Industry & Investment NSW
– Fisheries Research Report Series: 23

Data summary from the monitoring of Australian bass and native fisheries via competition-based angling in NSW: 1988 – 2008

Interim Report

by
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August 2009

ISSN 1837-2120

Recreational Fishing Trusts

NSW GOVERNMENT Industry & Investment

Industry & Investment NSW – Fisheries Research Report Series

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Title:	Data summary from the monitoring of Australian bass and native fisheries via competition-based angling in NSW: 1988 – 2008. Interim Report.
Authors:	Danielle Ghosn (nee Williams)
Published By:	Industry & Investment NSW (now incorporating NSW Department of Primary Industries)
Postal Address:	PO Box 21, Cronulla, NSW, 2230
Internet:	www.industry.nsw.gov.au

From the Recreational Freshwater Trust Funded Project "Monitoring of Australian bass fisheries in NSW via competition-based angling"

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ISSN 1837-2120

Note: Prior to July 2004, this report series was published by NSW Fisheries as the 'NSW Fisheries Resource Assessment Report Series' with ISSN number 1440-057X. Then, following the formation of the NSW Department of Primary Industries the report series was published as the 'NSW Department of Primary Industries – Fisheries Final Report Series' with ISSN number 1449-9959. The report series is now published by Industry & Investment NSW as the 'Industry & Investment NSW – Fisheries Final Report Series' with ISSN number 1837-2120.

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Thank you to the following organisations and persons for their contribution to this research project:

- The NSW Freshwater Fishing Trust and the NSW Department of Primary Industries (NSW DPI) for funding this research.
- All event organisers and participating anglers for their tireless efforts in providing data for this research.
- NSW DPI staff for their assistance with this report by means of graphing of results, data entry, data checking and/or data management including Geoff Barrett, Jim Craig, Antony Gould, Sandra Howarth, Emily Lawson, Yola Metti and Amy Smoothey.
- To my supervisors James Scandol, Aldo Steffe, Charles Gray and Steve Kennelly for their ongoing support and advice.
- To Kevin Rowling and Jeffrey Murphy for their time and contributions as reviewers of this report.
- To Tracey McVea for her time and contribution in formatting this report.

This report is dedicated to Dr John Harris who was responsible for the conception and initial design of this research program. Dr Harris along with research technicians including Simon Hartley, Tim Marsden, Garry Thorncraft and Matthew Barwick are responsible for the collation of the first decade of data included in this report. Bryan Van der Walt, Mark James and Timothy Park continued this research program up until 2006 when Danielle Ghosn assumed this role.

1. INTRODUCTION

The primary objective of this NSW monitoring program is to sample the catch and effort at Bass Catch events in support of the assessment of the recreational-only Australian bass *Macquaria novemaculeata* fishery. This monitoring is done via competition-based angling and marked its 20th Anniversary in 2008. Over these twenty years of monitoring, participating anglers have recorded the catch and release of about 59000 fish with about 55100 of those being Australian bass. This large monitoring data set represents one of very few long-term sources of information on Australian bass and other freshwater fisheries in NSW. Data are collected using a Catch Card Angler Return System (CARS). A detailed description of this CARS method can be found in Williams & Scandol (2008).

The Bass Catch component of this monitoring program started in the Hawkesbury-Nepean River System in 1988 and resulted from a strong interest by bass angling groups to participate in fisheries research and management. The Bass Catch project then expanded to other eastern drainage rivers of NSW in 1992. In addition to bass monitoring in the rivers, the program also expanded to impoundment events in 1998. To date, many participants of these earlier events remain consistent and reliable contributors of data for this research.

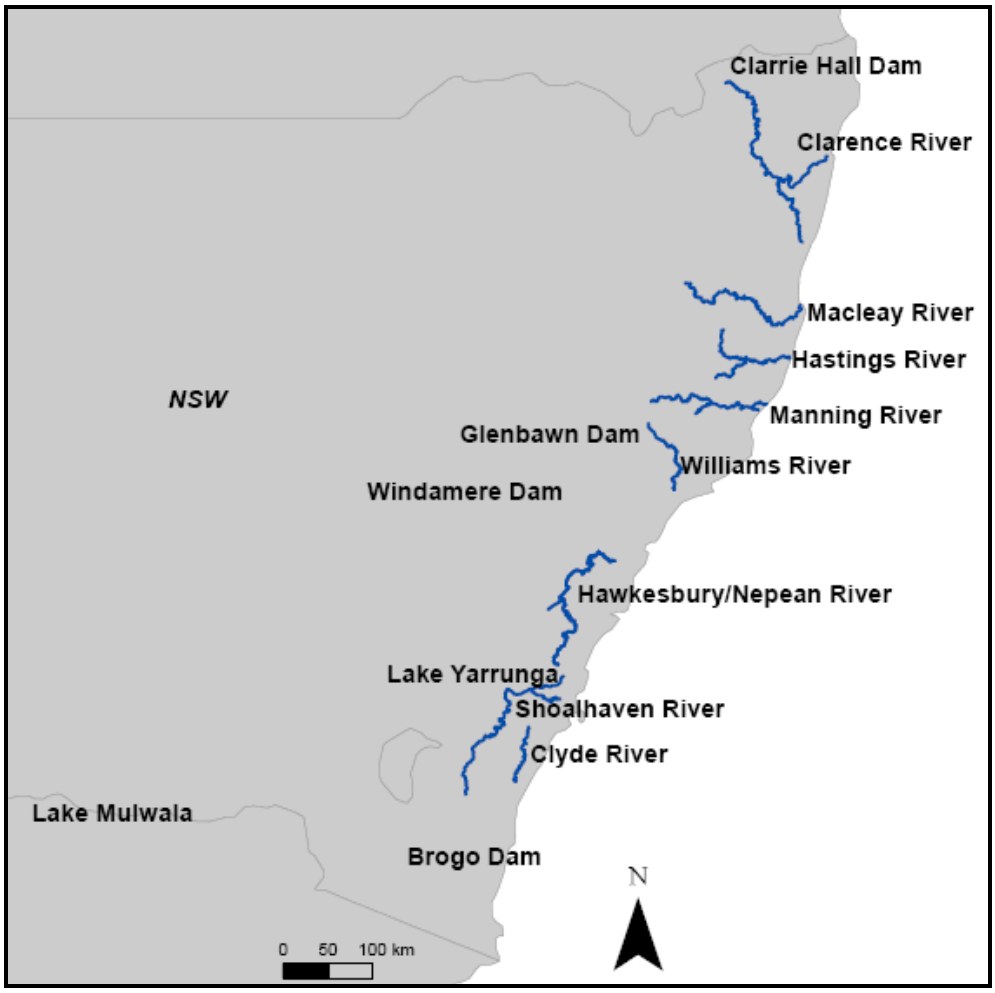
There are no previous reports that document all of these data. This interim report is therefore aimed at presenting an overview of this monitoring work. Graphical representations of catch rates, size statistics and size compositions are provided. Detailed interpretations of these data will be presented in future reports.

2. SUMMARY OF DATA

The current monitoring program collects data from at least eleven bass fishing events each fiscal year, conducted in eight river systems in NSW - the Clarence, Hastings, Macleay, Manning, Williams, Hawkesbury-Nepean, Shoalhaven and Clyde Rivers (Map 1). The fishing effort of participating bass anglers at these events has resulted in a total catch of about 45 000 native fish that were all measured and released. This included about 44 000 Australian bass *Macquaria novemaculeata* as well as other fish species such as estuary perch *Macquaria colonorum*, bream *Acanthopagrus spp*., tailor *Pomatomus saltatrix*, freshwater catfish *Tandanus tandanus* and freshwater herring *Potamalosa richmondia*.

Data are also currently collected from fishing events held at six NSW impoundments that include: Glenbawn Dam, Windamere Dam, Brogo Dam, Lake Mulwala, Tallowa Dam (Lake Yarrunga) and Clarrie Hall Dam (Map 1). The fishing effort of participating anglers in these impoundment events has resulted in the catch of about 14 000 fish that were all measured and released. This included about 11 100 Australian bass, 1600 golden perch *Macquaria ambigua* and 900 Murray cod *Maccullochella peelii* as well as other fish species such as silver perch *Bidyanus bidyanus*, freshwater catfish, European carp *Cyprinus carpio*, redfin *Perca fluviatilis* and rainbow trout *Oncorhynchus mykiss*.

A summary of data for these river and impoundment events, including catch rate, size statistics and size composition graphs, are provided in this report. Other information is also presented to accompany these data, including the history of fish stocked (if any) in each waterway and the average annual rainfall for each event location. Detailed interpretations of these data will be provided in future project reports.



Map 1. NSW rivers and impoundments where events in the current monitoring program are held.

3. OVERVIEW OF RIVER-BASED DATA

These data demonstrate differences in fishing outcomes between years and between rivers. Some rivers appear to have larger numbers and a wider size range of Australian bass available to the fishery. These rivers provide good fishing quality and a resilient fish population. Other rivers appear to have lower numbers and a wider size range of Australian bass. These areas provide lower fishing quality in terms of fish numbers, but may provide better fishing quality in terms of the size of fish available. Some rivers appear to have relatively high numbers of bass but the fish have a smaller size range. Bass populations with either a low abundance or a small size range are not likely to be as resilient to recruitment variability.

A contrasting example of bass populations is shown in the data from the Macleay and Manning Rivers (Table 1). In the Macleay River, catch rates are relatively high and there is a good size range of fish. The Macleay River also has the largest size range with overall minimum and maximum fork lengths of 40mm and 570mm, respectively (Table 1). The Manning River has the lowest overall average catch rate (indicating smaller numbers of bass available to the fishery) yet still has a good size range, with overall minimum and maximum fork lengths of 80mm and 580mm, respectively (Table 1).

It is interesting to compare these two rivers as they have very different flow regimes. The Macleay is an unregulated river while the Manning River has several causeways that can inhibit fish passage, particularly during periods of low rainfall. This highlights the potential impact that fish barriers and environmental variables (such as rainfall) can have on fish populations.

Table 1. Between river comparisons of Australian bass size ranges and catch rates. The minimum and maximum fork lengths (mm) and catch rates (number of fish per fisher hour) are presented for each river system. Indictors of between river differences include the difference between the maximum and minimum fork length and the overall average catch rate for each river.

	BETWEEN RIVER COMPARISONS OF AUSTRALIAN BASS SIZE RANGES AND CATCH RATES					
	Fork length (mm)			CPUE (fish/hr)		
River	Minimum	Maximum	Maximum - Minimum	Minimum	Maximum	Average
Clarence	75	510	435	0.04	1.25	0.40
Macleay	40	570	530	0.52	1.48	0.89
Hastings	70	495	425	0.28	1.15	0.71
Manning	80	580	500	0.02	1.33	0.34
Williams	40	510	470	0.08	2.91	1.34
Hawkesbury/Nepean	30	480	450	0.16	3.72	1.20
Shoalhaven	56	450	394	0.03	0.91	0.42
Clyde	80	440	360	0.14	1.37	0.63

There are indications that the catch rates and, by inference, the population size of the Australian bass population in the Manning River has increased over time. In the mid-1990's recruitment failures in the Manning River were apparent, as indicated by low catch rates and nil catch of juvenile bass (Figures 16 & 17). There are now indications of improved Australian bass recruitment with young-of-the-year bass being caught during many events since October 2001 (Figure 21 & 22). Catch rates have also increased since that time. Furthermore, in 2007 the average monthly rainfall increased significantly (Figure 19). This coincided with an influx of new recruits as many young-of-the-year Australian bass were caught during Bass Catch events in that year (Figure 22).

These trends observed in the Manning River demonstrate that these data can provide useful indicators of the status of the Australian bass population in that river. Inferences can also be made about the effect of environmental variables such as river flows and rainfall and how they may influence the Australian bass populations and any associated fisheries. More detailed analyses could be done in the future to assess these relationships. These investigations could be done using river or impoundment-based competition data.

Previous analyses using Bass Catch data are available in two published journal articles by Growns and James (2005) and Van der Walt *et al.* (2005). These articles are available upon request Danielle.ghosn@industry.nsw.gov.au or (02) 9527 8549 or Danielle Ghosn, I&I NSW, PO Box 21, Cronulla NSW 2230.

4. CONCLUSIONS AND FUTURE WORK

What these data demonstrate is that the Catch Card Angler Return System is a method that has the ability to provide information for the assessment of native fish stocks. Size composition data are particularly useful in assessing recruitment pulses and the survival of certain cohorts. These size compositions may also provide indicators of stocking success in some impoundments. Catch rates and size statistics are useful as indicators of fishing quality.

Catch rates may be influenced by various factors such as (but not limited to) environmental conditions, fishing methods, fishing gears and angler skill. To improve the usefulness of these catch rates as indices of abundance, future work needs to focus on the inclusion of these types of factors within standardisations of catch rates i.e. removing the influence of these variables on those catch rates. This may require additional surveys of past and current participating anglers to document some of the changes in fishing gears and methods used over the study period. Information that is currently collected that will assist catch rate standardisation includes fishing methods, lure types, river reaches fished and angler avidity.

To improve the use of catch rates as indicators of fishing quality, additional calculations also need to be done. The catch rates presented in this report were calculated as the total number of fish divided by the total number of fisher hours (known as the ratio of the means estimator). A different method that could be used would be to calculate a catch rate for each trip (as the number of fish divided by the number of fisher hours) and then the average of all these individual trip catch rates (known as the mean of the ratios estimator). It is suggested in Pollock *et al* (1997) that the mean of the ratios estimator provides a more robust indicator for assessing changes in fishing quality through time.

An ongoing focus of this research project is to increase participation rates in Bass Catch events, particularly where the number of participating anglers is too small. A participation increase would enable a greater spread of anglers throughout the river system. Data would be more representative of the river system as a whole and indicators of fishing quality, fish abundance and size structures would be more robust. Over the past two years of monitoring, there have been concerted efforts to improve the spread of anglers across the river reaches in each system. More detailed analyses of these data by each river reach will be provided in future reports.

The data set of this monitoring program is one of very few long-term sources of information that can be used to manage Australian bass populations in NSW. Continuation of this program into the future is thus important. Collection of data over the next few years will need to continue to focus on data quality to ensure the best outcomes from this research project. More detailed analyses using these data could provide a greater understanding of which characteristics represent healthy bass populations in NSW and how the recreational Australian bass fishery could be best managed in the future.

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Van der Walt, B., Faragher, R.A. and Harris, J. (2005) Comparative angler catches of Australian bass (*Macquaria novemavuleata*) in three major river systems in New South Wales, Australia. *Asian Fisheries Science* **18**, 175-193.

Williams, D.L. and Scandol, J.P. (2008) 'Review of NSW recreational fishing tournament-based monitoring methods and datasets. Fisheries Final Report Series No. 99.' NSW DPI, Cronulla, NSW Australia.

6. APPENDICES – DATA SUMMARY FIGURES

6.1. NSW Bass Catch river events

6.1.1. Clarence River: Copmanhurst Invitational (Oct-Nov) & Bridge to Bridge Classic (Aug-Sept)

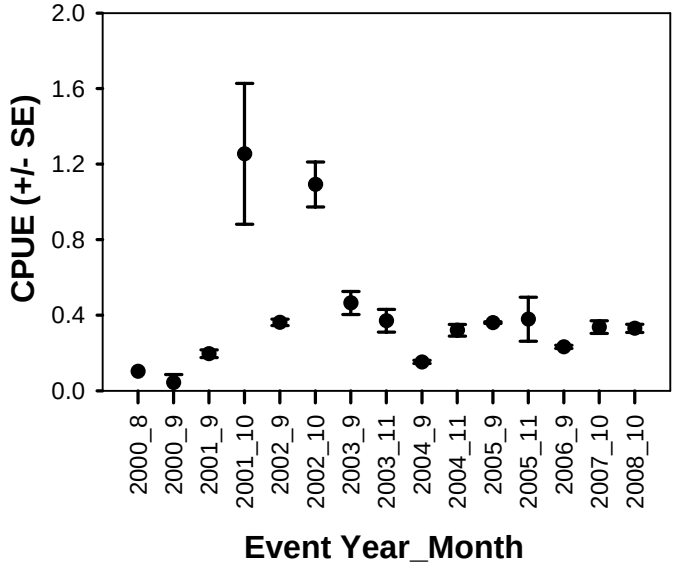

Figure 1. Catch per unit of effort (CPUE) as the number of fish per angler hour (± standard error) of Australian bass for each event over the monitoring period in the Clarence River.

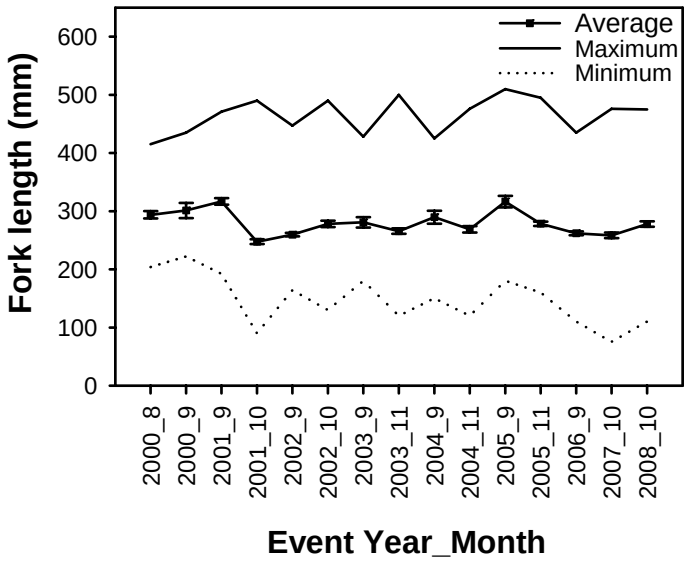

Figure 2. Minimum, maximum and average (± standard error) fork lengths of all Australian bass recorded for each event (year_month) over the monitoring period in the Clarence River.

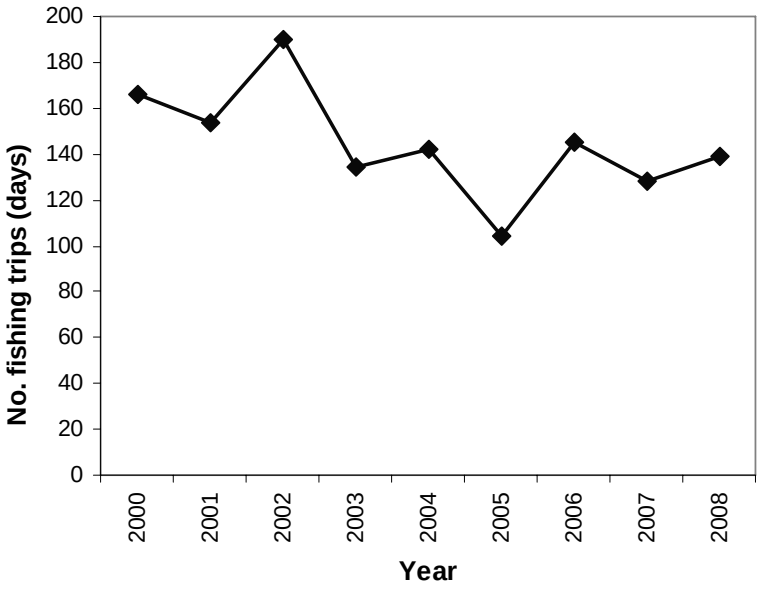

Figure 3. The total number of angler days of fishing recorded during each calendar year for all events monitored in the Clarence River.

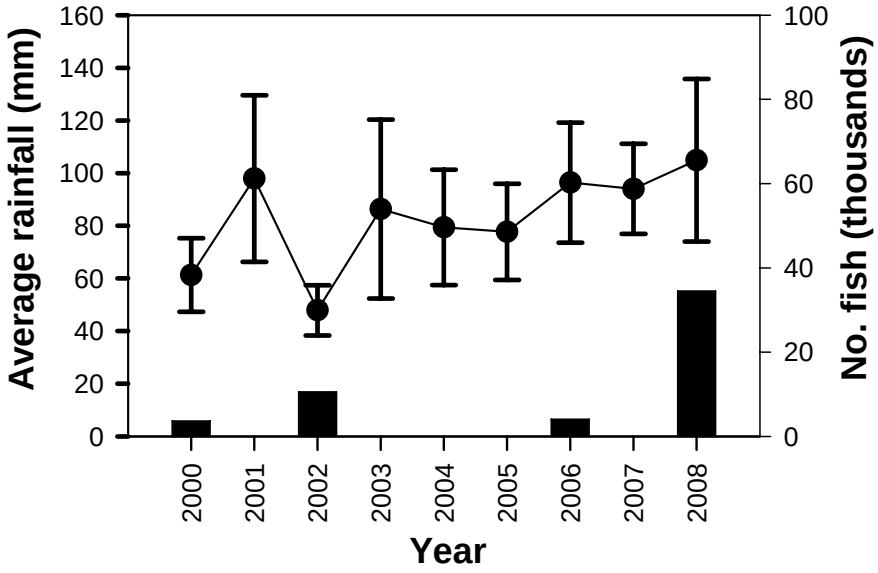

Figure 4. Number of Australian bass stocked and average monthly rainfall for the Clarence River through time. Rainfall data are for Grafton Pool (Clarence) and were obtained from the Bureau of Meteorology station number 058130.

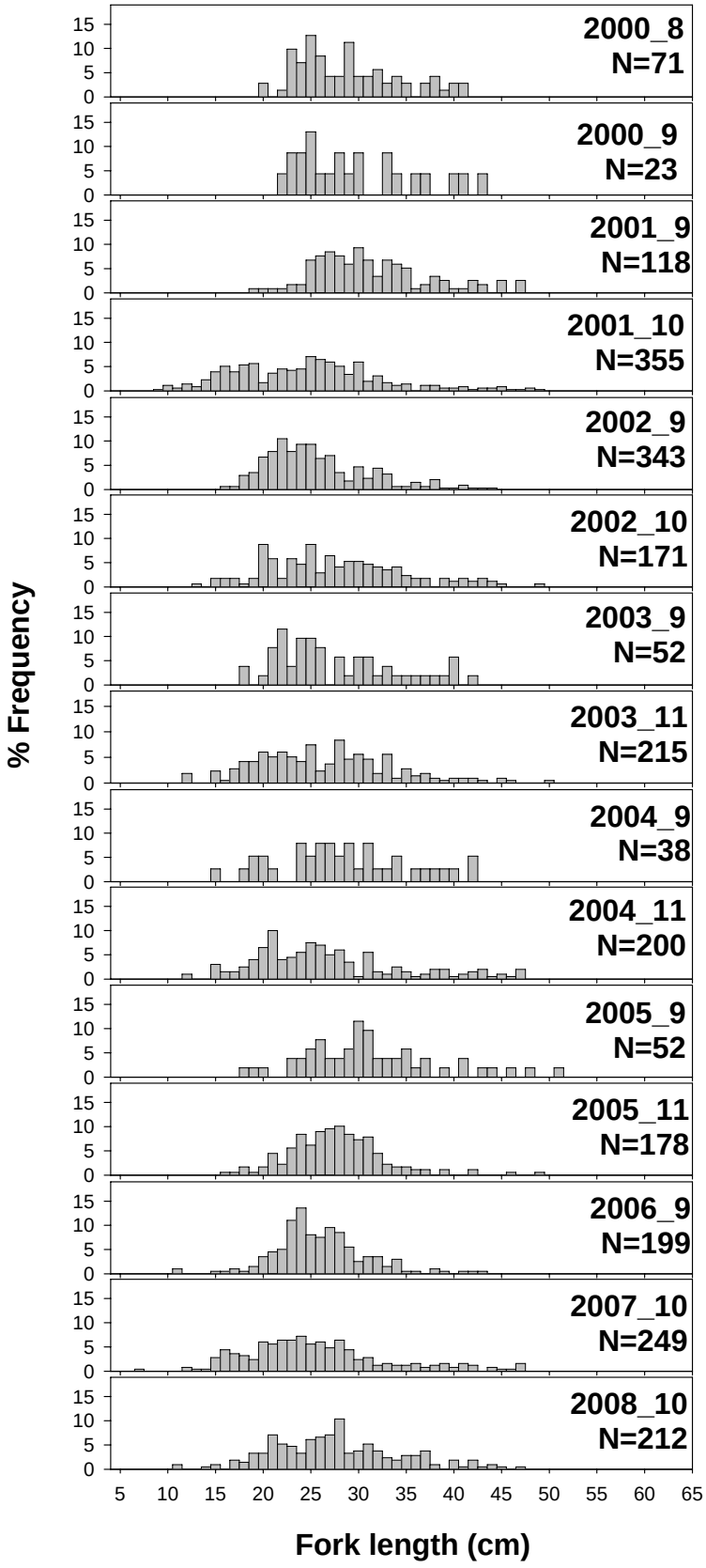

Figure 5. Length frequency compositions of Australian bass recorded for each event (year_month) over the monitoring period in the Clarence River. N equals the total number of fish measured for each event.

6.1.2. Macleay River Bass Catch

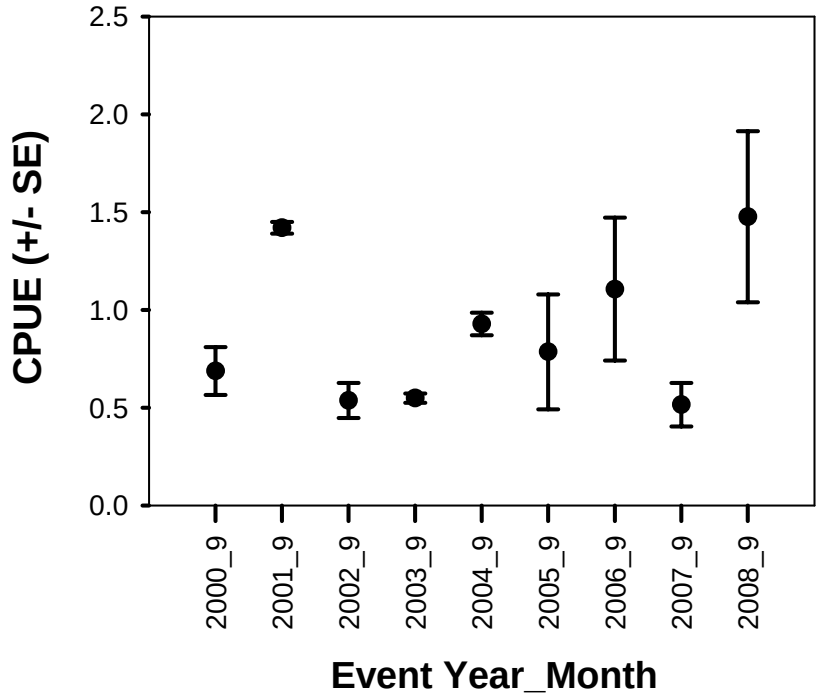

Figure 6. Catch per unit of effort as the number of fish per angler hour (± standard error) of Australian bass for each event over the monitoring period in the Macleay River.

