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Torres Strait Prawn Fishery

DATA SUMMARY 2018

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Torres Strait Prawn Fishery Data Summary 2018

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Also note that this Data Summary is available on the PZJA website.

Contents

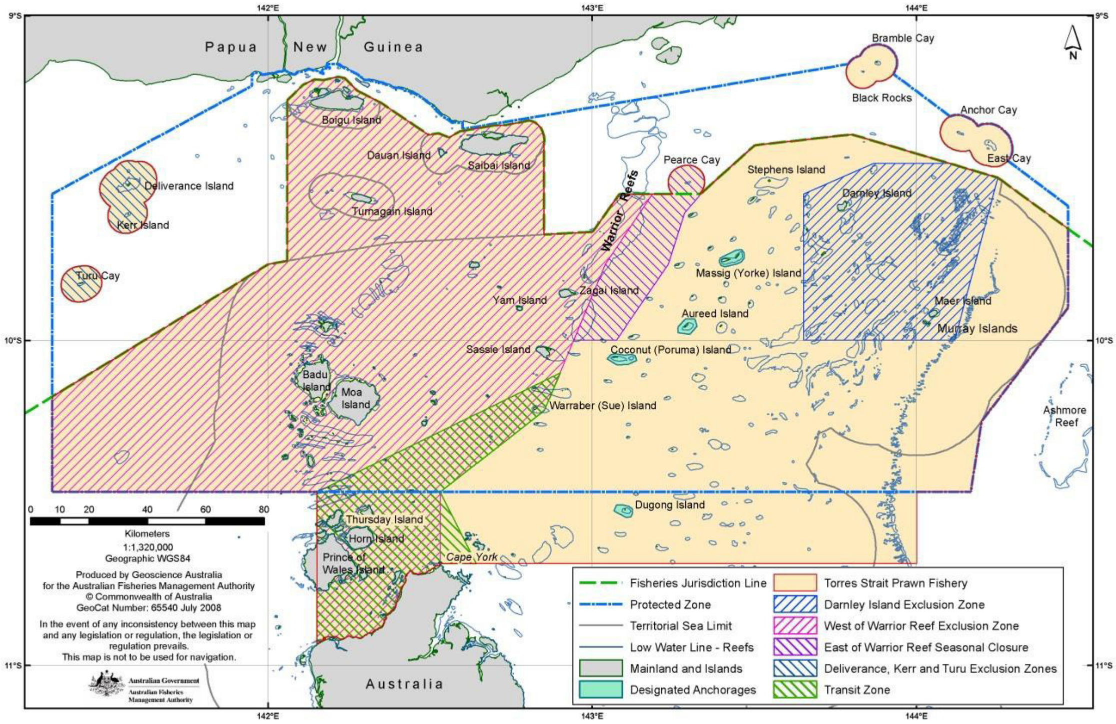
Introduction

This document summarises catch and effort information for the Torres Strait Prawn Fishery (TSPF) from the 2018 fishing season in comparison to previous years. The data summary is a valuable tool for providing feedback to stakeholders on logbook data received by AFMA. It is also used by the Torres Strait Prawn Management Advisory Committee in guiding management recommendations and discussions. The data summary is sent to license holders annually but is available to all stakeholders via the PZJA website (www.pzja.gov.au).

Thank you to the cooperative trawler skippers for submitting their logbook information, an essential record of catches and effort for the fishery has been built up over many years. This "time-series" of data spans 40 years (1978 to present) and is used to monitor trends in fishing effort, catches and catch rates by area (spatial trends), time (temporal trends) and species. A long time-series with wide variations in fishing effort and catches is needed for stock models. These models are used to estimate the level of fishing effort and catch that will ensure sustainability of the harvest while maximising the productivity of the fishery.

Description of the Torres Strait Prawn Fishery

Torres Strait Prawn Fishery and Closures



The TSPF is a multi-species prawn fishery which operates in the eastern part of the Torres Strait. Brown tiger prawns (*Penaeus esculentus*) and blue endeavour prawns (*Metapenaeus endeavouri*) are the key target species. Red spot king prawns (*Melicertus longistylus*), Moreton Bay bugs (*Thenus spp.*), scallops (*Amusium* spp.), slipper and shovel-nosed lobster (*Scyllaridae*) and squid (*Teuthooidea*) are taken as by-product.

Fishing is permitted in the TSPF from 1 February to 1 December each year and is limited by a Total Allowable Effort (TAE) in the form of fishing days. Individual fishers receive an annual use entitlement which is converted based on the TAE and the number of units of fishing capacity (UFC) they hold. Fishing for prawns in the TSPF occurs at night, primarily using the otter trawl method which involves towing two, three or four trawl nets behind a vessel. However, effort is referred to as fishing days due to definitions in the legislation. The TSPF has restrictions on the quantity of net (governed by head and footrope length) and length of vessel that can be used to operate in the fishery.

For detailed information on the management of the TSPF you can download the TSPF Handbook from the PZJA website (www.pzja.gov.au).

Data Collection Program

Logbooks

The PZJA collect data for the TSPF through both operator completed daily fishing logbooks and an automatic Vessel Monitoring System (VMS). The VMS is a satellite monitoring system which collects information on boat locations. A boat is recorded to be fishing if it moves more than 250m at any time between 1800 local time on that day and 0600 on the next day, isn't within a designated anchorage or if a boats VMS system is failing to poll.

VMS was introduced in 2005 and is mandatory on all boats in the TSPF. All TSPF operators are also required to complete a daily fishing logbook, which collects information on the boat, gear, area fishing and catch. The logbooks are available in electronic form, and are the simplest way to submit logbooks, avoiding the need to carry and order paper logbooks and manually submit logbooks which can sometimes be difficult to do at sea. Alternatively operators can complete the 'Northern and Torres Strait Prawn Fisheries Daily Fishing Log' (NP16), a paper logbook on a daily basis (see Torres Strait Fisheries Logbook Instrument 2015). Both paper logbook and e–log data are included in this data summary.

In 1993 each license holder was allocated a quota of "days of fishing access" which reduced the allowable effort in the fishery greatly. The allocation was based on their prior history of fishing in the TSPF and a manual reporting system was introduce to track the number of days that each vessel was within the Torres Strait Zone and hence deemed as fishing (1993-2004). This system was replaced by a VMS based quota tracking system in 2005 because there was full VMS coverage of the TSPF fleet.

Methods Used For Preparing Data Summary

The data used to prepare this summary is comprised of logbook information (NP16 and e-log) and Vessel Monitoring System data (VMS) data. VMS data is collected using satellite transceivers which can record the area fished and fishing speed, allowing AFMA to deduct days fished and monitor closed areas. This data is stored by AFMA.

The data used in this summary was extracted during February 2019. All logbook sheets for the 2018 season had been submitted by fishers at this time. The data is checked using species and fishing positions constraints to identify any records that have been incorrectly assigned to the TSPF. These records are filtered out and returned to the AFMA data section for checking and correction.

Plots of fishing effort post 1988 are based on the number of daily vessel logbook records (days fished) and the VMS. The "VMS" days fished are slightly higher than the logbook "days fished" because vessels are automatically flagged as fishing when steaming at trawl speed or if the VMS unit fails to poll. Fishers can claim back these fishing days if they verify that they were not fishing but often do not if it is near the end of the season and they still have unused days.

Prior to 1989 there was only partial logbook coverage of the fishery. All NPF endorsed vessels were required to records their catches whilst in the TSPF and a small percentage of the non-NPF operators voluntarily filled out NPF logbooks. The unload records that were collected for the fishery during 1978 to 1988 allowed an estimate of "logbook coverage" for the years of partial logbook coverage (1980-88). This was used to estimate of the total number of days fished and vessel numbers for 1980 to 1988.

Catch and Effort Data for the Torres Strait Prawn Fishery

Total fishing days in the area of the fishery

The total percentage of days used in 2018 was 30% of the allowable Australian proportion of the effort (6,867 days) detailed in Figure 1.

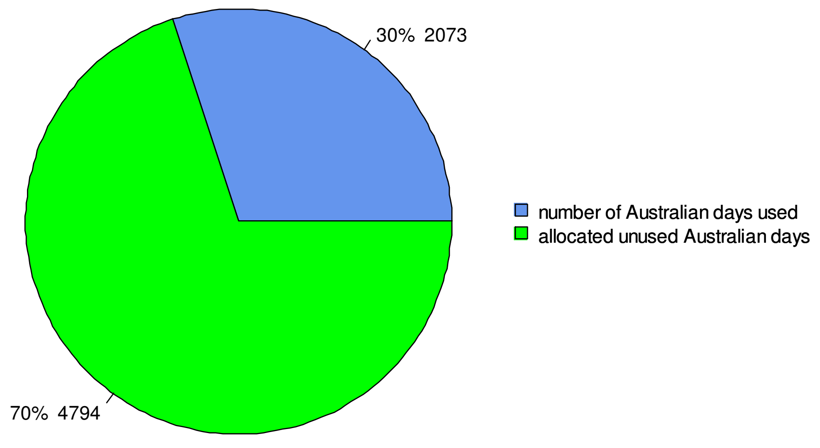


Figure 1. Proportion of the total TSPF Australian allocation (total of 6,867) of fishing days fished in the 2018 season.

The historical fishing effort in the TSPF is plotted in Figure 2 as days fished and number of active vessels. Fishing effort increased from an estimated 3000 days in the early 1980's to around 10,000 days during 1991-2003, then decreased to around 2,000 days by 2008 and has oscillated around 2,000 during the last ten years. The number of vessels fishing in the TSPF has decreased from 115 vessels in 1989 to around 20 vessels over the last ten years. The estimated number of vessels active in the fishery prior to 1989 was about 100 vessels

(Figure 2). Note that the estimates of total active vessels for 1980 and 1988 are unrealistically high. This is probably a result of the low logbook coverage for those years (<14%) and NPF endorsed vessels fishing Torres Strait for a few days on their way to or from the Northern Prawn Fishery.

