An investigation into methods to calculate effort controls in a multi-species fishery: northern and central Queensland otter trawl case study using data from 2017 to 2021

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Queensland Government

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Summary

This report investigated how to combine multiple species, with and without stock assessments, into regional trawl effort caps. This was in the form of effort units (EU) for the northern and central regions of the Queensland east coast otter trawl fishery.

Variations in methods (detailed or ratio), spatial inshore and offshore stratifications (filtered or allocated divisions within a region), co-caught adjustments (species proportions from effort or catch data) and different species inclusions were investigated. These comparisons resulted in 64 different effort cap calculations per region. The calculations used data from 2017 to 2021 and stock assessment results from 2023 (Lovett et al. (2023), Fox et al. (2023) and Wickens et al. (2023)).

Some of the 64 effort cap calculations were above, and some were below, the current 2024 effort caps. Considerations are needed to mitigate exceeding species-specific target reference points, to maintain or improve average catch rates per boat-day for economic profit, and to limit bycatch.

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Glossary

CSIRO	Commonwealth Scientific and Industrial Research Organisation
ECOTF	East Coast Otter Trawl Fishery
EU	Effort unit
EUCF	Effort unit conversion factor (also referred to as SHU)
HU	Hull unit
MEY	Maximum economic yield—The harvest and effort that allows maximum profit from a species or group of species. The SFS generally equated MEY to 60% virgin biomass as a proxy for MEY
MSY	Maximum sustainable yield—the maximum level at which the species can be routinely exploited without long-term depletion
RBC	Recommended biological catch—the total annual harvest that can be taken by fishing, while achieving the target management objectives for the fishery
SFS	Sustainable Fisheries Strategy, by the Queensland Government
SHU	Standardised hull unit (also referred to as EUCF)
SOI	Southern Oscillation Index
VMS	Vessel monitoring system

1 Introduction

The effects of fishing upon a stock can be determined using demographic analyses such as fishery stock assessments (Methot et al. 2013). Traditionally, fisheries management have considered stock assessments with focus on a single species or stock. Nowadays, stock assessments are being conducted more frequently and for an increasing number of species.

More stock assessments can present new opportunities for management, to achieve target reference points for multi-species fisheries. A multi-species fishery is where different sectors or operations can retain many species from deploying their fishing gear and effort.

The East Coast Otter Trawl Fishery (ECOTF) is a large multi-species fishery in Queensland, Australia. For the 2020-2021 financial year, the ECOTF caught 5992 tonnes of product from many species. The catch for the 2020-2021 financial year totalled approximately $117.3 million in gross value of production (GVP) (EconSearch 2022).

The ECOTF uses otter trawl nets to target prawn (family *Penaeidae*), scallop (family *Pectinidae*) and bug (family *Scyllaridae*) species. The multi-species nature of this fishery is complex, with species abundances and distributions varying both latitudinally (long-shelf, along the coast) and longitudinally (cross-shelf, inshore to deeper offshore waters). In recognition of this complexity, the ECOTF was broken up into five management regions, including the northern, central, southern inshore, southern offshore and Moreton Bay trawl regions (2.1).

Stock assessment has mainly focused on key primary species. In the northern management region of the ECOTF, tiger prawns (*Penaeus esculentus* and *Penaeus semisulcatus*) are the focal target and therefore have been the main species assessed (Wang 2015). In the central management region, while tiger prawns are also a target, there are other species targeted including red spot king prawns (*Melicertus longistylus*), Moreton Bay bugs (*Thenus australiensis* and *Thenus parindicus*) and previously scallops (*Ylistrum balloti*).

An additional intricacy of the ECOTF, was that catch-quota output controls were not used, but rather input controls using effort caps for each management region in the form of effort units (EU). In 2001, effort units were introduced based on vessels fishing days and effort unit conversion factors (EUCF, also known as standardised hull unit SHU) as the principle means of limiting fishing effort and effort creep (O'Neill et al. 2006).

In 2023, stock assessment results were available for ECOTF species such as tiger prawns (*Penaeus esculentus* and *Penaeus semisulcatus*) (Lovett et al. 2023), endeavour prawns (*Metapenaeus endeavouri* and *Metapenaeus ensis*) (Fox et al. 2023) and sand bugs (*Thenus australiensis*) (Wickens et al. 2023). These concurrent stock assessments provide information to consider multi-species harvest strategies and effort unit responses.

To calculate effort units per management region, methods must consider the fact that many species are co-caught together in the same trawls. One way to account for this was to combine multiple species with and without stock assessment results within a management region, accounting for co-caught species overlaps, into a single key output that can be converted to effort (i.e. the effort unit cap).

Therefore, the aims of this report were to investigate how to combine a range of species with and without stock assessments into a single management output (effort cap) in the form of effort units (EU) for the northern and central regions of the ECOTF (Figure 2.1). Findings highlighted important regional differences and decisions for species hierarchies/dominance.

2 Methods

2.1 Trawl management regions

The ECOTF is currently managed with effort caps in five regions. From north to south, these include the northern, central, southern inshore, southern offshore, and Moreton Bay trawl regions (Figure 2.1). The report focus, for effort calculations, was on the northern and central regions.

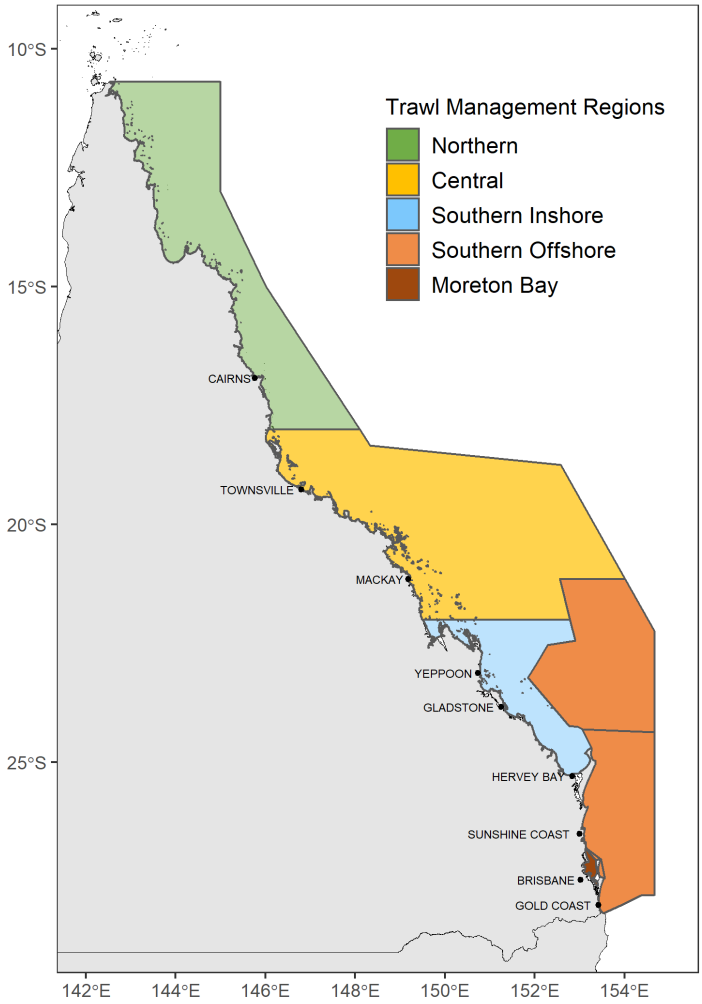

Figure 2.1: Management regions of the East Coast Otter Trawl Fishery

2.2 Current effort management of the fishery

Effort units are an important component of the overall management strategy in the ECOTF (Queensland Government 2021b). For each day of fishing by a vessel in a region, its EUCF (for the vessel size) is deducted from the regional effort unit cap (regardless of the hours fished). Vessel owners need to own sufficient effort units for their fishing aspirations in each region per year. For a detailed description of how effort unit usage is calculated, see Appendix A.

Currently, in the ECOTF there is an excess allocation of effort units when compared to the effort cap. Simply, this means there are more effort units available to fishers than the effort cap permits for use in that management region. This can create competition and a 'race to fish'. In recent times, the effort cap has not been reached for either the northern or central trawl regions with a significant amount of effort units remaining unused at the end of the season (Table 2.1).

Effort units are management region specific. For example, northern effort units cannot be used in the central zone. Vessel owners must acquire effort units for the regions they trawl, particularly if they wished to fish a different region more (e.g. if a 'bad year' occurs in their home region). This further adds to the competitive tally of effort units. See Table 2.1 for a summary of effort unit usage for the northern and central trawl regions in 2022 and 2023.

Table 2.1: Northern and central trawl region effort unit allocation and usage for 2022 and 2023. Data sourced from FishNet Public.

Year	Region	Unit allocation	Unit usage	% Unit usage
2022	Northern region	418657	214822	51.31%
	Central region	500711	283561	56.63%
2023	Northern region	250178	205659	82.21%
	Central region	318584	247403	77.66%

The fleet size of the ECOTF has reduced through time. In 1980, there were more than 1400 otter trawl licences operating on the east coast of Queensland (O'Neill et al. 2004). In 2023, 252 otter trawl licences were active (Figure 2.2).

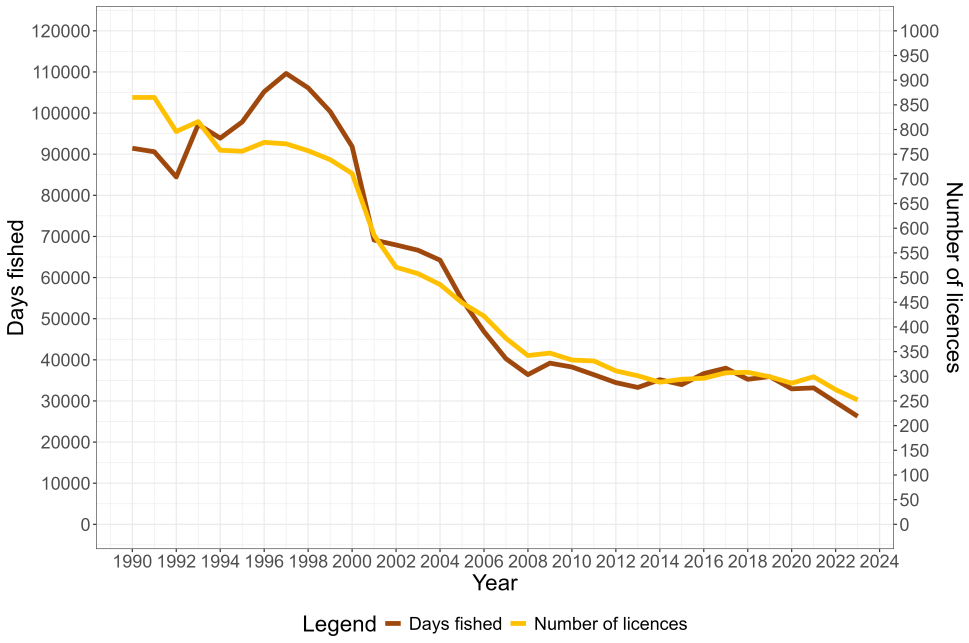

Figure 2.2: Summary of the numbers of licences and days fished for the ECOTF between 1990 and 2023. Data taken from Queensland Government (2023).

2.3 Effort calculations

Four main steps were needed to calculate a multi-species effort cap for the northern and central regions (2.3).

Step 1, the recommended biological catch (RBC) from stock assessments was calculated (Figure 2.3). The RBC is the recommended catch to maintain the stock at 60% biomass (B60), when the stock is at B60. If no stock assessment was available for a given species, the average catch from commercial logbooks from 2017 to 2021 was used in place of an RBC. The RBCs used can be found in Table B.1 of Appendix B.

Step 2, the RBCs were split between the northern and central trawl regions (Figure 2.3). For tiger prawns, a prescribed split of 70/30 was used as per the northern and central harvest strategies. For the remainder of the species, commercial logbook data was used to calculate the average catch split between the northern and central regions between 2017 and 2021. The northern and central catch shares used to split the RBCs can be found in Table B.2 of Appendix B.

Step 3, the regional RBCs (i.e. catch) were converted to effort units (Figure 2.3). Converting the regional RBCs to effort units was done by dividing the northern and central RBCs for each species, by their respective catch rates per effort unit for that region and species. A table of the region- and species-specific catch rates per effort unit and resulting un-adjusted effort units for each species in each region can be found in Tables B.5 and B.6 of Appendix B.

Step 4, the un-adjusted effort units were multiplied by the relevant co-caught adjustments to give the adjusted effort units for each species in each region (Figure 2.3). These adjusted effort units were then added for the total effort unit cap for the region. Tables C.1-C.16 and D.1-D.16 in Appendices C and D display the un-adjusted effort units, co-caught adjustments, and adjusted effort units for the various methods trialled as described below.

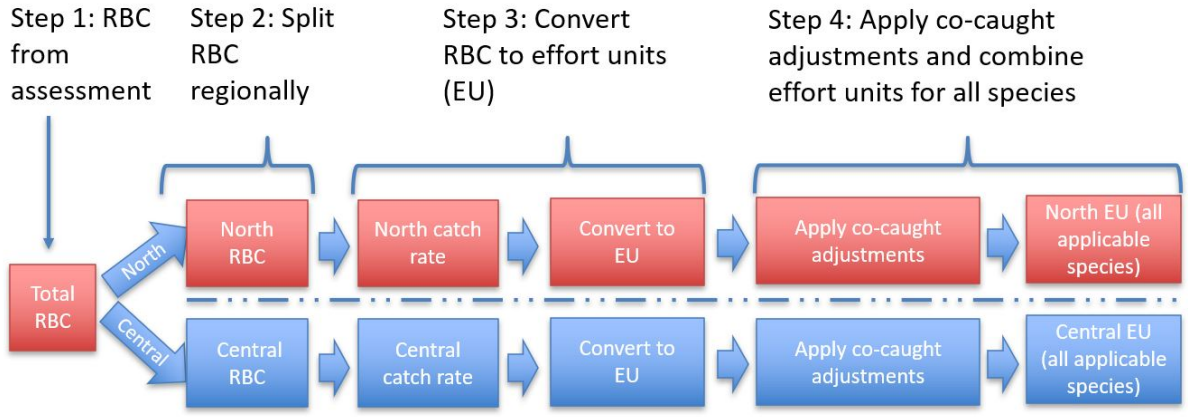

Figure 2.3: Schematic displaying the steps required to calculate a single multi-species effort cap from stock assessment RBCs.

Effort calculations varied in the use of stock assessment results, spatial division, target species definition and treatment of secondary species. For both the northern and central regions, 64 calculations were compared to estimate effort unit caps (Figure 2.4). The 64 approaches considered 2 **methods** × 2 within region **spatial** divides × 2 **target** adjustments × 8 possible **species** inclusions:

1. **Method:**
    a) Detailed – species by species calculations. The detailed method used all stock assessments and substituted logbook information (average of 2017–2021) for species without stock assessments.

b) Ratio – used stock assessment results only from the key species and proportionally related key species effort to infer other species effort.

