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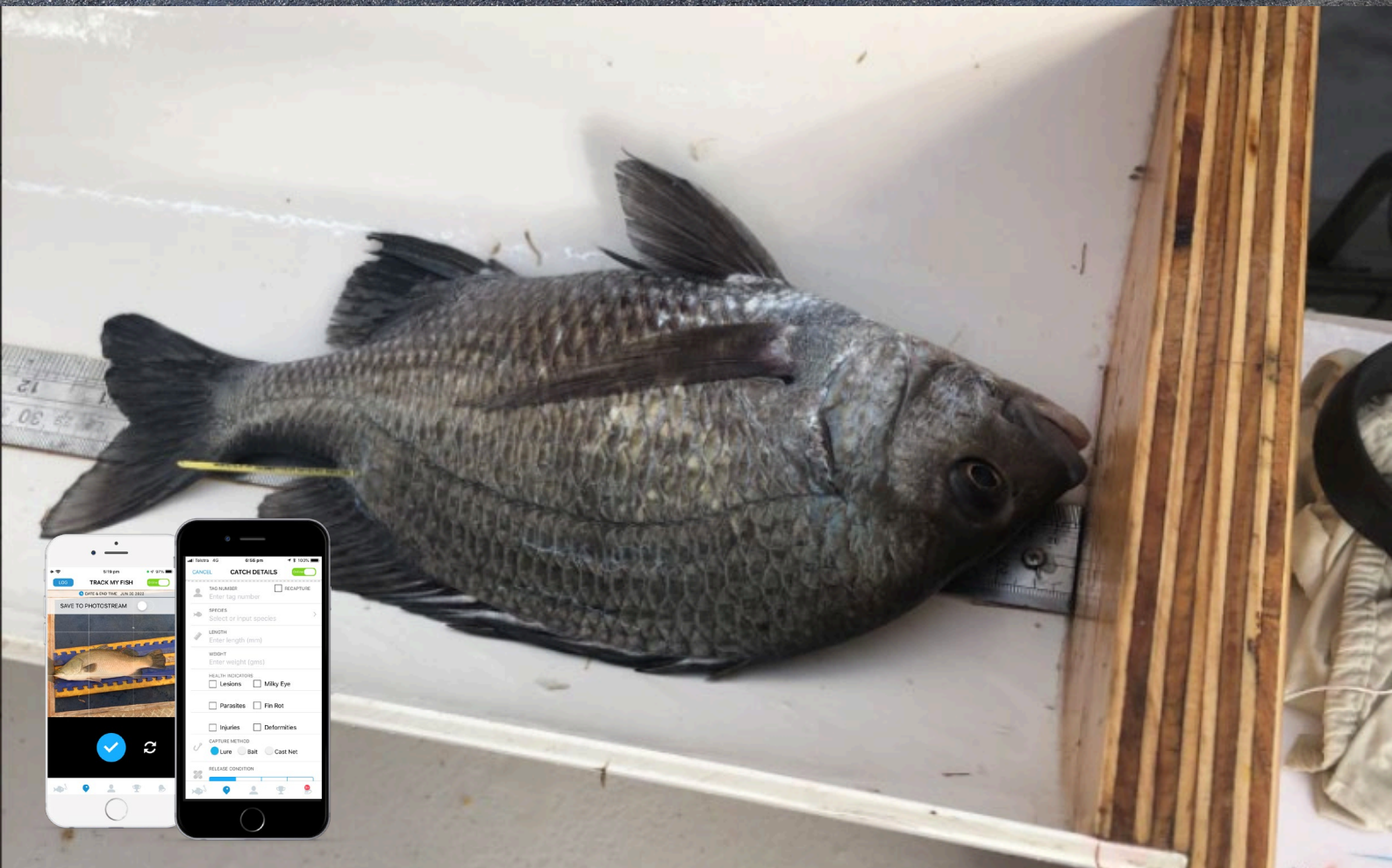
Gladstone Healthy Harbour Partnership

Fish condition health indicators for the Gladstone Harbour Report Card 2022



Fish condition health indicators for the Gladstone Harbour Report Card 2022

Stefan Sawynok, Bill Sawynok and Phoenix Sawynok

Infofish Australia Pty Ltd

12 Mingoola Street Murarrie Qld 4172

Project ISP23B-2022

June 2022

This report has been prepared by Infofish Australia Pty Ltd for the Gladstone Healthy Harbour Partnership. Infofish Australia have taken all steps to ensure the information contained in this publication is accurate at the time of publication. This report pertains to the period of study, new information will be added on the subject matter over time and will be available in subsequent reports.

Cover images – mouth of the Boyne River during the Boyne Tannum Hookup competition (top) and Pikey Bream measured at the BTHU live weigh-in (bottom).

Table of Contents

SUMMARY 4
1. INTRODUCTION 6
2. OBJECTIVES 7
3. GLADSTONE HARBOUR MONITORING ZONES 8
4. METHODS 9
5. RESULTS 19
6. DISCUSSION 32
7. REFERENCES 34
APPENDIX 1: VISUAL FISH CONDITION OBSERVATIONS AT GLADSTONE 35

Figures

Figure 1*:* Grading scale for the 2022 Gladstone Harbour Report Card. 7
Figure 2*:* Gladstone monitoring zones for the GHHP Report Card (from 2020 Gladstone Harbour Technical Report). 8
Figure 3: TMF screen to capture fish images and collect details of the fish. 10
Figure 4*:* Yellowfin Bream with moderate skin aberrations on side and damaged tail at the BTHU. 10
Figure 5: Weighing Barred Javelin at the ABT fishing competition. 11
Figure 6*:* Simplified flow chart of the process from field collection of data to the comparison of the machine and human assessment for VFC. 12
Figure 7*:* The grading scale and the scores used in the GHHP 2022 report card. .. 18
Figure 8: Sources of images for assessing Visual Fish Condition (VFC). 19
Figure 9: Timeframe for when images were obtained in 2021-2022. 19
Figure 10: Number of images for each of the key species. 20
Figure 11: Number of images obtained at locations. 20
Figure 12: Numbers of fish where length-weight was recorded at the BTHU competition. 23
Figure 13: Length-weight data for the key species using the historic data from the BTHU from 2003-2022. 23
Figure 14: Length-weight plot for Yellowfin Bream using data from the BTHU from 2003-2022. 24
Figure 15: Plot of FBC for Yellowfin Bream from 2003-2022. 24
Figure 16: Length-weight plot for Pikey Bream using data from the BTHU from 2003-2022. 25
Figure 17: Plot of FBC for Pikey Bream from 2003-2022. 25
Figure 18: Length-weight plot for Barred Javelin using data from the BTHU from 2003-2022. 26
Figure 19: Plot of FBC for Barred Javelin from 2003-2022. 26

Figure 20: Length-weight plot for Dusky Flathead using data from the BTHU from 2003-2022. 27
Figure 21: Plot of FBC for Dusky Flathead from 2003-2022. 27
Figure 22: Length-weight plot for Mangrove Jack using data from the BTHU from 2003-2022. 28
Figure 23: Plot of FBC for Mangrove Jack from 2003-2022 (small sample sizes 2003 - 2013). 28
Figure 24: Calliope River flows and mean monthly flows (ML) July 2018 – May 2022. 30
Figure 25: Awoonga lake levels and dam wall height (40m). 31

Tables

Table 1*:* Required fish health outputs for the 2022 Gladstone Harbour Report Card. 7
Table 2*:* Designation and score for the VFC assessed. 13
Table 3: Determining RCF scores for Fish Body Condition. 13
Table 4*:* Generating scores and grades for key species. 14
Table 5: Severity score of variable fins conditions for key species (eg YB = Yellowfin Bream) and the number of observations. 21
Table 6: Severity score of variable skin conditions for key species (eg YB = Yellowfin Bream) and the number of observations. 21
Table 7: Observation of VFC issues in key species in 2021-22. 22
Table 8: Numbers of fish where length-weight were recorded at the BTHU competition. 22
Table 9: FBC values ($\boldsymbol{W = a \times TL^{b}}$) for the key species using the historic data from the BTHU from 2003-2021. 29
Table 10: Mean, median, minimum and maximum condition factors for the key species from the historic data from the BTHU for 2003-2021. 29
Table 11: Mean, median, minimum and maximum condition factors and standard deviation for the key species in 2022. 29
Table 12: Mean, median scores and standard deviation for the key species in 2022. 30
Table 13: GHHP scores and grades for the 6 key species (figures in brackets are sample size) for the 2022 report card. 31
Table 14: Severity score of variable fins condition for Barramundi in Lake Awoonga and Lake Callemondah with the number of detections. 32
Table 15: VFC results for Barramundi in Lake Awoonga and Lake Callemondah 32
Table 16: GHHP scores and grades for Barramundi in Lake Awoonga and Lake Callemondah (figure in brackets is sample size). 32
Table 17: VFC detections for all species at Gladstone 35

SUMMARY

Fish condition (FC) health assessments in the Gladstone Harbour study area for the 2022 Report Card were based on a combination of Visual Fish Condition (VFC) and Fish Body Condition (FBC). Owing to fish movement FC is scored at the harbour level rather than at the individual monitoring zones level.

Fish images were used for VFC, and length-weight data were used to assess FBC based on activities 1-5 listed below. Images were collected from 1-5 while length-weight were collected from 2.

1. Images from the ABT Bream tournament in the Gladstone area using the Trackmyfish (TMF) app (September 2021).
2. Images and length-weights from the live weigh-in section of the Boyne Tannum HookUp (BTHU) fishing competition using TMF (April-May 2022).
3. Images from Suntag taggers including Gladstone Sportfishing Club members using TMF during normal fishing trips (July 2021-May 2022).
4. Images from the ABT Barramundi tournament in Lake Awoonga using the TMF app (September 2021).
5. Images from Lake Callemondah using the Gladstone Area Water Board (GAWB) version of the TMF app (July 2021-May 2022).

VISUAL FISH CONDITION

Images were assessed for VFC using the following indicators fins, skin, eyes, parasites and deformities. VFC was assessed using both machine learning algorithms and human assessors. Microsoft Azure was used again this year to undertake the machine assessment. There was close to 100% agreement between the human and machine assessment of each parameter.

The VFC of 6 key species Yellowfin Bream, Pikey Bream, Barred Javelin, Dusky Flathead, Mangrove Jack and Barramundi was obtained using 975 images mostly captured by the TMF app. The numbers of images for the key species are shown in the accompanying summary table.

For the key species the resulting level of observation of fin damage was moderate to high ranging from 6.8% for Dusky Flathead to 76.2% for Pikey Bream however the severity of the damage was low and assessed as light active erosion. Skin damage was low ranging from 0% for Pikey Bream and Mangrove Jack to 3.4% for Dusky Flathead with low severity of mild skin aberration. The observed level for eyes, parasites and deformities was very low (less than 1%) to none. The resulting VFC scores are shown in the accompanying summary table.

