

# Spangled Emperor (2023)

*Lethrinus nebulosus*



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## STOCK STATUS OVERVIEW

Jurisdiction	Stock	Stock status	Indicators
Western Australia	Gascoyne	Sustainable	Catch, fishing mortality
Western Australia	Kimberley	Sustainable	Catch, indicator species status
Western Australia	Pilbara	Sustainable	Catch, indicator species status
Western Australia	West Coast	Recovering	Catch, indicator species status
Northern Territory	Northern Australia	Negligible	Catch, SAFE assessment
Queensland	East Coast Queensland	Sustainable	Catch, effort, length and age frequency stability
Queensland	Gulf of Carpentaria	Undefined	Catch, effort
New South Wales	New South Wales	Negligible	Catch

## STOCK STRUCTURE

## STATUS OF AUSTRALIAN FISH STOCKS REPORT Spangled Emperor (2023)

Spangled Emperor has a widespread Indo-West Pacific distribution, ranging from the Red Sea, Persian Gulf, and East Africa east to southern Japan in the north, around northern Australia and extending east to Samoa [Carpenter and Allen 1989]. In Australia, Spangled Emperor are found from around Rottnest Island on the lower west coast, across northern Australia to south of Sydney on the east coast [Carpenter and Allen 1989; Carpenter and Niem 2001].

The population structure of Spangled Emperor in Western Australia has been studied by assessing spatial variation in allozymes [Johnson et al. 1993], otolith microchemistry [Moran et al. 1993], tagging and recapture [Moran et al. 1993], DNA micro-satellite markers [Berry et al. 2012], and acoustic telemetry [Pillans et al. 2014]. Individuals generally demonstrate a limited home range of less than three nautical miles [Moran et al. 1993]. Relatively high site fidelity has been shown for at least some individuals in Western Australia and elsewhere [Chateau and Wantiez 2008; Pillans et al. 2014]. Limited mixing of post-settlement individuals is also indicated from an analysis of otolith microchemistry of Spangled Emperor sampled from different sites [Moran et al. 1993].

Genetic studies have demonstrated homogeneous genetic characteristics across broad spatial scales (10–1,500 km) throughout the distribution of Spangled Emperor in Western Australia [Johnson et al. 1993]. Analysis of fine-scale patterns using high resolution micro-satellite markers, however, has found that juveniles exhibit fine-scale genetic autocorrelation, which declines with age [Berry et al. 2012]. This implies both larval cohesion and limited juvenile dispersal prior to maturity, primarily in the vicinity of the Ningaloo Marine Park [Berry et al. 2012]. Hydrodynamic modelling indicated that Spangled Emperor larvae were likely to be transported hundreds of kilometres, easily accounting for the observed gene flow, despite relatively restricted adult dispersal [Berry et al. 2012]. As such, Spangled Emperor are considered to comprise a single biological stock in at least Western Australia. However, there is limited mixing of adult Spangled Emperor. Given the absence of any discrete genetic structure, there is insufficient evidence to suggest revision of current management boundaries. Hence, the current boundaries that designate separate management units are deemed appropriate if adequate levels of adult biomass are maintained, as declines in one stock may have broader implications for the population network given the broader connectivity.

There is a high likelihood that these population characteristics (extensive gene flow, limited adult movement) are shared across each of the jurisdictions. Low genetic subdivision between northwest Western Australia and the Great Barrier Reef suggests gene flow is likely to be high between these regions [Berry et al. 2012]. There is possibly one genetic stock in Australia, however, improved stock delineation work is required in jurisdictions outside Western Australia.

Here, assessment of stock status is presented at the management unit level—West Coast, Gascoyne, Pilbara, Kimberley (Western Australia); Gulf of Carpentaria (Queensland), East Coast (Queensland); and New South Wales; and at the jurisdictional level—Northern Territory.

### STOCK STATUS

**East Coast Queensland** There has been no formal stock assessment of Spangled Emperor across the East Coast Queensland management unit. Estimated recreational harvest of Spangled Emperor in 2019–20 was 27 t at the whole of Queensland level (i.e., across both stocks) [Teixeira et al. 2021]. In 2004, decreased commercial catch coincided with expansion of no-take marine reserves within the Great Barrier Reef Marine Park and the introduction of a quota management system for coral reef finfish species. The annual reported commercial line harvest has been relatively stable with an average of 55 t over the last decade and catch of 51 t in 2021–22. Length and age frequencies collected from fishery dependent monitoring remain stable and showed that a strong year class entered the fishery in 2018–19, remaining dominant through to 2022–23 [QDAF Unpublished 2023]. The above evidence indicates recent strong recruitment and indicates that the biomass of this stock is unlikely to be depleted and recruitment is

unlikely to be impaired.

