A Survey of Recreational Fishing in the Greater Darwin Area 2017

Fishery Report No.125

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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 2017'. 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 2016* (Errity et al. 2022), 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

A conventional access-point methodology was utilised with fisher interviews conducted at selected boat ramps Between Dundee Beach and the mouth of the Adelaide River. Methodology followed Matthews et al (2019) with secondary ramps allocated surveys to estimate catch and effort from the angler interviews as in the 2016 survey.

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 2017 to 30 November 2017, recreational fishers (both residents and visitors) spent an estimated total of 471 276 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 Pot fishing (20%). The use of other fishing methods was far less common. Approximately 75% of all recreational fishing effort occurred in estuarine waters.

The Darwin Harbour region and its associated arms and creeks supported 39% of the total fishing effort, followed by Shoal Bay (10%) and Bynoe Harbour (10%). The offshore regions seaward of Bynoe Harbour and Dundee were the most popular sites for those fishers venturing beyond estuarine waters (13%).

Fishing effort was fairly consistent across the survey period, although activity during the run-off period (Mar-May) was slightly higher than in other seasons. An estimated 24% 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 (14%) and the East Arm ramp (11%).

The proportion of visiting angler effort (interstate or overseas) varied throughout the survey period and peaked during the dry season at 20% of the total fishing effort.

1.3.2. Catch

During the survey period from 1 March 2017 to 30 November 2017, recreational fishers (both residents and visitors) caught an estimated 540 796 aquatic organisms from the Greater Darwin area. Most of the catch (82%) was comprised of fish species (i.e. bony fish and sharks/rays) with the bulk of the remaining catch consisting of crabs and prawns.

Over 102 000 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 (18.9%) of the total fish catch and were a major contributor to the reef fish catch. Golden Snapper was the most commonly caught reef fish accounting for 8.5% of the total fish catch.

Approximately 98 003 individual crustaceans were captured during the survey period, composed primarily of Mud Crabs (86%).

Almost 63% of all fish and 39% 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 Coral Trout.

Sixty eight per cent of all captures by recreational anglers in the Greater Darwin area occurred in estuarine waters and 32% in offshore waters. Mud Crab were the most frequently caught species in estuarine waters, accounting for 22% of the overall catch. Excluding baitfish species, the most common fish species caught in estuaries were Golden Snapper and Barramundi. Sharks/rays was the most common fish species caught offshore followed by Stripey Snapper, Golden Snapper and cod/groupers.

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 Stripey Snapper, sharks/rays, Golden Snapper and cod/groupers dominating the catch. Mud Crab only represented 4% 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 21.9% 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 Stripey Snapper.

The Bynoe/Dundee offshore region was the most significant single region producing 15% of the total catch of all aquatic organisms followed by the Darwin Harbour region with 14% and Shoal Bay with 12% (Figure 17, Appendix 7). Collectively, Darwin Harbour and its associated arms and creeks produced 38% of the total catch.

The Darwin Harbour region dominated the fish catch with 39% of the total fish numbers coming from this area. This catch was composed primarily of Golden Snapper, mullet and Barramundi. The Bynoe/Dundee offshore region had the next highest catch of fish with 22%, primarily due to high numbers of reef fish species.

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 the run-off (March – May) not including baitfish was Stripey Snapper and Barramundi. In the build-up (September – November) period, sharks/rays and Golden Snapper dominated the catch, whereas Golden Snapper, Stripey Snapper and cod/groupers were the predominant 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 Snapper harvested ranged from 15–85 cm with a mean length of 40.6 cm. The length of Black Jewfish harvested ranged from 30–130 cm with a mean length of 84.5 cm. The length of Barramundi harvested ranged from 38–98 cm with a mean length of 66.1 cm.

The vast majority (90%) of male Mud Crabs captured were kept, whereas just over half (53%) of the female Mud Crabs caught were kept.

1.3.4. Vessel characteristics

Almost 80% of recreational fishing vessels surveyed were 4.5 m or longer in length. Sounders were fitted to 91% of all vessels, while 75% of vessels had a form of Global Positioning System (GPS) on board.

1.4. Future research

Another survey of the Greater Darwin area will take place in 2018. This will be the fifth such survey of the Darwin area in the past five years. 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 NT 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, and so 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 has 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 Golden Snapper are at high risk of depletion and Black Jewfish are recovering in the Greater Darwin area. (Saunders et al., 2016a; 2016b). 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 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 2015' and subsequently the 'Survey of Recreational Fishing in the Greater Darwin area 2016'. These studies 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 2015 and 2016 survey, funding was utilised to conduct a repeat of the survey in 2017. A similar access-point methodology was employed for this study in order to compare results across years.

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
- 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 similar methodology to the 2016 survey. However, before making any quantitative comparison with the information obtained from other previous NT surveys, 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 may 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, 2014, 2015 and 2016.
- Limitations in the survey design required the assumption of independence of data to be disregarded in order to estimate catch and effort totals for boat ramps and fishing regions.
- Dundee road boat ramp and Mandorah boat ramp were included in the results for the 2017 survey period as there was some fishing effort recorded.
- The Trailer boat club ramp was omitted from the results as no fishing effort was recorded during the shifts allocated for the 2017 survey period.

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, 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. 2016a; 2016b).

3.2. Survey zones

The Greater Darwin area was divided into two survey zones: (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 six boat ramps within Bynoe Harbour and included the coastal ramp at Dundee Beach (Figure 1).

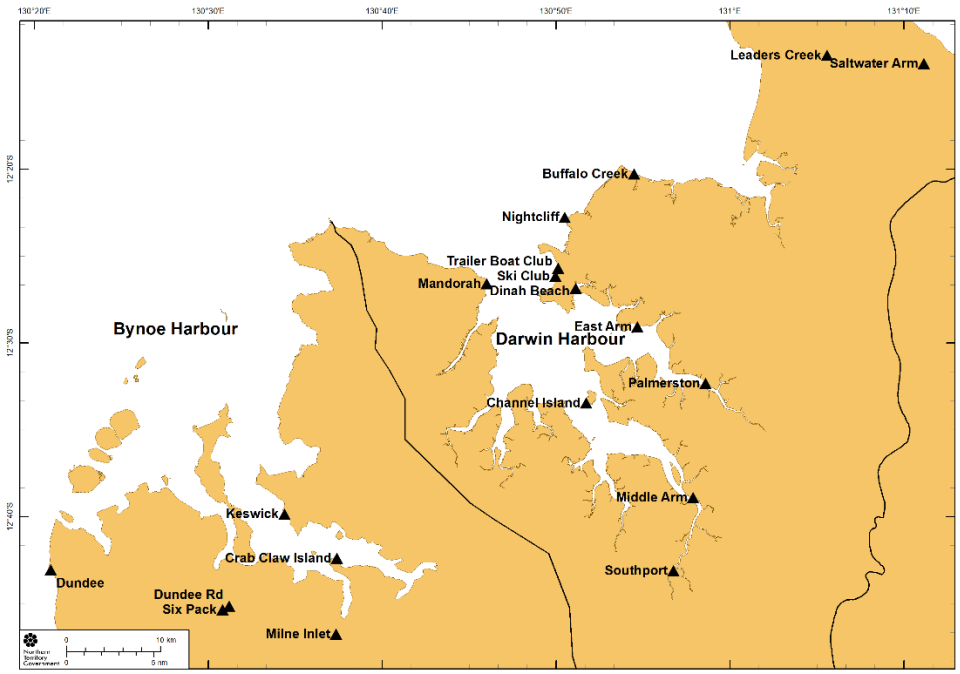

Figure 1. Map of the Greater Darwin area showing locations of public boat ramps

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). The estimated effort at each ramp from the previous survey year (Matthews et al 2019) was used to determine the probabilities for random allocation of survey days. Primary ramps, where effort is greatest, were allocated proportionally more survey days than secondary ramps in order to increase the accuracy of estimated totals and minimise the variance. All surveys at all ramps collected information about catch, fishing effort, catch rates, fish sizes, fishing regions visited, fishing activities undertaken and the residential status of fishers.

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

Fishing Zone		Boat Ramp	
Darwin Harbour & Surrounds			
	Primary	1	Buffalo Creek
		2	Dinah Beach
		5	East Arm
		6	Nightcliff
		10	Middle Arm
		12	Leaders Creek
		22	Saltwater Arm
	Secondary	3	Ski Club
		4	Channel Island
		7	Palmerston
		8	Trailer Boat Club
		9	Mandorah
		11	Southport
Bynoe Harbour & Dundee			
	Primary	15	Six Pack
		16	Keswick
		21	Dundee
	Secondary	13	Crab Claw Island
		14	Milne Inlet
		23	Dundee Road

Three boat ramps and access points were excluded from survey coverage. 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 all boat ramps in the two survey zones between 1 March 2016 and 28 February 2017 (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 and a half-hour shifts: early (08:30 – 14:00) and late (14:00 – 19:30).

Survey days were randomly allocated to ramps within each day-type and season stratum using a ramp probability likelihood based on total effort in the previous survey year. A survey shift was then randomly allocated to each selected survey day using a probability likelihood based on total effort in the previous survey year. However, logistical 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 ramps

Interviews with fishing parties were conducted at all ramps. A variety of data elements were collected during the interview process. The information collected directly by the trained survey staff included identification and number of fish retained (i.e. harvest), the size of selected species of fish retained, and the vessel characteristics and technology used by returning vessels that had been involved in recreational fishing activities. Some 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 were collected for all individual fishing regions and these were 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.

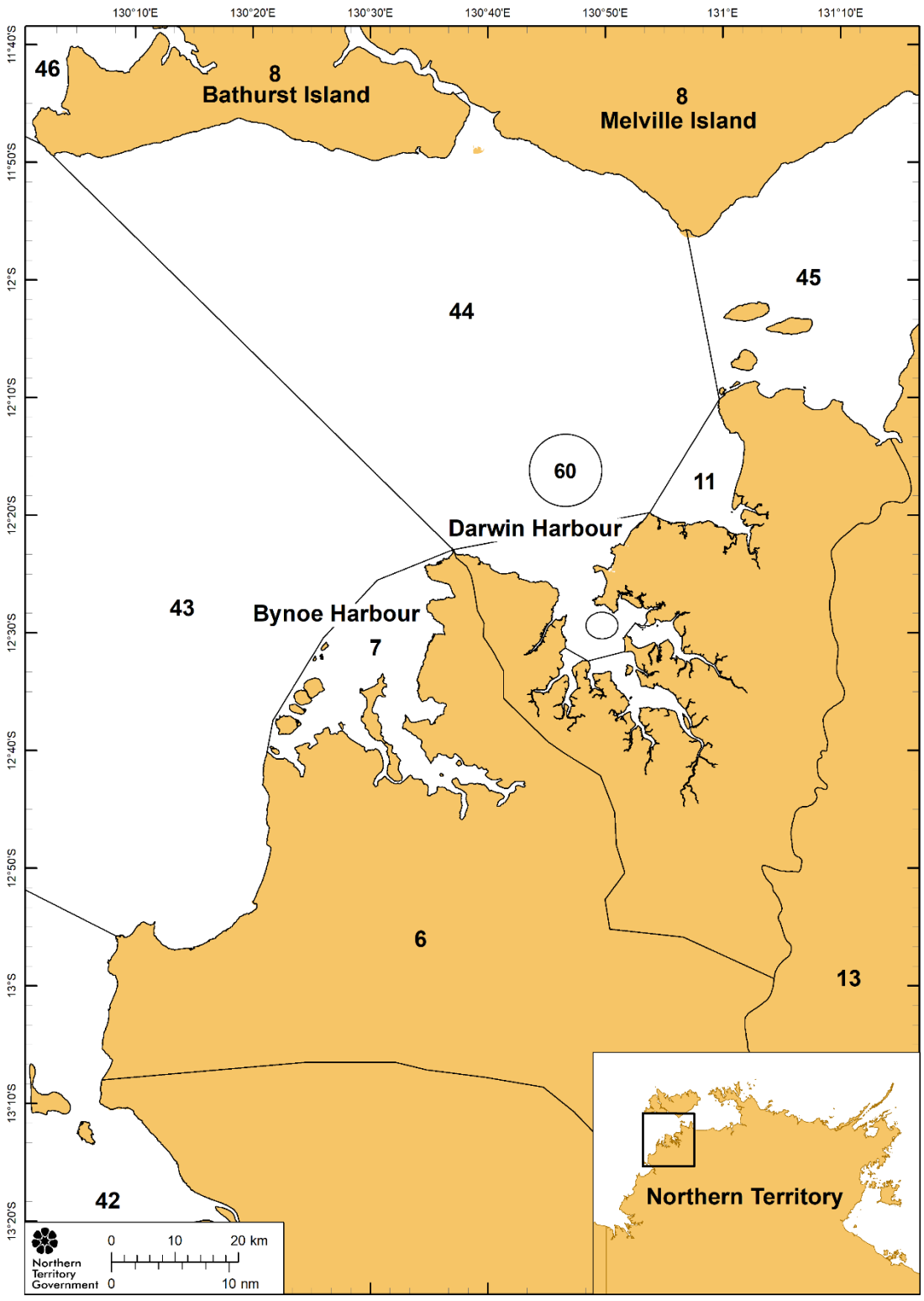

Figure 2. Map of the the fishing regions (numbered) used for reporting purposes

See Figure 3 for a detailed map of the Darwin Harbour area.

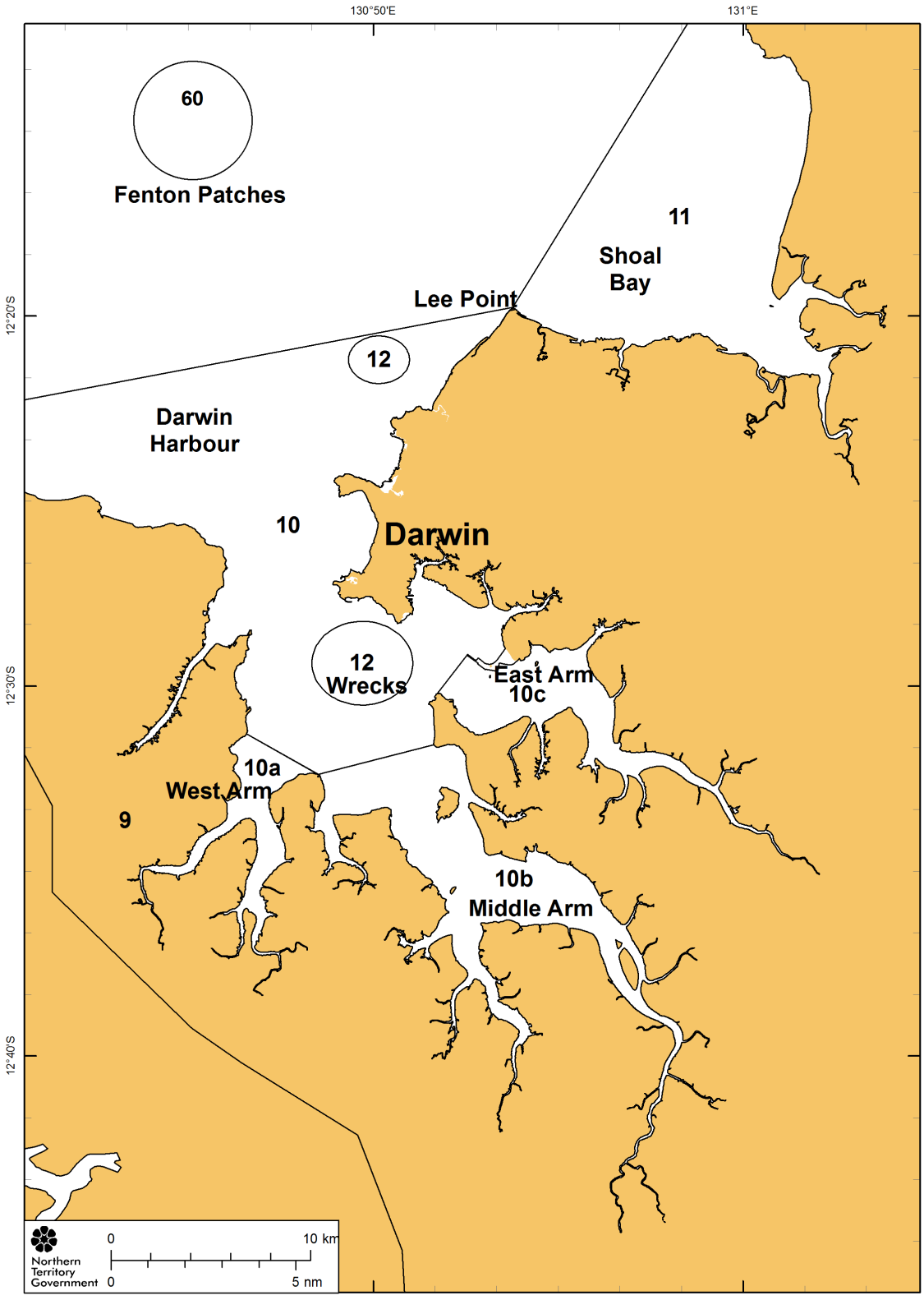

Figure 3. Map of the Darwin Harbour area showing fishing regions used for reporting purposes

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 provided ability to partition 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.

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.

3.5. Estimation methods for survey data

The survey estimates were derived from a direct expansion of survey data that covers the early and late shift strata (i.e. 08:30 to 19:30) at all boat ramps. A number of assumptions underpin the estimation procedure and need to be considered when examining the survey results.

Direct expansion of survey data that covers the early and late shift strata (i.e. 08:30 to 19:30) 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).

The daily value was adjusted for shift type and furthermore for drive-offs and refusals to estimate a daily value total for the full day.

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

$$\overline{\boldsymbol{x}}_{\boldsymbol{j}} = \frac{\sum \boldsymbol{x}_{\boldsymbol{ij}}}{\boldsymbol{n}_{\boldsymbol{j}}} \qquad \text{Eq. 1}$$

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:

$$\boldsymbol{Var}(\overline{\boldsymbol{x}}_{\boldsymbol{j}}) = \frac{\boldsymbol{s}_{\boldsymbol{j}}^{\boldsymbol{2}}}{\boldsymbol{n}_{\boldsymbol{j}}} \qquad \text{Eq. 2}$$

Where:

n_j is from equation 1;

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

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

$$\widehat{\boldsymbol{X}}_{\boldsymbol{j}} = \overline{\boldsymbol{x}}_{\boldsymbol{j}} \cdot \boldsymbol{N}_{\boldsymbol{j}} \qquad \text{Eq. 3}$$

Where:

$\overline{x}_j$ 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:

$$\boldsymbol{Var}(\widehat{\boldsymbol{X}}_{\boldsymbol{j}}) = \boldsymbol{Var}(\overline{\boldsymbol{x}}_{\boldsymbol{j}}) \cdot \boldsymbol{N}_{\boldsymbol{j}}^{\boldsymbol{2}} \qquad \text{Eq. 4}$$

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:

$$\widehat{\boldsymbol{X}}_{\boldsymbol{Total}} = \sum_{\boldsymbol{j=1}}^{\boldsymbol{j}} X \qquad \text{Eq. 5}$$

Where:

$\hat{X}_j$ is from equation 3.

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

$$\boldsymbol{Var}(\widehat{\boldsymbol{X}}_{\boldsymbol{Total}}) = \sum_{\boldsymbol{j=1}}^{\boldsymbol{j}} \boldsymbol{Var}(\widehat{\boldsymbol{X}}_{\boldsymbol{j}}) \qquad \text{Eq. 6}$$

Where:

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

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

$$\boldsymbol{SE}(\widehat{\boldsymbol{X}}_{\boldsymbol{Total}}) = \sqrt{\boldsymbol{Var}(\widehat{\boldsymbol{X}}_{\boldsymbol{Total}})} \qquad \text{Eq. 7}$$

Where:

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

3.6. 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 are 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 these data. In general terms, estimates that are more precise 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 relative standard errors that indicate less uncertainty in the survey estimates.

3.7. 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 2017 to 30 November 2017. 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, visiting fishers).

An estimated 471 276 fisher hours were spent recreational fishing in the Greater Darwin area during the survey period by both NT residents and visiting anglers. The direct expansion of primary ramps constituted 81% of the total effort and estimation of effort for secondary ramps comprised 19% 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 (75%) and the remainder in offshore waters (25%) (Figure 4).

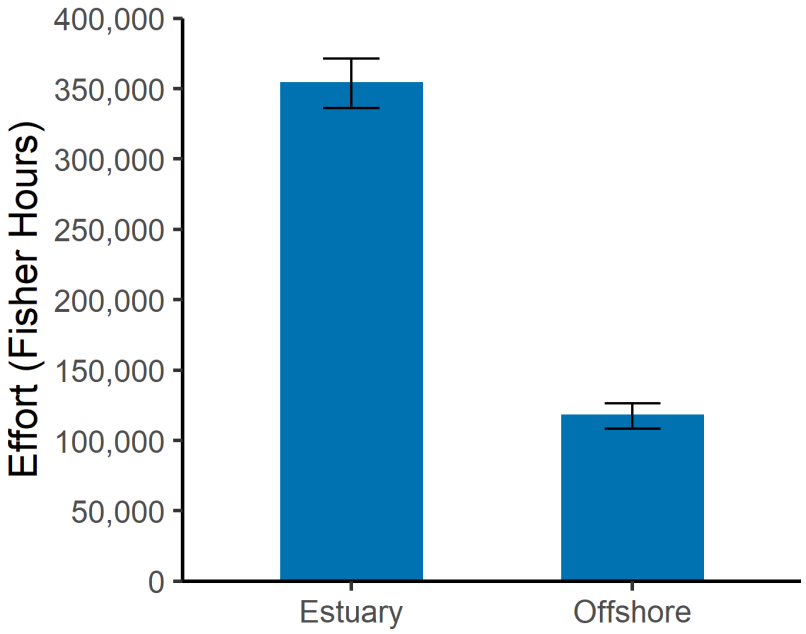

Figure 4. Fishing effort (fisher hours) by water body type in the Greater Darwin area for recreational fishers during the survey period from March 2017 to November 2017. Error bars represent one standard error.

