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# Comparative Angler Catches of Australian Bass (*Macquaria novemaculeata*) in Three Major River Systems in New South Wales, Australia

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## Abstract

A joint program between New South Wales Fisheries and three fishing clubs was initiated in 1988 with the aim of collecting standardised catch and effort data during biannual fishing competitions on three major rivers in New South Wales. This paper examines the data to determine trends in the catch of the target species, Australian bass (*Macquaria novemaculeata*) and to evaluate whether the data can be used to assess Australian bass populations over time. Distinct trends in Australian bass mean length in each river system were evident but catch rates were more variable. Median catch per unit effort was similar (mostly between 0.5 and 1.5 Australian bass$\cdot h^{-1}$ ) in the Nepean and Williams Rivers although catch rates in the Manning River were nearly always zero. There was an increasing trend in the mean length of Australian bass in all three rivers, possibly representing a recovery in fish populations following severe drought from 1979 to 1983. Low or zero catch rates were continually recorded in the Manning River and size composition data indicated a lack of recruitment through most of the study period. The standardised format of the data collection program provided qualitative and reliable time series data allowing the determination of long-term trends in the population structure of Australian bass which can be used for monitoring and management purposes.

## Introduction

Recreational angling is a major outdoor activity of great economic and social benefit to the Australian community (Henry 1984). Concern about the sustainability of Murray cod (*Maccullochella peelii*) populations, and conflict with the interests of recreational angling led to the closure of the commercial freshwater fishery in the state of New South Wales (NSW) to new entrants since 1983. The fishery has recently been restricted to the harvest of decapods (mainly *Euastacus armatus* and *Cherax destructor*) and carp (*Cyprinus carpio*). Therefore, recreational fishing is now the major means of fish harvest in rivers. Fishing license sales indicate that an estimated 190,000 participants fished in impoundments and inland rivers in 1998-99 (J. Diplock, pers. comm.). These waterways support substantial recreational fisheries for native fish and trout species. Despite the popularity of recreational angling, published reports on the recreational freshwater catch in NSW are few and most publications are concerned with assessments of marine fisheries (Pollock and Williams 1983, Henry 1984, West and Gordon 1994, Gartside et al. 1999) or with assessments of the status and ecology of riverine fish communities (Harris and Gehrke 1997). Freshwater fishery assessments in NSW are limited to a review of the commercial Murray cod fishery (Rowland 1989) and one-off surveys in impoundment fisheries that have been stocked to enhance recreational fishing (Battaglene 1985; Faragher and Gordon 1992). The latter studies have been costly and are limited to specific waterways and/or time periods.

Angling club records have been used to assess marine (Gartside et al.1999, Pollock and Williams 1983, Coetzee et al.1989) and freshwater (Quertermus 1991, Lee et al. 1993, Cooke et al. 1998) recreational fisheries. Such club records are usually long-term in nature and represent an inexpensive and simple method for obtaining catch and effort data, while providing an opportunity for anglers to participate in the management of their fishery. However, certain aspects of club records need to be addressed to enhance their value as a research tool. These include the standardisation of data collection and recording, the recording of zero catches, accurate reporting of fishing effort and assessment of errors. The studies of Gartside et al. (1999) and Pollock and Williams (1983) used records that did not record fishing effort, making it difficult to determine catch rates. Gartside et al. (1999) concluded that the value of angling club records could be greatly increased if catch data were collected in a more standardised format.

“Basscatch” was established as a collaborative project between The Department of Primary Industries and freshwater fishing clubs. Its aim was to collect high quality, standardised catch data in major river fisheries which could be used to monitor the status of Australian bass populations and to indicate fish condition. Basscatch fishing competitions were initiated on the Nepean River in 1988 and thereafter on other major rivers using common fishing rules, competition scoring and data recording methods. This has resulted in the collection of standardised catch and effort data that allow for a direct comparison of Australian bass populations in NSW. Long term data sets exist for the Nepean, Manning and Williams Rivers (Fig. 1). All three rivers, on the eastern seaboard of NSW, are adjacent to urban populations and are popular and accessible fishing locations. They support important recreational fisheries based on Australian bass in the freshwater reaches and estuarine species in their lower reaches.

The Australian bass (*Macquaria novemaculeata*) is endemic to the eastern seaboard of Australia and is catadromous, migrating to estuaries to spawn and returning to freshwater as adults and juveniles (Harris 1986). Wild populations have declined as a result of dams and weirs reducing available habitat by about half and restricting catadromous migrations (Harris 1984a, b). The Australian bass is regarded as a prize sport fish based on its fighting and edible qualities and is classified as a recreational species in NSW preventing its commercial harvest.


Fig. 1. Map showing the (a) Nepean River; (b) Williams River; (c) Manning River in NSW.

This paper compares standardised catch statistics of Australian bass collected by recreational club anglers at biannual fishing events in three major coastal rivers. From the data, catch statistics and relative abundance of Australian bass are determined and assessed for their value in monitoring Australian bass populations over time.