Spangled Emperor is a secondary target and by-product species in the Reef Line Fishery (RLF). Commercial harvest is only constrained by a multi-species total allowable commercial catch (TACC) and a minimum legal size. However, additional harvest constraints are provided through species-specific harvest control rules and catch reference points introduced in early 2020 for secondary target species through the RLF Harvest Strategy [QDAF 2020]. Harvest of Spangled Emperor that exceeds the harvest reference points and control rules will trigger a stock assessment and the implementation of an interim species-specific TACC. Recreational harvest is also controlled through the minimum legal size and a possession limit. It is likely that a portion of the biomass would be afforded some protection from fishing through zoning (restricting or prohibiting fishing) in the Great Barrier Reef Marine Park, although this has not been quantified.

Fishing pressure for Spangled Emperor has been stable over the last decade with nominal catch rates in the commercial sector averaging 16 kg/day. Fishing days peaked in 2009–10 at 4,529 days of effort before stabilising over the last decade to an average of 3,412 days of effort. Targeted catch and effort within the commercial fishery are limited to a small number of commercial operators in the northeast of the state due to market preferences for other species within the fishery. The above evidence indicates the current level of fishing pressure is unlikely to cause the stock to become recruitment impaired.

On the basis of the evidence provided above, the East Coast of Queensland management unit is classified as a **sustainable stock**.

### **Gascoyne**

Spangled Emperor in the Gascoyne is caught by commercial line fishers in the Gascoyne Demersal Scalefish Managed Fishery and the recreational/charter sectors. Spangled Emperor is one of the indicator species within the Gascoyne Demersal Scalefish Resource (GDSR). A weight of evidence-based assessment of Spangled Emperor in the Gascoyne used catch curve and per recruit analyses and included age composition data from 2007–08 for the northern and southern areas of the Gascoyne Coast Bioregion [Marriott et al. 2012]. This assessment indicated that fishing mortality on Spangled Emperor in the Gascoyne in 2007–08 was between the target and threshold levels and that the management unit was a sustainable stock at that time. This assessment of Spangled Emperor is supported by estimates of biomass and harvest rates from a more recent data-limited Catch-MSY assessment model compared periodically to a model prediction for maximum sustainable yield (MSY).

Total catch of Spangled Emperor in the Gascoyne over the last 10 years (2013–22) has ranged from 15–29 t (mean annual catch 19 t). This represents a decline in the average catch compared with the previous 10 years (mean annual catch 47 t). The recreational and charter catch is much larger than the commercial catch and has averaged approximately 82% of the total catch over the past 10 years. The Catch-MSY model applied to data on annual catches (1976–2022), indicates that the annual catches began around the median point estimate for maximum sustainable yield (MSY) then increased rapidly to above the upper 95% CI from 1984–98 (with the exception of 1994–96 being at MSY) then declined below the lower 95% CI, and have remained below until 2022. This is consistent with the predicted values for biomass going below BMSY in 1988 and declining below 0.25BMSY in 2000, and only increased above 0.25BMSY from 2020–22. Fishing mortality exceeded the limit in 1986 and remained above the limit until 2012 but has since been below FMSY. However, it

is important to recognise that Catch-MSY is a data-limited technique with relatively strong assumptions, dependent on user inputs. For this assessment assumptions included specified ranges for initial depletion (0.4–0.8), based on likely catches prior to the start of the time series, final depletion (0.15–0.5), based on recent catches relative to maximum recorded annual catch, and low resilience ( $r=0.1–0.6$ , consistent with species longevity, of approximately 31 years in WA). The above evidence indicates that the Spangled Emperor biomass is unlikely to be depleted. Furthermore, the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired.

Based on the evidence provided above, the Gascoyne (Western Australia) management unit is classified as a **sustainable stock**.