FISH BODY CONDITION

FBC was calculated using Relative Condition Factor (RCF) as used in previous years. FBC was obtained from a total of 462 fish for 5 of the target species. Barramundi were not included as no fish weights were obtained. The resulting FBC scores are shown in the accompanying summary table.

FISH CONDITION SCORES AND GRADES

The VFC and FBC scores were then averaged to provide a species FC score and an all of harbour score that were converted to GHHP grades from A to E. The following table provides a summary of the scores and grades with the sample size in brackets. All species and all of harbour grades were B.

Species	Visual Fish Condition (VFC)	Fish Body Condition (FBC)	Fish Condition (FC)	GHHP Species Grade
Yellowfin Bream	0.90 (422)	0.43 (277)	0.72	B
Pikey Bream	0.98 (244)	0.46 (28)	0.73	B
Barred Javelin	0.94 (83)	0.44 (75)	0.72	B
Dusky Flathead	0.97 (59)	0.43 (41)	0.70	B
Mangrove Jack	0.96 (68)	0.50 (41)	0.72	B
Barramundi	NA (20)	NA (0)	NA	NA
All of harbour	0.97	0.47	0.72	B
Barramundi (impoundments)	0.91 (317)	NA (0)	0.91 (VFC only)	A

COMPARISON WITH OTHER SITES

This year the only comparison made was for Barramundi in Lake Awoonga and Lake Callemondah using images using the TMF app for the ABT fishing competition held in Lake Awoonga and monitoring using the GAWB app in Lake Callemondah. Barramundi from the lakes can impact fish health when the dams spill and fish enter the downstream waterways, so it was considered relevant to include them in the assessment as a comparison.

However there has been no spilling of Awoonga since 2017. While Callemondah spills most year there was no evidence of fish leaving the lake this year, based on recaptures of tagged fish. An assessment was made for VFC only as no weights were able to be obtained. This resulted in a FC score of 0.91 (VFC only) and an equivalent GHHP grade of A.

1. INTRODUCTION

The Gladstone Healthy Harbour Partnership (GHHP) was established in 2012 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 fish health were identified as important environmental indicators for the report card by the Gladstone community.

In 2018 GHHP and the Fisheries Research and Development Corporation (FRDC) commissioned Infofish Australia to undertake a trial of new tools to assess visual fish health using photographs and artificial intelligence algorithms to recognise fish parts such as fins, tail, gills, eyes and mouth and fish health issues such as fin and tail damage, wounds and "redness" (e.g. lesions, scale damage).

Following the successful completion of that project GHHP has undertaken fish condition health assessments in 2018-19, 2019-20 and 2020-21 and included a fish condition health indicator score in its 2019, 2020 and 2021 report cards using 5 key species.

The results are contained in the reports:

- Visual fish health indicators for the Gladstone Harbour Report Card 2019 (Sawynok et al. 2019),
- Visual fish health indicators for the Gladstone Harbour Report Card 2020 (Sawynok et al. 2020) and
- Fish condition health indicators for the Gladstone Harbour Report Card 2021 (Sawynok et al. 2021).

A further fish condition assessment was undertaken in 2021-22 for the 2022 Report Card using the same methods developed in the previous projects.

2. OBJECTIVES

The objectives of the project were:

1. Produce Visual Fish Condition (VFC) and Fish Body Condition (FBC) scores and grades for the 2022 Gladstone Harbour Report Card. The required scores and grades are presented in Table 1 and the grading scale for the A to E grades is presented in Figure 1. The scores and grades to be calculated using the statistical methods developed in the 2019 visual fish condition project.

2. An updated fish condition project report.

Table 1: Required fish health outputs for the 2022 Gladstone Harbour Report Card.

Species	Visual Fish Condition (VFC)	Fish Body Condition (FBC)	Fish Condition (FC)	GHHP Grades
Yellowfin Bream	score	score	score	grade
Pikey Bream	score	score	score	grade
Barred Javelin	score	score	score	grade
Dusky Flathead	score	score	score	grade
Mangrove jack	Score	Score	Score	grade
Barramundi VFC only	score	NA	NA	grade VFC only
All of harbour	score	score	score	grade

Figure 1: Grading scale for the 2022 Gladstone Harbour Report Card.

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 2. However, owing to the potential for fish movement, fish health is scored at the harbour level. The single harbour score is justifiable as fish are mobile and the health of the key species cannot necessarily be attributed to individual monitoring zones.

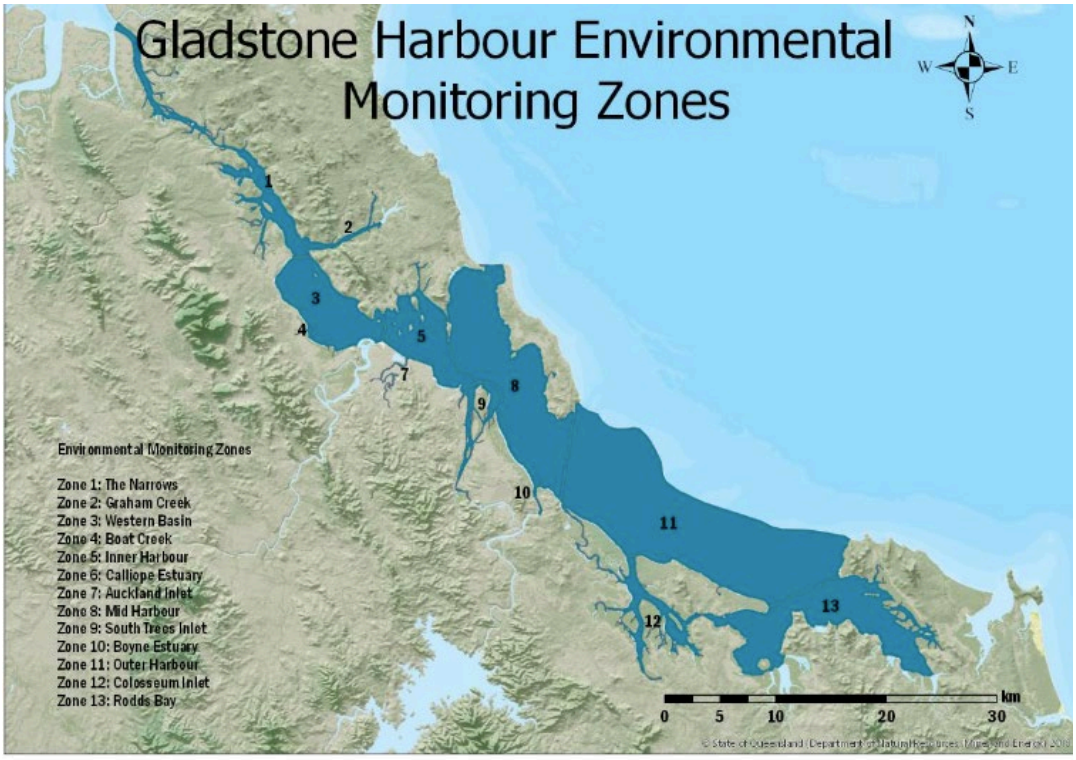


Figure 2*:* Gladstone monitoring zones for the GHHP Report Card (from 2020 Gladstone Harbour Technical Report).

4. METHODS

4.1 COLLECTING FISH SAMPLES

Data were collected from 1 July 2021 to 31 May 2022. The target was a minimum of 25 photographic samples of 6 species throughout the study area. There were 5 methods for collecting the fish samples using the Infofish Trackmyfish (TMF) phone apps (Figure 3).

1. Images from the ABT Bream tournament in the Gladstone area using the TMF app (September 2021).
2. Images and length-weights from the live weigh-in section of the Boyne Tannum HookUp (BTHU) fishing competition using TMF (April-May 2022).
3. Images from Suntag taggers including Gladstone Sportfishing Club members using TMF during normal fishing trips (July 2021-May 2022).
4. Images from the ABT Barramundi tournament in Lake Awoonga using the TMF app (September 2021).
5. Images from Lake Callemondah using the Gladstone Area Water Board (GAWB) version of the TMF app (July 2021-May 2022).

The data collected through the TMF apps were:

- Photos of one side of the fish, preferably on a measuring ruler.
- Tag number for fish that were tagged.
- Total length of the fish to nearest half centimetre.
- Weight of the fish in grams.
- Date and GPS location of where the fish were caught.

At the BTHU there were 2 stations where fish were presented for measuring, weighing and photographing. These were at the main station at Bray Park near the mouth of the Boyne River where Infofish staff collected data and at the Gladstone Marina where Gladstone Sportfishing Club volunteers collected data. This year an approximate location (e.g. Boyne River, Gladstone Harbour etc.) where the fish was captured was recorded to determine the geographic distribution of samples. As well as data collected through TMF, length-weights were also recorded manually as a backup. Figure 4 shows a fish sample collected at the BTHU with moderate skin aberrations on the side and damaged tail fin.

The following were the target species however images were collected from all species recorded.

- Yellowfin Bream (*Acanthopagrus australis*)
- Pikey Bream (*Acanthopagrus berda*)
- Barred Javelin (*Pomadasys kaakan*)
- Dusky Flathead (*Platycephalus fuscus*)
- Barramundi (*Lates calcarifer*)
- Mangrove Jack (*Lutjanus argentimaculatus*)

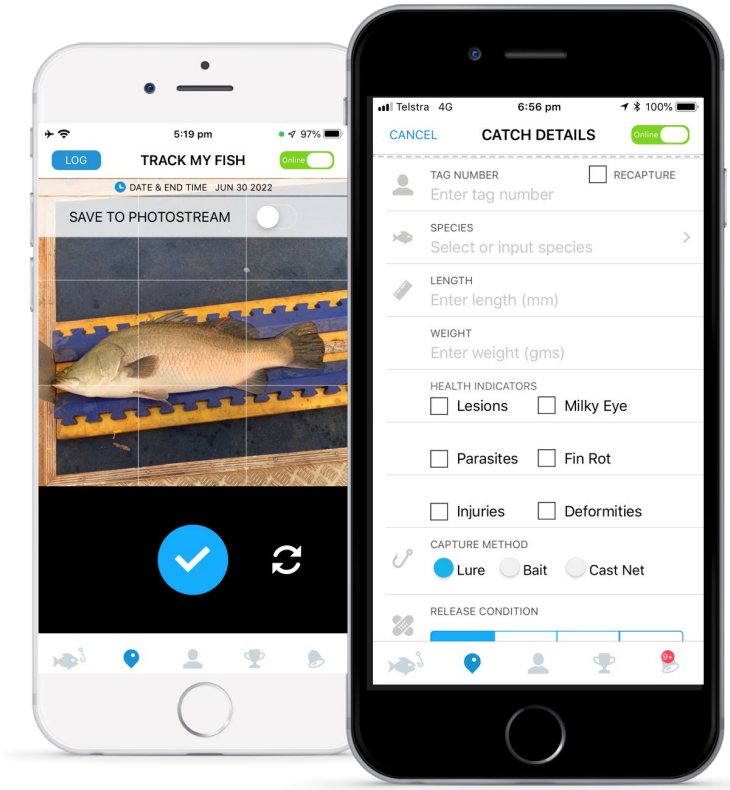


Figure 3: TMF screen to capture fish images and collect details of the fish.