### *Study sites*

#### Nepean River

The Nepean River rises in the Illawarra Range west of Wollongong and several major tributaries join the river before it enters the Hawkesbury estuary which discharges to the sea near Sydney (Fig. 1). The Hawkesbury-Nepean River is the principal freshwater system of Sydney. In the upper reaches of the Nepean river, water is impeded by a series of reservoirs including the Nepean Dam and four larger impoundments, the Avon, Cordeaux, Cataract and Warragamba reservoirs, situated on major tributaries of the river. There are 14 weirs downstream of the Nepean Dam and six of these weirs have working fishways (Gehrke et al. 1996). The catchment area of the Nepean River above Penrith Weir is 11,000 $km^2$. During the study period the mean daily water discharge reading at Penrith Weir was 2,475 (± 259 SE) megalitres·$day^{-1}$ and ranged from 26 to 611,227 megalitres·$day^{-1}$ (Australian Water Technologies Environment Measurement Services).

#### Williams River

The Williams River and its main tributary, the Chichester River, rise in the southern escarpment of the Barrington and Gloucester Tops before joining the Hunter River which discharges to the sea at Newcastle (Fig. 1). The catchment area of the Williams River above Glen Martin is 969 $km^2$. Mean daily water discharge recorded at Glen Martin during the study period was 477 (± 48 SE) megalitres·$day^{-1}$ and ranged from 0 to 104,000 megalitres·$day^{-1}$ (Department of Land and Water Conservation NSW surface water data archive version 6.1). The Seaham Weir in the lower reaches of the Williams River diverts water to Grahamstown Dam and has a fishway enabling fish migration (Harris 1984a).

#### Manning River

The Manning River rises in a plateau area of the Mount Royal Range north of the Barrington Tops and discharges to the sea at Taree (Fig. 1). The river has several tributaries, three of which have weirs with no fishways (N. Taffs, pers. comm.). The catchment area of the Manning

River above the estuary is 6,560 $km^2$. Mean daily water discharge during the study period was 2,347 (± 66 SE) megalitres·$day^{-1}$ and ranged from 57 to 279,720 megalitres·$day^{-1}$ (Department of Land and Water Conservation NSW surface water data archive version 6.1).

## Methods

### *Data collection*

Biannual fishing club events are held in each river system on weekends in the same months every year. Competitors fish from boats or canoes for Australian bass and the fishing events are conducted according to set rules. Participants are allowed to fish between 0600 and 1800 hours on Saturday and between 0600 and 1200 hours on Sunday. Fishing events occur in a defined stretch of each river. Data are recorded in fishing sessions of no defined length and separate sessions are recorded for Saturday and Sunday and whenever an angler has a break from fishing. Fishing time (excluding breaks) by each angler and measurements of the fork length in mm of all Australian bass (including undersize fish) caught are recorded for each fishing session on a special purpose catch-card designed by research staff. Rivers are divided into reaches which are recorded for each fish caught. Anglers may use lure or fly and one rod only. All fish caught are usually released and measurements are verified by another angler. Points are awarded according to fish size to determine the winners of events. A club officer usually takes responsibility for collecting all catch cards at the completion of each event, including cards with zero catch. Catch records have been collected biannually in the Nepean River since 1988 and in the Williams and Manning Rivers since 1990 and 1991, respectively. These events are usually held on the same two weekends every year but occasionally fishing events have had to be postponed because of flooding.

### *Data analysis*

Catch per unit effort (CPUE) provides a measure of the quality of a fishery and is widely used as an estimation or measure of relative abundance (Ricker 1975). CPUE was expressed as the number of Australian bass caught per angling hour in each system at each event. The mean length of Australian bass was also determined. Analysis of variance (ANOVA) and a posthoc comparison using Tukey’s honestly significant difference test (Statsoft 2000) was used to assess the significance of differences in mean length between seasons and between years for each season. A 0.05 alpha level was used in the analysis. Size data from autumn and spring/summer Basscatch events were combined to determine length-frequency distributions for each river to increase sample sizes enabling comparison of catches between years.

Fishing conditions in river systems can be influenced by factors such as weather and flood levels, the latter being most likely to influence fishing conditions. Catch rates in Basscatch events could be expected to be depressed during spates when fishing conditions become more difficult. Water discharge data (megalitres·day$^{-1}$) are recorded daily by the Department of Land and Water Conservation (NSW surface water data archive version 6.1) in the Williams and Manning Rivers and by Australian Water Technologies Environment Measurement Services in the Nepean River. Data from seven days, including the fishing event days and five days prior to an event, were used to calculate mean water discharge which was regressed against CPUE for each event. These data were used to determine any relationship between CPUE and river discharge levels.

## Results

### *Competition information*

Summary information of Basscatch events held on the three rivers are shown in table 1. A total of 18,107 Australian bass were caught and recorded by anglers during 16,995 h of fishing in Basscatch events in this study (Table 1). Participation has been highest in the Nepean River events followed by the Williams and Manning Rivers (Table 1). Fish as small as

Table 1. Summary information of Basscatch events held on the Nepean, Williams and Manning rivers

| | Nepean River | Williams River | Manning River |
|---|---|---|---|
| First event | October 1988 | November 1990 | November 1991 |
| Number of events held | 26 | 22 | 19 |
| Competition months | February/October | March/November | April/November |
| Total number of anglers | 1034 | 684 | 416 |
| Total number of fishing sessions | 1583 | 1321 | 659 |
| Total effort (h) | 8111 | 6131 | 2753 |
| Total number of Australian bass caught | 9704 | 7893 | 510 |
| Mean number of anglers per event ± (SE) | 41 (0.4) | 33 (0.5) | 23 (0.5) |
| Mean fishing effort per event (h) ± (SE) | 312 (15.3) | 289 (26.7) | 149 (16.9) |
| Mean number of Australian bass caught per event ± (SE) | 373 (36.9) | 371 (57.5) | 28 (5.0) |
| Median CPUE per river | 0.7 | 0.8 | 0 |
| (Mean CPUE per river) (Australian bass·h$^{-1}$) | 1.3 | 1.2 | 0.2 |
| Mean fork length (mm) ± (SE) | 195 (0.6) | 215 (0.6) | 330 (3.5) |
| Length range of fish (mm) | 50-425 | 50-510 | 100-580 |
| Percentage of sessions with zero catch of Australian bass | 22 | 21 | 67 |

