# Mackay Whitsunday Region Freshwater Fish Community Health Report

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Catchment
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**Cover Image**: Lower Gregory River; displaying good quality in-stream and terrestrial fish habitat. Fish photos, left to right; Mangrove jack (*Lutjanus argentimaculatus*), Snakehead Gudgeon (*Giuris margaritacea*) & Jungle perch (*Kuhlia rupestris*), all of which are diadromous and occur in the Mackay Whitsunday Region.

Information contained in this document is provided as general advice only. For application to specific circumstances, professional advice should be sought.

Catchment Solutions has taken all reasonable steps to ensure the information contained in this document is accurate at the time of publication. Readers should ensure that they make appropriate enquires to determine whether new information is available on the particular subject matter.

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# Summary

Aquatic ecosystems of Mackay Whitsunday region have been significantly impacted by intensive surrounding land use practices. Impacts include but are not limited to; poor water quality runoff, degraded riparian and in-stream habitats, flow modification and barriers to fish migration. The cumulative impacts of these modifications has led to changes in the condition of the region's fish communities, adversely impacting fish abundance, species richness, fish community composition and exacerbating the prevalence of pest fish species. Significantly, where in-stream and terrestrial habitats persist undisturbed, healthy fish populations remain. In order to better understand the region's aquatic ecosystems and assist in determining baseline condition, a comprehensive fish community monitoring program was developed.

The fish community monitoring program covers 14 of the region's 33 catchments, incorporating a diverse range of stream types. Catchments were chosen based on their surrounding landuse as a percentage of cane, grazing and bushland within the total catchment area. Sampling was undertaken across three distinct seasons, encompassing pre and post-wet season conditions in 2006/07 and pre-wet season conditions in 2007/08. Boat and backpack electrofishing methods were used to survey fish communities.

Results indicate that undisturbed 'bushland' catchments contain the healthiest fish communities, while catchments dominated by intensive surrounding landuse practices contain fish communities in 'very poor' to 'poor' condition (Table 1). Repulse Creek, with an entirely bushland catchment;, contains the healthiest fish communities in the region scoring a 'Very Good', while the other two bushland sites, Finch Hatton and St Helens Creeks, as well as grazing and intensive cropping catchment; Carmila Creek and grazing catchment Blacks Creek, received the equal second highest fish community health rating of 'good'. Intensive cropping catchments (>40% intensive cropping) Myrtle, Bakers and Sandy Creeks received the lowest fish community health rating of 'poor'.

**Table 1.** Mackay Whitsunday fish community health ratings and report card scores.

| Catchment Class | % Intensive Cropping | Sub-catchment | Stream Order | Fish Community Health Rating | Report Card Score |
|---|---|---|---|---|---|
| Bushland | 0 -2 % | Repulse Creek | 4 | Very Good* | A* |
| | | Finch Hatton Creek | 4 | Good | B- |
| | | St Helens | 4 | Good | B- |
| Grazing | 2 - 4 % | Basin Creek | 4 | Moderate | C- |
| | | Blacks Creek | 5 | Good | B- |
| Grazing/Intensive Cropping | 5 - 19 % | Plane Creek | 4 | Moderate | C- |
| | | Carmila Creek | 5 | Good | B- |
| | | Andromache River | 6 | Moderate | C- |
| Intensive Cropping/Grazing | 20 - 39 % | O'Connell River | 6 | Moderate | C+ |
| | | Rocky Dam Creek | 4 | Moderate | C- |
| | | Pioneer River | 6 | Moderate | C- |
| Intensive Cropping | 40 + % | Sandy Creek | 5 | Poor | D+ |
| | | Bakers Creek | 4 | Poor | D+ |
| | | Myrtle Creek | 4 | Poor | D- |
| Average | | | | Moderate | C- |

## Introduction

The Mackay/Whitsunday region boasts a diverse range of aquatic ecosystems, from lowland wetland complexes surrounded by cane fields to small rainforest streams draining the uniquely diverse Eungella National Park. The condition and health of these aquatic ecosystems is often intrinsically linked to the nature and intensity of surrounding landuse practices. Many of the region's rivers and wetland habitats are surrounded by intensive landuse practices and have suffered from habitat degradation, poor water quality, barriers to migration and flow regulation. However, a small proportion of aquatic habitats within or surrounded by national parks and pristine vegetated areas still contain excellent in-stream habitats, intact and healthy riparian habitats, excellent water quality, unmodified flow regimes and no barriers to fish migration.

