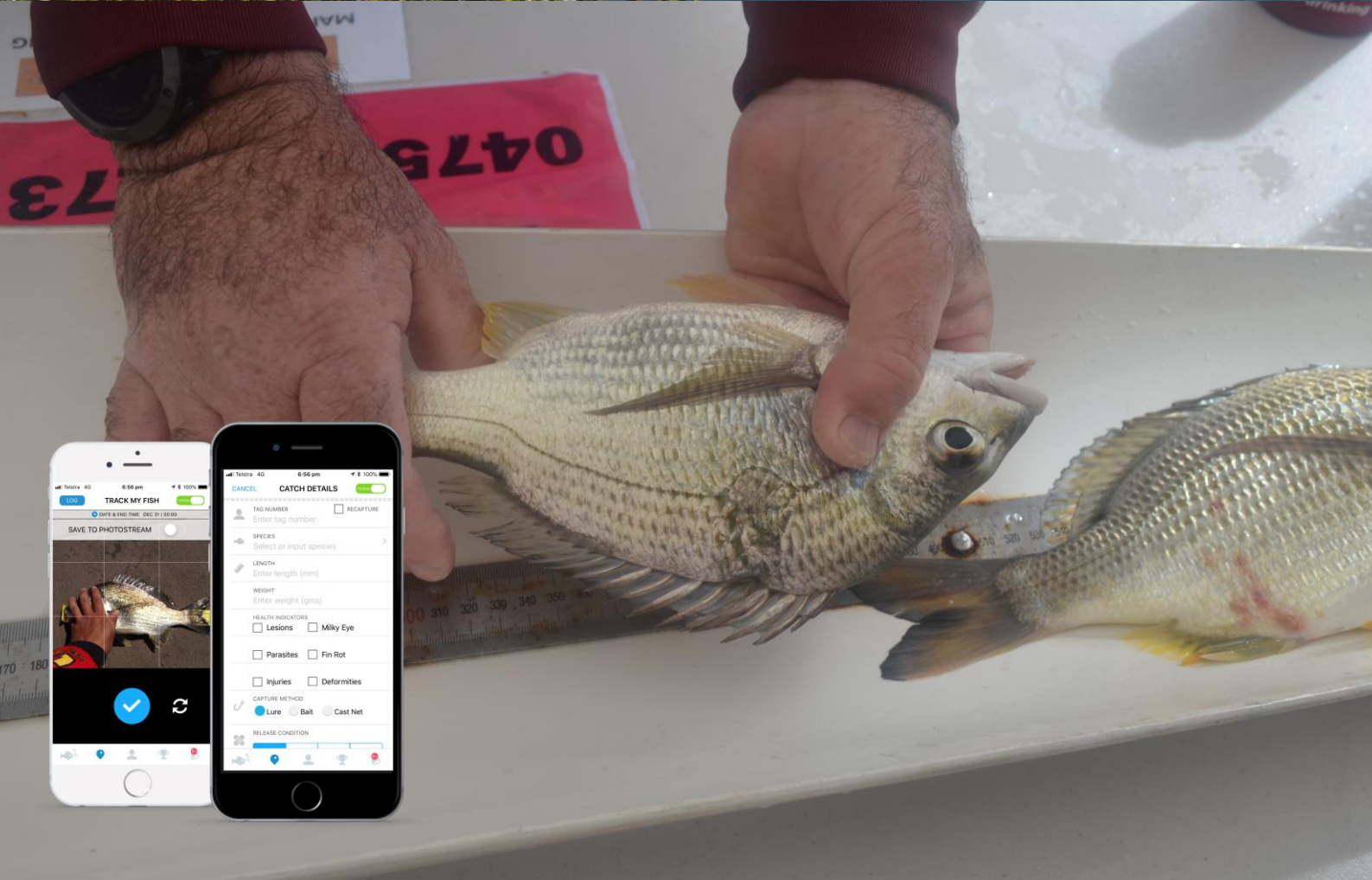


Fish condition health indicators for the Gladstone Harbour Report Card 2021



Fish condition health indicators for the Gladstone Harbour Report Card 2021

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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 period of study, new information will be added on the subject matter studied over time and is available in subsequent reports.

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Cover images – boats participating in the Australian Bass Tournaments (ABT) Bream competition (top) and Bream with skin damage at the Boyne Tannum HookUp (BTHU) weigh-in (bottom)

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SUMMARY

Fish condition (FC) health assessments in the Gladstone Harbour study area for the 2021 Report Card were based on a combination of Visual Fish Assessment (VFA) 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 VFA, and length-weight data were used to assess FBC based on activities 1-4 listed below. Images were collected from 1-4 while length-weight were collected from 1-2.

1. Fishers in the Australian Bass Tournament (ABT) Bream fishing competition (September 2020)
2. Live weigh-in at the Boyne Tannum Hookup (BTHU) fishing competition (May 2021)
3. Suntag fishers using the Infofish Trackmyfish phone app and photos submitted by fishers recapturing tagged fish (July 2020-May 2020)
4. Infofish line fishing (December 2020)

VISUAL FISH ASSESSMENT

Images are assessed for VFA using the following indicators fins, skin, eyes, parasites and deformities. VFA 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 VFA of 6 key species Yellowfin Bream, Pikey Bream, Barred Javelin, Dusky Flathead, Mangrove Jack and Barramundi was obtained using 1,666 images mostly captured by the Trackmyfish 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 17.0% for Dusky Flathead to 69.4% for Mangrove Jack however the severity of the damage was low and assessed as light active erosion. Skin damage was low ranging from 1.1% for Yellowfin Bream to 3.3% for Mangrove Jack with low severity of mild skin aberration. The observation level for eyes, parasites and deformities was very low to none. The resulting VFA scores are shown in the accompanying summary table.

FISH BODY CONDITION

FBC was calculated using Relative Condition Factor (RCF) as used for the 2020 report. FBC was obtained from a total of 1,139 fish for 6 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 VFA 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 Assessment (VFA)	Fish Body Condition (FBC)	Fish Condition (FC)	GHHP Species Grade
Yellowfin Bream	0.95 (792)	0.47 (639)	0.71	B
Pikey Bream	0.98 (424)	0.48 (69)	0.73	B
Barred Javelin	0.94 (162)	0.54 (92)	0.74	B
Dusky Flathead	0.97 (147)	0.54 (93)	0.76	B
Mangrove Jack	0.96 (121)	0.55 (74)	0.75	B
Barramundi (VFA only)	NA (20)	NA (0)	NA	NA
All of harbour	0.97	0.50	0.73	B

COMPARISON WITH OTHER SITES

This year the only comparison made was for Barramundi in Lake Awoonga using images from 2 fishing competitions held there and Gladstone Area Water Board (GAWB) monitoring. Barramundi from Lake Awoonga impact on fish health when the dam overtops and fish enter the downstream waterways, so it was considered relevant to include them in the assessment. However there has been no overtopping of the dam since 2017. An assessment was made for VFA only as no weights were able to be obtained. This resulted in a FC score of 0.96 (VFA 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 visual fish health assessments in 2018-19 and 2019-20 and included a fish condition health indicator score in its 2019 and 2020 report cards using 6 key species. The results are contained in the reports: Visual fish health indicators for the Gladstone Harbour Report Card 2019 (Sawynok et al. 2019) and Visual fish health indicators for the Gladstone Harbour Report Card 2020 (Sawynok et al. 2020).

A further visual health assessment was undertaken for the 2021 Report Card using the same methods developed in the previous projects.

2. OBJECTIVES

The objectives of the project were:

1. Produce visual fish assessment and fish body condition scores and grades for the 2021 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 are 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 2021 Gladstone Harbour Report Card.

Species	Visual Fish Assessment (VFA)	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
Barramundi VFA only	score	NA	NA	grade VFA only
All of harbour	score	score	score	grade



Figure 1: Grading scale for the 2021 Gladstone Harbour Report Card.

3. GLADSTONE HARBOUR MONITORING ZONES

The Gladstone Harbour has been divided into 13 environmental monitoring zones for the GHP 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 GHP Report Card (from 2020 Gladstone Harbour Technical Report).

4. METHODS

4.1 COLLECTING FISH SAMPLES

Data were collected from 1 July 2020 to 1 June 2021. The target was a minimum of 25 photographic samples of 6 species groups throughout the study area. There were 4 methods for collecting the fish samples using the Infofish Trackmyfish (TMF) phone apps (Figure 3) or photos submitted by the fishing public.

1. Images and length-weights from the ABT Bream tournament using the TMF app (September 2020).
2. Images and length-weights from the live weigh-in section of the Boyne Tannum HookUp (BTHU) fishing competition using TMF (May 2021).
3. Images from Suntag taggers including Gladstone Sportfishing Club members using TMF during normal fishing trips and photos provided by the general fishing public when reporting the recaptures of tagged fish (July 2020- June 2021).
4. Additional photos of fish (mostly Pikey and Yellowfin Bream) were obtained by Infofish by line fishing using the TMF app (December 2020).