2. **Spatial:** Inshore verse offshore divide within a region:
   a) Filtered – all records that did not contain tiger prawns were classed as offshore whilst all records that did not contain red spot king were classed as inshore.
   b) Allocated – used landings value (AUD) to allocate. Simply, the records where inshore species landings were higher valued were classed as inshore. Conversely, the records where offshore species landings were more valued were classed as offshore.
3. **Target:** species co-caught adjustment, for species targeting and to avoid double counting:
   a) Effort – species fractions were based on assigning days of fishing to a single target species. This method gives higher importance to the primary species such as tiger prawns.
   b) Catch – species fractions were based on the average percent contribution in the value of the harvest (AUD). This subtracted some importance from the primary species (e.g. tiger prawns) and added to the secondary species (e.g. endeavour prawns).
4. **Species:** Species to include, on top of the primaries:
   - Eight possible species combinations. The base combination used the two key species for the inshore component of the fishery (i.e. tiger and endeavour prawns) and two species for the offshore component of the fishery (i.e. red spot king prawns and sand bugs). Further considerations of mud bug, blue-leg king prawn and banana prawns were tallied.

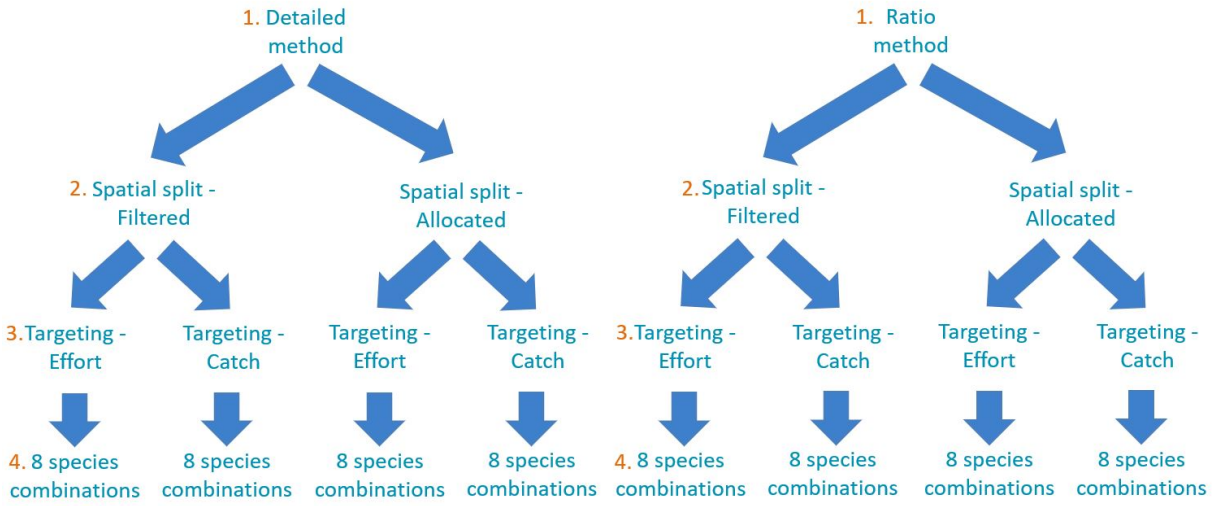

Figure 2.4: Schematic of the 64 effort unit calculations.

If implemented, this work can be re-calculated in future as new information becomes available. RBCs can be updated or added (detailed method only) as stock assessments are updated or new assessments (detailed method only) for new species are completed (step 1). For species without stock assessments, the period of time used to calculated the average annual logbook catch (in place of an RBC) could be updated as new logbook data becomes available (step 1) as well as regional catch shares (step 2). Additionally, updated stock assessments would also provide updated standardised catch rates to be input in step 3. More recent logbook information in conjunction with updated price information could be used to re-calculate the inshore offshore spatial split and species co-caught adjustments (step 4). Price information would be best sourced from industry and could be specific to each year and month.

2.4 Detailed methodology

Note that the variables outlined here are investigative only and when the methodology is applied for fishery management purposes their suitability needs to be carefully considered.

The detailed method used information from each species. This included the stock assessment estimates of the recommended biological catch (RBC) and catch rates for tiger prawns (Lovett et al. 2023), endeavour prawns (Fox et al. 2023) and sand bugs (Wickens et al. 2023). For species without stock assessments, average catch and catch rates were used from 2017–2021 logbook data. The averaging was done for banana prawns, blue leg king prawns, red spot king prawns and mud bugs, to infer their RBC.

The detailed method considered:

- **Species-specific RBC:** A target RBC (kg per month) for each species,
- **Species- and region-specific RBC:** Shares to allocate the species-RBC among the relevant trawl regions,
- **Non-additive effort units:** Converting the species- and region-specific RBC to effort units, and finally,
- **Additive effort units:** Applying the species co-caught adjustment, to enable effort units to be tallied across species to give an estimate of the effort unit cap per region.

For this report, the target RBC was B_{60} (i.e. 60% of virgin biomass). B_{60} was the default sustainable population biomass target (Queensland Government 2021b, Queensland Government 2021a and Queensland Government 2017).

It is important to note that the species- specific RBC estimates related to stock range of the species. In the case of tiger, endeavour, red spot king, blue leg king and banana prawns, the stocks and RBCs were relevant between 10.5 ° S to 22 ° S (i.e. northern and central trawl regions). For sand bugs, the RBC was relevant between 10.5 ° S to 26 ° S. For mud bugs, the stock included all trawl regions (from 10.5 ° S down to 28 ° S).

After the monthly species-specific RBC were calculated, from either stock assessment outputs or logbook data, they were allocated into their relevant trawl regions (species- and region-specific RBC). Allocations were based on average regional catch shares between 2017–2021. For tiger prawns, however, the northern and central trawl region harvest strategies prescribed a 70/30 split between the northern and central zones (Queensland Government 2021b, Queensland Government 2021a).

Next, the monthly species- and region-specific RBCs were converted into effort units. This was calculated by dividing the species- and region-specific RBCs by their monthly catch rate per effort unit for an average vessel targeting each species between 2017 and 2021 (see Appendix for more information on defining a standard vessel). It is important to note here that the resulting effort units required to catch the RBC for that given species and region were non-additive – as these effort units assumed each species was a spatially separate stock (i.e. no spatial overlap). Assuming each species was a separate stock was not valid as many species were co-caught in trawls. This co-caught issue was addressed by region-specific co-caught adjustments. The adjustments aimed to account for species spatial overlaps.

To simplify species co-caught adjustment calculations, the regions were first stratified into inshore and offshore divisions. As noted above, two spatial divisions were compared:

- The “filtered” division assigned effort units as inshore or offshore using an exclusion principle. Given the general spatial separation between tiger and red spot king prawns, inshore was defined by filtering out of records that contained (i.e. presence only) red spot king prawns in the catch. Offshore was the inverse, by simply filtering out any records that contained tiger prawns. An exclusion rule rather than an inclusion rule was used as data would likely be missed using an inclusion rule.
- The “allocated” division assigned effort units as inshore or offshore based on species value. Value was the monetary worth of each species ($/kg) multiplied by the kilograms in the catch. Inshore was allocated where tiger, endeavour, blue leg or banana prawns were the highest value. Offshore was where red spot king prawns or sand bugs had the highest value.

Price information was taken from BDO EconSearch (2020) specific to each of the trawl species (see Table 2.2 for a summary of price information used).

Table 2.2: Price information used to estimate catch value by species.

Species	Price per kg
Tiger	$15.33
Endeavour	$9.75
Mud bug	$24.87
Red spot king	$17.77
Sand bug	$24.87
Blue leg king	$17.68
Banana	$11.00

After the inshore and offshore divisions, the species co-caught adjustments were applied. Two adjustments were compared, effort targeting and catch targeting. Both methods utilised daily logbook records per vessel from 2017 to 2021 to calculate species co-caught adjustments.

The effort targeting method assigned vessel nights to the species with the highest value. Therefore, each vessel night of fishing in the inshore or offshore divisions, had a single target-species assigned. Once a target species was assigned, all other species in the catch were ignored. Effort targets were tallied to calculate species proportions relative to the primary, that accounted for being co-caught. The effort targeting method tended to apportion more importance to the primary species and less to secondary species. When applying the effort targeting all secondary species must be co-caught adjusted, but not the primary species. Therefore, the proportions were relative to one, for the primary inshore and primary offshore species.

Should two species have an equal highest value on the same night of fishing, an order of importance was used. The order of importance for inshore species from most to least important was tiger prawns (primary), endeavour prawns, blue leg king prawns, banana prawns and mud bugs for both the northern and central inshore areas (when all species were included). For northern offshore, red spot king was considered primary and more important than sand bugs. For offshore central, sand bugs were considered primary and more important than red spot kings. Changing the order of importance for species had little effect on results.

The catch targeting method calculated target proportions for each species, that sum to one. From the total catch value for the inshore or offshore vessel night, the proportion worth by species was calculated.

An average (i.e. mean proportion contributing to the catch per species between 2017 and 2021) defined the species fractions, that accounted for being co-caught.

The catch targeting method used a percentage-value-contribution method to consider all species, rather than just the most valuable. The catch targeting method shared the importance, still mainly with primary species, but more so with secondary species. Therefore, when applying the catch targeting method, all species must be co-caught adjusted including the primary species, as the importance of all species were calculated.

In using the species co-caught adjustments, the species- and regional-specific RBC effort units were multiplied by their respective proportions (i.e. species co-caught adjustments). The adjusted effort units were now additive over species, and inshore and offshore, to estimate the effort cap in each region.

2.5 Ratio methodology

The ratio method was a simpler alternative. The number of calculations was less and only relied on RBCs for the primary species.

The method used species proportions (i.e. co-caught adjustments) to scale the primary effort units up for secondary species. The species proportions were then used as a ratio to add in fractions of effort for secondary species not co-caught, relative to the primary. Effort units were tallied up for all species to give an estimate of the effort unit cap for the northern and central regions.

The calculations of species- and region-specific RBCs for each primary species and converting to effort units were as for the detailed method. However, the handling of effort targeting or catch targeting methods differed.

For the effort targeting method, the species co-caught adjustments (i.e. proportions) were re-scaled so that the relevant primary inshore and offshore species were equal to one. This was done by dividing all species proportions by their associated primary species (i.e. either inshore or offshore). For instance:

- In the northern region, inshore species proportions were divided by tiger prawn, whilst the offshore species proportions were divided by red spot king prawn.
- In the central region, inshore species proportions were divided by tiger prawn, whilst the offshore species proportions were divided by sand bug.

After the effort targeting re-scaling, the effort units for the primary species were multiplied by the species proportions (i.e. co-caught adjustments). The inshore and offshore totals were then tallied for total effort units within each region.

The catch targeting method just tallied the primary species effort units from inshore and offshore. Therefore, the allocation of species importance or dominance was important. In application, the catch targeting species proportions were not scalable and just deducted and added proportions back to re-tally the original primary effort units. The catch targeting process is applicable for tallying primary species only.

2.6 Species combinations

Although the northern and central trawl regions neighbour each other spatially, their species compositions differ. In the northern region, trawling was mainly focused on tiger prawns. Secondary species in the harvest strategy were considered lesser components of the total catch. However, in the central

region, more species were targeted including tiger prawns, red spot king prawns, and sand bugs, but also other species such as blue leg king and banana prawns in years of strong abundance.

Therefore, a base set of commonly targeted species was created with different combinations of species subsequently added in order of importance. This allowed testing of adding more species into the effort unit cap calculations.

For the base set of species, tiger and endeavour prawns were used for the inshore component of the fishery, whilst red spot king prawns and sand bugs were used for the offshore component of the fishery. It is important to note that further variations of species inclusion focused only on the inshore component of the fishery. This included adding mud bugs, banana prawns and blue leg king prawns as well as different combinations of these species. See Table 2.3 for the combinations trialed.

Table 2.3: Different species combinations used to calculate trawl effort.

Combination	Species
Base	Tiger, endeavour, red spot king, sand bug
Base + MB	Tiger, endeavour, red spot king, sand bug, mud bug
Base + BLK	Tiger, endeavour, red spot king, sand bug, blue leg king
Base + BAN	Tiger, endeavour, red spot king, sand bug, banana
Base + BLK + MB	Tiger, endeavour, red spot king, sand bug, blue leg king, mud bug
Base + BLK + BAN	Tiger, endeavour, red spot king, sand bug, blue leg king, banana
Base + BAN + MB	Tiger, endeavour, red spot king, sand bug, banana, mud bug
Base + BLK + BAN + MB	Tiger, endeavour, red spot king, sand bug, blue leg king, banana, mud bug

Note, scallops were not included. If targeted scallop fishing restarted in the central region, then a suitable RBC and catch rate is needed for calculations. Changes to species proportions also may not yield different effort (i.e. adding one species at expensive for another). Changes in effort should scallop be included, would likely arise from differing amounts of effort units prior to species co-caught adjustments being applied.

3 Results

3.1 Northern region

The trawl effort cap for the northern trawl region in 2024 was 250 178 effort units. Effort unit calculation results were both above and below the 2024 cap (Figure 3.1).

The similarity in results, between the detailed methods 1–2 and ratio methods 5–6, was due to the effort being mostly associated with tiger prawns in the northern region. For the north, both methods likewise hinged off the importance of tiger prawns.

Alternate spatial divides (filtered or allocated) had little effect on results. Including additional secondary species contributed insignificant changes in effort units.

Higher estimates occurred when more importance was placed on secondary species, and less on the primary species. This was shown for endeavour prawns by using catch targeting with the detailed method (approaches 3 and 4, Figure 3.1). In these calculations, endeavour prawns had a large RBC with lower catch rates, producing more effort units to associated with endeavour prawns compared to targeting tiger prawns.

Approaches 7–8 produced the lowest results. They were marginally under the 2024 effort cap. These calculations considered adding only the primary inshore (tiger prawn) and offshore (red spot king prawn) species. Approaches 7–8 mitigated inflation risks from over applying secondary species.

Tabulated calculations for Figure 3.1 are in Appendix B and C.

