

Recreational fishing surveys in the Greater Sydney Region

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NON-TECHNICAL SUMMARY

The Greater Sydney region covers a large area, stretching from the Newcastle area southwards to the Illawarra area. This region contains the three largest cities in New South Wales and a great number of the state's recreational fishers. Despite the importance of the recreational fishing sector, relatively little information is available to quantify the level of fishing effort and the size of the associated catch in this region. This paucity of information and the possibility that a Marine Park may be created within the Greater Sydney region led to the creation of this project, which was designed to provide site-specific, baseline information on the activities of the recreational sector in this region. Recreational fishing surveys were done over a two year period, starting in March 2007 and ending in February 2009. A variety of on-site survey designs and data collection methods were used during this project. Surveys of estuarine recreational fishing were carried out in the Hawkesbury River and Port Hacking estuaries. A series of surveys of coastal marine trailer boat fishing were done at Norah Head, Terrigal, adjacent to the Hawkesbury River system, Long Reef, adjacent to the Port Hacking system, Bellambi, Port Kembla and Shellharbour. Coastal marine fishing effort originating from access points within Sydney Harbour and Botany Bay was also monitored.

We estimated that about 653,600 and 670,000 fisher hours of daytime recreational effort (boat and shore combined) were expended in the Hawkesbury River estuarine fishery during the two survey years respectively. The much smaller Port Hacking estuary received an estimated 219,000 and 217,800 fisher hours of daytime recreational effort (boat and shore combined) during the two survey years respectively. The levels of recreational fishing effort expended in each estuarine fishery were similar between survey years.

We estimated that about 65,600 and 67,100 daytime recreational fishing trips originated from the sites surveyed for coastal marine fishing during each of the two survey years respectively. The levels of coastal marine fishing effort expended at each coastal survey site were similar between years. Not surprisingly, the largest levels of fishing effort in the coastal marine trailer boat fishery originated from access points within the four large Sydney metropolitan access sites (i.e., Hawkesbury River system, Sydney Harbour, Botany Bay and the Port Hacking system). The surveys at sites in the Illawarra area (Bellambi, Port Kembla and Shellharbour) had intermediate amounts of fishing effort whilst the northern survey sites (Norah Head, Terrigal and Long Reef) had the lowest levels of fishing effort.

Recreational fisheries in the Greater Sydney region offer a wide variety of fishing opportunities. The recreational harvest was characterised by its great diversity of 140 taxa observed in the retained catch (estuarine and coastal marine combined) during the two year survey period. We estimated that about 134,000 and 134,900 fish, crabs and cephalopods were harvested by daytime recreational fishers from the Hawkesbury River estuary during each of the two survey years respectively. In contrast, we estimated that about 77,800 and 82,100 fish, crabs and cephalopods were harvested by daytime recreational fishers from the Port Hacking estuary during each of the two survey years respectively. The ten most commonly harvested taxa in the estuarine surveys, by number, were yellowfin bream, dusky flathead, yellowtail, sand whiting, sand mullet, tailor, blue swimmer crab, silver trevally, luderick and yellowfin leatherjacket. These ten species accounted for most of the harvest in the Hawkesbury River and Port Hacking estuarine fisheries, ranging between 78.5% and 88.1% of the total harvest on an annual basis.

We estimated that about 257,000 and 253,900 fish, crustaceans and cephalopods were harvested by daytime recreational fishers at the sites surveyed for coastal marine fishing during each of the two survey years respectively. The ten most commonly harvested taxa in the coastal marine surveys, by number, were eastern bluespotted flathead, ocean leatherjacket, snapper, silver trevally, southern

calamari, blue mackerel, silver sweep, yellowtail, grey morwong and southern maori wrasse. These ten species accounted for most of the harvest (>80%) in the coastal marine fisheries.

The information in this report provides site-specific, baseline data on recreational fishing effort, catch (number of individuals) and the size structure of the retained catch within the Greater Sydney region. This information is vital because it provides a scientifically defensible, evidence-based framework for assessing any future changes in the recreational fisheries within this region. This extensive dataset will also allow us to determine the effectiveness of any future management changes in this region, whether they are spatial closures, changes in allocation among fishing sectors or modifications to existing bag and size limits.

1. INTRODUCTION

There have been major changes in the allocation of the marine fisheries resources of New South Wales (NSW) during the past decade. Notably, these allocation changes have occurred through the implementation of: (1) Recreational Fishing Havens that exclude most forms of commercial fishing; and (2) Marine Parks that are zoned spatially to incorporate different levels of public access to the resources within their boundaries. The effects of these management strategies on fish populations and on recreational fishers need to be better understood. Thus, it is important to assess the potential impacts of these types of management changes on both the recreational fishery and the recreational fishers.

The Greater Sydney region covers a large area, stretching from the Newcastle area southwards to the Illawarra area. This region contains the three largest cities in New South Wales and a great number of the state's recreational fishers. Despite the importance of the recreational fishing sector, relatively little information is available to quantify the level of fishing effort and the size of the associated catch in this region. This paucity of information and the possibility that a Marine Park may be created within the Greater Sydney region led to the creation of this project, which was designed to provide site-specific, baseline information on the activities of the recreational sector in this region. Accurate and precise information that quantifies the distribution of recreational fishing effort and the catch is needed to understand: (1) the potential direct impacts that the recreational sector has on fisheries resources in this region; and (2) the potential effects that any proposed Marine Park zoning plan will have on the recreational fishers and the fishery. The survey work that we have undertaken has been planned to provide important baseline measures of the usage patterns and quality of recreational fishing within the Greater Sydney region. This information is vital for providing an evidence-based assessment of the effectiveness of any future management changes.

2. OBJECTIVES

This project has two main objectives:

1. To collect site-specific, baseline data on recreational fishing effort and catch within the Greater Sydney region.
2. To collect information on the size structure of fish retained by recreational fishers within the region.

3. METHODS

3.1. Background

The Marine Park focus of this project introduced a variety of design criteria that were considered at the project planning stage. These design criteria were based on stakeholder expectations of what this project should deliver, an appraisal of the information needed, and the implementation of appropriate survey methods to collect these data. The main criteria considered were the need to obtain:

- (1) site-specific, scientifically defensible estimates of recreational fishing effort and catch that can be used in an evidence-based assessment of management changes;
- (2) accurate identifications of the variety of species taken by recreational fishers to address biodiversity issues that arise when considering the effectiveness of any future zoning plan;
- (3) accurate size information to describe the size structure of harvested fish populations so that the effects of any management changes can be quantified.

These design criteria were met by using on-site survey methods to assess the recreational fisheries in the region. On-site survey methods (i.e., surveys done at the fishing sites) allow trained survey staff to directly examine, identify and measure the fish, crustaceans and cephalopods retained by recreational fishers. On-site methods also minimise recall errors because respondents are providing details about fishing trips that are either in progress (shore-based fishery) or just completed (boat-based fishery).

This project consisted of two main modules: (a) an estuarine module that included two extensive surveys of the recreational fisheries in the Hawkesbury River and Port Hacking estuaries (Figures 1 & 2); and (b) a coastal marine module that included surveys of the trailer boat fisheries adjacent to ten large access sites along the coast (Figure 3).

3.2. Site selection

“Large marine parks attempt to include a range of interconnected ecosystems and habitats to provide for a greater continuity in ecological processes, more insulation from external threats, increased protection for mobile and widely dispersed populations, and a capacity to manage a wider range of impacts. Having many features spread over broad areas within a large marine park also provides for greater flexibility in multiple-use zoning, with more opportunities to meet community and stakeholder requirements while meeting primary conservation goals.” (page 9, Breen *et al.* 2005). It is also recognised that coordinated management of marine and terrestrial systems can help to conserve ecosystem function and mitigate against catchment-based threats. Integrated planning that seeks to locate marine parks in areas adjacent to terrestrial reserves is seen as a key mechanism for conserving coastal and marine biodiversity (Breen *et al.* 2005). This means that any future marine protected areas are likely to be located in areas adjacent to existing terrestrial National Parks. The Hawkesbury River and Port Hacking estuaries have large areas of terrestrial National Parks within their catchments and for this reason these estuaries were selected as the locations for the estuarine survey work (Figures 1 & 2).

In order to assess impacts on recreational fisheries arising from management changes it is necessary to have comparable information collected prior to any changes and also after the implementation of the management arrangements. It is also essential to collect information from areas that have been affected by the management changes (i.e., impacted sites) and areas that are unaffected (i.e., control sites). This is a difficult task to achieve when it is not known with certainty where or when the

management changes will be implemented. Consequently, we decided to maximise the number of access sites to be sampled within the region. This broad geographical spread of multiple survey sites (Figure 3) ensures that our sampling regime for the coastal marine recreational fishery includes impacted and control sites regardless of the outcome of any future spatial management plan.

3.3. Survey coverage, survey designs, stratification and sample sizes

We adopted a broad definition of recreational fishing for these surveys that included all forms of angling, spearfishing, the use of nets and traps to target crabs and rock lobster, and the activities of free divers that target abalone, rock lobster, urchins and turban snails. The scope of this report has been restricted to include estimates of angling and crabbing (fishing effort and the number of individuals harvested) in the two estuarine fisheries and estimates of angling (fishing effort and the number of individuals harvested) for the coastal marine fishery. That is, this report includes information on the catch kept by recreational fishers but excludes information on the released component of the catch. A summary of the survey coverage at each site is given in Table 1.

A number of different survey designs were used during this study. These designs represent the best available solutions for collecting unbiased information for the various survey sites. We follow the terminology of Pollock *et al.* (1994) and Steffe *et al.* (2008) to describe these survey designs. A summary of the survey designs is given in Table 2.

Random stratified sampling was used and the surveys covered a two year period, March 2007 to February 2009 inclusive. Each survey year was stratified into seasons and day-types within season (weekend and weekday strata). Public holidays were regarded as part of the weekend day stratum. Days were the primary sampling unit. We scheduled sampling on 9 weekdays and 9 weekend days within each season at each site. However, these target sample sizes were not achieved at all survey sites because of unforeseen logistic problems, the loss of some data in the mail and the deletion of data that were fabricated (see Tables 3 & 4 for sample size details).

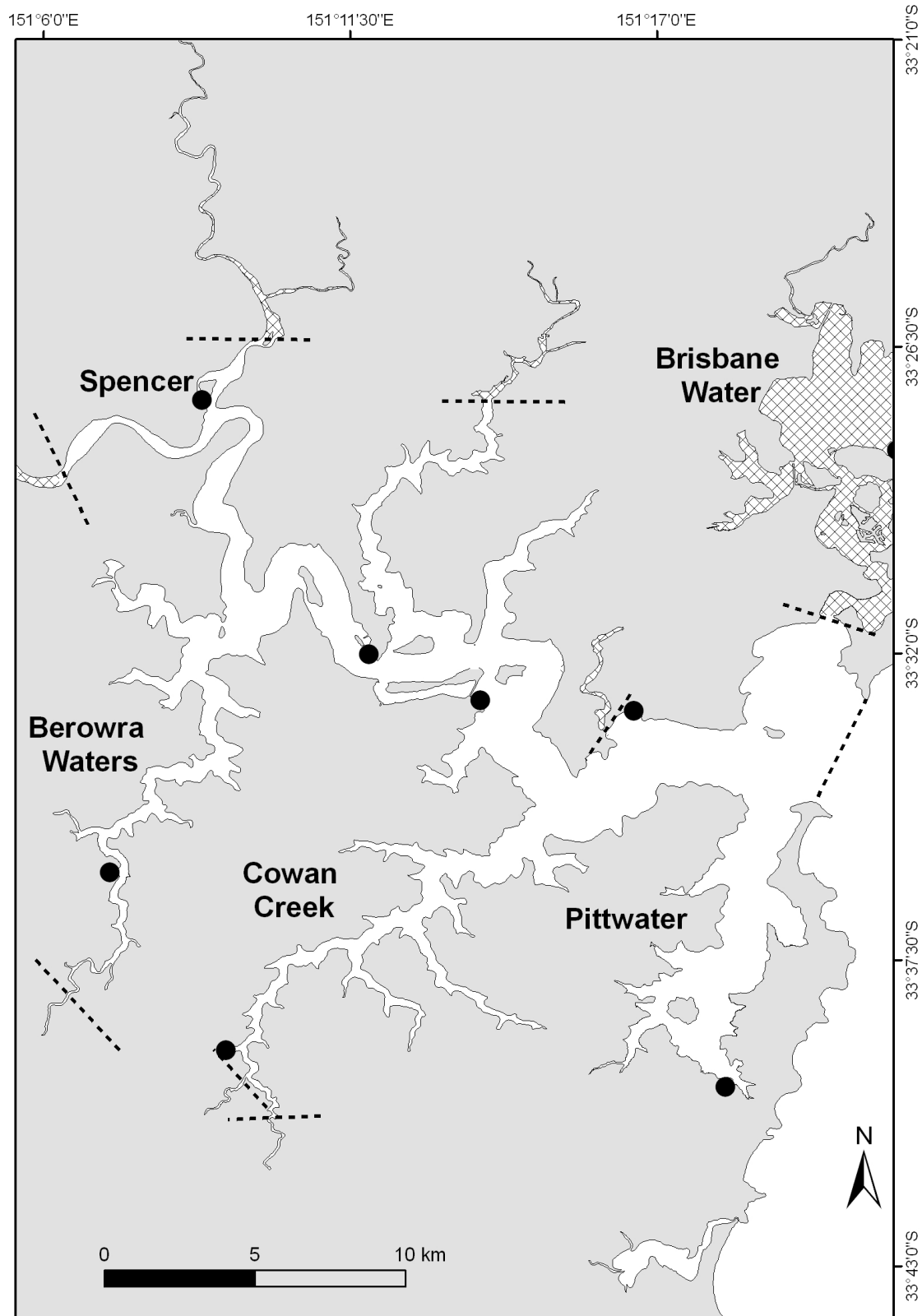


Figure 1. Map of the Hawkesbury River estuary showing the spatial extent of the survey. Filled circles denote public boat ramps that were surveyed. Dashed lines indicate survey boundaries.

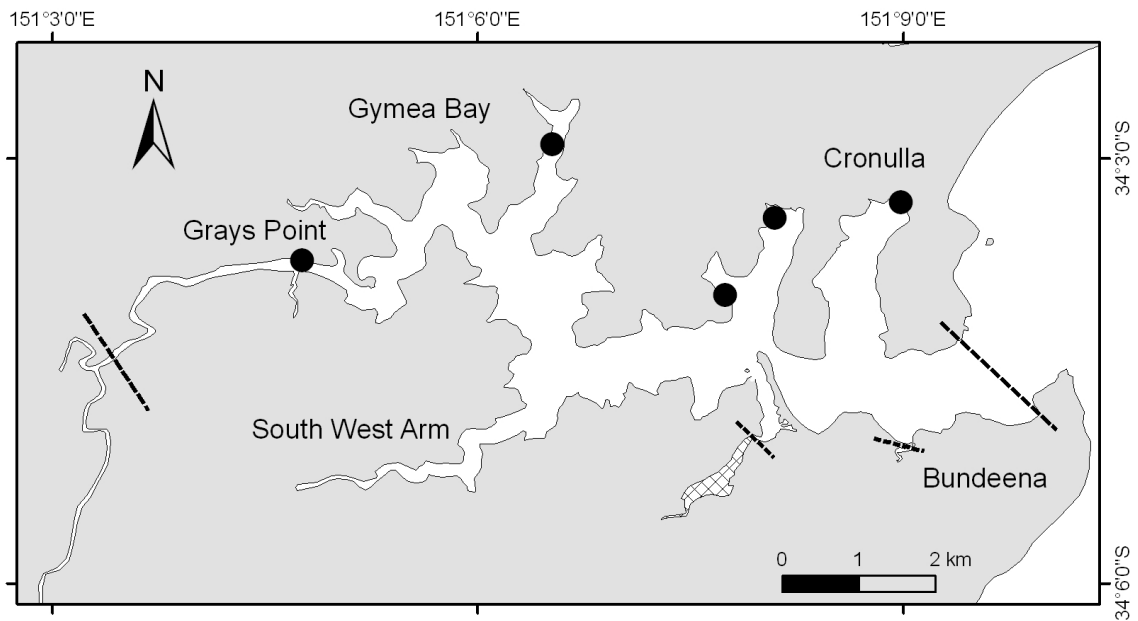


Figure 2. Map of the Port Hacking estuary showing the spatial extent of the survey. Filled circles denote public boat ramps that were surveyed. Dashed lines indicate survey boundaries.

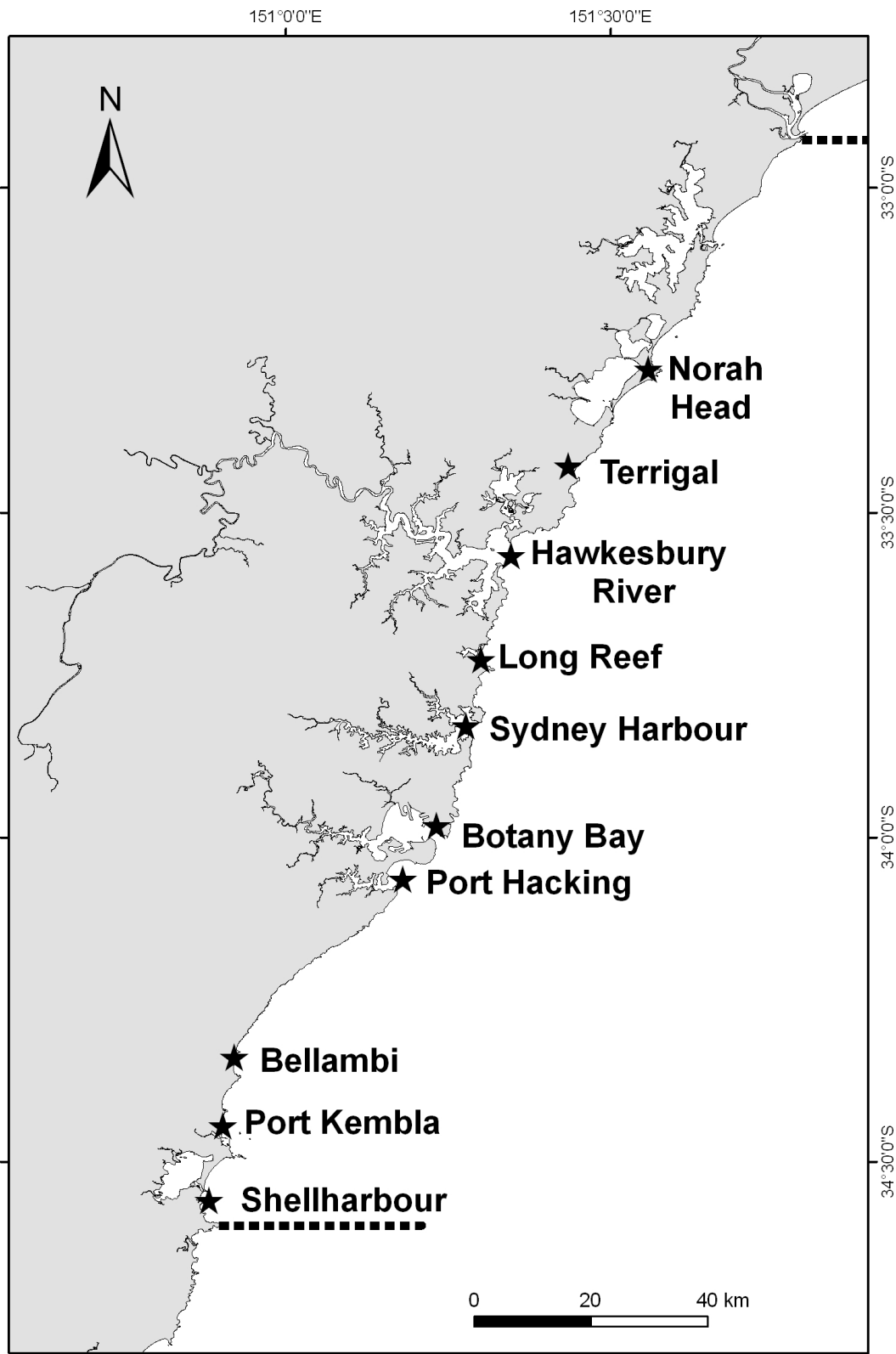


Figure 3. Map of the Greater Sydney Region showing the survey sites and spatial extent of the survey. Dashed lines indicate regional boundaries.

Table 1. Description of survey coverage and information collected at each survey site.

SITE/FISHERY	EFFORT	HARVEST
NORAH HEAD		
Coastal marine - trailer boats	Validated daily counts of trips and trip activities	On-site interviews with fishing parties
TERRIGAL		
Coastal marine - trailer boats	1. Validated daily counts of trips and trip activities 2. Traffic counter used to record auxiliary data on boat movements (activity unknown)	On-site interviews with fishing parties
HAWKESBURY		
Coastal marine - trailer boats	Daily counts of potential fishing boats (activity unknown)	On-site interviews with fishing parties
Estuarine - trailer boats	Daily progressive counts of fishing effort	On-site interviews with fishing parties
Estuarine - shore	Daily progressive counts of fishing effort	On-site interviews with fishing parties
LONG REEF		
Coastal marine - trailer boats	1. Validated daily counts of trips and trip activities 2. Traffic counter used to record auxiliary data on boat movements (activity unknown)	On-site interviews with fishing parties
SYDNEY HARBOUR		
Coastal marine - trailer boats	Daily counts of potential fishing boats (activity unknown)	N/A
BOTANY BAY		
Coastal marine - trailer boats	Daily counts of potential fishing boats (activity unknown)	N/A
PORT HACKING		
Coastal marine - trailer boats	Daily counts of potential fishing boats (activity unknown)	On-site interviews with fishing parties
Estuarine - trailer boats	Daily progressive counts of fishing effort	On-site interviews with fishing parties
Estuarine - shore	Daily progressive counts of fishing effort	On-site interviews with fishing parties
BELLAMBI		
Coastal marine - trailer boats	1. Validated daily counts of trips and trip activities 2. Traffic counter used to record auxiliary data on boat movements (activity unknown)	On-site interviews with fishing parties
PORT KEMBLA		
Coastal marine - trailer boats	1. Validated daily counts of trips and trip activities 2. Traffic counter used to record auxiliary data on boat movements (activity unknown)	On-site interviews with fishing parties
SHELLHARBOUR		
Coastal marine - trailer boats	1. Validated daily counts of trips and trip activities 2. Traffic counter used to record auxiliary data on boat movements (activity unknown)	On-site interviews with fishing parties

Table 2. Description of survey designs and methods used for estimating fishing effort, harvest rates and harvest for each fishery at each site.

SITE/FISHERY	SURVEY DESIGN	EFFORT (E)	HARVEST RATE (h)	HARVEST (H)	SOURCE
NORAH HEAD					
Coastal marine - trailer boats	Access(Effort)-Access(Harvest)	Direct expansion	N/A	Direct expansion	Pollock et al. 1994
TERRIGAL					
Coastal marine - trailer boats	Supplemented Access Point (SAP)	SAP using auxiliary data	Ratio of means (R_1)	H=Exh	Steffe et al. 2008; Pollock et al. 2007
HAWKESBURY					
Coastal marine - trailer boats	Access(Effort)-Access(Harvest)	Direct expansion	Ratio of means (R_1)	H=Exh	Pollock et al. 1994 & 1997
Estuarine - trailer boats	Roving(Effort)-Access(Harvest)	Expansion using progressive count data	Ratio of means (R_1)	H=Exh	Pollock et al. 1994 & 1997; Hoenig et al. 1993 & 1997
Estuarine - shore	Roving(Effort)-Roving(Harvest)	Expansion using progressive count data	Mean of ratios (R_2) with truncation	H=Exh	Pollock et al. 1994 & 1997; Hoenig et al. 1993 & 1997
LONG REEF					
Coastal marine - trailer boats	Supplemented Access Point (SAP)	SAP using auxiliary data	Ratio of means (R_1)	H=Exh	Steffe et al. 2008; Pollock et al. 2007
SYDNEY HARBOUR					
Coastal marine - trailer boats	Access(Effort)	Direct expansion	N/A	N/A	Pollock et al. 1994
BOTANY BAY					
Coastal marine - trailer boats	Access(Effort)	Direct expansion	N/A	N/A	Pollock et al. 1994
PORT HACKING					
Coastal marine - trailer boats	Access(Effort)-Access(Harvest)	Direct expansion	Ratio of means (R_1)	H=Exh	Pollock et al. 1994
Estuarine - trailer boats	Roving(Effort)-Access(Harvest)	Expansion using progressive count data	Ratio of means (R_1)	H=Exh	Pollock et al. 1994 & 1997; Hoenig et al. 1993 & 1997
Estuarine - shore	Roving(Effort)-Roving(Harvest)	Expansion using progressive count data	Mean of ratios (R_2) with truncation	H=Exh	Pollock et al. 1994 & 1997; Hoenig et al. 1993 & 1997
BELLAMBI					
Coastal marine - trailer boats	Supplemented Access Point (SAP)	SAP using auxiliary data	Ratio of means (R_1)	H=Exh	Steffe et al. 2008; Pollock et al. 2007
PORT KEMBLA					
Coastal marine - trailer boats	Supplemented Access Point (SAP)	SAP using auxiliary data	Ratio of means (R_1)	H=Exh	Steffe et al. 2008; Pollock et al. 2007
SHELLHARBOUR					
Coastal marine - trailer boats	Supplemented Access Point (SAP)	SAP using auxiliary data	Ratio of means (R_1)	H=Exh	Steffe et al. 2008; Pollock et al. 2007

Table 3. Sample size information for each site during the first survey year (March 2007 to February 2008 inclusive).

SITE/FISHERY	No. survey days (PSU) Effort counts	No. days Traffic counter data	No. survey days (PSU) Catch Interviews	No. catch interviews (cooperative)	No. catch interviews (refusals)	Interview success rate (%)
NORAH HEAD						
Coastal marine - trailer boats	72	N/A	72	184	110	62.6
TERRIGAL						
Coastal marine - trailer boats	72	345	72	310	135	69.7
HAWKESBURY						
Coastal marine - trailer boats	49	N/A	72	398	28	93.4
Estuarine - trailer boats	70	N/A	72	3467	325	91.4
Estuarine - shore	70	N/A	72	1033	28	97.4
LONG REEF						
Coastal marine - trailer boats	72	348	72	272	9	96.8
SYDNEY HARBOUR						
Coastal marine - trailer boats	63	N/A	N/A	N/A	N/A	N/A
BOTANY BAY						
Coastal marine - trailer boats	72	N/A	N/A	N/A	N/A	N/A
PORT HACKING						
Coastal marine - trailer boats	72	N/A	72	1077	38	96.6
Estuarine - trailer boats	72	N/A	72	1548	117	93.0
Estuarine - shore	72	N/A	72	989	28	97.2
BELLAMBI						
Coastal marine - trailer boats	71	338	71	675	33	95.3
PORT KEMBLA						
Coastal marine - trailer boats	73	359	73	685	39	94.6
SHELLHARBOUR						
Coastal marine - trailer boats	73	350	73	622	27	95.8

Table 4. Sample size information for each site during the second survey year (March 2008 to February 2009 inclusive).

SITE/FISHERY	No. survey days (PSU) Effort counts	No. days Traffic counter data	No. survey days (PSU) Catch Interviews	No. catch interviews (cooperative)	No. catch interviews (refusals)	Interview success rate (%)
NORAH HEAD						
Coastal marine - trailer boats	72	N/A	72	162	116	58.3
TERRIGAL						
Coastal marine - trailer boats	72	365	72	332	150	68.9
HAWKESBURY						
Coastal marine - trailer boats	51	N/A	72	312	26	92.3
Estuarine - trailer boats	72	N/A	72	3103	385	89.0
Estuarine - shore	72	N/A	72	878	17	98.1
LONG REEF						
Coastal marine - trailer boats	72	358	72	385	18	95.5
SYDNEY HARBOUR						
Coastal marine - trailer boats	68	N/A	N/A	N/A	N/A	N/A
BOTANY BAY						
Coastal marine - trailer boats	72	N/A	N/A	N/A	N/A	N/A
PORT HACKING						
Coastal marine - trailer boats	72	N/A	72	1010	52	95.1
Estuarine - trailer boats	72	N/A	72	1407	81	94.6
Estuarine - shore	72	N/A	72	1025	35	96.7
BELLAMBI						
Coastal marine - trailer boats	72	358	72	553	24	95.8
PORT KEMBLA						
Coastal marine - trailer boats	72	337	72	716	28	96.2
SHELLHARBOUR						
Coastal marine - trailer boats	72	338	72	584	24	96.1

3.4. Data collection methods

Two datasets are needed to estimate recreational harvest. Firstly, fishing effort information is needed to quantify the fishing pressure applied in the fishery. This fishing effort was collected in a variety of ways during this study (see descriptions below) and can be reported in a variety of different units (e.g., fisher hours, party hours or trips) depending on the method of data collection. Secondly, harvest information is needed to confirm species identifications and to quantify the numbers and sizes of retained cephalopods, crustaceans and fishes. Interviews with fishing parties carried out at the fishing sites were the source of the harvest information. Brief descriptions of the different datasets and the collection methods used at each survey site are provided below and in Table 2.

3.4.1. Fishing effort data

3.4.1.1. Progressive counts – estuarine module

Estimates of recreational fishing effort for the boat-based and shore-based fisheries in the Hawkesbury River and Port Hacking estuaries were made with progressive counts on randomly selected survey days. Progressive counts of fishing effort are made by counting recreational fishers and fishing boats over time during a circuit of the fishery. Progressive counts document fishing effort in terms of fisher hours (shore-based fishery) or party hours (boat-based fishery). These counts do not measure angler numbers or the number of trips in the fishery.

Progressive counts were made separately of all boats and all shore-based persons that were observed to be involved in some type of recreational fishing activity during daylight hours (sunrise to sunset). These recreational fishing activities included all forms of angling and the setting, checking and retrieval of crab nets, but excluded activities such as bait collecting and prawning. We specifically excluded boats traveling across the estuaries and anglers moving along the shore from the counts (even when recreational fishing gear was visible) when it was not possible to determine their destination or their immediate intent to engage in any recreational fishing activity. In contrast, we included boats in the counts when they were engaged in drift fishing and they were observed traveling to start another drift upstream. Drift fishing is commonly used to target bottom associated species such as flatheads and flounders.

The times needed to complete full circuits of each estuarine fishery were determined during a pilot study. These times were then used to schedule the starting times for each survey day from a set of discrete possible starting times as recommended by Hoenig *et al.* (1993). The starting location and direction of travel were randomly selected for each scheduled progressive count. This progressive count method will, under general conditions, provide unbiased estimates of fishing effort during the day (Hoenig *et al.* 1993). The scheduling of these progressive counts was independent of the days selected for interviewing fishing parties.

3.4.1.2. Validated counts of trips and activities – coastal marine module

These data were derived from direct observation and/or contact with boating parties on randomly scheduled survey days at the boat ramps with direct ocean access. On scheduled survey days all boats returning to the ramp were recorded and each trip was assigned into a fishing category (either angling or spearfishing) or a non-fishing category. The assignment of boat parties was done by asking party members about their activities on their current trip or by direct observation of fishing gear and harvests. The collection of accurate and complete counts of boating effort that quantified the number of completed trips and the activities of the boating parties was regarded as the highest

priority of survey staff on all survey days. At busy times, accurate effort and trip activity data were collected in preference to harvest rate and harvest information. These validated counts of boats and their activities provide the basis for interpreting the traffic counter data and the boat counts of potential fishing craft made from headlands. These validated boat counts started an hour after sunrise and ended at sunset.

