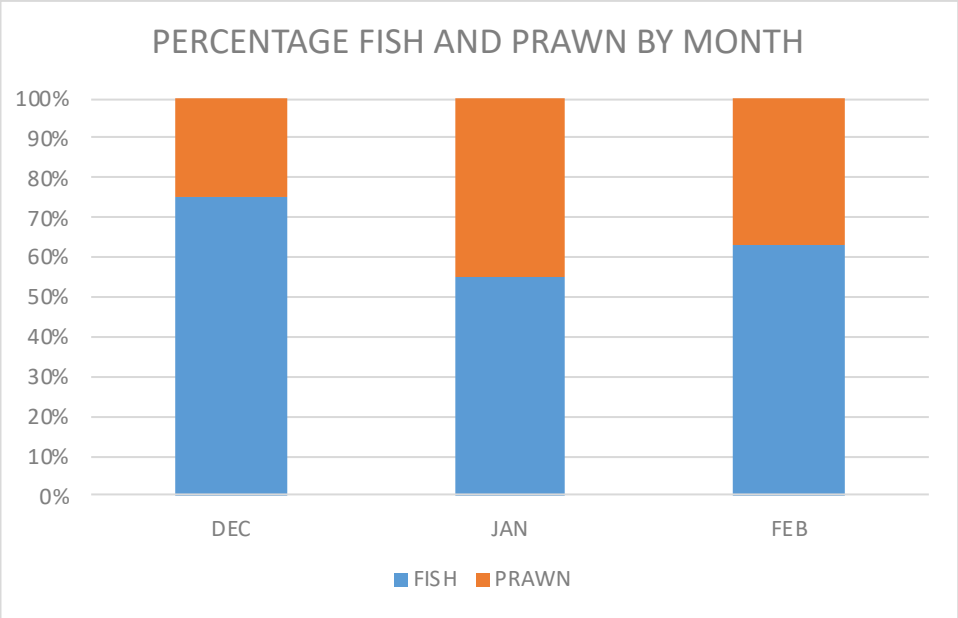


Figure 9: Percentage of fish and prawn in the catch from December 2024 - February 2025.
Figure 8

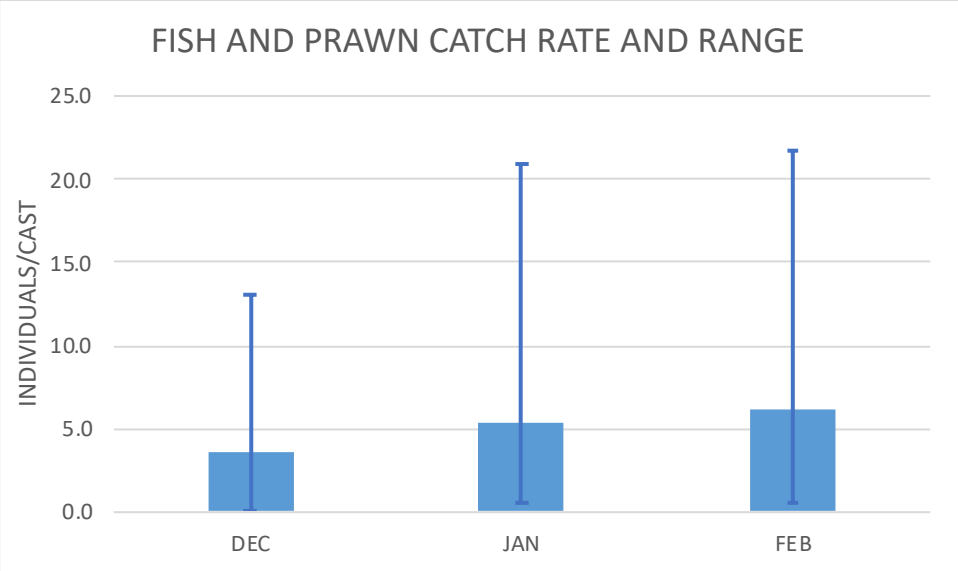


Figure 10: Catch rate of fish and prawn from December 2024 – February 2025 (bars show range of catch rates).

Figure 10 shows the catch rate and the range in catch rates for fish and prawn in each of the 3 monthly surveys with a low of 3.6 individuals/cast in December and a high of 6.2 in February. The overall catch rate was 5.1.

Table 2 provides a summary of the number of fish and prawn and the overall catch rate at each site from December 2024 - February 2025. Figure 11 shows the lowest to the highest catch rate from December - February with the February rate highlighted by the red dots.

Catch rates varied considerably between sites as shown in Table 2 and Figure 11. The highest catch rate was at 7 Mile Creek at 21.8 individuals/cast in February and dominated

by Banana Prawn. This was followed by Little Enfield Creek at 20.9 in January. Lowest catch rate was 0.1 at Wappentake Creek in December and 0.7 in January.

Table 2: Summary of catch and catch rates at each site from December 2024 - February 2025.

ZONE	SITE ID	SITE	SURVEYS	CASTS	FISH/ PRAWN	CATCH RATE
1	97	RAMSAY CROSSING	3	60	373	6.2
1	5	MUNDURAN CREEK	3	60	302	5.0
1	22	BLACK SWAN CREEK	3	60	152	2.5
1	51	TARGINNIE CREEK	3	60	456	7.6
2	62	HOBBLE GULLY	3	60	509	8.5
2	99	GRAHAM CREEK 2	3	60	588	9.8
3	146	WIGGINS ISLAND	3	60	275	4.6
4	35	BOAT CREEK	3	60	211	3.5
5	67	LITTLE ENFIELD CREEK	3	60	881	14.7
5	54	BARNEY POINT POND	3	60	51	0.9
6	6	BEECHER CREEK	3	60	76	1.3
6	81	OLD BRUCE HWY BRIDGE	3	60	341	5.7
7	49	CALLEMONDAH	3	60	398	6.6
8	95	FARMERS POINT	3	60	113	1.9
8	94	GATCOMBE ANCHORAGE	3	60	116	1.9
9	55	WAPPENTAKE CREEK	2	40	24	0.6
9	76	SOUTH TREES	3	60	374	6.2
9	90	CREMATORIUM POOL	3	60	148	2.5
10	48	OLD BOYNE	3	60	160	2.7
10	74	BOYNE HIGHWAY	3	60	133	2.2
11	OUTER HARBOUR NO SITES					
12	92	BROADACRES	3	60	621	10.4
12	147	FORESHORES	3	60	169	2.8
13	89	7 MILE CREEK	3	60	616	10.3
13	88	SANDY BRIDGE	3	60	231	3.9
13	87	OAKY CREEK	3	60	191	3.2
13	86	WORTHINGTON CREEK	3	60	373	6.2
		TOTAL	78	1540	7882	5.1

Sites that had daily tidal influence generally had a wider range of catch rates than those with intermittent tidal influence. The catch rate at 7 Mile Creek with daily tidal influence went from a low of 2.0 in December to 21.8 in February which was largely boosted by Banana Prawn. Barney Point Pond and Wappentake Creek have only intermittent tidal influence on peak spring tides and their catch rates were the lowest and fluctuated the least (Figure 11). Neither site had any significant freshwater flushing which normally boosts their use by juvenile fish.

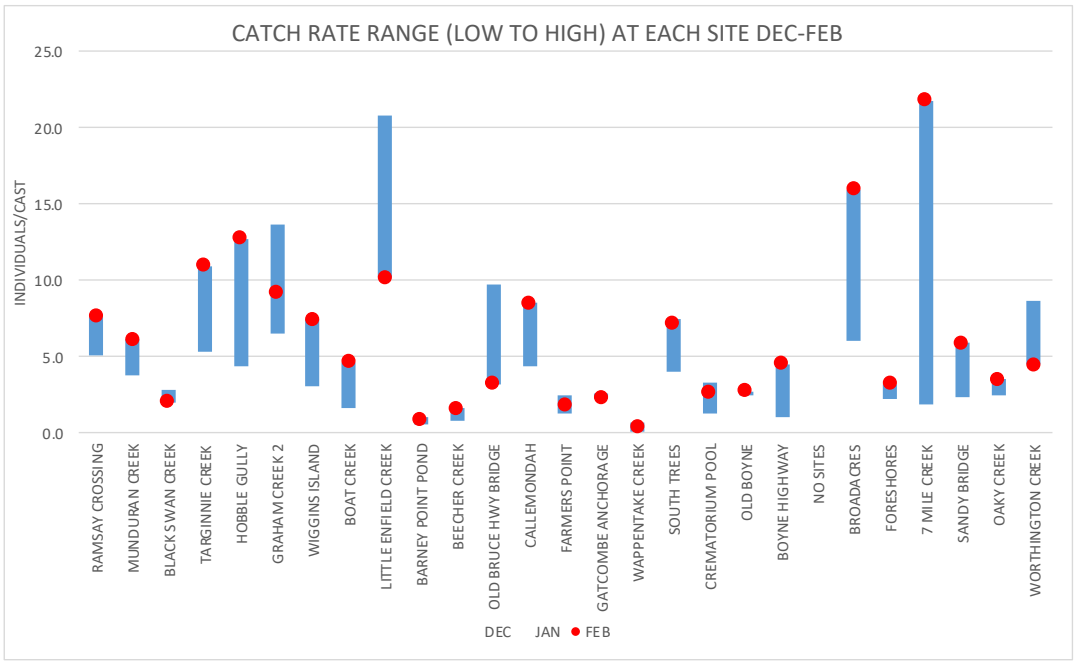


Figure 11: Catch rate at each site from December to February showing lowest to highest rate and red dots showing the February rate.

There was a total of 45 species recorded during the surveys. Figure 12 shows the 20 most recorded species. This year Banana Prawn was the most recorded at 2,905 (36.9%) followed by Flattail Mullet at 1,741 (22.1%). Pikey Bream was the 3rd most recorded species at 461 (5.8%) and Yellowfin Bream the 6th at 383 (4.9%).

There were 10 species (or species groups) of recreational, commercial, indigenous or conservation importance that were recorded during surveys. Figure 13 shows the number of sites where these species were recorded. The number of sites where each species was recorded is shown in Appendix 2.

Flattail Mullet was the only species recorded at all 26 sites. While Sea Mullet were only recorded at 1 site it is likely that some Flattail Mullet were incorrectly identified and were actually Sea Mullet, and likely to have been at more sites. Yellowfin Bream were recorded at 24 sites and Pikey Bream at 23 sites. This suggests that recruits of the two Bream species are found throughout the area up to the tidal limit and in brackish locations. Banana Prawn was recorded at 19 sites.

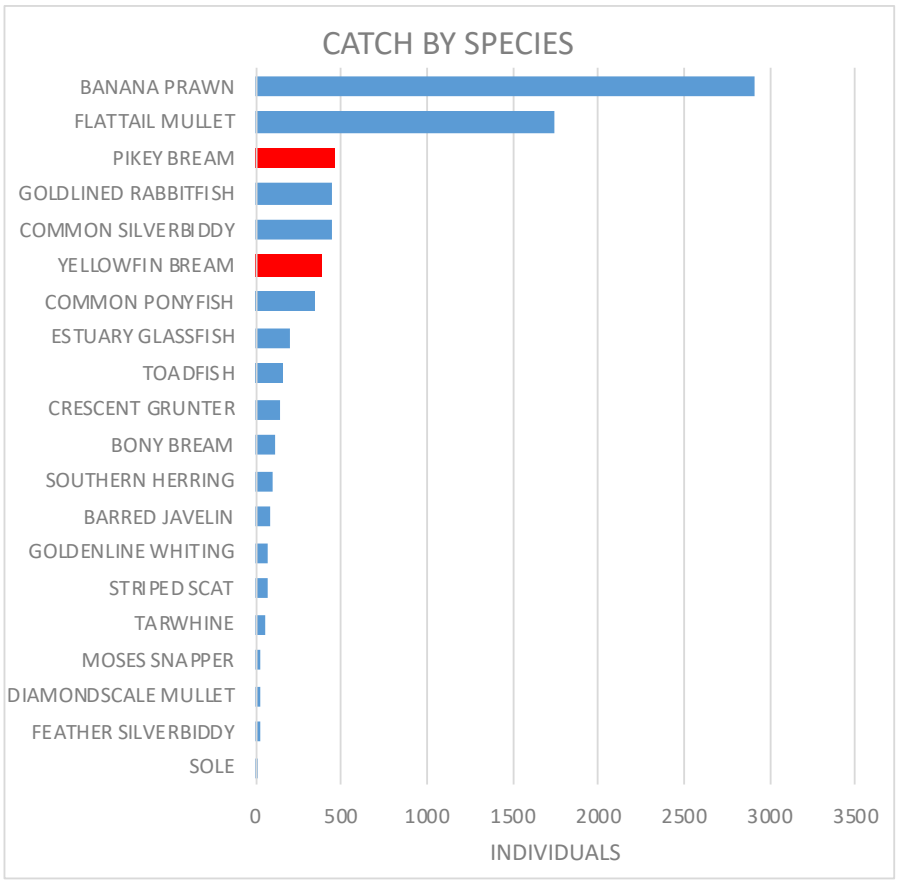


Figure 12: Number of individuals (fish and prawn) of top 20 species (key Bream species in red) recorded across all sites from December 2024 - February 2025.