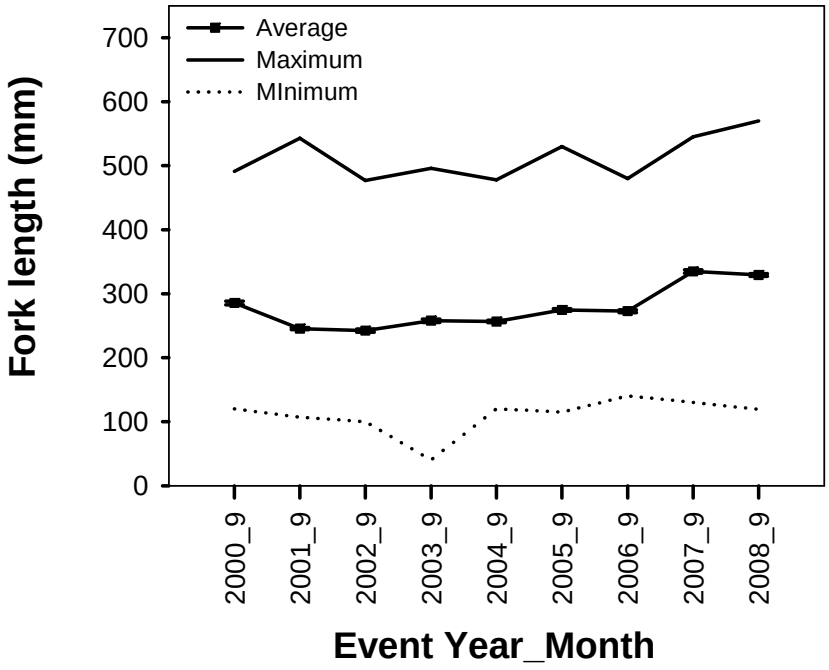

Figure 7. Minimum, maximum and average (± standard error) fork lengths of all Australian bass recorded for each event (year_month) over the monitoring period in the Macleay River.

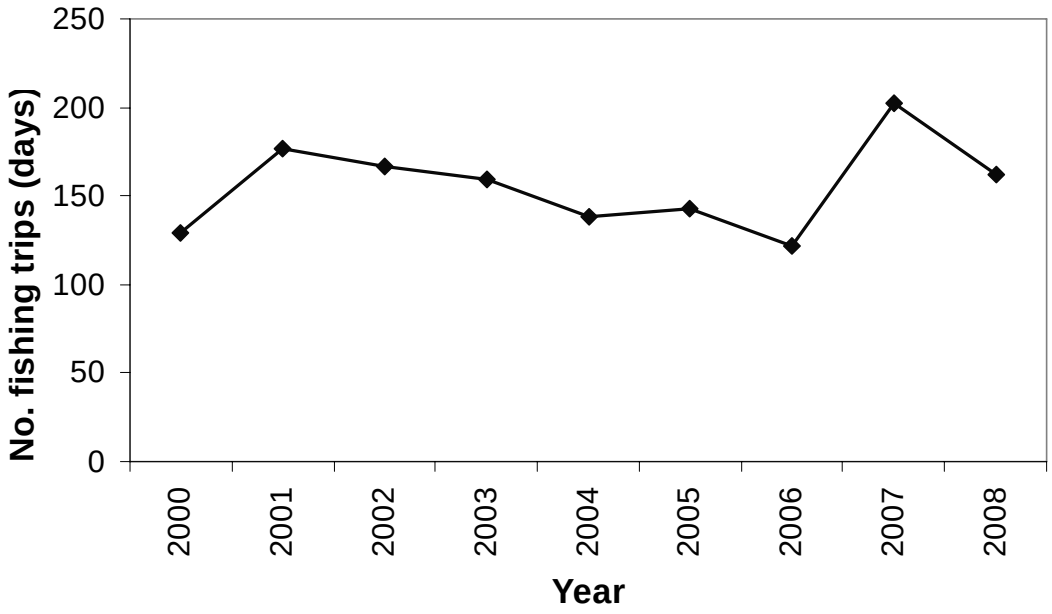

Figure 8. The total number of angler days of fishing recorded during each calendar year for all events monitored in the Macleay River.

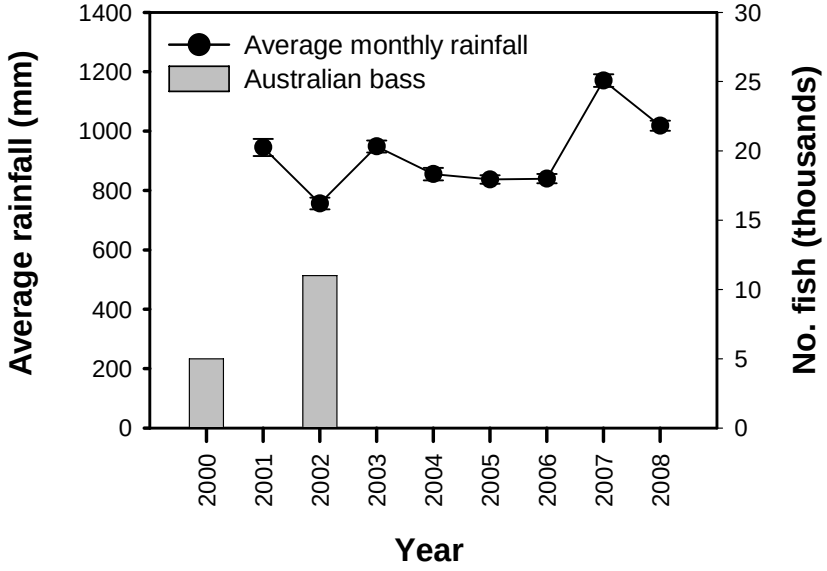

Figure 9. Number of Australian bass stocked and average monthly rainfall for the Macleay River through time. Rainfall data are for Aldavilla (closest station to the Macleay River) and were obtained from the Bureau of Meteorology station number 59135.

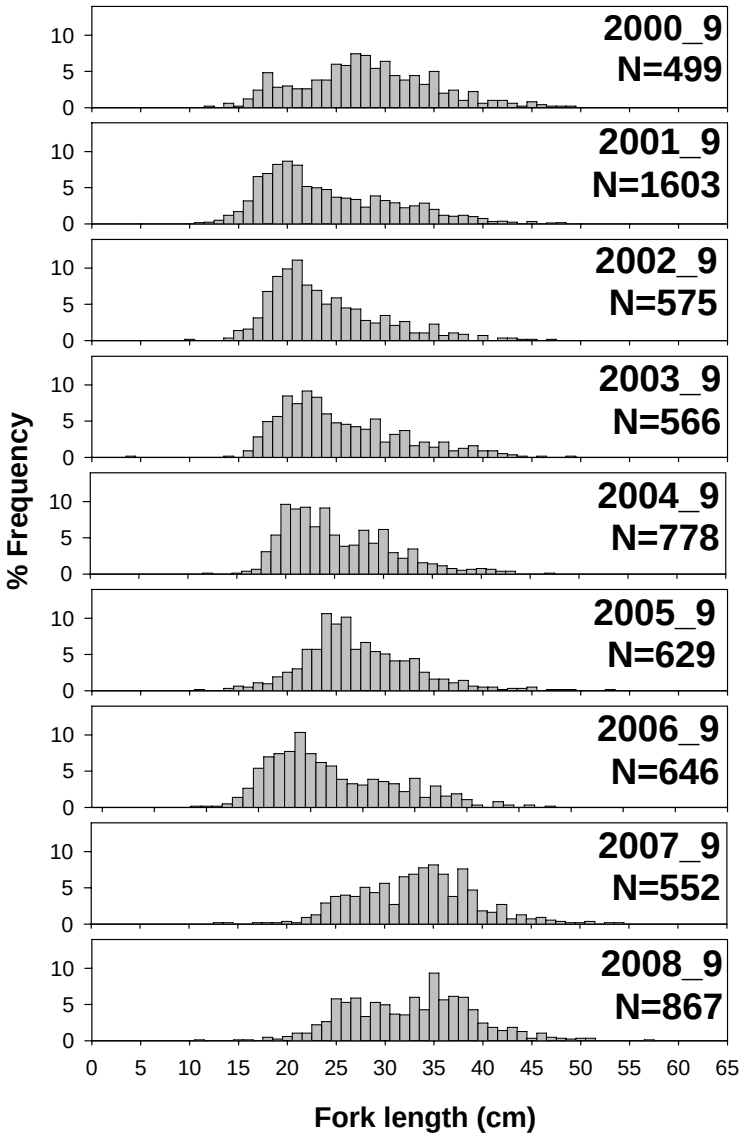

Figure 10. Length frequency compositions of Australian bass recorded for each event (year_month) over the monitoring period in the Macleay River. N equals the total number of fish measured for each event.

6.1.3. Hastings River Bass Catch

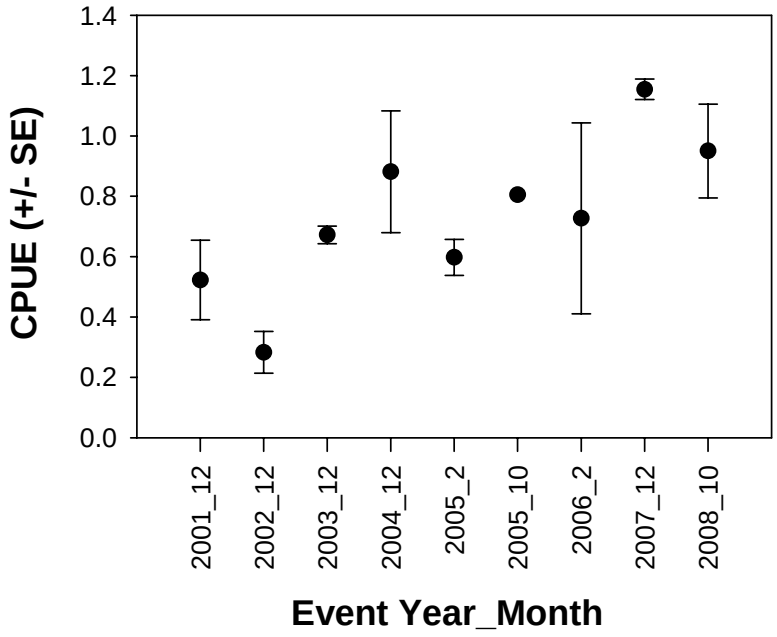

Figure 11. Catch per unit of effort as the number of fish per angler hour (± standard error) of Australian bass for each event over the monitoring period in the Hastings River.

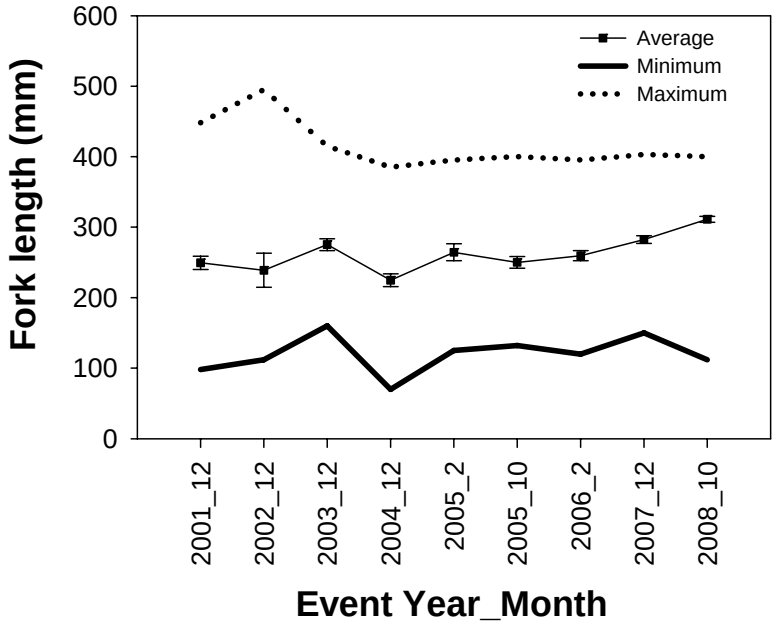

Figure 12. Minimum, maximum and average (± standard error) fork lengths of all Australian bass recorded for each event (year_month) over the monitoring period in the Hastings River.

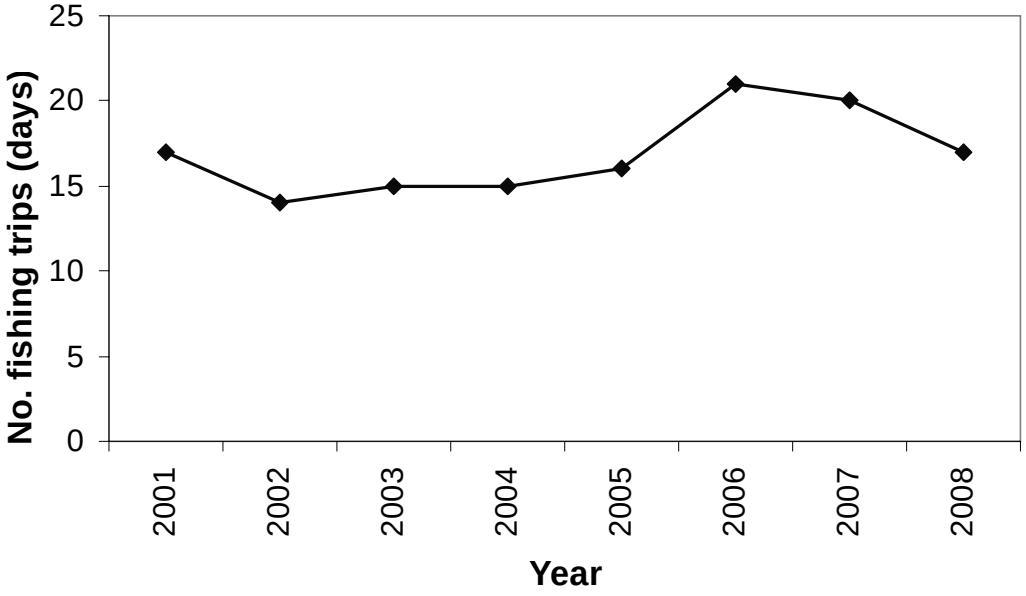

Figure 13. The total number of angler days of fishing recorded during each calendar year for all events monitored in the Hastings River.

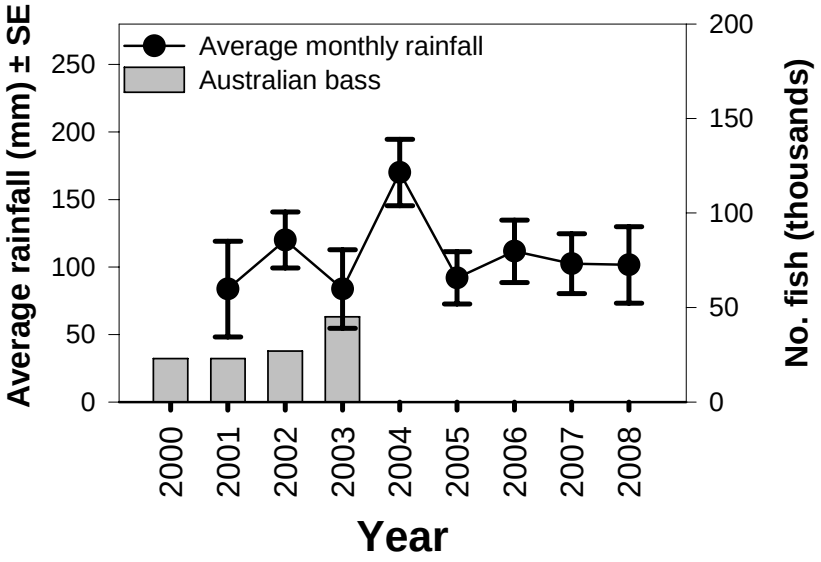

Figure 14. Number of Australian bass stocked and average monthly rainfall for the Hastings River through time. Rainfall data are for Wauchope (closest station to the Hastings River) and were obtained from the Bureau of Meteorology station number 60035.

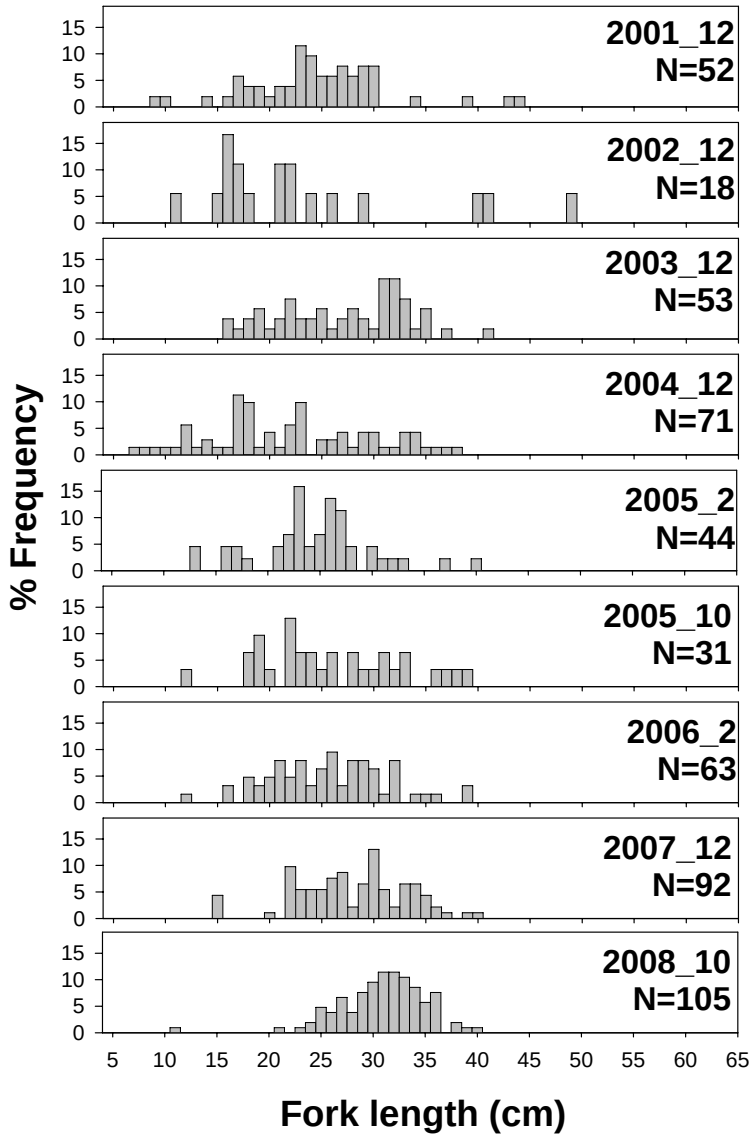

Figure 15. Length frequency compositions of Australian bass recorded for each event (year_month) over the monitoring period in the Hastings River. N equals the total number of fish measured for each event.

6.1.4. Manning River Bass Catch

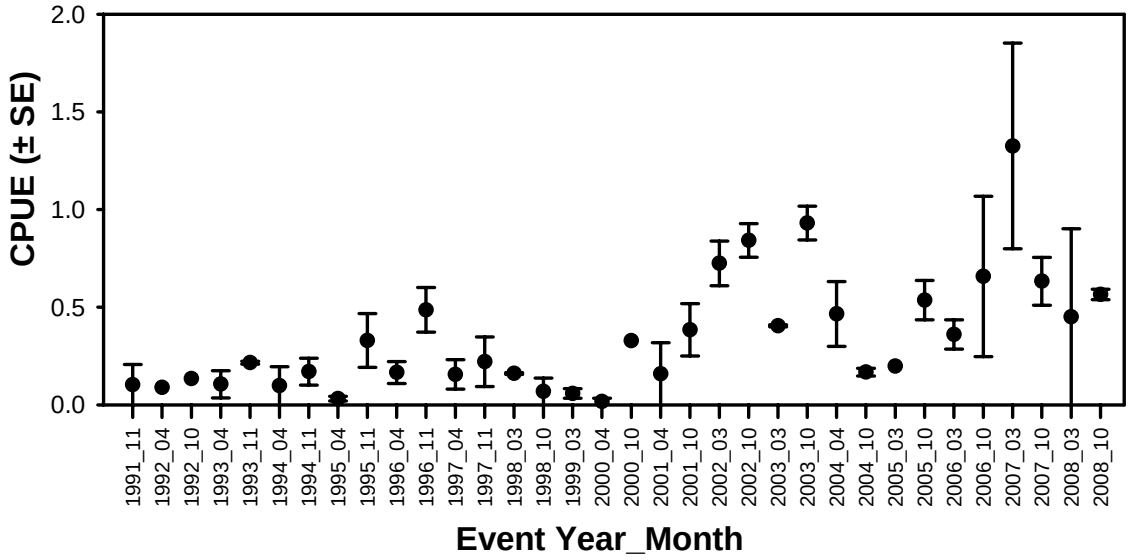

Figure 16. Catch per unit of effort as the number of fish per angler hour (± standard error) of Australian bass for each event over the monitoring period in the Manning River.

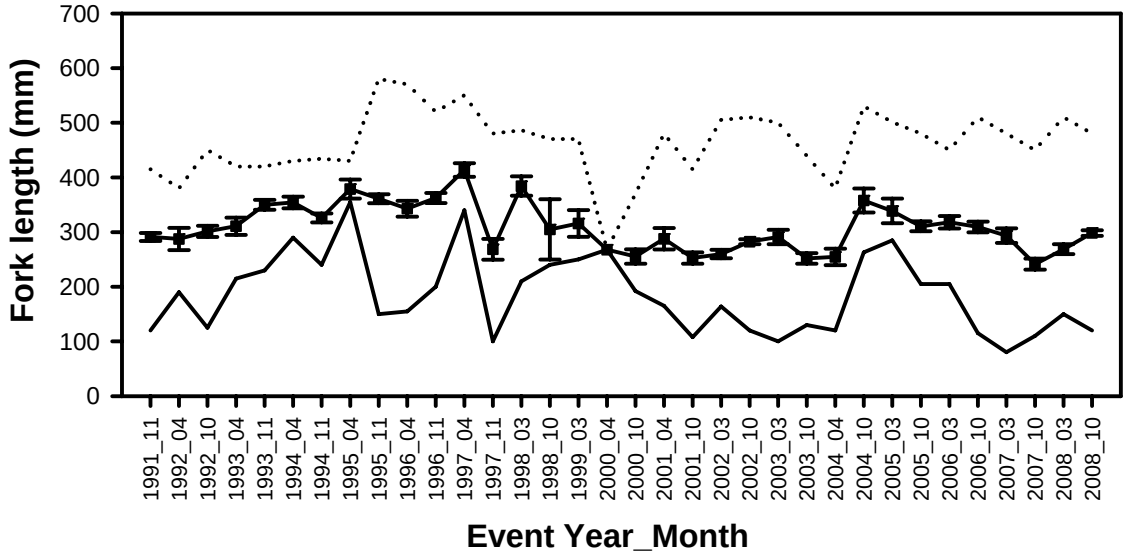

Figure 17. Minimum, maximum and average (± standard error) fork lengths of all Australian bass recorded for each event (year_month) over the monitoring period in the Macleay River.

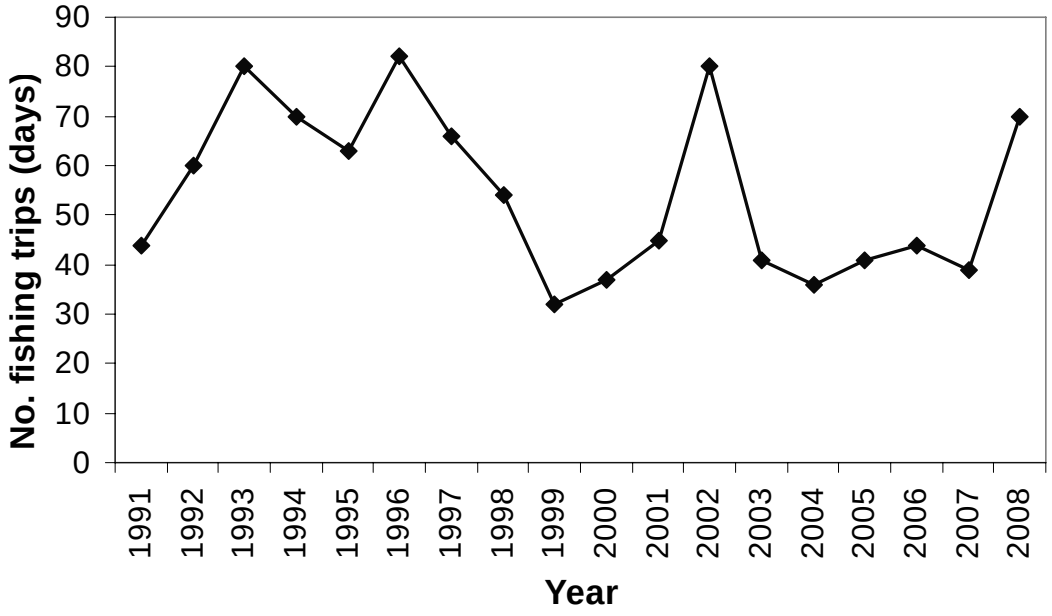

Figure 18. The total number of angler days of fishing recorded during each calendar year for all events monitored in the Manning River.

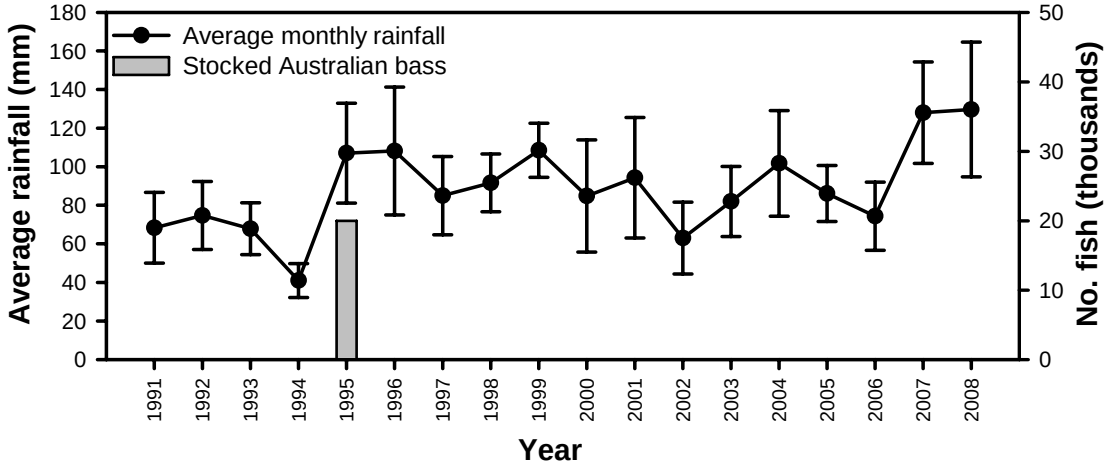

Figure 19. Number of Australian bass stocked and average monthly rainfall for the Manning River through time. Rainfall data are for Wingham (Lanark CLS) and were obtained from the Bureau of Meteorology station number 060036.