3.4.1.3. Traffic count data – coastal marine module

This dataset consists of automated traffic records collected at the boat ramps with direct ocean access. Traffic count data were collected to supplement the validated survey data by increasing the temporal coverage of general boating and fishing trips – it should be noted that these data represent an indirect measure of boat movements (activity unknown) that need to be validated. The automated ramp traffic system consisted of a weatherproof box that was securely chained to a fixed structure, such as a telegraph pole, adjacent to the position of deployment. The box housed a battery and a computer that was used to receive, process and store the records of traffic movements. A “road-tube” sensor was connected to the computer and fixed in position across the lane of the boat ramp. In theory, a count should have been recorded in the computer’s memory each time an axle passed over the road-tube sensor. The counter was calibrated so that data was recorded in separate blocks of five minutes duration (five minute bins) for each date. Count data were assigned into daytime and night-time categories to facilitate the estimation of daytime recreational fishing effort.

3.4.1.4. Boat counts made by direct observation from headlands – coastal marine module

The four large access sites in the Sydney area (Hawkesbury/Broken Bay, Sydney Harbour, Botany Bay and Port Hacking) have large numbers of boat ramps, marinas, private moorings and jetties that can be used by recreational boat-based fishers to access the coastal marine fishery. Counts of boats returning from the sea were made by observers located on the headlands to these sites. All potential recreational fishing craft were recorded and classified into separate categories, these being: trailer boats; cruisers and gameboats; charter boats; dive boats; and a miscellaneous category to accommodate any fishing vessels that did not fit within the other categories. We excluded all commercial vessels, jetskis, sail boats and paddle craft unless recreational fishing gear was visible. These boat counts from headlands were scheduled to coincide with the randomly selected survey days for the estuarine work. All counts started an hour after sunrise and ended at sunset.

3.4.2. Harvest data – estuarine and coastal marine modules

Harvest information was collected by interviewing fishing parties either during their trips (shore-based fishery) or at the completion of their trips (boat-based fishery). The survey sites that had direct ocean access (coastal marine module) were surveyed for boat-based fishing only. The two estuarine survey areas were surveyed for both boat-based and shore-based fishing. Also, interviews with fishing parties that had fished in the coastal marine area were done at the estuarine boat ramps. Surveys at the designated boat ramps within the estuaries were scheduled to provide simultaneous coverage on each survey day. The boat ramps covered in the Hawkesbury River estuary were located at Spencer, Berowra, Mooney Mooney, Brooklyn, Apple Tree Bay, Patonga and Bayview (Figure 1). The boat ramps covered in the Port Hacking estuary were located at Grays Point, Yowie Bay, Dolans Bay, Water Street and Gunnamatta Bay (Figure 2).

Roving circuits of the shore-based fishery were also done on survey days according to rosters that incorporated randomised start locations, direction of travel, and starting times during the day. On each survey day the roving circuit provided coverage of the entire shore-based fishery.

All interviews (boat- and shore-based) were done during the period starting an hour after sunrise and ending at sunset for each survey module. Fishing parties were approached and asked to participate in the survey by providing information about their fishing trip and their harvest. Attempts were made to interview all recreational fishing parties encountered, however, during periods of high recreational activity it was necessary to subsample systematically every second or third fishing party (depending on the number of fishing parties available for interview). Refusals to provide information or to show the fish retained were recorded. We asked co-operative recreational fishers about their targeting preferences during their current fishing trip, the time they started fishing and their fishing locations. We also recorded the number of fishers in the fishing party (non-fishers were not included as part of a fishing party), the sexes of all fishing party members, and the home postcodes of all persons (fishers and non-fishers). The retained catch was identified to species level by field staff and, whenever possible, measurements of all fish (fork length), crustaceans (carapace length) and cephalopods (mantle length) were taken to the nearest whole centimetre. When fishers were in a hurry to leave the ramp and it was not possible to measure all fish, crustaceans and cephalopods, the survey personnel were instructed to record counts of the identified harvest and attempt to measure a sub-sample of the harvest. Machine-readable interview forms were used to collect information from boat-based and shore-based fishing parties.

3.5. Estimation methods

A summary of the methods used for estimating fishing effort, harvest rates and harvest at each access site is provided in Table 2. The following sections provide brief explanations of the estimation methods used. Detailed explanations of the statistical methods and equations used can be found in Cochran (1977), Hoenig *et al.* (1993 & 1997), Pollock *et al.* (1994 & 1997), and Steffe *et al.* (2008).

3.5.1. Direct expansion

Direct expansion is the simplest method of fishing effort and harvest estimation. Essentially the survey data are expanded to account for the unsampled fraction of a stratum. This is done by calculating the mean daily fishing effort or harvest and then multiplying these mean values by the number of possible sample days in each day-type stratum. Day-type stratum totals are added together to obtain seasonal totals. Annual estimates are calculated by adding seasonal totals.

3.5.2. Expansion using progressive count data

Estimation of fishing effort was done separately for the boat-based fishery (party hours) and the shore-based fishery (fisher hours) in each estuary. The progressive counts of recreational fishing boats and shore-based fishers were multiplied by the length of the survey day to estimate the daily effort for each fishing day that was sampled. These daily effort estimates were then expanded for each day-type stratum within each season. This was done by multiplying the number of possible sample days in each day-type stratum with the the mean of the daily estimates of effort.

Seasonal estimates of fishing effort were obtained by adding the day-type stratum effort estimates together. Annual estimates were made by adding seasonal estimates together. It was necessary to convert the boat-based effort estimates into the same units as those for the shore-based fishery (i.e., from party hours to fisher hours). This was done by using interview data to calculate the mean number of fishers per boat in each day-type stratum and then multiplying these figures to the corresponding effort estimates in the same strata.

3.5.3. *Supplemented Access Point (SAP) method using auxiliary data*

The supplemented access point (SAP) sampling design can be viewed as an extension of an access point design. That is, the SAP design provides a cost-effective way of improving the accuracy and precision of fishing effort and harvest estimates derived from traditional access point and bus-route designs (Steffe *et al.* 2008). These on-site survey designs are widely used in many fisheries. The auxiliary data used to supplement these access point designs quantify recreational fishing effort. These auxiliary effort data can be collected in a variety of ways, such as automated traffic counts at a boat ramp (used in this project), logbook records of boat movements into or out of an estuary or by recording boat movements and direction with video/web-cam/closed circuit TV technologies at major choke points within a fishery. Importantly, these auxiliary data must be validated by direct observation usually coinciding with randomly selected survey days. Essentially, the SAP design is superior to a traditional access point or bus-route design in relative accuracy and precision because the collection of auxiliary data provides better coverage of the temporal sampling frame for fishing effort. This increased frame coverage occurs by maximising the sampling among days, which are the primary sampling units. For example, these auxiliary data may provide an extremely large sample or even a census of effort at a site (assuming no equipment failures or vandalism), thereby removing most of the sampling variability. Improvements in precision for effort are also reflected in harvest calculations. When supplemented auxiliary effort data are available it is possible to estimate harvest as the product of harvest rate (fish per trip) and effort (trip). The variance of effort, which is relatively small when derived from a supplemented sampling design, is incorporated into two of the three terms in the calculation of the variance of a product. Thus, improvements in the precision associated with effort estimates are also reflected in harvest variance calculations.

3.5.4. *Ratio of means (R_1) estimator*

When the objective is to estimate total harvest, and the interviews are based on completed trips, the correct harvest rate estimator to use is the “ratio of means” (Pollock *et al.* 1997). This estimator is essentially the ratio of mean harvest to mean effort on a given day. The ratio of means estimator was used for estimating the harvest of the boat-based fishery (estuarine and coastal marine modules).

3.5.5. *Mean of the ratios (R_2) estimator with truncation*

When the objective is to estimate total harvest, and the interviews are based on incomplete trips, the correct harvest rate estimator to use is the “mean of ratios” (Pollock *et al.* 1997, Hoenig *et al.* 1997). This estimator is essentially the mean of the individual harvest rates for all fishers interviewed on a given day. The mean of ratios was used for estimating the harvest of the shore-based fishery (estuarine module). Simulation procedures have shown that the mean of ratios estimator has a large variance caused by the inclusion of high harvest rates resulting from very short, incomplete trips that have harvested some fish already. Hoenig *et al.* (1997) recommended the truncation (exclusion) of all short incomplete trips thereby reducing the variance greatly without inducing an appreciable bias. We examined the relationship between the harvest rate and the duration of the fishing trip for shore-based interviews to determine the most appropriate level of truncation. We discarded all incomplete trips that had been in progress for less than 30 fisher minutes. The adoption of this truncation criterion resulted in the loss of 144 (7.5%) and 150 (7.4%) of usable shore-based interviews from harvest calculations in the Hawkesbury River and Port Hacking estuaries respectively.

We had routinely asked shore-based fishing parties about the intended finishing time for their current trip. We retained and used all shore-based interviews with fishing parties that had completed their trips but had fished for less than 30 fisher minutes. We believe it is logical to keep

and use the data from these complete short trips, regardless of the small amount of time fished or the amount of harvest taken, because it is these short trips that are under-represented in roving surveys due to “length-of-stay” bias (see Pollock *et al.* 1994).

3.5.6. *Confidence intervals for estimated totals*

Annual estimates of recreational fishing effort and harvest are presented for the estuarine and coastal marine fisheries. We have calculated 95% confidence limits for each of these estimated annual values to summarise the variability that exists in the survey sampling. The 95% confidence limits provide information about the plausible range that contains the true value of the parameter that has been estimated. Thus, when comparing any two estimates of interest it is important to determine whether the confidence intervals overlap. When the confidence intervals overlap we cannot be 95% certain that the two estimates being compared are different. Thus, we conclude that in this case there is no statistically significant difference between the two estimates ($p > 0.05$). Conversely, when the confidence intervals do not overlap we can be 95% certain that the two estimates are different. Thus, we can conclude that a statistically significant difference exists ($p < 0.05$) between the two estimates.

4. RESULTS

The information presented here provides important site-specific, baseline measures of the usage patterns (fishing effort) and the quality of recreational fishing (harvest numbers and size frequency data) within the Greater Sydney region. For brevity, we use common names in the text, figures and tables presented in this report. A complete list of common and scientific names for all taxa recorded in the recreational harvest is given in Appendix 1.

4.1. Estuarine module – fishing effort

The levels of fishing effort measured in the Hawkesbury River estuary were similar between years (Figure 4). The majority of daytime fishing effort in this estuarine fishery was boat-based. We estimated that about 514,500 and 520,800 fisher hours of daytime recreational boat-based effort were expended in this estuarine fishery during the two survey years respectively (Figure 4). This represented 78.7% and 77.7% of the annual effort for the total fishery (boat and shore combined) for these two survey years. In contrast, we estimated that about 139,100 and 149,200 fisher hours of daytime recreational shore-based effort were expended in this estuarine fishery during the two survey years respectively (Figure 4). This represented 21.3% and 22.3% of the annual effort for the total fishery (boat and shore combined) for these two survey years.

The levels of fishing effort measured in the Port Hacking estuary were similar between years (Figure 4). The majority of daytime fishing effort in this estuarine fishery was shore-based. We estimated that about 128,700 and 122,700 fisher hours of daytime recreational shore-based effort were expended in this estuarine fishery during the two survey years respectively (Figure 4). This represented 58.8% and 56.3% of the annual effort for the total fishery (boat and shore combined) for these two survey years. In contrast, we estimated that about 90,300 and 95,100 fisher hours of daytime recreational boat-based effort were expended in this estuarine fishery during the two survey years respectively (Figure 4). This represented 41.2% and 43.7% of the annual effort for the total fishery (boat and shore combined) for these two survey years.

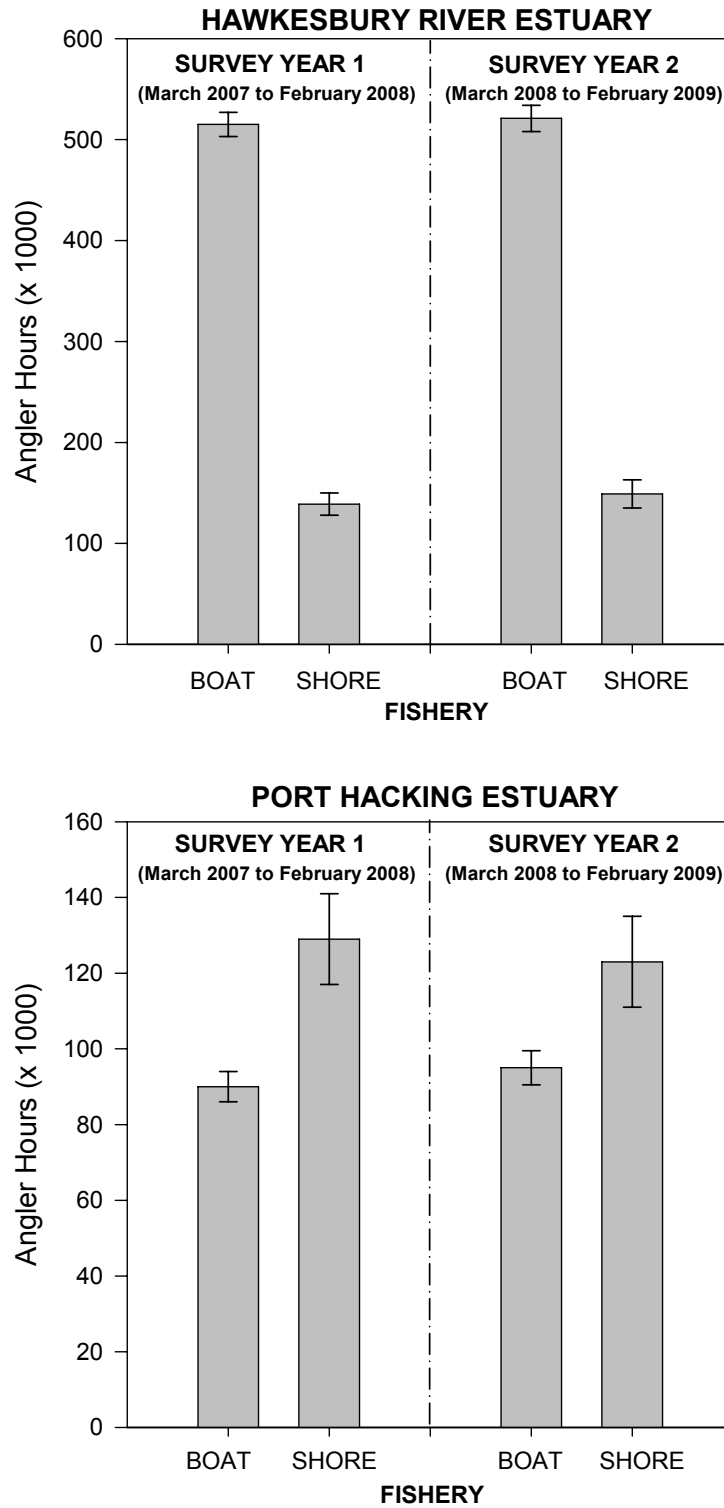


Figure 4. Annual estimates of daytime recreational fishing effort (angler hours) with 95% confidence intervals for the boat-based and shore-based fisheries in the Hawkesbury River and Port Hacking estuaries.

4.2. Estuarine module – harvest and size frequency data

Overall, we recorded 87 taxa during the surveys of estuarine fishing (Tables 5 – 12). The Hawkesbury River estuary yielded 79 taxa over the course of the two year survey period, whilst 60 taxa were recorded from the Port Hacking estuary (Tables 5 – 12). We estimated that about 134,000 and 134,900 fish, crabs and cephalopods were harvested by daytime recreational fishers from the Hawkesbury River estuary during each of the two survey years respectively (Tables 5 – 8). The ten most commonly harvested taxa, by number, accounted for 82.8% and 88.1% of the daytime recreational harvest during the two annual survey periods respectively (Tables 5 – 8). In contrast, we estimated that about 77,800 and 82,100 fish, crabs and cephalopods were harvested by daytime recreational fishers from the Port Hacking estuary during each of the two survey years respectively (Tables 9 – 12). The ten most commonly harvested taxa, by number, accounted for 81.0% and 78.5% of the daytime recreational harvest during the two annual survey periods respectively (Tables 9 – 12).

Graphical comparisons of annual size frequency for eight recreationally important species (Figures 5 – 12) are presented for each estuarine fishery survey (boat and shore fisheries combined). These figures provide summary information to describe the numbers of fish measured, the mean size of retained fish and the proportion of undersize fish in the retained catch. For example, size frequency comparisons for dusky flathead are similar between years within each estuary but differ markedly between estuaries (Figures 5 & 6). The mean sizes of dusky flathead taken in the Hawkesbury River estuary (ranging annually between 42 and 43 cm) were much smaller than for fish taken from the Port Hacking estuary (ranging annually between 47 and 48 cm).

Table 5. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by boat-based fishers in the Hawkesbury River estuary during the first survey year (March 2007 to February 2008).

**HAWKESBURY RIVER ESTUARY
BOAT-BASED
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Yellowfin Bream	32,225	27,564	to	36,886	31.2
Dusky Flathead	27,217	24,132	to	30,302	26.3
Blue Swimmer Crab	7,530	3,965	to	11,095	7.3
Tailor	3,725	2,573	to	4,877	3.6
Yellowfin Leatherjacket	3,006	1,316	to	4,696	2.9
Silver Trevally	2,959	617	to	5,301	2.9
Sand Whiting	2,948	2,005	to	3,891	2.9
Large-tooth Flounder	2,752	1,737	to	3,767	2.7
Mulloway	2,587	1,852	to	3,322	2.5
Ocean Leatherjacket	2,304	822	to	3,786	2.2
Yellowtail	2,172	500	to	3,844	2.1
Six-spine Leatherjacket	1,572	190	to	2,954	1.5
Salmon	1,405	41	to	2,769	1.4
Small-tooth Flounder	1,301	901	to	1,701	1.3
Eastern Bluespotted Flathead	1,296	549	to	2,043	1.3
Common Squid	973	573	to	1,373	0.9
Snapper	935	496	to	1,374	0.9
Luderick	681	5	to	1,357	0.7
Sea Garfish	512	0	to	1,516	0.5
Blue Mackerel	411	113	to	709	0.4
Southern Calamari	402	114	to	690	0.4
Estuary Cobbler	398	0	to	1,149	0.4
Leaping Bonito	384	0	to	1,137	0.4
Fanbelly Leatherjacket	348	87	to	609	0.3
Trumpeter Whiting	335	2	to	668	0.3
Australian Bonito	321	0	to	829	0.3
Giant Mud Crab	302	180	to	424	0.3
Yellowtail Kingfish	272	129	to	415	0.3
Eastern Red Scorpionfish	271	118	to	424	0.3
Largehead Hairtail	254	9	to	499	0.2
Octopus	195	0	to	434	0.2
Southern Maori Wrasse	189	0	to	389	0.2
Longfin Pike	156	0	to	319	0.2
Crimsonband Wrasse	128	8	to	248	0.1
Tarwhine	107	0	to	219	0.1
Silver Sweep	93	9	to	177	<0.1
Rough Leatherjacket	58	0	to	172	<0.1
River Garfish	54	0	to	160	<0.1
Frigate Mackerel	46	0	to	115	<0.1

Table 5. Continued.

**HAWKESBURY RIVER ESTUARY
BOAT-BASED
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Sergeant Baker	46	5	to	87	<0.1
Marbled Flathead	44	0	to	93	<0.1
Sand Mullet	36	0	to	83	<0.1
Northern Sand Flathead	33	0	to	74	<0.1
Whaler Sharks	32	0	to	95	<0.1
Samsonfish	32	0	to	75	<0.1
Eastern Wirrah	29	0	to	58	<0.1
Hammerhead Shark	25	0	to	74	<0.1
Grey Morwong	24	0	to	53	<0.1
Red Gurnard	22	0	to	51	<0.1
Striped Barracuda	22	0	to	65	<0.1
Shovelnose Ray	20	0	to	47	<0.1
Stingarees & Black Stingrays	19	0	to	56	<0.1
Australian Angelshark	16	0	to	47	<0.1
Red Morwong	14	0	to	41	<0.1
Estuary Perch	14	0	to	32	<0.1
Tiger Flathead	13	0	to	38	<0.1
Spotted Mackerel	13	0	to	38	<0.1
Mosaic Leatherjacket	13	0	to	38	<0.1
Lizardfish	12	0	to	36	<0.1
Maori Rockcod	11	0	to	33	<0.1
Bearded Cods	11	0	to	33	<0.1
Common Jack Mackerel	10	0	to	30	<0.1
Banjo Ray	9	0	to	27	<0.1
Conger Eel	7	0	to	21	<0.1
Rainbow Cale	7	0	to	21	<0.1
Eastern Blue Groper	6	0	to	18	<0.1
Giant Cuttlefish	4	0	to	12	<0.1
Total	103,368	68,720	to	138,016	100.0

Table 6. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by boat-based fishers in the Hawkesbury River estuary during the second survey year (March 2008 to February 2009).

**HAWKESBURY RIVER ESTUARY
BOAT-BASED
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Dusky Flathead	28,321	25,152	to	31,490	29.8
Yellowfin Bream	28,228	23,393	to	33,063	29.7
Yellowtail	6,179	2,118	to	10,240	6.5
Blue Swimmer Crab	5,241	3,657	to	6,825	5.5
Tailor	4,247	2,802	to	5,692	4.5
Mulloway	4,170	2,637	to	5,703	4.4
Smalltooth Flounder	2,949	1,814	to	4,084	3.1
Largetooth Flounder	1,806	1,194	to	2,418	1.9
Sand Whiting	1,655	1,051	to	2,259	1.7
Ocean Leatherjacket	1,440	582	to	2,298	1.5
Silver Trevally	1,396	445	to	2,347	1.5
Luderick	1,126	207	to	2,045	1.2
Yellowfin Leatherjacket	925	384	to	1,466	1.0
Eastern Bluespotted Flathead	915	368	to	1,462	1.0
Snapper	681	0	to	1,394	0.7
Common Squid	631	264	to	998	0.7
Sixspine Leatherjacket	624	152	to	1,096	0.7
River Garfish	599	0	to	1,465	0.6
Blue Mackerel	434	0	to	942	0.5
Salmon	405	117	to	693	0.4
Southern Calamari	395	0	to	909	0.4
Yellowtail Kingfish	367	51	to	683	0.4
Fanbelly Leatherjacket	299	85	to	513	0.3
Moray Eel	170	0	to	503	0.2
Sand Mullet	166	0	to	380	0.2
Southern Maori Wrasse	154	23	to	285	0.2
Giant Mud Crab	150	0	to	319	0.2
Silver Sweep	135	0	to	288	0.1
Marbled Flathead	119	1	to	237	0.1
Eastern Wirrah	109	0	to	262	0.1
Longfin Pike	100	0	to	200	0.1
Crimsonband Wrasse	92	4	to	180	<0.1
Sergeant Baker	87	0	to	185	<0.1
Red Morwong	81	0	to	163	<0.1
Shovelnose Ray	73	0	to	151	<0.1
Gummy Shark	66	0	to	176	<0.1
Octopus	61	0	to	137	<0.1
Largehead Hairtail	52	0	to	113	<0.1
Hammerhead Shark	48	0	to	142	<0.1

Table 6. Continued.

**HAWKESBURY RIVER ESTUARY
BOAT-BASED
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Estuarine Cuttlefish	42	0	to	124	<0.1
Eastern Red Scorpionfish	38	0	to	79	<0.1
Grey Morwong	37	0	to	84	<0.1
Blind Shark	28	0	to	83	<0.1
Whaler Sharks	26	0	to	77	<0.1
Conger Eel	25	0	to	74	<0.1
Australian Bonito	21	0	to	62	<0.1
Painted Grinner	18	0	to	53	<0.1
John Dory	13	0	to	38	<0.1
Rough Leatherjacket	11	0	to	33	<0.1
Trumpeter Whiting	9	0	to	27	<0.1
Southern Sand Flathead	9	0	to	27	<0.1
Samsonfish	7	0	to	21	<0.1
Total	94,980	65,372	to	124,588	100.0

Table 7. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by shore-based fishers in the Hawkesbury River estuary during the first survey year (March 2007 to February 2008).

**HAWKESBURY RIVER ESTUARY
SHORE-BASED
Survey Year 1**

Common Name	Total Fish (number)	95%			% Total
		Confidence Intervals			
Yellowfin Bream	8,453	2,353	to	14,553	27.6
Dusky Flathead	5,813	2,405	to	9,221	19.0
River Garfish	4,817	0	to	12,818	15.7
Tailor	2,447	1,187	to	3,707	8.0
Sand Whiting	2,161	313	to	4,009	7.1
Yellowfin Leatherjacket	1,540	585	to	2,495	5.0
Luderick	1,521	0	to	4,410	5.0
Fanbelly Leatherjacket	950	54	to	1,846	3.1
Southern Herring	679	0	to	1,512	2.2
Snapper	436	0	to	963	1.4
Largetooth Flounder	382	0	to	845	1.2
Common Squid	311	0	to	752	1.0
Yellowtail	252	0	to	593	0.8
Blue Swimmer Crab	179	0	to	430	0.6
Silver Trevally	115	0	to	340	0.4
Diamondfish	111	0	to	329	0.4
Stingarees & Black Stingrays	103	0	to	305	0.3
Sand Mullet	73	0	to	183	0.2
Longspine Flathead	52	0	to	154	0.2
Trumpeter Whiting	45	0	to	108	0.1
Smalltooth Flounder	44	0	to	130	0.1
Eastern Bluespotted Flathead	44	0	to	130	0.1
Salmon	42	0	to	124	0.1
Fourline Striped Grunter	17	0	to	50	<0.1
Conger Eel	15	0	to	44	<0.1
Stout Longtom	11	0	to	33	<0.1
Mulloway	8	0	to	24	<0.1
Total	30,621	1,134	to	60,108	100.0

Table 8. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by shore-based fishers in the Hawkesbury River estuary during the second survey year (March 2008 to February 2009).

**HAWKESBURY RIVER ESTUARY
SHORE-BASED
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Sand Whiting	12,746	0	to	34,931	31.9
Yellowfin Bream	12,099	657	to	23,541	30.3
Dusky Flathead	6,458	572	to	12,344	16.2
Blue Mackerel	1,861	0	to	5,509	4.7
Sand Mullet	1,800	0	to	3,985	4.5
Yellowfin Leatherjacket	1,264	8	to	2,520	3.2
Tailor	1,118	312	to	1,924	2.8
Yellowtail	888	0	to	2,291	2.2
Luderick	605	0	to	1,354	1.5
River Garfish	422	0	to	1,196	1.1
Fourline Striped Grunter	195	0	to	577	0.5
Fanbelly Leatherjacket	168	0	to	362	0.4
Mulloway	92	0	to	206	0.2
Diamondfish	76	0	to	225	0.2
Common Squid	67	0	to	198	0.2
Trumpeter Whiting	53	0	to	157	0.1
Blue Swimmer Crab	42	0	to	124	0.1
Smalltooth Flounder	2	0	to	6	<0.1
Total	39,956	0	to	91,450	100.0

Table 9. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by boat-based fishers in the Port Hacking estuary during the first survey year (March 2007 to February 2008).

**PORT HACKING ESTUARY
BOAT-BASED
Survey Year 1**

Common Name	Total Fish (number)	95%			% Total
		Confidence Intervals			
Common Squid	4,554	1,573	to	7,535	13.7
Yellowfin Bream	3,753	2,542	to	4,964	11.3
Australian Sardine	3,061	29	to	6,093	9.2
Southern Calamari	2,652	1,392	to	3,912	8.0
Sand Whiting	2,624	2,038	to	3,210	7.9
Dusky Flathead	2,397	1,878	to	2,916	7.2
Silver Trevally	1,664	719	to	2,609	5.0
Yellowtail	1,588	649	to	2,527	4.8
Yellowfin Leatherjacket	1,451	887	to	2,015	4.4
Tailor	1,427	727	to	2,127	4.3
Blue Swimmer Crab	1,278	696	to	1,860	3.8
Luderick	1,264	31	to	2,497	3.8
Eastern Bluespotted Flathead	811	274	to	1,348	2.4
Blue Mackerel	622	7	to	1,237	1.9
Snapper	585	362	to	808	1.8
Silver Sweep	504	0	to	1,008	1.5
Sand Mullet	376	0	to	974	1.1
Ocean Leatherjacket	325	90	to	560	1.0
Australian Bonito	295	0	to	726	0.9
Smalltooth Flounder	263	120	to	406	0.8
Trumpeter Whiting	252	3	to	501	0.8
Fanbelly Leatherjacket	245	29	to	461	0.7
Sixspine Leatherjacket	203	66	to	340	0.6
Largetooth Flounder	198	86	to	310	0.6
Yellowtail Kingfish	145	71	to	219	0.4
Sea Garfish	145	0	to	394	0.4
Red Gurnard	85	9	to	161	0.3
Fourline Striped Grunter	78	0	to	231	0.2
Mulloway	59	8	to	110	0.2
Frigate Mackerel	54	0	to	109	0.2
Tarwhine	52	0	to	111	0.2
Estuary Perch	49	0	to	123	0.1
Longfin Pike	47	0	to	108	0.1
Leaping Bonito	30	0	to	79	<0.1
Sergeant Baker	25	0	to	64	<0.1
Painted Grinner	21	0	to	62	<0.1
Salmon	14	0	to	34	<0.1
Southern Maori Wrasse	12	0	to	36	<0.1
Estuarine Cuttlefish	11	0	to	25	<0.1

Table 9. Continued.

**PORT HACKING ESTUARY
BOAT-BASED
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Black Sole	9	0	to	27	<0.1
Octopus	8	0	to	24	<0.1
Comb Wrasse	7	0	to	21	<0.1
Shovelnose Ray	6	0	to	18	<0.1
Giant Cuttlefish	2	0	to	6	<0.1
Total	33,251	13,596	to	52,906	100.0

Table 10. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by boat-based fishers in the Port Hacking estuary during the second survey year (March 2008 to February 2009).

**PORT HACKING ESTUARY
BOAT-BASED
Survey Year 2**

Common Name	Total Fish (number)	95%			% Total
		Confidence Intervals			
Yellowfin Bream	3,625	2,761	to	4,489	13.0
Southern Calamari	3,569	2,458	to	4,680	12.8
Yellowtail	3,510	1,848	to	5,172	12.6
Australian Sardine	2,729	0	to	5,943	9.8
Sand Whiting	2,602	1,757	to	3,447	9.3
Common Squid	1,556	790	to	2,322	5.6
Dusky Flathead	1,346	958	to	1,734	4.8
Tailor	1,043	535	to	1,551	3.7
Blue Mackerel	947	210	to	1,684	3.4
Luderick	933	296	to	1,570	3.3
Silver Sweep	921	394	to	1,448	3.3
Yellowfin Leatherjacket	690	245	to	1,135	2.5
Snapper	580	329	to	831	2.1
Eastern Bluespotted Flathead	553	259	to	847	2.0
Ocean Leatherjacket	497	0	to	1,136	1.8
Blue Swimmer Crab	492	227	to	757	1.8
Silver Trevally	420	210	to	630	1.5
Large-tooth Flounder	328	116	to	540	1.2
Yellowtail Kingfish	184	64	to	304	0.7
Trumpeter Whiting	178	9	to	347	0.6
Smalltooth Flounder	176	72	to	280	0.6
Fourline Striped Grunter	144	0	to	426	0.5
Sand Mullet	120	0	to	298	0.4
Sea Garfish	112	0	to	232	0.4
Mulloway	106	39	to	173	0.4
Red Gurnard	99	25	to	173	0.4
Sixspine Leatherjacket	75	0	to	155	0.3
Salmon	55	2	to	108	0.2
Rough Leatherjacket	52	0	to	154	0.2
Longfin Pike	49	4	to	94	0.2
Stout Longtom	47	0	to	114	0.2
Fanbelly Leatherjacket	42	0	to	87	0.2
Tarwhine	30	0	to	63	0.1
Crimsonband Wrasse	27	0	to	64	<0.1
Southern Maori Wrasse	23	0	to	50	<0.1
Eastern Red Scorpionfish	22	0	to	65	<0.1
Frigate Mackerel	15	0	to	37	<0.1
Giant Mud Crab	12	0	to	36	<0.1
Stingarees & Black Stingrays	11	0	to	33	<0.1

Table 10. Continued.

