Stock Status Summary – 2022/23

NSW Stock Status Summary – Yellowtail Scad
(*Trachurus novaezelandiae*)

Assessment author and year

Broadhurst, M.K. 2023. NSW Stock Status Summary 2022/23 – Yellowtail Scad (*Trachurus novaezelandiae*). NSW Department of Primary Industries, Fisheries. **9** pp.

Stock status

Current stock status	On the basis of the evidence presented in this stock assessment report, the eastern Australian biological stock of Yellowtail Scad is classified as **Sustainable** in NSW waters.

Stock structure and distribution

Yellowtail Scad have an Australian distribution from southern Queensland to northern Western Australia, and also occur off New Zealand. While Yellowtail Scad's distribution encompasses Victoria and South Australia, only negligible catches and effort are reported from these states. The biological stock structure of Yellowtail Scad remains unknown; but in New South Wales there is evidence of spatial differences in growth which might be indicate subpopulations. Similar spatial population variability has been observed for Yellowtail Scad in New Zealand.

Here, assessment of stock status is presented at the biological stock level—Eastern Australia; and jurisdictional—Western Australia.

Biology

Only a few Australian studies have assessed the biology and population dynamics of Yellowtail Scad, and all work is limited to the east coast (Stewart and Ferrell, 2001; Neira, 2009; Neira et al., 2015; Broadhurst et al., 2018; Dawson et al., 2020; Shilling et al., 2022). Annual spawning is assumed to occur along continental-shelf waters off NSW and QLD during early spring (October), and potentially in response to discrete water masses with specific temperatures (e.g. ~21.5°C; Neira, 2009; Neira et al., 2015). Juveniles typically recruit to inshore marine areas, including the lower reaches of estuaries, across shallow, soft substrates, and often remain close to permanent structures, where they consume various zooplankton (Shilling et al., 2022) and grow quite quickly (Stewart and Ferrell, 2001). There are no formal published estimates of 50% size at maturity, but using unpublished data, Kailola et al. (1993) proposed sizes of ~20 and 22 cm fork length (FL) for males and females. According to Stewart and Ferrell (2001), such sizes correspond to 2-and 3-year-old fish; depending on latitudinal variation. Adults remain distributed across coastal areas, and often are associated with rocky reefs. Estimated maximum sizes are between 24 and 31 cm FL, and with a reported maximum age of 28 years (Stewart and Ferrell, 2001).

FISHERY STATISTICS

Catch information

Commercial

Partitioned annual reported commercial catches of Yellowtail Scad in NSW are available from 1997–98 to the present and encompass six fisheries (Fig. 1). Total reported annual commercial catches have ranged from 297 (2009–10) to 601 t (1997–98), but mostly have remained fairly stable at 450–520 t (mean ± SD of 474 ± 85 t; Fig. 1). Typically, around 80–90% of all landed Yellowtail Scad are purse seined by vessels working in the NSW ocean-haul fishery or caught using submersible lift nets and/or purse seines in the Commonwealth tuna-bait fishery (the latter under a Section 37 permit). Within these two fisheries, NSW ocean-haul purse seiners have historically landed at least 60% of the total catch for a mean (± SD) of 299 ± 66 t p.a. Commonwealth vessels land 119 ± 55 t p.a.; although data are unavailable prior to 2008–09,and have been populated in Figure 1 based on the average of recent reported fiscal years.