50 mm were caught in the Nepean and Williams River while the largest recorded Australian bass was caught in the Manning River with a length of 580 mm and estimated weight of 3.9 kg (1987).

***Angler success***

Overall success was high in the Nepean and Williams rivers, with only 22% and 21% of sessions, respectively, resulting in a zero catch (Table 1). The number of Australian bass caught per fishing session ranged from 0 to 82 and 0 to 95 per fishing session in the Nepean and Williams Rivers, respectively (Fig. 2). In the Manning River, 67% of all fishing sessions had a zero catch with the number of Australian bass caught per fishing session ranging from 0 to 14 fish.

***CPUE***

The distributions of the catch frequencies for the three rivers were non-normal and skewed to the right (Fig. 2). This phenomenon is typical of angling results, in which a small proportion of anglers usually catch a large proportion of the total catch (Small 1991). The calculation of a mean catch rate is usually based on a symmetrical normal distribution which allows the determination of

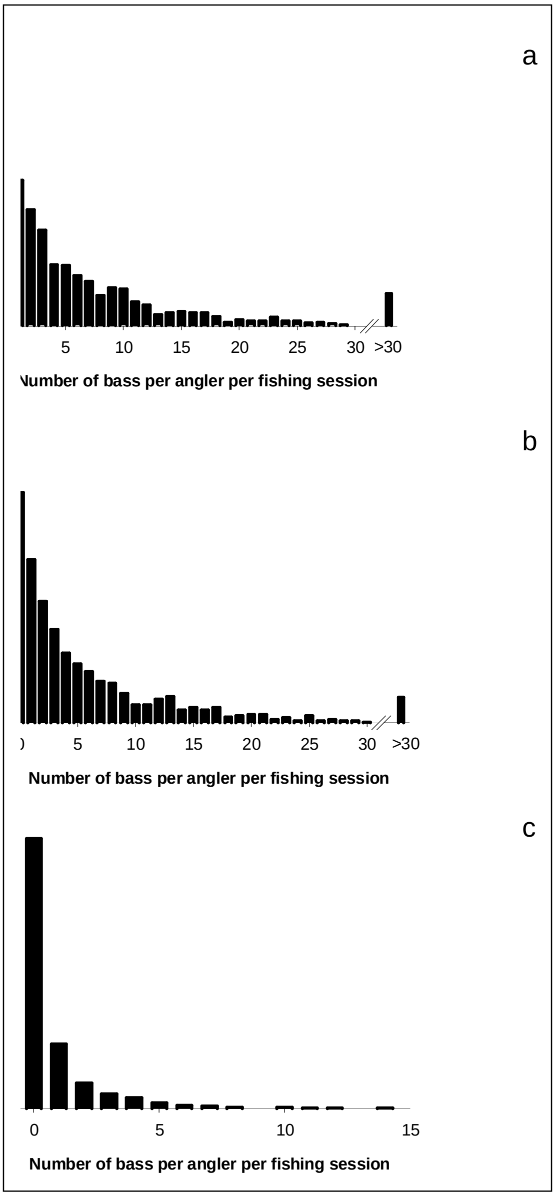


Fig. 2. The percentage of anglers catching various numbers of Australian bass in fishing session during Basscatch events between 1988 and 2001 held on the (a) Nepean River; (b) Williams River; (c) Manning River.

confidence intervals and the rejection region which is split equally between both tails of the distribution (Jones et al. 1995). The mode is an alternative central value that can be used to indicate the location of a distribution (Mood and Graybill 1963). Because of the skewed nature of the distribution of fishing success in this study, CPUE was expressed as a median catch rate rather than as a mean catch rate.

CPUE of all Basscatch events in the Nepean and Williams Rivers were comparable (Table 1). The majority of CPUE values for each event in the Nepean and Williams rivers were between 0.5 and 1 Australian bass·h$^{-1}$ (Fig. 3). Catch rates in the Nepean River were comparable between seasons and relatively stable from 1988 to 1996. CPUE decreased in the four events during 1997 and 1998 although catch rates increased after 1998 to near the rates recorded in previous years.

