

## CHARACTERISTICS OF RECREATIONAL ANGLERS IN THE BLACKWOOD ESTUARY, A POPULAR TOURIST DESTINATION IN SOUTHWESTERN AUSTRALIA

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Recreational anglers were interviewed in the Blackwood Estuary, Western Australia, to ascertain demographics, spatial and temporal patterns of use, expenditures, and attitudes to conservation and fisheries management. Although almost half of the angling groups encountered were tourist families staying in caravan parks, most anglers were male, 31–45 years old, with relaxation as the primary motive for fishing. On average, boat-based anglers fished more frequently than shore-based anglers and locals fished more frequently in the Blackwood Estuary than tourists. Expenditures by anglers on bait, tackle, and capital equipment were considerable. Although support for biodiversity conservation measures and fisheries management regulations was high, noncompliance with minimum size limits was common and further education of anglers appears to be necessary. The study has shown that for fisheries management purposes, any creel survey of the Blackwood Estuary should ensure that local anglers and boat-based anglers are adequately surveyed.

Key words: Fishing; Expenditure; Catches; Attitudes; Compliance

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### Introduction

Recreational fishing is undertaken for sport or leisure purposes and, in developed countries, more leisure time and affluence have led to increased participation rates (Kearney, 2002a). While harvest of fish for food may not be the primary objective, it is often an important outcome for anglers, and, for some species, landings by recreational anglers ex-

ceed those of the commercial sector (Coleman, Figueira, Ueland, & Crowder, 2004). Internationally, recreational fishing is usually managed by output controls (e.g., bag and size limits), with no restriction on the number of anglers that may participate (Coleman et al., 2004).

Increasingly, there is recognition that fisheries management requires understanding of both the fish stocks and the users of the resource (i.e., anglers)

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(Ditton & Hunt, 2001; Smith & Pollard, 1996). Unfortunately, the social science aspects of fisheries management have often been neglected, despite the need for understanding of the motivations, behavior, and attitudes of the people involved (Jennings, Kaiser, & Reynolds, 2001). Recreational anglers are diverse with many different motivations, and impacts of management strategies will differ among anglers (Kearney, 2001). Knowledge of angler characteristics is also useful to efficiently target educational efforts with respect to the angling community (Ditton, 2002).

Recreational angling is a popular activity in Western Australia, with around 600,000 people or 35% of the population estimated to go fishing at least once a year (Penn, Fletcher, & Head, 2003). Anglers in Western Australia often travel considerable distances to reach favored fishing locations (Cusack, 2004) and estuaries are focal places for recreation as they are accessible, sheltered, and offer high-quality fishing opportunities. Although a few creel surveys of recreational fishing have been conducted in Western Australian estuaries (Caputi, 1976; Malseed & Sumner, 2001a, 2001b; Malseed, Sumner, & Williamson, 2000), collection of demographic and socioeconomic information about anglers has been very limited.

The present investigation was undertaken as a pilot study in preparation for a comprehensive creel survey to be conducted in the Blackwood Estuary and presented an opportunity to conduct detailed questionnaires with recreational anglers. Information about their demographics, socioeconomics, spatial and temporal patterns of use, and attitudes to fisheries regulations and biodiversity conservation was collected in order to develop a profile of recreational anglers in the Blackwood Estuary. This was timely in view of plans to establish a marine protected area in the region (Department of Conservation and Land Management, 2004).

## Methods

### Study Area

The Augusta-Margaret River region in southwestern Australia has become a major tourism node, and the town of Augusta, located adjacent to the Blackwood Estuary (Fig. 1), is a popular holiday destination and favored retirement locale (Brearley,

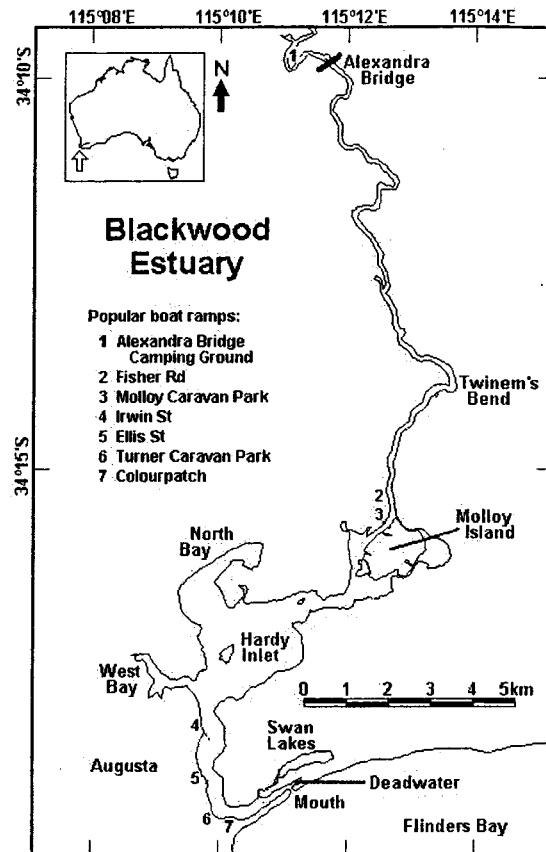


Figure 1. Map of the Blackwood Estuary, Western Australia, showing the study area, from the estuary mouth to Alexandra Bridge and the location of popular boat launching ramps.

2005). Many tourists are regular visitors and peak occupancy rates are attained over the summer and autumn months. Various recreational pursuits such as boat-based and shore-based angling, waterskiing, wind and kite surfing, sailing, canoeing, and swimming take place in the estuary.

