Fisheries Long Term Monitoring Program

Summary of barramundi (*Lates calcarifer*) survey results: 2000–06

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On 26 March 2009, the Department of Primary Industries and Fisheries was amalgamated with other government departments to form the Department of Employment, Economic Development and Innovation.

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Summary

Barramundi (*Lates calcarifer*) can be found in coastal rivers, estuaries, and around headlands and nearshore islands of Queensland. It is an important target species to indigenous, recreational and commercial fishers and the fishery is an important contributor to the economies of many regional areas of coastal Queensland.

Barramundi are caught by commercial fishers using set mesh gillnets and by recreational fishers using hook and lines. During this study barramundi were managed under the *Fisheries (Gulf of Carpentaria Inshore Fin Fish) Management Plan 1999*, *Fisheries Regulation 1995*. There is an indigenous subsistence fishery which is not subject to the management plan or regulations. The other sectors of the fishery are managed by gear restrictions on the length and mesh size of set gillnets (commercial fishery only), seasonal and area closures, size limits and bag limits (recreational only).

Estimates of commercial catch of barramundi are from the CFISH compulsory logbook system. In 2007, approximately 857 tonnes of barramundi, worth $7.86 million were harvested by commercial fishers in Queensland waters. The recreational harvest of barramundi is relatively small compared with the commercial harvest. The latest state-wide estimate, in 2005, of barramundi annual harvest from the recreational survey was 51 159 fish.

The Long Term Monitoring Program (LTMP) for barramundi began in 2000 with fishery-dependent and fishery-independent surveys which focused on investigating biological aspects of this species including age and length frequency distributions, length–weight relationships and sex ratios. Measuring these parameters annually provides important information about the dynamics of exploited barramundi populations on the major fishing grounds over time, and helps detect changes in the biology of the species not discernible from commercial catch and effort logbook data or recreational angler diaries.

This report is a summary of the data collected by the LTMP over the first seven years of the barramundi program. The summary report presents information on a range of biological characteristics of the fishery.

Results obtained from the surveys show:

- The Gulf of Carpentaria barramundi fishery is harvesting a narrower range of fish sizes compared to the Queensland east coast fishery.
- The Gulf of Carpentaria and the Queensland east coast barramundi fishery is highly reliant on a restricted set of age classes.
- Trends in the gender structure data collected in the Gulf of Carpentaria are now evident. The results from the surveys demonstrate that the younger and smaller the barramundi, the more likely it is to be a male fish.
- The length–weight relationships and age structures presented in this report are important input data for barramundi stock assessments (Hall *et al.* 2006).

The information presented may be incorporated into assessments of the barramundi stock and contributes to the annual status reports for the inshore finfish fisheries. The data also help assess the performance of fishery management planning initiatives. This ongoing monitoring and reporting will help ensure that Queensland's barramundi resources are managed on a sustainable basis for maximum community benefit into the future.

List of Acronyms

LTMP	Long Term Monitoring Program
TL	total length
CFISH	Commercial Fisheries Information Systems

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Introduction

Populations of barramundi (*Lates calcarifer*) can be found in coastal rivers, estuaries, and around headlands and nearshore islands of Queensland south to around 26 degrees south (Garrett 1995). Outside Queensland, barramundi are found throughout the Northern Territory's coastal waters and west to the Ashburton River in Western Australia (Kailola *et al.* 1993).

Typically, barramundi is a euryhaline catadromous fish (moving between freshwater and tidal areas during their life-history), taking advantage of the often landlocked, highly productive freshwater creeks, swamps and billabongs of river catchments as juveniles (Dunstan 1959; Davis 1987). Barramundi grow and usually reach maturity in these upper-river, freshwater habitats before moving downstream usually with, or just before, wet season flood events.

During the summer months, mature barramundi move to the mouths of rivers and gather in gutters and holes to spawn (Garrett and Williams 2002). The timing and duration of the breeding period varies between regions, river systems and from year to year (Davis 1985; Russell 1988). In addition, recruitment varies according to freshwater flows (Staunton-Smith *et al* 2004), so the year class strength of barramundi may vary quite markedly amongst locations and over time.

Barramundi is an important inshore gillnet species in the state. In 2007, 834 t of barramundi were harvested commercially in Queensland waters, representing more than $7.86 million in wholesale product (DPI&F 2008a, 2008b). Barramundi are caught by commercial fishers, primarily in the inshore gillnet fishery using fishing endorsements N2, N3 and N5. Details of the status of the fishery can be found in the Annual Status Report for the Queensland Gulf of Carpentaria Inshore Finfish Fishery (DPI&F 2008a) and the Annual Status Report for the Queensland East Coast Inshore Finfish Fishery (DPI&F 2008b).

Barramundi is in the top ten fish targeted by recreational fishers in freshwater and saltwater locations (McInnes 2006). In 2004 saltwater barramundi is targeted by recreational fishers (4.6% of all fish caught) and in freshwater the proportion is higher at 14.7% (McInnes 2006). Annual recreational barramundi landings for Queensland were estimated at 230 t for the period 2000–01 (Henry and Lyle 2003). In 2005, it was estimated that 51 159 barramundi were harvested and 139 722 released by the recreational anglers in Queensland (source: CHRISWeb database, 2008).

The most recent Queensland barramundi stock assessment stated that "Although absolute abundance is unknown, catch rate trends indicate the *direction* in which relative abundance is heading, and this appears to be clearly positive in four of the six geographic regions. (The CPUE in the east coast Cape York (ECCY) region and the total catch in the central east coast (CEC) region are fluctuating so much that we hesitate to reach even this mild conclusion.)" (Campbell *et al.* 2008, pg 6).

This assessment reinforced the general trend seen in previous assessments for a slowly recovering fishery in the Gulf of Carpentaria, and a more complex situation on the Queensland east coast due to spatial closures (Neil Gribble, DPI&F, pers. com. 2007). These assessments have relied almost exclusively on reported catch and effort data, and the model fits have been associated with a large degree of uncertainty. Hence, although current stocks in the Gulf of Carpentaria and on the east coast appear to be healthy and current levels of fishing effort appear to be sustainable, a stock assessment that draws on multiple independent data sources, such as an age structured model, is required to increase confidence in this conclusion.

During this study the commercial and recreational components of the Gulf of Carpentaria Inshore Finfish Fishery and the East Coast Inshore Finfish Fishery were managed through the *Fisheries (Gulf of Carpentaria Inshore Finfish) Management Plan 1999* (Gulf Management Plan), the *Fisheries Act 1994* and the *Fisheries Regulations 1995*.

The Long Term Monitoring Program (LTMP) for barramundi was carried out from 2000 in the Gulf of Carpentaria and on the east coast of Queensland.

Objectives

The objective of the barramundi monitoring program was to gather biological and fishery information that can be used to monitor the barramundi resource in Queensland waters.

The program aimed to develop a time-series of data from the eastern Gulf of Carpentaria and the Queensland east coast comprising:

- Age and length structured catch data from the commercial gillnet fishery operating in the major coastal fishing grounds, using fisheries-dependent and fisheries-independent procedures.
- Sex structured catch data from these same fishing grounds.

The program provides these data in a suitable format for stock assessment analysis. The data maybe used to assist in measuring the performance of the *Fisheries (Gulf of Carpentaria Inshore Fin Fish) Management Plan 1999* and provides input into annual fishery status reports.

The objective of this report is to provide a summary of the methods used to conduct annual surveys and to present the annual survey results from 2000 to 2006 in the form of age-structure for 2000-2005 and length/sex structure for the complete series.

Methods

The monitoring of barramundi involved dedicated sampling on major fishing grounds in the Gulf of Carpentaria and along the Queensland east coast, complemented by commercial catch monitoring. Both elements of the data collection program depended on the direct assistance from volunteer commercial fishers. A detailed description of the methods used to conduct the annual barramundi surveys is documented in DPI&F (2005a).

To determine the age of barramundi sampled during the 2000-2005 surveys, a sectioned otolith of each fish was read in the laboratory. A detailed description of the methods used to age barramundi is documented in DPI&F (2005b).

Sites

Four river systems in the eastern Gulf of Carpentaria (Flinders River, Staaten River, Mitchell River, Archer River) and two river systems on the Queensland east coast (Fitzroy River, Burdekin River) were surveyed in detail (Figure 1). These rivers were chosen to reflect major concentrations of fishing activity, and for which an existing database of species biological and commercial harvest information already exists (CFISH and RFISH databases).

The surveyed rivers did not cover all recognised barramundi genetic stocks in Queensland waters (Shaklee *et al*. 1993; Keenan 1994), but were located within the geographical boundaries of the three stocks that support the highest levels of fishing activity.

Times

Barramundi surveys were carried out in each Gulf of Carpentaria river system over the fourth first quarter moon period of the year (usually in March or April). Analysis of Commercial Fisheries Information Systems (CFISH) data by Gribble (1998) indicated that the barramundi catches for individual operators are adequate for data collection from both river and foreshore environments. During this period, and catch rates were not likely to be influenced by diminished gear efficiency in the strong river flows characteristic of the wet season (Gribble 1998).

Surveys of Queensland's east coast rivers were conducted as early as practical after the fishing season opens each year (February 1). Prior to 2002, all surveys were conducted in April. The Queensland east coast surveys were shifted to February in 2002, in order to link the surveys with the peak period of harvest on the east coast and thereby ensuring the maximum amount of information was obtained.

