# Western King Prawn

*Melicertus latisulcatus*

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## STOCK STATUS OVERVIEW

### Stock status determination

| Jurisdiction | Stock | Fisheries | Stock status | Indicators |
|---|---|---|---|---|
| Queensland | East Coast Otter Trawl Fishery | ECOTF | Sustainable | Catch, effort, ecological risk assessment |
| Western Australia | Exmouth Gulf Prawn Managed Fishery | EGPMF | Sustainable | Survey catch rates, size composition, catch, catch rates |
| South Australia | Gulf St. Vincent Prawn Fishery | GSVPF | Transitional-depleting ↓ | Survey catch rates, catch effort |
| Western Australia | North Coast Prawn Managed Fisheries | BPMF, NBPMF, OPMF | Sustainable | Catch |
| Western Australia | Shark Bay Prawn Managed Fishery | SBPMF | Sustainable | Survey catch rates, size composition, catch, catch rates |
| Western Australia | South West Trawl Managed Fishery | SWTMF | Sustainable | Catch |
| South Australia | Spencer Gulf Prawn Fishery | SGPF | Sustainable | Survey catch rates, catch |
| South Australia | West Coast Prawn Fishery | WCPF | Sustainable | Survey catch rates, catch |

**BPMF** Broome Prawn Managed Fishery (WA)
**ECOTF** East Coast Otter Trawl Fishery (QLD)
**EGPMF** Exmouth Gulf Prawn Managed Fishery (WA)
**GSVPF** Gulf St Vincent Prawn Fishery (SA)
**NBPMF** Nickol Bay Prawn Managed Fishery (WA)
**OPMF** Onslow Prawn Managed Fishery (WA)
**SBPMF** Shark Bay Prawn Managed Fishery (WA)
**SGPF** Spencer Gulf Prawn Fishery (SA)
**SWTMF** South West Trawl Managed Fishery (WA)
**WCPF** West Coast Prawn Fishery (SA)

## STOCK STRUCTURE

Western King Prawn is distributed throughout the Indo–West Pacific [1]. No research has been conducted into Western King Prawn biological stock structure in Western Australia or Queensland, and status in those states is therefore reported at the management unit level. In South Australia, one study of the genetic structure of Western King Prawn found no differences between the three fisheries [2]; however, each fishery functions as an independent population at time scales relevant to management, with distinct adult and juvenile habitats and independent variations in recruitment and abundance. Each fishery in South Australia is therefore assessed and managed as a separate management unit.

Here, assessment of stock status is presented at the management unit level—Shark Bay Prawn Managed Fishery, Exmouth Gulf Prawn Managed Fishery, North Coast Prawn Managed Fisheries, South West Trawl Managed Fishery (Western Australia); East Coast Otter Trawl Fishery (Queensland); Spencer Gulf Prawn Fishery, Gulf St. Vincent Prawn Fishery and West Coast Prawn Fishery (South Australia).

## STOCK STATUS

### Shark Bay Prawn Managed Fishery

The status of the stocks of Western King Prawns in Shark Bay is assessed annually using a weight-of-evidence approach that considers all available information about the stocks [3]. The assessment approach is primarily based on monitoring of fishery-independent survey indices of recruitment (March–April) and spawning stock levels (June–August) relative to reference points specified in terms of survey catch rates of recruits and mature prawns [4]. Although these abundance indices are the key indicators for the stocks, other information collected throughout the season (such as commercial catch, effort and environmental data) is also evaluated to provide insight on, for example, operational factors that might affect fishery performance, or environmental factors affecting prawn recruitment.

Western King Prawns are comparatively more resilient to fishing than the Brown Tiger Prawn (the other key target species) because they are less catchable (strongly nocturnal and readily bury themselves when disturbed) and have a protracted spawning period [5,6]. The two species overlap in their spatial distribution within Shark Bay, and the rates of fishing that maintain the spawning biomass of Brown Tiger Prawn near target levels are considered to be below those that could result in Western King Prawn becoming recruitment overfished [7].