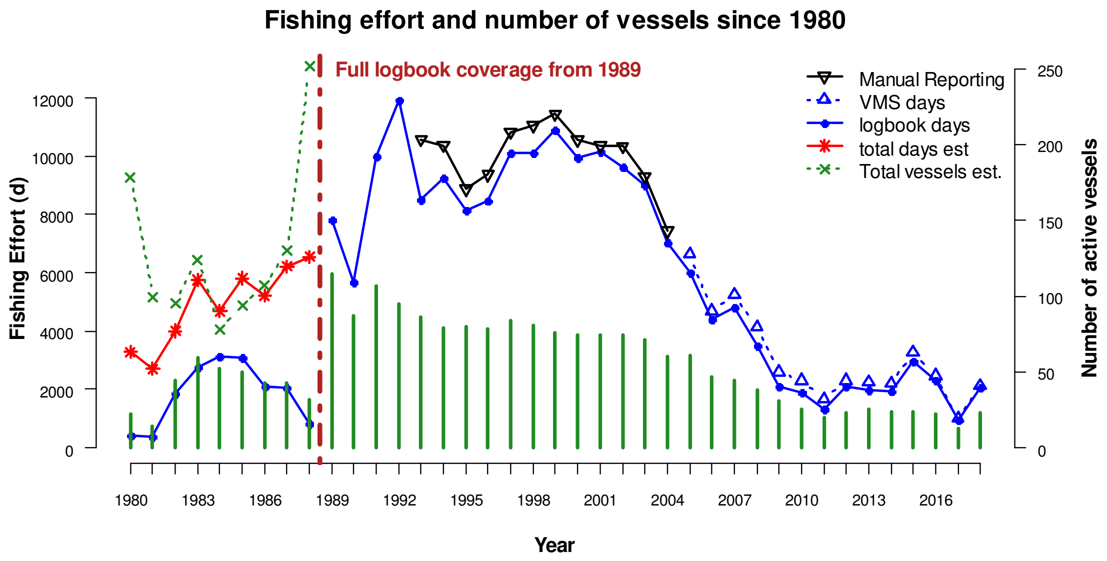


Figure 2. The total days fished in the Torres Strait Prawn Fishery since 1980; displayed as manually reported fishing days (1993-2004), quota usage from the Vessel Monitoring System (2005-2018), logbook days (1980-2018) and "Total Days est." (1980-1988) from logbook days adjusted by the logbook coverage of the total catch. The green vertical lines show the number of active vessels each year based on the logbook data. The yearly estimates of all active vessels during 1980-88 are plotted as "Vessel Number est". Note there was only partial coverage of the fishery by logbooks prior to 1989.

Catch and effort by year

Based on the history of catches and fishing effort (Table 1, Figures 2 and 3) there are four distinct time-periods for the TSPF.

1. "Developmental period" 1978 – 1991; annual fishing effort increased from an estimated 3000 days in the early 1980's to 9,978 days in 1991 when there were 107 active vessels. The prawn catch increased from 340 tonnes of mainly tiger prawn (83%) in 1978 to 1,871 tonnes that was 58% endeavour prawn in 1991.

2. "Period of highest fishing effort" 1991 - 2003; the mean annual fishing effort was 9699 (8155:11903)[1] days by 81 (71:107) vessels. The mean annual catches were 668 (465:965) tonnes of tiger prawn and 1094 (758:1511) tonnes of endeavour prawn. The annual catches are similar to the Maximum Sustainable Yield (MSY) estimates from stock assessments;

[1] The numbers in brackets are the range; minimum : maximum.

676 (95%CI[2] 523:899) tonnes for tiger prawn and 1105 (95%CI 1060:1184) tonnes for endeavour prawn. The 2004 tiger prawn stock assessment estimated the fishing effort that should produce a tiger prawn catch of MSY (E_{mys}) as being 9197 (95% CI 7116:11907) days.

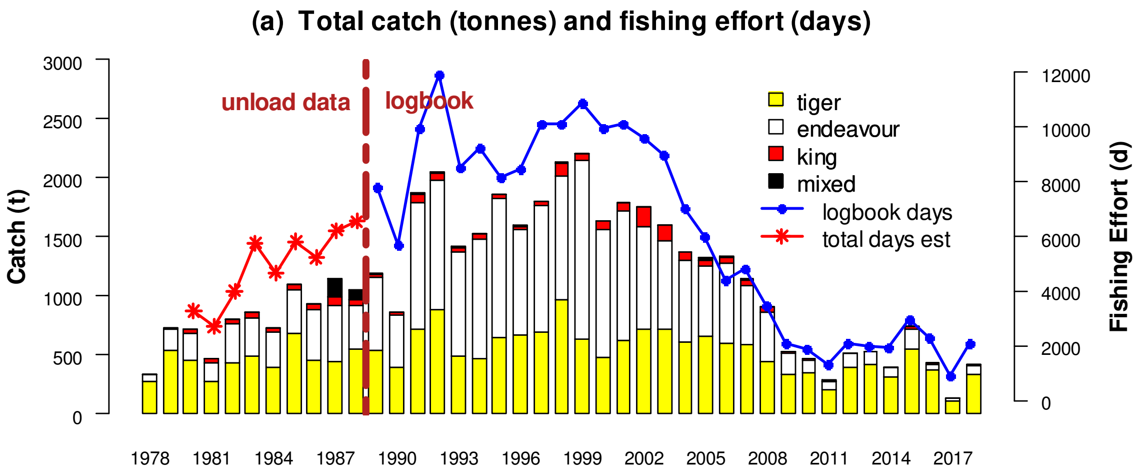
3. "Decreasing fishing effort" 2003 – 2008; fishing effort decreased from 8996 days in 2003 to 3477 days in 2008. At the same time endeavour catch dropped significantly from 758 to 420 tonnes in 2008. There was a smaller decrease in tiger prawn catch from 712 to 441 tonnes.

4. "Post 2008" (2009 – 2018); the mean annual fishing effort was 1960 (934:2969) days by 24 (13:31) vessels. The mean annual tiger and endeavour prawn catches were 338 (111:553) and 98 (25:173) tonnes. The 2016 season had the highest percentage of tiger prawn (85%) since 1978.

Table 1. Summary of catches and fishing effort over 4 time periods between 1978 and 2018.

Fishing period	Years	Annual fishing effort	Number of vessels	Annual tiger prawn catches (t)	Annual endeavour prawn catches (t)
Developmental period	1978 to 1991	Increased from 3000 to 9978 days	NA	Increased from 340 to 1871 (combined tiger and endeavour)	
Period of highest fishing effort	1991 to 2003	9699 mean (8155:11903)	81 (71:107)	668 mean (465:965)	1094 mean (758:1511)
Decreasing fishing effort	2003 to 2008	Decreased from 8996 to 3477 days	NA	Decreased from 712 to 441 tonnes	Decreased from 758 to 420 tonnes
Post 2008	2009 to 2018	1960 mean (934:2969)	24 mean (13:31)	338 mean (111:553)	98 mean (25:173)

[2] 676 is the mean estimate of MSY and 95% of the model estimates lie between 523 and 899 tonnes i.e. the 95% Confidence Interval



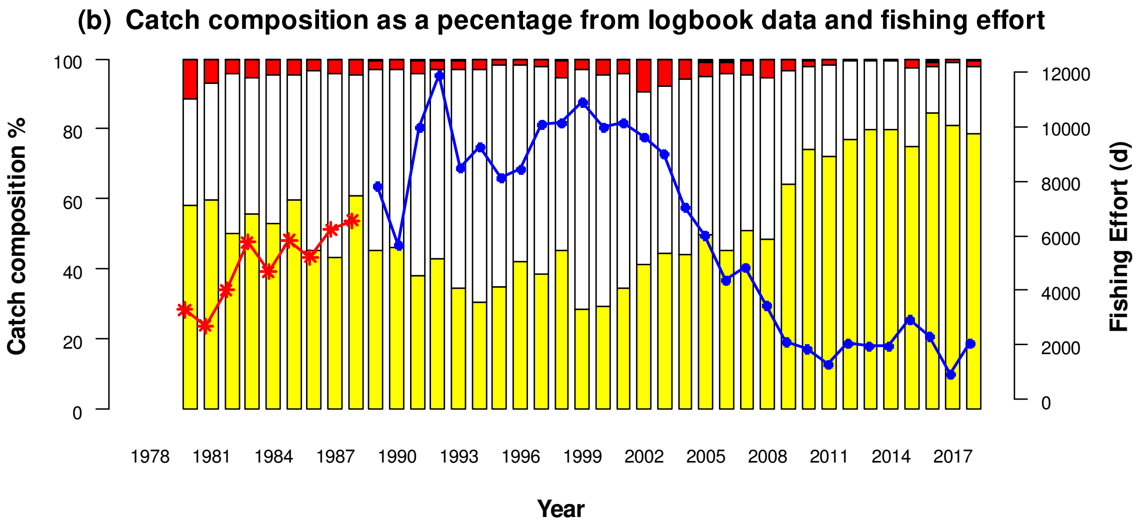


Figure 3. (a) Total catch in tonnes from unload data (1978-1988) and fishing effort (days) from logbook data. The "total days estimate" for 1980-88 is from logbook data adjusted by the logbook coverage. (b) Catch composition as a percentage from logbook data. Note that the 1980-1988 logbook data is from a subset of the fleet.

Table 2. Annual catch and effort data for the years 2005-2018 Data includes total catch (tonnes) and catch rates (Catch Per Unit of Effort as average kilograms per day per boat) both annually as well as the average for the post 2008 years (2009-2018) and the period of highest fishing effort (1991-2003).

Year	**Days fished (logbook)**	**VMS days fished**	**Catch (tonnes)**					**Catch rates CPUE (kg/day/ boat)**		
			All prawn	Tiger	Endeavour	King	Mixed	All prawn	Tiger	Endeavour
2005	6012	6633	1318	655	598	51	14	225	112	103
2006	4405	4685	1331	602	672	45	12	308	139	156
2007	4829	5253	1139	582	503	49	5	242	127	107
2008	3477	4127	911	441	420	48	2	268	138	124
2009	2102	2599	528	338	173	16	1	258	166	84
2010	1879	2309	465	344	110	9	2	252	187	61
2011	1305	1663	281	203	73	4	1	221	160	58
2012	2080	2310	517	398	115	3	0	253	195	58
2013	1988	2240	526	419	103	4	0	270	215	57
2014	1954	2203	393	315	76	3	0	205	164	40
2015	2969	3263	737	553	165	17	2	252	189	57
2016	2313	2472	432	366	56	5	5	192	162	30
2017	934	1004	137	111	25	1	0	152	123	31
2018	2073	2135	419	329	81	6	3	206	162	41
Average 2009-2018	1960	2220	444	338	98	7	1	226	172	52
Average 1991-2003	9699	NA	1785	668	1044	70	4	190	71	111

During discussions with TSPF fishers it was hypothesized that the decline in fishing effort after 2003 was mainly driven by increasing fuel prices and decreasing produce value making it less profitable to fish. The endeavour prawn catch declined first because it is the lower value product and it was more profitable for fishers to target areas of higher tiger prawn CPUE. Although tiger and endeavour prawns are almost always caught together, fishers can target a specific species to a certain degree, as the distribution of prawn stocks on the seabed is "patchy". There are areas of higher tiger prawn CPUE often only a few miles away from areas of lower tiger prawn CPUE but higher endeavour CPUE. Some TSP fishers have stated that they "target dollars rather than a particular species"; i.e. the species mix that provides the highest return.

Although the 2016-2018 fishing seasons were a month longer than previous years (1 February season opening instead of 1 March) catches can be directly compared with the earlier years because catch is dependent on catch rates (CPUE) and the total number of "allocated days of fishing access" that are utilised by the fleet. Making the season longer does not change the days of fishing access allocated to each vessel, just extends the time period in which they can catch it.

During November 2005 allowable fishing effort was reduced to implement the Total Allowable Effort (TAE) cap of 9,200 days. The two average rows at the bottom of Table 2 compare catch and effort for the post 2008 years (2009-2018) with the period of highest effort (1991-2003).