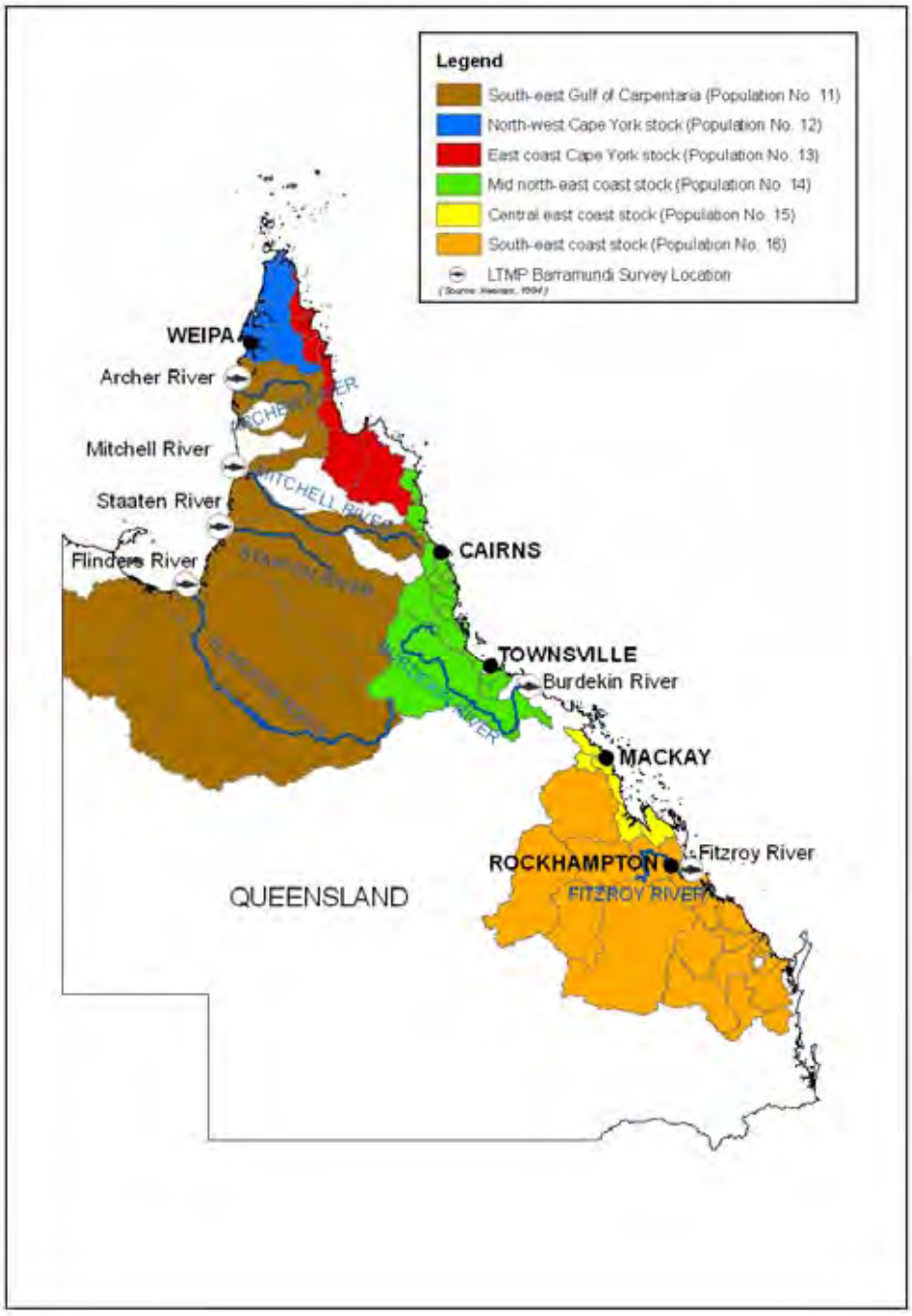

Figure 1. River systems where barramundi were monitored (marked and named in blue). Corresponding areas of genetically different barramundi stock are also indicated as reported by Keenan (1994).

Data limitations

The data presented in this report have limitations because of the collection methods employed and the early stage of the research. When interpreting this report the following provisions must be applied:

- Size and age class sex ratios have not been presented in this report for the Burdekin and Fitzroy Rivers due to limited sample sizes of known male and female barramundi from those river systems.
- Size and age of the barramundi recorded during surveys may be a direct result of the selectivity of the gillnet collection method and are a biased representation of the whole population.
- The sizes and ply ratings of the gillnets used by the commercial fishers varied during the surveys, between and within sites and sampling years. The size and number of fish caught are likely to be influenced by the gillnets used as well as the actual abundance and structure of the population at the time of the surveys.
- Catch may be affected by moon phase, and tidal cycle and amplitudes. As the dates of the surveys were chosen to be convenient for the participating fishers, the timing sometimes varied between years. The resulting change in environmental factors needs to be considered when interpreting the data presented for each river system.
- Confidentiality provisions are in place to protect the interests of individual fishers who contributed data voluntarily to the program.
- Otoliths were not collected from every barramundi. In some river systems a sub-sample of otoliths were collected.
- The aging information presented in this report does not conform to the current fish aging protocols being used by LTMP.

Results and discussion

A trend common in the Gulf of Carpentaria and the Queensland east coast barramundi fisheries was that both are highly reliant on a restricted set of age classes, partially because of the fish size-selectivity of the fishing gear used in the commercial fishery. The LTMP data suggest the catch in the Queensland east coast rivers was predominately of fish between two and six years old, and in the Gulf of Carpentaria between two and five years. These are relatively young fish, given that the life span of barramundi can be over thirty years.

Gulf of Carpentaria regional summary

Fishery-dependent surveys

From 2000 to 2006, catch sampling surveys were successfully completed in the Archer and Staaten Rivers. The time series of catch data for the Flinders and Mitchell Rivers are incomplete, as surveys were not undertaken in the Flinders River in 2002, and Mitchell River in 2004.

Length and age frequency

During the seven survey periods, a broad range of size classes of barramundi were measured in the commercial catch in the Gulf of Carpentaria; these fish ranged from 600 to 1200 mm total length (TL) in length (Figure 2). However, from all years surveyed (2000–06) 92% of the fish lengths were from 600 to 800 mm TL.

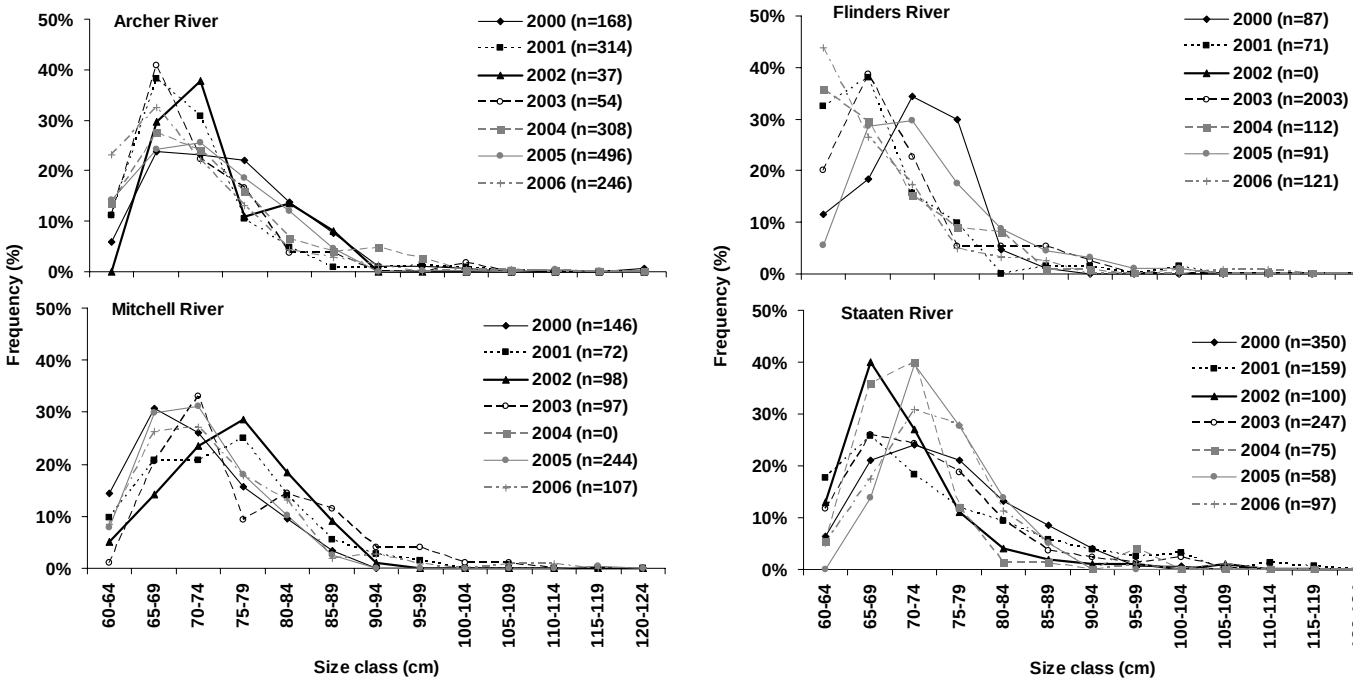

Figure 2. Length frequency of Gulf of Carpentaria barramundi (fishery-dependent) sampled by the Long Term Monitoring Program by year 2000 to 2006.