**PORT HACKING ESTUARY
BOAT-BASED
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Silver Drummer	10	0	to	30	<0.1
Samsonfish	6	0	to	18	<0.1
Banjo Ray	6	0	to	18	<0.1
Sergeant Baker	5	0	to	15	<0.1
Octopus	5	0	to	15	<0.1
Australian Bonito	4	0	to	12	<0.1
Total	27,956	12,595	to	43,317	100.0

Table 11. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by shore-based fishers in the Port Hacking estuary during the first survey year (March 2007 to February 2008).

**PORT HACKING ESTUARY
SHORE-BASED
Survey Year 1**

Common Name	Total Fish (number)	95%			% Total
		Confidence Intervals			
Yellowtail	16,554	8,804	to	24,304	37.2
Sand Mullet	9,510	0	to	27,334	21.4
Yellowfin Bream	3,422	1,856	to	4,988	7.7
Sand Whiting	2,296	316	to	4,276	5.2
Tailor	2,026	0	to	4,131	4.5
Southern Calamari	1,723	480	to	2,966	3.9
Silver Trevally	1,541	579	to	2,503	3.5
Dusky Flathead	1,134	307	to	1,961	2.5
Luderick	877	197	to	1,557	2.0
Common Squid	655	0	to	1,380	1.5
Ocean Leatherjacket	608	0	to	1,259	1.4
Blue Swimmer Crab	571	50	to	1,092	1.3
Blue Mackerel	505	0	to	1,097	1.1
Mulloway	459	0	to	1,359	1.0
Fourline Striped Grunter	387	0	to	1,124	0.9
Sixspine Leatherjacket	361	0	to	931	0.8
Snapper	295	0	to	601	0.7
Leaping Bonito	253	0	to	553	0.6
Longfin Pike	180	0	to	447	0.4
Trumpeter Whiting	179	0	to	530	0.4
Tarwhine	135	0	to	290	0.3
Yellowfin Leatherjacket	123	0	to	319	0.3
Smalltooth Flounder	110	0	to	245	0.2
Estuarine Cuttlefish	93	0	to	220	0.2
Australian Sardine	92	0	to	241	0.2
Largetooth Flounder	59	0	to	120	0.1
Salmon	54	0	to	119	0.1
Cobia	48	0	to	142	0.1
Wobbegong Sharks	48	0	to	142	0.1
Rock Blackfish	43	0	to	127	<0.1
Shovelnose Ray	38	0	to	112	<0.1
Diamondfish	33	0	to	84	<0.1
Octopus	30	0	to	65	<0.1
Southern Maori Wrasse	23	0	to	68	<0.1
Australian Bonito	16	0	to	47	<0.1
Eastern Blue Groper	15	0	to	39	<0.1
Rough Leatherjacket	14	0	to	41	<0.1
Fanbelly Leatherjacket	13	0	to	38	<0.1
Eastern Bluespotted Flathead	13	0	to	38	<0.1
Total	44,536	2,182	to	86,890	100.0

Table 12. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by shore-based fishers in the Port Hacking estuary during the second survey year (March 2008 to February 2009).

**PORT HACKING ESTUARY
SHORE-BASED
Survey Year 2**

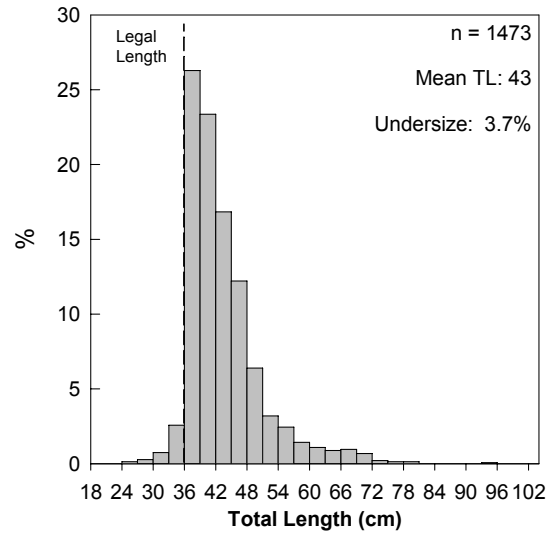
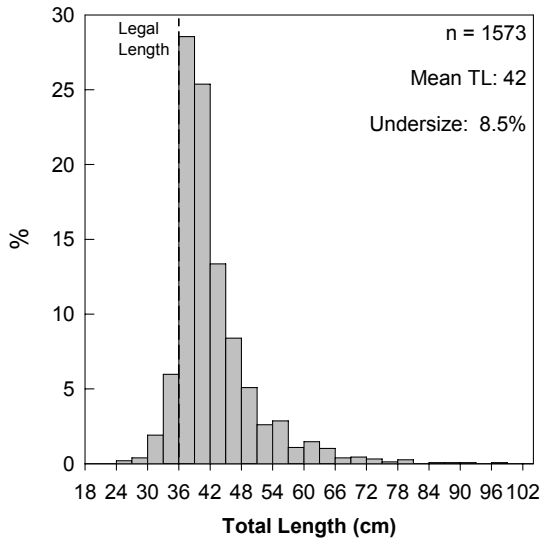
Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Yellowtail	17,804	9,468	to	26,140	32.9
Sand Mullet	7,893	0	to	23,024	14.6
Silver Trevally	5,487	524	to	10,450	10.1
Luderick	4,144	1,966	to	6,322	7.7
Tailor	2,726	0	to	5,609	5.0
Yellowfin Bream	2,655	1,665	to	3,645	4.9
Sand Whiting	1,995	684	to	3,306	3.7
Fourline Striped Grunter	1,574	0	to	4,055	2.9
Ocean Leatherjacket	1,481	0	to	3,451	2.7
Yellowfin Leatherjacket	1,349	0	to	3,338	2.5
Fanbelly Leatherjacket	1,196	0	to	2,784	2.2
Frigate Mackerel	1,145	0	to	3,181	2.1
Dusky Flathead	964	0	to	2,118	1.8
Blue Mackerel	713	0	to	1,440	1.3
Southern Calamari	684	6	to	1,362	1.3
Blue Sprat	555	0	to	1,643	1.0
Snapper	410	65	to	755	0.8
Tarwhine	220	0	to	565	0.4
Silver Sweep	194	0	to	574	0.4
Trumpeter Whiting	175	0	to	518	0.3
Australian Sardine	138	0	to	408	0.3
Common Squid	132	0	to	326	0.2
Large-tooth Flounder	129	0	to	382	0.2
Salmon	97	0	to	199	0.2
Smalltooth Flounder	69	0	to	181	0.1
Blue Swimmer Crab	64	3	to	125	0.1
Eastern Bluespotted Flathead	60	0	to	178	0.1
Crimsonband Wrasse	28	0	to	83	<0.1
Shovelnose Ray	20	0	to	59	<0.1
Eastern Wirrah	13	0	to	38	<0.1
Rough Leatherjacket	11	0	to	33	<0.1
Diamondfish	7	0	to	21	<0.1
Sixspine Leatherjacket	6	0	to	18	<0.1
Black Sole	3	0	to	9	<0.1
Total	54,141	1,942	to	106,340	100.0

HAWKESBURY RIVER ESTUARY

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Dusky Flathead



Yellowfin Bream

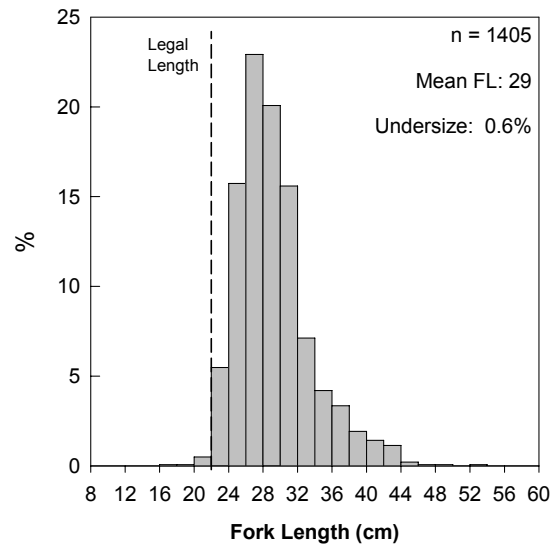
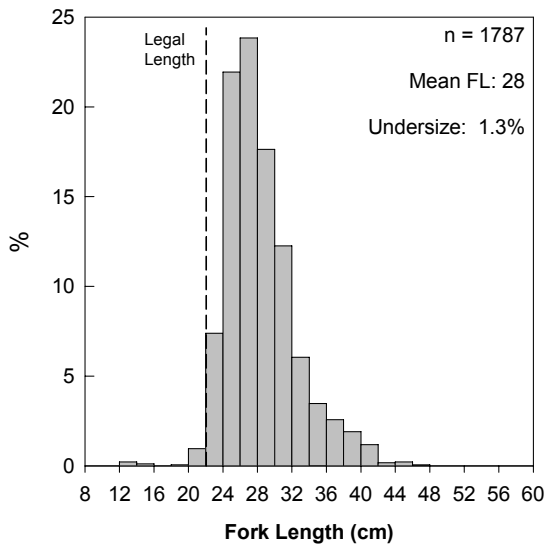


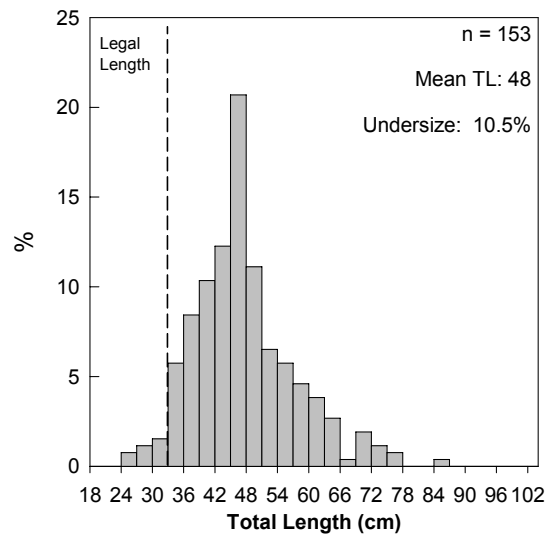
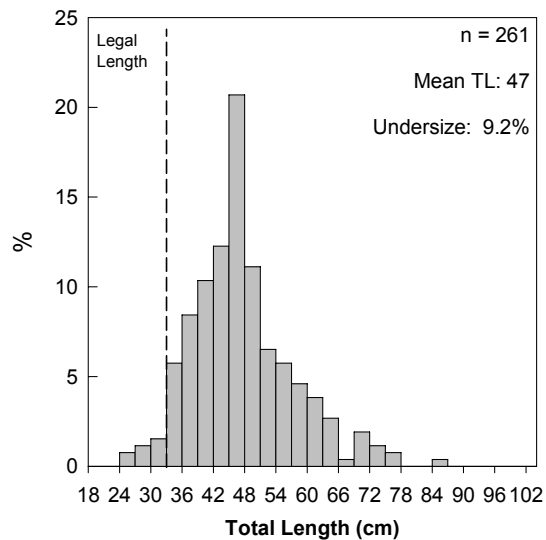
Figure 5. Annual length frequency distributions for dusky flathead and yellowfin bream taken by recreational fishers (boat and shore fisheries combined) in the Hawkesbury River estuary.

PORT HACKING ESTUARY

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Dusky Flathead



Yellowfin Bream

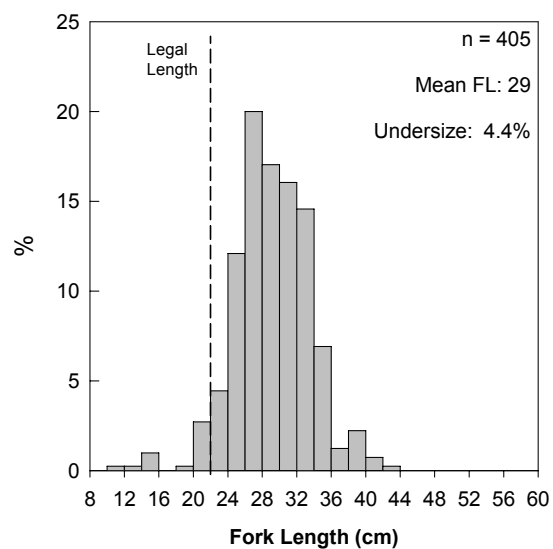
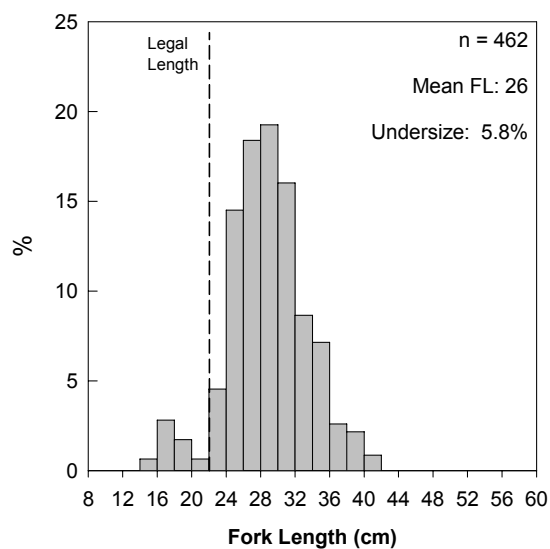


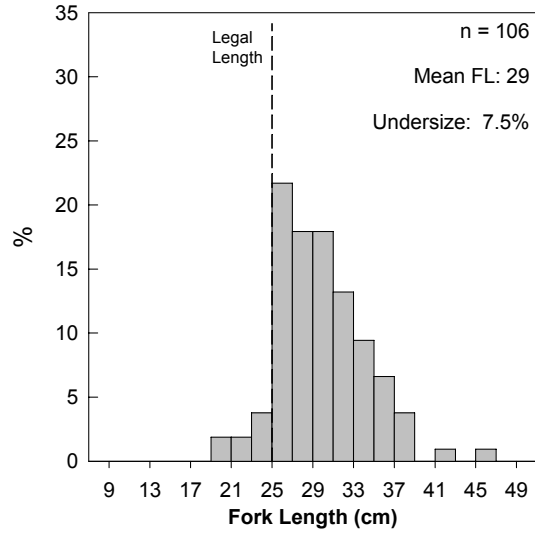
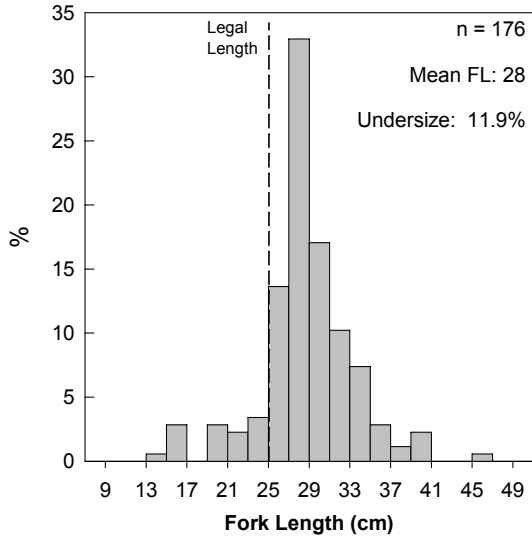
Figure 6. Annual length frequency distributions for dusky flathead and yellowfin bream taken by recreational fishers (boat and shore fisheries combined) in the Port Hacking estuary.

HAWKESBURY RIVER ESTUARY

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Sand Whiting



Luderick

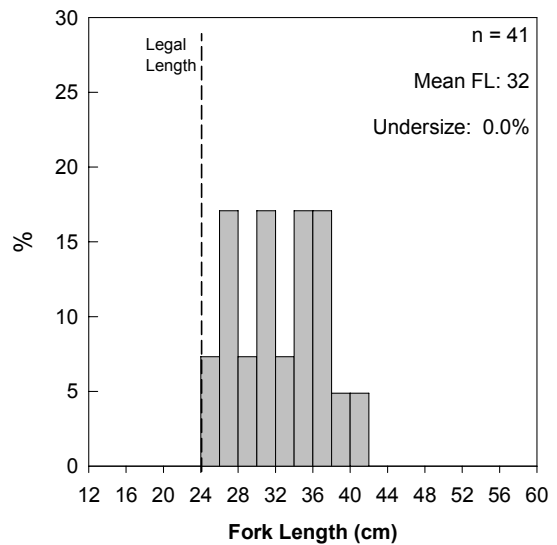
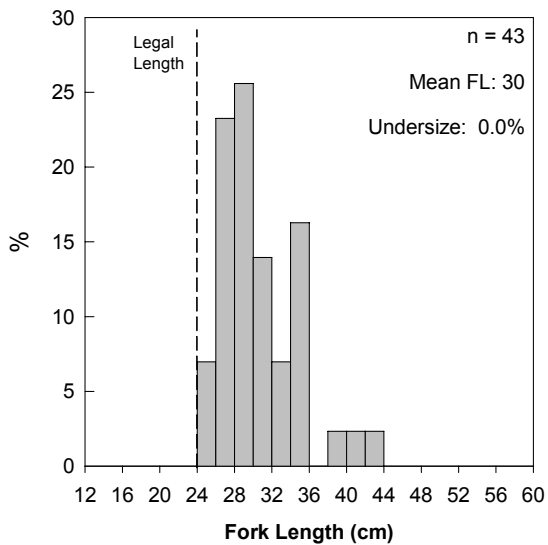


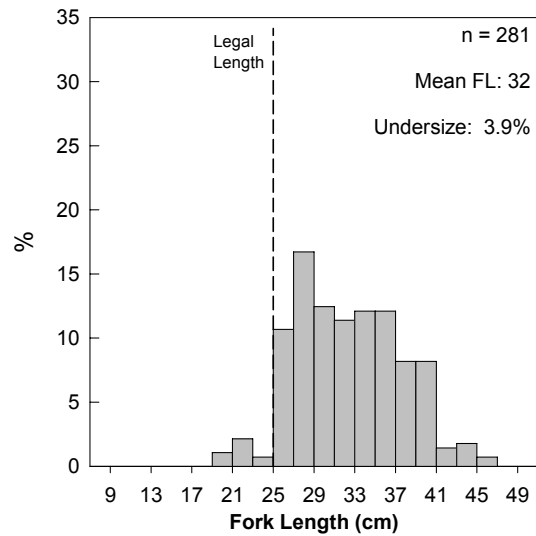
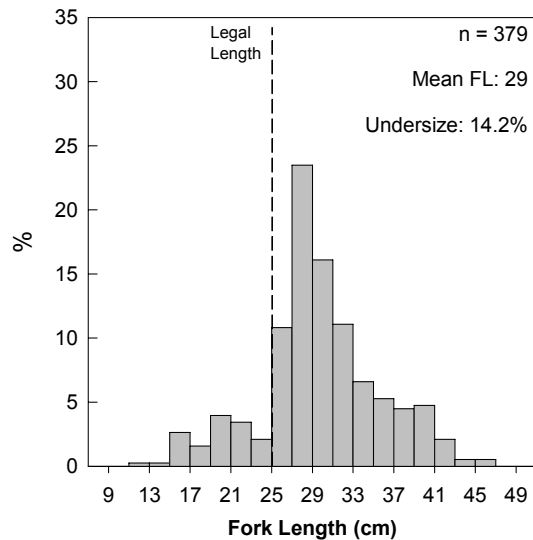
Figure 7. Annual length frequency distributions for sand whiting and luderick taken by recreational fishers (boat and shore fisheries combined) in the Hawkesbury River estuary.

PORT HACKING ESTUARY

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Sand Whiting



Luderick

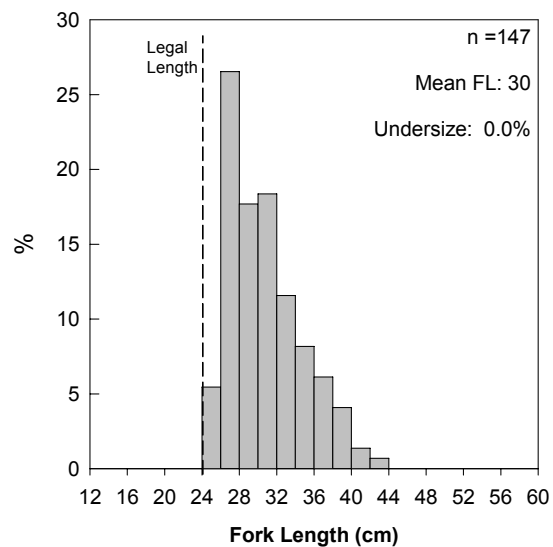
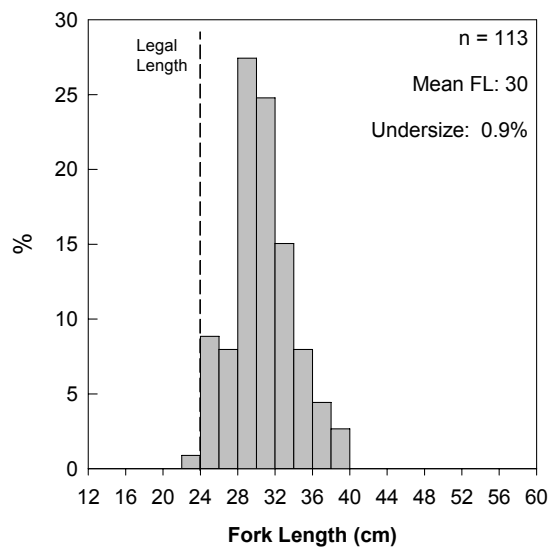


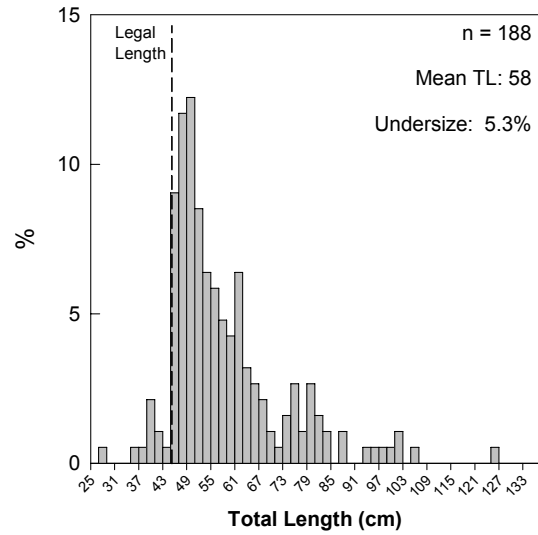
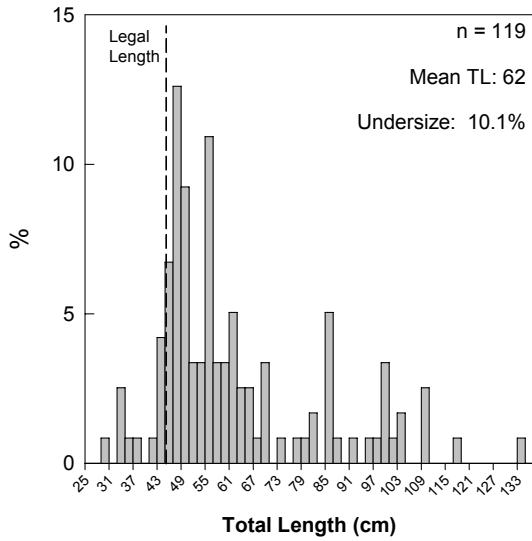
Figure 8. Annual length frequency distributions for sand whiting and luderick taken by recreational fishers (boat and shore fisheries combined) in the Port Hacking estuary.

HAWKESBURY RIVER ESTUARY

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Mulloway



Tailor

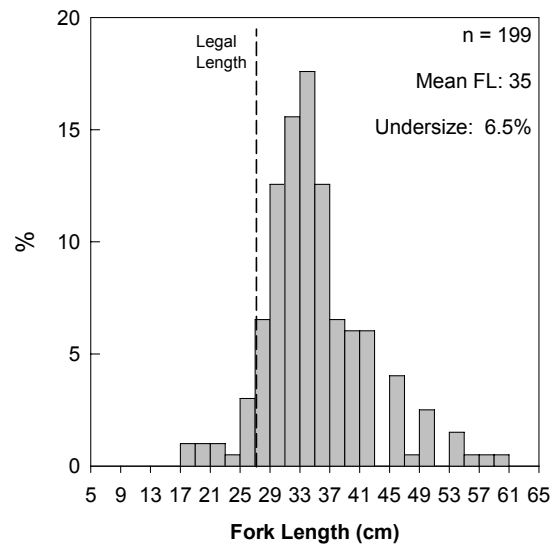
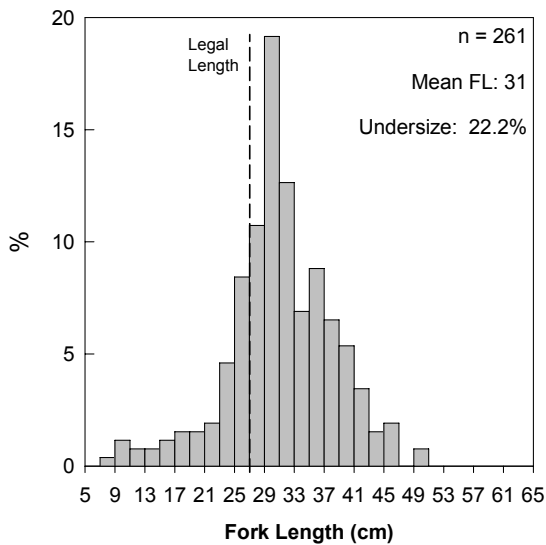


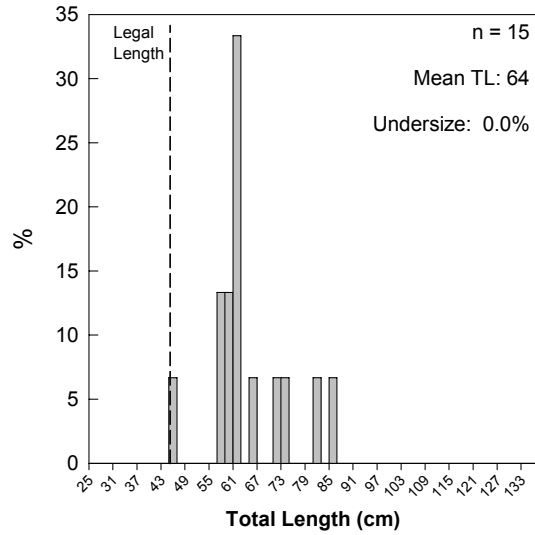
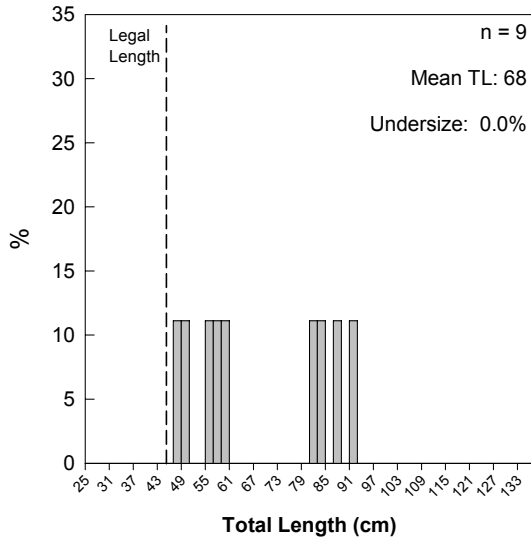
Figure 9. Annual length frequency distributions for mulloway and tailor taken by recreational fishers (boat and shore fisheries combined) in the Hawkesbury River estuary.

PORT HACKING ESTUARY

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Mulloway



Tailor

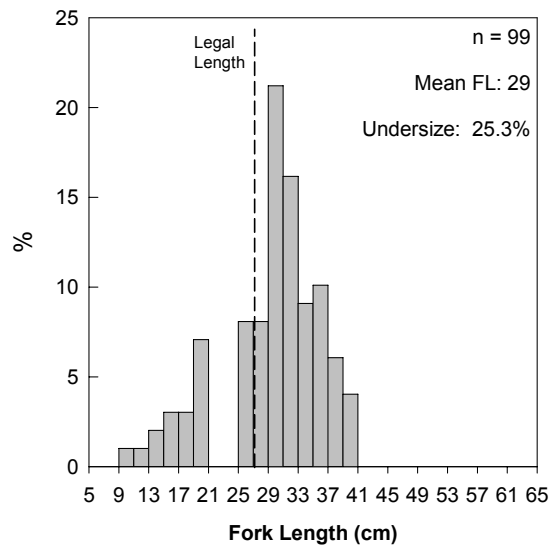
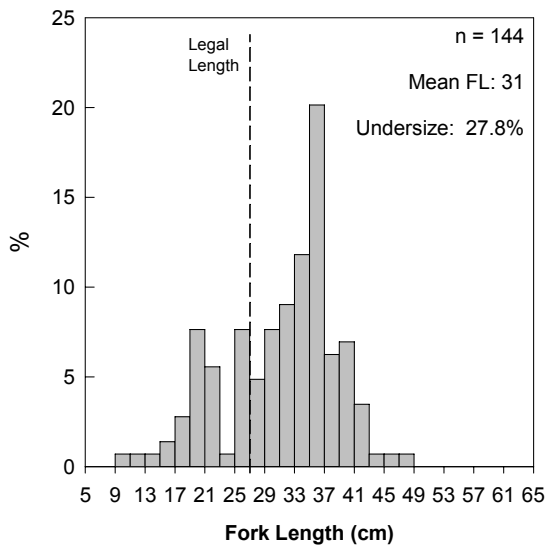


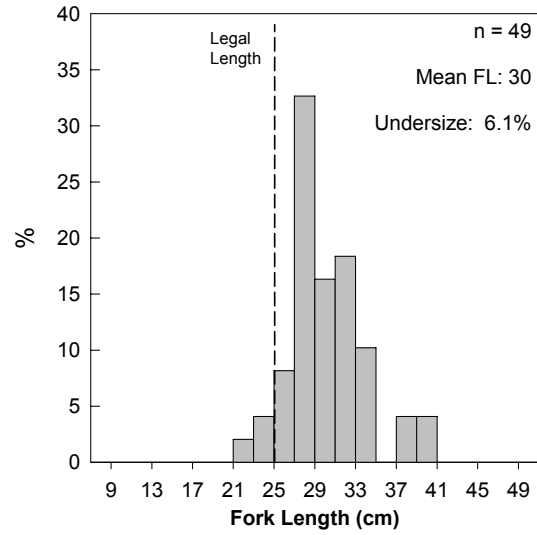
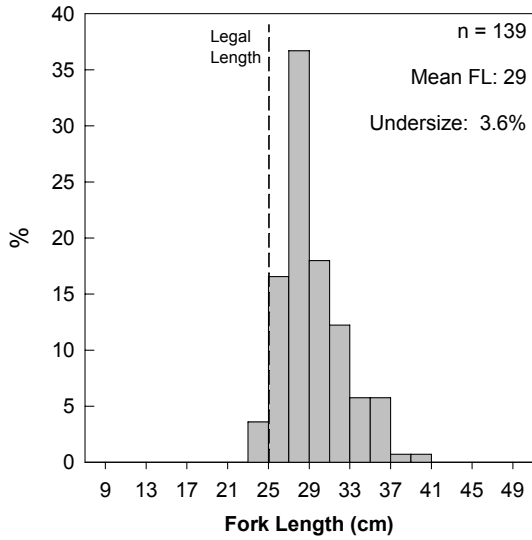
Figure 10. Annual length frequency distributions for mulloway and tailor taken by recreational fishers (boat and shore fisheries combined) in the Port Hacking estuary.