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.
- Check boxes to record visual health issues (lesions, eyes, parasites, fin damage, injuries and deformities) (Figure 3 – Infofish only).
- Date and GPS location of where the fish were caught.

Locations were not available for where fish were caught when they were presented at the BTHU live weigh-ins. There were 2 weigh-in stations and it was assumed that fish presented at Bray Park at Boyne Island were mostly from the Boyne River, South Trees Inlet and Rodds Bay. Fish presented at the Marina weigh-in station in Gladstone were mostly from Gladstone Harbour, Calliope River and the Narrows. Figure 4 shows a typical fish sample collected at the BTHU with lesions on the side.

Target species were the following however images were collected from all species recorded. Length-weight only of Whiting were obtained at the BTHU.

- Yellowfin Bream (*Acanthopagrus australis*)
- Pikey Bream (*Acanthopagrus berda*)
- Barred Javelin (*Pomadasys kaakan*)
- Dusky Flathead (*Platycephalus fuscus*)
- Barramundi (*Lates calcarifer*)
- Whiting (*Sillago spp*) (no images)
- Mangrove Jack (*Lutjanus argentimaculatus*)

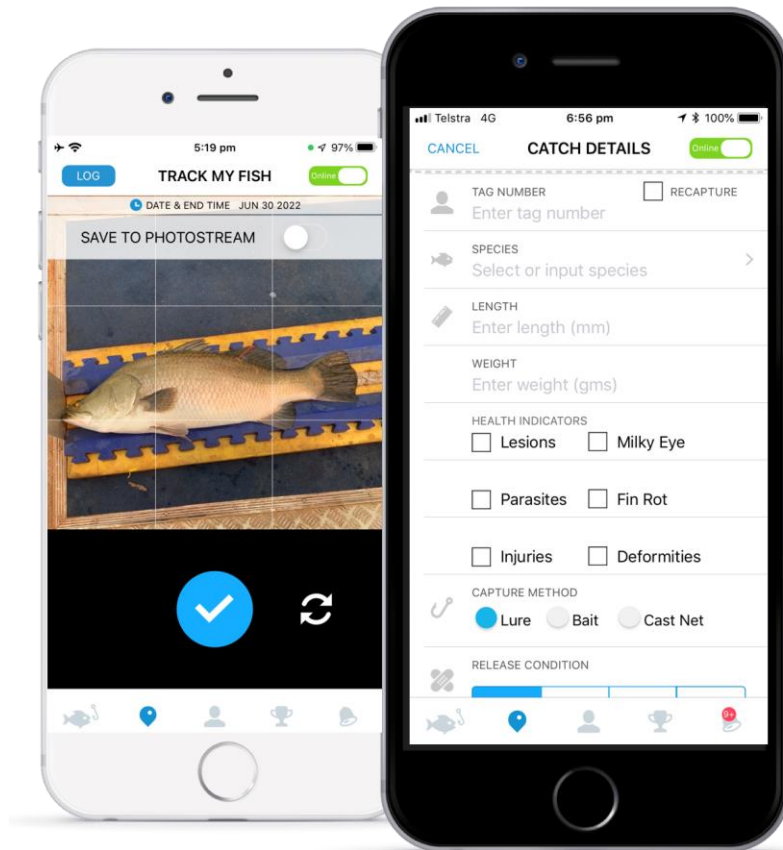


Figure 3: TMF screen to capture fish images and collect details of the fish.



Figure 4: Yellowfin Bream with mild skin aberrations on side at the BTHU.

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

- ABT Bream competition (26-27/9/2020).
- BTHU (30/4-2/5/2021) in conjunction with the live weigh-in conducted by the Gladstone Sportfishing Club.

Data on Yellowfin and Pikey Bream were collected at the ABT Bream competition although participation was limited due to restrictions associated with Covid-19.

Data at the BTHU were collected on all species presented at the live weigh-in even though some were not eligible for the competition. This included Pikey Bream resulting in fewer fish of that species being recorded. This was unfortunate as Bream are key species in assessing the health of Gladstone Harbour. Figure 5 shows the setup used for measuring and weighing fish at the ABT fishing competition.



Figure 5: Measuring and weighing fish at the ABT fishing competition.

4.2 VISUAL FISH ASSESSMENT (VFA)

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

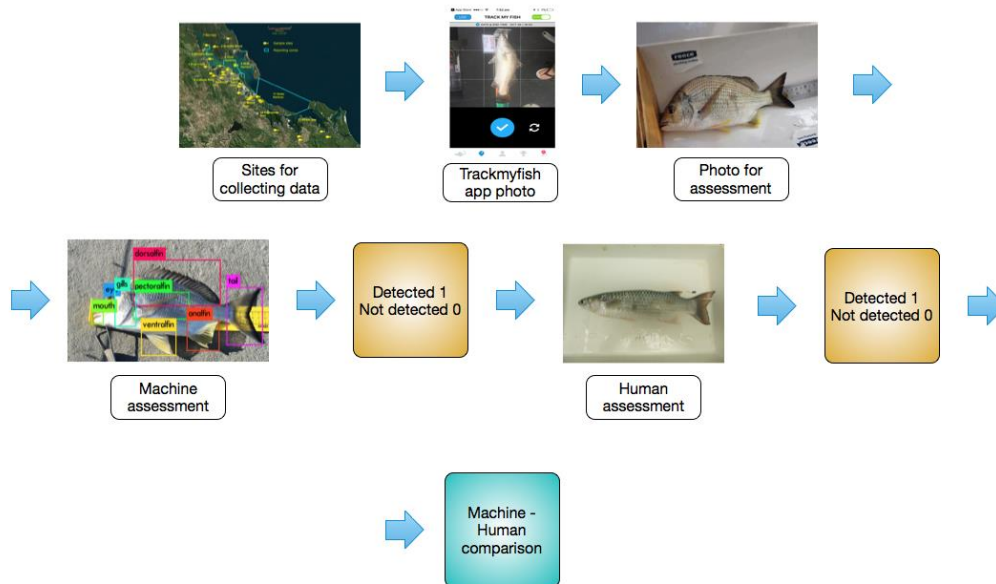


Figure 6: Simplified flow chart of the process from field collection of data to the comparison of the machine and human assessment for VFA.

VFA was assessed for all samples obtained from the study area as well as samples obtained from Lake Awoonga. 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 VFA scores reflecting healthier fish.

$$VFA = \frac{\text{maximum score} - \text{fish score}}{\text{maximum score}}$$

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 last year (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 2003-2021 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 overtopping of Awoonga dam. Overtopping has been associated with fish health issues since 2011, particularly in Barramundi in the Boyne River however there was no overtopping during the study period. Data on the dam level were obtained from the Gladstone Area Water Board.

4.5 GENERATING SPECIES SCORES AND GRADES

A species FC score was generated for each key species by averaging VFA 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 VFA and FBC were included in the overall report card score. Cut-off bands and graded are shown in Figure 7.

Key species for which there were sufficient data:

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

Table 4: Generating scores and grades for key species.

Species	Visual Fish Assessment (VFA)	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 2021 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).

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

4.7 COMPARISON WITH OTHER LOCATIONS

In the 2020 report VFC comparisons were made with regional locations at Baffle Creek, Hinchinbrook, Sunshine Coast, Moreton Bay and Lake Awoonga. Apart from fins the observation of skin, eyes, parasites and deformities were very low to none at all sites.

This year the only comparison made was with Awoonga as that has direct relevance to fish health issues in Gladstone Harbour and is likely to contribute to fish health issues in the future. Images of Barramundi were obtained from 2 fishing competitions held there and from continued monitoring. These were:

1. Lake Awoonga GAWB monitoring – 1/7/2020-31/5/2021
2. ABT Barramundi Australian Open – 29/9-1/10/2020
3. Basstastic Barra Round – 22/1-25/1/2021

No weights were able to be obtained for Barramundi so that it was not possible to calculate FBC.

5. RESULTS

5.1 VISUAL FISH ASSESSMENT (VFA)

A total of 1,853 images were collected from 1 July 2020 to 1 June 2021 to assess VFA. Figure 8 shows the sources of the images while Figure 9 shows the timeframe in which the images were collected.