The age structures of barramundi sampled, from the commercial catch in the Gulf of Carpentaria, varied between years and rivers. Over the six years of available data, age estimations of barramundi ranged from one to sixteen years of age. The majority of barramundi sampled from the commercial catch were aged two to five years (Figure 3 & Figure 4). The oldest barramundi aged from the Gulf of Carpentaria rivers was 16 years old, being a female of 1200 mm TL, sampled in 2000 from the Archer River.

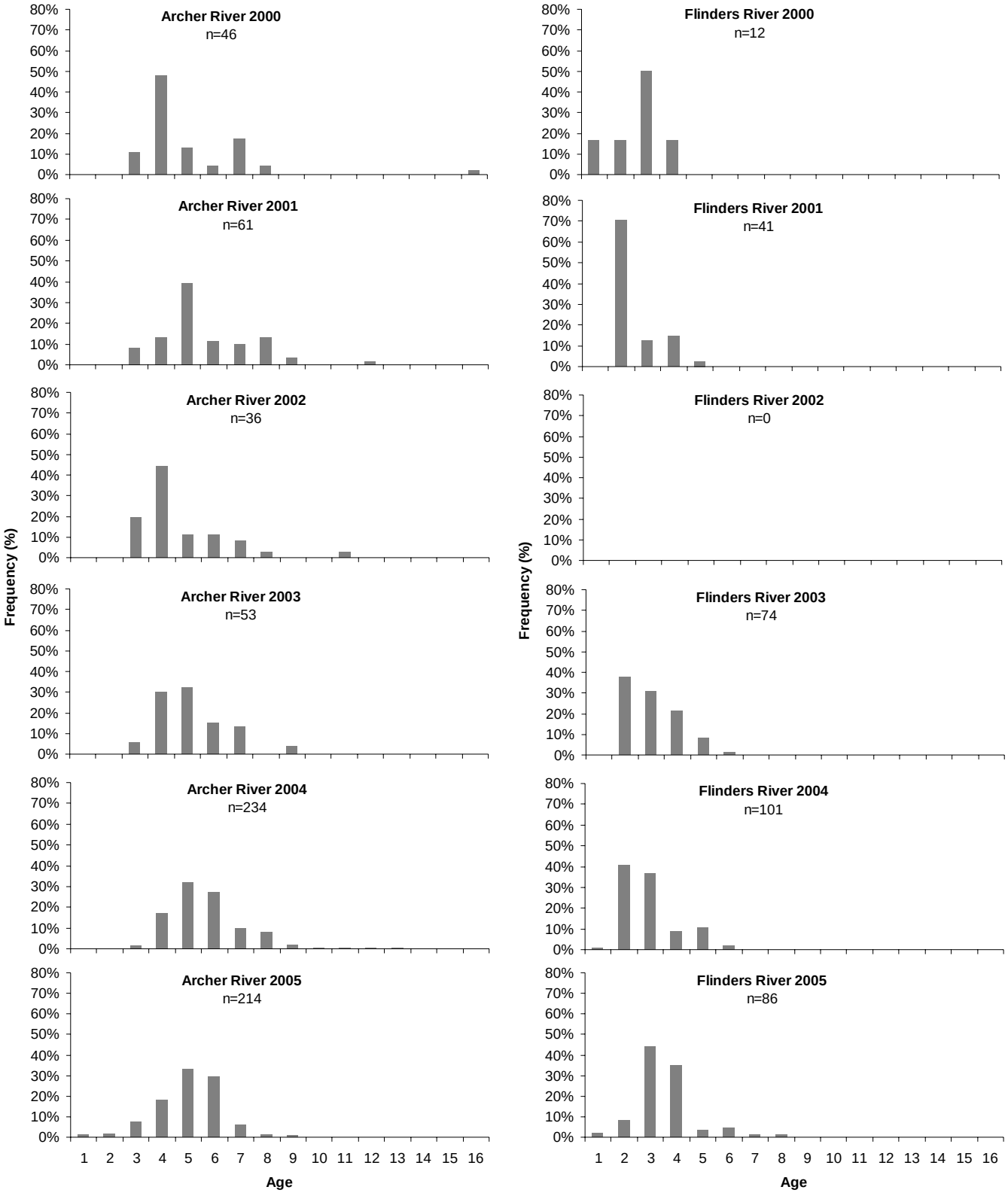

Figure 3. Age frequency of barramundi (fishery-dependent) from the Archer and Flinders Rivers surveyed by the Long Term Monitoring Program 2000 to 2005.

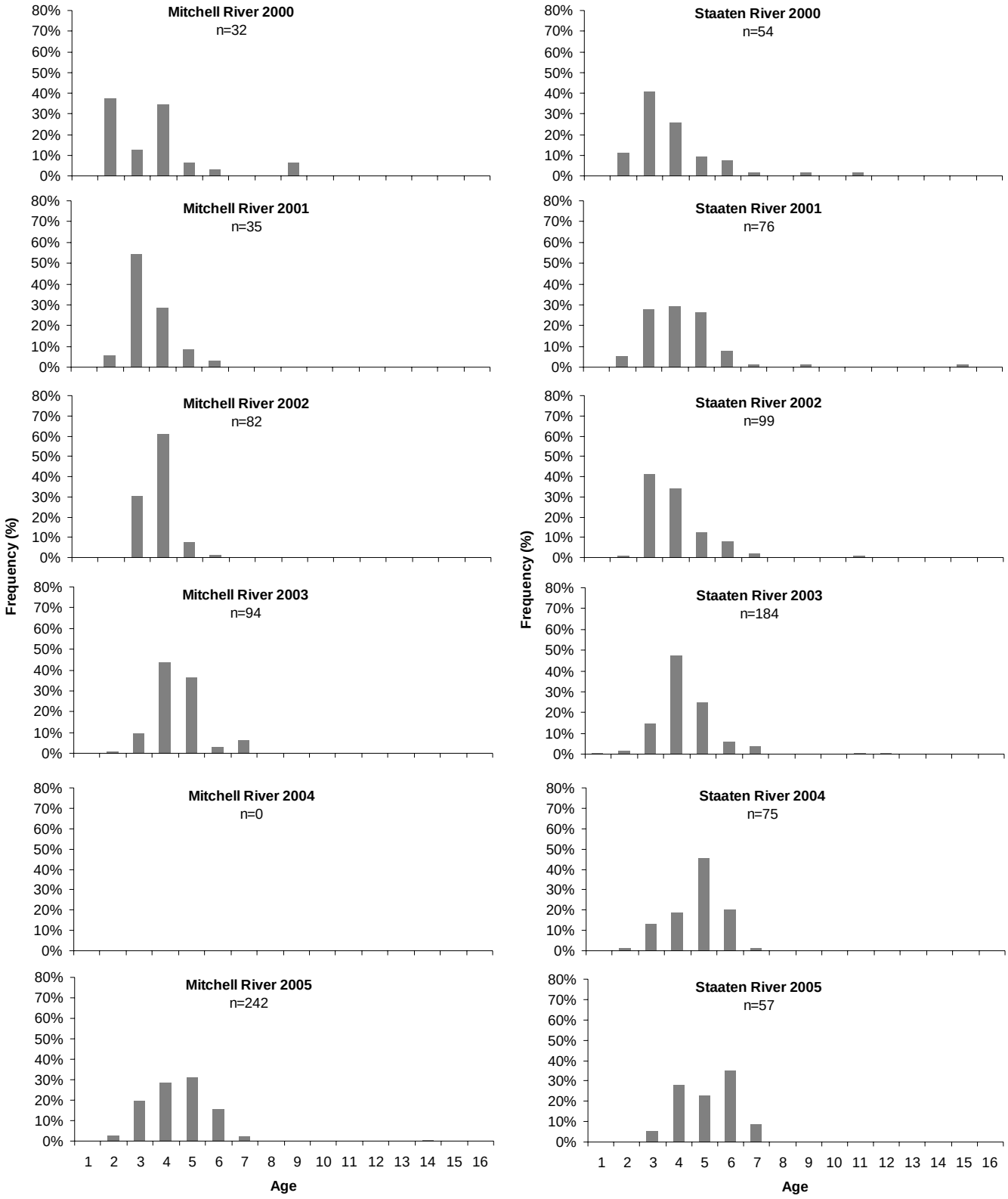

Figure 4. Age frequency of barramundi (fishery-dependent) from the Mitchell and Staaten Rivers survey by the Long Term Monitoring Program year 2000 to 2005.

In the years 2001 to 2004, the age structure of barramundi sampled from the Flinders River was different from the other three rivers sampled in the Gulf of Carpentaria (Figure 3). The age class structure was dominated by young fish; nearly half of the fish sampled in each year were two years of age. In comparison the other Gulf rivers had low occurrence of two year old fish in the annual samples. The highest occurrence of two year old fish, from the other three rivers, was 38% in the Mitchell River in 2000 (Figure 4).

An explanation for the difference in the Flinders River age structure could be the fishing technique used by the commercial fisher who was supplying samples to the program. The fisher may differ in gillnet placement (e.g. habitat type fished) or fishing gear (e.g. specific gillnet mesh size and ply rating). One of these factors or a combination of both could explain the difference in the Flinders Rivers biological catch characteristics.

