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Optimising Mesh Size with Escape Gaps Their Utility Portunus Traps

Troy Gaston*

Department of Primary Industries, the University of Auckland, Auckland, New Zealand

***Corresponding author:** Troy Gaston, Department of Primary Industries, The University of Auckland, Auckland, New Zealand, Email: trgaston@gmail.com

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Description

Information on the stock status of giant catfish Netuma thalassina (Rüppell, 1837) is meagre due to lack of catch and effort data. Therefore, we reconstructed catch and effort data of the giant catfish fishery in Tamil Nadu, India waters from 2001 to 2020. Catch and effort data were analyzed with Catch and Effort Data Analysis (CEDA), Catch Maximum Sustainable Yield (CMSY) and the Bayesian state-space implementation of the Schaefer production Model (BSM). Results indicated that giant catfish resources were fully exploited and reached the stage of overexploitation in 2014. Considering the high vulnerability to climate change, very high susceptibility to fishing, increased fishing effort and fully exploited status of giant catfish fishery, we propose a significant reduction of fishing effort to ensure sustainable exploitation. Biologists have theorized that stocking YY males (created via in-hatchery hormonal sex-reversal and selective breeding; hereafter MYY fish) could be used to eradicate unwanted non-native vertebrate populations, but little is known about the fitness of MYY individuals once released into the wild. We compared growth and body condition of stocked hatchery-reared MYY brook trout (Salvelinus fontinalis Mitchell) to wild conspecifics in two streams and two alpine lakes. Maximum age for wild fish was age 6 at one stream and age 4 or 5 at the remaining waters, whereas for hatchery MYY fish, maximum age was age 5 at one stream and age 4 at the remaining waters. Total length ranged from 103 to 359 mm for wild brook trout and 115 to 353 mm for hatchery MYY brook trout. Growth rates and body condition of stocked MYY brook trout did not differ from wild fish in the same waters. Given that the success of MYY eradication programs is primarily contingent upon MYY individuals having fitness characteristics similar to wild conspecifics, our results provide further evidence that the stocking of hatchery-reared MYY fish may be a viable tool for eradicating unwanted non-native fish populations.

Fishing Effort

Globally, the harvest of crustaceans, particularly decapods, has recently increased. One easily accessed decapod family, Portunidae, includes some 500 species, many of which are target or byproduct species in artisanal, recreational, and commercial fisheries throughout tropic and temperate zones. Various active and passive gears are used to harvest portunids although, owing to their sporadic distributions in shallow and confined areas among coastal estuarine and river systems, much of the global harvest comes from baited, small-mesh traps. Concerns over deploying small-meshed traps in areas associated with large abundances of small fauna, including juveniles of the target species, have led to many efforts to reduce portunid-trap bycatch, especially in Australia. Several portunids are targeted around Australia, although key species are the giant mud crab, Scylla seratta and blue swimmer crab, Portunus armatus, with a combined annual national commercial harvest of 1700 t and recreational harvest of 2500 t. Although their distributions overlap, S. seratta and P. armatus are broadly separated between northern and southern Australia, respectively. Within their distributions, S. seratta frequently inhabits brackish rivers, while P. armatus inhabits more saline estuaries. Both species' ranges extend into New South Wales (NSW; south-eastern Australia), although P. armatus [Minimum Legal Size (MLS) of 65 mm carapace length (CL)] is predominant with regional harvests comprising 20% of the Australian total. Commercial or recreational trapping is permitted in 120 coastal rivers or estuaries in NSW, however >70% of the commercial harvest of P. armatus is from Wallis Lake and Port Stephens. Regardless of the fishing sector, most P. armatus are caught using collapsible netted (polyethylene) cylindrical traps [hereafter termed “round traps” and made from 50 to 57-mm stretched mesh opening (SMO)]. Over the past decade, round traps have largely superseded traditional rectangular rigid-wire traps. Commercial fishers each deploy 20–70 baited traps (in permitted estuaries) for variable diel soak times and are limited to an annual total catch quota of ~225 t, while recreational fishers can deploy two traps each and retain 10 P. armatus (both sexes above legal size can be retained) day−1. Commercial fishers (but not recreational) can also retain legal-sized teleosts (mostly yellowfin bream, Acanthopagrus australis), and all fishers can retain legal-sized S. serrata (≥85 mm CL). Most of the catch is during the austral spring to autumn when water is warmest. Owing to the small mesh sizes used in round traps, all fishers catch large numbers of unwanted organisms, especially undersized P. armatus that are discarded. Most discarded portunids and teleosts survive over the short term.

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Escape Gaps

Nevertheless, discarding unwanted organisms can cause sublethal effects. Also, catching portunids that are not retained reduces a trap's carrying capacity, possibly affecting harvests. In recognition of poor trap selectivity, and following overseas efforts with other Portunus spp., three studies in NSW investigated technical modifications to improve round trap selectivity. This work included increasing mesh sizes (to 75- and 91-mm SMO) to better match the MLS of P. armatus, and retroactively installing escape gaps. Regardless of mesh size, installing escape gaps in round traps did not affect legal-sized P. armatus catch, but reduced the numbers of undersized conspecifics and A. australis by >51%. Further, small P. armatus egress increased with greater catches or more escape gaps. Based on the work done, a plastic, rectangular escape gap measuring 120 × 36 mm was developed, mass produced, and distributed among volunteer commercial fishers during 2018. The rectangular escape gap was designed to allow P. armatus <65 mm CL to escape, but not greatly affect the catch of legal-sized A. australis (≥25 cm total length–TL), which at 25 cm TL have a minimum body depth (height) and thickness (width) of 86 and 32 mm, and at sizes >28 cm TL cannot egress escape gaps. Anecdotal information suggested good industry uptake of the escape gaps, but no data are available describing fleet-wide use, with all experimental work spatiotemporally constrained (<3 weeks) at one location (Wallis Lake) and with few fishers. Previous studies imply at least some variability between gear-based research and the eventual adoption of fishing-gear modifications, which can reflect devolving or evolving refinements. Such variability can only be assessed as part of subsequent observer-based studies during conventional fishing. We sought to use observers to collect data from the NSW commercial fishery for P. armatus to (1) assess the uptake of escape gaps, before (2) determining if round traps configured with escape gaps were effective at reducing catches of undersized portunids and other species during conventional conditions. Ultimately, we sought to better inform stakeholders and policy makers of the most appropriate round-trap configuration for legislation.