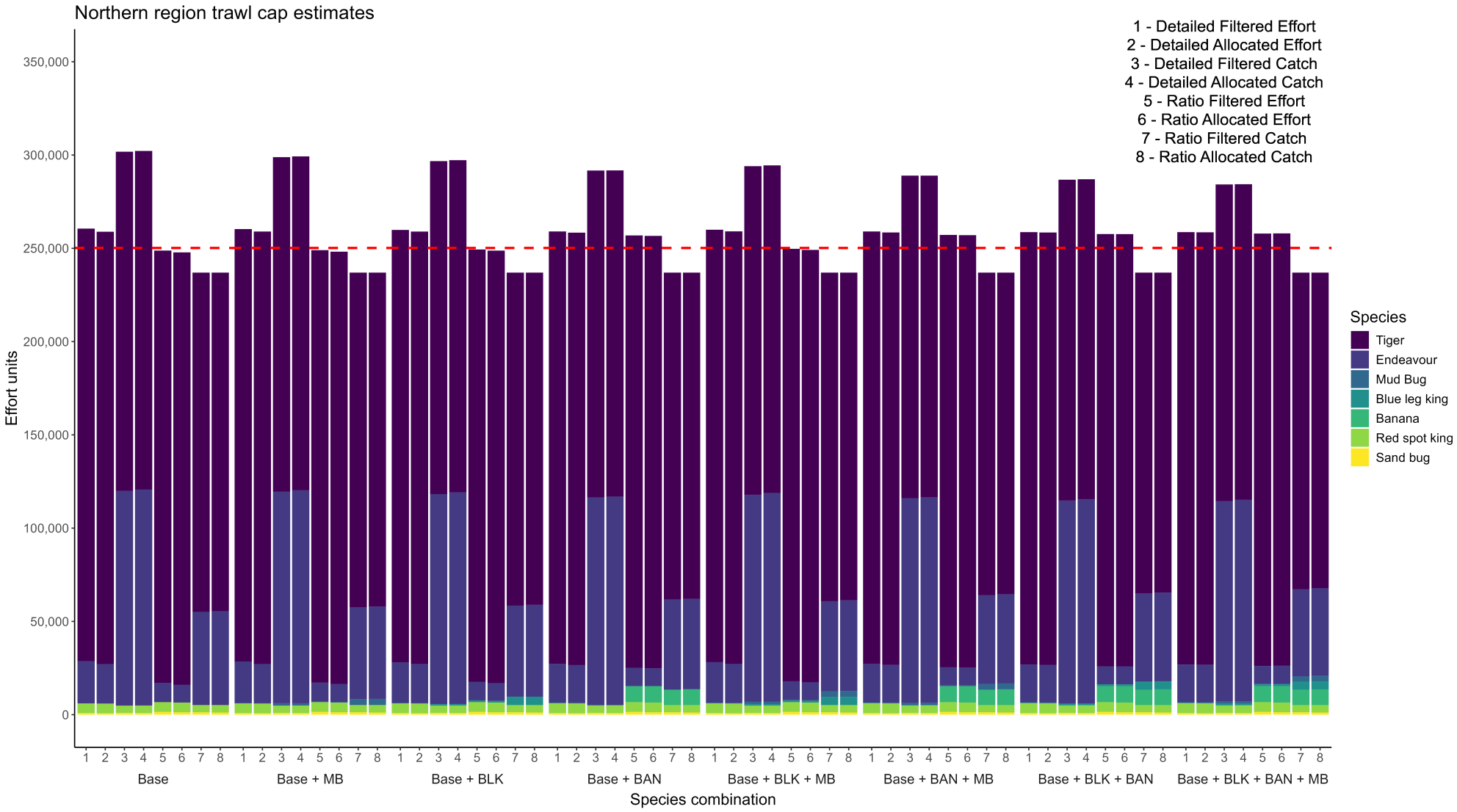

Figure 3.1: Summary of trawl effort cap by method and species for the northern trawl region. Dashed red line indicated current enforced effort cap for 2024. Base species combination - tiger prawns, endeavour prawns, red spot king prawns and sand bug, MB - mud bug, BLK - blue leg king prawn, BAN - banana prawn. Colours represent the contribution of each species to the total effort unit estimate.

3.2 Central region

The trawl effort cap for the central trawl region in 2024 was 318 584 effort units. Effort unit results varied around this cap (Figure 3.2). The mixture of species and their adjustments (effort or catch targeting) produced different results. In addition, for the ratio method, the importance ascribed first to either sand bug or red spot king in the offshore component was influential; sand bug was chosen based on its higher catch value.

Consequently, by choosing sand bug first, the ratio results fluctuated higher (approaches 5–6). Results fluctuated because a single species was not clearly dominant offshore. The ratio method worked best when a single species had strong occurrence. Red spot king (RSK) effort units appeared higher by associating effort to sand bug effort first (yellow bars for RSK, ratio results 5–6, Figure 3.2). RSK effort was inflated relative to sand bug by the high adjusted ratio (e.g. proportion approximately 0.5, Table C.9, Appendix D).

Ratio results from methods 5–6 might be less reliable in this region. However, results 7–8 mitigated the RSK inflation to only tally the primary tiger prawns and sand bugs to produce an effort unit total near the current 2024 cap (Figure 3.2).

For the detailed methods 1 and 2, with effort targeting, importance was mostly on the primary species sand bug. Sand bug had a large RBC and low catch rate, and this produced a higher effort unit total for the central region. In comparison, the detailed methods 3–4, with catch targeting, shared more importance with red spot king prawns over sand bugs. Methods 3-4 calculations lowered the effort unit cap.

Alternate spatial divides for splitting data into the inshore and offshore components had small effect on results. Including additional secondary species contributed little to effort units.

Tabulated calculations for Figure 3.2 are in Appendix B and D.

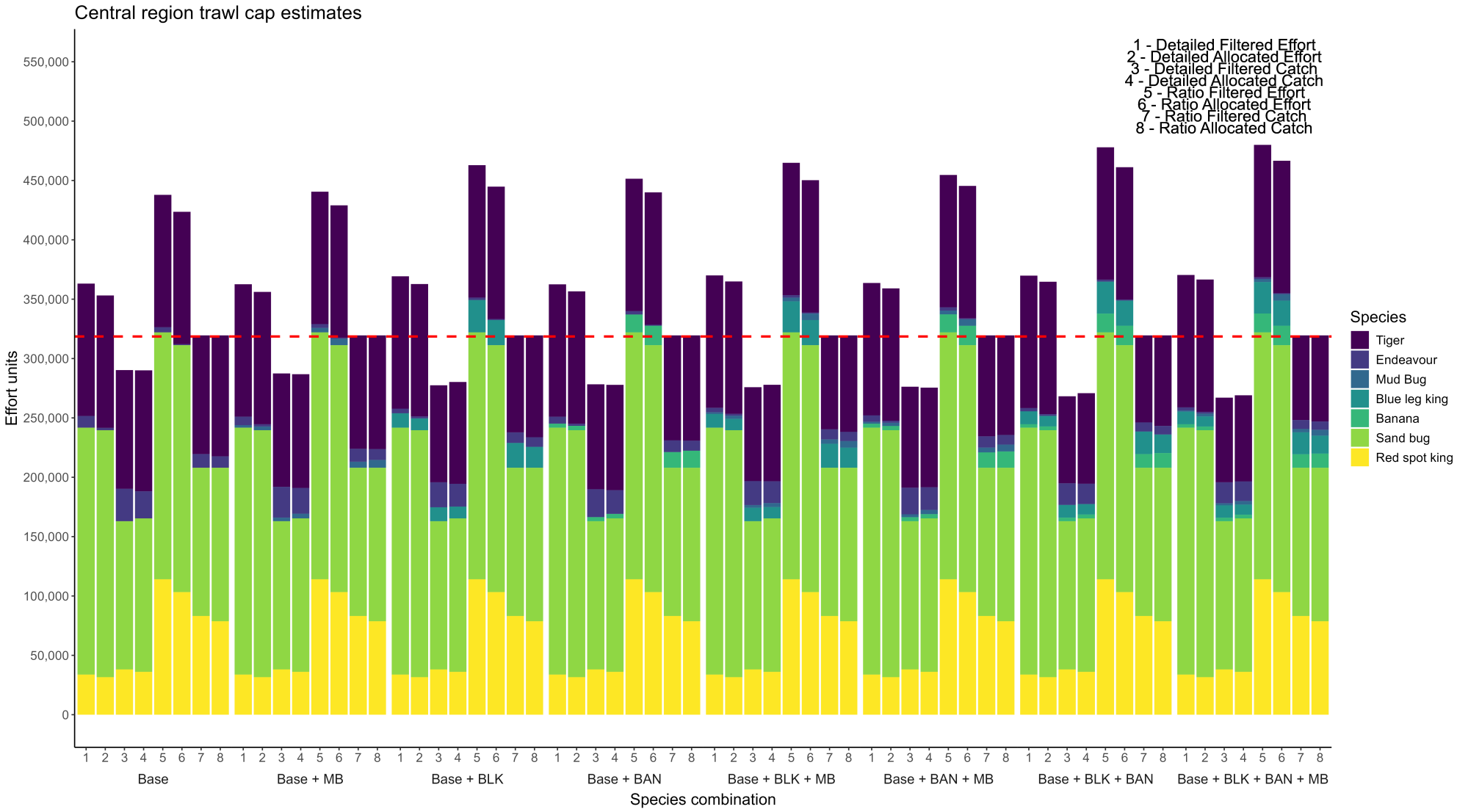

Figure 3.2: Summary of trawl effort cap by method and species for the central trawl region. Dashed red line indicated current enforced effort cap for 2024. Base species combination - tiger prawns, endeavour prawns, red spot king prawns and sand bug, MB - mud bug, BLK - blue leg king prawn, BAN - banana prawn. Colours represent the contribution of each species to the total effort unit estimate.

4 Discussion

Several caveats must be considered with this work. Foremost, this work calculated species combined effort caps for the northern and central trawl regions. Each region was inclusive of several possible species (i.e. tiger, endeavour, mud bug, banana, blue leg king, red spot king and sand bugs). However, the extent of combining species needs to consider the overfishing risk on individual species and their target reference points. Overfishing can arise when expended effort units exceed the species-specific target-limits. Real-time VMS monitoring of the spatial separation of effort (i.e. inshore, and offshore), with trigger reference points, could prevent excess effort on a single species.

Excess effort on a single species could also arise through fluctuations in abundance for different species at different times. For example, early conditions for prawn recruitment could be ideal, whilst the same conditions for bugs could be suboptimal. Results herein assumed species proportions based on the logbook average from 2017 to 2021. Differences from the average primary species proportions (for the highest value species) could flag that lower effort units are needed for better catch rates and profitability. To prevent excess effort on a single species, a mitigation approach is to consider $B_{MEY} \geq B_{60}$, given the high operating costs of otter trawling, and application of an uncertainty adjustment (Queensland Government 2021b and Ralston et al. 2011).

Also, fluctuations in environmental conditions can occur in cycles of years (i.e. such as El Nino and La Nina), with bias towards one climatic pattern. According to the Bureau of Meteorology (BOM), the period between 2017 and 2021 had a mostly neutral Southern Oscillation Index (SOI), likely acting as a good climatic average. The period between 2021 and 2023 was mostly positive (i.e. La Nina). Therefore, if future updates to these calculations are made, then results might be biased towards La Nina conditions. Use of longer/different periods of averaging data may overcome this potential issue of cyclic climatic conditions.

Other caveats relate to the use of commercial logbook data. Firstly, as blue leg king prawns, banana prawns, red spot king prawns and mud bugs did not have stock assessment RBC results, the average catch between 2017 and 2021 was substituted in place of an RBC. Although these species have been otter trawled for over 40 years, an RBC from a working stock assessment may be more defensible to identify profitability for these other species.

The filtered spatial division relied on logbook data of two key species. Tiger prawns and red spot king prawns were generally considered to be inshore and offshore species, respectively. These characteristics were then used to stratify effort into inshore and offshore components. Despite less than 3% of records in the northern and central containing both tiger and red spot king prawns, these records would be excluded for species proportions completely. Additionally, records that did not contain either tiger or red spot king prawns would have been included in both inshore and offshore calculations (i.e. included twice). This caveat suggested the allocated spatial division might be the more accurate of the two techniques.

In general, running costs for otter trawlers can be high with significant diesel fuel usage per night. Consequently, B_{60} (i.e. the SFS proxy for maximum economic yield; Queensland Government 2017) was potentially below B_{MEY}; this was found previously for tiger prawns and eastern king prawns (Heliodonoitis et al. 2020, Pascoe et al. 2014, Dichmont et al. 2008) . Maintaining profitability is often associated with

higher catch rates of primary species. The addition of effort units beyond primary species might promote late season effort.

Secondary species might still be targeted by some vessels, but they largely act to supplement the trawl nights income from the primary species. Consequently, the logbook catch rates (i.e. used to convert the RBC to effort units) for secondary species were likely lower than if they were targeted as a primary species. Lower catch rates than if targeted, can produce large amounts of effort as the RBC was filled at a slower rate. Generally, after the species co-caught adjustments (i.e. proportions) were applied, little effort was allocated to secondary species. The impact of using secondary species catch rates needs to be cautioned.

Precaution should also be placed on the use of the ratio method (i.e. approached 5–8). The ratio method utilised only stock assessments for primary species. Further, red spot king prawns are the primary offshore species in the northern region but did not have a stock assessment RBC result to use. Therefore, the ratio method for RSK in the northern offshore region was based on logbook data (i.e. average logbook catches in place of RBC) and the inferred RBC might not be exact.

In conclusion, this report produced 64 effort-cap options for the northern and central trawl regions. The results investigated variations in methods, spatial inshore and offshore splits, targeting using species co-caught adjustments (i.e. proportions) and species combinations. The work was requested for the purposes of effort unit fishery management.

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Appendix A Effort unit conversion factor

A.1 Calculations for each vessel

Effort units were introduced in the ECOTF to standardise effort usage between small and large boats. Two pieces of information were needed to calculate the effort unit usage of a vessel, this included the hull unit of the vessel and the effort unit conversion factor (EUCF). In other words, the size of the boat needed to be calculated in a consistent way in addition to understanding how the fishing ability of a vessel changed with size. EUCF are also referred to as standardised hull units (SHU), but from here on the term EUCF is used.

A.1.1 Hull units

Hull units (HU) measure the size of vessels.

Hull units are defined as the under deck volume of the vessel (QECTMP 2001):

$$HU = \frac{\text{length} \times \text{beam} \times \text{depth} \times 0.6}{2.83}$$

This formula is cited from .

Alongside the requirement for vessels to be less than 20 m in overall length, management also prohibited vessels to be larger than 120 hull units, limiting the beam and depth of vessels.

A database of hull unit information for each trawl vessel was constructed. The hull unit information was pulled and combined from the LogEffort.OperationEffortView, Authority.HistoryView and Authority.BoatHistoryView tables of the Queensland Fisheries DME database. This information included the authority chain number (ACN) and boat mark as well as the start and end date of the hull unit attached to each ACN and boat mark. The start and end date for each hull unit and ACN boat mark combination were important in identifying if vessels operating under a ACN boat mark combination changed, due to sale, for example.

A.1.2 Effort unit conversion factor

The effort unit conversion factor (EUCF) detailed how the fishing ability changed with vessel size hull units.

In April 2000, the Commonwealth Scientific and Industrial Research Organisation (CSIRO) investigated the relationship between vessel size and catch rates. The relationship assimilated attributes of different vessels (Dichmont et al. 2000). Through this work, CSIRO developed a relationship to standardise vessel fishing ability based on its respective hull unit, termed an effort unit conversion factor (EUCF). Simply, the EUCF was the number of effort units used per day of fishing for a vessel given its size. This enables the effort unit procedure, whereby a larger vessel uses more effort units than a smaller vessel per fishing day (O'Neill et al. 2004).

Each vessels effort unit conversion factor was calculated using the formula:

$$EUCF = 2.4052 \times HU^{0.7617}$$

This formula was developed by CSIRO (Dichmont et al. 2000) and is shown in figure A.1.