Sex ratio within size and age class

In general, male barramundi in all monitored Gulf of Carpentaria rivers were more common than females in size classes below 900 mm TL. The proportion of male to female fish in the catch varied between size classes and river systems (Figure 5). In all surveyed Gulf of Carpentaria rivers, no barramundi greater than 1050 mm TL was identified as being male. However, few fish, 2%, were sampled over 950 mm TL. Two female barramundi less than the minimum legal size were measured in the Staaten River (450 mm size class) and Archer River (550 mm size class).

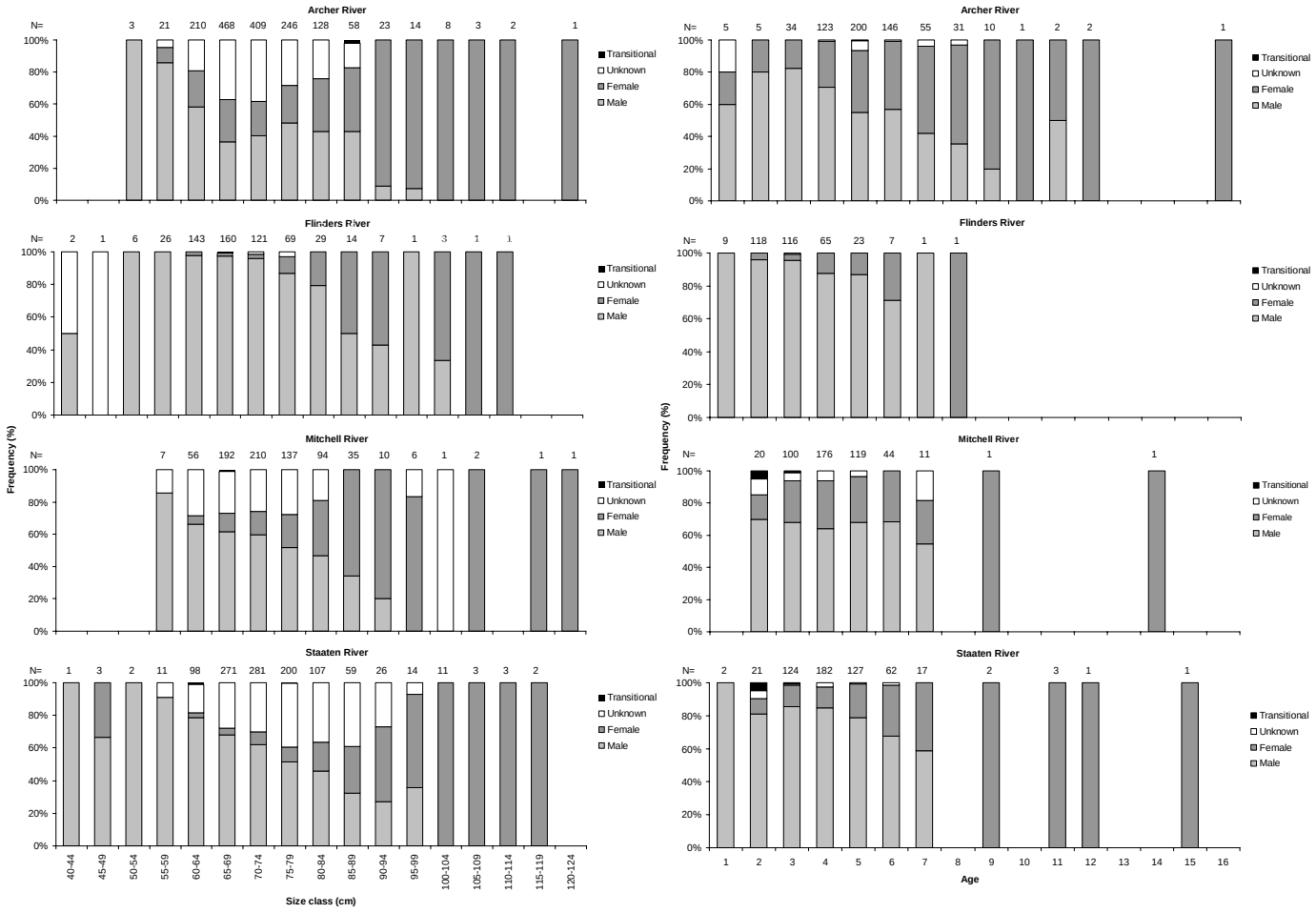

Figure 5. Proportion of male, female, unknown and transitional genders in each size and age class sampled by the Long Term Monitoring Program for the Gulf of Carpentaria pooled by year 2000 to 2001. Note: n indicates numbers of fish in each size or age class.

Male barramundi in all surveyed Gulf of Carpentaria rivers were more common than females in age classes below six years of age. The proportion of male to female fish varied between age classes and river systems (Figure 5). Barramundi older than eleven years were always identified as female. However, this may be biased due to low numbers of old fish sampled. Only six barramundi greater than eleven years of age were collected in the samples. Female barramundi occurred in the younger age classes (less than six years) however, the proportions are small compared to male fish.

In 2002, the program stopped microscopically staging the gonad samples due to a change in the structure of programs sampling design. The sampling design was restricted to providing information from only a few days in each year. To monitor length and age trends in transitional males, the barramundi program would need to adopt a continuous sampling design similar to that used by Davis 1982. The barramundi program continued to examine gonad samples macroscopically to separate male from female gonads to report on sex ratio.

A more comprehensive study of transitional male barramundi was conducted by Davis (1982). Results show that the mean length of transitional male barramundi in the southern Gulf of Carpentaria was 820 mm and ranged between 680 and 900 mm. Generally the transitional males in the LTMP sample were within this range.

Growth

Barramundi in all monitored Gulf of Carpentaria rivers showed a large overlap of fish length across the age classes, this varied between rivers (Figure 6).

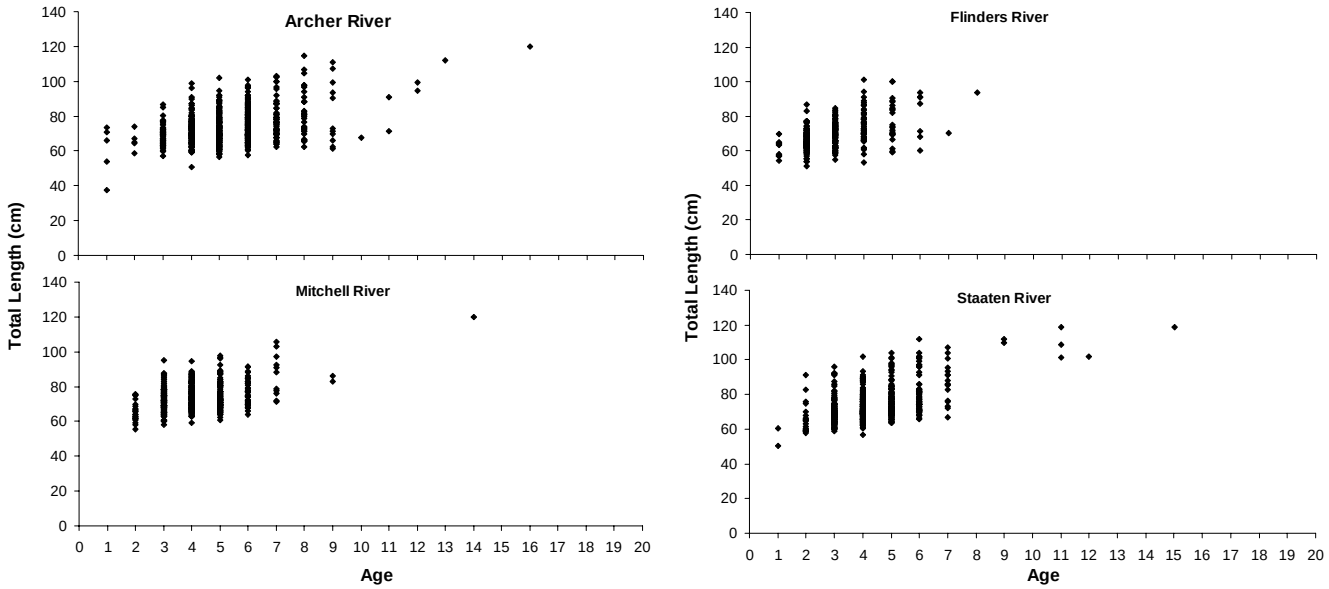

Figure 6. Length at age of barramundi from Gulf of Carpentaria from fishery-dependent surveys, years pooled 2000 to 2005 sampled by the Long Term Monitoring Program.

Length-weight

Barramundi from all the monitored Gulf of Carpentaria rivers had a strong relationship between total fish length and weight, this varied between rivers (Archer R2 =0.92, Mitchell R2 = 0.89, Staaten R2 = 0.89, Flinders R2 = 0.94) (Figure 7).