With the growing impetus to restore and enhance the condition of rivers and wetland systems and improve the water quality run-off from surrounding landuse practices, comes the need to effectively assess and measure the condition and health of aquatic ecosystems. Quantifying the condition and health of aquatic ecosystems enables natural resource managers to effectively gauge the success of catchment based water quality and river restoration activities. To effectively assess the condition and health of rivers requires monitoring of a wide range of ecological and water quality based parameters that can be efficiently acquired and are sensitive to a wide range of environmental variables. Freshwater fish are an excellent ecological indicator of river health (Karr, 1981, Simon, 1999, Alonso *et al.,* 2011) and were therefore chosen by Reef Catchments Limited (RCL) group as one of a suite of indicators that would help to assess and quantify the health of the region's waterways.

To achieve this, RCL contracted Fisheries Queensland to undertake extensive baseline freshwater fish community surveys in 14 Mackay Whitsunday sub-catchments. The project 'Fish Community Condition of the Mackay Whitsunday Region' was undertaken across a twelve month period (August 2006- June 2007) and included both pre and post wet season sampling at each site to provide an accurate account of fish communities present in the region under varying environmental conditions. In addition to the initial comprehensive twelve month survey, further sampling was conducted at the same sites during pre-wet season conditions between September 2007 and November 2007 to further strengthen the data set. Sampling techniques undertaken to assess the region's fish communities included both boat and backpack electrofishing. Further details regarding sampling methods, results, discussion and conclusions can be found in the report: Moore M, Power T, Marsden T (2007) Fish Community Condition of the Mackay Whitsunday Region, Brisbane.

### Site Selection

The Mackay Whitsunday region encompasses coastal catchments from Eden Lassie in the north to Flaggy Rock Creek near Carmila in the south. Fish community sampling was conducted over a broad range of sites, however funding constraints limited the sampling to 14 of the 33 sub-catchments in the region. The 33 sub-catchments in the Mackay Whitsunday region have been classified into catchment classes based on surrounding landuse practices and land form/relief. Catchments were compared based on their surrounding landuse as a percentage of cane, grazing and bushland within the total catchment area (Table 2).

**Table 2.** Catchment class (percentage of intensive cropping) in each sampled catchment.

| Catchment Class | % Intensive Cropping | Sub-catchment | Stream Order |
|---|---|---|---|
| Bushland | 0 – 2 % | Repulse Creek | 4 |
| | | Finch Hatton Creek | 4 |
| | | St Helens | 4 |
| Grazing | 2 -4 % | Basin Creek | 4 |
| | | Blacks Creek | 5 |
| Grazing/Intensive Cropping | 5 - 19 % | Plane Creek | 4 |
| | | Carmila Creek | 5 |
| | | Andromache River | 6 |
| Intensive Cropping/Grazing | 20 - 39 % | O'Connell River | 6 |
| | | Rocky Dam Creek | 4 |
| | | Pioneer River | 6 |
| Intensive Cropping | 40 + % | Sandy Creek | 5 |
| | | Bakers Creek | 4 |
| | | Myrtle Creek | 4 |

Sub-catchment selection for the 'Fish Community Condition of the Mackay Whitsunday Region' (FCCMWR) monitoring project was based on a number of factors. These included: providing an accurate representation of river/stream types and habitats known to occur in the Mackay Whitsunday region, presence of water quality monitoring sites and gauging stations for precise recording of water quality data, historical records of water quality and fish community data for accurate comparisons over time and surrounding landuse practices. After taking these factors into consideration, 14 sub catchments were chosen for use in the FCCMWR (Table 2; Refer to MWNRMG; Water Quality Improvement Plan Draft Defining the Region report for more detailed information relating to sub-catchment selection and catchment class definition). A total of 48 sampling sites within the 14 sub-catchments were selected for the survey. Where possible, upper, middle, lower and estuarine sites were chosen within each sub-catchment to provide a better representation of the fish communities of the region. Note: Estuarine sites were not included in the freshwater fish health report card scores.