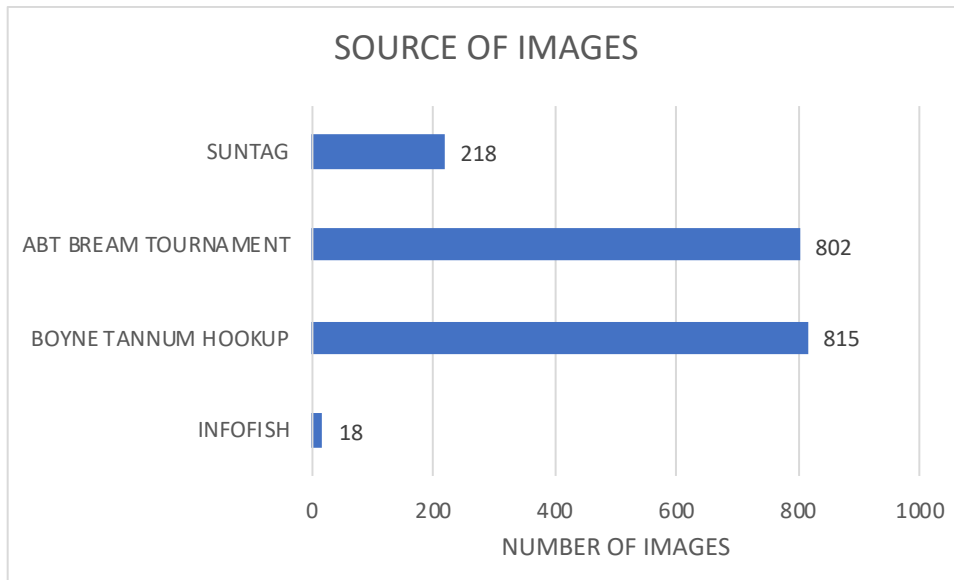


Figure 8: Sources of images for Visual Fish Assessment.

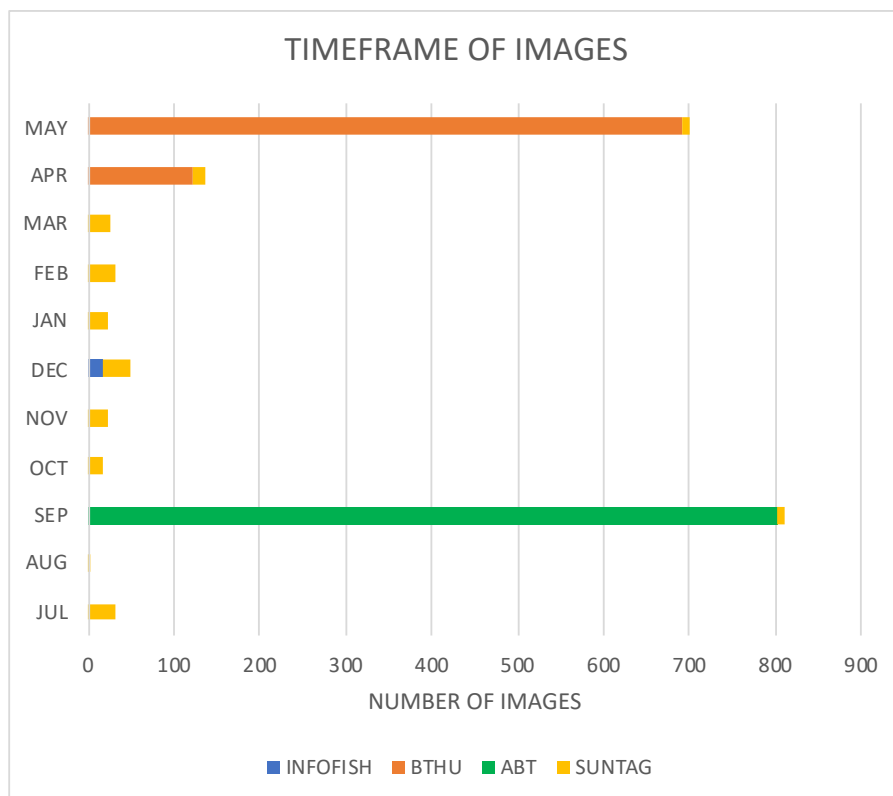


Figure 9: Timeframe for when images were obtained in 2020-2021.

Figure 10 shows the number of images based on species. There was a total of 1,666 images for the key species and a further 187 of other species making a total of 1,853 images.

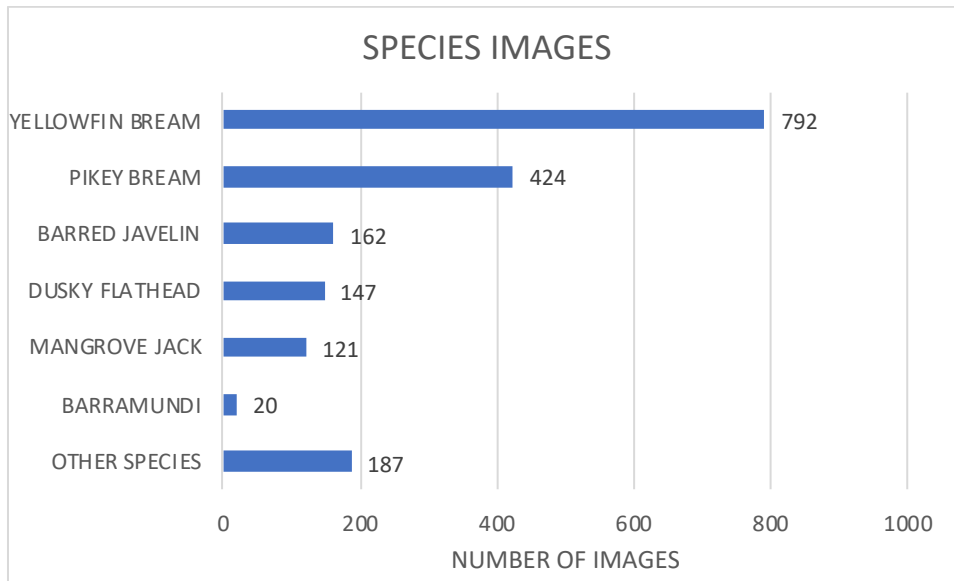


Figure 10: Number of images for each of the key species.

VFA 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. There were negligible observations of eye abnormalities, parasites and deformities.

Table 5 shows the number of observations in images of the key species, however this does not account for the severity of the issue. Fin damage was the most detected issue at 53.3% followed by skin damage at 1.3%. There were no eye conditions detected while possible parasites were 0.05% (just 1 fish) and deformities were 0.3%.

Table 6 and Table 7 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.

Table 5: Observation of VFA issues in key species in 2020-21.

Species	Images	Fins	Skin	Eyes	Parasites	Deformities	GHHP score
Yellowfin Bream	792	520 (65.7%)	9 (1.1%)	0	1 (0.1%)	3 (0.4%)	0.89
Pikey Bream	424	185 (43.6%)	7 (1.7%)	0	0	3 (0.7%)	0.92
Barred Javelin	216	83 (38.4%)	2 (1.2%)	0	0	0	0.90
Dusky Flathead	147	25 (17.0%)	2 (1.4%)	0	0	0	0.97
Mangrove Jack	121	84 (69.4%)	4 (3.3%)	0	0	0	0.88
Barramundi	20	8 (40.0%)	0	0	0	0	
All species	1853	988 (53.3%)	24 (1.3%)	0 (0%)	1 (0.05%)	6 (0.3%)	

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

Fins	Score	YB	PB	BJ	DF	MJ	B
No Active Erosion	0	272	239	77	122	37	12
Light Active Erosion	10	507	181	76	23	84	8
Moderate Active Erosion with some haemorrhage	20	12	3	9	2	0	0
Severe Active Erosion with some haemorrhage	30	1	1	0	0	0	0

Table 7: 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	783	417	160	145	117	20
Mild skin aberrations	10	9	6	2	2	4	0
Moderate skin aberrations	20	0	1	0	0	0	0
Severe skin aberrations	30	0	0	0	0	0	0

5.2 FISH BODY CONDITION (FBC)

Fish Body Condition (FBC) was assessed using Relative Condition Factor (RCF) as was used last year. There was a total of 1,139 fish of 6 of the target species where length and weight were recorded. Table 8 and Figure 11 show the numbers of fish recorded with length-weight at the BTHU and the ABT competitions.

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

SPECIES	BTHU	ABT	TOTAL
YELLOWFIN BREAM	604	35	639
PIKEY BREAM	33	36	69
BARRED JAVELIN	92		92
DUSKY FLATHEAD	93		93
MANGROVE JACK	74		74
BARRAMUNDI	0		0
WHITING	172		172
TOTAL	1068	71	1139

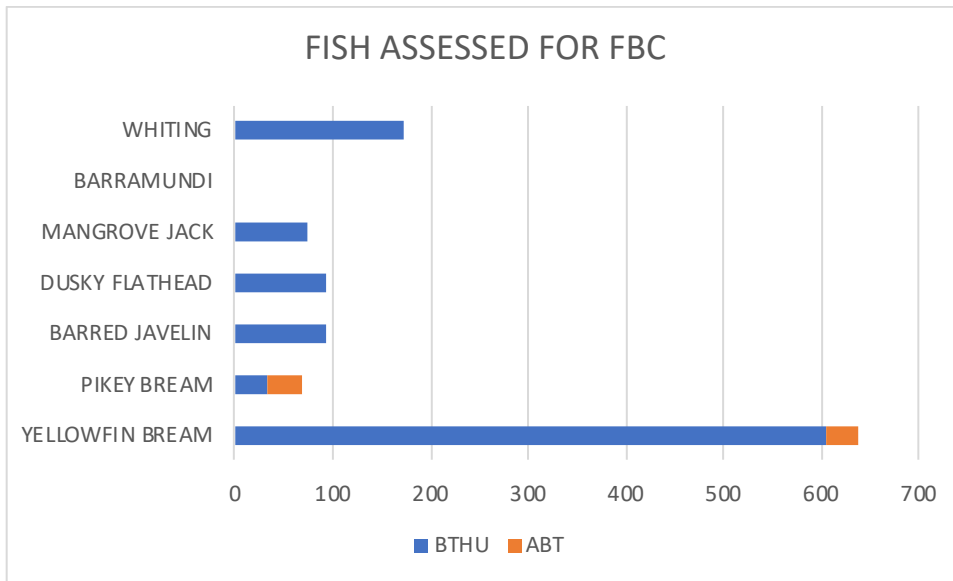


Figure 11: Numbers of fish where length-weight was recorded at the BTHU and ABT competitions.