Spatial and temporal analysis of historical commercial catch and effort data complemented by research sampling to identify key recruitment and spawning grounds provided no evidence of reduced recruitment for Western King Prawns across the range of spawning biomass levels in the 1970s–90s [7], indicating that the spawning stock was never reduced to levels that affected recruitment. During this period, recruitment remained relatively stable despite substantial environmental changes, including variations in the Leeuwin Current, La Niña, and El Niño. There was also no significant correlation between spawning stock and recruitment indices derived from

fishery-independent surveys for the Western King Prawn since 2000 [8]. The fishery-independent recruitment surveys undertaken each year since 2000 assess size structure, and are used for catch predictions [8,9] and to inform management decisions regarding spatial-temporal opening of fishing areas.

There is no evidence of a declining trend in recruitment in fishery-independent survey indices since 2000 [8]with the annual recruitment indices remaining well above the target reference level each year (25 kg per hour) [10]. The fishery-independent recruitment survey in 2015 indicated a mean catch rate (144 kg per hour) which was the third highest since surveys commenced in 2000, with a catch prediction between 940 and 1410 tonnes (t) [4]. The introduction of seasonal, moon and area-closures since the early 1990s limits the overall fishing effort, providing protection for the breeding stock of Western King Prawn [8]. Although the spawning stock surveys conducted in Shark Bay target key Brown Tiger Prawn areas, they also cover some of the Western King Prawn spawning areas and are considered to be indicative of overall spawning stock abundance for this species [8] and a target catch rate level of 25 kg per hour is set for this area. In 2015, the mean spawning stock survey catch rate (54.1 kg per hour) was the highest since surveys commenced.

Historical catch from 1989–98, when it was known that recruitment was not affected by fishing effort, were used as the basis for calculating target total catch ranges for this stock [4] (950–1350 t). Total commercial catch for 2015 of 1633 t was above the target catch range [4,8] as a result of the very good recruitment.

The above evidence indicates that the biomass of the management unit is unlikely to be recruitment overfished and that the current level of fishing pressure is unlikely to cause the management unit to become recruitment overfished.

On the basis of the evidence provided above, the Shark Bay Prawn Managed Fishery (Western Australia) management unit is classified as a **sustainable stock**.

### Exmouth Gulf Prawn Managed Fishery

As with the Shark Bay management unit, the status of stocks is assessed annually using a weight-of-evidence approach that considers all available information about the stocks [3]. The assessment is based on a combination of fishery-independent and fishery-dependent catch rates where fishery-independent surveys provide the recruitment indices and fishery-dependent data provide the spawning stock indices. Analysis of these two indices from the 1970s–90s provide no evidence of a stock-recruitment relationship for Western King Prawn [7], with no indication of reduced recruitment in relation to spawning stock sizes over this period. Elevated temperatures since 2011 in this region appears to be contributing to lower than average recruitment levels [11], in response to which conservative harvesting strategies have been introduced, resulting in reduced annual landings.

Fishery-independent recruitment surveys have been undertaken in March and April each year since 1985 to assess prawn abundance and size structure and are used for catch predictions [9] and management decisions such as spatial-temporal opening of fishing areas [12,13]. In 2015, the Western King Prawn fishery-independent mean recruitment index was 25.4 kg per hour which was below the

target [13] (30 kg per hour). Fishing was therefore delayed in key Western King Prawn grounds until August when additional fishery-independent surveys indicated catch rates were above the target. The spawning stock catch rate index, derived from commercial catch and effort data in August–September in key Western King Prawn fishing grounds for 2015 was 35 kg per hour above the target (25 kg per hour) [13].

In 1983, the effort on Western King Prawn increased significantly following action to reduce effort on the Brown Tiger Prawn. The annual production of Western King Prawn increased by around 40 per cent due to this increased effort. This increased production and higher than historical annual catches did not appear to result in any decrease in overall production over time or recruitment, indicating that spawning biomass of the stock was not reduced to levels that could affect recruitment. Current effort levels are well below the 1983 effort level. This indicates that at current levels of fishing pressure and with variations in environmental conditions, sufficient breeding stock will be available to ensure sufficient recruitment in the future.