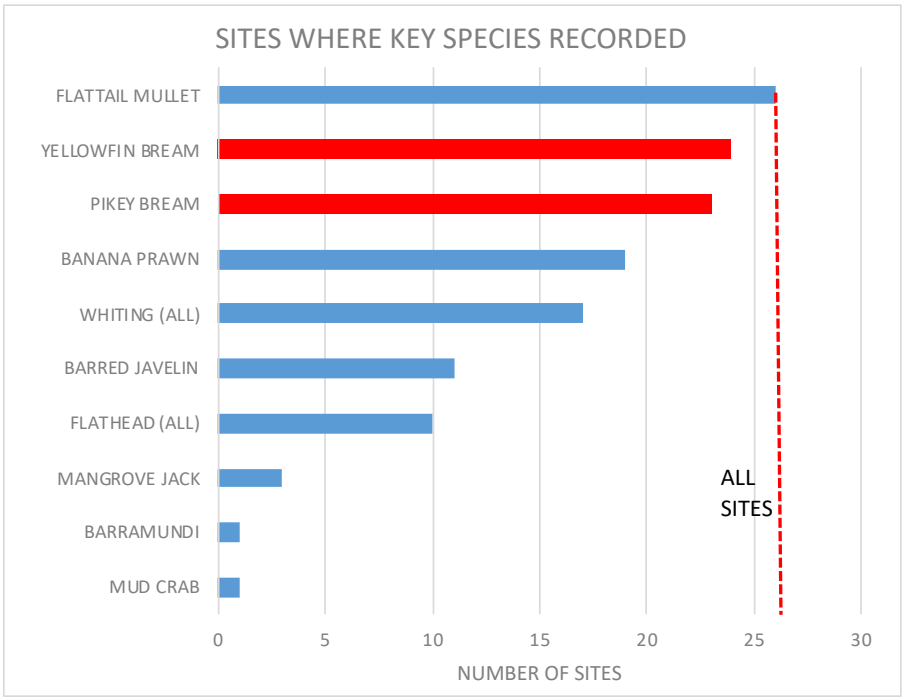


Figure 13: Number of sites where key species (Bream species in red) were recorded (dotted line total number of sites).

7.2 Bream in 2024-25

Bream recruitment is important for maintaining fish stocks and is being used as a key fish indicator for the Gladstone Harbour Report Card. Figure 14 shows the number of Bream recorded in the surveys from December 2024 - February 2025, with a total of 383 Yellowfin Bream and 461 Pikey Bream.

The number of Pikey Bream ranged from 119 in December to 188 in January. Yellowfin Bream numbers ranged from 99 in February to 164 in December.

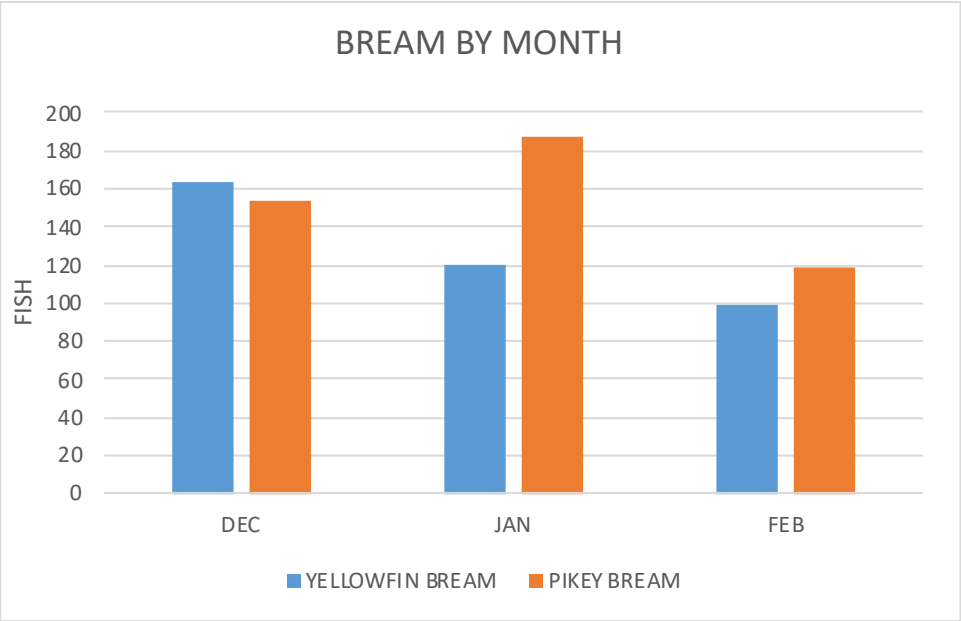


Figure 14: Numbers of Bream recorded during monthly surveys from December 2024 – February 2025.

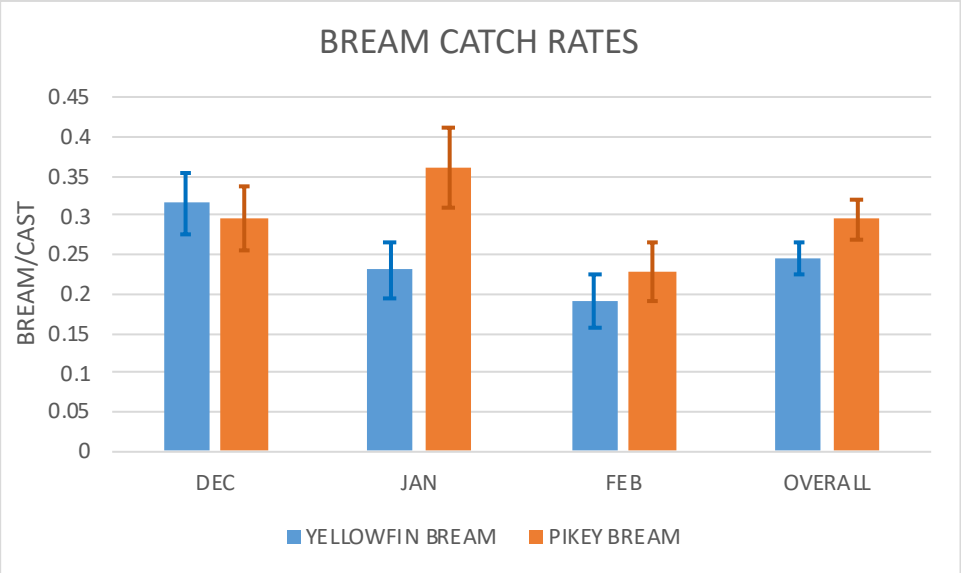


Figure 15: Mean monthly catch rates with 95% confidence bars for each Bream species from December 2024 – February 2025 and overall.

Figure 15 shows the mean catch rates for each of the Bream species in each month's surveys and the overall catch rates for all surveys.

Overall, the catch rate for Pikey Bream was 0.30 fish/cast and ranged from 0.23 in February to 0.36 in January. For Yellowfin Bream the overall catch rate was 0.25 and ranged from 0.19 in February to 0.32 in December.

Table 3: Bream recorded at each site in surveys from December 2024 – February 2025.

ZONE	SITE ID	SITE	SURVEYS	CASTS	YELLOW FIN BREAM	PIKEY BREAM
1	97	RAMSAY CROSSING	3	60	15	19
1	5	MUNDURAN CREEK	3	60	9	10
1	22	BLACK SWAN CREEK	3	60	5	16
1	51	TARGINNIE CREEK	3	60	23	18
2	62	HOBBLE GULLY	3	60	4	34
2	99	GRAHAM CREEK 2	3	60	1	29
3	146	WIGGINS ISLAND	3	60	21	17
4	35	BOAT CREEK	3	60	1	6
5	67	LITTLE ENFIELD CREEK	3	60	7	130
5	54	BARNEY POINT POND	3	60	0	0
6	6	BEECHER CREEK	3	60	11	10
6	81	OLD BRUCE HWY BRIDGE	3	60	10	11
7	49	CALLEMONDAH	3	60	13	14
8	95	FARMERS POINT	3	60	4	0
8	94	GATCOMBE ANCHORAGE	3	60	2	10
9	55	WAPPENTAKE CREEK	3	60	0	0
9	76	SOUTH TREES	3	60	26	22
9	90	CREMATORIUM POOL	3	60	36	9
10	48	OLD BOYNE	3	60	24	9
10	74	BOYNE HIGHWAY	3	60	47	4
11	OUTER HARBOUR NO SITES					
12	92	BROADACRES	3	60	4	8
12	91	FORESHORES	3	60	34	37
13	89	7 MILE CREEK	3	60	7	27
13	88	SANDY BRIDGE	3	60	22	1
13	87	OAKY CREEK	3	60	34	12
13	86	WORTHINGTON CREEK	3	60	23	8
		TOTAL	78	1560	383	461

Table 3 and Figure 16 show the numbers of Bream recorded at each of the sites from December to February. The largest number of Yellowfin Bream (47) was recorded at Boyne Highway while the largest number of Pikey Bream (130) was recorded at Little Enfield Creek.

Bream were recorded at 24 of the 26 sites. Yellowfin Bream were recorded at 24 sites and Pikey Bream were recorded at 23 sites. There were no sites surveyed in zone 11 (Outer Harbour) as there was no habitat suitable for juvenile Bream in that zone.

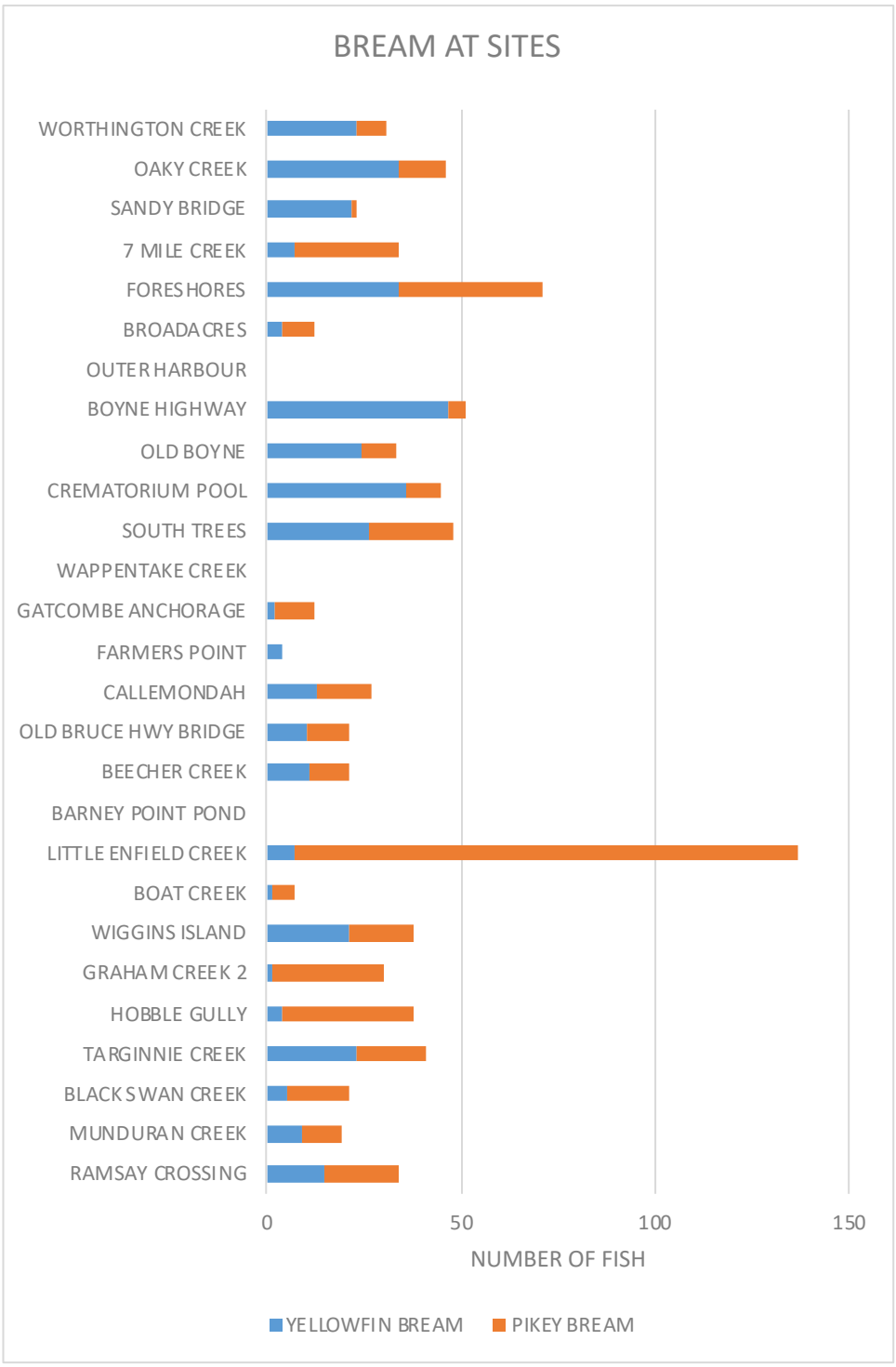


Figure 16: Numbers of Yellowfin and Pikey Bream recorded at each site in surveys from December 2024 - February 2025.

Figure 17 shows the range of lengths recorded in the surveys each month showing fork length (mm) of Bream. Crosses show the average length while the horizontal line shows the median length and dots show observations that fall outside the upper and lower fences of the boxplots.

The average length for Yellowfin Bream rose from 62mm in December to 79mm in February. The average length for Pikey Bream rose from 61mm in December to 74mm in February. The smallest Yellowfin Bream recorded was 39mm in December and the smallest Pikey Bream was 30mm in December. Growth rates are consistent with previous years.