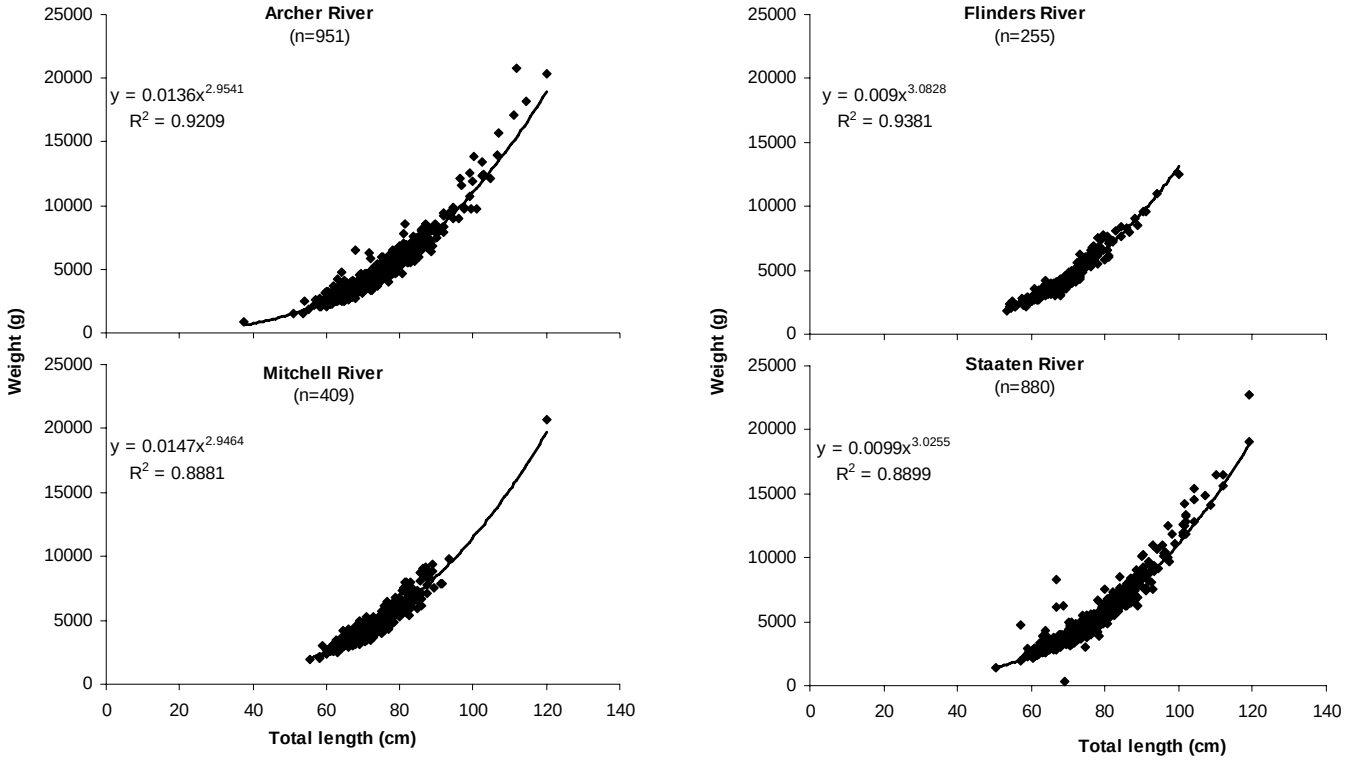

Figure 7. Length-weight of barramundi from the Gulf of Carpentaria from fishery-dependent surveys, years pooled 2000 to 2006 sampled by the Long Term Monitoring Program.

Commercial fishing gear

Commercial fishers whose operations were monitored in the Gulf of Carpentaria from 2000 to 2006 used a variety of different mesh sizes and ply ratings (Appendix 1). These gillnet features affect the size of fish caught because of the selectivity differences in mesh, ply and hanging ratios. Typically, smaller meshes are favoured to target fish of a smaller size. A general fleet gillnet gear survey is required to determine if the gear used by those fishers participating in the LTMP surveys was representative of the gillnet fishery. More recently, Hyland (2007) has completed a desk-top study of previous research projects to determine selectivity of set gillnets in the commercial fishery. Results obtained from Hyland's study will help explain differences in the fish size and net selectivity.

Gulf of Carpentaria fishery-independent surveys

Over 2000-2005, three fishery-independent netting surveys have been conducted in each of the Archer, Staaten and Flinders Rivers and two in the Mitchell River (Appendix 2). The frequency of the netting surveys and the number of species caught varied between rivers (Appendix 2). In all years, barramundi accounted for the majority of the catch in the fishery-independent surveys with the exception of the Flinders River. The 2000, Flinders River fishery-independent survey recorded king threadfin species as the most common catch component (Appendix 2). Post 2000, the most common catch components in the fishery-independent surveys were non commercial hairback herring and catfish species.

In addition to barramundi, five other commercially important species captured in the fishery-independent surveys were: scaly jewelfish, blue and king threadfin, queenfish and barred javelinfish.

The last fishery-independent survey in the Gulf of Carpentaria was conducted in 2005. The fishery-independent surveys were stopped due to inconsistency in the time series and low numbers of barramundi caught in each survey. Consistency in the collection of data between years could not be maintained due to limited availability of fishing gear and availability of suitable vessels and weather conditions.

East coast of Queensland regional summary

Burdekin and Fitzroy River fishery-dependent surveys

In the Burdekin and Fitzroy Rivers 2000 to 2001, few samples were collected in the April catch sampling surveys due to poor catches in the commercial fishery. From 2002, the monitoring program accessed samples in February from fish wholesalers in the Burdekin River area. The numbers of samples collected from the Burdekin River improved to over 100 fish measured each year. However, sample numbers did not improved in the Fitzroy River.

Commercial catches in the Fitzroy River are very dependent on river flow events after seasonal rain and the monitoring program was only accessing fish from one commercial fisher. A combination of theses two factors resulted in low numbers of barramundi sampled. In 2003, the program accessed catch samples from fish wholesalers in the Fitzroy region. Sample numbers were still very low due to flow events in the river and fish market demand. In the Fitzroy over fifty percent of the barramundi captured (over the five days surveyed) were sold whole due to market forces. Access to these whole fish was not possible due to transport and packaging requirements. In 2004, the number of catches sampled improved in the Fitzroy with over 240 barramundi measured. The timing of the catch sampling survey for that year coincided with peak catches of barramundi in the Fitzroy system.

No gender information could be recorded from fish surveyed at the fish wholesalers (either Burdekin or Fitzroy locations), as the barramundi were gilled and gutted by the fishers before being delivered to the wholesalers.

Length and Age Frequency

During the surveys a wide range of size classes of barramundi were measured in the Burdekin and Fitzroy River commercial catch (Figure 8). In the rivers 93% of the fish measured were between 580 to 950 mm TL.

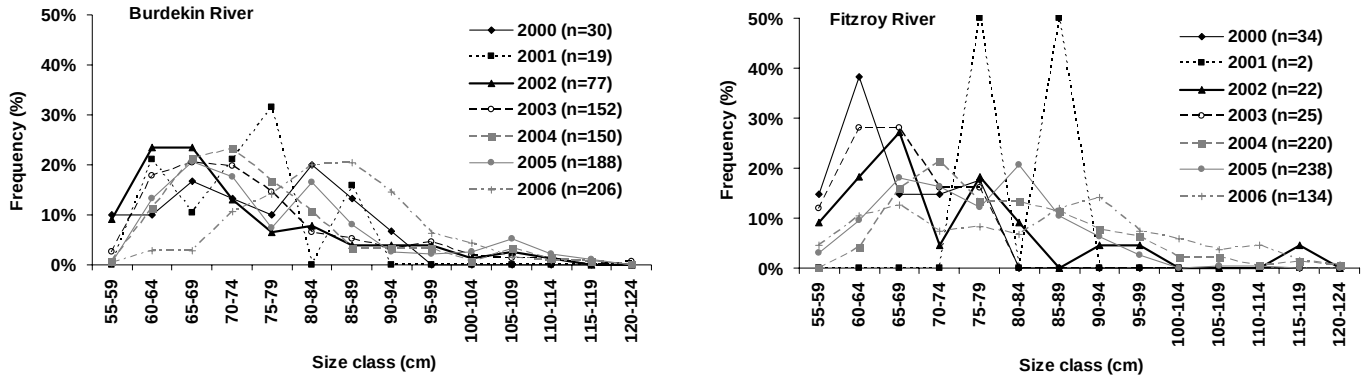

Figure 8. Length frequency of east coast of Queensland barramundi (fishery-dependent) sampled by the Long Term Monitoring Program by year 2000 to 2006.

Length frequency distributions in the Burdekin and Fitzroy Rivers were variable between years. The variability in the trends maybe due to low sample numbers recorded in the Burdekin (years 2000 & 2001) and the Fitzroy Rivers (years 2000, 2001, 2002 & 2003). The Burdekin River length frequency structure was more consistent between the years surveyed, from 2002 onward when sample size increased.

Age estimations of barramundi sampled in the commercial operations from the Burdekin River over the last five years were mainly from two to six years with a very small number of older individuals (Figure 9). The proportions of barramundi within each age class fluctuated between years. Very few otoliths were aged in 2000 and no barramundi otoliths were collected in 2001. The oldest barramundi observed, using otolith age estimation, was a 18 years old female of 1050 mm TL, caught in 2003.

The samples of barramundi otoliths from the Fitzroy River have been irregular. No barramundi otoliths were collected in 2001 and 2003. Low numbers of otoliths were collected in 2000 and 2002. In 2004, a good sample of 237 barramundi otoliths were collected from fish wholesalers in the Fitzroy River area (Figure 9). The 2004 barramundi age estimates, ranged from two to seven years old. In the 2004 survey 60% of fish collected were three years old. The oldest fish collected and aged was a female at 31 years old.