Historical catch and catch rates from 1989–98, when it was known that recruitment was not affected by fishing effort, were used as the basis for calculating target total catch ranges for this stock [4] (350–500 t) and a mean catch rate target (12 kg per hour; range 8–14 kg per hour). This target total catch range is being reviewed due to the apparent negative impacts of increased water temperature on Western King Prawn recruitment and with the level of effort having declined for the fishery as a result of fleet restructures and targeting larger prawns. The commercial catch for 2015 of 192 t was well below the target range with a mean catch rate (8.7 kg per hour) at the lower end of the target catch rate range.

The above evidence indicates that the biomass of the management unit is unlikely to be recruitment overfished and that the current level of fishing pressure is unlikely to cause the management unit to become recruitment overfished.

On the basis of the evidence provided above, the Exmouth Gulf Prawn Managed Fishery (Western Australia) management unit is classified as a **sustainable stock**.

### North Coast Prawn Managed Fisheries

The North Coast Prawn Managed Fisheries (Western Australia) management unit is made up of four separate multispecies prawn fisheries, but is reported as one unit due to minimal catches. Western King Prawn forms a very minor part of total prawn landings in these fisheries and in some years no Western King Prawns are landed in at least one of these four fisheries [4]. Total commercial catch for 2015 was less than 1 t. Only in the Broome Prawn Managed Fishery is Western King Prawn the key target species, but costs and logistics of fishing in this fairly remote fishery has meant that since 2008 only one or two out of five boats have fished. Prior to 2008, between 1200 and 4200 trawl hours were recorded annually for a mean catch rate between 14 and 43 kg per hour. Since 2008, 30–275 hours of trawling has been conducted annually for a similar mean catch rate range. In 2015, only 30 hours of trawling was recorded. As for Exmouth Gulf, elevated water temperatures since 2011 in these North Coast Prawn Managed Fisheries may be contributing to lower than average recruitment levels [11].

The above evidence indicates that the biomass of the management unit is unlikely to be recruitment overfished and that the current level of fishing pressure is unlikely to cause the management unit to become recruitment overfished.

On the basis of the evidence provided above, the North Coast Prawn Managed Fisheries (Western Australia) management unit is classified as a **sustainable stock**.

### South West Trawl Managed Fishery

The South West Trawl Managed Fishery (Western Australia) (SWTMF) management unit is a comparatively small, low-activity fishery, in which effort has been related to either the abundance of Western King Prawn or Ballot's Saucer Scallop in any given year, which can be highly variable due to sporadic scallop recruitment. Only two–four vessels have operated in the fishery since 2005, and they have only covered approximately one–three per cent of the allowable fishery area [4]. Since 2005, an average of 168 boat days have been recorded annually, with a catch range of between 3 and 14 t, compared to 490 boat days on average over the previous 10 years (1995–2004), with a catch range of between 9 and 37 t. The level of fishing pressure is unlikely to adversely impact the spawning biomass of Western King Prawn. No vessels fished in the SWTMF in 2015 due to low Ballot's Saucer Scallop abundance. The above evidence indicates that the fishing pressure is unlikely to cause the stock to become recruitment overfished. It also indicates that the biomass of this stock is unlikely to be recruitment overfished.

On the basis of the evidence provided above, the South West Trawl Managed Fishery (Western Australia) management unit is classified as a **sustainable stock**.

### East Coast Otter Trawl Fishery

Long-term (1998–2016) nominal catch rates for Western King Prawns species range from 31.0–58.3 kg per day. At 51.2 kg per day, nominal catch rates for 2015 were at the higher end of this range; albeit marginally lower than 2014 (58.3 kg per day). In 2013, an ecological risk assessment (ERA) for the East Coast Otter Trawl Fishery (Queensland) found that Western King Prawns were at low risk of becoming recruitment overfished within the Great Barrier Reef Marine Park (GBRMP) [14]. This is in part driven by the biology of the species, which exhibits protracted spawning behavior, and partly by low levels of susceptibility to trawling, given the extent of area closed to the fishery. The above evidence indicates that the biomass of this management unit is unlikely to be recruitment overfished.