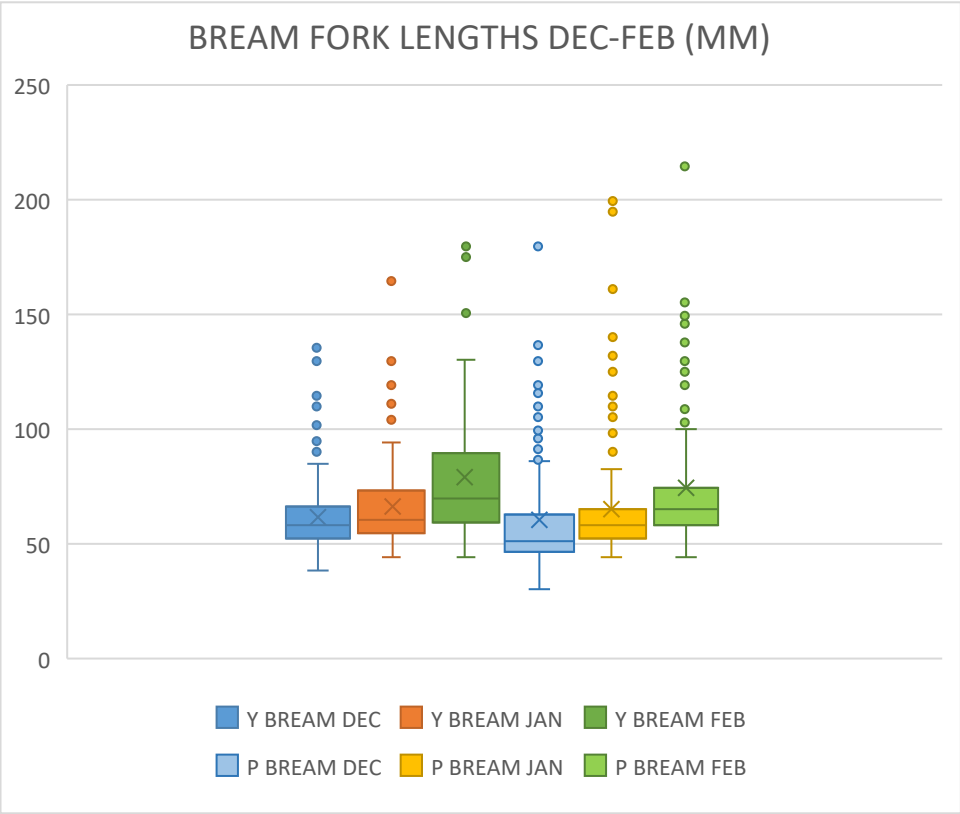


Figure 17: Fork lengths (mm) of Bream recorded during surveys from December 2024 – February 2025.

Figure 18 shows the long term mean monthly rainfall recorded at the Gladstone Airport station 039326, rainfall from March 2024 to February 2025, and the number of Bream recruits (Yellowfin and Pikey combined) recorded during surveys from December to February.

This shows low rainfall during the Bream spawning period with stable climatic conditions. While rainfall from November to January was around the long term mean, much of this rainfall was from isolated storms and varied over the survey area. Most sites did not get a freshwater flush until January, and this was likely to have led to the boost in Prawn numbers in February.

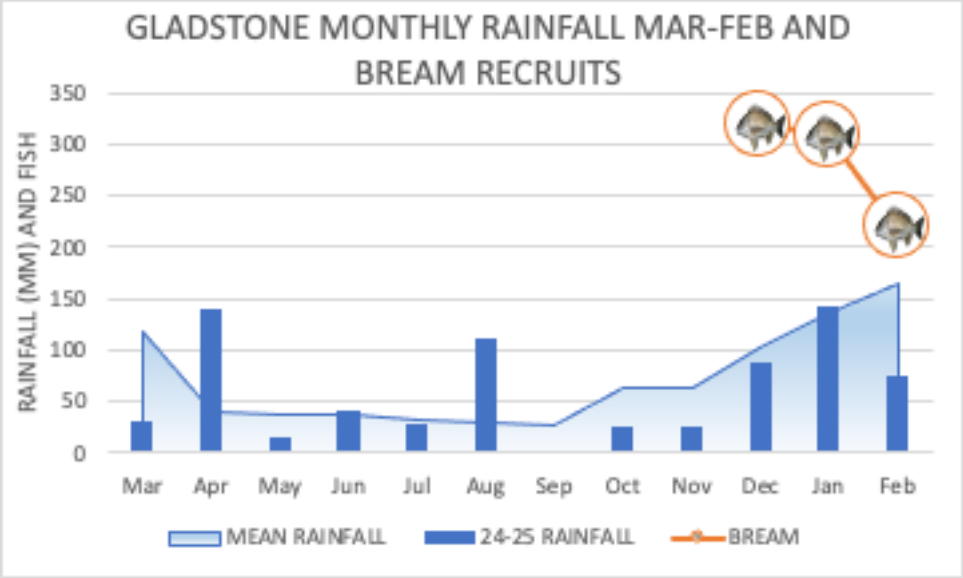


Figure 18: Gladstone mean monthly rainfall, rainfall March 2024-February 2025, and Bream recruits (December to February).

8. COMPARING RESULTS FROM 2016-17 TO 2024-25

There are now 10 years of surveys however, only 9 years are used in comparing results. Table 4 and Figure 19 shows the number of fish and prawn recorded each year. In 2015-16 there were 103 surveys with 2,020 casts while in 2016-17, 2017-18, 2018-19 and 2019-20 there were 104 surveys with 2,080 casts from December to March. From 2020-21 to 2022-23 there were 78 surveys with 1,560 casts from December to February while in 2023-24 there were 77 surveys with 1,540 casts (1 site not able to be surveyed in December). In 2024-25 there were 78 surveys with 1,560 casts.

For comparison, only data from the December to February surveys from 2016-17 to 2024-25 (9 years) were used. That is from 78 surveys with 1,560 casts each year except for 2023-24.

Table 4: Summary of surveys of fish and prawn recorded from December to February 2016-17 to 2024-25.

YEAR	SURVEYS	CASTS	FISH	PRAWN	TOTAL	FISH/ CAST	PRAWN /CAST
24-25	78	1560	4974	2908	7882	3.19	1.86
23-24	77	1540	4866	1795	6661	3.16	1.17
22-23	78	1560	5195	3077	8272	3.33	1.97
21-22	78	1560	5782	497	6279	3.71	0.32
20-21	78	1560	5178	3366	8544	3.32	2.16
19-20	78	1560	5237	1742	6979	3.36	1.12
18-19	78	1560	3910	516	4426	2.51	0.33
17-18	78	1560	4398	1068	5466	2.82	0.68
16-17	78	1560	4862	1544	6406	3.12	0.99

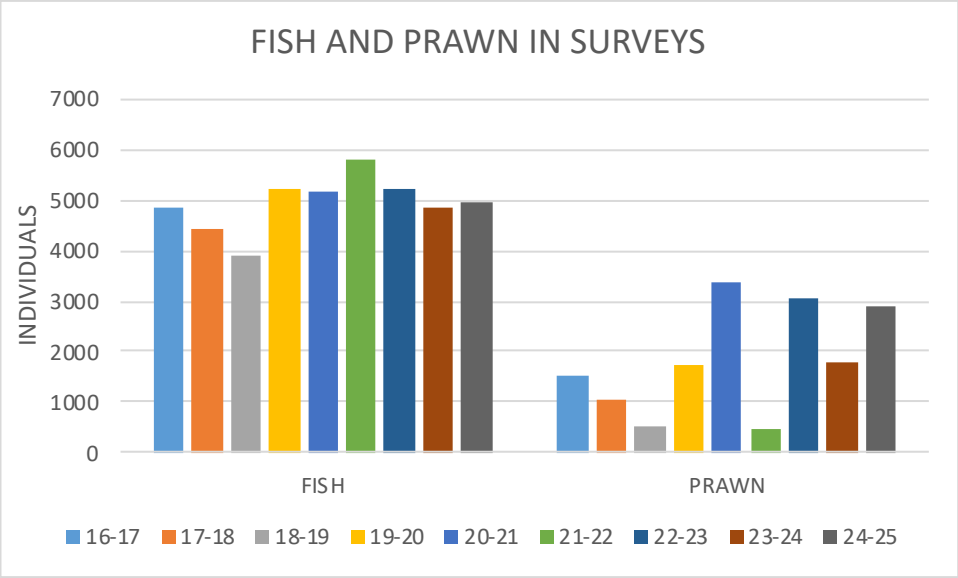


Figure 19: Numbers of fish and prawn recorded during surveys from December to February 2016-17 to 2024-25.

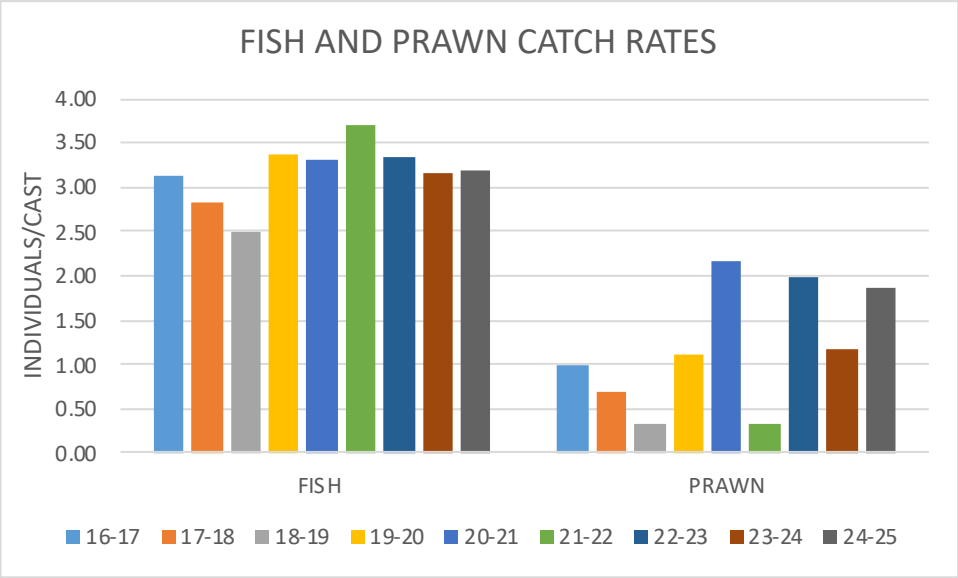


Figure 20: Catch rates of fish and prawn recorded during surveys from December to February 2016-17 to 2024-25.

Figure 20 shows the catch rate of fish and prawn recorded each year. The highest catch rate of fish was 3.71 fish/cast in 2021-22 and the lowest was 2.51 in 2018-19. In 2024-25 the catch rate of fish was 3.19. The prawn catch rate fluctuated more, with the highest catch rate of 2.16 in 2020-21, and the lowest catch rate of 0.32 in 2021-22. In 2024-25 the prawn catch rate was 1.86.

The percentage of NIL casts in each of the survey years is shown in Figure 21. In 2024-25 the NIL casts were 21.6%, with the highest at 39.3% occurring in 2018-19. The lowest percentage of NIL casts was 16.4% in 2020-21.

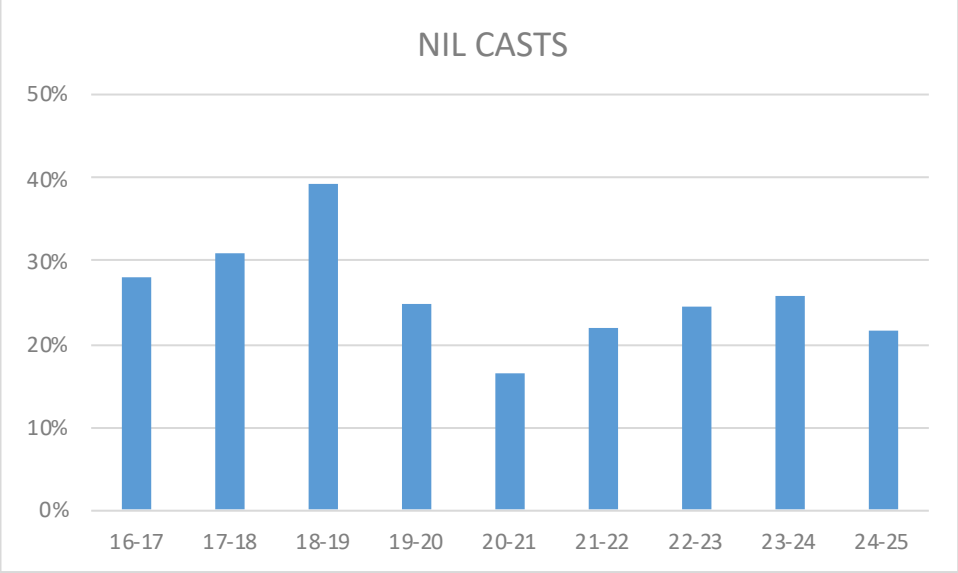


Figure 21: Percentage of NIL casts in each year from December to February 2016-17 to 2024-25.

Table 5 provides a summary of the Bream catch in surveys from 2016-17 to 2024-25 while Figure 22 provides the numbers of Bream recorded each year.

Table 5: Summary of surveys of the Bream catch from December to February 2016-17 to 2024-25.

