

A Survey of Recreational Fishing in the Greater Darwin Area 2015

Fishery Report No. 121



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1. Summary

1.1. Background

This report summarises the key results from the 'Survey of Recreational Fishing in the Greater Darwin Area 2015'. The report includes detailed information relating to recreational fishing activities in the coastal area surrounding Darwin. Specifically, the report includes details on where people fish, how much time they spend fishing (effort), what fishing methods they use, and the type and number of fish harvested or released during the survey period. Additional information is provided on the size (length) of some socially important fish species as well as details on the size of recreational fishing vessels and level of technology used by recreational anglers.

The methodology applied during this survey follows that of the *Survey of Recreational Fishing in the Greater Darwin Area 2014* (Matthews et al. 2019), allowing comparisons of results between years.

The results of both reports will be incorporated into future stock assessments and harvest strategy development and will benefit the recreational fishing sector by ensuring that our Top End fisheries are managed in a sustainable way.

1.2. Survey methods

On-site surveys were conducted at selected boat ramps between Dundee Beach and the mouth of the Adelaide River. A conventional access-point methodology was utilised with a combination of fisher interviews and estimates of effort based on trailer counts.

The total fishing effort (fisher hours), the number of fish harvested (kept) and the number of fish released were estimated for the recreational fishery in the Greater Darwin Area.

1.3. Key results

1.3.1. Effort

During the survey period from 1 March 2015 to 30 November 2015, recreational fishers (both residents and visitors) spent an estimated total of 513 055 hours fishing in the Greater Darwin Area.

Line fishing (using bait, lures or flies) was the most common fishing method used, accounting for 72% of the total effort, followed by Mud Crab potting (23%). The use of cast nets and other fishing methods was far less common. Approximately 70% of all recreational fishing effort occurred in estuarine waters.

The Darwin Harbour region and its associated arms and creeks supported 40% of the total fishing effort, followed by Bynoe Harbour (14%) and Shoal Bay (6%). The offshore regions seaward of Bynoe Harbour and Dundee were the most popular sites for those fishers venturing beyond estuarine waters.

Fishing effort was fairly consistent across the survey period, although activity during the build-up period (September-November) was slightly higher than in other seasons. An estimated 22.5% of all fishing effort was attributed to vessels using the Dundee Beach boat ramp. Significant levels of effort were also estimated for vessels using the Dinah Beach ramp (16.5%) and the East Arm ramp (9.2%).

The proportion of visiting angler effort (interstate or overseas) varied throughout the survey period and peaked during the dry season at 16.6% of the total fishing effort.

1.3.2. Catch

During the survey period from 1 March 2015 to 30 November 2015, recreational fishers (both residents and visitors) caught an estimated 496 952 aquatic organisms from the Greater Darwin Area. Most of the catch (84%) comprised of fish species (i.e. bony fish and sharks/rays) with the bulk of the remaining catch consisting of crabs and prawns.

Over 111 000 tropical snappers of the genus *Lutjanus* (e.g. Golden Snapper, Stripey Snapper, Indonesian Snapper and other tropical snappers) were caught and formed a major component (26.7%) of the total fish catch and were a major contributor to the reef fish catch. Golden Snapper was the most commonly caught fish accounting for 12.4% of the total fish catch.

Approximately 77 600 individual crustaceans were captured during the survey period, composed primarily of Mud Crabs (80.9%) and marine prawns (13.5%).

Almost 69% of all fish and 40% of crustaceans caught were released; however, actual release rates varied significantly depending on species. High release rates were reported for sharks/rays and catfish, whereas very low release rates were reported for mullet, whiting and King Threadfin.

Sixty five per cent of all captures by recreational anglers in the Greater Darwin Area occurred in estuarine waters and 35% in offshore waters. Mud Crab was the most frequently caught species in estuarine waters, accounting for 19% of the overall catch. Excluding baitfish species, the most common fish species caught in estuaries were Golden Snapper and Barramundi. Stripey Snapper was the most common fish species caught offshore followed by Golden Snapper, emperors and sharks/rays.

Golden Snapper and Stripey Snapper were the most common species caught by line fishing methods. Mud Crabs dominated the catch by pots and mullet dominated the catch from cast nets followed by other baitfish species.

The Bynoe Harbour/Dundee fishing zone represented an area of high importance for the capture of reef fish, with Golden Snapper, Stripey Snapper and emperor dominating the catch. Mud Crabs only represented 2.8% of the total catch from this zone. By contrast, the Darwin Harbour/Surrounds fishing zone was very important for the capture of Mud Crabs as it accounted for over 18.5% of the total catch from this zone. Excluding baitfish species, the most commonly captured fish species in the Darwin Harbour/Surrounds fishing zone were Golden Snapper and cod/groupers.

The Bynoe/Dundee offshore region was the most significant area, producing 16% of the total catch of all aquatic organisms followed by Darwin Harbour with 12% and Bynoe Harbour with 11% (Figure 17, Appendix 7). Collectively, Darwin Harbour and its associated arms and creeks produced 38% of the total catch.

The Bynoe/Dundee offshore region dominated the fish catch with 18.8% of the total fish numbers coming from this area. This catch was composed primarily of reef fish species. The Bynoe Harbour region had the next highest catch of fish with 12.9%, primarily due to high numbers of Golden Snapper, mullet and Barramundi.

Overall, catch composition varied by season but Mud Crabs remained the most commonly caught species throughout the survey period. The most commonly caught fish species in both the run-off (March-May) and the build-up (September-November) period was Golden Snapper, whereas Stripey Snapper, cod/groupers and Golden Snapper dominated the fish catch during the dry season (June-August) months.

1.3.3. Length and sex data

Length data (total length) of harvested fish was recorded for the key species of Golden Snapper, Black Jewfish and Barramundi. The length of Golden Snappers harvested ranged from 20 to 80 cm, with a mean length of 39 cm. The length of Black Jewfish harvested ranged from 40 to 135 cm, with a mean length of 81 cm. The length of Barramundi harvested ranged from 53 to 98 cm, with a mean length of 64 cm.

A vast majority (87%) of captured male Mud Crabs were kept, whereas less than half (46%) of caught female Mud Crabs were kept.

1.3.4. Vessel characteristics

More than 80% of the surveyed recreational fishing vessels were 4.5 m or longer in length. Most vessels (92%) had sounders fitted and more than 82% of vessels had a form of Global Positioning System (GPS) on board.

1.4. Future research

Another survey of the Greater Darwin Area was planned to take place in 2016. This would be the third such survey of the Darwin area. These successive surveys, using similar methodologies, will help determine estimates of inter-annual variation in fish populations and provide sound information on which to base future sustainable management of Northern Territory fish stocks.

2. Introduction

2.1. Background

Recreational fishing is a popular lifestyle activity in the Northern Territory (NT) and angling-related expenditure forms a significant component of the local economy. A national recreational fishing survey in 2000-01 revealed that the NT had the highest resident participation rate of any state/territory in Australia (at 32% or 44 000 resident fishers) and the highest proportion of interstate visiting anglers (over 35 000 fishers) (Henry and Lyle 2003). In addition, the most recent NT-wide survey in 2009-10 indicated that NT residents spend in excess of \$50 million annually in relation to recreational fishing (West et al. 2012). This figure did not include expenditure by visiting anglers, or money spent on charter fishing operations. Therefore, the overall annual expenditure could be in the vicinity of \$80 million (NT Government 2012; NT Government 2015).

Recognising the importance of recreational fishing to the Top End, the NT Government commissioned several major research projects over the years to monitor this activity (West et al. 2012). The most recent NT-wide survey took place in 2009-10 and highlighted the significance of the recreational catch of some of our most vulnerable reef fish species.

Recent stock assessments on Black Jewfish (*Protonibea diacanthus*) and Golden Snapper (*Lutjanus johnii*) indicate that both species are at high risk of depletion in the Greater Darwin Area, due to increasing fishing pressure (Saunders et al., 2014a; 2014b). Although these species are some of the most heavily targeted reef fishes in NT waters, other reef-associated species (such as emperors and other snappers) may also be under threat.

Reef fish are targeted more efficiently than ever before due to advances in fishing technology, enhanced information sharing and improvements in access to popular areas. Biological traits, such as susceptibility to barotrauma, are also likely to exacerbate the problem as most deep-water reef fishes experience serious physical damage as a result of capture and are unlikely to survive after release. Additionally, many of popular reef fish species are long-lived and late-maturing, with a low reproductive success that makes them susceptible to over exploitation

Given the significance and anticipated growth of recreational fishing in the NT, appropriate monitoring of this sector is essential to ensure the effective management and future sustainability of target species. The absence of up-to-date information for recreational fishery assessments represents a high risk to sustainable management and impedes effective whole-of-fishery management in the NT. These risks are heightened in areas where commercial fishing is prohibited, as recreational fishing represents the only potential source of fishery-dependent data for assessment.

To ensure the fishery resources of the NT remain sustainable, the NT Government provided a level of ongoing funding to monitor fish stocks to benefit recreational fishing. The cost involved in conducting an 'NT-wide' recreational fishing survey is substantial. It was therefore considered appropriate to monitor a discrete geographical area where fish stocks are under significant pressure. Given recent concerns regarding the sustainability of reef fish in the Greater Darwin region, the survey effort was directed towards increasing our knowledge of the impact of recreational fishing in this area.

This resulted in the 'Survey of Recreational Fishing in the Greater Darwin Area 2014' and involved a series of access-point surveys conducted at selected boat ramps between Dundee Beach and the Adelaide River mouth. This area was chosen for monitoring as it represents the region with the greatest recreational fishing pressure (West et al. 2012) and could provide a reasonable estimate of the impact on vulnerable reef fish species.

Following completion of the 2014 survey, funding was utilised to conduct a repeat of the survey in 2015. A similar access-point methodology was employed for this study in order to compare results between 2014 and 2015.

2.2. Objectives

The primary focus of the survey was to collect data on recreational fishing catch and effort in the Greater Darwin Area with a focus on coastal fishing activity and vulnerable reef fish species. The specific objectives were to:

- estimate the annual catch (harvest and release) by number and effort (fisher hours) for key fish and other species;
- collect relevant biological information on some socially important fish and crustacean species; and
- collect information on vessel size and technological aids such as sounders and GPS.

2.3. Notes to the reader

A large amount of information was collected on recreational fishing in the Greater Darwin Area during the survey period. This report is a summary of the key findings.

While reading this report, the following points should be considered:

- The report has been presented using the same format as previous recreational fishing surveys in the NT and uses identical methodology to the 2014 survey. However, before making any quantitative comparison with the information obtained from other previous NT surveys, such as the 2009 survey, changes in the survey scope and methodology should be noted.
- Key terms and definitions used in the document are defined in Appendix 1.
- The results presented here are in the form of expanded estimates and relative percentages, often without commentary or interpretation.
- The grand totals and group totals in the tables have been estimated as separate variables from the survey data. Consequently, the estimated totals do not equal the sum of individual line items (i.e. other taxa in the group or entire table).
- Relative percentages have been rounded to the nearest integer. For example, a result showing 0% of effort for a particular region does not necessarily mean that no fishing occurred there; it simply means that the level of effort was very small (i.e. <0.5%).
- In those cases where expanded estimates are represented in histograms, they are also expressed numerically in tables included in the appendices.

- Standard errors (SE) are calculated and included in most figures and tables to account for statistical uncertainty associated with an estimate.
- The estimated values for total catch and effort are underestimates of the true values. Budgetary and logistic constraints necessitated the omission of night-time fishing, freshwater fishing, land-based fishing and ultimately, wet-season fishing. These omissions are consistent with the previous on-site surveys conducted in 2009 and 2014.

3. Survey method and analysis

3.1. Survey scope

Recreational fishing was broadly defined as the capture or attempted capture of aquatic animals in NT waters other than for commercial purposes. All recreational fishing techniques and harvesting activities carried out in salt water were considered in-scope, including line-fishing, potting, nets, spears, and hand and dive collection. The survey included saltwater boat-based fishing activity conducted during daylight hours when the majority of all fishing activity occurs. Resident and non-resident fishers over five years of age were included within the scope. Shore-based fishing was not covered by the survey.

The geographical scope of the survey included the coastal zone extending from Dundee Beach (to the west of Darwin) to the mouth of the Adelaide River (specifically Saltwater Arm, to the east of Darwin). This area receives the highest recreational fishing effort within the NT (West et al. 2012) and is the area in which reef fish stocks are considered to be most at risk of “overfishing” (Saunders et al. 2014a; 2014b).

3.2. Survey zones

The Greater Darwin Area was divided into two zones that were surveyed independently: (a) the Darwin Harbour/Surrounds zone and (b) the Bynoe Harbour/Dundee zone (Figure 1). The Darwin Harbour/Surrounds zone had 11 boat ramps within Darwin Harbour and two ramps to the east of Darwin at Adelaide River (Saltwater Arm) and Leaders Creek. The Bynoe Harbour/Dundee zone had five boat ramps within Bynoe Harbour and included the coastal ramp at Dundee Beach (Figure 1).

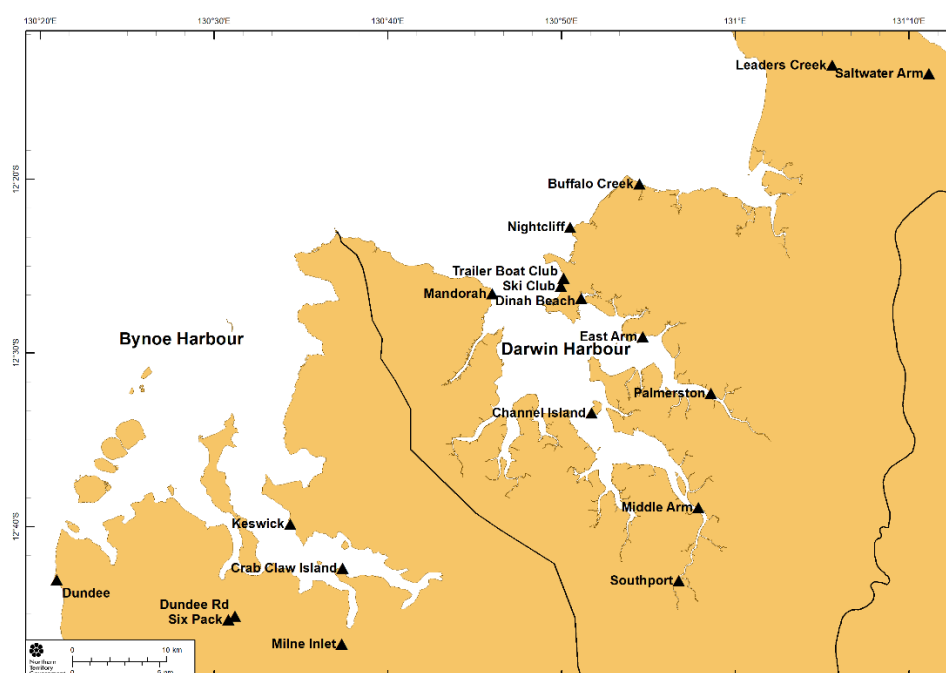


Figure 1. Map of the Greater Darwin Area showing locations of public boat ramps

3.3. Primary and secondary boat ramps

Prior knowledge of fishing activity targeting coastal reef fish (Henry and Lyle 2003, West et al. 2012) was used to categorise boat ramps as either primary or secondary access sites (Table 1). Different survey sampling strategies were used at primary and secondary access sites. The primary ramps were included in the main survey that collected information about catch, fishing effort, catch rates, fish sizes, fishing regions visited, fishing activities undertaken and the residential status of fishers. Secondary boat ramps were only visited to obtain counts of trailers (Table 1).

Table 1. Primary and secondary boat ramps included in the Darwin Harbour/Surrounds (DHS) and Bynoe Harbour/Dundee (BD) fishing zones

Boat Ramp Number		Fishing zone	Interviews conducted	Trailer counts conducted
<i>Primary</i>				
1	Buffalo Creek	DHS	✓	✓
2	Dinah Beach	DHS	✓	✓
5	East Arm	DHS	✓	✓
6	Nightcliff	DHS	✓	✓
10	Middle Arm	DHS	✓	✓
12	Leaders Creek	DHS	✓	✓
15	Six Pack	BD	✓	✓
16	Keswick	BD	✓	✓
21	Dundee	BD	✓	✓
22	Saltwater Arm	DHS	✓	✓
<i>Secondary</i>				
3	Ski Club	DHS		✓
4	Channel Island	DHS		✓
7	Palmerston	DHS		✓
8	Trailer Boat Club	DHS		✓
9	Mandorah	DHS		✓
11	Southport	DHS		✓
13	Crab Claw Island	BD		✓
14	Milne Inlet	BD		✓
23	Dundee Road	BD		✓

Three boat ramps and access points were excluded from the survey. These were Vestey's beach (a rarely used access point), Larrakeyah ramp (a military base with no public access) and Cullen Bay Marina (a private facility for residents and charter operators). The boat ramp in the upper Adelaide River was excluded as it is used to access freshwater fishing locations.

3.4. Survey design and sampling at primary ramps

Access point surveys (Pollock et al. 1994) were conducted at the primary boat ramps in the two survey zones between 1 December 2014 and 30 November 2015 (Figure 1). The primary sampling unit was a calendar day. Stratified random sampling protocols were used. The survey year was divided into seasonal strata: run-off (March, April and May), dry (June, July and August), and build-up (September, October and November) (Appendix 2). Limited sampling was undertaken during the wet season (December, January and February) but this data was excluded from the final analysis. Day-type stratification was used within each season (i.e. weekday or weekend days and public holidays). Each calendar date was stratified into two five-hour shifts: early (09:00-14:00) and late (14:00-19:00).

Three survey days were randomly allocated to each day-type stratum within a season at each primary boat ramp. A survey shift was then randomly allocated to each survey day. However, logistic issues resulted in some over-sampling and under-sampling at different access sites. A summary of sampling at primary boat ramps is given in Appendix 3.

3.4.1. Data collected at primary ramps

Interviews with fishing parties were conducted at all primary ramps. A variety of data elements were collected during the interview process. The information often collected directly by the trained survey staff included identification and number of fish retained (i.e. harvest), the size of fish retained and the number of returning vessels that had been involved in recreational fishing activities. Many other data elements were self-reported by the fishers (e.g. identification and number of fish released, time spent fishing, activity undertaken and fishing region visited). These self-reported data elements may be less accurate than the data that is derived from direct observation. A description of the data elements collected during interviews is provided below.

3.4.2. Fishing regions

Fishing regions categorised by West et al. (2012) were used to quantify the spatial extent of fishing activity (Figures 2 and 3). Detailed catch and effort data was collected for all individual fishing regions and was combined to obtain estimates for the fishing zones (Table 2).

Table 2. Fishing zones and their fishing regions

Fishing zone	Regions included
Darwin Harbour/Surrounds	8, 9, 10, 10a, 10b, 10c, 11, 12, 13, 44, 45, 46* & 60
Bynoe Harbour/Dundee	6, 7, 42 & 43

* Note that no catch or effort was recorded from region 46 during the survey period.

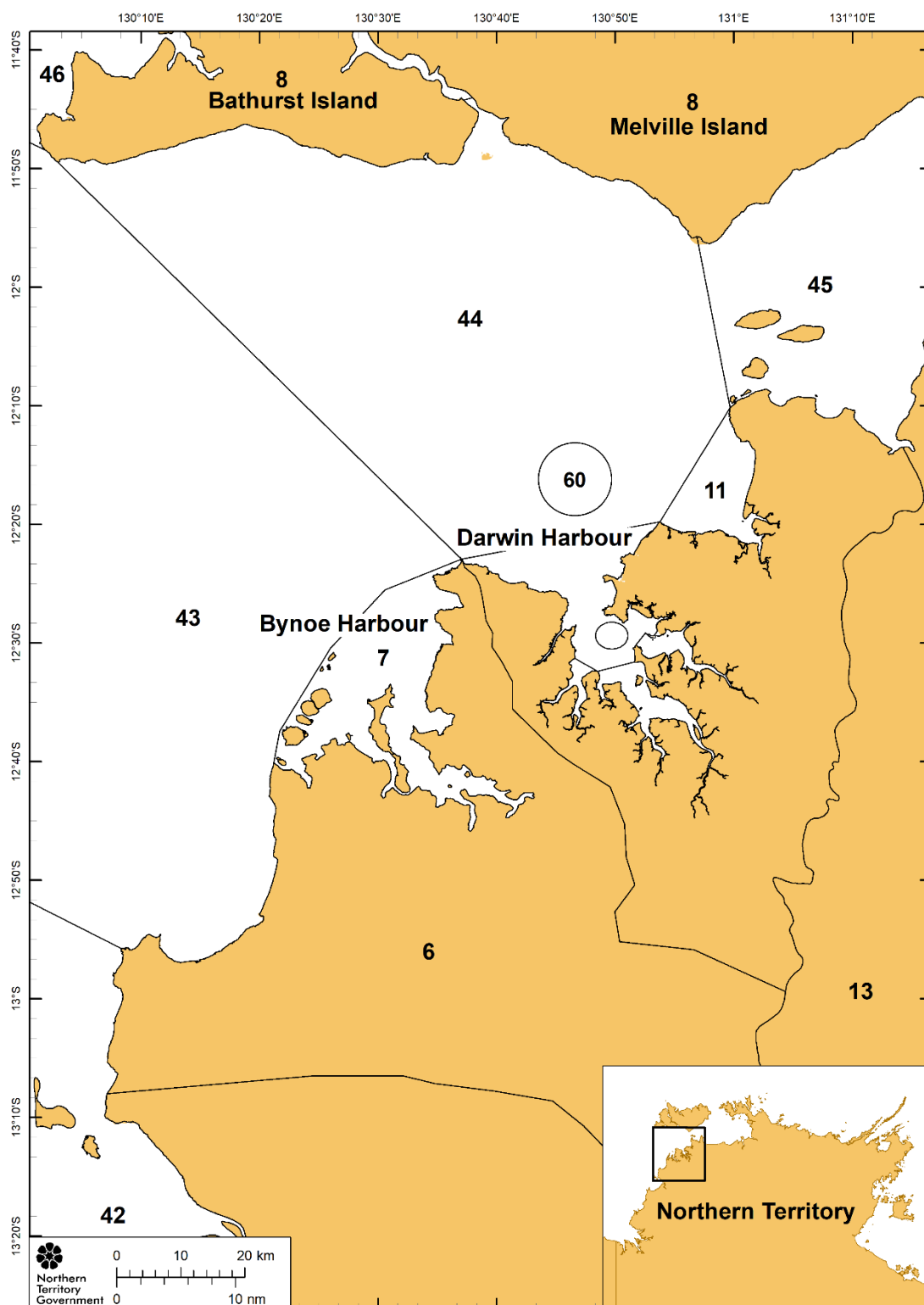


Figure 2. Map of the the fishing regions (numbered) used for reporting purposes. See Figure 3 for a detailed map of the Darwin Harbour area.