### **Gulf of Carpentaria**

There has been no stock assessment of the species across this management unit. Spangled Emperor is a by-product species group in the Gulf of Carpentaria Line Fishery and Gulf of Carpentaria Developmental Fin Fish Trawl Fishery with low annual harvest (approximately 1 t average since 2012–22). Estimated recreational harvest of Spangled Emperor was 27 t at the whole of Queensland level (i.e., across both stocks) [Teixeira et al. 2021]. There are no reliable estimates of catch of Spangled Emperor for Indigenous fishers in the GOC, but it is reasonably expected to be very low. The above evidence of likely low harvest suggests that it is unlikely that the biomass of Spangled Emperor in the GOC is depleted, however there is insufficient information available to confidently classify the status of this stock.

On the basis of the evidence provided above, the Gulf of Carpentaria (Queensland) management unit is classified as an **undefined stock**.

### **Kimberley**

Spangled Emperor in the Kimberley management unit is landed commercially in the Northern Demersal Scalefish Managed Fishery (NDSMF). Spangled Emperor is assessed on the basis of the status of several indicator species (for example, Red Emperor and Goldband Snapper in the Kimberley region) within the North Coast Demersal Resource (NCDR) that represent the entire inshore demersal suite of species occurring at depths of 30–250 m [Newman et al. 2018]. The indicator species in the Kimberley have been classified as sustainable [Wakefield et al. 2023]. The level of risk associated with the sustainability of Spangled Emperor in the NCDR is assessed as low. This assessment of Spangled Emperor is also supported by predictions for biomass and harvest rates from a data-limited Catch-MSY assessment model compared periodically to a model prediction for maximum sustainable yield (MSY).

Total catch of Spangled Emperor in the Kimberley over the last 10 years (2013–22) have ranged from 18–36 t, with a mean annual catch of 25 t. This is consistent with the averages catches across the previous 10 years of 26 t. Recreational and charter catch are relatively low compared to the commercial catch, in the past 10 years where reliable catches estimates are available, the proportion of the total catch has averaged < 5%. The Catch-MSY model applied to data on annual catches for this species (1993–2022), indicate that the annual catches have generally fluctuated around the upper and lower 95% CI on the median model estimate for maximum sustainable yield (MSY), with the exception of years 1993–96, 2001–03, and 2017, which were above the 95% CI. This is also consistent with the predicted values for biomass only going below BMSY in 2005–07 over the entire time series, and fishing mortality remaining below FMSY. However, it is important to recognise that Catch-MSY is a data-limited technique with relatively strong assumptions, dependent on user inputs. For this

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assessment, these included specified ranges for initial depletion (0.4–0.8), based on likely but unknown catches from foreign fleets prior to the start of the time series, final depletion (0.15–0.7), based on recent catches relative to maximum recorded annual catch and the non-targeted nature, and low resilience ( $r=0.1–0.6$ , consistent with species longevity, of approximately 31 years in WA). Given the recent catches of this species are below the predicted MSY, and status of the indicator species for the Kimberley, it is considered unlikely that the biomass of Spangled Emperor in the Kimberley is depleted and 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, Spangled Emperor in the Kimberley (Western Australia) management unit is classified as a **sustainable stock**.

**New South Wales**

Stock status for Spangled Emperor in New South Wales is reported as Negligible due to historically low catches in this jurisdiction and because the stock has generally not been subject to targeted fishing. The New South Wales commercial catch in the period 2015–22 averaged 0.11 t per annum, and Spangled Emperor is not a major component of recreational landings [West et al. 2015; Murphy et al. 2020, 2022]. Fishing is unlikely to be having a negative impact on the stock.

On the basis of the evidence provided above, Spangled Emperor in New South Wales is classified as a **Negligible stock**.

**Northern Australia**

Stock status for Spangled Emperor in the Northern Territory is reported as Negligible due to historically low catches in this jurisdiction, and because the stock has generally not been subject to targeted fishing. During the period 2010–19, Fishing Tour Operators in the Northern Territory have reported small (< 0.1 t) annual catches of Spangled Emperor. The Northern Territory commercial catch during 2017–18 to 2021–22 averaged less than 700 kg per annum, and Spangled Emperor is not a major component of recreational landings. Fishing is unlikely to be having a negative impact on the stock.

On the basis of the evidence provided above, Spangled Emperor in the Northern Territory is classified as a **Negligible stock**.