## Fish Assemblages as Indicators of Aquatic Ecosystem Health

Fish community characteristics have been used to determine relative aquatic ecosystem health since the beginning of the 19th century to the present day (Simon, 1999). Fish have been and remain a major component of any aquatic study designed to evaluate water quality (Simon 1999). Fish exhibit many traits and life history strategies that make them ideal indicators of ecosystem health, including; continually inhabiting receiving waters, sensitive to a wide range of water quality impacts, occupy the upper part of the trophic food chain, long lived, well known life-history information for most species, and require different and often large connected habitats at varying stages to complete their life-cycle (Karr, 1981, Simon, 1999, Alonso *et al.,* 2011,). Additional advantages of fish as indicators for aquatic ecosystem health include; Cost effective sampling methods, rapid bio-assessment techniques, relatively easy to identify (on-site), highly visible nature and elevated public appeal all contribute to make fish an ideal indicator species.

A variety of quantitative metrics can be used to define specific bio-criteria, including indicator species or guilds; species richness, diversity, abundance and the Index of Biological Integrity (Simon 1999). Kennard (1995) suggests that for South-eastern Queensland and other similarly variable environments in Australia (i.e. Central Queensland) indicators based on native fish assemblage composition, native fish species richness and alien fish species are potentially powerful indicators of human disturbance and can form the basis for river health monitoring programs. Therefore, fish species richness, abundance and alien fish species metrics have been selected to a measure fish community condition of the Mackay Whitsunday region and assist in evaluating overall aquatic ecosystem health.

## Fish Community Condition Indicator Metrics

Three fish community indicator metrics were used to determine freshwater fish community condition of each of the 14 sub-catchments monitored during the 'Fish Community Condition of the Mackay Whitsunday Region' study, with the average of all these results equalling the relative fish health score of the Mackay Whitsunday region.  Fish health metrics were based on ecological fish fauna characteristics that were collected and analysed from the fish community monitoring rounds. The three metrics: 1. Catch per unit effort (CPUE), i.e. the number of fish sampled per minute of electrofishing 'on' time (fish/minute); 2. Fish fauna richness, i.e. the total number of native species recorded from all river reaches (upper, middle & lower) across all sampling rounds (pre & post) for each sub catchment and 3. Pest fish species richness, were tabled and collated.

Scaling scores of one to five (with one being very poor and five equating to very good) were assigned to each sub-catchment depending on 'how well' they addressed each of the three fish health indicator metrics (Tables 3 - 7). Scores for all three metrics were than totalled and averaged to determine fish health report card scores for each sub catchment (Table 8). Potential report card scores ranged from A+ to E- (Table 9). For a sub-catchment to attain a fish health report card score of A+, the sub catchment would have to attain the total maximum score for each fish health metric, i.e. three scores of five.

Fish species richness scores for each sub-catchment were weighted dependant on their stream order. Smaller ordered streams, i.e. 4, did not have to be represented by as many fish species to obtain a 'good' score as a stream order 6 (table 3 & 5 respectively). Pest fish are extremely tolerant of degraded aquatic ecosystems and have the ability to impact native fish species through competition for food resources, predation, habitat utilisation and the nipping of fins which in-turn leaves the affected fish species susceptible to disease. Kennard (2005) suggests the ability of pest fish to occupy and potentially further exacerbate degraded aquatic ecosystems indicates that pest fish species are a good indicator of ecosystem health.

