

# Red Emperor (2020)

*Lutjanus sebae*



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## STOCK STATUS OVERVIEW

Jurisdiction	Stock	Stock status	Indicators
Western Australia	Gascoyne	Sustainable	Age structure, fishing mortality rates of indicator species
Western Australia	Kimberley	Sustainable	Spawning stock level, age structure, catch, CPUE
Western Australia	Pilbara	Sustainable	Spawning stock level, age structure, catch, CPUE
Northern Territory	Arafura Sea	Sustainable	Biomass, fishing mortality
Northern Territory	Joseph Bonaparte Gulf	Undefined	Catch
Northern Territory	Timor Sea	Sustainable	Biomass, fishing mortality
Northern Territory, Queensland	Gulf of Carpentaria	Sustainable	Biomass, fishing mortality
Queensland	East Coast Queensland	Undefined	Catch, effort, standardised CPUE

## STOCK STRUCTURE

Red Emperor are widely distributed throughout the Western Pacific and Indian Oceans, ranging from western and eastern Australia to southern Japan, and westward to east Africa and the southern Red Sea (Allen 1985). Within Australia, Red Emperor range from Cape Naturaliste (33°30' S) in Western Australia, north and east across northern Australia and down the east coast to Sydney in New South Wales. Red Emperor is exploited primarily in the North Coast Bioregion of Western Australia [Newman et al. 2020]. Smaller catches are taken in the Northern Territory and Queensland. Red Emperor is one of the indicator species used to assess the

status of the demersal resources in the North Coast Bioregion [Newman et al. 2018].

van Herwerden et al. [2009] examined the genetic connectivity of Red Emperor using mitochondrial DNA from samples collected at two locations in Western Australia (Browse Island, Kimberley region; Montebello Islands, Pilbara region) and two locations on the east coast (High Peak Island and Catfish Shoal, East Coast Queensland). The mitochondrial DNA data for Red Emperor did not differ genetically either within or between coasts at the locations examined, suggesting a panmictic population structure with high levels of gene flow among populations. This study indicates that eastern and western Australian populations of Red Emperor form a single inter-breeding genetic stock [van Herwerden et al. 2009] or one biological stock. The results of van Herwerden et al. [2009] confirm those derived by Johnson et al. [1993] using allozymes for Red Emperor in Western Australian waters. Johnson et al. [1993] examined allozyme samples of Red Emperor from the Lacepede Islands, Bedout island, Lowendal Islands, Ningaloo and Shark Bay. This study reported extensive connectivity and gene flow among populations throughout the sampled range of 1 400 km in Western Australia.

Stephenson et al. [2001] examined stable isotopes in sagittal otolith carbonates of Red Emperor from four locations; Shark Bay (Gascoyne), Ningaloo (Gascoyne), Pilbara and Broome (Kimberley). Significant differences in stable isotope ratios provided evidence that there was limited mixing of adult Red Emperor between three broad zones; Shark Bay (Gascoyne), Pilbara, and Broome (Kimberley), a distance of approximately 1 400 km [Stephenson et al. 2001]. Therefore, these broad locations could be managed separately for the purposes of fishery management, if management arrangements were established to harmonise with the spatial patterns of exploitation. Stephenson et al. [2001] reported partial mixing of Red Emperor from Pilbara west and east sites. The overlap in the multivariate analyses of otolith stable isotope signatures between some sites potentially reflects dispersal by a proportion of juvenile or adult fish. This suggests that, in Western Australia, Red Emperor can be managed as a number of separate management units. Additionally, Saunders et al. [2018] used otolith microchemistry and parasitology to identify separate biological Red Emperor stocks in the Joseph Bonaparte Gulf, Timor Sea, Arafura Sea and Gulf of Carpentaria.

Here, assessment of stock status is presented at the management unit level — Gascoyne, Pilbara and Kimberley (Western Australia) and East coast (Queensland); and at the biological stock level for the Joseph Bonaparte Gulf, Timor Sea, Arafura Sea and Gulf of Carpentaria.

## STOCK STATUS

**Arafura Sea** Red Emperor were initially harvested by the foreign trawl fleet operating in this region in the 1970s and 1980s with a peak catch of 69 tonnes (t) recorded in 1989. In 1991 this fleet left Northern Territory waters and only small catches were recorded by trap and line gear in the Demersal Fishery (DF). From 1995 a single trawl vessel in the fishery resulted in a slight increase in catch which was further increased when three additional trawlers commenced fishing in 2012. This catch peaked at 25 t in 2017 before declining to 9 t in 2019.