YEAR	SURVEYS	CASTS	Y'FIN	PIKEY	TOTAL	Y'FIN/ CAST	PIKEY/ CAST
24-25	78	1560	383	461	844	0.25	0.30
23-24	77	1540	236	405	641	0.15	0.26
22-23	78	1560	340	193	533	0.22	0.12
21-22	78	1560	316	448	768	0.21	0.29
20-21	78	1560	329	297	626	0.21	0.19
19-20	78	1560	273	411	684	0.18	0.26
18-19	78	1560	213	152	365	0.14	0.10
17-18	78	1560	276	354	630	0.18	0.26
16-17	78	1560	454	255	709	0.29	0.16

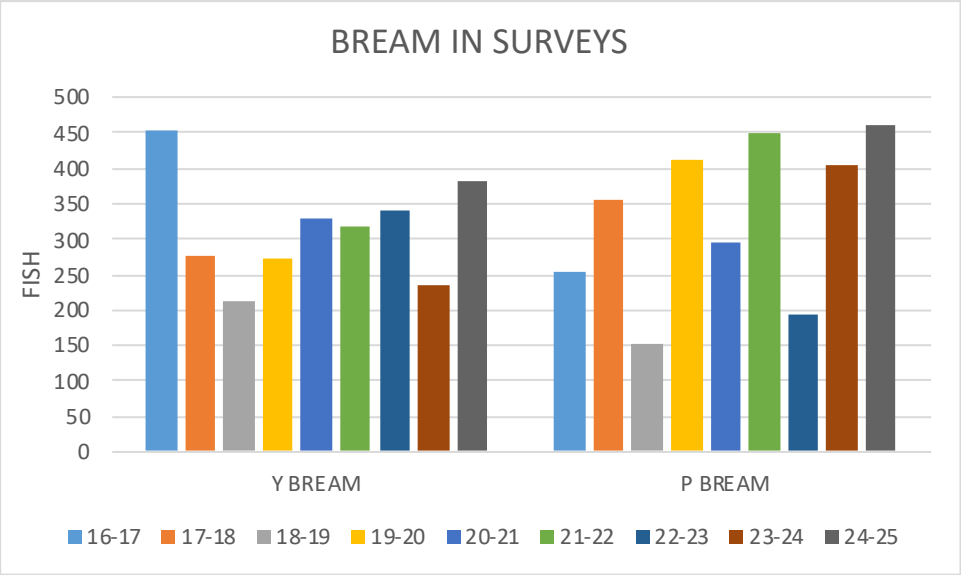


Figure 22: Numbers of Yellowfin and Pikey Bream recorded in surveys from December to February 2016-17 to 2024-25.

Figure 23 shows the catch rate of Bream per cast. In 2024-25 the catch rate for Yellowfin Bream was 0.25 fish/cast, while it was highest in 2016-17 at 0.29. The catch rate for Pikey Bream in 2024-25 was 0.30 which is the highest rate recorded so far.

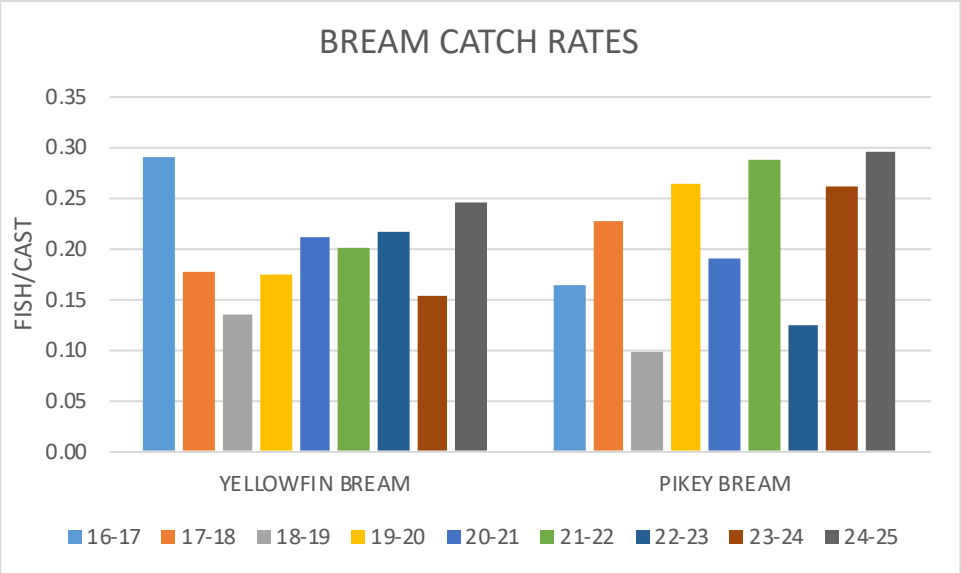


Figure 23: Comparison of Bream catch rates from December to February 2016-17 to 2024-25.

Table 6 and Figure 24 show the number of sites where Bream were recorded each year. In 2024-25 Yellowfin Bream were recorded at 25 of the 26 sites while Pikey Bream were recorded at 24 sites. Bream continue to be recorded at most of the sites. Over the 9 years of surveys Bream have been recorded at all 26 sites indicating their wide distribution throughout the Gladstone Harbour area.

Table 6: Number of sites where Bream were recorded from December to February 2016-17 to 2024-25.

YEAR	Y'FIN	PIKEY
24-25	25	24
23-24	25	22
22-23	22	17
21-22	23	21
20-21	24	20
19-20	24	24
18-19	20	20
17-18	23	24
16-17	20	20

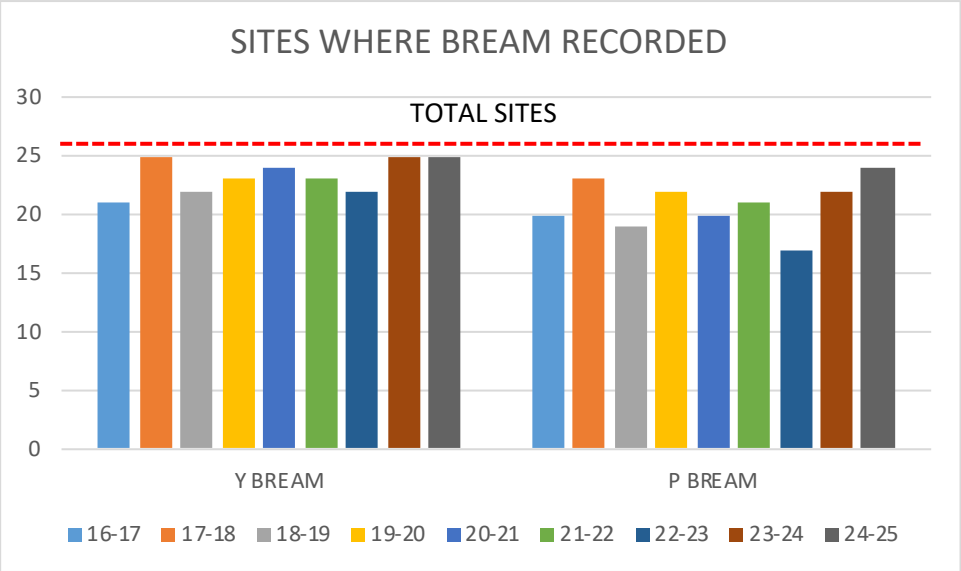
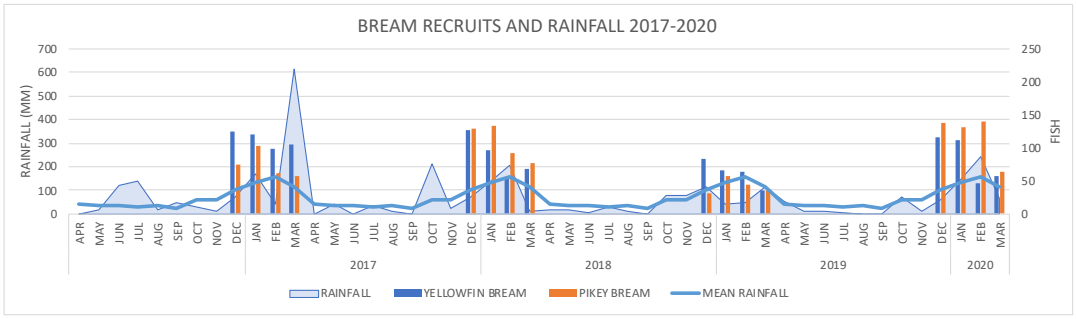


Figure 24: Sites where Bream were recorded December to February 2016-17 to 2024-25 (dotted line is the total number of sites surveyed (26)).

Figure 25 shows Gladstone monthly rainfall, mean monthly rainfall, and the numbers of Yellowfin and Pikey Bream recorded in each monthly survey. The top graph shows Bream recruits from surveys carried out from December to March while the bottom graph shows the surveys carried out from December to February.



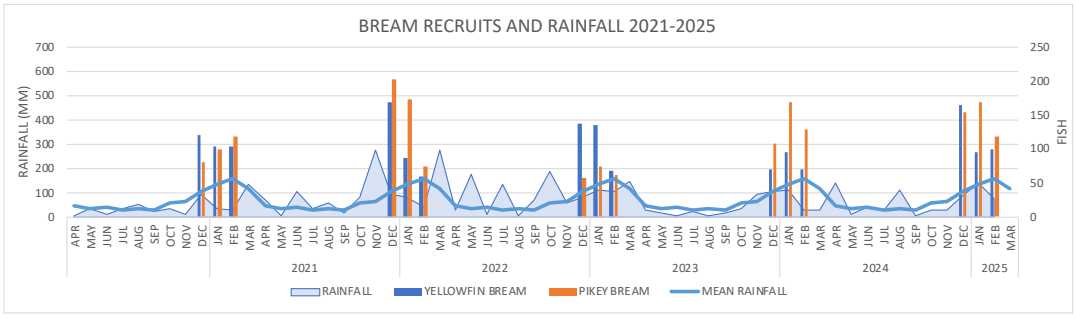


Figure 25: Bream recruits from 2016-17 to 2024-25, total monthly rainfall (mm) and mean monthly rainfall from April 2016-February 2025.

9. OTHER SPECIES

Apart from Bream there were 9 species or specie groups of recreational, commercial, indigenous or conservation importance that were recorded during surveys.

Table 7 shows the number of individuals recorded from 2016-17 to 2024-25. Figure 26 shows the number of fish for the top 4 other species recorded. Banana Prawn and Mullet (all) dominate the other species. Numbers of other species are from surveys from December to February in each year for comparability.

Table 7: Numbers of key species recorded in surveys from 2016-17 to 2024-25.

SPECIES	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25
BANANA PRAWN	1544	1268	516	1140	3366	497	3223	1795	2905
MULLET (ALL)	1626	1429	1257	1223	1808	1787	1845	2297	1742
BARRED JAVELIN	44	11	14	55	35	197	55	68	84
WHITING (ALL)	110	102	51	64	99	57	99	59	79
FLATHEAD (ALL)	21	34	16	15	23	18	16	22	11
MUD CRAB	24	8	14	5	14	0	1	3	1
MANGROVE JACK	12	16	6	3	6	3	9	12	5
BARRAMUNDI	0	1	0	0	2	3	2	0	1
KING THREADFIN	0	2	2	0	0	1	3	1	0

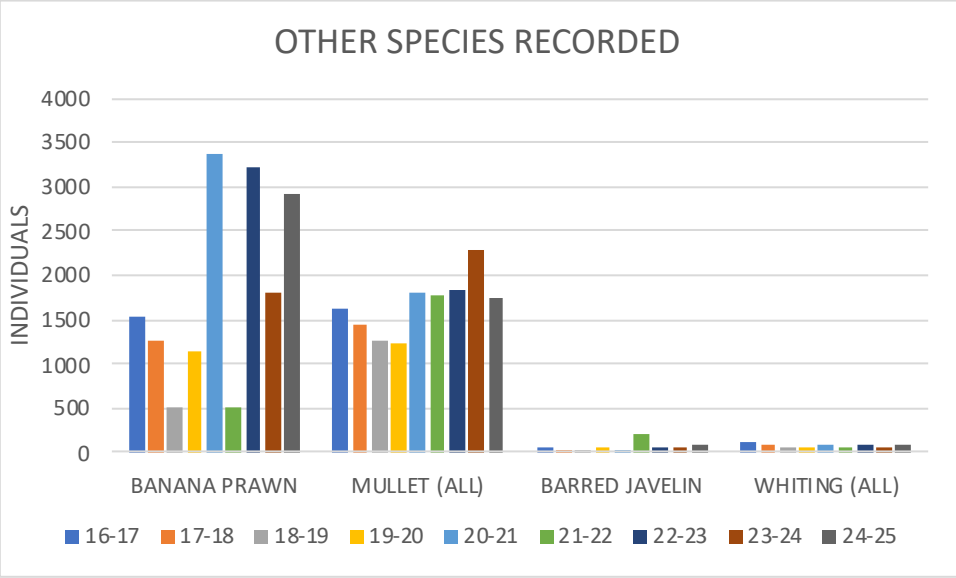


Figure 26: Numbers of other species recorded from December to February 2016-17 to 2024-25.