Figure 4*:* Yellowfin Bream with moderate skin aberrations on side and damaged tail at the BTHU.

Length-weight data used to assess FBC were collected at:

- BTHU (29/4-1/5/2021) in conjunction with the live weigh-in conducted by the Gladstone Sportfishing Club.

Length-weight data at the BTHU was limited for Pikey Bream as this species was removed from the live weigh-in in 2021 and again in 2022. While not part of the competition, data were collected on Pikey Bream that were presented. This allowed a smaller sample of legal length fish to be recorded.

Images and lengths for Yellowfin and Pikey Bream were collected at the ABT Bream competition however weights were not obtained as that was not required as part of the competition.

Figure 5 shows a Barred Javelin being weighed after being tagged and measured at the BTHU.

Figure 5: Weighing Barred Javelin at the ABT fishing competition.

4.2 VISUAL FISH CONDITION (VFC)

A simplified flow chart for Visual Fish Condition (VFC) is presented in Figure 6 (Sawynok et al 2018a).

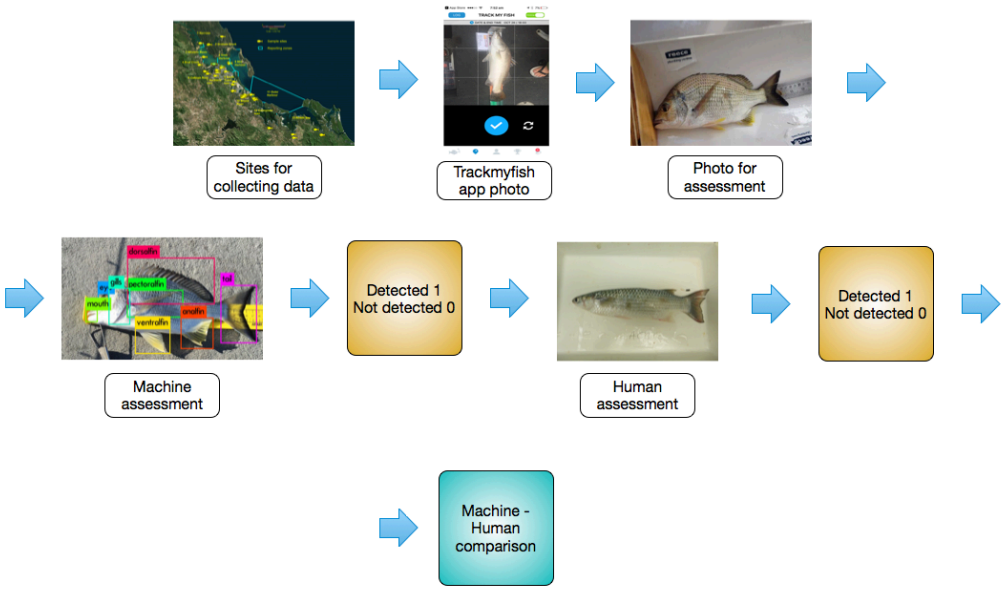


Figure 6*: Simplified flow chart of the process from field collection of data to the comparison of the machine and human assessment for VFC.*

VFC was assessed for all samples obtained from the study area as well as samples obtained from Lake Awoonga and Lake Callemondah. For all images the assessment was carried out using the same methods outlined in Sawynok et al. 2020. Both human and machine assessment continue to be used. Microsoft Azure was again used as the machine learning tool as this has been adopted by a number of fisheries agencies including Fisheries Queensland.

The 5 visual condition factors assessed were:

- Fins
- Skin
- Eyes
- Parasites
- Deformities

Table 2 and an overall score was generated for each individual fish with low scores reflecting healthier fish. The overall score was then converted to a 0-1 score using the following formula with high VFC scores reflecting heathier fish.

$$VFC = \frac{maximum\ score - fish\ score}{maximum\ score}$$

Table 2: Designation and score for the VFC assessed.

Fins		
Variable Condition	Designation	Score
No Active Erosion	0	0
Light Active Erosion	1	10
Moderate Active Erosion with some haemorrhage	2	20
Severe Active Erosion with some haemorrhage	3	30

Skin		
Variable Condition	Designation	Score
Normal no aberrations	0	0
Mild skin aberrations	1	10
Moderate skin aberrations	2	20
Severe skin aberrations	3	30

Eyes		
Variable Condition	Designation	Score
No aberrations	0	0
Opaque/Milky Eye	1	10
Swollen Eye	2	20
Haemorrhaging or bleeding Eye	3	30
Missing Eye	3	30

Parasites		
Variable Condition	Designation	Score
No parasites	0	0
Observed parasites	1	10

Deformities		
Variable Condition	Designation	Score
No deformity	0	0
Observed Deformity	3	30

4.3 FISH BODY CONDITION (FBC)

FBC was calculated using Relative Condition Factor (RCF) using the same methods as in previous years (Sawynok S et al. 2020). Values calculated for the FBC are presented as shown in Table 3. Historic length-weight data collected at the BTHU from 2003-2022 was also assessed for FBC.

Table 3: Determining RCF scores for Fish Body Condition.

Species	number	Relative Condition Factor score				
		Mean	Median	Min	Max	Std dev
Species 1	value	value	value	value	value	value
Species 2	value	value	value	value	value	value

4.4 INFLUENCE OF RIVER FLOW

To provide some context to the assessment of FC there was a need to examine some environmental conditions. Fish health can be influenced by river flow and rainfall. Skin aberrations are often associated with freshwater flows. While there can be considerable variation in flows and rainfall throughout the study area the following were used as measures of relevant environmental conditions.

Monthly flows recorded at the Castlehope recording station 132001A on the Calliope River were considered indicative of flows in the rivers and creeks in the study area.

The exception is the Boyne River where flows are related to water releases and spilling of Awoonga dam. Spilling has been associated with fish health issues since 2011, particularly in Barramundi in the Boyne River however there was no spilling during the study period. Data on the dam level were obtained from the GAWB.

4.5 GENERATING SPECIES SCORES AND GRADES

A species FC score was generated for each key species by averaging VFC and FBC as shown in Table 4 and these were aggregated to provide a single harbour wide score for fish condition health. Only those species with a VFC and FBC were included in the overall report card score. Cut-off bands and grades are shown in Figure 7.

$$FC = \frac{VFC + FBC}{2}$$

Key species for which there were sufficient data:

- Yellowfin Bream
- Pikey Bream
- Barred Javelin
- Dusky Flathead
- Mangrove Jack
- Barramundi (VFC only)

Table 4: Generating scores and grades for key species.

Species	Visual Fish Condition (VFC)	Fish Body Condition (FBC)	Fish Condition (FC)	Species Grade
Yellowfin Bream	0 – 1	0 – 1	Score (0 – 1)	Grade (A – E)
Pikey Bream	0 – 1	0 – 1	Score (0 – 1)	Grade (A – E)
Barred Javelin	0 – 1	0 – 1	Score (0 – 1)	Grade (A – E)
Dusky Flathead	0 – 1	0 – 1	Score (0 – 1)	Grade (A – E)
Mangrove Jack	0 – 1	0 – 1	Score (0 – 1)	Grade (A – E)
Barramundi	0 – 1		Score (0 – 1)	Grade (A – E)

Figure 7*:* The grading scale and the scores used in the GHHP 2022 report card.

4.6 GENERATING HARBOUR SCORES AND GRADES

A harbour-wide score FC score was generated by averaging the individual species FC scores for Yellowfin Bream (YB), Pikey Bream (PB), Barred Javelin (BJ), Dusky Flathead (DF) and Mangrove Jack (MJ).

$$All\ of\ harbour\ score = \frac{YB\ score + PB\ score + BJ\ score + DF\ score + MJ\ score}{5}$$

4.7 COMPARISON WITH OTHER LOCATIONS

Barramundi stocked in Lake Awoonga are relevant to fish health issues in Gladstone Harbour and are likely to contribute to fish health issues in the future. This also applies to Lake Callemondah which is a small impoundment on Auckland Creek within the Gladstone city area regularly stocked with Barramundi.

Fish leave both impoundments when they spill. Lake Awoonga has not spilled since 2017 while Lake Callemondah spills most years directly into the Auckland Creek estuary.

This year sufficient images of Barramundi were obtained from Lake Callemondah so these have now been included with those from Lake Awoonga. Images were only assessed for VFC as no weights were able to be obtained for Barramundi so that it was not possible to calculate FBC.

Images were obtained from the following:

1. ABT Barramundi Australian Open – September 2021
2. Fishing in Lake Awoonga – July 2021-May 2022
3. Fishing in Lake Callemondah – July 2021-May 2022

5. RESULTS

5.1 VISUAL FISH CONDITION (VFC)

VFC was assessed for 975 images collected in the study area and 317 images in Lakes Awoonga and Callemondah from July 2021-May 2022. Figure 8 shows the sources of the images while Figure 9 shows the timeframe in which the images were collected.

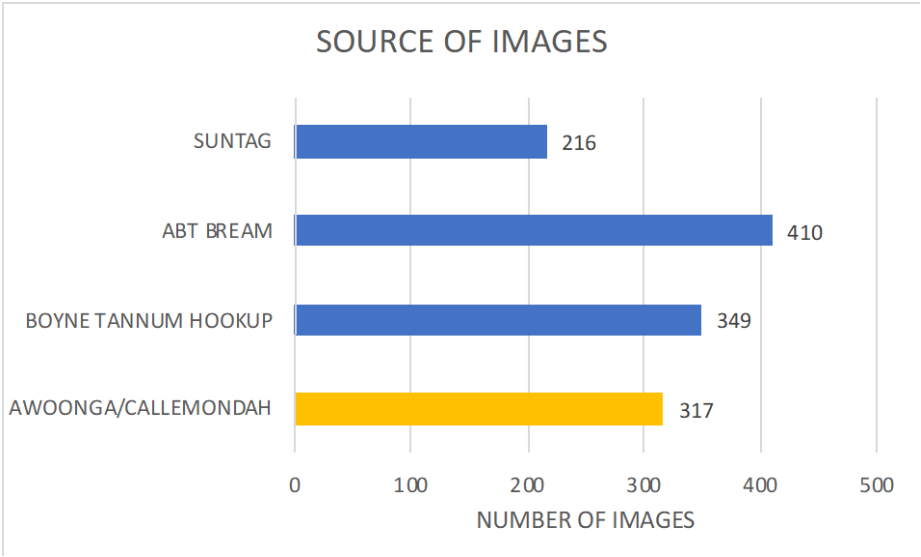


Figure 8: Sources of images for assessing Visual Fish Condition (VFC).