A similar trend in CPUE was recorded in Basscatch events on the Williams River and catch rates were relatively stable over the 11 year period. Although median CPUE values of zero were recorded in summer 1992 and 1993, this was followed by the best return to anglers in autumn 1993 in which the highest median catch rate of 1.8 Australian bass·h$^{-1}$ was recorded. Despite infrequent individual catches of up to 14 Australian bass in fishing sessions in the Manning River (Fig. 2), median CPUE values recorded in each event were mostly zero. Exceptions were Basscatches held in autumn 1995 and 1996 in

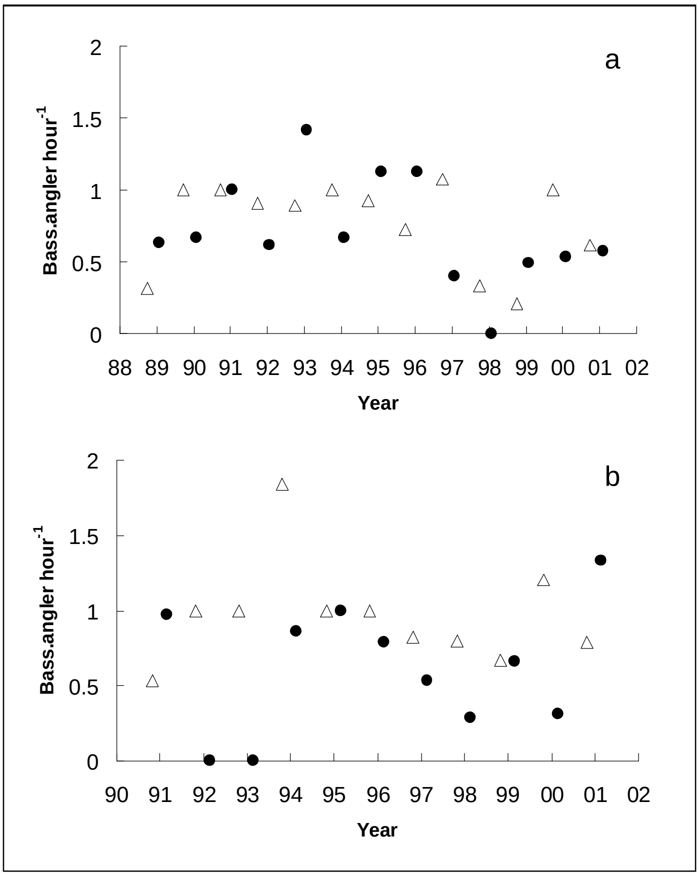


Fig. 3. CPUE (median) of Australian bass caught by anglers during Basscatch events between 1988 and 2001 held on the (a) Nepean River-spring events (êê), summer events (ll); (b) Williams River-spring events (êê), autumn events (ll).

which median catch rates of 0.2 and 0.4 Australian bass·$h^{-1}$ were recorded, respectively.

#### *Regression analysis*

The locations for river discharge data collection by state government agencies were Penrith Weir on the Nepean River and Glen Martin on the Williams River. No regression was calculated for data from the Manning River as median catch rates in Basscatches were mostly zero. There were no significant correlations detected between river discharge and Australian bass catch rates between any years for the Nepean ($F = 0.21$, $r = 0.009$, $P > 0.05$) and Williams ($F = 4.4$, $r = 0.28$, $P > 0.05$) Rivers.

#### *Mean length*

Size compositions of the catch in each of the three rivers had normal distributions and mean lengths of all Australian bass caught in each of the three river systems varied significantly between years ($F = 2669$, $df = 8$, $P < 0.05$) and were different from each other (Tukey's HSD) (Table 1). Mean length of Australian bass in the Manning River was substantially higher compared to mean length in the other two rivers (Table 1).

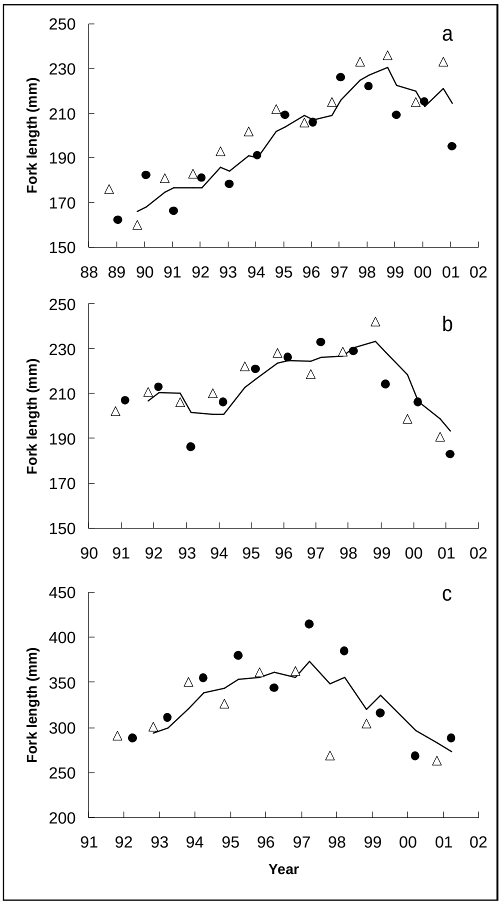


Fig. 4. Mean length of Australian bass caught by anglers during Basscatch events during 1988 and 2001 held on the (a) Nepean River-spring events (êê), summer events (ll); (b) Williams River-spring events (êê), autumn events (ll); (c) Manning River-summer, events (êê), autumn events (ll). The solid curves were fitted to 3 year moving averages and represent trends. Note y axes are Fork length (mm)

**Nepean River**

There was a significant difference between seasonal mean lengths in the Nepean River ($F = 60.1$, $df = 12$, $P < 0.05$) and mean lengths recorded in spring Basscatches were mostly higher than mean lengths in summer (Fig. 4). Between years, there were also significant differences in mean length in spring and in summer (Tukey's HSD). A moving average was fitted to the mean lengths recorded in spring and summer events to illustrate trends. There was a marked increasing trend in the mean length of Australian bass from 1988 to 1998 after which the mean length decreased slightly (Fig. 4). This is evident in the size compositions (Fig. 5). These are baseline indicators which can be used to monitor changes (if any) in the size structure of the fishery. The modes were between 140 and 160 mm from 1988-89 to 1992-93 and had increased to 220 mm by 1998-99. Numbers of small fish increased in the catches thereafter which decreased the mode.