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 20% of the total effort. Cast netting accounted for almost 6% of the effort hours and other methods, such as spearing, diving and hand collection combined only constituted 2% of total effort.

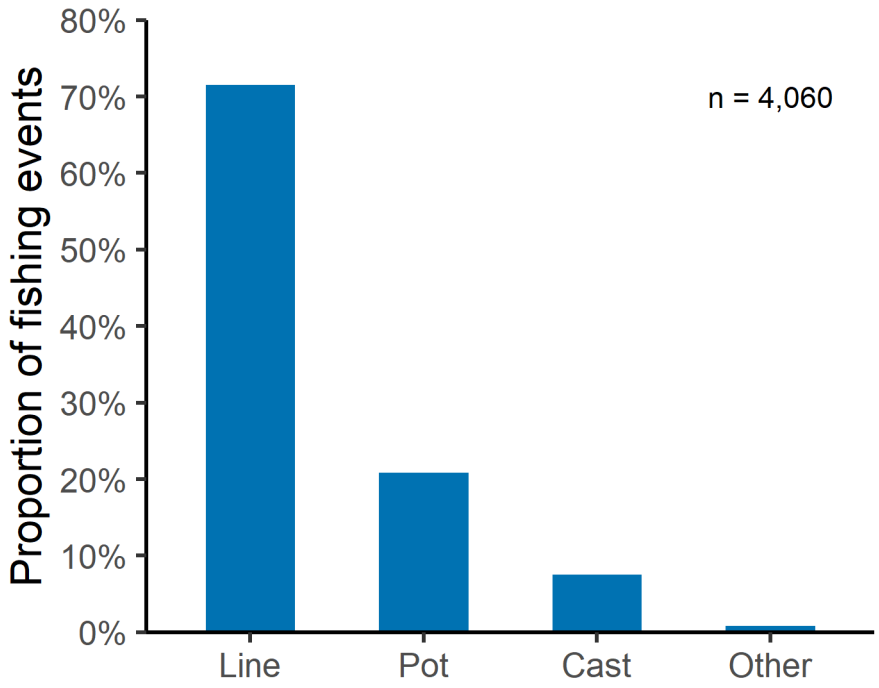

Figure 5. The proportion (%) of fishing effort by fishing method for recreational anglers in the Greater Darwin area during the survey period from March 2017 to November 2017

4.3. Effort by fishing zone and region

4.3.1. 4.3.1 Effort by fishing zone

The Darwin Harbour/Surrounds fishing zone supported 64% of the total fishing effort (fisher hours) within the Greater Darwin area, with the Bynoe Harbour/Dundee fishing zone supporting the remaining 36% of effort (Appendix 13).

4.3.2. Effort by fishing region

Darwin Harbour and its associated arms and creeks accounted for 39% of the total fishing effort (fisher hours) followed by Bynoe Harbour (10%) and Shoal Bay (10%) (Figure 6, Appendix 7). The region offshore of Bynoe Harbour and Dundee was the most popular offshore water for recreational fishing accounting for 13% of the overall effort.

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

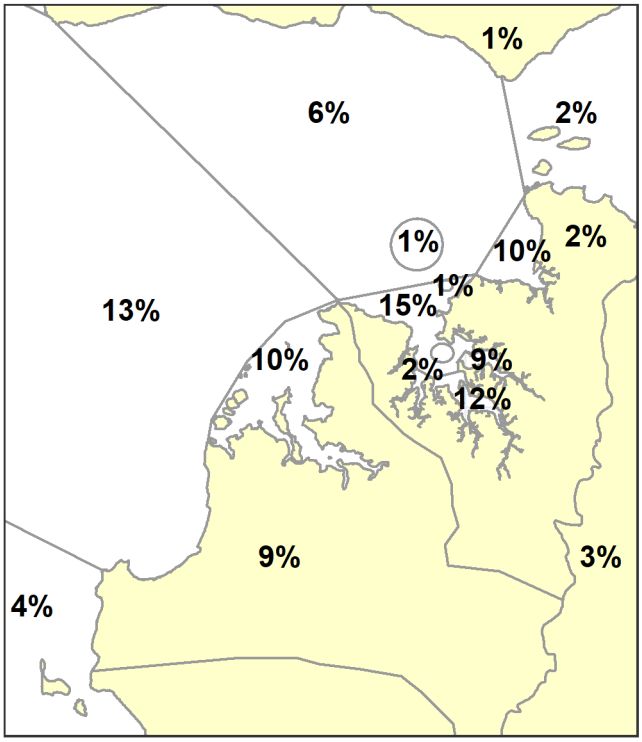

Figure 6. Map showing the spatial distribution (%) of fishing effort (fisher hours) by fishing region in the Greater Darwin area for recreational fishers during the survey period from March 2017 to November 2017.

4.4. Effort by boat ramp

Recreational fishing vessels using the Dundee Beach boat ramp accounted for 24.1% of the total fisher hours in the Greater Darwin area (Figure 7, Appendix 8). Vessels departing from Dinah Beach (13.7%), East Arm (10.9%) and Buffalo Creek (10.4%) also made a major contribution to the total number of fisher hours.

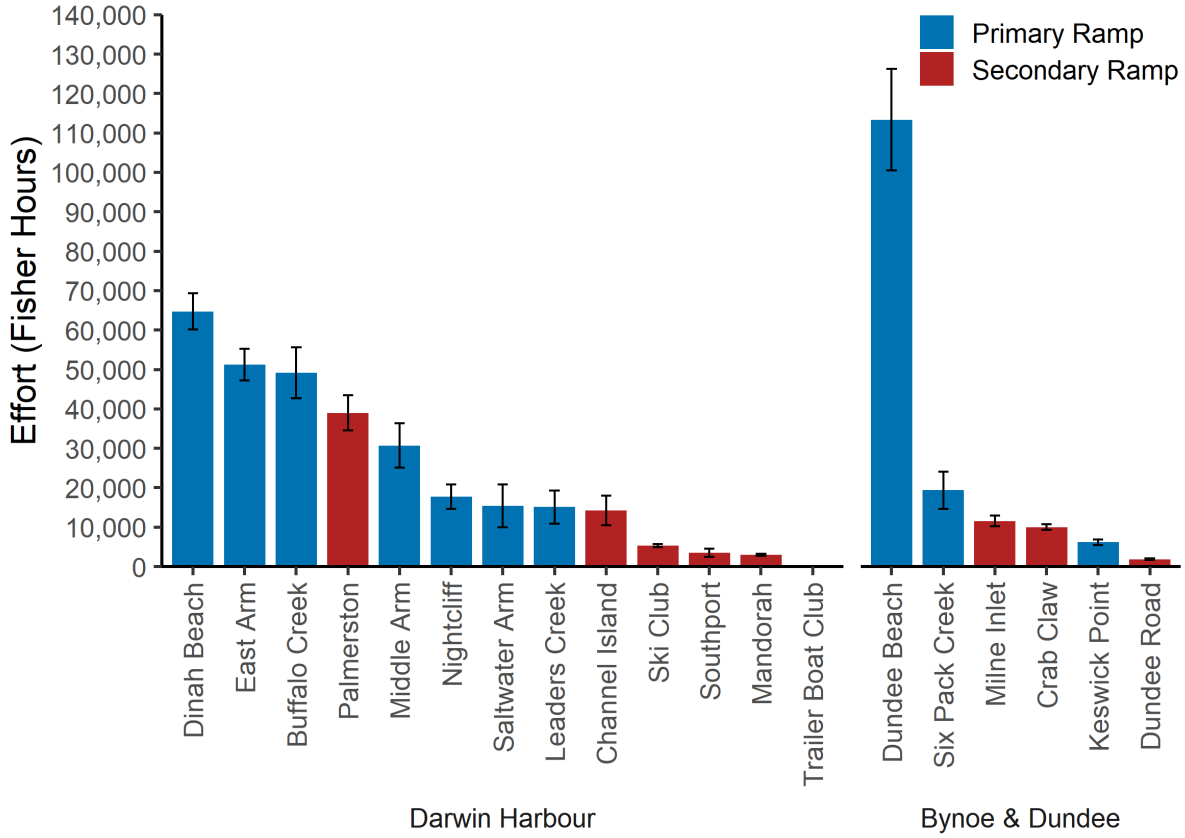

Figure 7. Fishing effort (fisher hours) by fishing zone and by boat ramp in the Greater Darwin area for recreational anglers during the survey period from March 2017 to November 2017. Error bars represent one standard error.

4.5. Effort by season

There was relatively no difference in fishing effort between seasons, with the run-off season accounting for the most effort (36%) followed by the dry season (34%) and then the build-up period (30%) (Figure 8).

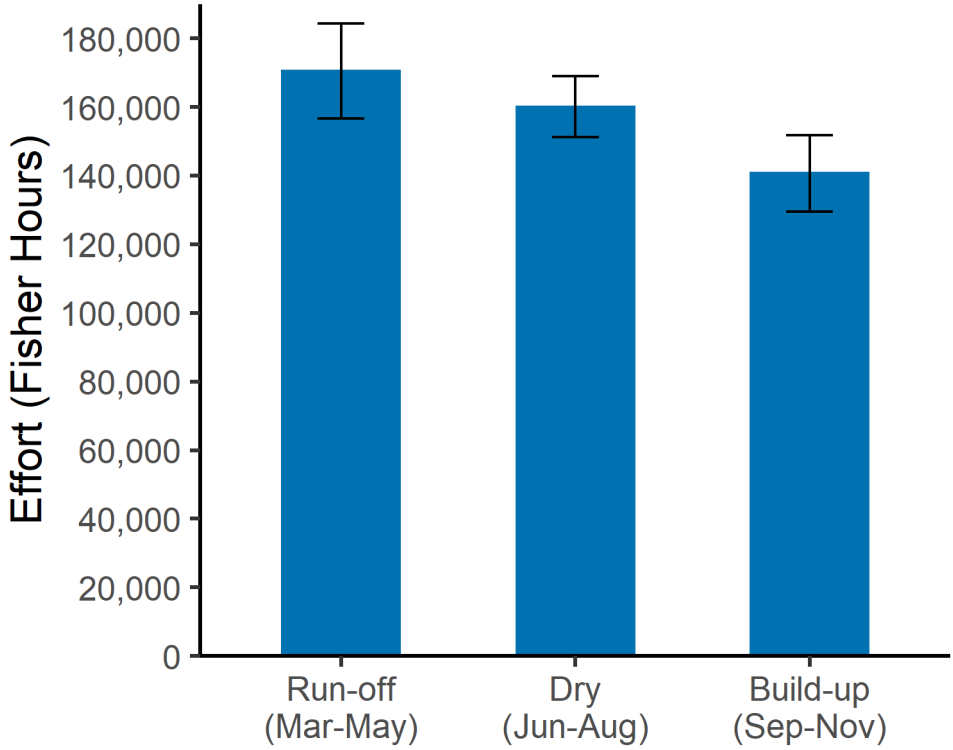

Figure 8. Fishing effort (fisher hours) by season in the Greater Darwin area for recreational anglers during the survey period from March 2017 to November 2017. Error bars represent one standard error.

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 20% of the total fishing effort (Figure 9). Visitor angler effort accounted for 10% of the effort in the run-off and 9% of effort in the build-up.

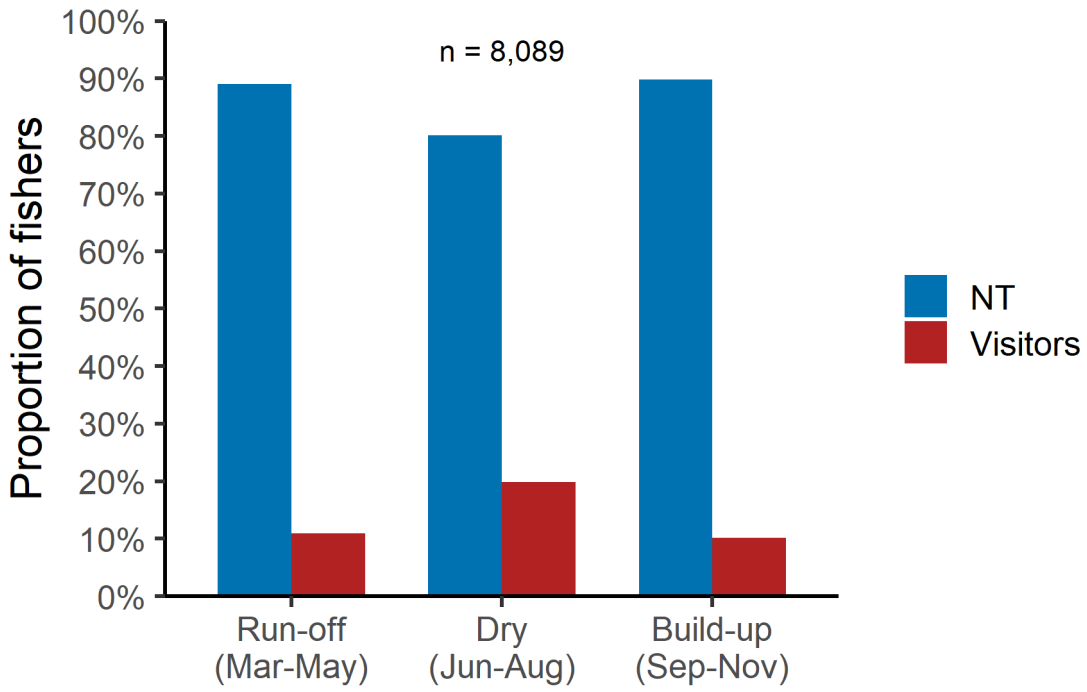

Figure 9. Unexpanded seasonal proportion of effort by residential origin of anglers in the Greater Darwin area during the survey period from March 2017 to November 2017.

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 2017 to 30 November 2017; Table 4). A full list of all taxa caught during the survey is provided in Appendix 9.

5.1. Total catch summary

An estimated 540 796 aquatic organisms were caught during the survey period. The direct expansion of primary ramps constituted 81% of the total catch and estimation of catch for secondary ramps comprised 19% 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, 540 796 (82%) were fish (i.e. teleosts - bony fishes) and elasmobranchs (sharks/rays), with the bulk of the remaining catch (18%) comprised of crustaceans (primarily Mud Crabs and marine prawns). Some cephalopods and other non-fish taxa (0.1%) were also recorded.

Golden Snapper was the most commonly caught fish species with an estimated 45 833 individuals caught (8.5% of the total fish catch). Other fish species of importance, included 39 666 Stripey Snapper (7.3%), 38 456 mullet (7.1%) and 35 891 sharks/rays (6.6%).

Collectively, over 102 000 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 (18.9%) of the overall fish catch and a major contributor to the reef fish catch.

An estimated 98 003 crustaceans were caught, comprised largely of Mud Crabs (86%). For a full breakdown of catch by taxa refer to Appendix 9.

Almost 63% of all fish and only 39% 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 Coral Trout (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 2017 to November 2017. SE is standard error.

Species/group	Total Number	SE	Kept Number	SE	Released Number	SE	% released
Barramundi	31861	3841	8200	1160	23662	3388	74.3
Bream, pikey	18287	1790	7842	1625	10448	654	57.1
Catfish	22811	4039	513	196	22298	4034	97.8
Cod/groupers	33086	2760	10349	1408	22730	1887	68.7
Coral trout	2330	414	1685	336	646	187	27.7
Emperor, other	18460	2760	7474	1175	10988	1938	59.5
Emperor, red	1452	457	943	300	509	190	35.1
Flathead	627	107	202	61	426	85	67.9
Javelin fish	11571	1289	2677	775	8892	965	76.8
Jewfish, black	9059	1987	5526	731	3535	1588	39
Jewfish, other	38	24	20	20	18	13	47.4
Mackerel, grey	1119	319	341	94	777	293	69.4
Mackerel, Spanish	3676	815	2822	702	853	213	23.2
Mackerel, spotted	962	259	473	157	489	183	50.8
Moonfish/Batfish	13209	1213	1490	304	11719	1160	88.7
Mullet	38456	4860	36424	4550	2033	744	5.3
Queenfish	8297	2030	1589	243	6707	1850	80.8
Sharks & rays	36724	5037	1428	906	35294	4889	96.1
Small baitfish	23439	5099	13408	3221	10031	3777	42.8
Snapper, gold-band	15	15	15	15	0	0	0
Snapper, golden	45833	3332	21580	1811	24248	2293	52.9
Snapper, mangrove jack	1623	212	907	123	719	163	44.3
Snapper, Moses'	1133	363	116	67	1016	333	89.7
Snapper, other	100	70	0	0	100	70	100
Snapper, saddletail/crimson/indonesian	13999	2416	6688	1555	7307	1259	52.2
Snapper, stripey	39666	4057	10553	1502	29109	3274	73.4
Tarpon/ox-eye herring	464	176	206	125	259	124	55.8
Threadfin, blue	8943	1304	4622	921	4314	919	48.2
Threadfin, king	3045	498	1721	321	1322	277	43.4
Trevally, giant	3818	893	678	310	3137	825	82.2
Trevally, golden	4349	572	661	166	3683	530	84.7
Trevally, other	13522	3563	1998	274	11521	3492	85.2
Tuna, longtail	2024	343	983	175	1039	192	51.3
Tuna, mackerel	1850	444	765	185	1084	301	58.6
Whiting	994	446	588	278	405	221	40.7
Wrasse, tuskfish	6893	831	3151	483	3742	569	54.3
Scalefish, other	17810	2335	4898	974	12910	2103	72.5
Mud crab	84754	8545	55136	5350	29616	3545	34.9
Crustaceans, other	13249	1612	5091	936	8161	1216	61.6

Cephalopods	433	399	428	399	5	5	1.2
Gastropods	783	558	783	558	0	0	0
Other taxa	32	24	0	0	32	24	100

5.2. Catch by water body

Of the total catch by recreational anglers in the Greater Darwin area, 68% was derived from estuarine waters and 32% 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 (22.9%) (Figure 10). The next most common species caught from estuarine waters were mullet (10.3%), Golden Snapper (8%) and Barramundi (7.5%).

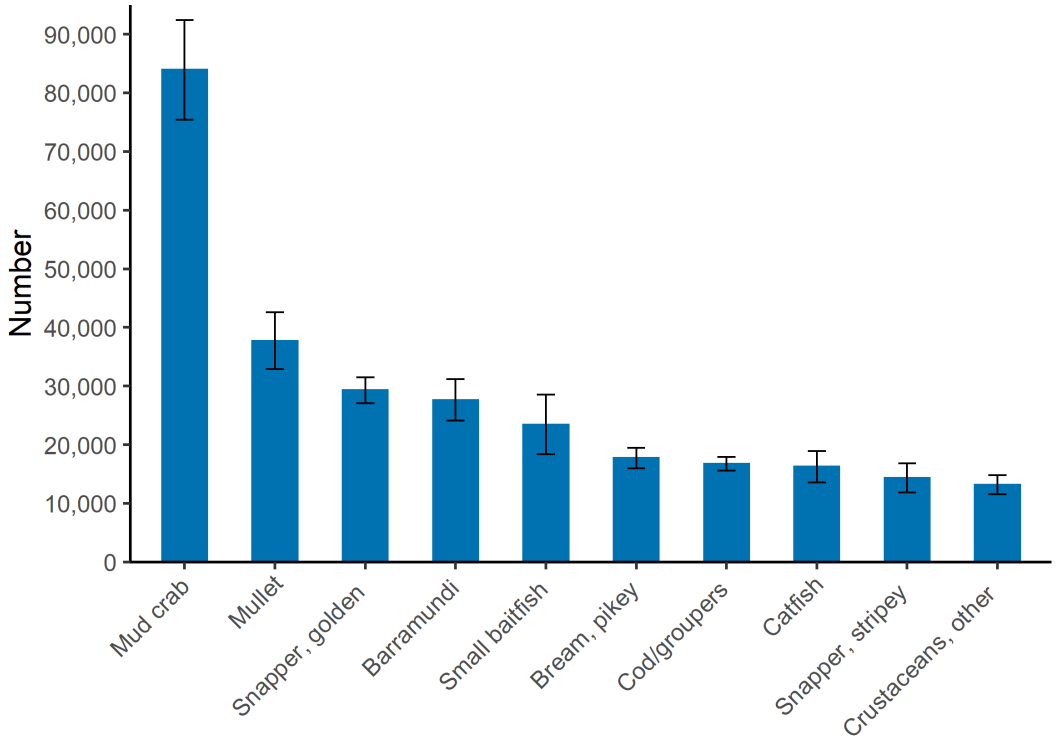

Figure 10. Catch estimates (numbers of fish) of the ten most frequent species/groups caught in estuarine waters of the Greater Darwin area for recreational fishers during the survey period from March 2017 to November 2017. Error bars represent one standard error.