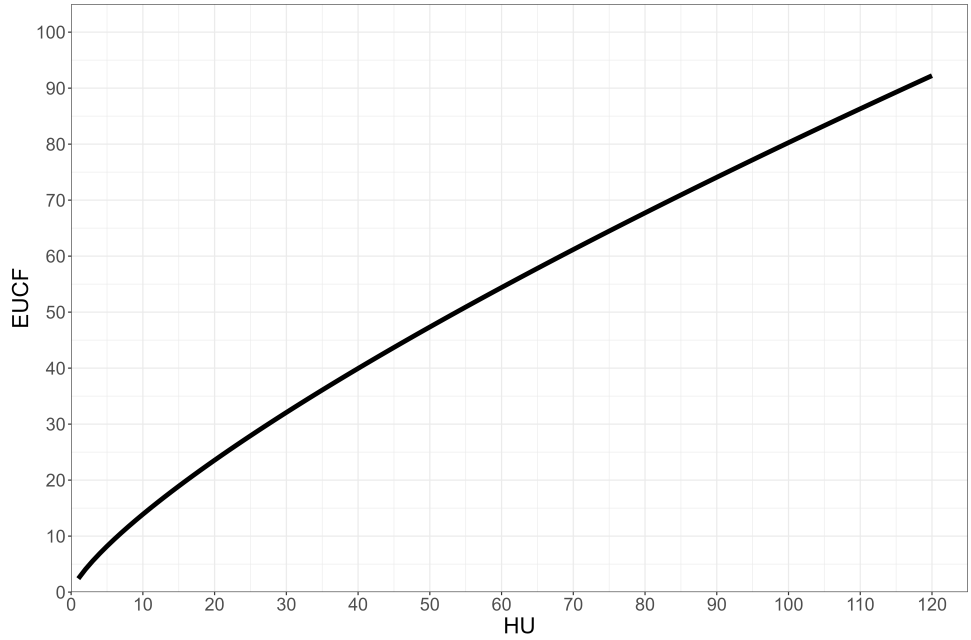

Figure A.1: Relationship between hull unit and its fishing ability. EUCF = effort unit conversion factor, HU = hull unit.

Appendix B Workings for the ratio and detailed methods

B.1 Reccommended biological catch summary

Below are the monthly RBCs used for tiger prawns, endeavour prawns, blue leg king prawns, banana prawns, mud bugs, red spot king prawns and sand bugs. The monthly RBCs were for the entire stock range.

For tiger prawns, endeavour prawns and sand bugs, the monthly RBCs were outputs from the stock assessments used in Lovett et al. (2023), Fox et al. (2023) and Wickens et al. (2023).

Monthly RBCs for blue leg king prawns, banana prawns, red spot king prawns and mud bugs were calculated as average harvests based on logbook data between 2017 and 2021.

As the northern and central regions were closed to fishing in January and February, the RBCs were zero kilograms.

Table B.1: Whole stock recommended biological catch (RBC kilograms) for each species by month. Monthly RBCs for tiger prawns, endeavour prawns and sand bugs were estimated from stock assessments. RBCs for other species were averages of logbook harvests between 2017 and 2021.

Month	Tiger	Endeavour	Blue leg king	Banana	Mud bug	Red spot king	Sand bug
January	0	0	0	0	815.5	0	40513.9
February	0	0	0	0	482.1	0	23138.2
March	144214.2	146988.9	22364.1	17403.8	1859.6	8115.3	76012.9
April	173082.9	212372	13553.8	36797	1863.4	7371	48238.1
May	183960.2	191419.7	16070.8	53612.4	2451	13980.8	28620.1
June	136646.5	122287.6	21565.2	23917.9	2840.2	29869.4	35266.5
July	124650.1	94020.3	25519.2	16029.2	3588.6	33111.8	25762.9
August	135527.1	123241.9	20694.9	7590.3	3215.6	28821	25762.7
September	125429.5	95546.4	8525.9	3409.6	3252.1	15570.3	44925
October	97553.7	61769.2	4799.4	1553.5	4180.2	16143	59059.6
November	43458	23858.2	1352.8	272.6	3200.9	10636	50943.8
December	6820.6	4127.4	695.9	79.9	2659.3	4623.7	33622.5

B.2 Splitting RBC among regions

Below are the corresponding catch shares per trawl region by species (Table B.2). For the purposes of this work, only the proportions for the northern and central regions were used.

For tiger and endeavour prawns, most of the catch came from the northern region (Table B.2). For blue leg king, banana, red spot king and mud bugs, much of the catch came from the central trawl region (Table B.2). For sand bugs, the majority of catch came from the southern inshore trawl region between 2017 and 2021 (see table B.2).

Table B.2: Regional catch shares for each species 2017 to 2021. Note that the catch share for tiger prawns was 70% to the northern and 30% to the central region from the harvest strategy. Row proportions for each species summed to one acorss the regions.

Species	Northern region	Central region	Southern inshore region	Southern offshore region	Moreton Bay region
Tiger	0.7	0.3			
Endeavour	0.8321	0.1679			
Blue leg king	0.1528	0.8472			
Banana	0.0771	0.9229			
Mud bug	0.2253	0.503	0.1126	0.0199	0.1392
Red spot king	0.0288	0.9712			
Sand bug	0.0018	0.36	0.5671	0.0712	

Below are the monthly RBCs into the northern and central regions (Table B.3), by using Table B.1 and Table B.2.

Table B.3: Regional monthly RBCs in kilograms for the northern and central trawl regions.

Region	Month	Tiger	Endeavour	Blue leg king	Banana	Mud bug	Red spot king	Sand bug
Northern	January	0	0	0	0	0	0	0
	February	0	0	0	0	0	0	0
	March	100949.9	122314.1	3416.9	1342.3	418.9	234.1	133.7
	April	121158	176721.4	2070.8	2838	419.8	212.6	84.8
	May	128772.1	159286.3	2455.4	4134.9	552.1	403.3	50.3
	June	95652.5	101759.3	3294.8	1844.7	639.8	861.7	62
	July	87255.1	78237.2	3898.9	1236.3	808.4	955.2	45.3
	August	94869	102553.4	3161.8	585.4	724.4	831.5	45.3
	September	87800.7	79507.1	1302.6	263	732.6	449.2	79
	October	68287.6	51400.1	733.3	119.8	941.7	465.7	103.9
	November	30420.6	19853.2	206.7	21	721.1	306.8	89.6
	December	4774.4	3434.5	106.3	6.2	599	133.4	59.1
Central	January	0	0	0	0	0	0	0
	February	0	0	0	0	0	0	0
	March	43264.2	24674.9	18947.2	16061.5	935.4	7881.2	27366.7
	April	51924.9	35650.7	11483	33959	937.2	7158.4	17367
	May	55188.1	32133.4	13615.4	49477.5	1232.8	13577.5	10304
	June	40993.9	20528.3	18270.4	22073.2	1428.6	29007.7	12696.9
	July	37395	15783.1	21620.3	14792.9	1805	32156.6	9275.3
	August	40658.1	20688.5	17533.1	7004.9	1617.4	27989.5	9275.3
	September	37628.9	16039.3	7223.2	3146.6	1635.7	15121.1	16174.2
	October	29266.1	10369.1	4066.1	1433.7	2102.6	15677.3	21263
	November	13037.4	4005.1	1146.1	251.6	1610	10329.2	18341.1
	December	2046.2	692.9	589.6	73.8	1337.6	4490.3	12105

B.3 Conversion of RBC into effort units

To convert an RBC into effort units, a fleet average catch rate and matching fleet average EUCF was used. Below were the fleet average EUCFs for each species and region (see table B.4).

The resulting effort unit totals for each species, month and region are in Table B.6. Note, these totals for each species, month and region are yet to be corrected for the multi-species co-caught adjustments (i.e. species proportions).

Table B.4: Average EUCF (i.e. definition of an average vessel) used to predict catch rates in the stock assessments for sand and mud bugs.

Region	Species	Average EUCF	Number of logbook records used in average
Northern trawl region	Tiger	47.4163	22451
	Endeavour	47.8357	21623
	Mud bug	47.0707	9447
	Red spot king	51.1168	351
	Sand bug	47.7891	640
	Blue leg king	52.0933	4072
	Banana	28.8414	1362
Central trawl region	Tiger	45.1526	13880
	Endeavour	45.4851	8373
	Mud bug	46.3772	6180
	Red spot king	49.4897	11593
	Sand bug	48.8288	12653
	Blue leg king	46.2368	6765
	Banana	47.2934	2888

Below are the catch rates for each species per effort unit, per night in kilograms (Table B.5). To produce these catch rates per EUCF (see Table B.5), the average catch rate in kilograms per night per vessel, was simply divided by the respective average EUCF from Table B.4 for each corresponding species, month and region.

Table B.5: Monthly average catch rates kg per effort unit 2017 to 2021.

Region	Month	Tiger	Endeavour	Blue leg king	Banana	Mud bug	Red spot king	Sand bug
Northern	January	0	0	0	0	0	0	0
	February	0	0	0	0	0	0	0
	March	3.9	1.5	0.5	1.5	0.1	0.7	0.2
	April	4.5	2.4	0.6	1.6	0	1	0.2
	May	4.1	2	0.6	1.9	0.1	1.2	0.2
	June	3.5	1.6	0.5	1.9	0.1	1.3	0.2
	July	3.4	1.6	0.5	2.3	0.1	1.2	0.2
	August	3.2	1.8	0.5	1.4	0.1	1.1	0.2
	September	3.1	1.7	0.4	1.1	0.1	0.8	0.2
	October	3	1.1	0.3	1.1	0.1	0.6	0.2
	November	2.5	0.7	0.2	0.6	0.1	0.5	0.3
	December	2.2	0.6	0.2	0.2	0.1	0.5	0.2
Central	January	0	0	0	0	0	0	0
	February	0	0	0	0	0	0	0
	March	3.5	0.6	2.9	5	0.2	1.4	0.8
	April	4	1	2.3	8.2	0.1	1.8	0.8
	May	3.7	0.8	2.1	7.3	0.2	2.2	0.8
	June	3.1	0.6	2.1	5.1	0.2	2.5	0.9
	July	3	0.6	2	4.2	0.2	2.2	0.8
	August	2.8	0.7	1.9	2.8	0.2	2	0.7
	September	2.8	0.7	1.1	1.4	0.2	1.5	0.7
	October	2.7	0.5	0.7	0.8	0.3	1.2	0.7
	November	2.3	0.3	0.5	0.5	0.3	1	0.8
	December	1.9	0.3	0.5	0.7	0.4	0.9	0.6

Table B.6: Monthly un-adjusted effort unit totals for each species, month and region. Note, these totals were not corrected for the co-caught adjustments and species overlap. Therefore, these effort unit (EU) totals for each species cannot be added together.

Region	Month	Tiger un-adjusted EU)	Endeavour un-adjusted EU	Blue leg king un-adjusted EU	Banana un-adjusted EU	Mud bug un-adjusted EU	Red spot king un-adjusted EU	Sand bug un-adjusted EU
Northern	January	0	0	0	0	0	0	0
	February	0	0	0	0	0	0	0
	March	25826.371	80075.9374	7541.0748	919.4734	6224.1295	314.6072	814.3475
	April	26844.9137	74229.8707	3441.3133	1817.7761	9122.1146	214.7889	491.4792
	May	31119.5985	81050.625	4357.5783	2158.921	10390.4785	339.2417	318.1267
	June	27120.2108	65491.965	7071.9794	962.9914	9142.6916	642.2606	287.9075
	July	25874.7593	50098.2379	8068.3915	529.268	9679.8823	798.9804	203.3926
	August	29958.2587	56917.6654	6251.8885	411.5217	9727.6623	761.3741	223.0597
	September	27961.6623	47368.4336	3153.3894	237.5678	9433.2711	564.6302	380.0538
	October	22934.6569	45014.3458	2116.732	113.9568	11247.417	728.5156	501.1387
	November	11951.2462	28232.879	1017.9667	37.3424	9577.6662	564.4891	356.0728
	December	2190.8687	5415.2554	443.0943	27.4512	6160.287	263.4961	275.1731
Central	January	0	0	0	0	0	0	0
	February	0	0	0	0	0	0	0
	March	12426.0512	39593.6726	6487.0925	3199.5712	5094.1099	5776.5481	35063.1723
	April	12916.1109	36703.0757	5031.5434	4137.7031	7280.9316	3943.7688	22845.3753
	May	14972.8246	40075.6084	6604.4124	6810.7229	7204.9409	6228.8657	13331.5921
	June	13048.5668	32382.6046	8549.1143	4302.9698	6135.9784	11792.6385	14627.2511
	July	12449.3326	24771.1521	10869.1196	3532.005	7243.4638	14670.1915	11611.8358
	August	14414.0598	28143.0287	9332.5166	2540.7658	8369.7016	13979.6983	12982.4057
	September	13453.4212	23421.3961	6808.1265	2248.708	8068.7806	10367.2546	24058.6979
	October	11034.7373	22257.4137	5692.6857	1902.102	8197.4592	13376.3777	30467.7942
	November	5750.1999	13959.7912	2183.1541	508.4877	5852.9663	10364.6647	24007.7836
	December	1054.1104	2677.5815	1136.3346	106.6187	3716.8758	4838.0897	18996.5012

Appendix C Detailed method results

C.1 Northern region

C.1.0.1 Base

Table C.1: Results from northern base (tiger, endeavour, red spot king and sand bug)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Northern	Detailed	Filtered	Effort	Tiger	Primary inshore	231783	1 (0.9574)	231783	260566
		Filtered	Effort	Endeavour	Secondary inshore	533895	0.0426	22722	
		Filtered	Effort	Red spot king	Primary offshore	5192	1 (0.7742)	5192	
		Filtered	Effort	Sand bug	Secondary offshore	3851	0.2258	870	
		Allocated	Effort	Tiger	Primary inshore	231783	1 (0.9604)	231783	258885
		Allocated	Effort	Endeavour	Secondary inshore	533895	0.0396	21148	
		Allocated	Effort	Red spot king	Primary offshore	5192	1 (0.8021)	5192	
		Allocated	Effort	Sand bug	Secondary offshore	3851	0.1979	762	
		Filtered	Catch	Tiger	Primary inshore	231783	0.7844	181807	301781
		Filtered	Catch	Endeavour	Secondary inshore	533895	0.2156	115114	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	3851	0.2486	957	
		Allocated	Catch	Tiger	Primary inshore	231783	0.7831	181511	302197
		Allocated	Catch	Endeavour	Secondary inshore	533895	0.2169	115796	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	3851	0.2258	869	

C.1.0.2 Base plus mud bug

Table C.2: Results from northern base with mud bug added (tiger, endeavour, red spot king, sand bug and mud bug)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Northern	Detailed	Filtered	Effort	Tiger	Primary inshore	231783	1 (0.9566)	231783	260306
		Filtered	Effort	Endeavour	Secondary inshore	533895	0.0418	22314	
		Filtered	Effort	Mud bug	Secondary inshore	90706	0.0016	148	
		Filtered	Effort	Red spot king	Primary offshore	5192	1 (0.7742)	5192	
		Filtered	Effort	Sand bug	Secondary offshore	3851	0.2258	870	
		Allocated	Effort	Tiger	Primary inshore	231783	1 (0.9589)	231783	258994
		Allocated	Effort	Endeavour	Secondary inshore	533895	0.0395	21115	
		Allocated	Effort	Mud bug	Secondary inshore	90706	0.0016	142	
		Allocated	Effort	Red spot king	Primary offshore	5192	1 (0.8021)	5192	
		Allocated	Effort	Sand bug	Secondary offshore	3851	0.1979	762	
		Filtered	Catch	Tiger	Primary inshore	231783	0.7739	179371	298872
		Filtered	Catch	Endeavour	Secondary inshore	533895	0.2124	113397	
		Filtered	Catch	Mud bug	Secondary inshore	90706	0.0137	1245	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	3851	0.2486	957	
		Allocated	Catch	Tiger	Primary inshore	231783	0.7722	178983	299268
		Allocated	Catch	Endeavour	Secondary inshore	533895	0.2138	114121	
		Allocated	Catch	Mud bug	Secondary inshore	90706	0.014	1274	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	3851	0.2258	869	