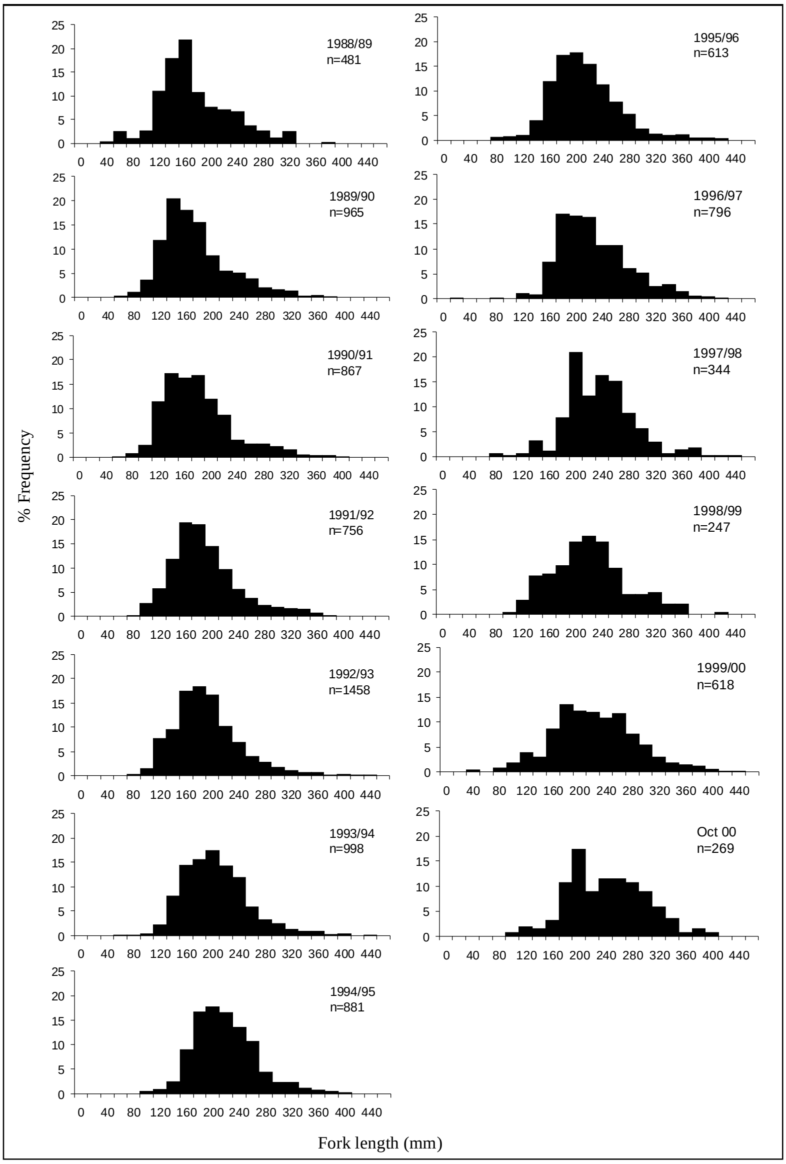


Fig. 5. Annual length-frequency distributions of Australian bass caught by anglers during Basscatch events between 1988 and 2001 on the Nepean River. Distributions combine autumn and spring/summer events were combined for each year to give an annual size composition.

**Williams River**

Mean lengths between seasons were not significantly different in the Williams River ($F = 0.5$, $df = 10$, $P < 0.05$) and mean lengths in spring and summer were similar (Fig. 4). However, pooling spring and summer data resulted in a significant difference between years (Tukey's HSD). An increasing trend was evident in the mean length of Williams River fish although this trend was not as marked as in the Nepean River. Mean lengths decreased after 1999 in the Williams River. Comparison of size compositions indicated little difference in the length-frequency distributions between years, except in 1999/00 and November 2000 when high numbers of small fish were captured (Fig. 6).

**Manning River**

There were no significant seasonal differences in mean length between autumn and summer competitions in the Manning River ($F = 3.7$,