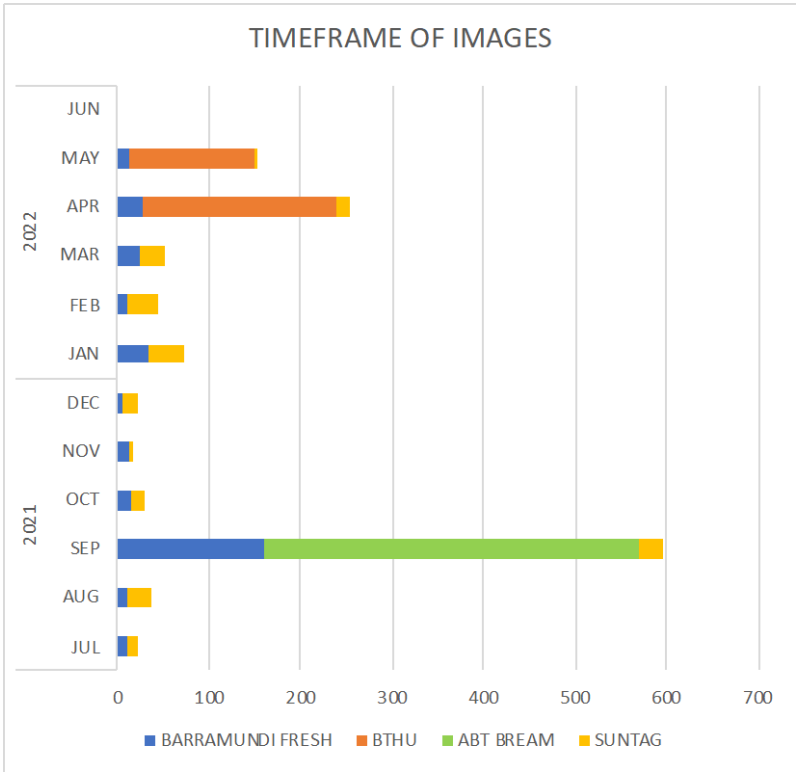


Figure 9: Timeframe for when images were obtained in 2021-2022.

Figure 10 shows the number of images collected for each species and Figure 11 shows the general area from where the images were obtained.

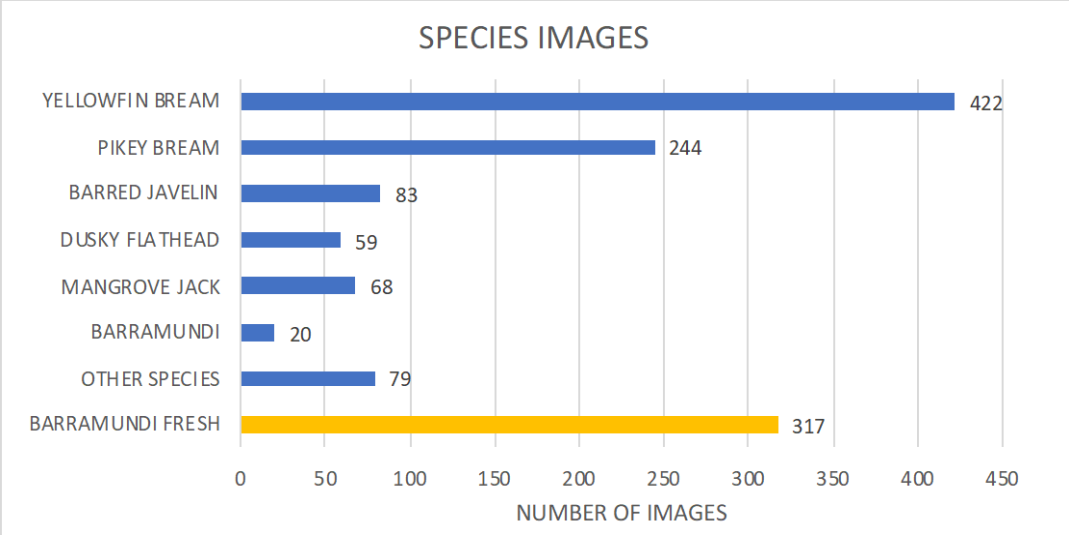


Figure 10: Number of images for each of the key species.

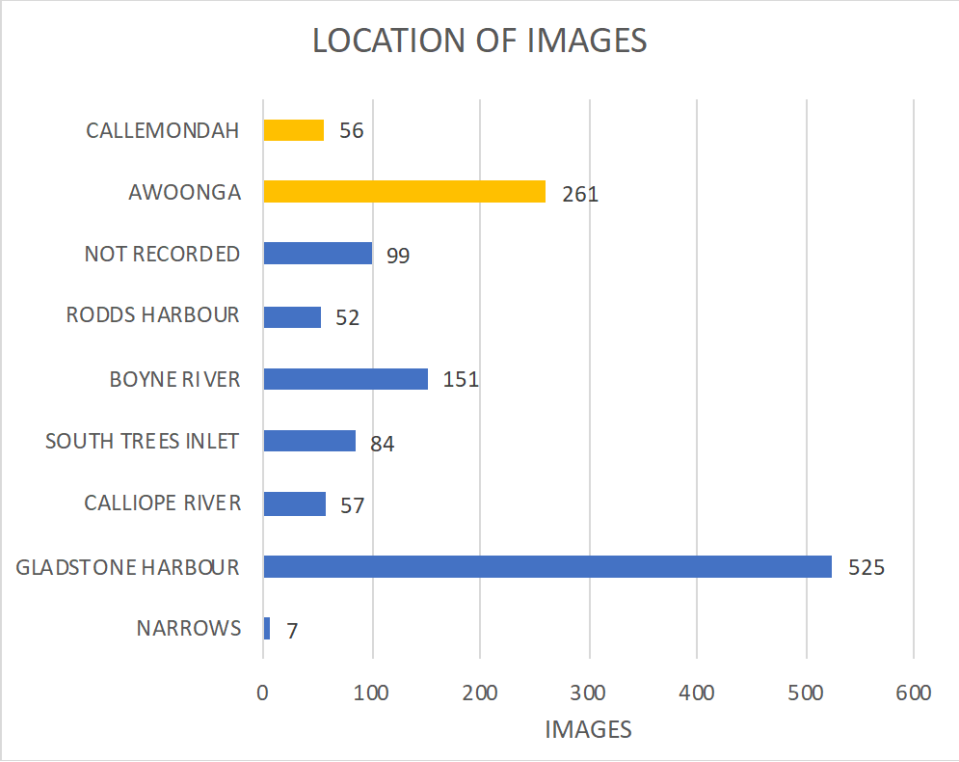


Figure 11: Number of images obtained at locations.

There was a total of 975 images for the key species in the study area. VFC condition was not assessed for Barramundi as there were insufficient images obtained in the study area. There were over 50 images obtained from all locations except the Narrows. However, there were 317 Barramundi images obtained from Lake Awoonga and Lake Callemondah that were used for comparison.

VFC was assessed based on images of the key species using human and machine assessments for each condition and the overall result was close to 100% agreement between the 2 methods.

Table 5 and Table 6 provide the severity of detection for fins and skin damage for the key species. The level of severity was mostly light active erosion for fins and mild skin aberrations for skin. There were low detections for eyes (less than 1%), and none for parasites or deformities.

Table 5: Severity score of variable fins condition for key species (eg YB = Yellowfin Bream) and the number of observations.

Fins	Score	YB	PB	BJ	DF	MJ	B
No Active Erosion	0	198	58	58	55	34	9
Light Active Erosion	10	222	179	25	4	34	11
Moderate Active Erosion with some haemorrhage	20	2	7	0	0	0	0
Severe Active Erosion with some haemorrhage	30	0	0	0	0	0	0

Table 6: Severity score of variable skin conditions for key species (eg YB = Yellowfin Bream) and the number of observations.

Skin	Score	YB	PB	BJ	DF	MJ	B
Normal no aberrations	0	420	244	81	57	68	20
Mild skin aberrations	10	2	0	2	2	0	0
Moderate skin aberrations	20	0	0	0	0	0	0
Severe skin aberrations	30	0	0	0	0	0	0

Table 7 shows the number of observations in images of the key species. Fin damage was the most detected issue for all species at 53.5% however was as high 76.2% in Pikey Bream and 55% in Barramundi. It was a low 11.9% for Pikey Bream.

Apart from fin damage all other conditions were at a low level at less than 1%. Skin damage was the second most observed issue at 0.5%. Barred Javelin had the highest level of skin damage at 2.4%. Eye damage was recorded in 0.3% of the fish with 1 fish recorded for Yellowfin Bream, Barred Javelin and Mangrove Jack. There were no incidences of parasites or deformities recorded.

Table 7: Observation of VFC issues in key species in 2021-22.

Species	Images	Fins	Skin	Eyes	Parasites	Deform-ities	GHHP score
Yellowfin Bream	422	224 (53.1%)	3 (0.7%)	1 (0.2%)	0	0	0.96
Pikey Bream	244	186 (76.2%)	0	0	0	0	0.94
Barred Javelin	83	25 (30.1%)	2 (2.4%)	1 (1.2%)	0	0	0.97
Dusky Flathead	59	7 (11.9%)	0	0	0	0	0.99
Mangrove Jack	68	34 (50%)	0	1 (1.5%)	0	0	0.96
Barramundi	20	11 (55%)	0	0	0	0	NA
All species	975	522 (53.5%)	5 (0.5%)	3 (0.3%)	0	0	

5.2 FISH BODY CONDITION (FBC)

Fish Body Condition (FBC) was assessed using Relative Condition Factor (RCF) as used in previous years. There was a total of 462 fish of 5 of the target species where length and weight were recorded at the BTHU. Table 8 and Figure 11 show the numbers of fish recorded with length and weight at the BTHU competition.

For each of the key species historic data recorded during the BTHU competition from 2003-2022 were used to generate the length-weight curve of best fit and subsequently to generate the parameters for each of the key species. Figure 12 shows the length-weight scatterplot for each of the key species showing the difference in length-weight.

Table 8: Numbers of fish where length-weight were recorded at the BTHU competition.

SPECIES	BTHU
Yellowfin Bream	277
Pikey Bream	28
Barred Javelin	75
Dusky Flathead	41
Mangrove Jack	41
Total	462

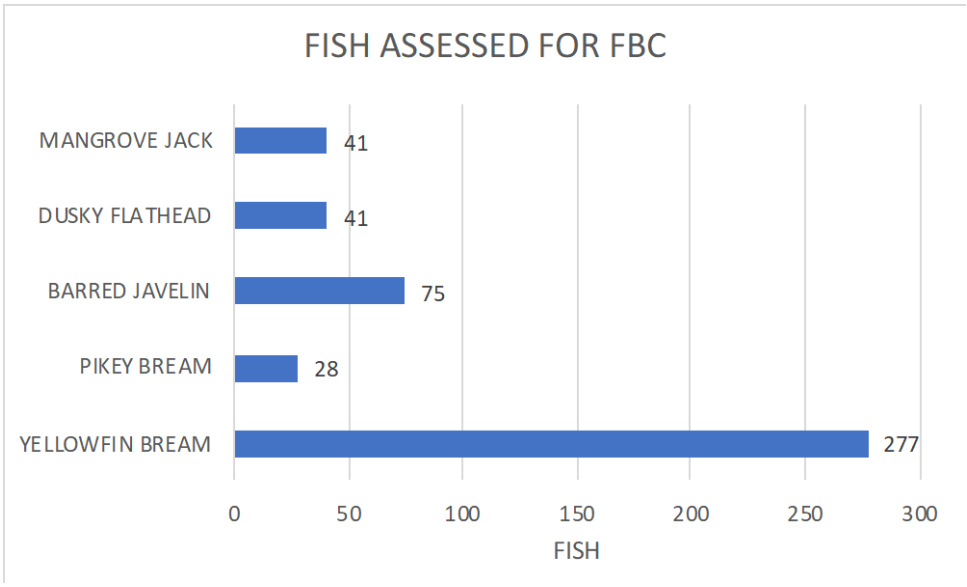


Figure 12: Numbers of fish where length-weight was recorded at the BTHU competition.