For each of the key species historic data recorded during the BTHU competition from 2003-2021 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.

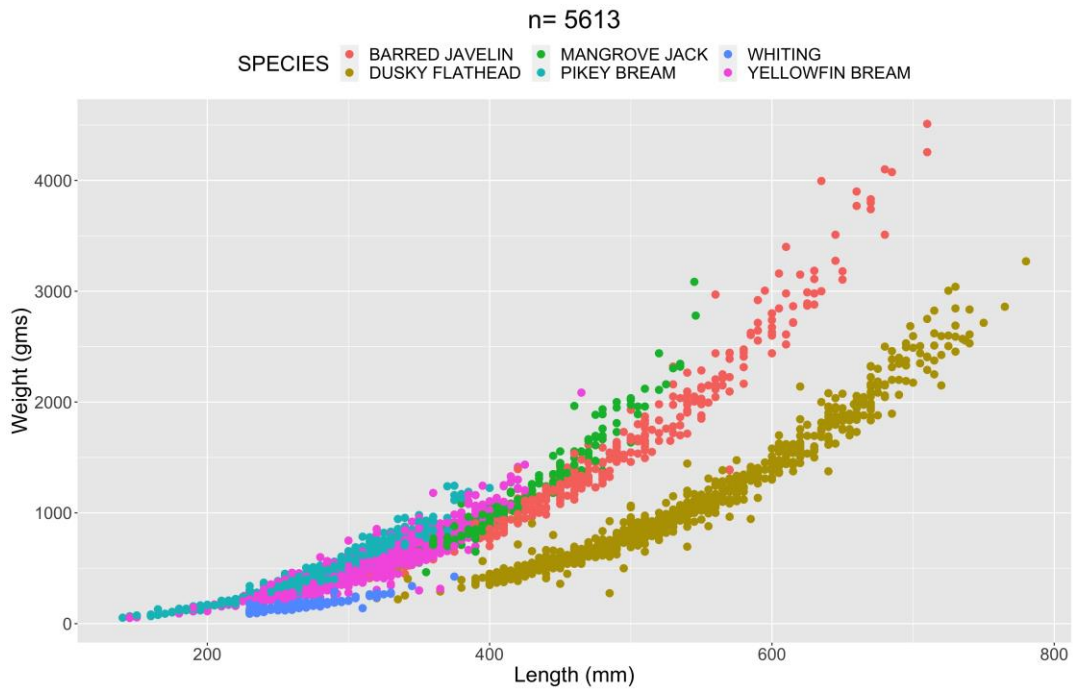


Figure 12: Length-weight data for the key species using the historic data from the BTHU from 2003-2021.

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. Length-weight data for Whiting (all species) were obtained for the first time this year and is shown in Figure 13 however were not used in the scoring of FBC.

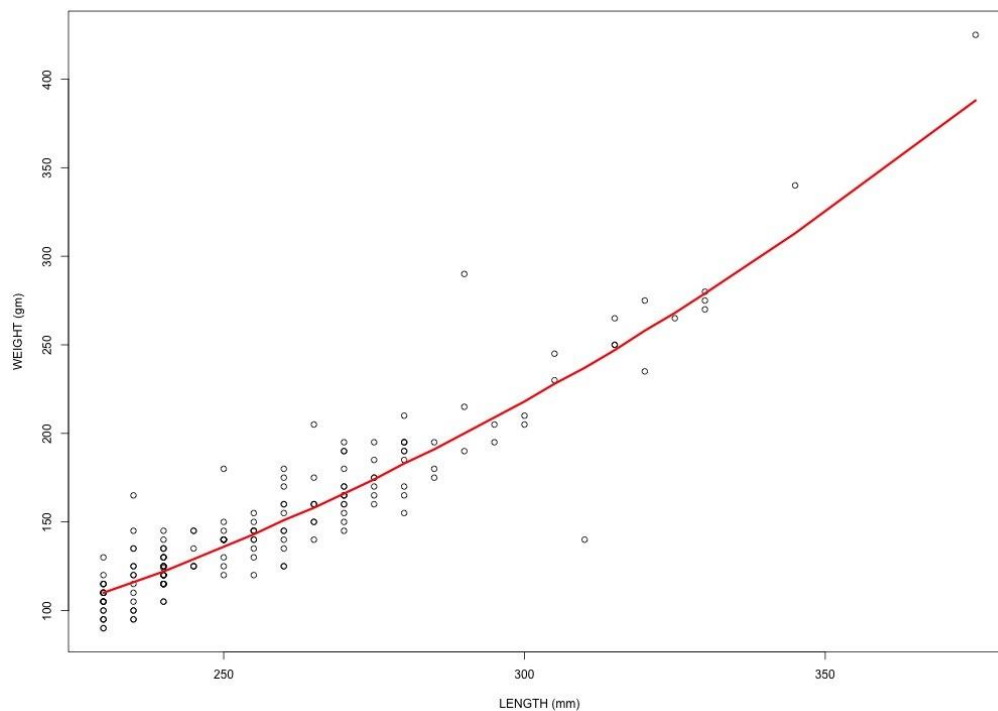


Figure 13: Length-weight plot for Whiting (all species) using data from the BTHU 2021.

Figure 14 shows the length-weight plot for Yellowfin Bream using historic data from the BTHU from 2003-2021 while Figure 15 shows the plot of FBC for each year.

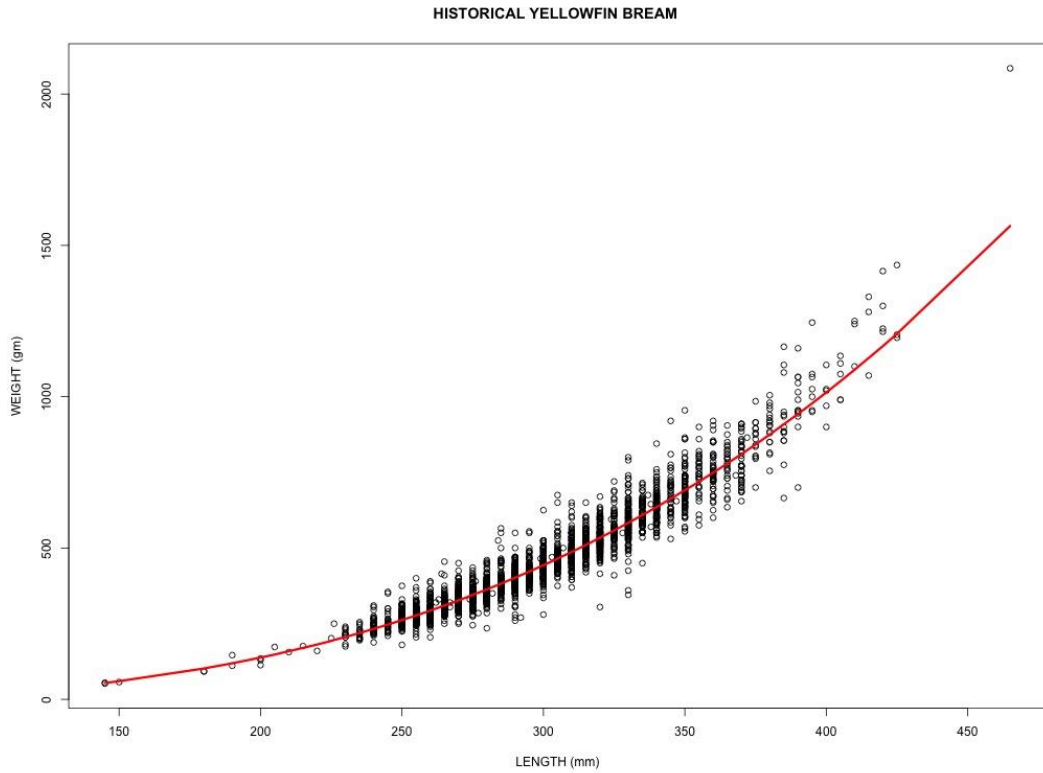


Figure 14: Length-weight plot for Yellowfin Bream using data from the BTHU from 2003-2021.