HAWKESBURY RIVER ESTUARY

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Silver Trevally



Blue Swimmer Crab

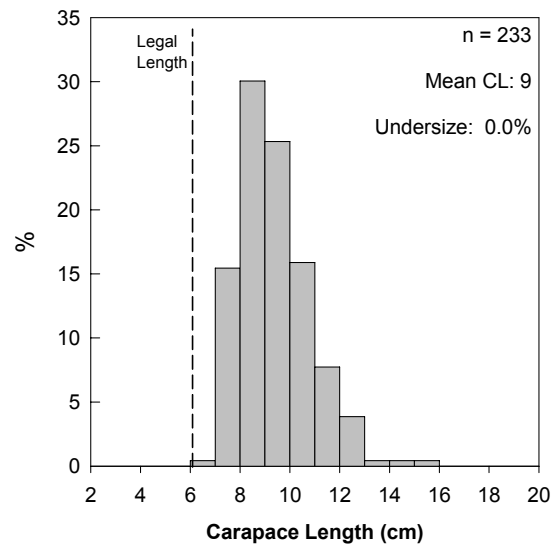
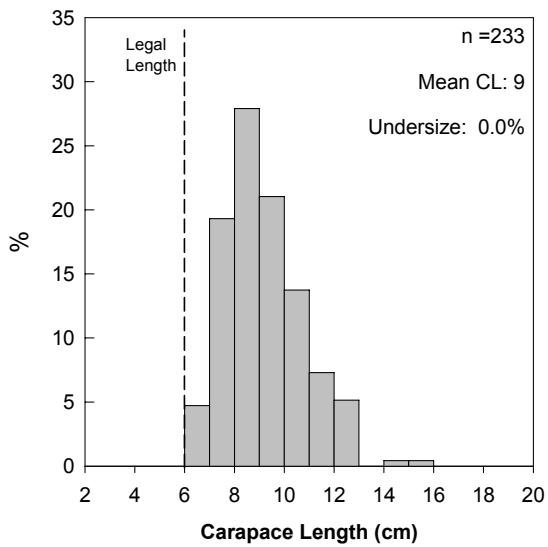


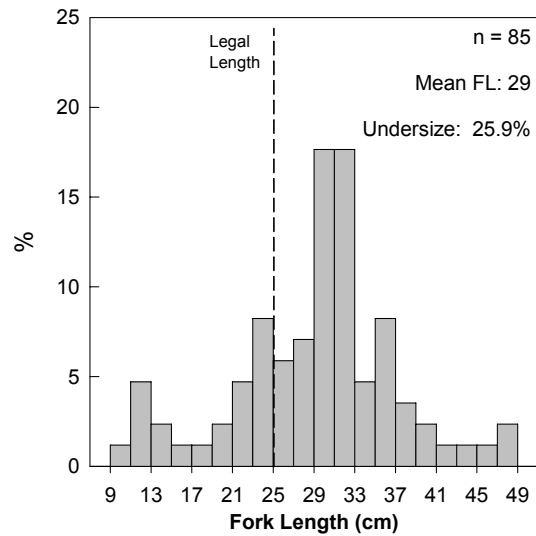
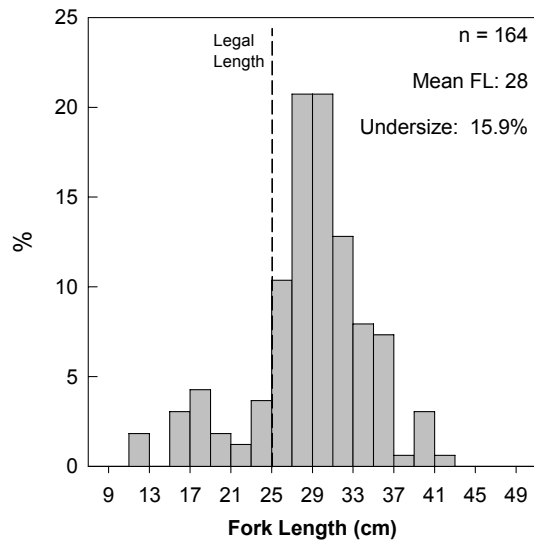
Figure 11. Annual length frequency distributions for silver trevally and blue swimmer crab taken by recreational fishers (boat and shore fisheries combined) in the Hawkesbury River estuary.

PORT HACKING ESTUARY

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Silver Trevally



Blue Swimmer Crab

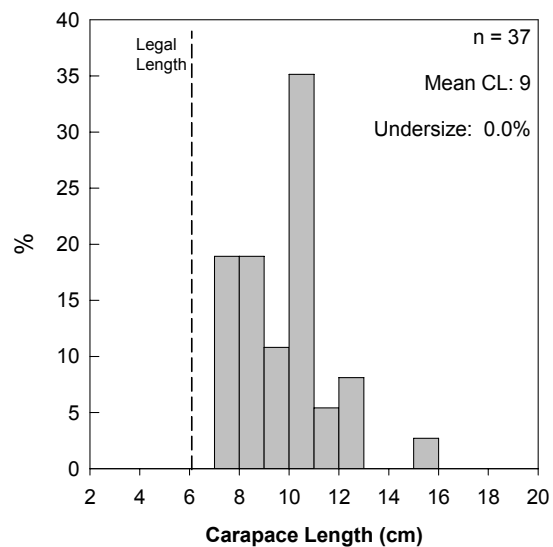
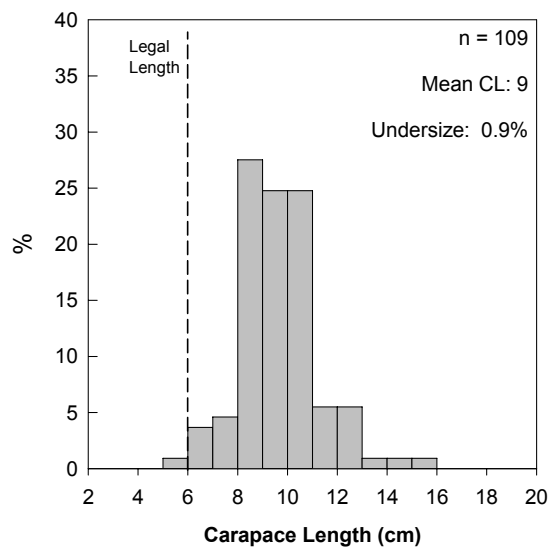


Figure 12. Annual length frequency distributions for silver trevally and blue swimmer crab taken by recreational fishers (boat and shore fisheries combined) in the Port Hacking estuary.

4.3. Coastal marine module – fishing effort

The levels of coastal marine fishing effort were similar between years (Figure 13). Not surprisingly, the largest amounts of fishing effort originated from the four large access sites in the Sydney metropolitan area (i.e., Hawkesbury estuary, Sydney Harbour, Botany Bay and Port Hacking). The three direct ocean access sites in the Illawarra area (i.e., Bellambi, Port Kembla and Shellharbour) had intermediate levels of fishing effort. The lowest levels of fishing effort were measured at the Long Reef, Terrigal and Norah Head ramps (Figure 13).

4.4. Coastal marine module – harvest and size frequency data

Overall, we recorded 119 taxa during the surveys of coastal marine fishing (Tables 13 – 28). The first survey year yielded 103 taxa, whilst 99 taxa were recorded during the second survey year (Tables 13 – 28). We estimated that about 257,000 and 253,900 fish, crustaceans and cephalopods were harvested by daytime recreational fishers at the sites surveyed for coastal marine fishing during each of the two survey years respectively (Tables 13 – 28). The ten most commonly harvested taxa, by number, at these sites accounted for 81.2% and 80.1% of the daytime recreational harvest during the two annual survey periods respectively (Tables 13 – 28). Site-specific summaries of harvest information for coastal marine fishing are provided (Tables 13 – 28).

The recreational harvest (number of individuals) of some species varied considerably between survey years at some sites (e.g., ocean leatherjacket, Tables 13 – 28) despite the relatively stable levels of annual fishing effort. Graphical comparisons of annual harvest among survey sites were created for six recreationally important species (Figures 14 – 19) to show how data from the harvest tables can be used (Tables 13 – 28). Graphical comparisons of size frequency information (Figures 20 – 43) are also presented for six recreationally important species in the coastal marine fishery. The size frequency information summarises the numbers of fish measured, the mean size of retained fish and the proportion of undersize fish in the retained catch. For example, size frequency comparisons for eastern bluespotted flathead show latitudinal differences within the Greater Sydney region. The mean sizes of eastern bluespotted flathead taken in the northern part of the region (i.e., Norah Head, Terrigal, Hawkesbury River system, and Long Reef access sites) tended to be larger, ranging annually between 40 and 45 cm (Figures 20 – 23), than the mean sizes of fish taken from access sites in the southern part of the region (i.e., Port Hacking system, Bellambi, Port Kembla and Shellharbour), which ranged annually between 39 and 41 cm (Figures 24 – 27).

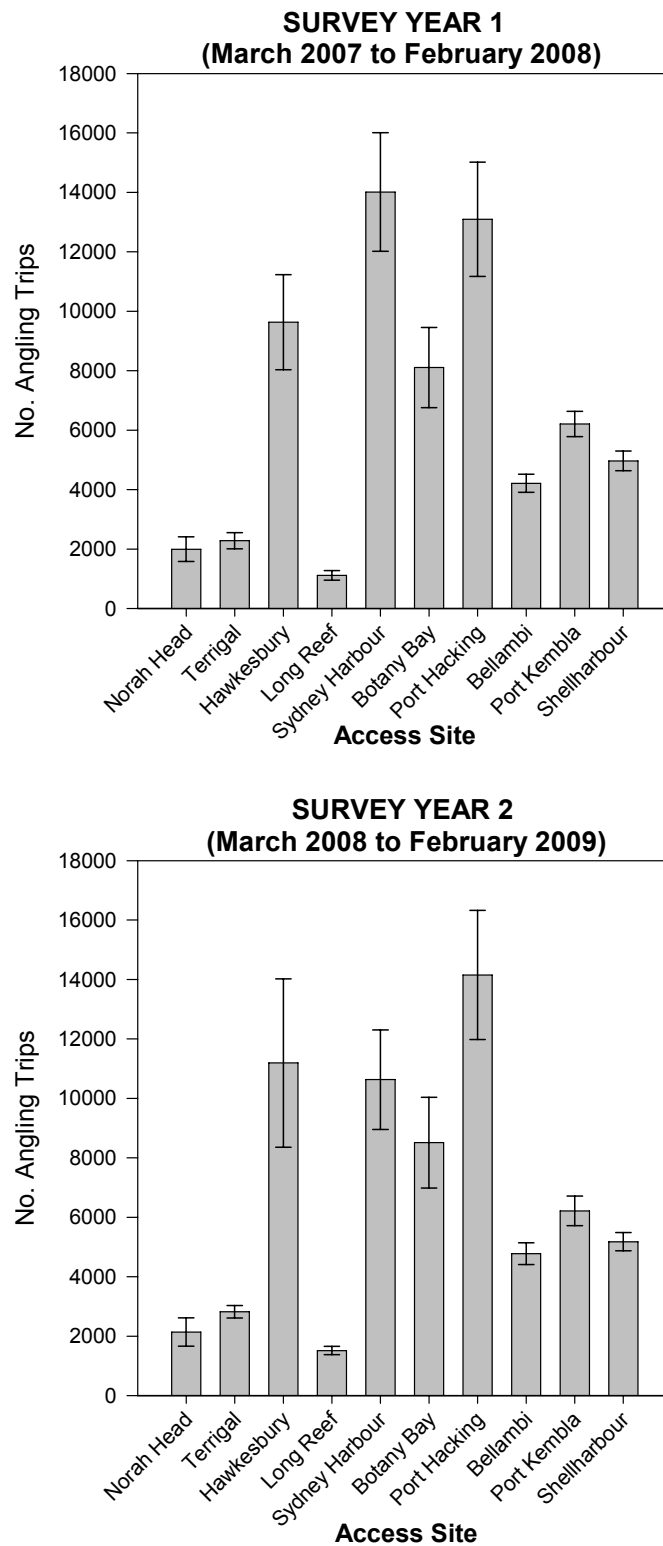


Figure 13. Annual estimates of daytime recreational fishing effort (angling trips) with 95% confidence intervals for trailer boat fishing in the coastal marine waters adjacent to each survey site.

Eastern Bluespotted Flathead

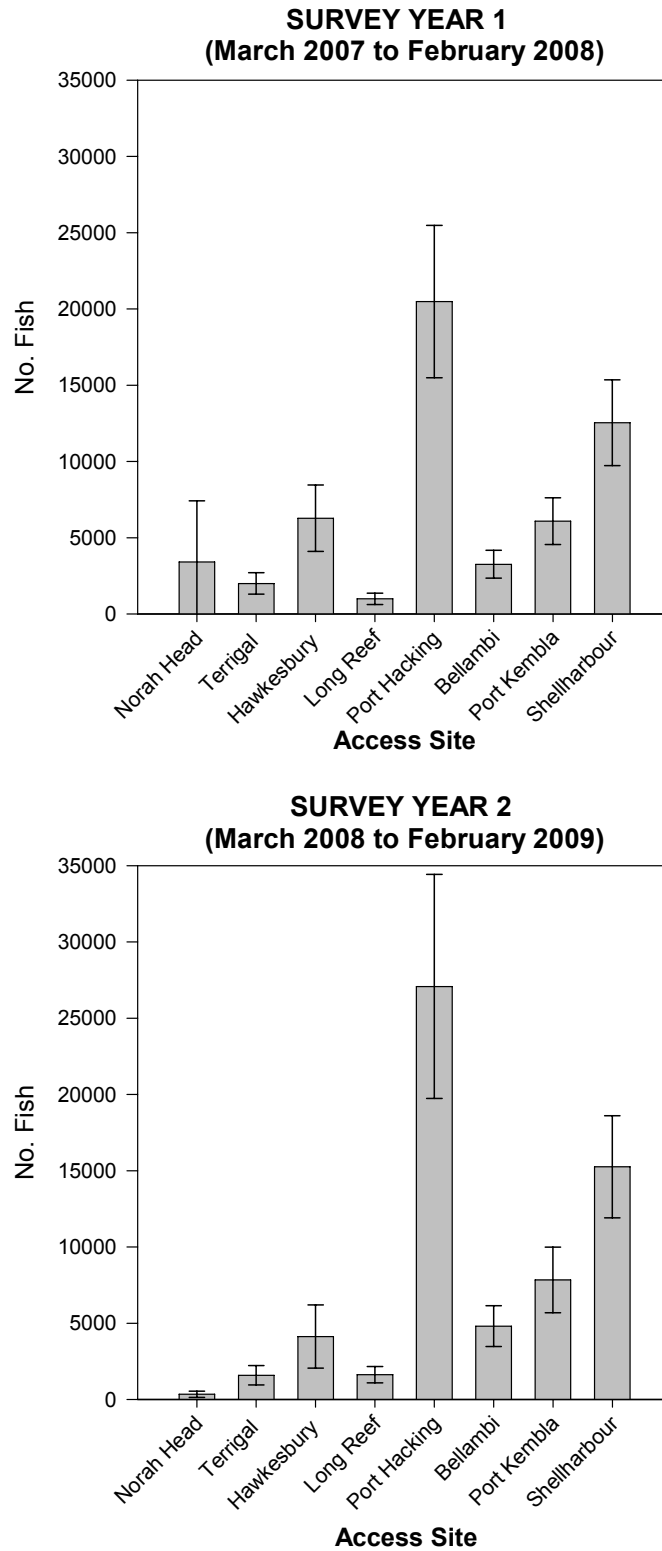


Figure 14. Annual estimates of recreational harvest (number of individuals) with 95% confidence intervals for eastern bluespotted flathead taken by trailer boat fishers in the coastal marine waters adjacent to each survey site.

Snapper

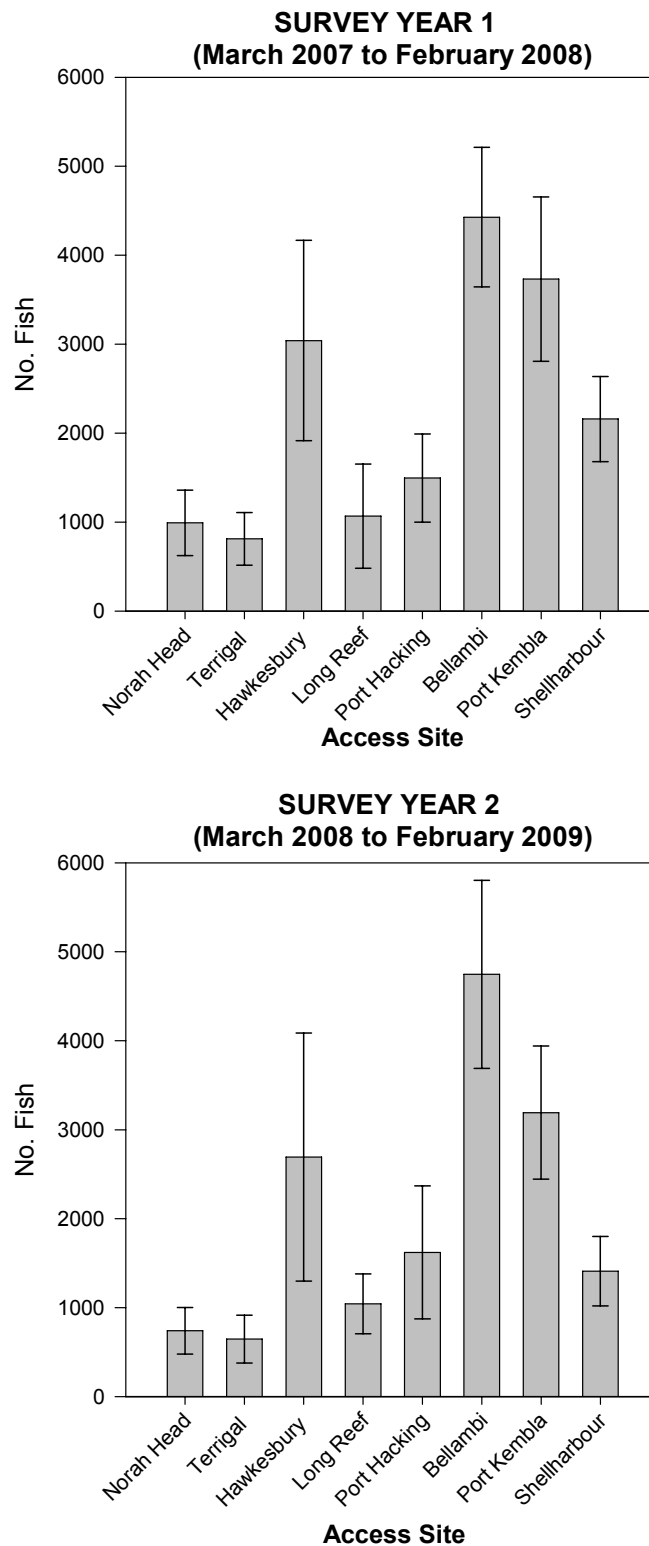


Figure 15. Annual estimates of recreational harvest (number of individuals) with 95% confidence intervals for snapper taken by trailer boat fishers in the coastal marine waters adjacent to each survey site.

Grey Morwong

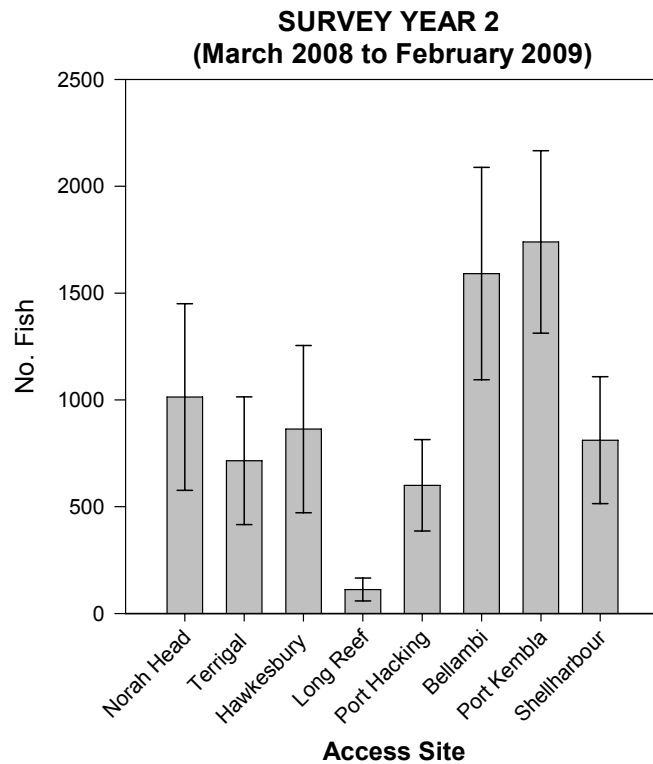
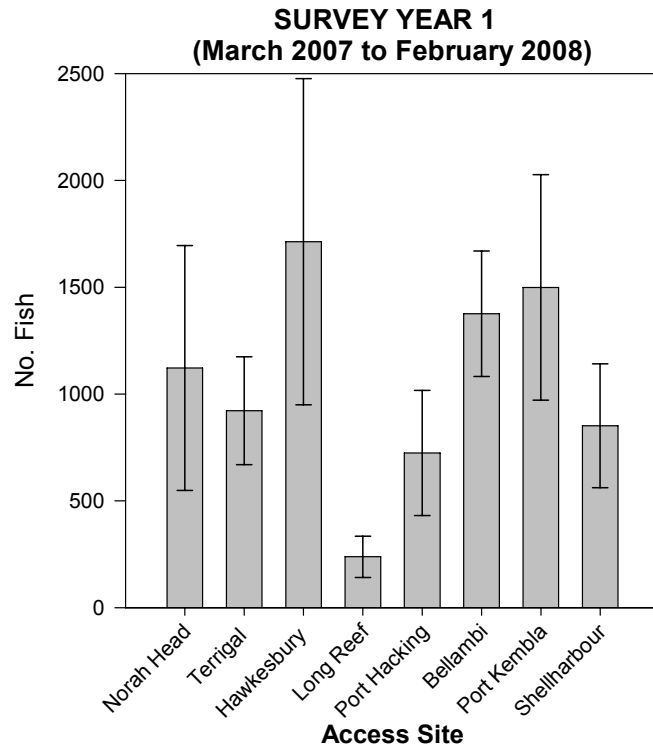


Figure 16. Annual estimates of recreational harvest (number of individuals) with 95% confidence intervals for grey morwong taken by trailer boat fishers in the coastal marine waters adjacent to each survey site.

Ocean Leatherjacket

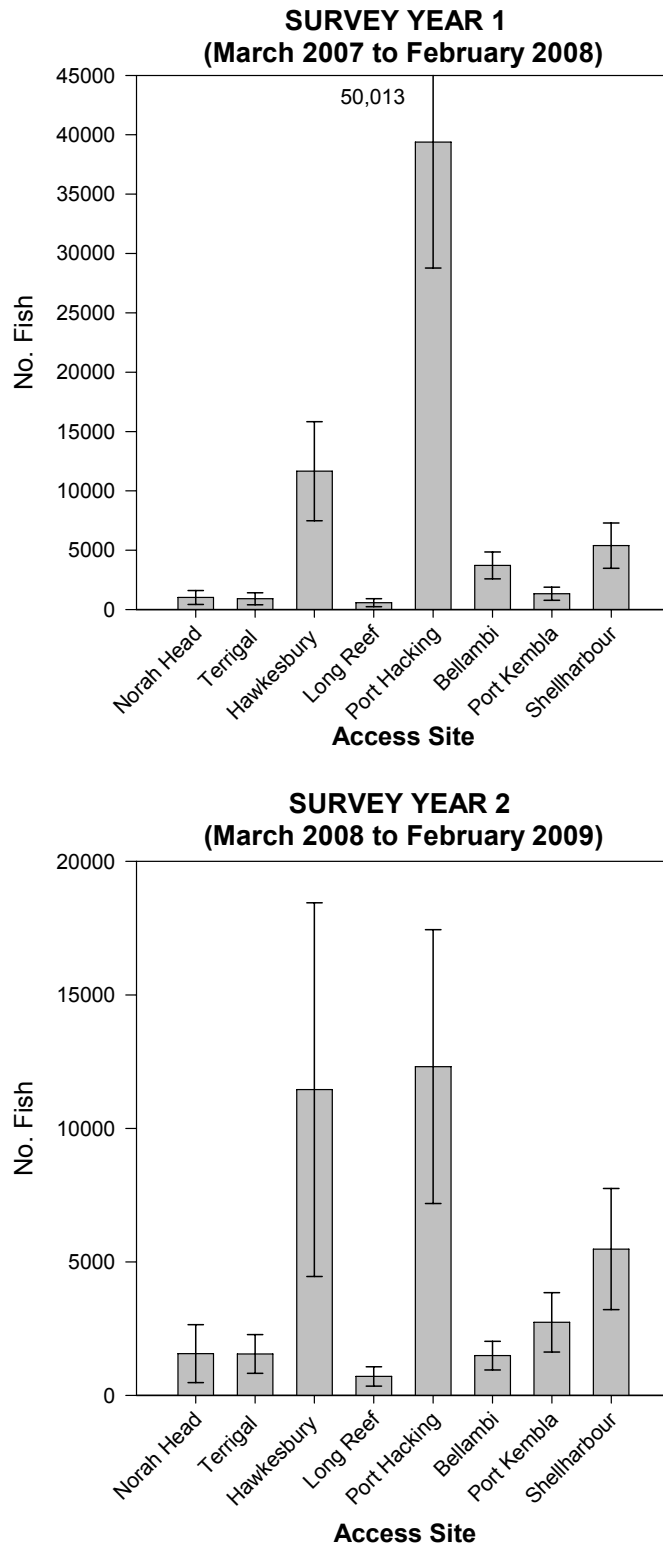


Figure 17. Annual estimates of recreational harvest (number of individuals) with 95% confidence intervals for ocean leatherjacket taken by trailer boat fishers in the coastal marine waters adjacent to each survey site.

Silver Trevally

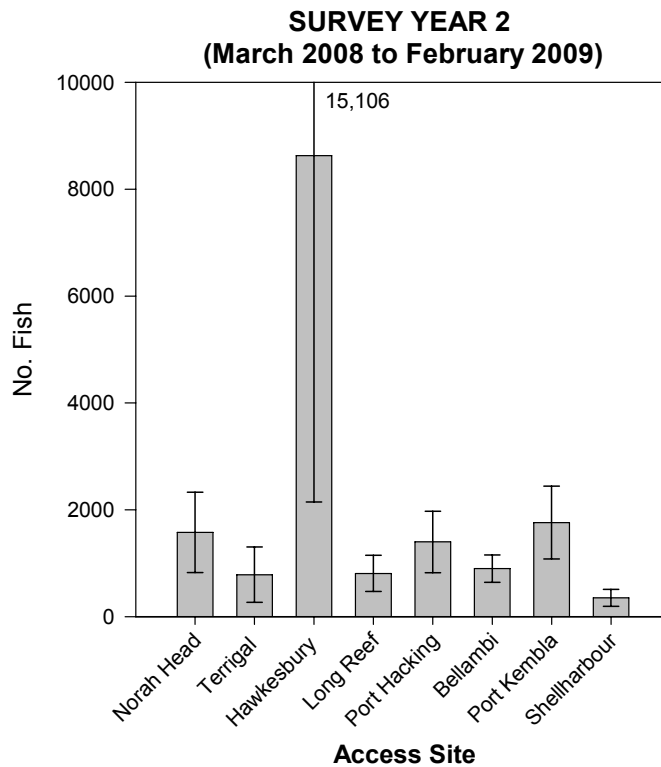
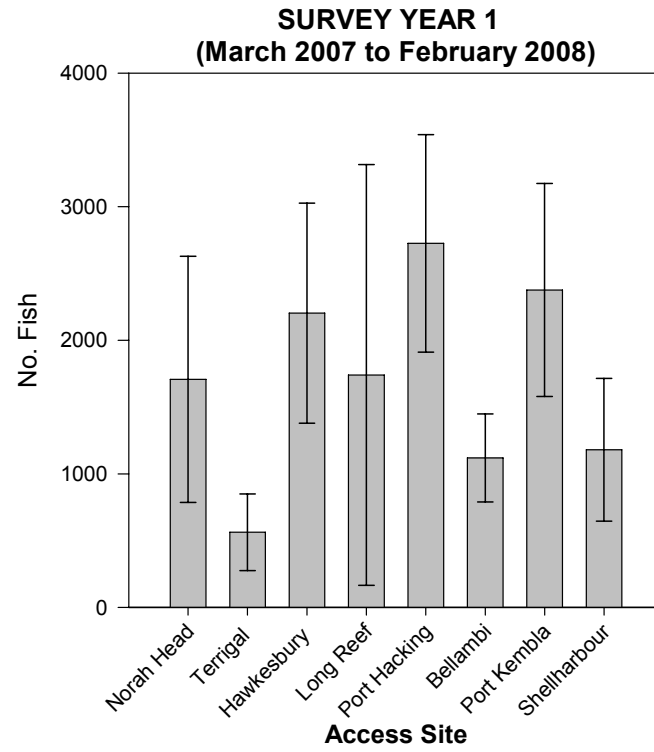


Figure 18. Annual estimates of recreational harvest (number of individuals) with 95% confidence intervals for silver trevally taken by trailer boat fishers in the coastal marine waters adjacent to each survey site.

Silver Sweep

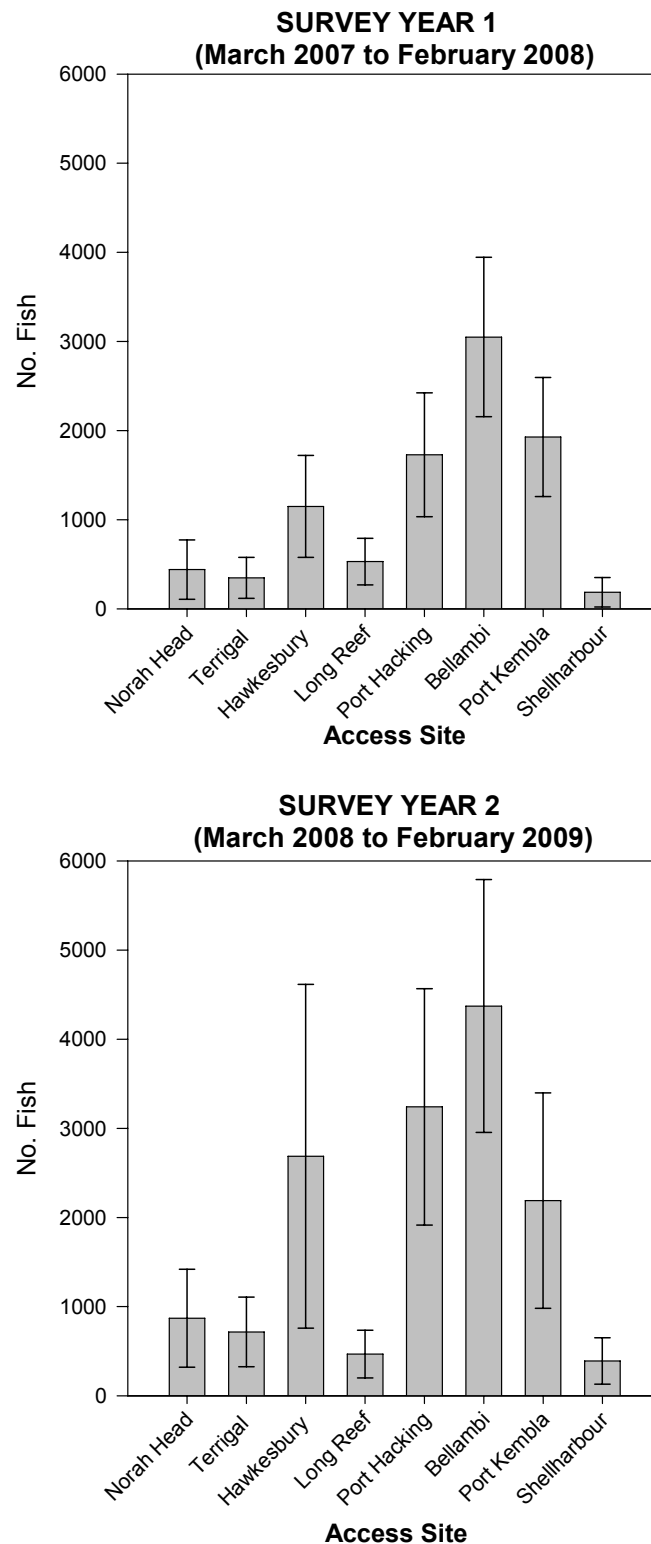


Figure 19. Annual estimates of recreational harvest (number of individuals) with 95% confidence intervals for silver sweep taken by trailer boat fishers in the coastal marine waters adjacent to each survey site.