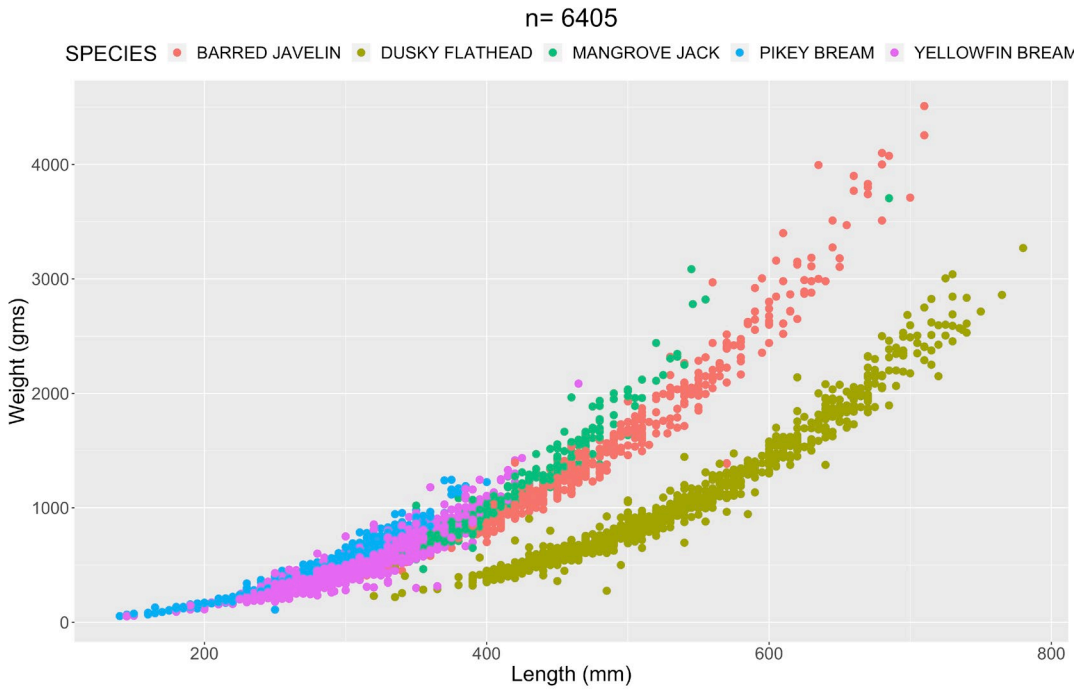


Figure 13: Length-weight data for the key species using the historic data from the BTHU from 2003-2022.

The historic length-weight data were plotted separately for each species and FBC was recalculated using RCF for all years. For each year box plots show the mean RCF, 25th and 75th percentiles, range and outliers. FBC=RCF=1 means average condition.

Figures 13, 15, 17, 19 and 21 show the length-weight plots for the 5 key species using historic data from the BTHU from 2003-2022 while Figures 14, 16, 18, 20 and 22 show the plots of FBC for each year.

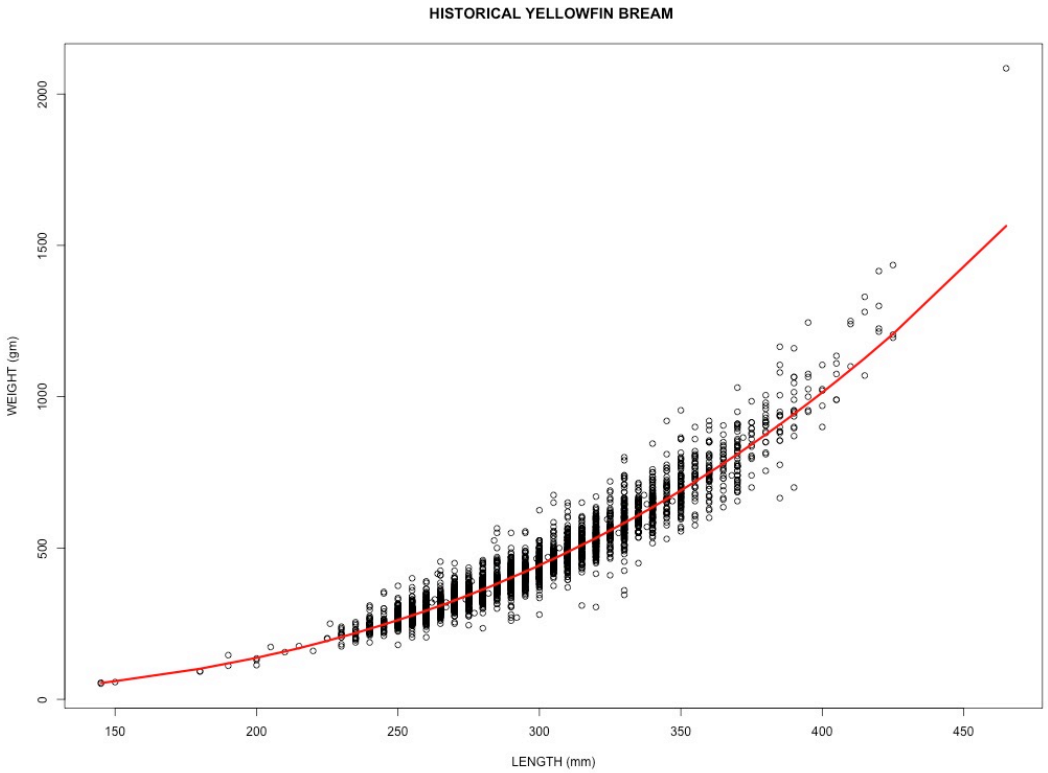


Figure 14: Length-weight plot for Yellowfin Bream using data from the BTHU from 2003-2022.

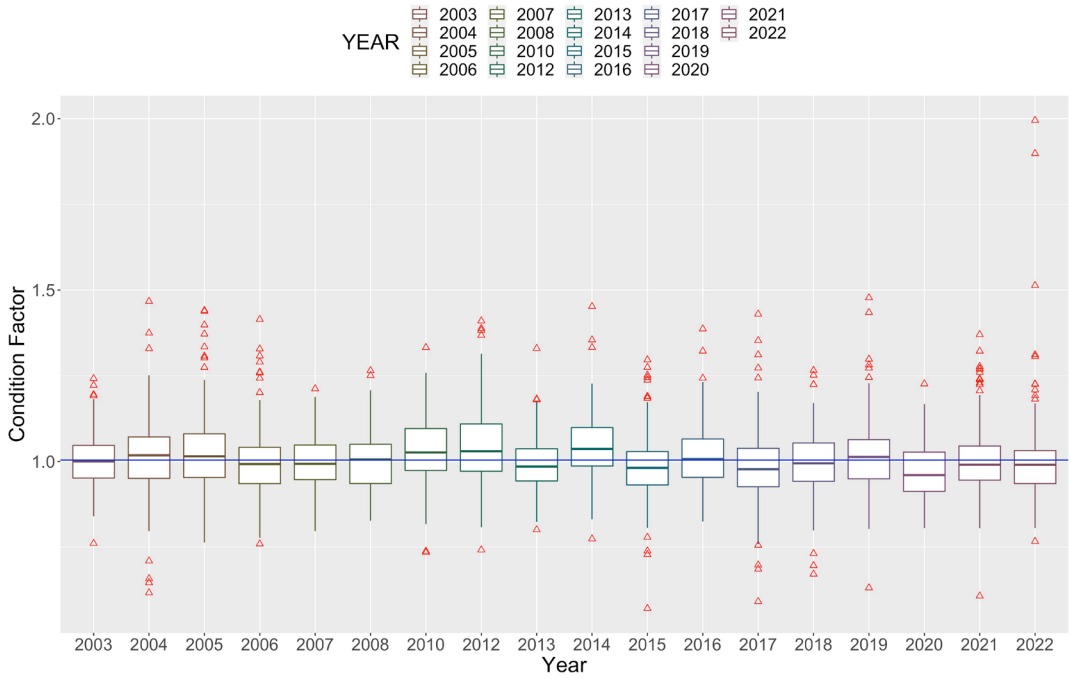


Figure 15: Plot of FBC for Yellowfin Bream from 2003-2022.

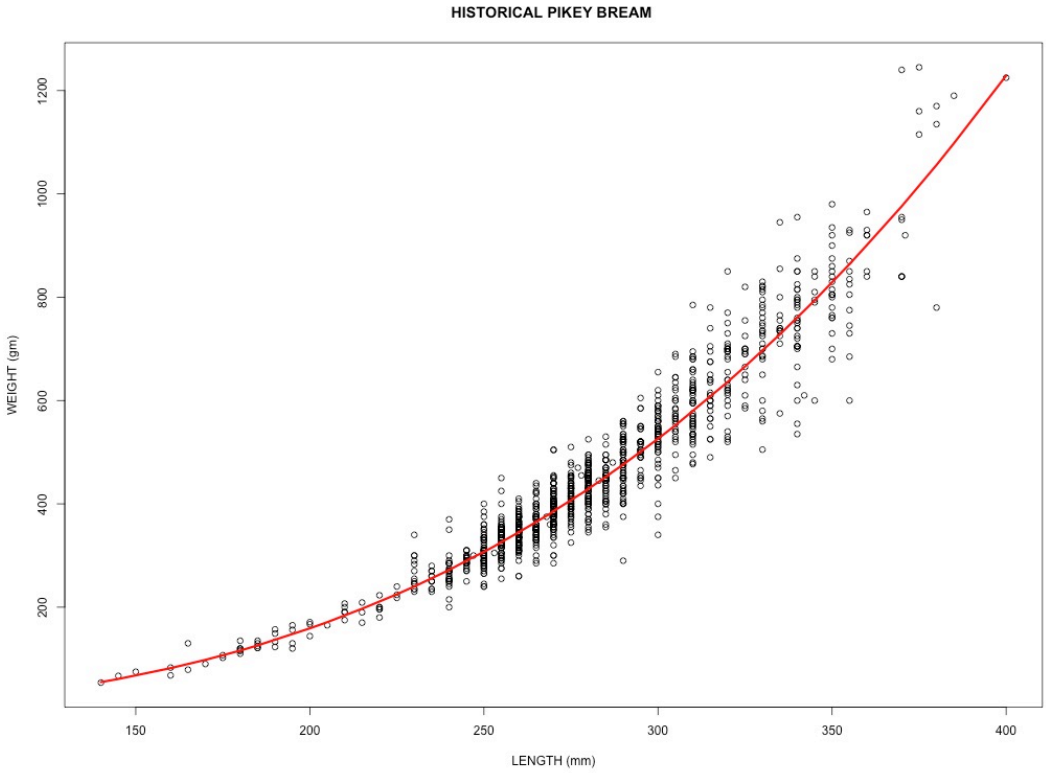


Figure 16: Length-weight plot for Pikey Bream using data from the BTHU from 2003-2022.