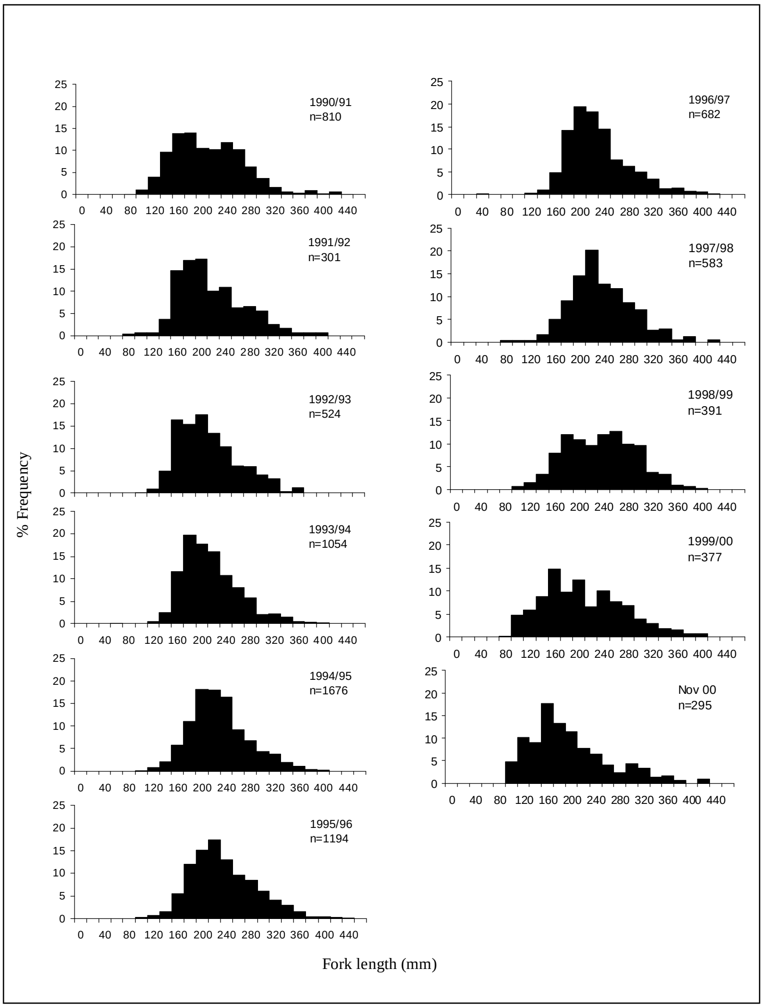


Fig. 6. Annual length-frequency distributions of Australian bass caught by anglers during Basscatch events between 1990 and 2001 on the Williams River. Distributions combine autumn and spring/summer events were combined for each year to give an annual size composition. The 1999-2000 distribution is not shown because the November 1999 Basscatch event was cancelled due to bad weather and only one fish was caught during the April 2000 event.

df = 8, P < 0.05) but there was a significant difference between years of pooled seasonal data (Tukey's HSD). Despite low catch rates of Australian bass in the Manning River, an increasing trend in mean length observed in the Nepean and Williams Rivers was also apparent in this system (Fig. 4). The mean length of Australian bass decreased in the four years of Basscatch events to 2001. The mean length in the Manning River was always at least 70 mm larger than the mean length in the other river systems until 1997 after which the mean length started to decline. Length-frequency distributions revealed this distinct difference in the size of catches compared to the Nepean and Williams Rivers' catches, with large fish dominating catches in all years in the Manning River (Fig. 7).

## Discussion

***Angler catch in the Nepean, William and Manning rivers***

To measure and compare fishing quality and relative abundance of Australian bass between river systems, we used the median catch rate. Apart from a few events in which very low or zero catch rates were recorded, median catch rates in the Nepean and Williams rivers were mostly between 0.5 and 1.5 fish·h$^{-1}$ (Fig. 2). Individual angler median catch rates ranged as high as 20 fish·h in the Nepean River and 10.75 fish·h$^{-1}$ in the Williams River. Catch rates of Australian bass determined from catch cards at stocked impoundments in Queensland ranged between 0.01 and 0.77 fish·angler·h$^{-1}$ (Holloway et al. 1999). Following the success of the Basscatch program in this study, additional events have been recently established on other major rivers in NSW and median catch rates of between 0 and 0.48 Australian bass·h$^{-1}$ have been recorded (Department of Primary Industries, unpublished data). Basscatch CPUE values in the Nepean and Williams Rivers mostly exceeded those recorded in Queensland stocked impoundments and other river systems in NSW. The Nepean and Williams Rivers have not been stocked with hatchery fish and catch rates in these systems represent abundances of wild populations of Australian bass.

Distinct trends in mean length in each river system were evident, but catch rates were more variable. The dates and times of Basscatch events are predetermined and thus anglers cannot select optimal fishing times. Furthermore, the data in this study represent fishing effort collected on only two weekends per year for each river system which may explain some of the variability of catch rates. Catch rates of other fish species have been shown to be affected by a variety of environmental factors and significant correlations between anglers' catch and factors such as water discharge levels and water temperature have been found (Aprahamian and Ball 1995; Slipke et al. 1998; L' Abée-Lund and Aspås 1999). Basscatch anglers report that fishing conditions are affected by spates during which catch rates of Australian bass usually decrease. However, there was no statistical association between catch rates and river discharge recorded in the Nepean and Williams rivers. How discharge levels influence the activity patterns of Australian bass is unknown but Basscatch anglers report that fishing conditions become more difficult during high discharge events which in turn influence catch rates.