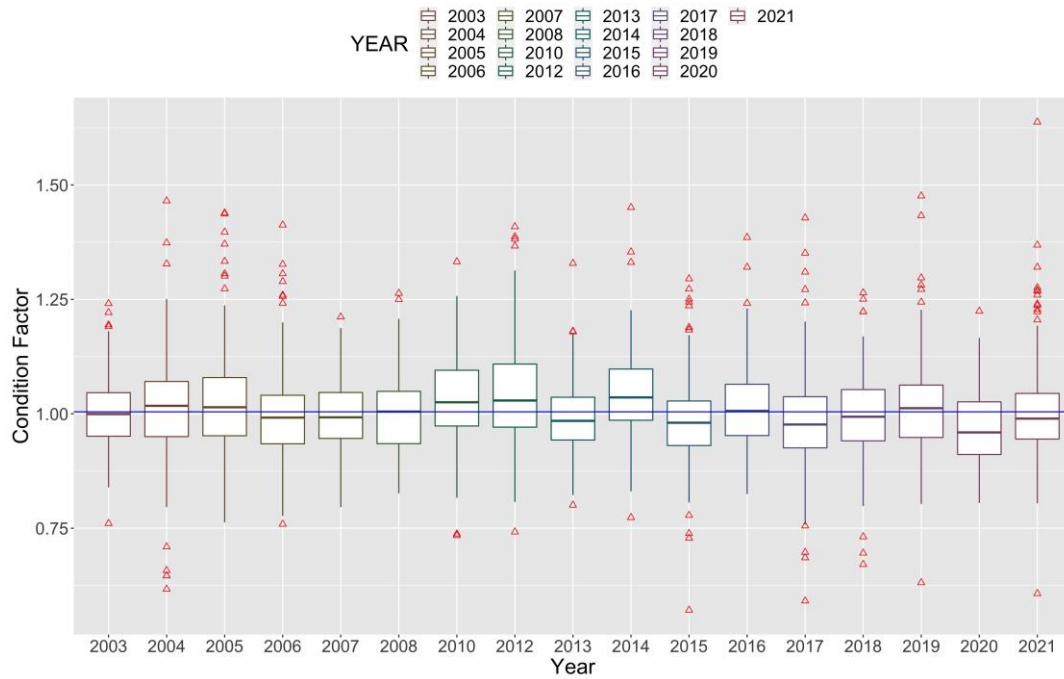


Figure 15: Plot of FBC for Yellowfin Bream from 2003 – 2021.

Figure 16 shows the length-weight plot for Pikey Bream using historic data from the BTHU from 2003-2021 while Figure 17 shows the plot of FBC for each year.

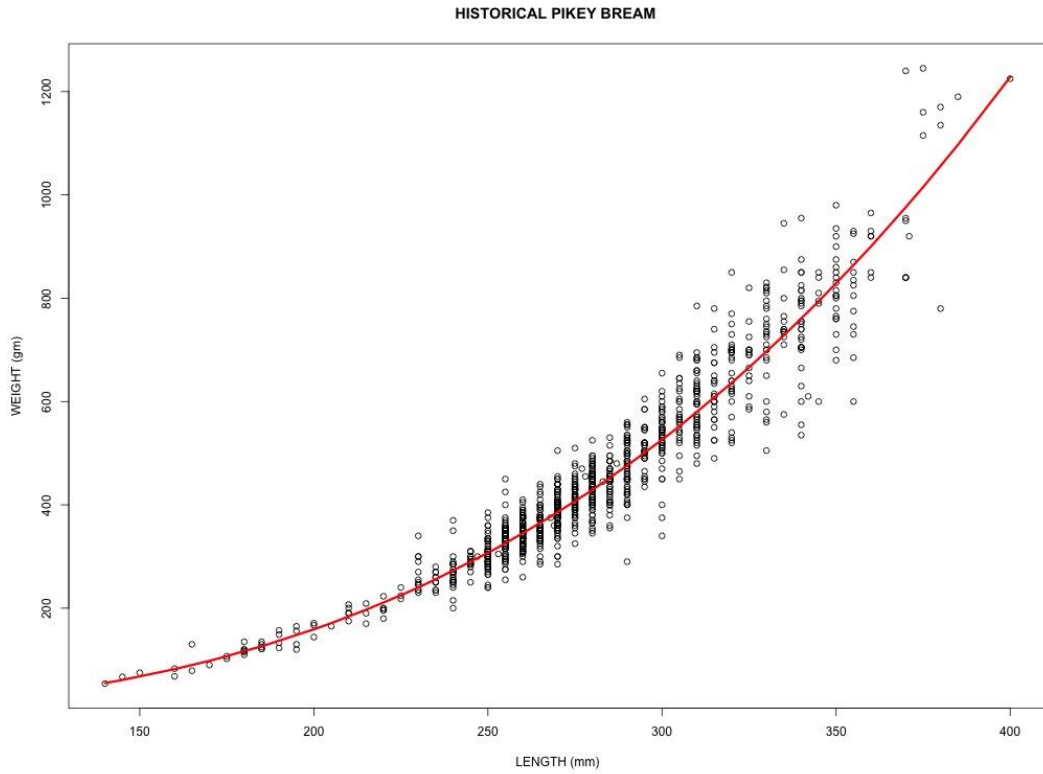


Figure 16: Length-weight plot for Pikey Bream using data from the BTHU from 2003-2021.

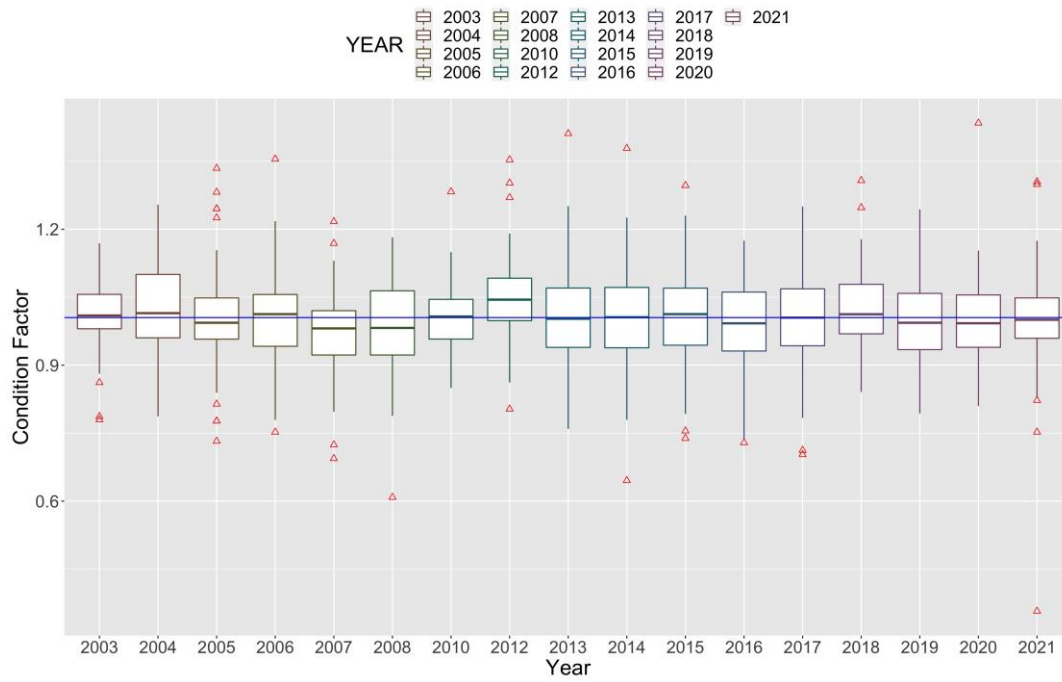


Figure 17: Plot of FBC for Pikey Bream from 2003 – 2021.

Figure 18 shows the length-weight plot for Barred Javelin using historic data from the BTHU from 2003-2021 while Figure 19 shows the plot of FBC for each year.