A preliminary assessment using catch data from all commercial fisheries applied to a modified catch-MSY model (developed by Martell and Froese [2013] and modified by Haddon et al. [2018]), estimated that the 2019 biomass of Red Emperor was 58 per cent of unfished levels [Saunders 2020a] suggesting that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired. Similarly, the fishing mortality in 2019 was 0.12 which was around the target level and well below the limit reference point indicating 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, Red Emperor in the Arafura Sea biological stock is classified as a **sustainable stock**.

**East Coast Queensland** There has been no stock assessment to determine biomass, and there is no estimate of MSY, for the East Coast Queensland management unit. Recreational catches of Red Emperor were around 73 per cent (95 t) of the total landings for

the species based on the 2019–20 recreational catch numbers [Teixeira et al. 2021] and commercial landings in 2018–19. Recreational harvest estimates decreased from 2000–01 (235 t) to 2013–14 (85 t), however the estimate increased slightly in 2019–20 (95 t). It is not known if the overall decline in recreational catch and harvest is related to lower biomass or decreased effort (or both).

In 2004–05 the reported commercial harvest declined from between 100–200 t per year to less than 61 t per year. The decrease 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. Both management interventions likely reduced commercial targeting of Red Emperor. Over the last decade, annual commercial catches have generally declined from 61 t (2009–10) to 35 t (2018–19). Red Emperor is a secondary target and by-product species in the Reef Line Fishery (RLF). While commercial harvest is constrained by a multi-species total allowable commercial catch (TACC) and a minimum legal size, species-specific harvest control rules and catch reference points introduced in early 2020 for secondary target species including Red Emperor through the RLF Harvest Strategy [QDAF 2020] provide additional control of fishing pressure. Harvest of Red Emperor that exceeds the catch 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. The Indigenous catch is unknown but is expected to be minor. A portion of the biomass is afforded some protection from fishing by zoning in the Great Barrier Reef Marine Park although this has not been quantified. There is insufficient information available on the current biomass to confidently classify the status of this stock.

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

### **Gascoyne**

The Gascoyne management unit of Red Emperor is a component of the Gascoyne Demersal Scalefish Managed Fishery (Western Australia) (GDSMF) [Gaughan and Santoro 2020]. Red Emperor is assessed on the basis of the status of the indicator species for other demersal finfish species in the GDSMF (particularly Goldband Snapper [Newman et al. 2018]).

An assessment of fishing mortality derived from representative samples of the age structure of Goldband Snapper was undertaken in the GDSMF in 2017. These fishing mortality based assessments utilise reference levels defined below for the Pilbara management unit. The fishing mortality based assessments and associated uncertainty ranges indicated that the fishing mortality rate on Goldband Snapper was less than the target level, indicating that the level of exploitation experienced by Goldband Snapper in the Gascoyne has been low. Catches of Red Emperor in the GDSMF have been low and stable for the past 10 years (2010–19), ranging from 7–16 tonnes (t), with a mean annual catch of 14.3 t. The above evidence indicates that 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**

Red Emperor in this stock has historically been taken by demersal fish trawl (Gulf of Carpentaria Developmental Fin Fish Trawl Fishery (GOCDFFTF) and Northern Territory Demersal Fishery (DF)). There is no reliable estimate of recreational or Indigenous harvest of Red Emperor in the Gulf of Carpentaria, but it is expected to be minor given the offshore nature of the fishery. This stock was also exposed to historical fishing from foreign fleets during the 1950s to the 1980s [O'Neill et al. 2011]. These catches peaked during the 1970s at approximately 30 t and were only slightly higher than the recent peak catch of

23 t in 2008. Commercial catches were initially dominated by the GOCDFFTF however these have declined markedly since 2012 as a result of transfer of effort to Northern Territory stocks outside the Gulf of Carpentaria. In 2019, the commercial catch increased to 9 t due to the DF substantially increasing its fishing effort in this stock area targeting Saddletail and Crimson Snappers (*Lutjanus malabaricus* and *Lutjanus erythropterus*).

A preliminary assessment using catch data from all commercial fisheries applied to a modified catch-MSY model (developed by Martell and Froese [2013] and modified by Haddon et al. [2018]), estimated that the 2019 biomass of Red Emperor was 59 per cent of unfished levels [Saunders and Roelofs 2020] suggesting that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired. Similarly, the fishing mortality in 2019 was 0.07 which was well below the limit reference point indicating 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, Red Emperor in the Gulf of Carpentaria biological stock is classified as a **sustainable stock**.