In Torres Strait the prawn harvest is comprised of three main species; the brown tiger prawn (*Penaeus esculentus*), the blue endeavour prawn (*Metapenaeus endeavouri*) and the red spot king prawn (Melicertus longistylus). The other tiger, endeavour and king prawn species that are found in the Torres Strait are only a few percent of the catch. King prawn has always been a small component of the catch and is regarded as a by-product of fishing for tiger and endeavour prawns.

Fishing catch rates (CPUE) and stock biomass

Figures 4 and 5 show the historical "catch rates" or "Catch Per Unit of Effort" (CPUE). This is measured as the average "kilograms of catch per boat day of fishing" (kg/d). The small percentage (3-10%) of daily vessel records that are flagged as representing a partial day of fishing (hours trawled < 9) are excluded from the estimates of CPUE.

CPUE is an indication of the numbers of prawns on the seabed. High CPUE often indicates a large prawn biomass while low CPUE often indicates a small prawn biomass, however, there are other factors that can impact on the CPUE of an individual vessel in addition to prawn abundance. These factors are; vessel size, engine power, type of nets, time of the year, moon phase, area within the fishery, fisher experience etc. The standardised CPUE used in the stock assessment models are slightly different to those presented in this data summary because they are adjusted for the factors that can affect individual vessel catch rates. This ensures that the catch rates can more accurately reflect the stock size or biomass of prawns on the seabed.

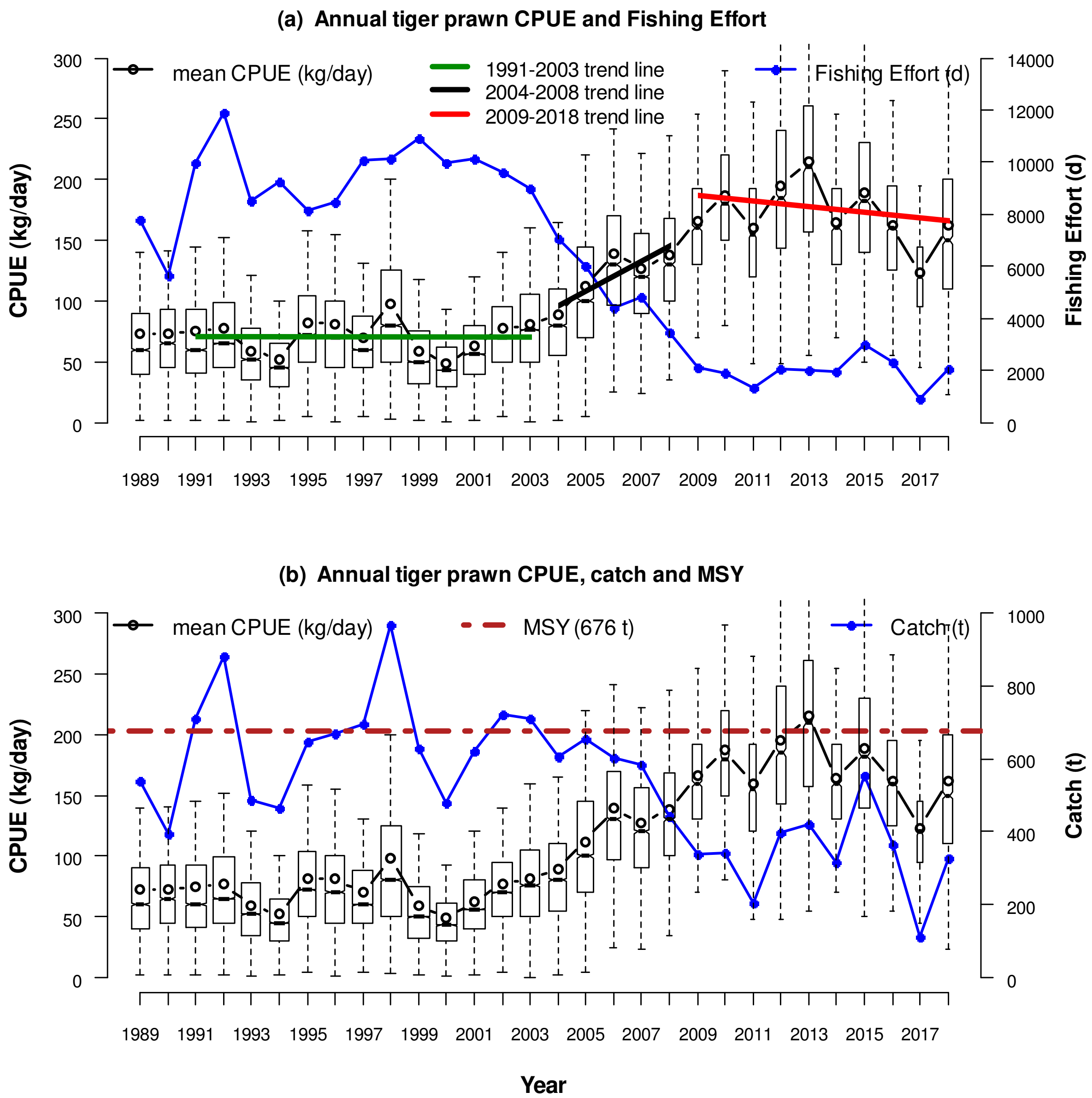


Figure 4 Tiger prawn catch rates (CPUE) as kilograms per vessel per day fished (kg/d) compared with (a) fishing effort in days and (b) catch in tonnes. The boxplots show the range of daily vessel CPUE's for each year. The median CPUE is indicated by notch and line near the middle of the boxes and black line with circles is plot of the mean (average) CPUE for each year. Fifty percent of the records are within the rectangles. The "whiskers or dotted lines" extending from the rectangles show the overall range. The width of the rectangles indicates the number of records for each season. As a result the rectangles for the years 1991-2003 are wider due to the higher level of fishing effort.

Although the "red" trend line fitted to the 2009-2018 tiger prawn CPUE's has a small downward slope (Figure 4a), the CPUE is roughly double the CPUE for 1991-2003 (green line). The highest tiger prawn CPUE occurred in 2013 and the lowest CPUE since 2005 was in 2017. During the period of highest fishing effort (1991-2003), tiger prawn CPUE (Figure 4(a)) was variable but there is no overall upward or downward trend in the CPUE data as indicated by the green trend line for the year's 1991-2003 in Figure 5.

During the years of decreasing fishing effort (2004-2008) the trend in CPUE was upward. This is most likely due to the combined effect of fishers targeting tiger prawn in preference to endeavour prawn and the higher abundance of tiger prawn due to the decrease in fishing effort. This is supported by stock assessment results which indicate that the tiger prawn biomass was increasing during 2001-2006, was at a higher level than during the 1990s and was above Bmsy (The biomass that supports Maximum Sustainable Yield (MSY)).

Tiger prawn catch during 1991-2003 varied around the estimate of MSY (675t) with the higher catches generally occurring in years of higher CPUE and the lower catches in years of lower CPUE (Figures 4b). After 2003 the tiger prawn catch was below MSY and since 2009 has varied around a mean of 340 tonnes which is about 1/2 of MSY. The highest tiger prawn catch since 2009 was in 2015 (553t) due to the highest fishing effort (2969 days) since 2009 combined with a high catch rate (189 kg/d). Conversely 2017 had the lowest tiger prawn catch (111 t) due to the lowest fishing effort (934 days) since 1989 and the lowest tiger prawn CPUE (123 kg/d) since 2005.

In contrast to tiger prawns, the CPUE for endeavour prawn over that last 10 years is lower than during the years of high and declining fishing effort which is evidence for this species being more productive and hence more abundant, when fishing effort is high. The trend line fitted to the endeavour prawn CPUE data for 1991-2008 (Figure 5a) is horizontal and with a mean CPUE of 113 (87:156) kg/d. The trend line fitted to the last 10 years has a negative slope and mean of 52 kg/d (30:84). Endeavour prawn CPUE remained high during the years where fishing effort and endeavour prawn catch was decreasing (2003-2008). The halving of endeavour prawn CPUE occurred at the end of the decline in catch and effort.

Endeavour prawn catch oscillated around the estimate of MSY (1105t) during the years of high fishing effort, then decreased as effort decreased, to an annual mean of 98 (25:173) tonne (Figure 5b) over the last 10 years. The decrease in endeavour prawn catch is a result of the decrease in fishing effort to 1/5th of what it was during the high effort years (Figure 5a) and the halving of endeavour prawn CPUE since 2008.

Due to the very low level of effort in the fishery and fishers targeting the higher value tiger prawn, the mean fleet CPUE for endeavour prawns can be easily biased by which vessels are fishing and where and when they are fishing; therefore the current CPUE for endeavour prawn is a poor index of the endeavour stock biomass. The below average endeavour prawn catch rates since 2009 (Figure 5) can partly be explained by fishers focusing on the higher value tiger prawns.