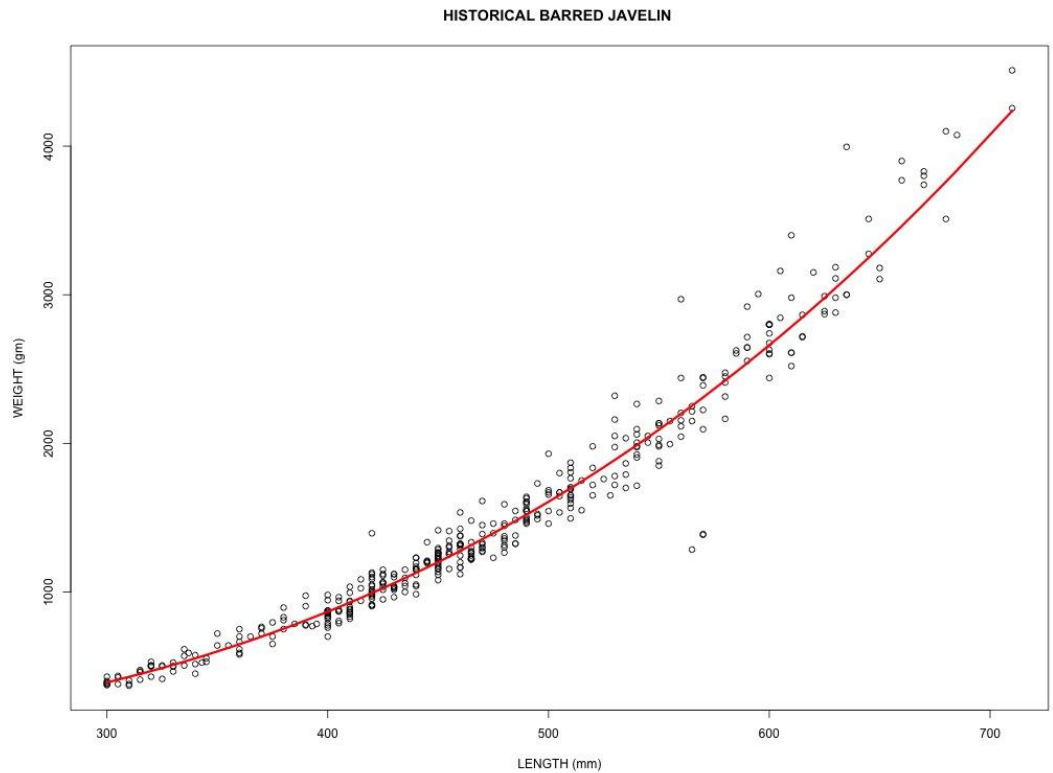


Figure 18: Length-weight plot for Barred Javelin using data from the BTHU from 2003-2021.

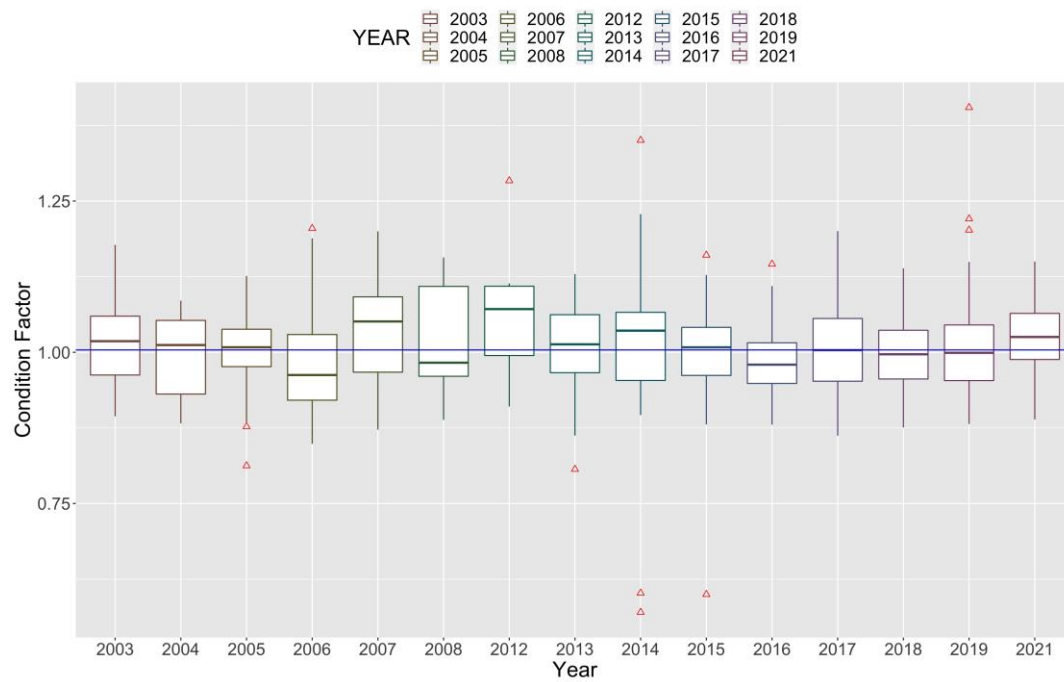


Figure 19: Plot of FBC for Barred Javelin from 2003 – 2021.

Figure 20 shows the length-weight plot for Dusky Flathead using historic data from the BTHU from 2003-2021 while Figure 21 shows the plot of FBC for each year.

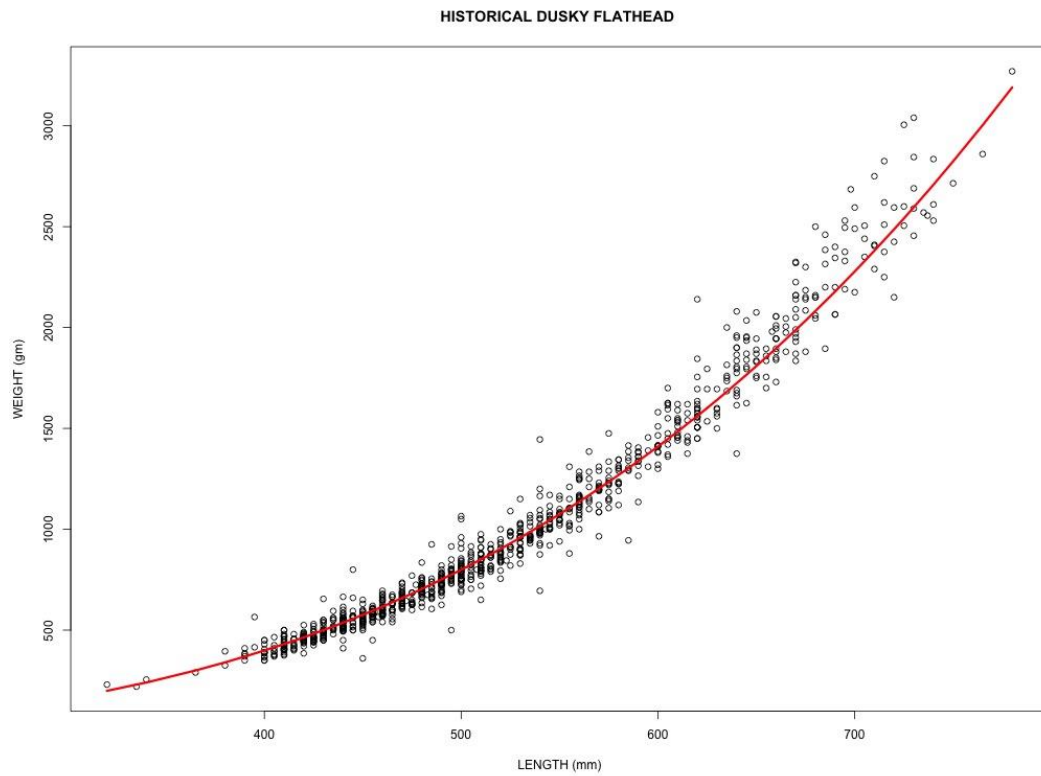


Figure 20: Length-weight plot for Dusky Flathead using data from the BTHU from 2003-2021.

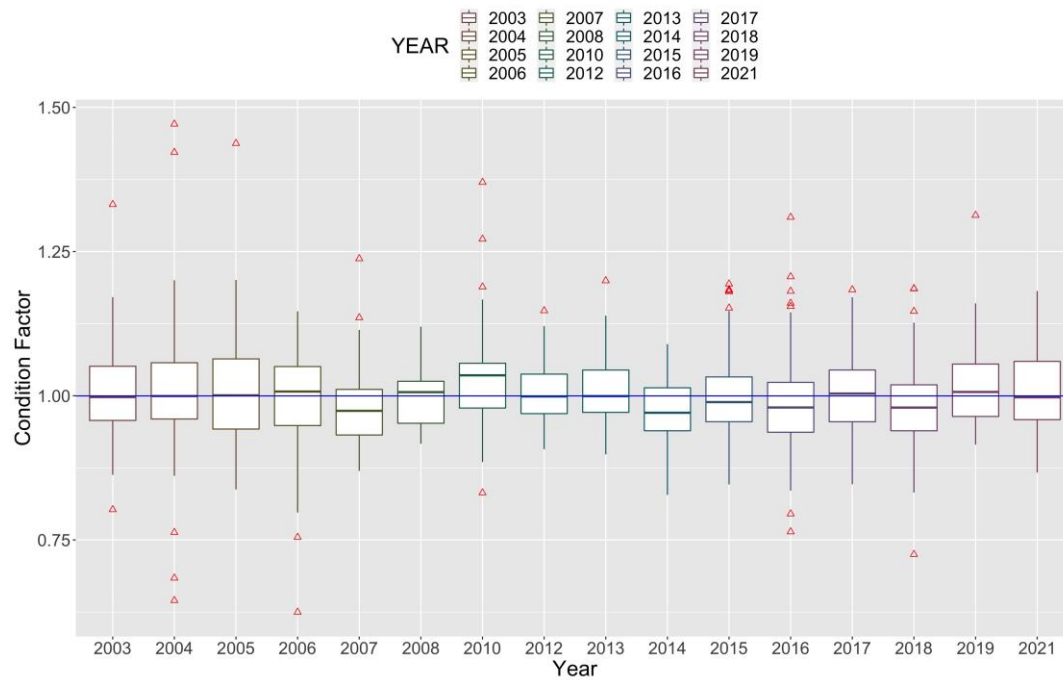


Figure 21: Plot of FBC for Dusky Flathead from 2003 – 2021.