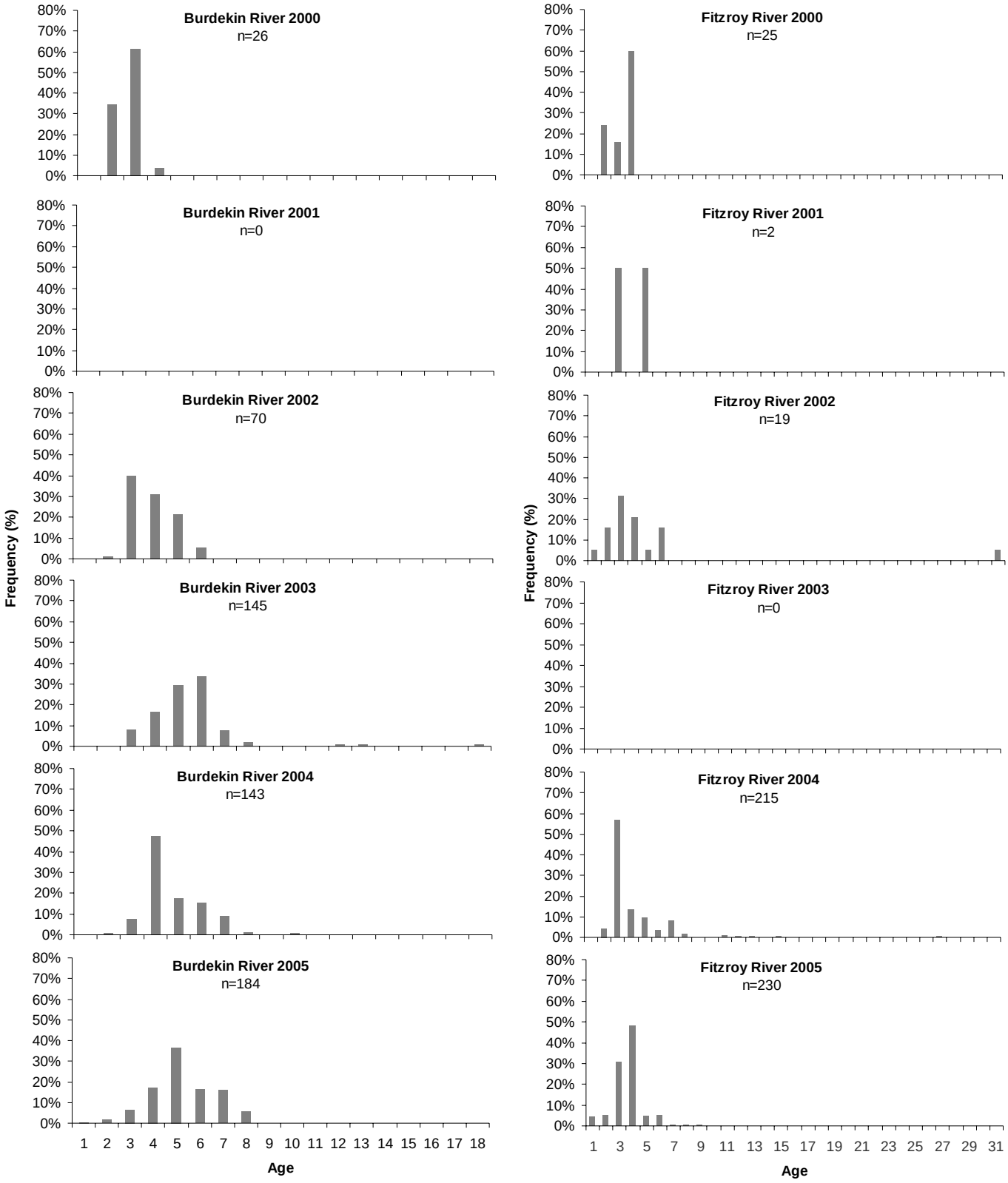

Figure 9. Long Term Monitoring Program barramundi (fishery-dependent) age frequency for Burdekin and Fitzroy Rivers by year 2000 to 2005.

Growth

Barramundi in the Burdekin and Fitzroy River showed a large overlap of fish length across the age classes, this varied between rivers (Figure 10).

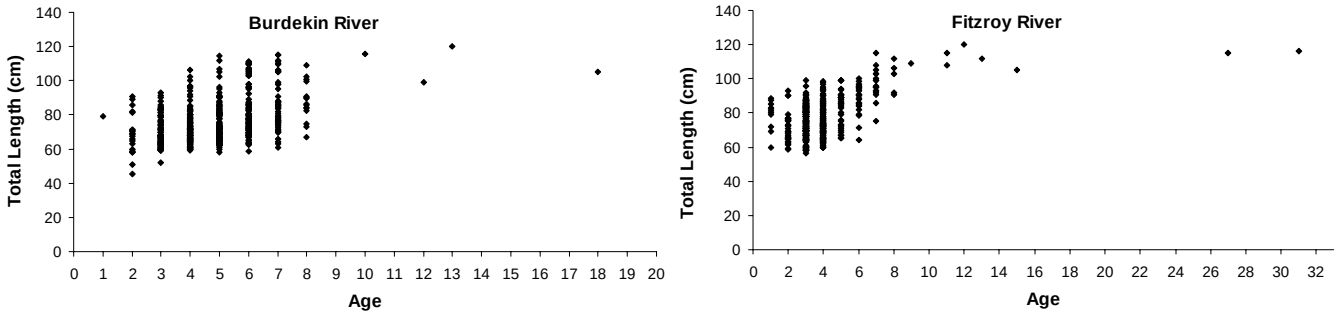

Figure 10. Length at age of barramundi from the east coast of Queensland from fishery-dependent surveys, years pooled 2000 to 2005 sampled by the Long Term Monitoring Program.

Commercial fishing gear

Commercial fishers whose operations were monitored in the Burdekin and Fitzroy Rivers from 2000 to 2006 used a variety of different mesh sizes and ply ratings (Appendix 3). These gillnet features affect the size of fish caught because of the selectivity differences in mesh size and ply rating. Typically, smaller mesh sizes are favoured to target fish of a smaller size.

Length-weight

Barramundi from the Burdekin and Fitzroy Rivers had a strong relationship between total fish length and weight; this varied between rivers (Burdekin R^2 =0.95 & Fitzroy R^2 = 0.95) (Figure 11).

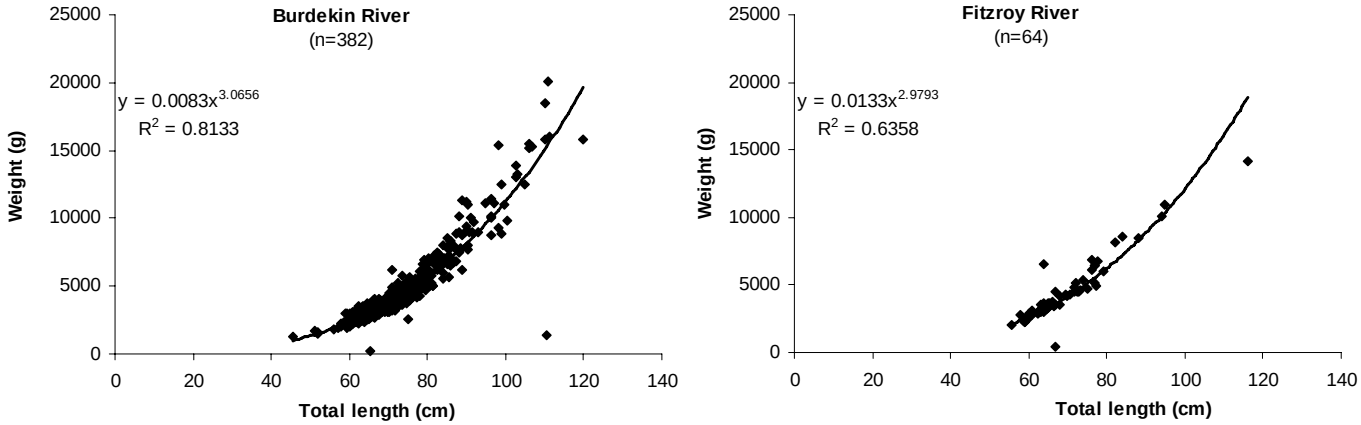

Figure 11. Length-weight of barramundi from the east coast of Queensland from fishery-dependent surveys, years pooled 2000 to 2005 sampled by the Long Term Monitoring Program (a polynomial regression to the data is presented as the solid line with the equation to the line in the upper left of the graph).

Burdekin and Fitzroy River fishery-independent surveys

In the Burdekin River, fishery-independent surveys were conducted in 2000 and 2001. From 2002 to 2004, both Queensland east coast rivers were surveyed (Appendix 4). Very few fish species were caught during the Burdekin and Fitzroy River surveys. Barramundi accounted for the majority of the catch in each river, along with blue threadfin in the Burdekin fishery-independent surveys, and king threadfin in the Fitzroy surveys. In 2005, the fishery-independent surveys on the Queensland east coast were discontinued due to the low numbers of barramundi caught in each survey.