The permanently open Blackwood Estuary experiences salinity fluctuations in response to river flow and tidal incursions (Hodgkin & Hesp, 1998). An entrance channel leads to a shallow basin of 9 km<sup>2</sup> (known as the Hardy Inlet), upstream of which the main river channel is 50–100 m wide and >5 m depth, with some deep holes >20 m (Hodgkin, 1978). The estuary is bordered by both private land and national parks, with boating access achieved via several boat launching ramps and private jetties around the townsite of Augusta and further upstream near

Molloy Island and Alexandra Bridge. For the purposes of this study, the estuary was defined as from the mouth to Alexandra Bridge, about 25 km upstream (Fig. 1).

The Augusta region experiences warm, dry summers and cool, wet winters, with most rain falling from May to September (Bureau of Meteorology, 2004). Winds blow strongly from the southeast in summer, with transitional, relatively calm, periods in April and October (Pearce & Pattiaratchi, 1999). Winter cold fronts generate gale force westerly winds, and these conditions result in heavy rainfall (Hodgkin, 1978).

#### *Questionnaire Survey*

Sampling was carried out on a seasonal basis in 2005, with four trips of 10 consecutive days (including 4 weekend days) undertaken. Each seasonal trip was designed to partially coincide with school holidays when there was an influx of tourists to the region, to allow a broad sample of anglers to be interviewed. Periods of interviewing boat-based and shore-based recreational anglers alternated between mornings and afternoons on consecutive days. The interviewers traveled from the mouth to Alexandra Bridge or vice versa in a small dinghy with a 15-hp outboard motor. By intercepting people actively participating in fishing, and only interviewing each angler once, selection and avidity biases (Pollock, Jones, & Brown, 1994) were minimized.

For each party of anglers intercepted, the number of people in the group and their approximate ages were ascertained and one representative (>16 years of age) was selected to answer the detailed questionnaire. In most interviews of boat-based anglers, the skipper of the boat nominated him/herself and undertook this role. Information was collected about the fishing trip in progress, demographics, place of residence, expenditures, general fishing activity, and extent of support for fisheries management regulations and biodiversity conservation measures. Fish retained by anglers were identified to species level (Hutchins & Thompson, 2001) and total lengths measured to the nearest centimeter. Anglers were asked to indicate the number of each fish species they had released during the fishing trip.

Data were entered and queried in a Microsoft Access database before analysis in Microsoft Ex-

cel. Interviewed recreational anglers were considered to be a "local" if they resided either in Augusta or the two adjacent postal districts, or a "tourist" if they were visiting from further afield. Occupations of anglers were classified according to the Australian Standard Classification of Occupations (McLennan, 1997), which is used to analyze Australian census data. Geographical coordinates of the localities where the interviewees were fishing were imported into the Geographic Information System (GIS) program, IDRISI, for spatial analyses.

#### Results

In total, 233 detailed questionnaires were completed with 131 boat-based and 102 shore-based angling parties, surveying 307 and 205 anglers, respectively. A further eight angling parties were "recaptured" for interview and, on those occasions, only data about the fishing trip in progress were obtained. The response rate was 99%, with only two parties declining to be interviewed. Most interviews were conducted in summer (47%) and autumn (34%), with low numbers of anglers encountered during winter (10%) and spring (9%) sampling periods. Recreational anglers were interviewed throughout the Blackwood Estuary and popular fishing spots were more heavily sampled. Nodes of shore angling were apparent in highly accessible locations, such as around the townsite of Augusta and at Molloy Island.

#### *Demographics*

The mean number of anglers per party was  $2.34 \pm 0.08$  (SE) on boats and  $1.99 \pm 0.10$  on the shore, while total group size (including persons not fishing) ranged from one to nine. The majority of anglers in the Blackwood Estuary were male (77%) and most were in the 31–45 year age group (Fig. 2). Males also dominated as interview respondents. However, about half of the boat-based and shore-based fishing trips were considered to be family outings, based on the presence of at least one adult female in the total group who may or may not have been fishing.

The occupations of most interviewed anglers of working age were classified as tradespersons and related workers, followed by professionals and associate professionals (Fig. 3). In total, 27% of the interviewees were retired, and many of these anglers

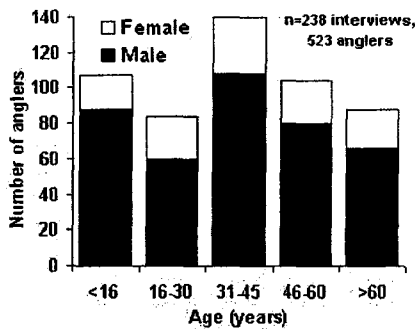


Figure 2. Age and gender of recreational anglers intercepted in the Blackwood Estuary, 2005.

cited the managerial occupation of “farmer” as their previous occupation.

Only 14% of interviewees were local residents and the rest were classified as tourists. Forty percent of all interviewed anglers were tourists who lived within 200 km of the Blackwood Estuary (about 2-hour drive) and a further 30% originated from the greater metropolitan area of Perth, Western Australia’s capital city, located >300 km to the north. Among the tourists, the city of Bunbury, approximately 150 km north of Augusta, polled highest as the place of primary residence.

Three quarters of all the tourist anglers staying at least 1 night indicated that they would be in the region

for a period for up to 1 week, while some anglers indicated that their stay would be of several weeks’ or months’ duration (Fig. 4). More than half of all tourist anglers staying in the Augusta region resided in local caravan parks (52%), with rented houses (12%), staying with family (11%), and camping (8%) the next most popular forms of accommodation.