Figure 22 shows the length-weight plot for Mangrove Jack using historic data from the BTHU from 2003-2021 while Figure 23 shows the plot of FBC for each year.

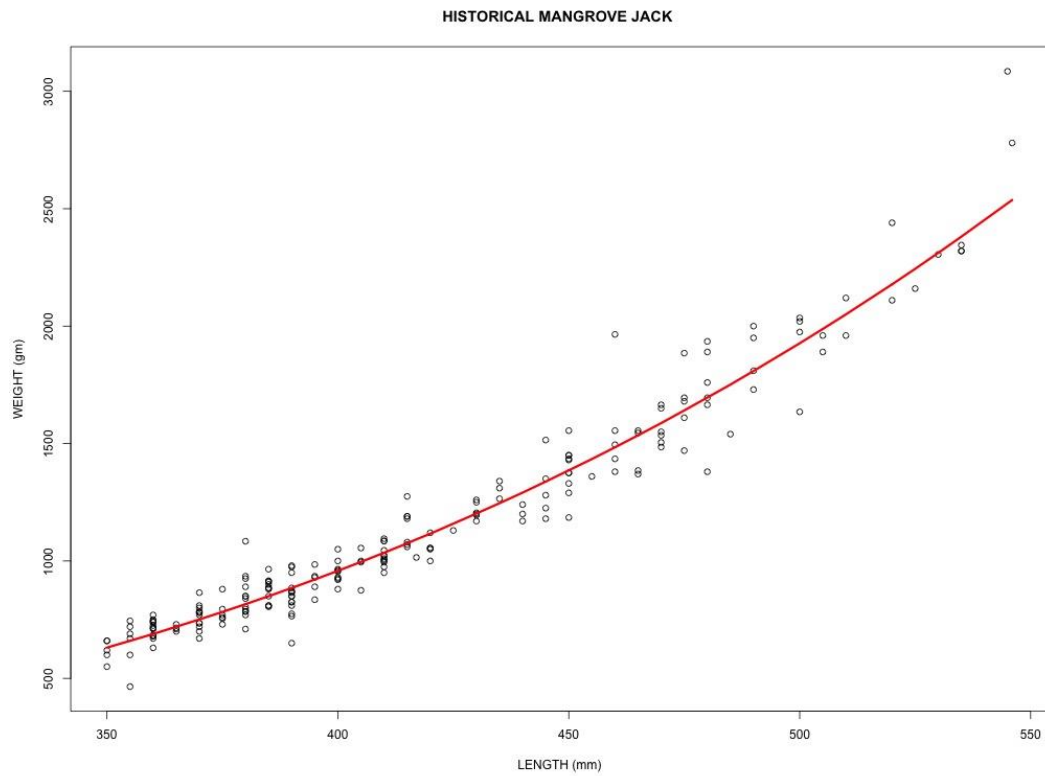


Figure 22: Length-weight plot for Mangrove Jack using data from the BTHU from 2003-2021.

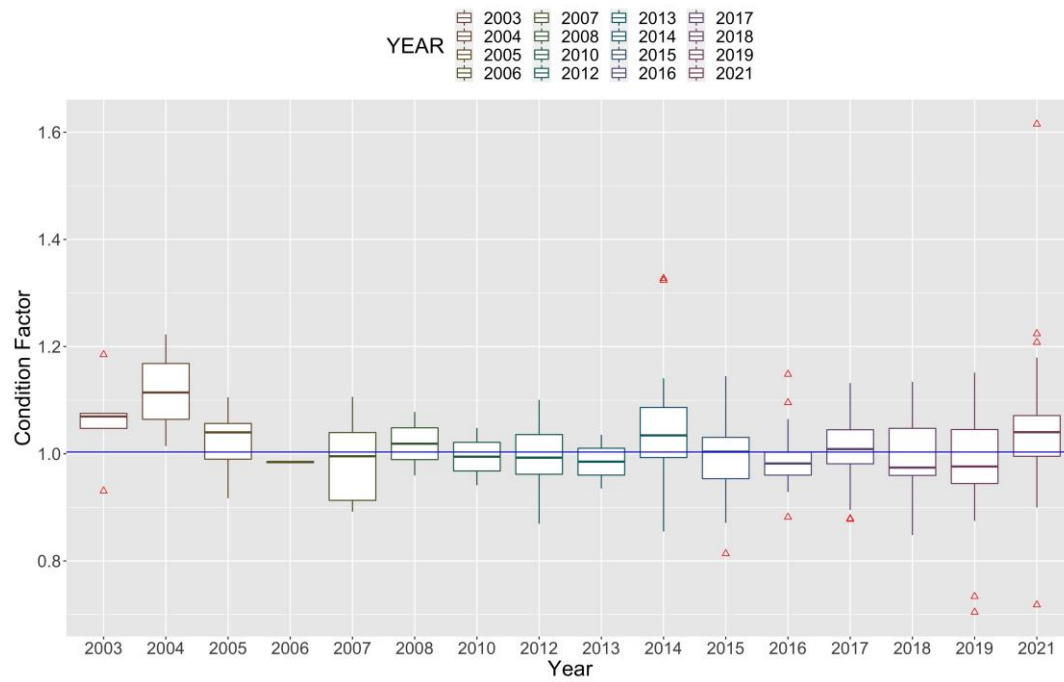


Figure 23: Plot of FBC for Mangrove Jack from 2003 - 2021 (small sample sizes 2003 - 2013).

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 2021 and Table 12 shows the values converted to FBC scores for 2021.

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	2820	3.33E-05	2.876	0.923
PIKEY BREAM	1060	2.69E-05	2.944	0.940
BARRED JAVELIN	401	5.60E-05	2.763	0.973
DUSKY FLATHEAD	950	3.20E-06	3.112	0.959
MANGROVE JACK	207	6.95E-06	3.128	0.950

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	0.999	0.906	1.102
PIKEY BREAM	1.005	1.005	0.904	1.106
BARRED JAVELIN	1.004	1.004	0.917	1.090
DUSKY FLATHEAD	1.000	0.994	0.919	1.080
MANGROVE JACK	1.003	0.997	0.922	1.084

Table 11: Mean, median, minimum and maximum condition factors and standard deviation for the key species in 2021.

Species	Sample size	Mean Condition	Median Condition	Minimum Condition	Maximum Condition	Standard deviation condition
YELLOWFIN BREAM	639	0.998	0.989	0.607	1.638	0.086
PIKEY BREAM	69	1.007	1.003	0.357	1.305	0.124
BARRED JAVELIN	92	1.024	1.025	0.889	1.150	0.059
DUSKY FLATHEAD	93	1.010	0.997	0.867	1.182	0.068
MANGROVE JACK	74	1.044	1.040	0.718	1.615	0.099

Table 12: Mean, median scores and standard deviation for the key species in 2021.

Species	Mean Score	Median Score	Standard Deviation Score
YELLOWFIN BREAM	0.47	0.46	0.09
PIKEY BREAM	0.48	0.47	0.15
BARRED JAVELIN	0.54	0.55	0.07
DUSKY FLATHEAD	0.46	0.44	0.08
MANGROVE JACK	0.55	0.54	0.16

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 – 1 June 2021. 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 of 9,446 ML in March. The highest flow was in February 2020 with 32,745ML compared with a mean flow of 52,682 ML for that month.

Figure 25 shows the Awoonga lake level at the dam wall. There has not been any overtopping of the dam since November 2017 and a steady decline in the lake level from 40.00m (full) on 15 January 2018 to 33.22m on 31 May 2021 was recorded.

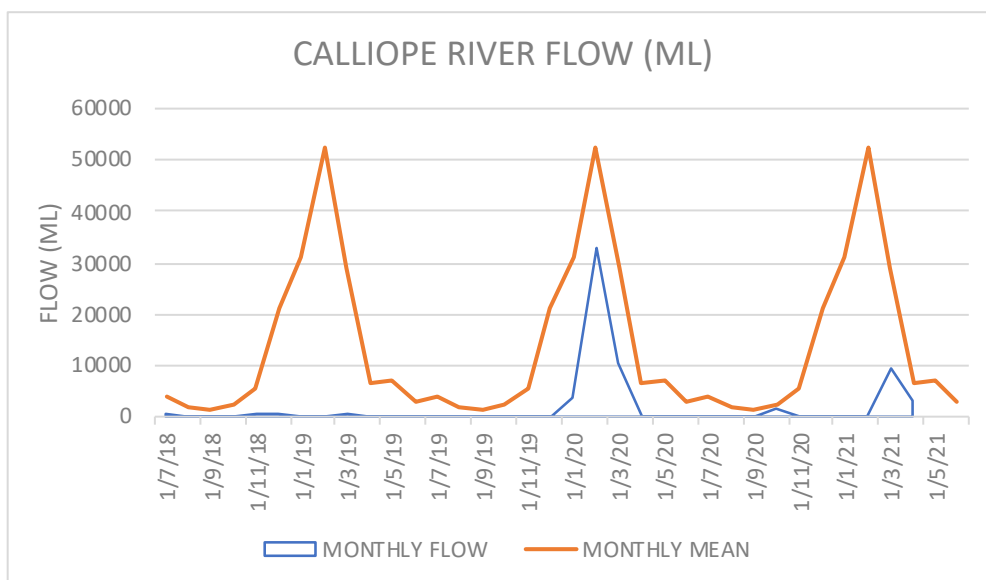


Figure 24: Calliope River flows and mean monthly flows (ML) July 2018 – May 2021.