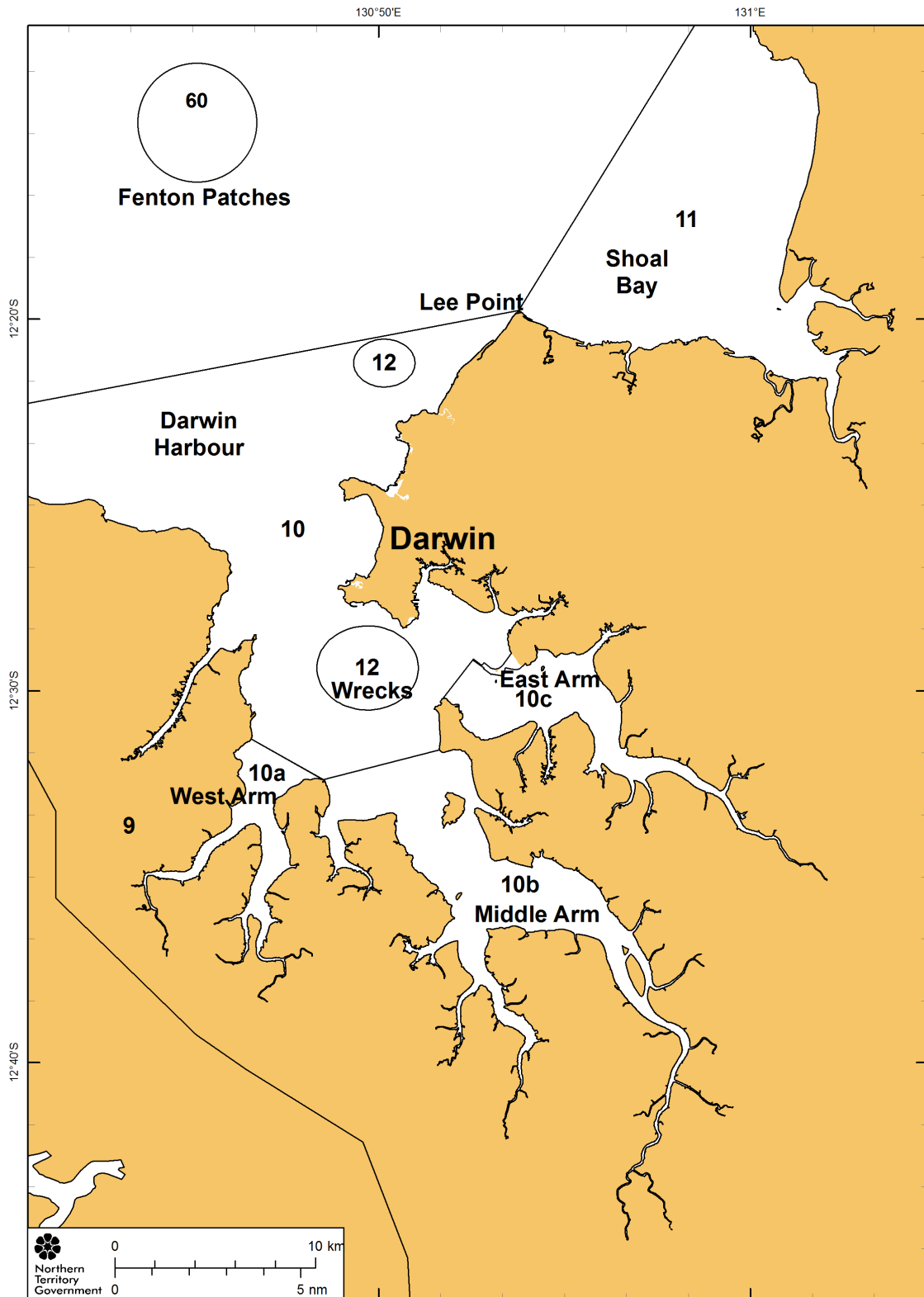


Figure 3. Map of the Darwin Harbour area showing fishing regions used for reporting purposes

3.4.3. Fishing events

Interviewers collected information on an 'event' basis, with an event being defined as a discrete fishing episode. Separate fishing events were recorded when there was a change in the fishing region or method used. Therefore, a day's fishing could consist of a number of fishing events. For example, line fishing in region 10 would be considered a separate event to line fishing in region 12, even if conducted by the same fishing party on the same day. Similarly, the cast netting of fish would be considered a separate event to using line methods to catch fish. The delineation of fishing activity in this way enabled the partitioning of catch and effort on the basis of gear type and fishing region.

3.4.4. Fishing gear

The following gear categories were recorded for individual fishing events during interviews held at primary ramps:

- Line fishing (bait/lure or fly).
- Potting (pot/trap).
- Cast net.
- Other gear/methods (e.g. diving, surface/hand spear, beach seining, surface hand collection, dip nets, hooking).

3.4.5. Catch (harvested and released fish)

The number of fish kept (harvest) and the number of fish released were recorded during interviews with fishing parties. Where possible, the catch was recorded to a species level (e.g. Barramundi or Golden Snapper). However, the identification of some taxa to species level was difficult, particularly when relying on the identification skills and recollection of fishers to document the released portion of the catch. Hence, it was necessary to broadly group some categories, such as 'red snappers'. Furthermore, some species were represented (in the data) by very few individuals making it necessary to pool these into a category of 'other scalefish' (e.g. Sailfish and Cobia). Taxa recorded during the survey are listed in Appendix 4.

3.4.6. Directed fishing effort

Directed fishing effort is a measure of effort targeted towards a particular species or group of species. Directed fishing effort can occur when fishing occurs at specific habitats (e.g. reef fishing or estuarine fishing) and when using different types of gear (e.g. line fishing or crab potting). Directed fishing effort for each event was calculated in fisher hours (i.e. for each event the number of fishers is multiplied by the time spent fishing). Fishing effort (fisher hours) with different gear types in the same fishing region can be simultaneous (e.g. potting for crabs occurs at the same time as line fishing for finfish). The fishing effort for any one event in a region was assumed to be the maximum time spent fishing in that region irrespective of gear type used.

3.4.7. Fisher demographics

Information was collected on the number of fishers (aged five years or older) in each fishing party and the state/territory of residence of each fisher. This data was used to estimate the proportion of fishing activity by resident and non-resident fishers.

Where fishing parties comprised NT residents and visitors, the fishing information was recorded separately for each group (i.e. catch/effort for NT residents and catch/effort for visitors). In those cases where a fishing event was shared between members of a party (e.g. crab potting or cast netting) the catch was proportionally allocated to the respective residential groups.

3.4.8. Length and sex data

Total length estimates (to the nearest centimetre) for harvested Black Jewfish, Golden Snapper and Barramundi were collected throughout the survey period and used to calculate average harvest lengths for these species.

Where possible, the sex of both kept and released Mud Crabs was recorded to determine the retention/release rate by sex and to provide some insight into spatial and seasonal variations in these variables.

3.4.9. Vessel characteristics and technology

Data was also collected on boat sizes and technology specifications to determine the proportion of different size vessels used in the fishery and the extent of electronic aids commonly used by coastal fishers in the Darwin area.

The significance of vessel size is that larger vessels are able to carry more anglers, thereby increasing both fishing effort (per boat) and fishing power. Larger vessels also allow anglers to travel greater distances in shorter periods and to fish through adverse weather conditions that may be unsafe in smaller craft.

Sounder dimensions can also influence fishing power. In general, the larger the dimension of a sounder, the greater is the picture quality and resolution of the display. This increased resolution provides greater detail and increases the ability of an angler to distinguish fish from general structure or scatter, thereby increasing the targeting ability and fishing power.

3.4.10. Trailer counts

A trailer count was carried out at the completion of each late shift at all primary ramps to enable an assessment of daytime fishing activity (i.e. number of trips) that had been missed because the shift had finished before dark. We excluded known non-fishing boat trailers (e.g. jet-ski trailers).

3.5. Data collected at secondary ramps

A trailer count was carried out at every secondary boat ramp on three to four randomly allocated sampling days for day type stratum within each season (Appendix 5). Trailer counts were conducted between the hours of 11:00 and 14:00, which generally coincides with the maximum number of trailers present during the day. Known non-fishing boat trailers (e.g. jet-ski trailers) were excluded from the count. No interviews with fishing parties were done at secondary ramps.

3.6. Estimation methods for survey data

The survey estimates were derived by combining the results of three different data analyses:

- (1) A direct expansion of survey data that covers the early and late shift strata (i.e. 09:00 to 19:00) at primary boat ramps;
- (2) An estimation procedure that covers the period between the end of the late shift and sunset at the primary boat ramps; and
- (3) An estimation procedure that covers the daytime fishing activity at secondary boat ramps.

Each analysis has different assumptions that underpin the estimation procedures. These assumptions, outlined in the respective sections below, need to be considered when examining the survey results. The addition of estimates derived from these three analyses provide a total estimate of daytime fishing effort, harvest and released catch for primary and secondary boat ramps in each survey zone.

3.6.1. Direct expansion of survey data that covers the early and late shift strata (i.e. 09:00 to 19:00) at primary boat ramps

The estimation of fishing effort (fisher hours) within each fishing region and the number of fish kept and the number of fish released within each fishing region was calculated separately for each primary boat ramp. The base level of estimation was for each fishing region: shift (early or late) within each day-type (weekday days or weekend and public holiday days) within each season (run-off or dry or build-up). Stratum totals for shift types and day types were added together to obtain seasonal totals. The equations used follow Pollock et al. (1994).

Mean daily values (\bar{x}_j) were calculated for fishing effort, harvest, and fish released for the j^{th} stratum:

$$\bar{x}_j = \frac{\sum x_{ij}}{n_j} \quad \text{Eq. 1}$$

Where:

x_{ij} is the daily value for the i^{th} day sampled within each fishing region within each day-type within each season stratum;

n_j is the number of sampling days for the j^{th} stratum.

The estimated variance of the mean daily values for the j^{th} stratum is:

$$Var(\bar{x}_j) = \frac{s_j^2}{n_j} \quad \text{Eq. 2}$$

Where:

n_j is from equation 1;

s_j^2 is the standard deviation for the j^{th} stratum.

The estimated stratum total (effort, kept fish, released fish) for the j^{th} stratum is:

$$\hat{X}_j = \bar{x}_j \cdot N_j \quad \text{Eq. 3}$$

Where:

\bar{x}_j is from equation 1;

N_j is the total number of primary sample units in the j^{th} stratum.

The estimated stratum variance of total effort, total kept fish, total released fish is:

$$Var(\hat{X}_j) = Var(\bar{x}_j) \cdot N_j^2 \quad \text{Eq. 4}$$

Where:

$Var(\bar{x}_j)$ is from equation 2; and

N_j is from equation 3.

The estimated total effort, total kept fish, total released fish for all strata combined (i.e. seasonal totals or survey year) is:

$$\hat{X}_{Total} = \sum_{j=1}^j X \quad \text{Eq. 5}$$

Where:

\hat{X}_j is from equation 3.

The estimated variance of total effort, total kept fish, total released fish is:

$$Var(\hat{X}_{Total}) = \sum_{j=1}^j Var(\hat{X}_j) \quad \text{Eq. 6}$$

Where:

$Var(\hat{X}_j)$ is from equation 4.

The estimated standard error of total effort, total kept fish, total released fish is:

$$SE(\hat{X}_{Total}) = \sqrt{Var(\hat{X}_{Total})} \quad \text{Eq. 7}$$

Where:

$Var(\hat{X}_{Total})$ is from equation 6.

3.6.2. Estimation procedure that covers the period between the end of the late shift and sunset at the primary boat ramps

The trailer counts made at the end of late shifts were directly expanded to provide estimates of the number of fishing trips that had been missed by the survey coverage. This was done separately for each primary ramp using equations 1 to 4. We have assumed that all trailers counted were related to recreational fishing activity. This assumption is reasonable given that we excluded known non-fishing boat trailers (e.g. jet-ski trailers) from the counts and that it was known from previous work that the majority of other trailer boats are accessing the recreational fishery from these boat ramps.

We then converted these effort estimates (trips) into units of fisher hours. The first step was to obtain an estimate of the mean trip length (fisher hours) for each primary sample unit. This was done by calculating a daily mean trip length (fisher hours) for each survey shift.

Note that at any primary ramp each shift was scheduled on a different calendar day.

Secondly, the mean of the daily mean trip length values was calculated using the general form of equation 1. The variance of this mean of the daily mean trip length values was calculated using the general form of equation 2. Finally, the conversion of total effort from trips into fisher hours was done by multiplying the mean of the daily mean trip length values by the number of days in a stratum. This was done using the general form of equation 3.

The variance of this additional fishing effort was estimated as follows:

$$Var(\hat{E}_j) = [Y_j^2 \times Var(\bar{X}_j)] + [\bar{X}_j^2 \times Var(Y_j)] - [Var(Y_j) \times Var(\bar{X}_j)] \quad \text{Eq. 8}$$

Where:

\bar{X}_j is the mean of the daily mean trip length values for stratum j;

$Var(\bar{X}_j)$ is the variance of the mean of the daily mean trip length values for stratum j;

\hat{Y}_j is the total fishing effort (trips) for stratum j;

$Var(Y_j)$ is the variance of total fishing effort (trips) for stratum j.

For each primary ramp this additional fishing effort was then partitioned and allocated proportionally to the fishing regions that had been visited by fishing parties using that ramp. Similarly, additional harvested fish and released fish were allocated to each fishing region in proportion to the amount of additional fishing effort. We assumed that the catches recorded during interviews for each fishing region were representative of catches associated with the additional fishing effort. The same estimation procedure was used to allocate additional variance for catches within each fishing region.

3.6.3. Estimation procedure that covers the daytime fishing activity at secondary boat ramps

The only data available for the secondary ramps were counts of trailers. The trailer counts were directly expanded to provide estimates of the number of fishing trips originating from secondary ramps. This was done separately for each secondary ramp using equations 1 to 4.

Data from nearby primary ramps (Table 3) was then used to convert these effort estimates (trips) into units of fisher hours. The mean trip length (fisher hours) for each primary sample unit at the nearby primary ramp was used as a proxy for the secondary ramp. The same estimation procedure described in Section 3.6.2 was used. This additional fishing effort from the secondary ramp was then partitioned and allocated proportionally to the fishing regions that had been visited by fishing parties using the nearby primary ramp. The nearby primary ramp was also used as a proxy for catch rates at the secondary ramp (Table 3). Additional harvested fish and released fish were allocated to each fishing region in proportion to the amount of additional fishing effort. The same procedure was used to allocate additional variance for catches within each fishing region.

Table 3. Secondary ramps and their allocated primary ramp used to estimate catch and effort

Boat ramp number		Fishing zone	Proxy ramp/region
3.	Ski Club	DHS	Ramp 6, (Nightcliff), All Fishing Regions
4.	Channel Island	DHS	Ramp 10, (Middle Arm), Fishing Region 10b only
7.	Palmerston	DHS	Ramp 5, (East Arm), Fishing Region 10c only
8.	Trailer Boat Club	DHS	Ramp 6, (Nightcliff), All Fishing Regions
9.	Mandorah	DHS	Ramp 6, (Nightcliff), All Fishing Regions
11.	Southport	DHS	Ramp 10, (Middle Arm), Fishing Region 10b only
13.	Crab Claw Island	BD	Ramp 16, (Keswick), Fishing Region 7 only
14.	Milne Inlet	BD	Ramp 16, (Keswick), Fishing Region 7 only
23.	Dundee Road	BD	Ramp 15, (Six Pack), All Fishing Regions

The estimation procedures used have several assumptions: (a) that a trailer count provides an accurate measure of recreational fishing activity for a survey shift, (b) that fishing effort at a secondary ramp has the same spatial distribution among fishing regions as that measured at a nearby primary boat ramp that is used as a proxy and (c) that the composition and spatial distribution of catch (harvested and released fish) at a secondary ramp has the same spatial distribution among fishing regions as that measured at a nearby primary boat ramp that is used as a proxy.

3.7. Uncertainty in survey estimation

Survey estimates are subject to uncertainty for a variety of reasons. Suboptimal survey designs may cause coverage problems of the target survey population leading to biased results. Similarly, sampling errors, such as measurement and non-response errors, may occur during the data collection phase of a survey. Survey estimation is also uncertain because variable data is derived from a sample of the target population. Therefore, many strong assumptions are necessary when expanding these data to obtain survey totals.

In the absence of survey bias, it is possible to express the uncertainty in the survey estimates in terms of their precision. The standard error (SE) for each estimate is presented as a measure of the variability of this data. In general terms, more precise estimates have small SEs that indicate less uncertainty in the survey estimates. The relative SE (RSE) is the SE expressed as a percentage of the survey estimate. The RSE facilitates comparisons of the uncertainty associated with survey estimates that have different magnitudes. Within this report, results with an RSE of between 25% and 50% are represented by italic text, while results with an RSE of greater than 50% are represented by bold text. In general terms, more precise survey estimates have small RSEs that indicate less uncertainty in the survey estimates.

3.8. Key species profiles

Data collected throughout the survey has been collated and presented individually for a number of key species targeted by recreational fishers in the Greater Darwin Area. The species highlighted below in Section 6 have been chosen for one or more of the following reasons: they are iconic species; have excellent eating qualities; are great sportfish; or are considered 'indicator' species on which to gauge and monitor the recovery of reef fish populations in the Greater Darwin Area.

4. Fishing effort

The following results represent the total fishing effort expended by recreational fishers aged five years or more during daylight hours within the Greater Darwin Area for the period from 1 March 2015 to 30 November 2015. Fishing effort is expressed as fisher hours. We present fishing effort partitioned by the type of water body, the fishing method used, the zone and region fished, the boat ramps used by fishers, the season and the residential origin of fishing activity (i.e. NT residents or visiting fishers).

An estimated 513 055 fisher hours were spent recreational fishing in the Greater Darwin Area during the survey period by both NT residents and visiting anglers. This figure of total effort was derived by the addition of the three analyses described in Section 3.6. The direct expansion of primary ramps constituted 65.5% of the total effort, estimation of effort for primary ramps post late shift to sunset 13.5% and estimation of effort for secondary ramps comprised 18% of the total effort. For a full breakdown of effort by analysis and ramp refer to Appendix 6.

4.1. Effort by water body

The majority of fishing effort (fisher hours) occurred in estuarine waters (70%) and the remainder in offshore waters (30%) (Figure 4).

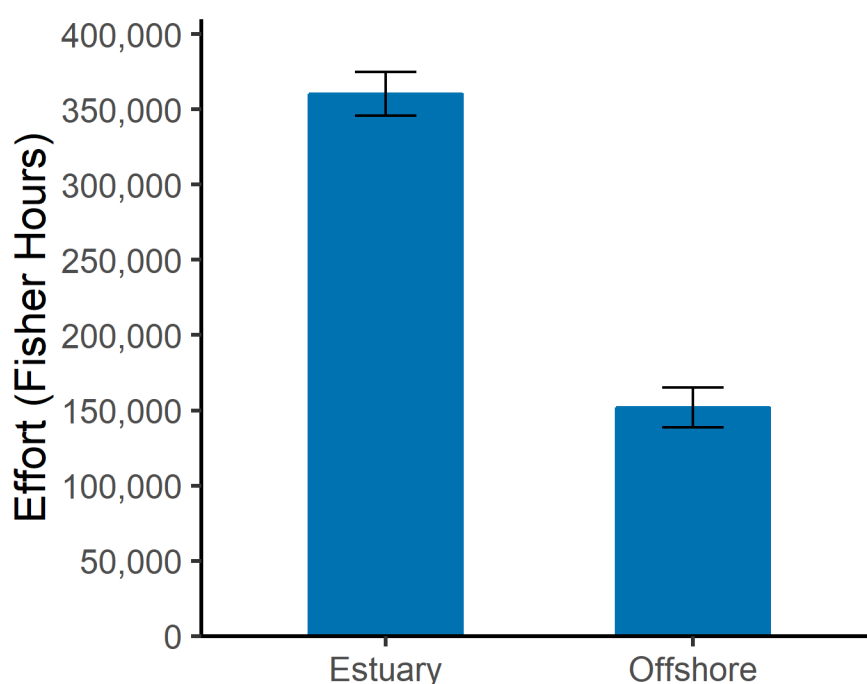


Figure 4. Fishing effort (fisher hours) by water body type in the Greater Darwin Area for recreational fishers during the survey period from March 2015 to November 2015. Error bars represent one standard error.

4.2. Effort by fishing method

Line fishing (e.g. bait, lures, and jigs) was the most common fishing method used by recreational anglers and accounted for almost 72% of the total fisher hours during the survey period (Figure 5). Pot fishing was the second most important method representing 23% of the total effort. Cast netting accounted for almost 5% of the effort hours and other methods, such as spearing, diving and hand collection combined only constituted 0.2% of total effort.

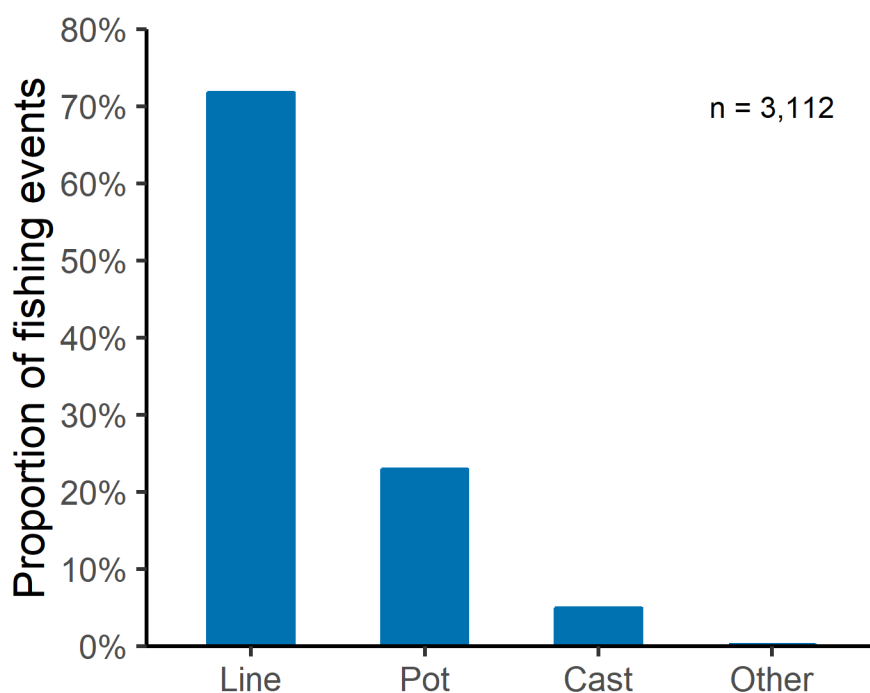


Figure 5. The proportion (%) of fishing effort by fishing method for recreational anglers in the Greater Darwin Area during the survey period from March 2015 to November 2015

4.3. Effort by fishing zone and region

4.3.1. Effort by fishing zone

The Darwin Harbour/Surrounds fishing zone supported 63% of the total fishing effort (fisher hours) within the Greater Darwin Area, with the Bynoe Harbour/Dundee fishing zone supporting the remaining 37% of effort (Appendix 13).

4.3.2. Effort by fishing region

Darwin Harbour and its associated arms and creeks accounted for 40% of the total fishing effort (fisher hours) followed by Bynoe Harbour (14%) and Shoal Bay (6%) (Figure 6, Appendix 7). The region offshore of Bynoe Harbour and Dundee was the most popular offshore water for recreational fishing accounting for 14% of the overall effort.

For full details of the relative fishing effort in each region please refer to Appendix 7.

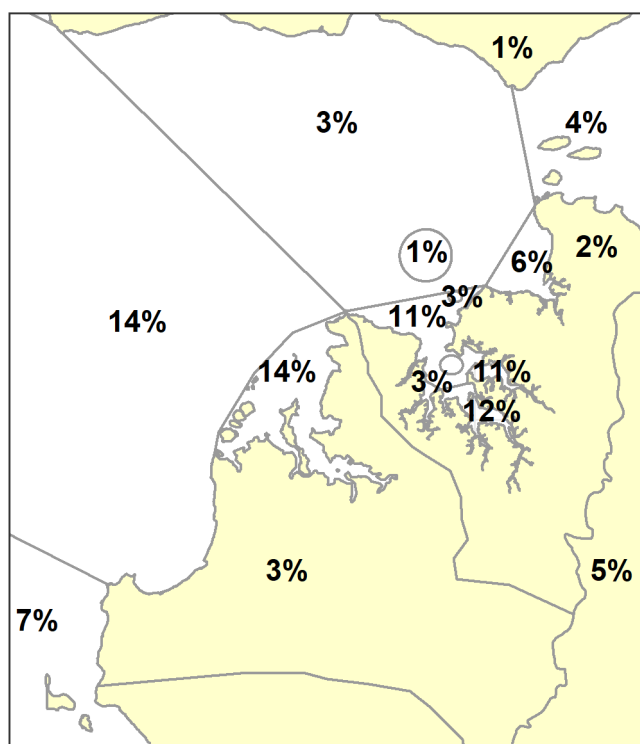


Figure 6. Map showing the spatial distribution (%) of fishing effort (fisher hours) by fishing region in the Greater Darwin Area for recreational fishers during the survey period from March 2015 to November 2015

4.4. Effort by boat ramp

Recreational fishing vessels using the Dundee Beach boat ramp accounted for 22.5% of the total fisher hours in the Greater Darwin Area (Figure 7, Appendix 8). Vessels departing from Dinah Beach (16.5%), East Arm (9.2%) and Buffalo Creek (6.8%) also made a major contribution to the total number of fisher hours.