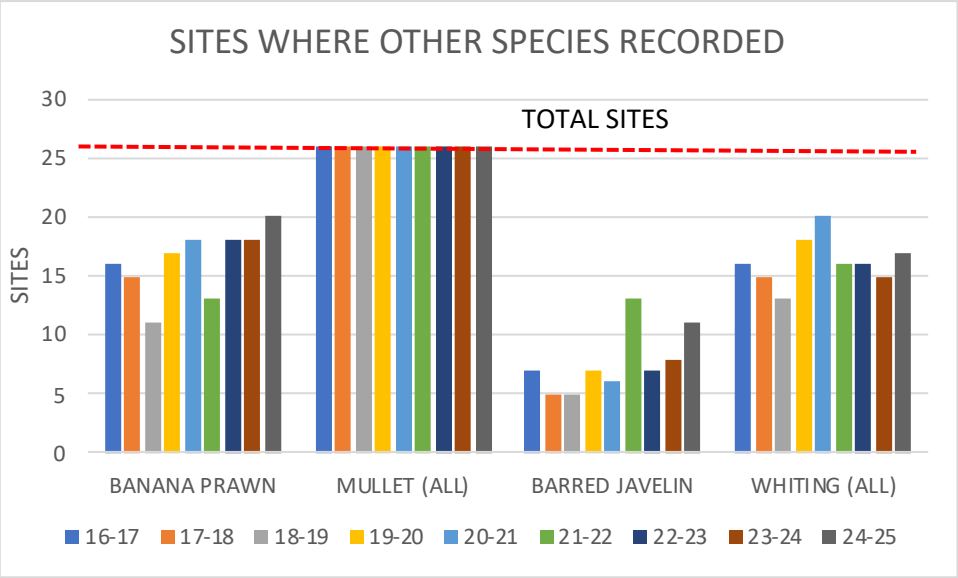


Figure 27: Sites where other species were recorded 2016-17 to 2024-25 (dotted line is the total number of sites (26)).

Figure 27 shows the number of sites where the top 4 other species or species group were recorded from December to February in each survey year. Mullet (all) have been consistently recorded at all 26 sites while Banana Prawn have been recorded at 11-20 sites. There has been a steady increase in the number of sites where Barred Javelin were recorded over the years and in 2024-25 they were recorded at 11 sites. In 2021-22 they were recorded at 13 sites. Whiting (all) were recorded at 13-20 sites in all years.

10. RECRUITMENT INDEX

A negative binomial random effects statistical model (Sawynok B, Sawynok S and Venables B (2018)) has been applied to the pooled data commencing in 2011-12. While the purpose of fitting this model is to obtain grades for the current survey year 2024-25, it relies on the use of historical data to estimate key model parameters.

One of the important concerns is the stability of the process itself. To examine stability, the results of 2 parameters are presented, namely for the data set up to last year only (that is, for 2011-12 to 2023-24 inclusive), compared with the results for the entire data record, including 2024-25. This shows the result for last year, as if the method now suggested was used, and the effect on it of adding this year's additional data.

10.1 Negative binomial model parameter

The estimated negative binomial model parameters θ are very stable when approximately equal to 2. Re-estimating them from the final fitted model, for the restricted and full data sets, yields

- $\hat{\theta}$ = 2 for the model fitted with data up to year 2022-23 only, and
- $\hat{\theta}$ = 2 when the further data for year 2023-24 is included and
- $\hat{\theta}$ = 2 when the further data for year 2024-25 is included.

Fixing this parameter at $\theta = 2$ provides a degree of stability in the process, but leaves the crucial estimates, and the scores and grades, relatively unaffected.

10.2 Variance

The additional data gained in the 2024-25 surveys also leaves the variance component estimates for Site and Year x Site relatively unaffected, as shown in Table **8**. However, the results for Year x Site shows a reduction in variability with the extra data included.

Table 8: Variance component estimates (as standard deviations) for the main model using (a) only data up to year 19-20, (b) only data to year 20-21 and (c) all available data.

	(a) data to22-23	(b) data to 23-24	(c) data to 24-25
Site	0.8343	0.8389	0.8524
Year	0.2199	0.2053	0.2201
Year x Site	0.5040	0.4916	0.4758

10.3 Site Main Effects

The site main effects, $E_S \sim \mathrm{N}(0, \sigma_S^2)$, indicate how variable Bream abundance is at sites. These effects are on a logarithmic scale, so comparisons are proportional rather than differenced. Sites with naturally low average Bream abundance have a low capacity to show small proportional differences, whereas those with higher natural abundance have a greater capacity. It is making justifiable allowance for these natural differences between sampling sites that is a key challenge of this analysis.

In order to show the relative stability of the site main effects with the addition of new data Figure **28** shows the BLUPs using data up to 2023-24 (horizontal scale) and estimates using the full data set to 2024-25 (vertical scale). The diagram is partitioned into zones to show

the high degree of heterogeneity between and within zones. Sites with the greatest heterogeneity were Rodds Bay and Inner Harbour. It is this heterogeneity that complicates the production of fully justifiable scores. The diagonal line in each panel indicates where the two estimates would be equal. Points relatively distant from the line had the greatest change. Noted was that very few sites were distant from the equality line.

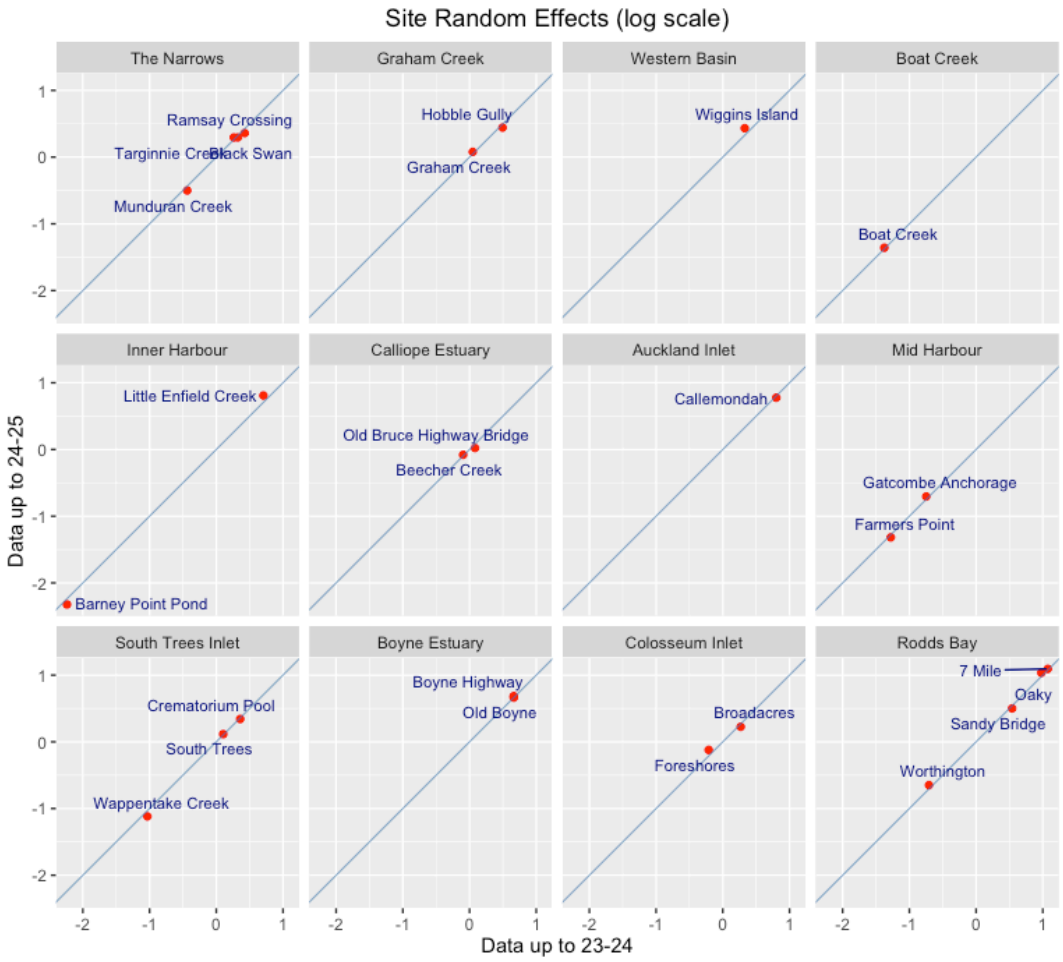


Figure 28: Site random effect estimates. A comparison of BLUPs using the restricted data set with those using the full data set.

Table 9 shows the combined year and year by site BLUP estimates, that is $E_Y + E_{YS}$, for all years in the study. The year BLUP, E_Y, is the representation of how much each year differs in aggregate from a conceptual long-term mean in catch rate, and the year by site BLUP, E_{YS}, represents the deviation of each site from its year aggregate. Both of these are *after the allowance* for aggregate site differences, as encapsulated by the site BLUPs, E_S.

Table 9: Random effects estimates (BLUPs), $\boldsymbol{E_Y + E_{YS}}$, for the Gladstone Harbour Bream survey sites for years 2016-17 to 2024-25.

Zone	Site	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25
The Narrows	Ramsay Crossing	0.42	0.28	-0.31	0.47	-0.78	0.28	-0.54	-0.30	0.01
	Munduran Creek	0.33	-0.01	-0.48	-0.39	0.17	-0.01	-0.02	-0.20	0.03
	Black Swan	0.90	0.08	-0.27	0.21	0.10	0.16	-0.10	-0.16	0.12
	Targinnie Creek	0.01	0.05	-1.10	0.37	0.39	0.52	-0.14	0.27	0.48
Graham Creek	Graham Creek	-0.40	0.09	-1.18	0.67	0.26	0.59	-0.03	0.04	0.44
	Hobble Gully	-0.27	0.16	-0.53	0.44	0.58	0.31	0.02	0.01	0.10
Western Basin	Wiggins Island	-0.40	-0.23	-1.13	0.52	0.41	0.87	0.25	0.39	0.64
Boat Creek	Boat Creek	-0.25	0.13	-0.15	-0.23	-0.26	-0.24	0.04	0.11	0.39
Inner Harbour	Little Enfield Creek	-0.24	-0.13	-1.01	0.05	0.06	0.46	0.19	0.89	0.91
	Barney Point Pond	-0.07	0.22	-0.52	-0.13	-0.10	-0.04	-0.24	0.05	0.06
Calliope Estuary	Beecher Creek	0.24	-0.11	-0.10	0.19	0.01	-0.06	-0.42	0.21	0.40
	Old Bruce Highway Bridge	0.29	0.70	-0.61	0.18	0.55	0.05	-0.26	-0.26	0.05
Auckland Inlet	Callemondah	0.48	0.49	0.08	0.44	0.17	0.17	-0.19	-0.20	0.06
Mid Harbour	Farmers Point	1.07	0.28	-0.79	-0.35	0.18	-0.15	0.15	-0.18	0.14
	Gatcombe Anchorage	-0.44	-0.24	-0.91	0.51	0.63	0.35	-0.25	0.24	0.43
South Trees Inlet	Wappentake Creek	0.14	0.62	-0.03	-0.03	0.04	-0.20	-0.43	-0.18	0.16
	South Trees	0.08	0.34	-0.36	-0.14	-0.26	0.23	0.10	-0.29	0.45
	Crematorium Pool	0.79	0.22	-0.39	-0.35	0.09	0.19	-0.60	-0.05	0.29
Boyne Estuary	Old Boyne	0.26	-0.08	-0.65	-0.26	0.04	0.13	-0.32	0.47	0.27
	Boyne Highway	0.25	-0.11	0.02	0.07	-0.10	0.19	-0.15	-0.12	0.42
Colosseum Inlet	Broadacres	0.14	0.45	-0.11	0.28	0.01	-0.05	0.48	0.10	0.02
	Foreshores/Iveragh	0.09	-0.40	-0.17	-0.06	0.05	-0.65	0.00	0.27	0.83
Rodds Bay	Oaky	0.12	0.02	-0.06	0.17	-0.29	-0.21	0.33	0.00	0.42
	7 Mile	0.08	0.21	-0.32	-0.21	0.32	0.01	0.06	0.13	0.23
	Worthington	0.20	0.05	-0.46	0.28	0.00	-0.29	-0.32	0.10	0.66
	Sandy Bridge	0.54	-0.17	-0.15	-0.60	-0.30	0.01	0.57	0.15	0.06

The BLUPs are transformed into *scores* by dividing by their standard deviation and finding the cumulative probability in the standard normal distribution. In symbols:

$$qZ_{YS} = \frac{E_Y + E_{YS}}{\sqrt{\sigma_Y^2 + \sigma_{YS}^2}}, \qquad \text{Score}_{YS} = \Phi(Z_{YS})$$

Where $\Phi(z)$ is the standard normal (cumulative) distribution function for a random variable z.

Table 10 shows the score estimates for the Gladstone Harbour Bream survey sites for all years from 2016-17 to 2024-25.

Table 10: Score estimates on a $(\mathbf{0}, \mathbf{1})$ −scale, for the Gladstone Harbour Bream survey sites for 2016-17 to 2024-25.