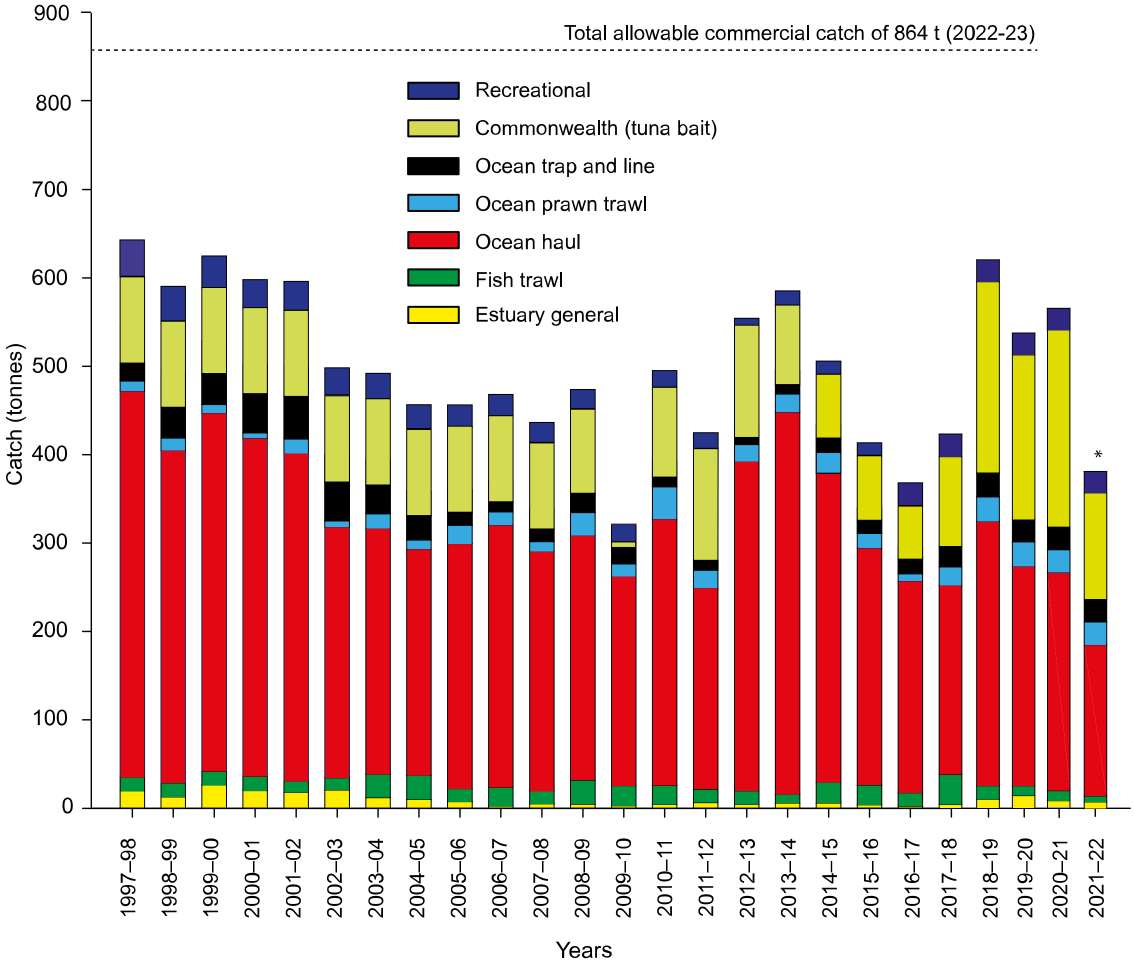

Fig. 1. Annual catches (t) of Yellowtail Scad reported by all sectors for which there are data in New South Wales waters/fisheries by fiscal year from 1997–98 to 2021–22. Recreational catch data are restricted to surveys completed in 2000–01, 2013–14 and 2017–18 with preceding, intervening and subsequent years interpolated based on these three-point differences. *data are incomplete for the fiscal year, with a small percentage of fisher returns outstanding at the time of writing.

Reported fish- and ocean prawn-trawl catches have remained fairly consistent among years at means (± SD) of 29 ± 6 and 16 ± 7 t p.a. By comparison, estuary general and ocean trap-and-line catches peaked at 21 and

49 t p.a. respectively before 2006–07, and then stabilised at 4 ± 1 and 14 ± 4 t p.a. over the subsequent decade, although estuary general catches did rise to 17 t during 2019-20, but were only 6 and 5 t in the last two financial years (Fig. 1).

Discarding by NSW commercial fishers is known to occur across all fisheries (Liggins, 1996; Liggins et al., 1996; Kennelly et al., 1998; Gray et al., 2001) and for an estimated total of ~31 t each year. These discards are fairly evenly distributed among ocean trap and line fishers (~11 t) fish and prawn trawlers (~11 t), and estuary general methods (~9 t).

Other jurisdictional commercial catches of Yellowtail Scad off eastern Australia are comparatively low, but quite variable, ranging from < 10 t to ~65 t p.a. In recent years, most of these catches (>50%) have come from the Commonwealth Small Pelagic Fishery.