### Fishing Trips

All anglers intercepted during the survey indicated that their fishing trip would take place between 6:30 am and 8:30 pm, except for one shore-based angling party who indicated that they had fished overnight. Linear trend lines through the data suggest that anglers who started earlier in the day fished for a longer period than those who started later in the day. Of the 225 interviewees who gave an expected finishing time, 109 (48%) anticipated that the duration of their fishing outing would be  $\leq 2$  hours and 81 (36%) expected to fish for 2–4 hours. The mean anticipated total fishing time for boat-based anglers was  $3.19 \pm 0.18$  hours, over an hour more than for those fishing from the shore (Table 1). This difference was found to be statistically significant [ $t$ -test assuming  $\neq \sigma^2$ ,  $t(222) = 4.948$ ,  $p < 0.05$ ], but there was no difference in anticipated fishing trip duration between locals and tourists [ $t$ -test assuming  $= \sigma^2$ ,  $t(223) = 0.012$ ,  $p > 0.05$ ].

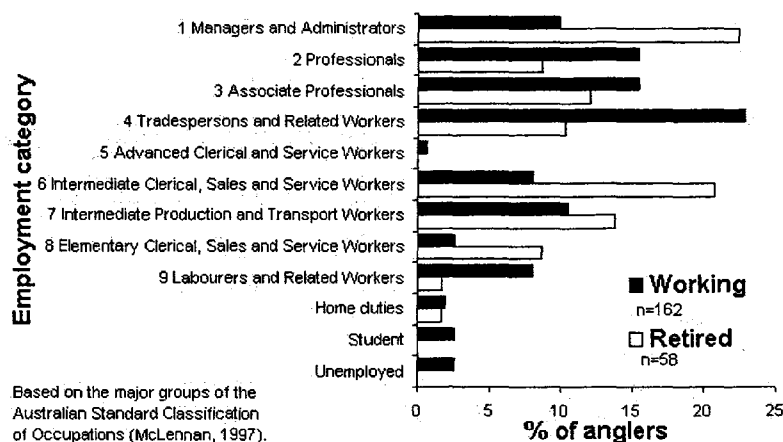


Figure 3. Occupations of anglers and previous occupations of retired anglers interviewed in the Blackwood Estuary, 2005. Categories based on the Australian Standard Classification of Occupations (McLennan, 1997).

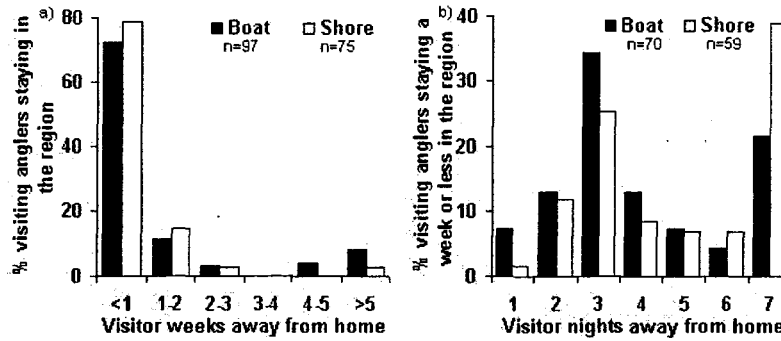


Figure 4. Duration of stay by tourist anglers in the Blackwood Estuary, 2005. (a) Number of weeks away from home, (b) number of nights away from home for those staying less than 1 week.

The majority of boat (85%) and shore (93%) angling parties used fishing rods exclusively, and a further 8% and 5%, respectively, only used handlines. Most were fishing with baited hooks (93% and 96%), while a minority used lures. Three fly fishermen fishing from boats were intercepted. Prawns were the most common bait used, followed by polychaete worms and some anglers had collected shrimp (*Palaemonetes australis*) from the estuary for use as bait.

Frequency and Location of Fishing

On average, boat anglers had fished in the Blackwood Estuary more in the past month and previous year than shore anglers, and these differences were significant [*t*-tests assuming  $\neq\sigma^2$ ,  $t(223) = 2.190$ ,  $p < 0.05$  and  $t(199) = 3.839$ ,  $p < 0.05$ , respectively] (Table 2). When interviewed, 46 boat anglers (35%) and 54 shore anglers (53%) indicated that, in the previous year, they had fished

in the Blackwood Estuary only in the preceding month. Similarly, 38 boat anglers (29%) and 49 shore anglers (48%) stated that they had fished in the Blackwood Estuary only in the week prior to interview. These data indicate a large component of infrequently visiting tourist anglers, particularly among those fishing from the shore. Locals had fished for a significantly greater mean number of days during the preceding month and past 12 months than tourists [*t*-test assuming  $=\sigma^2$ ,  $t(231) = 1.801$ ,  $p < 0.05$ , and *t*-test assuming  $\neq\sigma^2$ ,  $t(233) = 4.462$ ,  $p < 0.05$ ] (Fig. 5).

