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T45 side panels improve penaeid-trawl selection

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ABSTRACT

The utility of fitting panels of mesh turned 45° ('T45' or 'square-shaped' mesh) in a generic penaeid trawl body was investigated for improving selectivity. Compared to a conventional trawl comprising 43-mm diamond-shaped mesh throughout the body and a codend made from 27-mm T45 mesh, replacing just the side panels (18% of the total trawl area) with those made from 32- and 35-mm T45 mesh generally improved size-selection for school prawns, *Metapenaeus macleayi*—which was the dominant species—and especially in the trawl with 35-mm T45 mesh. This trawl also had a trend of improved size selection for the much less abundant eastern king prawns, *Penaeus plebejus*. Commercial catches of both penaeids were not negatively affected by the modifications. No teleosts were significantly affected by T45 side panels—although the predicted mean numbers of species with individuals smaller than the 32- and 35-mm T45 meshes were slightly lower. We conclude that retroactively inserting T45 side panels with an appropriate mesh size into penaeid-trawl bodies could be a simple and effective strategy for improving size selection; either as an adjunct to T45 codends, or as an alternative modification.

1. Introduction

Penaeid trawling occurs globally and is among the world's most controversial fishing methods; primarily because of the small mesh sizes required (< 50-mm stretched mesh opening–SMO) and use in inshore, shallow areas often characterized by large assemblages of small species, and therefore disproportional catches of unwanted organisms (Kelleher, 2005; Gillett, 2008). The collateral mortality of discarded juveniles of teleosts targeted in other fisheries is a primary resource inefficiency issue and there is the potential for growth overfishing among economically important species (Hall, 1996; Broadhurst, 2000; Broadhurst et al., 2006a). Beyond teleost bycatch, penaeid trawls also are poorly selective for the targeted species, nearly always catching a wide range of sizes that include individuals too small for sale (Broadhurst et al., 2006a, 2015).

Previous studies have demonstrated that the size selectivity of penaeid trawls can be improved by increasing and maintaining lateral mesh openings at strategic locations—especially in the codend (because this is where the catch accumulates)—by orientating the mesh 45° to the direction of netting tension (i.e. 'turned 45°' and termed 'T45') so it assumes a square shape (Broadhurst et al., 2004; Macbeth et al., 2007). Compared to conventional diamond-mesh codends (referred to as 'T0'), those made from often smaller-sized T45 mesh can have improved size selection for penaeids and various other species across steeper selectivity ogives (Robertson and Stewart, 1988; Broadhurst et al., 2004; Macbeth et al., 2007; Bahamon et al., 2006).

Based on their improved selectivity, T45 codends have been implemented in some small-scale penaeid-trawl fisheries (e.g. Macbeth et al., 2007). But because the load is aligned to the longitudinal bars (and the codend cannot expand laterally), in some cases when large catches are retained there have been concerns over netting strength and mesh distortion (Robertson, 1986; Broadhurst et al., 2006b). One option is to orientate codend meshes 90° to the tension ('T90'), which allows the knot to partially improve lateral openings while maintaining strength and the capacity to expand (Bayse et al., 2016; Gorman and Dixson, 2015). There have been few studies of T90 codends in penaeid-trawl fisheries, but these might offer some practical benefits while still maintaining lateral openings (Gorman and Dixson, 2015).

Even less research has been done to investigate the utility of improving lateral mesh openings at other potentially important locations (that are not routinely subjected to heavy loading) in penaeid trawls for regulating selectivity, and more specifically in the anterior body. In one of the few studies, we assessed the benefits of shortening the body taper

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of conventional trawls used in an Australian estuary from 1N3B (~28°) to 1N5B (~35°), while reducing mesh size from 41- to 35-mm SMO combined with: (i) forcing square-shaped meshes at the frame lines (the ropes to which the netting is attached) via an increased hanging ratio (defined as the taper size ÷ by the length of line to which it is attached); and (ii) inserting relatively narrow T45 side panels (Broadhurst et al., 2015).

Of the two modifications, T45 side panels were most effective; retaining up to 54% fewer sub-commercial (< 15 mm carapace length–CL) school prawns, *Metapenaeus macleyi* than the conventional 41-mm trawl (with the shallow side taper–1N3B) while maintaining catches of target-sized individuals. These results were attributed to improved openings along the steeper side panels increasing the frequency of *M. macleyi* encounters and facilitating the escape of small individuals. Such research should be promoted, because intuitively increasing the possibility of unwanted organisms escaping at first contact with meshes in a trawl might minimise their associated mortality.

However, rather than completely new trawls and body tapers, anterior modifications to improve penaeid-trawl selection ideally should first involve simple, retroactively fitted solutions to existing fishing gear—primarily because this might facilitate adoption by fishers. We sought to investigate the utility of such modifications here in an Australian commercial estuarine penaeid-trawl fishery. Specifically, we tested the hypothesis that two sizes of T45 mesh (nominal SMOs of 32 and 35 mm) fitted to the side panels of a generic penaeid trawl (43-mm mesh) would not affect the (i) target and (ii) incidental catches, and trawl (iii) drag and (iv) wing-end spread.