Offshore

Sharks/rays (15.1%) were the most common caught species in offshore waters, followed by Stripey Snapper (14.6%), Golden Snapper (9.5%), cod/groupers (9.4%) and emperor, other (8.9%) (Figure 11). Batfish (5.1%) were less frequently caught along with trevally, catfish and other scalefish species.

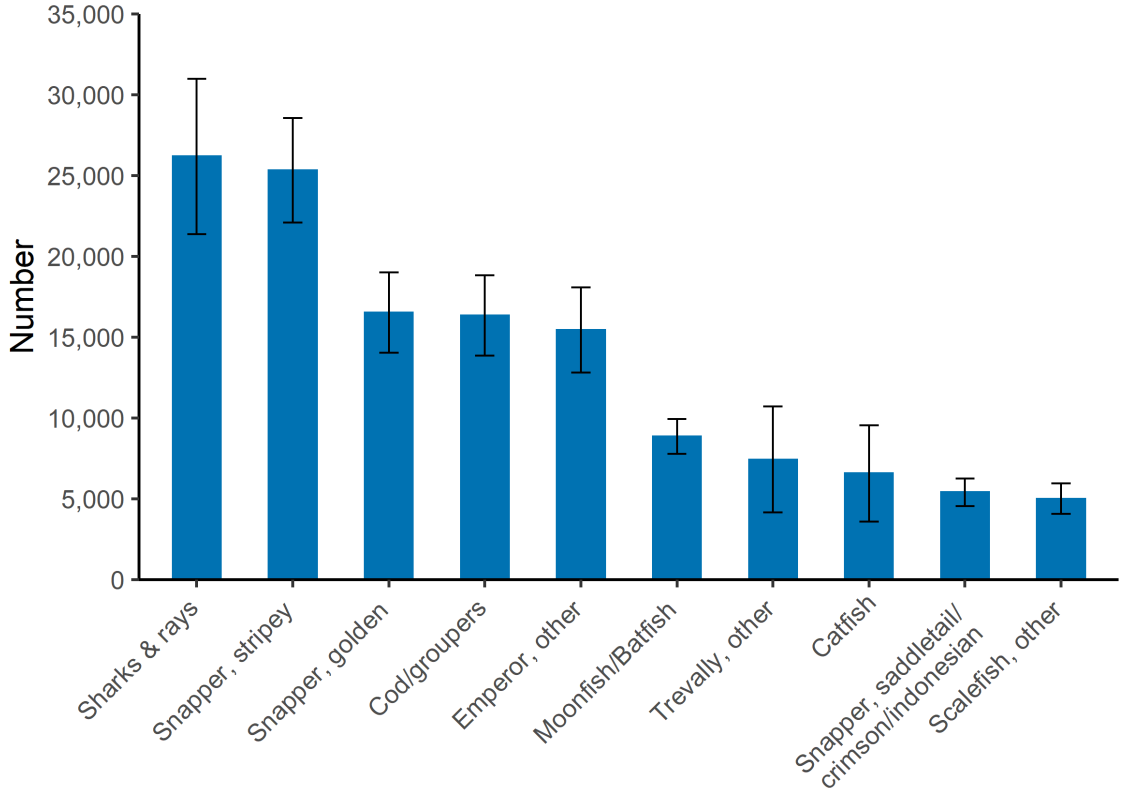

Figure 11. Estimated total catch (numbers of fish) of the ten most frequent species/groups caught in offshore waters of the Greater Darwin area for recreational fishers during the survey period from March 2017 to November 2017. Error bars represent one standard error.

5.3. Catch by fishing method

Line fishing methods accounted for 67.8% of all organisms caught, followed by cast nets (18%) and pots (13.8%). 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 (12.5%) and Stripey Snapper (10.8%) being the most captures. Sharks/rays (9.9%), cod/groupers (8.6%), Barramundi (8.1%) were less frequently caught with catfish (6%) encountered in lower numbers (Figure 12, Appendix 12).

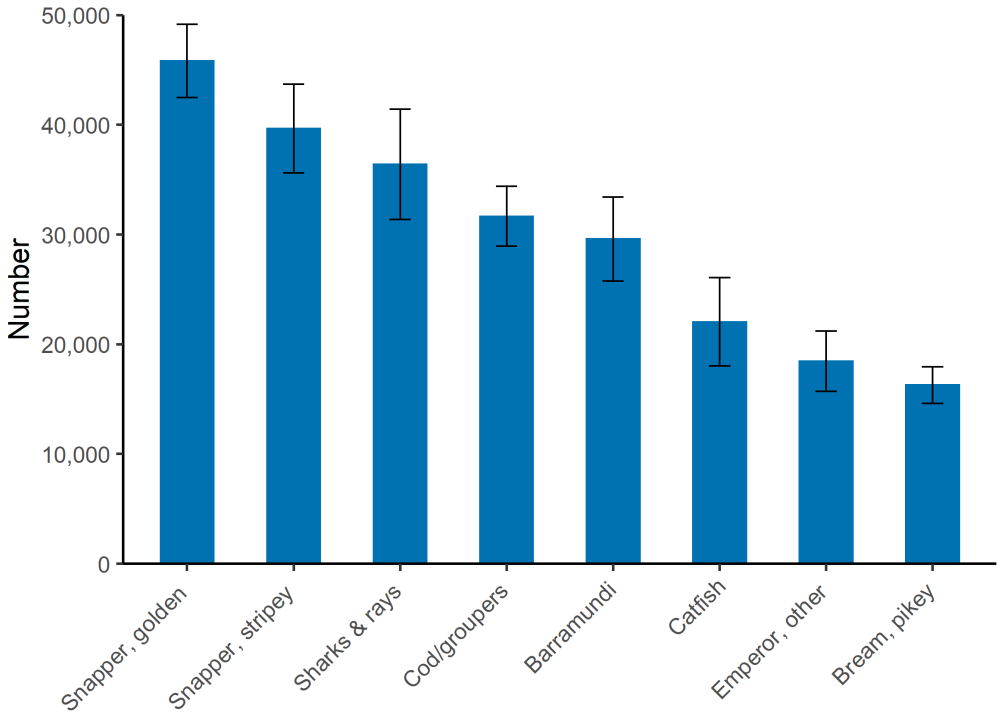

Figure 12. Estimated total catch (numbers of fish) of the most frequent species/groups caught by line fishing methods for recreational fishers in the Greater Darwin area during the survey period from March 2017 to November 2017. Error bars represent one standard error.

5.3.2. Pot

Mud Crabs dominated the catch in pots (86.5%) followed by other crustaceans (9.9%), most of which were Blue Swimmer Crabs. The remaining 3.6% consisted of incidental captures of various fish species (Figure 13, Appendix 12).

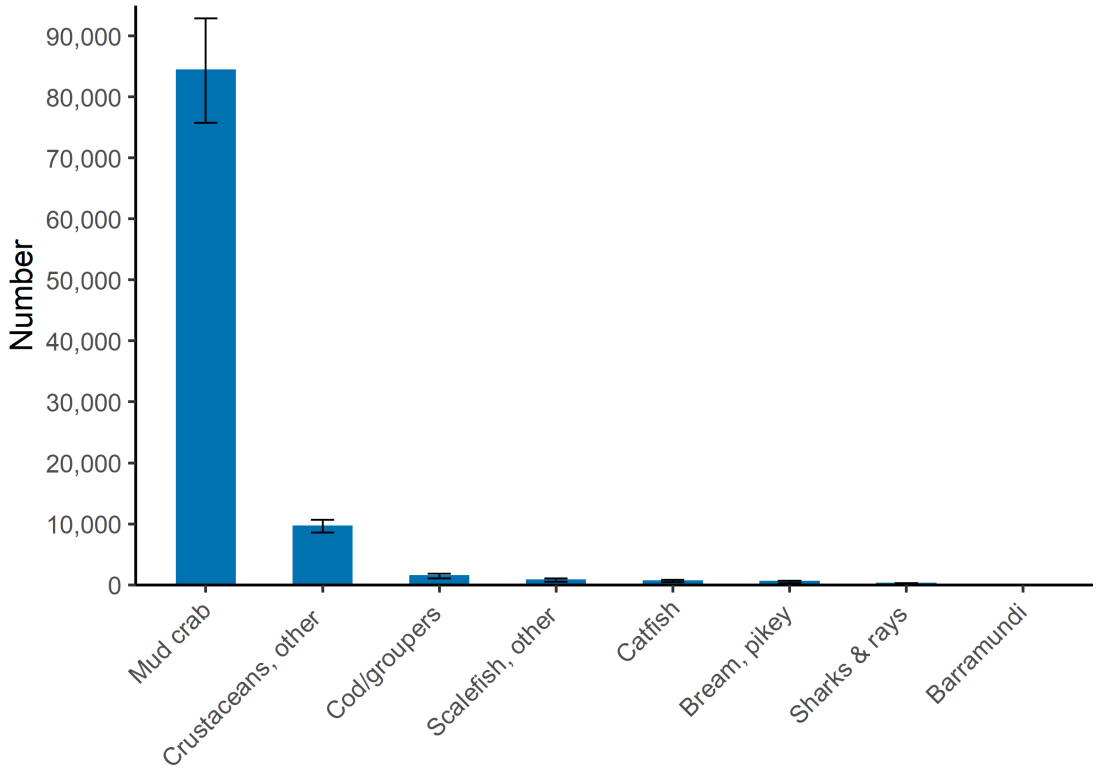

Figure 13. Estimated total catch (numbers of fish) of the most frequent species/groups caught by pot fishing methods for recreational fishers in the Greater Darwin area during the survey period from March 2017 to November 2017. Error bars represent one standard error.

5.3.3. Cast net

The cast net catch was dominated by mullet (50.2%). Small baitfish (31.3%) were also a major contributor to the catch from cast nets. The remainder of the catch comprised of other scalefish species (6.1%) and a mixture of crustaceans, such as prawns totalling 4.7% (Figure 14, Appendix 12).

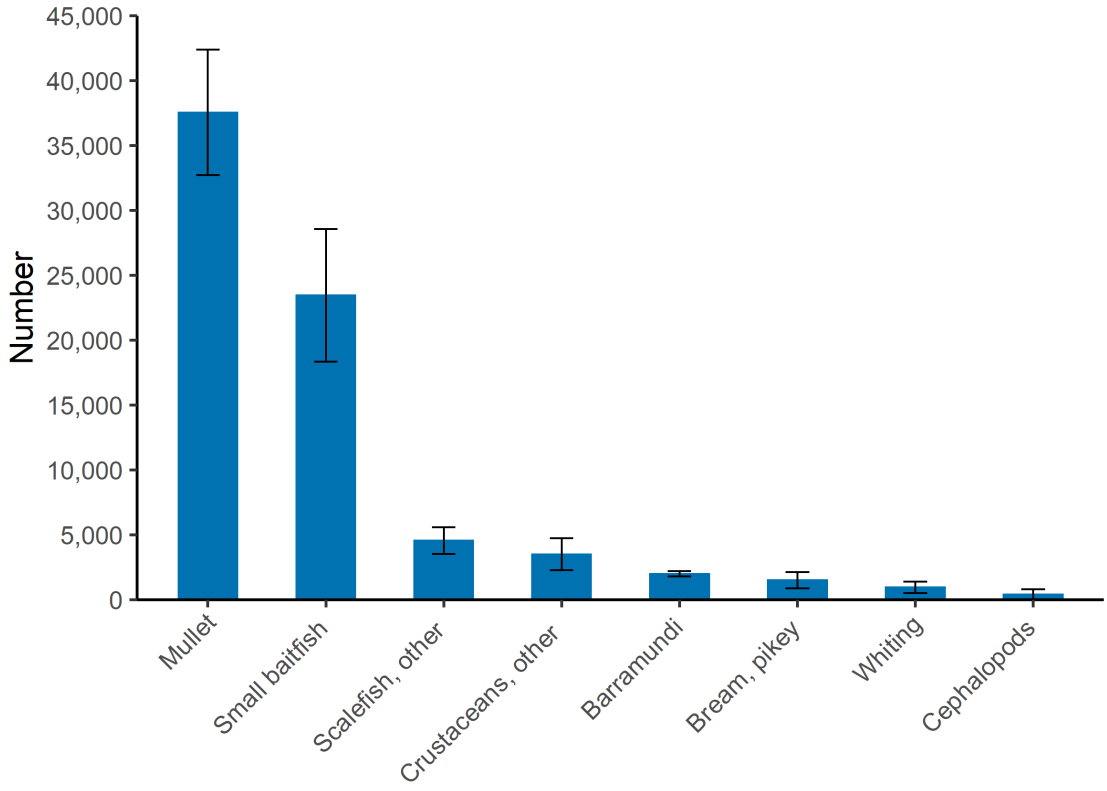

Figure 14. Estimated total catch (numbers of fish) of the most frequent species/groups caught by cast net fishing methods for recreational fishers in the Greater Darwin area during the survey period from March 2017 to November 2017. Error bars represent one standard error.

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

Stripey Snapper (11.6%) and sharks/rays (11.1%) were the most commonly caught species in the Bynoe Harbour/Dundee fishing zone followed by Golden Snapper (10.3%), and cod/groupers (9%) (Figure 15). Only 4% of the total catch for the zone was comprised of Mud Crabs.

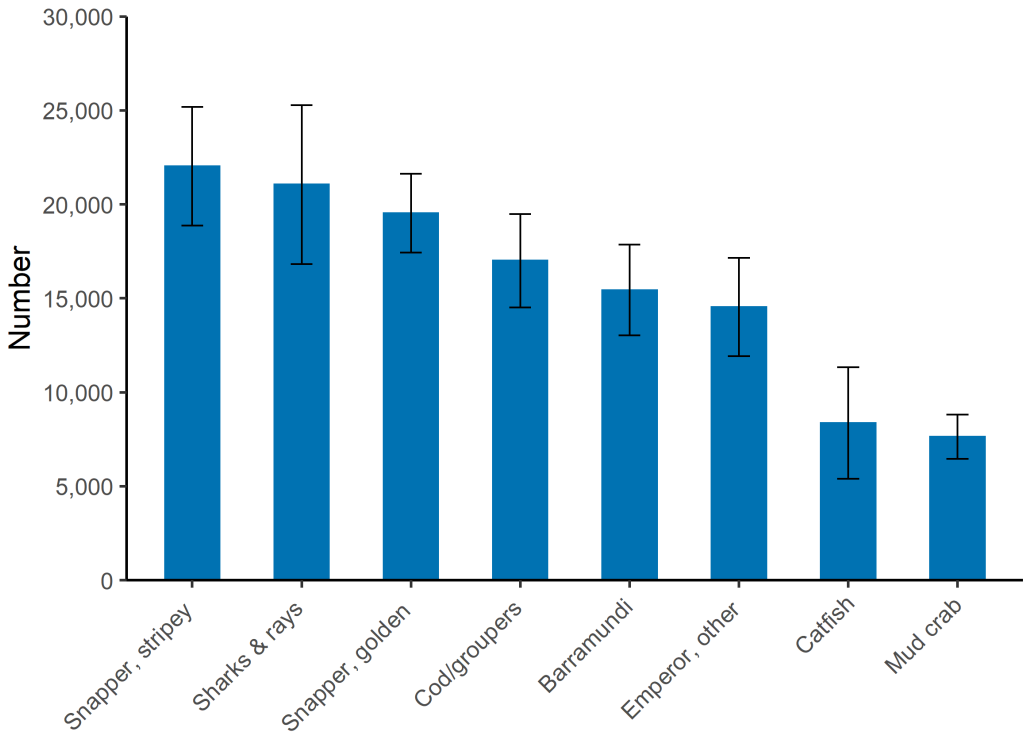

Figure 15. Catch estimates (numbers of fish) of the most frequent species/groups caught in the Bynoe Harbour/Dundee fishing zone by recreational anglers during the survey period from March 2017 to November 2017. Error bars represent one standard error.

5.4.1.2. Darwin Harbour/Surrounds fishing zone

Mud Crabs (21.9%) dominated the catch from the Darwin Harbour/Surrounds fishing zone, followed by mullet (9.3%), Golden Snapper (7.5%), small baitfish (5.6%) and Stripey Snapper (5%) (Figure 16).

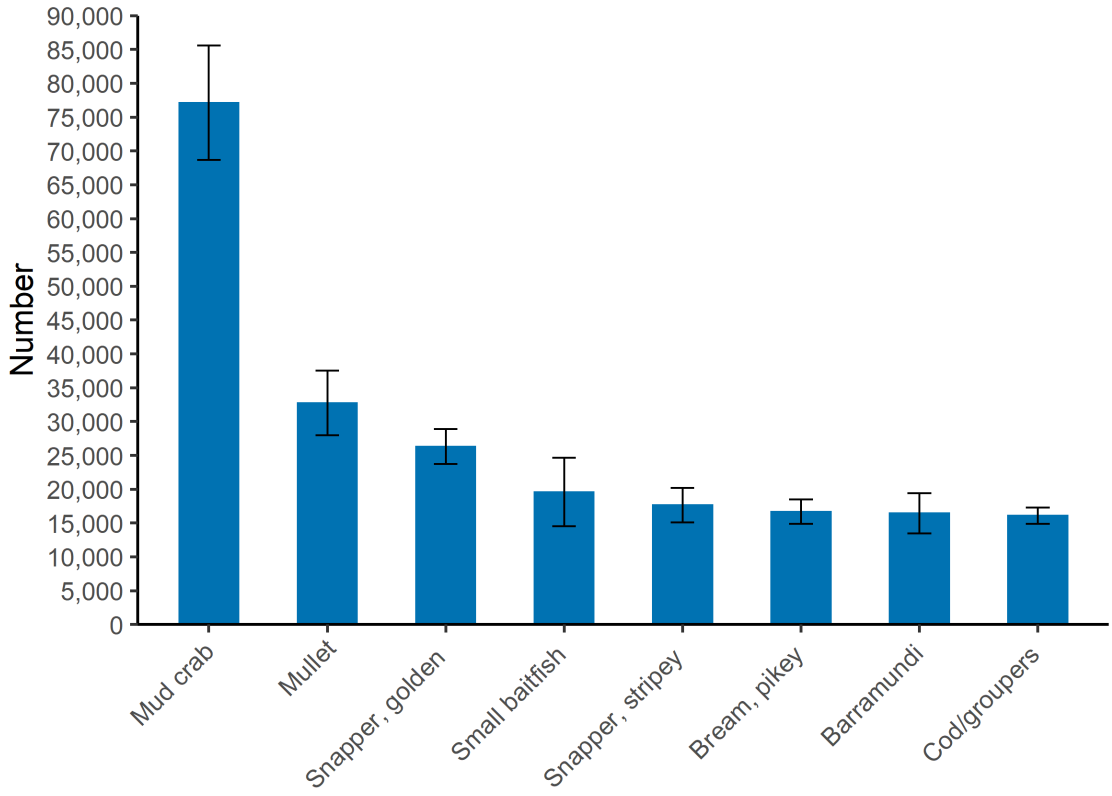

Figure 16. Catch estimates (numbers of fish) of the most frequent species/groups caught in the Darwin Harbour/Surrounds fishing zone by recreational anglers during the survey period from March 2017 to November 2017. Error bars represent one standard error.

5.4.2. Catch by fishing region

The Bynoe/Dundee offshore region was the most significant single region producing 15% of the total catch of all aquatic organisms followed by the Darwin Harbour region with 14% and Shoal Bay with 12% (Figure 17, Appendix 7). Collectively, Darwin Harbour and its associated arms and creeks produced 38% of the total catch.

The Darwin Harbour region dominated the fish catch with 39% of the total fish numbers coming from this area. This catch was composed primarily of Golden Snapper, mullet and Barramundi. The Bynoe/Dundee offshore region had the next highest catch of fish with 22%, primarily due to high numbers of reef fish species.

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

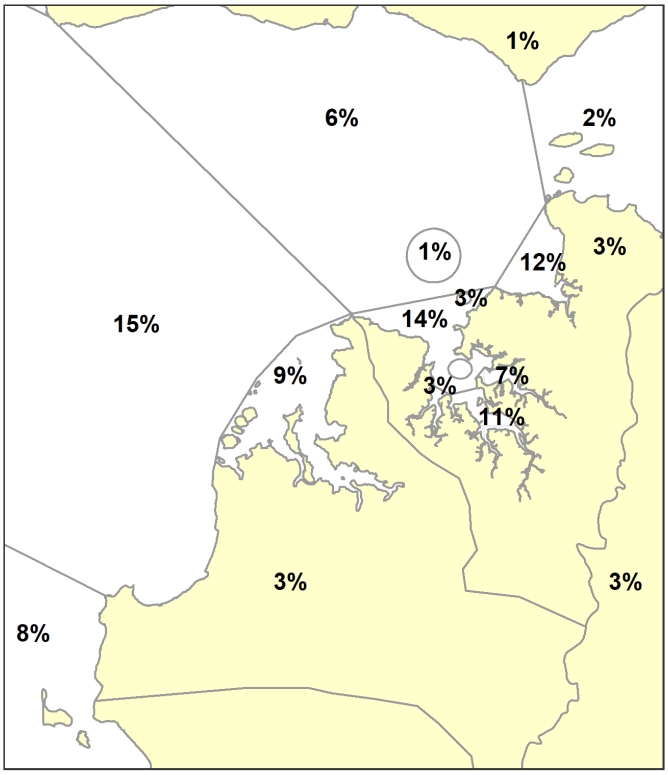

Figure 17. Map showing the spatial distribution (percentage) of catch by fishing region in the Greater Darwin area for recreational fishers during the survey period from March 2017 to November 2017.