Zone	Site	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25
The Narrows	Ramsay Crossing	0.79	0.70	0.27	0.82	0.07	0.71	0.15	0.28	0.50
	Munduran Creek	0.74	0.50	0.18	0.23	0.63	0.49	0.44	0.35	0.52
	Black Swan	0.96	0.56	0.31	0.66	0.58	0.62	0.43	0.38	0.59
	Targinnie Creek	0.51	0.54	0.02	0.76	0.77	0.84	0.39	0.70	0.82
Graham Creek	Graham Creek	0.22	0.56	0.01	0.90	0.69	0.87	0.47	0.53	0.80
	Hobble Gully	0.30	0.62	0.16	0.80	0.87	0.72	0.51	0.51	0.57
Western Basin	Wiggins Island	0.22	0.33	0.02	0.84	0.78	0.95	0.68	0.77	0.89
Boat Creek	Boat Creek	0.30	0.59	0.39	0.33	0.31	0.32	0.53	0.59	0.77
Inner Harbour	Little Enfield Creek	0.33	0.40	0.03	0.54	0.55	0.81	0.64	0.96	0.96
	Barney Point Pond	0.45	0.66	0.16	0.40	0.42	0.47	0.33	0.54	0.55
Calliope Estuary	Beecher Creek	0.68	0.42	0.42	0.64	0.50	0.45	0.21	0.66	0.78
	Old Bruce Highway Bridge	0.71	0.91	0.12	0.64	0.85	0.54	0.31	0.31	0.54
Auckland Inlet	Callemondah	0.82	0.83	0.56	0.80	0.63	0.63	0.36	0.35	0.55
Mid Harbour	Farmers Point	0.98	0.70	0.07	0.25	0.63	0.39	0.61	0.37	0.60
	Gatcombe Anchorage	0.20	0.32	0.04	0.83	0.89	0.75	0.31	0.68	0.79
South Trees Inlet	Wappentake Creek	0.60	0.88	0.48	0.48	0.53	0.35	0.21	0.36	0.38
	South Trees	0.56	0.74	0.25	0.39	0.31	0.67	0.58	0.29	0.80
	Crematorium Pool	0.93	0.66	0.23	0.25	0.57	0.64	0.13	0.47	0.71
Boyne Estuary	Old Boyne	0.69	0.44	0.11	0.31	0.53	0.60	0.27	0.82	0.70
	Boyne Highway	0.68	0.42	0.52	0.56	0.42	0.64	0.38	0.41	0.79
Colosseum Inlet	Broadacres	0.61	0.80	0.42	0.71	0.51	0.46	0.18	0.58	0.51
	Foreshores/Iveragh	0.57	0.23	0.37	0.46	0.54	0.11	0.50	0.70	0.94
Rodds Bay	Oaky	0.59	0.51	0.45	0.63	0.29	0.34	0.74	0.50	0.79
	7 Mile	0.56	0.66	0.27	0.34	0.73	0.51	0.55	0.60	0.67
	Worthington	0.65	0.46	0.19	0.70	0.50	0.29	0.27	0.58	0.89
	Sandy Bridge	0.85	0.37	0.39	0.13	0.28	0.51	0.86	0.62	0.55

10.4 Aggregation to the Zone Level

Scores are aggregated to the zone level within years by averaging over sites. Zone scores are then averaged to produce an all-of-harbour score.

The results of this averaging process are shown in Table **11**, and the resulting grades are shown in Table **12**.

Table 11: Score estimates on a $(\mathbf{0}, \mathbf{1})$ −scale, averaged over sites within zones, and over all zones to give all-of harbour scores.

Zone	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25
The Narrows	0.75	0.58	0.20	0.62	0.51	0.66	0.35	0.43	0.61
Graham Creek	0.26	0.59	0.08	0.85	0.78	0.80	0.49	0.52	0.69
Western Basin	0.22	0.33	0.02	0.84	0.78	0.95	0.68	0.77	0.89
Boat Creek	0.30	0.59	0.39	0.33	0.31	0.32	0.53	0.59	0.77
Inner Harbour	0.39	0.53	0.09	0.47	0.49	0.64	0.48	0.75	0.75
Calliope Estuary	0.69	0.67	0.27	0.64	0.68	0.50	0.26	0.48	0.66
Auckland Inlet	0.82	0.83	0.56	0.80	0.63	0.63	0.36	0.35	0.55
Mid Harbour	0.59	0.51	0.05	0.54	0.76	0.57	0.46	0.52	0.70
South Trees Inlet	0.70	0.76	0.32	0.37	0.47	0.55	0.30	0.37	0.63
Boyne Estuary	0.68	0.43	0.31	0.43	0.48	0.62	0.33	0.61	0.74
Colosseum Inlet	0.59	0.51	0.39	0.58	0.52	0.28	0.34	0.64	0.73
Rodds Bay	0.66	0.50	0.33	0.45	0.45	0.41	0.60	0.57	0.73
All of Gladstone Harbour	0.56	0.57	0.25	0.58	0.57	0.58	0.43	0.55	0.70

Table 12: Grades for (unadjusted) averaged scores over sites within zones, and over zones within the harbour.

Zone	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25
The Narrows	B	C	E	C	C	B	D	D	C
Graham Creek	D	C	E	A	B	B	D	C	B
Western Basin	E	D	E	B	B	A	B	B	A
Boat Creek	D	C	D	D	D	D	C	C	B
Inner Harbour	D	C	E	D	D	C	D	B	B
Calliope Estuary	B	B	D	C	B	D	D	D	B
Auckland Inlet	B	B	C	B	C	C	D	D	C
Mid Harbour	C	C	E	C	B	C	D	C	B
South Trees Inlet	B	B	D	D	D	C	D	D	C
Boyne Estuary	B	D	D	D	D	C	D	C	B
Colosseum Inlet	C	C	D	C	C	D	D	C	B
Rodds Bay	B	C	D	D	D	D	C	C	B
All of Gladstone Harbour	C	C	D	C	C	C	D	C	B

To provide uncertainty measures for the scores, standard bootstrapping techniques were used as described in Sawynok et al (2018). Bootstrap simulations were used in the aggregation process to incorporate zone- and harbour-level scores into higher levels of the GHHP report card.

Table 13 and Figure 29 show the original scores for the 12 zones, and all of harbour, together with their lower and upper uncertainty limits as calculated by the bootstrap simulation method. The Western Basin had the highest A grade while Auckland Inlet had the lowest C grade.

Table 13: Estimates and bootstrap uncertainty intervals.

Zone	Score	2.5%	97.5%
The Narrows	0.6096	0.5033	0.7040
Graham Creek	0.6857	0.5387	0.8314
Western Basin	0.8893	0.7511	0.9584
Boat Creek	0.7736	0.5848	0.9254
Inner Harbour	0.7532	0.6693	0.8257
Calliope Estuary	0.6591	0.5300	0.7546
Auckland Inlet	0.5478	0.3374	0.7110
Mid Harbour	0.6981	0.5305	0.8366
South Trees Inlet	0.6316	0.5328	0.7268
Boyne Estuary	0.7412	0.6265	0.8503
Colosseum Inlet	0.7286	0.5318	0.8658
Rodds Bay	0.7253	0.6671	0.7790
All of Harbour	0.7036	0.6470	0.7586

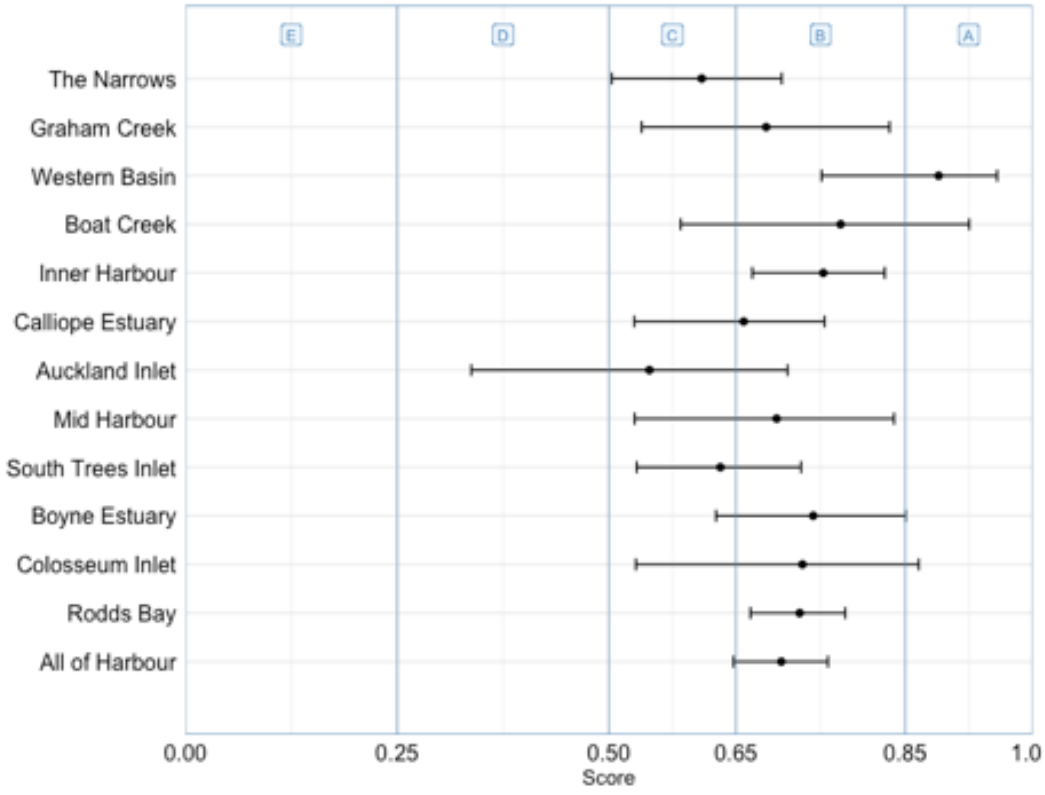


Figure 29: Zone scores and corresponding bootstrap 95% confidence intervals.

11. DISCUSSION

The full number of 78 surveys and 1,560 casts were completed in 2024-25. There was only one change - site 91 Iveragh was replaced by site 147 Foreshores. The Iveragh site was subject to intermittent tidal input while Foreshores is subject to daily tidal flow. The greatest number of Bream recorded at Iveragh was 33 in 2023-24 while the 2024-45 surveys at Foreshores recorded 71. This is likely due to the difference in tidal effects at the 2 sites.

This year data from 78 surveys were collected from December to February. Surveys from 2016-17 to 2024-25 were used for year-to-year comparisons. This provided 9 years of data based on the same number of surveys over the same time period, as this was considered to be the most comparable data.

Using the data from December to February over the 9 years the total number of Yellowfin Bream sampled was 2,820, while for Pikey Bream it was 2,976. There were 4 years when there were more Yellowfin and 4 years when there were more Pikey Bream. This suggests that over a timeframe of a number of years that recruitment of the 2 species is similar.

It is also likely that recruitment is influenced by environmental conditions which are largely driven by rainfall. While there have been annual variations in recruitment there does not appear to be a particular trend.

12. REFERENCES

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APPENDIX 1 – SURVEY SITES

Table 14 provides a summary of sites and site details, as stored in the Infofish database, along with a more detailed description of the habitat. Details for each site are available in the report "Fish recruitment indicators for the Gladstone Harbour Report Card using data derived from castnet sampling 2018" (Sawynok et al 2018) and in the Infofish database.

Table 14: Summary of site details.

Sub-Region	Site ID	Site Name	Latitude	Longitude	Map	Grid
1	97	RAMSAY CROSSING	-23.641	151.066	CIS	S31
1	5	MUNDURAN CREEK	-23.658	151.048	CISG	R33
1	22	BLACK SWAN	-23.679	151.089	CISG	V35
1	51	TARGINNIE CREEK	-23.762	151.13	GLD	HZ1
2	62	HOBBLE GULLY	-23.71	151.222	GLD	NZ10
2	99	GRAHAM CREEK 2	-23.712	151.24	GLD	MZ12
3	146	WIGGINS ISLAND	-23.821	151.218	GLD	AZ10
4	35	BOAT CREEK	-23.814	151.162	GLD	BZ4
5	67	LITTLE ENFIELD CREEK	-23.775	151.266	GLD	FZ15
5	54	BARNEY POINT POND	-23.86	151.275	GLD	D16
6	6	BEECHER CREEK	-23.923	151.207	CR02	I9
6	81	OLD BRUCE HIGHWAY BRIDGE	-23.964	151.154	CR02	P4
7	49	CALLEMONDAH	-23.862	151.232	GLD	D12
8	95	FARMERS POINT	-23.774	151.33	GLD	GZ22
8	94	GATCOMBE ANCHORAGE	-23.876	151.365	GLD	F25
9	55	WAPPENTAKE CREEK	-23.89	151.282	BRG	H17
9	76	SOUTH TREES	-23.951	151.291	BRG	N17
9	90	CREMATORIUM POOL	-23.972	151.334	BRG	Q22
10	48	OLD BOYNE	-23.981	151.33	BRG	R21
10	74	BOYNE HIGHWAY	-24.01	151.338	BRG	U22
11		OUTER HARBOUR NO SITES				
12	92	BROADACRES	-23.991	151.392	BRG	S28
12	147	FORESHORES	-24.08	151.485	RBT	J15
13	89	7 MILE CREEK	-24.131	151.561	RBT	R21
13	88	SANDY BRIDGE	-24.15	151.567	RBT	R23
13	87	OAKY CREEK	-24.11	151.663	RBT	AB18
13	86	WORTHINGTON CREEK	-24.135	151.689	RBT	AE21

APPENDIX 2 - SPECIES

Table 15 is a list of species recorded using standard name, scientific name, number of sites, and number of fish recorded in surveys from December 2024 – February 2025. Note that Pikey Bream was previously known as *Aconthopagrus berda*.

Table 15: Number of each species recorded and number of sites where recorded.