Conclusions

Findings from the LTMP for barramundi presented in this report include:

- The Gulf of Carpentaria barramundi fishery is harvesting a narrower range of fish sizes compared to the east coast fishery. Of the barramundi measured by the monitoring program from the Gulf of Carpentaria rivers 92% were between 600 mm and 850 mm, compared to 93% between 580 mm and 950 mm from the east coast rivers.
- Both the Queensland Gulf of Carpentaria and east coast barramundi fisheries are highly reliant on a narrow span of age classes. The LTMP data suggest the catch in all surveyed rivers was predominately from fish between two and six years old. These are relatively young fish considering the life span of barramundi can be thirty years plus. A combination of the legal size limits for barramundi and the size selectivity of the fishing gears used by the commercial industry is the likely reason why the catch is from relatively young fish.
- Length-weight relationships and age structures represented in this report maybe utilised as data source for future barramundi stock assessments.
- The results from the surveys demonstrate that the younger and smaller a fish is, the more likely it is to be a male. In general, fish less than 900 mm TL or six years of age were nearly all male. Small female fish were measured in the sample, the smallest being 450 mm TL. The youngest female was two years of age. Very few transitional males (male fish changing sex to female) were present in the catch sample. Monitoring changes in the sex ratio of barramundi within age and size classes may show how the species reacts to different levels of fishing pressures.
- The barramundi monitoring has established and documented a baseline dataset, against which future monitoring data can be compared. Through the ongoing process of collecting and analysing LTMP data, and refinement of monitoring protocols, the program will improve the level of information on the biological characteristics of the Queensland barramundi catch.

References

Campbell, A.B., O'Neill, M.F. and Officer, R. (2008) Assessment of the barramundi fishery in Queensland, 1989–2007. Department of Primary Industries and Fisheries, Brisbane, Australia.

Davis, T.L.O. (1982). Maturity and sexuality in barramundi, *Lates calcarifer* (Bloch), in the Northern Territory and southeastern Gulf of Carpentaria. *Australian Journal of Marine and Freshwater Research* 33(3), 529–545.

Davis, T.L.O. (1985). Seasonal changes in gonad maturity, and abundance of larvae and early juveniles of barramundi, *Lates calcarifer* (Bloch), in Van Diemen Gulf and the Gulf of Carpentaria. *Australian Journal of Marine and Freshwater Research* 36, 177–190.

Davis, T.L.O. (1987). Biology of wildstock *Lates calcarifer* in northern Australia. In 'ACIAR Proceedings.' No. 20, pp. 22–29. (Australian Centre for International Agricultural Research, Canberra)

Department of Primary Industries and Fisheries (2005a). Fisheries Long Term Monitoring Program Sampling Protocol - Barramundi: (2000–2005) Section 1. Department of Primary Industries and Fisheries, Brisbane, Australia.

Department of Primary Industries and Fisheries (2005b). Fisheries Long Term Monitoring Program Sampling Protocol – Determination of the Ages of Fish at Northern Fisheries Centre, Cairns: (2000–2003). Department of Primary Industries and Fisheries, Brisbane, Australia.

Department of Primary Industries and Fisheries (2008a). Annual Status Report for the Queensland Gulf of Carpentaria Inshore Finfish Fishery. Department of Primary Industries and Fisheries, Brisbane, Australia.

Department of Primary Industries and Fisheries (2008b). Annual Status Report for the Queensland East Coast Inshore Finfish Fishery. Department of Primary Industries and Fisheries, Brisbane, Australia.

Dunstan, D.J. (1959). The barramundi *Lates calcarifer* (Bloch) in Queensland waters. CSIRO Australian Division of Fisheries and Oceanography, Technical Paper no. 5.

Environment Protection and Biodiversity Conservation Act 1999, http://www.comlaw.gov.au/, Commonwealth of Australia.

Fisheries Act 1994, *www.legislation.qld.gov.au/*, Office of the Queensland Parliamentary Council

Fisheries (Gulf of Carpentaria Inshore Fin Fish) Management Plan 1999, subordinate legislation of the *Fisheries Act 1994*, *www.legislation.qld.gov.au/*, Office of the Queensland Parliamentary Council.

Fisheries Regulation 1995, subordinate legislation of the *Fisheries Act 1994*, *www.legislation.qld.gov.au/*, Office of the Queensland Parliamentary Council.

Garrett, R.N. (1995). Biology and fishery information for some commonly taken fishes of tropical Queensland coastal waters. Tropical Fin Fish Management Advisory Committee Restricted Circulation Information Paper. 41pp. Unpublished report to the Queensland Fisheries Management Authority, Brisbane, Australia.

Garrett, R.N., and Williams, L.E. (2002). Barramundi. In 'Queensland's fisheries resources: current condition and recent trends 1988–2000.' (Ed. L.E.Williams.) pp. 110–115. QI02012. (Queensland Department of Primary Industries: Brisbane, Australia).

Gribble, N.A. (1998). Tropical Resource Assessment Program: fisheries stock assessment workshop. In 'Conference and Workshop Proceedings, Cairns Qld, 28th–31st October 1997'. (Ed. N.A. Gribble.) 54pp. QC98003. (Queensland Department of Primary Industries: Cairns, Australia.)

Hall, N.G., de Lestang, P., Buckworth, R.C., Hearneden, M.N., Gribble, N.A., Newman, S.J., Garrett, R.N., Halliday, I.A.,. Officer, R.A, Wise, B.S., Walters, C.J., and Griffin, R.K. (2006). Development of a Sex, Habitat, and Age-structured Stock Assessment Model for Australian barramundi fisheries. National

Barramundi assessment Working Group. 27 February – 3 March 2006, Western Australian Fisheries and Marine Research Laboratories, Hillary's Boat harbour, Perth, Australia.

Henry, G.W., and Lyle, J.M. (2003). The National Recreational and Indigenous Fishing Survey. Fisheries Research and Development Corporation final report, project no. 99/158. 190pp. ISBN 0642539847. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, Australia.

Hyland S. J. (2007). Mesh selectivity for Barramundi. (DPI&F Project Report, DPI&F, Northern Fisheries Centre, Cairns), 12pp.

Kailola, P., Williams, M.J., Stewart, P., Reichelt, R., McNee, A., and Grieve, C. (1993). 'Australian fisheries resources.' 422pp. (Bureau of Resource Sciences, Department of Primary Industries and Energy: Canberra, Australia).

Keenan, C.P. (1994). Recent evolution of population structure in Australian barramundi *Lates calcarifer* (Bloch): an example of isolation by distance in one dimension. *Australian Journal of Marine and Freshwater Research* 45, 1123–1148.

Lunow, C., Garrett, R., Gribble, N., Helmke, S., and Rose, D. (2005). Fisheries Long Term Monitoring Program – Barramundi (*Lates calcarifer*) surveys results: 2000–2002. Department of Primary Industries and Fisheries, Brisbane, Queensland.

McInnes, K.L. (Ed) (2006) 2004 biennial recreational fishing telephone survey of Queensland residents. Queensland Department of Primary Industries and Fisheries, Brisbane, Australia.

Russell, D.J. (1988). An assessment of the east Queensland inshore gill net fishery. 57pp. Queensland Department of Primary Industries, Brisbane, Australia.

Shaklee, J.B., Salini, J., and Garrett, R.N. (1993). Electrophoretic characterization of multiple genetic stocks of barramundi perch in Queensland, Australia. *Transactions of the American Fisheries Society* 122(5), 685–701.

Staunton-Smith, J., Robins, J.B,, Mayer, D.G., Sellin, M.J., and Halliday, I.A. (2004) Does the quantity and timing of fresh water flowing into a dry tropical estuary affect year-class strength of Barramundi (*Lates calcarifer*)? Marine and Freshwater Research 55, 787–797.

Appendix 1. Gulf of Carpentaria commercial fishing gear – Gillnet mesh sizes (mm) and ply ratings by year for rivers surveyed in the Gulf of Carpentaria by the Long Term Monitoring Program. X indicates use of the mesh size and ply rating.

Mesh size (mm)	Mesh ply rating	Archer River						Flinders River					Mitchell River				Staaten River					
		2000	2001	2002	2004	2005	2006	2000	2001	2003	2004	2005	2000	2001	2002	2005	2000	2001	2002	2003	2004	2005
162.5	33					X																
	40				X				X	X	X	X							X			
	45																		X	X		
	50					X							X			X	X	X	X		X	X
	70	X	X	X	X		X		X					X	X	X	X	X	X	X	X	X
169	40							X														
	50							X														
	70												X									
175	22					X																
	25					X																
	33					X																
	50					X																
	70					X	X															
	120																	X				
181	70	X																		X		
187.5	70	X																				
	90		X		X																	
200	90																X	X				

Appendix 2. Gulf of Carpentaria Fishery in-dependent surveys – Species encountered, by year, during the Long Term Monitoring Program fishery-independent surveys in the Gulf of Carpentaria. First number in row is the catch per unit effort (fish/hour/meter of net), number of fish in adjacent brackets.