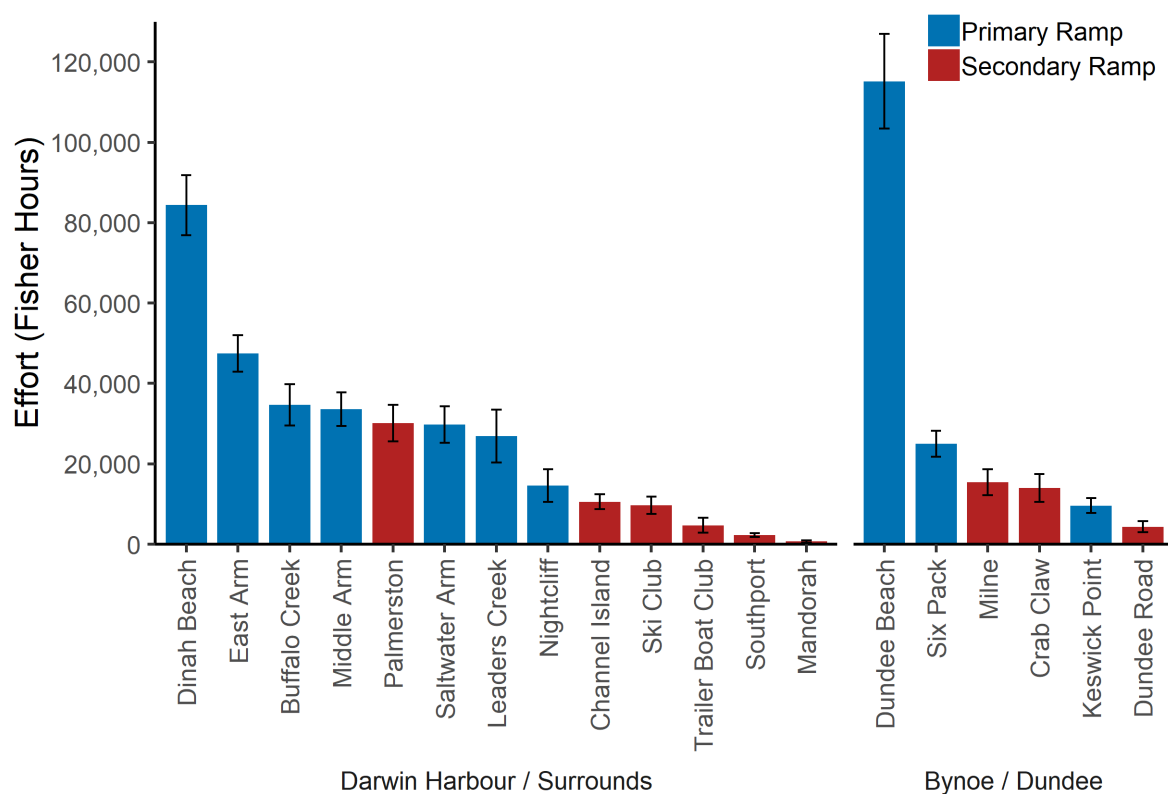


Figure 7. Fishing effort (fisher hours) by fishing zone and by boat ramp in the Greater Darwin Area for recreational anglers during the survey period from March 2015 to November 2015. Error bars represent one standard error.

4.5. Effort by season

There was relatively no difference in fishing effort between seasons, with the build-up season accounting for the most effort (35%) followed by the dry season (34%) and then the run-off period (31%) (Figure 8).

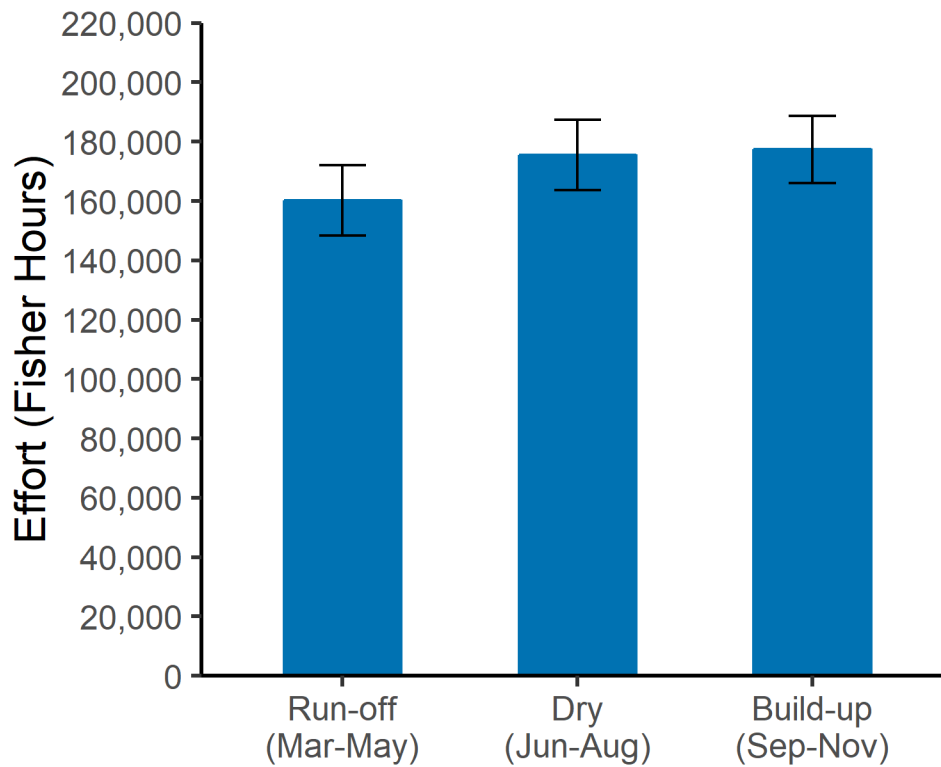


Figure 8. Fishing effort (fisher hours) by season in the Greater Darwin Area for recreational anglers during the survey period from March 2015 to November 2015. Error bars represent one standard error.

4.6. Seasonal proportion of effort by residential origin of anglers

The proportion of visiting angler effort (interstate or overseas) varied during the survey period and peaked in the dry season at 16.6% of the total fishing effort (Figure 9). Visitor angler effort accounted for 11.3% of the effort in the run-off and 9.2% of effort in the build-up.

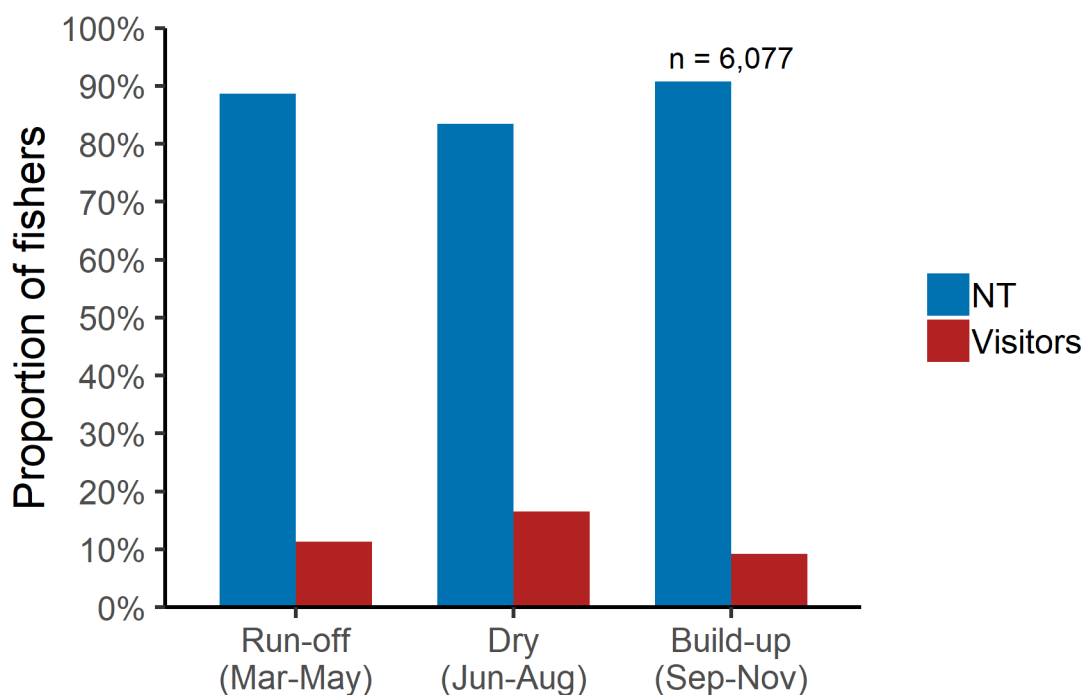


Figure 9. Unexpanded seasonal proportion of effort by residential origin of anglers in the Greater Darwin Area during the survey period from March 2015 to November 2015

5. Catch

The following results represent estimates of the total catch of aquatic organisms by vessel-based fishers (aged five years or older) within the Greater Darwin Area during the survey period (1 March 2015 to 30 November 2015; Table 4). A full list of all taxa caught during the survey is provided in Appendix 9.

5.1. Total catch summary

An estimated 496 952 aquatic organisms were caught during the survey period. This figure of total catch was derived by the addition of the three analyses described in Section 3.6. The direct expansion of primary ramps constituted 70% of the total catch, estimation of catch for primary ramps post late shift to sunset accounted for 14% and estimation of catch for secondary ramps comprised 15% of the total catch. For a full breakdown of catch by analysis and ramp, refer to Appendix 10.

Of the total estimated catch of aquatic organisms, 418 351 (84.2%) were fish (i.e. teleosts - bony fishes) and elasmobranchs (sharks/rays), with the bulk of the remaining catch (15.6%) comprised of crustaceans (primarily Mud Crabs and marine prawns). Some cephalopods and other non-fish taxa (0.2%) were also recorded.

Golden Snapper was the most commonly caught fish species with an estimated 51 755 individuals caught (12.4% of the total fish catch). Other fish species of importance included 34 934 Stripey Snapper (8.4%), 32 422 cods and groupers (7.7%) and 31 725 mullet (7.6%).

Collectively, over 111 000 tropical snappers from the genus *Lutjanus* (Golden Snapper, Stripey Snapper, Indonesian Snapper and other tropical snappers) were caught and this genus formed a major component (26.6%) of the overall fish catch and a major contributor to the reef fish catch.

An estimated 77 610 crustaceans were caught, comprising largely of Mud Crabs (80.9%) and marine prawns (13.5%). For a full breakdown of catch by taxa, refer to Appendix 9.

Almost 69% of all fish and only 40% of crustaceans caught were released; however, actual release rates varied markedly depending on species. High release rates were reported for sharks/rays and catfish, whereas very low release rates were reported for mullet, whiting and King Threadfin (Table 4).

Table 4. Estimated catch (total, kept and released numbers) and proportion released/discarded for key reporting groups in the Greater Darwin Area by recreational fishers during the survey period from March 2015 to November 2015

Species/group	Total		Kept		Released		% released
	Number	SE	Number	SE	Number	SE	
Barramundi	19211	1600	4888	449	14323	1296	74.6
Bream, pikey	13801	1619	5587	665	8215	1193	59.5
Catfish	21085	2188	488	132	20597	2177	97.7
Cod/groupers	32422	2081	6661	517	25761	1836	79.5
Coral trout	4064	698	2387	370	1676	488	41.2
Emperor, other	23635	3840	8398	1526	15237	2550	64.5
Emperor, red	919	246	592	195	327	77	35.6
Flathead	1084	126	199	46	886	114	81.7
Javelin fish	13313	1179	2579	429	10734	917	80.6
Jewfish, black	7618	858	4233	466	3385	587	44.4
Jewfish, other	451	203	114	107	338	145	74.9
Mackerel, grey	2569	700	1023	197	1546	598	60.2
Mackerel, Spanish	6899	1035	3035	388	3863	818	56
Mackerel, spotted	2333	444	925	206	1408	321	60.4
Moonfish/Batfish	10596	937	1102	185	9494	918	89.6
Mullet	31725	3883	28700	3481	3025	1205	9.5
Queenfish	8116	1162	1344	168	6771	1098	83.4
Sharks & rays	28138	1995	707	125	27431	1972	97.5
Small baitfish	16551	3981	5073	1222	11477	3341	69.3
Snapper, golden	51755	3201	20907	1355	30848	2237	59.6
Snapper, mangrove jack	2917	400	1503	195	1414	266	48.5
Snapper, Moses'	2853	520	484	168	2369	395	83
Snapper, saddletail, crimson and Indonesian	18204	2194	6084	895	12120	1625	66.6
Snapper, stripey	34934	3721	6527	675	28407	3423	81.3
Tarpon/ox-eye herring	278	74	39	24	239	70	86
Threadfin, blue	11226	1300	5249	542	5977	1006	53.2
Threadfin, king	1824	255	1340	210	484	105	26.5
Trevally, giant	4844	698	687	139	4158	662	85.8
Trevally, golden	3551	570	474	87	3077	555	86.7
Trevally, other	8958	1351	848	157	8110	1266	90.5
Tuna, longtail	1536	593	523	168	1014	556	66
Tuna, mackerel	1463	516	304	70	1159	490	79.2
Whiting	1175	306	922	229	254	117	21.6
Wrasse, tuskfish	10183	1303	3092	346	7091	1110	69.6
Scalefish, other	18121	1356	3621	529	14500	1155	80
Mud crab	62766	6794	36161	3681	26605	3282	42.4
Crustaceans, other	14844	3727	10222	3171	4622	1307	31.1
Cephalopods	953	547	930	546	23	21	2.4
Other taxa	35	24	0	0	35	24	100

SE is standard error; values in italics have RSE between 25–50% and values in bold have RSE >50%.

5.2. Catch by water body

Of the total catch by recreational anglers in the Greater Darwin Area, 65% was derived from estuarine waters and 35% from offshore waters. Numeric catch estimates for the ten most common species encountered by recreational fishers in estuarine and offshore waters are given in Figures 10 and 11, respectively. Details of all species caught in each water body type are provided in Appendix 11.

Estuary

Mud Crabs were the most frequently caught species in estuarine waters (19%) (Figure 10). The next most common species caught from estuarine waters were mullet (9.6%), Golden Snapper (9.4%) and Barramundi (5.8%).

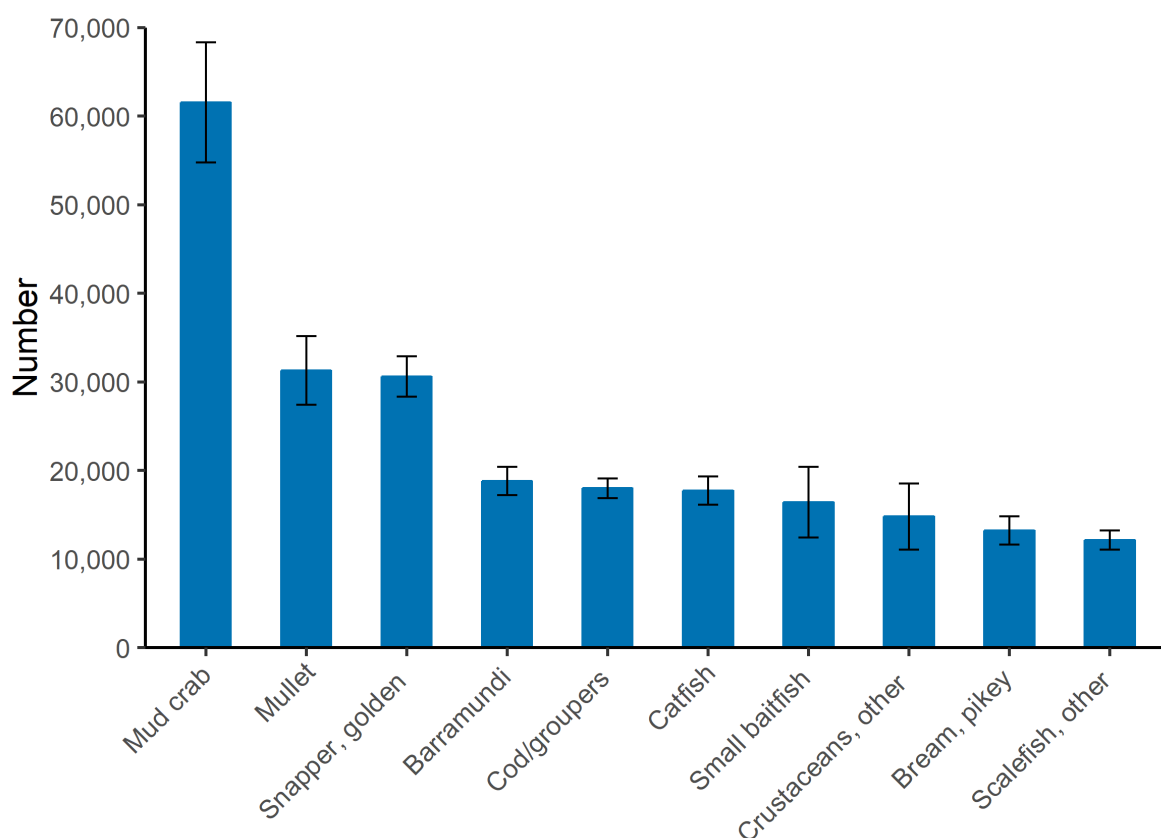


Figure 10. Catch estimates (numbers of fish) of the ten most frequent species/groups caught in estuarine waters of the Greater Darwin Area for recreational fishers during the survey period from March 2015 to November 2015. Error bars represent one standard error.

Offshore

Stripey Snapper (14.5%) were the most common caught species in offshore waters, followed by Golden Snapper (12.3%), emperor (e.g. Tricky, Blue lined) (12.1%), sharks/rays (9.5%) and cods/groupers (8.3%) (Figure 11). Species of red snappers (Saddletail, Crimson and Indonesian) (5.1%) were less frequently caught along with Blue Threadfin, Trevally, Spanish Mackerel and other scalefish species.

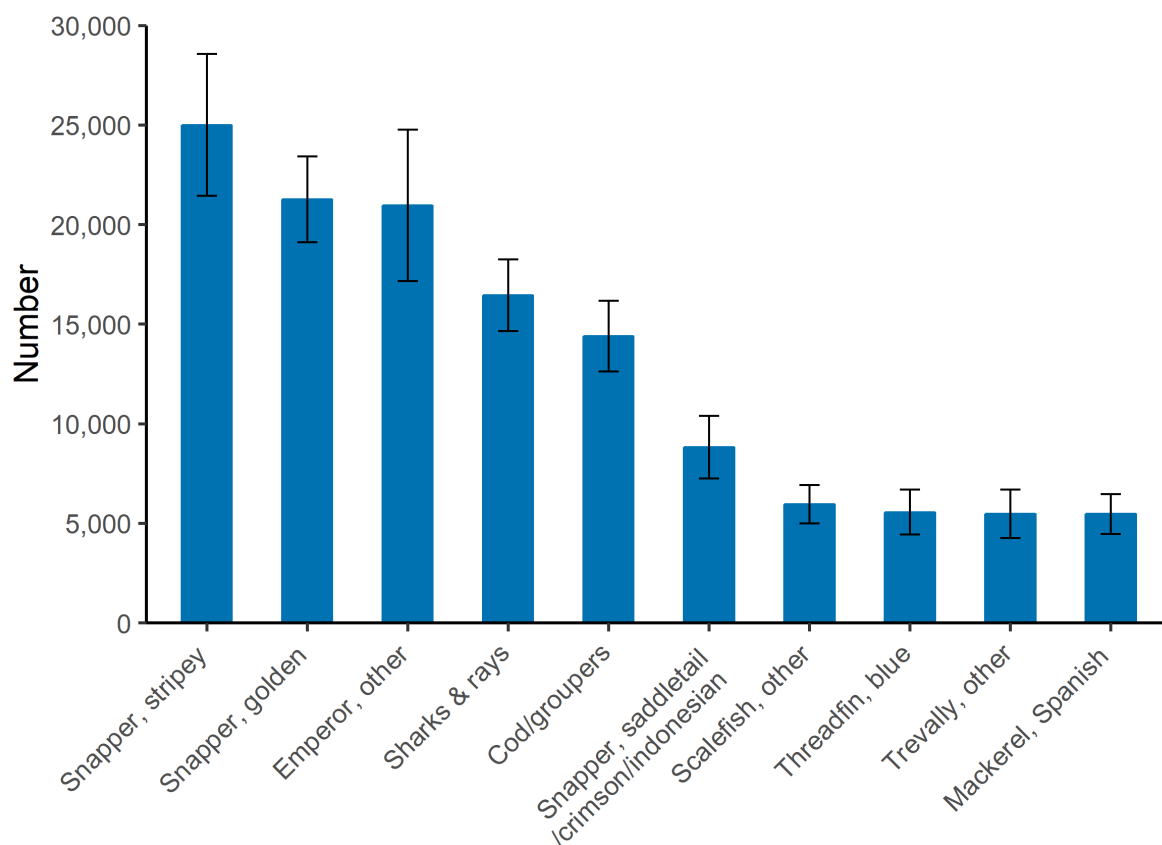


Figure 11. Estimated total catch (numbers of fish) of the ten most frequent species/groups caught in offshore waters of the Greater Darwin Area for recreational fishers during the survey period from March 2015 to November 2015. Error bars represent one standard error.

5.3. Catch by fishing method

Line fishing methods accounted for 60.8% of all organisms caught, followed by cast nets (24.1%) and pots (15.0%). There were very few captures using other fishing methods (0.1%). Numeric catch estimates for the ten most common species encountered by recreational fishers using the three primary fishing methods are given in Figures 12, 13 and 14. Details of all species caught by each fishing method are provided in Appendix 12

5.3.1. Line

Fish accounted for almost all of the line catch, with Golden Snapper (14.4%) and Stripey Snapper (9.7%) being the most captured. Cods/groupers (8.5%), Sharks/rays (7.8%), emperors (6.5%) and catfish (5.7%) were less frequently caught with Barramundi (5.3%) encountered in lower numbers (Figure 12, Appendix 12).

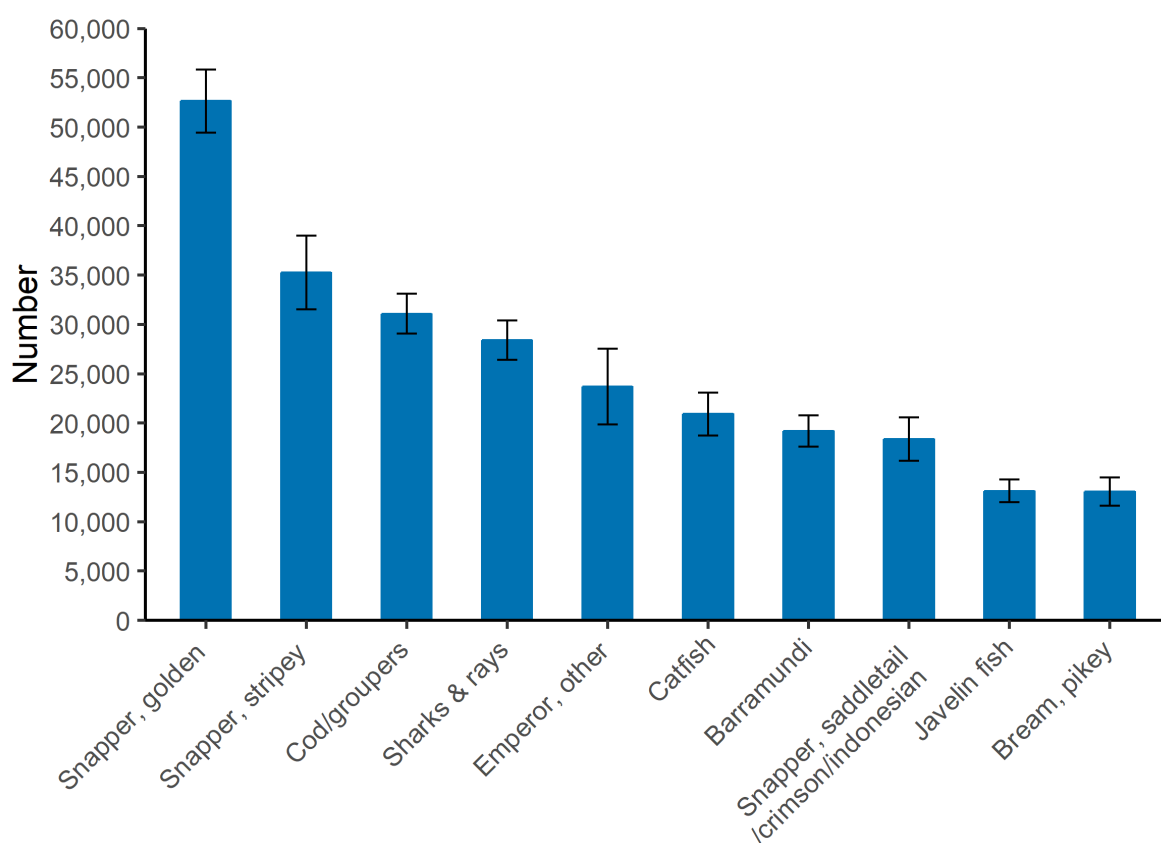


Figure 12. Estimated total catch (numbers of fish) of the ten most frequent species/groups caught by line fishing methods for recreational fishers in the Greater Darwin Area during the survey period from March 2015 to November 2015. Error bars represent one standard error.

5.3.2. Pot

Mud Crabs dominated the catch in pots (84.3%) followed by other crustaceans (7.4%), most of which were Blue Swimmer Crabs. The remaining 8.3% consisted of incidental captures of various fish species (Figure 13, Appendix 12).