STANDARD NAME	SCIENTIFIC NAME	SITES	NUMBER
Prawn – Banana	*Fenneropenaeus indicus*	19	2905
Mullet – Flattail	*Liza dussumieri*	26	1741
Bream – Pikey	*Acanthopagrus pacificus*	23	461
Rabbitfish – Goldlined	*Siganus lineatus*	22	448
Silverbiddy – Common	*Gerres subfasciatus*	21	443
Bream – Yellowfin	*Acanthopagrus australis*	24	383
Ponyfish – Common	*Leiognathus equulus*	20	341
Glassfish – Estuary	*Ambassis marianus*	15	199
Toadfish – Common	*Tetractenos hamiltoni*	17	151
Grunter – Crescent	*Terapon jarbua*	20	138
Bream – Bony	*Nematalosa erebi*	8	121
Herring – Southern	*Herklotsichthys castelnaui*	9	105
Javelin – Barred	*Pomadasys kaakan*	11	84
Whiting – Goldenline	*Sillago analis*	15	77
Scat – Striped	*Selenotoca multifasciata*	8	71
Tarwhine	*Rhabdosargus sarba*	8	52
Snapper – Moses	*Lutjanus russellii*	12	29
Mullet - Diamondscale	*Liza vaigiensis*	3	25
Silverbiddy – Threadfin	*Gerres filamenttosus*	3	23
Diamondfish	*Monodactylus argenteus*	6	13
Sole – Black	*Brachinus nigra*	6	13
Trevally spp		8	8
Flathead – Bartail	*Platycephalus indicus*	3	7
Queenfish – Giant	*Scomeroides commersonnianus*	4	6
Mangrove Jack	*Lutjanus argentimaculatus*	3	5
Flathead – Dusky	*Platycephalus fuscus*	8	4
Anchovy spp	*Engraulis spp*	1	3
Rockcod – Goldspotted	*Epinephelus coioides*	3	3
Prawn – Tiger	*Penaeus monodon*	1	3
Whiting spp	*Sillago spp*	1	2
Steelback	*Ophiocara porocephala*	1	2
Gudgeon – Mud	*Ophiocara spp*	2	2
Rabbitfish – Whitelined	*Siganus spp*	1	2
Garfish spp		1	1

Mullet – Sea	*Mugil cephalus*	1	1
Herring – Giant	*Elops machnata*	2	1
Crab – Giant Mud	*Scylla serrata*	1	1
Ray – Common Shovelnose	*Glaucostegus typus*	1	1
Strippy – Australian	*?*	1	1
Squid		1	1
Barramundi	*Lates calcarifer*	1	1
Milkfish	*Chanos chanos*	1	1
Flathead – Fringe-eye	*Cymbacephalus nematophthalmus*	1	1
Stingray - Estuary	*Hemitrygon fluviorum*	1	1
Grinner	*Trachinocephalus spp*	1	1

APPENDIX 3 – BREAM SIZE PROFILE

Figure 30 and Table 16 show the size distribution of the Bream catch, by species, for each of the 3 months of the surveys and for all of harbour.

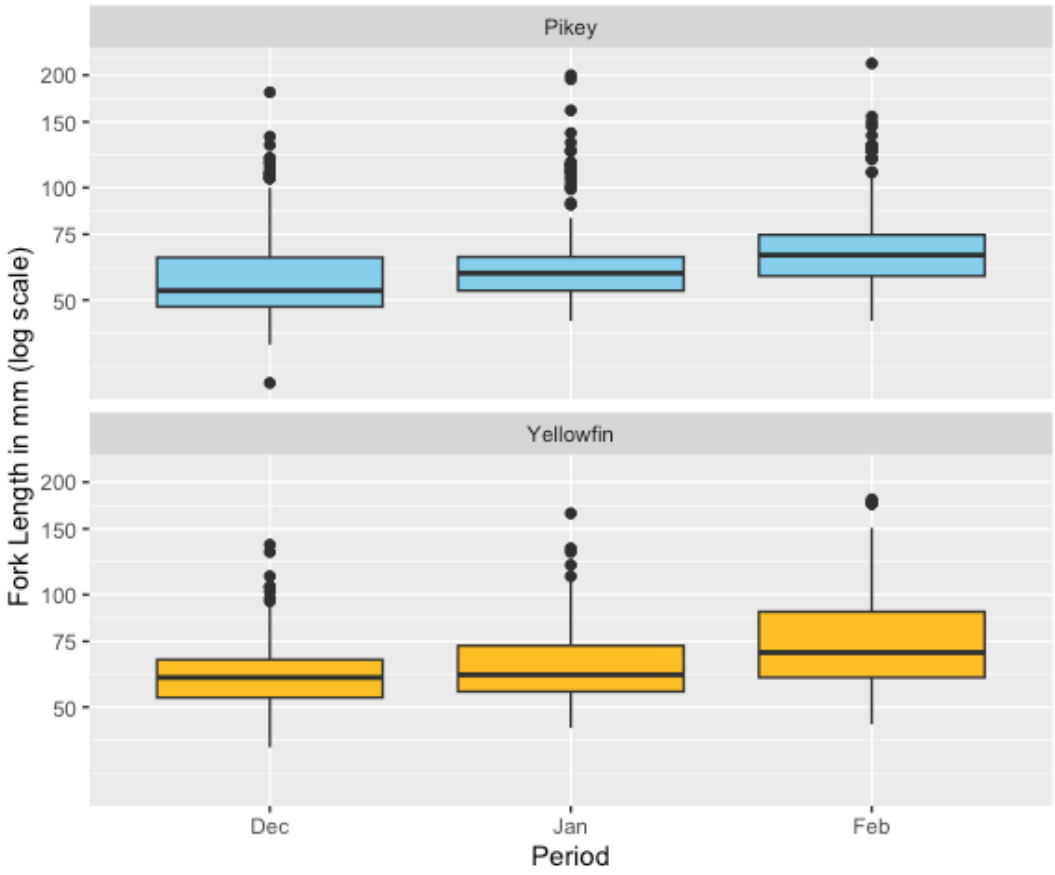

Figure 30: Fork Length change at the harbour level over the data collection period.

Table 16: Bream size distribution summary statistics: Fork Length (mm).

Species	Month	Min.	1st Qu.	Median	Mean	3rd Qu.	Max.
Pikey Bream	Dec	30	48	53	63	65	180
	Jan	44	53	59	66	65	200
	Feb	44	58	66	74	75	215
Yellowfin Bream	Dec	39	53	60	62	67	136
	Jan	44	55	61	67	73	165
	Feb	45	60	70	79	90	180

APPENDIX 4 – CATCH AND EFFORT DATA

Table 17: Numbers of casts per site from 2016-17 to 2024-25.

Zone	Site	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25
The Narrows	Ramsay Crossing	80	80	80	80	60	60	60	60	60
	Munduran Creek	80	80	80	80	60	60	60	60	60
	Black Swan	80	80	80	80	60	60	60	60	60
	Targinnie Creek	80	80	80	80	60	60	60	60	60
Graham Creek	Graham Creek	80	80	80	80	60	60	60	60	60
	Hobble Gully	80	80	80	80	60	60	60	60	60
Western Basin	Wiggins Island	80	80	80	80	60	60	60	60	60
Boat Creek	Boat Creek	80	80	80	80	60	60	60	60	60
Inner Harbour	Little Enfield Creek	80	80	80	80	60	60	60	60	60
	Barney Point Pond	80	80	80	80	60	60	60	60	60
Calliope Estuary	Beecher Creek	80	80	80	80	60	60	60	60	60
	Old Bruce Highway Bridge	80	80	80	80	60	60	60	60	60
Auckland Inlet	Callemondah	80	80	80	80	60	60	60	60	60
Mid Harbour	Farmers Point	80	80	80	80	60	60	60	60	60
	Gatcombe Anchorage	80	80	80	80	60	60	60	60	60
South Trees Inlet	Wappentake Creek	80	80	80	80	60	60	60	40	60
	South Trees	80	80	80	80	60	60	60	60	60
	Crematorium Pool	80	80	80	80	60	60	60	60	60
Boyne Estuary	Old Boyne	80	80	80	80	60	60	60	60	60
	Boyne Highway	80	80	80	80	60	60	60	60	60
Colosseum Inlet	Broadacres	80	80	80	80	60	60	60	60	60
	Iveragh	80	80	80	80	60	60	60	60	60
Rodds Bay	Oaky	80	80	80	80	60	60	60	60	60
	7 Mile	80	80	80	80	60	60	60	60	60
	Worthington	80	80	80	80	60	60	60	60	60
	Sandy Bridge	80	80	80	80	60	60	60	60	60

Table 18: Total numbers of Pikey Bream caught per site from 2016-17 to 2024-25.

Zone	Site	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25
The Narrows	Ramsay Crossing	48	56	26	74	1	42	9	14	3
	Munduran Creek	0	0	1	1	1	0	1	2	6
	Black Swan	77	22	21	33	21	25	7	8	16
	Targinnie Creek	2	6	0	20	8	22	14	12	18
Graham Creek	Graham Creek	8	24	0	60	28	36	16	16	29
	Hobble Gully	24	53	20	84	83	59	40	33	30
Western Basin	Wiggins Island	3	8	0	15	8	18	5	16	17
Boat Creek	Boat Creek	1	2	3	2	0	1	1	1	6
Inner Harbour	Little Enfield Creek	24	30	6	39	33	95	40	145	130
	Barney Point Pond	0	1	0	0	0	0	0	0	0
Calliope Estuary	Beecher Creek	2	0	10	9	5	5	1	12	10
	Old Bruce Highway Bridge	37	12	12	18	11	10	12	11	11
Auckland Inlet	Callemondah	43	57	34	37	28	27	5	14	14
Mid Harbour	Farmers Point	0	3	0	0	0	0	0	0	0
	Gatcombe Anchorage	1	0	0	12	18	8	0	0	10
South Trees Inlet	Wappentake Creek	1	1	1	1	1	0	0	0	0
	South Trees	16	44	11	13	7	27	18	10	22
	Crematorium Pool	0	14	9	7	11	16	0	13	9
Boyne Estuary	Old Boyne	0	6	3	5	4	12	2	30	9
	Boyne Highway	0	1	0	0	0	1	0	5	4
Colosseum Inlet	Broadacres	12	31	8	14	8	9	3	12	8
	Foreshores/Iveragh	3	1	5	2	0	0	0	0	37
Rodds Bay	Oaky	12	13	10	12	3	7	6	3	12
	7 Mile	16	35	9	15	17	14	13	27	27
	Worthington	4	5	2	2	1	3	0	4	8
	Sandy Bridge	2	4	5	0	0	0	0	8	1

Table 19: Total numbers of Yellowfin Bream caught per site from 2016-17 to 2024-25.

Zone	Site	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25
The Narrows	Ramsay Crossing	22	9	4	7	1	10	2	3	0
	Munduran Creek	29	15	8	6	17	12	12	6	1
	Black Swan	17	4	2	2	4	2	12	5	5
	Targinnie Creek	21	21	2	25	32	26	5	12	23
Graham Creek	Graham Creek	0	0	0	0	0	1	0	1	1
	Hobble Gully	0	2	0	2	2	3	0	0	5
Western Basin	Wiggins Island	3	2	0	25	21	49	20	12	21
Boat Creek	Boat Creek	0	4	3	0	1	0	4	4	1
Inner Harbour	Little Enfield Creek	4	1	2	9	4	4	13	3	7
	Barney Point Pond	0	1	0	0	0	0	0	1	0
Calliope Estuary	Beecher Creek	20	12	7	13	7	5	4	6	11
	Old Bruce Highway Bridge	8	76	1	23	47	15	4	2	10
Auckland Inlet	Callemondah	35	20	15	30	9	11	18	4	13
Mid Harbour	Farmers Point	26	6	0	1	6	2	7	2	4
	Gatcombe Anchorage	0	4	0	6	2	5	4	2	2
South Trees Inlet	Wappentake Creek	3	10	5	2	2	0	0	1	0
	South Trees	15	11	13	10	5	19	15	2	26
	Crematorium Pool	123	35	16	14	23	27	8	14	36
Boyne Estuary	Old Boyne	42	20	10	15	23	20	13	25	24
	Boyne Highway	49	29	51	40	23	40	26	18	47
Colosseum Inlet	Broadacres	11	9	13	16	8	11	3	8	4
	Foreshores/Iveragh	20	8	18	19	21	5	21	33	34
Rodds Bay	Oaky	25	15	27	30	10	9	45	21	34
	7 Mile	19	6	17	7	26	2	21	8	7
	Worthington	14	8	7	20	10	2	6	9	23
	Sandy Bridge	68	18	27	8	13	17	74	13	22

Table 20: Total numbers of Pikey Bream and Yellowfin Bream combined per site from 2016-17 to 2024-25.

Zone	Site	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25
The Narrows	Ramsay Crossing	70	65	30	81	2	52	11	17	3
	Munduran Creek	29	15	9	7	18	12	13	8	7
	Black Swan	94	26	23	35	25	27	19	13	21
	Targinnie Creek	23	27	2	45	40	48	19	33	41
Graham Creek	Graham Creek	8	24	0	60	28	37	16	17	30
	Hobble Gully	24	55	20	86	85	62	40	33	35
Western Basin	Wiggins Island	6	10	0	40	29	67	25	28	38
Boat Creek	Boat Creek	1	6	6	2	1	1	5	5	7
Inner Harbour	Little Enfield Creek	28	31	8	48	37	99	53	148	137
	Barney Point Pond	0	2	0	0	0	0	0	1	0
Calliope Estuary	Beecher Creek	22	12	17	22	12	10	5	18	21
	Old Bruce Highway Bridge	45	88	13	41	58	25	16	13	21
Auckland Inlet	Callemondah	78	77	49	67	37	38	23	18	27
Mid Harbour	Farmers Point	26	9	0	1	6	2	7	2	4
	Gatcombe Anchorage	1	4	0	18	20	13	4	10	12
South Trees Inlet	Wappentake Creek	4	11	6	3	3	0	0	1	0
	South Trees	31	55	24	23	12	46	33	12	48
	Crematorium Pool	123	49	25	21	34	43	8	27	45
Boyne Estuary	Old Boyne	42	26	13	20	27	32	15	55	33
	Boyne Highway	49	30	51	40	23	41	26	23	51
Colosseum Inlet	Broadacres	23	40	21	30	16	20	6	20	12
	Foreshores/Iveragh	23	9	23	21	21	5	21	33	71
Rodds Bay	Oaky	37	28	37	42	13	16	51	24	46
	7 Mile	35	41	26	22	43	16	34	35	34
	Worthington	18	13	9	22	11	5	6	13	31
	Sandy Bridge	70	22	32	8	13	17	74	21	23

Table 21: Pikey Bream catch per visit of 20 Casts, (CPUE), per site from 2016-17 to 2024-25.

