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Diversity and composition of catches and discards in a recreational charter fishery

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ABSTRACT

A spatially and temporally stratified scientific observer program was used to examine variation in the diversity and composition of retained and discarded catches in a coastal charter-vessel line fishery. The 181 observed trips yielded 126 species and 13,357 individuals. Overall, 88 and 92 species were retained and discarded, respectively, with 34 and 38 species either solely retained or discarded. The 10 most numerous species accounted for 75% of total individuals, with 40 species encountered only once. Regional-scale differences in retained and discarded catch compositions and diversity were consistent across seasons, with species diversity being greatest in the northern region that encompassed the convergence zone of tropical and temperate waters. Within-region port-related differences in catch compositions were driven by particular species being captured in different quantities and frequencies from vessels at one port compared to the other, and together with the high level of trip-to-trip variation in catches, were the result of localised and often vessel-specific differences in fishing practices, grounds and habitats fished, and client/operator preferences. Habitat-related differences in catch compositions were greatest between bare sand and structured reef and reef/gravel substrata. Discarding patterns varied among regions, with 25–52% of individuals with a prescribed legal length limit, and 14–72% of individuals with no length limit, being discarded. Discarding was due to a combination of compliance with length-based and no-take regulations, as well as client and operator preferences for particular species and sizes, and not the result of catch quotas. The results show that assessments and management of charter fisheries need to consider the human dimensions, as well as the ecological, aspects of catch variation.

1. Introduction

Many fisheries substantially impact the diversity and abundances of aquatic fauna across a plethora of habitats throughout the world (Dayton et al., 1995; Jackson et al., 2001). Whilst traditional fisheries assessments and management arrangements have primarily concentrated on harvested organisms, there is now global acceptance that other ecosystem impacts, including effects on the organisms discarded from fishing activities, be assessed and reported (Punt et al., 2006; Davies et al., 2009; Bellido et al., 2011). These data are particularly important in the context of ecosystem-based fisheries management (Crowder et al., 2008; Hobday et al., 2011). A necessary component in achieving such management goals is identifying and quantifying the composition and diversity of all catches across appropriate spatial and temporal scales (Stobutzki et al., 2001; Uhlmann et al., 2014).

A variety of methods have been used to monitor fisheries catches, bycatches and discards including: scientific surveys using research vessels, Coast Guard inspections, post-trip sampling of landings, post-trip interviews of captains and crews, and getting fishers to self-record data by completing logbooks at sea (Kelleher, 2005; Cotter and Pilling, 2007). But by far the most reliable and accurate way to collect data on actual catches, bycatches and discards in a fishery is through the use of onboard observer programs (Kelleher, 2005; Uhlmann et al., 2014). Many such programs now exist throughout the world and they have become a major, mainstream source of fisheries and ecosystem-related information (Stratoudakis et al., 1999; Cotter and Pilling, 2007; Lewison et al., 2014; Uhlmann et al., 2014).

Whilst many observer-based surveys have been implemented in commercial fisheries, fewer have been incorporated into recreational fisheries. Worldwide, recreational fisheries are a major contributing component to total fishery harvests and ecosystem impacts (Coleman et al., 2004; Cook and Cowx, 2004). Consequently, there has been a call for greater emphasis on monitoring and reporting catches and impacts of recreational fisheries. Pay-for-hire recreational charter fishing enterprises occur globally and, depending on fleet sizes, catch rates and specific management regulations, they may contribute to large harvests

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and significant discards across fisheries. Charter fishery catch data are often based on operator logbooks and interviews (Dell'Apa et al., 2015; Lichtkoppler et al., 2015; Ryan et al., 2016), which can be problematic due to recall bias, under-reporting of catches, species and fishing effort, and general lack of discard information (Bochenek et al., 2012; Gray and Kennelly, 2017). Independent quantitative data of the composition and diversity of both the retained and discarded catch components from charter fishing fleets, and how they vary across latitudinal clines and habitats, are scant and little evaluated for sustainable ecosystem-based management (*e.g.* Pradervand and van der Elst, 2008; Garner and Patterson, 2015). Many charter fisheries are suited to observer-based data-collection strategies that could provide valuable long-term independent catch and discard information for management and species assessments (*e.g.* Garner and Patterson, 2015; Gray and Kennelly, 2017a).

This study used a spatially and temporally stratified observer program to specifically test the hypothesis that the diversity and composition of the retained and discarded catches in an Australian recreational charter fishery would vary according to the broad scales of geographic region, habitat and season. We did this study to identify fishery catch attributes, discarding practices and potential ecosystem interactions, as a precursor to identifying appropriate fishery management arrangements. Moreover, this specific study and the independent discard data contained herein, in conjunction with the previous assessment of industry logbook and observer-based retained catch data in the fishery (Gray and Kennelly, 2017a, b), will collectively enhance the development of appropriate fishery catch and discard monitoring strategies.