**Note:** Due to the undisturbed nature of Repulse Creek*, it was assigned a category score of 'Very Good' and a health report card score of 'A'. This reference catchment is situated in the protected Conway National Park, is surrounded by pristine lowland rainforest and contains no intensive surrounding landuse practices. Due to its pristine nature, there are no vehicle access tracks, making boat electrofishing near impossible. Therefore, only backpack electrofishing occurred in the upper reaches of Repulse Creek. Backpack electrofishing does not have the sampling power of boat electrofishing, potentially 'under-sampling' and skewing results with the possible effect of reducing the CPUE and species richness scores. When this is combined with the absence of a 'lower' reach sampling site, scores for this catchment were greatly underestimated. Lower reaches of rivers contain the highest species richness (in comparison to upper stream reaches), this is due longitudinal zonation within rivers, whereby the lower reaches contain a larger wetted stream width,  greater habitat complexity and niche and resource availability which in turn increases species richness.

**Table 3.** Example of the scaling score system derived based on 'how well' each sub catchment addresses the fish health metric, in this case, catch per unit effort (fish/minute).

| Catch Per Unit Effort (fish/minute) | Category | Score |
|---|---|---|
| > 40 | Very good | 5 |
| 30.1 - 40 | Good | 4 |
| 20.1 - 30 | Moderate | 3 |
| 10.1 - 20 | Poor | 2 |
| 0 - 10 | Very Poor | 1 |

**Table 4.** Scoring system for the fish health metric 'Fish Richness' (stream order ≥ 6).

| Fish Richness -Stream Order ≥6 | Category | Score |
|---|---|---|
| ≥35 | Very good | 5 |
| 25 - 34 | Good | 4 |
| 16 -24 | Moderate | 3 |
| 11 - 15 | Poor | 2 |
| 0 - 10 | Very Poor | 1 |

**Table 5.** Fish Richness health metric scoring system for stream order 5.

| Fish Richness -Stream Order 5 | Category | Score |
|---|---|---|
| ≥30 | Very good | 5 |
| 22 - 29 | Good | 4 |
| 15 - 21 | Moderate | 3 |
| 11 -14 | Poor | 2 |
| 0 - 10 | Very Poor | 1 |

**Table 6.** Fish Richness health metric scoring system for stream order 4.

| Fish Richness -Stream Order 4 | Category | Score |
|---|---|---|
| ≥25 | Very good | 5 |
| 20 - 24 | Good | 4 |
| 14 - 19 | Moderate | 3 |
| 9 - 13 | Poor | 2 |
| 0 - 8 | Very Poor | 1 |

**Table 7.** Example of the scaling score system that is derived based on 'how well' each sub catchment addresses the fish health metric, in this case: 'Pest Fish Occurrence'.

| Pest Fish Occurrence | Category | Score |
|---|---|---|
| 0 | Very good | 5 |
| 1 | Good | 4 |
| 2 | Moderate | 3 |
| 3 | Poor | 2 |
| >4 | Very Poor | 1 |

**Table 8.** Showing 'average score' (mean of all three health metrics – middle column) which was used to determine the resultant 'category' and 'report card score'.

| Category | Average Score | Report Card Score |
|---|---|---|
| Very good | 5 | A |
| Good | 4 | B |
| Moderate | 3 | C |
| Poor | 2 | D |
| Very Poor | 1 | E |

**Table 9.** Showing finite rating scale and resultant report card score for an average score between 4 and 5.

| Category | Average Score: Finite Rating Scale | Report Card Score |
|---|---|---|
| Very good | 4.7 - 5 | A+ |
| Very good | 4.4 - 4.6 | A |
| Very good | 4.0 - 4.3 | A- |

## Results

## Catch per unit effort (CPUE)

### Overall – All Sampling Seasons

Bushland catchment class sites St Helens and Finch Hatton Creeks recorded the highest CPUE average across all three sampling rounds (06/07 pre and post wet season and 07/08 pre wet season rounds) during the 'Fish Community Condition of the Mackay Whitsunday Region' study with 46.08 and 32.87 fish/min respectively (Table 10). Carmila Creek in the Gazing/Intensive cropping catchment class recorded the third highest average CPUE across all three sampling rounds. The average CPUE of all sampling sites across all sampling seasons equated to 22.10 fish/min.

