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Selective commercial line fishing and biodiversity conservation co-exist on seamounts in a deepwater marine reserve

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ABSTRACT

Enhanced socio-economic and conservation outcomes for both an existing fishery and a new deep-water marine reserve off eastern Australia were achieved by research that identified additional options for conservation managers. Commercial power hand-line fishing was permitted to continue on productive seamount fishing grounds within the reserve because new information enabled boundaries and zoning proposed in the reserve's draft Management Plan to be revised and consistent fisheries regulations to be formulated. The draft plan would have removed access to fishing grounds that provide approximately 25% of the annual regional Australian total allowable catch of the premium fishery species, Blue-eye Trevalla (*Hyperoglyphe antarctica*). Day-time power handline fishing in 280–550 m depths on Taupo and Barcoo Seamounts avoided Harrisson's Dogfish (*Centrophorus harrissoni*) – the primary species of conservation concern – because the shark is a diel vertical migrator, residing deeper than Blue-eye during the day before ascending to shallower depths at night to feed on micronekton. Harrisson's Dogfish occurs on several other seamounts where it was previously unrecorded. These results, together with expectation of low mortality of any incidental dogfish bycatch and low impacts on benthic habitats, supported changes to management arrangements which preserve the seamount Blue-eye fishery worth approximately A$1M annually whilst protecting more seamounts and greater areas of benthic habitat in the restricted 200–700 m depth range. Research uptake was facilitated by clarifying policy options at a critical stage in the planning process. This required having clearly articulated management objectives that aligned conservation and fishery imperatives, involving knowledgeable fishers in making robust field observations to address specific knowledge gaps and management needs, and identifying the requirements for ongoing fishery monitoring that addresses remaining management uncertainties. This potential to identify win-win outcomes in the Australian marine planning process provides some general signposts for future policy decisions as marine reserve networks are implemented and reviewed, and for scientists wanting to effectively engage in decision-making processes.

1. Introduction

Australia has developed one of the world's first national networks of offshore marine reserves: the Commonwealth Marine Reserves (CMR) network comprising five marine planning regions. All reserves have their boundaries in place, but relatively few have approved management plans that determine their International Union for Conservation of Nature (IUCN) zoning. Management plans for other bioregions were delayed in 2013 to enable additional stakeholder consultation, and new science now has a limited time in which to contribute directly to the consultation. We use a case study to illustrate a process – developed jointly by environmental managers, fishery managers and scientists – to formulate new policy alternatives for managing the CMR network.

An objective of spatial planning for biodiversity conservation in the CMR network is to minimize negative socio-economic impacts (Principle 9), whilst management plans allow for sustainable use of marine resources where this does not interfere with the protection and conservation of natural and cultural resources. Management of Australia's Commonwealth fisheries using ecosystem-based management principles includes ensuring that fishery interactions with vulnerable biota are sustainable. Thus, policies and regulations governing conservation and commercial fishing in Australia's marine environment are inextricably entwined. Where potential conflicts arise, the trade-offs between conservation and continued fishing need to be understood. This is an imperative for Australia, given the establishment of the national CMR network and the increasing use of marine spatial closures as a fisheries management tool.

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We illustrate how the results from a targeted field study were used to expand policy alternatives for a CMR to meet conservation and fishery management objectives, whilst reducing negative socio-economic impacts on a commercial fishery.

The impetus for the study came from an intersection of biodiversity conservation planning by the federal Department of the Environment (DoE, 2013) with a management strategy administered by the Australian Fisheries Management Authority (AFMA, 2012) for Harrisson's Dogfish (*Centrophorus harrissoni*). This is an endemic east coast deepwater 'gulper shark' severely depleted by bottom-contact fishing (Graham et al., 2001); it occurs in the 'Temperate East Region' (TER) conservation region where historical fishing grounds are located. Conservation planning for the TER included declaration of CMRs to form part of Australia's national network of reserves. One of these, the Central Eastern CMR, covers 70,054 km^2 and includes much of the Tasmantid Seamount Chain (Fig. 1)—Australia's most extensive group of relatively large seamounts (Williams et al., 2012).

The draft management plan for the Central Eastern CMR proposed to include the Derwent Hunter Seamount (zoned Multiple Use—IUCN Category VI), and the Taupo and Barcoo Seamounts (zoned Marine National Park—IUCN Category II). This proposed higher level of protection for Taupo and Barcoo Seamounts was primarily due to their 2010 closure by AFMA on the basis of Taupo being the only Tasmantid seamount where the presence of Harrisson's Dogfish was verified. Marine National Park zoning prohibits all forms of fishing meaning that, if implemented on the Taupo and Barcoo Seamounts, it would have immediately stopped the harvesting of Blue-Eye Trevalla (*Hyperolglyphe antarctica*: Centrolophidae)—a premium seafood fish in eastern Australia.