5.5. Catch by season

Numeric catch estimates for the eight 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 Crab remained the most commonly caught species throughout the survey period. Nonetheless, the Mud Crab catch did fluctuate across the survey period with about 23 400 individuals caught in the run-off, about 43 600 in the dry, about 17 600 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 crab (13%) and mullet (10%) were the primary species caught in the Greater Darwin area during the run-off period. Other species of importance were Stripey Snapper (8.6%) and Barramundi (8.5%) (Figure 18).

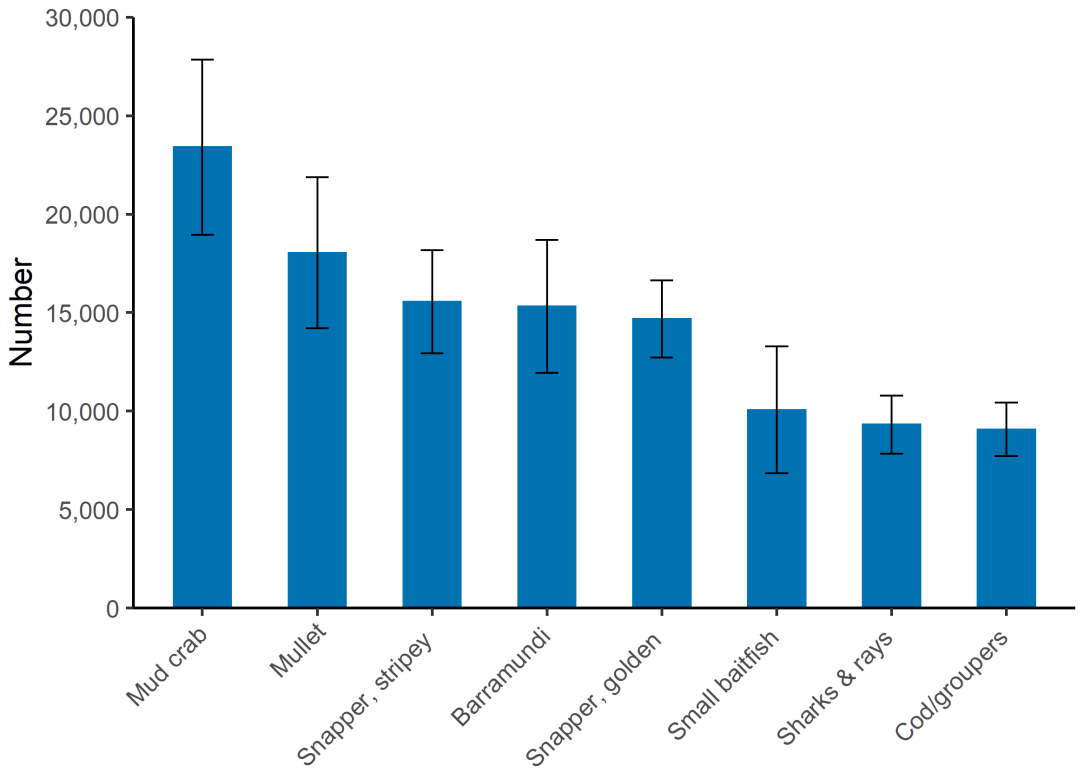

Figure 18. Catch estimates (numbers of fish) of the most frequent species/groups caught in the Greater Darwin area by recreational anglers during the run-off (March – May) season. Error bars represent one standard error.

5.5.2. Dry season (June – August)

Mud Crabs (22.5%) dominated the catch during the dry season followed by Golden Snapper (8.8%), Stripey Snapper (6.7%) and cod/groupers (6.6%) (Figure 19).

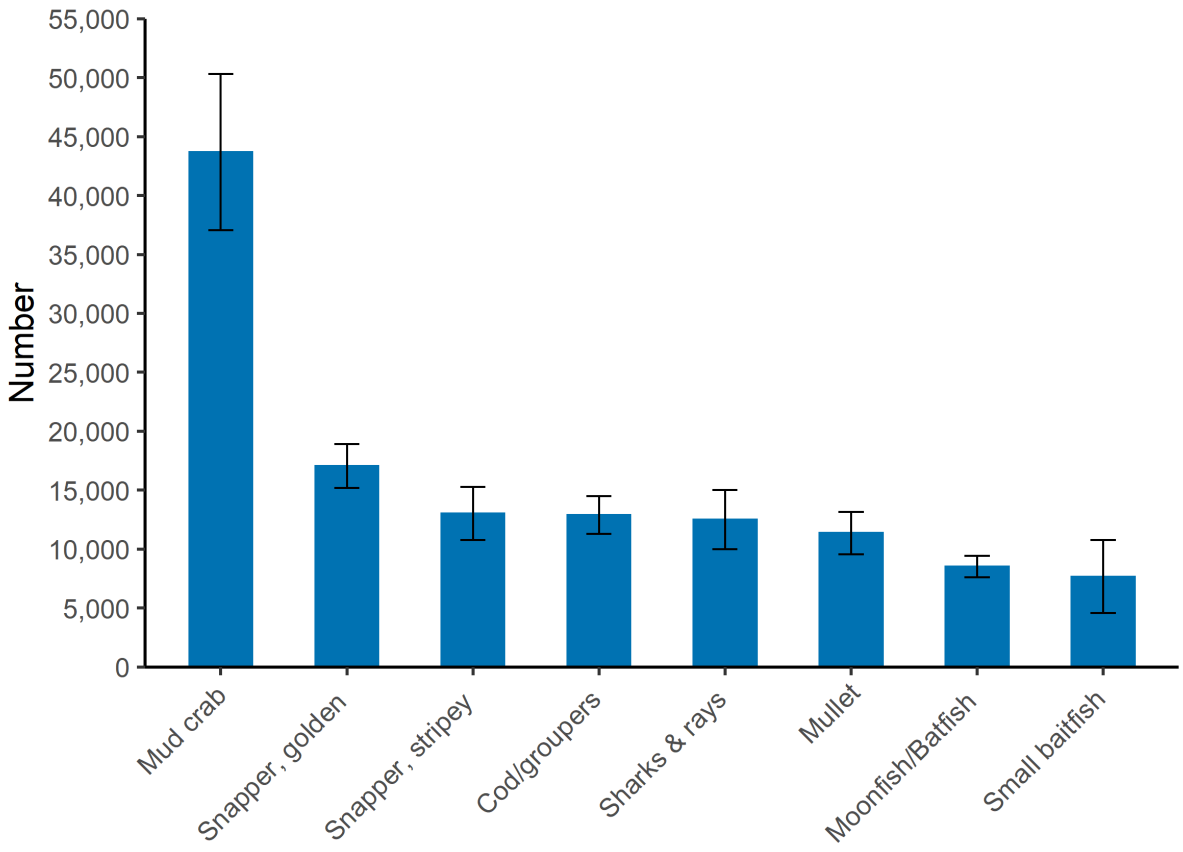

Figure 19. Catch estimates (numbers of fish) of the most frequent species/groups caught in the Greater Darwin area by recreational anglers during the dry season (June – August). Error bars represent one standard error.

5.5.3. Build-up (September – November)

Mud crab (10.6%) were the predominant catch during the build-up months followed by sharks/rays (9%), Golden Snapper (8.5%), Barramundi (7.2%) and catfish (7%)

(Figure 20).

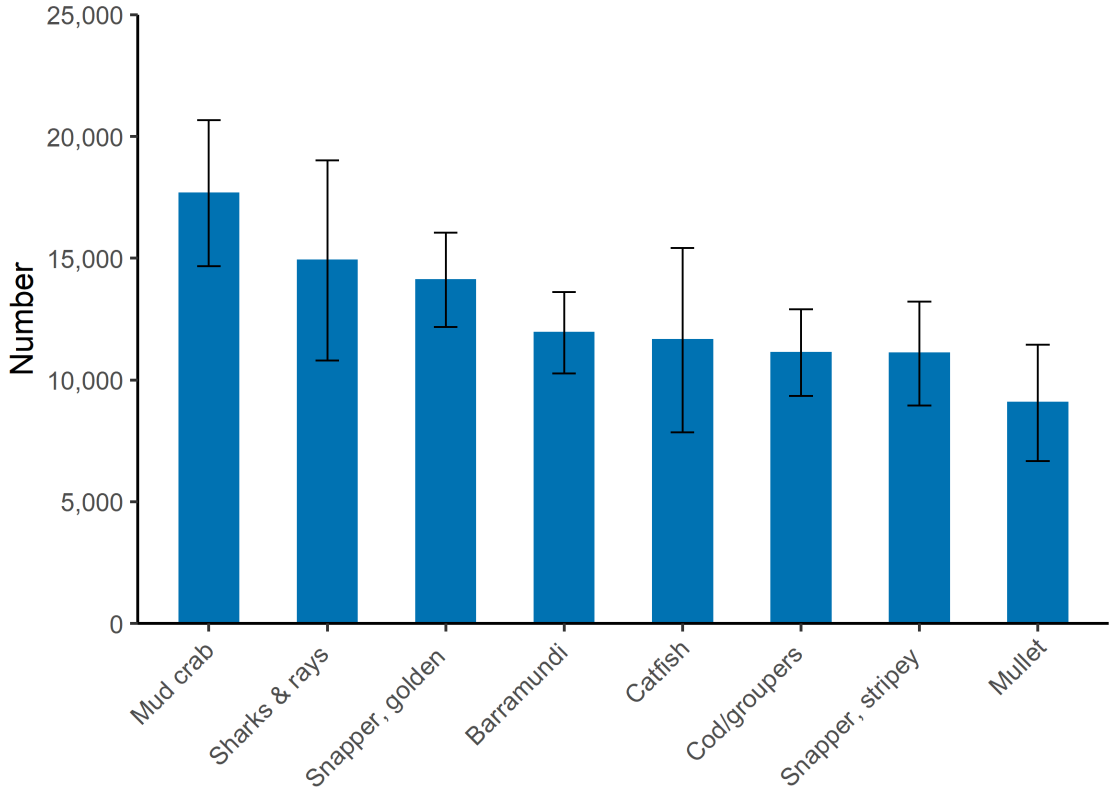

Figure 20. Catch estimates (numbers of fish) of the most frequent species/groups caught in the Greater Darwin area by recreational anglers during the build-up (Sept – Nov) season. Error bars represent one standard error.

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 (22%), the Finnis River region (22%), Bynoe Harbour (15%) and Shoal Bay (11%) (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 run-off (48%) and followed by the build-up (37.5%) (Figure 21C). The majority of Barramundi captures were by line fishing methods (93%) (Figure 21D) and predominantly from estuarine waters (87%) (Figure 21E).

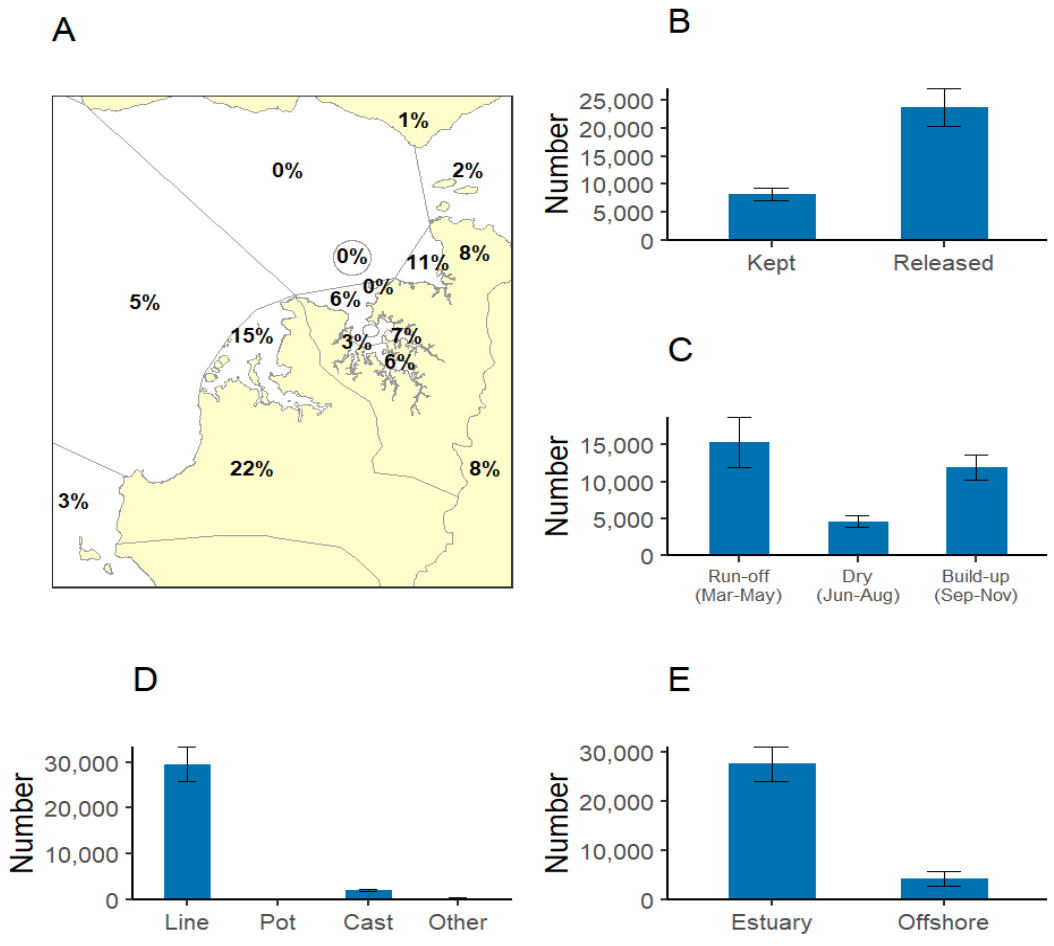

Figure 21. Summary results for Barramundi in the Greater Darwin area from March 2017 to November 2017: A) proportion (%) of the total catch by region, B) total numbers kept and released, C) catch by season D) proportion (%) of catch by fishing method and E) total catch by water body. Error bars represent one standard error.

6.2. Black Jewfish (Protonibea diacanthus)

Black Jewfish has been assessed as recovering in the Greater Darwin area (Saunders et al. 2016a) after several management measures were 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 Mouth of the Adelaide River (22%), the Bynoe Harbour area (19%) and the Darwin Harbour area (18%) (Figure 22A). More than 39% of all Black Jewfish captured were released (Figure 22B) with the highest catches reported in the build-up (45%) followed by the dry season (28%) and run-off with around 27% of the total (Figure 22C). All Black Jewfish were caught using line fishing methods (Figure 22D) and with 65% caught from estuarine waters (Figure 22E).

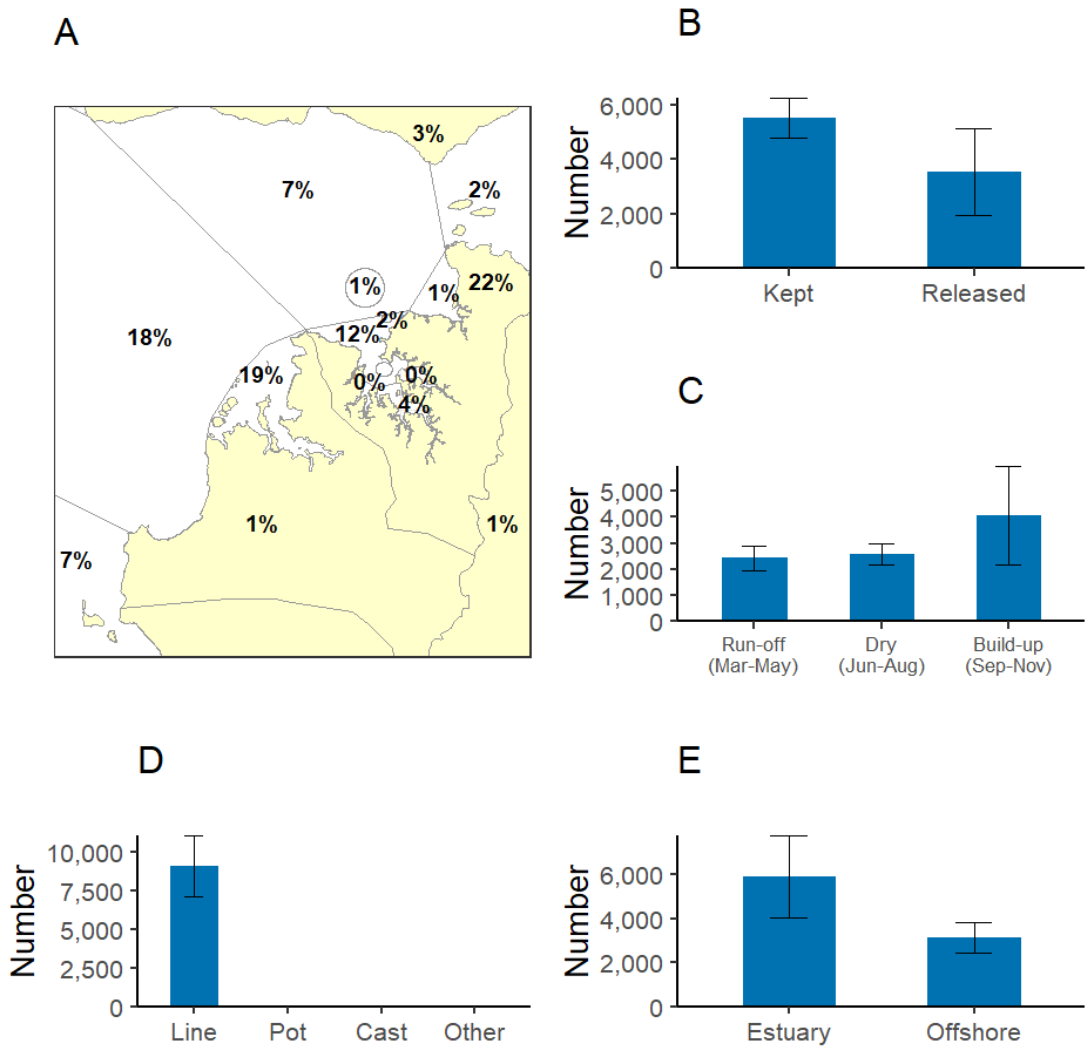

Figure 22. Summary results for Black Jewfish in the Greater Darwin area from March 2017 to November 2017: A) proportion (%) of the total catch by region, B) total numbers kept and released, C) catch by season D) proportion (%) of catch by fishing method and E) total catch by water body. Error bars represent 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 Dundee offshore area (51%). The Peron Islands area (30%) and offshore Darwin area (12%) were also significant areas for the capture of Coral Trout (Figure 23A). More than 73% of all Coral Trout captured were kept (Figure 23B). The highest catch of Coral Trout occurred in the run-off (46%) followed by the build-up (29%) and the dry season (25%) (Figure 23C). All Coral Trout were caught using line fishing methods (Figure 23D) and they were captured primarily in offshore waters (96%) (Figure 23E).

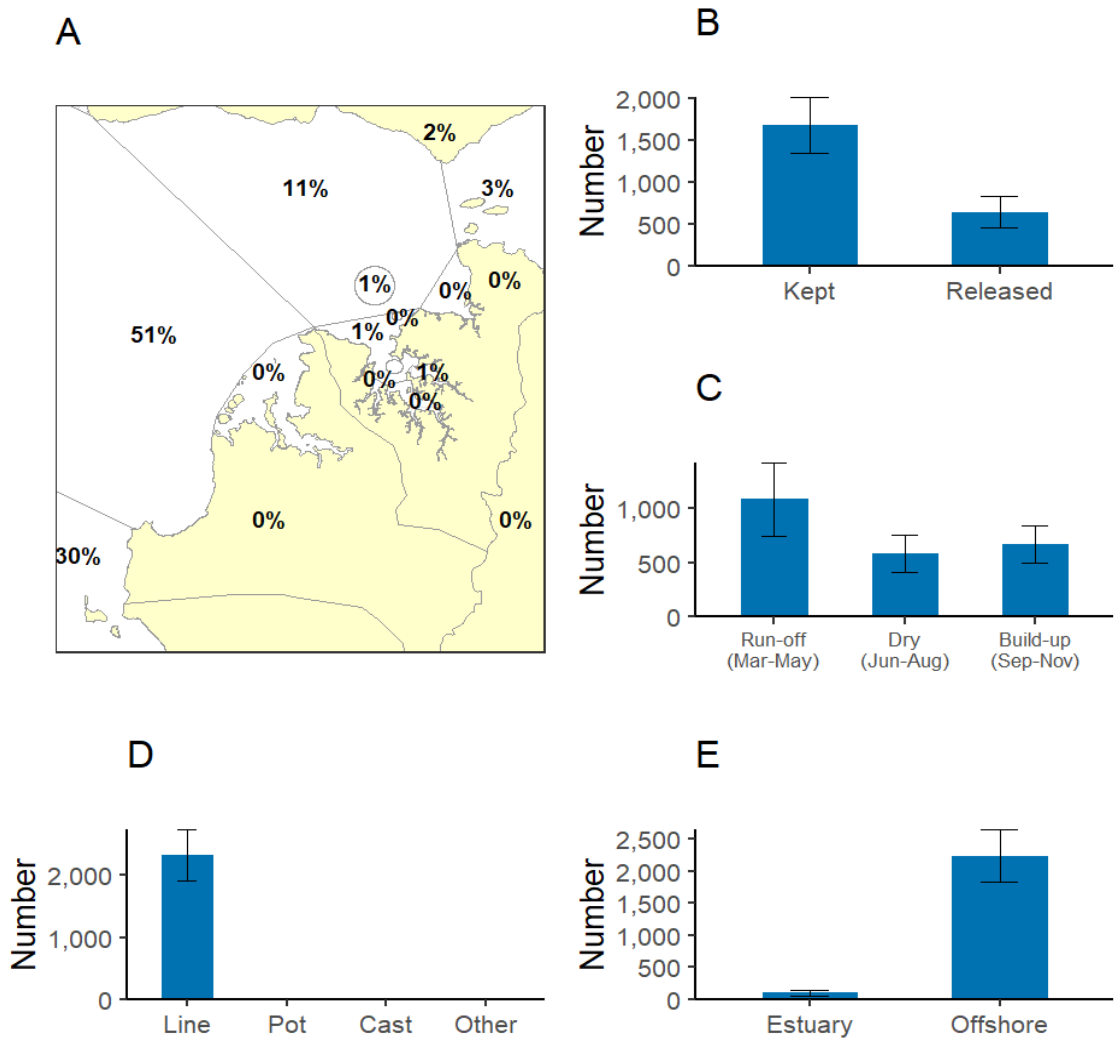

Figure 23. Summary results for Coral Trout in the Greater Darwin area from March 2017 to November 2017: A) proportion (%) of the total catch by region, B) total numbers kept and released, C) catch by season D) proportion (%) of catch by fishing method and E) total catch by water body. Error bars represent one standard error.