Recreational and charter boats

Estimates of the recreational harvest (hook-and-line) of Yellowtail Scad are available from three recreational fishing surveys, and are minimal compared to commercial catches. All three recreational surveys estimated catches in terms of numbers, which have been crudely transformed to weights using mean sizes. Specifically, in 2000–01, the estimated harvest was ~152 000 fish weighing 33 t (Henry and Lyle, 2003), while in 2013–14 (West et al., 2015) and 2017–18 (Murphy et al., 2020), some 90 000 fish or 16 t and 150 000 fish or 31 t were retained.

Yellowtail Scad are also caught from charter boats (hook-and-line) in NSW, but until 2016 catches were not separated from Jack Mackerel (*Trachurus declivis*) and therefore are excluded. More recent charter-catch data pertaining only to Yellowtail Scad suggest steady annual catches. Specifically, the estimated total numbers each year since 2016 have ranged from 7 170 to 13 671 individuals.

Total recreational discarding is estimated to be ~13.5 t each year. However, ongoing data are required to validate discarding by the recreational sector (Gray and Kennelly, 2018).

First nations people

Catches by first nations people remain unknown; but are presumed to be negligible.

Illegal, unregulated and unreported

Given there is no minimum legal size for Yellowtail Scad and a very large recreational bag limit, their reported recreational catches might be fairly representable for that sector. By comparison, commercial logbook reporting might be prone to some misreporting, particularly among fishers targeting Yellowtail Scad for bait (i.e. which are never landed). However, there is no formal evidence to negate the existing catch and effort data.

Fishing-effort information

Historical commercial effort data describing the targeting of Yellowtail Scad are only available for vessels in the NSW ocean-haul and Commonwealth tuna-bait fisheries, and the latter only date to 2009–10. Further, prior to 2009, logbook effort data in the NSW ocean-haul fishery were calculated on monthly rather than daily returns, and so to standardize comparisons, data have been adjusted accordingly.

New South Wales (ocean haul) purse-seine effort peaked at >2000 days in 1999–00, fell sharply the following year to 1300 days, and then steadily declined within a range of 950–680 days over the subsequent 15 years following reductions in vessel numbers. By comparison, estimated Commonwealth tuna-bait effort has remained quite low and fairly steady, but did peak at 287 days in 2018–19.

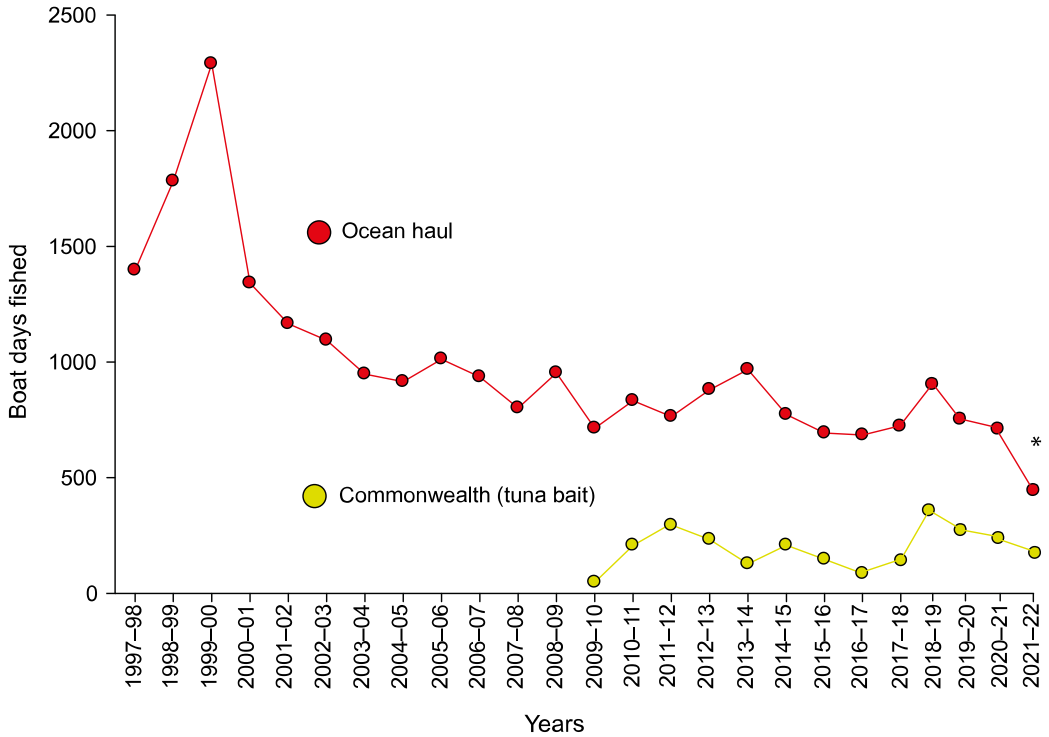

Figure 2. Purse-seine effort (days fished) for New South Wales ocean-haul (red) and purse-seine/lift-net effort for Commonwealth tuna-bait (green) fishers that reported targeting Yellowtail Scad for each fiscal year from 1997–98 to 2021–22.*data are incomplete for the fiscal year, with a small percentage of fisher returns outstanding at the time of writing.