Total catch of Western King Prawns in 2015 has increased since 2013 when catches were below historical averages. The GBRMP accounts for around 90 per cent of the total Western King Prawn catch and has experienced a 23 per cent decline in otter trawl effort since 2009 (the trawl ERA representative fishing year). Given this decline in effort, it is unlikely that the risk of this species being recruitment overfished has increased from the original 'low risk' evaluation. This is supported by research which has shown that around 40 per cent of the Western King Prawn biomass is afforded protection from trawl fishing through permanent closures within the GBRMP [15].These closures remain in place and provisions governing the use of these areas have not been the subject of significant amendments since the last Status of Australian Fish Stocks assessment. The above

evidence indicates that the biomass of this stock is unlikely to be overfished, and that current level of fishing pressure is unlikely to cause this stock to become recruitment overfished.

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

### Spencer Gulf Prawn Fishery

While time series and spatial distribution of commercial catches are presented by calendar year, the stock status for South Australia's Spencer Gulf Prawn Fishery and Gulf St Vincent Prawn Fishery management units refer to the 2014–15 financial year as it more closely aligns with the fishing seasons for those fisheries (October–June or September).

The primary measure for stock status in Spencer Gulf is the weighted average catch rate of adult prawns (defined as 20 or fewer prawns per pound), used as an index of relative biomass, obtained during fishery-independent surveys conducted yearly in November, February and April [16]. This index is evaluated against limit and trigger reference points of 48 and 68 kg per hour, respectively, where the trigger reference point is considered to be the minimum catch rate at which future recruitment to the fishery will be adequate (that is, the level that delineates a stock status classification of sustainable from transitional).

Mean catch rates of adult prawns for surveys in November 2014 and February and April 2015 were 85, 78 and 104 kg per hour, respectively, while those for 'newly-recruited' prawns (more than 20 prawns per pound) were 26, 57 and 67 kg per hour, respectively. The weighted average catch rate of 91 kg per hour for adult prawns was above the limit and trigger reference points. The above evidence indicates that the biomass of this stock is unlikely to be recruitment overfished.

The fishery has shown a long history of stable recruitment and commercial catch (generally between 1600 and 2400 t). In 2015, the total catch of 1616 t was below the long-term (2006–14) average (1908 t), while effort, at 1972 vessel nights was virtually the same as the long-term average (1973 vessel nights). The above evidence indicates that the current level of fishing mortality is unlikely to cause the management unit to become recruitment overfished.

On the basis of the evidence provided above, the Spencer Gulf Prawn Fishery (South Australia) management unit is classified as a **sustainable stock**.

### Gulf St. Vincent Prawn Fishery

The Gulf St. Vincent Prawn Fishery has undergone considerable management changes in the past decade. Two significant changes were implemented in the fishery during the 2011–12 season: 1) the number of surveys conducted during the fishing season were reduced from four–two (in April and May); and 2) from March 2012, all trawl nets used for commercial fishing were required to have T90-mesh codends and grids to facilitate the escapement of small prawns and reduce the level of non-prawn bycatch. The fishery was closed in 2012–13 and 2013–14, primarily due to consecutive years of poor financial returns, so no survey results were available for 2013. Along with low mean survey

catch rates in 2012, consecutive declines in annual catch to the lowest since the fishery was closed in 1991–92 and 1992–93 indicated that, while the biomass was not considered to be recruitment overfished, fishing pressure was moving the stock in the direction of becoming recruitment overfished. In May 2014 a spatially reduced survey was conducted. The fishery was subsequently re-opened under an interim management framework including individually transferable effort in the form of transferable fishing nights.

The primary measures for stock status in Gulf St. Vincent are the average catch rates obtained during fishery-independent surveys and catch rates from fishery-dependent data. This assessment is based on data from the 2014–15 season, which extended from 1 November 2014–31 July 2015 [17].