6.4. Golden Snapper (Lutjanus johnii)

Golden Snapper has been assessed as overfished in the Greater Darwin area (Saunders et al. 2016b) 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 (37%), Bynoe Harbour (19%) and the area offshore from Dundee (17%) (Figure 24A). More than half of all Golden Snapper captured were released (53%) (Figure 24B). Golden Snapper were captured throughout the survey period with the highest catches occurring in the dry season (37%) followed by the run-off (32%) and the build-up (31%) (Figure 24C). All Golden Snappers were caught using line fishing methods (Figure 24D) with catches being higher in estuarine waters (64%) than in offshore waters (36%) (Figure 24E).

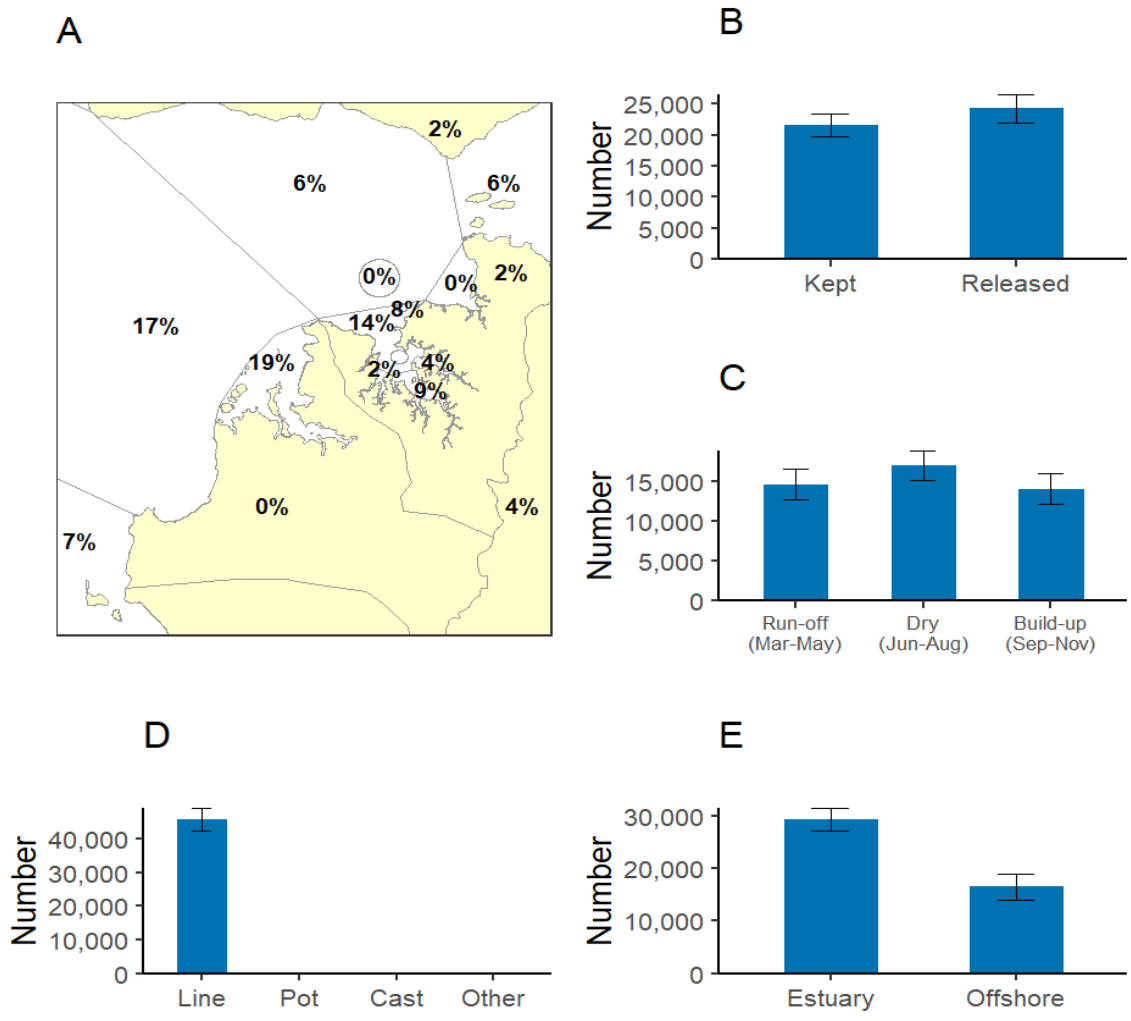

Figure 24. Summary results for Golden Snapper in the Greater Darwin area from March 2017 to November 2017: A) proportion (%) of the total catch by region, B) total numbers kept and released, C) catch by season D) proportion (%) of catch by fishing method and E) total catch by water body. Error bars represent one standard error.

6.5. Mud Crab (Scylla spp.)

Mud Crabs are another 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 in Darwin Harbour (45%) followed by Shoal Bay (39%) and to a lesser extent Bynoe Harbour (5%) (Figure 25A). Just over 65% of all Mud Crabs captured were kept (Figure 25B) with the highest catches occurring during the dry season (52%) and the run-off (28%). The build-up months produced 20% 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 (99%) (Figure 25E).

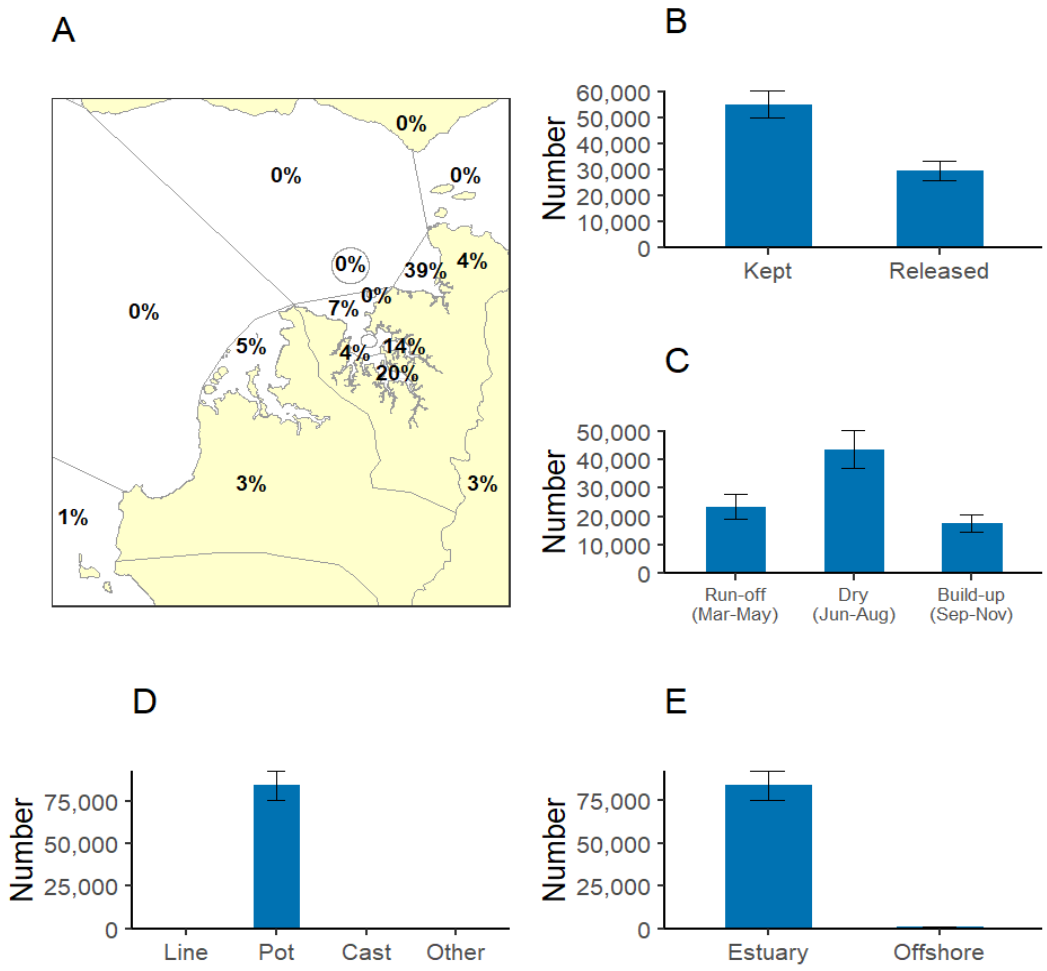

Figure 25. Summary results for Mud Crab in the Greater Darwin area from March 2017 to November 2017: A) proportion (%) of the total catch by region, B) total numbers kept and released, C) catch by season D) proportion (%) of catch by fishing method and E) total catch by water body. Error bars represent 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 Mackerel in the Greater Darwin area occurred offshore of Dundee and Bynoe Harbour (43%) and around the Peron Islands (30%) (Figure 26A). Approximately 77% of all Spanish Mackerels captured were kept (Figure 26B) with the majority of catches occurring in the build-up (54%) (Figure 26C). All Spanish Mackerels were caught using line fishing methods (Figure 26D), predominantly from offshore waters (83%) (Figure 26E).

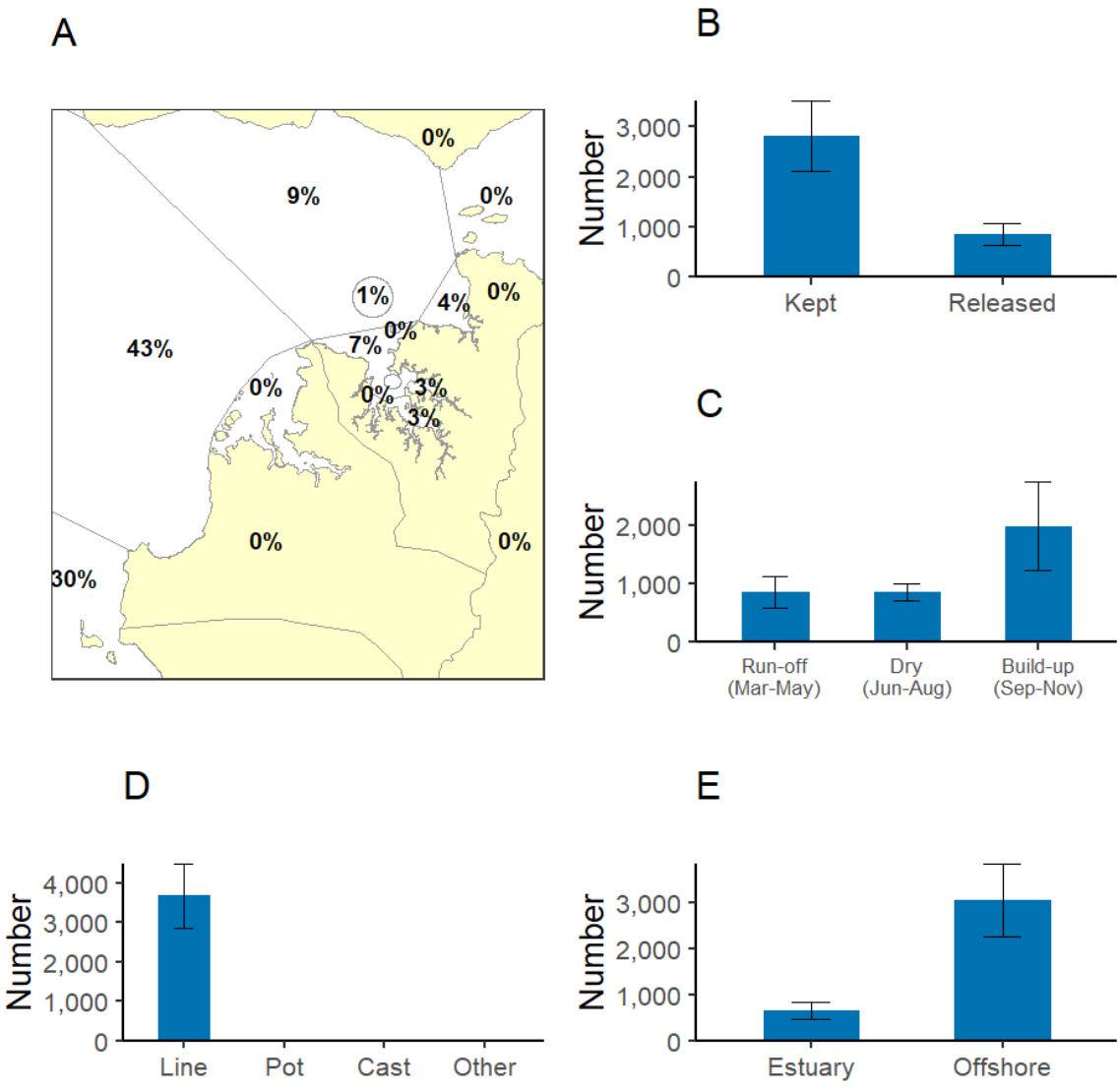

Figure 26. Summary results for Spanish Mackerel in the Greater Darwin area from March 2017 to November 2017: A) proportion (%) of the total catch by region, B) total numbers kept and released, C) catch by season D) proportion (%) of catch by fishing method and E) total catch by water body. Error bars represent one standard error.

6.7. Emperors (Family Lethrinidae)

Emperors comprised mainly of Grass Emperor (*Lethrinus laticaudis*) are 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 emperors in the Greater Darwin area occurred in the offshore Peron Islands area (47%) and the Dundee offshore area (29%). The Darwin Harbour (13%) was also a significant area for the capture of emperors (Figure 27A). More than 59% of all emperors captured were released (Figure 27B). The highest catch of emperors occurred in the build-up (39%) followed by the run-off (32%) and the dry season (29%) (Figure 27C). All emperors were caught using line fishing methods (Figure 27D) and they were captured primarily in offshore waters (84%) (Figure 27E).

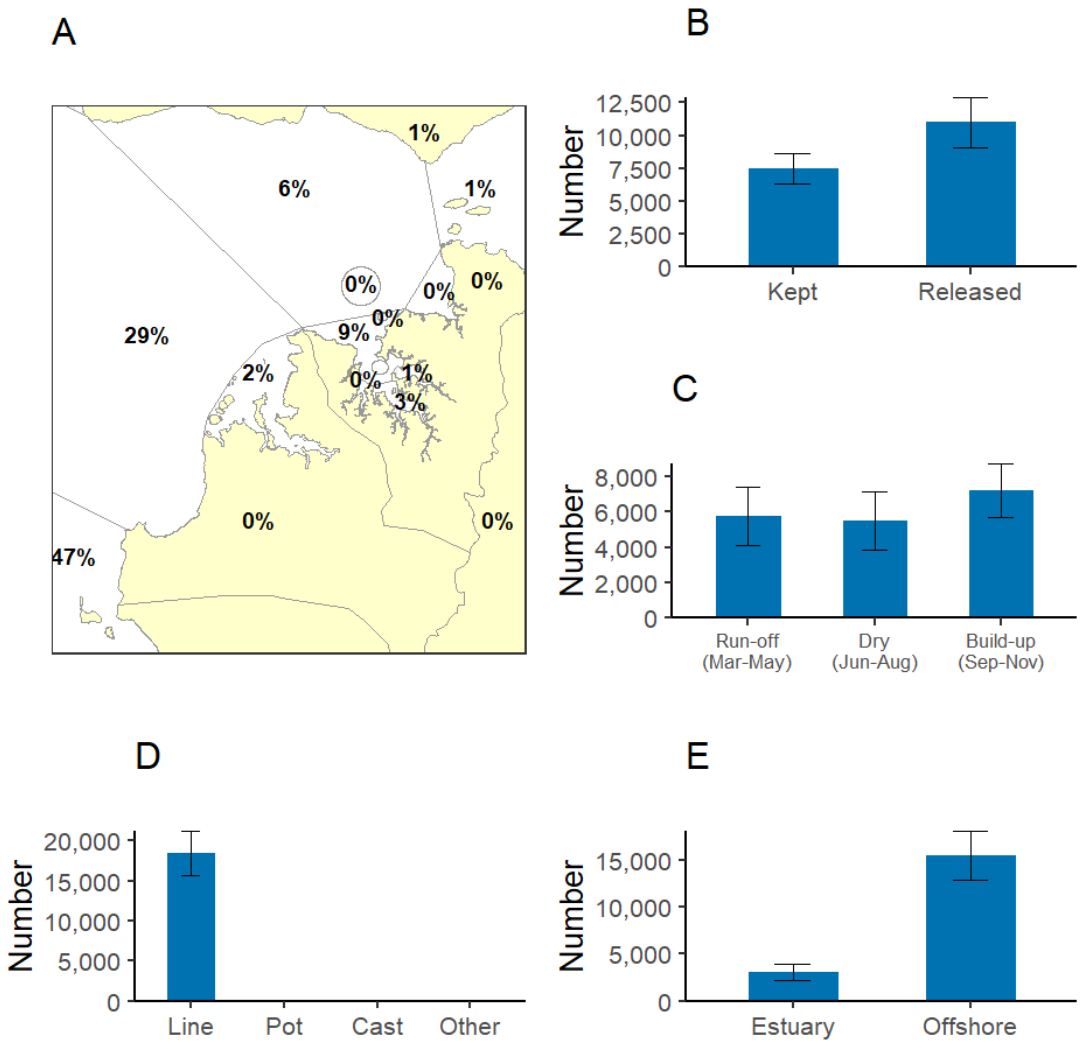

Figure 27. Summary results for emperors in the Greater Darwin area from March 2017 to November 2017: A) proportion (%) of the total catch by region, B) total numbers kept and released, C) catch by season D) proportion (%) of catch by fishing method and E) total catch by water body. Error bars represent 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 15 to 85 cm. The most frequent length (mode) was 40 cm and the mean length was 40.6 cm (Figure 28).

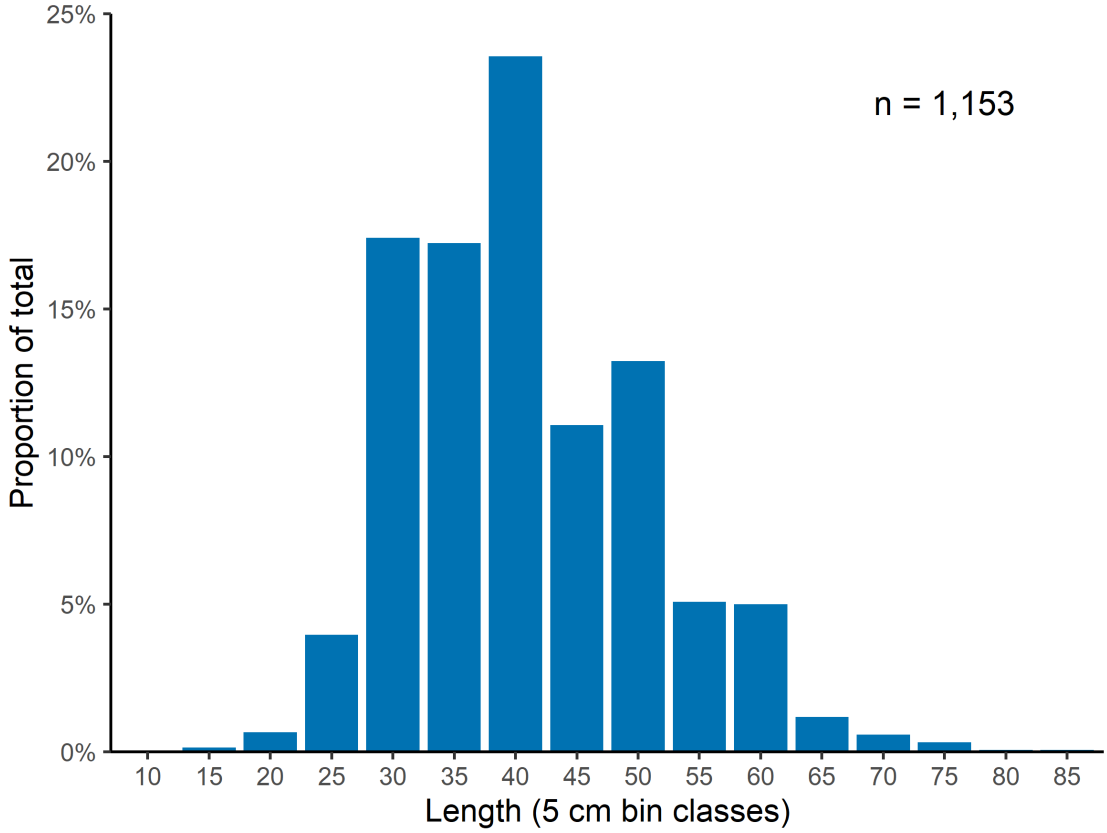

Figure 28. Length frequency distribution of harvested Golden Snappers from the Greater Darwin area taken by recreational fishers during the survey period from March 2017 to November 2017.