C.1.0.3 Base plus blue leg king

Table C.3: Results from northern base with blue leg king added (tiger, endeavour, red spot king, sand bug and blue leg king)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Northern	Detailed	Filtered	Effort	Tiger	Primary inshore	231783	1 (0.9552)	231783	259852
		Filtered	Effort	Endeavour	Secondary inshore	533895	0.0409	21836	
		Filtered	Effort	Blue leg king	Secondary inshore	43463	0.0039	171	
		Filtered	Effort	Red spot king	Primary offshore	5192	1 (0.7742)	5192	
		Filtered	Effort	Sand bug	Secondary offshore	3851	0.2258	870	
		Allocated	Effort	Tiger	Primary inshore	231783	1 (0.9566)	231783	258973
		Allocated	Effort	Endeavour	Secondary inshore	533895	0.0395	21066	
		Allocated	Effort	Blue leg king	Secondary inshore	43463	0.0039	170	
		Allocated	Effort	Red spot king	Primary offshore	5192	1 (0.8021)	5192	
		Allocated	Effort	Sand bug	Secondary offshore	3851	0.1979	762	
		Filtered	Catch	Tiger	Primary inshore	231783	0.7701	178494	296744
		Filtered	Catch	Endeavour	Secondary inshore	533895	0.2108	112562	
		Filtered	Catch	Blue leg king	Secondary inshore	43463	0.0191	829	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	3851	0.2486	957	
		Allocated	Catch	Tiger	Primary inshore	231783	0.7683	178072	297245
		Allocated	Catch	Endeavour	Secondary inshore	533895	0.2125	113448	
		Allocated	Catch	Blue leg king	Secondary inshore	43463	0.0192	836	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	3851	0.2258	869	

C.1.0.4 Base plus banana

Table C.4: Results from northern base with banana added (tiger, endeavour, red spot king, sand bug and banana)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Northern	Detailed	Filtered	Effort	Tiger	Primary inshore	231783	1 (0.9264)	231783	259033
		Filtered	Effort	Endeavour	Secondary inshore	533895	0.0392	20940	
		Filtered	Effort	Banana	Secondary inshore	7216	0.0344	248	
		Filtered	Effort	Red spot king	Primary offshore	5192	1 (0.7742)	5192	
		Filtered	Effort	Sand bug	Secondary offshore	3851	0.2258	870	
		Allocated	Effort	Tiger	Primary inshore	231783	1 (0.9264)	231783	258393
		Allocated	Effort	Endeavour	Secondary inshore	533895	0.0382	20400	
		Allocated	Effort	Banana	Secondary inshore	7216	0.0354	255	
		Allocated	Effort	Red spot king	Primary offshore	5192	1 (0.8021)	5192	
		Allocated	Effort	Sand bug	Secondary offshore	3851	0.1979	762	
		Filtered	Catch	Tiger	Primary inshore	231783	0.7559	175214	291694
		Filtered	Catch	Endeavour	Secondary inshore	533895	0.2086	111365	
		Filtered	Catch	Banana	Secondary inshore	7216	0.0355	256	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	3851	0.2486	957	
		Allocated	Catch	Tiger	Primary inshore	231783	0.7542	174810	291757
		Allocated	Catch	Endeavour	Secondary inshore	533895	0.2094	111795	
		Allocated	Catch	Banana	Secondary inshore	7216	0.0364	263	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	3851	0.2258	869	

C.1.0.5 Base plus blue leg king and mud bug

Table C.5: Results from northern base with blue leg king and mud bug added (tiger, endeavour, red spot king, sand bug, blue leg king and mud bug)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Northern	Detailed	Filtered	Effort	Tiger	Primary inshore	231783	1 (0.9538)	231783	259960
		Filtered	Effort	Endeavour	Secondary inshore	533895	0.0408	21804	
		Filtered	Effort	Blue leg king	Secondary inshore	43463	0.0038	163	
		Filtered	Effort	Mud bug	Secondary inshore	90706	0.0016	148	
		Filtered	Effort	Red spot king	Primary offshore	5192	1 (0.7742)	5192	
		Filtered	Effort	Sand bug	Secondary offshore	3851	0.2258	870	
		Allocated	Effort	Tiger	Primary inshore	231783	1 (0.9551)	231783	259081
		Allocated	Effort	Endeavour	Secondary inshore	533895	0.0394	21033	
		Allocated	Effort	Blue leg king	Secondary inshore	43463	0.0039	170	
		Allocated	Effort	Mud bug	Secondary inshore	90706	0.0016	141	
		Allocated	Effort	Red spot king	Primary offshore	5192	1 (0.8021)	5192	
		Allocated	Effort	Sand bug	Secondary offshore	3851	0.1979	762	
		Filtered	Catch	Tiger	Primary inshore	231783	0.7601	176186	294032
		Filtered	Catch	Endeavour	Secondary inshore	533895	0.2078	110968	
		Filtered	Catch	Blue leg king	Secondary inshore	43463	0.0187	814	
		Filtered	Catch	Mud bug	Secondary inshore	90706	0.0133	1205	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	3851	0.2486	957	
		Allocated	Catch	Tiger	Primary inshore	231783	0.7578	175647	294454
		Allocated	Catch	Endeavour	Secondary inshore	533895	0.2095	111848	
		Allocated	Catch	Blue leg king	Secondary inshore	43463	0.019	824	
		Allocated	Catch	Mud bug	Secondary inshore	90706	0.0137	1246	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	3851	0.2258	869	

C.1.0.6 Base plus banana and mud bug

Table C.6: Results from northern base with banana and mud bug added (tiger, endeavour, red spot king, sand bug, banana and mud bug)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Northern	Detailed	Filtered	Effort	Tiger	Primary inshore	231783	1 (0.9254)	231783	259022
		Filtered	Effort	Endeavour	Secondary inshore	533895	0.039	20809	
		Filtered	Effort	Banana	Secondary inshore	7216	0.0343	248	
		Filtered	Effort	Mud bug	Secondary inshore	90706	0.0013	121	
		Filtered	Effort	Red spot king	Primary offshore	5192	1 (0.7742)	5192	
		Filtered	Effort	Sand bug	Secondary offshore	3851	0.2258	870	
		Allocated	Effort	Tiger	Primary inshore	231783	1 (0.925)	231783	258498
		Allocated	Effort	Endeavour	Secondary inshore	533895	0.0382	20369	
		Allocated	Effort	Banana	Secondary inshore	7216	0.0353	255	
		Allocated	Effort	Mud bug	Secondary inshore	90706	0.0015	137	
		Allocated	Effort	Red spot king	Primary offshore	5192	1 (0.8021)	5192	
		Allocated	Effort	Sand bug	Secondary offshore	3851	0.1979	762	
		Filtered	Catch	Tiger	Primary inshore	231783	0.746	172909	288966
		Filtered	Catch	Endeavour	Secondary inshore	533895	0.2056	109754	
		Filtered	Catch	Banana	Secondary inshore	7216	0.0353	255	
		Filtered	Catch	Mud bug	Secondary inshore	90706	0.0131	1188	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	3851	0.2486	957	
		Allocated	Catch	Tiger	Primary inshore	231783	0.7438	172397	288961
		Allocated	Catch	Endeavour	Secondary inshore	533895	0.2064	110185	
		Allocated	Catch	Banana	Secondary inshore	7216	0.0363	262	
		Allocated	Catch	Mud bug	Secondary inshore	90706	0.0135	1228	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	3851	0.2258	869	

C.1.0.7 Base plus blue leg king and banana

Table C.7: Results from northern base with blue leg king and banana added (tiger, endeavour, red spot king, sand bug, blue leg king and banana)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Northern	Detailed	Filtered	Effort	Tiger	Primary inshore	231783	1 (0.9237)	231783	258673
		Filtered	Effort	Endeavour	Secondary inshore	533895	0.0382	20417	
		Filtered	Effort	Blue leg king	Secondary inshore	43463	0.0038	164	
		Filtered	Effort	Banana	Secondary inshore	7216	0.0343	248	
		Filtered	Effort	Red spot king	Primary offshore	5192	1 (0.7742)	5192	
		Filtered	Effort	Sand bug	Secondary offshore	3851	0.2258	870	
		Allocated	Effort	Tiger	Primary inshore	231783	1 (0.9229)	231783	258479
		Allocated	Effort	Endeavour	Secondary inshore	533895	0.0381	20323	
		Allocated	Effort	Blue leg king	Secondary inshore	43463	0.0038	164	
		Allocated	Effort	Banana	Secondary inshore	7216	0.0352	254	
		Allocated	Effort	Red spot king	Primary offshore	5192	1 (0.8021)	5192	
		Allocated	Effort	Sand bug	Secondary offshore	3851	0.1979	762	
		Filtered	Catch	Tiger	Primary inshore	231783	0.742	171978	286773
		Filtered	Catch	Endeavour	Secondary inshore	533895	0.2039	108869	
		Filtered	Catch	Blue leg king	Secondary inshore	43463	0.0187	812	
		Filtered	Catch	Banana	Secondary inshore	7216	0.0354	256	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	3851	0.2486	957	
		Allocated	Catch	Tiger	Primary inshore	231783	0.74	171520	287022
		Allocated	Catch	Endeavour	Secondary inshore	533895	0.2052	109545	
		Allocated	Catch	Blue leg king	Secondary inshore	43463	0.0185	806	
		Allocated	Catch	Banana	Secondary inshore	7216	0.0363	262	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	3851	0.2258	869	

C.1.0.8 Base plus blue leg king, banana and mud bug

Table C.8: Results from northern base with blue leg king, banana and mud bug added (tiger, endeavour, red spot king, sand bug, blue leg king, banana and mud bug)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Northern	Detailed	Filtered	Effort	Tiger	Primary inshore	231783	1 (0.9227)	231783	258683
		Filtered	Effort	Endeavour	Secondary inshore	533895	0.038	20310	
		Filtered	Effort	Blue leg king	Secondary inshore	43463	0.0037	160	
		Filtered	Effort	Banana	Secondary inshore	7216	0.0343	247	
		Filtered	Effort	Mud bug	Secondary inshore	90706	0.0013	121	
		Filtered	Effort	Red spot king	Primary offshore	5192	1 (0.7742)	5192	
		Filtered	Effort	Sand bug	Secondary offshore	3851	0.2258	870	
		Allocated	Effort	Tiger	Primary inshore	231783	1 (0.9215)	231783	258584
		Allocated	Effort	Endeavour	Secondary inshore	533895	0.038	20293	
		Allocated	Effort	Blue leg king	Secondary inshore	43463	0.0038	164	
		Allocated	Effort	Banana	Secondary inshore	7216	0.0352	254	
		Allocated	Effort	Mud bug	Secondary inshore	90706	0.0015	136	
		Allocated	Effort	Red spot king	Primary offshore	5192	1 (0.8021)	5192	
		Allocated	Effort	Sand bug	Secondary offshore	3851	0.1979	762	
		Filtered	Catch	Tiger	Primary inshore	231783	0.7326	169797	284236
		Filtered	Catch	Endeavour	Secondary inshore	533895	0.2011	107378	
		Filtered	Catch	Blue leg king	Secondary inshore	43463	0.0183	798	
		Filtered	Catch	Banana	Secondary inshore	7216	0.0353	255	
		Filtered	Catch	Mud bug	Secondary inshore	90706	0.0127	1150	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	3851	0.2486	957	
		Allocated	Catch	Tiger	Primary inshore	231783	0.73	169205	284357
		Allocated	Catch	Endeavour	Secondary inshore	533895	0.2023	108007	
		Allocated	Catch	Blue leg king	Secondary inshore	43463	0.0183	794	
		Allocated	Catch	Banana	Secondary inshore	7216	0.0362	261	
		Allocated	Catch	Mud bug	Secondary inshore	90706	0.0132	1201	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	3851	0.2258	869	

C.2 Central region

C.2.0.1 Base

Table C.9: Results from central base (tiger, endeavour, red spot king and sand bug)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Central	Detailed	Filtered	Effort	Tiger	Primary inshore	111519	1 (0.9627)	111519	363134
		Filtered	Effort	Endeavour	Secondary inshore	263985	0.0373	9858	
		Filtered	Effort	Sand bug	Primary offshore	207992	1 (0.6459)	207992	
		Filtered	Effort	Red spot king	Secondary offshore	95338	0.3541	33764	
		Allocated	Effort	Tiger	Primary inshore	111519	1 (0.9925)	111519	353133
		Allocated	Effort	Endeavour	Secondary inshore	263985	0.0075	1992	
		Allocated	Effort	Sand bug	Primary offshore	207992	1 (0.6682)	207992	
		Allocated	Effort	Red spot king	Secondary offshore	95338	0.3318	31629	
		Filtered	Catch	Tiger	Primary inshore	111519	0.8964	99962	290279
		Filtered	Catch	Endeavour	Secondary inshore	263985	0.1036	27358	
		Filtered	Catch	Sand bug	Primary offshore	207992	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	95338	0.3997	38111	
		Allocated	Catch	Tiger	Primary inshore	111519	0.9135	101874	290067
		Allocated	Catch	Endeavour	Secondary inshore	263985	0.0865	22833	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	95338	0.3784	36079	

C.2.0.2 Base plus mud bug

Table C.10: Results from central base with mud bug added (tiger, endeavour, red spot king, sand bug and mud bug)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Central	Detailed	Filtered	Effort	Tiger	Primary inshore	111519	1 (0.9411)	111519	362583
		Filtered	Effort	Endeavour	Secondary inshore	263985	0.0272	7175	
		Filtered	Effort	Mud bug	Secondary inshore	67165	0.0317	2132	
		Filtered	Effort	Sand bug	Primary offshore	207992	1 (0.6459)	207992	
		Filtered	Effort	Red spot king	Secondary offshore	95338	0.3541	33764	
		Allocated	Effort	Tiger	Primary inshore	111519	1 (0.9466)	111519	356141
		Allocated	Effort	Endeavour	Secondary inshore	263985	0.0072	1900	
		Allocated	Effort	Mud bug	Secondary inshore	67165	0.0462	3100	
		Allocated	Effort	Sand bug	Primary offshore	207992	1 (0.6682)	207992	
		Allocated	Effort	Red spot king	Secondary offshore	95338	0.3318	31629	
		Filtered	Catch	Tiger	Primary inshore	111519	0.8562	95486	287455
		Filtered	Catch	Endeavour	Secondary inshore	263985	0.0983	25958	
		Filtered	Catch	Mud bug	Secondary inshore	67165	0.0454	3052	
		Filtered	Catch	Sand bug	Primary offshore	207992	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	95338	0.3997	38111	
		Allocated	Catch	Tiger	Primary inshore	111519	0.8588	95769	286817
		Allocated	Catch	Endeavour	Secondary inshore	263985	0.0823	21731	
		Allocated	Catch	Mud bug	Secondary inshore	67165	0.0589	3957	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	95338	0.3784	36079	