Table 13. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to Norah Head during the first survey year (March 2007 to February 2008).

**NORAH HEAD
Survey Year 1**

Common Name	Total Fish (number)	95%			% Total
		Confidence Intervals			
Eastern Bluespotted Flathead	3,408	0	to	7,418	27.5
Silver Trevally	1,707	786	to	2,628	13.8
Grey Morwong	1,122	549	to	1,695	9.0
Ocean Leatherjacket	1,019	433	to	1,605	8.2
Snapper	992	623	to	1,361	8.0
Tailor	561	180	to	942	4.5
Silver Sweep	441	108	to	774	3.6
Tarwhine	438	185	to	691	3.5
Yellowfin Bream	306	132	to	480	2.5
Redfish	294	130	to	458	2.4
Yellowtail	275	84	to	466	2.2
Longfin Perch	275	0	to	661	2.2
Samsonfish	201	33	to	369	1.6
Southern Maori Wrasse	175	39	to	311	1.4
Sixspine Leatherjacket	116	35	to	197	0.9
Yellowtail Kingfish	109	24	to	194	0.9
Australian Bonito	89	0	to	180	0.7
Sergeant Baker	86	4	to	168	0.7
Eastern Red Scorpionfish	64	4	to	124	0.5
Marbled Flathead	55	0	to	139	0.4
Crimsonband Wrasse	52	0	to	141	0.4
Yellowfin Leatherjacket	52	0	to	110	0.4
Rough Leatherjacket	51	0	to	143	0.4
Dusky Flathead	41	0	to	93	0.3
Teraglin	40	0	to	94	0.3
Longfin Pike	40	0	to	89	0.3
Eastern Pigfish	37	2	to	72	0.3
Mahi Mahi	35	0	to	99	0.3
Wobbeong Sharks	32	0	to	75	0.3
Eastern Blue Groper	31	0	to	64	0.2
Tiger Flathead	31	3	to	59	0.2
Frigate Mackerel	29	0	to	76	0.2
Salmon	25	0	to	58	0.2
Black Reef Leatherjacket	23	0	to	60	0.2
Banjo Ray	21	0	to	50	0.2
Southern Calamari	20	0	to	46	0.2
Pearl Perch	16	0	to	42	0.1
Bearded Cods	14	0	to	40	0.1
Giant Cuttlefish	14	0	to	39	0.1
Blue Catfish	10	0	to	26	<0.1

Table 13. Continued

**NORAH HEAD
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Shovelnose Ray	7	0	to	20	<0.1
Cobia	7	0	to	18	<0.1
Rock Blackfish	7	0	to	20	<0.1
Tasselsnout Flathead	7	0	to	20	<0.1
Mulloway	7	0	to	20	<0.1
Blacksaddle Goatfish	6	0	to	16	<0.1
Red Gurnard	6	0	to	16	<0.1
Mosaic Leatherjacket	3	0	to	8	<0.1
Bastard Trumpeter	3	0	to	8	<0.1
Bluestriped Goatfish	3	0	to	8	<0.1
Total	12,403	2,315	to	22,491	100.0

Table 14. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to Norah Head during the second survey year (March 2008 to February 2009).

**NORAH HEAD
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Silver Trevally	1,577	823	to	2,331	17.1
Ocean Leatherjacket	1,564	480	to	2,648	16.9
Grey Morwong	1,013	576	to	1,450	11.0
Silver Sweep	870	320	to	1,420	9.4
Snapper	741	480	to	1,002	8.0
Yellowtail Kingfish	450	203	to	697	4.9
Southern Maori Wrasse	414	163	to	665	4.5
Eastern Bluespotted Flathead	342	134	to	550	3.7
Australian Bonito	258	91	to	425	2.8
Sixspine Leatherjacket	231	98	to	364	2.5
Teraglin	190	0	to	488	2.1
Redfish	169	83	to	255	1.8
Tailor	168	11	to	325	1.8
Samsonfish	160	0	to	324	1.7
Sergeant Baker	152	18	to	286	1.6
Southern Calamari	147	0	to	336	1.6
Tarwhine	136	51	to	221	1.5
Yellowtail	99	0	to	220	1.1
Yellowfin Bream	94	10	to	178	1.0
Longfin Perch	73	0	to	193	0.8
Eastern Pigfish	68	18	to	118	0.7
Eastern Red Scorpionfish	53	0	to	108	0.6
Salmon	41	0	to	98	0.4
Skipjack Tuna	27	0	to	57	0.3
Marbled Flathead	23	0	to	46	0.2
Eastern Blue Groper	23	2	to	44	0.2
Bluestriped Goatfish	21	0	to	48	0.2
Halfbanded Seaperch	21	0	to	60	0.2
Giant Cuttlefish	20	0	to	43	0.2
Tiger Flathead	18	0	to	47	0.2
Crimsonband Wrasse	13	0	to	28	0.1
Pearl Perch	13	0	to	35	0.1
Rock Cale	9	0	to	24	<0.1
Dusky Flathead	7	0	to	18	<0.1
Blacksaddle Goatfish	7	0	to	18	<0.1
Sand Mullet	7	0	to	18	<0.1
Red Morwong	7	0	to	18	<0.1
Bearded Cods	7	0	to	18	<0.1
Mulloway	7	0	to	18	<0.1
Shovelnose Ray	6	0	to	16	<0.1
Total	9,246	3,234	to	15,258	100.0

Table 15. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to Terrigal during the first survey year (March 2007 to February 2008).

**TERRIGAL
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Eastern Bluespotted Flathead	1,998	1,293	to	2,703	22.8
Grey Morwong	922	670	to	1,174	10.5
Ocean Leatherjacket	903	404	to	1,402	10.3
Snapper	812	516	to	1,108	9.3
Silver Trevally	563	276	to	850	6.4
Samsonfish	394	102	to	686	4.5
Silver Sweep	348	117	to	579	4.0
Yellowtail Kingfish	334	121	to	547	3.8
Yellowtail	329	101	to	557	3.8
Redfish	267	120	to	414	3.0
Sixspine Leatherjacket	219	91	to	347	2.5
Australian Bonito	208	46	to	370	2.4
Southern Calamari	181	0	to	366	2.1
Blue Mackerel	165	0	to	368	1.9
Tailor	115	38	to	192	1.3
Southern Maori Wrasse	110	17	to	203	1.3
Eastern Red Scorpionfish	91	29	to	153	1.0
Marbled Flathead	86	29	to	143	1.0
Mahi Mahi	82	0	to	181	0.9
Salmon	79	13	to	145	0.9
Eastern Pigfish	60	0	to	127	0.7
Tiger Flathead	52	11	to	93	0.6
Sergeant Baker	50	9	to	91	0.6
Yellowfin Bream	46	4	to	88	0.5
Dusky Flathead	45	14	to	76	0.5
Longfin Perch	36	0	to	81	0.4
Giant Cuttlefish	35	9	to	61	0.4
Eastern Blue Groper	31	0	to	63	0.4
Senator Wrasse	28	0	to	74	0.3
Frigate Mackerel	27	5	to	49	0.3
Teraglin	19	0	to	39	0.2
Mulloway	19	0	to	44	0.2
Red Gurnard	18	4	to	32	0.2
Tarwhine	17	2	to	32	0.2
Pearl Perch	14	0	to	28	0.2
Bearded Cods	10	0	to	21	0.1
Largetooth Flounder	9	0	to	24	0.1
Gummy Shark	9	0	to	23	0.1
Smalltooth Flounder	8	0	to	17	<0.1
Rough Leatherjacket	7	0	to	18	<0.1

Table 15. Continued.

**TERRIGAL
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Crimsonband Wrasse	6	0	to	18	<0.1
Bluestriped Goatfish	5	0	to	13	<0.1
Longspine Flathead	5	0	to	13	<0.1
Reef Ocean Perch	3	0	to	7	<0.1
Amberjack	3	0	to	9	<0.1
Shovelnose Ray	3	0	to	9	<0.1
Total	8,771	3,904	to	13,638	100.0

Table 16. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to Terrigal during the second survey year (March 2008 to February 2009).

**TERRIGAL
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Ocean Leatherjacket	1,614	873	to	2,355	14.3
Eastern Bluespotted Flathead	1,589	953	to	2,225	14.1
Yellowtail	947	249	to	1,645	8.4
Silver Trevally	785	267	to	1,303	7.0
Silver Sweep	716	326	to	1,106	6.3
Grey Morwong	715	416	to	1,014	6.3
Redfish	702	41	to	1,363	6.2
Australian Bonito	649	367	to	931	5.8
Snapper	647	378	to	916	5.7
Tailor	423	58	to	788	3.7
Yellowtail Kingfish	395	179	to	611	3.5
Sergeant Baker	272	0	to	625	2.4
Yellowfin Bream	263	36	to	490	2.3
Southern Calamari	237	48	to	426	2.1
Mahi Mahi	159	0	to	337	1.4
Longfin Perch	150	0	to	371	1.3
Salmon	133	33	to	233	1.2
Southern Maori Wrasse	118	59	to	177	1.0
Eastern Red Scorpionfish	117	0	to	274	1.0
Marbled Flathead	116	39	to	193	1.0
Samsonfish	93	39	to	147	0.8
Crimsonband Wrasse	80	0	to	166	0.7
Longfin Pike	68	0	to	140	0.6
Teraglin	45	10	to	80	0.4
Pigfish	43	9	to	77	0.4
Pearl Perch	40	0	to	84	0.4
Sixspine Leatherjacket	32	12	to	52	0.3
Tiger Flathead	22	0	to	45	0.2
Large-tooth Flounder	15	1	to	29	0.1
Yellowfin Leatherjacket	12	0	to	31	0.1
Whaler Sharks	12	0	to	32	0.1
Blue Mackerel	10	0	to	24	<0.1
Gummy Shark	8	0	to	21	<0.1
John Dory	8	0	to	21	<0.1
Amberjack	7	0	to	19	<0.1
Mulloway	7	0	to	19	<0.1
Dusky Flathead	7	0	to	19	<0.1
Bearded Cods	6	0	to	12	<0.1
Striped Marlin	6	0	to	17	<0.1
Skipjack Tuna	6	0	to	16	<0.1

Table 16. *Continued.*

TERRIGAL Survey Year 2					
Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Shovelnose Ray	4	0	to	10	<0.1
Tarwhine	4	0	to	10	<0.1
Red Gurnard	3	0	to	9	<0.1
Total	11,285	4,107	to	18,463	100.0

Table 17. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to the Hawkesbury River system during the first survey year (March 2007 to February 2008).

**HAWKESBURY - COASTAL MARINE
Survey Year 1**

Common Name	Total Fish (number)	95%			% Total
		Confidence Intervals			
Ocean Leatherjacket	11,655	7,474	to	15,836	26.5
Eastern Bluespotted Flathead	6,280	4,104	to	8,456	14.3
Snapper	3,041	1,915	to	4,167	6.9
Silver Trevally	2,203	1,379	to	3,027	5.0
Tailor	2,146	624	to	3,668	4.9
Mahi Mahi	2,073	12	to	4,134	4.7
Grey Morwong	1,713	950	to	2,476	3.9
Southern Maori Wrasse	1,363	519	to	2,207	3.1
Yellowtail Kingfish	1,354	642	to	2,066	3.1
Silver Sweep	1,150	578	to	1,722	2.6
Yellowfin Bream	1,140	547	to	1,733	2.6
Yellowtail	938	199	to	1,677	2.1
Sixspine Leatherjacket	860	385	to	1,335	2.0
Eastern Red Scorpionfish	734	297	to	1,171	1.7
Dusky Flathead	695	341	to	1,049	1.6
Redfish	555	161	to	949	1.3
Blue Mackerel	481	0	to	1,033	1.1
Sergeant Baker	443	148	to	738	1.0
Salmon	438	131	to	745	1.0
Southern Calamari	410	140	to	680	0.9
Marbled Flathead	391	29	to	753	0.9
Tarwhine	343	147	to	539	0.8
Smalltooth Flounder	338	0	to	678	0.8
Crimsonband Wrasse	333	144	to	522	0.8
Largetooth Flounder	315	0	to	660	0.7
Frigate Mackerel	301	0	to	853	0.7
Skipjack Tuna	275	44	to	506	0.6
Australian Bonito	274	107	to	441	0.6
Yellowfin Leatherjacket	207	0	to	416	0.5
Samsonfish	196	31	to	361	0.4
Luderick	133	0	to	347	0.3
Tiger Flathead	128	0	to	263	0.3
Giant Cuttlefish	115	0	to	241	0.3
Longfin Perch	109	0	to	238	0.2
Longfin Pike	92	15	to	169	0.2
Fourline Striped Grunter	92	0	to	239	0.2
Eastern School Whiting	92	0	to	202	0.2
Longspine Flathead	76	0	to	214	0.2
Eastern Wirrah	69	0	to	142	0.2
Rough Leatherjacket	65	0	to	184	0.1

Table 17. Continued.

**HAWKESBURY - COASTAL MARINE
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Eastern Pigfish	55	0	to	110	0.0
Yellowfin Tuna	43	0	to	112	<0.1
Bluestriped Goatfish	43	0	to	122	<0.1
Mulloway	39	0	to	103	<0.1
Eastern Blue Groper	29	0	to	64	<0.1
Red Gurnard	24	0	to	51	<0.1
Gummy Shark	24	0	to	62	<0.1
Teraglin	22	0	to	58	<0.1
Lizardfish	14	0	to	38	<0.1
Albacore	14	0	to	37	<0.1
Total	43,923	20,252	to	67,594	100.0

Table 18. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to the Hawkesbury River system during the second survey year (March 2008 to February 2009).

**HAWKESBURY - COASTAL MARINE
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Ocean Leatherjacket	11,453	4,456	to	18,450	24.6
Silver Trevally	8,626	2,146	to	15,106	18.5
Eastern Bluespotted Flathead	4,124	2,055	to	6,193	8.9
Snapper	2,692	1,298	to	4,086	5.8
Silver Sweep	2,687	759	to	4,615	5.8
Tailor	2,376	259	to	4,493	5.1
Yellowtail	1,607	0	to	3,349	3.5
Southern Maori Wrasse	1,481	477	to	2,485	3.2
Mahi Mahi	1,341	122	to	2,560	2.9
Southern Calamari	1,092	0	to	2,380	2.3
Dusky Flathead	1,062	335	to	1,789	2.3
Smalltooth Flounder	968	173	to	1,763	2.1
Grey Morwong	863	471	to	1,255	1.9
Blue Mackerel	826	0	to	1,699	1.8
Yellowfin Bream	722	0	to	1,613	1.6
Sixspine Leatherjacket	630	161	to	1,099	1.4
Eastern Red Scorpionfish	577	35	to	1,119	1.2
Australian Bonito	508	50	to	966	1.1
Crimsonband Wrasse	477	0	to	1,039	1.0
Redfish	399	63	to	735	0.9
Sergeant Baker	399	126	to	672	0.9
Yellowtail Kingfish	326	0	to	690	0.7
Salmon	244	29	to	459	0.5
Skipjack Tuna	143	0	to	321	0.3
Tarwhine	134	24	to	244	0.3
Marbled Flathead	107	14	to	200	0.2
Tiger Flathead	80	0	to	160	0.2
Largetooth Flounder	62	0	to	167	0.1
Samsonfish	52	0	to	139	0.1
Eastern Foxfish	46	0	to	130	<0.1
Eastern Blue Groper	46	0	to	125	<0.1
Bearded Cods	42	0	to	102	<0.1
Yellowfin Leatherjacket	41	0	to	96	<0.1
Blacksaddle Goatfish	37	0	to	104	<0.1
Halfbanded Seaperch	37	0	to	104	<0.1
Butterfly Perch	31	0	to	81	<0.1
Teraglin	27	0	to	71	<0.1
Eastern Pigfish	27	0	to	70	<0.1
Snook	27	0	to	70	<0.1
Eastern Wirrah	26	0	to	70	<0.1

Table 18. *Continued.*

**HAWKESBURY - COASTAL MARINE
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Pearl Perch	25	0	to	65	<0.1
Mulloway	23	0	to	60	<0.1
Red Gurnard	19	0	to	50	<0.1
Giant Cuttlefish	15	0	to	40	<0.1
Rock Blackfish	15	0	to	40	<0.1
Gummy Shark	12	0	to	32	<0.1
Northern Sand Flathead	10	0	to	25	<0.1
Total	46,564	11,947	to	81,181	100.0

Table 19. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to Long Reef during the first survey year (March 2007 to February 2008).

**LONG REEF
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Silver Trevally	1,740	165	to	3,315	21.7
Snapper	1,067	481	to	1,653	13.3
Eastern Bluespotted Flathead	994	619	to	1,369	12.4
Blue Mackerel	644	0	to	1,496	8.0
Yellowtail	584	233	to	935	7.3
Ocean Leatherjacket	568	234	to	902	7.1
Silver Sweep	530	268	to	792	6.6
Tailor	473	164	to	782	5.9
Yellowtail Kingfish	268	99	to	437	3.3
Grey Morwong	238	141	to	335	3.0
Southern Maori Wrasse	163	65	to	261	2.0
Samsonfish	105	21	to	189	1.3
Tarwhine	78	12	to	144	1.0
Mulloway	73	1	to	145	0.9
Marbled Flathead	62	20	to	104	0.8
Sixspine Leatherjacket	59	25	to	93	0.7
Sergeant Baker	47	5	to	89	0.6
Southern Calamari	41	12	to	70	0.5
Dusky Flathead	32	12	to	52	0.4
Eastern Red Scorpionfish	31	12	to	50	0.4
False Fusilier	29	0	to	64	0.4
Redfish	27	3	to	51	0.3
Crimsonband Wrasse	27	0	to	67	0.3
Tiger Flathead	26	6	to	46	0.3
Salmon	20	0	to	42	0.2
Australian Bonito	14	3	to	25	0.2
Eastern Pigfish	9	1	to	17	0.1
Banjo Ray	7	0	to	20	<0.1
Frigate Mackerel	6	0	to	13	<0.1
Yellowfin Leatherjacket	6	0	to	15	<0.1
Giant Cuttlefish	6	0	to	16	<0.1
Yellowfin Bream	5	0	to	13	<0.1
Skipjack Tuna	5	0	to	11	<0.1
Pearl Perch	5	1	to	9	<0.1
Rock Blackfish	4	0	to	11	<0.1
Amberjack	3	0	to	7	<0.1
Eastern School Whiting	3	0	to	7	<0.1
Eastern Blue Groper	2	0	to	5	<0.1
Bearded Cods	2	0	to	5	<0.1
Bastard Trumpeter	2	0	to	5	<0.1

Table 19. *Continued.*

**LONG REEF
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Banded Seaperch	2	0	to	6	<0.1
Mosaic Leatherjacket	2	0	to	6	<0.1
Blue Swimmer Crab	1	0	to	3	<0.1
Red Gurnard	1	0	to	3	<0.1
Bluestriped Goatfish	1	0	to	3	<0.1
Total	8,012	2,341	to	13,683	100.0

Table 20. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to Long Reef during the second survey year (March 2008 to February 2009).

**LONG REEF
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Eastern Bluespotted Flathead	1,628	1,089	to	2,167	19.2
Snapper	1,043	707	to	1,379	12.3
Yellowtail	851	268	to	1,434	10.0
Blue Mackerel	831	392	to	1,270	9.8
Silver Trevally	808	469	to	1,147	9.5
Ocean Leatherjacket	709	348	to	1,070	8.3
Tailor	543	264	to	822	6.4
Silver Sweep	467	200	to	734	5.5
Yellowtail Kingfish	203	79	to	327	2.4
Skipjack Tuna	187	0	to	440	2.2
Samsonfish	171	95	to	247	2.0
Southern Maori Wrasse	141	56	to	226	1.7
Grey Morwong	112	58	to	166	1.3
Australian Bonito	110	23	to	197	1.3
Tiger Flathead	93	42	to	144	1.1
Sergeant Baker	74	6	to	142	0.9
Sixspine Leatherjacket	64	31	to	97	0.8
Longfin Pike	46	15	to	77	0.5
Southern Calamari	40	18	to	62	0.5
Marbled Flathead	37	21	to	53	0.4
Mulloway	36	0	to	73	0.4
Mahi Mahi	35	0	to	92	0.4
Whaler Sharks	32	0	to	77	0.4
Eastern Red Scorpionfish	28	12	to	44	0.3
Dusky Flathead	23	0	to	50	0.3
Rock Blackfish	23	0	to	51	0.3
Eastern School Whiting	16	0	to	36	0.2
Gummy Shark	16	0	to	45	0.2
Bluestriped Goatfish	16	0	to	39	0.2
Teraglin	15	0	to	33	0.2
Salmon	12	1	to	23	0.1
Frigate Mackerel	10	0	to	23	0.1
Redfish	8	0	to	18	<0.1
False Fusilier	7	0	to	19	<0.1
Giant Cuttlefish	7	0	to	16	<0.1
Eastern Wirrah	7	0	to	16	<0.1
Red Gurnard	6	0	to	13	<0.1
Eastern Pigfish	5	0	to	14	<0.1
Black Trevally	5	0	to	13	<0.1
Yellowfin Bream	5	0	to	11	<0.1

Table 20. *Continued.*

**LONG REEF
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Crimsonband Wrasse	5	0	to	12	<0.1
Sea Garfish	3	0	to	8	<0.1
Rough Leatherjacket	3	0	to	7	<0.1
Mado	3	0	to	9	<0.1
Shortfin Mako Shark	3	0	to	7	<0.1
Eastern Blue Groper	2	0	to	6	<0.1
Stout Longtom	2	0	to	5	<0.1
Barracouta	1	0	to	3	<0.1
Total	8,492	4,020	to	12,964	100.0

Table 21. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to the Port Hacking system during the first survey year (March 2007 to February 2008).

**PORT HACKING - COASTAL MARINE
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Ocean Leatherjacket	39,393	28,773	to	50,013	42.5
Eastern Bluespotted Flathead	20,482	15,484	to	25,480	22.1
Southern Calamari	9,339	5,981	to	12,697	10.1
Blue Mackerel	3,055	1,298	to	4,812	3.3
Silver Trevally	2,725	1,911	to	3,539	2.9
Southern Maori Wrasse	2,198	1,345	to	3,051	2.4
Yellowtail	2,101	960	to	3,242	2.3
Silver Sweep	1,729	1,034	to	2,424	1.9
Tailor	1,636	949	to	2,323	1.8
Snapper	1,496	1,000	to	1,992	1.6
Sixspine Leatherjacket	759	520	to	998	0.8
Grey Morwong	724	431	to	1,017	0.8
Yellowfin Bream	700	398	to	1,002	0.8
Eastern Red Scorpionfish	646	420	to	872	0.7
Salmon	613	335	to	891	0.7
Yellowtail Kingfish	583	307	to	859	0.6
Giant Cuttlefish	453	99	to	807	0.5
Crimsonband Wrasse	444	219	to	669	0.5
Mahi Mahi	427	69	to	785	0.5
Australian Bonito	324	16	to	632	0.3
Sergeant Baker	306	194	to	418	0.3
Tarwhine	236	111	to	361	0.3
Eastern Wirrah	180	71	to	289	0.2
Smalltooth Flounder	178	76	to	280	0.2
Pigfish	175	71	to	279	0.2
Rock Blackfish	163	6	to	320	0.2
Eastern School Whiting	148	26	to	270	0.2
Redfish	114	27	to	201	0.1
Yellowfin Leatherjacket	110	35	to	185	0.1
Largetooth Flounder	104	49	to	159	0.1
Eastern Blue Groper	87	19	to	155	<0.1
Skipjack Tuna	79	15	to	143	<0.1
Tiger Flathead	71	5	to	137	<0.1
Dusky Flathead	59	8	to	110	<0.1
Blue Swimmer Crab	55	0	to	155	<0.1
Shovelnose Ray	51	1	to	101	<0.1
Common Squid	49	0	to	108	<0.1
Marbled Flathead	48	0	to	102	<0.1
Mado	43	0	to	109	<0.1
Bearded Cods	40	0	to	80	<0.1

Table 21. Continued.

**PORT HACKING - COASTAL MARINE
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Rough Leatherjacket	38	9	to	67	<0.1
Blue-eye Trevalla	36	0	to	94	<0.1
Longfin Pike	34	4	to	64	<0.1
Gemfish	32	0	to	70	<0.1
Whaler Sharks	28	0	to	78	<0.1
Cobia	26	0	to	57	<0.1
Samsonfish	25	0	to	53	<0.1
Bastard Trumpeter	23	0	to	66	<0.1
Bluestriped Goatfish	22	0	to	51	<0.1
Black Reef Leatherjacket	21	0	to	46	<0.1
Red Morwong	21	0	to	59	<0.1
Gummy Shark	20	0	to	45	<0.1
Albacore	18	0	to	47	<0.1
Octopus	17	0	to	38	<0.1
Frigate Mackerel	16	0	to	42	<0.1
Jackass Morwong	16	0	to	42	<0.1
Red Gurnard	14	0	to	40	<0.1
Hammerhead Shark	13	0	to	35	<0.1
Imperador	12	0	to	31	<0.1
Comb Wrasse	12	0	to	33	<0.1
Halfbanded Seaperch	12	0	to	33	<0.1
Yellowfin Tuna	12	0	to	33	<0.1
Shortfin Mako Shark	10	0	to	28	<0.1
John Dory	10	0	to	27	<0.1
Rock Cale	10	0	to	28	<0.1
Mosaic Leatherjacket	7	0	to	19	<0.1
Longfin Perch	7	0	to	19	<0.1
Banded Seaperch	6	0	to	15	<0.1
Mulloway	6	0	to	15	<0.1
Banjo Ray	6	0	to	16	<0.1
Total	92,653	61,948	to	123,358	100.0

Table 22. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to the Port Hacking system during the second survey year (March 2008 to February 2009).

**PORT HACKING - COASTAL MARINE
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Eastern Bluespotted Flathead	27,077	19,733	to	34,421	34.2
Southern Calamari	13,551	8,264	to	18,838	17.1
Ocean Leatherjacket	12,310	7,184	to	17,436	15.5
Blue Mackerel	4,202	1,796	to	6,608	5.3
Silver Sweep	3,242	1,916	to	4,568	4.1
Southern Maori Wrasse	2,359	1,401	to	3,317	3.0
Yellowtail	2,007	874	to	3,140	2.5
Snapper	1,621	873	to	2,369	2.0
Silver Trevally	1,398	822	to	1,974	1.8
Yellowfin Bream	1,331	546	to	2,116	1.7
Tailor	1,305	663	to	1,947	1.6
Australian Bonito	1,169	147	to	2,191	1.5
Mahi Mahi	918	423	to	1,413	1.2
Sixspine Leatherjacket	859	469	to	1,249	1.1
Eastern Red Scorpionfish	771	518	to	1,024	1.0
Crimsonband Wrasse	614	353	to	875	0.8
Grey Morwong	600	386	to	814	0.8
Skipjack Tuna	551	56	to	1,046	0.7
Salmon	428	80	to	776	0.5
Longfin Pike	355	3	to	707	0.4
Sergeant Baker	314	162	to	466	0.4
Yellowtail Kingfish	274	110	to	438	0.3
Redfish	273	105	to	441	0.3
Dusky Flathead	152	0	to	306	0.2
Giant Cuttlefish	143	0	to	289	0.2
Eastern Blue Groper	126	0	to	259	0.2
Eastern Wirrah	122	56	to	188	0.2
Mado	117	0	to	329	0.1
Smalltooth Flounder	86	32	to	140	0.1
Largetooth Flounder	84	25	to	143	0.1
Rough Leatherjacket	78	24	to	132	<0.1
Shovelnose Ray	71	9	to	133	<0.1
Yellowfin Leatherjacket	70	0	to	141	<0.1
Gemfish	70	0	to	198	<0.1
Eastern Pigfish	68	21	to	115	<0.1
Gummy Shark	65	6	to	124	<0.1
Eastern School Whiting	62	4	to	120	<0.1
Samsonfish	55	0	to	110	<0.1
Stout Longtom	42	0	to	119	<0.1
Rock Blackfish	38	0	to	88	<0.1

Table 22. *Continued.*

**PORT HACKING - COASTAL MARINE
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
White-ear	29	0	to	82	<0.1
Shortfin Mako Shark	27	0	to	63	<0.1
Senator Wrasse	26	0	to	61	<0.1
Octopus	22	0	to	49	<0.1
Tarwhine	20	1	to	39	<0.1
John Dory	18	0	to	47	<0.1
Tiger Flathead	17	0	to	36	<0.1
Blue Swimmer Crab	17	0	to	48	<0.1
Toadfish & Puffers	16	0	to	43	<0.1
Sea Garfish	16	0	to	42	<0.1
Amberjack	16	0	to	42	<0.1
Red Morwong	14	0	to	31	<0.1
Bluestriped Goatfish	10	0	to	28	<0.1
Blind Shark	9	0	to	24	<0.1
Port Jackson Shark	9	0	to	24	<0.1
Frigate Mackerel	8	0	to	21	<0.1
Common Squid	8	0	to	21	<0.1
Black Reef Leatherjacket	7	0	to	18	<0.1
Marbled Flathead	7	0	to	19	<0.1
Total	79,274	46,702	to	111,846	100.0

Table 23. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to Bellambi during the first survey year (March 2007 to February 2008).

**BELLAMBI
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Snapper	4,428	3,643	to	5,213	16.4
Ocean Leatherjacket	3,726	2,595	to	4,857	13.8
Eastern Bluespotted Flathead	3,260	2,342	to	4,178	12.1
Silver Sweep	3,049	2,155	to	3,943	11.3
Blue Mackerel	2,189	1,416	to	2,962	8.1
Yellowtail	1,627	852	to	2,402	6.0
Southern Maori Wrasse	1,457	1,104	to	1,810	5.4
Grey Morwong	1,376	1,082	to	1,670	5.1
Silver Trevally	1,119	789	to	1,449	4.1
Sixspine Leatherjacket	661	483	to	839	2.4
Pigfish	619	467	to	771	2.3
Sergeant Baker	538	393	to	683	2.0
Eastern Red Scorpionfish	385	266	to	504	1.4
Tailor	363	205	to	521	1.3
Crimsonband Wrasse	309	199	to	419	1.1
Redfish	230	116	to	344	0.9
Giant Cuttlefish	192	26	to	358	0.7
Mahi Mahi	184	19	to	349	0.7
Southern Calamari	157	85	to	229	0.6
Yellowfin Bream	122	50	to	194	0.5
Yellowtail Kingfish	103	46	to	160	0.4
Skipjack Tuna	97	0	to	229	0.4
Eastern Blue Groper	96	34	to	158	0.4
Longfin Pike	94	46	to	142	0.3
Salmon	86	15	to	157	0.3
Marbled Flathead	51	19	to	83	0.2
Samsonfish	47	16	to	78	0.2
Australian Bonito	46	20	to	72	0.2
Gummy Shark	41	17	to	65	0.2
Fourline Striped Grunter	39	0	to	111	0.1
Yellowfin Leatherjacket	25	1	to	49	<0.1
Blacksaddle Goatfish	22	3	to	41	<0.1
Shortfin Mako Shark	21	3	to	39	<0.1
Red Gurnard	19	0	to	41	<0.1
Whaler Sharks	18	1	to	35	<0.1
Mulloway	17	0	to	37	<0.1
Eastern Wirrah	16	0	to	45	<0.1
Shovelnose Ray	15	0	to	34	<0.1
Barracouta	12	0	to	26	<0.1
Tiger Flathead	11	0	to	26	<0.1

Table 23. *Continued.*

**BELLAMBI
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Banded Seaperch	11	0	to	24	<0.1
Sand Whiting	10	0	to	27	<0.1
Mado	10	0	to	26	<0.1
Dusky Flathead	9	0	to	25	<0.1
Halfbanded Seaperch	9	0	to	20	<0.1
Large-tooth Flounder	9	0	to	19	<0.1
King George Whiting	9	0	to	25	<0.1
Red Morwong	9	0	to	26	<0.1
Teraglin	9	0	to	25	<0.1
Rock Blackfish	8	0	to	17	<0.1
Gould's squid	7	0	to	18	<0.1
Smalltooth Flounder	7	0	to	16	<0.1
Bearded Cods	6	0	to	16	<0.1
Bluethroat Wrasse	5	0	to	14	<0.1
Hammerhead Shark	5	0	to	15	<0.1
Yellowfin Tuna	5	0	to	13	<0.1
Albacore	5	0	to	13	<0.1
John Dory	5	0	to	13	<0.1
Rainbow Cale	4	0	to	11	<0.1
Mackerel Tuna	4	0	to	11	<0.1
Rough Leatherjacket	3	0	to	9	<0.1
Jackass Morwong	3	0	to	9	<0.1
Luderick	3	0	to	7	<0.1
Total	27,022	18,322	to	35,722	100.0

Table 24. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to Bellambi during the second survey year (March 2008 to February 2009).

