



## Short Communication

## Recreational catch composition, catch rates, effort and expenditure in a specialised land-based pelagic game fish fishery

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## ABSTRACT

A specialised recreational land-based game fish fishery in south-eastern Australia was characterised using electronic fisher diaries. Live bait and lure-casting were the primary methods used during long trip durations (mean  $9.44 \pm \text{SD } 6.65$  h). Effort was temporally and spatially dynamic, whereby fishers appeared to follow the  $20^\circ\text{C}$  sea surface temperature isotherm. A total of 4436 fish from 44 taxa was recorded. The highest mean catch rates were recorded for *Seriola lalandi*, *Thunnus tonggol*, and *Istiompax indica* ( $0.0025\text{--}0.0224$  fish  $\text{h}^{-1}$ ). However, at least 42% of trips were unsuccessful in capturing nominated target species. High average expenditure of \$1734.75 ( $\pm 788.07$ ) per fisher  $\text{yr}^{-1}$  was attributed to long travel distances to fishing locations and specialised equipment. The study highlighted the need to develop cost-effective survey methods to access a representative sample of 'hard-to-reach' fishers from specialised recreational fisheries.

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## 1. Introduction

Recreational fisheries in many countries are becoming increasingly diversified and efficient owing to new fishing technologies (e.g. GPS) and information exchange (e.g. internet forums) (McPhee et al., 2002; Griffiths et al., 2010). Catches from emerging specialised sub-fisheries (e.g. game fisheries) can exceed the commercial catch for some species (Brouwer and Buxton, 2002; Griffiths et al., 2006). However, specialised fisheries are poorly represented in general recreational fishing surveys, since participants are rare and widely dispersed within the general community (Teisl and Boyle, 1997).

The south-eastern coast of Australia hosts a highly unique specialised land-based game fish fishery (LBGF) for tunas, billfish, sharks and other neritic pelagic species, which has existed since at least the 1960s. The fishery exists due to the continental shelf being close to a coastline of large rocky headlands that provide fishers with access to relatively deep waters. The southward-flowing East Australian Current (EAC) strengthens in the Austral summer and transports warm water, and seasonally moving game fishes, within close proximity of the coast (Ridgway and Godfrey, 1997).

The low cost of capital and participation relative to offshore boat-based fishing and increased exposure in the popular fishing media has seen the LBGF increase in popularity in recent years.

In adjacent offshore waters, two other major fisheries share the same species targeted by LBGF: the commercial East Coast Tuna and Billfish Fishery (ETBF), taking around 5000 t per year of tunas and billfish (AFMA, 2009), and a recreational boat-based game fish fishery, estimated to catch 340 t of billfish in 1998 (Whitelaw, 2003). In recent years in the region, there has been growing conflict between these commercial and recreational fisheries over access to shared species, such as striped marlin (Bromhead et al., 2004). Therefore, an understanding of the catch and effort from all recreational sub-fisheries is required for effective management of shared species.

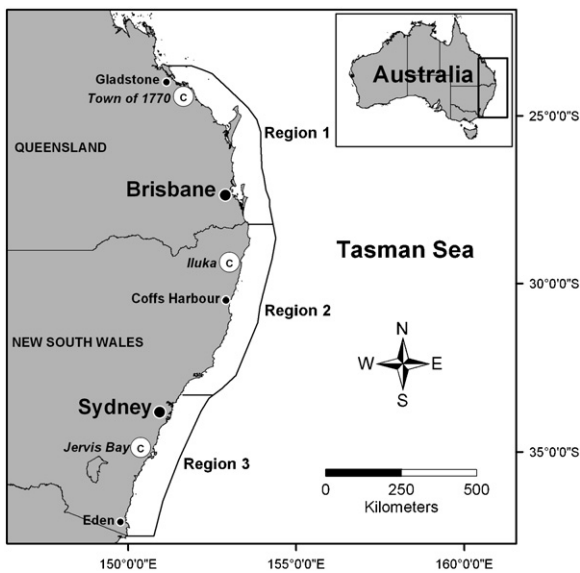
The aims of this study were to provide a preliminary description of the: (i) characteristics of the LBGF, including targeting practices and fisher profiles and (ii) species composition of the catch, catch rates, expenditure and directed fishing effort for game and bait fish in three regions of the fishery.

## 2. Materials and methods

Sampling took place between 1 October 2006 and 30 June 2008 between Gladstone, Queensland and Eden, New South Wales (Fig. 1). Specialised LBG fishers comprise a 'hard-to-reach' population, lacking a complete list frame of participants who are rare in

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**Fig. 1.** Map of study region and the three reporting regions covering the coastline from Eden, New South Wales to Gladstone, Queensland. Locations of the creel surveys are denoted with a ©.

the wider community. Therefore, traditional survey methods (e.g. telephone) are too costly and inefficient for accessing these rare fishers (Griffiths et al., 2010). The principles of chain-referral and venue-based sampling methods developed by epidemiologists to survey rare or 'hidden' populations (Magnani et al., 2005) were used to recruit LBG fishers from a known aggregation point at an online forum ([www.sportfishextreme.com](http://www.sportfishextreme.com)), who were encouraged to refer other eligible fishers. This approach did not allow for non-sampling biases (e.g. non-response) to be assessed. However, respondents covered a wide range of ages and avidity levels, and were considered generally representative for providing a description of the LBGf.