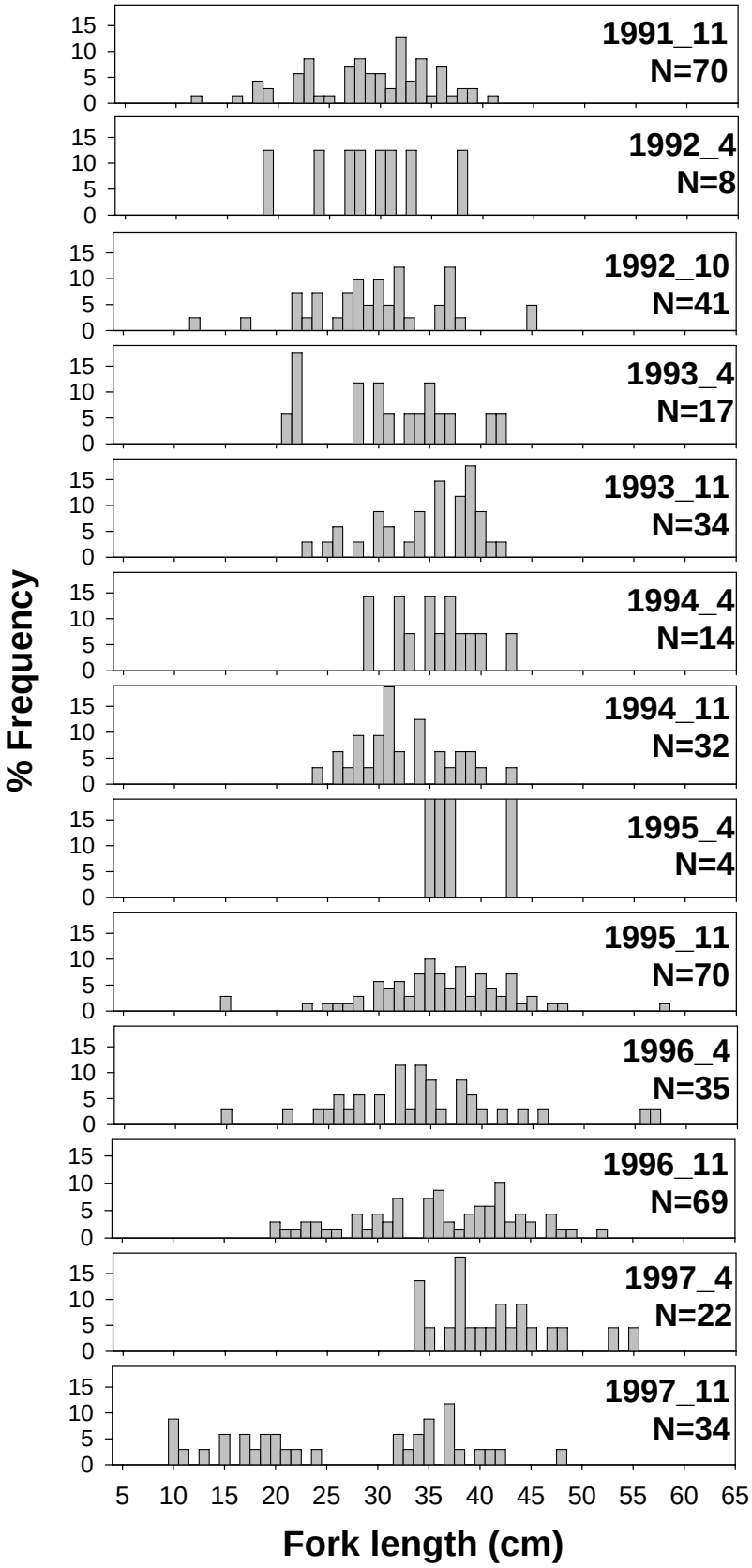

Figure 20. Length frequency compositions of Australian bass recorded for each event (year_month) over part of the monitoring period (1991-1997) in the Manning River. N equals the total number of fish measured for each event.

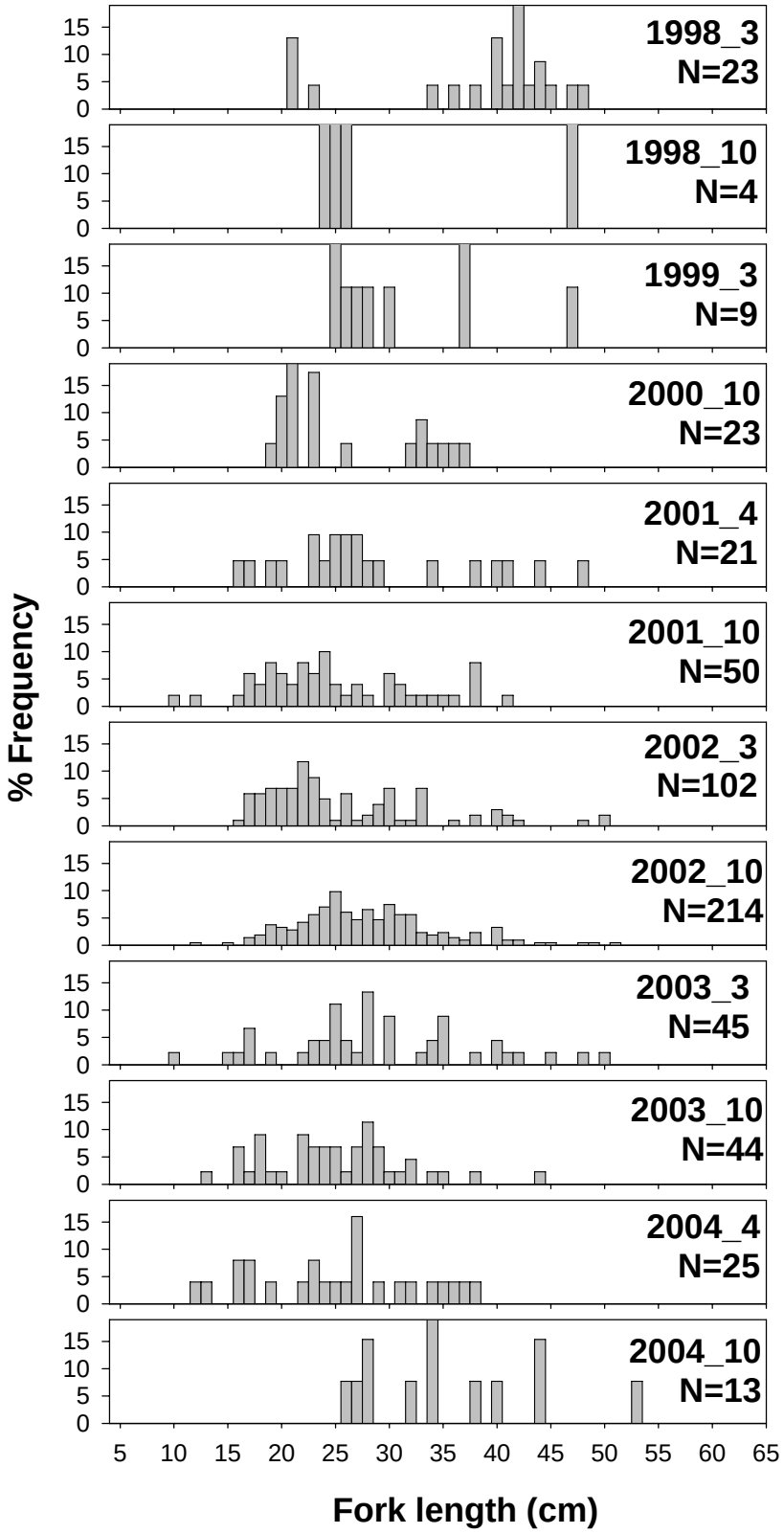

Figure 21. Length frequency compositions of Australian bass recorded for each event (year_month) over part of the monitoring period (1998-2004) in the Manning River. N equals the total number of fish measured for each event.

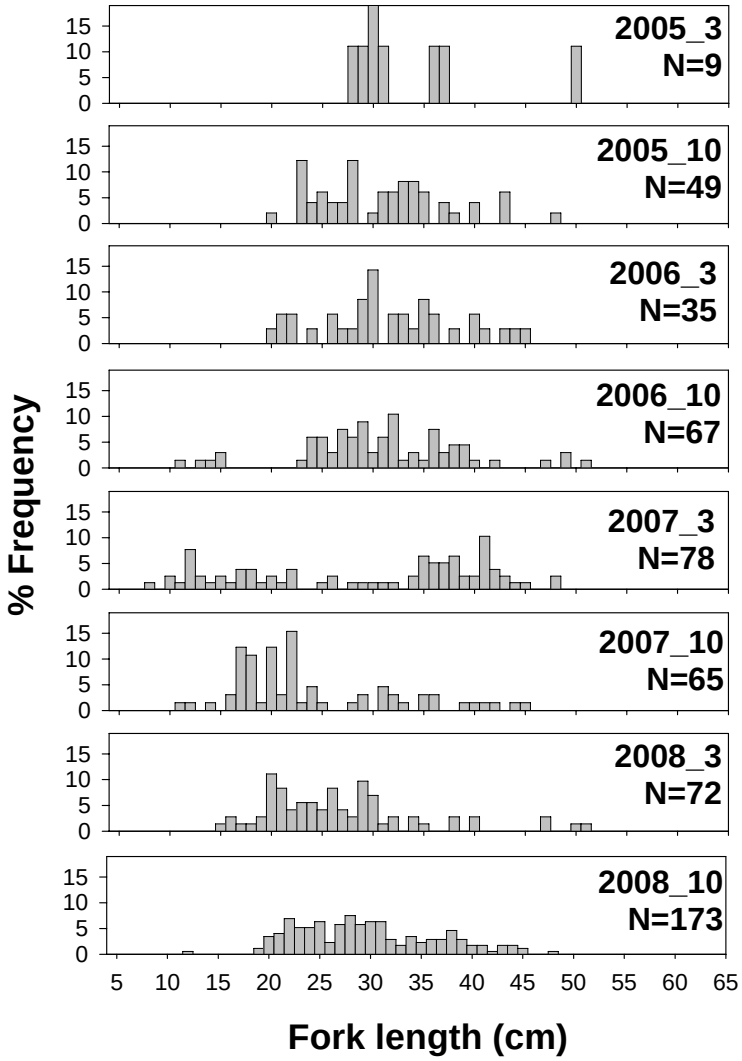

Figure 22. Length frequency compositions of Australian bass recorded for each event (year_month) over part of the monitoring period (2005-2008) in the Manning River. N equals the total number of fish measured for each event.

6.1.5. Williams River Bass Catch

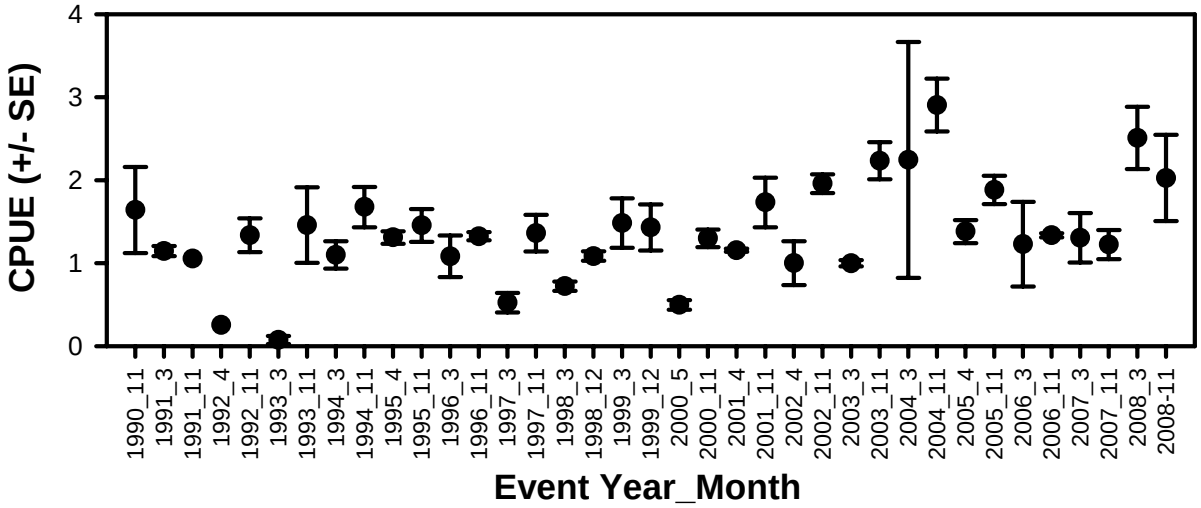

Figure 23. Catch per unit of effort as the number of fish per angler hour (± standard error) of Australian bass for each event over the monitoring period in the Williams River.

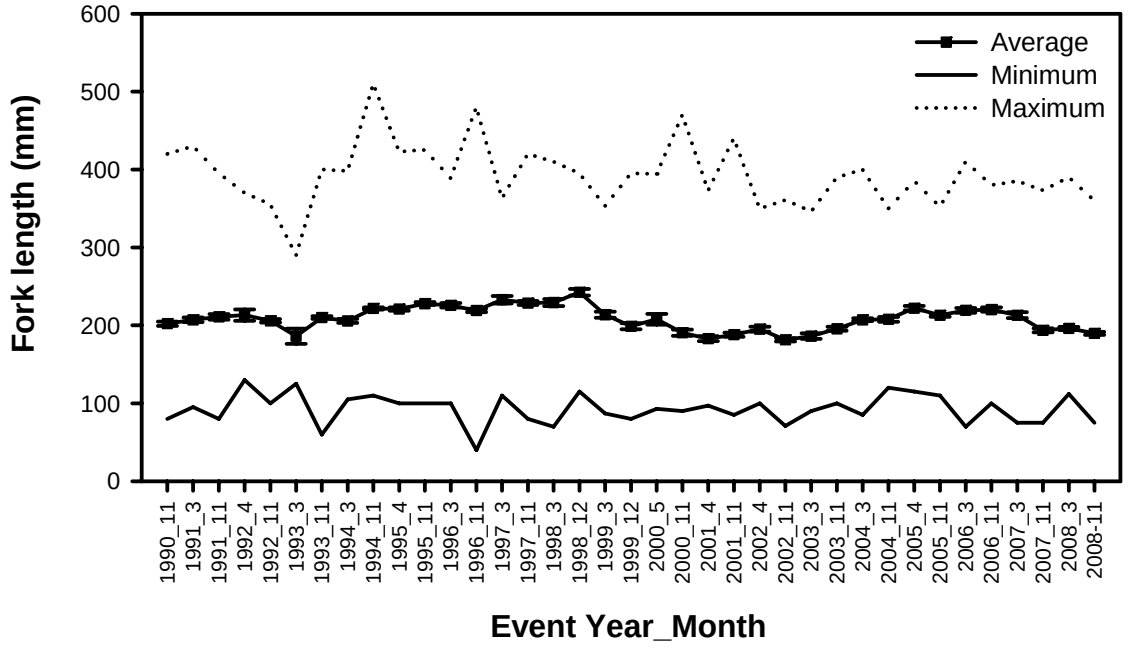

Figure 24. Minimum, maximum and average (± standard error) fork lengths of all Australian bass recorded for each event (year_month) over the monitoring period in the Williams River.

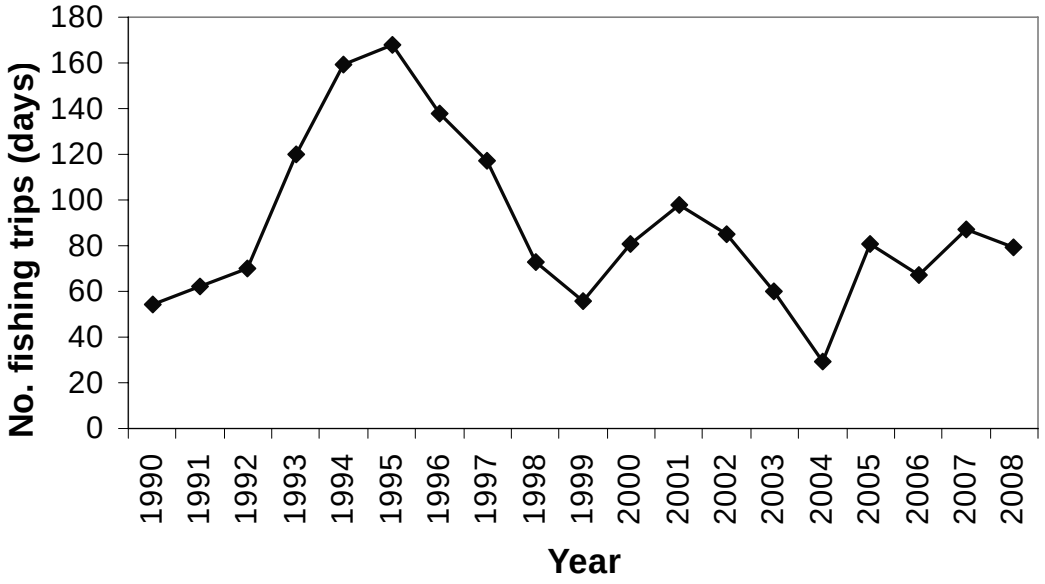

Figure 25. The total number of angler days of fishing recorded during each calendar year for all events monitored in the Williams River.

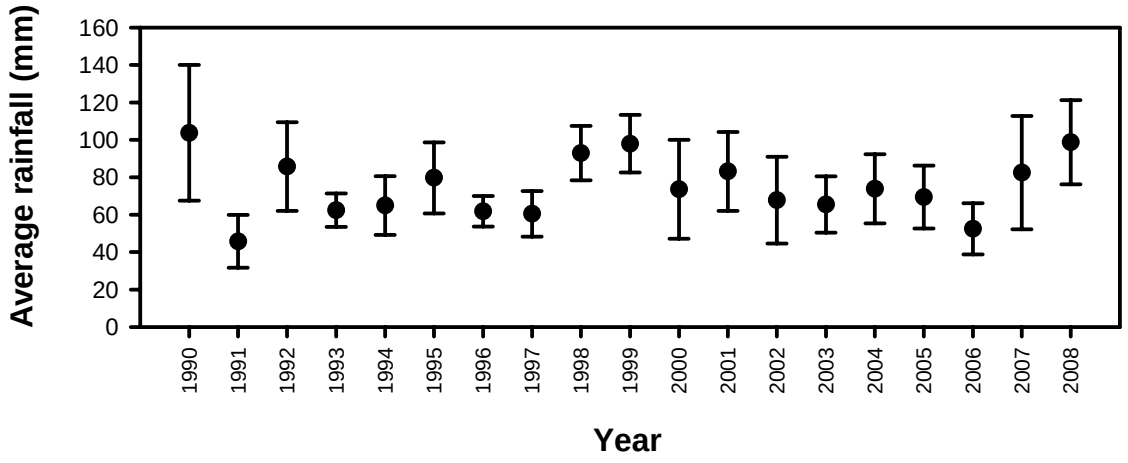

Figure 26. Average monthly rainfall for the Williams River through time. Rainfall data are for Patterson (Tocal AWS) (closest station to the Williams River) and were obtained from the Bureau of Meteorology station number 061250. Please note that there are no records of stocking of Australian bass in the Williams River.

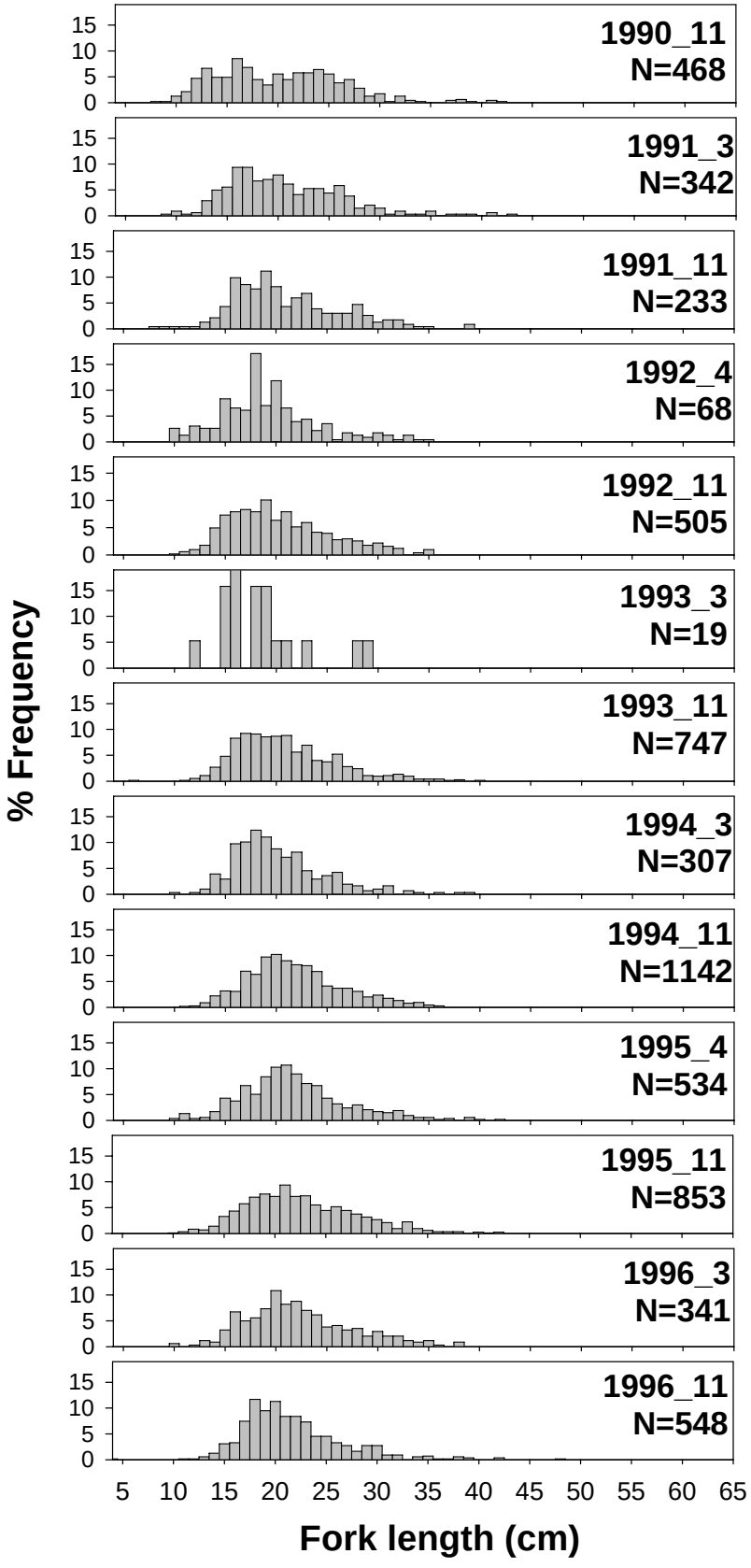

Figure 27. Length frequency compositions of Australian bass recorded for each event (year_month) over part of the monitoring period (1990-1996) in the Williams River. N equals the total number of fish measured for each event.

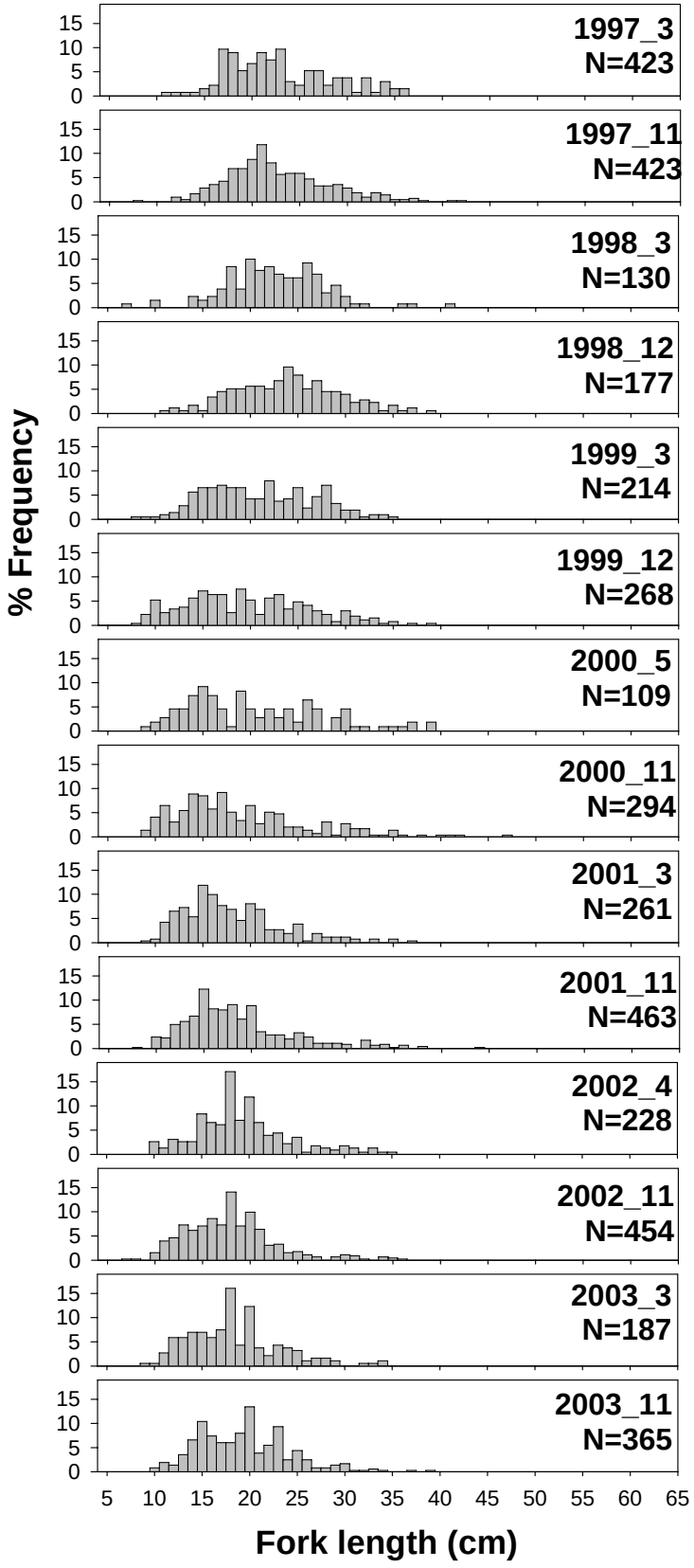

Figure 28. Length frequency compositions of Australian bass recorded for each event (year_month) over part of the monitoring period (1997-2003) in the Williams River. N equals the total number of fish measured for each event.