### **Joseph Bonaparte Gulf**

Harvest of this Red Emperor stock was first reported in 1985, and the average catch from trap and line vessels in the Demersal Fishery (DF) to 2011 was very small (average < 1 t) compared to the adjacent Timor Sea stock. From 2012 a trawler entered the fishery and catches increased to a peak of 12 t in 2019. A trawl survey conducted on this stock [Ramm 1994] did not provide an estimate of Red Emperor biomass. Consequently, there is insufficient evidence to classify the status of this stock.

Based on the evidence above, the Joseph Bonaparte biological stock is classified as an **undefined stock**.

### **Kimberley**

Red emperor is one of the indicator species used to assess the status of the demersal scalefish resources in the Kimberley subregion of the North Coast Bioregion of Western Australia [Newman et al. 2018]. The major performance measures for the Kimberley management unit of Red Emperor are spawning stock levels and fishing mortality estimated using an integrated age-structured assessment. The target reference level of spawning biomass is 40 per cent of unfished (1980) levels, with a threshold reference level of 30 per cent and limit reference level of 20 per cent. The spawning biomass level of Red Emperor was estimated to be approximately 30 per cent in the Northern Demersal Scalefish Managed Fishery (NDSMF) in 2017 [Newman et al. 2020]. The above evidence indicates that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired.

An assessment of fishing mortality derived from representative samples of the age structure of Red Emperor has also been undertaken for the NDSMF. These fishing mortality based assessments utilise reference levels defined for the Pilbara management unit. The fishing mortality based assessments indicated that the fishing level on Red Emperor is at or below the limit level in 2017 [Newman et al. 2020]. This indicates that fishing is not having an unacceptable impact on the age structure of the population. Catch levels of Red Emperor in the NDSMF over the last 10 years (2010–19) have ranged from 128–192 t, with a mean annual catch of 141 t [Newman et al. 2020]. The above evidence indicates that the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired.

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

### **Pilbara**

Red emperor is one of the indicator species used to assess the status of the

demersal scalefish resources in the Pilbara subregion of the North Coast Bioregion of Western Australia [Newman et al. 2018]. The major performance measures for the Pilbara management unit of Red Emperor landed in the Pilbara Trap Managed Fishery and Pilbara Fish Trawl Interim Managed Fishery are spawning stock levels and fishing mortality estimated using an integrated age-structured assessment. The target reference level of spawning biomass is 40 per cent of unfished (1980) levels, with a threshold reference level of 30 per cent and limit reference level of 20 per cent. Estimates of the relative spawning biomass for the overall stock have fluctuated between the target and threshold levels in the Pilbara Demersal Scalefish Fisheries since the mid-1980s. The spawning biomass level of Red Emperor overall (across all management areas) was estimated to be above the threshold level in the Pilbara Demersal Scalefish Fisheries in 2015, the year the last integrated assessment was undertaken [Newman et al. 2020]. All scenarios evaluated in the assessment model indicate that there is a high probability that the estimate of spawning biomass of Red Emperor is above the threshold level. The above evidence indicates that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired.

An assessment of fishing mortality derived from representative samples of the age structure of Red Emperor in the Pilbara management unit was also undertaken in 2015. These fishing mortality (F)-based assessments utilise the following reference levels based on ratios of natural mortality (M) that are applicable to each species, such that  $F_{\text{target}} = 2/3M$ ,  $F_{\text{threshold}} = M$  and  $F_{\text{limit}} = 3/2M$  (DPIRD 2017). The fishing mortality based assessments indicated that the fishing level on Red Emperor in 2011 was generally between the target and the threshold level, but between the threshold and limit levels in some areas. This indicates that fishing was having an impact on the age structure of the population in some management areas.

Effort reductions since 2008 have resulted in decreasing catch levels and the total retained catches of Red Emperor in the Pilbara Demersal Scalefish Fisheries have been stable since trawl effort was reduced in 2009 as part of a stock rebuilding strategy. Recreational catches are a minor component of total catches. These stable annual catch trends and estimates of F that are below the limit level in all areas suggest no evidence of recent stock depletion. The stability in the adjusted fish trawl catch rates since 1998 indicates that stock abundance has remained stable during this period, with some indication of recent increasing abundance in the western area of the fishery. Catch levels of Red Emperor in the Pilbara over the last 10 years (2010–19) have ranged from 103–219 t, with a mean annual catch of 145 t [Newman et al. 2020]. The above evidence indicates that the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired.