Blue-eye Trevalla harvested from the Tasmantid seamount chain contribute about 25% of the annual regional total allowable catch of about 320–400 ton (Williams et al., 2013a). Local fishers using power handlines to catch Blue-eye reported that Taupo and Barcoo Seamounts were important fishing grounds, and that they rarely caught Harrisson's Dogfish on the seamounts using their fishing method. The implications of fishers' claims were that the Marine National Park zoning of Taupo and Barcoo Seamounts would fail the socio-economic planning objective for reserve design whilst providing little or no benefit for Harrisson's Dogfish.

This situation raised three important questions for conservation and fishery managers. Could harvesting of Blue-eye using power handlines on Taupo and Barcoo Seamounts continue without directly impacting Harrisson's Dogfish? If so, could an alternative reserve design achieve the desired biodiversity goals? And lastly, could alternative reserve design and fishery management goals be effectively integrated in practice? To help answer these questions, our study had four main aims: (i) to establish whether Blue-eye Trevalla could be selectively harvested on the Taupo and Barcoo Seamounts whilst avoiding a bycatch of Harrisson's Dogfish; (ii) to identify ecological factors and fishing methods that underpinned fishing selectivity on Barcoo and Taupo Seamounts; (iii) to document the presence of gulper sharks along seamount chain and (iv) to place the findings in a broader fishery and conservation management context, including to clarify policy alternatives.

2. Materials and methods

2.1. Study Area

We sampled seven seamounts in the Tasmantid Seamount chain off eastern Australia; individual seamounts rise from continental rise depths (>2000 m) and peak at depths of ~500 m or shallower (Fig. 1). The primary experimental work was undertaken on the Taupo and Barcoo Seamounts ('southern' seamounts); supplementary sampling occurred on the Fraser, Recorder, Queensland, Britannia and Derwent Hunter Seamounts ('northern' seamounts).

2.2. Sampling gears and commercial fishing methods

The main sampling was by commercial power handline (or 'minor line') fishing (see description of method in Williams et al., 2013a). This method uses a hydraulically powered reel to fish 10–20 hooks on Dyneema® fishing line (a thin but strong and durable ultra-high molecular weight polyethylene). For this study, the bottom 25 m of each line was rigged with 18 hooks and a 5–10 kg steel weight; three lines were deployed at any one time (referred to as a drop). During standard fishing operations when targeting Blue-eye Trevalla, the vessel echosounder was used by the vessel's master to identify 'Blue-eye marks'. Marks are characteristic echotraces that indicate Blue-eye in the water column within 50 m of the seabed and/or topographic features on the seamount that previously had yielded commercial catch rates of Blue-eye. For each drop, the vessel was positioned to drift across the 'Blue-eye mark' as the baited lines descend to the seabed. When on the bottom, the lines are tended by hand with soak times usually between five and ten minutes (longer on northern seamounts). During this time, experienced crew can feel when fish are being hooked and recognize the likely species by their bite pattern; when the fisher determines that several fish have been hooked, the line is hauled.

Sampling on Taupo and Barcoo included some dropline fishing to maximize fishing effort: droplines were set close to other fishing locations and left to fish for 1–2 h while the vessel continued fishing with power handlines. Droplines comprised a static, vertical-set line with a weight to anchor the bottom and a float at the surface. Hooks were attached at ~1 m intervals above the weight and fished through a depth range of ~5–75 m above the seabed. We used 54 hooks per dropline to match the 54 hooks used for each power handline drop (i.e. 3 lines each of 18 hooks).

2.3. Field program and protocols

Two commercial vessels jointly completed 15 commercial fishing trips, each of 4–5 days duration. Ten trips (on the same vessel with the same fishing skipper) were to Taupo and Barcoo Seamounts to provide the data for the selectivity experiment as described below (aims i and ii). An additional five trips (two vessels) were made to the northern seamounts to provide supplementary data on the distribution of Harrisson's Dogfish (aim iii). Table 1 shows details of the distribution of effort (power handline and dropline operations) by habitat ('Harrisson's Dogfish Habitat' was defined based on depth zone and time of day) and targeting of 'Blue-eye marks'. All fishing was overseen by an experienced scientific observer (Ken Graham).

The selectivity experiment on Taupo and Barcoo was a combination of standard commercial fishing for Blue-eye Trevalla (described above) and both targeted and non-targeted fishing in other locations and depths, according to an experimental design. Fishing drops were selected at random (in a haphazard manner)—the fishing vessel circled the seamounts in the required depth range and conducted targeted and non-targeted drops, based on the identified 'Blue-eye marks'. Standard fishing used power handline gear deployed for short soak times (~10 min) during daylight in depths between 280 to 550 m (hereafter "Mid Zone"). All other fishing (termed 'experimental') was in a deeper depth stratum, or at night, or in a location with no 'Blue-eye marks'. Data were analyzed according to these factors (Table 2).

All landed catch was identified to species, and individual fish counted. When necessary, samples were retained to confirm identifications. Sampling was carried out with the appropriate AFMA