**Pilbara**

Spangled Emperor is landed commercially in the Pilbara Demersal Scalefish Fisheries (PDSF: Pilbara Fish Trawl (Interim) Managed Fishery, Pilbara Line Fishery and Pilbara Trap Managed Fishery) in the Pilbara management region of the North Coast Bioregion of Western Australia [Newman et al. 2020]. Spangled Emperor is assessed on the basis of the status of three indicator species (Red Emperor, Rankin Cod and Bluespotted Emperor) within the North Coast Demersal Resource (NCDR) that represent the entire inshore demersal suite of species occurring at depths of 30–250 m [Newman et al. 2018]. The indicator species in the Pilbara have been classified as sustainable [Wakefield et al. 2023]. The level of risk associated with the sustainability of Spangled Emperor in the Pilbara is assessed as low. This assessment of Spangled Emperor is also supported by predictions for biomass and harvest rates from a data-limited Catch-MSY assessment model compared periodically to a model prediction for maximum sustainable yield (MSY).

Total annual catch of Spangled Emperor in the Pilbara over the last 10 years (2013–22) has ranged from 35–88 t, with a mean annual catch of 61 t. This is consistent with the average catches across the previous 10 years of 66 t.

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Recreational and charter catch are relatively low compared to the commercial catch, in the past 10 years where reliable catches estimates are available, the proportion of the total catch has averaged approximately 21%. The Catch-MSY model applied to data on annual catches for this species (1973–2022), indicate that the annual catches from foreign fleets at the start of the time series were above the upper 95% CI on the median model estimate for maximum sustainable yield (MSY), then declined to below the lower 95% CI when the fishery transitioned into a domestic only fishery in the 1980s and with the exception of years 1996 and 2003 has been below MSY. This is also consistent with the predicted values for biomass declining to 0.25 by 1990 but then increasing to 0.5 (BMSY) in 2022, and fishing mortality remaining below FMSY. However, it is important to recognise that Catch-MSY is a data-limited technique with relatively strong assumptions, dependent on user inputs. For this assessment, these included specified ranges for initial depletion (0.8–0.975), based on catches prior to foreign fleets at the start of the time series were likely to be low, final depletion (0.15–0.7), based on recent catches relative to maximum recorded annual catch and the non-targeted nature, and low resilience ( $r=0.1-0.6$ , consistent with species longevity, of approximately 31 years in WA). Given the recent catches of this species are below the predicted MSY, and status of the indicator species for the Pilbara, it is considered unlikely that the biomass of Spangled Emperor in the Pilbara is depleted and 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 Pilbara (Western Australia) management unit is classified as a **sustainable stock**.

**West Coast** The West Coast management unit of Spangled Emperor is exploited as a component of the West Coast Demersal Scalefish (Interim) Managed Fishery (WCDSIMF). Spangled Emperor is assessed on the basis of the status of three indicator species (West Australian dhufish, Snapper and Baldchin Groper) that represent the entire inshore demersal suite of species occurring at depths of 30–250 m in the West Coast Bioregion [WCB; Newman et al. 2018]. In 2007, an assessment of three indicator species for the West Coast Demersal Scalefish Resource (WCDSR), to which Spangled Emperor belongs, identified that overfishing had been occurring (fishing mortality rates exceeded the limit reference point of 1.5 times the value to natural mortality). Management arrangements for both the commercial and recreational sectors were introduced between 2007 and 2010 to reduce fishing effort and hence catch of demersal scalefish species in the WCB by at least 50%. A 20-year recovery plan was put in place to monitor the recovery of the WCDSR.

A 2021 assessment of the WCDSR showed that declines in the spawning biomass of key indicator species (West Australian Dhufish and Snapper) at the bioregion level have been halted but remain below the threshold reference level corresponding to BMSY [Fairclough et al. 2021]. In the case of Snapper, the estimated relative spawning biomass in the WCB in 2020 was still below the limit reference level of 0.2, with model projections indicating that fishing pressure has remained too high to allow stocks to recover above the threshold level by 2030. In response, new management measures for the WCDSR were implemented in early 2023, designed to further reduce retained catches and post-release mortality of key demersal scalefish species in the WCB, to below 50% of the original recovery benchmarks specified in the WCDSR Harvest Strategy [DPIRD 2021]. The indicator species approach used is based on management being focused on species at the highest risk of further depletion, to ensure the overall

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WCDSR is sustainably fished [Newman et al. 2018].