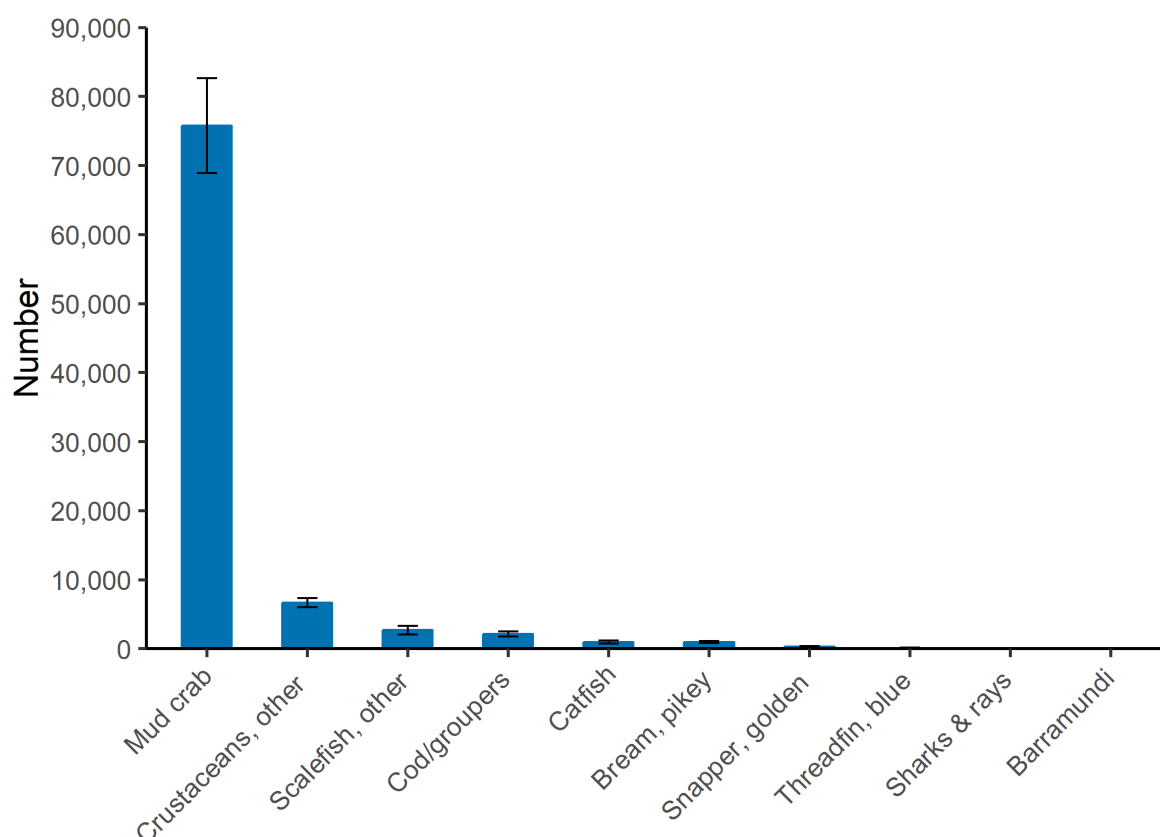


Figure 13. Estimated total catch (numbers of fish) of the ten most frequent species/groups caught by pot fishing methods for recreational fishers in the Greater Darwin Area during the survey period from March 2015 to November 2015. Error bars represent one standard error.

5.3.3. Cast net

The cast net catch was dominated by mullet (50.5%). Small baitfish (25.2%) were also a major contributor to the catch from cast nets. The remainder of the catch comprised a mixture of crustaceans, such as prawns (9.6%) and other scalefish species totalling 14.7% (Figure 14, Appendix 12).

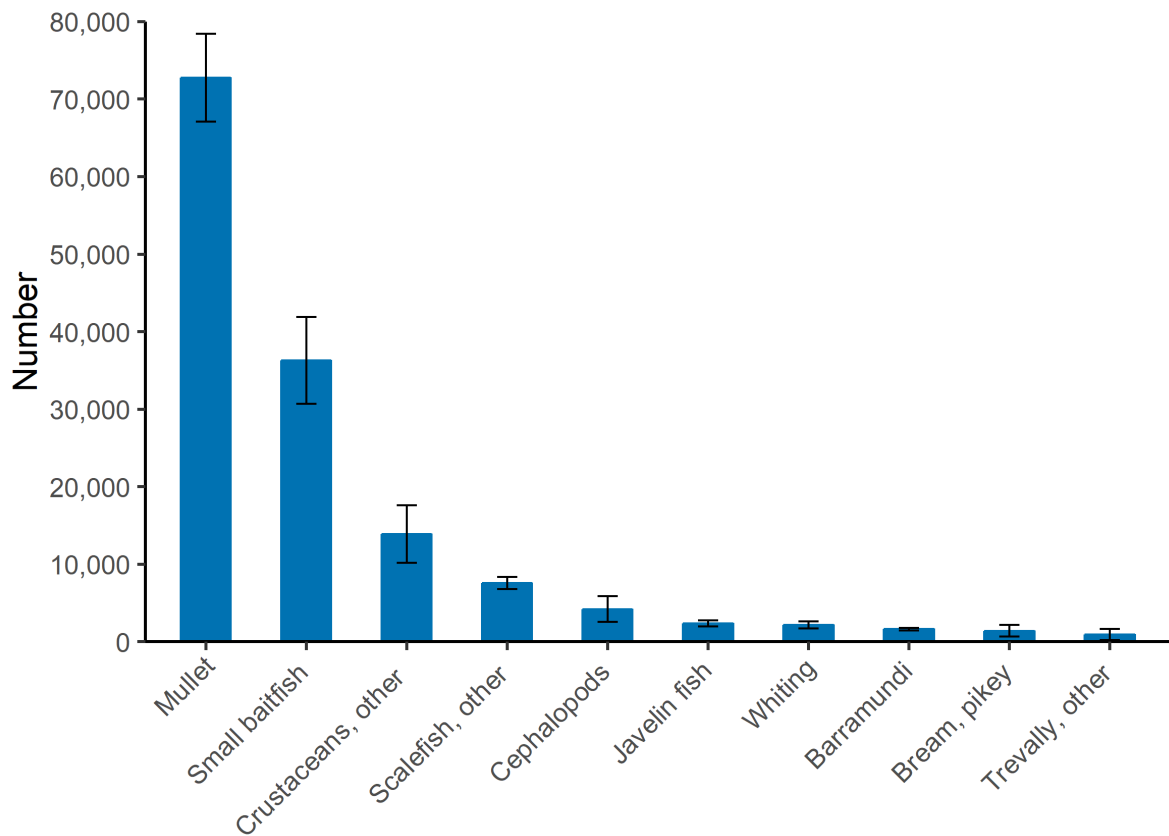


Figure 14. Estimated total catch (numbers of fish) of the ten most frequent species/groups caught by cast net fishing methods for recreational fishers in the Greater Darwin Area during the survey period from March 2015 to November 2015. Error bars represent one standard error.

5.4. Catch by fishing zone and region

5.4.1. Catch by fishing zone

Numeric catch estimates for the ten most common species encountered by recreational fishers in the Bynoe Harbour/Dundee and Darwin Harbour/surrounds regions are given in Figures 15 and 16, respectively.

Detailed information on catch by fishing zone is provided in Appendix 13.

5.4.1.1. Bynoe Harbour/Dundee fishing zone

Golden Snapper (12.8%) and Stripey Snapper (12.8%) were the most commonly caught species in the Bynoe Harbour/Dundee fishing zone followed by emperors (10.8%), and sharks/rays (9.4%) (Figure 15). Only 2.8% of the total catch for the zone was comprised of Mud Crabs.

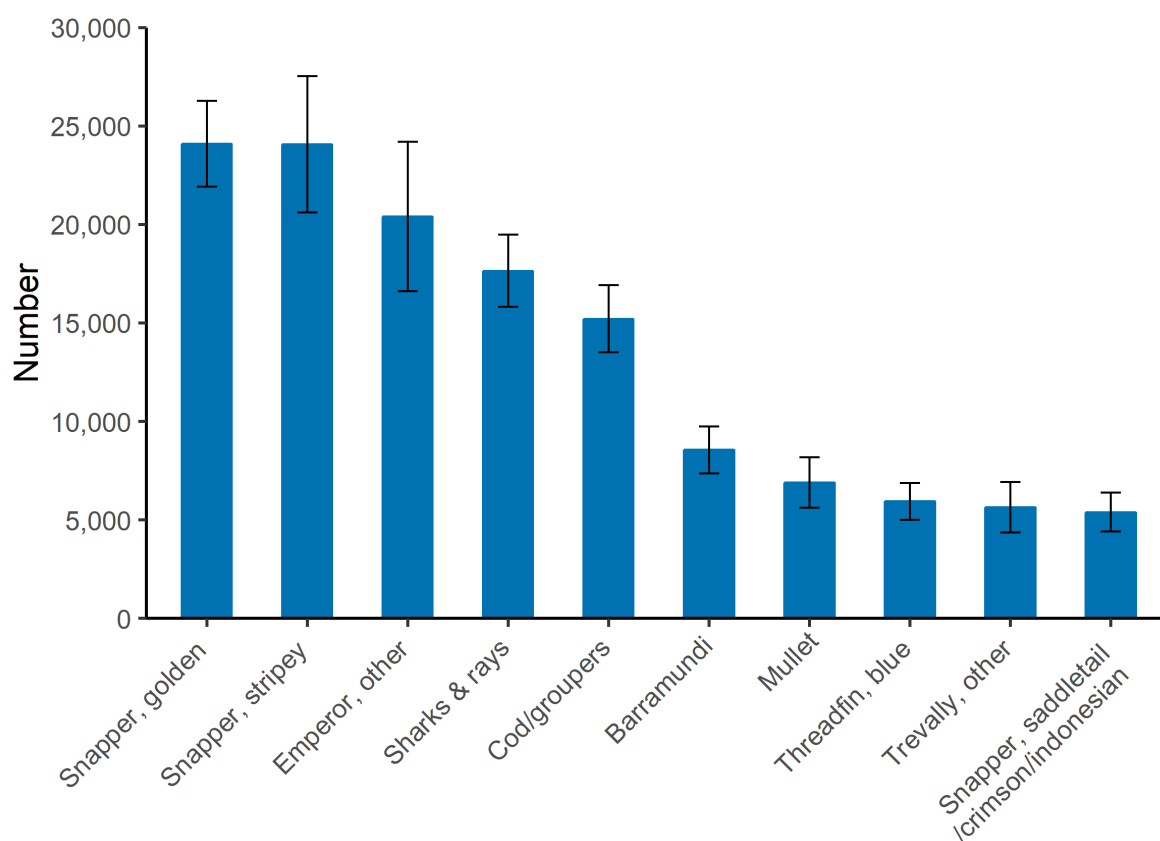


Figure 15. Catch estimates (numbers of fish) of the ten most frequent species/groups caught in the Bynoe Harbour/Dundee fishing zone by recreational anglers during the survey period from March 2015 to November 2015. Error bars represent one standard error.

5.4.1.2. Darwin Harbour/Surrounds fishing zone

Mud Crabs (18.5%) dominated the catch from the Darwin Harbour/Surrounds fishing zone, followed by Golden Snapper (9.1%), mullet (8.0%), cods/groupers (5.6%) and catfish (5.3%) (Figure 16).

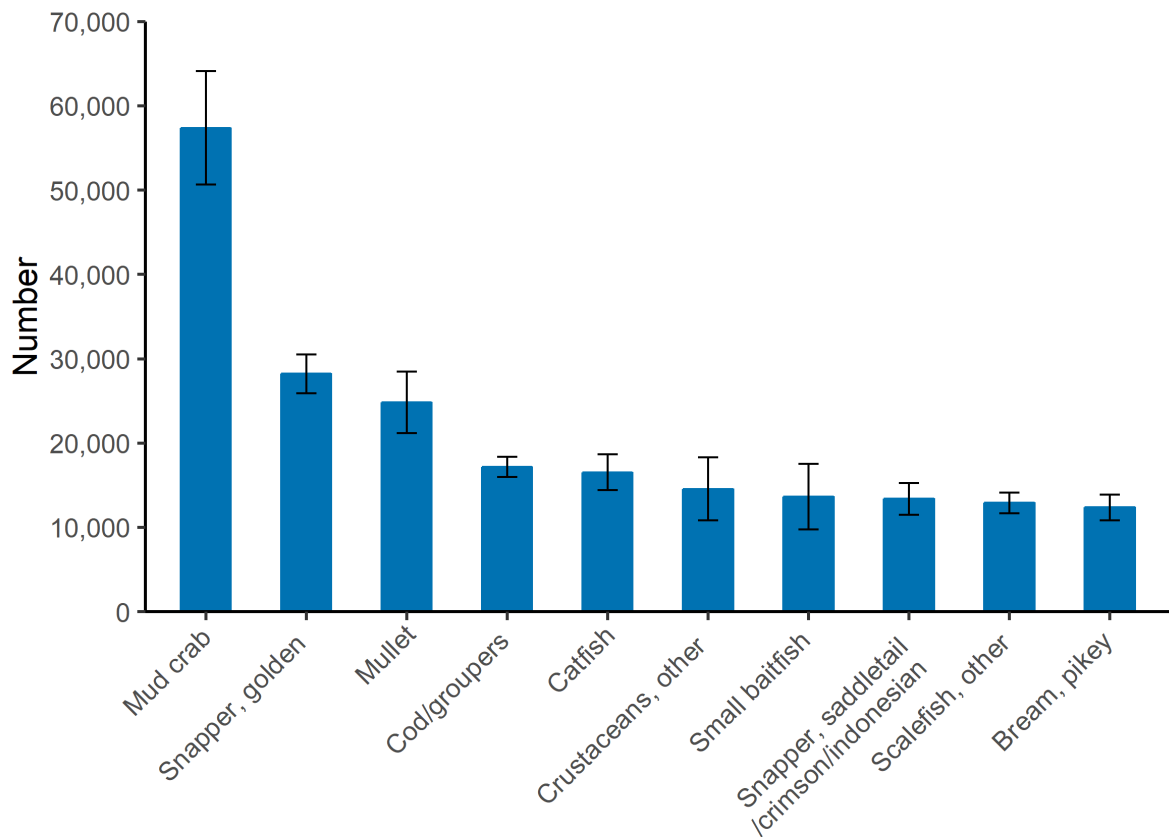


Figure 16. Catch estimates (numbers of fish) of the ten most frequent species/groups caught in the Darwin Harbour/Surrounds fishing zone by recreational anglers during the survey period from March 2015 to November 2015. Error bars represent one standard error.

5.4.2. Catch by fishing region

The Bynoe/Dundee offshore region was the most significant single region producing 16% of the total catch of all aquatic organisms followed by Darwin Harbour with 12% and Bynoe Harbour with 11% (Figure 17, Appendix 7). Collectively, Darwin Harbour and its associated arms and creeks produced 38% of the total catch.

The Bynoe/Dundee offshore region dominated the fish catch with 18.8% of the total fish numbers coming from this area. This catch was composed primarily of reef fish species. The Bynoe Harbour region had the next highest catch of fish with 12.9%, primarily due to high numbers of Golden Snapper, mullet and Barramundi.

For full details of the relative catch in each region please refer to Appendix 7.

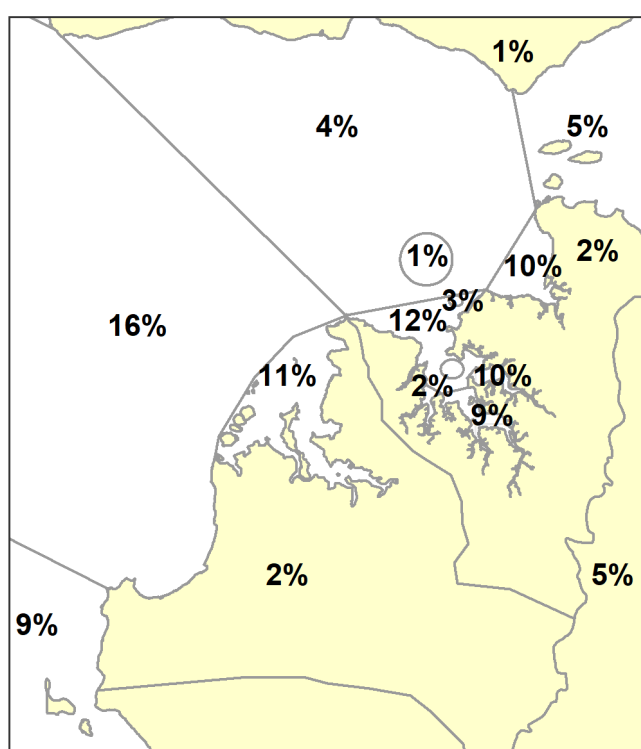


Figure 17. Map showing the spatial distribution (percentage) of catch by fishing region in the Greater Darwin Area for recreational fishers during the survey period from March 2015 to November 2015

5.5. Catch by season

Numeric catch estimates for the ten most commonly encountered species in each season are summarised in Figures 18, 19 and 20 below. Despite the overall catch composition varying by season, Mud Crabs remained the most commonly caught species throughout the survey period. Nonetheless, the Mud Crab catch did fluctuate across the survey period with about 23 000 individuals caught in the run-off, about 29 000 in the dry season and only about 10 000 individuals caught during the build-up.

Full details of the range of species caught in each season are provided in Appendix 14.

5.5.1. Run-off (March-May)

Mud Crabs (13.1%) and Golden Snapper (10.6%) were the primary species caught in the Greater Darwin Area during the run-off period. Other species of importance were sharks/rays (6.7%) and mullet (6.2%) (Figure 18).

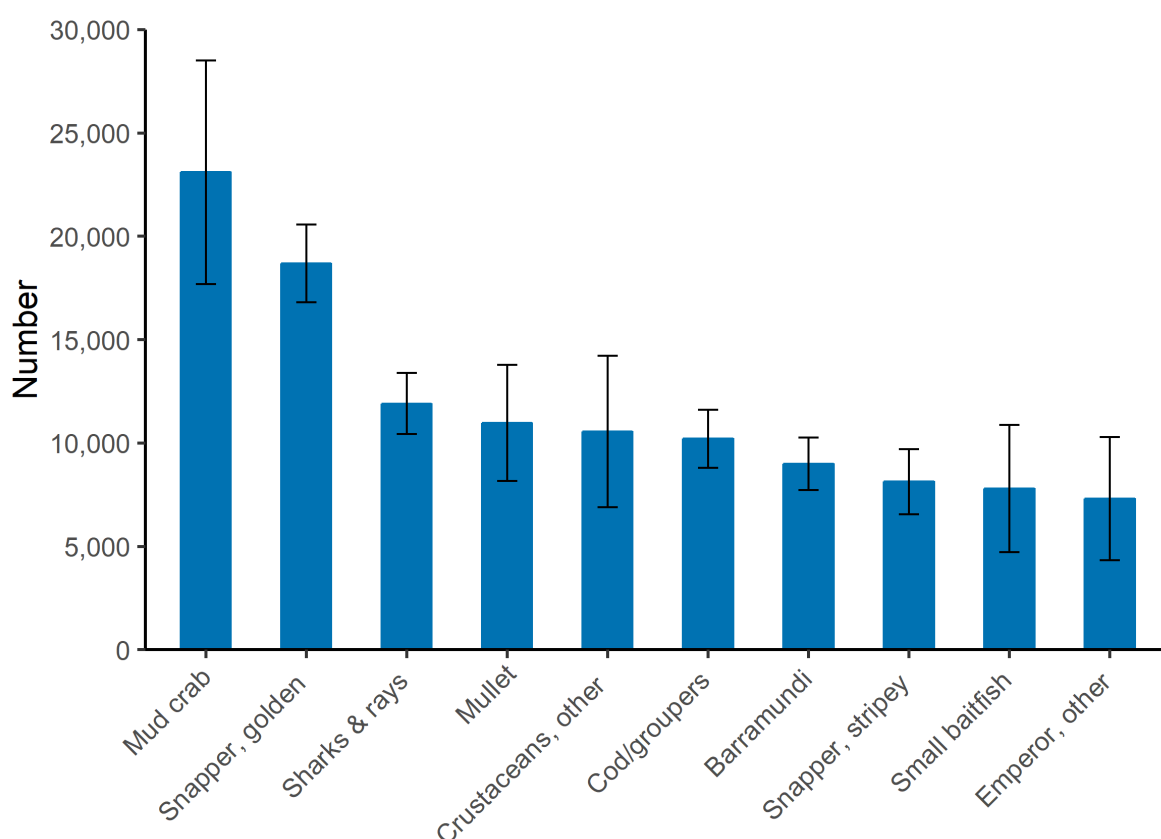


Figure 18. Catch estimates (numbers of fish) of the ten most frequent species/groups caught in the Greater Darwin Area by recreational anglers during the run-off (March-May) season. Error bars represent one standard error.

5.5.2. Dry season (June-August)

Mud Crabs (18.5%) dominated the catch during the dry season followed by Stripey Snappers (7.8%), cod/groupers (7.5%) and Golden Snapper (7.4%) (Figure 19).

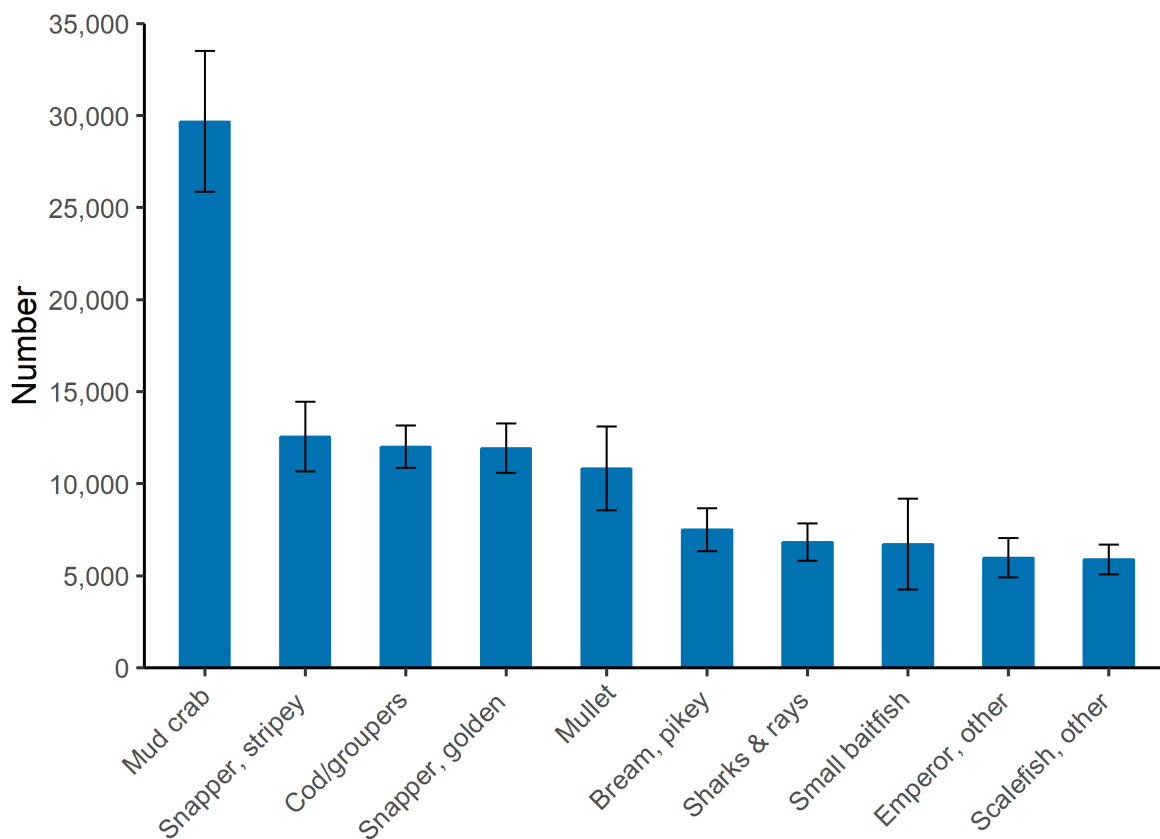


Figure 19. Catch estimates (numbers of fish) of the ten most frequent species/groups caught in the Greater Darwin Area by recreational anglers during the dry season (June-August). Error bars represent one standard error.

5.5.3. Build-up (September-November)

Golden Snapper (13.2%) were the predominant catch during the build-up months followed by Stripey Snapper (8.9%), emperor (6.5%), cod/groupers (6.4%) and Mud Crab (6.2%) (Figure 20).