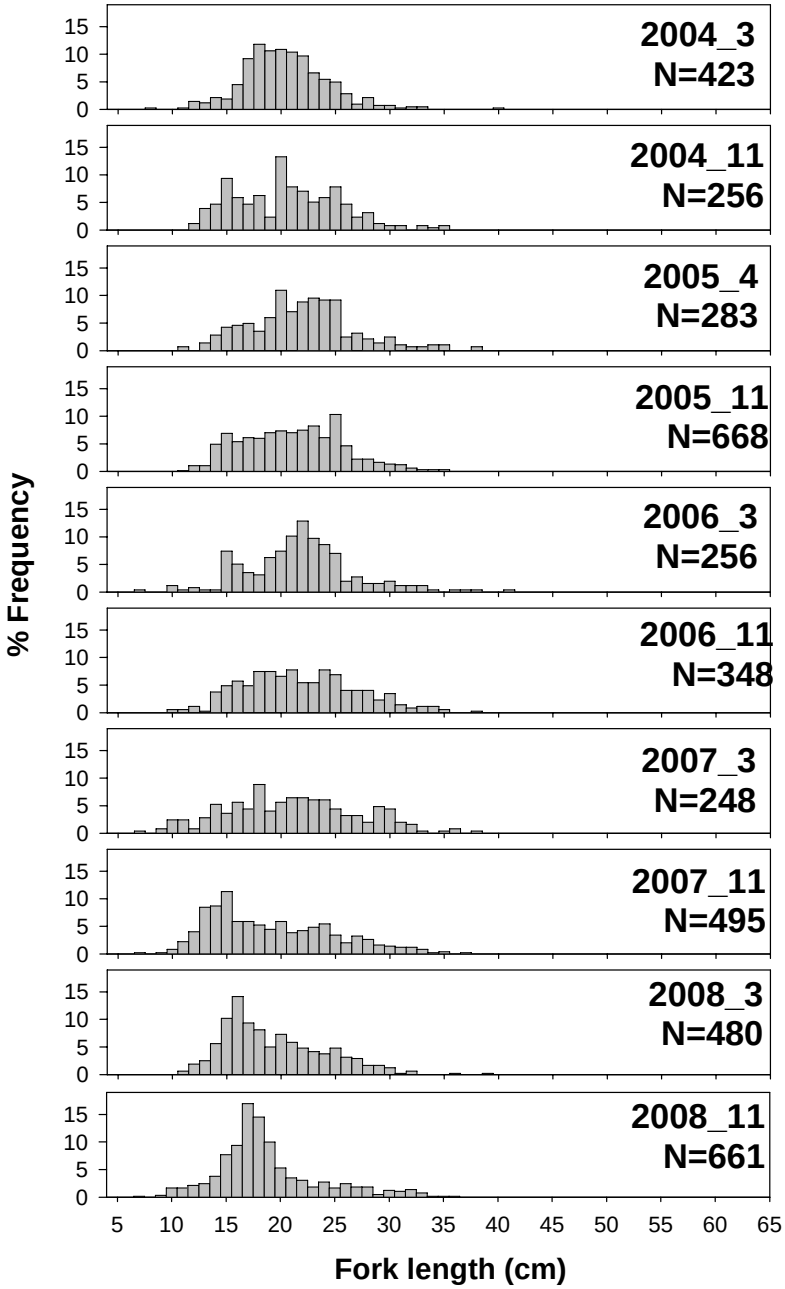

Figure 29. Length frequency compositions of Australian bass recorded for each event (year_month) over part of the monitoring period (2004-2008) in the Williams River. N equals the total number of fish measured for each event.

6.1.6. Hawkesbury-Nepean River Bass Catch

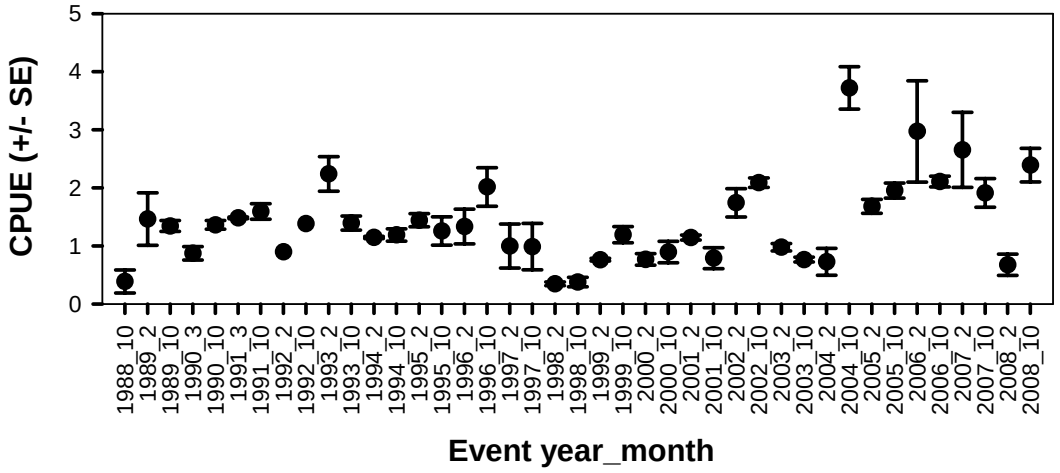

Figure 30. Catch per unit of effort as the number of fish per angler hour (± standard error) of Australian bass for each event of the Hawkesbury-Nepean River Bass Catch over the monitoring period.

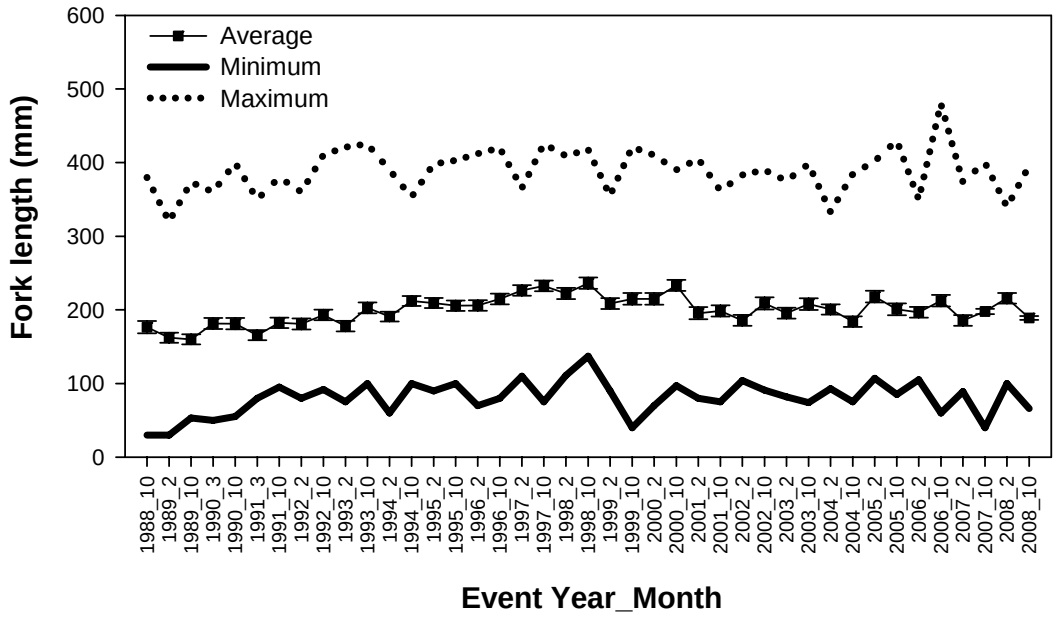

Figure 31. Minimum, maximum and average (± standard error) fork lengths of all Australian bass recorded for each event of the Hawkesbury-Nepean River Bass Catch (year_month) over the monitoring period.

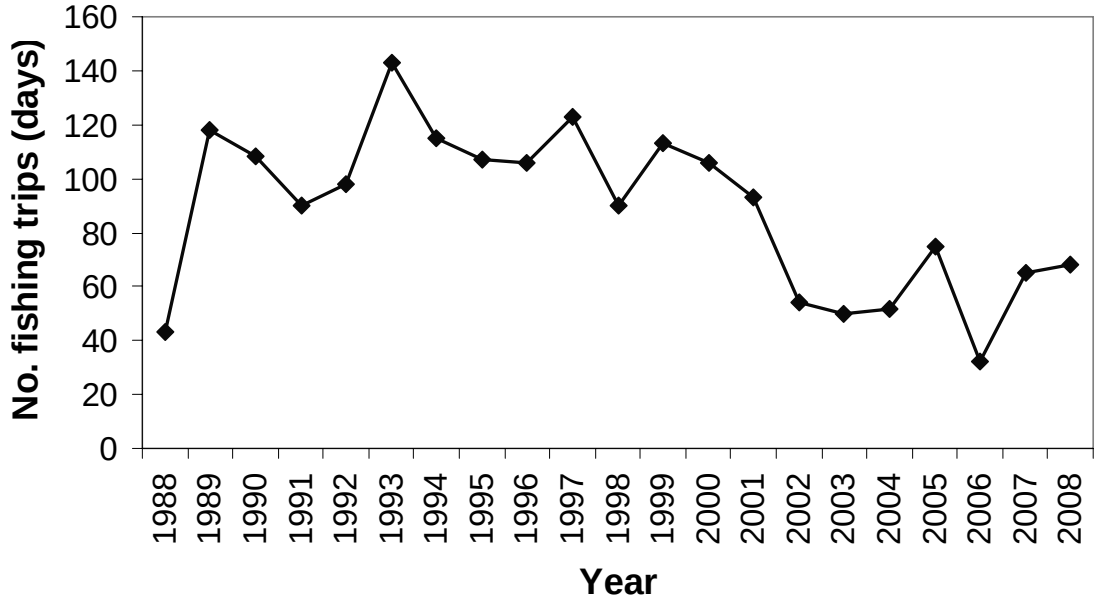

Figure 32. The total number of angler days of fishing recorded during each calendar year for the Hawkesbury-Nepean River Bass Catch.

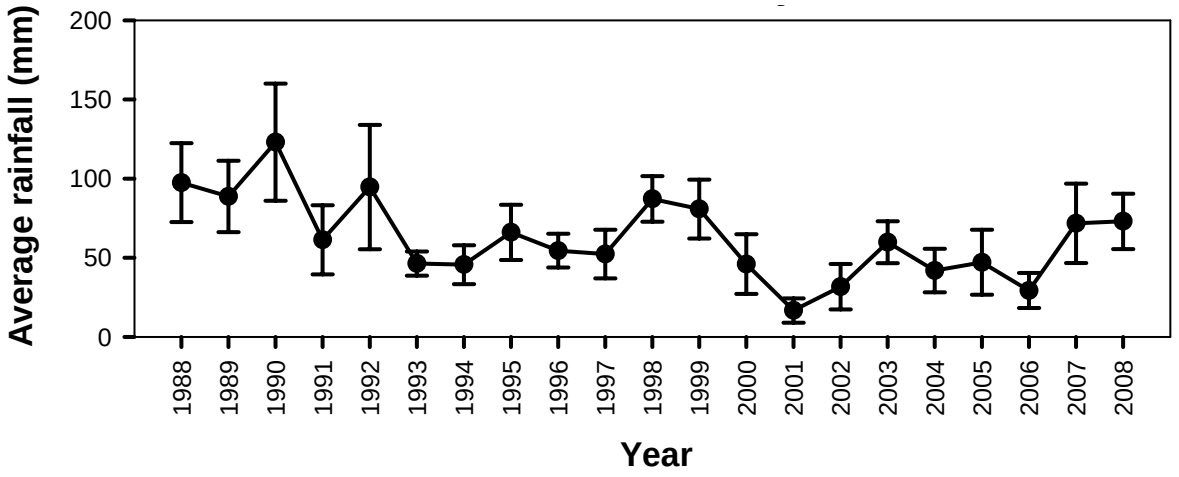

Figure 33. Average monthly rainfall for the Nepean River through time. Rainfall data are for Castlereagh Road (closest station to the Nepean River) and were obtained from the Bureau of Meteorology station number 067002. Please note that there are no records of stocking of Australian bass in the Nepean River.

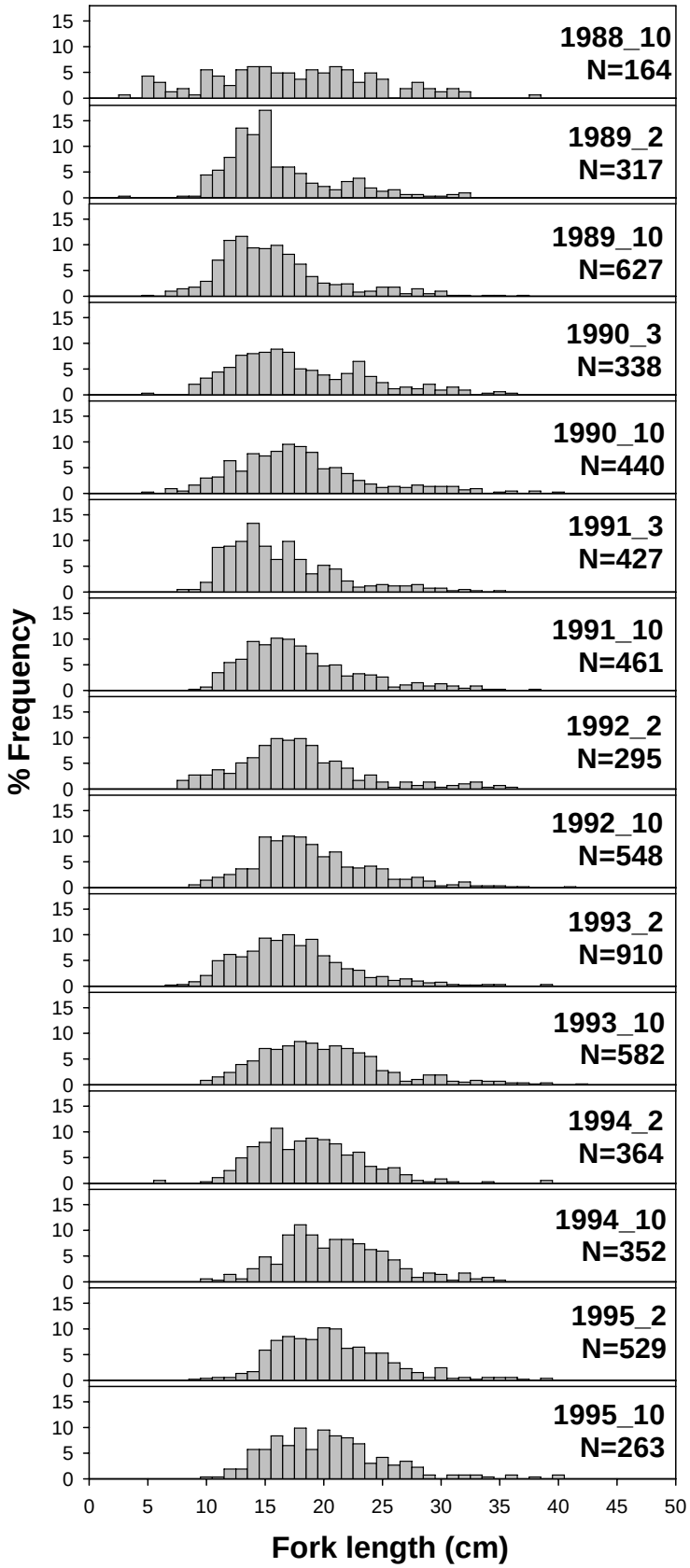

Figure 34. Length frequency compositions of Australian bass recorded for each event of the Hawkesbury-Nepean River Bass Catch (year_month) over part of the monitoring period (1988-1995). N equals the total number of fish measured for each event.

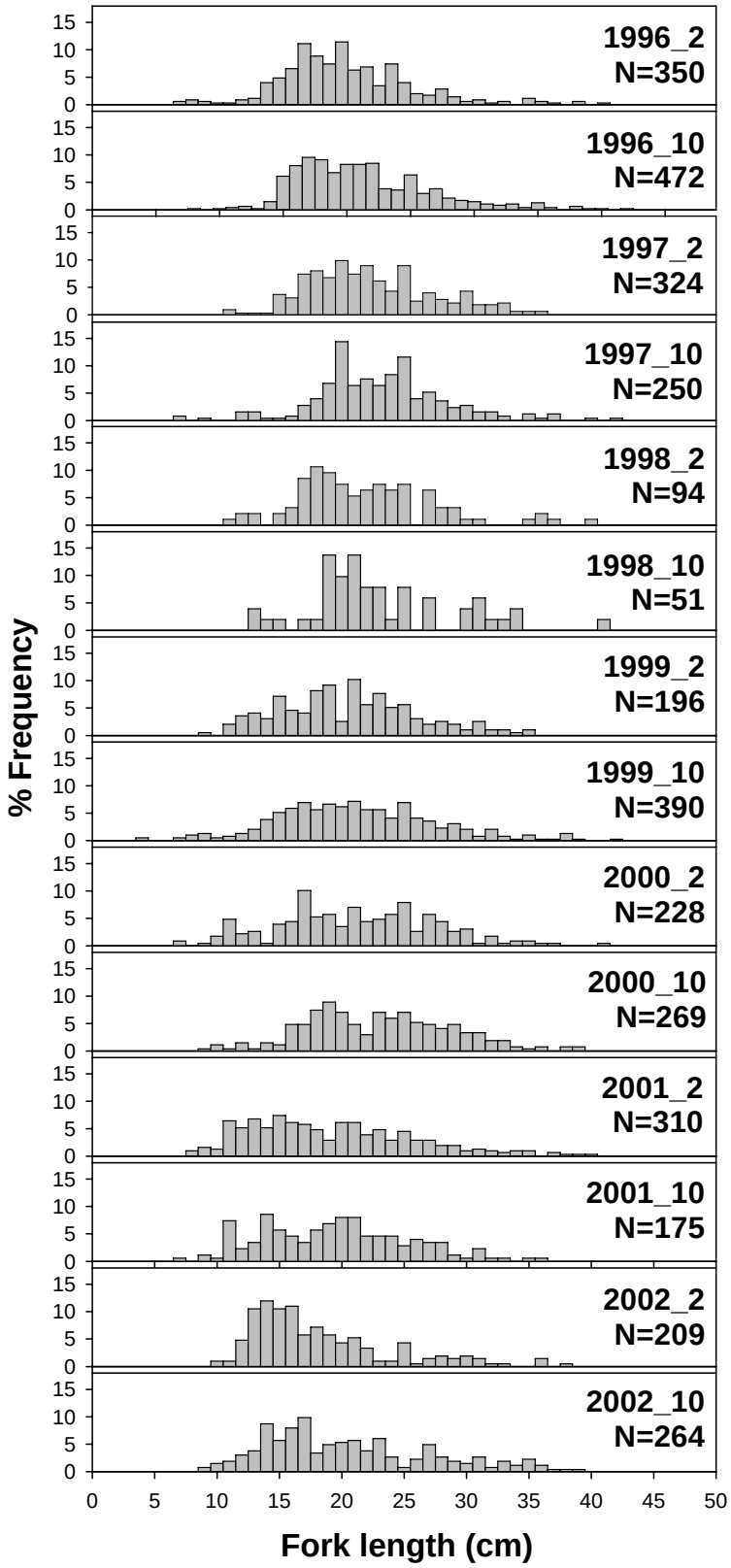

Figure 35. Length frequency compositions of Australian bass recorded for each event of the Hawkesbury-Nepean River Bass Catch (year_month) over part of the monitoring period (1996-2002). N equals the total number of fish measured for each event.

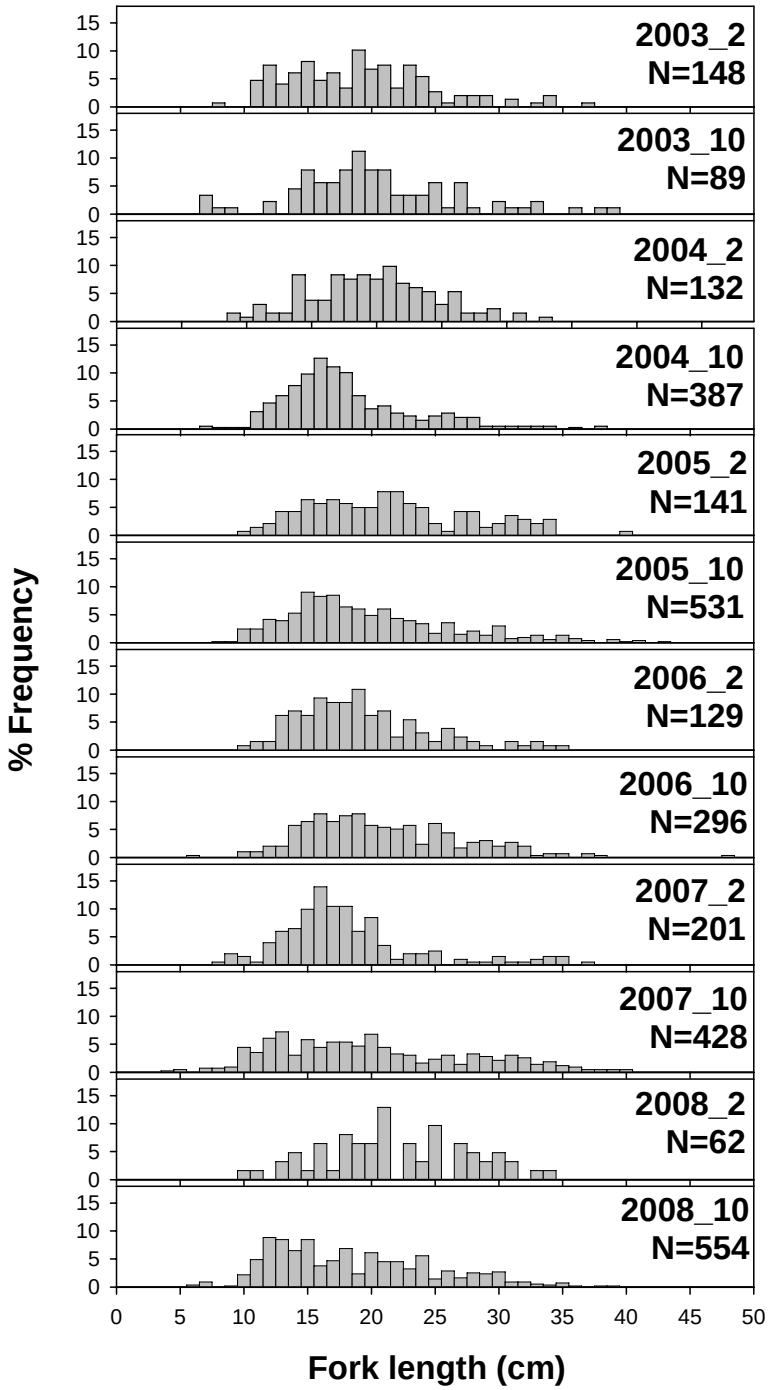

Figure 36. Length frequency compositions of Australian bass recorded for each event of the Hawkesbury-Nepean River Bass Catch (year_month) over part of the monitoring period (2003-2008). N equals the total number of fish measured for each event.

6.1.7. Hawkesbury-Nepean Bass Anglers (HNBA) Interclub

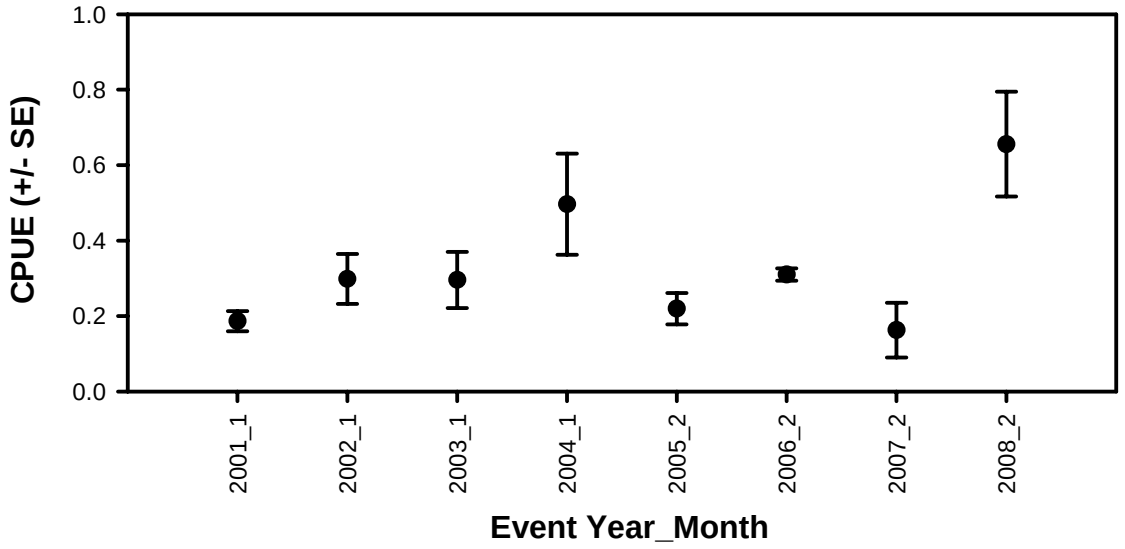

Figure 37. Catch per unit of effort as the number of fish per angler hour (± standard error) of Australian bass for each event of the Hawkesbury-Nepean River Bass Anglers Interclub Challenge over the monitoring period.

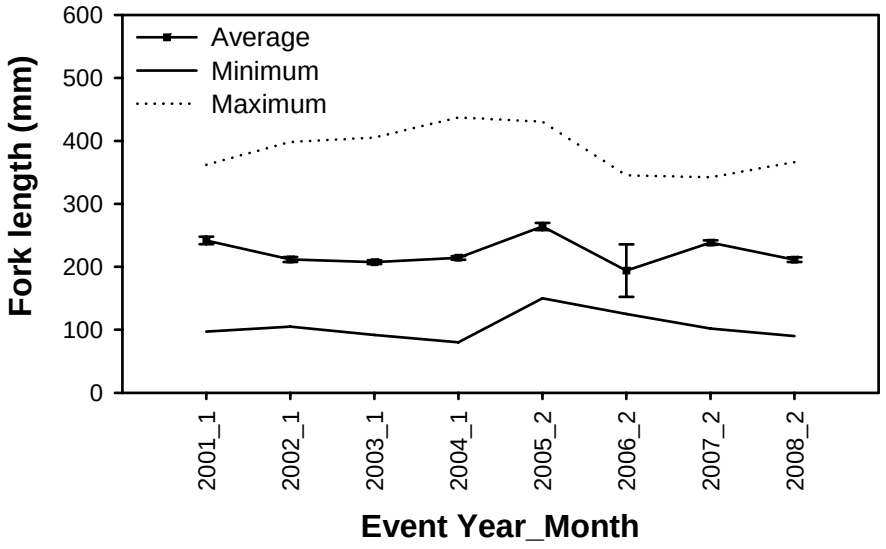

Figure 38. Minimum, maximum and average (± standard error) fork lengths of all Australian bass recorded for each event of the Hawkesbury-Nepean River Bass Anglers Interclub Challenge (year_month) over the monitoring period.