7.2. Black Jewfish (Protonibea diacanthus) harvest length data

The length of harvested Black Jewfish ranged from 30 to 130 cm. The most frequent length was 70 cm and the mean length was 84.5 cm (Figure 29).

As was the case with the 2016 survey, Black Jewfish in the 90 cm size class were under-represented in the 2017 harvest sample.

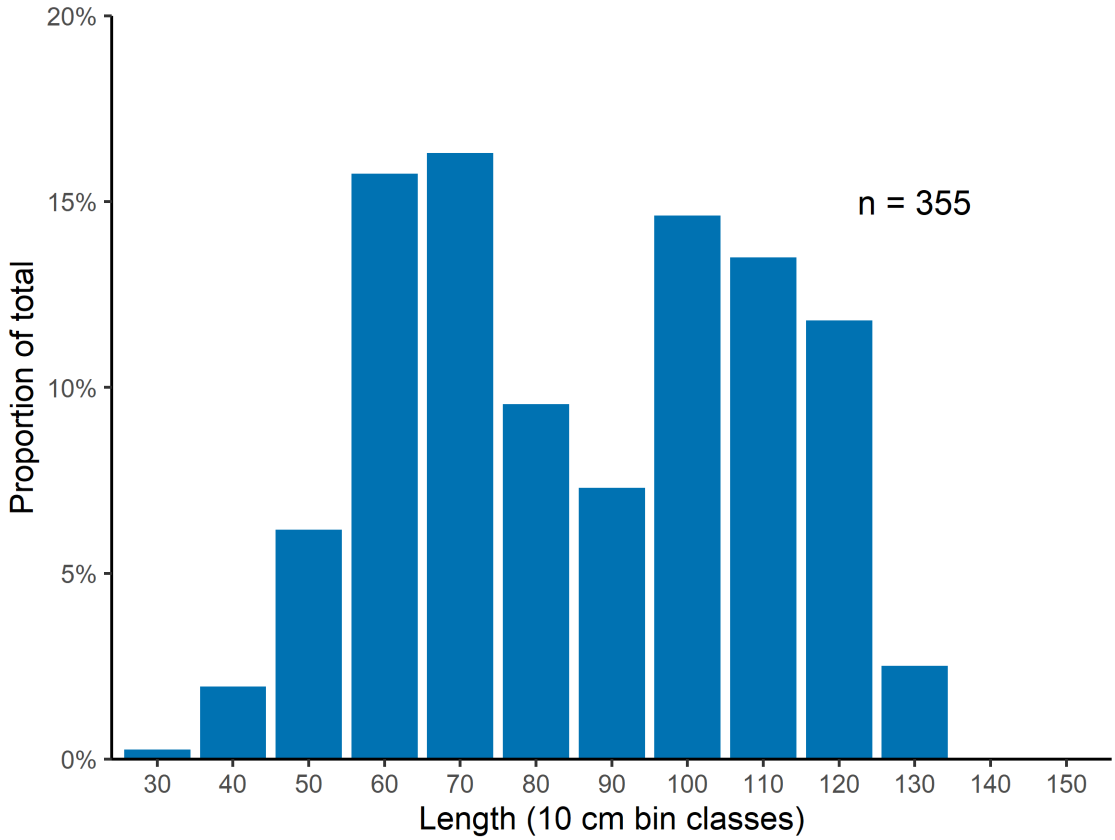

Figure 29. Length frequency distribution of harvested Black Jewfish from the Greater Darwin area taken by recreational fishers during the survey period from March 2017 to November 2017.

7.3. Barramundi (Lates calcarifer) harvest length data

The length of harvested Barramundi ranged from 55 to 98 cm. The most frequent length was 60 cm and the mean length was 66.1 cm (Figure 30).

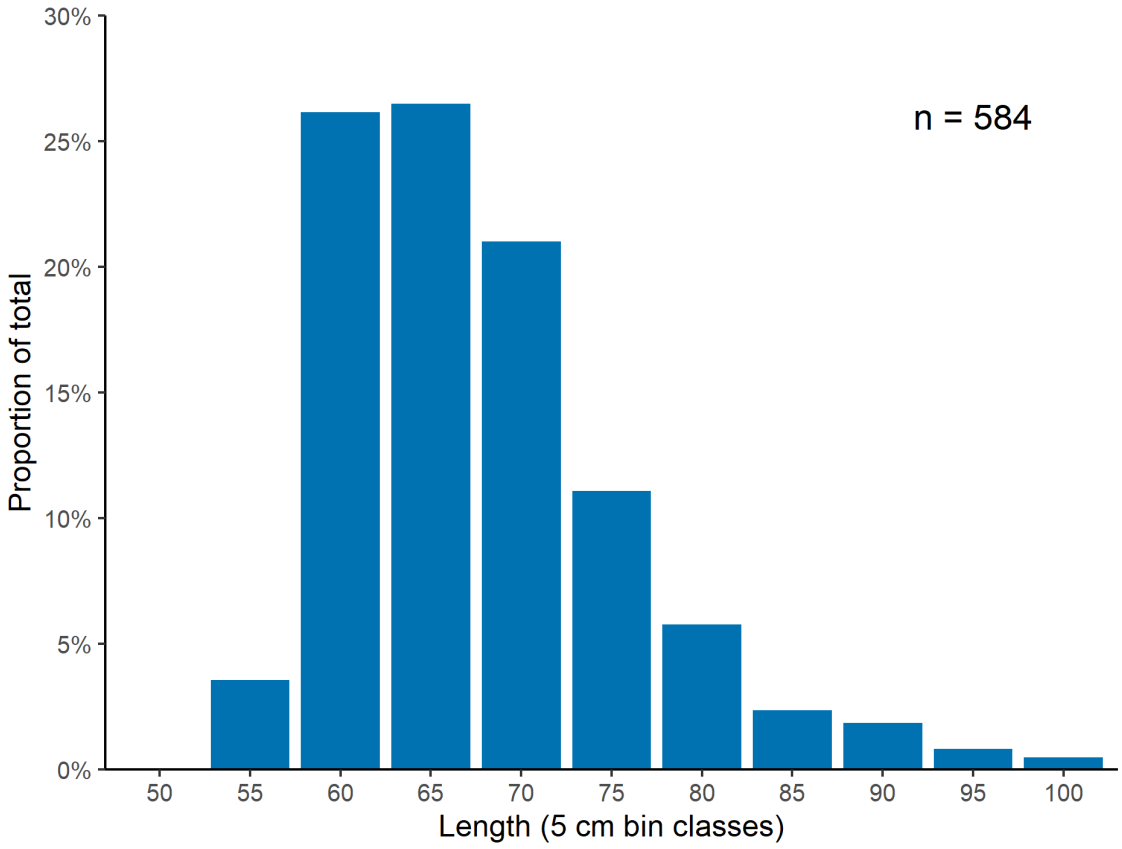

Figure 30. Length frequency distribution of harvested Barramundi from the Greater Darwin area taken by recreational fishers during the survey period from March 2017 to November 2017.

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 2016 survey. The overall catch was highest in May/June before decreasing in July and increasing again in August. The catch then decreased again from September towards the end of the year. (Figure 31). 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, 90% were kept, whereas only 53% of female crabs were kept. The proportion of males kept each month was always high (at least 80%), but the proportion of females kept in a given month, rarely exceeded 65%, dropping as low as 26% in April (Figure 32).

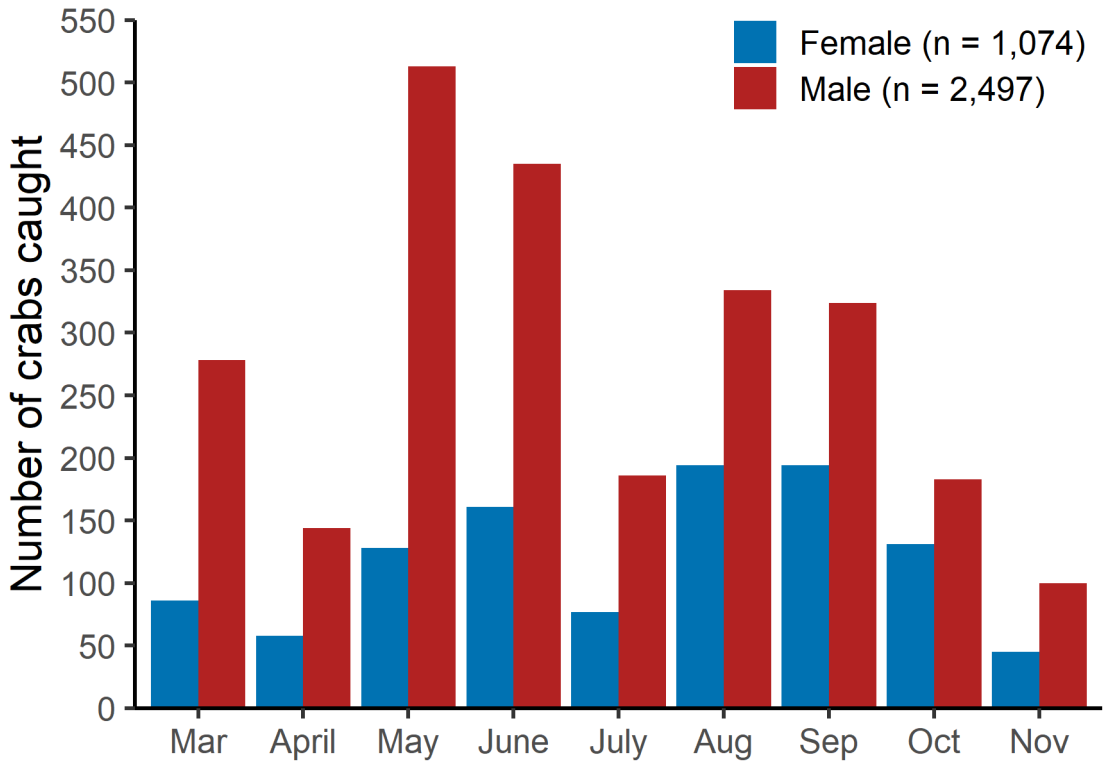

Figure 31. Monthly catch of male and female Mud Crabs by recreational fishers in the Greater Darwin area during the survey period from March 2017 to November 2017.

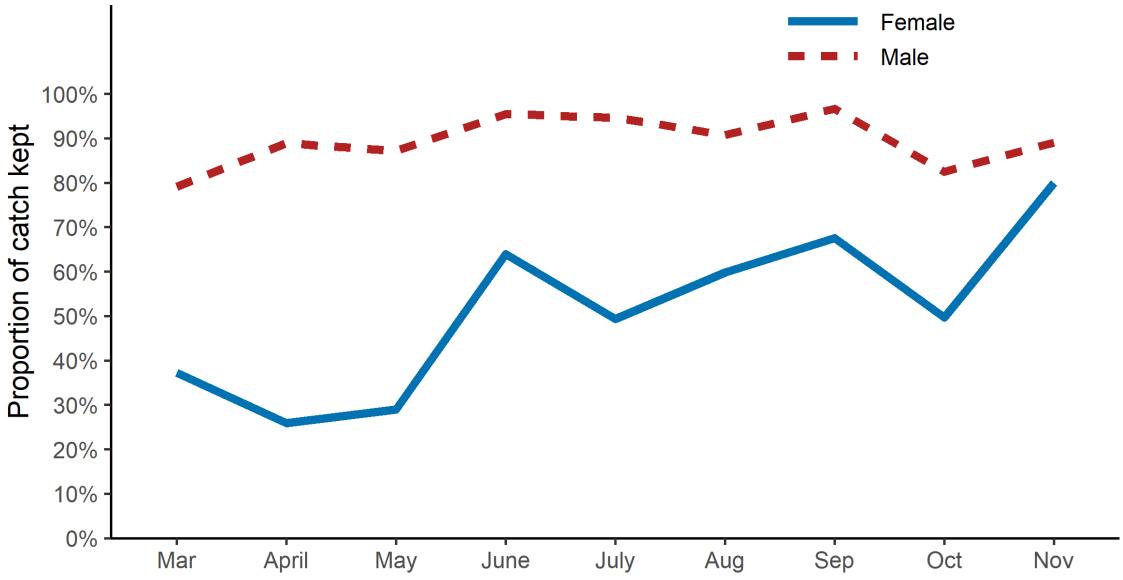

Figure 32. The proportion of Mud Crab catch (n=3571) kept by month for each sex by recreational fishers in the Greater Darwin area during the survey period from March 2017 to November 2017

8. Vessel characteristics and technology

8.1. Vessel size

Almost 80% of the recreational vessels observed were 4.5 m long or larger (Figure 33).

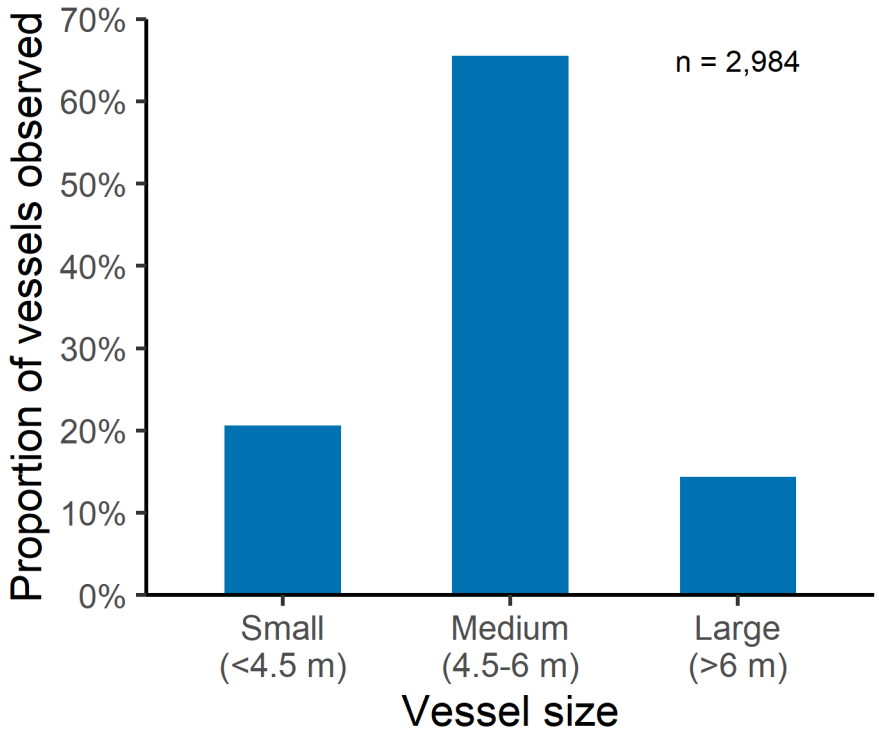

Figure 33. The proportion of recreational fishing vessels by size class in the Greater Darwin area during the survey period from March 2016 to November 2016.

8.2. Vessel technology

More than 90% of the recreational fishing vessels observed were fitted with sounders (Figure 34). Most vessels (61%) had a sounder screen that was 10 to 20 cm wide. Only 15% of vessels had a sounder with a screen exceeding 20 cm in width.

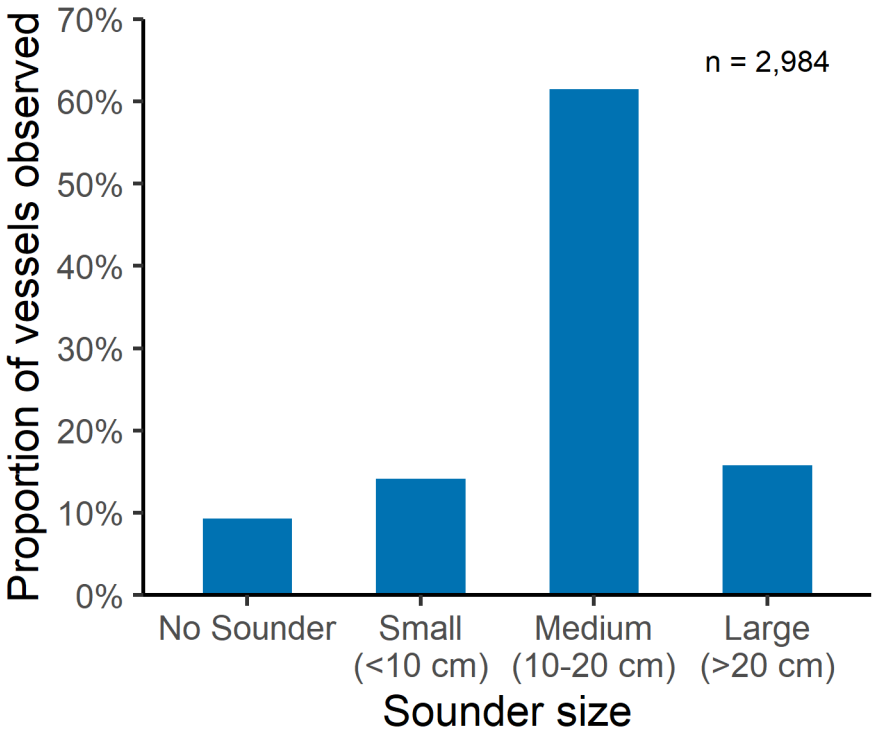

Figure 34. The proportion of recreational fishing vessels by sounder dimensions from a subset of recreational fishers who fished in the Greater Darwin area during the survey period from March 2017 to November 2017.

More than 75% of recreational fishing vessels surveyed were fitted with a GPS (Figure 35). Most vessels (51%) had a GPS screen size of 10 to 20 cm and were often an integrated component of the sounder unit.

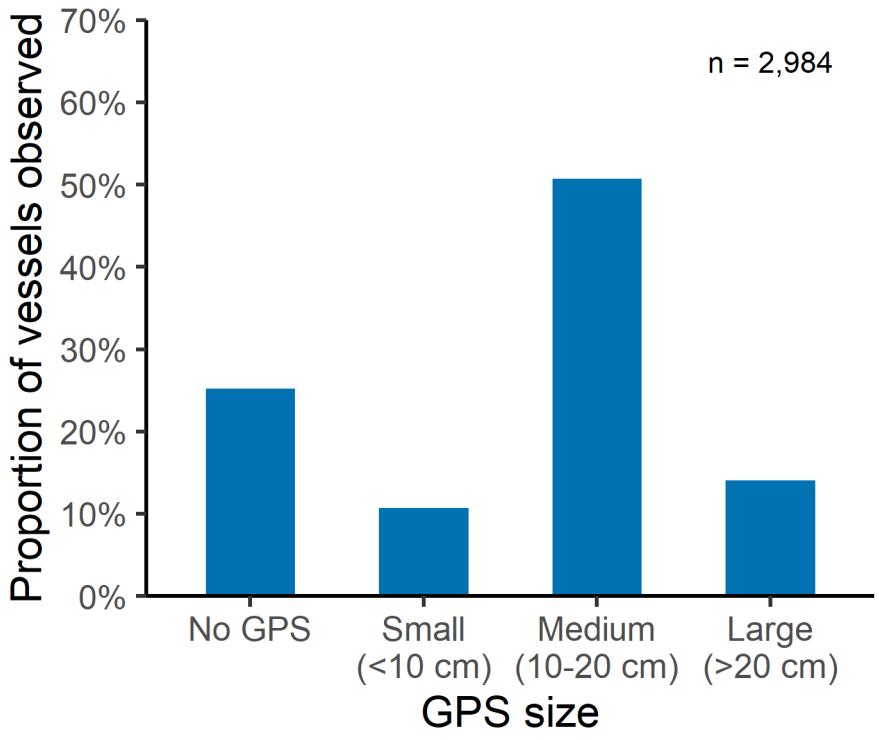

Figure 35. The proportion of vessels by GPS dimensions from a subset of recreational fishers who fished in the Greater Darwin area during the survey period from March 2017 to November 2017.

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, 90% of all vessels surveyed had a sounder and 75% 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 2017' 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 a modified methodology based on the "*Survey of Recreational Fishing in the Greater Darwin Area 2016*" and so comparisons of results should be made with caution. Additionally, 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 the 2016 and 2017 survey years revealed that effort (fisher hours) across the Greater Darwin area increased from 418 401 to 471 276 hours (an increase of about 11%). However, the effort in the Darwin Harbour/Surrounds Zone decreased from 68% in 2016 to 64% of the total in 2017. In contrast, the total effort in the Bynoe Harbour/Dundee Zone increased from 32% in 2016 to 36% in 2017. Seasonal effort in 2016 and 2017 was greatest for the run-off period.

There was an increase in total catch from 509 179 organisms in 2016 to 540 796 organisms in 2017, an increase of over 31 000 individuals (or about 6%). A 71% increase in Barramundi numbers accounted for a large part of the difference in catch along with a 25% increase in Mud Crab total catch.