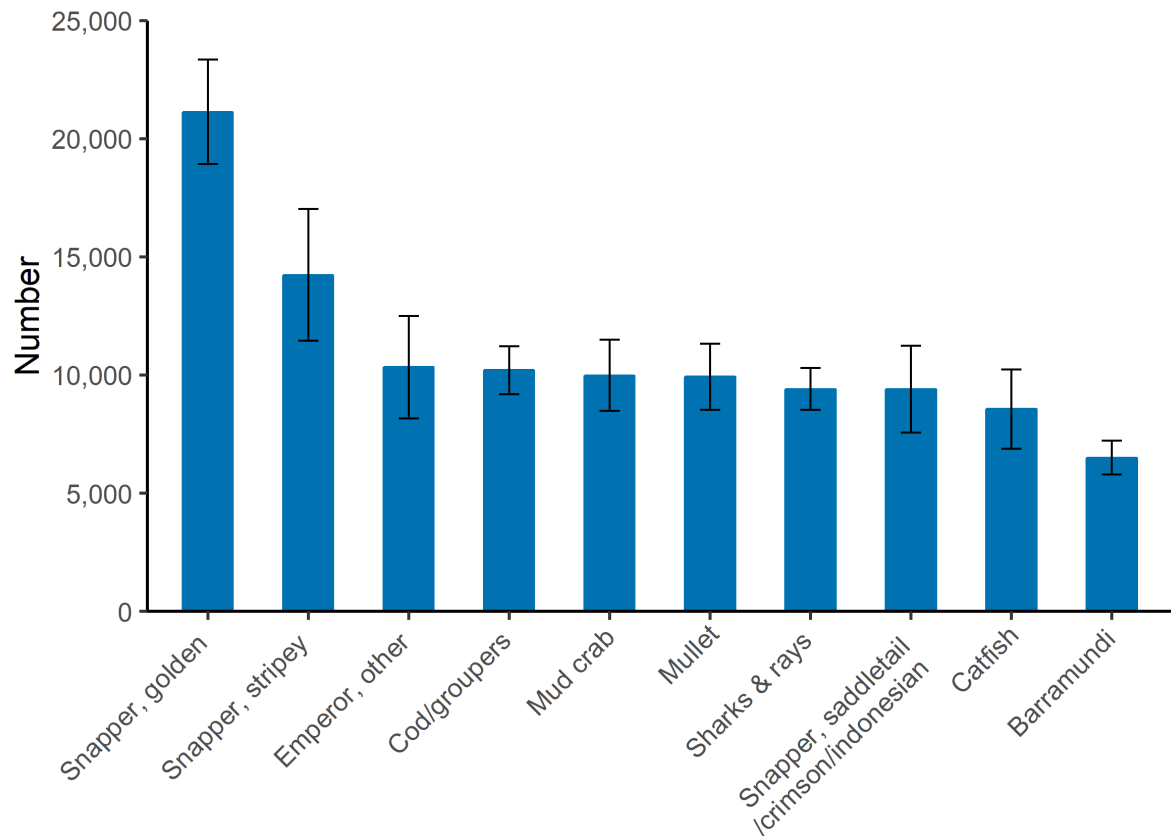


Figure 20. Catch estimates (numbers of fish) of the ten most frequent species/groups caught in the Greater Darwin Area by recreational anglers during the build-up (September-November) season. Error bars represent one standard error.

6. Key species profiles

6.1. Barramundi (*Lates calcarifer*)

Barramundi are an iconic and key target species for recreational fishers in the NT. Monitoring of the barramundi population and the size of the recreational catch is important to ensure the ongoing sustainability of these fish stocks in the Greater Darwin Area.

The majority of the recreational catch of Barramundi in the Greater Darwin Area occurred within the confines of Darwin Harbour (35%), Bynoe Harbour (25%) and the Finnis River region (20%). Adelaide River (8%), Tiwi Islands (8%) and Shoal Bay (5%) were also major contributors (Figure 21A). More than 74% of all Barramundi captured were released (Figure 21B). Barramundi were captured throughout the survey period with the highest catches recorded in the build-up (46.8%) followed by the run-off (33.8%) and the dry season (19.3%) (Figure 21C). Most of the Barramundi were captured by line fishing methods (91%) (Figure 21D) and predominantly from estuarine waters (88%) (Figure 21E).

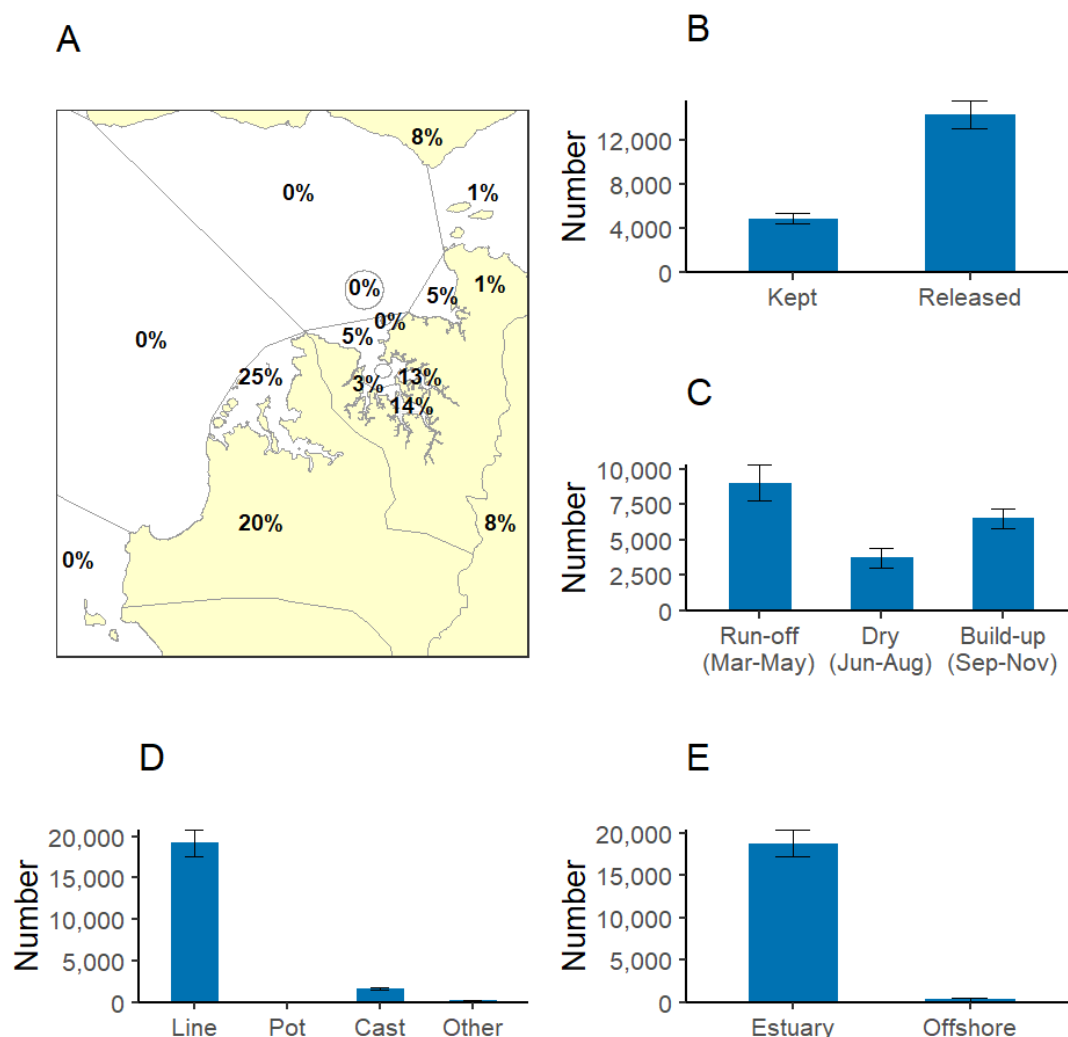


Figure 21. Summary results for Barramundi in the Greater Darwin Area from March 2015 to November 2015: A) proportion (%) of the total catch by region, B) total numbers kept and released, C) catch by season D) proportion (%) of catch by fishing method and E) total catch by water body. Error bars represent one standard error.

6.2. Black Jewfish (*Protonibea diacanthus*)

Black Jewfish has been assessed as overfished in the Greater Darwin Area (Saunders et al. 2014a) and several management measures have been implemented to promote the recovery of this species. Regular monitoring of the recreational catch of Black Jewfish is necessary to gauge the effectiveness of these recovery efforts.

Recreational catches of Black Jewfish occurred around the Vernon Islands, Cape Hotham and Melville Island region (21%), Darwin Harbour (20%) and offshore Dundee area (16%) (Figure 22A). More than 44% of all Black Jewfish captured were released (Figure 22B) with the highest catches reported in the run-off (52%) followed by the build-up (32%) and dry season with around 16% of the total (Figure 22C). All Black Jewfish were caught using line fishing methods (Figure 22D) and with negligible difference in numbers caught from estuary or offshore (Figure 22E).

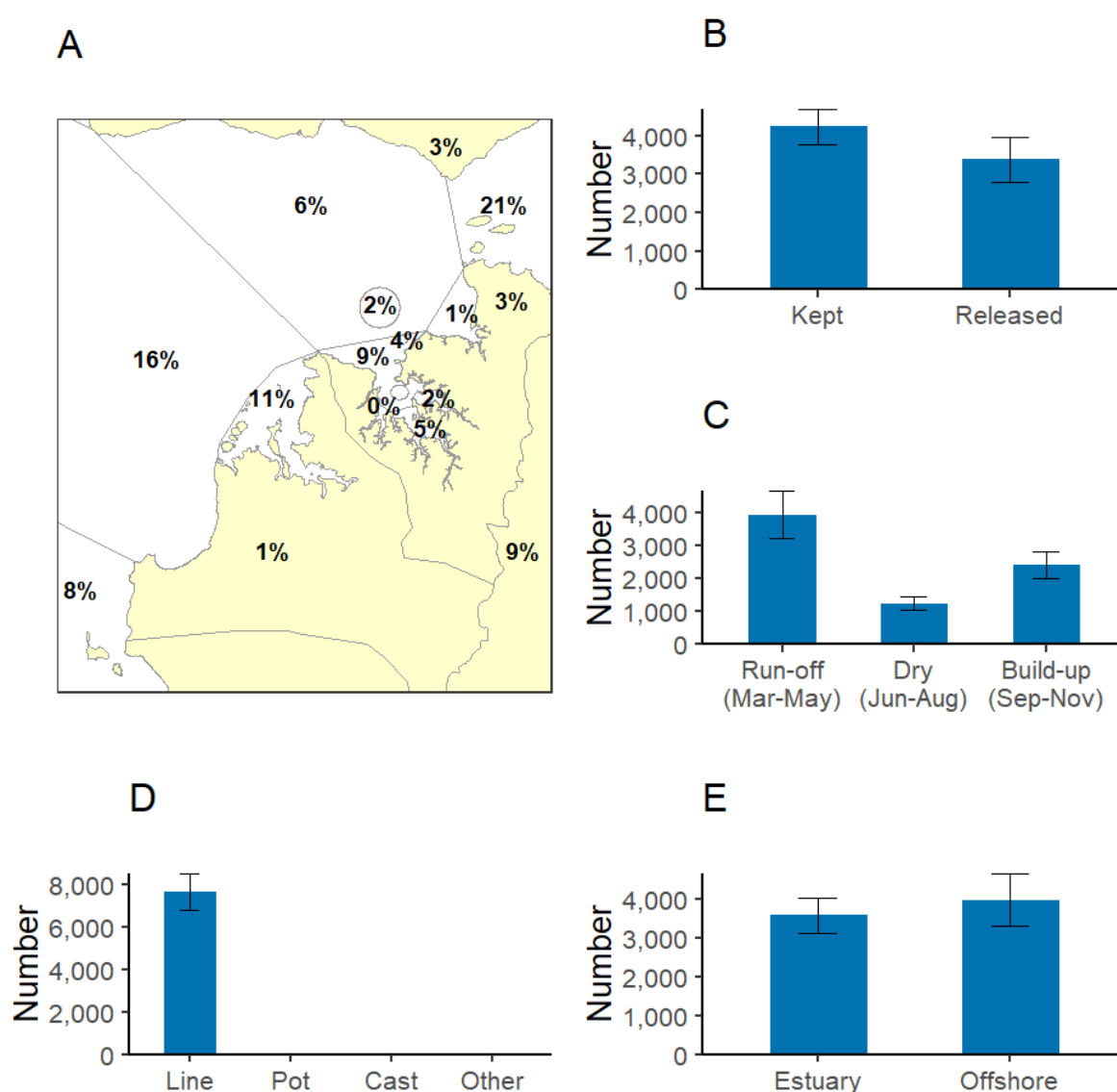


Figure 22. Summary results for Black Jewfish in the Greater Darwin Area from March 2015 to November 2015: A) proportion (%) of the total catch by region, B) total numbers kept and released, C) catch by season D) proportion (%) of catch by fishing method and E) total catch by water body. Error bars represent one standard error.

6.3. Coral Trout (*Plectropomus maculatus*)

Coral Trout is a highly prized table fish in the Top End and information on the recreational catch of this species can provide an indication of the status of other reef fish stocks in the Greater Darwin Area.

The greatest proportion of the recreational catch of Coral Trout in the Greater Darwin Area occurred in the offshore Dundee area (42%). The Peron Islands area (35%) and the Vernon Islands (11%) were also significant areas for the capture of Coral Trout (Figure 23A). More than 65% of all Coral Trout captured were kept (Figure 23B). The highest catch of Coral Trout occurred in the dry season (45%) followed by the run-off (29%) and the dry season (26%) (Figure 23C). All Coral Trout were caught using line fishing methods (Figure 23D) and they were captured primarily in offshore waters (92.4%) (Figure 23E).

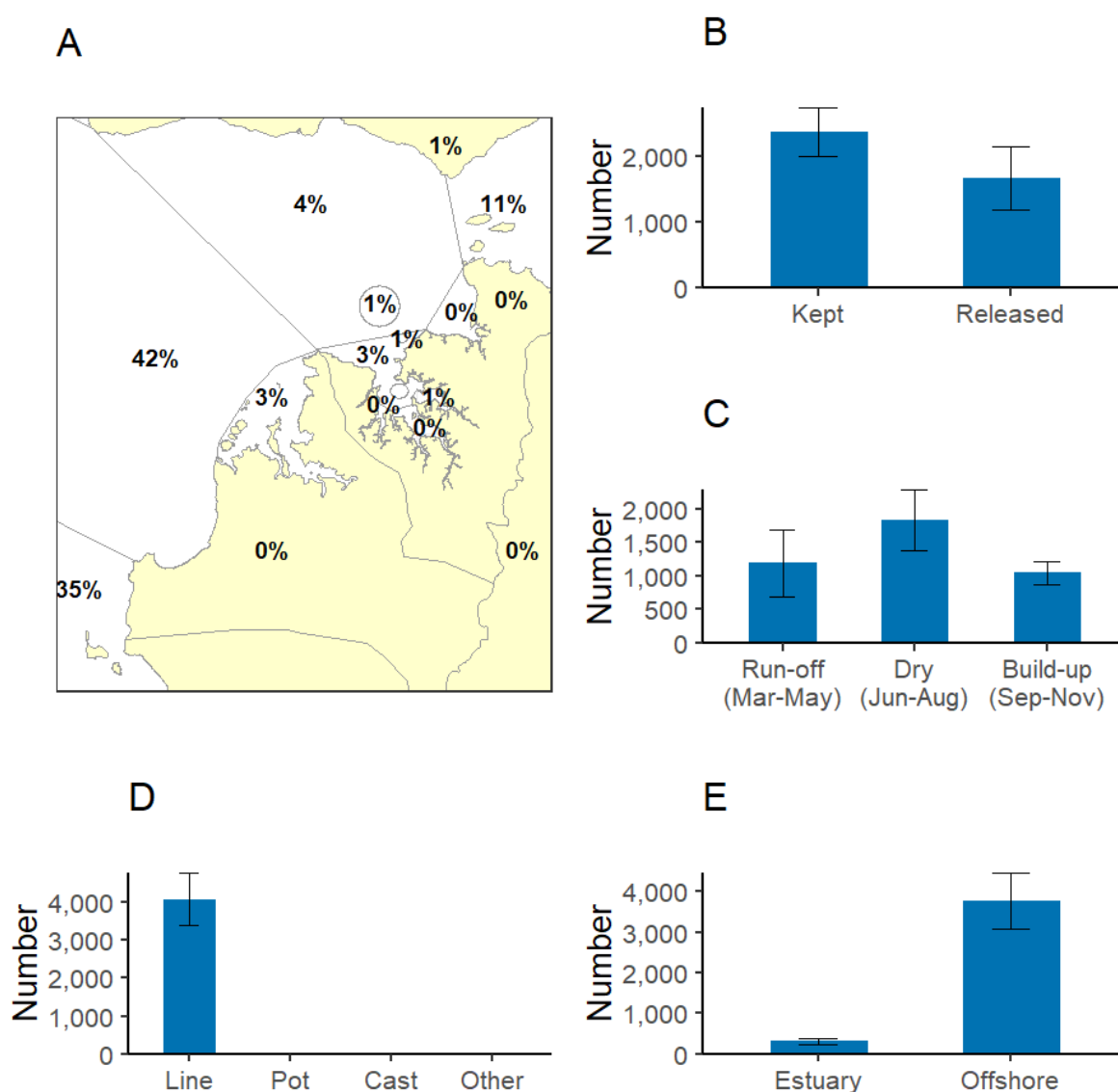


Figure 23. Summary results for Coral Trout in the Greater Darwin Area from March 2015 to November 2015: A) proportion (%) of the total catch by region, B) total numbers kept and released, C) catch by season D) proportion (%) of catch by fishing method and E) total catch by water body. Error bars represent one standard error.

6.4. Golden Snapper (*Lutjanus johnii*)

Golden Snapper has been assessed as overfished in the Greater Darwin Area (Saunders et al. 2014b) and several management measures have been implemented to promote the recovery of this species. Regular monitoring of the recreational catch of Golden Snapper is necessary to gauge the effectiveness of recovery efforts.

The majority of the recreational catches of Golden Snapper occurred within Darwin Harbour (32%), the area offshore from Dundee (19%) and Bynoe Harbour (18%) (Figure 24A). More than half of all Golden Snappers captured were released (60%) (Figure 24B). Golden Snappers were captured throughout the survey period with the highest catches occurring in the build-up (41%) followed by the run-off (36%) and the dry season (23%) (Figure 24C). Almost all Golden Snappers were caught using line fishing methods (99.3%) (Figure 24D) with catches being slightly higher in estuarine waters (59%) than in offshore waters (41%) (Figure 24E).

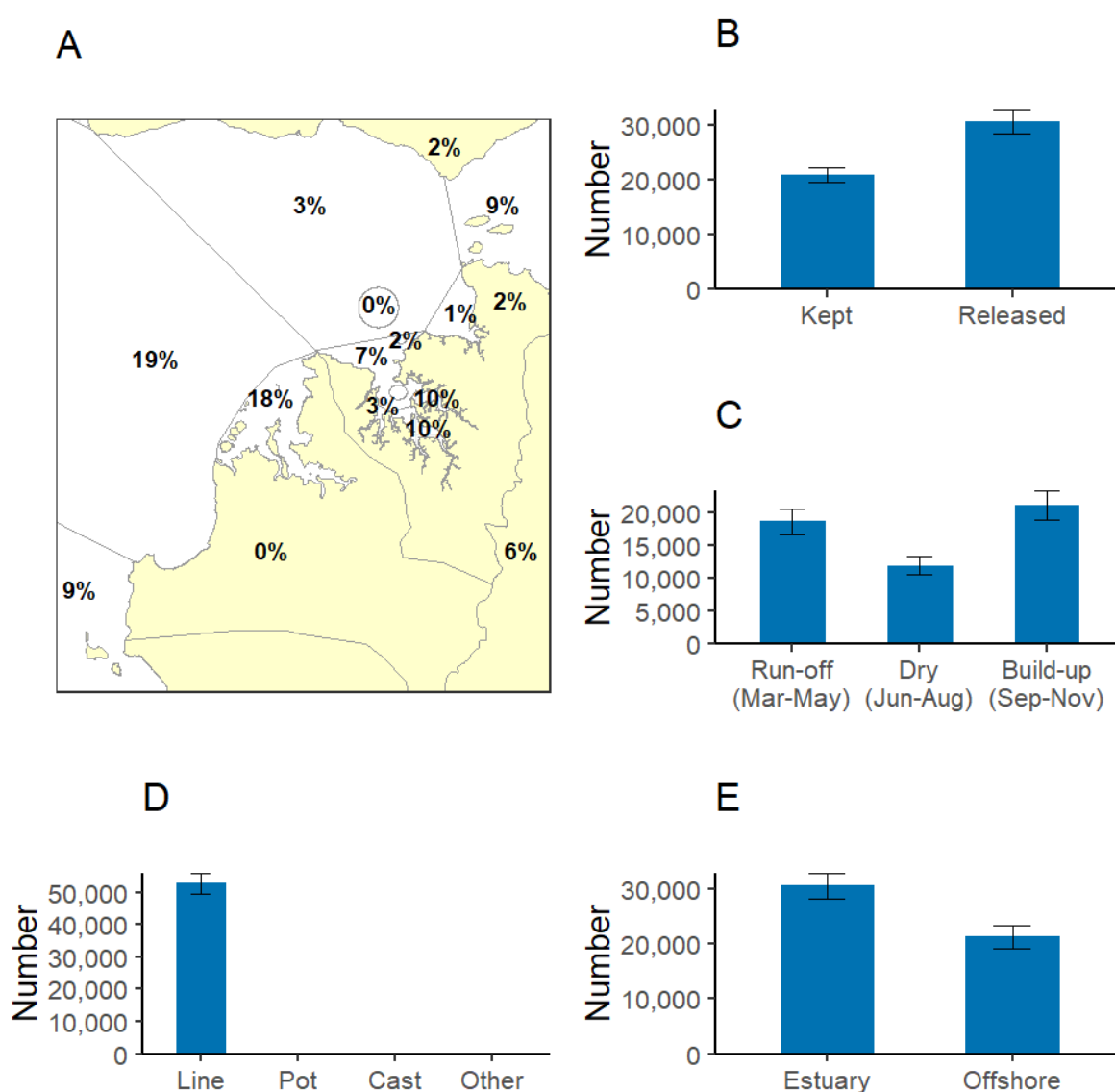


Figure 24. Summary results for Golden Snappers in the Greater Darwin Area from March 2015 to November 2015: A) proportion (%) of the total catch by region, B) total numbers kept and released, C) catch by season D) proportion (%) of catch by fishing method and E) total catch by water body. Error bars represent one standard error.

6.5. Mud Crab (*Scylla* spp.)

Mud Crabs an iconic Top End species and a primary target for many fishers due to their excellent eating qualities.

The majority of the recreational catch of Mud Crabs in the Greater Darwin Area originated from Shoal Bay (44%) followed by Darwin Harbour (28%) and to a lesser extent the Adelaide River (13%) (Figure 25A). Just over 57% of all Mud Crabs captured were kept (Figure 25B) with the highest catches occurring during the dry season (47%) and the run-off (36%). The build-up months produced 16% of the Mud Crab catch for the survey period (Figure 25C). The vast majority of Mud Crabs were caught in pots (99.6%) with minor catches by line or cast net (Figure 25D). Almost all Mud Crabs were caught in estuarine waters (98.5%) (Figure 25E).

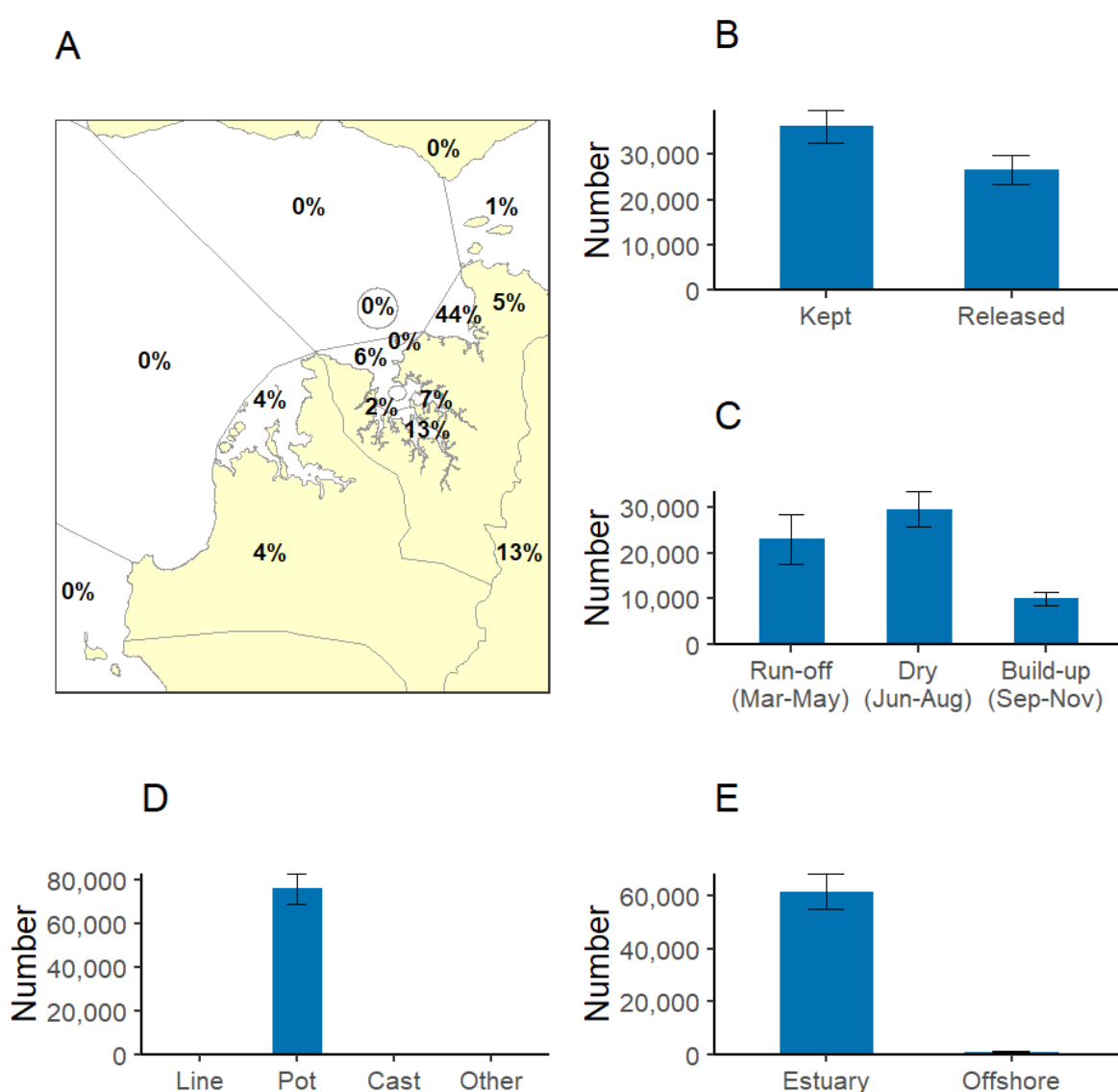


Figure 25. Summary results for Mud Crabs in the Greater Darwin Area from March 2015 to November 2015: A) proportion (%) of the total catch by region, B) total numbers kept and released, C) catch by season D) proportion (%) of catch by fishing method and E) total catch by water body. Error bars represent one standard error.