Along with catches, state-wide estimates of recreational fishing effort are limited to three time points: 2000–01, 2013–14 and 2017–18. The latter two estimates are state surveys and with greater consistency in approaches. Nevertheless, effort estimates are not species-specific, but rather encompass broad spatial (e.g. coastal region, fresh vs. saltwater, boat- vs. shore-based, etc.) and technical categories (gear type). For all saltwater fishing in NSW, there was slight decrease in effort (by 9%) between the two state survey estimates.

For charter boats, there were no separated effort data catching only Yellowtail Scad until 2016 (data were combined with those for Jack Mackerel). A revision of reporting requirements means the two species now have to be separated, which confounds any historical trends. Nevertheless, the historical total effort has been quite low at <3000 boat-hours fished each year.

Catch-rate information

The commercial sector is responsible for >95% of Yellowtail Scad harvests in NSW, and so those catch rates are the most relevant index of trends. Since 1999, the purse-seined catch rate (kg per boat-day fished) of Yellowtail Scad in the NSW ocean-haul fishery steadily increased to 2011–12, but more recently remained at 300–450 kg per boat day (Fig. 3). The reported catch rates of fishers in the Commonwealth tuna-bait fishery are only available post 2008–09. While catch rates also increased until 2011–12, there was a subsequent reduction that appeared slightly (and negatively) correlated to the catch rate by purse seiners in the NSW ocean-haul fishery (Fig. 3).