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

### Timor Sea

Red Emperor harvest in this stock began in 1988, and quickly peaked at just over 100 t in 1991 as the Timor Reef Fishery (TRF) quickly developed. However, targeting quickly shifted to the more abundant Goldband Snapper thereafter, and only small annual catches (average <10t) were reported between 1994–1999. Thereafter, the trap effort in the TRF and Demersal Fishery (DF) increased substantially and catches of Red Emperor increased to an annual average of 37 t during 2000–2019.

A preliminary assessment using catch data from all commercial fisheries applied to a modified catch-MSY model (developed by Martell and Froese [2013] and modified by Haddon et al. [2018]), estimated that the 2019 biomass of Red Emperor was 62 per cent of unfished levels [Saunders 2020b] suggesting that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired. Similarly, the fishing mortality in 2019 was 0.07 which was well below the limit reference point indicating that the current level of

fishing mortality is unlikely to cause the stock to become recruitment impaired.

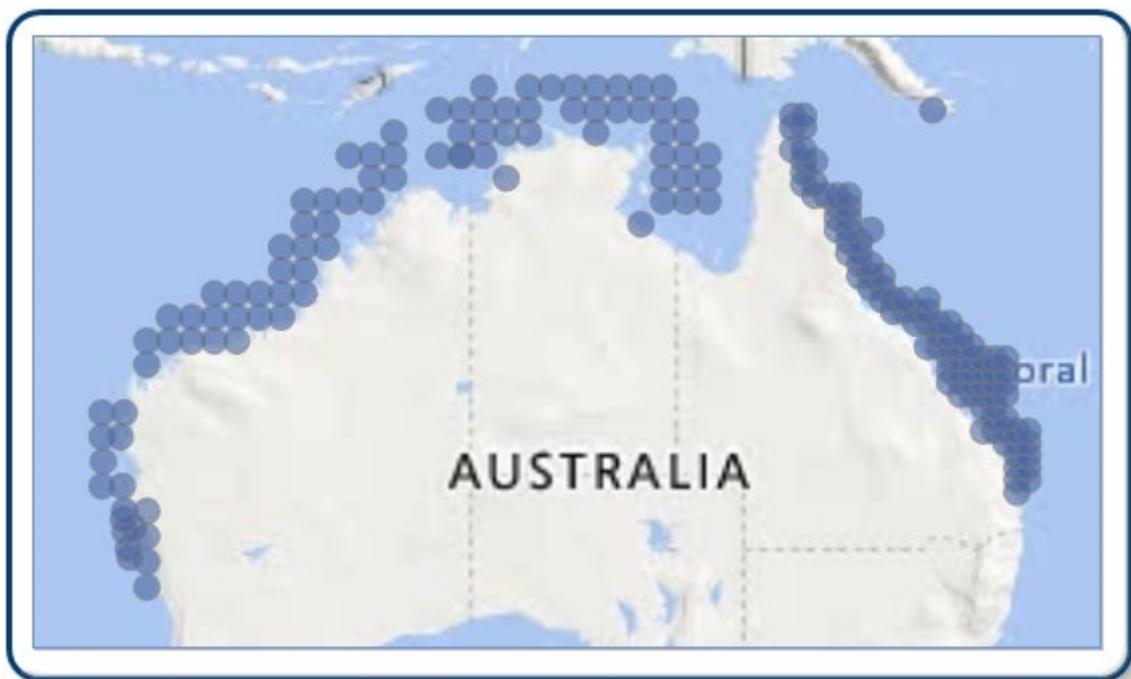
On the basis of the evidence provided above, Red Emperor in the Timor Sea biological stock is classified as a **sustainable stock**.

## BIOLOGY

**Red Emperor biology** [McPherson et al. 1992, McPherson and Squire 1992, Newman et al. 2000, 2001, Newman and Dunk 2002, Newman et al. 2010, O'Neill et al. 2011, DAF unpublished data 2018]

Species	Longevity / Maximum Size	Maturity (50 per cent)
Red Emperor	WA: 40–45 years' 800 mm FL (860 mm TL) East coast Queensland: 22 years, at least 900 mm TL	WA: 4–6 years, 430–460 mm FL (460–490 mm TL) East Coast Queensland: 5 years, 542 mm FL for females

## DISTRIBUTION



Distribution of reported commercial catch of Red Emperor.