6.6. Spanish Mackerel (*Scomberomorus commerson*)

Spanish Mackerel is an important sportfish in the Top End, particularly during the dry season when large numbers of these apex predators come close to the coast, making them more accessible to recreational anglers.

The majority of the recreational catch of Spanish Mackerels in the Greater Darwin Area occurred around the Peron Islands (30%) and offshore of Dundee and Bynoe Harbour (24%) (Figure 26A). Approximately 44% of all Spanish Mackerels captured were kept (Figure 26B) with catches being fairly consistent throughout seasons (Figure 26C). All Spanish Mackerels were caught using line fishing methods (99.8%) (Figure 26D), predominantly from offshore waters (80%) (Figure 26E).

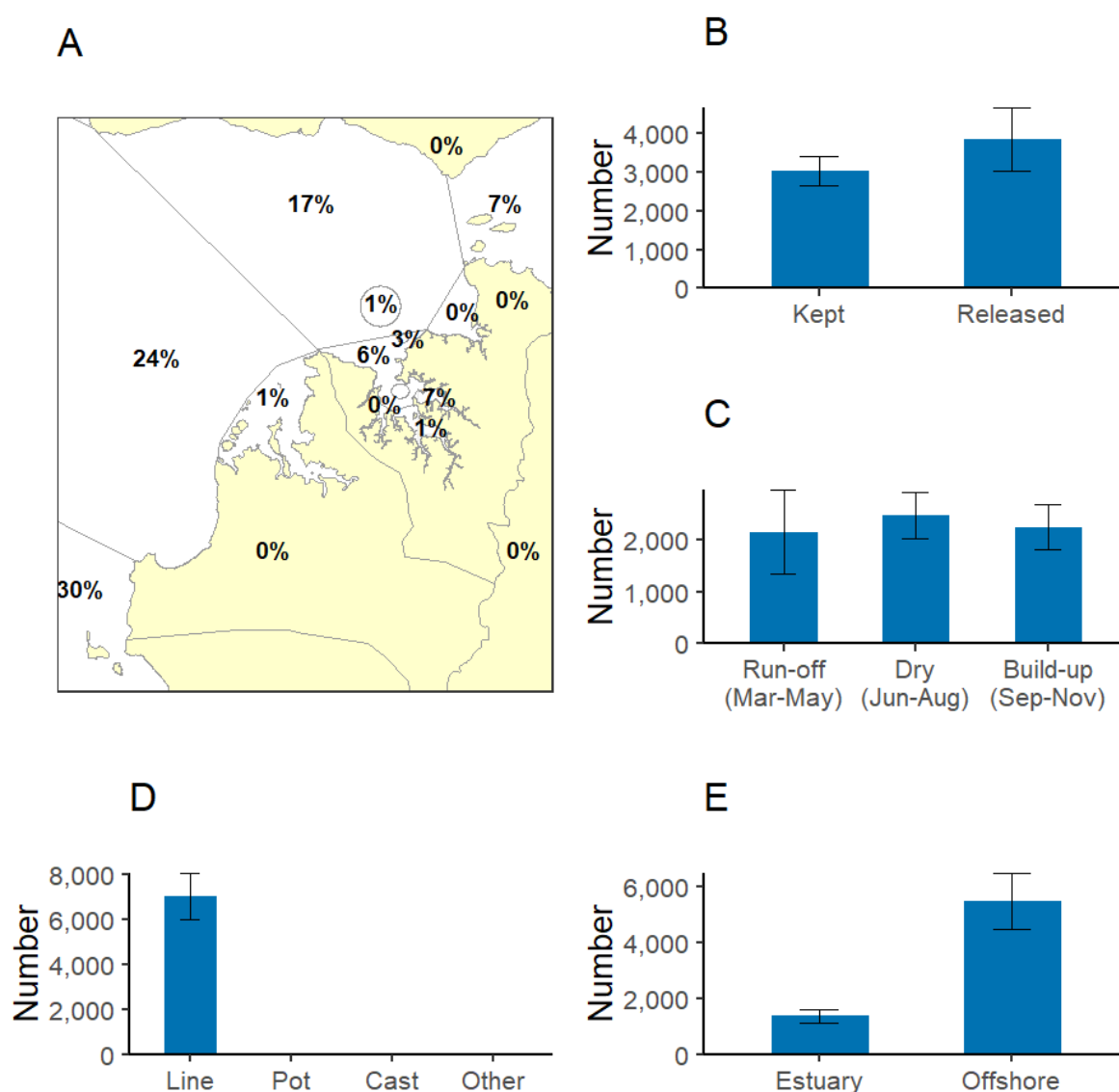


Figure 26. Summary results for Spanish Mackerels in the Greater Darwin Area from March 2015 to November 2015: A) proportion (%) of the total catch by region, B) total numbers kept and released, C) catch by season D) proportion (%) of catch by fishing method and E) total catch by water body. Error bars represent one standard error.

7. Length and sex data

7.1. Golden Snapper (*Lutjanus johnii*) harvest length data

The length of harvested Golden Snappers ranged from 20 to 80 cm. The most frequent length (mode) was 40 cm and the mean length was 39 cm (Figure 27).

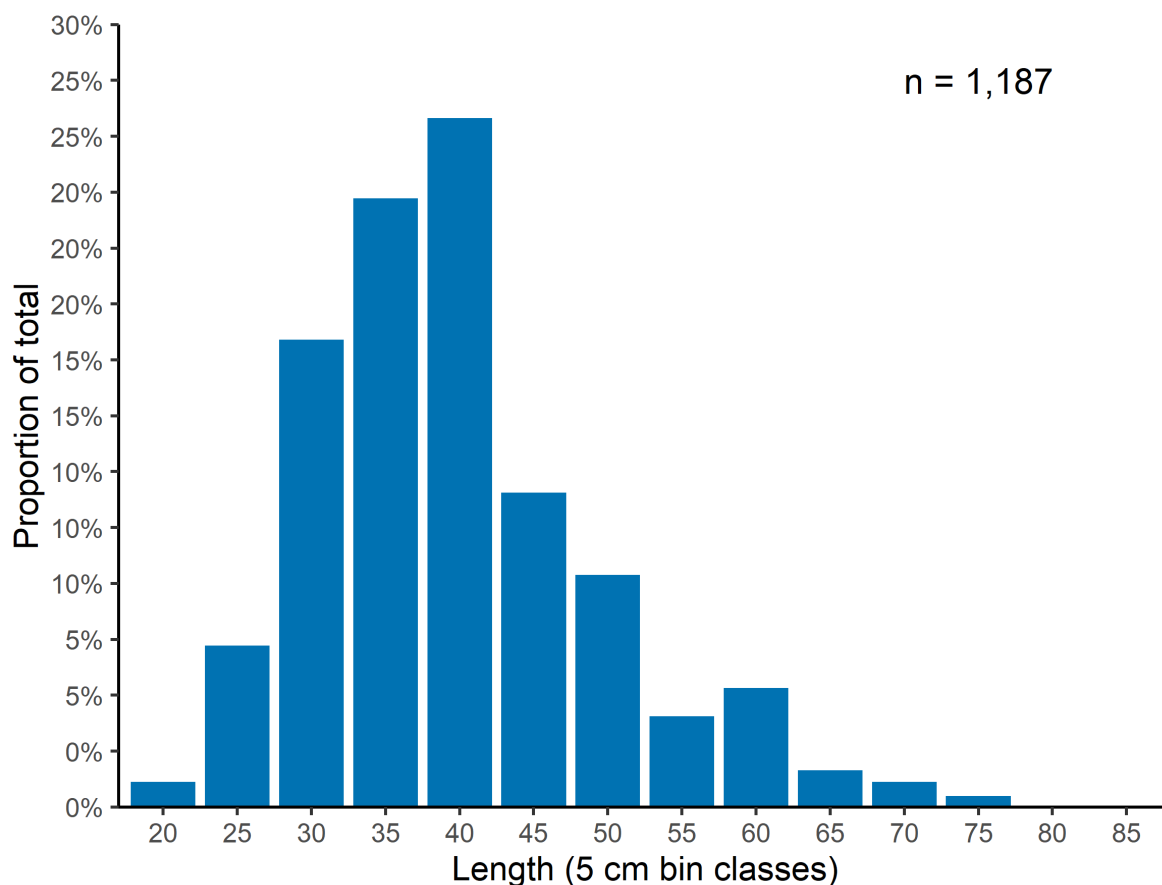


Figure 27. Length frequency distribution of harvested Golden Snappers from the Greater Darwin Area taken by recreational fishers during the survey period from March 2015 to November 2015

7.2. Black Jewfish (*Protonibea diacanthus*) harvest length data

The length of harvested Black Jewfish ranged from 40 to 135 cm. The most frequent length was 60 cm and the mean length was 81 cm (Figure 28). These figures were down slightly from the 2014 survey where the mode was 70 cm and the mean was 84 cm.

As was the case with the 2014 survey, Black Jewfish in the 90 cm size class were under-represented in the 2015 harvest sample

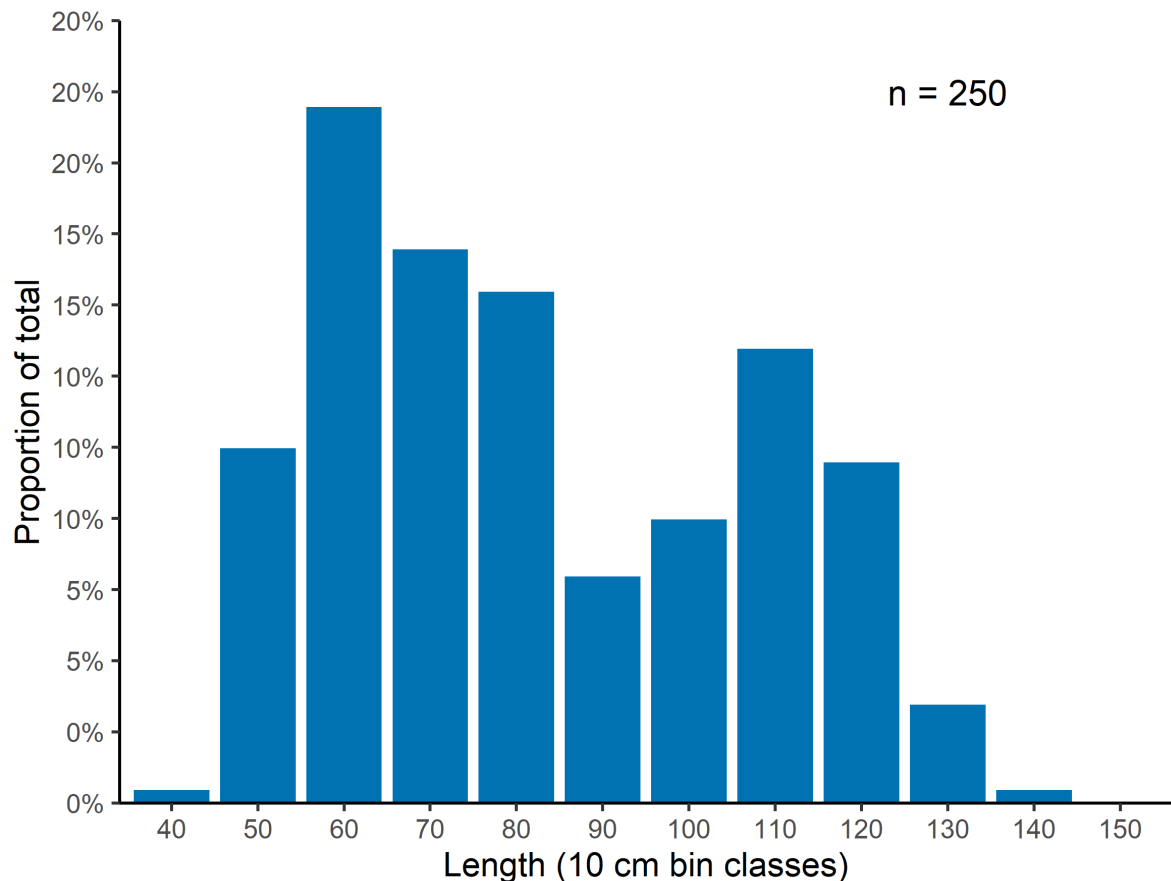


Figure 28. Length frequency distribution of harvested Black Jewfish from the Greater Darwin Area taken by recreational fishers during the survey period from March 2015 to November 2015

7.3. Barramundi (*Lates calcarifer*) harvest length data

The length of harvested Barramundi ranged from 53.5 to 98 cm. The most frequent length was 60 cm and the mean length was 64.4 cm (Figure 29).

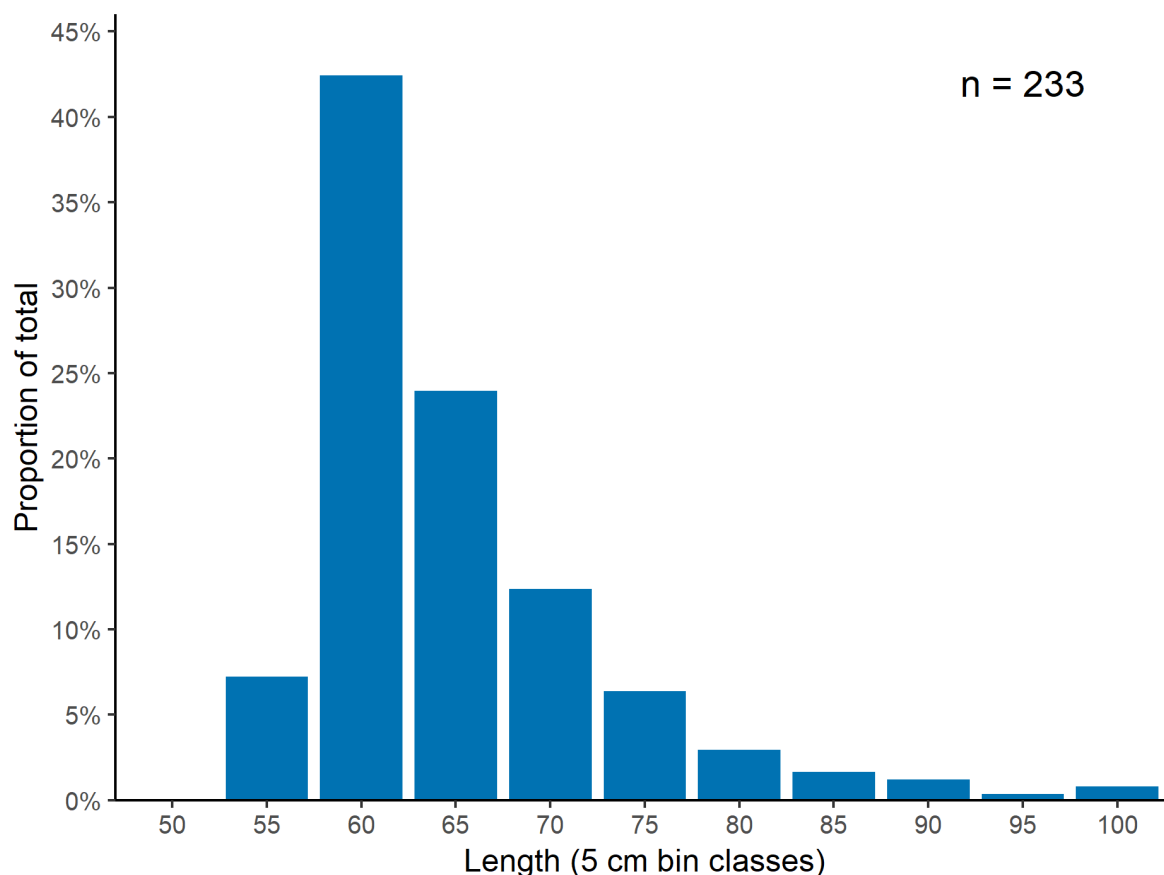


Figure 29. Length frequency distribution of harvested Barramundi from the Greater Darwin Area taken by recreational fishers during the survey period from March 2015 to November 2015

7.4. Mud Crab sex data

In those cases where fishers were confident in identifying the sex of mud crabs, interviewers recorded how many mud crabs of each sex were kept and/or released. Within this subset of data, the number of male crabs caught was roughly double the number of female crabs caught. This was also the case in the 2014 survey. The overall catch was highest in May and decreased towards the end of the year (Figure 30). A notable poor crabbing month seems to have occurred in September, 2015. However, care must be exercised when interpreting these results due to sampling artefacts (such as differences in people's ability to identify the gender of mud crabs).

Of the male crabs caught, 86% were kept, whereas only 42% of female crabs were kept. The proportion of males kept each month was always high (at least 70%), but the proportion of females kept in a given month, rarely exceeded 50%, dropping as low as 20% in April (Figure 31).

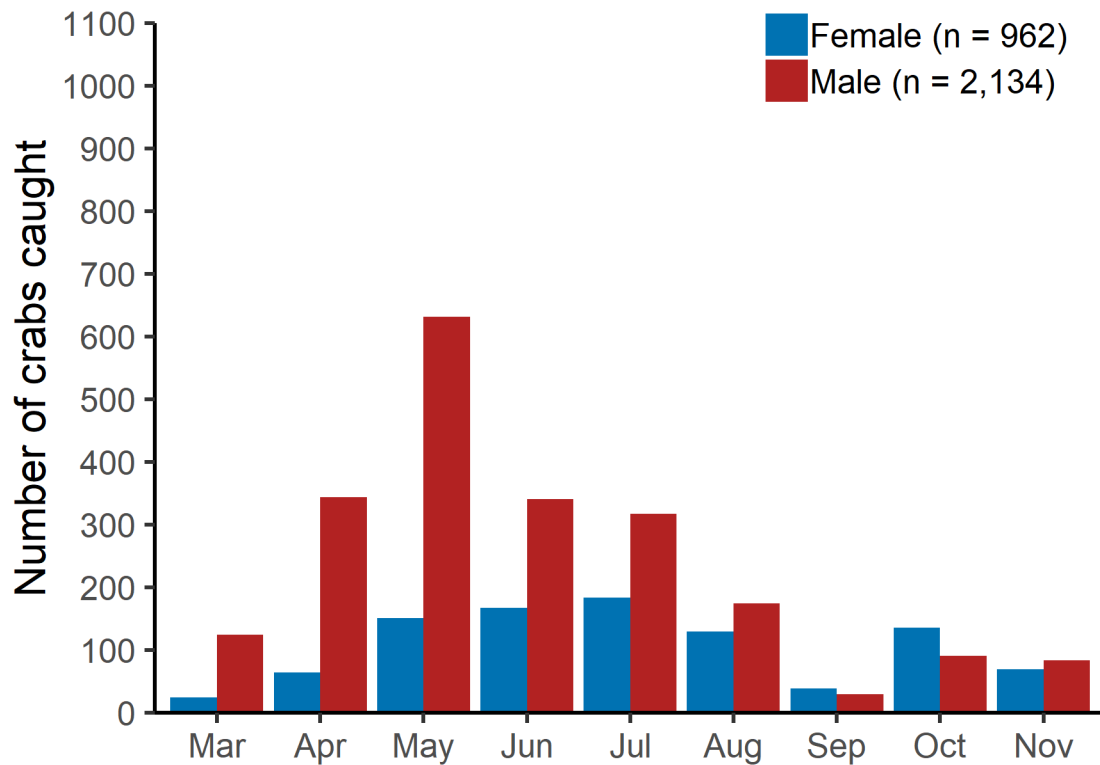


Figure 30. Monthly catch of male and female Mud Crabs by recreational fishers in the Greater Darwin Area during the survey period from March 2015 to November 2015

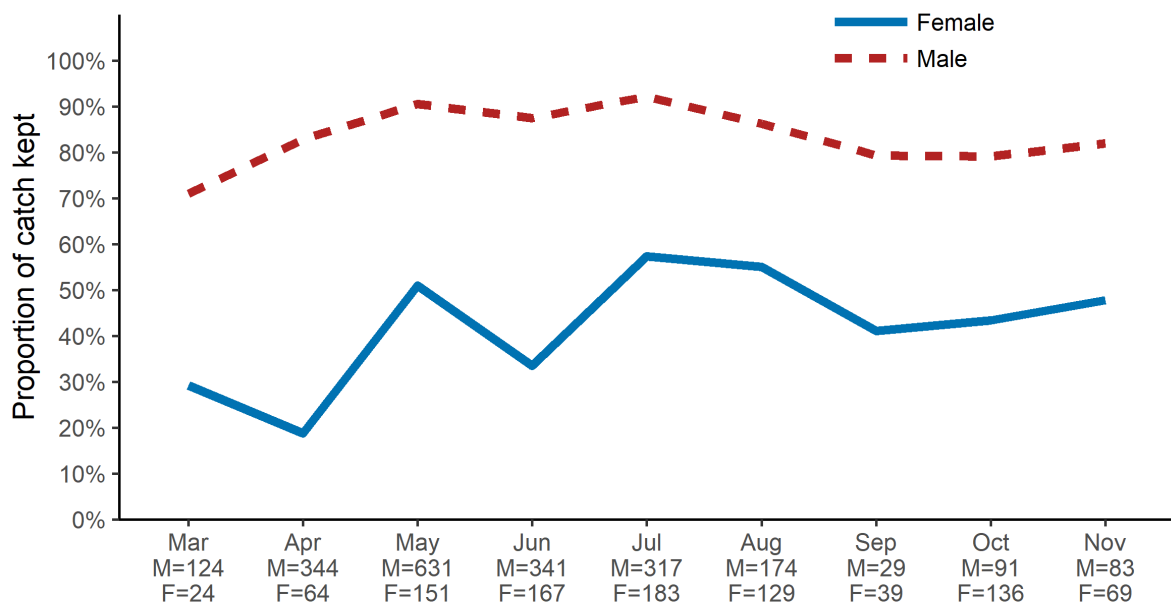


Figure 31. The proportion of Mud Crab catch (n=3096) kept by month for each sex by recreational fishers in the Greater Darwin Area during the survey period from March 2015 to November 2015

8. Vessel characteristics and technology

8.1. Vessel size

More than 80% of the recreational vessels observed were 4.5 m long or larger (Figure 32).

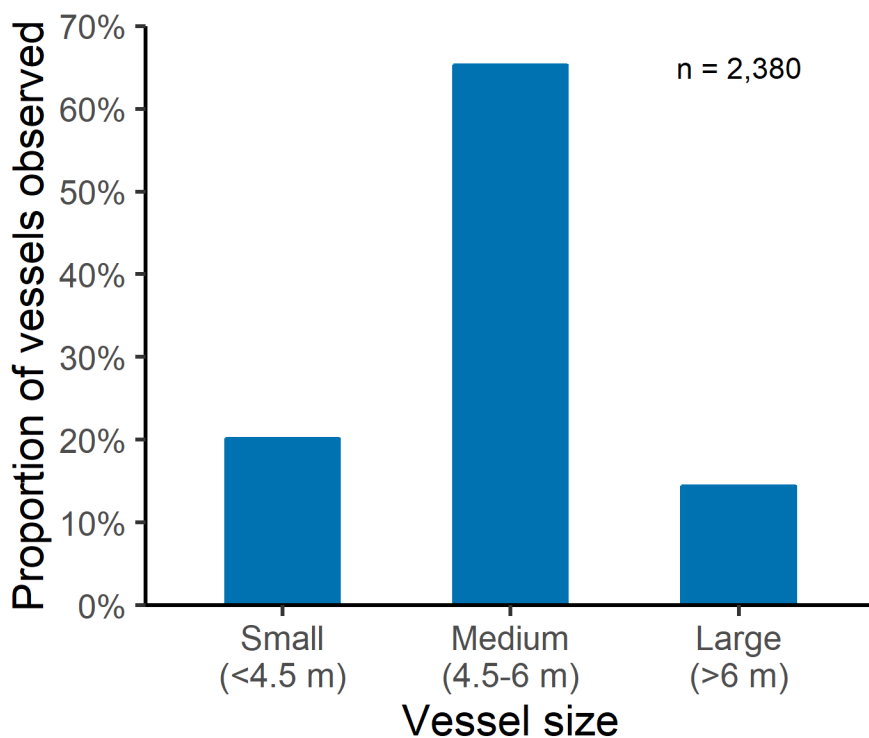


Figure 32. The proportion of recreational fishing vessels by size class in the Greater Darwin Area during the survey period from March 2015 to November 2015

8.2. Vessel technology

More than 92% of the recreational fishing vessels observed were fitted with sounders (Figure 33). Most vessels (59%) had a sounder screen that was 10 to 20 cm wide. Only 13% of vessels had a sounder with a screen exceeding 20 cm in width.