C.2.0.3 Base plus blue leg king

Table C.11: Results from central base with blue leg king added (tiger, endeavour, red spot king, sand bug and blue leg king)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Central	Detailed	Filtered	Effort	Tiger	Primary inshore	111519	1 (0.7917)	111519	369286
		Filtered	Effort	Endeavour	Secondary inshore	263985	0.0147	3874	
		Filtered	Effort	Blue leg king	Secondary inshore	62694	0.1936	12136	
		Filtered	Effort	Sand bug	Primary offshore	207992	1 (0.6459)	207992	
		Filtered	Effort	Red spot king	Secondary offshore	95338	0.3541	33764	
		Allocated	Effort	Tiger	Primary inshore	111519	1 (0.835)	111519	362764
		Allocated	Effort	Endeavour	Secondary inshore	263985	0.0063	1676	
		Allocated	Effort	Blue leg king	Secondary inshore	62694	0.1587	9948	
		Allocated	Effort	Sand bug	Primary offshore	207992	1 (0.6682)	207992	
		Allocated	Effort	Red spot king	Secondary offshore	95338	0.3318	31629	
		Filtered	Catch	Tiger	Primary inshore	111519	0.7329	81732	277479
		Filtered	Catch	Endeavour	Secondary inshore	263985	0.0797	21038	
		Filtered	Catch	Blue leg king	Secondary inshore	62694	0.1874	11750	
		Filtered	Catch	Sand bug	Primary offshore	207992	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	95338	0.3997	38111	
		Allocated	Catch	Tiger	Primary inshore	111519	0.7692	85786	280263
		Allocated	Catch	Endeavour	Secondary inshore	263985	0.0728	19213	
		Allocated	Catch	Blue leg king	Secondary inshore	62694	0.158	9904	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	95338	0.3784	36079	

C.2.0.4 Base plus banana

Table C.12: Results from central base with banana added (tiger, endeavour, red spot king, sand bug and banana)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Central	Detailed	Filtered	Effort	Tiger	Primary inshore	111519	1 (0.8616)	111519	362508
		Filtered	Effort	Endeavour	Secondary inshore	263985	0.0221	5826	
		Filtered	Effort	Banana	Secondary inshore	29290	0.1163	3406	
		Filtered	Effort	Sand bug	Primary offshore	207992	1 (0.6459)	207992	
		Filtered	Effort	Red spot king	Secondary offshore	95338	0.3541	33764	
		Allocated	Effort	Tiger	Primary inshore	111519	1 (0.8663)	111519	356604
		Allocated	Effort	Endeavour	Secondary inshore	263985	0.0066	1739	
		Allocated	Effort	Banana	Secondary inshore	29290	0.1272	3724	
		Allocated	Effort	Sand bug	Primary offshore	207992	1 (0.6682)	207992	
		Allocated	Effort	Red spot king	Secondary offshore	95338	0.3318	31629	
		Filtered	Catch	Tiger	Primary inshore	111519	0.7926	88395	278304
		Filtered	Catch	Endeavour	Secondary inshore	263985	0.089	23482	
		Filtered	Catch	Banana	Secondary inshore	29290	0.1184	3468	
		Filtered	Catch	Sand bug	Primary offshore	207992	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	95338	0.3997	38111	
		Allocated	Catch	Tiger	Primary inshore	111519	0.7954	88702	277842
		Allocated	Catch	Endeavour	Secondary inshore	263985	0.0758	20007	
		Allocated	Catch	Banana	Secondary inshore	29290	0.1288	3773	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	95338	0.3784	36079	

C.2.0.5 Base plus blue leg king and mud bug

Table C.13: Results from central base with blue leg king and mud bug added (tiger, endeavour, red spot king, sand bug, blue leg king and mud bug)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Central	Detailed	Filtered	Effort	Tiger	Primary inshore	111519	1 (0.7808)	111519	370030
		Filtered	Effort	Endeavour	Secondary inshore	263985	0.0145	3821	
		Filtered	Effort	Blue leg king	Secondary inshore	62694	0.1832	11485	
		Filtered	Effort	Mud bug	Secondary inshore	67165	0.0216	1449	
		Filtered	Effort	Sand bug	Primary offshore	207992	1 (0.6459)	207992	
		Filtered	Effort	Red spot king	Secondary offshore	95338	0.3541	33764	
		Allocated	Effort	Tiger	Primary inshore	111519	1 (0.8023)	111519	364937
		Allocated	Effort	Endeavour	Secondary inshore	263985	0.0061	1611	
		Allocated	Effort	Blue leg king	Secondary inshore	62694	0.1525	9558	
		Allocated	Effort	Mud bug	Secondary inshore	67165	0.0391	2627	
		Allocated	Effort	Sand bug	Primary offshore	207992	1 (0.6682)	207992	
		Allocated	Effort	Red spot king	Secondary offshore	95338	0.3318	31629	
		Filtered	Catch	Tiger	Primary inshore	111519	0.7091	79074	275870
		Filtered	Catch	Endeavour	Secondary inshore	263985	0.0768	20262	
		Filtered	Catch	Blue leg king	Secondary inshore	62694	0.1814	11375	
		Filtered	Catch	Mud bug	Secondary inshore	67165	0.0328	2200	
		Filtered	Catch	Sand bug	Primary offshore	207992	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	95338	0.3997	38111	
		Allocated	Catch	Tiger	Primary inshore	111519	0.7286	81257	277893
		Allocated	Catch	Endeavour	Secondary inshore	263985	0.0698	18417	
		Allocated	Catch	Blue leg king	Secondary inshore	62694	0.1523	9547	
		Allocated	Catch	Mud bug	Secondary inshore	67165	0.0493	3312	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	95338	0.3784	36079	

C.2.0.6 Base plus banana and mud bug

Table C.14: Results from central base with banana and mud bug added (tiger, endeavour, red spot king, sand bug, banana and mud bug)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Central	Detailed	Filtered	Effort	Tiger	Primary inshore	111519	1 (0.841)	111519	363657
		Filtered	Effort	Endeavour	Secondary inshore	263985	0.0205	5425	
		Filtered	Effort	Banana	Secondary inshore	29290	0.1146	3357	
		Filtered	Effort	Mud bug	Secondary inshore	67165	0.0238	1600	
		Filtered	Effort	Sand bug	Primary offshore	207992	1 (0.6459)	207992	
		Filtered	Effort	Red spot king	Secondary offshore	95338	0.3541	33764	
		Allocated	Effort	Tiger	Primary inshore	111519	1 (0.8312)	111519	359104
		Allocated	Effort	Endeavour	Secondary inshore	263985	0.0063	1668	
		Allocated	Effort	Banana	Secondary inshore	29290	0.122	3573	
		Allocated	Effort	Mud bug	Secondary inshore	67165	0.0405	2722	
		Allocated	Effort	Sand bug	Primary offshore	207992	1 (0.6682)	207992	
		Allocated	Effort	Red spot king	Secondary offshore	95338	0.3318	31629	
		Filtered	Catch	Tiger	Primary inshore	111519	0.7625	85034	276272
		Filtered	Catch	Endeavour	Secondary inshore	263985	0.085	22442	
		Filtered	Catch	Banana	Secondary inshore	29290	0.1163	3407	
		Filtered	Catch	Mud bug	Secondary inshore	67165	0.0362	2429	
		Filtered	Catch	Sand bug	Primary offshore	207992	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	95338	0.3997	38111	
		Allocated	Catch	Tiger	Primary inshore	111519	0.7522	83883	275499
		Allocated	Catch	Endeavour	Secondary inshore	263985	0.0726	19152	
		Allocated	Catch	Banana	Secondary inshore	29290	0.1233	3610	
		Allocated	Catch	Mud bug	Secondary inshore	67165	0.052	3493	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	95338	0.3784	36079	

C.2.0.7 Base plus blue leg king and banana

Table C.15: Results from central base with blue leg king and banana added (tiger, endeavour, red spot king, sand bug, blue leg king and banana)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Central	Detailed	Filtered	Effort	Tiger	Primary inshore	111519	1 (0.7153)	111519	369843
		Filtered	Effort	Endeavour	Secondary inshore	263985	0.0105	2761	
		Filtered	Effort	Blue leg king	Secondary inshore	62694	0.1729	10838	
		Filtered	Effort	Banana	Secondary inshore	29290	0.1013	2968	
		Filtered	Effort	Sand bug	Primary offshore	207992	1 (0.6459)	207992	
		Filtered	Effort	Red spot king	Secondary offshore	95338	0.3541	33764	
		Allocated	Effort	Tiger	Primary inshore	111519	1 (0.7438)	111519	364693
		Allocated	Effort	Endeavour	Secondary inshore	263985	0.0057	1493	
		Allocated	Effort	Blue leg king	Secondary inshore	62694	0.1413	8861	
		Allocated	Effort	Banana	Secondary inshore	29290	0.1092	3198	
		Allocated	Effort	Sand bug	Primary offshore	207992	1 (0.6682)	207992	
		Allocated	Effort	Red spot king	Secondary offshore	95338	0.3318	31629	
		Filtered	Catch	Tiger	Primary inshore	111519	0.6572	73293	268218
		Filtered	Catch	Endeavour	Secondary inshore	263985	0.0692	18255	
		Filtered	Catch	Blue leg king	Secondary inshore	62694	0.1705	10692	
		Filtered	Catch	Banana	Secondary inshore	29290	0.1031	3020	
		Filtered	Catch	Sand bug	Primary offshore	207992	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	95338	0.3997	38111	
		Allocated	Catch	Tiger	Primary inshore	111519	0.6837	76250	270831
		Allocated	Catch	Endeavour	Secondary inshore	263985	0.0651	17181	
		Allocated	Catch	Blue leg king	Secondary inshore	62694	0.1402	8788	
		Allocated	Catch	Banana	Secondary inshore	29290	0.111	3251	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	95338	0.3784	36079	

C.2.0.8 Base plus blue leg king, banana and mud bug

Table C.16: Results from central base with blue leg king, banana and mud bug added (tiger, endeavour, red spot king, sand bug, blue leg king, banana and mud bug)

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Adjusted effort units	Total
Central	Detailed	Filtered	Effort	Tiger	Primary inshore	111519	1 (0.706)	111519	370400
		Filtered	Effort	Endeavour	Secondary inshore	263985	0.0099	2606	
		Filtered	Effort	Blue leg king	Secondary inshore	62694	0.168	10536	
		Filtered	Effort	Banana	Secondary inshore	29290	0.1006	2948	
		Filtered	Effort	Mud bug	Secondary inshore	67165	0.0154	1035	
		Filtered	Effort	Sand bug	Primary offshore	207992	1 (0.6459)	207992	
		Filtered	Effort	Red spot king	Secondary offshore	95338	0.3541	33764	
		Allocated	Effort	Tiger	Primary inshore	111519	1 (0.7178)	111519	366569
		Allocated	Effort	Endeavour	Secondary inshore	263985	0.0055	1441	
		Allocated	Effort	Blue leg king	Secondary inshore	62694	0.1364	8551	
		Allocated	Effort	Banana	Secondary inshore	29290	0.1054	3086	
		Allocated	Effort	Mud bug	Secondary inshore	67165	0.035	2350	
		Allocated	Effort	Sand bug	Primary offshore	207992	1 (0.6682)	207992	
		Allocated	Effort	Red spot king	Secondary offshore	95338	0.3318	31629	
		Filtered	Catch	Tiger	Primary inshore	111519	0.6393	71293	267057
		Filtered	Catch	Endeavour	Secondary inshore	263985	0.067	17686	
		Filtered	Catch	Blue leg king	Secondary inshore	62694	0.1659	10403	
		Filtered	Catch	Banana	Secondary inshore	29290	0.1021	2990	
		Filtered	Catch	Mud bug	Secondary inshore	67165	0.0257	1726	
		Filtered	Catch	Sand bug	Primary offshore	207992	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	95338	0.3997	38111	
		Allocated	Catch	Tiger	Primary inshore	111519	0.6504	72537	269052
		Allocated	Catch	Endeavour	Secondary inshore	263985	0.0627	16539	
		Allocated	Catch	Blue leg king	Secondary inshore	62694	0.1357	8507	
		Allocated	Catch	Banana	Secondary inshore	29290	0.1069	3130	
		Allocated	Catch	Mud bug	Secondary inshore	67165	0.0443	2979	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	95338	0.3784	36079	

Appendix D Ratio method results

D.1 Northern region

D.1.0.1 Base

Table D.1: Results from northern base (tiger, endeavour, red spot king and sand bug) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
Northern	Ratio	Filtered	Effort	Tiger	Primary inshore	231783	0.9574	1	231783	248792
		Filtered	Effort	Endeavour	Secondary inshore	231783	0.0426	0.0444	10303	
		Filtered	Effort	Red spot king	Primary offshore	5192	0.7742	1	5192	
		Filtered	Effort	Sand bug	Secondary offshore	5192	0.2258	0.2917	1514	
		Allocated	Effort	Tiger	Primary inshore	231783	0.9604	1	231783	247816
		Allocated	Effort	Endeavour	Secondary inshore	231783	0.0396	0.0412	9560	
		Allocated	Effort	Red spot king	Primary offshore	5192	0.8021	1	5192	
		Allocated	Effort	Sand bug	Secondary offshore	5192	0.1979	0.2468	1281	
		Filtered	Catch	Tiger	Primary inshore	231783	0.7844	0.7844	181807	236975
		Filtered	Catch	Endeavour	Secondary inshore	231783	0.2156	0.2156	49975	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	5192	0.2486	0.2486	1291	
		Allocated	Catch	Tiger	Primary inshore	231783	0.7831	0.7831	181511	236975
		Allocated	Catch	Endeavour	Secondary inshore	231783	0.2169	0.2169	50271	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	5192	0.2258	0.2258	1172	

D.1.0.2 Base plus mud bug

Table D.2: Results from northern base with mud bug added (tiger, endeavour, red spot king, sand bug and mud bug) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
Northern	Ratio	Filtered	Effort	Tiger	Primary inshore	231783	0.9566	1	231783	249011
		Filtered	Effort	Endeavour	Secondary inshore	231783	0.0418	0.0437	10127	
		Filtered	Effort	Mud bug	Secondary inshore	231783	0.0016	0.0017	395	
		Filtered	Effort	Red spot king	Primary offshore	5192	0.7742	1	5192	
		Filtered	Effort	Sand bug	Secondary offshore	5192	0.2258	0.2917	1514	
		Allocated	Effort	Tiger	Primary inshore	231783	0.9589	1	231783	248193
		Allocated	Effort	Endeavour	Secondary inshore	231783	0.0395	0.0412	9560	
		Allocated	Effort	Mud bug	Secondary inshore	231783	0.0016	0.0016	377	
		Allocated	Effort	Red spot king	Primary offshore	5192	0.8021	1	5192	
		Allocated	Effort	Sand bug	Secondary offshore	5192	0.1979	0.2468	1281	
		Filtered	Catch	Tiger	Primary inshore	231783	0.7739	0.7739	179371	236975
		Filtered	Catch	Endeavour	Secondary inshore	231783	0.2124	0.2124	49230	
		Filtered	Catch	Mud bug	Secondary inshore	231783	0.0137	0.0137	3182	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	5192	0.2486	0.2486	1291	
		Allocated	Catch	Tiger	Primary inshore	231783	0.7722	0.7722	178983	236975
		Allocated	Catch	Endeavour	Secondary inshore	231783	0.2138	0.2138	49544	
		Allocated	Catch	Mud bug	Secondary inshore	231783	0.014	0.014	3255	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	5192	0.2258	0.2258	1172	