**BELLAMBI
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Eastern Bluespotted Flathead	4,810	3,473	to	6,147	15.9
Snapper	4,746	3,690	to	5,802	15.7
Silver Sweep	4,373	2,954	to	5,792	14.5
Yellowtail	2,520	1,698	to	3,342	8.3
Blue Mackerel	2,321	1,358	to	3,284	7.7
Southern Maori Wrasse	2,200	1,466	to	2,934	7.3
Grey Morwong	1,591	1,094	to	2,088	5.3
Ocean Leatherjacket	1,489	952	to	2,026	4.9
Silver Trevally	898	641	to	1,155	3.0
Sixspine Leatherjacket	780	549	to	1,011	2.6
Pigfish	706	473	to	939	2.3
Sergeant Baker	683	258	to	1,108	2.3
Eastern Red Scorpionfish	423	254	to	592	1.4
Crimsonband Wrasse	334	203	to	465	1.1
Southern Calamari	265	134	to	396	0.9
Giant Cuttlefish	234	72	to	396	0.8
Longfin Pike	178	103	to	253	0.6
Tailor	149	82	to	216	0.5
Salmon	124	13	to	235	0.4
Eastern Blue Groper	124	16	to	232	0.4
Yellowfin Bream	122	45	to	199	0.4
Barracouta	111	41	to	181	0.4
Redfish	103	50	to	156	0.3
Skipjack Tuna	84	0	to	203	0.3
Yellowtail Kingfish	83	22	to	144	0.3
Mahi Mahi	66	0	to	141	0.2
Australian Bonito	64	11	to	117	0.2
Yellowfin Tuna	61	0	to	131	0.2
Albacore	45	0	to	117	0.1
Dusky Flathead	36	12	to	60	0.1
Samsonfish	32	7	to	57	0.1
Shortfin Mako Shark	31	11	to	51	0.1
Red Gurnard	30	4	to	56	<0.1
Tiger Flathead	28	0	to	59	<0.1
Blacksaddle Goatfish	27	0	to	61	<0.1
Whaler Sharks	25	0	to	53	<0.1
Eastern Wirrah	24	1	to	47	<0.1
Fourline Striped Grunter	23	0	to	52	<0.1
Yellowfin Leatherjacket	21	3	to	39	<0.1
Bearded Cods	19	0	to	39	<0.1

Table 24. *Continued.*

**BELLAMBI
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Teraglin	18	0	to	48	<0.1
Banded Seaperch	18	3	to	33	<0.1
Mado	17	0	to	36	<0.1
Bastard Trumpeter	17	0	to	48	<0.1
Black Marlin	15	0	to	42	<0.1
Frigate Mackerel	15	0	to	39	<0.1
Rock Blackfish	15	0	to	35	<0.1
Marbled Flathead	14	0	to	31	<0.1
Banjo Ray	12	0	to	25	<0.1
Pearl Perch	12	1	to	23	<0.1
Tarwhine	12	0	to	31	<0.1
Largetooth Flounder	11	0	to	24	<0.1
Gummy Shark	9	0	to	20	<0.1
Hammerhead Shark	9	0	to	25	<0.1
Striped Marlin	7	0	to	21	<0.1
Rough Leatherjacket	5	0	to	13	<0.1
Octopus	5	0	to	13	<0.1
Gould's squid	5	0	to	13	<0.1
Reef Ocean Perch	4	0	to	10	<0.1
Old Wife	4	0	to	10	<0.1
Smalltooth Flounder	4	0	to	11	<0.1
Red Morwong	3	0	to	7	<0.1
Halfbanded Seaperch	3	0	to	9	<0.1
Total	30,217	19,491	to	40,943	100.0

Table 25. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to Port Kembla during the first survey year (March 2007 to February 2008).

**PORT KEMBLA
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Eastern Bluespotted Flathead	6,082	4,551	to	7,613	19.5
Snapper	3,731	2,807	to	4,655	12.0
Yellowtail	3,368	1,524	to	5,212	10.8
Silver Trevally	2,376	1,579	to	3,173	7.6
Blue Mackerel	2,133	1,169	to	3,097	6.8
Silver Sweep	1,928	1,259	to	2,597	6.2
Grey Morwong	1,499	971	to	2,027	4.8
Ocean Leatherjacket	1,334	782	to	1,886	4.3
Yellowfin Bream	894	572	to	1,216	2.9
Tailor	844	417	to	1,271	2.7
Sixspine Leatherjacket	803	513	to	1,093	2.6
Southern Maori Wrasse	743	479	to	1,007	2.4
Luderick	654	144	to	1,164	2.1
Yellowtail Kingfish	480	201	to	759	1.5
Eastern Red Scorpionfish	477	284	to	670	1.5
Southern Calamari	380	0	to	901	1.2
Rock Blackfish	336	56	to	616	1.1
Sergeant Baker	313	215	to	411	1.0
Crimsonband Wrasse	305	144	to	466	1.0
Salmon	273	56	to	490	0.9
Pigfish	268	127	to	409	0.9
Mahi Mahi	192	0	to	450	0.6
Redfish	183	78	to	288	0.6
Largetooth Flounder	120	43	to	197	0.4
Rough Leatherjacket	105	0	to	215	0.3
Marbled Flathead	103	50	to	156	0.3
Yellowfin Leatherjacket	100	24	to	176	0.3
Mado	90	0	to	214	0.3
Dusky Flathead	82	29	to	135	0.3
Australian Bonito	79	24	to	134	0.3
Albacore	78	0	to	209	0.3
Tiger Flathead	75	28	to	122	0.2
Giant Cuttlefish	58	18	to	98	0.2
White-ear	57	0	to	161	0.2
Blacksaddle Goatfish	51	15	to	87	0.2
Samsonfish	50	14	to	86	0.2
Eastern Blue Groper	46	10	to	82	0.1
Longfin Pike	44	0	to	91	0.1
Sand Whiting	38	0	to	92	0.1
Yellowfin Tuna	31	0	to	73	<0.1

Table 25. Continued.

**PORT KEMBLA
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Red Gurnard	25	3	to	47	<0.1
Eastern Wirrah	24	0	to	51	<0.1
Whaler Sharks	23	0	to	57	<0.1
Bearded Cods	22	0	to	48	<0.1
Frigate Mackerel	21	0	to	44	<0.1
Eastern Pomfred	20	0	to	52	<0.1
Gummy Shark	19	0	to	42	<0.1
Hammerhead Shark	18	0	to	48	<0.1
Smalltooth Flounder	17	0	to	34	<0.1
Banjo Ray	16	0	to	45	<0.1
Skipjack Tuna	16	0	to	32	<0.1
Bluestriped Goatfish	15	0	to	31	<0.1
Amberjack	13	0	to	34	<0.1
Spotted Mackerel	13	0	to	34	<0.1
Shortfin Mako Shark	12	0	to	26	<0.1
Blue Warehou	11	0	to	28	<0.1
Tarwhine	10	0	to	26	<0.1
Shovelnose Ray	9	0	to	25	<0.1
Painted Grinner	9	0	to	25	<0.1
Bastard Trumpeter	8	0	to	21	<0.1
Unicorn Leatherjacket	7	0	to	20	<0.1
Reef Ocean Perch	6	0	to	15	<0.1
Halfbanded Seaperch	6	0	to	15	<0.1
Silver Drummer	6	0	to	16	<0.1
Red Morwong	6	0	to	15	<0.1
Rainbow Runner	5	0	to	15	<0.1
Banded Seaperch	5	0	to	15	<0.1
Octopus	3	0	to	9	<0.1
Port Jackson Shark	3	0	to	9	<0.1
Total	31,171	17,664	to	44,678	100.0

Table 26. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to Port Kembla during the second survey year (March 2008 to February 2009).

**PORT KEMBLA
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Eastern Bluespotted Flathead	7,836	5,687	to	9,985	21.8
Snapper	3,192	2,443	to	3,941	8.9
Blue Mackerel	2,808	779	to	4,837	7.8
Ocean Leatherjacket	2,738	1,625	to	3,851	7.6
Yellowtail	2,661	1,682	to	3,640	7.4
Silver Sweep	2,190	981	to	3,399	6.1
Yellowfin Bream	1,839	807	to	2,871	5.1
Silver Trevally	1,760	1,079	to	2,441	4.9
Grey Morwong	1,739	1,312	to	2,166	4.8
Luderick	1,400	405	to	2,395	3.9
Southern Maori Wrasse	988	629	to	1,347	2.7
Sixspine Leatherjacket	683	462	to	904	1.9
Salmon	560	202	to	918	1.6
Tailor	486	218	to	754	1.4
Skipjack Tuna	469	0	to	1,031	1.3
Australian Bonito	449	189	to	709	1.2
Eastern Red Scorpionfish	416	267	to	565	1.2
Redfish	331	152	to	510	0.9
Pigfish	320	173	to	467	0.9
Southern Calamari	302	150	to	454	0.8
Sergeant Baker	272	152	to	392	0.8
Rock Blackfish	207	0	to	435	0.6
Mahi Mahi	198	0	to	418	0.6
Giant Cuttlefish	182	79	to	285	0.5
Yellowtail Kingfish	178	73	to	283	0.5
Longfin Pike	171	27	to	315	0.5
Yellowfin Leatherjacket	160	59	to	261	0.4
Dusky Flathead	151	73	to	229	0.4
Crimsonband Wrasse	140	81	to	199	0.4
Tarwhine	109	0	to	251	0.3
Mulloway	91	6	to	176	0.3
Marbled Flathead	89	43	to	135	0.2
Eastern Blue Groper	69	3	to	135	0.2
Albacore	66	19	to	113	0.2
Gummy Shark	65	0	to	145	0.2
Red Gurnard	57	12	to	102	0.2
Yellowfin Tuna	53	0	to	124	0.1
Banjo Ray	52	0	to	129	0.1
Octopus	47	0	to	123	0.1
Blacksaddle Goatfish	45	5	to	85	0.1

Table 26. *Continued.*

**PORT KEMBLA
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Samsonfish	39	6	to	72	0.0
Frigate Mackerel	37	3	to	71	0.0
Largetooth Flounder	32	0	to	68	<0.1
Mado	31	8	to	54	<0.1
Banded Seaperch	31	0	to	82	<0.1
Gould's squid	22	2	to	42	<0.1
Whaler Sharks	17	0	to	47	<0.1
Pearl Perch	16	0	to	42	<0.1
Barracouta	13	0	to	32	<0.1
Moray Eel	13	0	to	37	<0.1
Hammerhead Shark	12	0	to	28	<0.1
Tiger Flathead	11	0	to	23	<0.1
Shortfin Mako Shark	10	0	to	27	<0.1
Mosaic Leatherjacket	10	0	to	26	<0.1
Sea Garfish	9	0	to	26	<0.1
Cobia	8	0	to	22	<0.1
Smalltooth Flounder	8	0	to	23	<0.1
Stout Longtom	6	0	to	16	<0.1
Black-Tipped Bullseye	6	0	to	16	<0.1
Sand Whiting	4	0	to	10	<0.1
Toothbrush Leatherjacket	4	0	to	10	<0.1
Eastern Wirrah	4	0	to	10	<0.1
Red Morwong	4	0	to	10	<0.1
Eastern School Whiting	4	0	to	11	<0.1
Bearded Cods	4	0	to	11	<0.1
Rainbow Cale	3	0	to	8	<0.1
Rough Leatherjacket	3	0	to	8	<0.1
Total	35,930	19,508	to	52,352	100.0

Table 27. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to Shellharbour during the first survey year (March 2007 to February 2008).

**SHELLHARBOUR
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Eastern Bluespotted Flathead	12,540	9,724	to	15,356	38.0
Ocean Leatherjacket	5,391	3,484	to	7,298	16.3
Blue Mackerel	3,352	1,760	to	4,944	10.1
Snapper	2,159	1,680	to	2,638	6.5
Yellowtail	1,555	658	to	2,452	4.7
Silver Trevally	1,180	645	to	1,715	3.6
Grey Morwong	851	561	to	1,141	2.6
Southern Maori Wrasse	809	289	to	1,329	2.4
Yellowfin Bream	633	387	to	879	1.9
Sixspine Leatherjacket	622	378	to	866	1.9
Eastern Red Scorpionfish	351	195	to	507	1.1
Tiger Flathead	295	150	to	440	0.9
Tailor	285	79	to	491	0.9
Rock Blackfish	269	67	to	471	0.8
Crimsonband Wrasse	230	64	to	396	0.7
Sergeant Baker	197	84	to	310	0.6
Silver Sweep	186	22	to	350	0.6
Salmon	182	72	to	292	0.6
Redfish	174	49	to	299	0.5
Luderick	150	0	to	307	0.5
Yellowfin Leatherjacket	142	35	to	249	0.4
Yellowtail Kingfish	138	27	to	249	0.4
Pigfish	110	61	to	159	0.3
Gemfish	109	0	to	239	0.3
Australian Bonito	107	33	to	181	0.3
Tarwhine	103	24	to	182	0.3
Mahi Mahi	102	0	to	232	0.3
Red Gurnard	80	15	to	145	0.2
Skipjack Tuna	75	18	to	132	0.2
Southern Calamari	70	8	to	132	0.2
Eastern Blue Groper	69	6	to	132	0.2
Marbled Flathead	64	23	to	105	0.2
Dusky Flathead	60	33	to	87	0.2
Longfin Pike	44	0	to	89	0.1
Giant Cuttlefish	44	15	to	73	0.1
Gummy Shark	37	4	to	70	0.1
Yellowfin Tuna	35	0	to	75	0.1
Samsonfish	27	2	to	52	<0.1
Gulper Sharks (Endeavour Dogfish)	26	0	to	68	<0.1
Large-tooth Flounder	22	0	to	48	<0.1

Table 27. Continued.

**SHELLHARBOUR
Survey Year 1**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Albacore	18	0	to	38	<0.1%
Comb Wrasse	16	0	to	42	<0.1%
Blacksaddle Goatfish	16	0	to	42	<0.1%
Smalltooth Flounder	13	0	to	28	<0.1%
Whaler Sharks	13	0	to	28	<0.1%
Rough Leatherjacket	12	0	to	26	<0.1%
Longfin Perch	9	0	to	24	<0.1%
Hammerhead Shark	7	0	to	18	<0.1%
Frigate Mackerel	6	0	to	16	<0.1%
Banjo Ray	6	0	to	16	<0.1%
Pearl Perch	6	0	to	16	<0.1%
Mado	5	0	to	14	<0.1%
Purple Wrasse	5	0	to	14	<0.1%
Shovelnose Ray	5	0	to	14	<0.1%
Blue-eye Trevalla	4	0	to	11	<0.1%
John Dory	4	0	to	10	<0.1%
Banded Seaperch	4	0	to	10	<0.1%
One Spot Puller	4	0	to	11	<0.1%
Bearded Cods	3	0	to	9	<0.1%
Shortfin Mako Shark	3	0	to	8	<0.1%
Total	33,034	20,493	to	45,575	100.0

Table 28. Annual estimates of recreational harvest (number of individuals) and 95% confidence intervals for taxa taken by trailer boat recreational fishers in the coastal marine waters adjacent to Shellharbour during the second survey year (March 2008 to February 2009).

**SHELLHARBOUR
Survey Year 2**

Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Eastern Bluespotted Flathead	15,256	11,904	to	18,608	46.4
Ocean Leatherjacket	5,478	3,210	to	7,746	16.7
Blue Mackerel	1,501	758	to	2,244	4.6
Snapper	1,410	1,019	to	1,801	4.3
Yellowtail	1,314	577	to	2,051	4.0
Grey Morwong	811	514	to	1,108	2.5
Skipjack Tuna	709	217	to	1,201	2.2
Tiger Flathead	641	286	to	996	2.0
Southern Maori Wrasse	531	238	to	824	1.6
Sixspine Leatherjacket	493	284	to	702	1.5
Silver Sweep	390	130	to	650	1.2
Eastern Red Scorpionfish	381	189	to	573	1.2
Southern Calamari	354	0	to	755	1.1
Silver Trevally	352	193	to	511	1.1
Redfish	311	95	to	527	0.9
Salmon	272	71	to	473	0.8
Australian Bonito	270	115	to	425	0.8
Albacore	236	0	to	502	0.7
Mahi Mahi	221	26	to	416	0.7
Tailor	206	77	to	335	0.6
Pigfish	198	92	to	304	0.6
Yellowfin Bream	191	87	to	295	0.6
Crimsonband Wrasse	161	36	to	286	0.5
Yellowtail Kingfish	118	57	to	179	0.4
Yellowfin Leatherjacket	105	22	to	188	0.3
Yellowfin Tuna	97	15	to	179	0.3
Gemfish	90	16	to	164	0.3
Luderick	89	0	to	192	0.3
Sergeant Baker	68	24	to	112	0.2
Longfin Pike	58	17	to	99	0.2
Eastern School Whiting	56	0	to	113	0.2
Marbled Flathead	50	9	to	91	0.2
Samsonfish	45	0	to	95	0.1
Blue-eye Trevalla	40	0	to	80	0.1
Eastern Blue Groper	39	7	to	71	0.1
Dusky Flathead	35	0	to	92	0.1
Red Gurnard	34	0	to	70	0.1
Rock Blackfish	30	4	to	56	<0.1
Moray Eel	27	0	to	71	<0.1
Mado	21	0	to	56	<0.1

Table 28. *Continued.*

SHELLHARBOUR
Survey Year 2

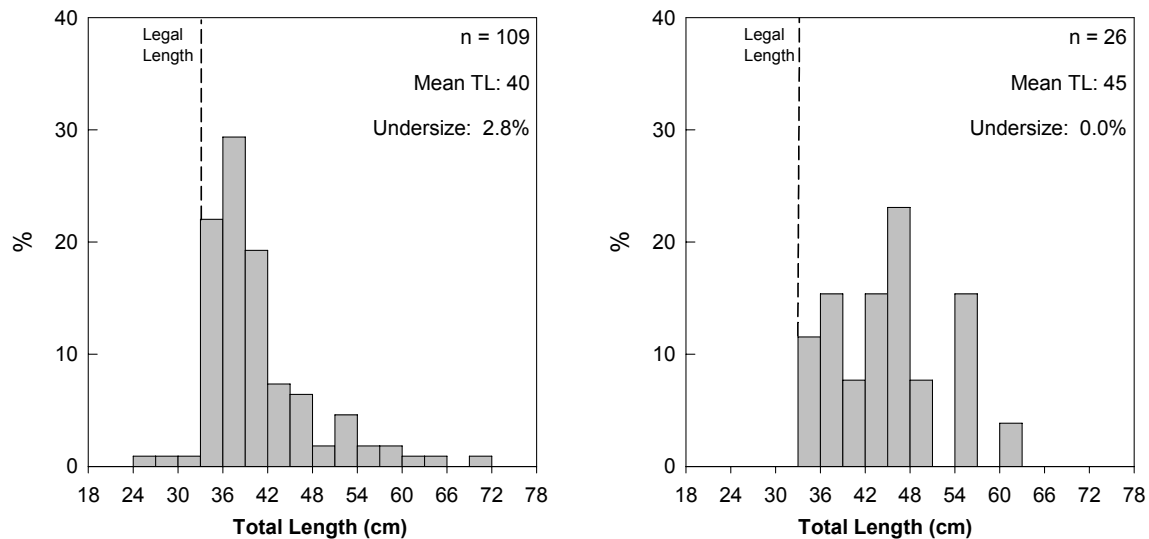
Common Name	Total Fish (number)	95% Confidence Intervals			% Total
Gulper Sharks (Endeavour Dogfish)	20	0	to	53	<0.1
Gummy Shark	19	0	to	42	<0.1
Mulloway	16	0	to	44	<0.1
Banjo Ray	14	1	to	27	<0.1
Giant Cuttlefish	12	0	to	26	<0.1
Smalltooth Flounder	12	0	to	25	<0.1
Banded Seaperch	12	0	to	26	<0.1
Hammerhead Shark	7	0	to	18	<0.1
Largetooth Flounder	7	0	to	19	<0.1
Blacksaddle Goatfish	6	0	to	16	<0.1
Bearded Cods	6	0	to	13	<0.1
Black Reef Leatherjacket	5	0	to	13	<0.1
Gould's squid	5	0	to	13	<0.1
Barracouta	5	0	to	13	<0.1
Tarwhine	4	0	to	11	<0.1
Octopus	4	0	to	10	<0.1
Rough Leatherjacket	4	0	to	10	<0.1
Shortfin Mako Shark	4	0	to	11	<0.1
Total	32,851	20,071	to	45,631	100.0

NORAH HEAD

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Eastern Bluespotted Flathead



Snapper

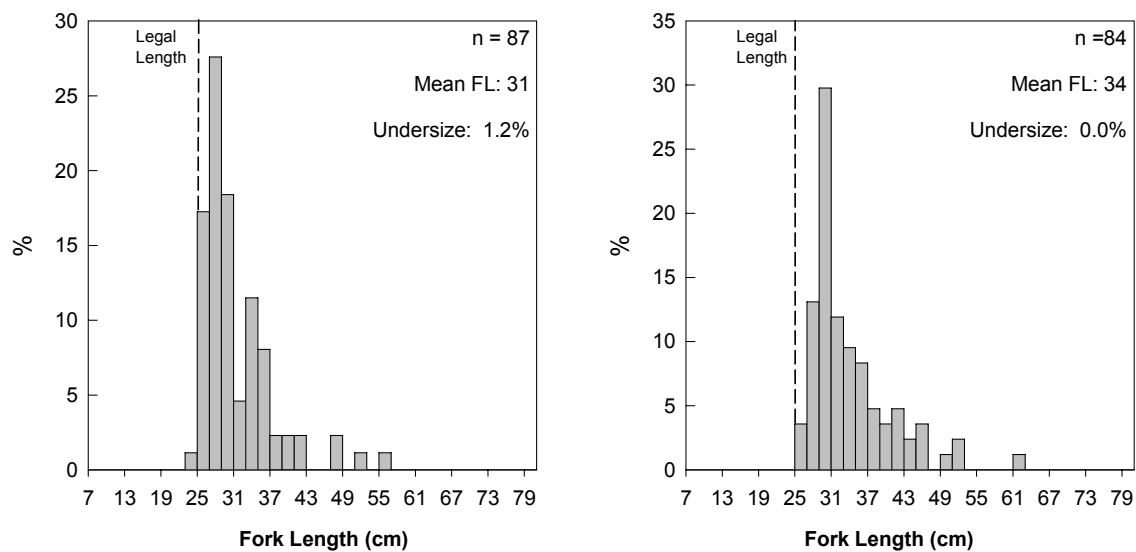


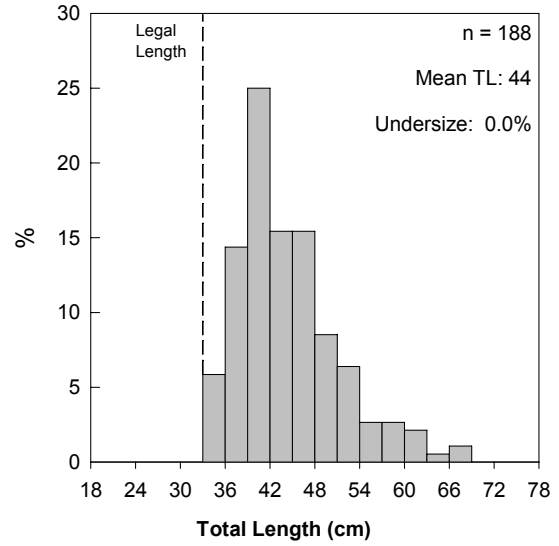
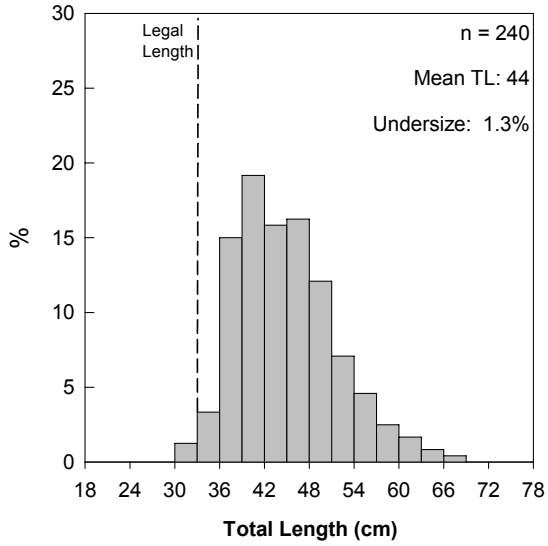
Figure 20. Annual length frequency distributions for eastern bluespotted flathead and snapper taken by recreational trailer boat fishers in the coastal marine waters adjacent to Norah Head.

TERRIGAL

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Eastern Bluespotted Flathead



Snapper

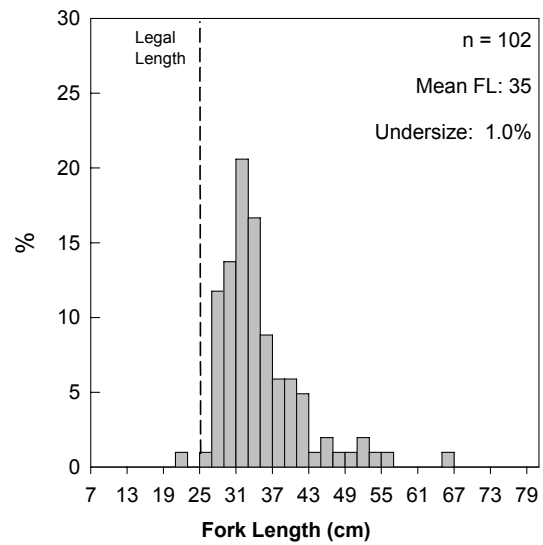
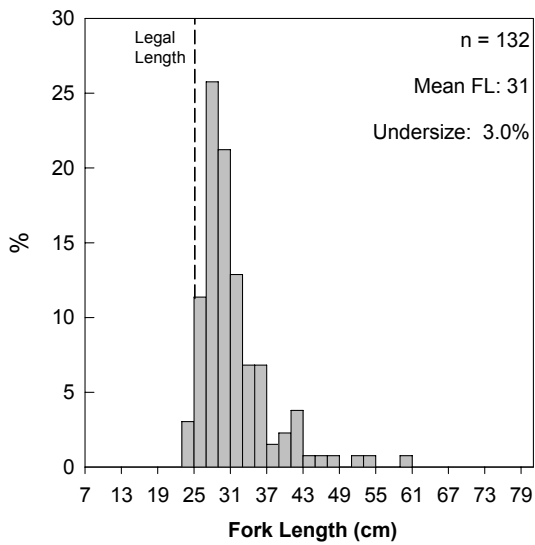


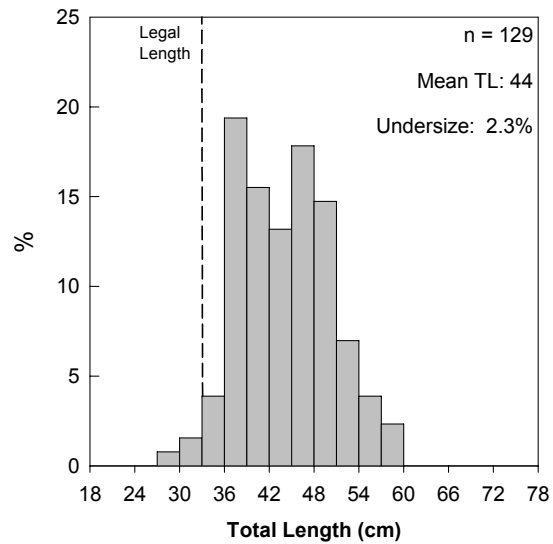
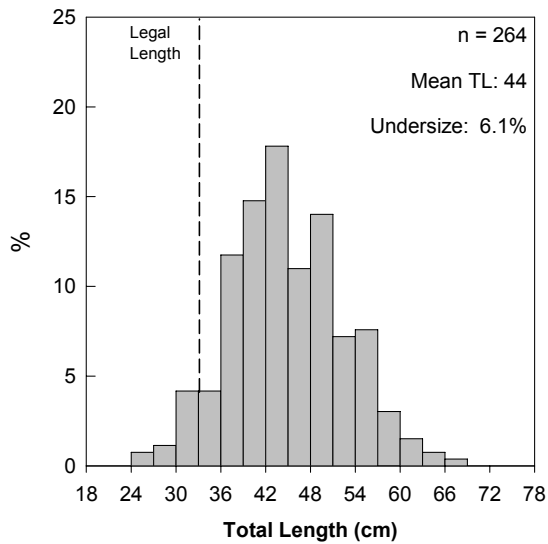
Figure 21. Annual length frequency distributions for eastern bluespotted flathead and snapper taken by recreational trailer boat fishers in the coastal marine waters adjacent to Terrigal.

HAWKESBURY - COASTAL MARINE

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Eastern Bluespotted Flathead



Snapper

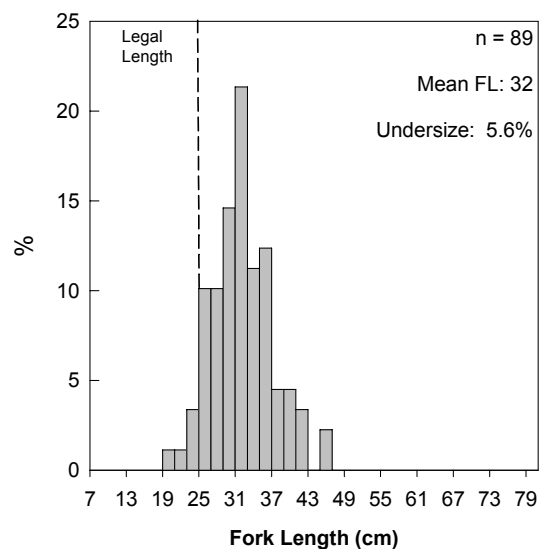
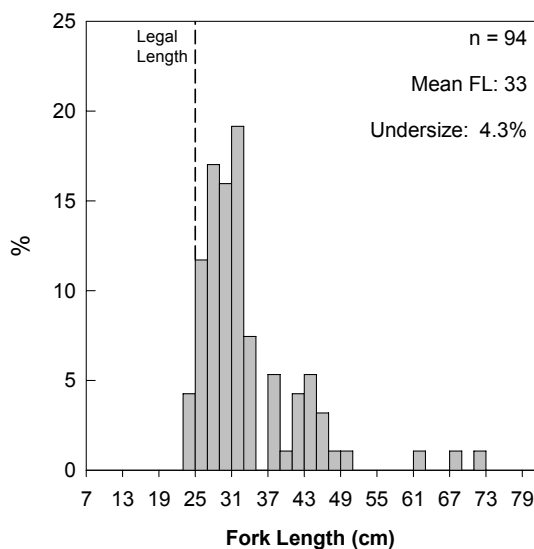


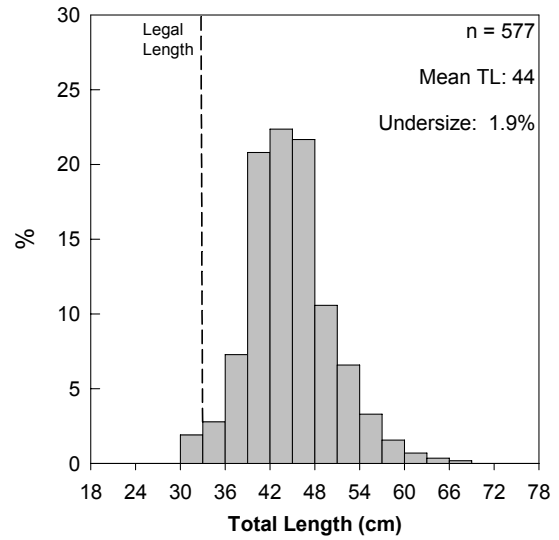
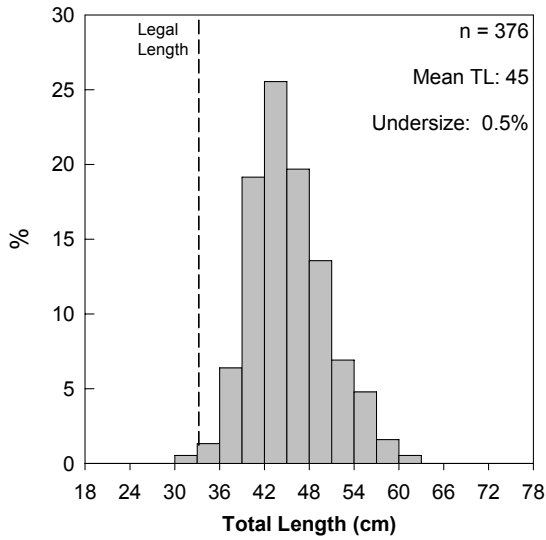
Figure 22. Annual length frequency distributions for eastern bluespotted flathead and snapper taken by recreational trailer boat fishers in the coastal marine waters adjacent to the Hawkesbury River system.