Most recreational anglers indicated that their usual fishing location in the Blackwood Estuary was within the study area, with five anglers (2%) indicating that they also fished upstream of Alexandra Bridge as far as Warner Glen, and another three anglers (1%) indicating that they also fished in the Scott River, a tributary that flows into the Blackwood Estuary. Relatively few boat anglers (11%) and shore anglers (9%) indicated that they made specific night fishing

Table 1  
Anticipated Fishing Trip Duration (Hours) for Recreational Anglers Interviewed in the Blackwood Estuary, 2005

Anglers	Local		Tourist		Overall	
	n	Mean (SE)	n	Mean (SE)	n	Mean (SE)
Boat	16	3.33 (0.44)	111	3.17 (0.20)	127	3.19 (0.18)
Shore	12	1.75 (0.36)	86	2.00 (0.19)	98	1.97 (0.17)
Overall	28	2.65 (0.33)	197	2.66 (0.14)	225	2.66 (0.13)

Table 2  
Number of Days Fished in the Previous Week, Preceding Month, and Past 12 Months by Recreational Anglers Interviewed in the Blackwood Estuary, 2005

Angler	Week		Month		Year	
	Range	Mean (SE)	Range	Mean (SE)	Range	Mean (SE)
Boat ( <i>n</i> = 131)	1-7	1.93 (0.11)	1-25	3.74 (0.40)	1-100	16.11 (1.96)
Shore ( <i>n</i> = 102)	1-7	1.95 (0.13)	1-18	2.66 (0.29)	1-60	7.50 (1.10)
Overall ( <i>n</i> = 233)	1-7	1.94 (0.08)	1-25	3.27 (0.26)	1-100	12.34 (1.23)

expeditions in the Blackwood Estuary. The mean number of nights fished in the past year for those who had been fishing at night (after removal of an outlier of 80 nights) was  $4.20 \pm 1.12$  nights.

Boats used for fishing were launched at public and caravan park boat ramps or kept at private moorings and jetties. Irwin Street boat ramp (Fig. 1) was found to have the highest utilization by those interviewed, and the majority of locals launched from this location (Fig. 6). The estuary was also directly accessed from the four adjacent caravan parks, with those ramps mainly patronized by tourists.

The locations where anglers were interviewed while fishing were often correlated with location of boat launch, with those launching near Augusta remaining in the lower estuary, and those launching upstream of the estuary basin fishing in the more riverine section (Fig. 7). The spatial "footprints" from access points with a high level of use by locals, such as the private moorings and jetties in the entrance channel, Molloy Island, and the Irwin Street boat ramp, generally extended further than the footprints from other access points mainly utilized by tourists.

#### Fishing Experience

In total, 80% of the recreational anglers interviewed cited "relaxation" as their primary motive for fishing and this was highly valued across both genders and age categories. "Food" and "sport" were also important secondary motives. A smaller proportion of locals, and tourists staying in the region for >4 weeks, indicated they were fishing for "relaxation," and for these anglers, the objective of "food" was often more important.

Years of fishing experience generally increased with age, and several older interviewees claimed to

have >50 years of general fishing experience. Familiarity with fishing in the Blackwood Estuary was more variable, with most anglers indicating fewer years of experience. Mean general fishing experience was  $32.0 \pm 1.05$  years and more specifically in the Blackwood Estuary,  $11.4 \pm 0.90$  years. In total, 114 anglers (49%) indicated they had fished in the Blackwood Estuary for <5 years, with 55 of those (24%) in their first year of fishing in the estuary. Although locals had greater mean years of fishing experience than tourists, these differences were not found to be statistically significant. Membership of angling clubs was very low, and only seven anglers (3%) were associated with a fishing club.

The majority of anglers (85% of boat and 77% of shore) indicated that, in addition to estuarine fishing, they also participated in other forms of fishing. More than half of all anglers stated that they fished from the marine shore as well, and offshore boat fishing was also popular. Previous experience of fishing in other estuarine locations in Western Australia was fairly common, with 57% of boat and 54% of

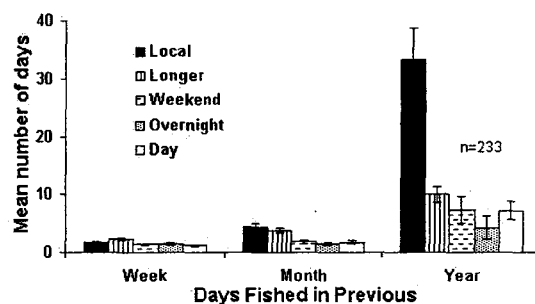


Figure 5. Mean number of days fished ( $\pm$ SE) in the previous week, previous month, and previous year by local and tourist recreational anglers in the Blackwood Estuary, 2005.

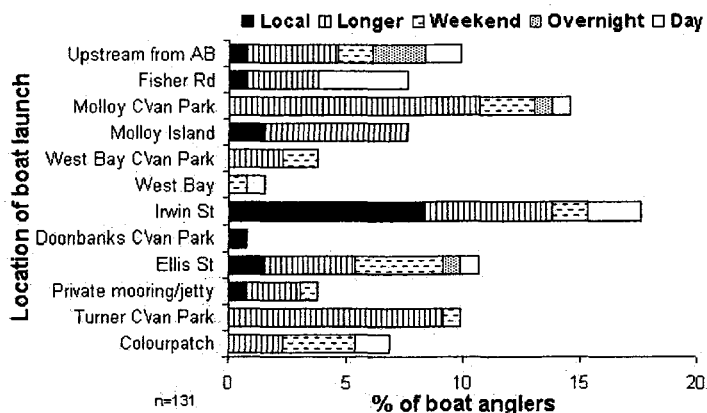


Figure 6. Locations where boat-based recreational anglers launched in the Blackwood Estuary, 2005. AB, Alexandra Bridge; C'van, Caravan.

shore anglers indicating they had fished in other estuaries, particularly the Peel-Harvey, Walpole-Nornalup, Swan-Canning, and Leschenault systems.