Fishing was conducted over 294 vessel nights in 2014–15 with 50 vessel nights fished during the early spawning period (November–December)—the latter representing a substantial increase in effort compared to the 24 vessel nights fished in 2011–12. The total commercial catch of 249.4 t in 2014–15 was almost double that in 2011–12 (125.0 t) and among the highest in recent years. Harvest during the early spawning period (November–December) was 57.1 t in 2014–15; this represented 22.6 per cent of the total annual catch and was the largest catch during early spawning since 2002–03 (64 t).

The most recent survey was conducted in May 2015, where the mean nominal catch rate was 60.4 kg per hour. This represented a significant increase compared to before the fishery closure following the May 2012 survey (43.5 kg per hour), but remained below levels seen from 2006–07 to 2009–10 (range 71.1–83.3 kg per hour). The annual nominal commercial CPUE in 2014–15 was 85.9 kg per hour. This was 67 per cent higher than 2011–12 (51.5 kg per hour) and the highest since 2009–10 (95.5 kg per hour). In contrast, the recruitment index (recruits per hour, estimated from a 7 kg subsample per shot) declined by 55 per cent from 681 recruits per hour in 2012 to 306 recruits per hour in 2015. This was the lowest value on record, but above the recruitment limit reference point (250 recruits per hour). The management response to low recruitment values during the May 2015 survey was to reduce the number of nights available for fishing during November and December 2015 to 30 vessel nights, which aims to protect the spawning biomass and future recruitment into the fishery. The above evidence indicates that the biomass of this stock is unlikely to be recruitment overfished, but that recruitment appears to be declining.

This evidence indicates that the current level of fishing pressure may cause the stock to become recruitment overfished.

On the basis of the evidence provided above, the Gulf St. Vincent Prawn Fishery (South Australia) management unit is classified as a **transitional–depleting stock.**

**West Coast Prawn Fishery**

The West Coast Prawn Fishery (South Australia) harvests from an oceanic stock that shows large fluctuations in recruitment, thought to be environmentally-driven, and consequently in commercial

catch. The primary measures for stock status on the west coast are the total commercial catch and the annual average catch rate from fishery-independent surveys (conducted annually in March, June and November), which are used as an indicator of relative biomass.

The fishery appeared to experience a prolonged period of stock depletion from 2002 until it was closed in 2006. During this period, survey catch rates remained below 30 kg per hour and annual commercial catch below 42 t. However, both commercial catch and survey catch rates indicate that the stock has rebuilt and the fishery has been in a relatively strong position since 2011 [18]. During the 2015 season (calendar year), the commercial catch of 191 t was 31 per cent greater than 2014 and the highest catch since 1996 (216 t). The annual commercial catch rate was 102 kg per hour in 2015 and this was the highest on record. The mean survey catch rate in 2015 of 85 kg per hour was 26 per cent higher than 2014 and the highest on record. The above evidence indicates that the biomass is unlikely to be recruitment overfished and that the current level of fishing pressure is unlikely to cause the management unit to become recruitment overfished.

On the basis of the evidence provided above, the West Coast Prawn Fishery (South Australia) management unit is classified as a **sustainable stock.**

## BIOLOGY

Western King Prawn biology [8,19,20]

### Biology

| Species | Longevity / Maximum Size | Maturity (50 per cent) |
|---|---|---|
| **Western King Prawn** | 2–3 years, maximum 4 years South Australia: males 46 mm CL, females 57 mm CL Western Australia: males 45 mm CL, females 60 mm CL | 6–7 months; 25 mm CL |

## DISTRIBUTIONS


Distribution of reported commercial catch of Western King Prawn

## TABLES

### Fishing methods

| | Western Australia | Queensland | South Australia |
|---|---|---|---|
| Commercial | | | |
| Otter Trawl | ✔ | ✔ | ✔ |
| Unspecified | ✔ | | |
| Recreational | | | |
| Diving | ✔ | | |
| Hand collection | ✔ | | |
| Dip Net | ✔ | | |