Of particular note, there was a significant increase in the total catch of Barramundi from 9,300 in 2016 to 31,861 in 2017 (or about 71%). Mud Crab total catch also increased about 25% from 63,351 in 2016 to 84,754 in 2017. This could be due in part to having much higher rainfall totals for the 2017 wet season as compared to the previous consecutive poor wet seasons experienced in 2015 and 2016. Darwin Airport's wet season rainfall total of 2484.4 mm for the 2016/17 wet season was its third-highest on record (BoM 2018).

Other notable results include:

- Dundee Beach surpassed Dinah Beach as the ramp contributing the greatest number of fisher hours (effort).
- Visiting angler effort was similar for the total dry season effort in 2017 at 20% as compared to 18% in 2016.

9.2. Future monitoring

The Greater Darwin region supports about 80% of the overall fishing activity across the Northern Territory (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 is expected that the Survey of Recreational Fishing in the Greater Darwin Area will be repeated in 2018. Information obtained from the three 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, Evan Needham, Steven Matthews, Graham Schultz, Blake Taylor, Mark Grubert, Will Bowman, Quentin Allsop and Hock Seng-Lee.
- The on-site survey interviewing team Keith Saunders, Michael Usher, Ash Keast, Phil Parker, Natalie Leader, Deepak Pazhayamadom, Gaylene Schilling, Tony McGregor and Krystal Grzelak who worked tirelessly in all weather conditions to obtain quality data.
- Lastly, and most importantly, we would like to 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.

Drive-offs People who drive off before being interviewed.

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).

Fisher hours Hours spent recreational fishing by fishers.

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.

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.

Refusals People who decline to be interviewed.

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 and a half-hour period of the day (either 8:30-14:00 hr or 14:00-19:30 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
Run-Off	WD	66
(March, April, May)	WE	26
Dry	WD	66
(June, July, August)	WE	26
Build-Up	WD	65
(September, October, November)	WE	26

WD - weekday, WE – weekend

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

Boat Ramp		Season / Day Type								Total
		Run-Off		Dry		Build-up		Wet #		
		WD	WE	WD	WE	WD	WE	WD	WE	
Darwin Harbour										
Primary										
1	Buffalo Creek	8	8	7	8	5	8	1	2	47
2	Dinah Beach	7	8	8	8	6	8	2	2	49
5	East Arm	9	5	6	5	4	9	1	1	40
6	Nightcliff	3	4	1	3	5	1	1	-	18
10	Middle Arm	2	3	3	2	5	2	3	1	21
12	Leaders Creek	3	3	5	5	4	2	1	1	24
22	Saltwater Arm	4	5	4	3	5	4	-	1	26
Secondary										
3	Ski Club	1	1	-	1	1	1	1	-	6
4	Channel Island	-	1	2	2	3	2	1	-	11
7	Palmerston	2	1	1	3	2	2	2	2	15
11	Southport	-	1	2	-	-	1	1	1	6
8	Trailer Boat Club	1	-	1	-	-	-	-	-	2
9	Mandorah	-	1	-	-	-	1	-	1	3
	Sub-Total	**40**	**41**	**40**	**40**	**40**	**41**	**14**	**12**	**268**
Bynoe & Dundee										
Primary										
15	Six Pack Creek	6	3	4	6	4	6	1	-	30
16	Keswick Point	1	3	1	-	2	1	3	1	12
21	Dundee Beach	5	6	6	6	6	6	2	1	38
Secondary										
13	Crab Claw	1	1	1	-	-	1	1	-	5
14	Milne Inlet	-	-	1	1	2	-	2	-	6
23	Dundee Road	-	1	-	-	-	1	-	-	2
	Sub-Total	**13**	**14**	**13**	**13**	**14**	**15**	**9**	**2**	**93**
	Total	**53**	**55**	**53**	**53**	**54**	**56**	**23**	**14**	**361**

subsequently removed from expansion

WD - weekday, WE – weekend

Appendix 4: List of species caught by recreational anglers in the Greater Darwin area during the survey period of March 2017 to November 2017

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

Trevally, other	Trevally, other	Carangidae - undifferentiated
Tuna, longtail	Longtail tuna	*Thunnus tonggol*
Tuna, mackerel	Mackerel tuna	*Euthynnus affinis*
Whiting	Whiting	Sillaginidae - undifferentiated
Wrasse, tuskfish	Parrotfish/tuskfish	Scaridae - undifferentiated
Scalefish, other	Archer fish	Toxotidae - undifferentiated
	Barracuda	Sphyraenidea
	Bony bream (freshwater)	*Nematalosa erebi*
	Bream, other	Sparidae
	Cobia	*Rachycentron canadum*
	Eel	Various families
	Fish, other	Various families
	Flounder/sole	Various families
	Fusilier	Caesionidae
	Garfish	Hemiramphidae - undifferentiated
	Jawfish/stargazer	Opistognathidae & Uranoscopidae
	Knife fish	Labridae
	Leatherjacket	Monacanthidae
	Long tom	Belonidae
	Marlin – black	*Makaira indica*
	Milkfish	Chanidae
	Rainbow runner	Carangidae
	Remora	Echeneidae - undifferentiated
	Sailfish	*Istiophorus platypterus*
	Sand bass	*Psammoperca waigiensis*
	Scat/butterfish	Scatophgidae - undifferentiated
	Sooty grunter (freshwater)	*Hephaestus fuliginosus*
	Stonefish	Scorpaenidae
	Sweetlip	Haemulidae - undifferentiated
	Toads/pufferfish	Various families
	Tripletail	*Lobotes surinamensis*
	Wolf herring	*Chirocentrus dorab*
	Yellowtail scad	*Atule mate*
Mud crab	Mud crab	*Scylla* spp
Crustaceans, other	Blue swimmer crab	*Portunus pelagicus*
	Crab, other	Brachyura - undifferentiated
	Prawn, marine	Penaeoidea & Caridea - undifferentiated
Cephalopods	Squid	Loliginidae - undifferentiated
Gastropods	Non-fish, other	Various families
Other taxa	Non-fish, other	Various families

Appendix 5: Summary of Fisher origin and number of fishers during the survey period of March 2017 to November 2017

Fisher Origin	Number of Fishers	% of Total
Northern Territory	6964	86.18
Victoria	269	3.33
Queensland	269	3.33
New South Wales	207	2.56
South Australia	163	2.02
Western Australia	119	1.47
International	57	0.71
Tasmania	21	0.26
Australian Capital Territory	12	0.15
Total Fishers	8081	
Total Boats Interviewed	3151	
Average fishers per boat	3	

Appendix 6: Recreational effort (fisher hours) by analysis and ramp for the survey period of March 2017 to November 2017

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	1. Buffalo Creek	49150	6422
	2. Dinah Beach	64708	4606
	5. East Arm	51248	4054
	6. Nightcliff	17745	3107
	10. Middle Arm	30681	5623
	12. Leaders Creek	*15083*	*4252*
	15. Six Pack	19358	4719
	16. Keswick Point	6182	710
	21. Dundee Beach	113344	12876
	22. Saltwater Arm	*15421*	*5463*
	Total	382920	
Secondary ramp	3. Ski Club	5281	371
	4. Channel Island	*14221*	*3792*
	7. Palmerston	38994	4457
	8. Trailer Boat Club	0	0
	9. Mandorah	2955	277
	11. Southport	*3518*	*1045*
	13. Crab Claw	10000	697
	14. Milne Inlet	11539	1350
	23. Dundee road	1848	219
	Total	88356	
	Grand Total	471276	

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 2017 to November 2017

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	*43794*	*10290*	*46265*	*4696*	*2759*	*936*	*9398*	*3410*	*72729*	*5993*	*11020*	*1519*	*56370*	*6952*	*44509*	*3568*
Catch																
Barramundi	*6949*	*1849*	*4754*	*392*	**226**	**117**	**2699**	**2411**	*1999*	*657*	*979*	*229*	*1976*	*352*	*2080*	*418*
Bream, Pikey	*0*	*0*	*1362*	*81*	*0*	*0*	**266**	**266**	*1763*	*389*	**634**	**348**	*2431*	*590*	*3036*	*603*
Catfish	*1633*	*378*	*2144*	*345*	**25**	**25**	*4640*	*2234*	*998*	*223*	*288*	*103*	*1530*	*536*	*704*	*158*
Cod/Groupers	**48**	**43**	*2350*	*286*	**198**	**127**	**276**	**266**	*4367*	*796*	*472*	*199*	*3564*	*498*	*2919*	*205*
Coral Trout	*0*	*0*	**4**	**4**	**44**	**44**	*0*	*0*	*29*	*12*	**5**	**5**	*0*	*0*	**13**	**10**
Emperor, other	*0*	*0*	**415**	**240**	**93**	**68**	*0*	*0*	*1675*	*709*	*0*	*0*	**570**	**395**	**240**	**123**
Emperor, Red	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	**9**	**9**
Flathead	*0*	*0*	**30**	**26**	**4**	**4**	*0*	*0*	*142*	*66*	*70*	*30*	*93*	*19*	*140*	*55*
Javelin fish	**90**	**85**	*5045*	*825*	**55**	**39**	*0*	*0*	*1328*	*314*	**1062**	**746**	*908*	*272*	*587*	*168*
Jewfish, Black	**92**	**48**	*1704*	*239*	**278**	**155**	**1972**	**1802**	*1060*	*321*	**5**	**5**	*378*	*45*	**31**	**18**
Jewfish, other	**7**	**7**	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Mackerel, Grey	*0*	*0*	*0*	*0*	**90**	**63**	*0*	*0*	**53**	**29**	*0*	*0*	**12**	**12**	*0*	*0*
Mackerel, Spanish	*0*	*0*	*0*	*0*	**8**	**8**	*0*	*0*	*262*	*76*	*0*	*0*	**98**	**98**	**105**	**105**
Mackerel, Spotted	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	**66**	**38**	*0*	*0*	**17**	**17**	*0*	*0*
Moonfish/Batfish	*0*	*0*	*1736*	*256*	*0*	*0*	*0*	*0*	*1150*	*319*	**12**	**9**	**298**	**216**	*756*	*230*
Mullet	**1470**	**806**	*4210*	*341*	*0*	*0*	*0*	*0*	*9000*	*2086*	**2618**	**1792**	*5490*	*2345*	*2562*	*569*
Queenfish	**117**	**66**	*970*	*91*	**117**	**117**	**106**	**77**	*1360*	*396*	*177*	*87*	**774**	**410**	*800*	*143*
Sharks/Rays	*52*	*22*	*2438*	*429*	**156**	**107**	**589**	**379**	*3898*	*1317*	*134*	*55*	*950*	*177*	*958*	*354*
Small baitfish	**413**	**413**	*3453*	*218*	*0*	*0*	*0*	*0*	**6350**	**3462**	*1045*	*429*	**5777**	**3097**	*2187*	*914*
Snapper, Gold-band	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Snapper, Golden	**22**	**22**	*8552*	*462*	*806*	*337*	**1040**	**794**	*6195*	*1540*	*763*	*237*	*4271*	*765*	*1862*	*406*
Snapper, Mangrove jack	*0*	*0*	*300*	*53*	**36**	**36**	*0*	*0*	*186*	*54*	*208*	*99*	*290*	*66*	*222*	*52*
Snapper, Moses'	*0*	*0*	*31*	*0*	*0*	*0*	*0*	*0*	**354**	**179**	*0*	*0*	**349**	**239**	**171**	**156**
Snapper, other	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*	*0*
Snapper, Saddletail/Crimson/Indo	*0*	*0*	**392**	**321**	**224**	**136**	**7**	**7**	*5486*	*2097*	*0*	*0*	*1723*	*729*	*514*	*197*
Snapper, Stripey	*0*	*0*	**204**	**104**	**16**	**11**	*0*	*0*	*6948*	*1944*	**1006**	**892**	**2143**	**1151**	*483*	*210*
Tarpon/Ox-eye herring	**118**	**107**	**10**	**10**	*0*	*0*	*0*	*0*	**96**	**84**	**17**	**14**	**98**	**86**	**33**	**25**
Threadfin, Blue	*1070*	*461*	*576*	*116*	**170**	**127**	*670*	*116*	**500**	**278**	*154*	*53*	*548*	*195*	*283*	*107*
Threadfin, King	*772*	*266*	*274*	*28*	**34**	**25**	**80**	**80**	**250**	**159**	**51**	**36**	*341*	*101*	*60*	*13*
Trevally, Giant	*0*	*0*	*320*	*22*	*0*	*0*	*0*	*0*	*320*	*119*	**302**	**296**	**70**	**40**	**162**	**94**

Trevally, Golden	0	0	*113*	*33*	0	0	0	0	*555*	*183*	*122*	*49*	*594*	*161*	*636*	*174*
Trevally, other	0	0	*3122*	*1351*	**216**	**135**	**187**	**187**	936	168	*335*	*149*	*566*	*158*	*545*	*222*
Tuna, Longtail	0	0	0	0	**33**	**33**	0	0	**337**	**183**	0	0	0	0	0	0
Tuna, Mackerel	0	0	0	0	**87**	**87**	0	0	**4**	**4**	0	0	0	0	0	0
Whiting	0	0	0	0	0	0	0	0	**46**	**28**	0	0	**33**	**33**	**39**	**27**
Wrasse, Tuskfish	0	0	**107**	**54**	**13**	**13**	**266**	**266**	1885	388	4	4	**646**	**337**	**102**	**54**
Scalefish, other	*293*	*145*	*444*	*152*	**44**	**44**	**1340**	**1330**	3222	*787*	*443*	*142*	*2956*	*1141*	1016	227
Mud crab	*2465*	*824*	4353	*673*	**20**	**20**	*3726*	*1774*	6178	1149	*3029*	*1425*	*16596*	*4635*	11698	761
Crustaceans, other	**13**	**13**	1807	143	0	0	0	0	4238	924	**468**	**275**	*2324*	*1017*	2562	415
Cephalopods	0	0	0	0	0	0	0	0	0	0	0	0	**5**	**5**	0	0
Gastropods	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other taxa	0	0	0	0	0	0	0	0	**32**	**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	47608	*6609*	6521	1414	*12877*	*5320*	18506	4425	59324	*6652*	25996	2909	*10062*	*2813*	3204	730
Catch																
Barramundi	3501	*649*	0	0	**2476**	**1337**	**1020**	**603**	**1687**	**927**	0	0	**481**	**271**	0	0
Bream, Pikey	**2428**	**1428**	5791	0	**21**	**21**	0	0	**241**	**192**	0	0	**314**	**256**	0	0
Catfish	*1077*	*278*	0	0	*3205*	*1287*	**3205**	**2867**	*1388*	*561*	*563*	134	*1390*	*629*	**21**	**21**
Cod/Groupers	1878	*444*	*228*	*80*	*446*	*188*	2900	*617*	11662	2390	*1261*	*321*	**402**	**213**	*74*	*31*
Coral Trout	0	0	0	0	0	0	*688*	*296*	1184	252	*267*	*110*	**80**	**80**	**16**	**12**
Emperor, other	0	0	**24**	**15**	0	0	*8765*	*2380*	5355	1043	*1083*	*333*	**231**	**122**	**9**	**7**
Emperor, Red	0	0	0	0	0	0	*988*	*417*	*247*	*62*	**179**	**173**	**29**	**29**	0	0
Flathead	*96*	*39*	0	0	0	0	0	0	**52**	**26**	0	0	0	0	0	0
Javelin fish	**37**	**37**	**49**	**49**	**175**	**129**	**6**	**6**	*1029*	*268*	*973*	*314*	**227**	**158**	0	0
Jewfish, Black	*108*	*46*	**218**	**161**	**80**	**44**	**641**	**386**	*1630*	*547*	614	141	**150**	**83**	**98**	**79**
Jewfish, other	**11**	**11**	0	0	**20**	**20**	0	0	0	0	0	0	0	0	0	0
Mackerel, Grey	0	0	**7**	**7**	0	0	**122**	**67**	**494**	**250**	**283**	**168**	**54**	**42**	**4**	**4**
Mackerel, Spanish	**158**	**92**	**7**	**7**	0	0	**1089**	**686**	1582	392	337	68	0	0	**30**	**22**
Mackerel, Spotted	**100**	**77**	0	0	0	0	**32**	**27**	*485*	*202*	**248**	**134**	0	0	**14**	**8**
Moonfish/Batfish	**111**	**58**	*288*	*111*	0	0	**82**	**71**	*1498*	*477*	5842	*668*	**221**	**135**	**1215**	**702**
Mullet	*11273*	*3028*	0	0	*1087*	*373*	0	0	**26**	**26**	**50**	**50**	**670**	**396**	0	0
Queenfish	*126*	*52*	**7**	**7**	**117**	**65**	**211**	**133**	**2269**	**1865**	**894**	**463**	**252**	**137**	0	0
Sharks/Rays	*732*	*185*	*238*	*72*	*402*	*182*	**6649**	**3866**	11914	1670	*4733*	*1819*	**2767**	**1419**	**114**	**59**
Small baitfish	*4214*	*1786*	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Snapper, Gold-band	0	0	0	0	0	0	0	0	0	0	0	0	**15**	**15**	0	0
Snapper, Golden	*182*	*78*	3761	168	*1862*	*847*	*3023*	*1270*	*7937*	1599	*2744*	*702*	*2744*	*1245*	**69**	**35**
Snapper, Mangrove Jack	**241**	**133**	**4**	**4**	**33**	**33**	0	0	**8**	**8**	0	0	**74**	**43**	0	0
Snapper, Moses'	**97**	**70**	0	0	0	0	0	0	**127**	**115**	**4**	**4**	0	0	0	0
Snapper, other	0	0	0	0	0	0	**28**	**20**	**72**	**67**	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
Snapper,Saddletail/Crimson/Indo.	**57**	**57**	*187*	*84*	0	0	**648**	**340**	1514	354	*2279*	*625*	*574*	*257*	*394*	*191*
Snapper, Stripey	**358**	**202**	3151	*273*	**34**	**25**	*5365*	*1766*	16464	2622	2638	551	*725*	*269*	**131**	**118**
Tarpon/Ox-eye herring	**50**	**50**	0	0	0	0	0	0	0	0	0	0	0	0	**42**	**42**
Threadfin, Blue	*836*	*274*	**255**	**193**	**360**	**252**	**73**	**54**	*2279*	*870*	*250*	*111*	**919**	**607**	0	0
Threadfin, King	*365*	*103*	0	0	**445**	**315**	**7**	**7**	**149**	**80**	33	0	**60**	**38**	0	0
Trevally, Giant	**8**	**8**	**4**	**4**	0	0	*684*	*338*	*284*	*109*	*869*	*387*	**32**	**27**	**763**	**639**
Trevally, Golden	0	0	**37**	**26**	**70**	**56**	*391*	*177*	*876*	*318*	*841*	*303*	**8**	**8**	**106**	**74**
Trevally, other	*128*	*57*	**56**	**33**	0	0	**557**	**288**	**965**	**598**	**4575**	**3181**	**300**	**169**	*1034*	*317*
Tuna, Longtail	0	0	0	0	0	0	**179**	**154**	*552*	*195*	874	144	**6**	**6**	**43**	**25**
Tuna, Mackerel	**12**	**12**	0	0	0	0	**367**	**192**	*1011*	*324*	**286**	**215**	**6**	**6**	**77**	**44**
Whiting	**868**	**443**	0	0	0	0	0	0	0	0	**8**	**8**	0	0	0	0
Wrasse, Tuskfish	**43**	**39**	**34**	**20**	**13**	**13**	*1126*	*405*	1612	343	*888*	*241*	**141**	**94**	**13**	**8**
Scalefish, other	*2443*	*824*	**170**	**136**	*434*	*211*	*1330*	*355*	*3009*	*853*	*349*	*82*	**269**	**205**	**48**	**24**
Mud Crab	33011	*6436*	**19**	**19**	*2830*	*1277*	**513**	**487**	**299**	**172**	0	0	**17**	**17**	0	0
Crustaceans, other	*1724*	*660*	0	0	**27**	**27**	0	0	**86**	**77**	0	0	0	0	0	0
Cephalopods	0	0	0	0	0	0	**30**	**30**	**398**	**398**	0	0	0	0	0	0
Gastropods	**783**	**558**	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other taxa	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Appendix 8: Estimated effort (fisher hours) by boat ramp during the survey period of March 2017 to November 2017

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 Beach	113344	12876	24.1
Dinah Beach	64708	4606	13.7
East Arm	51248	4054	10.9
Buffalo Creek	49150	6422	10.4
Palmerston	38994	4457	8.3
Middle Arm	30681	5623	6.5
Six Pack Creek	19358	4719	4.1
Nightcliff	17745	3107	3.8
Saltwater Arm	15421	5463	3.3
Leaders Creek	15083	4252	3.2
Channel Island	14221	3792	3
Milne Inlet	11539	1350	2.4
Crab Claw	10000	697	2.1
Keswick Point	6182	710	1.3
Ski Club	5281	371	1.1
Southport	3518	1045	0.7
Mandorah	2955	277	0.6
Dundee Road	1848	219	0.4
Trailer Boat Club	0	0	0

