

Dusky Whaler (2023)

Carcharhinus obscurus



Matias Braccini: Department of Primary Industries and Regional Development, Western Australia, **Victor Peddemors:** New South Wales Department of Primary Industries, **Michael Drew:** South Australian Research and Development Institute, **Michael Usher:** Department of Industry, Tourism and Trade, Northern Territory, **Brooke D'Alberto:** Australian Bureau of Agricultural and Resource Economics and Sciences, **Ian Jacobsen:** Department of Agriculture and Fisheries, Queensland

STOCK STATUS OVERVIEW

Jurisdiction	Stock	Stock status	Indicators
Commonwealth, Queensland, New South Wales	Eastern Australia	Sustainable	Catch, NeOGen modelling
Commonwealth, Western Australia, Northern Territory	Western Australia	Recovering	Catch, CPUE, direct estimates of fishing mortality, demographic analysis, risk assessment

STOCK STRUCTURE

Dusky Whaler has a tropical to warm-temperate distribution and is found off the west, south and north coasts of Australia, mostly between latitudes 18°S and 36°S [McAuley et al. 2007; Rogers et al. 2013a], and off the east coast, where the full extent of the species' geographic distribution is unclear. Electronic and conventional tagging studies have shown Dusky Whalers move between South Australia and Western Australia [Simpfendorfer et al. 1999; Rogers et al. 2013b; Huvneers et al. 2014, 2021] and between Queensland, New South Wales, Victoria and Tasmania [Huvneers et al. 2021], and genetic analyses suggest there is restricted gene flow between Dusky Whaler off eastern and western Australia [Geraghty et al. 2014]. Therefore, Dusky Whaler in South Australian, Western Australian and Northern Territory waters are considered to form a single biological stock (the Western Australia stock). This biological stock exhibits a high degree of ontogenetic segregation, with juveniles most common in temperate latitudes and adults in warmer northern latitudes [McAuley et al. 2007, 2015].

Here, assessment of stock status is presented at the biological stock level—western Australia and eastern Australia.

STOCK STATUS

Eastern Australia

Dusky Whaler is taken as a non-target species by Commonwealth fishers in the Eastern Tuna and Billfish Fishery (ETBF). The species has been considered using ecological risk assessment methods and found to be at medium risk [Sporcic et al. 2019]. Commonwealth commercial catch averaged less than one tonne (t) per year during the 2017–18 to 2021–22 financial years and was less than 1 t in the 2021–22 financial year.

In Queensland, species-specific reporting for the Dusky Whaler commenced in 2009 and is now required in all fisheries that retain shark. However, the species is only retained in small quantities in the East Coast Inshore Fishery (ECIF). Annual harvest rates since 2008–09 range from 0.4 t to 3.7 t with the ECIF retaining an annual average of 1.4 t of Dusky Whaler over the last 10 years (2012–13 to 2021–22). This average declines to 0.8 t when only the last five years of data are considered (2016–17 to 2021–22).

Outside of the commercial fishing sector, the catch of Dusky Whaler in Queensland waters is low to negligible. On average, 11 Dusky Whalers are caught in the Queensland Shark Control Program each year (2001–2017 data) [Queensland Government, 2023]. No recreational data is available for this species [Teixeira et al. 2021]. However, recreational harvest is limited by a one shark in possession limit and a maximum legal size limit of 1.5 m total length.

In New South Wales, Dusky Whaler was not identified and reported at the species level in commercial catch logbooks until 2009. Observer data indicate that whaler sharks are the second most commonly caught shark species group in the New South Wales Ocean Trap and Line Fishery (15% of overall catch) [Macbeth et al. 2009]. Historical catch of Dusky Whaler is therefore likely to have been around 7.5 t from 2000 to 2005, whereafter increased targeting of large whaler sharks led to three years of higher catch, peaking at approximately 30 t in 2006–07. Dusky Whaler catch reduced to approximately 15 t in 2007–08 once fishers started differentiating some of the whaler sharks in preparation of the new species-specific logbook requirements, specific conditions and restrictions being implemented in the OTL fishery [Macbeth et al. 2009]. Since 2015, under 3 t of Dusky Whaler was landed each year by the OTL fishery in New South Wales. An annual catch of less than one t was reported by the New South Wales Shark Meshing Program.