### Management methods

| Method | Western Australia | Queensland | South Australia |
|---|---|---|---|
| Commercial | | | |
| Catch limits | | | ✔ |
| Effort limits | ✔ | ✔ | ✔ |
| Limited entry | ✔ | ✔ | ✔ |
| Spatial closures | ✔ | ✔ | ✔ |
| Vessel restrictions | ✔ | ✔ | ✔ |
| Recreational | | | |
| Bag limits | ✔ | ✔ | |
| Charter licensing | ✔ | | |
| Gear restrictions | ✔ | | |
| Limited entry | ✔ | | |
| Passenger restrictions | ✔ | | |
| Possession limit | | ✔ | |
| Recreational fishing licence | ✔ | | |
| Spatial zoning | ✔ | | |

**Active vessels**

| | Western Australia | Queensland | South Australia |
|---|---|---|---|
| | 6 in EGPMF, 5 in NBPMF, 3 in OPMF, 18 in SBPMF | 102 in ECOTF | 10 in GSVPF, 39 in SGPF, 3 in WCPF |

**ECOTF** East Coast Otter Trawl Fishery (QLD)

**EGPMF** Exmouth Gulf Prawn Managed Fishery (WA)
**GSVPF** Gulf St Vincent Prawn Fishery (SA)
**NBPMF** Nickol Bay Prawn Managed Fishery (WA)
**OPMF** Onslow Prawn Managed Fishery (WA)
**SBPMF** Shark Bay Prawn Managed Fishery (WA)
**SGPF** Spencer Gulf Prawn Fishery (SA)
**WCPF** West Coast Prawn Fishery (SA)

### Catch

| | Western Australia | Queensland | South Australia |
|---|---|---|---|
| Commercial | 260.00kg in BPMF, 191.71t in EGPMF, 40.00kg in NBPMF, 11.00kg in OPMF, 1.63Kt in SBPMF | 149.06t in ECOTF | 212.42t in GSVPF, 1.62Kt in SGPF |
| Indigenous | Unknown | Zero | Unknown |
| Recreational | Unknown | Zero | Zero |

**BPMF** Broome Prawn Managed Fishery (WA)
**ECOTF** East Coast Otter Trawl Fishery (QLD)
**EGPMF** Exmouth Gulf Prawn Managed Fishery (WA)
**GSVPF** Gulf St Vincent Prawn Fishery (SA)
**NBPMF** Nickol Bay Prawn Managed Fishery (WA)
**OPMF** Onslow Prawn Managed Fishery (WA)
**SBPMF** Shark Bay Prawn Managed Fishery (WA)
**SGPF** Spencer Gulf Prawn Fishery (SA)

**a Queensland - Indigenous** In Queensland, under the Fisheries Act 1994 (Qld), Indigenous fishers in Queensland are able to use prescribed traditional and non-commercial fishing apparatus in waters open to fishing. Size and possession limits, and seasonal closures do not apply to Indigenous fishers. Further exemptions to fishery regulations may be applied for through permits.

### CATCH CHART


Commercial catch of Western King Prawn

## EFFECTS OF FISHING ON THE MARINE ENVIRONMENT

- In 2011, the Spencer Gulf Prawn Fishery (South Australia) became the first prawn fishery in the South Pacific to become accredited by the Marine Stewardship Council (MSC). Accreditation by the MSC has been maintained since. The Shark Bay and Exmouth Gulf prawn fisheries (Western Australia) were both accredited by MSC in October 2015.
- Fishing for Western King Prawns in Western Australia, Queensland and South Australia is considered to be of low risk to the trophic structures in the ecosystems in which the fisheries operate. Although harvest rates may be relatively high, Western King Prawn have very high natural mortality rates and make up only a small proportion of the total biomass on the trawl grounds. Predators of prawns need to be opportunistic because of the natural variations in prawn populations. Consequently, given the small areas and short periods now fished, it is considered unlikely that the commercial take of prawns impacts significantly on other trophic levels [4,8,12]. An assessment of trawl-related risk to trophic structures was not explicitly assessed for the East Coast Otter Trawl Fishery (Queensland) (ECOTF), but in the

Great Barrier Reef Marine Park (GBRMP). It found that there is no more than an intermediate risk of overfishing species assemblages exposed to trawling [14].