LONG REEF

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Eastern Bluespotted Flathead



Snapper

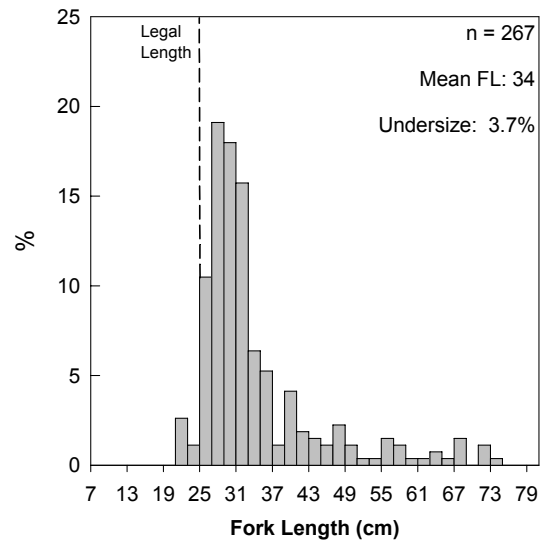
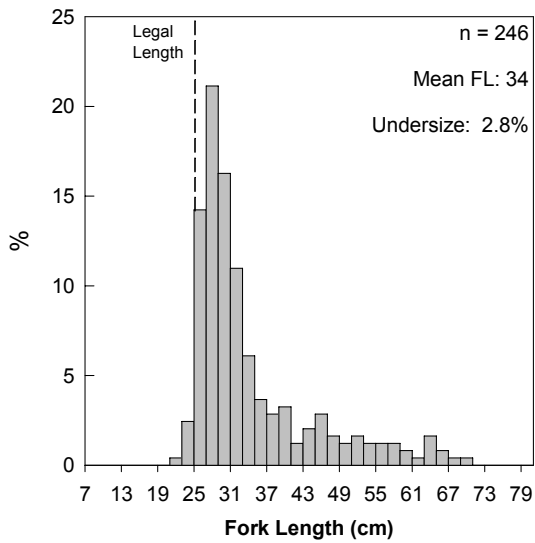


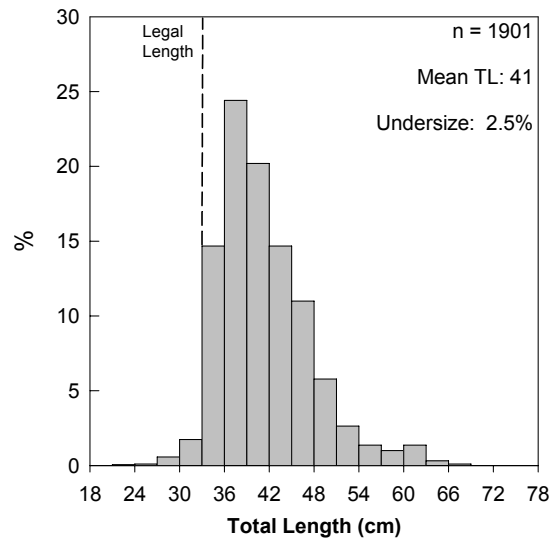
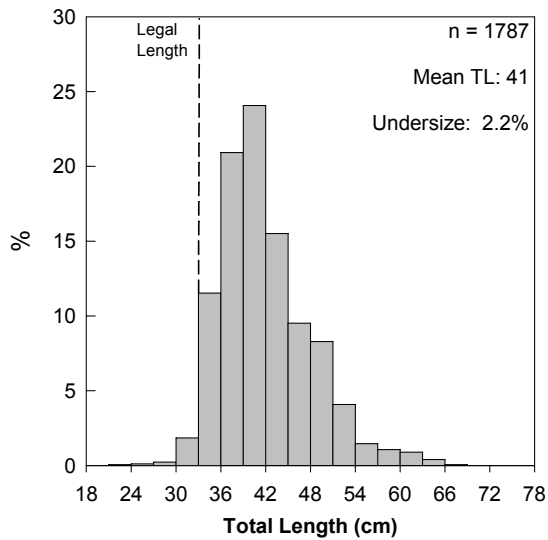
Figure 23. Annual length frequency distributions for eastern bluespotted flathead and snapper taken by recreational trailer boat fishers in the coastal marine waters adjacent to Long Reef.

PORT HACKING - COASTAL MARINE

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Eastern Bluespotted Flathead



Snapper

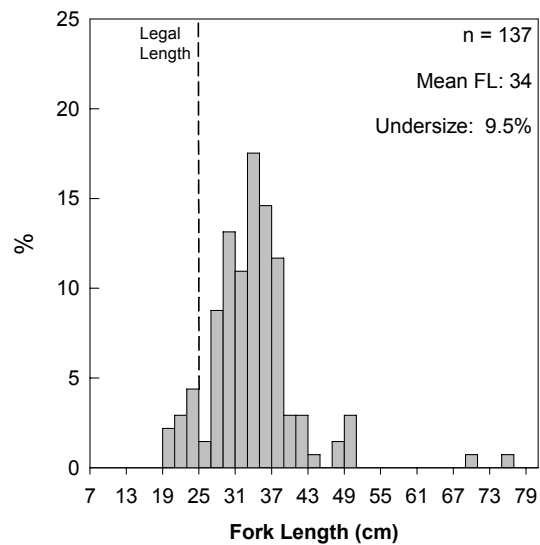
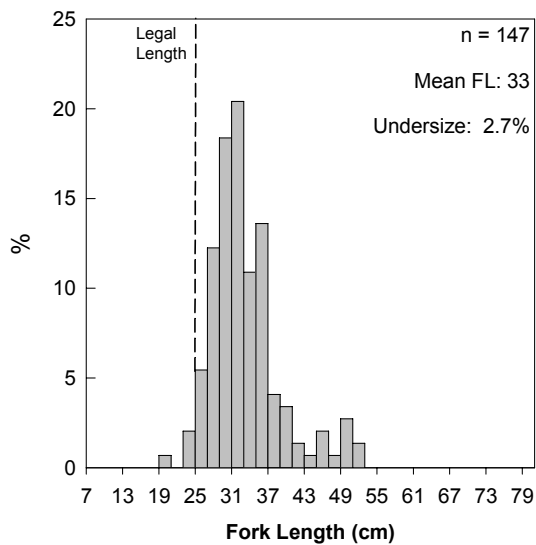


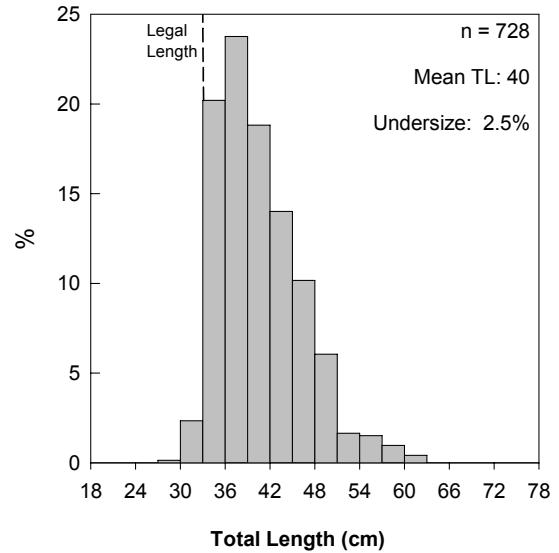
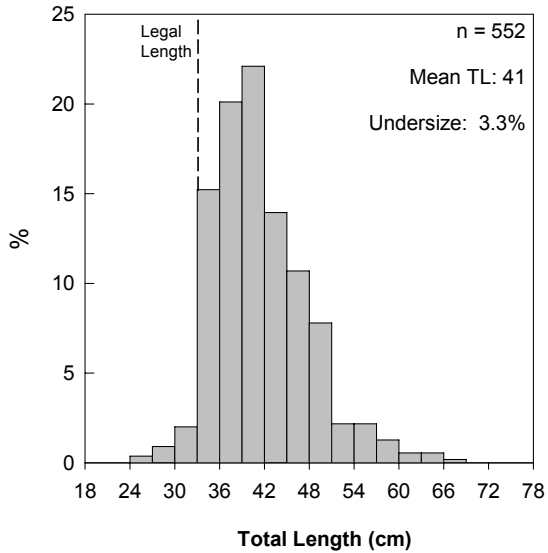
Figure 24. Annual length frequency distributions for eastern bluespotted flathead and snapper taken by recreational trailer boat fishers in the coastal marine waters adjacent to the Port Hacking system.

BELLAMBI

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Eastern Bluespotted Flathead



Snapper

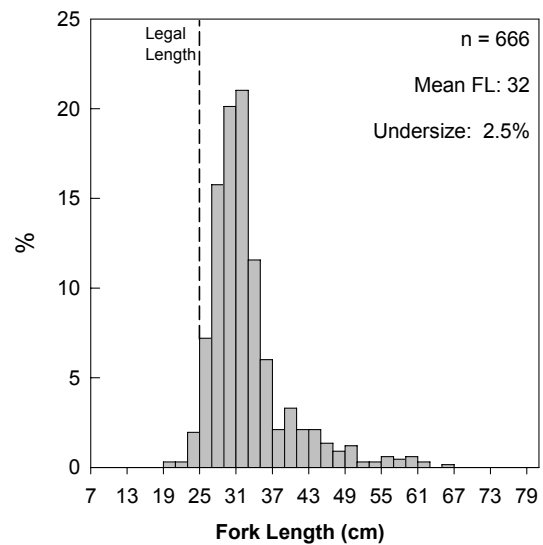
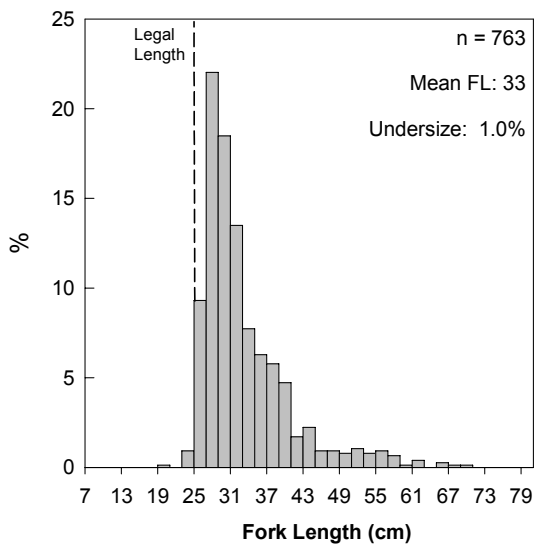


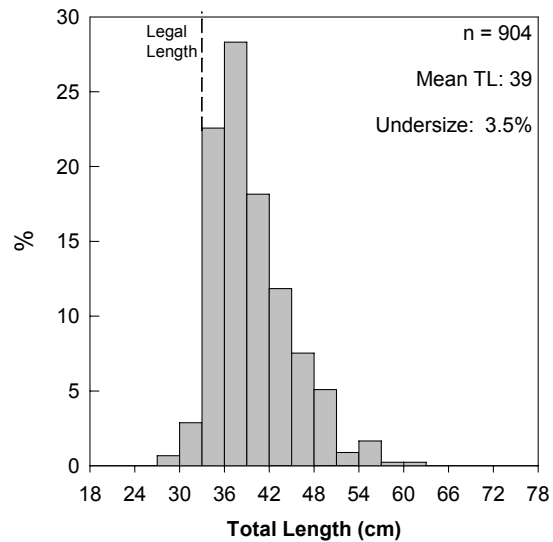
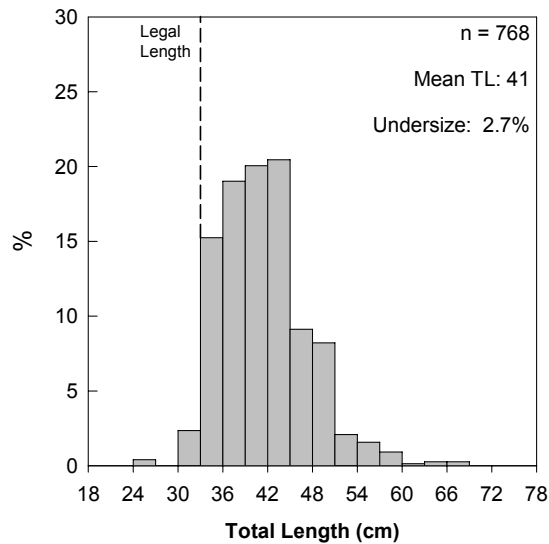
Figure 25. Annual length frequency distributions for eastern bluespotted flathead and snapper taken by recreational trailer boat fishers in the coastal marine waters adjacent to Bellambi.

PORT KEMBLA

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Eastern Bluespotted Flathead



Snapper

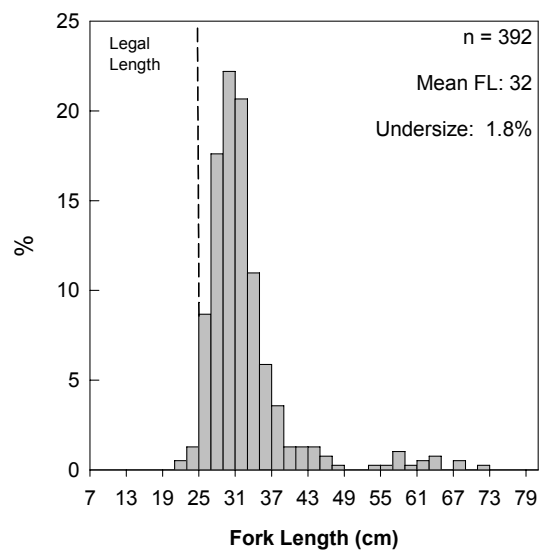
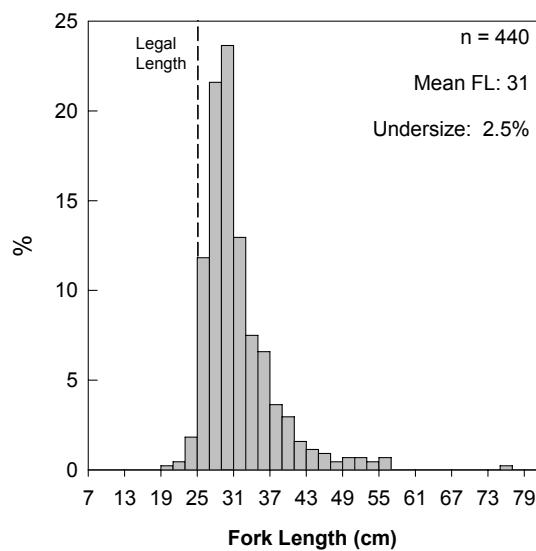


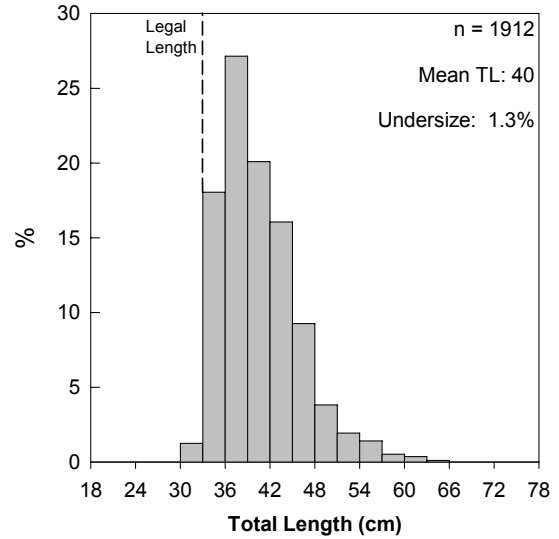
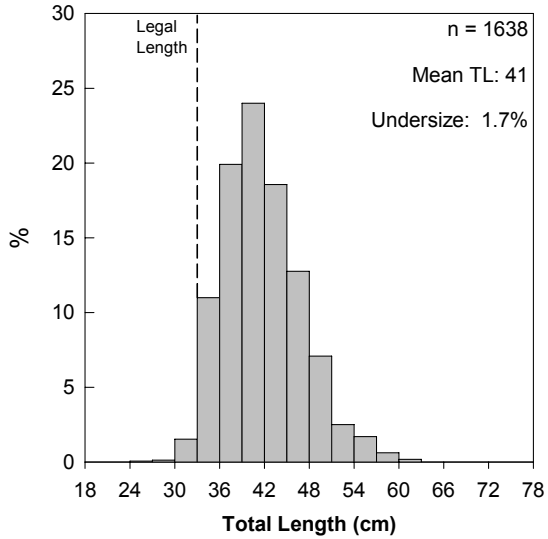
Figure 26. Annual length frequency distributions for eastern bluespotted flathead and snapper taken by recreational trailer boat fishers in the coastal marine waters adjacent to Port Kembla.

SHELLHARBOUR

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Eastern Bluespotted Flathead



Snapper

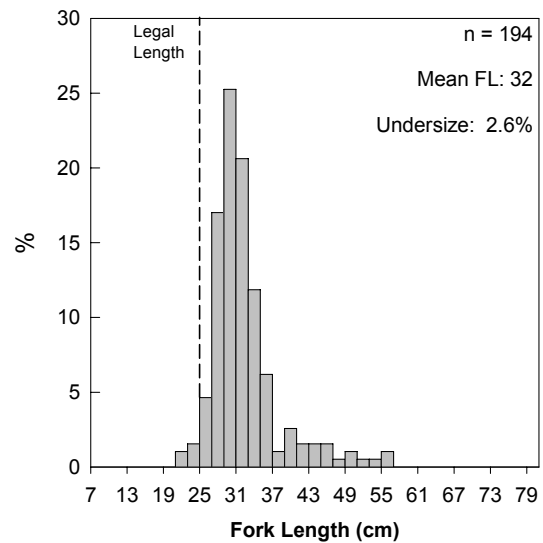
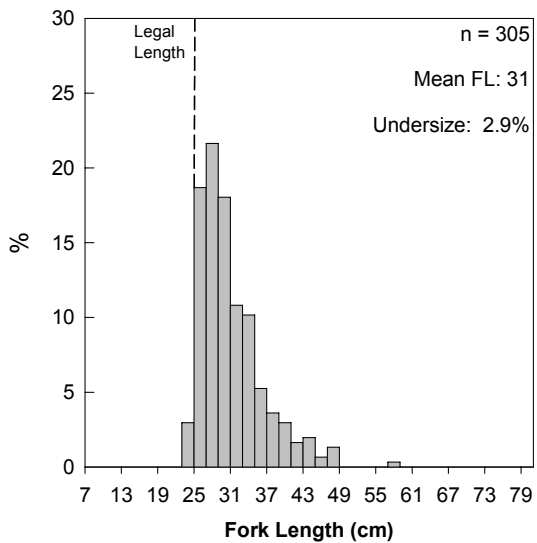


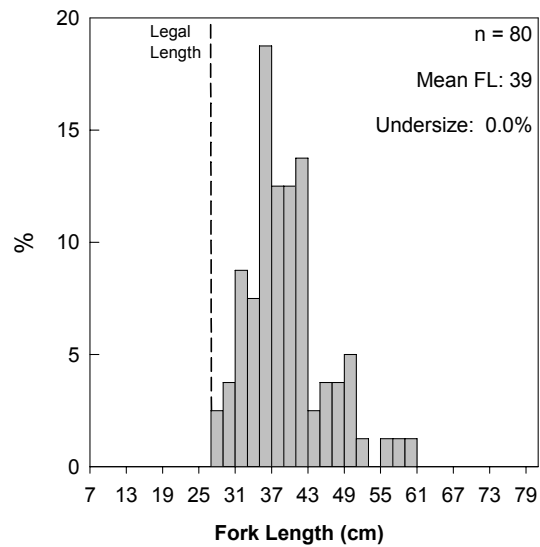
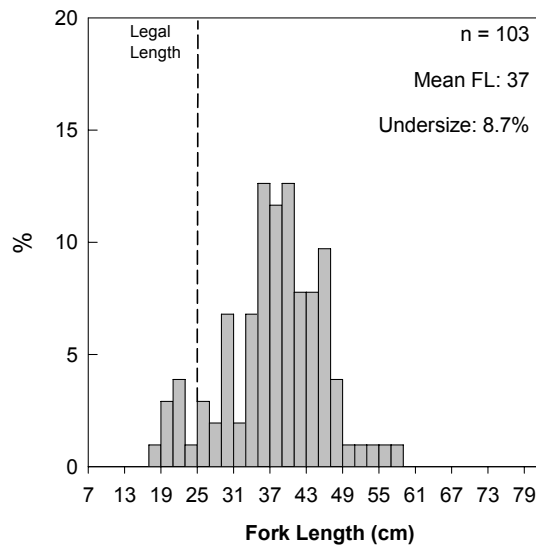
Figure 27. Annual length frequency distributions for eastern bluespotted flathead and snapper taken by recreational trailer boat fishers in the coastal marine waters adjacent to Shellharbour.

NORAH HEAD

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Grey Morwong



Ocean Leatherjacket

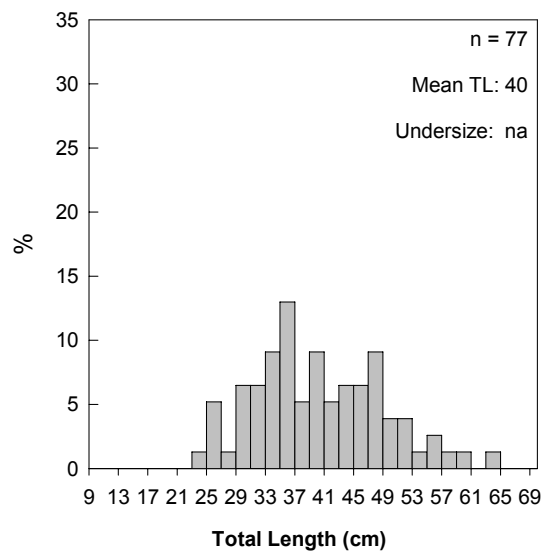
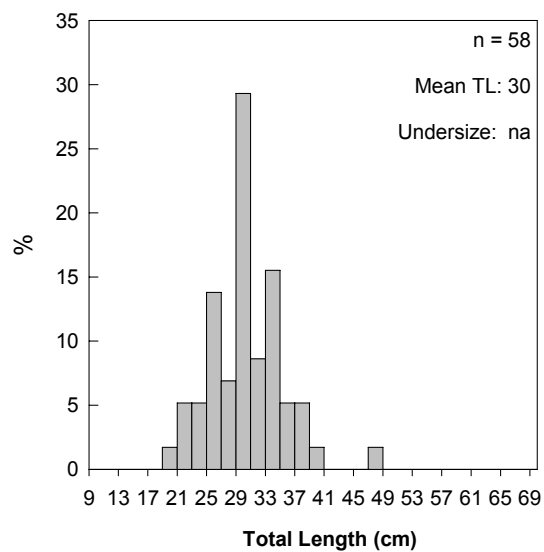


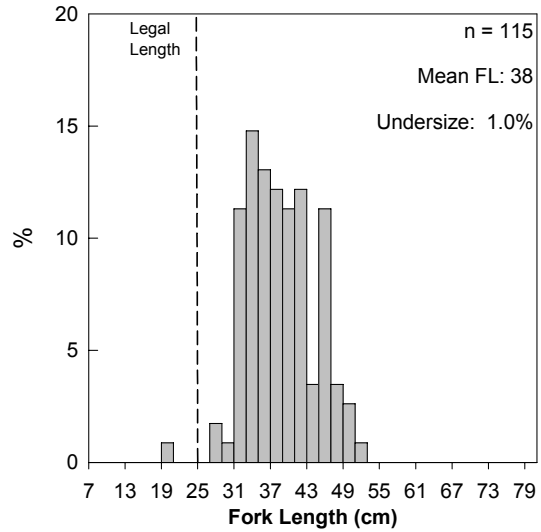
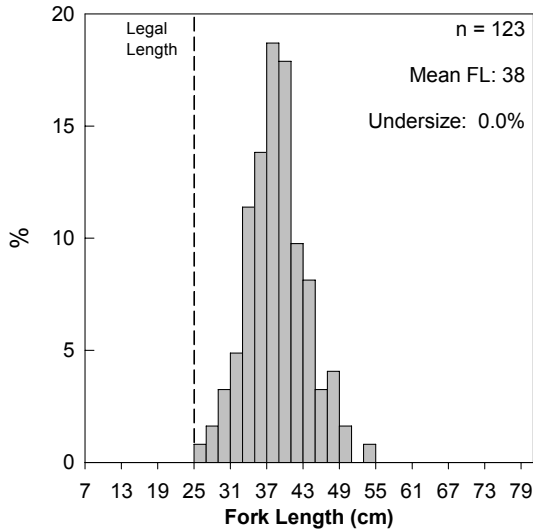
Figure 28. Annual length frequency distributions for grey morwong and ocean leatherjacket taken by recreational trailer boat fishers in the coastal marine waters adjacent to Norah Head.

TERRIGAL

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Grey Morwong



Ocean Leatherjacket

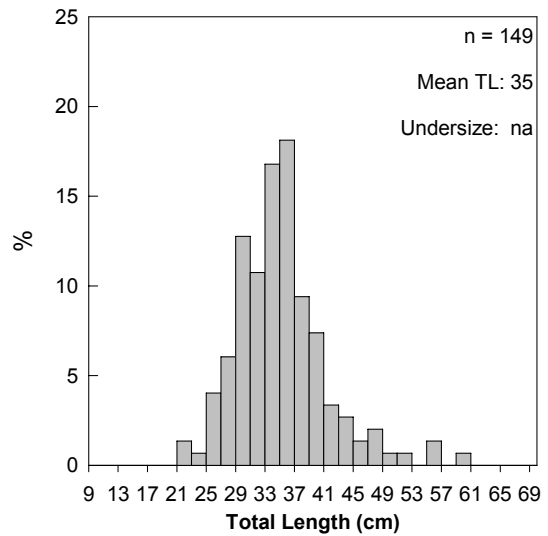
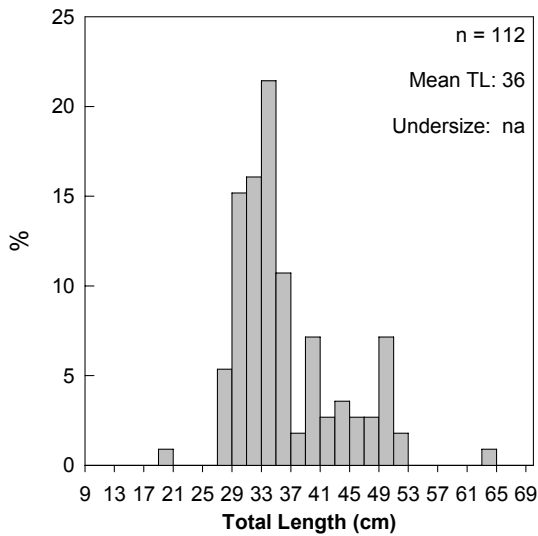


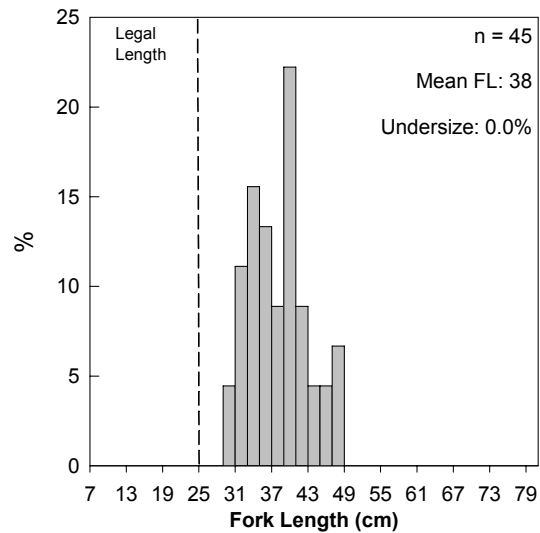
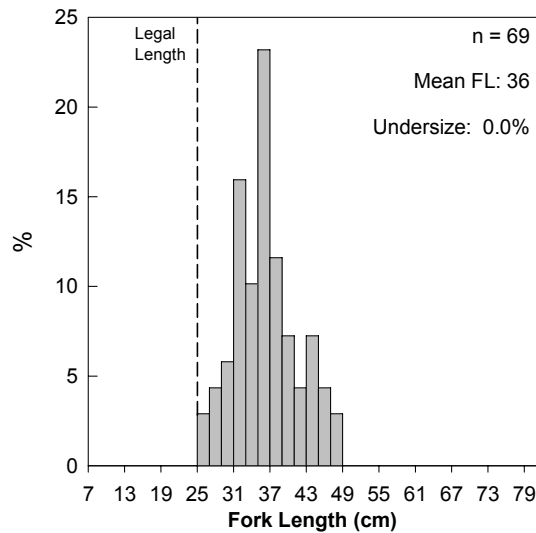
Figure 29. Annual length frequency distributions for grey morwong and ocean leatherjacket taken by recreational trailer boat fishers in the coastal marine waters adjacent to Terrigal.