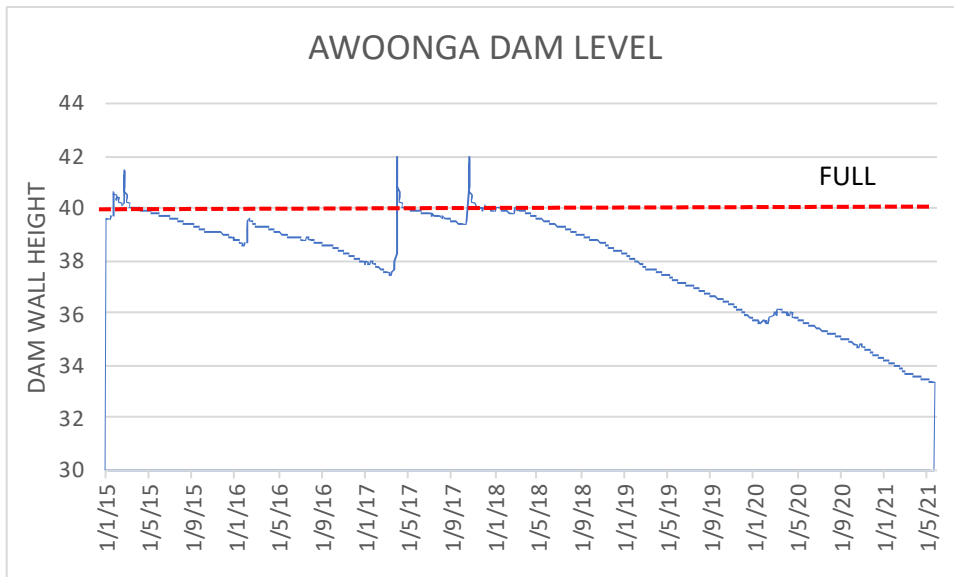


Figure 25: Awoonga lake levels and dam wall height (40m).

5.4 SPECIES SCORES AND GHHP GRADES

Table 13 shows the VFA 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 2021 report card.

Species	Visual Fish Assessment (VFA)	Fish Body Condition (FBC)	Fish Condition (FC)	GHHP Species Grade
Yellowfin Bream	0.95 (792)	0.47 (639)	0.71	B
Pikey Bream	0.98 (424)	0.48 (69)	0.73	B
Barred Javelin	0.94 (162)	0.54 (92)	0.74	B
Dusky Flathead	0.97 (147)	0.54 (93)	0.76	B
Mangrove Jack	0.96 (121)	0.55 (74)	0.75	B
Barramundi (VFA only)	NA (20)	NA (0)	NA	NA
All of harbour	0.97	0.50	0.73	B

5.5 VFA COMPARISON BY LOCATION

There were 490 images of Barramundi that were assessed for VFA for fish caught in Awoonga. Table 14 and Table 15 show the number of severity scores for fins and skin while Table 16 shows the GHHP scores and grade, based on VFA only. No observations were made in relation to eyes, parasites or deformities.

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

Fins	Score	B
No Active Erosion	0	273
Light Active Erosion	10	215
Moderate Active Erosion with some haemorrhage	20	2
Severe Active Erosion with some haemorrhage	30	0

Table 15: Severity score of variable skin conditions for Barramundi in Lake Awoonga and the number of observations.

Skin	Score	B
Normal no aberrations	0	488
Mild skin aberrations	10	2
Moderate skin aberrations	20	0
Severe skin aberrations	30	0

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

Species	Visual Fish Assessment (VFA)	Fish Body Condition (FBC)	Fish Condition (FC)	GHHP Species Grade
Barramundi	0.96 (490)	NA	0.96 (VFA only)	A

6. DISCUSSION

The overall grade for Gladstone Harbour was B (0.73) with all species receiving a B grade. With the BTHU going ahead this year length-weight data were able to be obtained for the key species except Barramundi. Unfortunately, the BTHU decided not to include Pikey Bream in the live weigh-in categories which limited the data available for that species. The dropping of Pikey Bream was not advised prior to the competition so it was not possible to discuss this with the organising committee. 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.

Fortunately, there were length-weights for Pikey Bream obtained during the ABT Bream competition and combined with the BTHU samples there were enough to provide a FBC score. For the first time this year length-weight data were obtained for Whiting. There was no discrimination of the Whiting species however almost all were Sand or Goldenline Whiting.

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.

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.

Environmental conditions were very dry for the year with flows during the wet season being very low compared with the monthly means and no flow during January or February, normally the wettest months. The conditions were like those in 2019 when there was very little flow over the wet season months. There was a wet season flow in 2020 but that was below the monthly average flows resulting in 3 years of below average conditions. There was no overtopping of the Awoonga dam wall since November 2017.

These conditions put considerable strain on the habitats with a likely reduction in food supply. However, local rainfall in December 2020 resulted in a boost in Prawn numbers (Sawynok B and Sawynok S 2021) which may have contributed to average FBCs for most of the key species.

The lack of freshwater flows and flooding would also have contributed to a lower incidence of skin infections which are more prevalent following freshwater flows. Previously, overtopping 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.

The environmental conditions were similar for the last 3 years and the VFA results can be considered as a “background” level which would be found in a normal population. It is likely that a similar level of issues would be recorded in years of comparable environmental conditions and if not then they would be outside the background level. For years outside those conditions, there are likely to be deviations away from the background level. This is likely to apply to very wet years such as 2011 when fish health issues emerged. At this stage there have been no years where the river flows have exceeded the average so the level of issues cannot be compared.

Fish health issues in 2011 occurred in several fish species throughout the Gladstone Harbour area and impacted Barramundi that left Lake Awoonga when the dam overtopped. The incidence of Barramundi leaving the lake also occurred in 2015 and 2017 however fish health issues and fish deaths were largely confined to Barramundi in the Boyne River resulting from injury in going over the dam wall. This will likely recur when the dam overtops again.

This meant that it was relevant to include a comparative assessment of VFA for Barramundi in the lake. There were a number of fishing competitions in Awoonga since 2019 and ongoing monitoring by GAWB using a phone app where photos have been collected and these were used to determine VFA. Lengths were available for the fish but not weights so FBC could not be calculated.

7. REFERENCES

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APPENDIX 1: FISH HEALTH CONDITION OBSERVATIONS AT GLADSTONE

Table 17: Visual detections for all species at Gladstone.

Species	Fins	Skin	Eyes	Parasites	Deformities	Images
BARRACUDA	1	0	0	0	0	2
BARRAMUNDI	8	0	0	0	0	20
BARRED JAVELIN	85	2	0	0	0	162
BARTAIL FLATHEAD	13	0	0	0	0	24
BLACKSPOTTED ROCKCOD	0	0	0	0	0	5
BLUE THREADFIN	0	0	0	0	0	1
BUTTER BREAM	3	0	0	0	0	9
CATFISH	1	0	0	0	0	3
DUSKY FLATHEAD	25	2	0	0	0	147
FRINGE-EYE FLATHEAD	5	0	0	0	0	8
GIANT TREVALLY	2	0	0	0	0	7
GOLDEN SNAPPER	4	0	0	0	0	5
GOLDEN TREVALLY	1	0	0	0	0	3
GOLDSPOTTED ROCKCOD	7	0	0	0	0	17
GRASS EMPEROR	2	0	0	0	0	2
KING THREADFIN	0	0	0	0	0	1
LONGFIN ROCKCOD	0	0	0	0	0	1
MACKERAL TUNA	0	0	0	0	0	2
MANGROVE JACK	84	4	0	0	0	121
MOSES SNAPPER	4	0	0	0	0	31
MULLET	2	0	0	0	0	3
PIKE	2	0	0	0	0	5
PIKEY BREAM	185	7	0	0	3	424
QUEENFISH	3	0	0	0	0	9
RIVER JEWFISH	2	0	0	0	0	2
SAND FLATHEAD	0	0	0	0	0	1
SAND MULLET	1	0	0	0	0	1
SILVER JEWFISH	1	0	0	0	0	2
SNAPPER	0	0	0	0	0	1
SPECKLED JAVELIN	5	0	0	0	0	9
SUMMER WHITING	1	0	0	0	0	3
TARPON	11	0	0	0	0	16
TARWHINE	9	0	0	0	0	9
WHITING	1	0	0	0	0	5

YELLOWFIN BREAM	520	9	0	1	3	792
ALL SPECIES	988	24	0	1	6	1853
PERCENTAGE	53.3	1.3	0	0.05	0.3	