Application of a new software package known as NeOGen [Blower et al 2019] estimated the total population size of Dusky Whalers on the eastern Australian coastline at approximately 35,000 individuals [Blower 2020]. Simulations at the historically higher fishing levels indicate those fishery harvest volumes to be sustainable [Blower 2020; Peddemors et al. 2020].

The above evidence indicates that the biomass of this stock is unlikely to be depleted and recruitment is unlikely to be impaired. The above evidence also indicates that the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired.

On the basis of the evidence provided above, the Eastern Australia biological stock is classified as a **sustainable stock**.

Western Australia

The cross-jurisdictional Western Australia Dusky Whaler stock is taken in fisheries managed by the Commonwealth, Western Australia, Northern Territory

and South Australia. This biological stock is most abundant in waters between north-west and southern Western Australia (to longitude 120°E). The whaler shark species composition in South Australia's commercial multispecies, multi-gear and multi-sectoral Marine Scalefish Fishery (MSF) is not resolved in log-books. Onboard sampling showed carcharhinid catches by the MSF largely comprised juvenile Bronze Whalers (*C. brachyurus*) [Rogers et al. 2013a; SARDI unpublished data]. The presence of Dusky Whalers in catches in South Australian waters is seasonally and spatially variable [Jones 2008; Rogers et al. 2013a].

The Commonwealth commercial catch in the Gillnet, Hook and Trap Sector (GHTS) of the Southern and Eastern Scalefish and Shark Fishery (SESSF) of Western Australia Dusky Whaler stock averaged less than one t per year during 2017–18 to 2021–22 financial years and no catch in the 2021–22 financial year.

Catches of Dusky Whaler in Western Australia's Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery, and the West Coast Demersal Gillnet and Demersal Longline Fishery have historically consisted of neonate (young of the year) and one-to-two year-old sharks. Collectively, these age classes accounted for 89% of the observed catch during the 1990s [Simpfendorfer et al. 2002, McAuley and Simpfendorfer 2003]. The status of this stock was initially assessed using demographic modelling techniques, fishing mortality rates estimated from a tagging study in the 1990s, and contemporary catch and catch per unit effort (CPUE) data [McAuley et al. 2007; Simpfendorfer 2010]. A 2005 assessment confirmed that recorded catches of young juvenile sharks in the target fisheries have been sustainable since the mid-1990s. However, the assessment model also predicted that very low levels of fishing mortality (1–2% per year) applied to sharks older than 10 years would result in recruitment overfishing [McAuley et al. 2007]. Previous assessments therefore concluded that the declining trend observed in the effective Dusky Whaler CPUE series between the mid-1990s and 2004–05 indicated that the breeding biomass, and hence recruitment, had been gradually depleted by poorly quantified levels of intrinsic (e.g., WA Rock lobster fishery) and extraneous fishing mortality, including fisheries operating in other jurisdictions [Jones 2008; Rogers et al. 2013a; McAuley et al. 2015; Marshall et al. 2016; Braccini et al. 2021]. Based on the above lines of evidence the stock was considered to be depleted and recruitment impaired [McAuley et al. 2015]. As a result, comprehensive measures to mitigate cryptic mortality of older Dusky Whalers within all Western Australian managed commercial fisheries, and to reduce catches of juveniles to below the levels determined to be sustainable in the mid-1990s, have been introduced since 2006–07. An increasing trend in the effective CPUE from 2006–12 was interpreted as improved recruitment and a recovering stock, suggesting that management arrangements were suitably precautionary to ensure that the biological stock continued to recover [McAuley et al. 2015].