Respondents were asked to record details of individual trips into an electronic diary – created in Microsoft Excel – and return the file via email on a fortnightly basis. Diarists were contacted fortnightly to remind them to record and submit recent trip data to minimise recall bias (see Lyle et al., 2002). Diary data fields were: respondent contact details, trip date, start time/end time of fishing, weather and ocean conditions, method(s) used, target species, experience level, and catch details including species caught, number retained and released, estimated or measured total length and/or weight, trip-specific and annual expenditure. Although catch rates and expenditure in this paper reflect that of individual fishers, diarists were asked to record the number, age (in 5-year categories) and club membership of fishing companions for each trip to obtain a broader understanding of the fishery.

Diary surveys can suffer from several biases depending on the attitudes, perceptions and experience of respondents (Pollock et al., 1994). Therefore, five on-site roving creel surveys were undertaken at three locations (Iluka, Jervis Bay, and the Town of 1770; Fig. 1) to validate species and size composition of the catch recorded in diaries, quantify directed effort towards bait collection, and to recruit additional fishers to the diary survey.

Fishers often target particular species using specific methods, or use a variety of methods to catch any available species. In particular, fishers often spend several hours during the night and early morning targeting live bait using Sabiki rigs consisting of 6–10 small feather, tinsel or rubber lures evenly spaced along 1–2 m of monofilament line, terminating with a sinker. The rig is connected to the main line and cast from the shore. The fisher twitches the rod tip at various speed and frequency (i.e. jigging) whilst retrieving

line, making the jigs attractive to small predatory baitfish. It was important to calculate directed effort for both baitfish and target species since the catch rate of baitfish would be underestimated if the total trip duration was used. Therefore, fishers were asked to estimate the percentage of the trip spent using a specific gear type and collecting baitfish. Bait collection effort was included in the effort estimates for target species because they generally cannot be caught without the use of live bait. For trips where both lure-casting and live bait were used, catch rates were effectively calculated for each method and combined to produce a catch rate for the trip.

Expenditure was estimated by respondents for each fishing trip for 'consumable' items (e.g. food, bait, batteries), fuel, accommodation and the distance travelled from home to the fishing location. Respondents also estimated expenditure on 'durable items' that were purchased in the previous 12 months and used for multiple LBG fishing trips (e.g. fishing rods and camping equipment).

Because trips reported in diaries were complete, the mean (and SD) catch rate of each primary target and baitfish species (number of fish  $h^{-1}$ ) was estimated using the ratio of means, following the recommendations of Pollock et al. (1994). One-way analysis of variance (ANOVA) was used to compare mean catch and effort between regions. Comparisons of fishing effort with sea surface temperature in the three reporting regions were made using data from <http://oceancurrent.imos.org.au>.

### 3. Results

A total of 183 fishing trips was recorded in diaries by 28 fishers. A further 20 fishers were interviewed during creel surveys, of which 16 agreed to participate in the diary survey, although only 2 submitted data. Of the 483 fishers represented in fishing parties of diarists or creel survey respondents, only 44 (9%) were members of a fishing club. All fishers, except one, were male ranging in age categories from 16–20 years to 46–50 years, with the mode being 31–35 years.

Four fishing methods were used including bait jigging, lure-casting, live bait and dead bait, with fishers generally using more than one method, often simultaneously, per trip. The most commonly used methods in each region were: Region 1, lure-casting (100% of trips), live bait (60%) and bait-jigging (10%); Region 2, live bait (81%) lure-casting (31%) and bait-jigging (26%); and Region 3, live bait (75%), dead bait (36%), lure-casting (32%) and bait-jigging (16%). Target species differed among regions, with fishers in Region 1 targeting only two species: *Thunnus tonggol* (58% of trips) and *Scomberomorus commerson* (42%). *T. tonggol* (71%) was also the primary target species in Region 2, along with *Rachycentron canadum* (15%), *Thunnus albacares* (9%) and *Seriola lalandi* (3%). In Region 3, fishers primarily targeted *Istiompax indica* (39%) and *S. lalandi* (37%), followed by *T. albacares*, *T. tonggol* and *Sarda australis*.

A total of 5108 h of fishing effort was reported in diaries. Fishing duration for individual trips ranged between 0.5 and 16 h (mean  $9.44 \pm 6.65$ ). Mean trip duration did not differ among regions ( $F=0.333$ ,  $df=2$ ;  $P=0.341$ ). Highest effort in Regions 1, 2 and 3 occurred during January, April and July, respectively, coinciding with sea surface temperatures of around 20°C in each region (Fig. 2).

A total of 4482 fish representing 44 taxa were recorded. Apart from the 19 primary and secondary target game fish and baitfish species highlighted in Table 1, the remaining species were mainly caught incidentally when targeting baitfish, and 35–100% were released alive. The percentage of fish released representing target species ranged from 0 (*R. canadum* and *T. albacares*) to 63% (*S. lalandi*). The most commonly caught target species were *S. australis* (177 fish), *S. lalandi* (71), and *T. tonggol* (66), more than 70% of the fish caught are baitfish (according to Table 1). Mean catch rates (no.

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