Common name	Scientific name	Archer River			Flinders River			Mitchell River		Staaten River		
		2002	2004	2005	2000	2003	2004	2002	2005	2001	2003	2005
Australian Blacktip Shark	*Carcharhinus tilstoni*		0.02(1)									
Australian Cownose Ray	*Rhinoptera neglecta*		0.02(1)									
Barramundi	*Lates calcarifer*	0.77(31)	0.48(23)	1.66(46)	0.71(80)	0.20(14)		0.64(22)	0.51(10)	1.19(86)	0.78(68)	0.23(8)
Barred Javelinfish	*Pomadasys kaakan*		0.12(6)		0.02(3)	0.01(1)	0.68(5)			0.01(1)	0.02(2)	
Bartail Flathead	*Platycephalus indicus*		0.02(1)									
Beach Salmon	*Leptobrama muelleri*					0.13(9)				0.01(1)		0.05(2)
Black Jewfish	*Protonibea diacanthus*											0.02(1)
Mud Crab (giant)	*Scylla serrata*		0.10(5)		0.00(1)	0.01(1)	0.27(2)				0.02(2)	
Black Pomfret	*Parastromateus niger*								0.20(4)			0.08(3)
Blue Catfish	*Neoarius graeffei*										0.01(1)	
Blue Threadfin	*Eleutheronema tetradactylum*		0.31(15)		0.00(1)	0.41(28)		0.02(1)		0.08(6)	0.02(2)	0.02(1)
Bluetail Mullet	*Valamugil buchanani*					0.02(2)	0.41(3)					
Bony Bream	*Nematalosa erebi*	0.20(8)					0.82(6)		0.25(5)	0.30(22)		
SWORDFISH	Xiphiidae - undifferentiated				0.00(1)							
Bull Shark	*Carcharhinus leucas*	0.05(2)							0.15(3)			
CATFISH	*Arius* spp.	0.10(4)	0.20(10)	0.32(9)	0.11(13)					0.13(10)	0.05(5)	0.02(1)
Catfishes	Ariidae - undifferentiated					0.75(51)	9.48(69)	0.02(1)				
Common Forktailed Catfish	*Netuma thalassinus*				0.01(2)	0.01(1)	0.54(4)			0.01(1)		
CRAB	Xanthidae - undifferentiated						0.13(1)					
Diamondscale Mullet	*Liza vaigiensis*					0.07(5)				0.02(2)	0.02(2)	
Dusky Flathead	*Platycephalus fuscus*											
EELTAIL CATFISH	Plotosidae - undifferentiated									0.01(1)	0.01(1)	
Freshwater Sawfish	*Pristis microdon*	0.02(1)										
Giant Queenfish	*Scomberoides commersonnianus*		0.02(1)	0.28(8)				0.14(5)		0.11(8)		0.11(4)
Giant Shovelnose Ray	*Rhinobatos typus*		0.02(1)									
Hairback Herring	*Nematalosa come*		0.20(10)	0.57(16)	0.12(14)	0.80(54)		0.35(12)				0.08(3)
King Threadfin	*Polydactylus macrochir*		0.39(19)	0.03(1)	1.44(163)	0.16(11)	1.92(14)			0.25(18)	0.22(19)	
Lemon Shark	*Negaprion acutidens*										0.05(5)	
Leopard Whipray	*Himantura undulata*										0.01(1)	
Mangrove Jack	*Lutjanus argentimaculatus*								0.05(1)			

Appendix 2 (cont.). Gulf of Carpentaria fishery-independent surveys – Species encountered, by year, during the Long Term Monitoring Program fishery-independent surveys in the Gulf of Carpentaria. First number in row is the catch per unit effort (fish/hour/meter of net), number of fish in adjacent brackets.

Common name	Scientific name	Archer River			Flinders River			Mitchell River		Staaten River		
		2002	2004	2005	2000	2003	2004	2002	2005	2001	2003	2005
Mangrove Whipray	*Himantura granulata*		0.02(1)									
Milkfish	*Chanos chanos*			0.07(2)								
MULLET	Mugilidae - undifferentiated					0.07(5)						
Nakedhead Catfish	*Euristhmus nudiceps*					0.10(7)						
Narrow Sawfish	*Anoxypristis cuspidata*		0.23(11)								0.01(1)	
Northern Sand Flathead	*Platycephalus arenarius*										0.01(1)	
Oxeye Herring	*Megalops cyprinoides*			0.07(2)								
Pigeye Shark	*Carcharhinus amboinensis*		0.02(1)									
Pikey Bream	*Acanthopagrus berda*					0.05(4)	0.68(5)					
QUEENFISH	*Scomberoides* spp.										0.02(2)	0.02(1)
Saltwater Crocodile	*Crocodylus porosus*		0.02(1)									
SAWFISH	Pristidae - undifferentiated									0.04(3)		
Scaly Jewelfish	*Nibea squamosa*		0.16(8)		0.25(29)	0.22(15)	0.96(7)	0.11(4)	0.10(2)	0.45(33)	0.02(2)	
Sevenspot Archerfish	*Toxotes chatareus*			0.32(9)								
Silver Jewfish	*Nibea soldado*					0.01(1)						
Sicklefish	*Drepane punctata*		0.06(3)	0.07(2)								
Silver Javelin	*Pomadasys argenteus*											
SOLE	Soleidae - undifferentiated					0.01(1)	0.13(1)					
Spotted Scat	*Scatophagus argus*						0.13(1)			0.01(1)		
Striped Scat	*Selenotoca multifasciata*										0.032(32)	
Talang Queenfish	*Scomberoides commersonnianus*		0.02(1)	0.28(8)				0.14(5)		0.11(8)		0.11(4)
Two-line Sea Catfish	*Arius bilineatus*								0.15(3)			
White-Sspotted Eagle Ray	*Aetobatus narinari*		0.04(2)									
Winghead Shark	*Eusphyra blochii*		0.06(3)								0.01(1)	0.05(2)

Appendix 3. East coast of Queensland commercial fishing gear – Gillnet mesh sizes (mm) and ply ratings by year for rivers surveyed on the east coast of Queensland by the Long Term Monitoring Program. X indicates use of the mesh size and ply rating.

Mesh size (mm)	Mesh ply rating	Burdekin River							Fitzroy River			
		2000	2001	2002	2003	2004	2005	2006	2000	2001	2002	2003
112.5	24		X									
	40		X									
125	24			X								
	30		X		X							
	40		X	X		X						
150	24			X								
	30		X	X								
	35								X			
	36						X					
	40		X	X	X	X						X
	50	X			X	X	X					
	70				X		X	X				
	80										X	
	(blank)			X								
156	40		X									X
	50		X			X						
162.5	30				X	X						
	35									X		X
	40		X	X								X
	50	X	X	X	X							
	60			X								
	70			X	X	X	X	X				
	90			X								
169	50					X						
	70					X						
175	40		X		X							
	50					X					X	
	70	X		X	X	X	X	X				
	90						X					
187.5	50				X							
	90	X			X							
200	70		X	X								
	90			X	X	X	X	X				
	120					X						
212.5	80										X	
	90			X	X	X		X				
	120				X	X						
219	90						X					
	120						X					

Appendix 4. East coast of Queensland fishery-independent surveys – Species encountered, by year, during the Long Term Monitoring Program fishery-independent surveys on the east coast of Queensland. First number in row is the catch per unit effort (fish/hour/meter of net), number of fish in adjacent brackets.

Common name	Scientific name	Burdekin River					Fitzroy River		
		2000	2001	2002	2003	2004	2002	2003	2004
Barramundi	*Lates calcarifer*	0.24(12)	0.24(13)	0.07(1)	0.17(4)	0.84(10)	0.76(43)	0.71(14)	0.00(1)
Blue Catfish	*Arius graffei*						0.03(2)		
Blue Threadfin	*Eleutheronema tetradactylum*	0.30 (15)	0.01 (1)	0.15 (2)	0.94 (22)		0.03(2)		
CATFISH	*Arius* spp.			0.07(1)	0.08(2)	0.16(2)		0.05(1)	
Dusky Flathead	*Platycephalus fuscus*	0.02(1)	0.01(1)						
False Trevally	*Lactarius lactarius*						0.01(1)		
FLATHEAD	Platycephalidae – undifferentiated						0.03(2)		
Giant Queenfish	*Scomberoides commersonnianus*		0.03(2)						
Golden Snapper	*Lutjanus johnii*			0.15(2)					
King Threadfin	*Polydactylus macrochir*	0.02(1)					0.17(10)	0.05(1)	0.01(5)
MUD CRAB	*Scylla* spp.						0.01(1)		
Mud Crab (giant)	*Scylla serrata*					0.08(1)			
Scalloped Hammerhead	*Sphyrna lewini*			0.07(1)					
SCAT	Scatophagidae – undifferentiated				0.04(1)				
Sea Catfish	*Plicofollis argyropleuron*			0.23(3)					
SHARK	*Carcharhinidae*				0.21(5)		0.10(6)		0.00(3)
Sicklefish	*Drepane punctata*		0.01(1)	0.15(2)	0.12(3)	0.16 (2)			
Silver Jewfish	*Nibea soldado*	0.04(2)			0.04(1)				
Silver Javelin	*Pomadasys argenteus*				0.04(1)				
Spotted Scat	*Scatophagus argus*	0.02(1)					0.07(4)		
Stars and Stripes Puffer	*Arothron hispidus*	0.02(1)							
STINGRAY	Dasyatididae – undifferentiated		0.01(1)	0.15(2)					
THREADFIN	Polynemidae – undifferentiated				0.04(1)				
Tripletail	*Lobotes surinamensis*				0.17(4)		0.01(1)		
Yellowfin Bream	*Acanthopagrus australis*							0.05(1)	