In 2018, a stock assessment was conducted based on a risk-based weight of evidence approach using all available lines of evidence, including simulated biomass trajectories derived from a combination of demographic modelling and catch-only modelling [Braccini et al. 2018]. This assessment estimated a "Medium" current sustainability risk from fishing for the Dusky Whaler stock [Braccini et al. 2018].

Updated stock assessments using a range of catch-only methods, state-space biomass dynamics models (JABBA, Winker et al. [2018]), integrated age-structured models (Stock Synthesis, Methot and Wetzel [2013]), and time-series of reconstructed catches, catch rates, abundance and length composition are underway (Braccini et al. unpublished). Preliminary findings, based on catch-only

STATUS OF AUSTRALIAN FISH STOCKS REPORT
Dusky Whaler (2023)

methods and the state space biomass dynamics model, indicate that for the last 10 years total catches have been below those required for MSY and that the recent biomass trajectory has considerably increased. In addition, fishery independent surveys of the adult component of the stock in northern western Australia show a strong increasing trend since 2016.

The above evidence indicates that the biomass of this stock is likely to be depleted and that recruitment is likely to be impaired. However, for the period 2016 to 2022 these indicators suggest a recovering stock. The above evidence indicates that the current level of fishing mortality should allow the stock to recover from its recruitment impaired state.

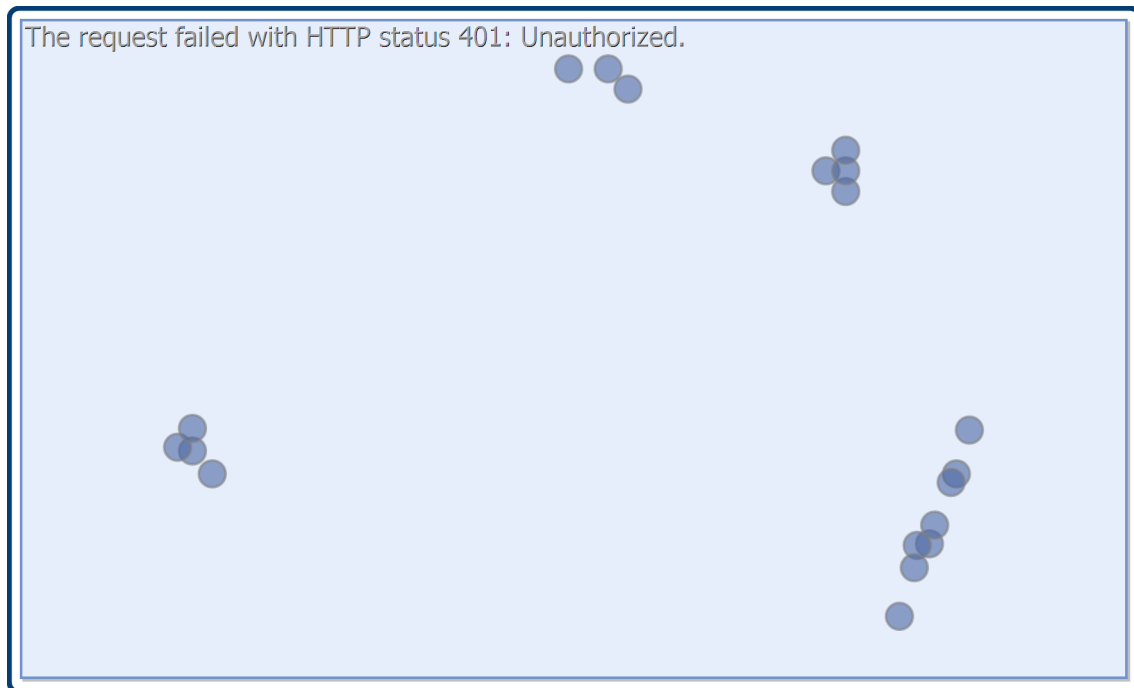
On the basis of the evidence provided above, the Western Australia biological stock is classified as a **recovering stock**.