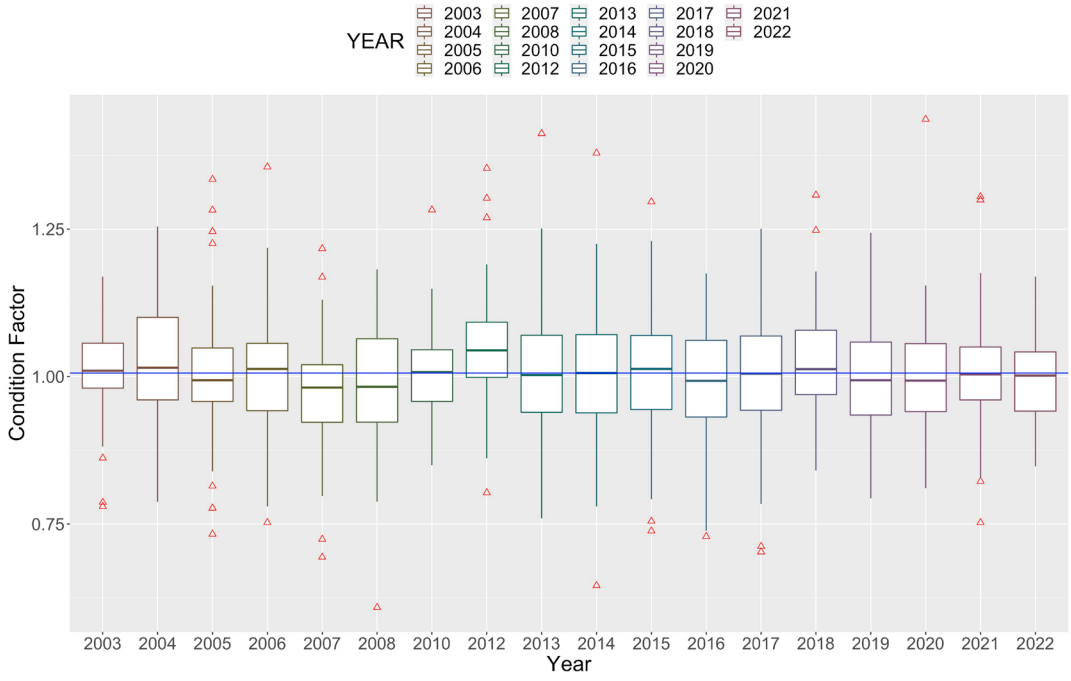


Figure 17: Plot of FBC for Pikey Bream from 2003-2022.

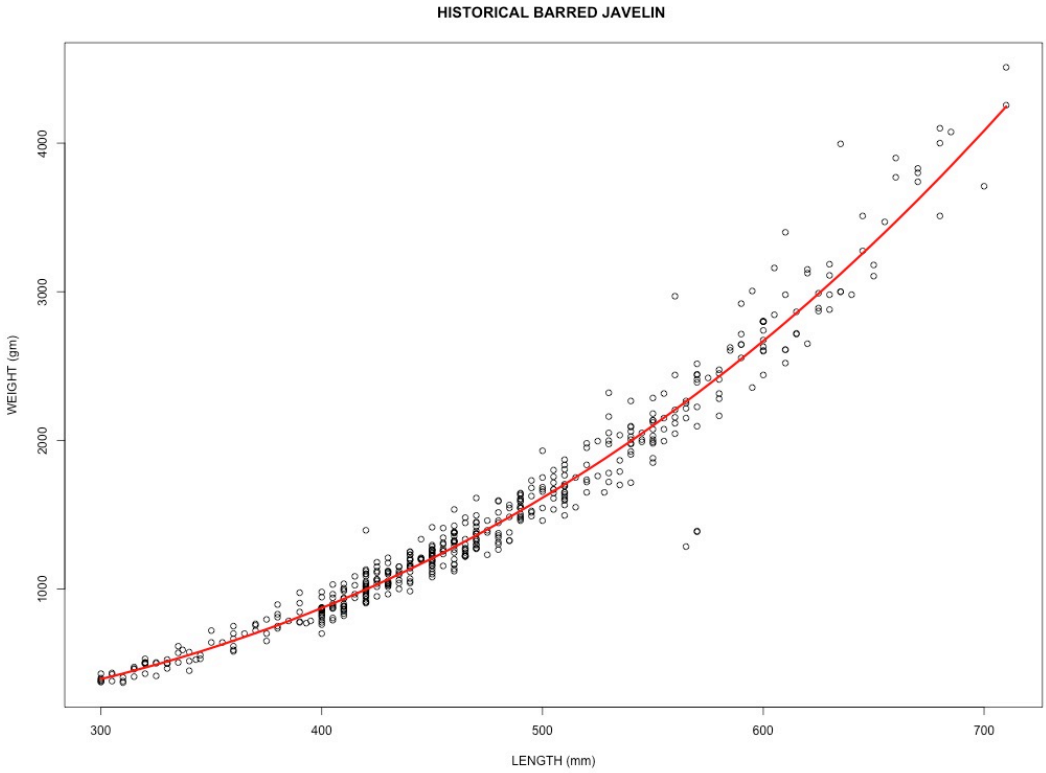


Figure 18: Length-weight plot for Barred Javelin using data from the BTHU from 2003-2022.

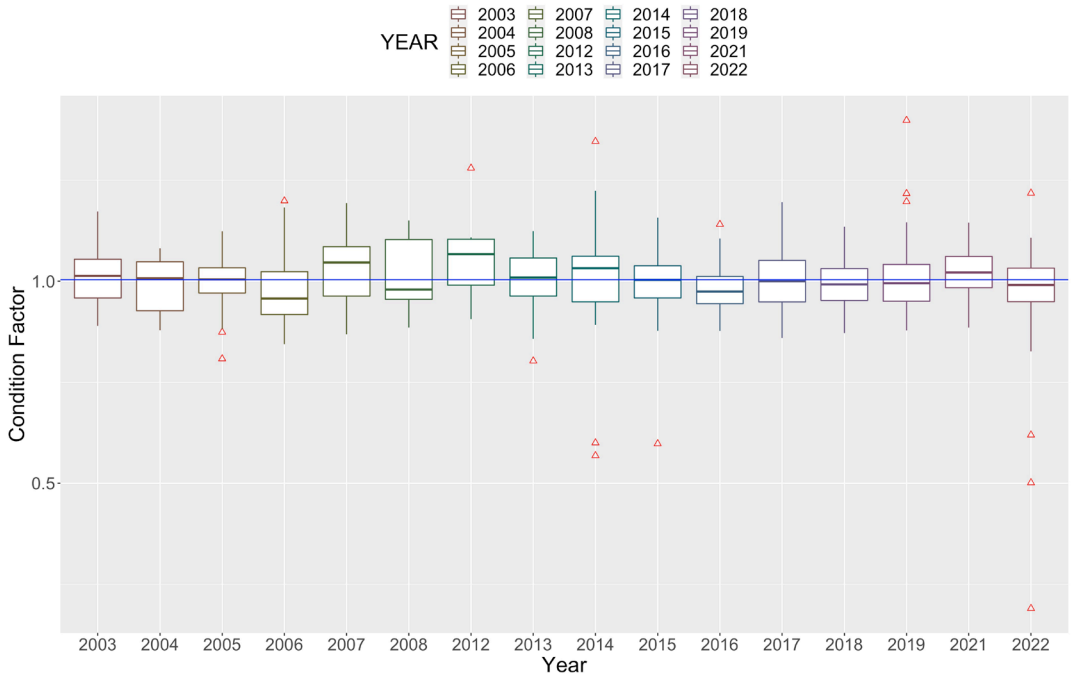


Figure 19: Plot of FBC for Barred Javelin from 2003-2022.

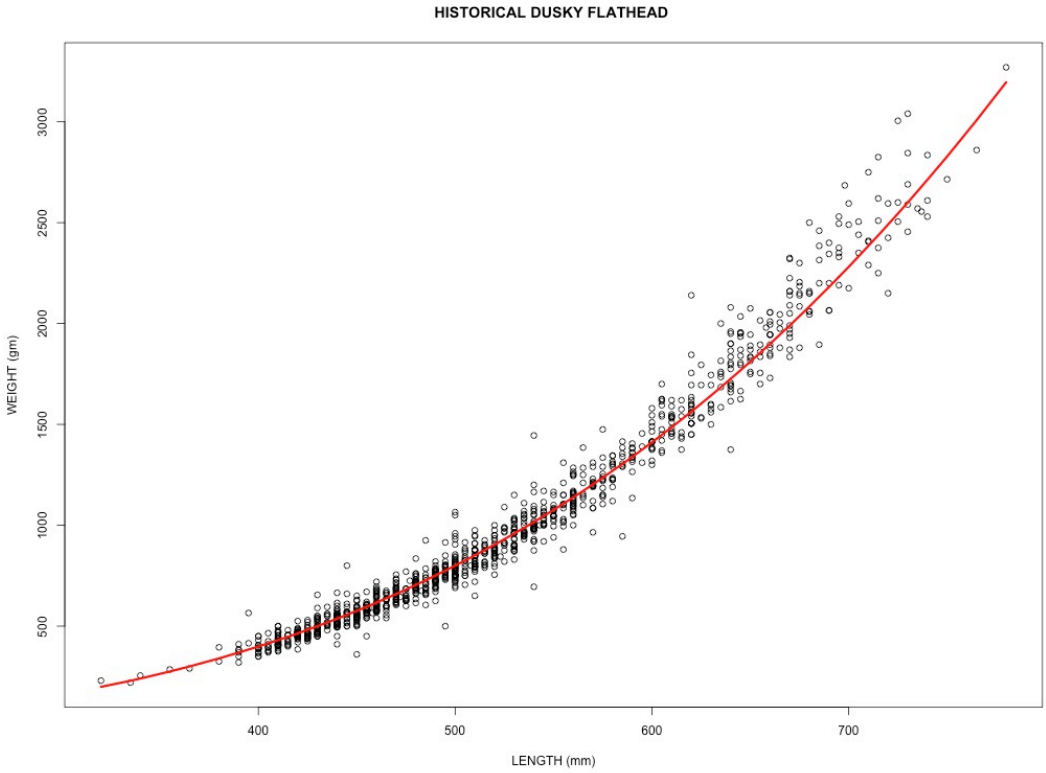


Figure 20: Length-weight plot for Dusky Flathead using data from the BTHU from 2003-2022.