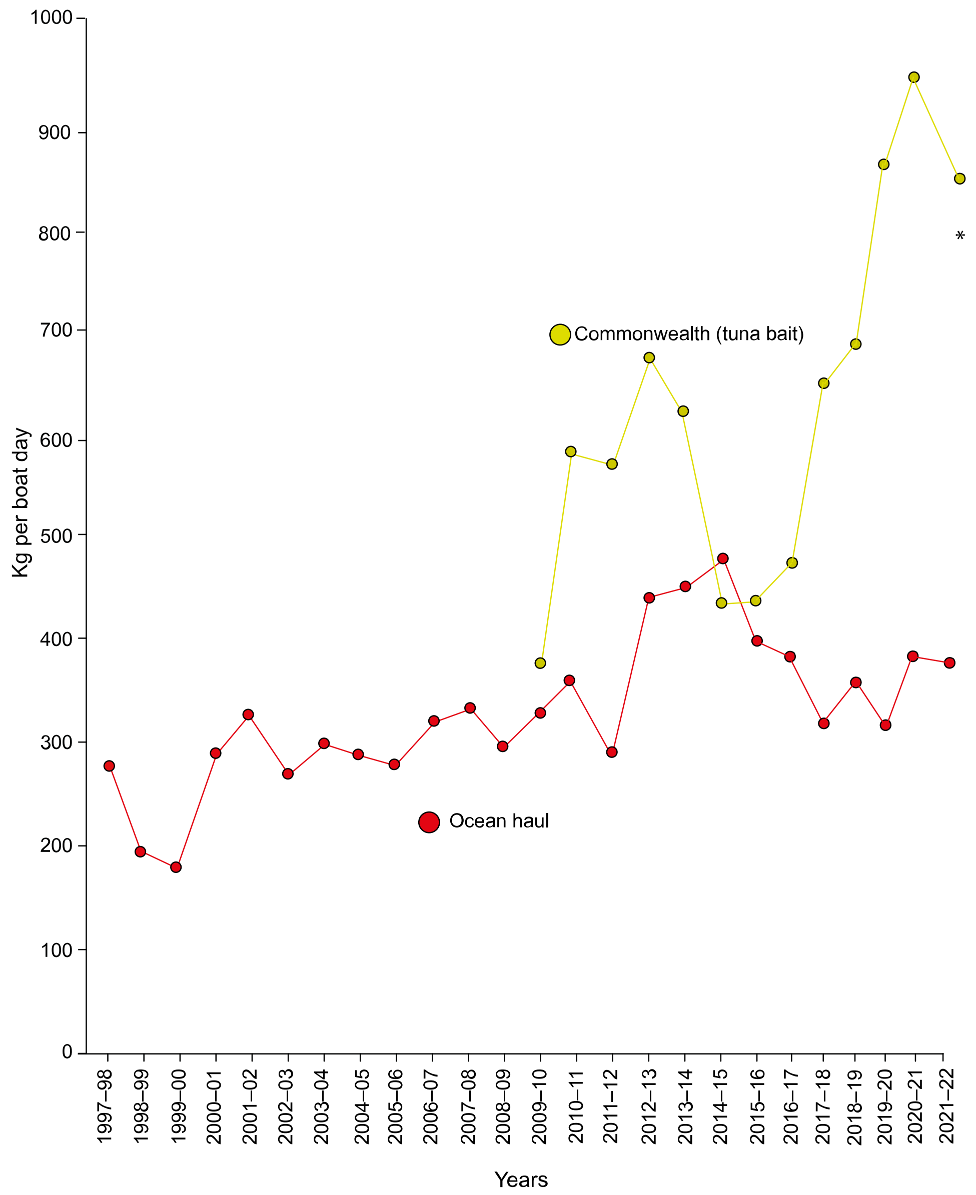

Figure 3. Standardized temporal commercial catch rates (kg per boat day) of Yellowtail Scad purse seined in the New South Wales ocean-haul fishery and caught in the Commonwealth tuna-bait fishery for the fiscal years 1997–98 to 2021–22. *data are incomplete, with a small percentage of fisher returns outstanding at the time of writing.

STOCK ASSESSMENT

Stock Assessment Methodology

Year of most recent assessment:

2022

Assessment method:

Published stock assessment, weight of evidence, and interpolation.

Main data inputs:

Commercial fishing catches: reported annual catches for all sectors by fiscal years (1997–98 to 2021–22);

Recreational fishing catches: interpolated annual catches preceding, intervening and subsequent to two survey points (national recreational and indigenous fishing survey in 2000–01 and NSW state-wide recreational fishing surveys in 2013–14 and 2017–18);

Charter-boat fishery catches: reported annual catches by fiscal year (to 2021–2022);

Size-at-age data comprising 2 347 otoliths of fish ages 0+ to -18 years;

Estimated discards: all fisheries and based on published single time point observer-based accounts extrapolated among years using ratios to retained catches;

Commercial catch rates: reported annual catch-and-effort data for purse seiners (responsible for 80–90% of the total catch);

Length compositions and most recent size-at-age in catches: port monitoring (2000 to present); and

Growth: estimated from otoliths and sizes.

Key model structure and assumptions:

The published stock assessment involved hazard functions applied to two decades of data to enable survival analyses (Broadhurst et al., 2018). Models were rerun in 2020 with two-additional years data, but outputs remained the same.

Key assumptions are that:

1. Annual intervals among collected size-at-age data did not affect modelling outputs (not evident based on model convergence and fits);
2. Purse-seine selectivity is defined by a logistic regression (needs to be formally assessed); and
3. Fishing mortality was not overly affected by variable fishing power.

Sources of uncertainty evaluated:

The models were successfully converged, and not affected by variable inputs within the above assumptions.

Status Indicators - Limit and Target Reference Levels

Biomass indicator or proxy	No biomass indicator.
Biomass Limit Reference Point	20% B0 (20% of pre-exploitation biomass)

Biomass Target Reference Point	NA
Fishing mortality indicator or proxy	Fishing mortality (F) relative to natural mortality (M).
Fishing mortality Limit Reference Point	F >> M (Fishing mortality estimated to be substantially greater than natural mortality).The estimated natural mortality is 0.22 p.a., and this would be the limit for fishing mortality.
Fishing Mortality Target Reference Point	NA

Stock Assessment Result Summary

Biomass status in relation to Limit	Although there is no indicator or proxy for Bcurrent relative to B0, during the last two decades F << M, and so it is likely that Bcurrent >> B0.
Biomass status in relation to Target	As above.
Fishing mortality in relation to Limit	F << M. A predicted 5-fold increase in effort would be required to inflict a fishing mortality approaching the estimated M of 0.22.
Fishing mortality in relation to Target	NA
Current SAFS stock status	Sustainable