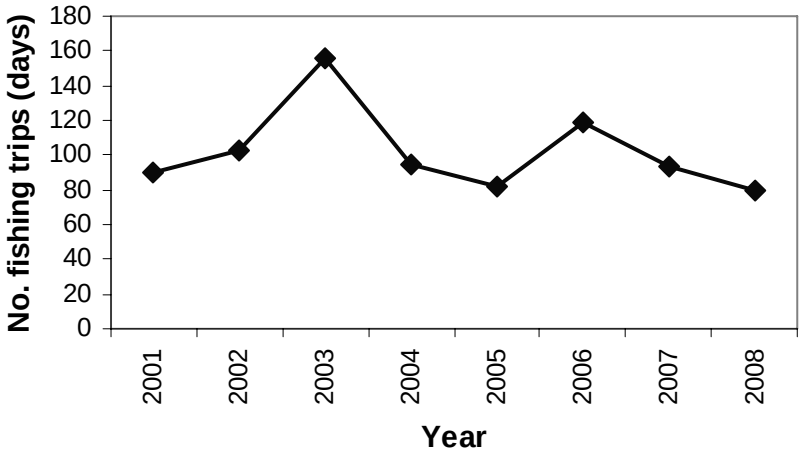

Figure 39. The total number of angler days of fishing recorded during each calendar year for the Hawkesbury-Nepean River Bass Anglers Interclub Challenge.

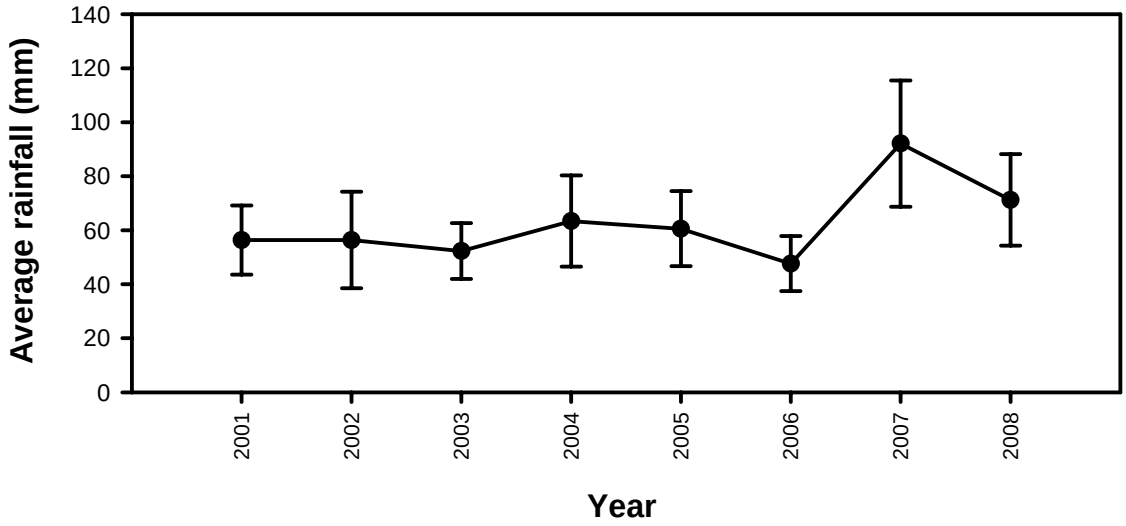

Figure 40. Average monthly rainfall (± standard error) for Lower Portland (Hawkesbury River). These data were obtained from the Bureau of Meteorology Station Number 067094. Please note that there are no records of stocking of Australian bass in the Hawkesbury-Nepean River.

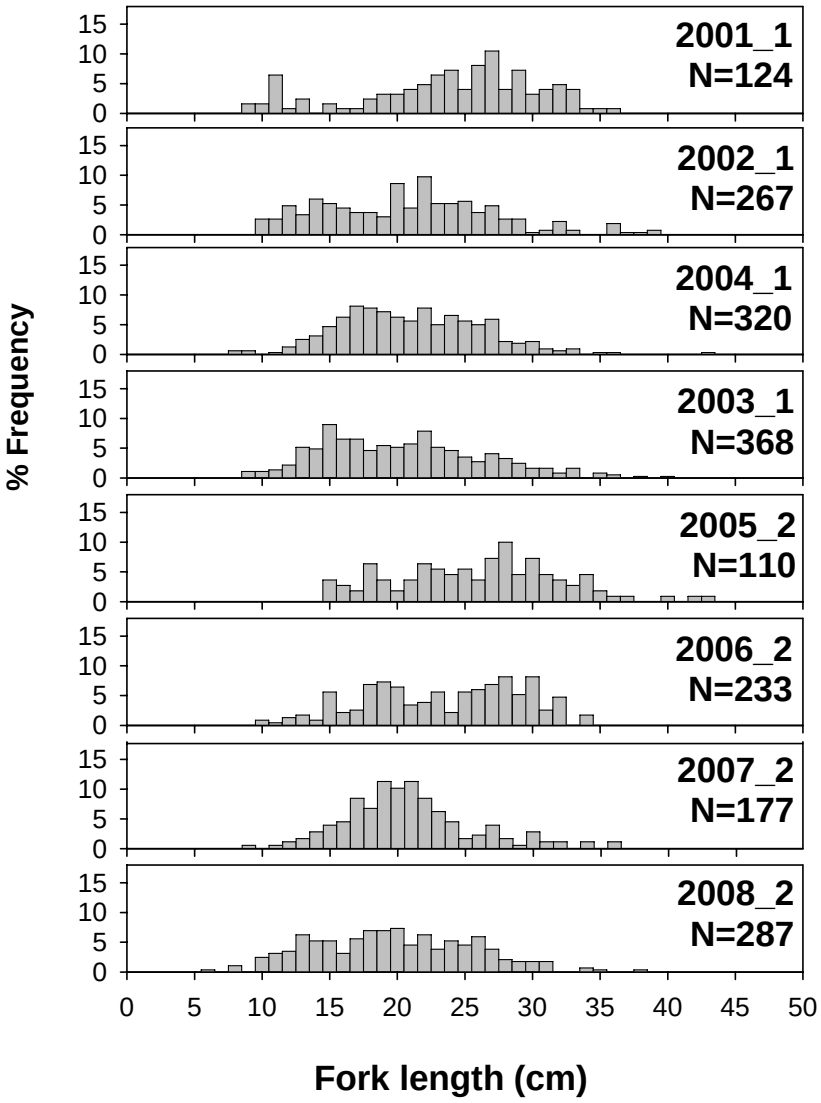

Figure 41. Length frequency compositions of Australian bass recorded for each event of the Hawkesbury-Nepean River Bass Anglers Interclub Challenge (year_month) over part of the monitoring period. N equals the total number of fish measured for each event.

6.1.8. Shoalhaven River Bass Catch

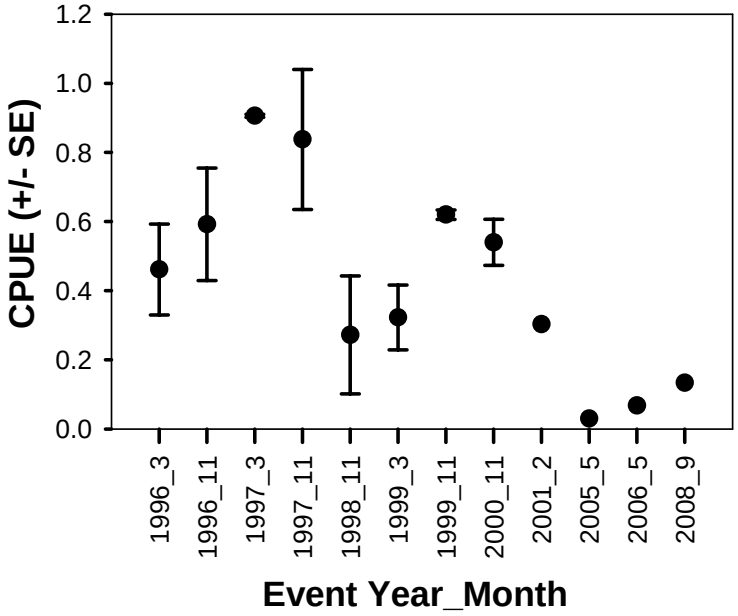

Figure 42. Catch per unit of effort as the number of fish per angler hour (± standard error) of Australian bass for each event over the monitoring period in the Shoalhaven River.

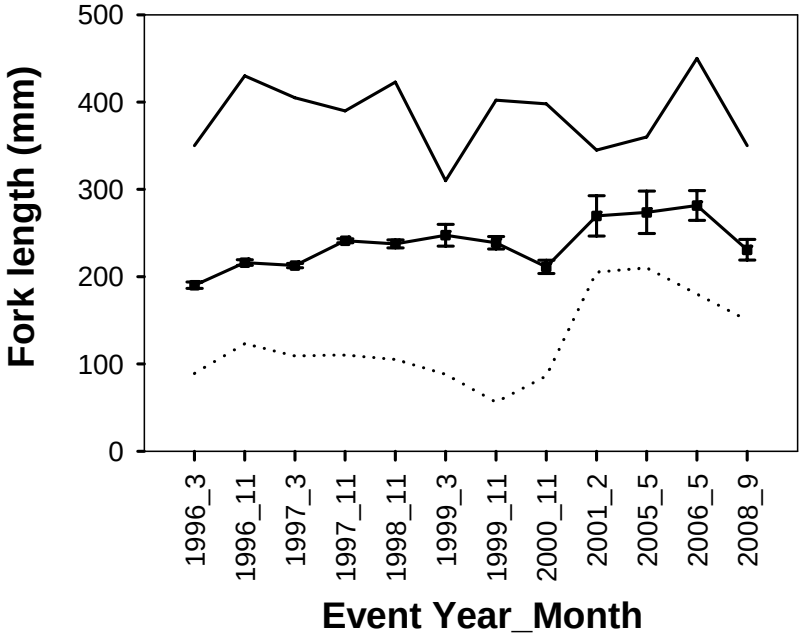

Figure 43. Minimum, maximum and average (± standard error) fork lengths of all Australian bass recorded for each event (year_month) over the monitoring period in the Shoalhaven River.

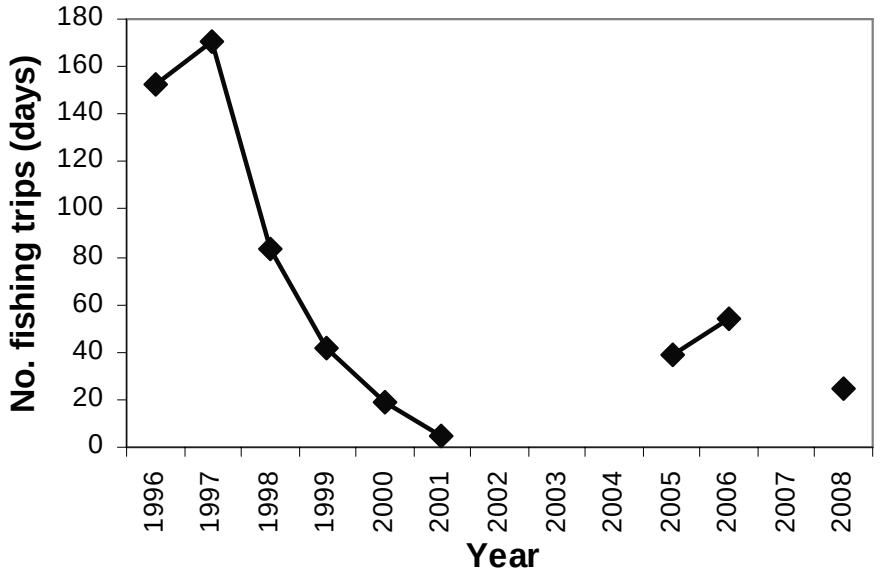

Figure 44. The total number of angler days of fishing recorded during each calendar year for all events monitored in the Shoalhaven River.

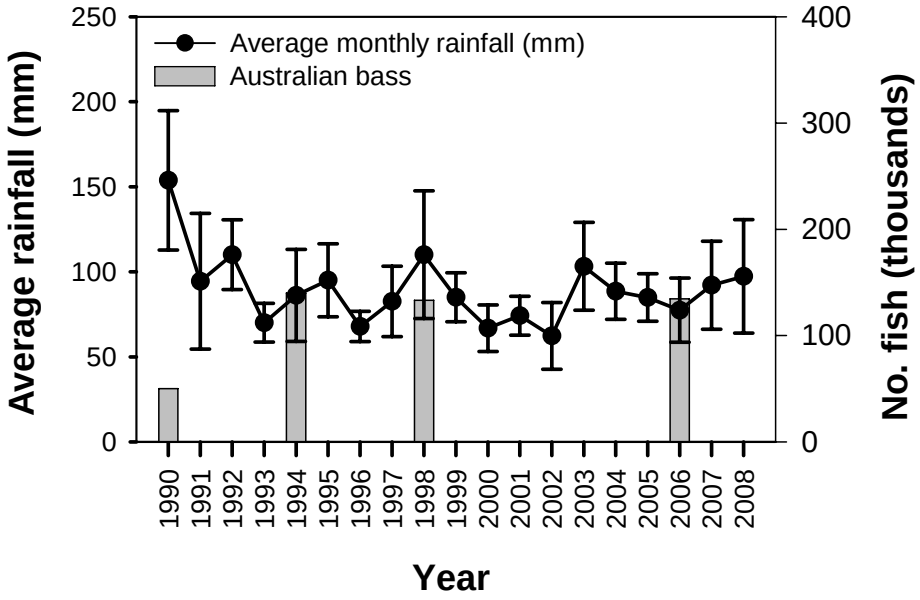

Figure 45. Number of Australian bass stocked and average monthly rainfall for the Shoalhaven River through time. Rainfall data are for the Greenwell Point Bowling Club (closest station to the Shoalhaven River) and were obtained from the Bureau of Meteorology station number 068080.

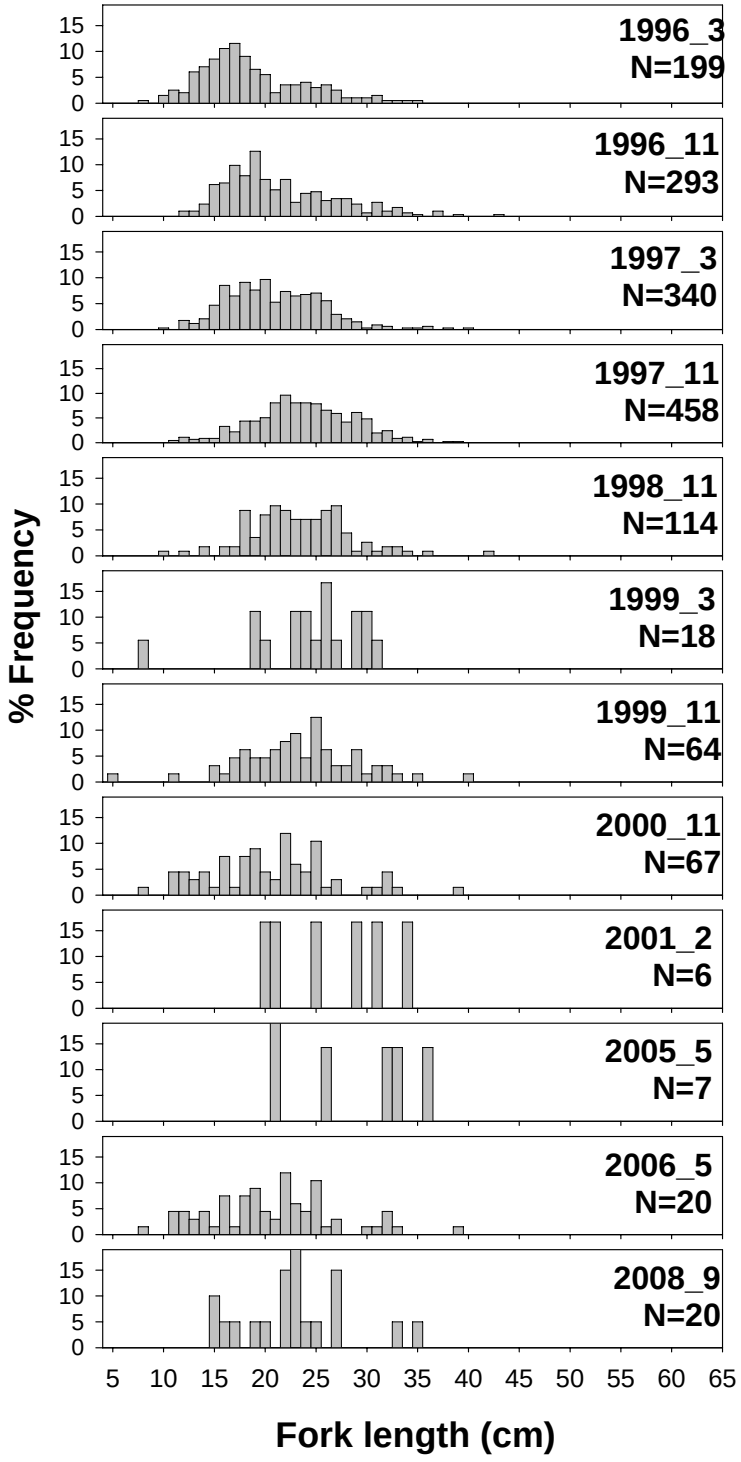

Figure 46. Length frequency compositions of Australian bass recorded for each event (year_month) over the monitoring period in the Shoalhaven River. N equals the total number of fish measured for each event.

6.1.9. Clyde River Bass Catch

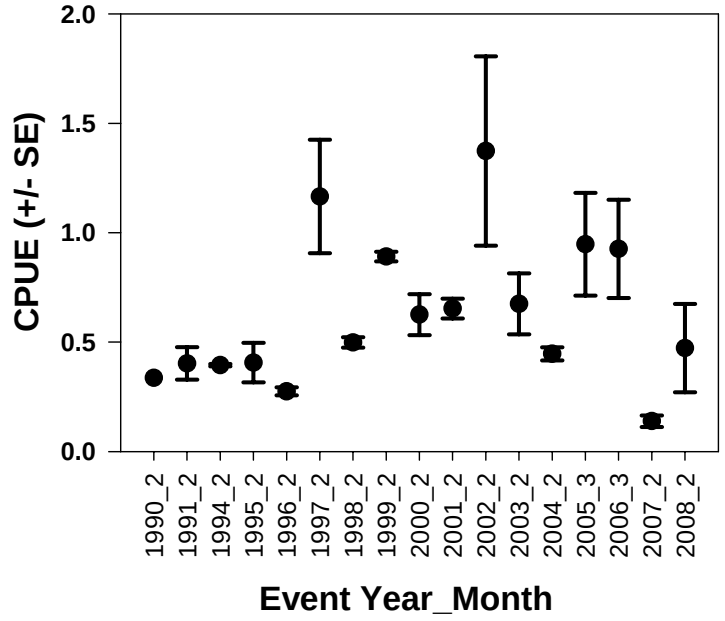

Figure 47. Catch per unit of effort as the number of fish per angler hour (± standard error) of Australian bass for each event over the monitoring period in the Clyde River.

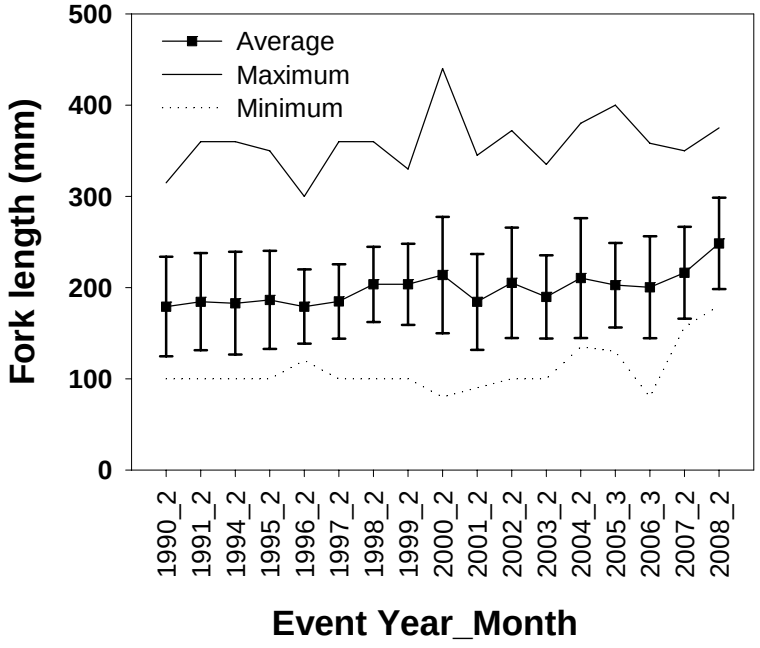

Figure 48. Minimum, maximum and average (± standard error) fork lengths of all Australian bass recorded for each event (year_month) over the monitoring period in the Clyde River.

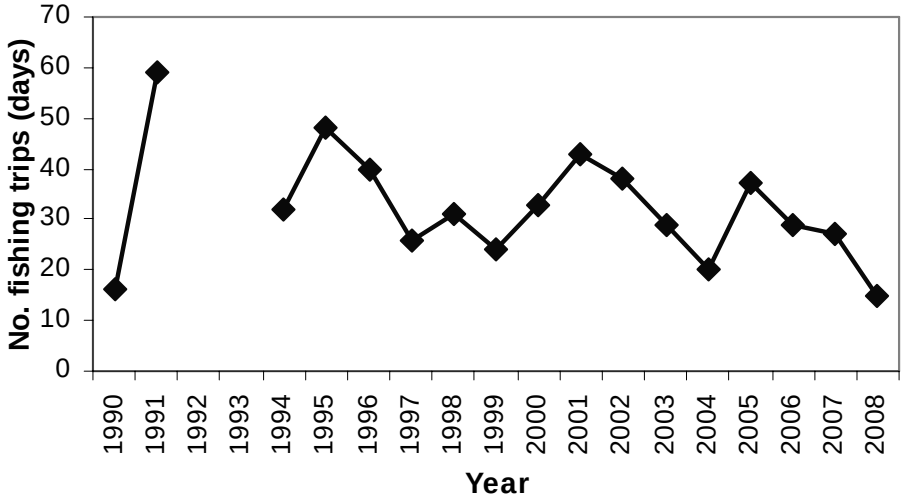

Figure 49. The total number of angler days of fishing recorded during each calendar year for all events monitored in the Clyde River.

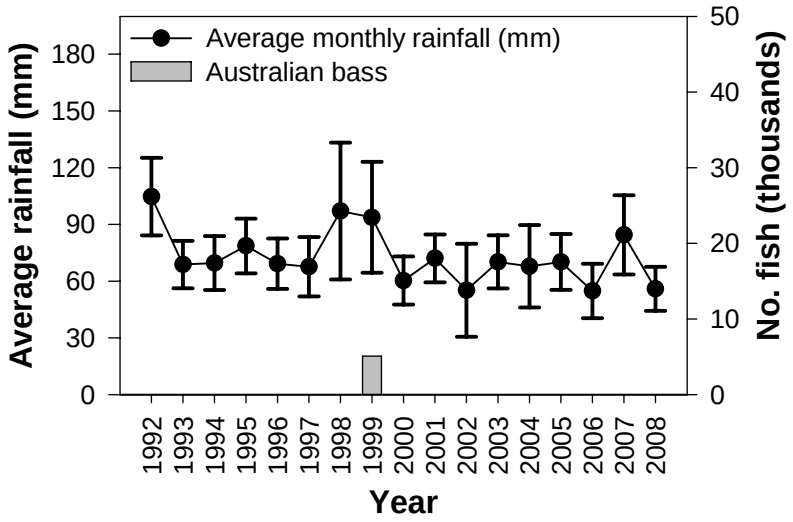

Figure 50. Number of Australian bass stocked and average monthly rainfall for the Clyde River through time. Rainfall data are for the Batemans Bay Country Club (closest station to the Clyde River) and were obtained from the Bureau of Meteorology station number 069134.

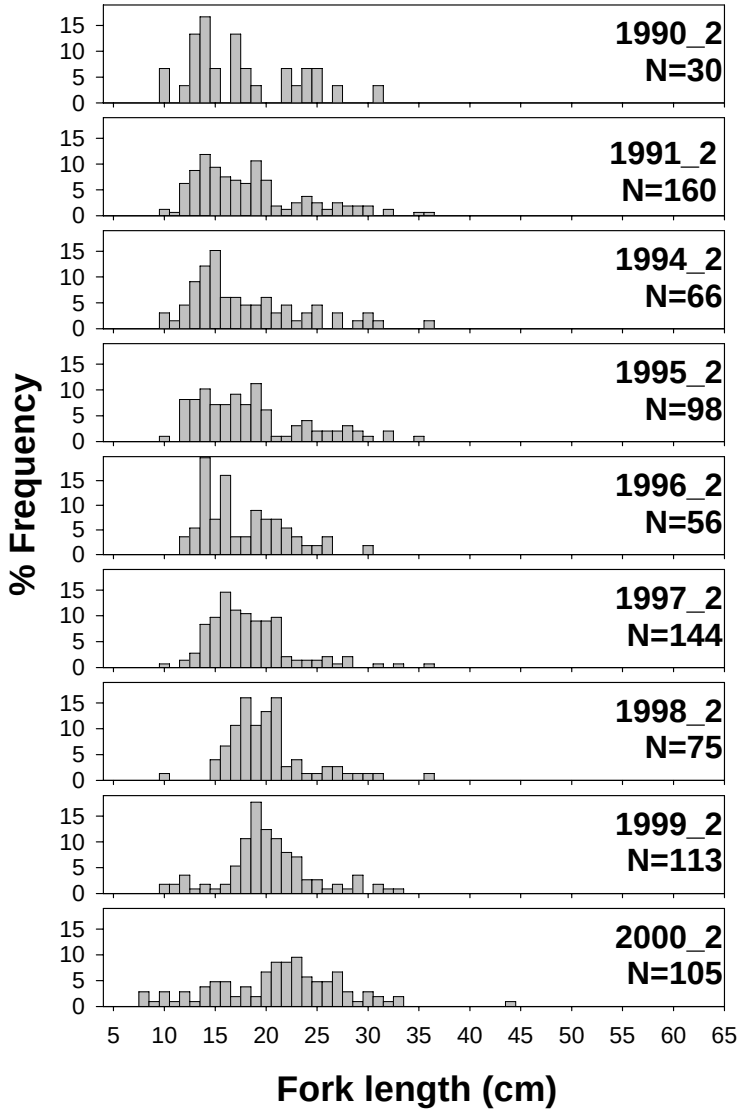

Figure 51. Length frequency compositions of Australian bass recorded for each event (year_month) over part of the monitoring period (1990-2000) in the Clyde River. N equals the total number of fish measured for each event.