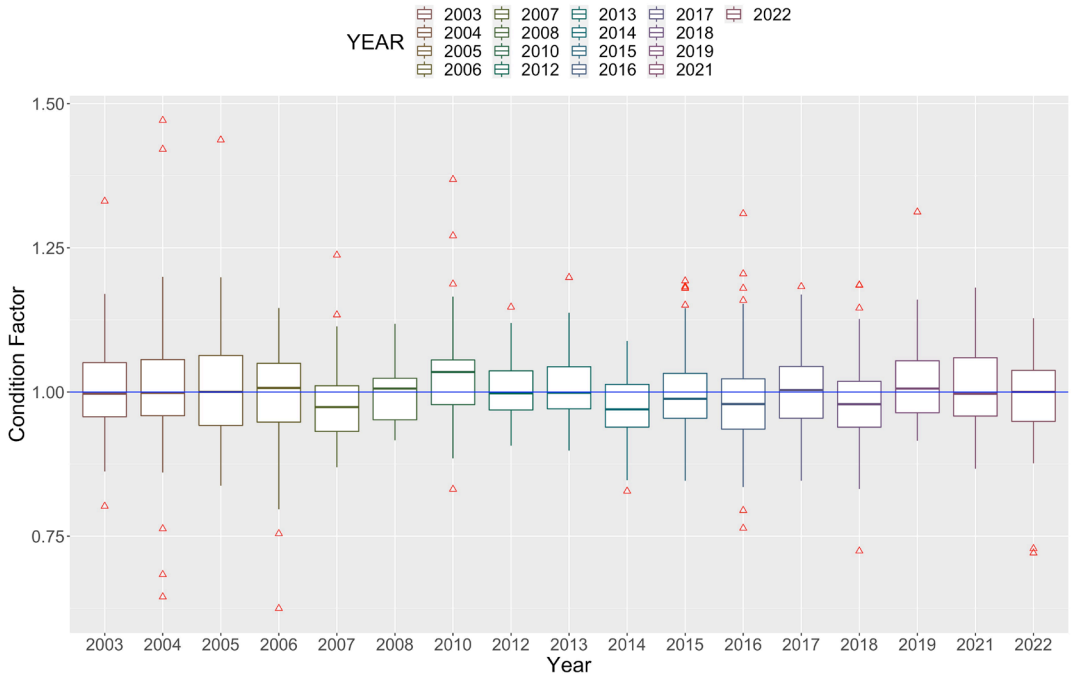


Figure 21: Plot of FBC for Dusky Flathead from 2003-2022.

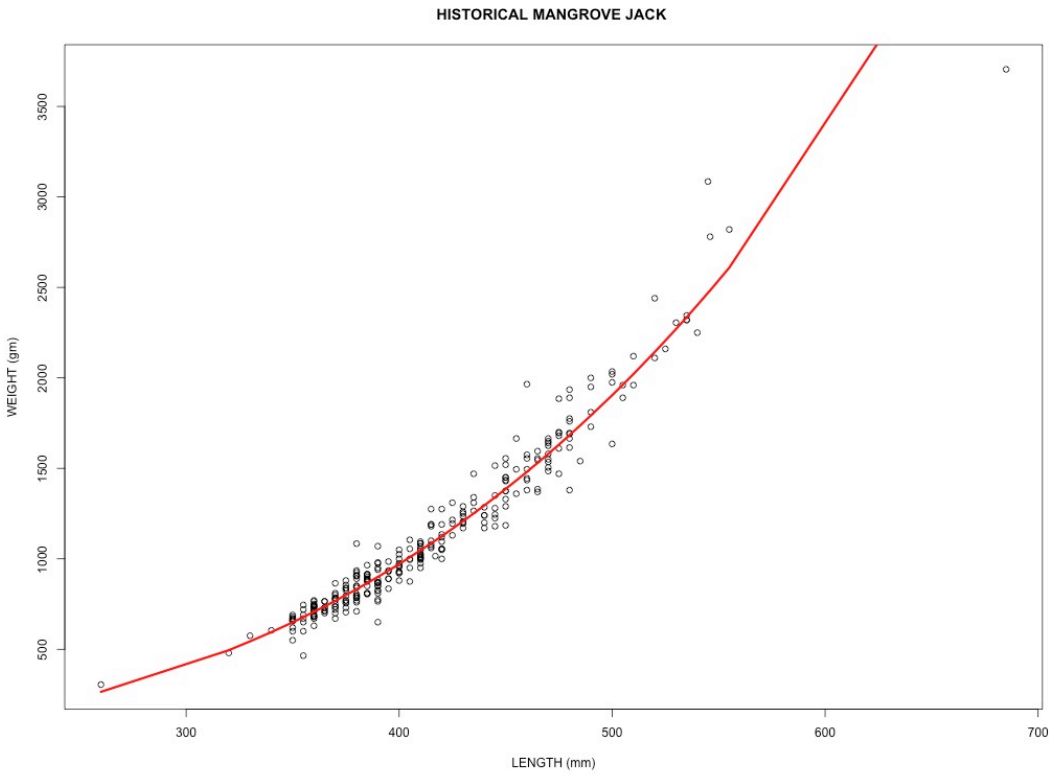


Figure 22: Length-weight plot for Mangrove Jack using data from the BTHU from 2003-2022.

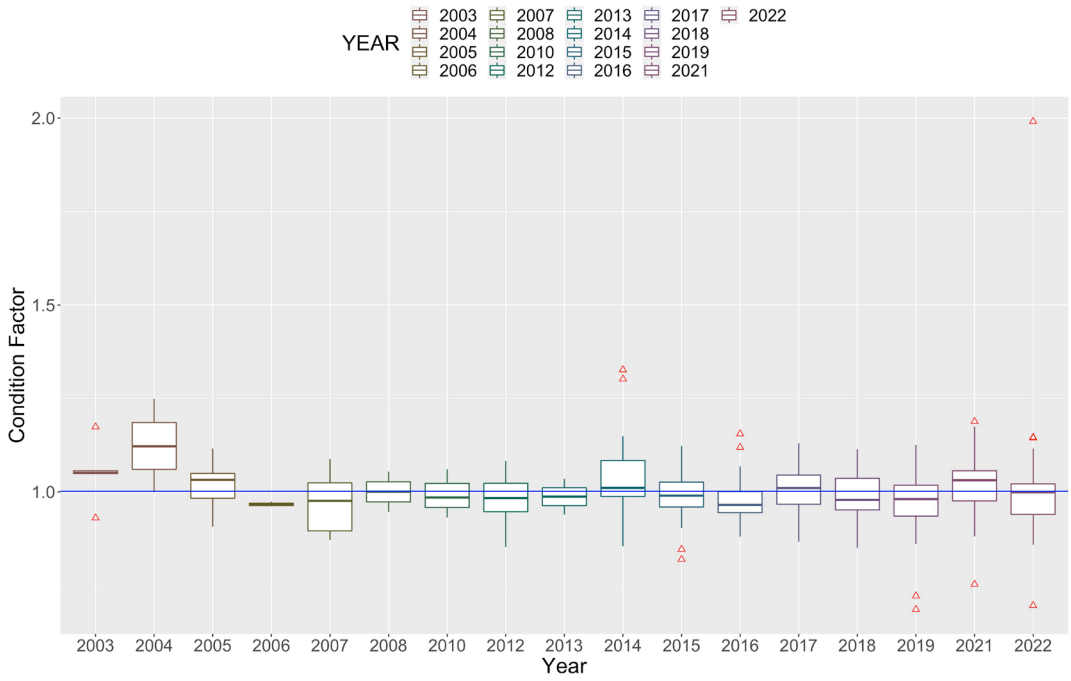


Figure 23: Plot of FBC for Mangrove Jack from 2003-2022 (small sample sizes 2003 - 2013).

Table 9 shows the FBC values calculated for the key species using the historic data from the BTHU from 2003-2021. Table 10 show the mean, median, minimum and maximum FBC from the historic data from 2003-2021. Table 11 shows the values calculated for 2022 and Table 12 shows the values converted to FBC scores for 2022.

Table 9: FBC values ($W = a \times TL^b$) for the key species using the historic data from the BTHU from 2003-2021.

SPECIES	Number Samples	a	b	R^2
Yellowfin Bream	3459	3.29E-05	2.878	0.923
Pikey Bream	1129	2.66E-05	2.946	0.934
Barred Javelin	493	5.78E-05	2.759	0.973
Dusky Flathead	1043	3.15E-06	3.114	0.961
Mangrove Jack	281	1.39E-05	3.015	0.949

Table 10: Mean, median, minimum and maximum condition factors for the key species from the historic data from the BTHU for 2003-2021.

SPECIES	Mean Condition	Median Condition	Minimum Condition	Maximum Condition
Yellowfin Bream	1.004	0.996	0.571	1.478
Pikey Bream	1.006	1.005	0.608	1.436
Barred Javelin	1.003	1.003	0.568	1.398
Dusky Flathead	1.000	0.993	0.625	1.471
Mangrove Jack	1.002	0.999	0.686	1.326

Table 11: Mean, median, minimum and maximum condition factors and standard deviation for the key species in 2022.

Species	Sample size	Mean Condition	Median Condition	Minimum Condition	Maximum Condition	Standard deviation condition
Yellowfin Bream	277	0.998	0.990	0.710	1.995	0.122
Pikey Bream	28	0.993	1.002	0.848	1.170	0.081
Barred Javelin	75	0.998	0.992	0.501	1.900	0.141
Dusky Flathead	41	0.990	1.000	0.721	1.128	0.083
Mangrove Jack	41	1.004	0.999	0.696	1.991	0.178

Table 12: Mean, median scores and standard deviation for the key species in 2022.

Species	Mean Score	Median Score	Standard Deviation Score
Yellowfin Bream	0.47	0.46	0.13
Pikey Bream	0.46	0.48	0.10
Barred Javelin	0.49	0.51	0.16
Dusky Flathead	0.43	0.44	0.10
Mangrove Jack	0.50	0.49	0.28

5.3 RIVER FLOW CONDITIONS

Figure 24 shows the monthly flow and the mean monthly flow in the Calliope River at Castlehope from 1 July 2018 – 31 May 2022. There was very little flow in the river in 2019, with below average flows during the 2020 wet season and moderate flows in February and March. There was no flow in either January or February 2021 and a low flow in March. The highest flow in 2021 was 20,154ML in November prior to the wet season. Since 2019 monthly river flows have mostly been well below mean monthly flows with only 2020 having a reasonable wet season flow.

Figure 25 shows the Awoonga lake level at the dam wall. There has not been any spilling of the dam since November 2017. There was a slight increase in the lake level in 2022 however it is still well below full level.