Because Australian bass are catadromous, artificial barriers such as weirs and dams have obstructed spawning and recruitment migrations of Australian bass in many coastal rivers and in some rivers, migration is only possible in those years during which high flows drown-out barriers (Harris 1984b). A severe drought period was experienced between 1979

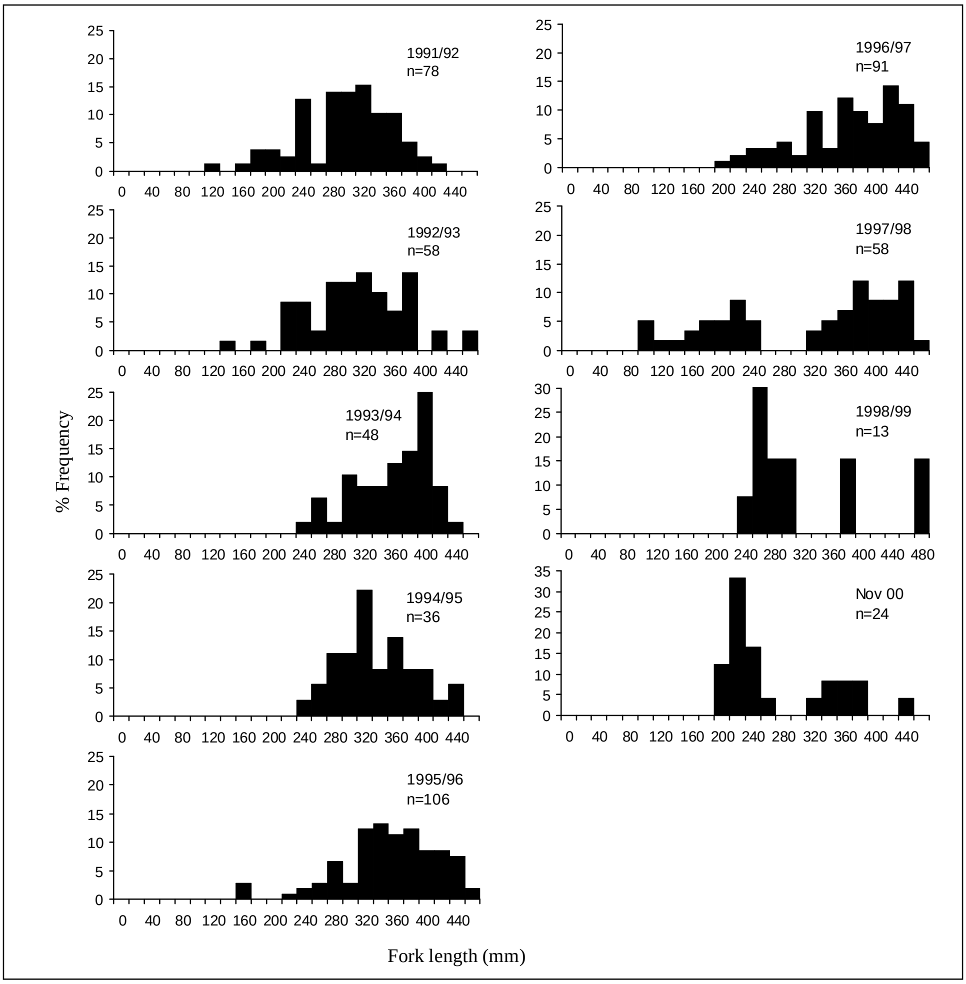


Fig. 7. Annual length-frequency distributions of Australian bass caught by anglers during Basscatch events between 1991 and 2001 on the Manning River. Distributions combine autumn and spring/ summer events were combined for each year to give an annual size composition.

and 1983 in NSW which would have impacted severely on Australian bass populations. Harris (1988) observed zero or very low recruitment of Australian bass during this drought period in a study on the Hawkesbury-Nepean system using a variety of sampling techniques. A decrease in the mean size and age of fish over this four year period was also observed, which was possibly attributed to fishing mortality. Flooding was the most important mechanism controlling cohort strength and subsequent population abundance, and other factors such as food abundance and loss of macrophytic habitat were probable secondary controls (Harris 1988). Length data recorded in this study have indicated trends in the population structure in the Nepean River. Mean length increased significantly from the initiation of Basscatch events in 1988 up until 1998 and catch rates remained relatively stable. During this period, small fish were present in the catches in all years suggesting a recovery in the recruitment of Australian bass populations from the severe drought when recruitment was low or zero. This trend is also supported by a gill net survey conducted by Gehrke et al. (1996) which indicated an increase in the abundance of the Australian bass population over a similar period. An upgrade of the fishway at Penrith Weir in 1987 may have also contributed to an increase in the Australian bass population observed in this study and by Gehrke et al. (1996).

An increasing trend in mean length of Australian bass was also evident in the Williams River up until 1998 although the trend was less marked than that observed in the Nepean River. Catch rates remained relatively stable during this period and may also suggest a recovery in the Australian bass population from the effects of drought experienced between 1979 to 1983. After 1999 mean length decreased but catch rates either remained the same as in previous years or increased. Catch rates of Australian bass were dominated by smaller fish after 1998 and the decrease in mean length may be attributable to a strong year class of Australian bass observed during Basscatch events in these later years (Fig. 6).