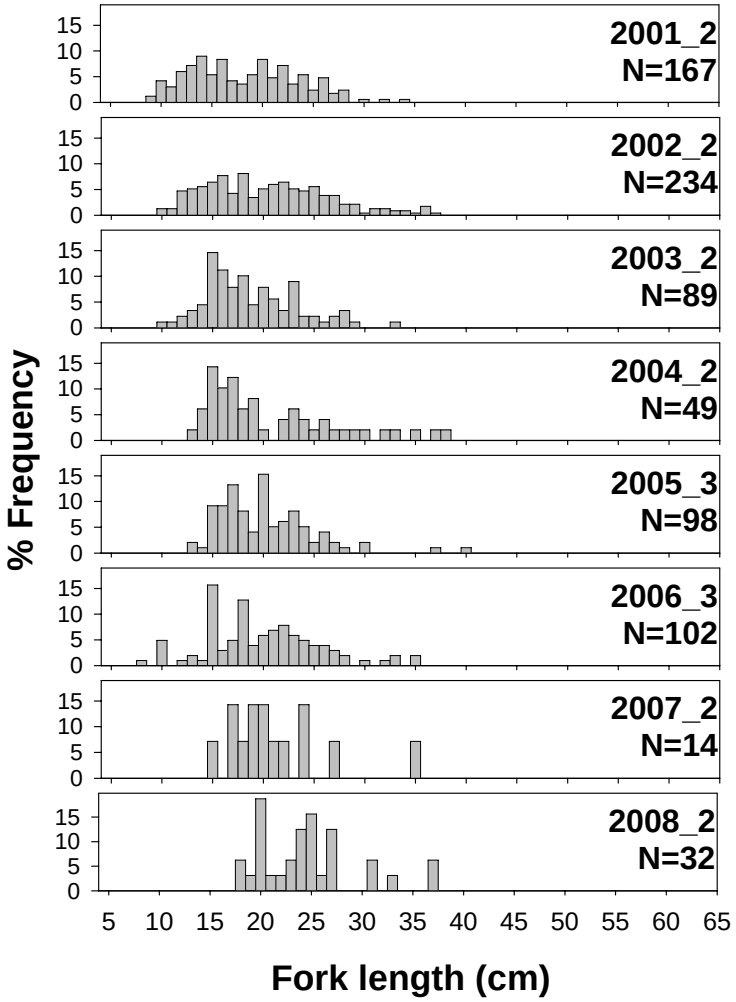

Figure 52. Length frequency compositions of Australian bass recorded for each event (year_month) over part of the monitoring period (2001-2008) in the Clyde River. N equals the total number of fish measured for each event.

6.2. NSW Impoundment events

6.2.1. Clarrie Hall Dam Bass Catch

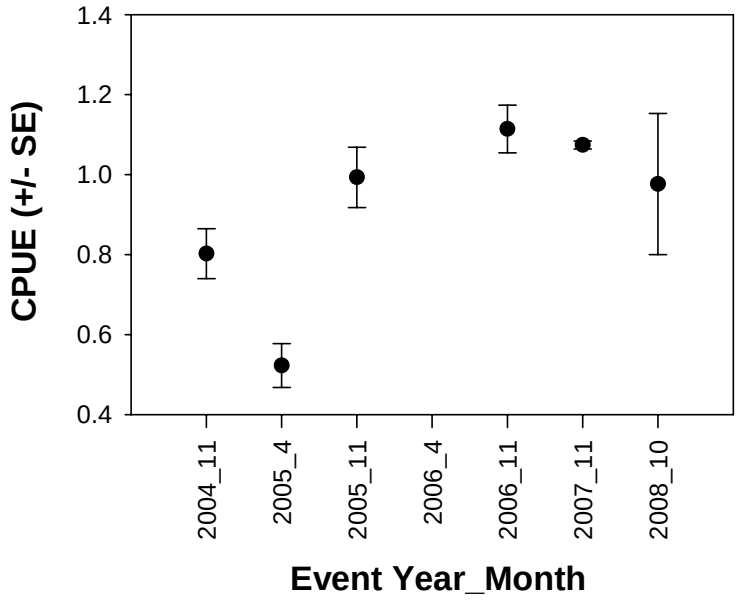

Figure 53. Catch per unit of effort as the number of fish per angler hour (± standard error) of Australian bass for each event over the monitoring period in the Clarrie Hall Dam. Please note that the CPUE has not been calculated for the 2006 April event as there were no fishing effort data for this event.

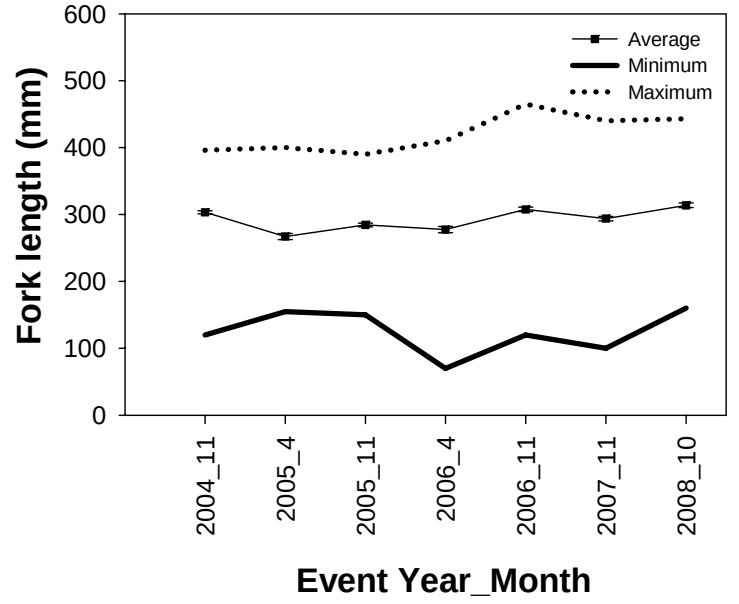

Figure 54. Minimum, maximum and average (± standard error) fork lengths of all Australian bass recorded for each event (year_month) over the monitoring period in the Clarrie Hall Dam.

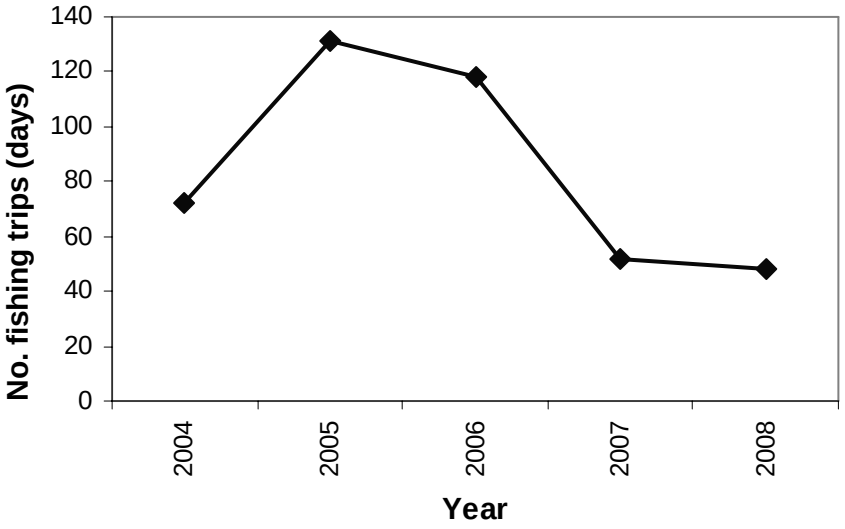

Figure 55. The total number of angler days of fishing recorded during each calendar year for all events monitored in the Clarrie Hall Dam.

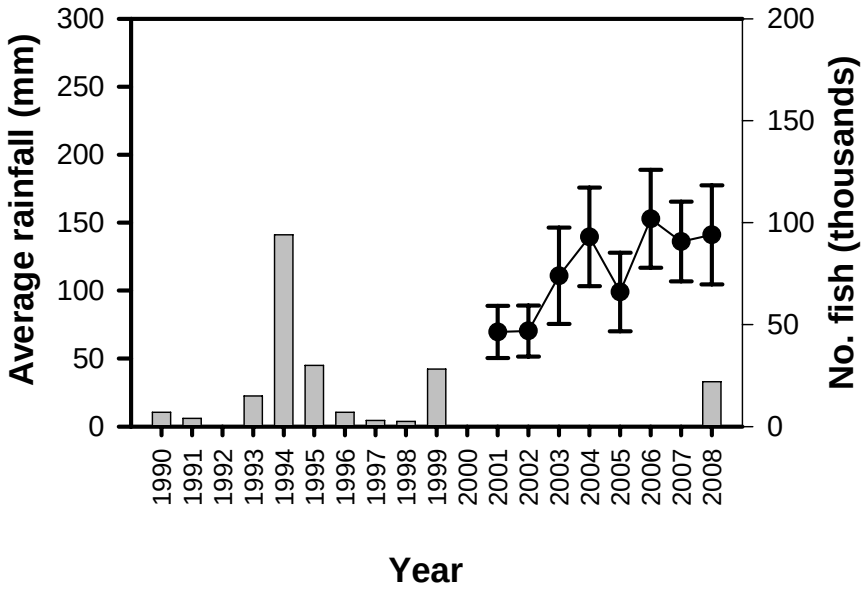

Figure 56. Number of Australian bass stocked and average monthly rainfall for the Clarrie Hall Dam through time. Rainfall data are for Uki (closest station to the Clarrie Hall Dam) and were obtained from the Bureau of Meteorology station number 58167.

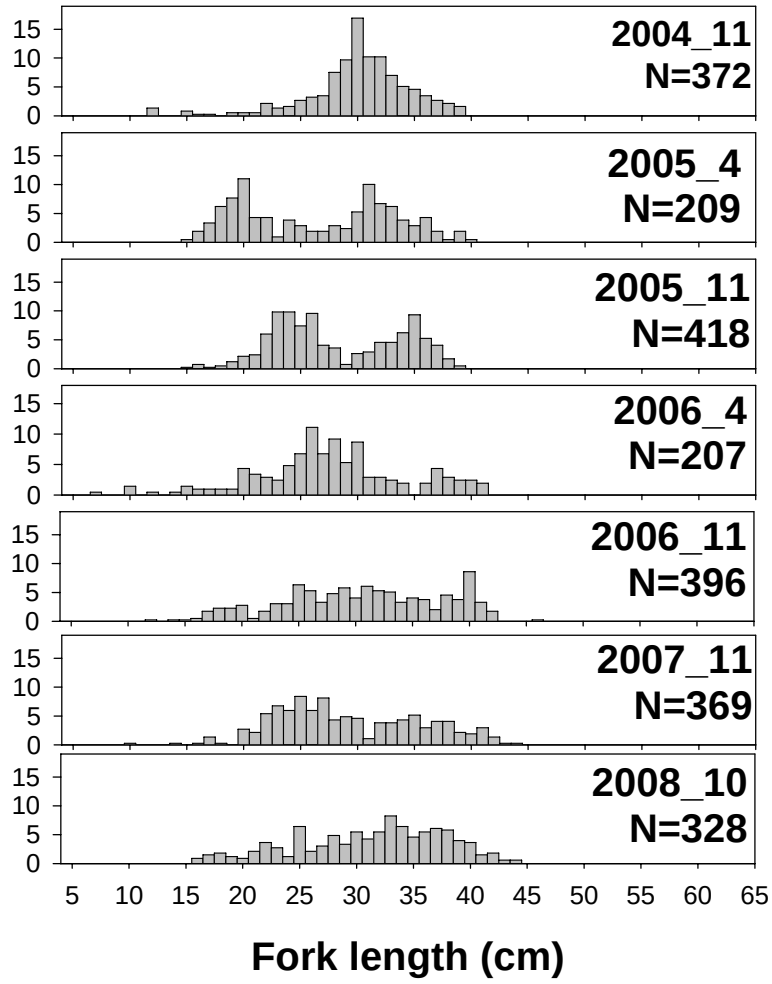

Figure 57. Length frequency compositions of Australian bass recorded for each event (year_month) over the monitoring period in the Clarrie Hall Dam. N equals the total number of fish measured for each event.

6.2.2. Glenbawn Dam

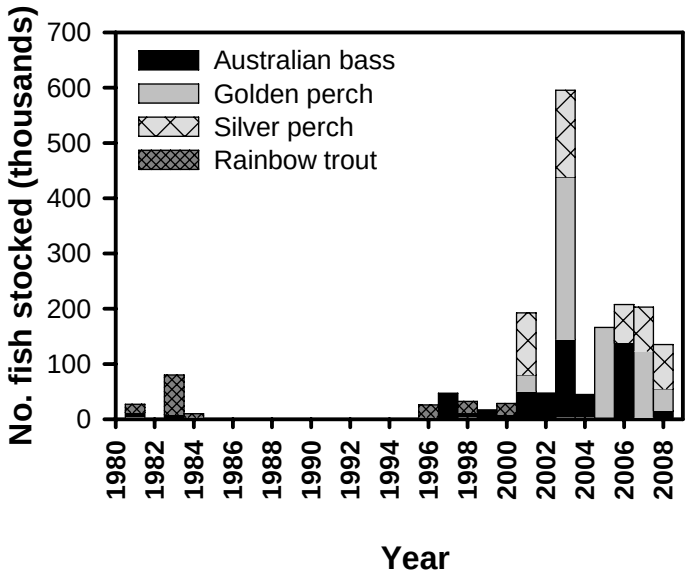

Figure 58. Number of each species stocked in Glenbawn Dam through time. Species that have been stocked in this impoundment include Australian bass, golden perch, silver perch and rainbow trout.

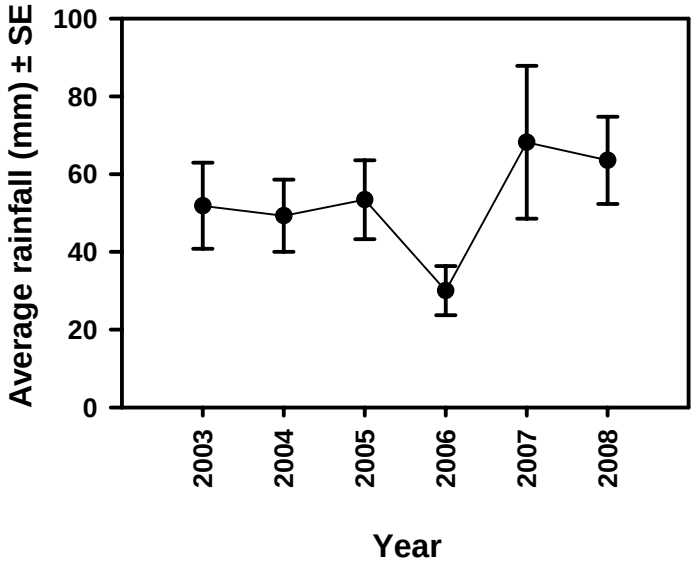

Figure 59. Average monthly rainfall for the Glenbawn Dam through time. Rainfall data were obtained from the Bureau of Meteorology station number 061094.

6.2.2.1. ANSA Catch and Release Convention (Glenbawn Dam)

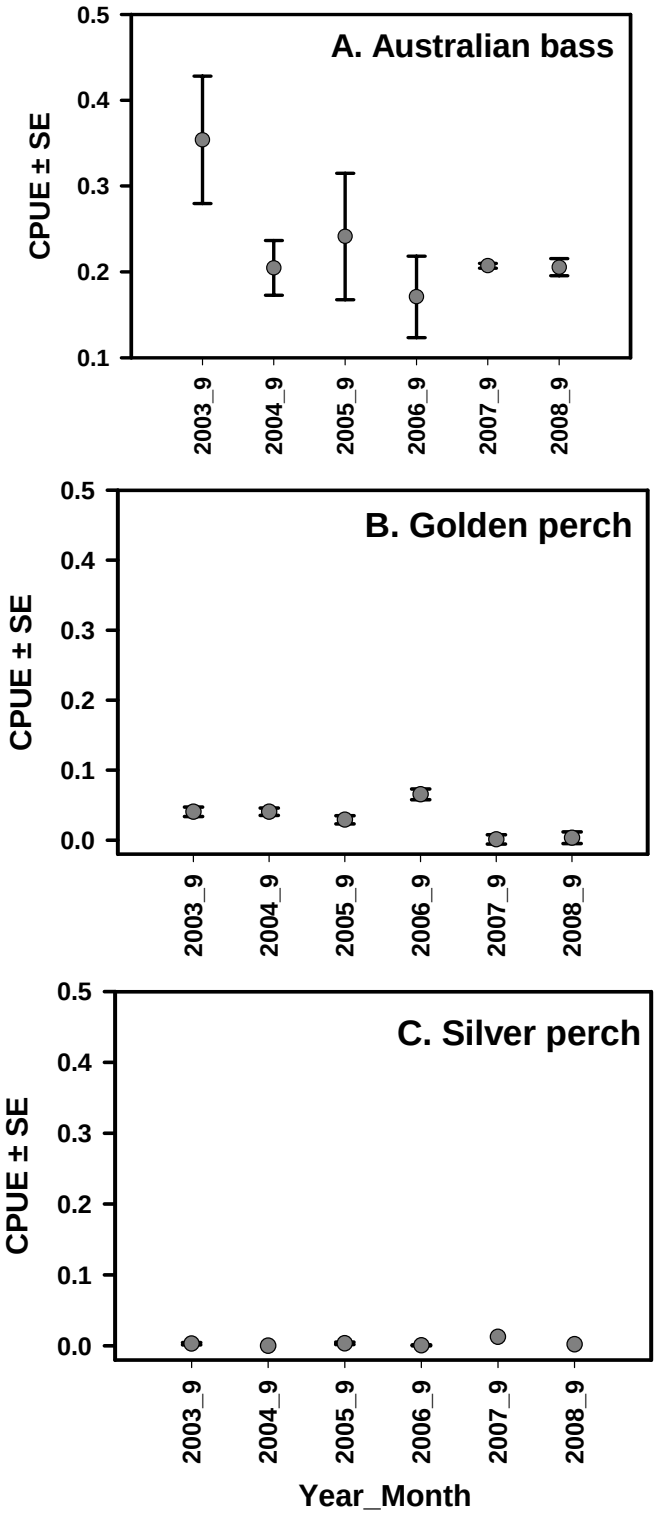

Figure 60. Catch per unit of effort as the number of fish per angler hour (± standard error) of a) Australian bass; b) golden perch; and, c) silver perch for each event (year_month) of the ANSA Catch and Release Convention over the monitoring period in Glenbawn Dam.

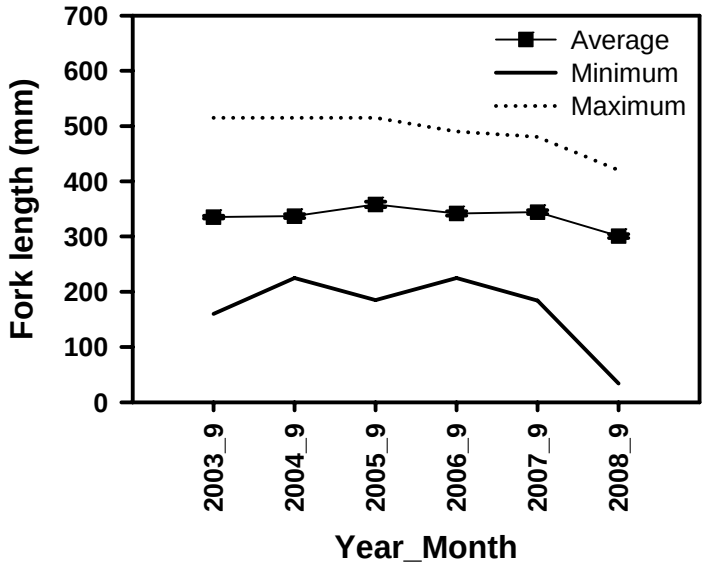

Figure 61. Minimum, maximum and average (± standard error) fork lengths of all Australian bass recorded for each event (year_month) of the ANSA Catch and Release Convention over the monitoring period in Glenbawn Dam.

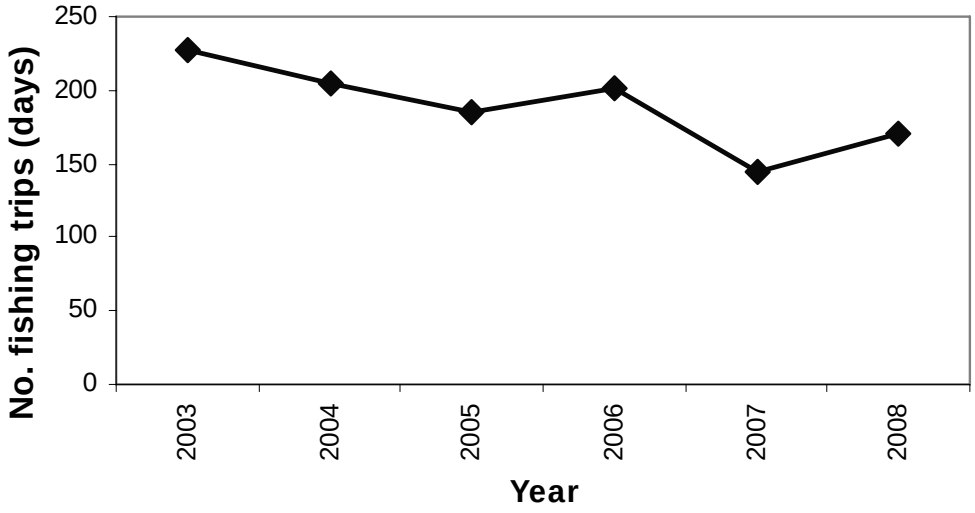

Figure 62. The total number of angler days of fishing recorded during each calendar year for all events of the ANSA Catch and Release Convention monitored in Glenbawn Dam.

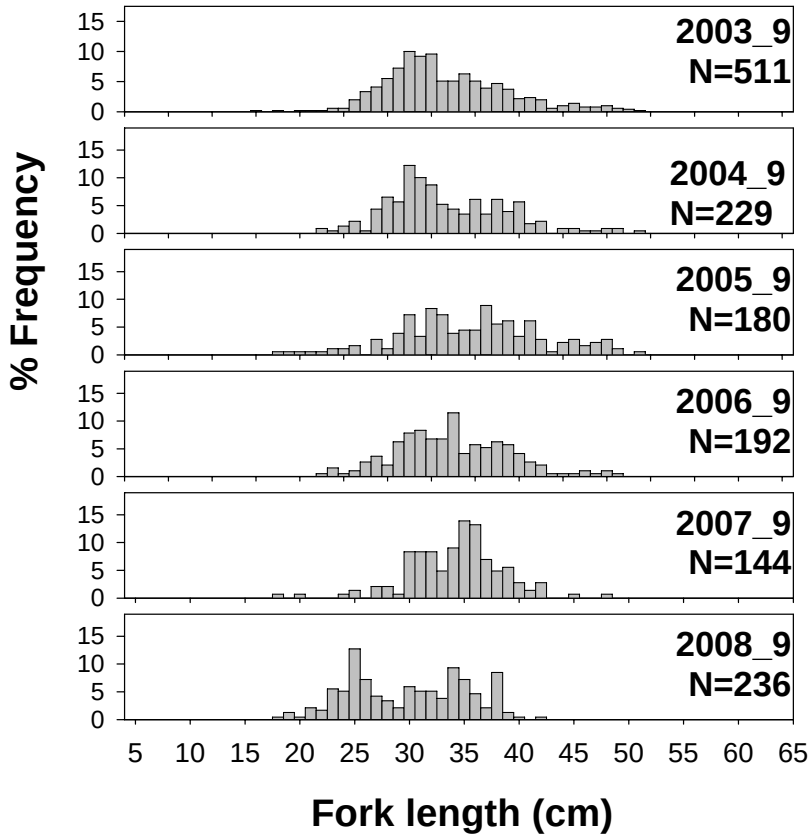

Figure 63. Length frequency compositions of Australian bass recorded for each event (year_month) of the ANSA Catch and Release Convention over the monitoring period in Glenbawn Dam. N equals the total number of fish measured for each event.

6.2.2.2. Freshwater Fishing Masters (Glenbawn Dam)

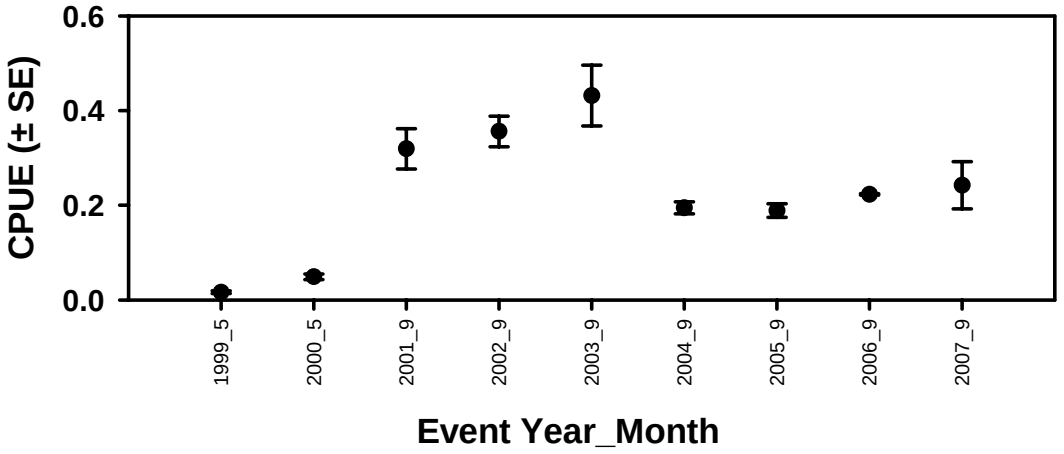

Figure 64. Catch per unit of effort as the number of fish per angler hour (± standard error) of Australian bass for each event of the Freshwater Fishing Masters over the monitoring period (year_month) at the Glenbawn Dam.

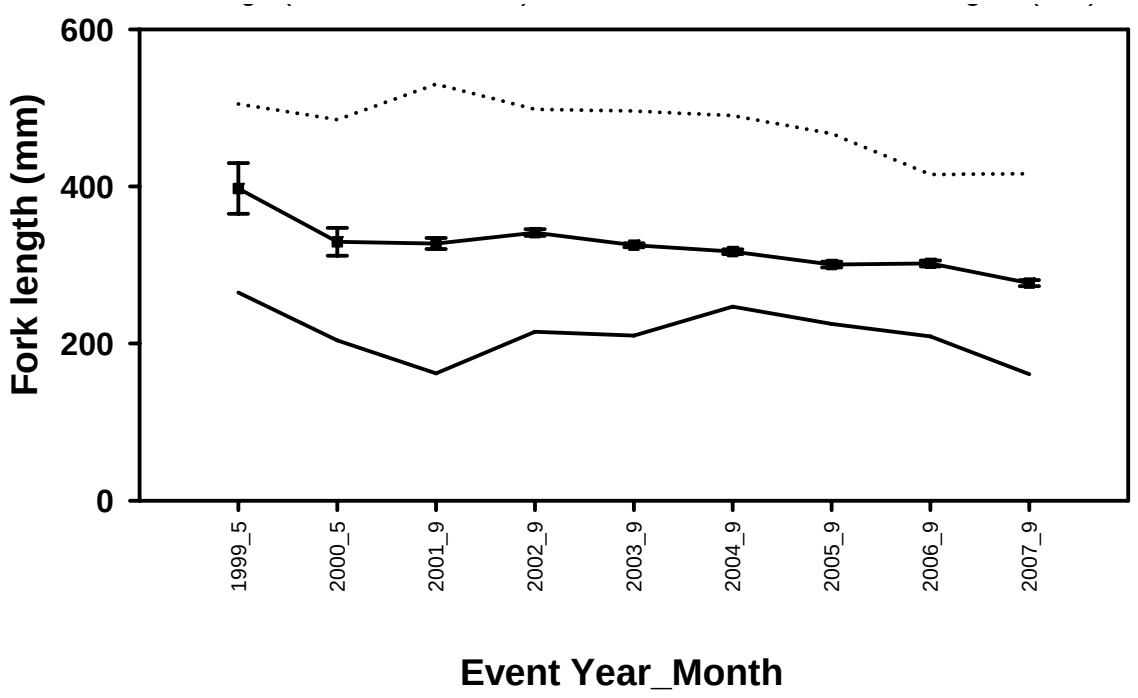

Figure 65. Minimum, maximum and average (± standard error) fork lengths of all Australian bass recorded for each event (year_month) of the Freshwater Fishing Masters over the monitoring period in Glenbawn Dam.