Fishery interactions

Several fishing gears used to catch Yellowtail Scad within the designated fisheries (Fig. 1) are known to interact with listed or protected species of concern. These species include Black Rock Cod (*Epinephelus daemelii*), Eastern Blue Devil (*Paraplesiops bleekeri*), Green Turtle (*Chelonia mydas*), Greynurse Shark (*Carcharias taurus*), Great Hammerhead (*Sphyrna mokarran*), Humpback Whale (*Megaptera novaeangliae*), Scalloped Hammerhead (*Sphyrna lewini*), Short-tail Shearwater (*Ardenna tenuirostris*), Southern Dogfish (*Centrophorus zeehaani*), and White Shark (*Carcharodon carcharias*), Great Hammerhead, Green Turtle, Loggerhead Turtle (*Caretta caretta*), seals and Scalloped Hammerhead (Kennelly, 2018).

Qualifying comments

Based on formal stock assessment, there appears to be minimal fishing mortality on Yellowtail Scad (there has been a consistent annual >300 t shortfall in landed catch against the TAAC), implying an underutilised fisheries resource, albeit with some caveats. First, the collected size-at-age data used in the stock assessment were sporadic. Ideally, the chosen modelling approach (survival analysis) supports long-term (5–7 consecutive years) of size-at-age data, although based on meaningful model convergences, gaps between years clearly are feasible. Second, purse-seine catchability and selectivity should be validated, which would be best done by applied work following empirical methods used among similar fishing gears. Third, it is important to appreciate that various factors can affect fishing mortality, including chronological variations (typically an increase) in fishing power. Certainly, the observed increase in catch rate by the NSW ocean-haul purse-seine fleet among recent years supports an enhanced capacity to target Yellowtail Scad. But, information concerning variable fishing power remains unavailable, and an annual increase in fishing power of 2 and 4% failed to improve model fit.

Like most species subject to quota, ongoing size-at-age, and catch-and-effort data are required to inform future decisions regarding management. Another consideration is that ~90% of the commercial catch is reported from only 5 degrees of latitude (32–37°S). The importance of this area to life-history (e.g. reproduction) warrants assessment; particularly given the observed differences in growth rates among sampled specimens between northern and southern regions. Pelagic species like Yellowtail Scad are quite vulnerable to capture in purse seines and appropriate spatial consideration of effort might be required.

References

Broadhurst, M. K., Suuronen, P. and Hulme, A. 2006. Estimating collateral mortality from towed fishing gear. Fish Fish. 7: 180–218. doi.org/10.1111/j.1467-2979.2006.00213.x

Broadhurst, M.K., Wooden, M.E.L. and Millar, R.B. 2007. Isolating selection mechanisms in beach seines. Fish. Res. 88: 56–69. doi:10.1016/j.fishres.2007.07.009

Broadhurst, M.K., Butcher, P.A. and Cullis, B.R. 2012. Catch-and-release angling mortality of south-eastern Australian *Pomatomus saltatrix*. Afr. J. Mar. Sci. 34: 289–295. doi:10.2989/1814232X.2012.675127

Broadhurst, M.K., Kienzle, M. and Stewart, J. 2018. Natural mortality of *Trachurus novaezelandiae* and their size selection by purse seines off south-eastern Australia. Fish. Man. Ecol. 25: 332–338. doi: 10.1111/fme.12286

Butcher, P.A., Broadhurst, M.K., Hall, K.C., Cullis, B.R. and Nicoll, R.G. 2010. Scale loss and mortality in angled-and-released eastern sea garfish (*Hyporhamphus australis*). ICES J. Mar. Sci. 67: 522–529. doi:10.1093/icesjms/fsp257

Dawson, G., Suthers, I.M., Brodie, S. and Smith, J.A. 2020. The bioenergenetics of a coastal forage fish: Importance of empirical values for ecosystem models. Deep-Sea Res II. 175 (104700).