## TABLES

Fishing methods	Northern Territory	Queensland	Western Australia
<b>Charter</b>			
Hook and Line	✓	✓	
Rod and reel			✓
Spearfishing		✓	✓
<b>Commercial</b>			
Bottom Trawls	✓		

Dropline			✓
Fish Trap	✓		✓
Gillnet			✓
Hand Line, Hand Reel or Powered Reels			✓
Handline	✓		
Line		✓	✓
Otter Trawl			✓
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			✓
Gear restrictions		✓	
In possession limits		✓	
Limited entry	✓		✓
Passenger restrictions	✓		✓
Possession limit	✓		
Size limit		✓	✓
Spatial closures	✓	✓	✓
Spatial zoning			✓
Temporal closures		✓	
<b>Commercial</b>			
Effort limits			✓
Gear restrictions	✓	✓	✓
Individual transferable quota		✓	
Limited entry		✓	✓
Size limit		✓	✓
Spatial closures	✓	✓	✓

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

Catch			
	Northern Territory	Queensland	Western Australia
Charter	0.4 t		9 t
Commercial	84.245 t	34.951 t	415.499 t
Indigenous	Unknown	Unknown	Unknown
Recreational	0.6 t (2015)	95 t (2019–20)	28 t (2017/18)

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

**Western Australia – Commercial (management methods)** Red Emperor forms part of the combined Total Allowable Commercial Catch for other mixed demersal species in the Gascoyne Demersal Scalefish Managed Fishery.

**Western Australia – Recreational (Catch)** Boat-based recreational catch is from 1 September 2017–31 August 2018. These data are derived from those reported in Ryan et al. 2019.

**Western Australia – Recreational (management methods)** A Recreational Fishing from Boat Licence 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

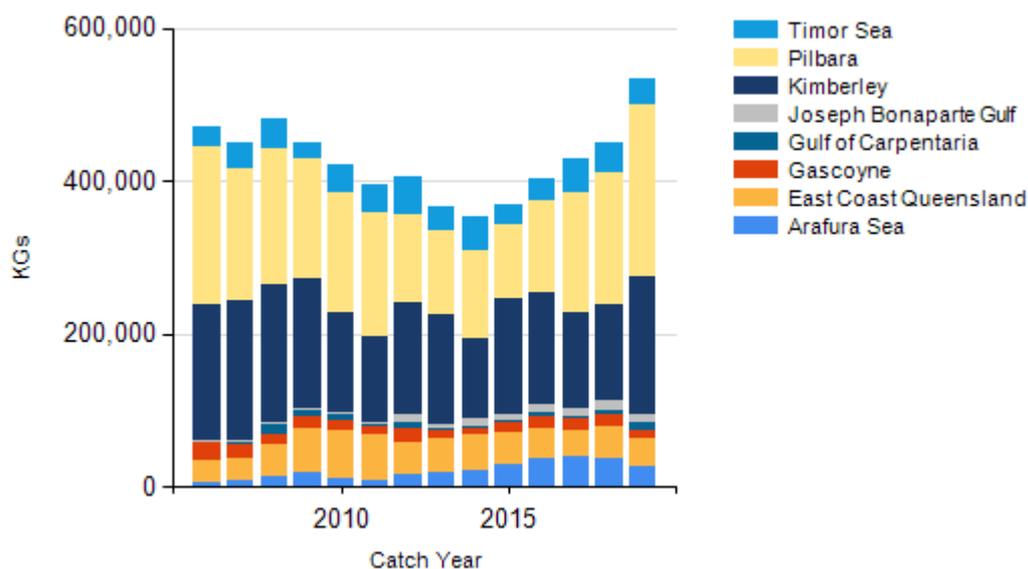
211 of the *Native Title Act 1993* (Cth), and the exemption from a requirement to hold a recreational fishing licence, the non-commercial take by Indigenous fishers is covered by the same arrangements as that for recreational fishing.

**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 “...without derogating from any other law in force in the Territory, nothing in a provision of this Act or an instrument of a judicial or administrative character made under it limits the right of Aboriginals who have traditionally used the resources of an area of land or water in a traditional manner from continuing to use those resources in that area in that manner”.

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

### CATCH CHART



Commercial catch of Red Emperor - note confidential catch not shown

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STATUS OF AUSTRALIAN FISH STOCKS REPORT  
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