#### Expenditures on Fishing

Boat anglers spent significantly more than shore anglers on bait per day and on terminal tackle [ $t$ -tests assuming  $\neq\sigma^2$ ,  $t(229) = 1.835$ ,  $p < 0.05$  and  $t(196) = 2.660$ ,  $p < 0.05$ , respectively]. Tourists spent more on bait per day than locals [ $t$ -test assuming  $\neq\sigma^2$ ,  $t(102) = 6.070$ ,  $p < 0.05$ ] (Table 3). The reverse was observed for expenditures on terminal tackle and capital equipment, but these differences were not statistically significant. However, total expenditures on bait over the 12 months prior to interview (expenditures for day of interview extrapolated to number of days fished in the Blackwood Estuary in the previous 12 months) showed that local boat anglers spent more ( $\$93 \pm 29$ ) than tourist boat anglers ( $\$46 \pm 7$ ). The mean amount spent by shore anglers on bait was  $\$21 \pm 3$  and this was unrelated to their residential status.

#### Catch Composition

A total of 594 fishes comprising 12 species from six families was caught and retained by the anglers intercepted in this study (Table 4). The dominant species was *Sillago schomburgkii* (58%), followed by *Arripis georgianus* (17%), *Acanthopagrus butcheri* (5%), *Sillaginodes punctata* (4%), and *Rhabdosargus*

*sarba* (4%). Size frequency distributions (Fig. 8) showed that >85% of the retained *S. punctata*, *Arripis truttaceus*, and *Pagrus auratus* were below their relevant minimum legal length (MLL).

#### Opinions, Knowledge of Regulations, and Compliance

Of the 130 anglers with  $\geq 5$  years fishing experience in the Blackwood Estuary, 54% thought that fishing had deteriorated in the estuary, 37% felt that it had not, and 9% could not give a definitive answer. A greater proportion of locals (68%) than tourists (51%) indicated that fishing in the Blackwood Estuary had deteriorated over the years.

The majority of anglers interviewed (88%) gave in principle support to the establishment of biodiversity conservation sanctuaries (i.e., "no-take" areas) in Western Australia, although outright support for establishment of a "no-take" area in the Blackwood Estuary was less (70%). Several anglers expressed concerns about the location and size of a potential "no-take" area, and the necessity for scientific justification for such a conservation measure.

Support for the recreational fisheries management regulations established by the Western Australian Department of Fisheries was very high, particularly for minimum legal lengths (97%) and for bag limits (100%). However, in the test question on the minimum legal length for black bream (*A. butcheri*), only half of all the anglers interviewed either knew the