BIOLOGY

Dusky Whaler biology [Simpfendorfer et al. 2002; McAuley et al. 2007; Geraghty et al. 2013, 2016; Kyne et al. 2021]

Species	Longevity / Maximum Size	Maturity (50 per cent)
Dusky Whaler	Females > 40 years, 2 890 mm FL Males > 32 years, 3 560 mm TL (~2 920 mm FL)	Females 27–35 years, 2 540 mm FL (Western Australia) Females 15.5 years, 2811 mm TL (Eastern Australia)

DISTRIBUTION



STATUS OF AUSTRALIAN FISH STOCKS REPORT
Dusky Whaler (2023)

Distribution of reported commercial catch of Dusky Whaler

TABLES

Fishing methods					
	Commonweal th	New South Wales	Northern Territory	Queensland	South Australia
Charter					
Hook and Line		✓		✓	
Commercial					
Demersal Longline		✓			
Dropline		✓			
Gillnet					
Hook and Line		✓			
Line				✓	
Longline (Unspecified)					
Mesh Net		✓			
Net				✓	
Otter Trawl		✓			
Pelagic Longline	✓				
Unspecified			✓		
Various		✓			
Recreational					
Hook and Line		✓	✓	✓	✓
Unspecified					

Management Methods					
	New South Wales	Northern Territory	Queensland	South Australia	Western Australia
Charter					
Bag limits	✓				✓
Licence (boat-based sector)	✓				✓
Size limits					✓

STATUS OF AUSTRALIAN FISH STOCKS REPORT
Dusky Whaler (2023)

Western Australia	
	✓
	✓
	✓
	✓

STATUS OF AUSTRALIAN FISH STOCKS REPORT
Dusky Whaler (2023)

Spatial closures					✓
Commercial					
Bag/possession limits	✓		✓		
Catch limits					✓
Effort limits				✓	
Effort limits (individual transferable effort)					✓
Gear restrictions	✓	✓	✓	✓	✓
Harvest Strategy			✓		
Limited entry	✓		✓	✓	✓
Processing restrictions		✓	✓	✓	✓
Quota		✓			
Seasonal or spatial closures			✓		
Size limit					✓
Size limits			✓		
Spatial closures	✓			✓	✓
Total allowable catch			✓		
Vessel restrictions			✓		
Recreational					
Bag limits	✓			✓	✓
Bag/possession limits			✓		
Gear restrictions			✓	✓	✓
Licence (boat-based sector)					✓
Processing restrictions			✓		
Seasonal or spatial closures			✓		
Size limit					✓

STATUS OF AUSTRALIAN FISH STOCKS REPORT
Dusky Whaler (2023)

Size limits			✓		
Spatial closures					✓

Catch					
	Commonwealth	New South Wales	Northern Territory	Queensland	South Australia
Commercial	0.096 t	3.97546 t	0.84 t	1.72535 t	
Indigenous		Unknown	Undetermined but likely to be negligible	Unknown	Unknown
Recreational		Shore-based catches are undetermined but consist primarily of juveniles	Undetermined but likely to be negligible	Unknown	Undetermined but likely to be negligible

STATUS OF AUSTRALIAN FISH STOCKS REPORT
Dusky Whaler (2023)

Western Australia
3.55969 t
Undetermined but likely to be negligible
<10 t of whaler sharks caught from boats is retained, shore- based catches are undetermined

Commercial (catch) Western Australian (state) and Eastern Australia biological stock is for Dusky Whaler only. However, South Australian catches are reported as undifferentiated whaler sharks and are therefore not presented.

Commonwealth – Commercial Data provided for the Commonwealth align with 2021–22 financial year.