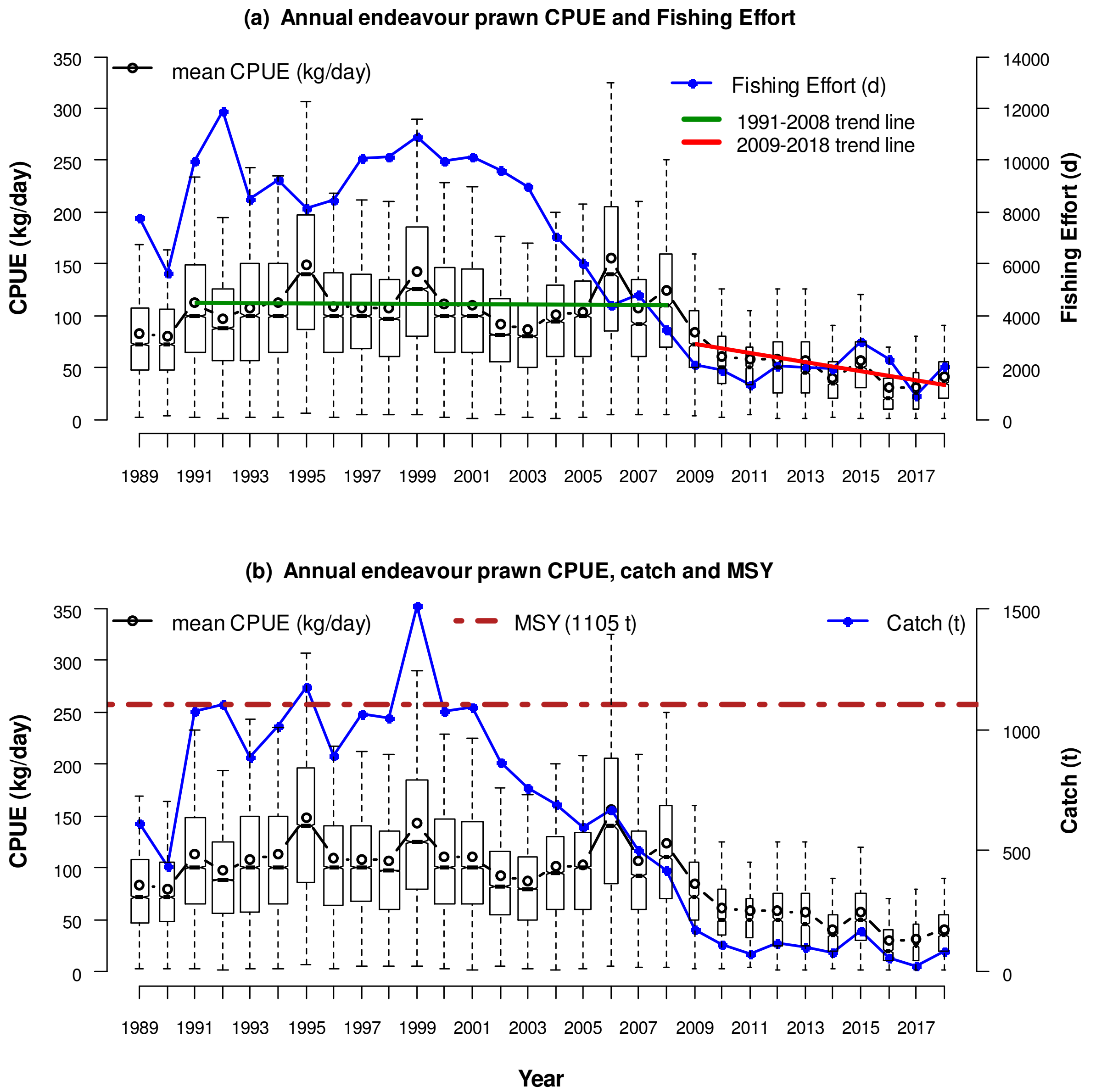


Figure 5 Endeavour prawn catch rates (CPUE) as kilograms per vessel per day fished (kg/d) compared with (a) fishing effort in days and (b) catch in tonnes. The boxplots show the range of daily vessel CPUE's for each year. The median CPUE is indicated by notch and line near the middle of the boxes and black line with circles is plot of the mean (average) CPUE for each year. Fifty percent of the records are within the rectangles. The "whiskers or dotted lines" extending from the rectangles show the overall range. The width of the rectangles indicates the number of records for each season. As a result the rectangles for the years 1991-2003 are wider due to the higher level of fishing effort.

Spatial distribution of fishing effort and catches

The spatial distribution of fishing effort and catches, summarised to the 6 minute grid level are presented for the 2005, 2017 and 2018 fishing seasons in Figure 6 and Figure 7. To abide with logbook confidentiality requirements the data for grids where less than five vessels fished during the season are not shown. Because the Fisheries Jurisdiction Line passes through the lower sections of some grids along the border region the catch of these grids ‘appear’ to be in PNG waters as the grid centre is north of the line. Catches in grids that are within the East of Warrior closure occurred during August to November when this area is open to fishing.

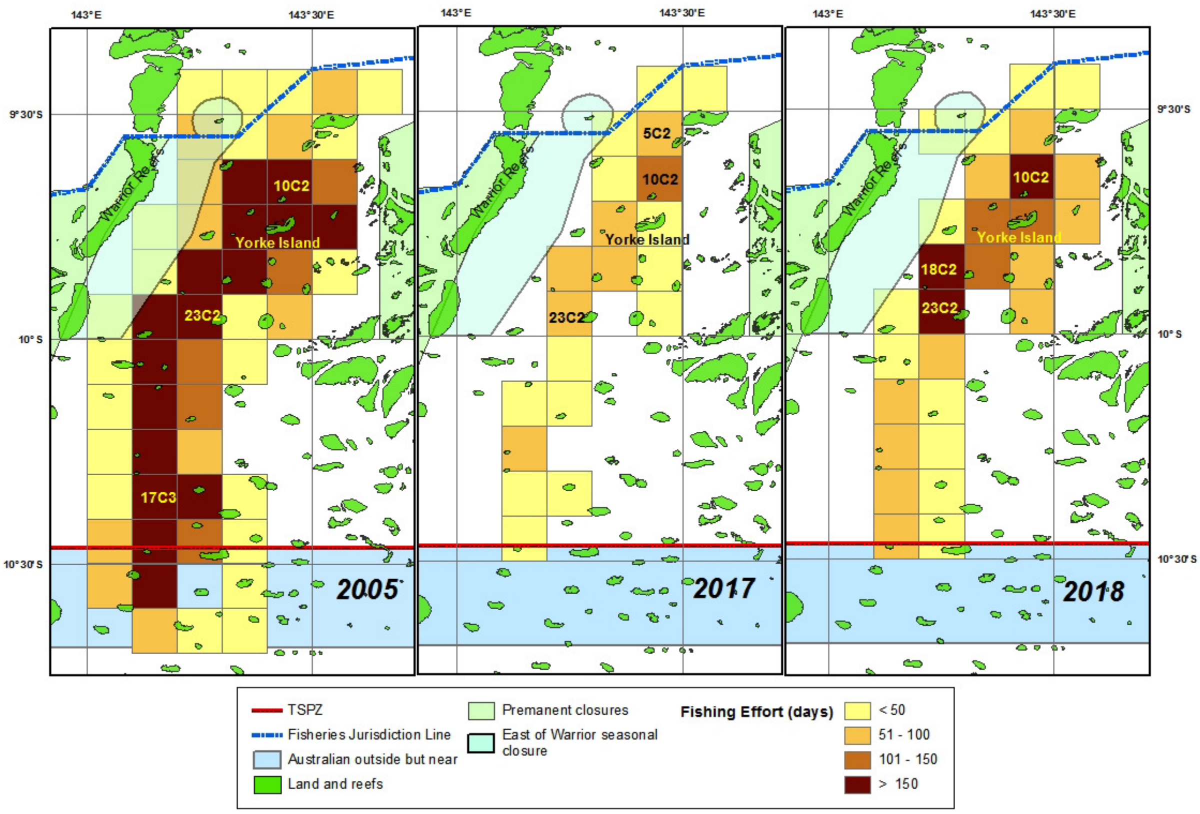


Figure 6. Effort distribution (fishing days across all boats) within the TSPF for the 2005, 2017 and 2018 fishing seasons by 6-minute grid.

The 2005 fishing season was chosen as a base year for comparison with the two most recent fishing seasons, because in November 2005 there was a pro rata effort reduction for the fishery to a 9,200 day cap. Also, the 2005 fishing effort was approximately 60% of the years of highest effort (1991-2001) and the 2005 tiger prawn catch of 655 tonne was just below the 1991-2003 mean of 668 tonne and the estimate of MSY (676 t). There were 16 grids where fishing effort was above 150 days during the 2005 fishing season (Figure 6). The grid with the highest effort and catch in 2005 was 17C3 where 408 days of effort from 53 vessels produced 39 tonne of tiger prawn, 48 tonne of endeavour prawn and 2.3 tonne of king prawn. The grids next highest in fishing effort were 10C2 and 23C2 with 364 and 350 days fished resulting in 48 and 35 tonne of tiger prawn harvest.

In 2017 the grids with the highest fishing effort were 10C2 (111 days), 5C2 (81 days) and 23C2 (81 days). These grids produced 15.2, 13.3 and 11.9 tonne of prawn catch. In 2018 the grids with the highest fishing effort were 10C2 (217 days), 23C2 (187 days) and 18C2 (163 days). These grids produced 49.2, 37.7 and 34.6 tonne of prawn catch.

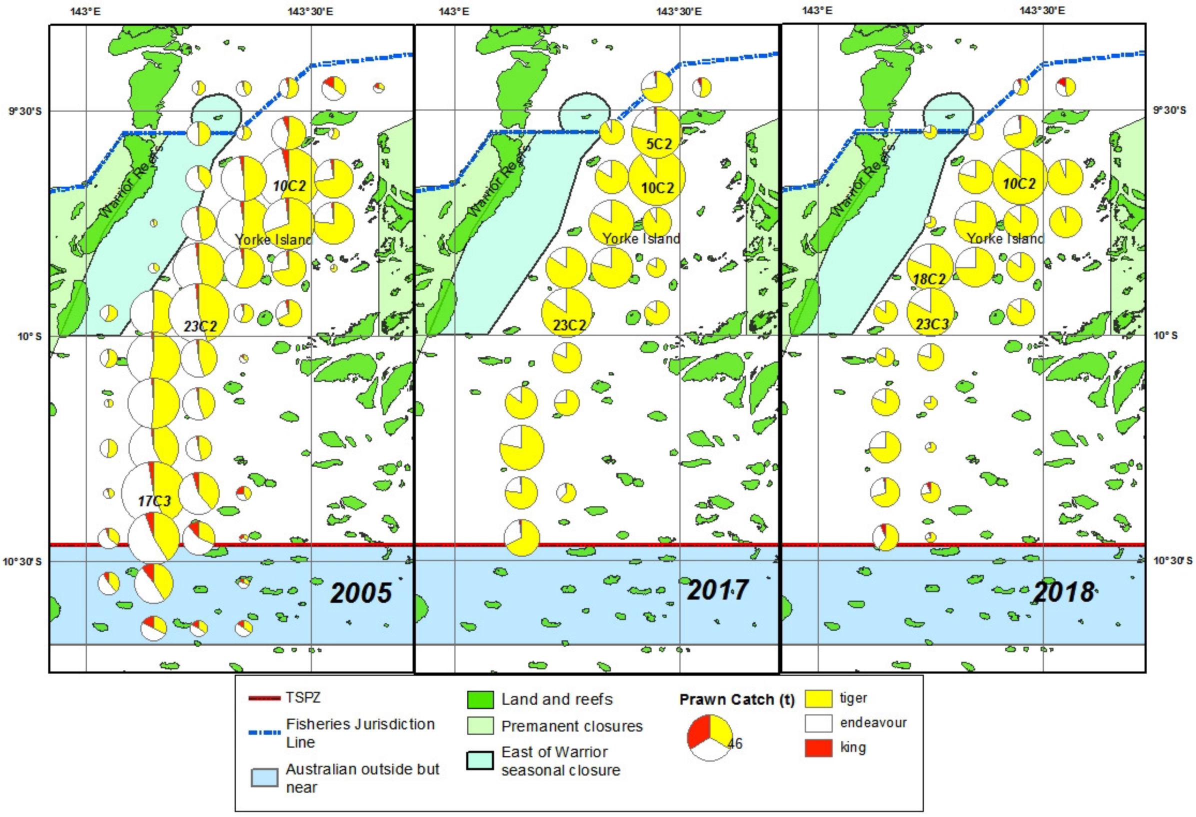


Figure 7. Spatial distribution of catch for tiger, endeavour and king prawns during the 2005, 2017 and 2018 fishing seasons. The diameters of the pie charts are scaled by the total prawn catch for each grid.