### Individual Sampling Seasons

Bushland catchment St Helens Creek recorded the highest average CPUE during 06/07 pre wet season sampling with 64.72 fish/min, followed by Carmila and Finch Hatton Creeks with 35.46 and 33.96 fish/min respectively (Table 10). Bushland catchments Repulse and Finch Hatton Creeks recorded the two highest CPUE averages during 06/07 post wet season sampling with 43.18 and 42.51 respectively, followed by Blacks Creek with 40.47 fish/min. Bushland catchments St Helens and Finch Hatton Creeks, recorded the highest CPUE averages during 07/08 pre wet season sampling with 46.08 and 32.87 fish/min respectively, followed by Carmila Creek with 32.14 fish/min.

**Table 10.** Total CPUE of each catchment during each individual sampling season and the overall average CPUE of the three sampling seasons (Average).

| Catchment Class | Percentage Intensive Cropping | Sub-Catchment | CPUE | | | |
| --- | --- | --- | --- | --- | --- | --- |
| | | | Pre 06/07 | Post 06/07 | Pre 07/08 | Average |
| **Bushland** | 0 – 2 % | Repulse Creek | 19.04 | 43.18 | 26.43 | 29.55 |
| | | Finch Hatton Creek | 33.96 | 42.51 | 22.14 | 32.87 |
| | | St Helens | 64.72 | 39.42 | 34.09 | 46.08 |
| **Grazing** | 2 - 4 % | Basin Creek | 12.22 | 14.13 | 20.12 | 15.49 |
| | | Blacks Creek | 31.30 | 40.47 | 21.94 | 31.24 |
| **Grazing/Intensive Cropping** | 5 - 19 % | Plane Creek | 15.87 | 21.84 | 10.81 | 16.17 |
| | | Carmila Creek | 35.46 | 34.22 | 26.73 | 32.14 |
| | | Andromache River | 22.70 | 22.17 | 26.40 | 23.76 |
| **Intensive Cropping/Grazing** | 20 - 39 % | O'Connell River | 27.18 | 21.08 | 19.62 | 22.63 |
| | | Rocky Dam Creek | 5.24 | 11.75 | 7.93 | 8.31 |
| | | Pioneer River | 13.44 | 26.80 | 18.82 | 19.69 |
| **Intensive Cropping** | 40 + % | Sandy Creek | 3.31 | 9.09 | 16.66 | 9.69 |
| | | Bakers Creek | 12.54 | 12.78 | 10.26 | 11.86 |
| | | Myrtle Creek | 4.06 | 12.54 | 13.20 | 9.93 |
| **Average** | | | 21.50 | 25.14 | 19.65 | **22.10** |

## Species Richness

### Overall – All Sampling Seasons

The O'Connell River recorded the highest total species richness across all three sampling seasons with 28 individual species, followed by Sandy Creek with 25 species and the Andromache River with 22 species. Lower river reach sites on average contained the highest species richness with 16 species, compared to upper river reach sites with an average of 13 species. The average total species richness of all sampling sites across all sampling seasons equated to 18 fish species per catchment for the Mackay Whitsunday region.

### Individual Sampling Seasons

St Helens Creek and the Pioneer River recorded the equal highest species richness during 06/07 pre-wet season sampling with 17 species, followed by Plane Creek and the O'Connell River with 16 species (Table 11). The Andromache River recorded the highest species richness during 06/07 post wet sampling with 20 species, followed by the O'Connell River and Sandy Creek with 18 and 17 species respectively. The O'Connell River recorded the highest species richness during 07/08 pre-wet season sampling with 24 species, followed by Sandy Creek with 21 species.

**Table 11.** Total species richness recorded during each sampling season and the total number of species recorded from each sub-catchment across all three sampling seasons.