2. Methods

2.1. Fishery and fishing practices

The New South Wales (NSW) coastal charter-vessel line fishery has been in operation since the 1950s and currently there are 276 registered vessels (10–30 m length) operating out of 36 ports along 1000 km of coast. The fishery is one of the most valuable fisheries in the state, with operators and clients providing an estimated annual $AUD 50.2 million of output to local economies (McIlgorm and Pepperell, 2014). Current catch monitoring data for the fishery are restricted to operator-logbooks that contain fishing effort (numbers of fishing days) and subsequent catch of each retained species per-trip (Gray and Kennelly, 2017b). Recent analyses identified these data under-report total fleet-wide fishing effort by up to 50% (*i.e.* not all trips are reported) and thus total harvests (McIlgorm and Pepperell, 2014), and the retained catches of rare species and those used as bait (compared to observed catches from this current study), and do not include discard information (Gray and Kennelly, 2017b) necessary for ecosystem-based fishery assessment and management. Nevertheless, the fishery could harvest over 150,000 individuals per-annum (Gray and Kennelly, 2017a,b), significantly contributing to total mortality schedules of several species.

Most vessels that operate as part of the nearshore demersal line-based fishery undertake day trips of 6–8 h duration, carry 8–15 clients, and target a range of species by typically drifting across fishing grounds (observed between 10 and 130 m deep) that range from bare sand to gravel and complex reef and their combinations (Gray and Kennelly, 2017b). Depending on weather conditions, client requirements and *in-situ* catches, the locations and habitats fished often change within, as well as among, fishing trips. Operators also often tow (troll) surface lures to and from demersal fishing grounds targeting seasonal pelagic species. The fishing gears used by clients are mostly provided by the operators with rod and non-electric reels typically used with a Paternoster hook (maximum two hooks) and sinker rig. Bait usually comprises a mixture of frozen squid, pilchards (*Sardinops* spp.) and penaeid shrimp but is often supplemented with fresh fish caught *in-situ*.

Several primary fish species taken in the fishery have mandated minimum legal total lengths (MLL) that dictate whether each individual fish caught is retained or discarded. In contrast, most secondary species have no such length prescriptions so the choice of whether they are retained or discarded is determined by each client and operator. All protected species (regardless of size) must be released. Individual client trip (bag or quota) limits apply to some primary species as prescribed for all recreational anglers. Anglers are not permitted to sell or trade their catch for profit.

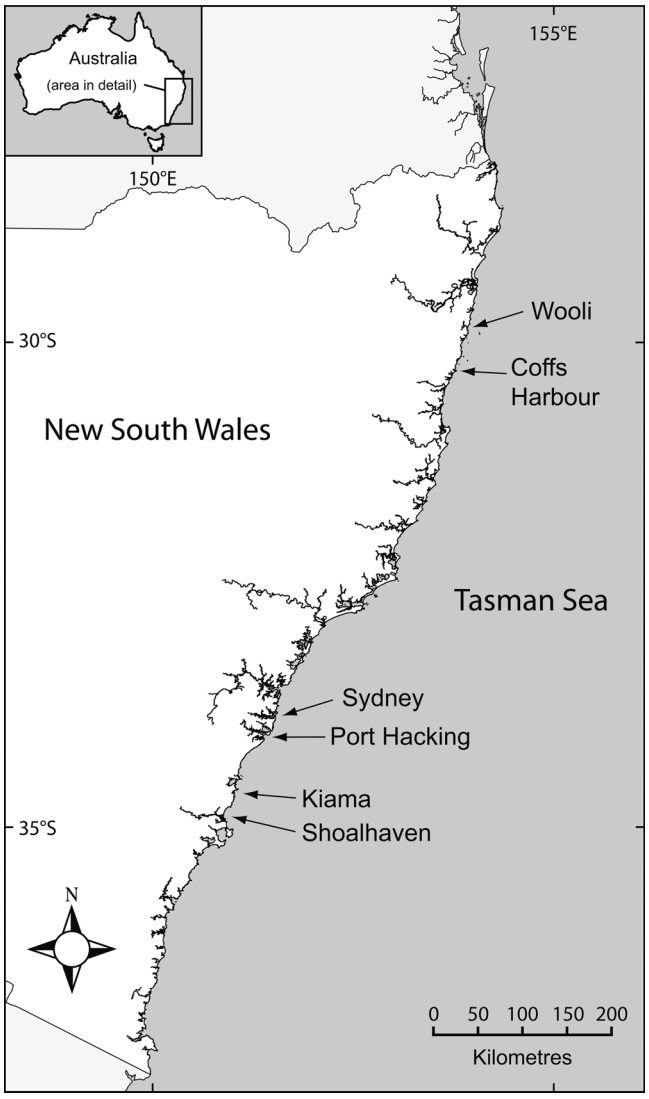

Fig. 1. Map of New South Wales coastline showing the location of the six ports sampled.

2.2. Sampling

Sampling of charter vessel catches was stratified temporally across seasons between December 2014 and February 2016, and spatially across two ports in each of three regions along the NSW coast that have strong history of charter fishing activity. The specific ports were: Wooli (−29.89S) and Coffs Harbour (−30.31S) in the northern-most region, Sydney (−33.83S) and Port Hacking (−34.07S) in the central region, and Kiama (−34.67S) and Shoalhaven (−34.90S) in the southern-most region (Fig. 1). Based on previous years reported fishing effort and discussions with current operators, the sampled trips in each port for each region and season were randomly allotted to available fishing days and vessels. This meant that most sampling occurred on weekends when client demand and fleet fishing activity (*i.e.* available fishing days) was greatest, ensuring that the trips sampled were representative