The total catch of Spangled Emperor in the West Coast has been low and stable for the past 10 years (2013–22), ranging from 6.8–11.6 t, with a mean annual catch of 9.1 t. This is consistent with the average catches across the previous 10 years of 12.5 t. Recreational and charter catch are relatively low compared to the commercial catch, in the past 10 years where reliable catches estimates are available, the proportion of the total catch has averaged 28%. The above evidence indicates that prior to management changes the biomass of the West Coast management unit of Spangled Emperor was likely experiencing recruitment overfishing. However, based on the recent low catches, recovery of Spangled Emperor in the WCB is expected to continue under the new management arrangements for the WCDSR, which will further reduce fishing effort and catch of key demersal scalefish species in this area. 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 West Coast (Western Australia) management unit is classified as a **recovering stock**.

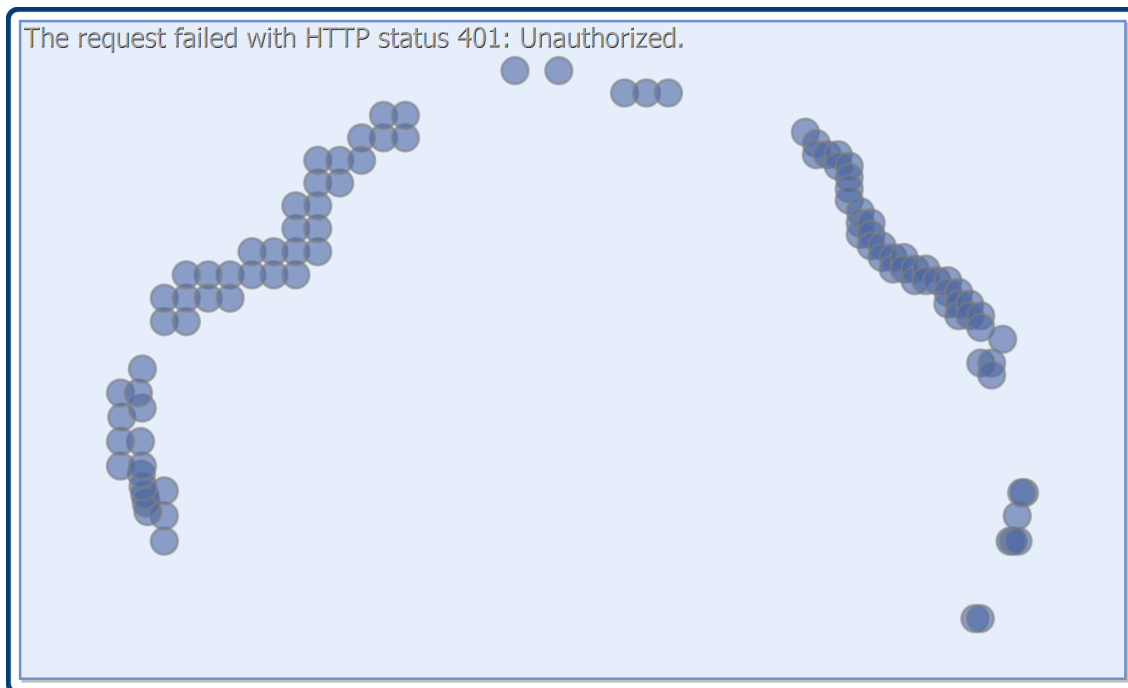
## BIOLOGY

**Spangled Emperor biology** [Currey et al. 2013; DAF unpublished data: Marriott et al. 2010, 2011]

Species	Longevity / Maximum Size	Maturity (50 per cent)
Spangled Emperor	31 years: 707 mm FL (WA) 24 years, 810 mm FL and 8.9kg (east coast Queensland/GBR)	3.6 years: 350 mm FL

## DISTRIBUTION

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Distribution of reported commercial catch of Spangled Emperor

TABLES

Fishing methods	New South Wales	Northern Territory	Queensland	Western Australia
<b>Charter</b>				
Hook and Line	✓	✓	✓	✓
Rod and reel				✓
Spearfishing			✓	✓
<b>Commercial</b>				
Dropline				✓
Fish Trap	✓			✓
Hand Line, Hand Reel or Powered Reels				✓
Hook and Line	✓			
Line			✓	✓
Midwater Trawl			✓	
Otter Trawl				✓
Unspecified		✓		