The percentage of king prawn catch in 2017 was very low and no king prawn catch was recorded for more than half of the grids that were fished. In contrast 2018 had a small percentage of king prawn recorded for most grid that were fished. Note the percentages are too small to be visible in many of the 2018 pie graphs in figure 7. King is visible in the pie graphs for the grids in the northern and southern ends of the fishery were the catch of this species has always been highest.

Monthly trends in Fishing Effort and Number of active Vessels

Figures 8(a) and 9(a) show that effect of the large reduction in fishing effort since 2003 on the monthly trends in fishing effort and the number of vessels fishing each month. During the years of high annual fishing effort (1991-2003) the monthly fishing effort was generally highest at the start of the season (March), decreased until June, and was level until September then decreased until the end of the season (Figure

8(a)). The trend in the number of vessels is similar (Figure 9(a)). In contrast the trends in monthly fishing effort and vessel numbers since 2009 has been much lower and almost level across the season. There is a small peak in March while November and February (only open since 2016) usually have the lowest “days fished” and “vessel numbers”. The mean fishing effort for March of the years 1991-2003 was 1800 days by an average of 70 vessels. March of 1991 was the maximum with 95 vessels fishing a total of 2477 days. The year by month tables in the appendix provide the individual values for each month.

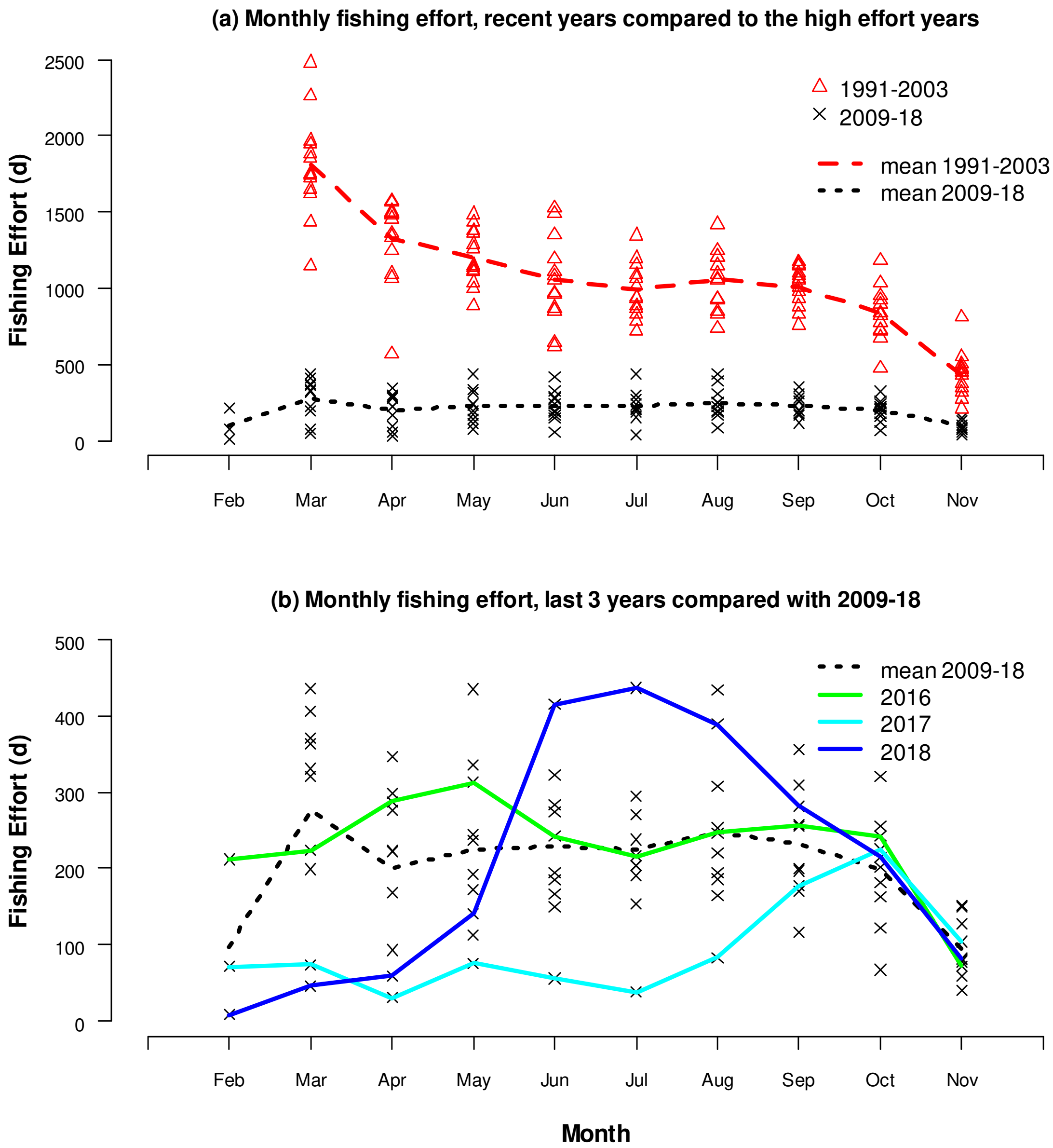


Figure 8. (a) Monthly fishing effort (days) for recent years (2009-18) compared to the years of high fishing effort (1991-2003). The point symbols (x and triangles) show the individual monthly fishing effort for the two time periods and the lines are the monthly means for the two time periods. (b) Monthly fishing effort for the last 3 years compared to all years since 2009.

The 2017 season was the year of lowest annual fishing effort and the days fished each month and vessel numbers were the lowest on record from April to August

(Figures 8(b) and 9(b)). During September a few more vessels entered the fishery so effort and vessel number were near the average for the remainder of the 2017 season. Fishing effort in February and March of 2018 was lower than for 2017 as only three vessels fished the first three months of the season. However, the number of vessels increased to 20 and monthly days fished rose to 437 by July which was the month of highest fishing effort for the 2018 season. The 2016 season had the highest annual fishing effort of the last three years and the monthly vessel numbers and days fished was relatively constant across the season.

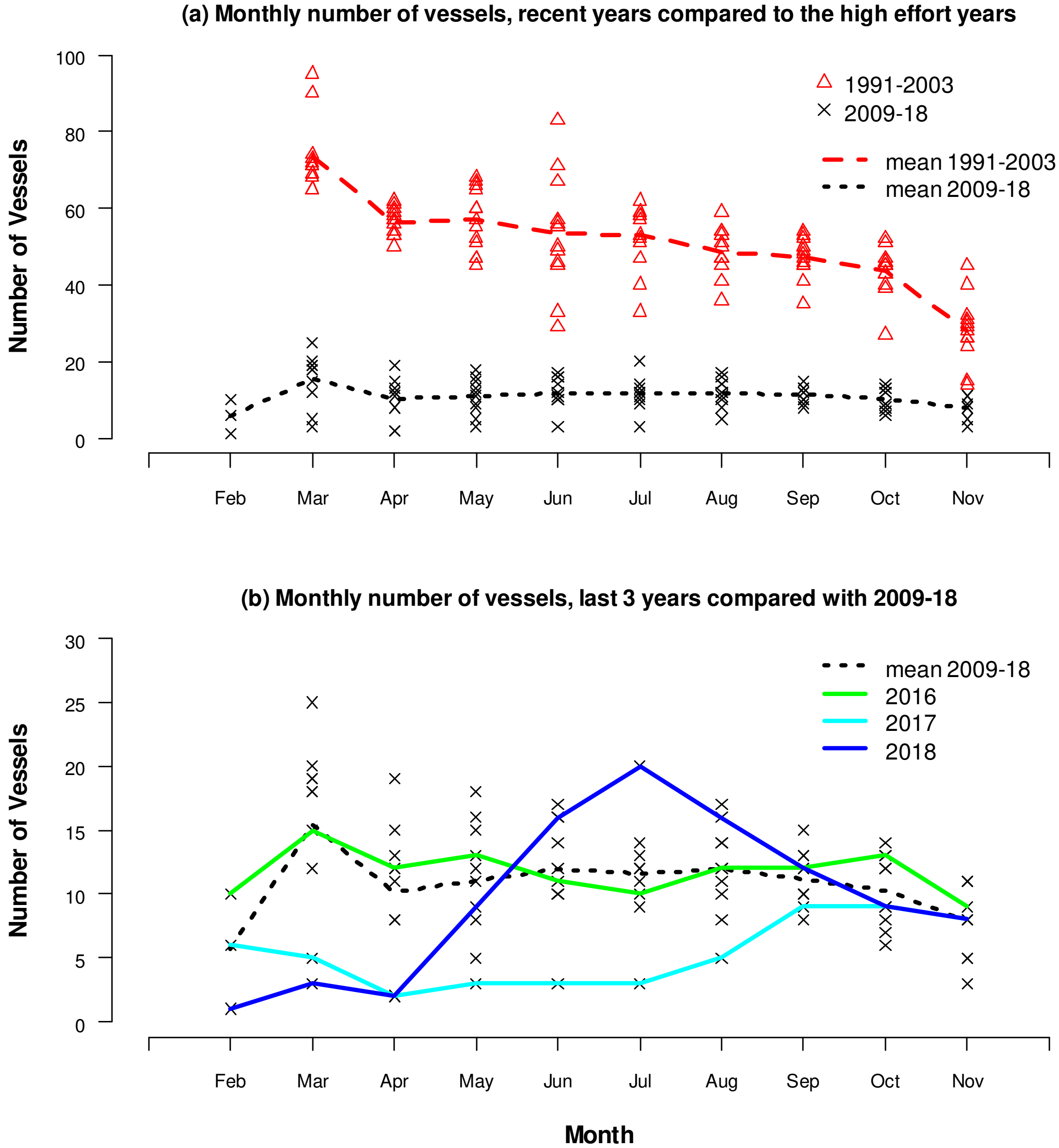


Figure 9. (a) The number of vessels that fished each month for recent years (2009-18) compared to the years of high fishing effort (1991-2003). The point symbols (x and triangles) show the individual monthly vessel numbers for the two time periods and the lines are the monthly means for two time periods. (b) The number of vessels that fished each month for the last 3 years compared to all years since 2009.

Monthly trends in CPUE

Figures 10(a) and 10(b) plot the monthly trends in catch rates (CPUE) for tiger prawn and endeavour prawn. The monthly CPUE for 2016, 2017 and 2018 is compared with the distribution and mean CPUE values for all years since 2009 and the years of high fishing effort (1991-2003).