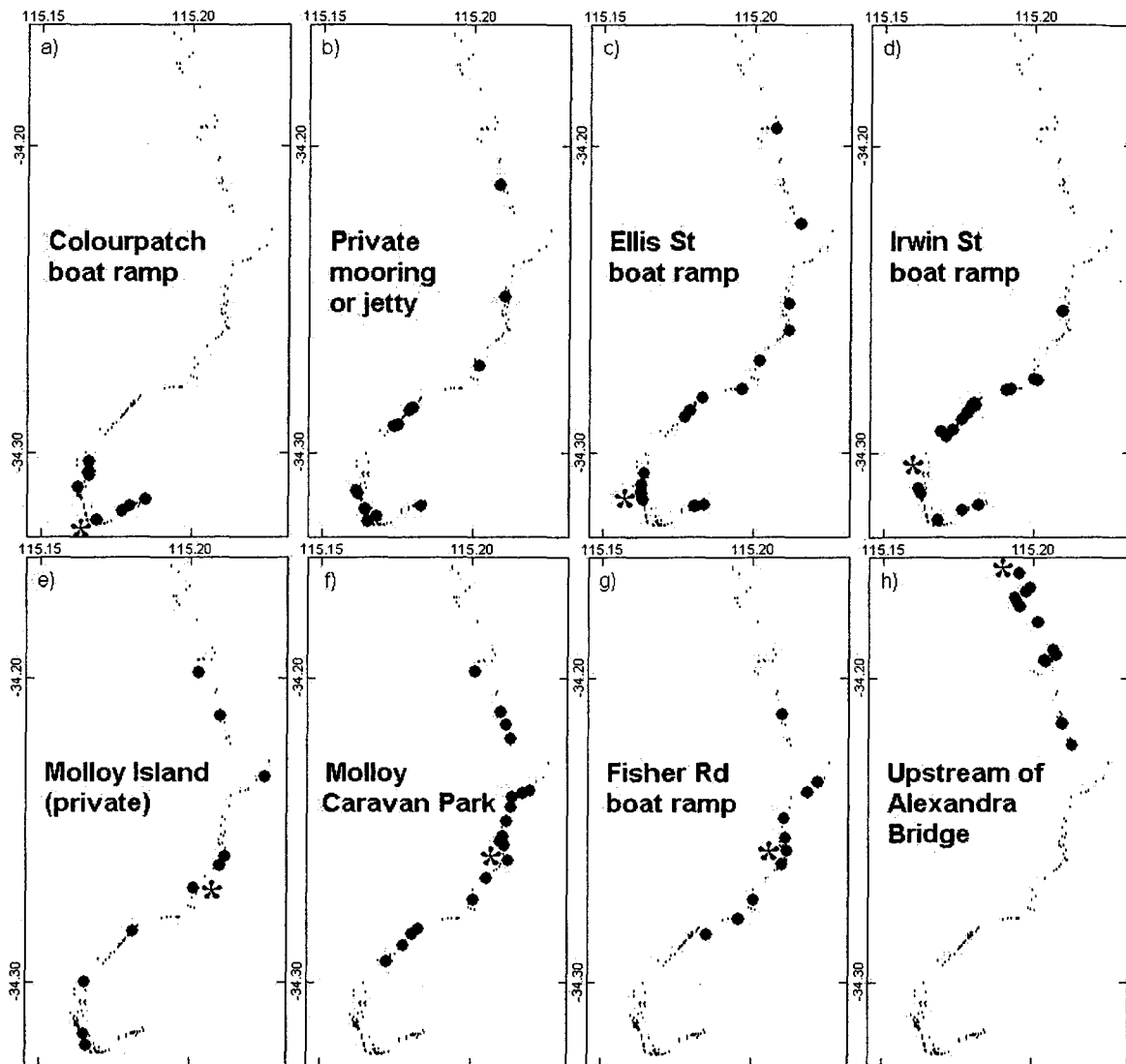


Figure 7. Locations where boat anglers were intercepted while fishing in the Blackwood Estuary, 2005, following boat launch at (a) Colourpatch, (b) private moorings and jetties in the channel, (c) Ellis St, (d) Irwin St, (e) Molloy Island, (f) Molloy Caravan Park, (g) Fisher Rd, and (h) upstream of Alexandra Bridge. The asterisk (\*) indicates boat launch site.

correct size of 25 cm and/or possessed a Department of Fisheries “fish ruler” sticker indicating the minimum size. For anglers specifically targeting black bream as a first preference, 81% knew the regulation or had the sticker. Knowledge of the current bag limit for this species, which is not indicated on the sticker, was much poorer, with only 24% of all anglers and 40% of anglers specifically targeting black bream aware of the current regulation.

Despite remarkable support for fisheries management regulations, events of noncompliance were regularly recorded for each of the six species of fin-fish with MLLs retained by recreational anglers in the Blackwood Estuary. A total of 30 angling parties (12% of the 241 total or 29% of the 105 parties who had retained fish at the time of interview) kept fish <MLL for those species. All of these parties were tourists and more than half knew the “test” MLL of



Table 3

Average Expenditures on Bait for the Day of Interview, Terminal Tackle (i.e., Hooks, Lines, Sinkers, Lures) Over the Preceding Month, and Capital Equipment (i.e., Rods, Reels) for Estuarine Fishing Over the Previous 12 Months by Anglers Interviewed in the Blackwood Estuary, 2005

Expenditure	Boat (n = 131)		Shore (n = 101)		Local (n = 32)		Tourist (n = 200)		Overall (n = 232)	
	Range	Mean (SE)	Range	Mean (SE)	Range	Mean (SE)	Range	Mean (SE)	Range	Mean (SE)
Bait (day of interview)	\$0-30	\$5.80 (0.55)	\$0-20	\$4.49 (0.45)	\$0-7	\$2.13 (0.43)	\$0-30	\$5.73 (0.41)	\$0-30	\$5.23 (0.37)
Terminal tackle (past month)	\$0-200	\$22.15 (3.32)	\$0-120	\$12.09 (1.81)	\$0-200	\$27.17 (7.84)	\$0-200	\$16.27 (2.02)	\$0-200	\$17.77 (2.06)
Capital equipment (past 12 months)	\$0-3000	\$182.10 (36.98)	\$0-2000	\$134.43 (30.67)	\$0-300	\$260.44 (121.38)	\$0-2000	\$145.49 (21.23)	\$0-3000	\$161.35 (24.79)

SE

Table 4

Catch Composition by Recreational Anglers Interviewed in the Blackwood Estuary, 2005, With Total Lengths (TL) of Fish Measured

Scientific Name	Common Name	Kept	Released <sup>a</sup>	Retained Measured	TL Size Range (cm)
Platycephalidae					
<i>Platycephalus</i> sp.	Flathead	0	1	—	—
Terapontidae					
<i>Pelates sexlineatus</i>	Eastern striped grunter	2	47	1	19
Apogonidae					
<i>Apogon rueppellii</i>	Western gobbleguts	0	2	—	—
Sillaginidae					
<i>Sillaginodes punctata</i>	King George whiting	24	12	21	22-31
<i>Sillago bassensis</i>	Southern school whiting	10	7	10	15-19
<i>Sillago schomburgkii</i>	Yellowfin whiting	342	24	339	17-30
Carangidae					
<i>Pseudocaranx dentex</i>	Silver trevally	19	11	17	19-33
<i>Trachurus novaezelandiae</i>	Yellowtail scad	2	0	2	19-22
Arripidae					
<i>Arripis truttaceus</i>	Western Australian salmon	15	10	15	18-32
<i>Arripis georgianus</i>	Australian herring	100	43	99	17-28
Sparidae					
<i>Acanthopagrus butcheri</i>	Black bream	30	63	28	23-42
<i>Rhabdosargus sarba</i>	Tarwhine	24	70	22	16-28
<i>Pagrus auratus</i>	Snapper	11	31	11	18-21
Scorpididae					
<i>Scorpis georgiana</i>	Banded sweep	0	5	—	—
Mugilidae					
<i>Aldrichetta forsteri</i>	Yelloweye mullet	0	5	—	—
Bothidae					
<i>Pseudorhombus</i> sp.	Flounder	0	1	—	—
Tetraodontidae					
<i>Torquigener pleurogramma</i>	Weeping toadfish	15	32	2	11-12
Total		594		567	

<sup>a</sup>Estimate only. If anglers were uncertain about the exact number of fish of each species they had released, only one individual of each species was indicated in the table.