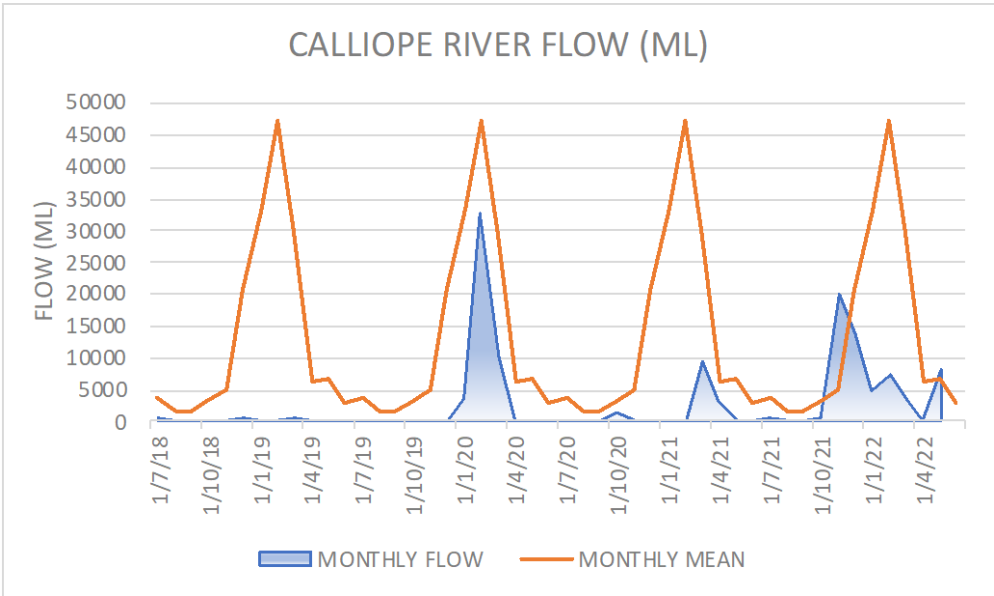


Figure 24: Calliope River flows and mean monthly flows (ML) July 2018 – May 2022.

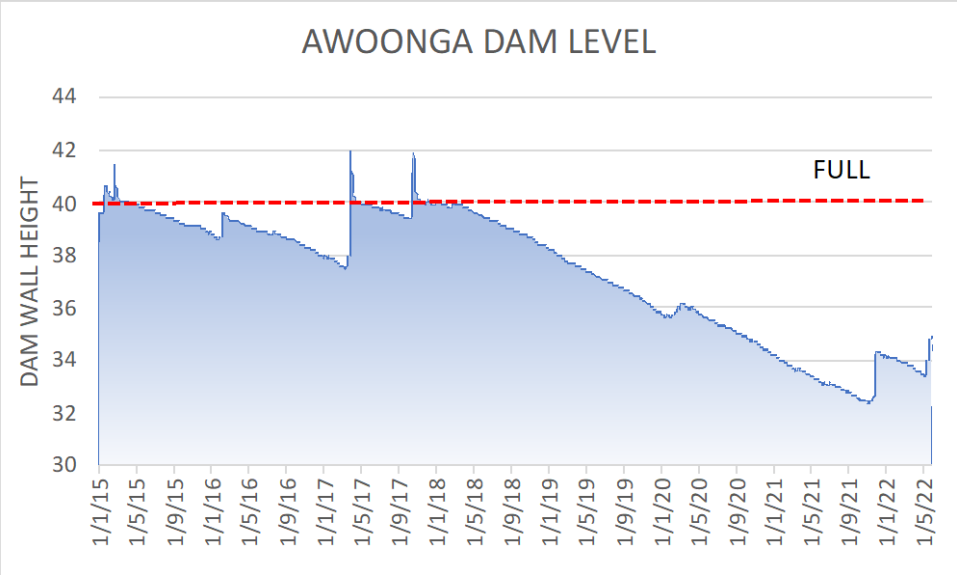


Figure 25: Awoonga lake levels and dam wall height (40m).

5.4 SPECIES SCORES AND GHHP GRADES

Table 13 shows the VFC and FBC scores for the 6 key species, the species score on a 0-1 scale and the corresponding GHHP grade. The GHHP grade for all species and all of harbour was B.

Table 13: GHHP scores and grades for the 6 key species (figures in brackets are sample size) for the 2022 report card.

Species	Visual Fish Condition (VFC)	Fish Body Condition (FBC)	Fish Condition (FC)	GHHP Species Grade
Yellowfin Bream	0.90 (422)	0.43 (277)	0.72	B
Pikey Bream	0.98 (244)	0.46 (28)	0.73	B
Barred Javelin	0.94 (83)	0.44 (75)	0.72	B
Dusky Flathead	0.97 (59)	0.43 (41)	0.70	B
Mangrove Jack	0.96 (68)	0.50 (41)	0.72	B
Barramundi (VFC only)	NA (20)	NA (0)	NA	NA
All of harbour	0.97	0.47	0.72	B

5.5 VFC COMPARISON BY LOCATION

While there were low numbers of Barramundi images recorded in the study area there were good numbers recorded in Lake Awoonga and Lake Callemondah. These provide an assessment of VFC that is relevant as when the dams spill the fish enter the study area.

There were 317 images of Barramundi that were assessed for VFC for fish caught in Lake Awoonga and Lake Callemondah. Table 14 shows the number of severity scores for fins while there were no detections made in relation to skin, eyes, parasites or deformities.

Table 15 shows the mean, median, minimum and maximum values for VFC for fish in both impoundments while Table 16 shows the GHHP grade.

Table 14: Severity score of variable fins condition for Barramundi in Lake Awoonga and Lake Callemondah with the number of detections.

Fins	Score	B
No Active Erosion	0	156
Light Active Erosion	10	160
Moderate Active Erosion with some haemorrhage	20	0
Severe Active Erosion with some haemorrhage	30	1

Table 15: VFC results for Barramundi in Lake Awoonga and Lake Callemondah

Species	Sample size	Mean Condition	Median Condition	Minimum Condition	Maximum Condition	Standard deviation condition
Barramundi	317	0.914	0.833	0.5	1.000	0.087

Table 16: GHHP scores and grades for Barramundi in Lake Awoonga and Lake Callemondah (figure in brackets is sample size).

Species	Visual Fish Condition (VFC)	Fish Body Condition (FBC)	Fish Condition (FC)	GHHP Species Grade
Barramundi	0.91 (317)	NA	0.91 (VFC only)	A

6. DISCUSSION

This year the number of images for the key species significantly exceeded the targets except for Barramundi. With poor recruitment in the last few years and no addition to stocks from fish spilling from Awoonga there has been a decline in the Barramundi population, and it was expected that reaching the target number of images would be difficult.

Both Lakes Awoonga and Callemondah are regularly stocked with Barramundi and fish enter the study area when they spill. Lake Awoonga has not spilled since November 2017 so has not “topped up” stocks in the Boyne River and Gladstone Harbour. Lake Callemondah is a small impoundment that spills almost every year so fish can enter Auckland Creek and Gladstone Harbour. It had not been included previously due to the low level of images collected from there. The comparatively low number of fish there do not have the same impact when the dam spills however may have an impact in the future so including data from there on VFC provides useful additional information. This year there were no recaptures of fish tagged in Lake Callemondah in Auckland Creek or Gladstone Harbour suggesting a low level of spilling of fish (Suntag 2022).

Length-weight data were able to be obtained for the key species at the BTHU except for Barramundi. Unfortunately, the BTHU committee decided to continue excluding Pikey Bream in the live weigh-in categories which limited the data available for that species. While both GHHP and the GSFC made representations to the BTHU committee to reinstate Pikey Bream as a live weigh-in species the committee decided against its reinstatement. Even though not eligible for the competition Pikey Bream were presented at the live weigh-in and photos, lengths and weights were obtained for these fish allowing FBC to be assessed.

The overall grade for Gladstone Harbour was B (0.72) with all species receiving a B grade. VFC scores were high for the key species ranging from 0.90 for Yellowfin Bream to 0.98 for Pikey Bream and an All of Harbour score of 0.97. The only VFC issue was in relation to fins. Fish handling and the use of inappropriate landing nets and containers for transporting the fish to the live weigh-ins are likely to have contributed to the moderate to high level of fin issues although most issues were classified as light.

Dry conditions are likely to reduce food supply and impact on FBC. In 2022, there was a moderate flow in the Calliope River following November rain, dry conditions in January and February then follow up low flows in March and May. These conditions put continuing strain on the habitats with a likely reduction in food supply. While there was moderate flow in local streams (except the Boyne River) in November this did not result in a boost to the numbers of Prawns with the lowest numbers recorded since 2015 (Sawynok B and Sawynok S 2022) suggesting food supply was lower than in previous years.

The low level of freshwater flows and flooding would also have contributed to a lower incidence of skin infections which are more prevalent following freshwater flows. Previously, spilling of Awoonga has been associated with an increase in visual health issues resulting from damage to fish going over the dam spillway. Also, when this has occurred there have been significant reports of dead Barramundi, particularly in the Boyne River, with no reports recorded this year.

7. REFERENCES

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3. Sawynok S, Sawynok W, Dunlop A and Sawynok P, Infofish Australia Pty Ltd (2019), Visual fish health indicators for the Gladstone Harbour Report Card 2019, Gladstone Healthy Harbour Partnership, Gladstone, Queensland
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5. Sawynok W, Sawynok S and Dunlop A, Infofish Australia Pty Ltd, (2018b), A visual fish condition index, Fisheries Research and Development Corporation report 2017-141
6. Sawynok B and Sawynok S, Infofish Australia Pty Ltd, (2021), Fish recruitment indicators for the Gladstone Harbour Report Card using data derived from castnet sampling, Gladstone Healthy Harbour Partnership, Gladstone, Queensland
7. Sawynok B and Sawynok S, Infofish Australia Pty Ltd, (2022), Fish recruitment indicators for the Gladstone Harbour Report Card using data derived from castnet sampling 2022, Gladstone Healthy Harbour Partnership, Gladstone, Queensland

APPENDIX 1: VISUAL FISH CONDITION OBSERVATIONS AT GLADSTONE

Table 17: VFC detections for all species at Gladstone.

Species	Fins	Skin	Eyes	Parasites	Deformities	Images
Barcheek Coral Trout	0	0	0	0	0	1
Barramundi	11	0	0	0	0	20
Barred Javelin	25	2	0	0	0	83
Bartail Flathead	0	0	0	0	0	11
Black Jewfish	7	0	0	0	0	11
Blackspotted Rockcod	4	0	0	0	0	9
Dusky Flathead	7	2	0	0	0	59
Fringe-eye Flathead	0	0	0	0	0	2
Golden Snapper	21	0	0	0	0	32
Goldspotted Rockcod	3	0	0	0	0	12
Mangrove Jack	34	0	0	0	0	68
Pikey Bream	186	0	0	0	0	244
Queensland Groper	0	0	0	0	0	1
Yellowfin Bream	224	3	1	0	0	422
All species	522	5	1	0	0	975
Percentage	53.5	0.5	0.1	0	0	
Species	Fins	Skin	Eyes	Parasites	Deformities	Images
Barramundi (impoundments)	161	0	0	0	0	317
Percentage	50.8	0	0	0	0	