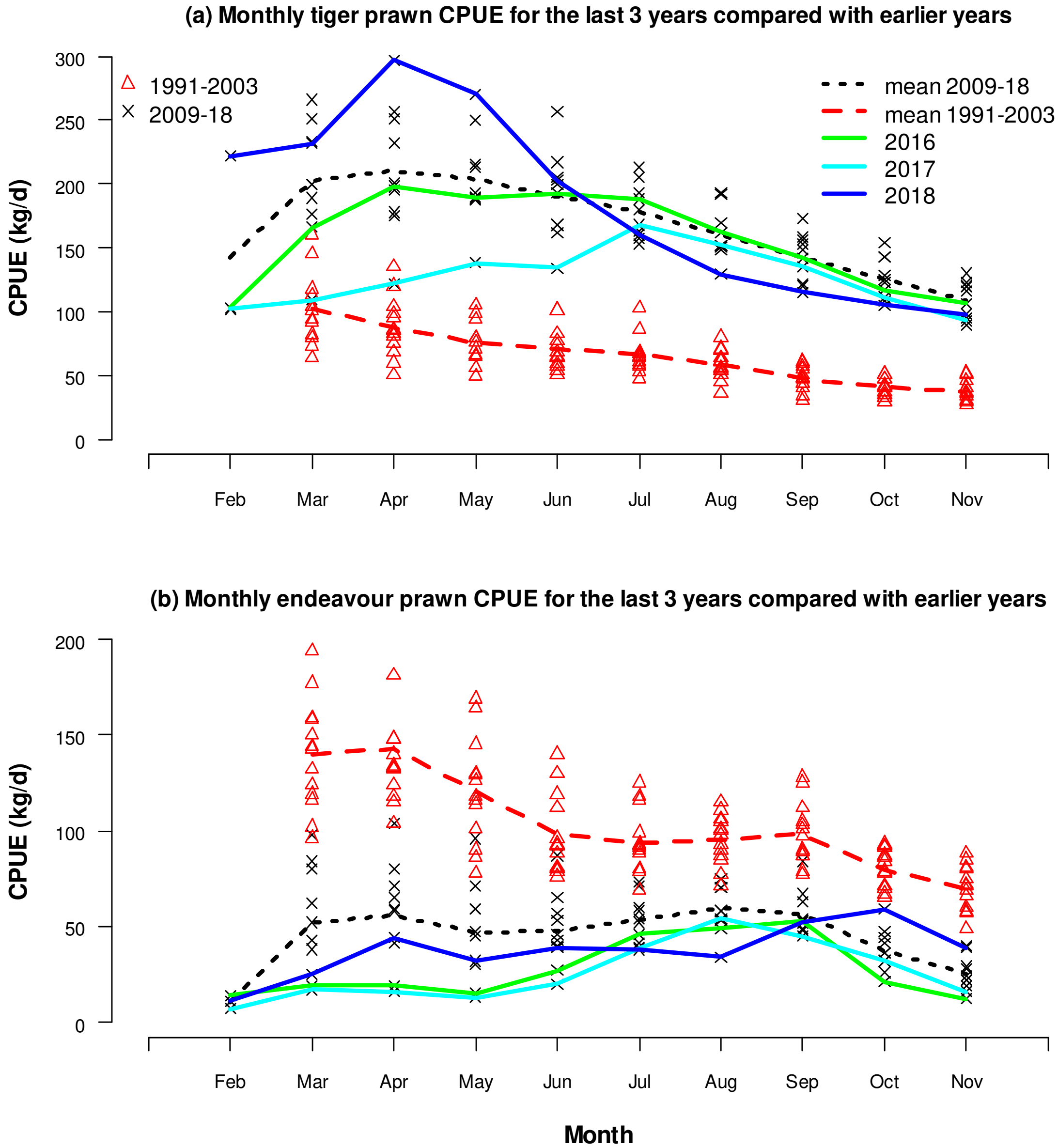


Figure 10. Catch Per Unit of Effort (CPUE) as kilograms per day for (a) tiger prawn and (b) endeavour prawn. The CPUE for each month of the years 2016, 2017 and 2018 is compared with the distribution and mean of the monthly CPUE for all years since 2009 and the years of highest fishing effort (1991-2003). The point symbols (x and triangles) show the individual monthly CPUE for the two time periods and the lines are the monthly means for 2016, 2017, 2018 and the two time periods.

The distribution and mean monthly CPUE of tiger prawn since 2009 is much higher than for the years of highest fishing effort (1991-2003). In addition CPUE remains high during March to May whereas for the 1991-2003 data, the highest CPUE was generally at the season start (March) then quickly dropped during the next few months (Figure 10(a)).

The 2016 season had the highest annual CPUE for tiger prawn of the last 3 years and the monthly trend in CPUE is the closest to the mean for the years since 2009. CPUE was lowest in February, increased to a maximum in April then slowly declined until the end of the season (November).

The 2018 season had the second highest annual CPUE for tiger prawn of the last 3 years and the monthly trend in CPUE is different to that of 2016. Tiger prawn CPUE was much higher than the mean (2009-18) for the first four month and was lower than the mean from July to the end of the season. The difference between the two seasons is partly explained by the difference in the monthly fishing effort and vessel numbers for the two seasons. During 2016 the days fished and number of vessels each month was fairly constant across the season (Figures 8(b) and 9(b)). In contrast there were only a few vessels fishing until April of 2018 and fishing effort was very low. However, during May 2018 the number of vessels and days fished increased to a much higher level than for 2016. The increase in fishing effort between April and July 2018 could explain the decrease in tiger prawn CPUE as tiger prawn abundance decreases in the area fished. While the decline in tiger prawn CPUE through 2018 is steeper than the long term average (2009-2018 and 1991-2008), it does follow a consistent pattern of CPUE decreasing throughout the year.

In 2017 the monthly tiger prawn CPUE gradually increased to July which was the maximum for the year, then tracked downward, just below the 2009-2018 mean (Figure 10(a)). February to April is generally when tiger prawn recruitment is strongest as indicated by the mean monthly tiger prawn CPUE (2009-18) which shows a rapid increase from February to April. This increase in CPUE while tiger prawn stock is being harvested could only occur if it is being replaced by more tiger prawn stock migrating from the juvenile closure areas (West of Warrior Reef and the East of Warrior closure) into the area open to trawling. The combined low fishing effort and low tiger prawn CPUE during the early months of the 2017 season indicates a poor recruit of tiger prawn at the start of the season. The tiger prawn CPUE for the latter months of 2017 was just below the average for those months indicating a normal recruitment for the latter part of the season.

In contrast to tiger prawn the distribution and mean monthly CPUE of endeavour prawn since 2009 is much lower than for the years of highest fishing effort (1991-2003). During 1991-2003 the mean endeavour prawn CPUE was highest in March-April, decreased until May, was level until September then decreased to November (Figure 10(b)). During recent years (2009-18) endeavour prawn CPUE was relatively constant across the season except for the start (February) and end (October-November) which were lower. Except for October-November of 2018, the monthly endeavour prawn CPUE's for 2016, 2017 and 2018 were below the mean values for the last ten years (2009-18). Comparing the last three years, 2018 had the highest annual endeavour prawn CPUE (Table 2) and with the exception of July to August, had the highest monthly endeavour prawn CPUE.

Bycatch and Threatened, Endangered and Protected species catches

The main bycatch species in the TSPF include red spot king prawn and various species of bugs (Morton bay bugs and shovel nosed and slipper lobsters). Cuttlefish and squid are also taken some years in reasonable quantities. TEP species are reported in table 4. Bugs were caught in fairly consistently high numbers since 2009, ranging from approximately 10,000 to 26,000. The mixed prawn category includes both target and bycatch prawn species (endeavor, red spot king and tiger prawn) and are generally soft and broken prawns. They are put in this category as soft and broken prawns are generally not abundant enough in our species to make up a whole box for sale. As such they are put together. Almost all bycatch species catches loosely followed the trends in effort, with increased take in years where effort was higher, peaking in 2015, particularly for bugs and king prawns, two particularly marketable bycatch species. Several species in Figure 11 were only caught once or twice in the time series so have gaps or single data points. 7,790kg of scallops were also taken in 2017, a singular event.

The majority of TEP species caught in the TSPF are seasnakes, followed by sygnathids (seahorses and pipefish). Occasionally sawsharks, turtles and sawfish are caught (Table 4). Only 2% of seasnakes were observed as “dead”; 62% were noted as being alive and the condition of 36% was “unknown” when returned to the sea. In Figure 11 the annual number of interactions with seasnake is plotted against the number of fishing days for each year. The rate of interactions with seasnakes (i.e. Catch Per Unit of Effort) expressed as number of interactions per 100 fishing days was 60-90 animals per 100 days during the years 2010-14, whereas during the remainder of the time-series (before and after these years) the rate was 20-50 animals per 100 days. Note that the data for 2004 only represents part of the year because recording of seasnake commenced during 2004.

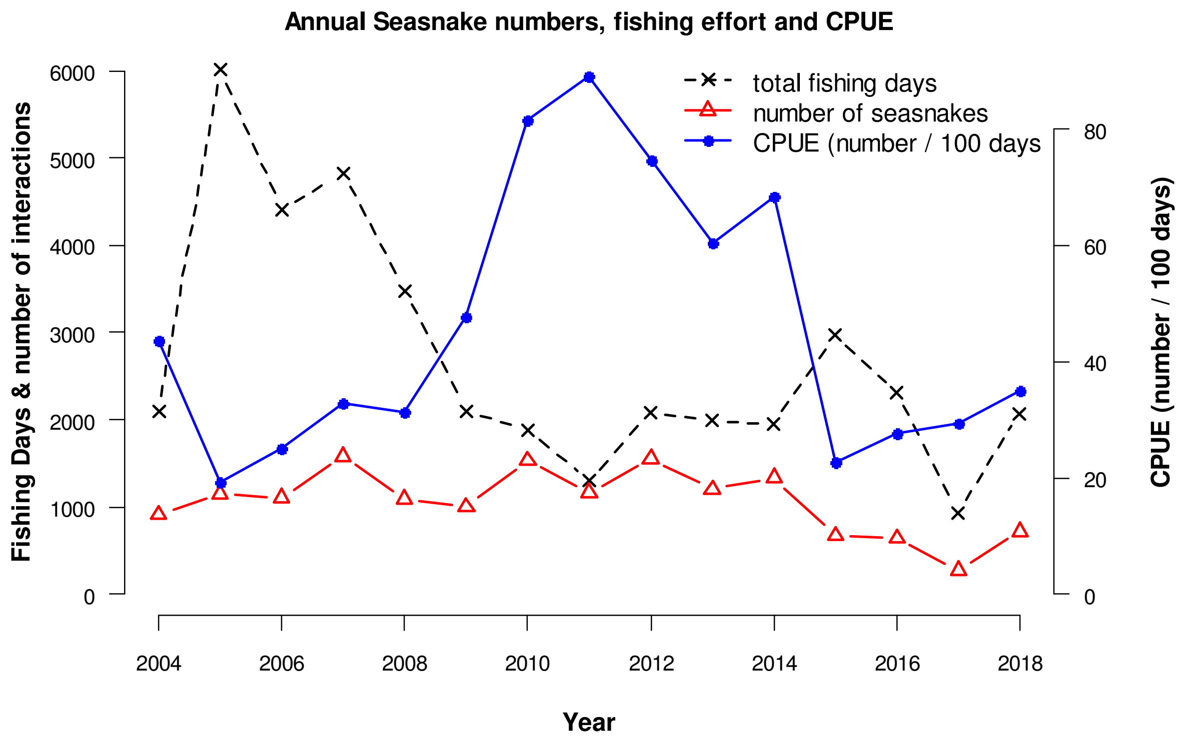


Figure 11. The annual number of interactions (reported in logbooks) with seasnake (red line with triangles) plotted against the number of fishing days (black dotted line with x) and both are scaled to the left y-axis. The solid blue line with circles is the Rate of interactions with seasnake (i.e. CPUE) expressed as number of interactions per 100 fishing days and is scaled to the right y-axis. Note that the data for 2004 only represents part of the year because the recording seasnake interactions commenced during 2004.