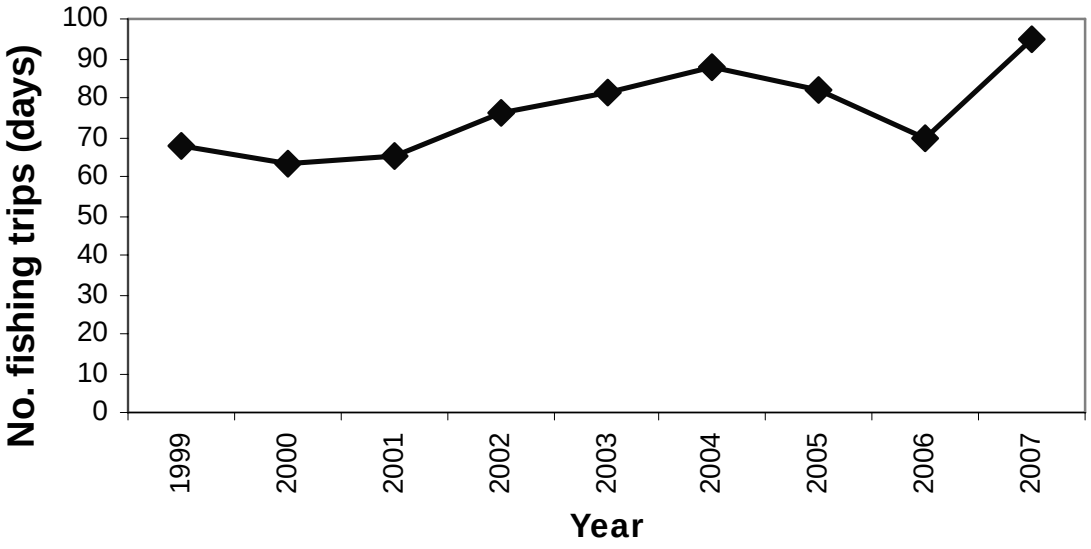

Figure 66. The total number of angler days of fishing recorded during each calendar year for all the events of the Freshwater Fishing Masters monitored in Glenbawn Dam.

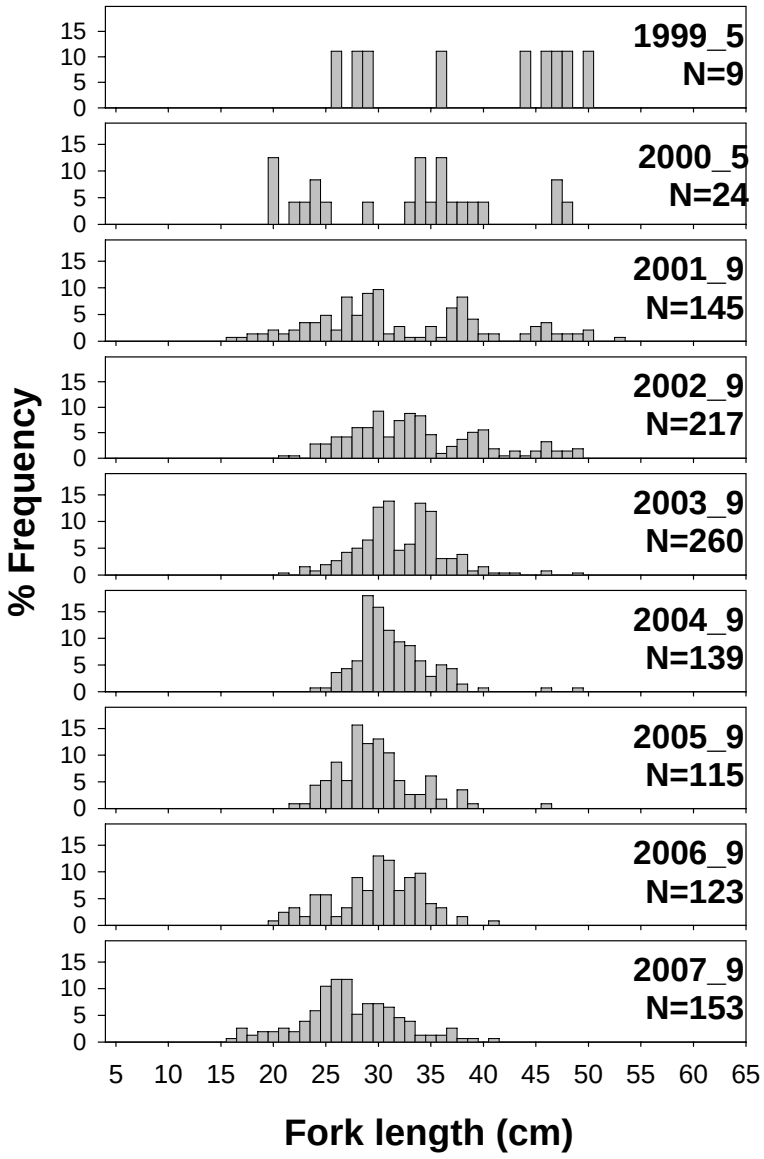

Figure 67. Length frequency compositions of Australian bass recorded each event (year_month) of the Freshwater Fishing Masters over the monitoring period in Glenbawn Dam. N equals the total number of fish measured for each event.

6.3. Freshwater Fishing Masters (Windamere Dam)

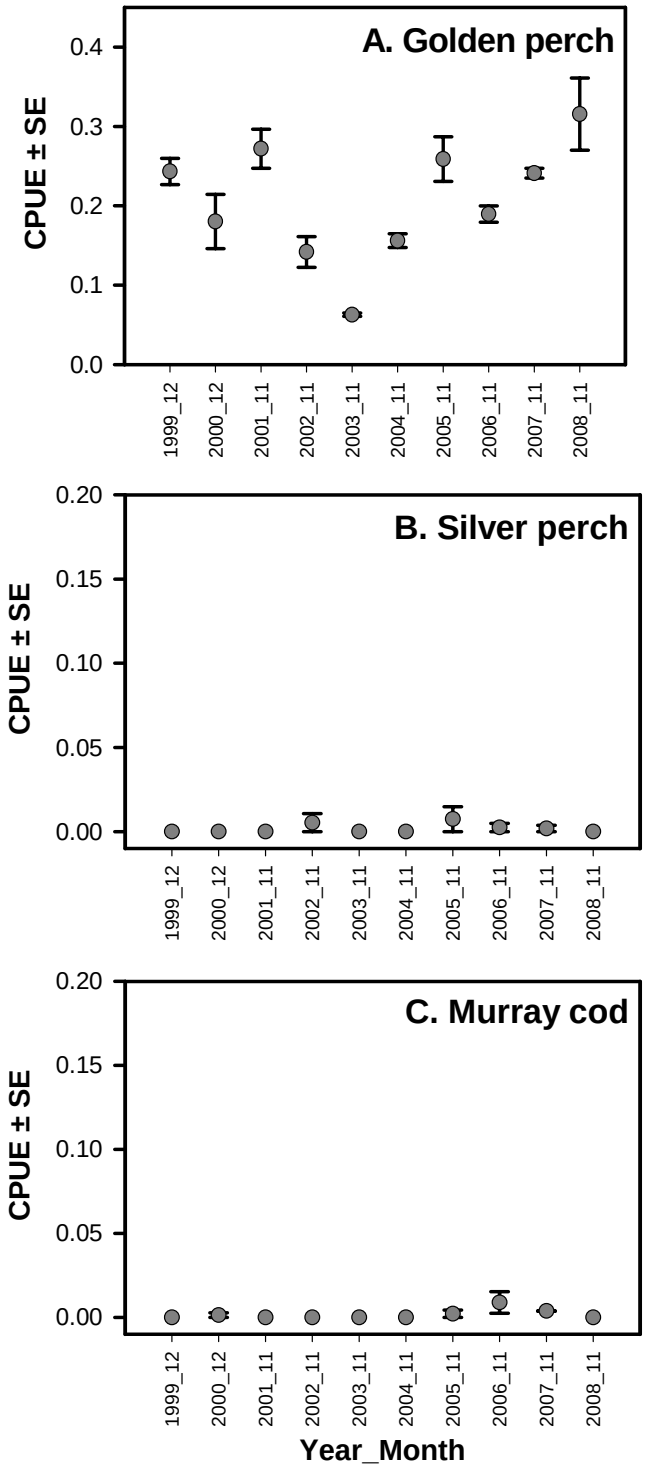

Figure 68. Catch per unit of effort as the number of fish per angler hour (± standard error) of a) golden perch; b) silver perch; and, c) Murray cod for each event (year_month) of the Freshwater Fishing Masters in Windamere Dam over the monitoring period.

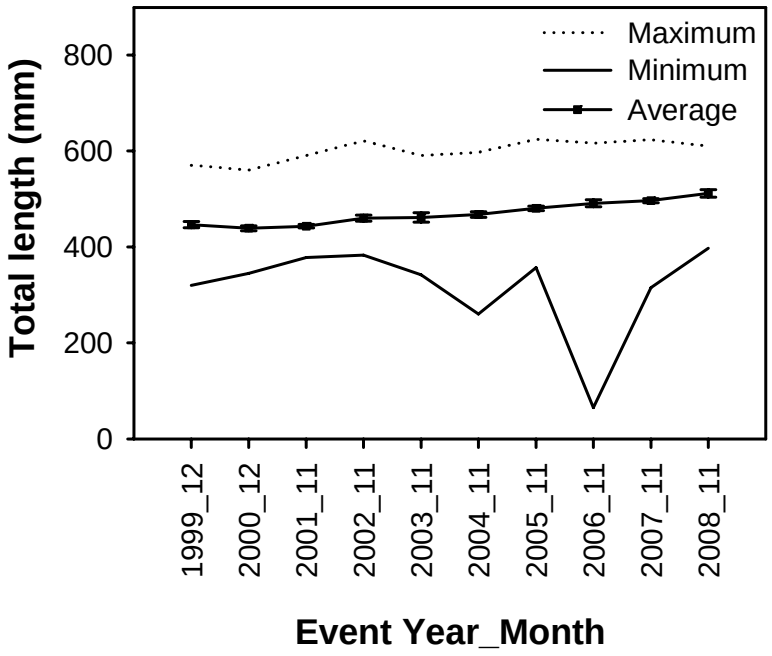

Figure 69. Minimum, maximum and average (± standard error) total lengths of all golden perch recorded for each event (year_month) of the Freshwater Fishing Masters over the monitoring period in Windamere Dam.

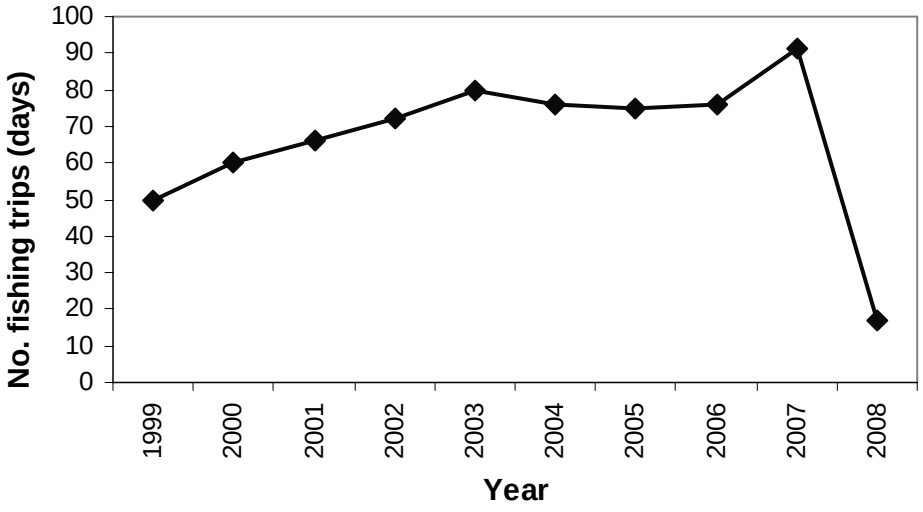

Figure 70. The total number of angler days of fishing recorded during each calendar year for all the events of the Freshwater Fishing Masters monitored in Windamere Dam.

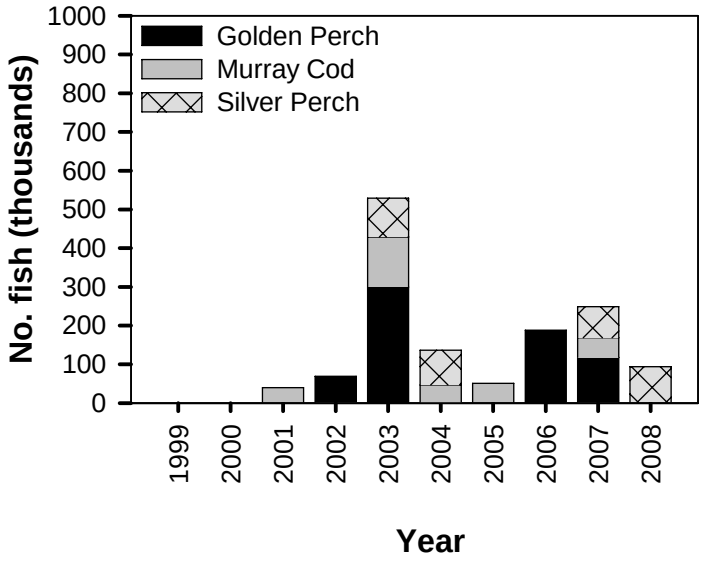

Figure 71. Number of each species stocked in Windamere Dam through time. Species that have been stocked in this impoundment include golden perch, Murray cod, silver perch and rainbow trout.

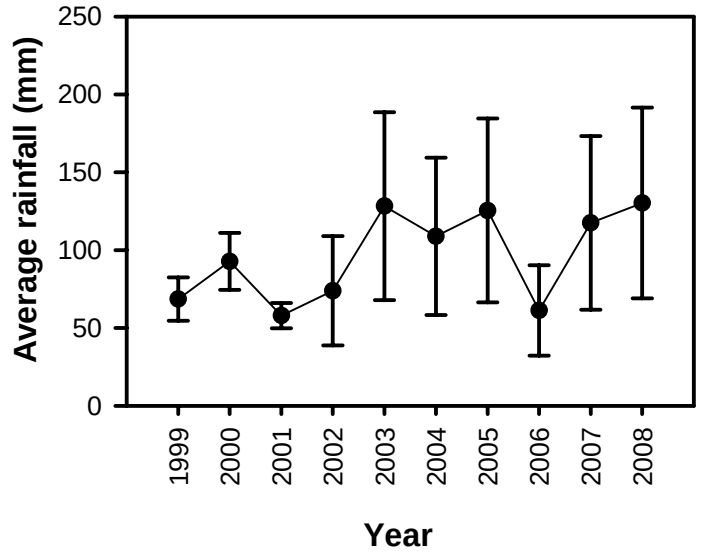

Figure 72. Average monthly rainfall for the Windamere Dam through time. Rainfall data were obtained from the Bureau of Meteorology station number IDCJAC0001.

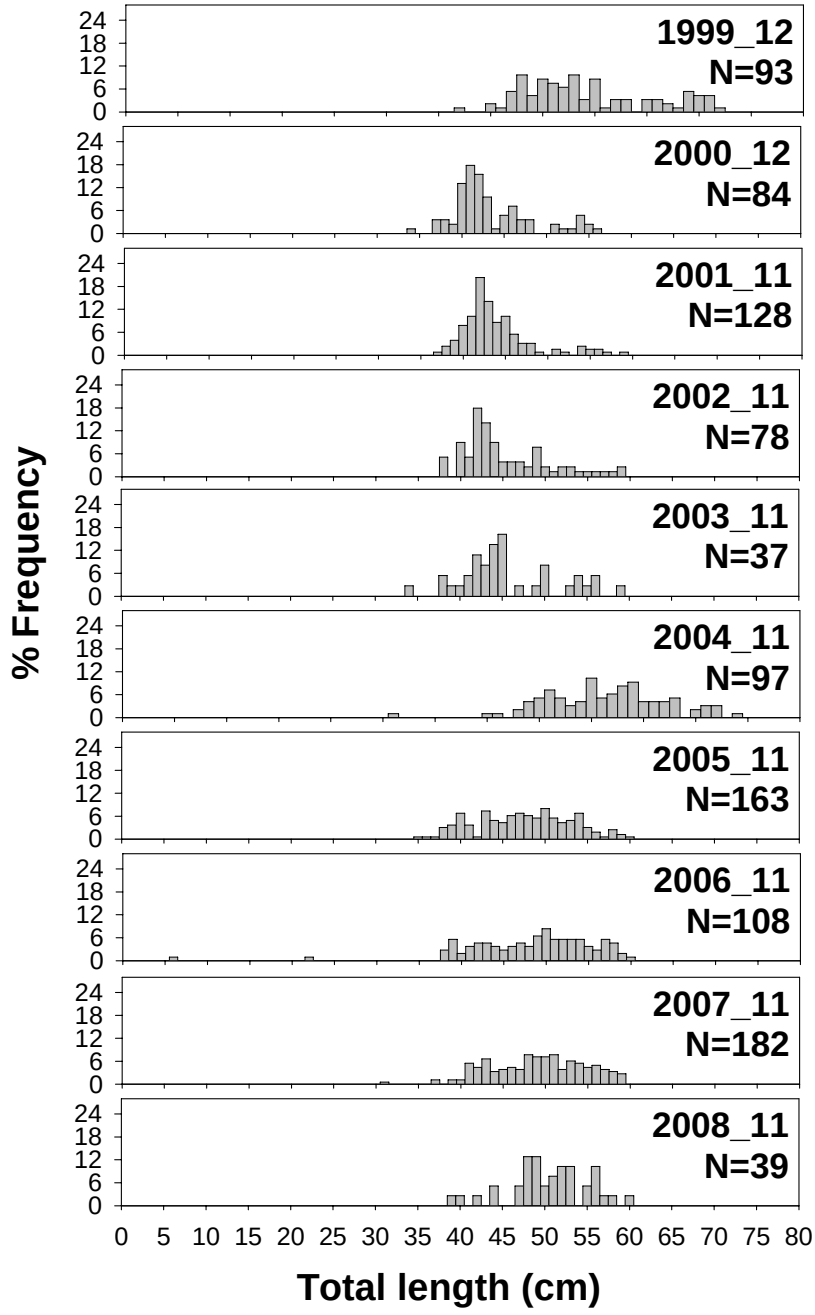

Figure 73. Length frequency compositions of golden perch recorded each event (year_month) of the Freshwater Fishing Masters over the monitoring period in Windamere Dam. N equals the total number of fish measured for each event.

6.3.1. Lake Yarrunga Invitational (Tallowa Dam)

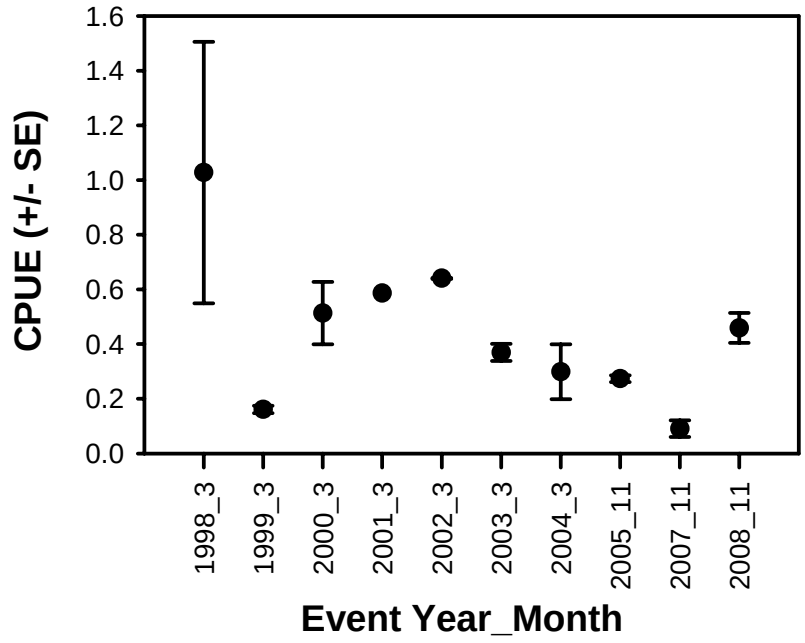

Figure 74. Catch per unit of effort as the number of fish per angler hour (± standard error) of Australian bass for each event over the monitoring period in Lake Yarrunga (Tallowa Dam).

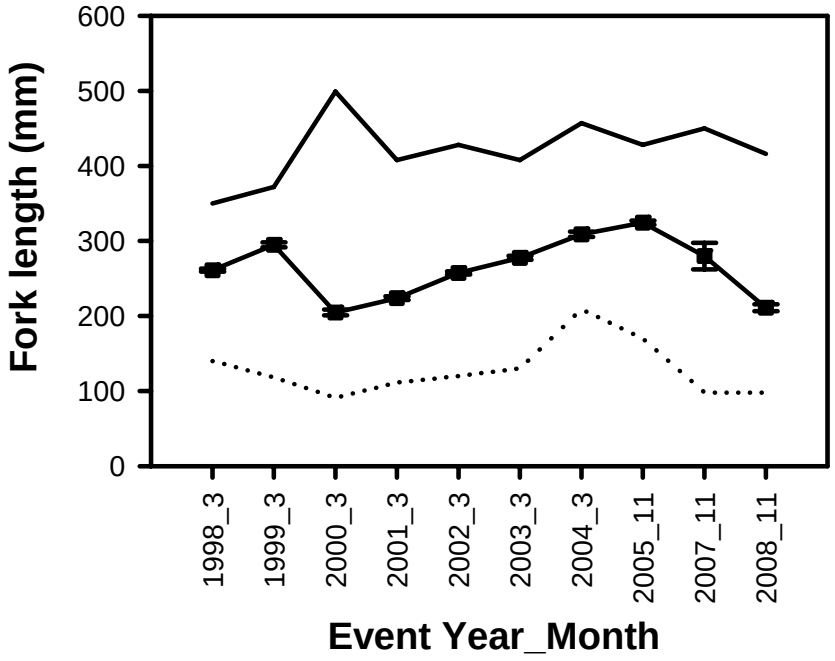

Figure 75. Minimum, maximum and average (± standard error) fork lengths of all Australian bass recorded for each event (year_month) over the monitoring period of the Lake Yarrunga (Tallowa Dam) Invitational.

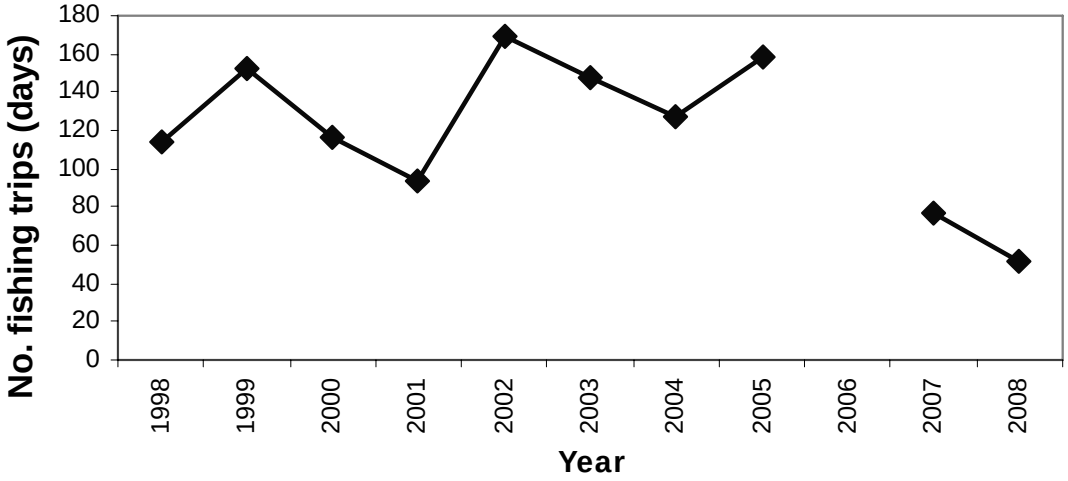

Figure 76. The total number of angler days of fishing recorded during each calendar year for all Lake Yarrunga (Tallowa Dam) Invitational events monitored.

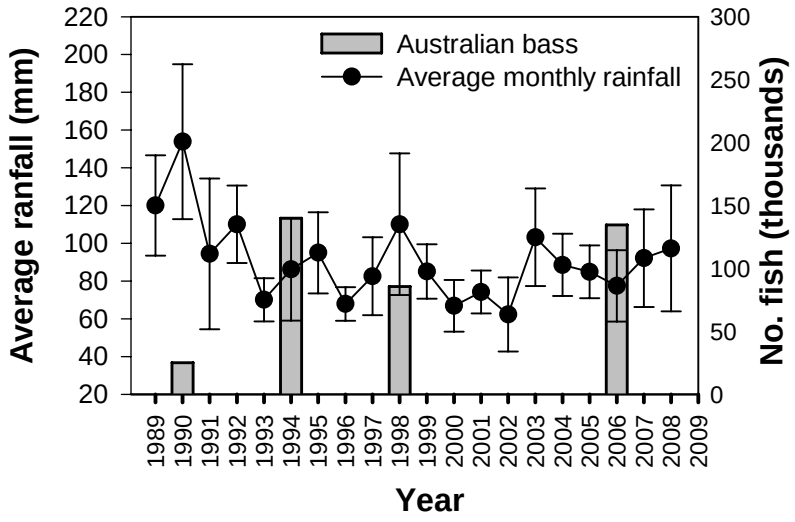

Figure 77. Number of Australian bass stocked and average monthly rainfall for Lake Yarrunga through time. Rainfall data are for the Greenwell Point Bowling Club (closest station to Lake Yarrunga) and were obtained from the Bureau of Meteorology station number 068080.