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Various	✓			
<b>Recreational</b>				
Hook and Line	✓	✓	✓	✓
Spearfishing	✓		✓	✓

<b>Management Methods</b>			
	<b>Northern Territory</b>	<b>Queensland</b>	<b>Western Australia</b>
<b>Charter</b>			
Bag limits			✓
Bag/possession limits		✓	
Gear restrictions		✓	
Limited entry	✓		✓
Passenger restrictions	✓		✓
Seasonal or spatial closures		✓	
Size limit			✓
Size limits		✓	
Spatial closures			✓
Spatial zoning			✓
<b>Commercial</b>			
Effort limits			✓
Gear restrictions	✓	✓	✓
Harvest Strategy		✓	
Limited entry	✓	✓	✓
Seasonal or spatial closures		✓	
Size limit			✓
Size limits		✓	
Spatial closures	✓		✓
Spatial zoning	✓		✓

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Total allowable catch	✓	✓	
Total allowable effort			✓
Vessel restrictions		✓	✓
<b>Recreational</b>			
Bag and possession limits	✓		
Bag limits			✓
Bag/possession limits		✓	
Gear restrictions	✓	✓	
Licence (Recreational Fishing from Boat License)			✓
Possession limit			✓
Seasonal or spatial closures		✓	
Size limit			✓
Size limits		✓	
Spatial closures	✓		✓

Catch	New South Wales	Northern Territory	Queensland	Western Australia
<b>Charter</b>			10 t	9.0 t
<b>Commercial</b>	0.15316 t	0.354 t	51.11 t	74.9546 t
<b>Indigenous</b>	Unknown	Unknown	Unknown	Unknown
<b>Recreational</b>	Unknown	Unknown	27 t (2019–20)	14.8 t (2020/21)

**Western Australia – Recreational (Catch).** Boat-based recreational catch is from 1 September 2020–31 August 2021. These data are derived from those reported in Ryan et al. (2022).

**Western Australia – Recreational (Management Methods).** A Recreational Fishing from Boat License is required for the use of a powered boat to fish or to transport catch or fishing gear to or from a land-based fishing location.

**Western Australia – Indigenous (Management Methods).** Subject to application of Section 211 of the *Native Title Act 1993* (Cth), and the exemption from a requirement to hold a recreational fishing licence, the non-commercial take by Indigenous fishers is covered by the same arrangements as that for recreational fishing.

**Western Australia – Commercial (Catch).** Catch is unavailable as there were fewer than three vessels in the Pilbara Fish Trawl Interim Managed Fishery, Pilbara Trap Managed Fishery and West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery.

**Western Australia – Active Vessels.** Data are confidential as there were fewer than three vessels in the Pilbara Fish Trawl Interim Managed Fishery, Pilbara Trap Managed Fishery and West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery.

**Western Australia – Commercial (Management Methods).** Spangled Emperor forms part of the combined Total Allowable Commercial Catch for other mixed demersal species in the GDSMF.

**Queensland – Recreational Fishing (Catch).** Data are based at the whole of Queensland level and derived from state-wide recreational fishing surveys. Where possible, estimates have been converted to weight (tonnes) using best known conversion multipliers. Conversion factors may display regional or temporal variability. In the absence of an adequate conversion factor, data presented as number of fish.

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

**Queensland – Commercial (Management Methods).** Harvest strategies are available at: <https://www.daf.qld.gov.au/business-priorities/fisheries/sustainable/harvest-strategy>