Table 3. – logbook catches (kg) of 8 main species caught as bycatch in the TSPF for 2009 - 2018.

	Species catch (kg)							
Year	**Bugs - Shovel nosed and slipper lobsters**	**Commercial Scallop**	**Cuttlefish (mixed)**	**King Prawns (mixed)**	**Moreton Bay Bugs**	**Prawns (mixed)**	**Redspot King Prawn**	**Squids**
2009	10089	0	923	0	3101	977	3101	1008
2010	13430	0	0	5125	3878	2215	3669	426
2011	9969	0	0	3690	1758	0	0	0
2012	14614	0	0	0	0	0	0	455
2013	19864	0	0	2990	1855	0	0	0
2014	17286	0	0	2434	729	0	0	0
2015	26154	0	531	15952	1800	2470	858	0
2016	12891	0	611	4570	2072	3951	825	0
2017	6023	7790	513	955	0	0	0	0
2018	15107	0	1179	3774	0	2545	2705	524

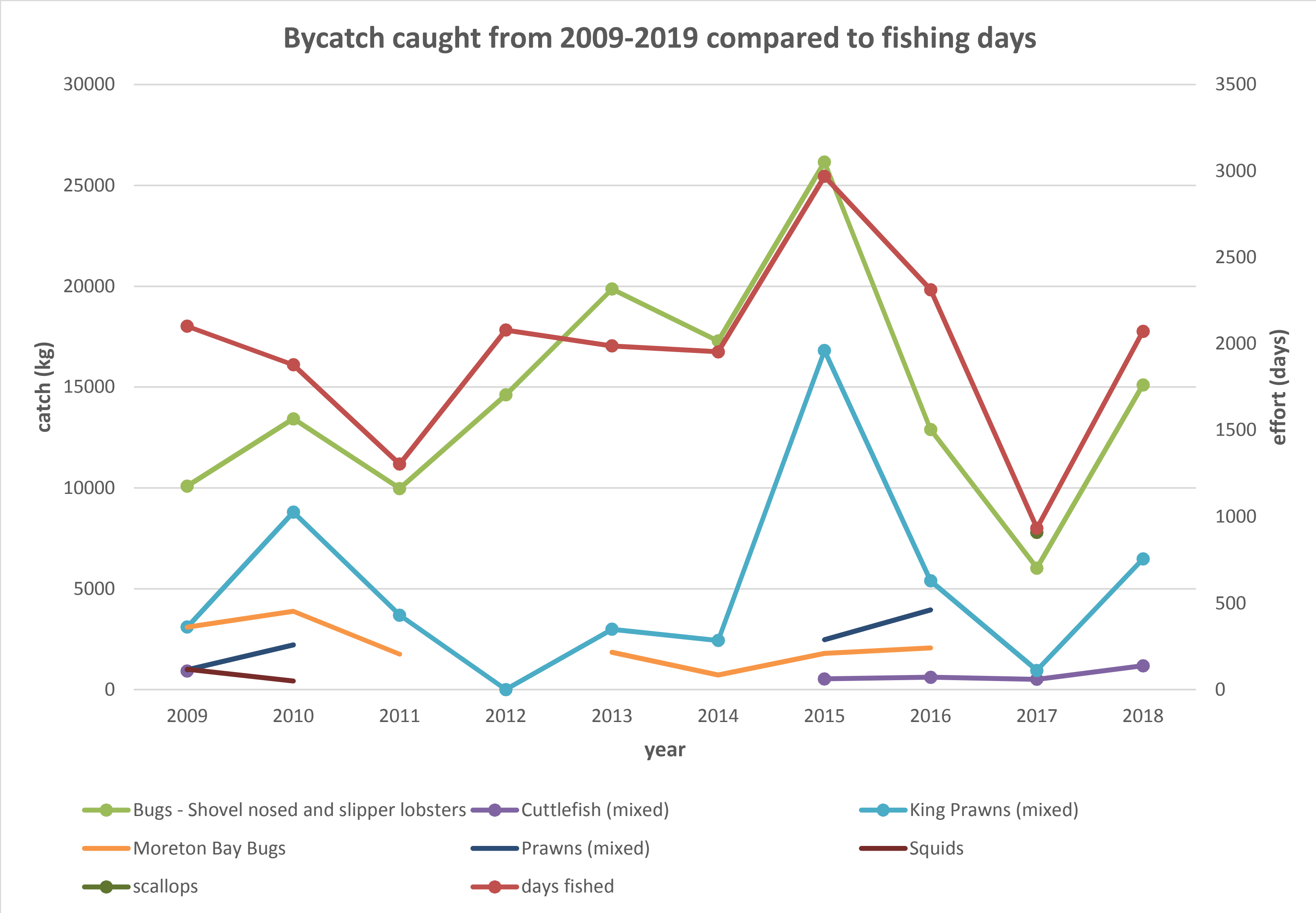


Figure 12. Logbook reported catch of major bycatch species by year for 2008-2018. Effort (days) is indicated by the red line. Single data points are for species only caught that one year.

Table 4. Threatened, Endangered and Protected Species caught (individuals) for 2008-2018. 3 animals were misreported as common sawshark and have been moved to the sawfishes category.

species	Flatback Turtle	Green Sawfish	Green Turtle	Hawksbill Turtle	Narrow Sawfish	Pacific (Olive) Ridely Turtle	Sawfishes	Seahorses & pipefishes	Seasnakes	Turtles	effort (days)
2008		1	2		1		1		1090		3477
2009	1						1		1003		2102
2010	1		2					1	1532		1879
2011									1168		1305
2012			4		1			69	1550	1	2080
2013			2		1				1204	2	1988
2014			1				1		1337	4	1954
2015			1		1				673	6	2969
2016	1			1	1		1	9	638	2	2313
2017		3					3		274	1	934
2018						1			723	1	2073
Grand Total	**3**	**4**	**12**	**1**	**5**	**1**	**4**	**79**	**11192**	**17**	

Summary

1. The 2018 season saw a return to the average (mean) catches, days fished, number of vessels and CPUE for the 2009-2018 time period. The first 4 months of 2018 had some of the highest tiger prawn CPUE to date. Although this is partly a result of only a few vessels fishing those months it also indicates a return to normal or average tiger prawn recruitment for the early part of the season. The 2018 tiger prawn CPUE from July until the end of the season was slightly below the mean and the drop in CPUE between May and July can be explained by the sudden increase in vessel numbers and fishing effort and a reducing abundance of tiger prawns as annual recruitment slows down. Comparing the last three years, 2018 had the highest annual endeavour prawn CPUE and with the exception of July to August, had the highest monthly endeavour prawn CPUE.

2. In contrast the combined low fishing effort and low tiger prawn CPUE during the early months of the 2017 season indicates a poor recruitment of tiger prawn at the start of the season. This resulted in the lowest catches since the start of unload records in 1978. The tiger prawn CPUE for the latter months of 2017 was near the mean for those months indicating a normal recruitment for the latter part of the season.

3. Historically tiger prawn CPUE was lowest when fishing effort, numbers of vessels and catch were highest (1991-2003). In addition CPUE was generally highest at the start of the season and decreased rapidly during the first few months. Since 2009 tiger prawn CPUE was double that of the high effort years and April instead of March often had the highest CPUE. This is a result of the reduction in fishing effort and vessel numbers to about $1/5^{th}$ of 1991-2003 level and a tiger prawn catch that been consistently lower, and 1/2 the Maximum Sustainable Yield for tiger prawn.

4. In contrast to tiger prawns the CPUE for endeavour prawn over that last 10 years is lower than during the years of high and declining fishing effort which is evidence for this species being more productive and hence more abundant, when fishing effort is high.

5. The decrease in endeavour prawn catch is a result of the decrease in fishing effort to 1/5th of what it was during the high effort years (1991-2003) and the halving of endeavour prawn CPUE since 2008. Endeavour prawn CPUE remained high during the years where fishing effort and endeavour prawn catch was decreasing (2003-2008). The halving of endeavour prawn CPUE occurred at the end of the decline in catch and effort.

Appendix 1 - Details by month of catches and effort since 1989

The tables below provide a summary of catch, effort and CPUE for each month of each year since 1989.

Note: Only the southern section of Torres Strait was open during March of 1989 so this data was neither presented nor used to calculate the averages displayed in the previous monthly figures.

Table 5. Tiger prawn catch in tonnes by month for the years 1989 to 2018.

year	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1989		13	173	123	64	59	43	29	25	8
1990			103	73	42	67	45	34	22	10
1991		220	65	119	108	55	43	49	31	19
1992		250	147	102	84	69	82	67	52	27
1993		92	89	63	39	54	69	36	30	15
1994		127	87	63	51	42	39	26	20	9
1995		191	119	105	72	54	44	35	19	8
1996		250	89	68	71	60	56	39	28	9
1997		175	109	90	59	55	73	69	42	22
1998		273	180	115	109	98	76	59	42	14
1999		132	90	96	73	77	62	49	34	17
2000		123	73	53	60	60	41	36	23	10
2001		136	125	87	74	64	56	46	23	10
2002		200	139	110	57	47	52	48	44	23
2003		182	133	77	62	79	72	54	35	19
2004		145	109	78	62	65	66	44	22	16
2005		194	165	96	51	31	36	44	28	10
2006		191	116	79	45	45	49	38	28	11
2007		116	126	111	59	40	46	40	31	12
2008		87	81	71	37	51	46	30	24	13
2009		81	51	44	45	28	28	30	25	7
2010		63	43	32	31	31	58	52	23	11
2011		39	16	21	28	32	38	20	7	3
2012		84	69	71	54	52	32	14	15	9
2013		99	56	60	47	49	35	30	27	15
2014		65	34	36	32	31	24	40	36	18
2015		87	80	93	65	51	72	52	39	14
2016	21	37	56	58	46	40	39	35	27	7
2017	7	8	4	10	7	6	12	23	24	10
2018	2	10	17	37	82	69	49	32	22	8

Table 6. Endeavour prawn catch in tonnes by month for the years 1989 to 2018.