Commonwealth – Recreational The Australian Government does not manage recreational fishing in Commonwealth waters. Recreational fishing in Commonwealth waters is managed by the state or territory immediately adjacent to those waters, under its management regulations.

Commonwealth – Indigenous The Australian Government does not manage non-commercial Indigenous fishing in Commonwealth waters, with the exception of the Torres Strait. In general, non-commercial Indigenous fishing in Commonwealth waters is managed by the state or territory immediately adjacent to those waters.

Western Australia – Recreational (Management Methods) A recreational fishing from boat licence is required for recreational fishing from a powered vessel in Western Australia.

New South Wales – Indigenous (Management Methods)

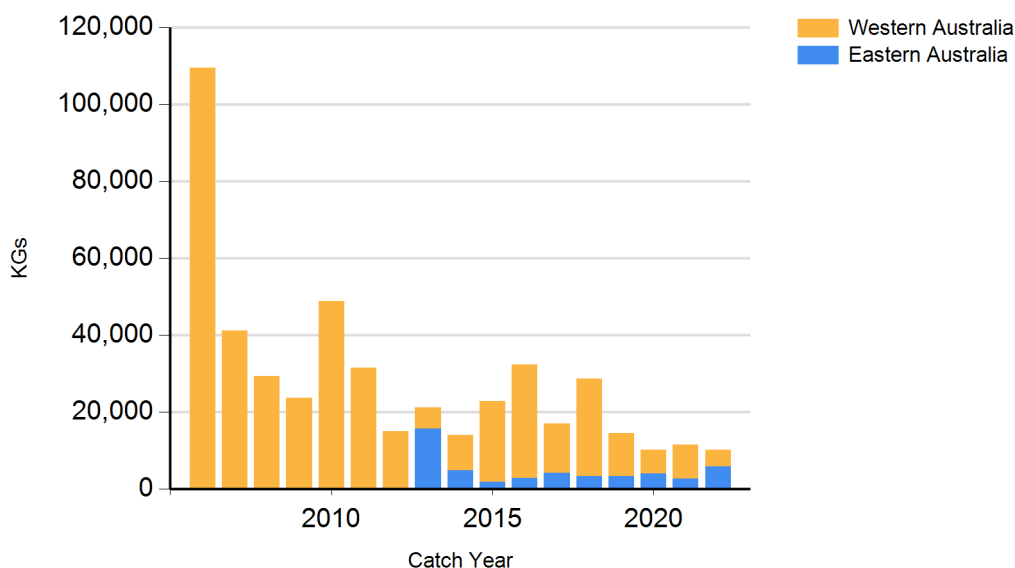
<https://www.dpi.nsw.gov.au/fishing/aboriginal-fishing>

Northern Territory - Indigenous (management methods) The Fisheries Act 1988 (NT), specifies that: “Unless expressly provided otherwise, nothing in this Act derogates or limits the right of Aboriginal people who have traditionally used the resources of an area of land or water in a traditional manner to continue to use those resources in that area in that manner.”

Queensland – Commercial QLD commercial and charter data has been sourced from the commercial fisheries logbook program. Further information available through the Fisheries Summary Report (<https://www.daf.qld.gov.au/business-priorities/fisheries/monitoring-research/data/queensland-fisheries-summary-report>)

Queensland – Indigenous (management methods) for more information see <https://www.daf.qld.gov.au/business-priorities/fisheries/traditional-fishing>

CATCH CHART



STATUS OF AUSTRALIAN FISH STOCKS REPORT
Dusky Whaler (2023)