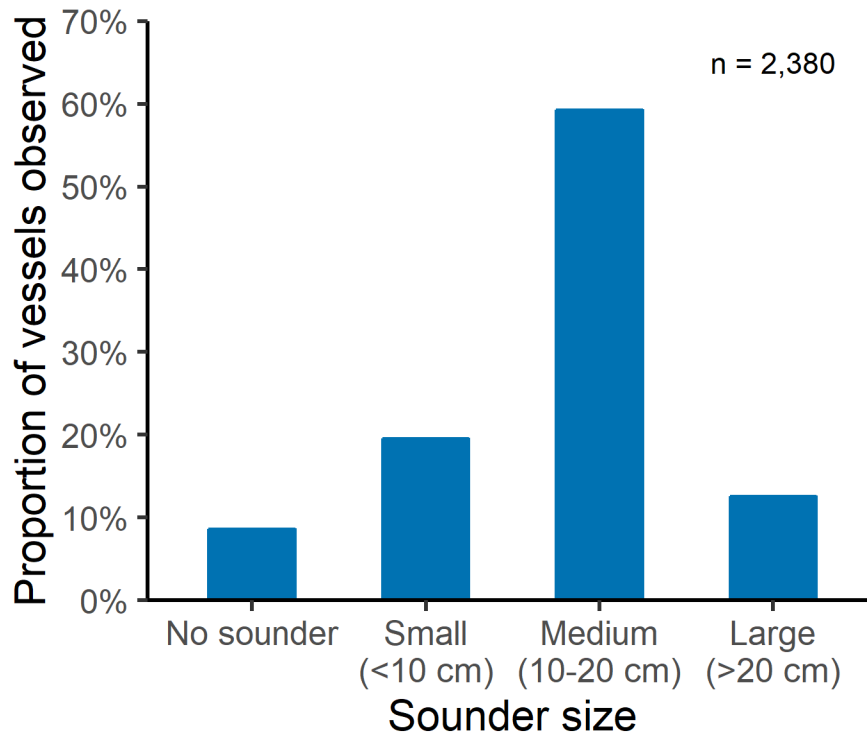


Figure 33. The proportion of recreational fishing vessels by sounder dimensions from a subset of recreational fishers, who fished in the Greater Darwin Area during the survey period from March 2015 to November 2015

More than 80% of recreational fishing vessels surveyed were fitted with a GPS (Figure 34). Most vessels (56%) had a GPS screen size of 10 to 20 cm and were often an integrated component of the sounder unit.

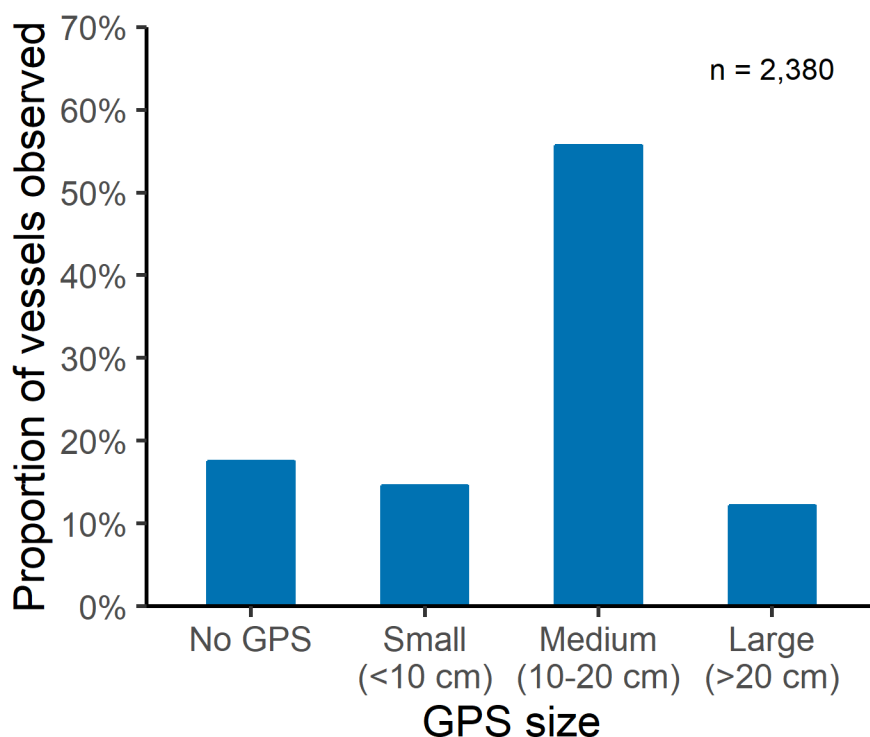


Figure 34. The proportion of vessels by GPS dimensions from a subset of recreational fishers who fished in the Greater Darwin Area during the survey period from March 2015 to November 2015

The use of sounders and GPS varied with boat size; however, the general trend indicated advanced technology was more frequently associated with larger vessels compared with smaller vessels. Nonetheless, 92% of all vessels surveyed had a sounder and 82% of all vessels had a GPS. It is also worth noting that chart plotting applications (apps) are now available for smart phones and tablets. Therefore, the absence of a GPS/plotter fitted to a boat does not necessarily mean a vessel lacked this technology.

9. Summary and future research

This report summarises the key results from the 'Survey of Recreational Fishing in the Greater Darwin Area 2015' and includes detailed information relating to recreational fishing activities in the coastal area surrounding Darwin. Monitoring of the recreational fishery is particularly important in areas where commercial effort is reduced or excluded or where the recreational sector takes a significant proportion of the overall catch. This report provides expanded estimates of the recreational fishing catch and effort, which subsequently inform the assessments for determining the sustainability of harvesting fish stocks.

9.1. Comparisons with previous surveys

This survey used the same methodology as the "*Survey of Recreational Fishing in the Greater Darwin Area 2014*" and so comparisons of results can be made between the two surveys. However, the reader should be mindful of the standard errors around each expanded estimate; large standard errors represent a high degree of uncertainty in the survey estimates. Apparent differences between years may not be statistically significant if the standard errors for these estimates overlap.

A comparison of effort between survey years revealed that effort across the Greater Darwin Area declined from 579 446 hrs in 2014 to 513 055 hrs in 2015 (a decrease of 11.5%). Of particular note is the fact that effort in the Darwin Harbour/Surrounds Zone decreased by 20%, whereas effort in the Bynoe Harbour/Dundee Zone increased by 8.4%.

The decline in fishing effort between years was accompanied by a decrease in total catch, from 638 440 organisms in 2014 to 496 952 organisms in 2015, a reduction of over 141 000 individuals (or 22%). Mud Crabs and other crustaceans (such as blue swimmer crabs and marine prawns) accounted for a large part (45%) of the overall reduction in catch. This was most likely due to the relatively poor wet season in 2014-15, which impacted on inshore productivity. Rainfall around Darwin during the 2013-14 wet season was 150 to 600 mm above the long-term average, whereas rainfall over the 2014-15 wet season was 75 to 300 mm below the long-term average (BoM 2018).

Differences in wet season rainfall between survey years may also have influenced seasonal fishing effort. The run-off season accounted for the greatest proportion of fishing effort in 2014 (following a good wet season) but the lowest proportion of effort in 2015 (following a poor wet season).

Other notable comparisons include:

- Dundee Beach surpassed Dinah Beach as the ramp contributing the greatest number of fisher hours (effort).
- Visiting angler effort was down from 22% of the total dry season effort in 2014 to 16% of the total dry season effort in 2015.

9.2. Future monitoring

The Greater Darwin region supports about 80% of the overall fishing activity across the NT (West et al. 2012) and is therefore highly significant from a management perspective. With concerns remaining in regard to reef fish sustainability in this heavily-fished region, it is prudent to continue these annual surveys. For this reason, it was expected that the Survey of Recreational Fishing in the Greater Darwin Area would be repeated in both 2016 and 2017. Information obtained from the two previous surveys may be used to improve the survey design going forward; however, the methodology employed will essentially be the same.

These successive surveys, using similar methodologies, will provide a long-term assessment of recreational fishing activity, improve our knowledge of fisher behaviour and provide managers with contemporary information to guide the development and refinement of fishery management plans.

10. Acknowledgments

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- The support and assistance of many NT Fisheries staff who contributed to the overall success of the project – in particular Ian Curnow, Bryan McDonald, Thor Saunders, Kane Dysart, Evan Needham, Chris Errity, Graham Schultz, Blake Taylor, Mark Grubert, Will Bowman, James Woodhams, Hock Seng-Lee and Patti Kuhl.
- The on-site survey interviewing team of Keith Saunders, Kerry Taylor, Ann Hyder, Peter Novak, Phil Parker, Sharon Every, Natalie Leader, Deepak Pazhayamadam and Clint Cameron who worked tirelessly in all weather conditions to obtain quality data.
- Lastly, and most importantly, we would like thank the many recreational anglers who willingly participated in the survey and made a valuable contribution to the future management of the resources. On this note, it is worth mentioning that the survey staff located at boat ramps in the Greater Darwin Area recorded exceptionally high response rates whilst conducting these surveys, indicating that the majority of recreational anglers support this data collection and are serious about assisting in the sustainable management of our fish stocks.

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12. Appendices

Appendix 1: Glossary of terms

Barotrauma	Physical damage to body tissue caused by a difference in pressure from a gas space inside the fish's body. The damage usually occurs when a reef fish is brought up from water deeper than 10 m.
Build-up	The season encompassing the months of September, October and November.
Catch	The total number of organisms caught, whether kept or released.
Cephalopods	A diverse group of molluscs that includes squid, cuttlefish and nautilus.
Crustaceans	A group of invertebrates that includes crabs, lobster (crayfish) and prawns.
Dry season	The season encompassing the months of June, July and August.
Estuary	A body of brackish water open to the sea with one or more rivers flowing into it. For the purposes of the survey, Darwin Harbour, Bynoe Harbour and Shoal Bay were all considered estuaries.
Fish	Includes both teleost (bony fishes) and elasmobranchs (sharks/rays).
Gastropods	A group of molluscs that include snails (e.g. abalone, longbums, periwinkles, conches and whelks).
Harvest	The total number of organisms that were caught and retained; the same as kept catch.
Fisher hours	Hours spent recreational fishing by fishers.
Kept catch	The total number of organisms that were caught and retained; the same as harvest.
Offshore	All areas seaward of the coastline and estuaries.
Primary sampling unit	A calendar day that fell within the survey period.
Recreational fisher	Any person, aged five years or more, that went recreational fishing in the Greater Darwin Area during the survey period.

Recreational fishing	The capture or attempted capture of aquatic organisms for non-commercial purposes.
Relative standard error	The standard error of an estimate divided by the estimate and expressed as a percentage.
Released catch	The total number of organisms that were caught and then returned to the water.
Residents	People who normally reside in the Northern Territory.
Run-off	The season encompassing the months of March, April and May.
Shift	A five hour period of the day (either 9:00-14:00 hr or 14:00-17:00 hr) in which interviewers collected data from recreational fishers.
Visitors	People who normally reside outside the NT.

Appendix 2: The total number of primary sampling units in each stratum

Season	Day Type	Total
Wet #	WD	61
(December, January, February)	WE	29
Run-Off	WD	62
(March, April, May)	WE	30
Dry	WD	63
(June, July, August)	WE	29
Build-Up	WD	65
(September, October, November)	WE	26
# subsequently removed from expansion		
WD - weekday, WE - weekend		

Appendix 3: Summary of number of sampling days at primary boat ramps

Primary Ramp		Fishing Zone	Season / Day Type								Total
			Wet #		Run-Off		Dry		Build-Up		
			WD	WE	WD	WE	WD	WE	WD	WE	
1	Buffalo Creek	DHS	2	2	6	6	6	6	6	6	40
2	Dinah Beach	DHS	2	2	6	6	6	7	6	6	41
5	East Arm	DHS	2	2	6	6	6	6	6	6	40
6	Nightcliff	DHS	2	2	6	6	6	6	6	7	41
10	Middle Arm	DHS	2	2	6	6	6	6	6	6	40
12	Leaders Creek	DHS	2	2	6	6	6	7	6	6	41
22	Saltwater Arm	DHS	2	2	7	6	6	6	6	6	41
Sub-Total			14	14	43	42	42	44	42	43	284
15	Six Pack	BD	2	2	6	6	7	6	7	5	41
16	Keswick	BD	2	2	6	6	6	6	6	6	40
21	Dundee	BD	2	2	6	6	6	6	6	6	40
Sub-Total			6	6	18	18	19	18	19	17	121
Total			20	20	61	60	61	62	61	60	405

subsequently removed from expansion

WD - weekday, WE - weekend, DHS - Darwin Harbour/Surrounds Zone, BD - Bynoe Harbour/Dundee

Appendix 4: List of species caught by recreational anglers in the Greater Darwin Area during the survey period of March 2015 to November 2015

Reporting group	Common name	Scientific name
Barramundi	Barramundi	<i>Lates calcarifer</i>
Bream, pikey	Pikey bream	<i>Acanthopagrus berda</i>
Catfish	Eeltail catfish	Plotosidae
	Forktail catfish	Ariidae
Cod/groupers	Cod/groupers	Serranidae - undifferentiated
Coral trout	Coral trout	<i>Plectropomus</i> spp
Emperor, red	Red emperor	<i>Lutjanus sebae</i>
Emperor, other	Emperor, other	Lethrinidae
Flathead	Flathead	Platycephalidae - undifferentiated
Javelin fish	Barred javelin	<i>Pomadasys kaakan</i>
Jewfish, black	Black jewfish	<i>Protonibea diacanthus</i>
Jewfish, other	Croaker	Sciaenidae
Mackerel, grey	Grey mackerel	<i>Scomberomorus semifasciatus</i>
Mackerel, Spanish	Spanish mackerel	<i>Scomberomorus commerson</i>
Mackerel, spotted	Spotted mackerel	<i>Scomberomorus munroi</i>
Moonfish/Batfish	Batfish	Ephippidae
Mullet	Mullet	Mugilidae - undifferentiated
Queenfish	Queenfish	<i>Scomberoides</i> spp
Sharks & rays	Rays/skates	Dasyatidae
	Sawfish	Pristidae
	Shark	Various families
Small baitfish	Baitfish, unspec.	Several families
	Herring, other	Clupeidae
Snapper, golden	Golden snapper	<i>Lutjanus johnii</i>
Snapper, mangrove jack	Mangrove jack	<i>Lutjanus argentimaculatus</i>
Snapper, Moses'	Moses' snapper	<i>Lutjanus russellii</i>
Snapper, saddletail/ crimson/indonesian	Saddletail, crimson & Indonesian snapper	<i>Lutjanus malabaricus</i> , <i>erythropterus</i> & <i>bitaeniatus</i>
Snapper, stripey	Stripey snapper	<i>Lutjanus carponotatus</i>
Snapper, other	Chinaman fish	<i>Symphorus nematophorus</i>
	Snapper, other	Various families
Tarpon/ox-eye herring	Oxeye herring	<i>Megalops cyprinoides</i>
Threadfin, blue	Blue threadfin	<i>Eleutheronema tetradaetylum</i>
Threadfin, king	King threadfin	<i>Polydactylus macrochir</i>
Trevally, giant	Giant trevally	<i>Caranx ignobilis</i>
Trevally, golden	Golden trevally	<i>Gnathanodon speciosus</i>
Trevally, other	Trevally, other	Carangidae - undifferentiated
Tuna, longtail	Longtail tuna	<i>Thunnus tonggol</i>

Reporting group	Common name	Scientific name
Tuna, mackerel	Mackerel tuna	<i>Euthynnus affinis</i>
Whiting	Whiting	Sillaginidae - undifferentiated
Wrasse, tuskfish	Parrotfish/tuskfish	Scaridae - undifferentiated
Scalefish, other	Archer fish	Toxotidae - undifferentiated
	Barracuda	Sphyraenidae
	Bream, other	Sparidae
	Cobia	<i>Rachycentron canadum</i>
	Eel	Various families
	Fish, other	Various families
	Flounder/sole	Various families
	Frogfish	Batrachoididae
	Fusiler	Caesionidae
	Garfish	Hemiramphidae - undifferentiated
	Jawfish/stargazer	Opistognathidae & Uranoscopidae
	Leatherjacket	Monacanthidae
	Lizardfish/grinner	Various families
	Long tom	Belonidae
	Milkfish	<i>Chanos chanos</i>
	Remora	Echeneidae - undifferentiated
	Sailfish	<i>Istiophorus platypterus</i>
	Sand bass	<i>Psammoperca waigiensis</i>
	Scat/butterfish	Scatophgidae - undifferentiated
	Scorpionfish	Scorpaenidae - undifferentiated
	Sweetlip	Haemulidae - undifferentiated
	Toads/pufferfish	Various families
	Tripletail	<i>Lobotes surinamensis</i>
	Trumpeter, yellowtail	<i>Amniataba caudovittatus</i>
	Wahoo	<i>Acanthocybium solandri</i>
	Small mouth scad	<i>Alepes spp</i>
Mud crab	Mud crab	<i>Scylla spp</i>
Crustaceans, other	Blue swimmer crab	<i>Portunus pelagicus</i>
	Hermit crab	<i>Coenobita variabilis</i>
	Crab, other	Brachyura - undifferentiated
	Prawn, marine	Penaeoidea & Caridea - undiff.
Cephalopods	Squid	Loliginidae - undifferentiated
Gastropods	Telescopium snail (Longbum)	Potamididae
Other taxa	Non-fish, other	Various families

Appendix 5: Summary of sampling at secondary boat ramps

Secondary Ramp		Fishing Zone	Season / DayType								Total
			Wet #		Run-Off		Dry		Build-Up		
			WD	WE	WD	WE	WD	WE	WD	WE	
3	Ski Club	DHS	3	3	4	4	3	3	3	3	26
4	Channel Island	DHS	3	3	4	4	3	3	3	3	26
7	Palmerston	DHS	3	3	4	4	3	3	3	3	26
8	Trailer Boat Club	DHS	3	3	4	4	3	3	3	3	26
9	Mandorah	DHS	3	3	4	4	3	3	3	3	26
11	Southport	DHS	3	3	4	4	3	3	3	3	26
13	Crab Claw Island	BD	3	3	4	4	3	3	3	3	26
14	Milne Inlet	BD	3	3	4	4	3	3	3	3	26
23	Dundee Road	BD	3	3	4	4	3	3	3	3	26
Total			27	27	36	36	27	27	27	27	234

subsequently removed from expansion

WD - weekday, WE - weekend, DHS - Darwin Harbour/Surrounds Zone, BD - Bynoe Harbour/Dundee

Appendix 6: Recreational effort (fisher hours) by analysis and ramp for the survey period of March 2015 to November 2015

SE is Standard Error; values in italics have an RSE between 25–50% and values in bold have an RSE >50%.

Analysis	Ramp	Effort	
		Fisher hours	SE
Primary ramp daytime direct expansion	1. Buffalo Creek	28931	5038
	2. Dinah Beach	72279	7211
	5. East Arm	40366	4224
	6. Nightcliff	14261	4079
	10. Middle Arm	30096	4073
	12. Leaders Creek	23813	6439
	15. Six Pack	21730	3032
	16. Keswick	8425	1757
	21. Dundee	84436	9256
	22. Saltwater Arm	27398	4462
	Total	351735	
Primary ramp post late shift to sunset estimation	1. Buffalo Creek	5763	1111
	2. Dinah Beach	12132	1965
	5. East Arm	7090	1615
	6. Nightcliff	343	175
	10. Middle Arm	3534	987
	12. Leaders Creek	3063	1336
	15. Six Pack	3275	1064
	16. Keswick	1183	520
	21. Dundee	30748	7274
	22. Saltwater Arm	2374	761
	Total	69505	
Secondary ramp estimation	3. Ski Club	9682	2184
	4. Channel Island	10540	1847
	7. Palmerston	30112	4539
	8. Trailer Boat Club	4698	1853
	9. Mandorah	683	305
	11. Southport	2288	454
	13. Crab Claw	14039	3470
	14. Milne Inlet	15433	3183
	23. Dundee Rd	4340	1386
	Total	91815	
Grand Total		513055	

Appendix 7: Recreational effort (fisher hours) and total catch of key species by fishing region in the Greater Darwin Area during the survey period of March 2015 to November 2015

SE is Standard Error; values in italics have an RSE between 25–50% and values in bold have an RSE >50%.

Fishing Region ->	6		7		8		9		10		10a		10b		10c	
Species/group	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE
Effort																
Effort hours	15748	3428	70039	6453	6834	6849	11403	2605	54804	4639	12896	2538	60398	5055	58739	5271
Catch																
Barramundi	3786	1032	4707	614	1527	602	285	156	986	230	618	218	2626	417	2590	451
Bream, pikey	0	0	1144	495	51	47	78	41	1814	837	575	172	2483	534	4968	960
Catfish	511	182	2981	351	1130	666	2080	636	1412	296	285	91	2472	293	2391	231
Cod/groupers	429	259	3416	396	688	327	204	93	3022	364	773	191	2642	226	2087	143
Coral trout	0	0	103	26	23	23	12	11	121	47	0	0	0	0	22	11
Emperor, other	0	0	491	125	70	68	0	0	1532	470	34	32	190	75	92	32
Emperor, red	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Flathead	0	0	124	33	22	21	0	0	265	65	19	12	207	57	352	68
Javelin fish	0	0	2371	507	162	159	64	61	2856	624	244	135	1870	381	1581	206
Jewfish, black	51	31	875	112	192	111	227	83	690	254	0	0	354	111	157	37
Jewfish, other	0	0	34	12	0	0	0	0	159	149	0	0	190	131	0	0
Mackerel, grey	0	0	68	24	23	23	0	0	774	594	11	10	59	47	44	14
Mackerel, Spanish	0	0	90	29	0	0	0	0	427	106	11	10	80	43	457	200
Mackerel, spotted	0	0	197	147	0	0	0	0	326	125	0	0	0	0	0	0
Moonfish/Batfish	0	0	915	289	0	0	82	53	701	175	128	69	458	139	1119	203
Mullet	360	254	6362	1260	106	96	16	15	3955	1012	1553	781	5641	1555	5177	716
Queenfish	0	0	1227	171	216	200	31	24	892	178	149	74	908	441	445	74
Sharks & rays	81	44	4684	580	128	71	341	150	2319	458	201	96	965	162	1258	150
Small baitfish	0	0	2843	890	11	10	0	0	2717	1692	1209	544	1527	690	4678	2339
Snapper, golden	0	0	9124	1255	833	272	1255	444	3613	518	1481	497	5321	775	5076	738
Snapper, mangrove jack	0	0	1108	220	125	40	22	21	112	45	57	45	223	83	496	199
Snapper, Moses'	0	0	386	93	0	0	0	0	182	99	11	11	249	97	1490	432
Snapper, saddletail/crimson/indo.	0	0	1833	683	0	0	31	28	4486	1091	26	24	778	302	1600	535
Snapper, stripey	0	0	3382	401	0	0	113	95	4378	893	54	27	511	222	256	56
Tarpon/ox-eye herring	11	10	30	23	0	0	0	0	9	8	11	10	14	9	134	59
Threadfin, blue	669	270	1041	128	983	541	495	169	463	95	177	78	287	66	509	142
Threadfin, king	163	87	870	148	64	47	65	29	29	16	89	67	137	50	53	17

Fishing Region ->	6		7		8		9		10		10a		10b		10c	
Species/group	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE
Trevally, giant	0	0	225	76	206	199	0	0	233	93	11	10	177	109	267	59
Trevally, golden	0	0	0	0	0	0	0	0	512	159	132	89	398	133	491	69
Trevally, other	51	31	1796	560	0	0	0	0	742	201	64	45	127	70	269	87
Tuna, longtail	0	0	0	0	0	0	0	0	186	102	11	10	0	0	0	0
Tuna, mackerel	0	0	0	0	0	0	0	0	21	13	0	0	0	0	0	0
Whiting	0	0	430	138	0	0	0	0	187	125	23	22	395	234	22	11
Wrasse, tuskfish	0	0	181	47	117	113	10	9	2557	499	33	23	164	49	1087	282
Scalefish, other	38	23	1144	287	0	0	190	88	2775	602	424	174	1679	449	2116	238
Mud crab	2646	922	2566	362	95	87	3134	1034	3593	626	1368	415	7894	1003	4556	475
Crustaceans, other	0	0	267	68	21	19	8	8	9110	3637	263	99	2903	646	1690	239
Cephalopods	0	0	0	0	0	0	0	0	23	21	0	0	48	33	0	0
Other taxa	0	0	0	0	0	0	0	0	35	24	0	0	0	0	0	0