By using angler catches to study fish populations, we assume that catches are representative of fish populations (Cowx 1991). This is reasonable to assume in this study as fish as small as 50 mm were caught in the Nepean and Williams Rivers. Catch rates in the Manning River were mostly zero and there was almost the virtual absence of small fish. This may indicate prolonged recruitment failure and a possible need for management intervention. The mean length of Australian bass in the Manning River was higher than in the other two river systems and showed a similar increasing trend in the early years to that observed in the other systems. This may indicate a recovery in the Australian bass population following the effects of drought. However, catch rates have remained low or zero and is more likely representative of low natural recruitment levels and an ageing, non-recruiting population. There are no obvious reasons to explain the low population density reflected in catch rates and apparent lack of small fish evidenced by a large mean length and size composition data of Australian bass compared to the Nepean and Williams rivers. The presence of three weirs with no fishways on three minor tributaries of the Manning River may obstruct localised fish passage. However, the impacts of these barriers to the passage of the Australian bass population in the Manning River system would be expected to be minimal. There are historical reports of substantial mortalities of spawning Australian bass in the lower reaches of the Manning River caused by commercial fishers. However, recent by-catch surveys of the commercial catch in the estuaries of two northern NSW rivers have reported low or zero catch rates of Australian bass (Gray 2002). There are also unconfirmed reports that acid-sulphate soil drainage in the lower river has possibly blocked or killed upstream migrating juveniles in the last decade (M. Riches, pers. comm.).

Stockings of hatchery-reared fish have been used successfully to enhance depleted fish populations in freshwater habitats (Kayle 1992, Tsukamoto 1995, Peck et al. 1999). Following poor catch rates of Australian bass in the Manning River during the first four years of Basscatch events, an experimental stocking of 20,000 hatchery-reared juveniles were released into the river in October 1995. Strontium-bath marking failed to identify these fish (Brown and Harris 1995). However, assuming survival of stocked juveniles, the mean size of the catch would be expected to decrease following the entry of small stocked fish into the fishery while CPUE should increase. A decreasing trend in mean length similar to that observed in the Nepean and Williams Rivers was apparent in the last four years of the Manning River Basscatch time series. Some of the small-sized Australian bass in these catches, such as in 1997-98 (Fig. 7) may have originated from the stocking and the size of fish caught were consistent with predicted growth rates of Australian bass determined by Harris (1985 1987). However, these fish may have also resulted from natural recruitment. It is recommended that any future stockings of Australian bass, particularly into the Manning River, are marked to enable identification and survival estimation.

***Efficiency of data collection using Basscatch***

The absence of any compulsory catch reporting systems in the NSW recreational freshwater fishery and the large number of accessible fishing sites and participants makes the collection and assessment of accurate catch and effort data difficult. On-site surveys such as roving creel surveys have been conducted in Australian recreational fisheries providing estimates of total catch (Koehn 1984, Battaglene 1985, Hall and MacDonald 1985a, b 1986, West and Gordon 1994). Such surveys involve the calculation of catch rates based on incomplete trips which can result in possible sources of bias and variation (Wade et al. 1991). Some studies have also used the number of licence sales (Churchward and Hickley 1991) and average fishing time (Koehn 1984, Gartside et al. 1999) to estimate fishing effort which may not relate to time actually spent fishing. Another major problem with catch returns from anglers is the tendency for anglers not to report zero catches (Rose and Hassler 1969, Small 1991). Catch data from Basscatch events in this study are based on complete trips and the data are exclusive of breaks, the inclusion of which would overestimate fishing effort. Basscatch data also represent targeted effort for Australian bass which makes it indicative of the true catch rate and abundance of this species (but only in areas where competitions take place). A major limitation of creel and other short term surveys for management of recreational fisheries is variation in catch over time (Gartside et al. 1999). Basscatch has provided ongoing time series data which serve to reduce variation around the means. Studies using competition data and fishing club records are also usually restricted to large fish which can qualify for prizes or fish that exceed the minimum legal lengths (Quertermus 1991, Cooke et al. 1998). Every Australian bass caught during Basscatch events is measured, as all fish (including undersize) contribute to the points tally of anglers. This study has shown that the standardised data collection process used in the Basscatch program results in qualitative and reliable time series data. Furthermore, the requirement for verification of fish measurements by other anglers encourages accurate data recording.

The standardised format of data collection in the Basscatch program has provided an opportunity to document long-term trends in the population structure of Australian bass. This paper has shown that the data can be used as an effective measure of fishing quality of club anglers and the relative abundance of Australian bass. Estimates of total catch are not possible from our data, but the program does provide accurate, standardised mean length data and indices of abundance which can be used for monitoring and management purposes. Although one-off surveys have provided data on the abundance of Australian bass in the Hawkesbury-Nepean River (Harris 1988, Gehrke et al. 1996) and other river systems (Schiller et al. 1997), no long-term monitoring studies have been done in NSW except for the Basscatch program. Given the importance of recreational freshwater fishing, the lack of data on freshwater river populations is of significant concern. The Basscatch program has provided a non-destructive, quantitative method of sampling popular angling species in large rivers that is not achieved easily by other sampling methods. As a collaborative study, largely supported by voluntary effort, the cost of the Basscatch program has also been minimal compared to other survey methods. The success of this program is dependent on the interaction between anglers and a fisheries agency and the production of regular basic summary statistics as feedback for the participating clubs is an essential component of such a program.

The number of organised competitive fishing events has increased in recent years in NSW. In some states in the USA, these events are regulated by fisheries agencies and provide opportunities to collect catch statistics and biological data efficiently and economically (Willis and Hartmann 1986, Schramm et al. 1991). Because of the success of the Basscatch program, the established procedures for data collection have recently been extended to other fishing events and competitions targeting Australian bass and other recreational species in the major riverine and impoundment fisheries around the state. This expanded program should provide information which can be used to monitor the status of recreationally exploited fish populations, measure the effectiveness of stocking programs and detect the responses of major recreational fish populations to any changes in management regulations in NSW.

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