D.1.0.3 Base plus blue leg king

Table D.3: Results from northern base with blue leg king added (tiger, endeavour, red spot king, sand bug and blue leg king) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
Northern	Ratio	Filtered	Effort	Tiger	Primary inshore	231783	0.9552	1	231783	249372
		Filtered	Effort	Endeavour	Secondary inshore	231783	0.0409	0.0428	9925	
		Filtered	Effort	Blue leg king	Secondary inshore	231783	0.0039	0.0041	957	
		Filtered	Effort	Red spot king	Primary offshore	5192	0.7742	1	5192	
		Filtered	Effort	Sand bug	Secondary offshore	5192	0.2258	0.2917	1514	
		Allocated	Effort	Tiger	Primary inshore	231783	0.9566	1	231783	248765
		Allocated	Effort	Endeavour	Secondary inshore	231783	0.0395	0.0412	9560	
		Allocated	Effort	Blue leg king	Secondary inshore	231783	0.0039	0.0041	949	
		Allocated	Effort	Red spot king	Primary offshore	5192	0.8021	1	5192	
		Allocated	Effort	Sand bug	Secondary offshore	5192	0.1979	0.2468	1281	
		Filtered	Catch	Tiger	Primary inshore	231783	0.7701	0.7701	178494	236975
		Filtered	Catch	Endeavour	Secondary inshore	231783	0.2108	0.2108	48867	
		Filtered	Catch	Blue leg king	Secondary inshore	231783	0.0191	0.0191	4421	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	5192	0.2486	0.2486	1291	
		Allocated	Catch	Tiger	Primary inshore	231783	0.7683	0.7683	178072	236975
		Allocated	Catch	Endeavour	Secondary inshore	231783	0.2125	0.2125	49252	
		Allocated	Catch	Blue leg king	Secondary inshore	231783	0.0192	0.0192	4459	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	5192	0.2258	0.2258	1172	

D.1.0.4 Base plus banana

Table D.4: Results from northern base with banana added (tiger, endeavour, red spot king, sand bug and banana) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
Northern	Ratio	Filtered	Effort	Tiger	Primary inshore	231783	0.9264	1	231783	256904
		Filtered	Effort	Endeavour	Secondary inshore	231783	0.0392	0.0423	9813	
		Filtered	Effort	Banana	Secondary inshore	231783	0.0344	0.0371	8602	
		Filtered	Effort	Red spot king	Primary offshore	5192	0.7742	1	5192	
		Filtered	Effort	Sand bug	Secondary offshore	5192	0.2258	0.2917	1514	
		Allocated	Effort	Tiger	Primary inshore	231783	0.9264	1	231783	256667
		Allocated	Effort	Endeavour	Secondary inshore	231783	0.0382	0.0412	9560	
		Allocated	Effort	Banana	Secondary inshore	231783	0.0354	0.0382	8851	
		Allocated	Effort	Red spot king	Primary offshore	5192	0.8021	1	5192	
		Allocated	Effort	Sand bug	Secondary offshore	5192	0.1979	0.2468	1281	
		Filtered	Catch	Tiger	Primary inshore	231783	0.7559	0.7559	175214	236975
		Filtered	Catch	Endeavour	Secondary inshore	231783	0.2086	0.2086	48347	
		Filtered	Catch	Banana	Secondary inshore	231783	0.0355	0.0355	8221	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	5192	0.2486	0.2486	1291	
		Allocated	Catch	Tiger	Primary inshore	231783	0.7542	0.7542	174810	236975
		Allocated	Catch	Endeavour	Secondary inshore	231783	0.2094	0.2094	48534	
		Allocated	Catch	Banana	Secondary inshore	231783	0.0364	0.0364	8439	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	5192	0.2258	0.2258	1172	

D.1.0.5 Base plus blue leg king and mud bug

Table D.5: Results from northern base with blue leg king and mud bug added (tiger, endeavour, red spot king, sand bug, blue leg king and mud bug) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
Northern	Ratio	Filtered	Effort	Tiger	Primary inshore	231783	0.9538	1	231783	249724
		Filtered	Effort	Endeavour	Secondary inshore	231783	0.0408	0.0428	9925	
		Filtered	Effort	Blue leg king	Secondary inshore	231783	0.0038	0.0039	913	
		Filtered	Effort	Mud bug	Secondary inshore	231783	0.0016	0.0017	396	
		Filtered	Effort	Red spot king	Primary offshore	5192	0.7742	1	5192	
		Filtered	Effort	Sand bug	Secondary offshore	5192	0.2258	0.2917	1514	
		Allocated	Effort	Tiger	Primary inshore	231783	0.9551	1	231783	249143
		Allocated	Effort	Endeavour	Secondary inshore	231783	0.0394	0.0412	9560	
		Allocated	Effort	Blue leg king	Secondary inshore	231783	0.0039	0.0041	949	
		Allocated	Effort	Mud bug	Secondary inshore	231783	0.0016	0.0016	377	
		Allocated	Effort	Red spot king	Primary offshore	5192	0.8021	1	5192	
		Allocated	Effort	Sand bug	Secondary offshore	5192	0.1979	0.2468	1281	
		Filtered	Catch	Tiger	Primary inshore	231783	0.7601	0.7601	176186	236975
		Filtered	Catch	Endeavour	Secondary inshore	231783	0.2078	0.2078	48175	
		Filtered	Catch	Blue leg king	Secondary inshore	231783	0.0187	0.0187	4342	
		Filtered	Catch	Mud bug	Secondary inshore	231783	0.0133	0.0133	3080	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	5192	0.2486	0.2486	1291	
		Allocated	Catch	Tiger	Primary inshore	231783	0.7578	0.7578	175647	236975
		Allocated	Catch	Endeavour	Secondary inshore	231783	0.2095	0.2095	48557	
		Allocated	Catch	Blue leg king	Secondary inshore	231783	0.019	0.019	4395	
		Allocated	Catch	Mud bug	Secondary inshore	231783	0.0137	0.0137	3184	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	5192	0.2258	0.2258	1172	

D.1.0.6 Base plus banana and mud bug

Table D.6: Results from northern base with banana and mud bug added (tiger, endeavour, red spot king, sand bug, banana and mud bug) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
Northern	Ratio	Filtered	Effort	Tiger	Primary inshore	231783	0.9254	1	231783	257180
		Filtered	Effort	Endeavour	Secondary inshore	231783	0.039	0.0421	9762	
		Filtered	Effort	Banana	Secondary inshore	231783	0.0343	0.0371	8595	
		Filtered	Effort	Mud bug	Secondary inshore	231783	0.0013	0.0014	334	
		Filtered	Effort	Red spot king	Primary offshore	5192	0.7742	1	5192	
		Filtered	Effort	Sand bug	Secondary offshore	5192	0.2258	0.2917	1514	
		Allocated	Effort	Tiger	Primary inshore	231783	0.925	1	231783	257044
		Allocated	Effort	Endeavour	Secondary inshore	231783	0.0382	0.0412	9560	
		Allocated	Effort	Banana	Secondary inshore	231783	0.0353	0.0382	8851	
		Allocated	Effort	Mud bug	Secondary inshore	231783	0.0015	0.0016	377	
		Allocated	Effort	Red spot king	Primary offshore	5192	0.8021	1	5192	
		Allocated	Effort	Sand bug	Secondary offshore	5192	0.1979	0.2468	1281	
		Filtered	Catch	Tiger	Primary inshore	231783	0.746	0.746	172909	236975
		Filtered	Catch	Endeavour	Secondary inshore	231783	0.2056	0.2056	47648	
		Filtered	Catch	Banana	Secondary inshore	231783	0.0353	0.0353	8188	
		Filtered	Catch	Mud bug	Secondary inshore	231783	0.0131	0.0131	3037	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	5192	0.2486	0.2486	1291	
		Allocated	Catch	Tiger	Primary inshore	231783	0.7438	0.7438	172397	236975
		Allocated	Catch	Endeavour	Secondary inshore	231783	0.2064	0.2064	47835	
		Allocated	Catch	Banana	Secondary inshore	231783	0.0363	0.0363	8414	
		Allocated	Catch	Mud bug	Secondary inshore	231783	0.0135	0.0135	3137	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	5192	0.2258	0.2258	1172	

D.1.0.7 Base plus blue leg king and banana

Table D.7: Results from northern base with blue leg king and banana added (tiger, endeavour, red spot king, sand bug, blue leg king and banana) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
Northern	Ratio	Filtered	Effort	Tiger	Primary inshore	231783	0.9237	1	231783	257649
		Filtered	Effort	Endeavour	Secondary inshore	231783	0.0382	0.0414	9596	
		Filtered	Effort	Blue leg king	Secondary inshore	231783	0.0038	0.0041	947	
		Filtered	Effort	Banana	Secondary inshore	231783	0.0343	0.0372	8615	
		Filtered	Effort	Red spot king	Primary offshore	5192	0.7742	1	5192	
		Filtered	Effort	Sand bug	Secondary offshore	5192	0.2258	0.2917	1514	
		Allocated	Effort	Tiger	Primary inshore	231783	0.9229	1	231783	257616
		Allocated	Effort	Endeavour	Secondary inshore	231783	0.0381	0.0412	9560	
		Allocated	Effort	Blue leg king	Secondary inshore	231783	0.0038	0.0041	949	
		Allocated	Effort	Banana	Secondary inshore	231783	0.0352	0.0382	8851	
		Allocated	Effort	Red spot king	Primary offshore	5192	0.8021	1	5192	
		Allocated	Effort	Sand bug	Secondary offshore	5192	0.1979	0.2468	1281	
		Filtered	Catch	Tiger	Primary inshore	231783	0.742	0.742	171978	236975
		Filtered	Catch	Endeavour	Secondary inshore	231783	0.2039	0.2039	47264	
		Filtered	Catch	Blue leg king	Secondary inshore	231783	0.0187	0.0187	4330	
		Filtered	Catch	Banana	Secondary inshore	231783	0.0354	0.0354	8211	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	5192	0.2486	0.2486	1291	
		Allocated	Catch	Tiger	Primary inshore	231783	0.74	0.74	171520	236975
		Allocated	Catch	Endeavour	Secondary inshore	231783	0.2052	0.2052	47557	
		Allocated	Catch	Blue leg king	Secondary inshore	231783	0.0185	0.0185	4298	
		Allocated	Catch	Banana	Secondary inshore	231783	0.0363	0.0363	8407	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	5192	0.2258	0.2258	1172	

D.1.0.8 Base plus blue leg king, banana and mud bug

Table D.8: Results from northern base with blue leg king, banana and mud bug added (tiger, endeavour, red spot king, sand bug, blue leg king, banana and mud bug) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
Northern	Ratio	Filtered	Effort	Tiger	Primary inshore	231783	0.9227	1	231783	257914
		Filtered	Effort	Endeavour	Secondary inshore	231783	0.038	0.0412	9556	
		Filtered	Effort	Blue leg king	Secondary inshore	231783	0.0037	0.004	926	
		Filtered	Effort	Banana	Secondary inshore	231783	0.0343	0.0371	8608	
		Filtered	Effort	Mud bug	Secondary inshore	231783	0.0013	0.0014	335	
		Filtered	Effort	Red spot king	Primary offshore	5192	0.7742	1	5192	
		Filtered	Effort	Sand bug	Secondary offshore	5192	0.2258	0.2917	1514	
		Allocated	Effort	Tiger	Primary inshore	231783	0.9215	1	231783	257994
		Allocated	Effort	Endeavour	Secondary inshore	231783	0.038	0.0412	9560	
		Allocated	Effort	Blue leg king	Secondary inshore	231783	0.0038	0.0041	949	
		Allocated	Effort	Banana	Secondary inshore	231783	0.0352	0.0382	8851	
		Allocated	Effort	Mud bug	Secondary inshore	231783	0.0015	0.0016	377	
		Allocated	Effort	Red spot king	Primary offshore	5192	0.8021	1	5192	
		Allocated	Effort	Sand bug	Secondary offshore	5192	0.1979	0.2468	1281	
		Filtered	Catch	Tiger	Primary inshore	231783	0.7326	0.7326	169797	236975
		Filtered	Catch	Endeavour	Secondary inshore	231783	0.2011	0.2011	46617	
		Filtered	Catch	Blue leg king	Secondary inshore	231783	0.0183	0.0183	4253	
		Filtered	Catch	Banana	Secondary inshore	231783	0.0353	0.0353	8178	
		Filtered	Catch	Mud bug	Secondary inshore	231783	0.0127	0.0127	2938	
		Filtered	Catch	Red spot king	Primary offshore	5192	0.7514	0.7514	3901	
		Filtered	Catch	Sand bug	Secondary offshore	5192	0.2486	0.2486	1291	
		Allocated	Catch	Tiger	Primary inshore	231783	0.73	0.73	169205	236975
		Allocated	Catch	Endeavour	Secondary inshore	231783	0.2023	0.2023	46889	
		Allocated	Catch	Blue leg king	Secondary inshore	231783	0.0183	0.0183	4236	
		Allocated	Catch	Banana	Secondary inshore	231783	0.0362	0.0362	8383	
		Allocated	Catch	Mud bug	Secondary inshore	231783	0.0132	0.0132	3069	
		Allocated	Catch	Red spot king	Primary offshore	5192	0.7742	0.7742	4020	
		Allocated	Catch	Sand bug	Secondary offshore	5192	0.2258	0.2258	1172	

D.2 Central region

D.2.0.1 Base

Table D.9: Results from central base (tiger, endeavour, red spot king and sand bug) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
Central	Ratio	Filtered	Effort	Tiger	Primary inshore	111519	0.9627	1	111519	437889
		Filtered	Effort	Endeavour	Secondary inshore	111519	0.0373	0.0388	4326	
		Filtered	Effort	Sand bug	Primary offshore	207992	0.6459	1	207992	
		Filtered	Effort	Red spot king	Secondary offshore	207992	0.3541	0.5483	114051	
		Allocated	Effort	Tiger	Primary inshore	111519	0.9925	1	111519	423618
		Allocated	Effort	Endeavour	Secondary inshore	111519	0.0075	0.0076	848	
		Allocated	Effort	Sand bug	Primary offshore	207992	0.6682	1	207992	
		Allocated	Effort	Red spot king	Secondary offshore	207992	0.3318	0.4964	103258	
		Filtered	Catch	Tiger	Primary inshore	111519	0.8964	0.8964	99962	319512
		Filtered	Catch	Endeavour	Secondary inshore	111519	0.1036	0.1036	11557	
		Filtered	Catch	Sand bug	Parimary offshore	207992	0.6003	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	207992	0.3997	0.3997	83144	
		Allocated	Catch	Tiger	Primary inshore	111519	0.9135	0.9135	101874	319512
		Allocated	Catch	Endeavour	Secondary inshore	111519	0.0865	0.0865	9646	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	207992	0.3784	0.3784	78711	