| Landuse category | Percentage Intensive Cropping | Sub-Catchment | Stream Order | Species Richness | | | |
|---|---|---|---|---|---|---|---|
| | | | | Pre 06/07 | Post 06/07 | Pre 07/08 | Total Sp. (all sites) |
| Bushland | 0 - 2% | Repulse Creek | 4 | 8 | 11 | 9 | 11 |
| | | Finch Hatton Creek | 4 | 12 | 13 | 11 | 14 |
| | | St Helens | 4 | 17 | 15 | 17 | 21 |
| Grazing | 2 - 4 % | Basin Creek | 4 | 8 | 7 | 8 | 11 |
| | | Blacks Creek | 5 | 14 | 15 | 16 | 17 |
| Grazing/Intensive Cropping | 5 - 19 % | Plane Creek | 4 | 16 | 14 | 18 | 20 |
| | | Carmila Creek | 5 | 13 | 12 | 13 | 16 |
| | | Andromache River | 6 | 12 | 20 | 16 | 22 |
| Intensive Cropping/Grazing | 20 - 39 % | O'Connell River | 6 | 16 | 18 | 24 | 28 |
| | | Rocky Dam Creek | 4 | 12 | 14 | 13 | 15 |
| | | Pioneer River | 6 | 17 | 16 | 18 | 21 |
| Intensive Cropping | 40 + % | Sandy Creek | 5 | 12 | 17 | 21 | 25 |
| | | Bakers Creek | 4 | 8 | 11 | 13 | 15 |
| | | Myrtle Creek | 4 | 13 | 12 | 12 | 19 |
| Average | | | | 13 | 14 | 15 | 18 |

# Pest Fish Richness

### Overall – All Sampling Seasons

Intensive Cropping catchments: Myrtle, Bakers and Sandy Creeks recorded the 1st, 2nd and 3rd highest total pest fish richness across all three sampling seasons with 3, 2, and 2 pest fish respectively.

### Individual Sampling Seasons

Bakers Creek recorded the highest pest fish species richness during 06/07 pre-wet season sampling with 2 species, followed by Myrtle and St Helens Creeks with 1 each (Table 12). Myrtle Creek recorded the highest pest fish species richness during 06/07 post-wet season sampling with 3 species, followed by Bakers and Sandy Creeks with 2 each respectively. Myrtle Creek recorded the highest pest fish species richness recorded during 07/08 pre-wet season sampling with 3 species, followed by Bakers and Sandy Creeks with 2 species each respectively.

**Table 12.** Total pest fish species richness recorded during each sampling season and the total number of pest fish species recorded across all three sampling seasons from each sub-catchment.

| Catchment Class | Percentage Intensive Cropping | Sub-Catchment | Stream Order | Pest Fish | | | Number of Pest Species in Total |
|---|---|---|---|---|---|---|---|
| | | | | Number of Pest Species per round | | | |
| | | | | Pre 06/07 | Post 06/07 | Pre 07/08 | |
| **Bushland** | 0 - 2% | Repulse Creek | 4 | | | | |
| | | Finch Hatton Creek | 4 | | | | |
| | | St Helens | 4 | 1 | 1 | 1 | 1 |
| **Grazing** | 2 - 4 % | Basin Creek | 4 | | | | |
| | | Blacks Creek | 5 | | | | |
| **Grazing/Intensive Cropping** | 5 - 19 % | Plane Creek | 4 | | 1 | | 1 |
| | | Carmila Creek | 5 | | | | |
| | | Andromache River | 6 | | 1 | 1 | 1 |
| **Intensive Cropping/Grazing** | 20 - 39 % | O'Connell River | 6 | | | 1 | 1 |
| | | Rocky Dam Creek | 4 | | | | |
| | | Pioneer River | 6 | | | | |
| **Intensive Cropping** | 40 + % | Sandy Creek | 5 | | 2 | 2 | 2 |
| | | Bakers Creek | 4 | 2 | 2 | 2 | 2 |
| | | Myrtle Creek | 4 | 1 | 3 | 3 | 3 |

## Fish Community Health Rating

Bushland Creek site, Repulse Creek, recorded the highest fish community health rating and report card score of all monitored sub-catchments during the study (refer to Note, under the 'Fish Health Indicator Metrics heading' at the start of this report for more information). Two bushland sites, Finch Hatton and St Helens Creeks, one grazing site, Blacks Creek and one grazing/intensive cropping site, Carmila Creek, recorded the equal second highest overall fish community health rating of 'good' (report card health rating of B-) during all fish community monitoring results (Table 13). Intensive cropping site Myrtle Creek recorded the lowest overall fish community health rating of 'Poor' (report card health rating of D-), followed by Sandy and Bakers Creeks with 'Poor' (report card health rating of D+), during all fish community monitoring results.