- Although trawling can impact on habitats, these effects are managed in the Western King Prawn fisheries in Western Australia, Queensland and South Australia. In Western Australia, extensive permanent and temporary closures result in the fleet operating in only seven per cent of the Shark Bay fishery region and 17 per cent of inner Shark Bay, generally less than 30 per cent of the Exmouth Gulf, and less than three per cent of the north coast region. Fishing operations are restricted to areas of sand and mud, where trawling has minimal long-term physical impact [4,8,12,21,22]. In Queensland, the GBRMP occupies 63 per cent of the ECOTF [23], 34 per cent of which is open to trawling [24], but effort is highly aggregated, occurring within only a small fraction of the open area. South of the GBRMP, the fishery operates in only 10 per cent of the area open to trawling [25]. In South Australia, trawl effort has decreased by more than 60 per cent from its historical peaks in all fisheries. Since the inception of the South Australian fisheries, permanent closures have included all waters less than 10 m to ensure protection of seagrass habitats [16].

- Although the incidental capture of by-product and bycatch species by trawling can lead to a range of indirect ecosystem effects [26], studies in Western Australia, Queensland and South Australia found no significant difference in biodiversity or overall distribution patterns of seabed biota between trawled and non-trawled areas [15,21,22,27]. The spatial contraction and/or temporal reduction in effort in all three jurisdictions are likely to have mitigated somewhat the ecosystem impacts of trawling.

- The use of bycatch reduction devices (BRDs) in prawn trawling can significantly reduce bycatch—by more than 50 per cent by weight in some fisheries [28,29]. All prawn trawlers operating in Western Australia must use BRDs, including turtle excluder devices (TEDs), secondary fish exclusion devices and hoppers to increase survival of returned fish. The introduction of TEDs in the Western Australian prawn trawl fisheries in 2003 reduced turtle bycatch by at least 95 per cent [30]. In the ECOTF, the use of BRDs became mandatory in 1999, and the introduction of TEDs in 2001 largely eliminated capture of most large bycatch species, including turtles, sharks and rays [31]. More recently, commitment to continuous improvement in bycatch mitigation has facilitated increased use of best practice TEDs and BRDs in the ECOTF. Reduced impact of trawling and a general absence of high risk of overfishing bycatch species have been acknowledged in recent ecological risk assessments of the fishery [14]. In South Australia, all vessels use crab bags, and 49 of the 52 vessels use hopper systems to ensure rapid return of bycatch to the water. The Spencer Gulf, Shark Bay Prawn Managed Fishery and the Exmouth Gulf Prawn Managed Fishery MSC certifications include the assessment of broad environmental impacts and are important evidence for low risk of trawling impacts. In the Gulf St. Vincent Prawn Fishery (South Australia), all 10 vessels use T90-mesh codends with rigid grids that substantially reduce bycatch volumes [32].

## ENVIRONMENTAL EFFECTS ON WESTERN KING PRAWN

- Major extreme weather events associated with the recent protracted La Niña episode [33] are thought to have influenced recent recruitment patterns and depressed catches of a number of oceanic fishery species in Queensland, including Western King Prawn in 2011. Management of Western King Prawn and other species in the East Coast Otter Trawl Fishery (Queensland) management unit will benefit from knowledge gained from current research into the interrelationships among physical oceanographic features (for example, sea surface temperature anomalies), catch rates, biological parameters, and the spatial distribution of Saucer Scallop, a co-occurring species in Queensland and Western Australian trawl fisheries.
- Water temperature has been shown to effect the recruitment of Western King Prawns in Western Australia, with elevated water temperatures in Exmouth Gulf since 2011 contributing to lower than average recruitment levels [11].
- In South Australia, there is some evidence to suggest that strong El Niño conditions result in unfavorable upwelling in critical spawning grounds, which may result in recruitment failure, particularly in the West Coast Prawn Fishery (South Australia) management unit [34].

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