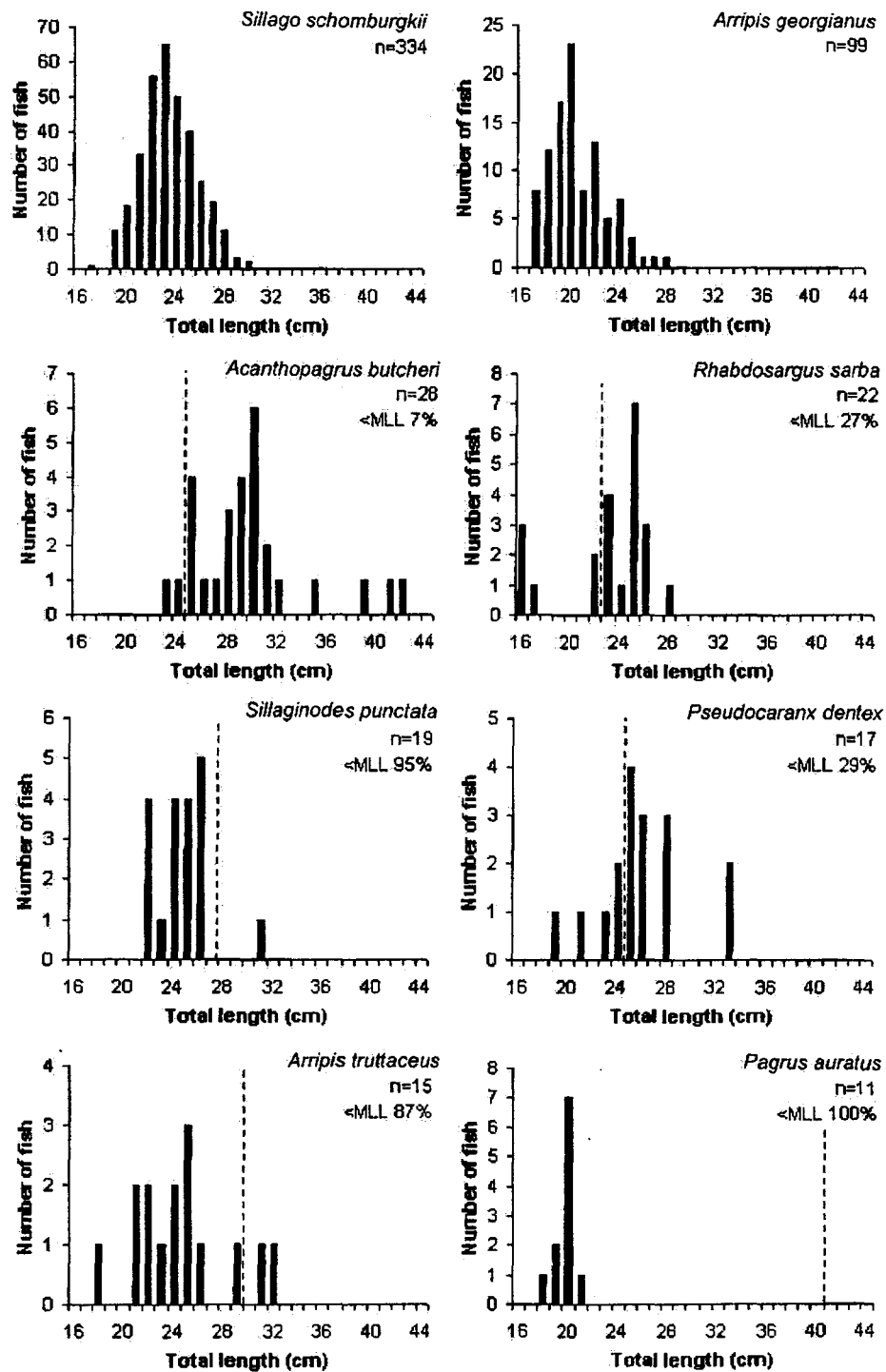


Figure 8. Length/frequency distributions for fish species caught and retained by recreational anglers in the Blackwood Estuary, 2005. Minimum legal length (MLL) indicated by a vertical dashed line and percentage retained <MLL indicated.

*A. butcheri*. Of particular concern was the high percentage of undersized *S. punctata*, *A. truttaceus*, and *P. auratus* retained. This noncompliance appeared to be largely due to ignorance (i.e., misidentification of species), rather than deliberate disregard for the fisheries regulations.

### Discussion

Sampling trips were designed to partially coincide with school holiday periods when there was an influx of tourists to the region, and as such, the proportion of tourists to locals may not be a true reflection of the overall population of anglers that utilize the Blackwood Estuary. High visitation rates to Western Australian estuaries have previously been linked with holiday periods and the proximity of estuaries to major population centers (Caputi & Lenanton, 1977). As the majority of the tourist anglers were from cities and towns in southwestern Australia, a region that has a population growth rate twice the national average (South West Development Commission, 2004), it would appear that the Blackwood Estuary is becoming increasingly accessible to a greater number of people.

Most anglers were male and in the 31–45 year age group, a similar result to that found by the National Recreational Fishing Survey conducted around Australia (Henry & Lyle, 2003). Many originated from Bunbury, which is an area of lower median household income (Gurran, Squires, & Blakely, 2005). The dominance of tradespersons among interviewed anglers is likely to reflect the housing boom in Western Australia at the time of the study, while the high proportion of retirees indicates the aged demographic within the town of Augusta and also the annual presence of retired semipermanent caravanners over the summer months.