Year	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1989		34	139	122	71	73	58	56	47	14
1990			66	66	35	57	65	69	53	23
1991		296	80	173	136	85	74	126	68	41
1992		225	162	117	104	81	122	125	102	63
1993		176	149	96	56	73	119	93	82	41
1994		211	213	144	111	89	99	77	49	20
1995		287	219	188	130	107	90	96	43	18
1996		246	140	96	78	84	95	85	45	23
1997		243	189	146	91	78	118	110	65	24
1998		196	164	129	121	135	106	90	85	24
1999		272	307	238	187	152	134	112	78	31
2000		287	198	136	99	102	89	94	56	18
2001		296	227	173	87	82	73	91	46	19
2002		230	172	109	66	48	63	76	67	31
2003		172	161	86	49	61	77	75	49	28
2004		121	128	98	65	74	84	67	34	18
2005		117	124	101	54	31	44	66	47	14
2006		187	177	95	51	41	40	41	32	7
2007		125	113	87	43	30	36	36	27	6
2008		87	93	71	34	34	42	33	19	6
2009		43	31	22	24	13	14	16	8	2
2010		20	14	10	7	9	23	20	6	1
2011		10	6	7	9	14	14	8	3	1
2012		15	21	23	18	17	12	5	3	2
2013		32	12	11	8	12	13	9	5	1
2014		14	7	6	8	8	8	13	9	3
2015		26	20	19	15	14	30	22	15	4
2016	2	4	4	3	5	9	12	13	4	1
2017	0	1	0	1	1	1	4	8	7	1
2018	0	1	3	4	15	16	13	14	12	3

Table 7. King prawn catch in tonnes by month for the years 1989 to 2018.

Year	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1989		3.4	6	6.2	3.1	1.5	1.4	1.5	1.7	0.6
1990			5.3	6.6	2.6	3.1	2	1.4	0.8	1.5
1991		30.3	5.4	8.7	6	4.4	3.3	4.5	4.6	2.8
1992		20.7	7.9	5.3	5.5	2.3	3.7	4	3	3
1993		12.3	6.9	5.3	2.8	3.4	4.7	1.2	1.3	0.5
1994		13.4	10.9	8.2	3.8	2.2	2.1	1.2	1	2.2
1995		9.8	6.4	5.9	2.7	2.7	1.2	1	0.8	0.1
1996		9.6	5.8	2.8	1.4	1.3	1	1.2	1.1	0.4
1997		6.5	7.3	4.2	3	1.6	2.9	2.7	3.2	3.3
1998		29.9	24.5	13.6	9.4	5.7	6.2	5.7	6.8	2.6
1999		19.6	13.3	6.1	4	3.7	3.1	3.7	4	3.3
2000		34.9	18	5.2	4.1	3.8	2	2	1.5	0.7
2001		28.1	14.3	5.9	2.4	1.3	1.7	5.4	9.7	8.4
2002		76.4	44.7	15	4.5	2.6	2.1	4.1	8.6	6.7
2003		49.7	25.2	15.2	6.6	5	4.4	5.5	8.3	6.1
2004		26.7	16.2	7.4	4.7	3.8	3.9	4.8	4.1	2.5
2005		11.8	13.5	9.9	4.6	1.4	2.3	3.5	3.3	0.8
2006		15.7	12.3	6.2	2.6	2	2.5	2.1	1.3	0.5
2007		18.8	12.1	6	3.3	2.2	2.2	1.6	1.7	1.3
2008		16.1	11.9	4.9	2.3	4.9	4.1	2.3	1.4	0.6
2009		5.2	3.7	1.8	2.3	1.2	0.6	0.7	0.7	0.1
2010		2.4	1.6	1.1	0.7	0.4	1.1	1.1	0.3	0.2
2011		0.2	0.2	0.2	1	1.2	1	0.1	0.1	0.2
2012		0.2	0.8	0.4	1.2	0.2	0	0.2	0.1	0
2013		0.2	0.3	0.5	0.2	0.3	0.3	0.4	0.2	1.3
2014		0.3	0.2	0.1	0.1	0.8	0.5	0.7	0.2	0.1
2015		0.1	0.2	0.7	1.4	0.6	3	0.7	4.1	5.9
2016	1.1	0.4	0.7	0.2	0.2	0.2	0.8	0.8	0.8	0.2
2017	0	0.1		0	0	0	0	0.1	0.4	0.2
2018				0	0.3	0.6	0.6	0.6	3.1	1.3

Table 8. Number of days recorded as fished in Torres Strait by the fleet by month for the years 1989 to 2018.

year	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1989		194	1426	1572	1068	1047	812	740	665	270
1990			956	980	513	869	810	720	537	303
1991		2477	566	1259	1526	1014	736	1060	840	505
1992		2262	1457	1375	1349	1090	1204	1172	1184	812
1993		1145	1095	993	640	826	1419	937	923	547
1994		1624	1483	1150	956	936	1149	880	720	346
1995		1652	1246	1138	966	884	827	758	478	209
1996		1754	1066	883	872	942	1061	829	727	319
1997		1725	1489	1289	1080	867	1206	1160	836	445
1998		1745	1358	1120	1108	1197	1094	1054	1033	468
1999		1433	1336	1484	1488	1343	1244	1146	948	480
2000		1945	1492	1105	1049	1154	930	1096	822	375
2001		1883	1561	1363	1191	1066	1054	1080	674	276
2002		1966	1504	1430	852	718	848	979	892	446
2003		1849	1571	1037	619	783	925	1005	778	429
2004		1160	1098	823	678	798	973	803	449	264
2005		1126	1182	914	603	386	451	615	550	185
2006		1145	877	578	358	316	356	361	304	110
2007		1022	871	703	442	342	425	431	409	184
2008		534	535	532	341	370	414	297	285	169
2009		436	299	237	284	191	194	200	202	59
2010		321	223	172	149	153	307	309	163	82
2011		199	93	112	167	204	253	170	67	40
2012		364	276	335	275	294	220	116	122	78
2013		407	222	245	185	238	186	197	181	127
2014		371	168	193	194	203	165	255	256	149
2015		331	347	435	322	271	434	356	321	152
2016	212	224	288	313	242	216	247	257	242	72
2017	71	74	30	76	56	38	83	177	225	104
2018	8	46	59	141	415	437	389	282	215	81

Table 9. Tiger prawn CPUE (kg/d) by month for the years 1989 to 2018.

year	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1989		69	128	81	64	59	55	42	41	34
1990			112	78	85	80	59	50	42	36
1991		92	120	99	74	57	61	48	40	40
1992		113	104	79	65	67	70	60	47	36
1993		82	83	65	64	68	50	40	33	31
1994		79	60	56	54	47	36	30	29	30
1995		118	98	94	77	64	56	47	42	41
1996		145	85	79	83	65	55	48	41	29
1997		104	75	71	57	65	62	61	51	51
1998		160	135	105	101	86	71	57	42	34
1999		94	68	66	50	58	51	44	37	36
2000		64	50	49	59	53	45	34	29	27
2001		73	81	65	64	61	54	44	35	37
2002		104	95	79	68	67	64	50	51	52
2003		101	86	76	101	103	80	55	47	46
2004		128	101	97	93	84	70	56	51	65
2005		176	143	107	88	84	80	73	52	56
2006		170	135	139	130	143	141	108	93	96
2007		123	148	162	140	121	112	99	83	73
2008		172	162	146	123	140	121	114	94	89
2009		189	175	190	162	153	151	153	128	116
2010		200	195	193	217	205	192	173	143	130
2011		200	178	188	168	163	152	120	108	89
2012		233	251	213	200	180	148	122	123	120
2013		251	257	250	257	213	193	156	154	119
2014		176	201	187	168	157	152	158	143	123
2015		266	232	215	205	193	170	148	125	95
2016	103	166	198	189	193	188	162	142	117	106
2017	102	109	122	138	134	168	152	135	111	93
2018	222	232	297	270	203	160	129	115	105	98

Table 10. Endeavour prawn CPUE (kg/d) by month for the years 1989 to 2018.

year	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov
1989		179	103	81	71	73	76	80	75	56
1990			72	71	72	69	84	102	103	80
1991		124	148	145	93	88	106	125	87	85
1992		102	115	90	80	79	105	112	91	81
1993		158	140	101	92	92	87	103	93	80
1994		132	148	130	119	99	90	90	71	60
1995		177	181	169	140	125	115	128	92	88
1996		143	133	114	92	91	93	105	65	75
1997		144	132	116	88	93	100	97	79	57
1998		116	124	118	112	118	101	87	84	58
1999		194	233	164	130	116	111	101	86	66
2000		150	134	126	96	90	98	89	71	49
2001		159	148	129	76	79	71	87	70	71
2002		119	118	78	79	69	77	79	78	72
2003		96	104	86	81	80	85	77	67	69
2004		106	119	123	99	95	90	86	80	73
2005		108	109	113	94	82	100	111	88	76
2006		166	207	169	147	132	116	118	106	68
2007		125	132	126	99	91	89	87	68	34
2008		168	175	136	103	94	105	114	69	35
2009		98	104	96	87	73	75	84	41	29
2010		62	65	59	53	58	75	67	36	22
2011		52	71	59	57	71	58	53	44	40
2012		43	80	71	65	60	58	48	26	24
2013		84	58	47	46	52	70	49	32	19
2014		38	41	30	40	41	53	54	36	22
2015		80	59	45	43	54	70	63	47	28
2016	14	19	19	15	27	46	49	53	21	12
2017	7	17	16	13	20	39	54	45	32	16
2018	11	25	44	32	39	38	34	52	59	39

Australian Government
Australian Fisheries Management Authority

AFMA 2019 Moon phase calendar

Full moon · First quarter · New moon · Third quarter

JANUARY

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

FEBRUARY

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28		

MARCH

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30
31						

APRIL

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30				

MAY

Su	Mo	Tu	We	Th	Fr	Sa
			1	2	3	4
5	6	7	8	9	10	11
12	13	14	15	16	17	18
19	20	21	22	23	24	25
26	27	28	29	30	31	

JUNE

Su	Mo	Tu	We	Th	Fr	Sa
						1
2	3	4	5	6	7	8
9	10	11	12	13	14	15
16	17	18	19	20	21	22
23	24	25	26	27	28	29
30						

JULY

Su	Mo	Tu	We	Th	Fr	Sa
	1	2	3	4	5	6
7	8	9	10	11	12	13
14	15	16	17	18	19	20
21	22	23	24	25	26	27
28	29	30	31			

AUGUST

Su	Mo	Tu	We	Th	Fr	Sa
				1	2	3
4	5	6	7	8	9	10
11	12	13	14	15	16	17
18	19	20	21	22	23	24
25	26	27	28	29	30	31

SEPTEMBER

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30					

OCTOBER

Su	Mo	Tu	We	Th	Fr	Sa
		1	2	3	4	5
6	7	8	9	10	11	12
13	14	15	16	17	18	19
20	21	22	23	24	25	26
27	28	29	30	31		

NOVEMBER

Su	Mo	Tu	We	Th	Fr	Sa
					1	2
3	4	5	6	7	8	9
10	11	12	13	14	15	16
17	18	19	20	21	22	23
24	25	26	27	28	29	30

DECEMBER

Su	Mo	Tu	We	Th	Fr	Sa
1	2	3	4	5	6	7
8	9	10	11	12	13	14
15	16	17	18	19	20	21
22	23	24	25	26	27	28
29	30	31				

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