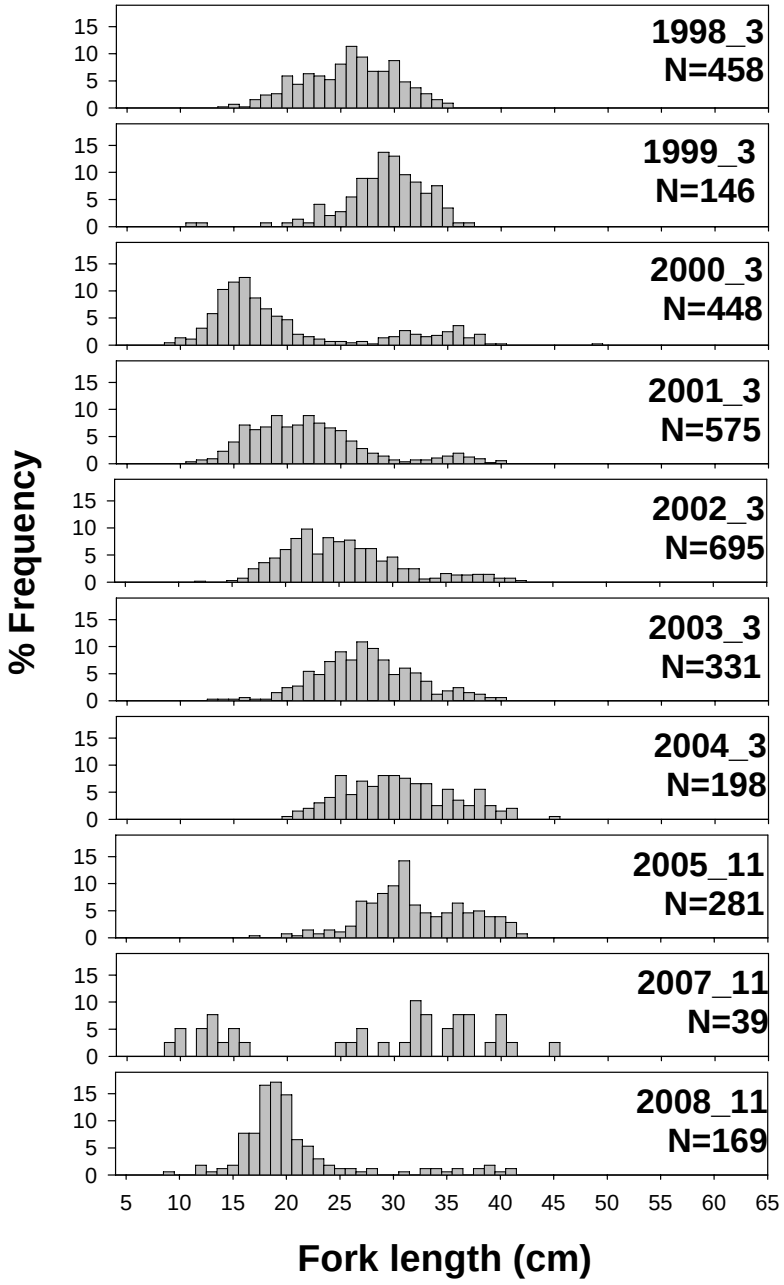

Figure 78. Length frequency compositions of Australian bass recorded for each event (year_month) over the monitoring period for the Lake Yarrunga Invitational (Tallowa Dam). N equals the total number of fish measured for each event.

6.3.2. Brogo Bass Bash (Brogo Dam)

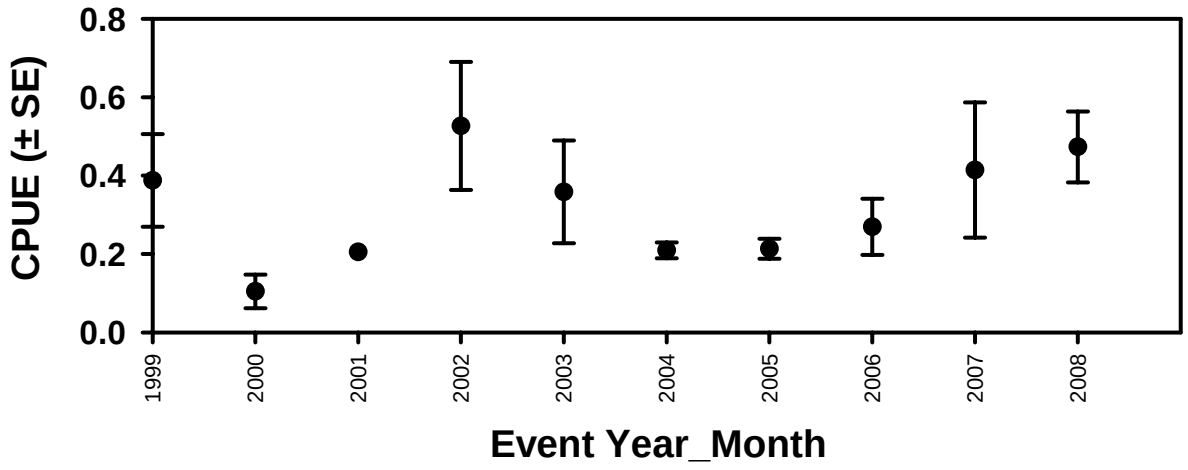

Figure 79. Catch per unit of effort as the number of fish per angler hour (± standard error) of Australian bass for each event over the monitoring period in the Brogo Dam.

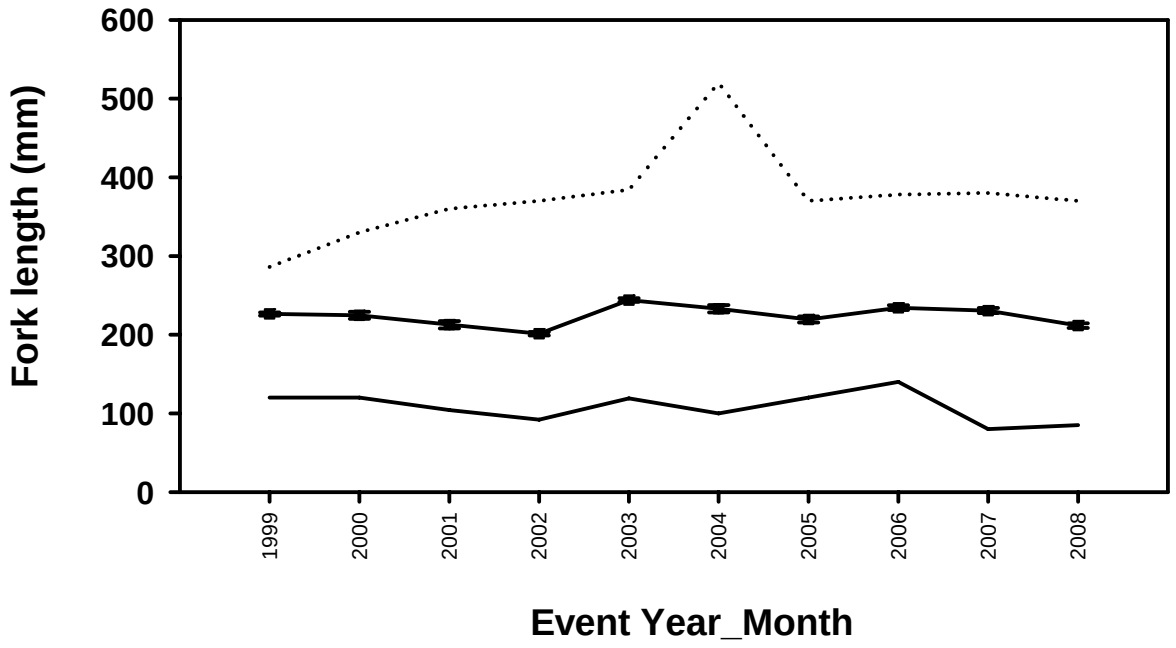

Figure 80. Minimum, maximum and average (± standard error) fork lengths of all Australian bass recorded for each event (year_month) over the monitoring period in Brogo Dam.

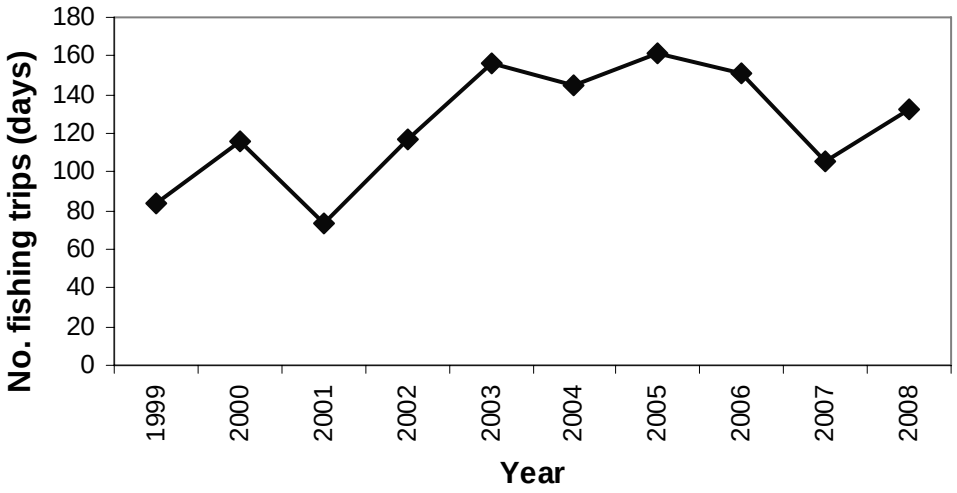

Figure 81. The total number of angler days of fishing recorded during each calendar year for all events monitored in Brogo Dam.

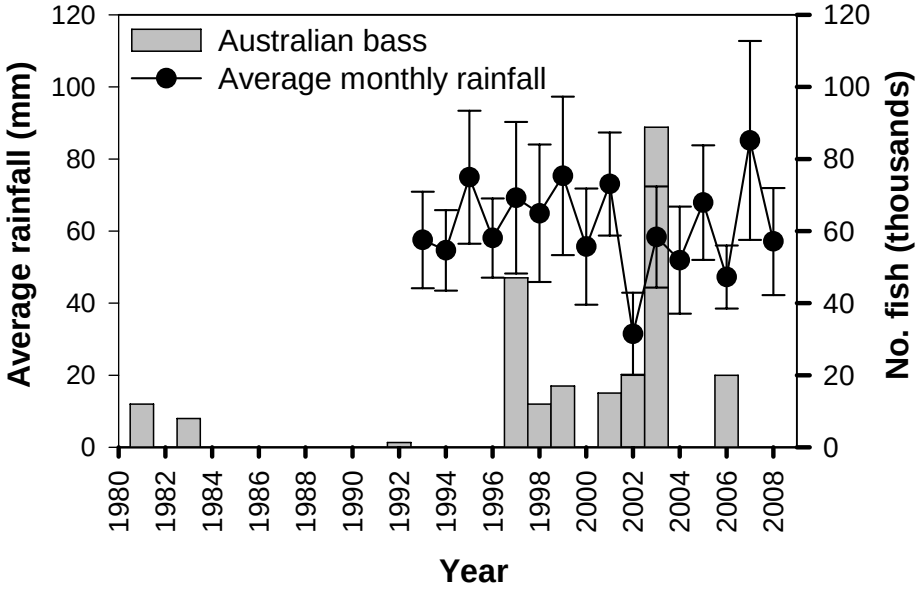

Figure 82. Number of Australian bass stocked and average monthly rainfall for Brogo Dam through time. Rainfall data are for the Brogo Dam and were obtained from the Bureau of Meteorology station number 069140.

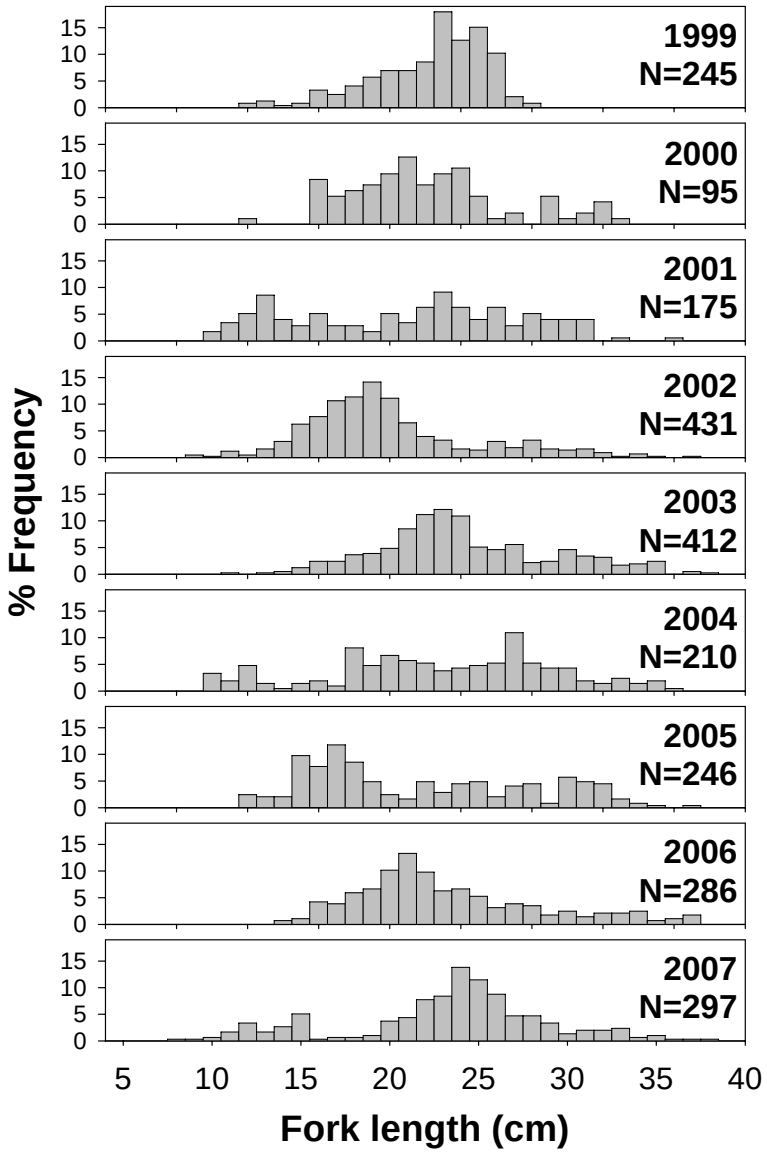

Figure 83. Length frequency compositions of Australian bass recorded for each event (year_month) over the monitoring period in Brogo Dam. N equals the total number of fish measured for each event.

6.3.3. Freshwater Fishing Masters (Lake Mulwala)

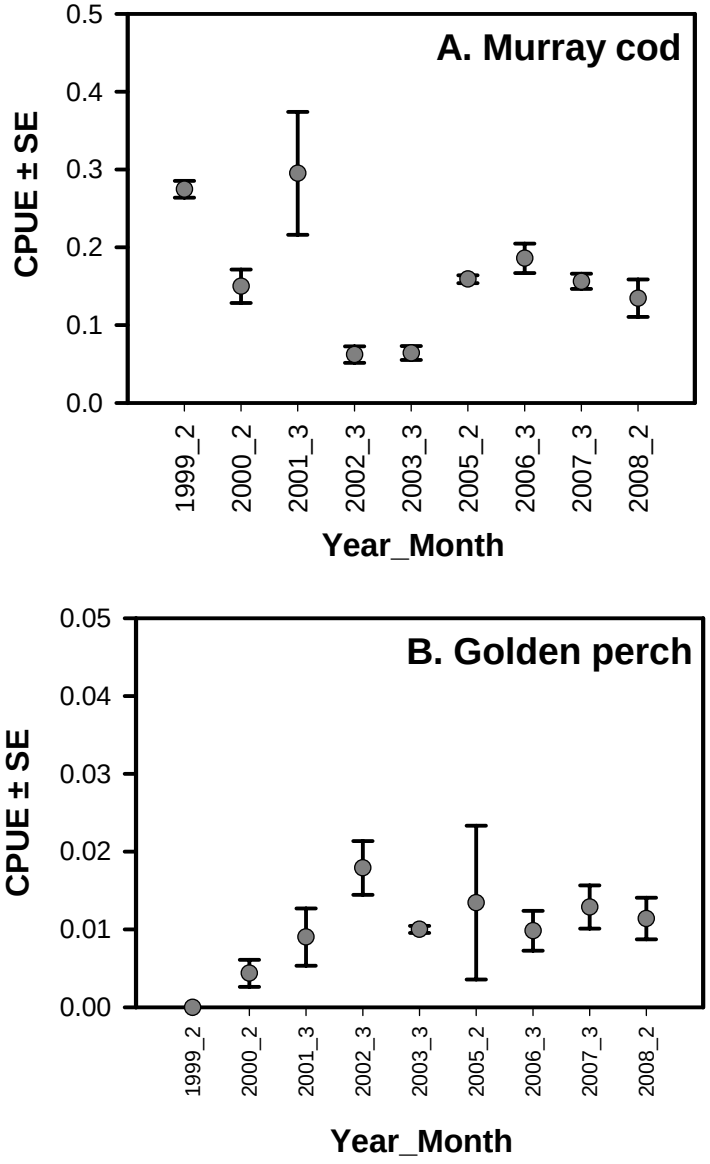

Figure 84. Catch per unit of effort as the number of fish per angler hour (± standard error) of a) Murray cod; and, b) golden perch for each event (year_month) of the Freshwater Fishing Masters in Lake Mulwala over the monitoring period.

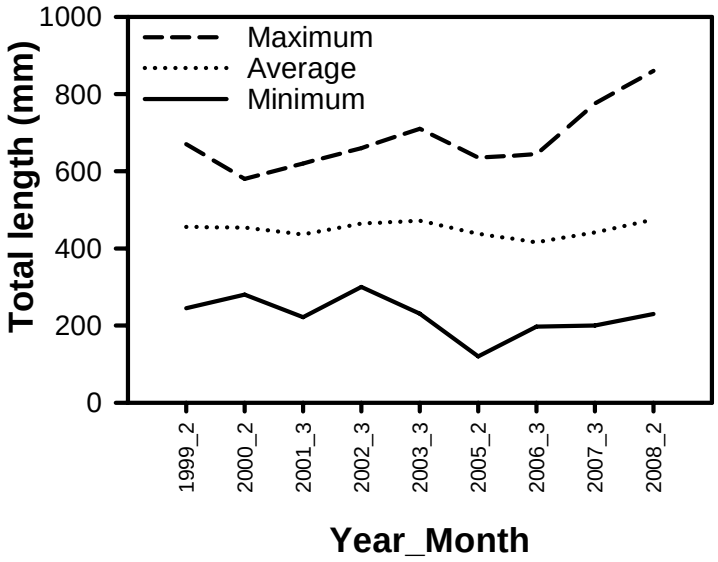

Figure 85. Minimum, maximum and average (± standard error) total lengths of all golden perch recorded for each event (year_month) of the Freshwater Fishing Masters over the monitoring period in Windamere Dam..

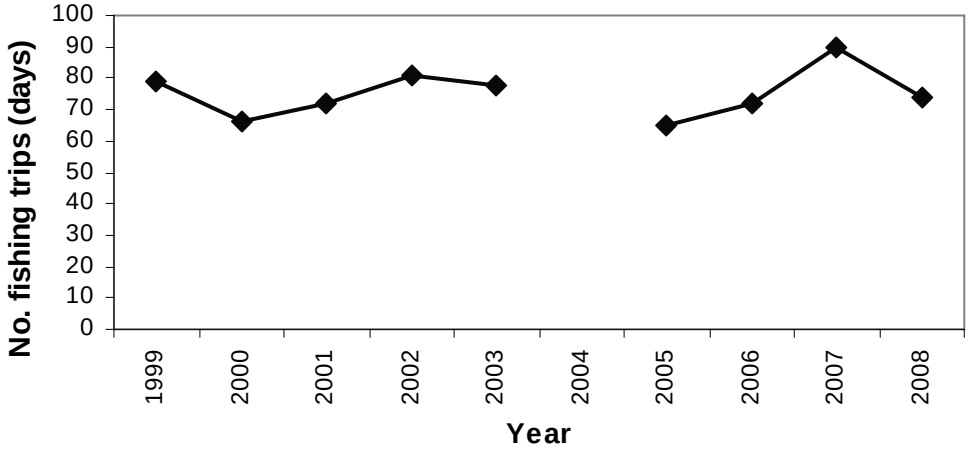

Figure 86. The total number of angler days of fishing recorded during each calendar year for all the events of the Freshwater Fishing Masters monitored in Lake Mulwala.

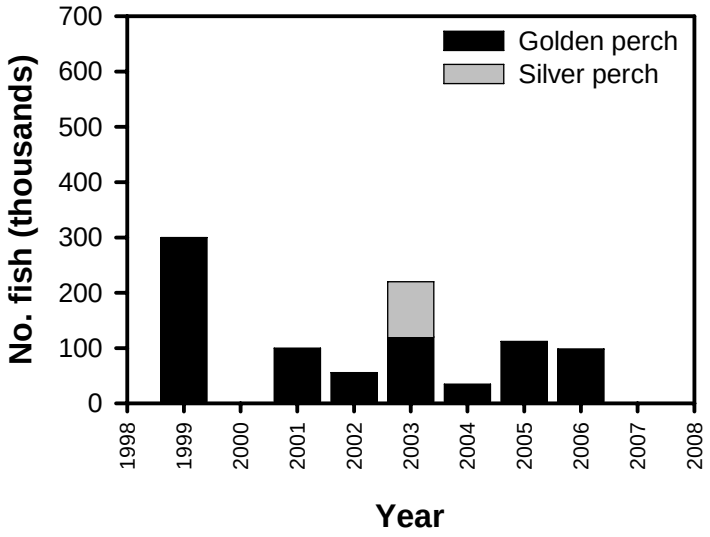

Figure 87. Number of each species stocked in Lake Mulwala through time. Species that have been stocked in this impoundment include golden perch and silver perch.

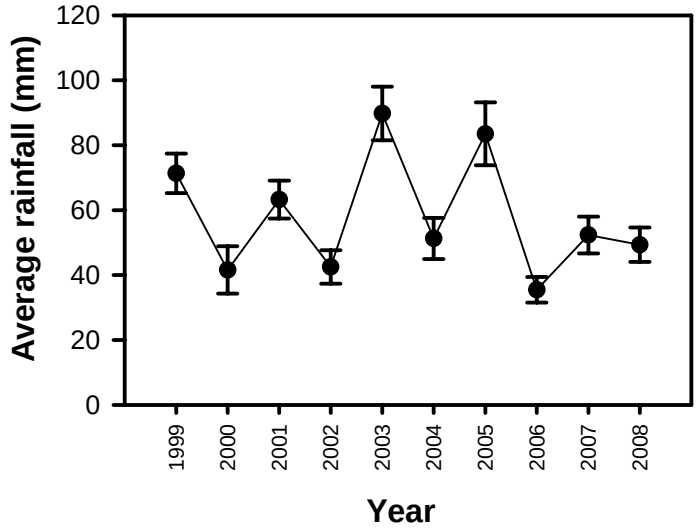

Figure 88. Average monthly rainfall (± standard error) for Lake Mulwala (Yarrawonga) through time. Rainfall data were obtained from the Bureau of Meteorology station number 81124.

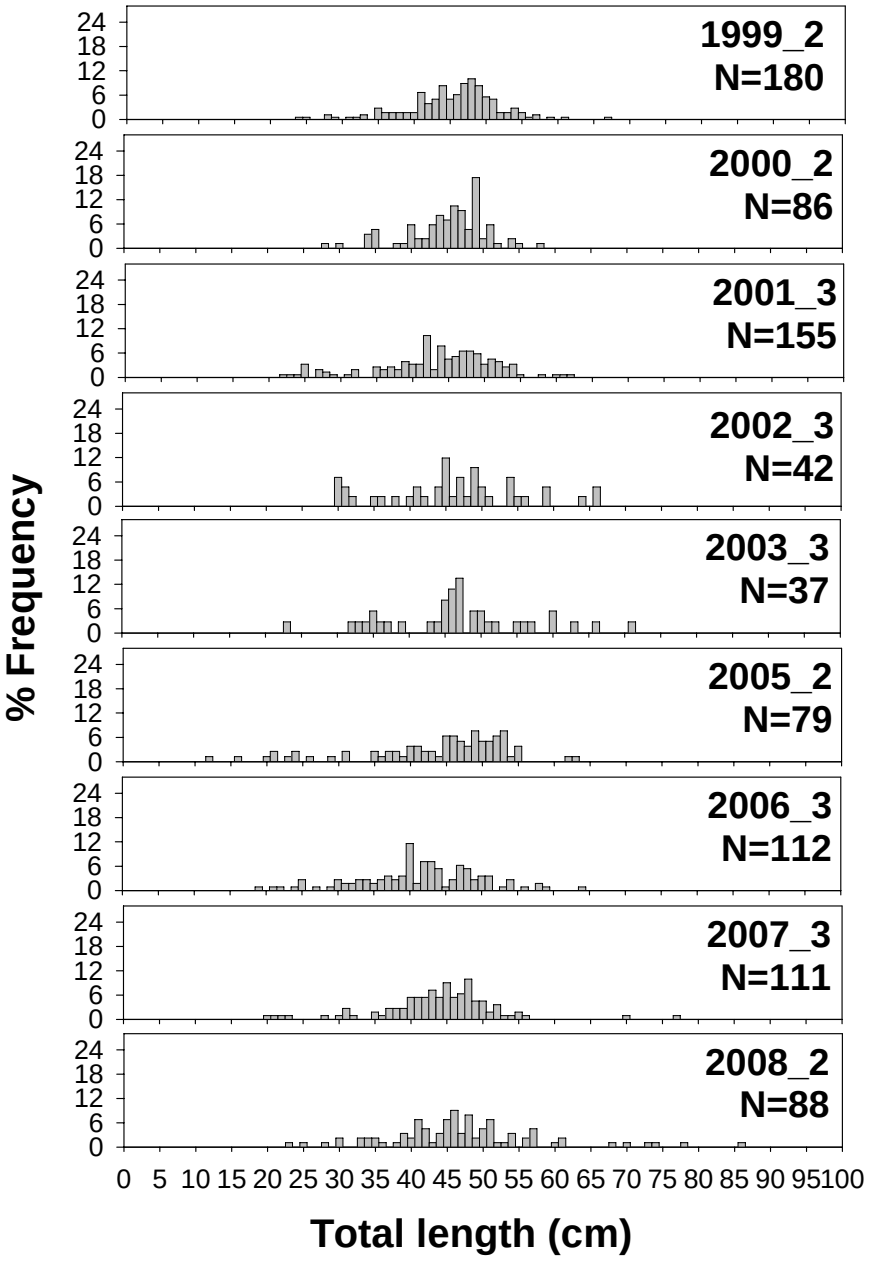

Figure 89. Length frequency compositions of Murray cod recorded each event (year_month) of the Freshwater Fishing Masters over the monitoring period in Lake Mulwala. N equals the total number of fish measured for each event.

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