Graham, K.J., Broadhurst, M.K. and Millar, R.B. 2009. Effects of codend circumference and twine diameter on selection in south-eastern Australian fish trawls. Fish. Res. 95: 341–349. doi:10.1016/j.fishres.2008.10.001

Gray C.A., Kennelly S.J., Hodgson K.E., Ashby C.J.T., Beatson, M.L. 2001. Retained and discarded catches from commercial beach-seining in Botany Bay, Australia. Fish. Res. 50: 205–219. doi:10.1016/S0165-7836(00)00228-9

Gray, C.A. and Kennelly, S.J. 2003. Catch characteristics of the commercial beach-seine fisheries in two Australian barrier estuaries. Fish. Res. 63: 405–422. doi:10.1016/S0165-7836(03)00076-6

Gray, C.A. and Kennelly, S.J. 2017. Recreational charter fishery attributes and variation in key species catches and discards: Resource management considerations. Fish. Man. Ecol. 24: 403–415. doi:10.1111/fme.12242

Gray, C.A. and Kennelly, S.J. 2018. Diversity and composition of catches and discards in a recreational charter fishery. Fish. Res. 199: 44–52. doi:10.1016/j.fish.res.2017.11.021

Henry, G.W. and Lyle, J.M. 2003. The national recreational and indigenous fishing survey. Australian Government Department of Agriculture, Fisheries and Forestry, Canberra, Australia. ISSN 1440-3544

Horn, P.L. 1993. Growth, age structure, and productivity of jack mackerels (*Trachurus* spp.) in New Zealand waters. NZ. J. Mar. Freshwater Res. 27: 145–155. doi:10.1080/00288330.1993.9516553

Hughes, J.M., Johnson, D.D., Murphy, J.J., Ochwada-Doyle, F.A. 2021. The NSW Recreational Fisheries Monitoring Program – Charter Fishery Monitoring 2017/18 NSW DPI – Fisheries Final Report Series No. 159.

Kailola, P.J., Williams, M.J., Stewart, P.C., Reichelt, R.E., McNee, A., and Grieve, C. 1993. Australian fisheries resources. Bureau of Resource Sciences, Australia and FRDC. 422 p

Kennelly, S.J. 2018. Developing a national bycatch reporting system. FRDC Project No 2015/208, 99 p.

Kennelly, S.J., Liggins, G.W. and Broadhurst, M.K. 1998. Retained and discarded by-catch from ocean prawn trawling in New South Wales, Australia. Fish. Res. 36: 217–236. doi:10.1016/S0165-7836(98)00091-5

Liggins, G.W. 1996. The interaction between fish trawling (in NSW) and other commercial and recreational fisheries. FRDC, Project report 92/97.

Liggins, G. W., Kennelly, S.J., and Broadhurst, M.K. 1996. Observer-based survey of by-catch from prawn trawling in Botany Bay and Port Jackson, New South Wales. Mar. Freshwater Res. 47: 877–888. doi:10.1071/MF9960877

Murphy, J.J., Ochwada-Doyle, F.A., West, L.D., Stark, K.E. and Hughes, J.M. 2020. The NSW Recreational Fisheries Monitoring Program - survey of recreational fishing, 2017/18. NSW DPI - Fisheries Final Report Series No. 158.

Neira, F.J. 2009. Provisional spawning biomass estimates of yellowtail scad (*Trachurus novaezelandiae*) off south-eastern Australia. NSW DPI Report, 32 pp.

Neira, F.J., Perry, R.A., Burridge, C.P., Lyle, J.M. and Keane, J.P. 2015. Molecular discrimination of shelf-spawned eggs of two co-occurring *Trachurus* spp. (Carangidae) in south-eastern Australia: a key step to future egg-based biomass estimates. ICES J. Mar. Sci. 72 (2): 614–624. doi:10.1093/icesjms/fsu151

Schilling, H.T., Smith, J.A., Everett, J.D., Harrison, D.P. and Suthers, I.M. 2022. Size-selective predation by three estuarine zooplanktivorous fish species Mar. Freshw. Res. 73: 823–832 doi:10.1071/Mf21344

Stewart, J. and Ferrell, D.J. 2001. Age, growth, and commercial landings of yellowtail scad (*Trachurus novaezelandiae*) and blue mackerel (*Scomber australasicus*) off the coast of New South Wales, Australia. NZ. J. Mar. Freshw. Res. 35: 541–551. doi:10.1080/00288330.2001.9517021

West, L.D., Stark, K.E, Murphy, J.J., Lyle, J.M. and Doyle, F.A. 2015. Survey of recreational fishing in New South Wales and the ACT, 2013/14. Fisheries Final Report Series No. 149. ISSN 2204-8669.