The real value of recreational fishing in developed countries is the social benefit (Kearney, 2002a). As in previous studies in Australia and abroad, recreational anglers interviewed in the Blackwood Estuary considered food and harvest motives secondary to relaxation (Barnham, Hopgood & Lewton, 1984; Henry, 1984; Pradervand, Beckley, Mann, & Radebe, 2003; Steffens & Winkel, 1999). Although escapism motives have been reported as replacing the importance of family recreation among freshwater anglers in the US (Schramm & Gerard, 2004),

this was not the case in the Blackwood Estuary, where fishing was usually undertaken with family and/or friends. Membership of angling clubs by interviewees was low, similar to that found for Perth and Western Australia (Ayvazian, Lenanton, Wise, Steckis, & Nowara, 1997; Henry & Lyle, 2003).

The greater expenditures on bait and fishing equipment by boat anglers than shore anglers was expected, as boat anglers had fished more frequently in the Blackwood Estuary over the previous year than shore anglers. Country people have been reported to go fishing more often than their city counterparts (W.G. Martinick & Associates, 1995) and this was reflected by the considerably higher frequency of days fished in the Blackwood over the previous year by locals than tourists ( $33.28 \pm 5.36$  vs.  $9.00 \pm 0.96$ ). Consequently, the greater mean expenditures by locals on tackle and fishing equipment were expected.

The economic contribution of recreational fishing to the economy of Western Australia has been reported to be in excess of \$570 million a year (Penn et al., 2003) and an estimated \$338 million was spent on fishing-related equipment and activities by anglers in Western Australia over a 12-month period in 2000–2001, at an average of \$706 per angler (Henry & Lyle, 2003). Hundloe (2004) has argued that a fish is worth more to a recreational angler than to a commercial fisher because, aside from the direct costs of fishing, anglers also pay for the enjoyment of the day, and spend on travel and accommodation, as well as boat and vehicle purchase, running, and maintenance. However, in the context of recreational fisheries, Kearney (2002b) has suggested that high expenditures can also be interpreted as an expression of economic inefficiency rather than value.

Perceptions have often played an important role in conflicts over access to fish resources (Kearney, 2002b). Individual recreational anglers may regard their impact on fish stocks as negligible, but the effects of cumulative exploitation need to be considered (Birkeland & Dayton, 2005; Cooke & Cowx, 2004). Some recreational anglers who stated that fishing had deteriorated in the Blackwood Estuary cited overfishing by netting (both commercial and recreational) and changes in the catchment as reasons for the decline, while others suggested that natural variations, such as the dramatic 1982 floods (Hodgkin & Hesp, 1998), were responsible.

Implementation of marine protected areas has been met with heated debate, often fueled by fear and ignorance in the absence of relevant data (Babcock, 2003). It was evident during this survey that many of the interviewed anglers misunderstood the objective of "no-take" areas to protect entire habitats and ecosystems, and not just fish stocks. Similar confusion, particularly of the term "biodiversity," was discovered during the public consultation process associated with the rezoning of the Great Barrier Reef Marine Park (Thompson, Jago, Fernandes, & Day, 2004). Once clarified, most anglers interviewed in the Blackwood Estuary gave, in principle, support for the establishment of biodiversity conservation sanctuaries. This highlights the need for effective communication with the actual resource users during planning and implementation of marine parks.

Output controls, such as size and bag limits, are common management measures for recreational fisheries, but their effectiveness is conditional on angler awareness of, and compliance with, current regulations. The majority of anglers in the Blackwood were very supportive of such management measures, but specific knowledge pertaining to the test species (the "iconic" *A. butcheri*) was not sound. Undersized fish had been kept by 29% of the angling parties who had retained fish at the time of interview, a much higher proportion than found in other estuarine creel surveys in Western Australia (Malseed & Sumner, 2001a, 2001b; Malseed et al., 2000). Recreational anglers in Australia often retain juvenile fish, either due to lack of knowledge or disregard for the regulations (McPhee, Leadbitter, & Skilleter, 2002; West & Gordon, 1994). The noncompliance observed in this study was deemed largely due to ignorance or misidentification by tourists of fish species that utilize estuaries as juvenile nursery areas (Potter, Beckley, Whitfield, & Lenanton, 1990).

Effective education measures and the presence of compliance officers at access points have contributed to positive angler attitudes and good knowledge of regulations in South Africa (Mann, James, & Beckley, 2002). Public display of current recreational fishing regulations around the Blackwood Estuary is very limited and installation of signage with illustrations of commonly caught fishes, some biological information, and the regulations is strongly recommended. Ideally, these signs should

be located at the high-usage boat ramps, public jetties, and also in caravan parks, where many tourists are based during their holidays.

### Conclusion

Recreational angling in the Blackwood Estuary was found to be a popular family activity with relaxation the primary motive. During the school holiday periods, the majority of anglers were tourists visiting from towns in southwestern Australia. This study has confirmed that local anglers fished more frequently in the Blackwood Estuary than the tourist anglers and, thus, for quantitative assessment of the recreational fishery (i.e., estimates of total catch and fishing effort), a comprehensive sampling program over a year would be necessary. Boat-based anglers fished more often, had longer trip durations, ranged more widely in the estuary, and spent more on bait and fishing equipment than their shore-based counterparts. This indicates that any assessment of catch and effort in the Blackwood estuary should ensure that anglers using boats need to be adequately sampled by either an on-water roving survey or an access point survey conducted at boat launching sites. Despite good support for biodiversity conservation measures and fisheries management regulations, noncompliance with size limits (largely due to species misidentification) was found to be common and it is concluded that better education of anglers is needed. During this study, the value of direct contact with anglers by scientists was affirmed and was instrumental in raising awareness among the anglers of both fisheries regulations and the marine park proposal.

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