**Table 13**. Showing overall fish community health rating, fish community health report card score, and individual scores for CPUE, species richness, and pest fish occurrence, from which the average (mean) score is derived and health rating determined.

| Catchment Class | % Intensive Cropping | Sub-Catchment | Stream Order | Fish Community Score | | | Total Score | Ave. Score | Fish Community Health Rating | Report Card Rating |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | CPUE (fish/min) | Fish Richness | Pest Fish Occurrence | | | | |
| **Bushland** | 0-2 % | Repulse Creek | 4 | 3 | 2 | 5 | 10 | 3.3 | Very Good* | A* |
| | | Finch Hatton Ck | 4 | 4 | 3 | 5 | 12 | 4.0 | Good | B- |
| | | St Helens | 4 | 5 | 4 | 4 | 13 | 4.3 | Good | B- |
| **Grazing** | 2.1 - 4 % | Basin Creek | 4 | 2 | 2 | 5 | 9 | 3.0 | Moderate | C- |
| | | Blacks Creek | 5 | 4 | 3 | 5 | 12 | 4.0 | Good | B- |
| **Grazing/Intensive Cropping** | 6 - 19 % | Plane Creek | 4 | 2 | 4 | 4 | 10 | 3.3 | Moderate | C- |
| | | Carmila Creek | 5 | 4 | 3 | 5 | 12 | 4.0 | Good | B- |
| | | Andromache R | 6 | 3 | 3 | 4 | 10 | 3.3 | Moderate | C- |
| **Intensive Cropping/Grazing** | 20 – 39 % | O'Connell River | 6 | 3 | 4 | 4 | 11 | 3.7 | Moderate | C+ |
| | | Rocky Dam Ck | 4 | 1 | 3 | 5 | 9 | 3.0 | Moderate | C- |
| | | Pioneer River | 6 | 2 | 3 | 5 | 10 | 3.3 | Moderate | C- |
| **Intensive Cropping** | 40 + % | Sandy Creek | 5 | 1 | 4 | 3 | 8 | 2.7 | Poor | D+ |
| | | Bakers Creek | 4 | 2 | 3 | 3 | 8 | 2.7 | Poor | D+ |
| | | Myrtle Creek | 4 | 1 | 3 | 2 | 6 | 2 | Poor | D- |
| **Mackay Whitsunday Average Score** | | | | 2.6 | 3.1 | 4.2 | 10 | 3.3 | **Moderate** | C- |

*Refer to 'Note' on page 4.

# References

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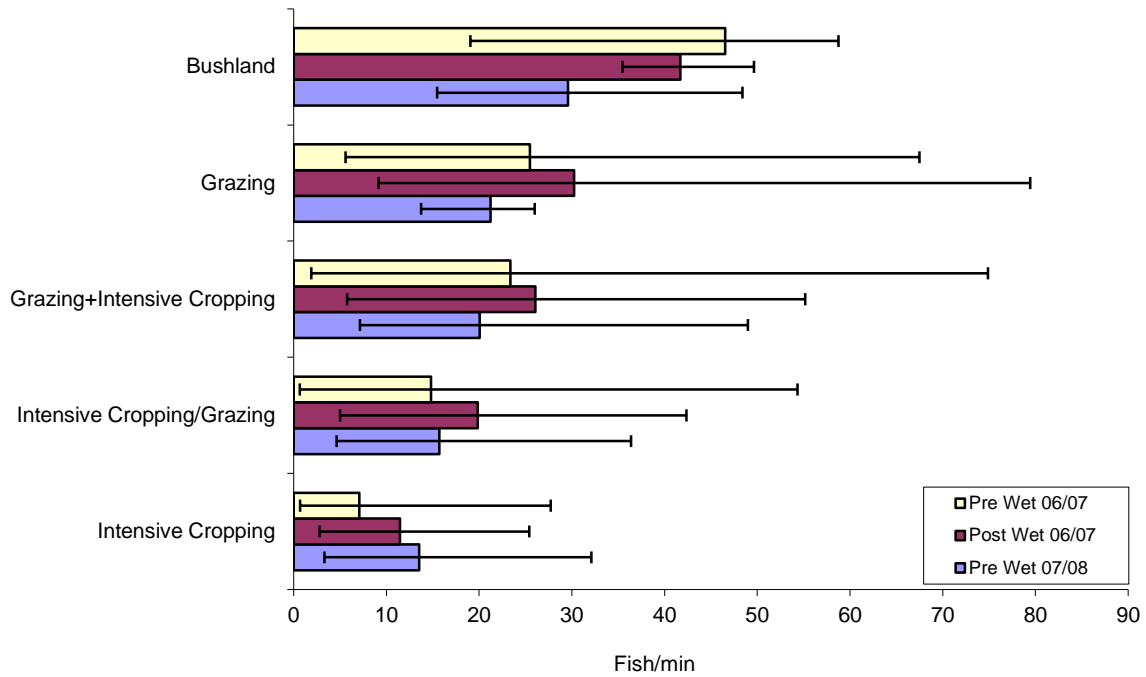
## Appendix 1