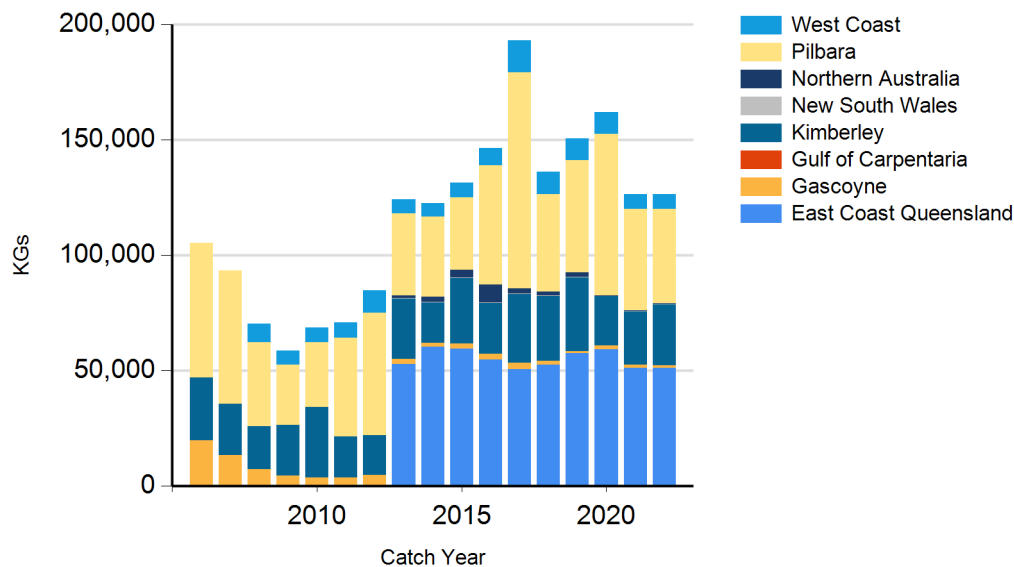
**Queensland – Indigenous (Management Methods).** For more information see <https://www.daf.qld.gov.au/business-priorities/fisheries/traditional-fishing>

**Northern Territory – Charter (Management Methods).** In the Northern Territory, charter operators are regulated through the same management methods as the recreational sector but are subject to additional limits on license and passenger numbers.

**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.”

## CATCH CHART

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Commercial catch of Spangled Emperor - note confidential catch not shown

References	
Berry et al. 2012	Berry, O, England, P, Marriott, RJ, Burridge, CP and Newman SJ 2012, Understanding age-specific dispersal in fishes through hydrodynamic modelling, genetic simulations and microsatellite DNA analysis. <i>Molecular Ecology</i> , 21, 2145–2159, doi:10.1111/j.1365-294X.2012.05520.x.
Carpenter and Allen 1989	Carpenter, KE and Allen, GR 1989, FAO Species Catalogue. Emperor Fishes and Large-Eyed Breams of the World (Family Lethrinidae). FAO Fisheries synopsis No. 125, Vol. 9. Rome: FAO, 126 pp.
Carpenter and Niem 2001	Carpenter, KE and Niem, VH (eds.) 2001, FAO species identification guide for fishery purposes, The living marine resources of the Western Central Pacific. Volume 5. Bony fishes part 3 (Menidae to Pomacentridae). Rome, FAO, pp. 2791–3380.
Currey et al. 2013	Currey, LM, Williams, AJ, Mapstone, BD, Davies CR, Carlos G, Welch DJ, Simpfendorfer, CA, Ballagh, AC, Penny, AL, Grandcourt, EM, Mapleston, A, Wiebkin AS and Bean K 2013, Comparative biology of tropical Lethrinus species (Lethrinidae): challenges for multi-species management. <i>Journal of Fish Biology</i> , 82: 764–788.
Johnson et al. 1993	Johnson, MS, Hebbert, DR, and Moran, MJ 1993, Genetic analysis of populations of north-western Australian fish species, <i>Australian Journal of Marine and Freshwater Research</i> , 44: 673–685.
Marriott et al. 2010	Marriott, RJ, Jarvis, NDC, Adams, DJ, Gallash, AE, Norriss, J and Newman SJ, 2010, Maturation and sexual ontogeny in the spangled emperor <i>Lethrinus nebulosus</i> . <i>Journal of Fish Biology</i> , 76 (6): 1396–1414. DOI: 10.1111/j.1095-8649.2010.02571.x
Moran et al. 1993	Moran, M, Edmonds, J, Jenke, J, Cassells, G and Burton, C, 1993, Fisheries biology of emperors (Lethrinidae) in north-west Australian coastal waters, Final Report to the Fisheries Research and Development Corporation (FRDC) on Project No. 89/20, Fisheries Department, Perth, Western Australia. 58p.
Pillans et al. 2014	Pillans, RD, Bearham, D, Boomer, A, Downie, R, Patterson, TA, Thomson, DP and Babcock, RC 2014, Multi-year observations reveal variability in residence of a tropical demersal fish, <i>Lethrinus nebulosus</i> : Implications for spatial management. <i>PLoS ONE</i> , 9(9), e105507.
Chateau and Wantiez 2008	Chateau, O and Wantiez, L 2008, Human impacts on residency behaviour of spangled emperor, <i>Lethrinus nebulosus</i> , in a marine protected area, as determined by acoustic telemetry, <i>Journal of the Marine Biological Association of the United Kingdom</i> , 88, 825–829.
Gaughan and Santoro 2018	Gaughan, DJ and Santoro K, (eds.) 2018, Status Reports of the Fisheries and Aquatic Resources of Western Australia 2016/17: The State of the Fisheries, Department of Primary Industries and Regional Development, Western Australia, Perth, Australia. 237p.