Fishing Region ->	11		12		13		42		43		44		45		60	
Species/group	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE
Effort																
Effort hours	30581	4418	17110	246 7	25432	3967	35493	9122	69459	7041	17538	3427	23076	5025	4818	1377
Catch																
Barramundi	1008	325	0	0	1604	469	44	36	11	10	0	0	252	168	0	0
Bream, Pikey	1620	458	147	66	441	154	0	0	265	123	79	44	106	83	0	0
Catfish	1106	373	202	138	3483	1117	642	256	399	119	91	60	2201	1418	10	8
Cod/groupers	2251	406	1585	573	868	233	2850	1142	8480	989	984	319	1659	575	301	114
Coral trout	0	0	28	15	0	0	1406	569	1687	418	152	68	431	174	57	32
Emperor, other	32	17	158	80	31	30	10987	3162	8927	1567	595	181	276	162	10	8
Emperor, red	0	0	0	0	0	0	386	110	522	219	0	0	11	11	0	0
Flathead	77	48	0	0	0	0	0	0	0	0	21	15	0	0	0	0
Javelin fish	26	23	297	219	165	56	58	49	1857	496	1249	502	513	247	0	0
Jewfish, black	63	48	288	123	720	248	582	234	1247	372	459	156	1576	544	118	86
Jewfish, other	0	0	0	0	68	43	0	0	0	0	0	0	0	0	0	0
Mackerel, grey	0	0	14	11	0	0	262	89	631	210	129	63	472	243	21	19
Mackerel, Spanish	32	18	199	75	0	0	2073	630	1648	424	1148	406	515	229	37	26
Mackerel, spotted	39	27	81	32	0	0	110	56	352	135	589	355	0	0	271	188
Moonfish/Batfish	134	70	2257	521	23	11	669	175	1192	320	1074	341	311	154	1550	800

Fishing Region	11		12		13		42		43		44		45		60	
Species/group	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE	Number	SE
Mullet	6352	2694	0	0	1770	998	0	0	109	96	23	21	206	189	0	0
Queenfish	92	29	61	32	50	28	667	502	2365	860	119	70	747	301	11	10
Sharks/rays	770	284	683	145	264	143	3599	695	9287	1328	1938	272	1407	380	126	45
Small baitfish	3212	2292	28	21	215	213	0	0	29	24	23	21	0	0	0	0
Snapper, golden	278	112	887	243	3192	911	4841	1227	9917	1023	1781	474	4431	1099	109	47
Snapper, mangrove jack	27	16	0	0	32	22	0	0	137	78	30	28	596	240	0	0
Snapper, moses'	0	0	112	70	25	23	0	0	233	152	11	11	0	0	171	88
Snapper, other	17	16	1023	369	68	64	1543	645	1856	578	1795	485	3044	1290	231	133
Snapper, saddletail/ crimson/indo.	64	31	1487	382	0	0	7953	1875	12536	2278	2378	640	1503	487	405	278
Snapper, stripey	0	0	33	25	25	23	0	0	0	0	0	0	0	0	0	0
Tarpon/Ox-eye herring	836	286	57	53	417	158	716	387	3517	847	463	211	849	575	0	0
Threadfin, blue	28	25	0	0	155	95	0	0	34	32	11	11	124	116	0	0
Threadfin, king	34	32	72	33	9	9	671	319	1313	437	435	229	304	212	507	251
Trevally, giant	55	29	140	57	25	23	175	95	959	461	283	130	148	68	250	120
Trevally, golden	49	35	294	127	88	73	1326	538	2568	929	494	136	858	304	147	66
Trevally, other	0	0	0	0	0	0	119	74	1157	574	40	27	0	0	28	24
Tuna, longtail	0	0	14	10	0	0	127	98	913	477	65	42	240	193	52	39
Tuna, mackerel	118	73	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Whiting	228	95	1956	899	0	0	747	350	1020	203	865	291	395	156	41	27
Wrasse, tuskfish	2503	647	661	151	597	264	573	136	3462	601	1161	631	623	430	92	34
Scalefish, other	27924	6158	0	0	8050	1916	15	12	25	23	100	67	805	368	0	0
Mud crab	335	183	0	0	197	142	0	0	0	0	0	0	0	0	0	0
Crustaceans, other	0	0	738	549	0	0	0	0	0	0	0	0	0	0	0	0
Cephalopods	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Gastropods	6352	2694	0	0	1770	998	0	0	109	96	23	21	206	189	0	0
Other taxa	92	29	61	32	50	28	667	502	2365	860	119	70	747	301	11	10

Appendix 8: Estimated effort (fisher hours) by boat ramp during the survey period of March 2015 to November 2015

SE is Standard Error; values in italics have an RSE between 25–50% and values in bold have an RSE >50%.

Boat ramp	Effort (fisher hours)	SE	Proportion of total effort
Dundee	115183	11772	22.5
Dinah	84411	7474	16.5
East Arm	47456	4522	9.2
Buffalo	34694	5159	6.8
Middle Arm	33630	4191	6.6
Palmerston	30112	4539	5.9
Saltwater Arm	29773	4526	5.8
Leaders	26876	6576	5.2
Six Pack	25005	3213	4.9
Milne	15433	3183	3.0
Nightcliff	14605	4083	2.8
Crab Claw	14039	3470	2.7
Channel Is	10540	1847	2.1
Ski Club	9682	2184	1.9
Keswick	9607	1832	1.9
Trailer Boat Club	4698	1853	0.9
Dundee Rd	4340	1386	0.8
Southport	2288	454	0.4
Mandorah	683	305	0.1

Appendix 9: Recreational catch (total, kept and released numbers) by reporting group and species from the Greater Darwin Area during the survey period of March 2015 to November 2015

SE is Standard Error; values in italics have an RSE between 25–50% and values in bold have an RSE >50%.

Reporting group	Common name	Scientific name	Total		Kept		Released	
			Number	SE	Number	SE	Number	SE
Barramundi	Barramundi	<i>Lates calcarifer</i>	19211	1600	4888	449	14323	1296
Bream, pikey	Pikey bream	<i>Acanthopagrus berda</i>	13801	1619	5587	665	8215	1193
Catfish	Eeltail catfish	Plotosidae	84	33	22	9	62	32
	Forktail catfish	Ariidae	21001	2186	466	131	20535	2175
Cod/groupers	Cod/groupers	Serranidae - undifferentiated	32422	2081	6661	517	25761	1836
Coral trout	Coral trout	<i>Plectropomus</i> spp	4064	698	2387	370	1676	488
Emperor, other	Emperor, other	Lethrinidae	23635	3840	8398	1526	15237	2550
Emperor, red	Red emperor	<i>Lutjanus sebae</i>	919	246	592	195	327	77
Flathead	Flathead	Platycephalidae - undifferentiated	1084	126	199	46	886	114
Javelin fish	Barred javelin	<i>Pomadasys kaakan</i>	13313	1179	2579	429	10734	917
Jewfish, black	Black jewfish	<i>Protonibea diacanthus</i>	7618	858	4233	466	3385	587
Jewfish, other	Croaker	Sciaenidae	451	203	114	107	338	145
Mackerel, grey	Grey mackerel	<i>Scomberomorus semifasciatus</i>	2569	700	1023	197	1546	598
Mackerel, Spanish	Spanish mackerel	<i>Scomberomorus commerson</i>	6899	1035	3035	388	3863	818
Mackerel, spotted	Spotted mackerel	<i>Scomberomorus munroi</i>	2333	444	925	206	1408	321
Moonfish/Batfish	Batfish	Ephippidae	10596	937	1102	185	9494	918
Mullet	Mullet	Mugilidae - undifferentiated	31725	3883	28700	3481	3025	1205
Queenfish	Queenfish	<i>Scomberoides</i> spp	8116	1162	1344	168	6771	1098
Sharks & rays	Rays/skates	Dasyatidae	584	135	27	19	557	134
	Sawfish	Pristidae	145	89	0	0	145	89
	Shark	Various families	27409	1975	680	123	26729	1951
Small baitfish	Herring, other	Clupeidae	2602	632	2450	626	151	40
	Baitfish, unspec.	Several families	13949	3659	2623	968	11326	3339

Reporting group	Common name	Scientific name	Total		Kept		Released	
			Number	SE	Number	SE	Number	SE
Snapper, golden	Golden snapper	<i>Lutjanus johnii</i>	51755	3201	20907	1355	30848	2237
Snapper, mangrove jack	Mangrove jack	<i>Lutjanus argentimaculatus</i>	2917	400	1503	195	1414	266
Snapper, Moses'	Moses' snapper	<i>Lutjanus russellii</i>	2853	520	484	168	2369	395
Snapper, saddletail/ crimson/indonesian	Saddletail, crimson & indonesian snapper	<i>Lutjanus malabaricus, erythropterus</i> & <i>bitaeniatus</i>	18204	2194	6084	895	12120	1625
Snapper, stripey	Stripey snapper	<i>Lutjanus carpontatus</i>	34934	3721	6527	675	28407	3423
Tarpon/ox-eye herring	Oxeye herring	<i>Megalops cyprinoides</i>	278	74	39	24	239	70
Threadfin, blue	Blue threadfin	<i>Eleutheronema tetradactylum</i>	11226	1300	5249	542	5977	1006
Threadfin, king	King threadfin	<i>Polydactylus macrochir</i>	1824	255	1340	210	484	105
Trevally, giant	Giant trevally	<i>Caranx ignobilis</i>	4844	698	687	139	4158	662
Trevally, golden	Golden trevally	<i>Gnathanodon speciosus</i>	3551	570	474	87	3077	555
Trevally, other	Trevally, other	Carangidae - undifferentiated	8958	1351	848	157	8110	1266
Tuna, longtail	Longtail tuna	<i>Thunnus tonggol</i>	1536	593	523	168	1014	556
Tuna, mackerel	Mackerel tuna	<i>Euthynnus affinis</i>	1463	516	304	70	1159	490
Whiting	Whiting	Sillaginidae - undifferentiated	1175	306	922	229	254	117
Wrasse, tuskfish	Parrotfish/tuskfish	Scaridae - undifferentiated	10183	1303	3092	346	7091	1110
Scalefish, other	Archer fish	Toxotidae - undifferentiated	2405	536	270	122	2135	463
	Barracuda	Sphyraenidea	1009	157	146	45	862	145
	Cobia	<i>Rachycentron canadum</i>	677	149	508	104	169	57
	Eel	Various families	58	34	0	0	58	34
	Fish, other	Various families	1324	486	90	75	1235	481
	Frogfish	Batrachoididae	274	61	0	0	274	61
	Fusiler	Caesionidae	33	29	0	0	33	29
	Garfish	Hemiramphidae - undifferentiated	1601	385	1404	383	197	60
	Jawfish/stargazer	Opistognathidae & Uranoscopidae	918	298	29	14	889	297
	Lizardfish/grinner	Various families	61	40	0	0	61	40

Reporting group	Common name	Scientific name	Total		Kept		Released	
			Number	SE	Number	SE	Number	SE
	Long tom	Belonidae	399	82	186	73	213	47
	Rainbow Runner	<i>Elegatis bipinnulata</i>	79	63	0	0	79	63
	Remora	Echeneidae - undifferentiated	345	105	11	11	334	100
	Sailfish	<i>Istiophorus platypterus</i>	16	13	0	0	16	13
	Sand bass	<i>Psammoperca waigiensis</i>	1067	329	112	49	956	325
	Scad, yellow-tail	<i>Trachurus novaezelandiae</i>	2314	608	359	232	1955	536
	Scat/butterfish	Scatophgidae - undifferentiated	54	25	0	0	54	25
	Sweetlip	Haemulidae - undifferentiated	1895	476	507	69	1388	465
	Toads/pufferfish	Various families	3591	715	0	0	3591	715
Mud crab	Mud crab	<i>Scylla</i> spp	62766	6794	36161	3681	26605	3282
Crustaceans, other	Blue swimmer crab	<i>Portunus pelagicus</i>	3945	575	1568	459	2376	344
	Hermit crab	<i>Coenobita variabilis</i>	147	127	0	0	147	127
	Crab, other	Brachyura - undifferentiated	252	76	0	0	252	76
	Prawn, marine	Penaeoidea & Caridea - undiff.	10500	3631	8654	3129	1846	1237
Cephalopods	Squid	Loliginidae - undifferentiated	953	547	930	546	23	21
Other taxa	Non-fish, other	Various families	35	24	0	0	35	24

Appendix 10: Recreational catch (total, kept and released numbers) by analysis and ramp for the survey period of March 2015 to November 2015

SE is Standard Error; values in italics have an RSE between 25–50% and values in bold have an RSE >50%

Analysis	Ramp	Total		Kept		Released	
		Number	SE	Number	SE	Number	SE
Primary ramp daytime direct expansion	1. Buffalo Creek	44473	9059	21688	5181	22785	4225
	2. Dinah Beach	74046	7229	29958	3816	44088	4008
	5. East Arm	33136	4717	12634	1902	20502	3390
	6. Nightcliff	14486	4204	4020	1200	10466	3372
	10. Middle Arm	21072	3010	10005	1894	11067	1544
	12. Leaders Creek	18599	4844	5528	1302	13072	3623
	15. Six Pack	16515	3122	5691	1274	10824	2071
	16. Keswick	8200	1851	2394	589	5806	1346
	21. Dundee	90702	11199	24488	3259	66214	8232
	22. Saltwater Arm	29421	5499	10009	2186	19412	3816
	Total	350650		126415		224236	
Primary ramp post late shift to sunset estimation	1. Buffalo Creek	8799	3425	4458	1920	4341	1641
	2. Dinah Beach	11641	2739	4671	1413	6970	1546
	5. East Arm	5636	1851	2246	743	3391	1295
	6. Nightcliff	349	414	113	161	235	317
	10. Middle Arm	2499	979	1272	654	1227	437
	12. Leaders Creek	2440	1575	752	460	1689	1146
	15. Six Pack	2087	998	693	393	1394	673

Analysis	Ramp	Total		Kept		Released	
		Number	SE	Number	SE	Number	SE
	16. Keswick	1152	726	348	244	804	513
	21. Dundee	32888	6958	9073	2066	23816	5048
	22. Saltwater Arm	2675	1710	864	669	1811	1181
	Total	70166		24490		45678	
Secondary ramp estimation	3. Ski Club	9791	626	2388	196	7403	565
	4. Channel Island	7295	381	3507	248	3788	258
	7. Palmerston	24026	870	9911	374	14115	641
	8. Trailer Boat Club	4847	454	1222	145	3625	412
	9. Mandorah	694	102	209	44	485	91
	11. Southport	1622	196	797	142	825	145
	13. Crab Claw	11267	969	3628	587	7638	830
	14. Milne Inlet	13182	871	4234	431	8947	719
	23. Dundee Rd	3412	645	1152	335	2260	362
	Total	76136		27048		49086	
Grand Total		496952		177953		319000	

Appendix 11: Recreational effort (fisher hours) and total catch of key species by water body in the Greater Darwin Area during the survey period of March 2015 to November 2015

SE is Standard Error; values in italics have an RSE between 25–50% and values in bold have an RSE >50%.

Species/group	Estuary		Offshore	
	Number	SE	Number	SE
Effort				
Effort hours	360388	14542	152016	13190
Catch				
Barramundi	18819	1593	307	172
Bream, pikey	13238	1609	449	155
Catfish	17738	1615	3342	1449
Cod/groupers	18005	1108	14395	1781
Coral trout	310	67	3767	697
Emperor, other	2635	498	20969	3809
Emperor, red	0	0	919	246
Flathead	1062	126	21	15
Javelin fish	9577	932	3763	735
Jewfish, black	3584	455	3982	678
Jewfish, other	451	203	0	0
Mackerel, grey	1027	597	1515	365
Mackerel, Spanish	1371	235	5474	1003
Mackerel, spotted	692	192	1636	439
Moonfish/batfish	5831	678	5329	871
Mullet	31293	3869	338	213
Queenfish	4155	531	3938	1039
Sharks & rays	11673	892	16448	1802
Small baitfish	16440	3976	52	32
Snapper, golden	30607	2281	21272	2154
Snapper, mangrove jack	2159	322	771	244
Snapper, Moses'	2438	496	454	175
Snappers, saddletail/ crimson/indo	9488	1458	8825	1581
Snapper, stripey	10249	1070	25010	3552
Tarpon/ox-eye herring	274	74	0	0
Threadfin, blue	5660	736	5562	1124
Threadfin, king	1654	225	169	121
Trevally, giant	1225	277	3708	656
Trevally, golden	1757	246	1842	511
Trevally, other	3537	638	5478	1220
Tuna, longtail	200	102	1344	577
Tuna, mackerel	36	17	1419	520
Whiting	1175	306	0	0
Wrasse, tuskfish	6712	1197	3121	517
Scalefish, other	12155	1101	5953	967
Mud crab	61568	6768	945	373
Crustaceans, other	14820	3727	0	0
Cephalopods	786	538	0	0
Other taxa	35	24	0	0

Appendix 12: Recreational catch of key species by fishing method in the Greater Darwin Area during the survey period of March 2015 to November 2015

Species/group	Method/Gear							
	Line		Pot		Cast		Other	
	Number	SE	Number	SE	Number	SE	Number	SE
Barramundi	19187	1598	58	28	1636	184	211	45
Bream, pikey	13047	1432	952	137	1406	751	0	0
Catfish	20922	2182	967	192	19	13	0	0
Cod/groupers	31091	2035	2178	365	0	0	0	0
Coral trout	4081	698	0	0	0	0	0	0
Emperor, other	23689	3840	0	0	0	0	0	0
Emperor, red	919	246	0	0	0	0	0	0
Flathead	999	121	28	25	422	69	0	0
Javelin fish	13121	1157	37	25	2379	394	0	0
Jewfish, black	7674	858	0	0	0	0	0	0
Jewfish, other	468	206	0	0	0	0	0	0
Mackerel, grey	2562	700	0	0	0	0	136	44
Mackerel, Spanish	7015	1037	0	0	0	0	11	10
Mackerel, spotted	2361	445	0	0	0	0	0	0
Moonfish/batfish	10865	944	33	23	0	0	10	9
Mullet	48	26	0	0	72770	5650	0	0
Queenfish	8150	1162	0	0	83	36	0	0
Sharks & rays	28392	1997	63	18	11	10	0	0
Small baitfish	124	38	0	0	36321	5596	0	0
Snapper, golden	52641	3201	311	58	58	41	0	0
Snapper, mangrove jack	2995	403	0	0	0	0	0	0
Snapper, Moses'	3043	530	0	0	0	0	0	0
Snapper, saddletail/ crimson/indonesian	18377	2196	0	0	0	0	0	0
Snapper, stripey	35281	3728	0	0	0	0	0	0
Tarpon/ox-eye herring	285	77	0	0	9	8	0	0
Threadfin, blue	11120	1300	132	43	185	38	0	0
Threadfin, king	1832	255	0	0	0	0	211	45
Trevally, giant	4889	698	0	0	0	0	29	25
Trevally, golden	3645	572	0	0	0	0	0	0
Trevally, other	8384	1245	10	9	944	721	0	0
Tuna, longtail	1542	594	0	0	0	0	0	0
Tuna, mackerel	1464	516	0	0	0	0	0	0
Whiting	434	242	0	0	2172	442	0	0
Wrasse, tuskfish	10392	1308	0	0	0	0	136	44
Scalefish, other	12852	1148	2699	612	7587	802	39	27
Mud crab	308	57	75813	6883	10	9	0	0
Crustaceans, other	0	0	6675	678	13902	3687	0	0
Cephalopods	143	65	0	0	4224	1683	0	0
Other taxa	35	24	0	0	0	0	0	0
Grand Total	364377		89956		144138		783	

Appendix 13: Recreational effort (fisher hours) and total catch of key species by fishing zone in the Greater Darwin Area during the survey period of March 2015 to November 2015

SE is Standard Error; values in italics have an RSE between 25–50% and values in bold have an RSE >50%.

Species/group	Bynoe Harbour/Dundee		Darwin Harbour/surrounds	
	Number	SE	Number	SE
Effort				
Effort hours	191585	13487	321907	15005
Catch				
Barramundi	8554	1201	10652	1057
Bream, pikey	1424	510	12364	1537
Catfish	4547	470	16538	2140
Cod/groupers	15210	1700	17183	1186
Coral trout	3195	677	864	168
Emperor, other	20402	3801	3228	533
Emperor, red	907	246	11	11
Flathead	124	33	960	122
Javelin fish	4293	729	9019	956
Jewfish, black	2763	379	4884	736
Jewfish, other	34	12	417	203
Mackerel, grey	960	266	1599	647
Mackerel, Spanish	3812	887	3068	529
Mackerel, spotted	659	210	1674	391
Moonfish/Batfish	2773	434	7473	835
Mullet	6898	1292	24827	3661
Queenfish	4212	1008	3881	579
Sharks & rays	17649	1826	10464	782
Small baitfish	2903	892	13647	3880
Snapper, golden	24099	2186	28218	2292
Snapper, mangrove jack	1253	233	1660	325
Snapper, Moses'	621	178	2219	488
Snapper,saddletail/crimson/ind	5396	993	13392	1894
Snapper, stripey	24083	3461	11216	1248
Tarpon/ox-eye herring	41	25	236	69
Threadfin, blue	5940	932	5281	907
Threadfin, king	1069	175	756	186
Trevally, giant	2210	538	2635	445
Trevally, golden	1135	472	2435	309
Trevally, other	5643	1278	3268	438
Tuna, longtail	1276	575	256	106
Tuna, mackerel	1040	491	418	159
Whiting	430	138	745	274
Wrasse, tuskfish	1949	400	8077	1237
Scalefish, other	5230	707	12914	1216
Mud crab	5269	991	57375	6720
Crustaceans, other	267	68	14557	3724
Cephalopods	0	0	953	547
Other taxa	0	0	35	24

Appendix 14: Recreational effort (fisher hours) and total catch of key species by season in the Greater Darwin Area during the survey period of March 2015 to November 2015

SE is Standard Error; values in italics have an RSE between 25–50% and values in bold have an RSE >50%.

Species/group	Run-off (March - May)		Dry season (June - Aug)		Build-up (Sept - Nov)	
	Number	SE	Number	SE	Number	SE
Effort						
Effort hours	160176	11872	175458	11882	177422	11299
Catch						
Barramundi	8999	1263	3710	675	6502	714
Bream, Pikey	4057	1033	7500	1161	2244	453
Catfish	7008	979	5516	1015	8561	1672
Cod/groupers	10206	1402	12014	1157	10203	1014
Coral Trout	1190	502	1828	451	1045	177
Emperor, other	7314	2986	5981	1061	10340	2169
Emperor, Red	406	220	241	98	272	50
Flathead	352	81	256	57	476	78
Javelin fish	6041	895	4281	549	2992	536
Jewfish, Black	3953	720	1240	216	2424	412
Jewfish, other	388	202	44	16	19	18
Mackerel, Grey	326	132	1242	633	1001	267
Mackerel, Spanish	2159	817	2486	458	2254	440
Mackerel, Spotted	315	112	380	182	1637	389
Moonfish/Batfish	3141	590	3721	548	3734	481
Mullet	10974	2813	10825	2284	9925	1395
Queenfish	3028	675	2527	579	2560	749
Sharks/rays	11908	1472	6818	1018	9412	883
Small baitfish	7801	3065	6726	2470	2023	591
Snapper, Golden	18684	1880	11933	1350	21138	2210
Snapper, Mangrove Jack	906	197	782	241	1229	252
Snapper, Moses'	595	207	883	236	1376	414
Snapper,Saddletail/Crimson/Indo	4441	864	4364	817	9399	1844
Snapper, Stripey	8131	1583	12568	1893	14235	2786
Tarpon/Ox-eye herring	134	59	95	36	50	27
Threadfin, Blue	3237	622	3702	957	4287	622
Threadfin, King	976	185	330	80	518	156
Trevally, Giant	1326	356	1149	321	2369	507
Trevally, Golden	728	195	1011	233	1813	482
Trevally, other	1931	579	1845	337	5182	1173
Tuna, Longtail	874	552	493	195	170	99
Tuna, Mackerel	712	468	511	205	239	73
Whiting	34	32	631	263	510	154
Wrasse, tuskfish	2433	438	4740	1130	3010	479
Scalefish, other	7248	964	5882	799	4991	520
Mud crab	23104	5408	29680	3827	9982	1506
Crustaceans, other	10550	3664	2333	429	1961	531
Cephalopods	882	546	71	39	0	0
Other taxa	0	0	35	24	0	0