**Figure 1.** Total catch per unit effort (fish/min) for each sampling season recorded during the 'Fish Community Condition of the Mackay Whitsunday Region' survey. Sub-catchments grouped into catchment class (+/- minimum and maximum recordings).
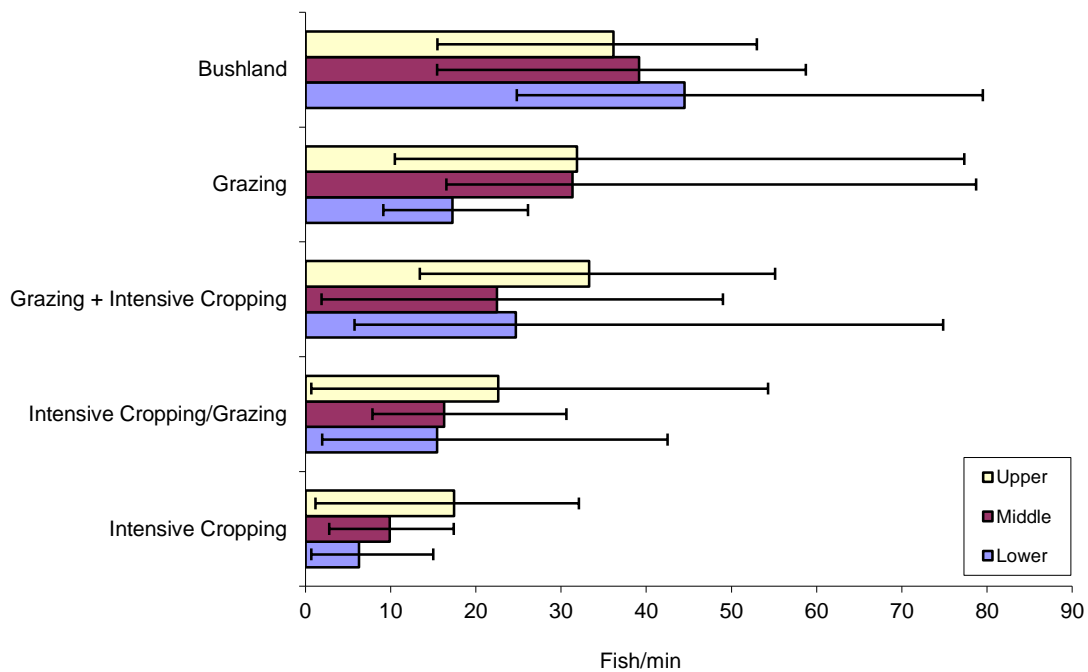


**Figure 2.** Total catch per unit effort (fish/min) for each sampling reach recorded during the 'Fish Community Condition of the Mackay Whitsunday Region' survey (three sampling seasons). Sub-catchments grouped into catchment class (+/- minimum and maximum recordings).