Zone	Site	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25
The Narrows	Ramsay Crossing	12.00	14.00	6.50	18.50	0.33	14.00	3.00	4.67	3.00
	Munduran Creek	0	0	0.25	0.25	0.33	0	0.33	0.67	3.00
	Black Swan	19.25	5.50	5.25	8.25	7.00	8.33	2.33	2.67	5.33
	Targinnie Creek	0.50	1.50	0	5.00	2.67	7.33	4.67	4.00	6.00
Graham Creek	Graham Creek	2.00	6.00	0	15.00	9.33	18.00	5.33	5.33	9.67
	Hobble Gully	6.00	13.25	5.00	21.00	27.67	19.67	13.33	11.00	10.00
Western Basin	Wiggins Island	0.75	2.00	0	3.75	2.67	4.50	1.67	5.33	5.67
Boat Creek	Boat Creek	0.25	0.50	0.75	0.50	0	0.33	0.33	0.33	2.00
Inner Harbour	Little Enfield Creek	6.00	7.50	1.50	9.75	11.00	23.75	13.33	48.33	43.33
	Barney Point Pond	0	0.25	0	0	0	0	0	0	0
Calliope Estuary	Beecher Creek	0.50	0	2.50	2.25	1.67	1.67	0.33	4.00	3.33
	Old Bruce Highway Bridge	9.25	3.00	3.00	4.50	3.67	3.33	3.93	3.67	3.67
Auckland Inlet	Callemondah	10.75	14.25	8.50	9.25	9.33	9.00	1.67	4.67	4.67
Mid Harbour	Farmers Point	0	0.75	0	0	0	0	0	0	0
	Gatcombe Anchorage	0.25	0	0	3.00	6.00	2.67	0	2.67	3.33
South Trees Inlet	Wappentake Creek	0.25	0.25	0.25	0.25	0.33	1.00	0	0	0
	South Trees	4.00	11.00	2.75	3.25	2.33	6.75	6.00	3.33	7.33
	Crematorium Pool	0.00	3.50	2.25	1.75	3.67	5.33	0	4.33	3.00
Boyne Estuary	Old Boyne	0	1.50	0.75	1.25	1.33	4.00	0.67	10.00	3.00
	Boyne Highway	0	0.25	0	0	0	0.33	0	1.67	1.33
Colosseum Inlet	Broadacres	3.00	7.75	2.00	3.50	2.67	2.25	1.00	4.00	2.67
	Foreshore/ Iveragh	0.75	0.25	1.25	0.50	0	0	0	0	12.33
Rodds Bay	Oaky	3.00	3.25	2.50	3.00	1.00	2.33	2.00	1.00	4.00
	7 Mile	4.00	8.75	2.25	3.75	5.67	7.00	4.33	9.00	9.00
	Worthington	1.00	1.25	0.50	0.50	0.33	1.00	0	1.33	2.67
	Sandy Bridge	0.50	1.00	1.25	0	0	0	0	4.00	0.33

Table 22: Yellowfin Bream catch per visit of 20 Casts, (CPUE), per site from 2016-17 to 2024-25.

Zone	Site	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25
The Narrows	Ramsay Crossing	5.50	2.25	1.00	1.75	0.33	3.33	0.67	1.00	0
	Munduran Creek	7.25	3.75	2.00	1.50	5.67	4.00	4.00	2.00	0.50
	Black Swan	4.25	1.00	0.50	0.50	1.33	0.67	4.00	1.67	1.67
	Targinnie Creek	5.25	5.25	0.50	6.25	10.67	8.67	1.67	7.00	7.67
Graham Creek	Graham Creek	0	0	0	0	0	0.50	0	0.33	0.33
	Hobble Gully	0	0.50	0	0.50	0.67	1.00	0	0	1.67
Western Basin	Wiggins Island	0.75	0.50	0	6.25	7.00	12.25	6.67	4.00	7.00
Boat Creek	Boat Creek	0.00	1.00	0.75	0	0.33	0	1.33	1.33	0.33
Inner Harbour	Little Enfield Creek	1.00	0.25	0.50	2.25	1.33	1.00	4.33	1.00	2.33
	Barney Point Pond	0	0.25	0	0	0	0	0	0.33	0
Calliope Estuary	Beecher Creek	5.00	3.00	1.75	3.25	2.33	1.67	1.33	2.00	3.67
	Old Bruce Highway Bridge	2.00	19.00	0.25	5.75	15.67	5.00	1.31	0.67	3.33
Auckland Inlet	Callemondah	8.75	5.00	3.75	7.50	3.00	3.67	6.00	1.33	4.33
Mid Harbour	Farmers Point	6.50	1.50	0	0.25	2.00	0.67	2.33	0.67	1.33
	Gatcombe Anchorage	0.00	1.00	0	1.50	0.67	1.67	1.33	0.67	0.67
South Trees Inlet	Wappentake Creek	0.75	2.50	1.25	0.50	0.67	0	0	0.33	0
	South Trees	3.75	2.75	3.25	2.50	1.67	4.75	5.00	0.67	8.67
	Crematorium Pool	30.75	8.75	4.00	3.50	7.67	9.00	2.67	4.67	12.00
Boyne Estuary	Old Boyne	10.50	5.00	2.50	3.75	7.67	6.67	4.33	8.33	8.00
	Boyne Highway	12.25	7.25	12.75	10.00	7.67	13.33	8.67	6.00	15.67
Colosseum Inlet	Broadacres	2.75	2.25	3.25	4.00	2.67	2.75	1.00	2.67	1.33
	Foreshores/ Iveragh	5.00	2.00	4.50	4.75	7.00	1.25	7.00	11.00	11.33
Rodds Bay	Oaky	6.25	3.75	6.75	7.50	3.33	3.00	15.00	7.00	11.33
	7 Mile	4.75	1.50	4.25	1.75	8.67	1.00	7.00	2.67	2.33
	Worthington	3.50	2.00	1.75	5.00	3.33	0.67	2.00	3.00	7.67
	Sandy Bridge	17.00	4.50	6.75	2.00	4.33	8.50	24.67	6.50	7.33

Table 23: Pikey Bream plus Yellowfin Bream catch per visit of 20 Casts, (CPUE), per site from 2016-17 to 2024-25.

Zone	Site	16-17	17-18	18-19	19-20	20-21	21-22	22-23	23-24	24-25
The Narrows	Ramsay Crossing	17.50	16.25	7.50	20.25	0.67	17.33	3.67	5.67	3.00
	Munduran Creek	7.25	3.75	2.25	1.75	6.00	4.00	4.33	2.67	3.50
	Black Swan	23.50	6.50	5.75	8.75	8.33	9.00	6.33	4.33	7.00
	Targinnie Creek	5.75	6.75	0.50	11.25	13.33	16.00	6.33	11.00	13.67
Graham Creek	Graham Creek	2.00	6.00	0	15.00	9.33	18.50	5.33	5.67	10.00
	Hobble Gully	6.00	13.75	5.00	21.50	28.33	20.67	13.33	11.00	11.67
Western Basin	Wiggins Island	1.50	2.50	0	10.00	9.67	16.75	8.33	9.33	12.67
Boat Creek	Boat Creek	0.25	1.50	1.50	0.50	0.33	0.33	1.67	1.67	2.33
Inner Harbour	Little Enfield Creek	7.00	7.75	2.00	12.00	12.33	24.75	17.67	49.33	45.67
	Barney Point Pond	0	0.50	0	0	0	0	0	0.33	0
Calliope Estuary	Beecher Creek	5.50	3.00	4.25	5.50	4.00	3.33	1.67	6.00	7.00
	Old Bruce Highway Bridge	11.25	22.00	3.25	10.25	19.33	8.33	5.25	4.33	7.00
Auckland Inlet	Callemondah	19.50	19.25	12.25	16.75	12.33	12.67	7.67	6.00	9.00
Mid Harbour	Farmers Point	6.50	2.25	0.00	0.25	2.00	0.67	2.33	0.67	1.33
	Gatcombe Anchorage	0.25	1.00	0	4.50	6.67	4.33	1.33	3.33	4.00
South Trees Inlet	Wappentake Creek	1.00	2.75	1.50	0.75	1.00	1.00	0	0.33	0
	South Trees	7.75	13.75	6.00	5.75	4.00	11.50	11.0	4.00	16.00
	Crematorium Pool	30.75	12.25	6.25	5.25	11.33	14.33	2.67	9.00	15.00
Boyne Estuary	Old Boyne	10.50	6.50	3.25	5.00	9.00	10.67	5.00	18.33	11.00
	Boyne Highway	12.25	7.50	12.75	10.00	7.67	13.67	8.67	7.67	17.00
Colosseum Inlet	Broadacres	5.75	10.00	5.25	7.50	5.33	5.00	2.00	6.67	4.00
	Foreshores/ Iveragh	5.75	2.25	5.75	5.25	7.00	1.25	7.00	11.00	23.67
Rodds Bay	Oaky	9.25	7.00	9.25	10.50	4.33	5.33	17.00	8.00	15.33
	7 Mile	8.75	10.25	6.50	5.50	14.33	8.00	11.33	11.67	11.33
	Worthington	4.50	3.25	2.25	5.50	3.67	1.67	2.00	4.33	10.33
	Sandy Bridge	17.50	5.50	8.00	2.00	4.33	8.50	24.67	10.50	7.67

Figure 31 shows the total Bream CPUE per site for survey year 2024-25 plotted against the same total Bream CPUE per site for survey year 2023-24, partitioned into recording zones. Points above the diagonal line correspond to sites whose CPUE increased in 2024-25 from what it was in 2023-24, and points below the line to those for which CPUE decreased.

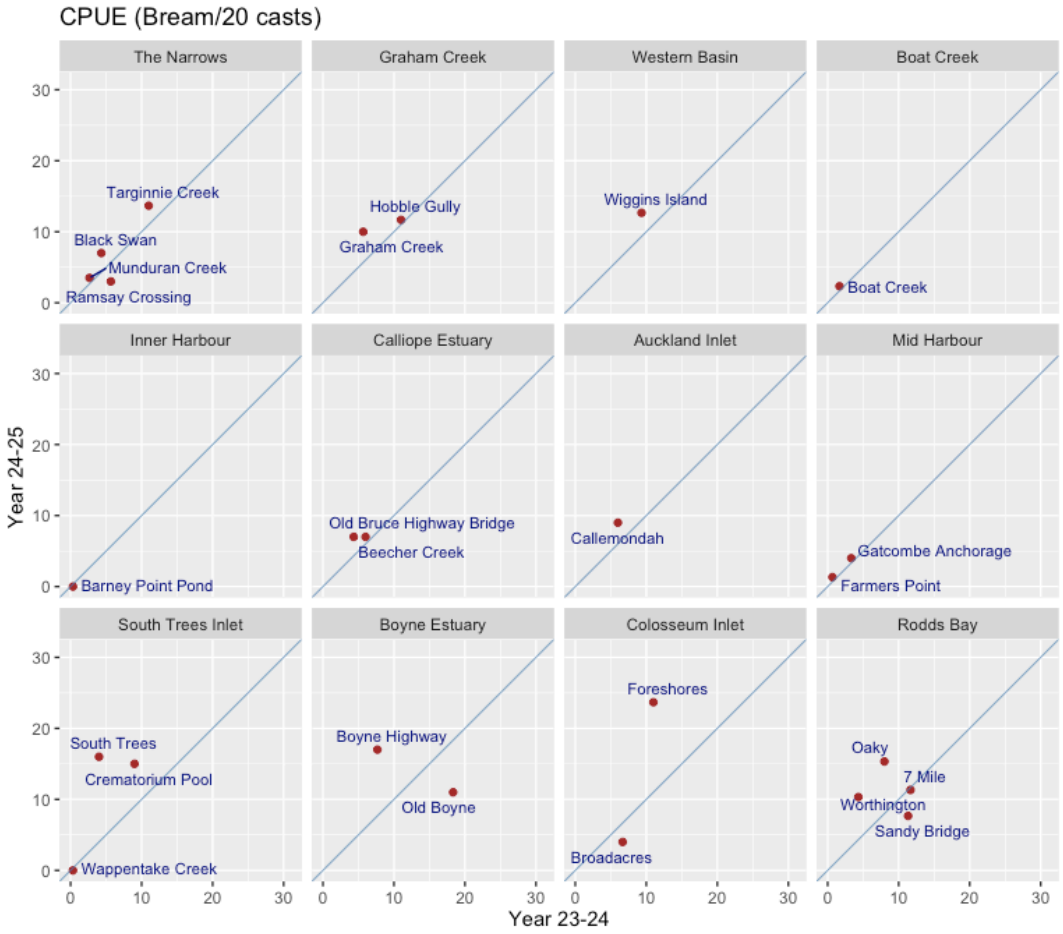

Figure 31: Bream CPUE for 2024-25 against CPUE for 2023-24 per site partitioned into recording zones.