Commercial catches of Dusky Whaler - note confidential catch not shown

References	
McAuley et al. 2007	McAuley, RB, Simpfendorfer, CA and Hall, NG 2007, A method for evaluating the impacts of fishing mortality and stochastic influences on the demography of two long-lived shark stocks, <i>ICES Journal of Marine Science</i> , 64: 1710–1722.
Rogers et al. 2013a	Rogers, PR, Huvneers, C, Goldsworthy SD, Cheung, WWL, Jones KG, Mitchell, JG and Seuront, L 2013, Population metrics and movement of two sympatric carcharhinids: a comparison of the vulnerability of pelagic sharks of the southern Australian gulfs and shelves, <i>Marine and Freshwater Research</i> , 64: 20–30.
Huvneers et al. 2014	Huvneers, C, Rogers, P and Drew, M 2014, Monitoring shark species of conservation concern within the Adelaide metropolitan and Gulf St Vincent regions, final report to the Adelaide and Mount Lofty Ranges Natural Resources Management Board, South Australian Research and Development Institute (Aquatic Sciences), SARDI publication F2013/000716-1, SARDI research report series 754, SARDI, Adelaide, 89.
Rogers et al. 2013b	Rogers, P, Huvneers, C, Goldsworthy, SD, Mitchell, JG and Seuront, L 2013, Broad-scale movements and pelagic habitat of the Dusky Shark <i>Carcharhinus obscurus</i> off Southern Australia determined using pop-up satellite archival tags, <i>Fisheries and Oceanography</i> , 22: 102–112.
Geraghty et al. 2014	Geraghty, PT, Williamson, JE, Macbeth, WG, Blower, DC, Morgan, JAT, Johnson, G, Ovenden, JR and Gillings, MR 2014, Genetic structure and diversity of two highly vulnerable carcharhinids in Australian waters, <i>Endangered Species Research</i> , 24: 45–60.
McAuley et al. 2015	McAuley, R, Braccini, M, Newman, SJ and O'Malley, J 2015, Temperate Demersal Gillnet and Demersal Longline Fisheries Status Report, in WJ Fletcher and K Santoro (eds), <i>Status Reports of the Fisheries and Aquatic Resources of Western Australia 2014/15</i> , Western Australian Department of Fisheries, Perth, 261–272.
Jones 2008	Jones, K 2008, Review of the fishery status for whaler sharks (<i>Carcharhinus</i> spp.) in South Australian and adjacent waters, report to the Fisheries Research and Development Corporation, FRDC project 2004/067, South Australian Research and Development Institute (Aquatic Sciences) publication F2007/000721-1, SARDI research report series 154, SARDI, Adelaide.
McAuley and Simpfendorfer 2003	McAuley, R and Simpfendorfer, C 2003, Catch composition of the Western Australian Temperate Demersal Gillnet and Demersal Longline fisheries, 1994–1999, Fisheries research report 146, Western Australian Department of Fisheries, Perth.
Simpfendorfer et al. 2002	Simpfendorfer, CA, McAuley, R, Chidlow, J and Unsworth, P 2002, Validated age and growth of the Dusky Shark, <i>Carcharhinus obscurus</i> , from Western Australian waters, <i>Marine and Freshwater Research</i> , 53: 567–573.
Simpfendorfer 1999	Simpfendorfer, C 1999, Demographic analysis of the dusky shark fishery in southwestern Australia, in JA Musick (ed.), <i>Life in the slow lane: Ecology and conservation of long-lived marine animals</i> , American Fisheries Society Symposium 23, Bethesda, Maryland, 149–160.
Marshall et al. 2016	Marshall, L, Giles, J and Johnson, GJ 2016, Catch composition of a traditional Indonesian shark fishery operating in the MOU Box, northwestern Australia: Results of shark fin identification from Operation Snapshot (May 2015), 2016/001375, Australian Fisheries Management Authority, Canberra.
Macbeth et al. 2009	Macbeth, WG, Geraghty, PT, Peddemors, VM and Gray, CA 2009, Observer-based study of targeted commercial fishing for large shark species in waters off northern New South Wales, Cronulla Fisheries Research Centre of Excellence, New South Wales Industry and Investment, Cronulla.
Geraghty et al. 2013	Geraghty PT, Macbeth, WG, Harry, AV, Bell, JE, Yerman, MN and Williamson, JE 2013, Age and growth parameters for three heavily exploited shark species off temperate eastern Australia, <i>ICES Journal of Marine Science</i> , 71: 559–573.
Simpfendorfer et al. 1999	Simpfendorfer CA, McAuley R, Chidlow JA, Lenanton R, Hall N and Bastow T 1999. Biology and stock assessment of Western Australia's commercially important shark species. Project 96/130 Fisheries Research and Development Corporation, Department of Fisheries of Western Australia, Perth.
Braccini et al 2018	Braccini, M, Blay, N, Hesp, A, and Molony, B 2018. Resource Assessment Report Temperate Demersal Elasmobranch Resource of Western Australia. Department of Primary Industries and Regional Development. Fisheries Research Report No. 294 Department of Primary Industries and Regional Development, Western Australia. 149 pp