2. Materials and methods

The experiment was done during the 2015 Austral summer in Lake Wooloweyah (29°26 S 153°22 E) NSW, Australia. This estuary supports a regionally important fishery involving up to 91 small otter trawlers (< 10 m) that fish throughout the Lake (sandy and mud substrata in ~1–2 m depth) during daylight in summer. The vessels target school prawns, but also retain eastern king prawns, *Penaeus plebejus* (both species are sought at sizes ~≥15 mm carapace length–CL) for a total penaeid catch often exceeding 140 t per annum.

A local double-rigged trawler (10 m with an 89-kW engine) was chartered for the experiment. The trawler had 8-mm diameter (Ø) stainless warps and 40-m bridles (6-mm Ø stainless wire) on two hydraulic winches and was equipped with a: global positioning system (GPS; Lowrance); two hull-mounted sum logs (EchoPilot, Bronze Log +); a Notus trawl monitoring system (Notus Trawlmaster System; Model no. TM800ET) to monitor wing-end spread; and load cells and associated data logger (Amalgamated Instrument Company; model no's PA6139 and TP4). The load cells were attached to the bridles (which

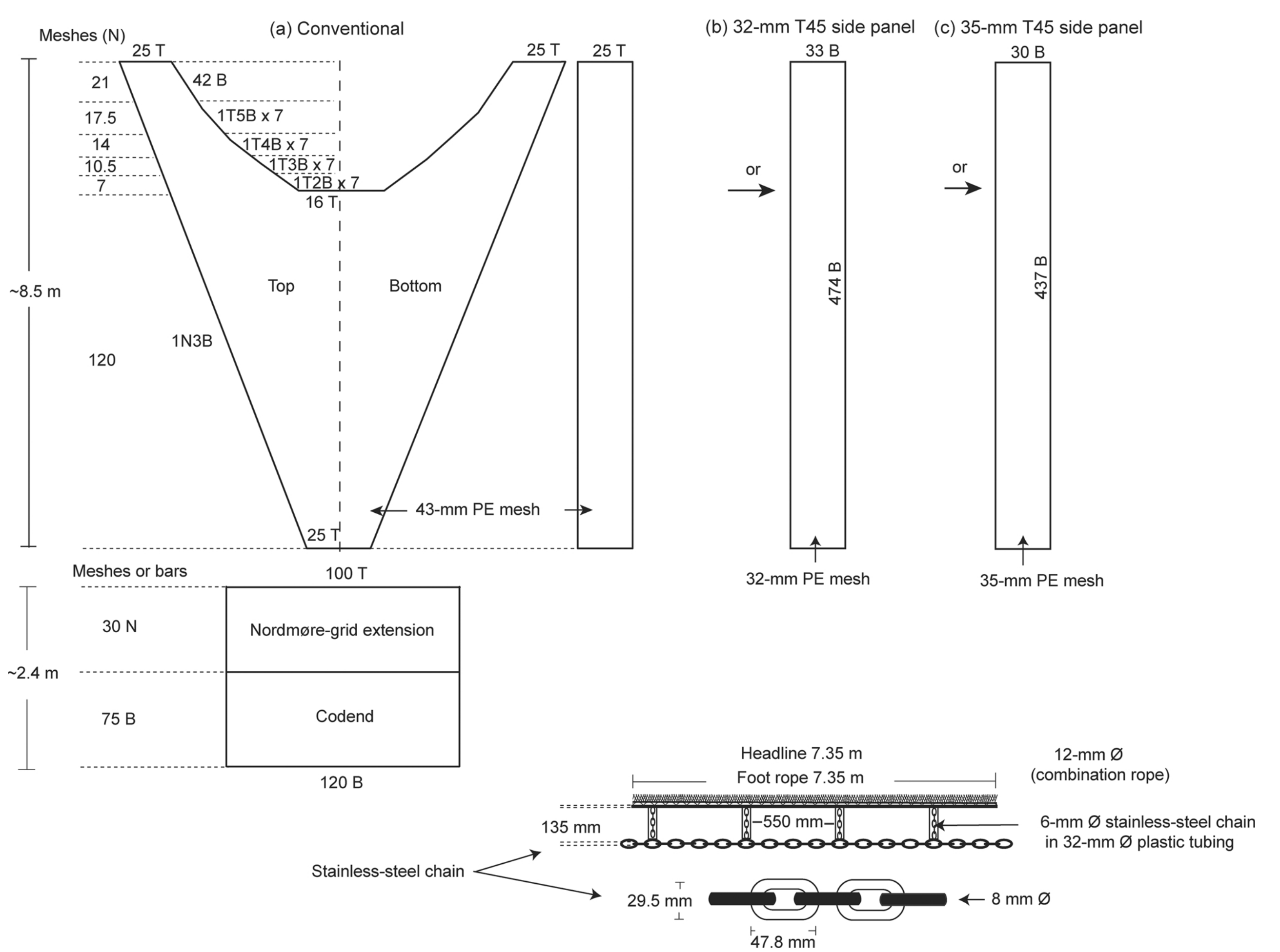

Fig. 1. Plan of the (a) conventional trawl and with the (b) 32- and (c) 35-mm T45 side panels, Ø, diameter; B, bars; T, transverse meshes; N, normal meshes; PE, polyethylene.