D.2.0.2 Base plus mud bug

Table D.10: Results from central base with mud bug added (tiger, endeavour, red spot king, sand bug and mud bug) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
Central	Ratio	Filtered	Effort	Tiger	Primary inshore	111519	0.9411	1	111519	440546
		Filtered	Effort	Endeavour	Secondary inshore	111519	0.0272	0.0289	3221	
		Filtered	Effort	Mud bug	Secondary inshore	111519	0.0317	0.0337	3762	
		Filtered	Effort	Sand bug	Primary offshore	207992	0.6459	1	207992	
		Filtered	Effort	Red spot king	Secondary offshore	207992	0.3541	0.5483	114051	
		Allocated	Effort	Tiger	Primary inshore	111519	0.9466	1	111519	429055
		Allocated	Effort	Endeavour	Secondary inshore	111519	0.0072	0.0076	848	
		Allocated	Effort	Mud bug	Secondary inshore	111519	0.0462	0.0488	5437	
		Allocated	Effort	Sand bug	Primary offshore	207992	0.6682	1	207992	
		Allocated	Effort	Red spot king	Secondary offshore	207992	0.3318	0.4964	103258	
		Filtered	Catch	Tiger	Primary inshore	111519	0.8562	0.8562	95486	319512
		Filtered	Catch	Endeavour	Secondary inshore	111519	0.0983	0.0983	10966	
		Filtered	Catch	Mud bug	Secondary inshore	111519	0.0454	0.0454	5068	
		Filtered	Catch	Sand bug	Parimary offshore	207992	0.6003	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	207992	0.3997	0.3997	83144	
		Allocated	Catch	Tiger	Primary inshore	111519	0.8588	0.8588	95769	319512
		Allocated	Catch	Endeavour	Secondary inshore	111519	0.0823	0.0823	9180	
		Allocated	Catch	Mud bug	Secondary inshore	111519	0.0589	0.0589	6570	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	207992	0.3784	0.3784	78711	

D.2.0.3 Base plus blue leg king

Table D.11: Results from central base with blue leg king added (tiger, endeavour, red spot king, sand bug and blue leg king) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
central	Ratio	Filtered	Effort	Tiger	Primary inshore	111519	0.7917	1	111519	462897
		Filtered	Effort	Endeavour	Secondary inshore	111519	0.0147	0.0185	2067	
		Filtered	Effort	Blue leg king	Secondary inshore	111519	0.1936	0.2445	27267	
		Filtered	Effort	Sand bug	Primary offshore	207992	0.6459	1	207992	
		Filtered	Effort	Red spot king	Secondary offshore	207992	0.3541	0.5483	114051	
		Allocated	Effort	Tiger	Primary inshore	111519	0.835	1	111519	444809
		Allocated	Effort	Endeavour	Secondary inshore	111519	0.0063	0.0076	848	
		Allocated	Effort	Blue leg king	Secondary inshore	111519	0.1587	0.19	21192	
		Allocated	Effort	Sand bug	Primary offshore	207992	0.6682	1	207992	
		Allocated	Effort	Red spot king	Secondary offshore	207992	0.3318	0.4964	103258	
		Filtered	Catch	Tiger	Primary inshore	111519	0.7329	0.7329	81732	319512
		Filtered	Catch	Endeavour	Secondary inshore	111519	0.0797	0.0797	8887	
		Filtered	Catch	Blue leg king	Secondary inshore	111519	0.1874	0.1874	20900	
		Filtered	Catch	Sand bug	Parimary offshore	207992	0.6003	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	207992	0.3997	0.3997	83144	
		Allocated	Catch	Tiger	Primary inshore	111519	0.7692	0.7692	85786	319512
		Allocated	Catch	Endeavour	Secondary inshore	111519	0.0728	0.0728	8116	
		Allocated	Catch	Blue leg king	Secondary inshore	111519	0.158	0.158	17617	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	207992	0.3784	0.3784	78711	

D.2.0.4 Base plus banana

Table D.12: Results from central base with banana added (tiger, endeavour, red spot king, sand bug and banana) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
Central	Ratio	Filtered	Effort	Tiger	Primary inshore	111519	0.8616	1	111519	451469
		Filtered	Effort	Endeavour	Secondary inshore	111519	0.0221	0.0256	2856	
		Filtered	Effort	Banana	Secondary inshore	111519	0.1163	0.135	15050	
		Filtered	Effort	Sand bug	Primary offshore	207992	0.6459	1	207992	
		Filtered	Effort	Red spot king	Secondary offshore	207992	0.3541	0.5483	114051	
		Allocated	Effort	Tiger	Primary inshore	111519	0.8663	1	111519	439987
		Allocated	Effort	Endeavour	Secondary inshore	111519	0.0066	0.0076	848	
		Allocated	Effort	Banana	Secondary inshore	111519	0.1272	0.1468	16370	
		Allocated	Effort	Sand bug	Primary offshore	207992	0.6682	1	207992	
		Allocated	Effort	Red spot king	Secondary offshore	207992	0.3318	0.4964	103258	
		Filtered	Catch	Tiger	Primary inshore	111519	0.7926	0.7926	88395	319512
		Filtered	Catch	Endeavour	Secondary inshore	111519	0.089	0.089	9920	
		Filtered	Catch	Banana	Secondary inshore	111519	0.1184	0.1184	13205	
		Filtered	Catch	Sand bug	Parimary offshore	207992	0.6003	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	207992	0.3997	0.3997	83144	
		Allocated	Catch	Tiger	Primary inshore	111519	0.7954	0.7954	88702	319512
		Allocated	Catch	Endeavour	Secondary inshore	111519	0.0758	0.0758	8452	
		Allocated	Catch	Banana	Secondary inshore	111519	0.1288	0.1288	14366	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	207992	0.3784	0.3784	78711	

D.2.0.5 Base plus blue leg king and mud bug

Table D.13: Results from central base with blue leg king and mud bug added (tiger, endeavour, red spot king, sand bug, blue leg king and mud bug) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
Central	Ratio	Filtered	Effort	Tiger	Primary inshore	111519	0.7808	1	111519	464878
		Filtered	Effort	Endeavour	Secondary inshore	111519	0.0145	0.0185	2067	
		Filtered	Effort	Blue leg king	Secondary inshore	111519	0.1832	0.2346	26166	
		Filtered	Effort	Mud bug	Secondary inshore	111519	0.0216	0.0276	3081	
		Filtered	Effort	Sand bug	Primary offshore	207992	0.6459	1	207992	
		Filtered	Effort	Red spot king	Secondary offshore	207992	0.3541	0.5483	114051	
		Allocated	Effort	Tiger	Primary inshore	111519	0.8023	1	111519	450246
		Allocated	Effort	Endeavour	Secondary inshore	111519	0.0061	0.0076	848	
		Allocated	Effort	Blue leg king	Secondary inshore	111519	0.1525	0.19	21192	
		Allocated	Effort	Mud bug	Secondary inshore	111519	0.0391	0.0488	5437	
		Allocated	Effort	Sand bug	Primary offshore	207992	0.6682	1	207992	
		Allocated	Effort	Red spot king	Secondary offshore	207992	0.3318	0.4964	103258	
		Filtered	Catch	Tiger	Primary inshore	111519	0.7091	0.7091	79074	319512
		Filtered	Catch	Endeavour	Secondary inshore	111519	0.0768	0.0768	8560	
		Filtered	Catch	Blue leg king	Secondary inshore	111519	0.1814	0.1814	20233	
		Filtered	Catch	Mud bug	Secondary inshore	111519	0.0328	0.0328	3652	
		Filtered	Catch	Sand bug	Parimary offshore	207992	0.6003	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	207992	0.3997	0.3997	83144	
		Allocated	Catch	Tiger	Primary inshore	111519	0.7286	0.7286	81257	319512
		Allocated	Catch	Endeavour	Secondary inshore	111519	0.0698	0.0698	7780	
		Allocated	Catch	Blue leg king	Secondary inshore	111519	0.1523	0.1523	16983	
		Allocated	Catch	Mud bug	Secondary inshore	111519	0.0493	0.0493	5500	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	207992	0.3784	0.3784	78711	

D.2.0.6 Base plus banana and mud bug

Table D.14: Results from central base with banana and mud bug added (tiger, endeavour, red spot king, sand bug, banana and mud bug) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
Central	Ratio	Filtered	Effort	Tiger	Primary inshore	111519	0.841	1	111519	454644
		Filtered	Effort	Endeavour	Secondary inshore	111519	0.0205	0.0244	2725	
		Filtered	Effort	Banana	Secondary inshore	111519	0.1146	0.1363	15197	
		Filtered	Effort	Mud bug	Secondary inshore	111519	0.0238	0.0283	3159	
		Filtered	Effort	Sand bug	Primary offshore	207992	0.6459	1	207992	
		Filtered	Effort	Red spot king	Secondary offshore	207992	0.3541	0.5483	114051	
		Allocated	Effort	Tiger	Primary inshore	111519	0.8312	1	111519	445424
		Allocated	Effort	Endeavour	Secondary inshore	111519	0.0063	0.0076	848	
		Allocated	Effort	Banana	Secondary inshore	111519	0.122	0.1468	16370	
		Allocated	Effort	Mud bug	Secondary inshore	111519	0.0405	0.0488	5437	
		Allocated	Effort	Sand bug	Primary offshore	207992	0.6682	1	207992	
		Allocated	Effort	Red spot king	Secondary offshore	207992	0.3318	0.4964	103258	
		Filtered	Catch	Tiger	Primary inshore	111519	0.7625	0.7625	85034	319512
		Filtered	Catch	Endeavour	Secondary inshore	111519	0.085	0.085	9481	
		Filtered	Catch	Banana	Secondary inshore	111519	0.1163	0.1163	12971	
		Filtered	Catch	Mud bug	Secondary inshore	111519	0.0362	0.0362	4034	
		Filtered	Catch	Sand bug	Parimary offshore	207992	0.6003	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	207992	0.3997	0.3997	83144	
		Allocated	Catch	Tiger	Primary inshore	111519	0.7522	0.7522	83883	319512
		Allocated	Catch	Endeavour	Secondary inshore	111519	0.0726	0.0726	8091	
		Allocated	Catch	Banana	Secondary inshore	111519	0.1233	0.1233	13746	
		Allocated	Catch	Mud bug	Secondary inshore	111519	0.052	0.052	5799	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	207992	0.3784	0.3784	78711	

D.2.0.7 Base plus blue leg king and banana

Table D.15: Results from central base with blue leg king and banana added (tiger, endeavour, red spot king, sand bug, blue leg king and banana) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
Central	Ratio	Filtered	Effort	Tiger	Primary inshore	111519	0.7153	1	111519	477943
		Filtered	Effort	Endeavour	Secondary inshore	111519	0.0105	0.0146	1631	
		Filtered	Effort	Blue leg king	Secondary inshore	111519	0.1729	0.2417	26951	
		Filtered	Effort	Banana	Secondary inshore	111519	0.1013	0.1417	15798	
		Filtered	Effort	Sand bug	Primary offshore	207992	0.6459	1	207992	
		Filtered	Effort	Red spot king	Secondary offshore	207992	0.3541	0.5483	114051	
		Allocated	Effort	Tiger	Primary inshore	111519	0.7438	1	111519	461179
		Allocated	Effort	Endeavour	Secondary inshore	111519	0.0057	0.0076	848	
		Allocated	Effort	Blue leg king	Secondary inshore	111519	0.1413	0.19	21192	
		Allocated	Effort	Banana	Secondary inshore	111519	0.1092	0.1468	16370	
		Allocated	Effort	Sand bug	Primary offshore	207992	0.6682	1	207992	
		Allocated	Effort	Red spot king	Secondary offshore	207992	0.3318	0.4964	103258	
		Filtered	Catch	Tiger	Primary inshore	111519	0.6572	0.6572	73293	319512
		Filtered	Catch	Endeavour	Secondary inshore	111519	0.0692	0.0692	7712	
		Filtered	Catch	Blue leg king	Secondary inshore	111519	0.1705	0.1705	19018	
		Filtered	Catch	Banana	Secondary inshore	111519	0.1031	0.1031	11497	
		Filtered	Catch	Sand bug	Parimary offshore	207992	0.6003	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	207992	0.3997	0.3997	83144	
		Allocated	Catch	Tiger	Primary inshore	111519	0.6837	0.6837	76250	319512
		Allocated	Catch	Endeavour	Secondary inshore	111519	0.0651	0.0651	7258	
		Allocated	Catch	Blue leg king	Secondary inshore	111519	0.1402	0.1402	15633	
		Allocated	Catch	Banana	Secondary inshore	111519	0.111	0.111	12379	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	207992	0.3784	0.3784	78711	

D.2.0.8 Base plus blue leg king, banana and mud bug

Table D.16: Results from central base with blue leg king, banana and mud bug added (tiger, endeavour, red spot king, sand bug, blue leg king, banana and mud bug) using the ratio method

Region	Method	Spatial	Targeting	Species	Species importance	Un-adjusted effort units	Co-caught adjustment	Re-scaled species co-caught adjustment	Adjusted effort units	Total
Central	Ratio	Filtered	Effort	Tiger	Primary inshore	111519	0.706	1	111519	479996
		Filtered	Effort	Endeavour	Secondary inshore	111519	0.0099	0.014	1559	
		Filtered	Effort	Blue leg king	Secondary inshore	111519	0.168	0.238	26544	
		Filtered	Effort	Banana	Secondary inshore	111519	0.1006	0.1425	15896	
		Filtered	Effort	Mud bug	Secondary inshore	111519	0.0154	0.0218	2435	
		Filtered	Effort	Sand bug	Primary offshore	207992	0.6459	1	207992	
		Filtered	Effort	Red spot king	Secondary offshore	207992	0.3541	0.5483	114051	
		Allocated	Effort	Tiger	Primary inshore	111519	0.7178	1	111519	466616
		Allocated	Effort	Endeavour	Secondary inshore	111519	0.0055	0.0076	848	
		Allocated	Effort	Blue leg king	Secondary inshore	111519	0.1364	0.19	21192	
		Allocated	Effort	Banana	Secondary inshore	111519	0.1054	0.1468	16370	
		Allocated	Effort	Mud bug	Secondary inshore	111519	0.035	0.0488	5437	
		Allocated	Effort	Sand bug	Primary offshore	207992	0.6682	1	207992	
		Allocated	Effort	Red spot king	Secondary offshore	207992	0.3318	0.4964	103258	
		Filtered	Catch	Tiger	Primary inshore	111519	0.6393	0.6393	71293	319512
		Filtered	Catch	Endeavour	Secondary inshore	111519	0.067	0.067	7471	
		Filtered	Catch	Blue leg king	Secondary inshore	111519	0.1659	0.1659	18505	
		Filtered	Catch	Banana	Secondary inshore	111519	0.1021	0.1021	11385	
		Filtered	Catch	Mud bug	Secondary inshore	111519	0.0257	0.0257	2866	
		Filtered	Catch	Sand bug	Parimary offshore	207992	0.6003	0.6003	124848	
		Filtered	Catch	Red spot king	Secondary offshore	207992	0.3997	0.3997	83144	
		Allocated	Catch	Tiger	Primary inshore	111519	0.6504	0.6504	72537	319512
		Allocated	Catch	Endeavour	Secondary inshore	111519	0.0627	0.0627	6987	
		Allocated	Catch	Blue leg king	Secondary inshore	111519	0.1357	0.1357	15132	
		Allocated	Catch	Banana	Secondary inshore	111519	0.1069	0.1069	11918	
		Allocated	Catch	Mud bug	Secondary inshore	111519	0.0443	0.0443	4946	
		Allocated	Catch	Sand bug	Primary offshore	207992	0.6216	0.6216	129281	
		Allocated	Catch	Red spot king	Secondary offshore	207992	0.3784	0.3784	78711	