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Wakefield et al. 2023	Wakefield, C, Trinnie, F, Skepper, C, Boddington, D, Newman, SJ, and Steele, A 2023, North Coast Demersal Resource Status Report 2022. pp. 167–176. In: Gaughan, DJ and Santoro, K (eds.) 2023. Status Reports of the Fisheries and Aquatic Resources of Western Australia 2021/22: The State of the Fisheries. Department of Primary Industries and Regional Development, Western Australia, Perth, Australia.
Newman et al. 2018	Newman, SJ, Brown, JI, Fairclough, DV, Wise, BS, Bellchambers, LM, Molony, BW, Lenanton, RCJ, Jackson, G, Smith, KA, Gaughan, DJ, Fletcher, WJ, McAuley, RB, and Wakefield, CB 2018, A risk assessment and prioritisation approach to the selection of indicator species for the assessment of multi-species, multi-gear, multi-sector fishery resources, <i>Marine Policy</i> , 88: 11–22.
Marriott et al. 2011	Marriott, RJ, Adams, DJ, Jarvis NDC, Moran, MJ, Newman SJ, Craine M, 2011, Age-based demographic assessment of fished stocks of spangled emperor, <i>Lethrinus nebulosus</i> in the Gascoyne Bioregion of Western Australia. <i>Fisheries Management and Ecology</i> 18 (2): 89-103.
Ryan et al. 2022	Ryan KL, Lai EKM, Smallwood CB. 2022. Boat-based recreational fishing in Western Australia 2020/21. Fisheries Research Report No. 327 Department of Primary Industries and Regional Development, Western Australia. 221pp.
West et al. 2015	West, LD, Stark, KE, Murphy, JJ, Lyle, JM and Ochwada-Doyle FA, 2015, Survey of recreational fishing in New South Wales and the ACT, 2013–14, Fisheries final report series 149, NSW Department of Primary Industries, Wollongong.
DPIRD 2017	DPIRD 2017, North Coast demersal scalefish resource harvest strategy 2017–2021. Version 1.0. Fisheries Management Paper No. 285. Department of Primary Industries and Regional Development, Government of Western Australia, Perth, Australia. 35p.
Murphy et al. 2020	Murphy, JJ, Ochwada-Doyle, FA, West, LD, Stark, KE and Hughes JM, 2021, The Recreational Fisheries Monitoring Program. Survey of recreational fishing in 2017–18, Fisheries final report series 158, NSW Department of Primary Industries, Wollongong.
Marriott et al. 2012	Marriott, R, Jackson, G, Lenanton, R, Telfer, C, Lai, E, Stephenson, P, Bruce, C, Adams, D, Norriss, J, and Hall, N, 2012, Biology and stock status of inshore demersal scalefish indicator species in the Gascoyne Coast Bioregion, Fisheries Research Report, No 228, Department of Fisheries, Western Australia.
QDAF 2020	Queensland Department of Agriculture and Fisheries, 2020, Reef line fishery harvest strategy: 2020–2025, Brisbane, Queensland.
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.
Murphy et al. 2022	Murphy, JJ, Ochwada-Doyle, FA, West, LD, Stark, KE, Hughes, JM, and Taylor, MD 2022, Survey of recreational fishing in NSW, 2019/20. NSW Department of Primary Industries, Nelson Bay, Fisheries Final Report Series No. 161. 80p.
QDAF Unpublished Data 2023	Queensland Department of Agriculture and Fisheries, Unpublished Data 2023, Fisheries Monitoring, State of Queensland, Brisbane.