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 2017 to November 2017

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 Number	SE	Kept Number	SE	Released Number	SE
Barramundi	Barramundi	*Lates calcarifer*	31861	3841	8200	1160	23662	3388
Bream, pikey	Bream, pikey	*Acanthopagrus pacificus*	18287	1790	7842	1625	10448	*654*
Catfish	Eeltail catfish	Plotosidae - undifferentiated	**464**	**385**	0	0	**464**	**385**
Catfish	Forktail catfish	Ariidae - undifferentiated	22347	4020	*513*	*196*	21834	4015
Cod/groupers	Cod/groupers	Serranidae - undifferentiated	33086	2760	10349	1408	22730	1887
Coral trout	Coral trout	*Plectropomus spp*	2330	414	1685	336	*646*	*187*
Emperor, other	Emperor, other	Lethrinidae	18460	2760	7474	1175	10988	1938
Emperor, red	Emperor, red	*Lutjanus sebae*	*1452*	*457*	*943*	*300*	*509*	*190*
Flathead	Flathead	Platycephalidae	627	107	*202*	*61*	426	85
Javelin fish	Javelin fish	*Pomadasys kaakan*	11571	1289	*2677*	*775*	8892	*965*
Jewfish, black	Jewfish, black	*Protonibea diacanthus*	9059	1987	5526	731	*3535*	*1588*
Jewfish, other	Jewfish, other	Sciaenidae	**38**	**24**	**20**	**20**	**18**	**13**
Mackerel, grey	Mackerel, grey	*Scomberomorus semifasciatus*	*1119*	*319*	*341*	*94*	*777*	*293*
Mackerel, Spanish	Mackerel, Spanish	*Scomberomorus commerson*	3676	815	2822	702	853	213
Mackerel, spotted	Mackerel, spotted	*Scomberomorus munroi*	*962*	*259*	*473*	*157*	*489*	*183*
Moonfish/Batfish	Moonfish/Batfish	Ephippidae	13209	1213	1490	304	11719	1160
Mullet	Mullet	Mugilidae - undifferentiated	38456	4860	36424	4550	*2033*	*744*
Queenfish	Queenfish	*Scomberoides spp*	8297	2030	1589	243	*6707*	*1850*
Sharks & rays	Rays/skates	Dasyatidae	*817*	*306*	**34**	**18**	*781*	*300*
	Sawfish	Pristidae	**16**	**13**	**12**	**12**	**5**	**5**
	Shark	Various families	35891	5027	**1382**	**905**	34508	4880
Small baitfish	Herring, other	Clupeidae	*10708*	*3344*	4912	555	**5795**	**3292**
	Small baitfish	Several families	*12731*	*3850*	*8496*	*3173*	*4236*	*1852*

Snapper, gold-band	Snapper, gold-band	*Pristipomoides multidens*	**15**	**15**	**15**	**15**	0	0
Snapper, golden	Snapper, golden	*Lutjanus johnii*	45833	3332	21580	1811	24248	2293
Snapper, mangrove jack	Snapper, mangrove jack	*Lutjanus argentimaculatus*	1623	212	907	123	719	163
Snapper, Moses'	Snapper, Moses'	*Lutjanus russelli*	*1133*	*363*	**116**	**67**	*1016*	*333*
Snapper, other	Chinamanfish	*Symphorus nematophorus*	**100**	**70**	0	0	**100**	**70**
Snapper, saddletail/crimson/indo	Snapper, saddletail/crimson/indo	*Lutjanus malabaricus, erythropterus & bitaeniatus*	13999	2416	6688	1555	7307	1259
Snapper, stripey	Snapper, stripey	*Lutjanus carpontatus*	39666	4057	10553	1502	29109	3274
Tarpon/ox-eye herring	Tarpon/ox-eye herring	*Megalops cyprinoides*	*464*	*176*	**206**	**125**	*259*	*124*
Threadfin, blue	Threadfin, blue	*Eleutheronema tetradaetylum*	8943	1304	4622	921	4314	919
Threadfin, king	Threadfin, king	*Polydactylus macrochir*	3045	498	1721	321	1322	277
Trevally, giant	Trevally, giant	*Caranx ignobilis*	3818	893	*678*	*310*	*3137*	*825*
Trevally, golden	Trevally, golden	*Gnathanodon speciosus*	4349	572	*661*	*166*	3683	530
Trevally, other	Trevally, other	Carangidae - undifferentiated	*13522*	*3563*	1998	274	*11521*	*3492*
Tuna, longtail	Tuna, longtail	*Thunnus tonggol*	2024	343	983	175	1039	192
Tuna, mackerel	Tuna, mackerel	*Euthynnus affinis*	1850	444	765	185	*1084*	*301*
Whiting	Whiting	Sillaginidae - undifferentiated	*994*	*446*	*588*	*278*	**405**	**221**
Wrasse, tuskfish	Wrasse, tuskfish	Scaridae - undifferentiated	6893	831	3151	483	3742	569
Scalefish, other	Archerfish	Toxotidae - undifferentiated	*1209*	*503*	**281**	**197**	*928*	*394*
	Barracuda	Sphyraenidea	**1945**	**979**	*82*	*35*	**1861**	**978**
	Bream, bony	*Nematalosa erebi*	*69*	*32*	**25**	**25**	*44*	*20*
	Bream, threadfin	Nemipteridae - undifferentiated	**23**	**23**	0	0	**23**	**23**
	Cobia	*Rachycentron canadum*	*625*	*167*	*182*	*59*	*443*	*155*
	Eel	Various families	**38**	**25**	0	0	**38**	**25**
	Fish, other	Various families	**109**	**105**	**105**	**105**	**4**	**4**
	Flounder/sole	Pleuronectidae - undifferentiated	**26**	**21**	0	0	**26**	**21**
	Fusiler	Caesionidae	**31**	**31**	**31**	**31**	0	0
	Garfish	Hemiramphidae	*3095*	*808*	*2672*	*770*	*424*	*193*
	Grunter, sooty	*Hephaestus fuliginosus*	**12**	**12**	0	0	**12**	**12**

	Knife fish	Labridae	**22**	**18**	0	0	**22**	**18**
	Leatherjacket	Monacanthidae	**10**	**7**	0	0	**10**	**7**
	Longtom	Belonidae	**832**	**498**	**690**	**500**	*143*	*53*
	Marlin	Istiophoridae	**26**	**16**	0	0	**26**	**16**
	Milkfish	Chanidae	**8**	**8**	0	0	**8**	**8**
	Rainbow runner	Carangidae	**37**	**28**	0	0	**37**	**28**
	Remora	Echeneidae - undifferentiated	*317*	*109*	*271*	*107*	**45**	**26**
	Sailfish	*Istiophorus platypterus*	*410*	*197*	0	0	*410*	*197*
	Sand bass	*Psammoperca waigiensis*	**1600**	**800**	**213**	**152**	**1388**	**786**
	Scad, yellow-tail	*Trachurus novaezelandiae*	**115**	**105**	**115**	**105**	0	0
	Scat	Scatophgidae - undifferentiated	117	26	0	0	117	26
	Stargazer	Uranoscopidae - undifferentiated	*2365*	*749*	0	0	*2365*	*749*
	Stonefish	Synanceiidae - undifferentiated	255	55	0	0	255	55
	Sweetlip, morwong	Haemulidae - undifferentiated	1843	415	*189*	*72*	1652	405
	Toads, pufferfish	Various families	**2617**	**1363**	**8**	**8**	**2609**	**1363**
	Tripletail	*Lobotes surinamensis*	**41**	**30**	**34**	**23**	**7**	**7**
	Wolf herring	*Chirocentrus dorab*	**13**	**9**	0	0	**13**	**9**
Mud crab	Mud crab	*Scylla spp*	84754	8545	55136	5350	29616	3545
Crustaceans, other	Blue swimmer crab	*Portunus pelagicus*	9311	1026	2999	558	6315	706
	Crab, other	Brachyura - undifferentiated	**436**	**219**	**18**	**18**	**418**	**218**
	Prawn, marine	Penaeoidea & Caridea - undifferentiated	*3502*	*1224*	*2074*	*751*	**1428**	**966**
Cephalopods	Octopus	Octopodidae - undifferentiated	**433**	**399**	**428**	**399**	**5**	**5**
Gastropods	Non-fish, other	Various families	**783**	**558**	**783**	**558**	0	0
Other taxa	Non-fish, other	Various families	**32**	**24**	0	0	**32**	**24**

Appendix 10: Recreational catch (total, kept and released numbers) by analysis and ramp for the survey period of March 2017 to November 2017

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

		Total		Kept		Released	
Analysis	**Ramp**	**Number**	**SE**	**Number**	**SE**	**Number**	**SE**
Primary ramp	1. Buffalo Creek	70834	7669	45313	5405	25514	2853
	2. Dinah Beach	95928	7340	41758	4117	54155	5593
	5. East Arm	38161	2234	13157	1196	25010	1756
	6. Nightcliff	15867	1108	5244	374	10619	954
	10. Middle Arm	35827	6094	22902	4451	12926	2829
	12. Leaders Creek	24717	4779	6291	1525	18424	4230
	15. Six Pack	12201	1426	4921	897	7274	954
	16. Keswick	7574	217	3722	95	3852	207
	21. Dundee	127495	8215	36642	2627	90843	7091
	22. Saltwater Arm	17914	2854	6789	1401	11126	2122
	Total	446518		186739		259743	
Secondary ramp	3. Ski Club	13214	0	7353	0	5862	0
	4. Channel Island	12678	2269	*4730*	*1226*	7947	1769
	7. Palmerston	32837	2233	14242	794	18593	1831
	8. Trailer Boat Club	0	0	0	0	0	0
	9. Mandorah	1181	0	591	0	591	0
	11. Southport	2151	0	1266	0	884	0
	13. Crab Claw	12818	0	6799	0	6020	0
	14. Milne Inlet	12506	1522	2752	232	9752	1382
	23. Dundee Road	6893	0	502	0	6392	0
	Total	94278		38235		56041	
	Grand Total	540796		224974		315784	

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 2016 to November 2016

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

	Estuary		Offshore	
Species/group	**Number**	**SE**	**Number**	**SE**
Effort				
Effort hours	353850	17712	117426	8992
Catch				
Barramundi	27639	3520	*4222*	*1537*
Bream, pikey	17732	1761	**555**	**320**
Catfish	16244	2713	*6567*	*2992*
Cod/groupers	16746	1172	16340	2499
Coral trout	*95*	*47*	2235	412
Emperor, other	*3017*	*858*	15443	2623
Emperor, red	**9**	**9**	*1443*	*457*
Flathead	575	104	**52**	**26**
Javelin fish	9336	1211	2235	442
Jewfish, black	*5926*	*1862*	3133	694
Jewfish, other	**38**	**24**	0	0
Mackerel, grey	*162*	*71*	957	311
Mackerel, Spanish	*638*	*187*	*3038*	*793*
Mackerel, spotted	*183*	*88*	*779*	*244*
Moonfish/Batfish	4351	531	8858	1091
Mullet	37710	4844	**746**	**400**
Queenfish	4671	627	**3626**	**1931**
Sharks & rays	10547	1518	26177	4802
Small baitfish	23439	5099	0	0
Snapper, gold-band	0	0	**15**	**15**
Snapper, golden	29316	2211	16517	2492
Snapper, mangrove jack	1520	207	*103*	*48*
Snapper, Moses'	*1002*	*344*	**131**	**115**
Snapper, other	0	0	**100**	**70**
Snappers, saddletail/crimson/indo	*8590*	*2259*	5409	856
Snapper, stripey	14343	2464	25323	3223
Tarpon/ox-eye herring	*422*	*171*	**42**	**42**
Threadfin, blue	5422	748	*3521*	*1068*
Threadfin, king	2672	474	*373*	*153*
Trevally, giant	*1186*	*335*	*2632*	*827*
Trevally, golden	2127	311	2222	480
Trevally, other	6091	1417	*7431*	*3270*
Tuna, longtail	**370**	**186**	1654	289
Tuna, mackerel	**103**	**88**	1747	435
Whiting	*986*	*446*	**8**	**8**
Wrasse, tuskfish	3113	586	3780	590
Scalefish, other	12805	2133	5005	950
Mud crab	83925	8529	**829**	**516**
Crustaceans, other	13163	1611	**86**	**77**
Cephalopods	**5**	**5**	**428**	**399**
Gastropods	**783**	**558**	0	0
Other taxa	**32**	**24**	0	0

Appendix 12: Recreational catch of key species by fishing method in the Greater Darwin Area during the survey period of March 2017 to November 2017

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

	Method/Gear							
	Line		Pot		Cast		Other	
Species/group	Number	SE	Number	SE	Number	SE	Number	SE
Barramundi	*29594*	*3835*	**41**	**31**	*1986*	*200*	*240*	*80*
Bream, pikey	*16291*	*1671*	*492*	*180*	*1504*	*618*	0	0
Catfish	*22049*	*4033*	*612*	*188*	**150**	**99**	0	0
Cod/groupers	*31659*	*2732*	*1427*	*393*	0	0	0	0
Coral trout	*2330*	*414*	0	0	0	0	0	0
Emperor, other	*18460*	*2760*	0	0	0	0	0	0
Emperor, red	*1452*	*457*	0	0	0	0	0	0
Flathead	*599*	*106*	0	0	**28**	**14**	0	0
Javelin fish	*11272*	*1283*	0	0	*299*	*122*	0	0
Jewfish, black	*9059*	*1987*	0	0	0	0	0	0
Jewfish, other	**20**	**20**	0	0	**18**	**13**	0	0
Mackerel, grey	*1119*	*319*	0	0	0	0	0	0
Mackerel, Spanish	*3676*	*815*	0	0	0	0	0	0
Mackerel, spotted	*962*	*259*	0	0	0	0	0	0
Moonfish/Batfish	*13185*	*1213*	**24**	**24**	0	0	0	0
Mullet	**621**	**432**	0	0	*37535*	*4832*	**300**	**300**
Queenfish	*8234*	*2030*	0	0	**28**	**20**	**35**	**19**
Sharks & rays	*36409*	*5035*	*169*	*76*	**24**	**16**	**122**	**114**
Small baitfish	0	0	0	0	*23439*	*5099*	0	0
Snapper, gold-band	***15***	***15***	0	0	0	0	0	0
Snapper, golden	*45833*	*3332*	0	0	0	0	0	0
Snapper, mangrove jack	*1623*	*212*	0	0	0	0	0	0
Snapper, Moses'	*1133*	*363*	0	0	0	0	0	0
Snapper, other	**100**	**70**	0	0	0	0	0	0
Snapper, saddletail/crimson/indonesian	*13999*	*2416*	0	0	0	0	0	0
Snapper, stripey	*39666*	*4057*	0	0	0	0	0	0
Tarpon/ox-eye herring	*250*	*111*	0	0	**214**	**137**	0	0
Threadfin, blue	*8818*	*1302*	**29**	**23**	**96**	**61**	0	0

Threadfin, king	2910	496	**24**	**24**	**28**	**17**	**83**	**43**
Trevally, giant	3818	893	0	0	0	0	0	0
Trevally, golden	4349	572	0	0	0	0	0	0
Trevally, other	*13493*	*3563*	0	0	**29**	**23**	0	0
Tuna, longtail	2024	343	0	0	0	0	0	0
Tuna, mackerel	1850	444	0	0	0	0	0	0
Whiting	**45**	**35**	0	0	*949*	*444*	0	0
Wrasse, tuskfish	6893	831	0	0	0	0	0	0
Scalefish, other	12482	2083	*778*	*275*	4545	1020	*5*	*5*
Mud crab	*177*	*81*	84339	8544	**28**	**20**	*210*	*81*
Crustaceans, other	*139*	*61*	9608	1047	*3502*	*1224*	0	0
Cephalopods	**35**	**31**	0	0	**398**	**398**	0	0
Gastropods	0	0	0	0	0	0	**783**	**558**
Other taxa	**32**	**24**	0	0	0	0	0	0
Grand Total	366675		97543		74800		1778	

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 2017 to November 2017

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

	Bynoe Harbour/Dundee		Darwin Harbour/surrounds	
Species/group	**Number**	**SE**	**Number**	**SE**
Effort				
Effort hours	168223	13852	303053	14237
Catch				
Barramundi	15444	2422	16417	2982
Bream, pikey	1603	209	16684	1778
Catfish	*8370*	*2966*	14441	2741
Cod/groupers	17001	2486	16085	1199
Coral trout	1876	389	*454*	*144*
Emperor, other	14535	2610	3925	897
Emperor, red	*1235*	*421*	**217**	**176**
Flathead	*82*	*37*	545	101
Javelin fish	6170	871	5401	950
Jewfish, black	4067	713	*4992*	*1855*
Jewfish, other	**7**	**7**	**31**	**23**
Mackerel, grey	*616*	*259*	*503*	*187*
Mackerel, Spanish	*2671*	*790*	1005	200
Mackerel, spotted	*517*	*203*	*445*	*160*
Moonfish/Batfish	3316	546	9893	1083
Mullet	5706	876	32750	4780
Queenfish	**3567**	**1874**	4730	783
Sharks & rays	21053	4233	15671	2729
Small baitfish	3866	467	*19573*	*5078*
Snapper, gold-band	0	0	**15**	**15**
Snapper, golden	19534	2093	26299	2592
Snapper, mangrove jack	329	57	1294	204
Snapper, Moses'	**158**	**115**	*975*	*344*
Snapper, other	**100**	**70**	0	0
Snapper,saddletail/crimson/ind	2554	586	11445	2343
Snapper, stripey	22033	3163	17633	2540
Tarpon/ox-eye herring	**128**	**108**	*336*	*140*
Threadfin, blue	3998	992	4945	846
Threadfin, king	1326	306	1719	394
Trevally, giant	*1288*	*356*	*2530*	*819*
Trevally, golden	*1380*	*366*	2969	439
Trevally, other	*4644*	*1505*	*8878*	*3230*
Tuna, longtail	*731*	*249*	1293	237
Tuna, mackerel	*1378*	*376*	**472**	**236**
Whiting	0	0	*994*	*446*
Wrasse, tuskfish	2845	533	4048	638
Scalefish, other	5076	947	12734	2134
Mud crab	7630	1183	77124	8463
Crustaceans, other	1906	163	11343	1604
Cephalopods	**428**	**399**	**5**	**5**
Gastropods	0	0	**783**	**558**
Other taxa	0	0	**32**	**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 2017 to November 2017

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

	Run-off (March - May)		Dry season (June - Aug)		Build-up (Sept - Nov)	
Species/group	**Number**	**SE**	**Number**	**SE**	**Number**	**SE**
Effort						
Effort hours	170541	13868	160026	8879	140709	11110
Catch						
Barramundi	15324	3373	*4595*	753	11942	1676
Bream, Pikey	8891	*439*	*6919*	1615	*2477*	*636*
Catfish	*6062*	854	5113	1126	*11636*	*3783*
Cod/groupers	9077	1355	12888	1610	11121	1786
Coral Trout	*1083*	*335*	*579*	*175*	*668*	*169*
Emperor, other	*5755*	*1639*	*5492*	*1629*	7213	1508
Emperor, Red	**469**	**244**	**336**	**187**	**647**	**338**
Flathead	*218*	*65*	*193*	*74*	216	42
Javelin fish	*2591*	*826*	5443	497	3537	856
Jewfish, Black	2423	478	2571	391	*4065*	*1888*
Jewfish, other	**38**	**24**	0	0	0	0
Mackerel, Grey	*184*	*75*	**563**	**288**	*372*	*115*
Mackerel, Spanish	*849*	*263*	849	152	*1978*	*756*
Mackerel, Spotted	*204*	*81*	*237*	*102*	*521*	*224*
Moonfish/Batfish	1801	357	8526	905	*2882*	*725*
Mullet	18039	3837	11355	1791	*9062*	*2385*
Queenfish	*5001*	*1959*	1317	199	*1979*	*497*
Sharks/rays	9314	1465	12508	2515	*14902*	*4111*
Small baitfish	*10068*	*3230*	*7670*	*3087*	*5701*	*2458*
Snapper, gold-band	0	0	**15**	**15**	0	0
Snapper, Golden	14684	1966	17043	1863	14106	1940
Snapper, Mangrove Jack	483	119	661	148	479	94
Snapper, Moses'	**179**	**139**	**276**	**162**	*678*	*293*
Snapper, other	**15**	**15**	**79**	**68**	**6**	**6**
Snapper,Saddletail/Crimson/Indo	*3899*	*1814*	*3905*	*979*	6195	1259
Snapper, Stripey	15556	2615	13024	2247	11086	2138
Tarpon/Ox-eye herring	**280**	**144**	**134**	**88**	**50**	**50**
Threadfin, Blue	3141	*674*	*2325*	*657*	*3477*	*903*
Threadfin, King	1608	340	361	89	*1076*	*354*
Trevally, Giant	*906*	*419*	*947*	*335*	*1965*	*714*
Trevally, Golden	1074	258	2152	442	1123	255
Trevally, other	**5735**	**3169**	3856	820	*3931*	*1409*
Tuna, Longtail	*498*	*225*	1383	249	*143*	*70*
Tuna, Mackerel	*549*	*199*	*837*	*373*	*464*	*137*
Whiting	**397**	**355**	**196**	**129**	**401**	**236**
Wrasse, tuskfish	1267	316	3353	585	2273	499
Scalefish, other	5232	904	6038	1312	*6540*	*1707*
Mud crab	23400	4458	43684	*6646*	17670	2996
Crustaceans, other	*3881*	*1223*	5687	846	3681	*624*
Cephalopods	**35**	**31**	**398**	**398**	0	0
Gastropods	0	0	**783**	**558**	0	0
Other taxa	0	0	**11**	**11**	**21**	**21**