STATUS OF AUSTRALIAN FISH STOCKS REPORT
Dusky Whaler (2023)

Blower et al. 2019	Blower DC, Riginos, C and Ovenden, JR. 2019. NeOGen: A tool to predict genetic effective population size (N_e) for species with generational overlap and to assist empirical N_e study design. <i>Molecular Ecology Resources</i> 19: 290-271.
Blower 2020	Blower, D. C. 2020. Estimating contemporary abundance, demography, and vulnerability to change for long-lived species with effective population size and population simulation. PhD thesis. School of Biological Sciences, p. 257. The University of Queensland.
Geraghty et al. 2016	Geraghty PT, Macbeth WG and Williamson JE 2016, Aspects of the reproductive biology of dusky, spinner and sandbar sharks (Family Carcharhinidae) from the Tasman Sea, <i>Marine and Freshwater Research</i> , 67: 513–525
Teixeira et al. 2021	Teixeira, D, Janes, R, and Webley, J 2021, 2019–20 Statewide Recreational Fishing Survey Key Results. Project Report. State of Queensland, Brisbane.
Kyne et al. 2021	Kyne, P. M., Heupel, M. R., White, W. T. & Simpfendorfer, C. A. (2021). The Action Plan for Australian Sharks and Rays 2021. National Environmental Science Program. Hobart, Australia.
Queensland Government 2023	Queensland Government, 2023, Shark Control Program: Shark Catch Statistics by Year. Available at: https://www.data.qld.gov.au/dataset/shark-control-program-shark-catch-statistics (Accessed: 2 August 2023).
Sporcic et al. 2019	Sporcic, M, Hobday, A, Bulman, C, Hartog, J, Fuller, M 2019 Ecological Risk Assessment for the Effects of Fishing: Report for the Eastern Tuna and Billfish Fishery: Longline sub-fishery, data to 2015. Report for the Australian Fisheries Management Authority. 234 pp.
Winker et al. 2018	JABBA: Just Another Bayesian Biomass Assessment. <i>Fish. Res.</i> 204, 275–288
Methot, R.D., Wetzel, C.R., 2013	Stock synthesis: A biological and statistical framework for fish stock assessment and fishery management. <i>Fish. Res.</i> 142, 86–99
Huveneers et al. 2021	Continental-Scale Network Reveals Cross-Jurisdictional Movements of Sympatric Sharks With Implications for Assessment and Management. <i>Frontiers in Marine Science</i> 8: 697175
Peddemors et al. 2020	Peddemors, V, Macbeth, W, Collins, D, Goulstone, A, Ives, M., Ovenden, J., Butcher, P. 2020. Shark Futures: Sustainable management of the NSW whaler shark fishery. Port Stephens, NSW. 190pp
Braccini et al. 2021	Braccini, M, Kangas, M, Jaiteh, V and Newman, S 2021, Quantifying the unreported and unaccounted domestic and foreign commercial catch of sharks and rays in Western Australia. <i>Ambio</i> , 50(7), 1337-1350