HAWKESBURY - COASTAL MARINE

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Grey Morwong



Ocean Leatherjacket

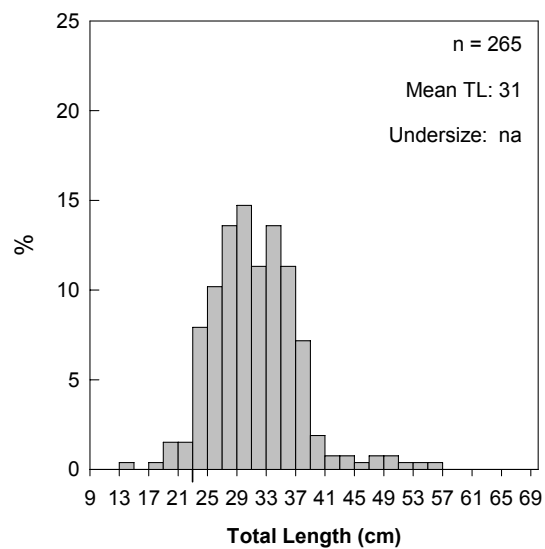
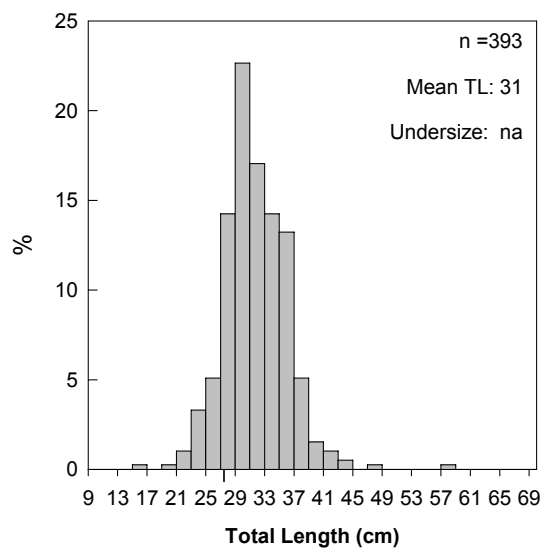


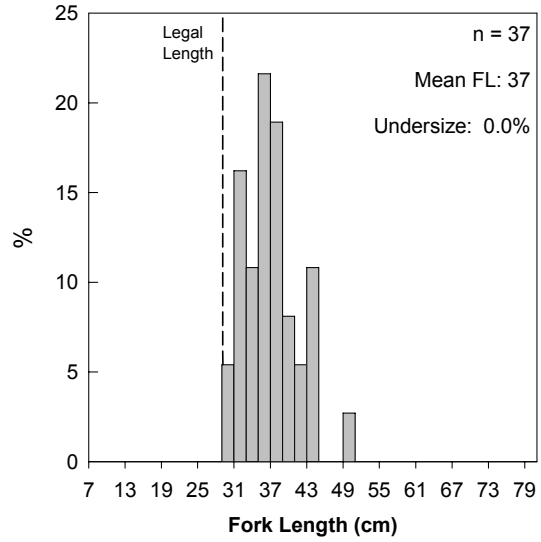
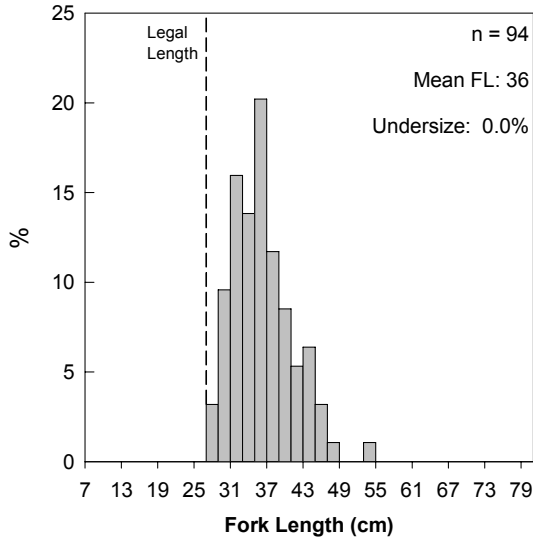
Figure 30. Annual length frequency distributions for grey morwong and ocean leatherjacket taken by recreational trailer boat fishers in the coastal marine waters adjacent to the Hawkesbury River system.

LONG REEF

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Grey Morwong



Ocean Leatherjacket

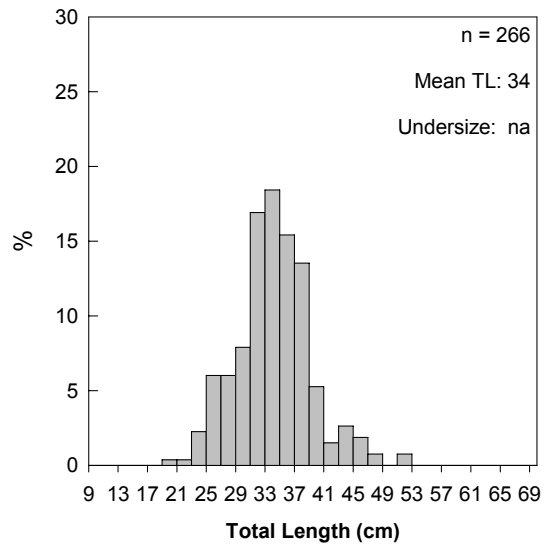
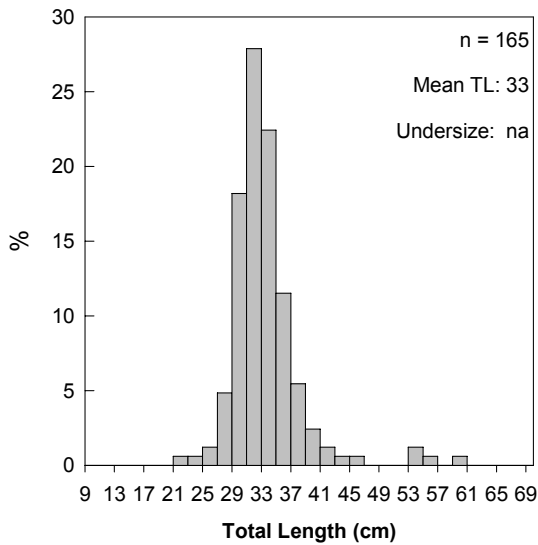


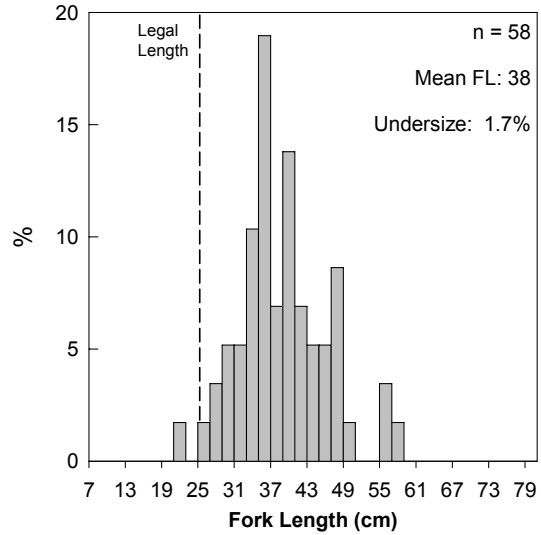
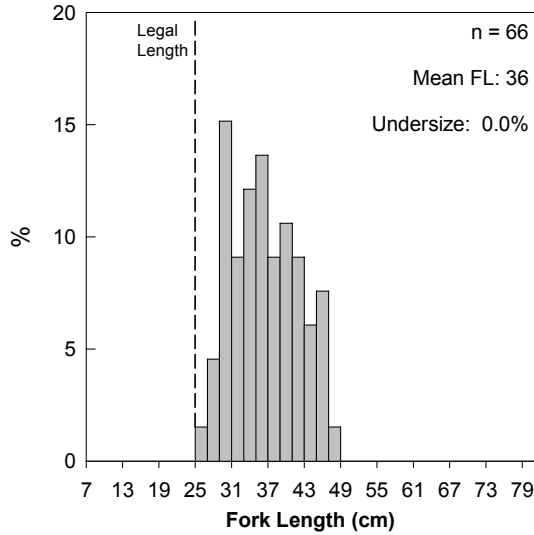
Figure 31. Annual length frequency distributions for grey morwong and ocean leatherjacket taken by recreational trailer boat fishers in the coastal marine waters adjacent to Long Reef.

PORT HACKING - COASTAL MARINE

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Grey Morwong



Ocean Leatherjacket

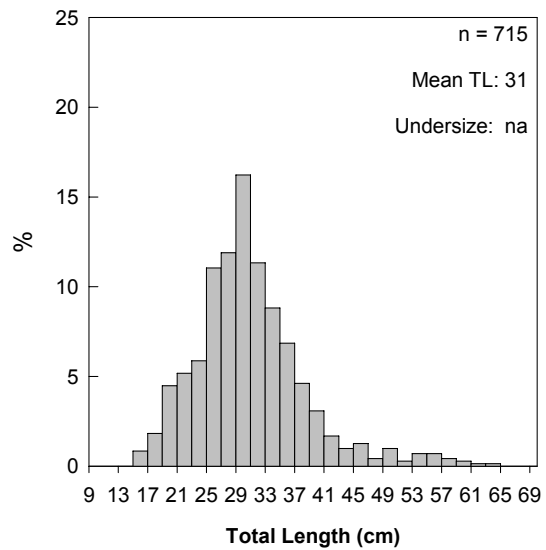
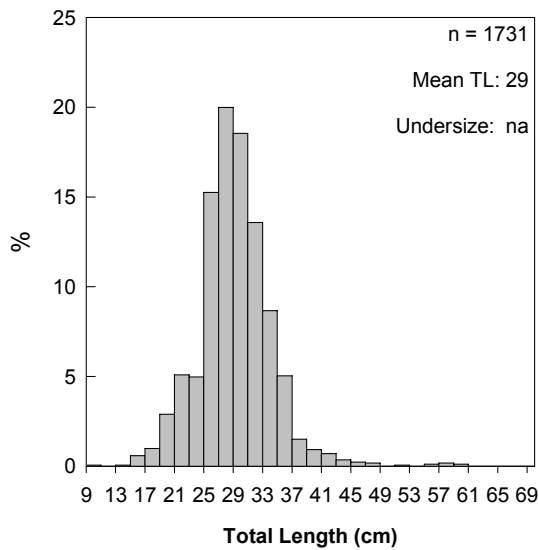


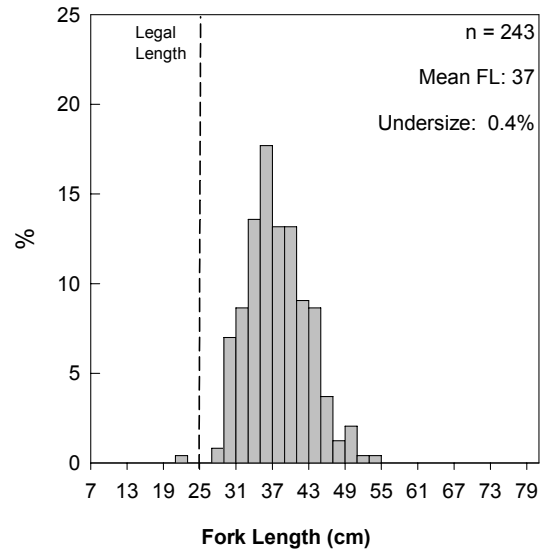
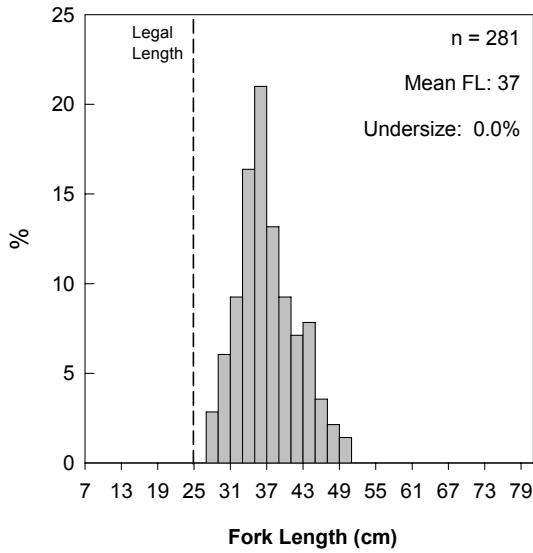
Figure 32. Annual length frequency distributions for grey morwong and ocean leatherjacket taken by recreational trailer boat fishers in the coastal marine waters adjacent to the Port Hacking system.

BELLAMBI

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Grey Morwong



Ocean Leatherjacket

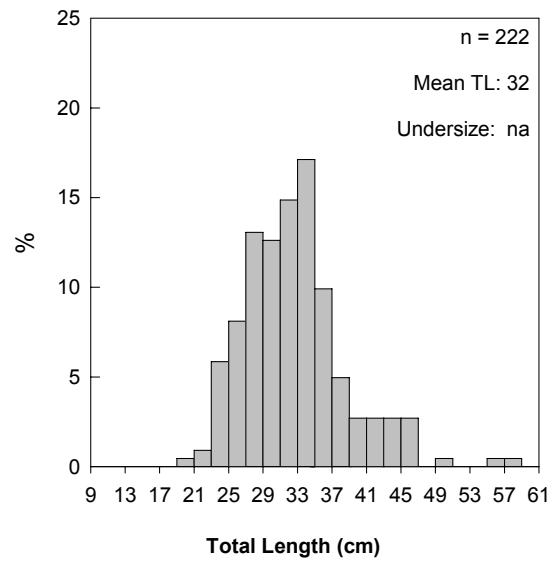
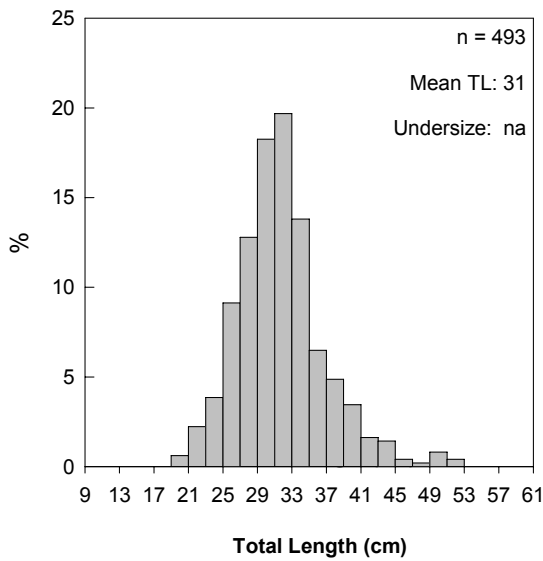


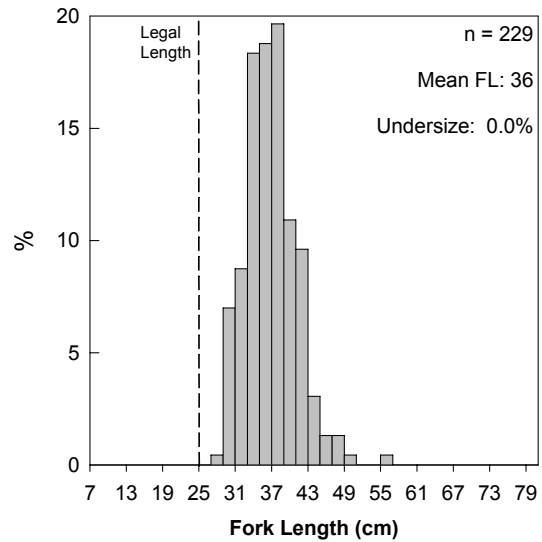
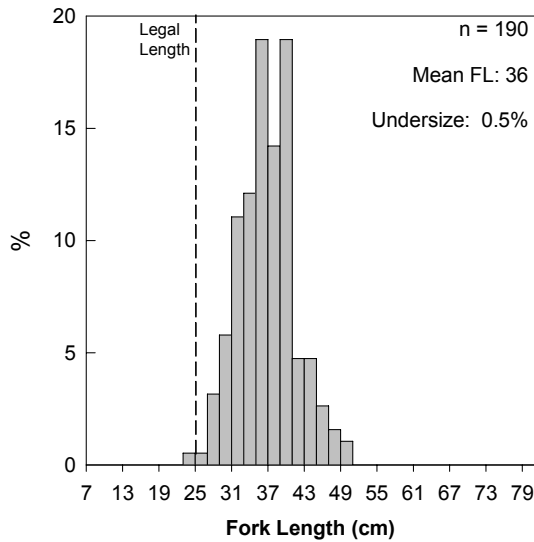
Figure 33. Annual length frequency distributions for grey morwong and ocean leatherjacket taken by recreational trailer boat fishers in the coastal marine waters adjacent to Bellambi.

PORT KEMBLA

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Grey Morwong



Ocean Leatherjacket

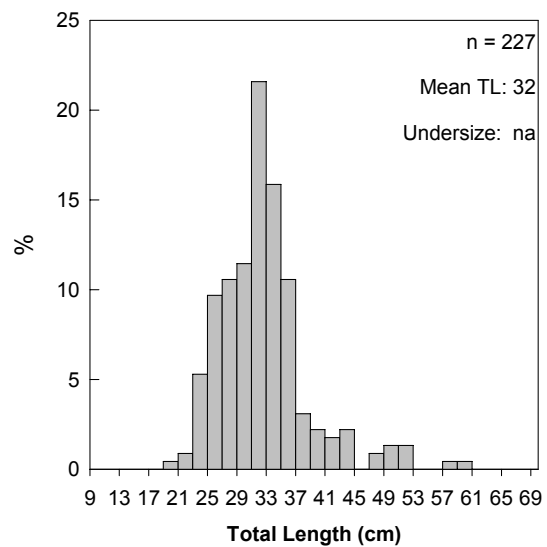
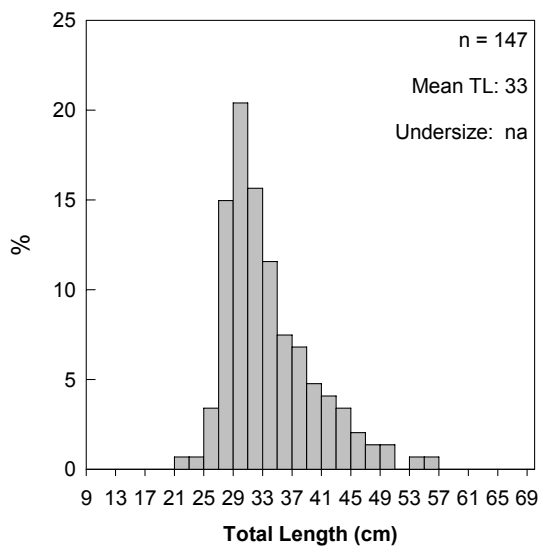


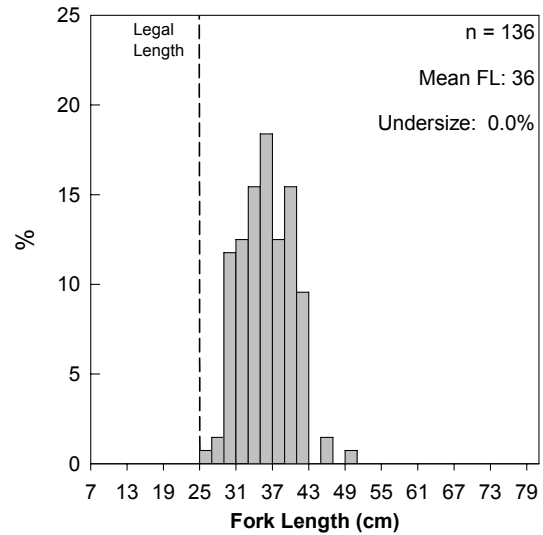
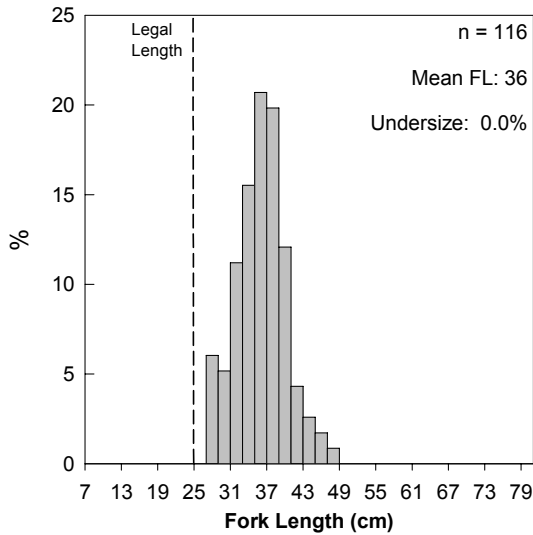
Figure 34. Annual length frequency distributions for grey morwong and ocean leatherjacket taken by recreational trailer boat fishers in the coastal marine waters adjacent to Port Kembla.

SHELLHARBOUR

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Grey Morwong



Ocean Leatherjacket

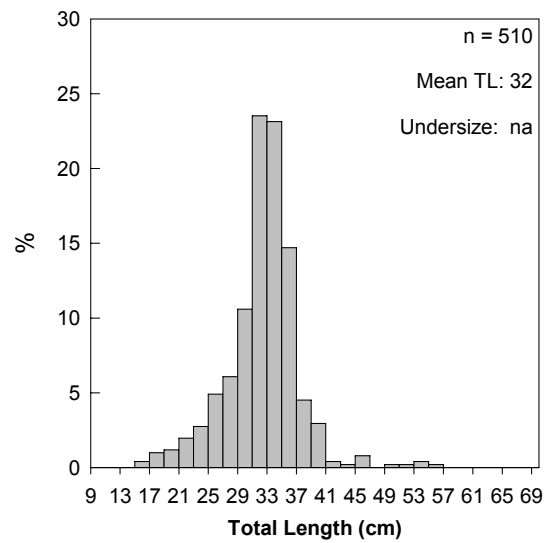
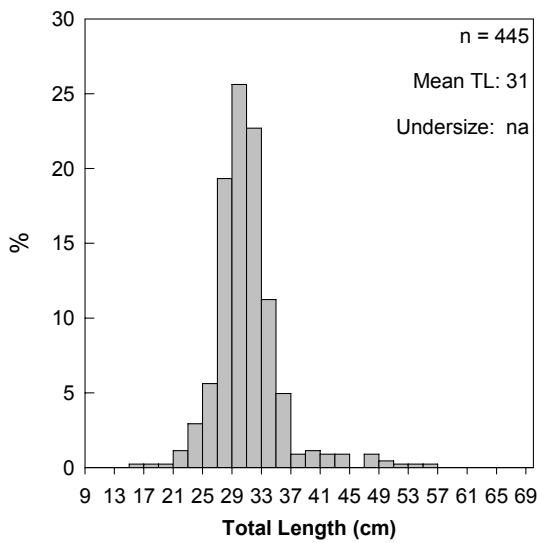


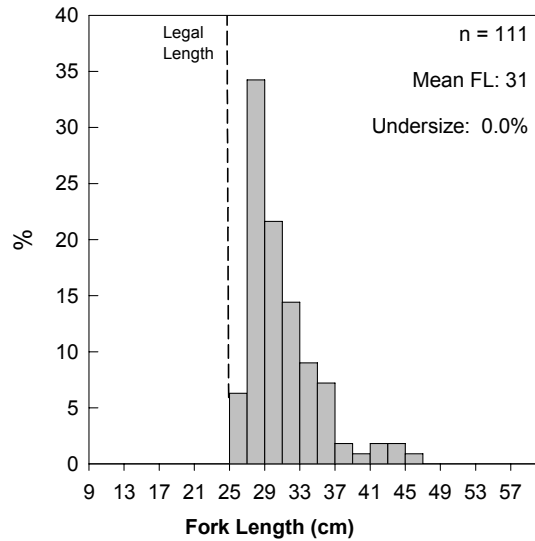
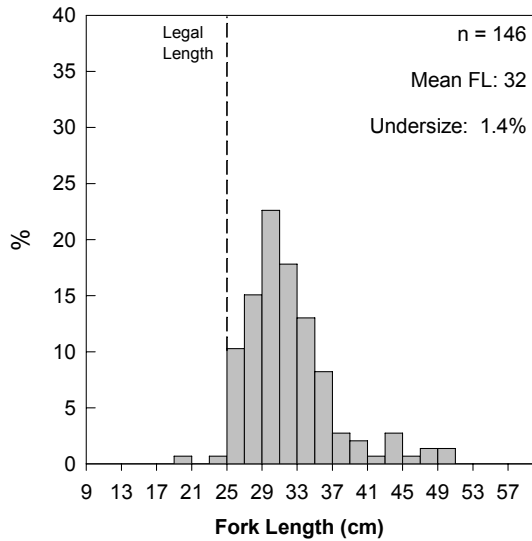
Figure 35. Annual length frequency distributions for grey morwong and ocean leatherjacket taken by recreational trailer boat fishers in the coastal marine waters adjacent to Shellharbour.

NORAH HEAD

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Silver Trevally



Silver Sweep

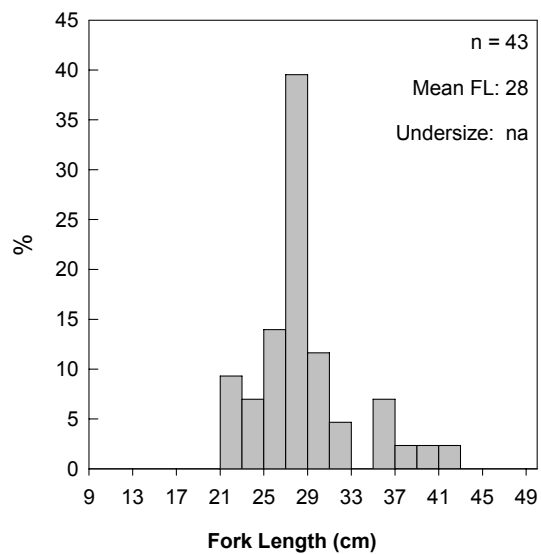
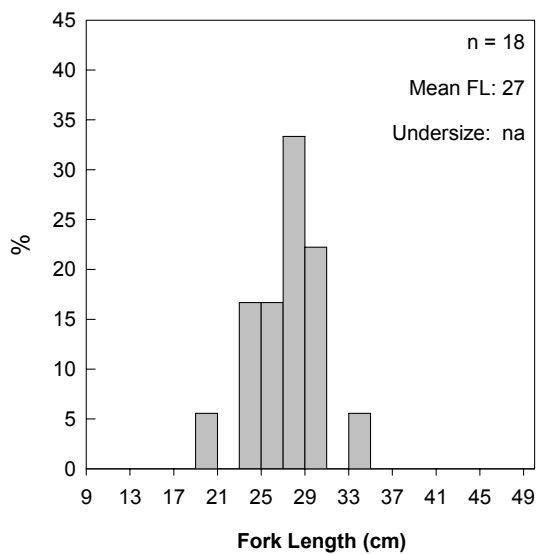


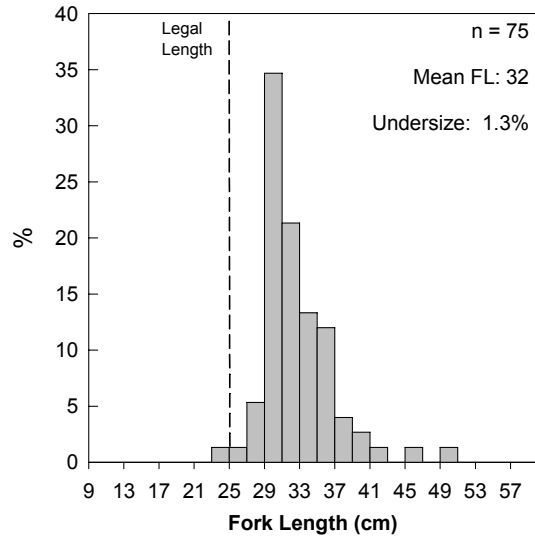
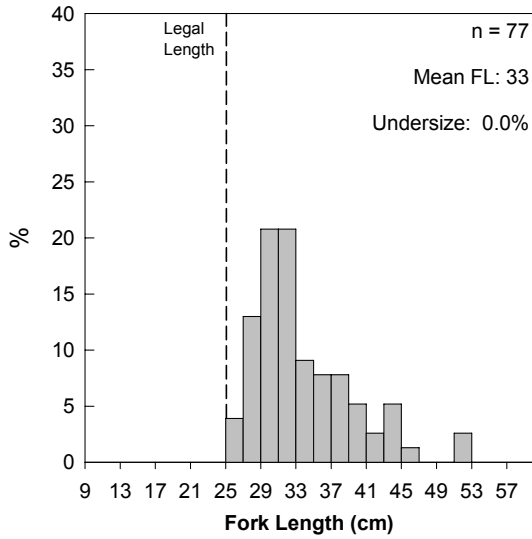
Figure 36. Annual length frequency distributions for silver trevally and silver sweep taken by recreational trailer boat fishers in the coastal marine waters adjacent to Norah Head.

TERRIGAL

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Silver Trevally



Silver Sweep

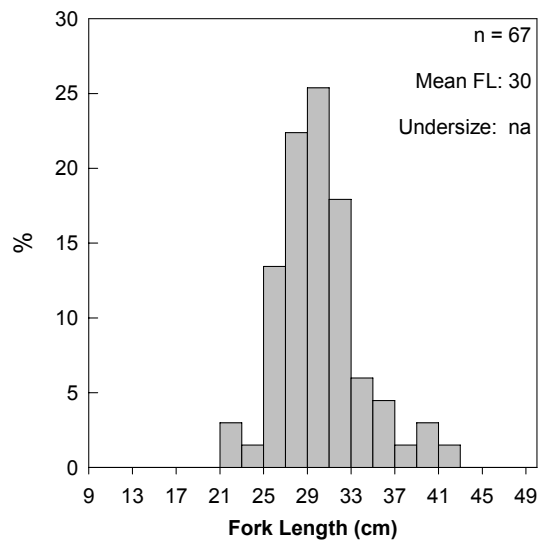
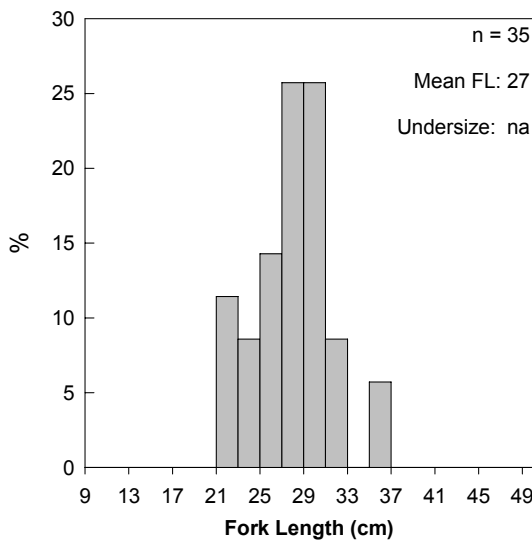


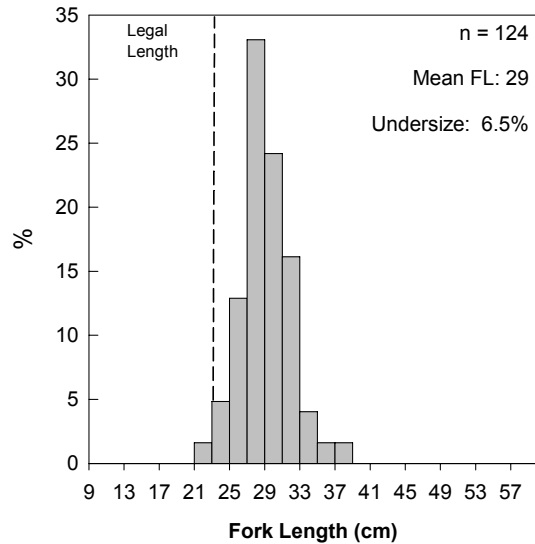
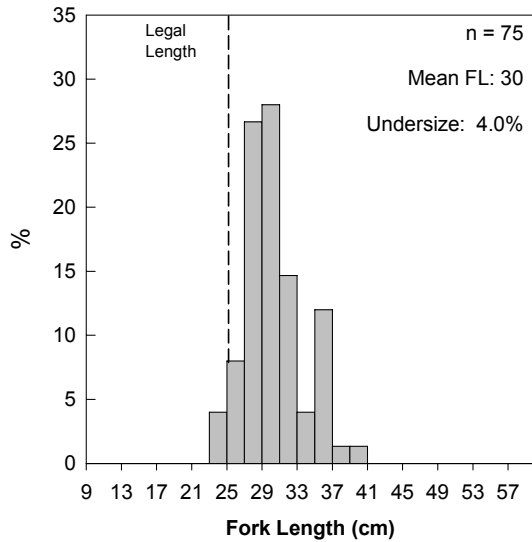
Figure 37. Annual length frequency distributions for silver trevally and silver sweep taken by recreational trailer boat fishers in the coastal marine waters adjacent to Terrigal.

HAWKESBURY - COASTAL MARINE

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Silver Trevally



Silver Sweep

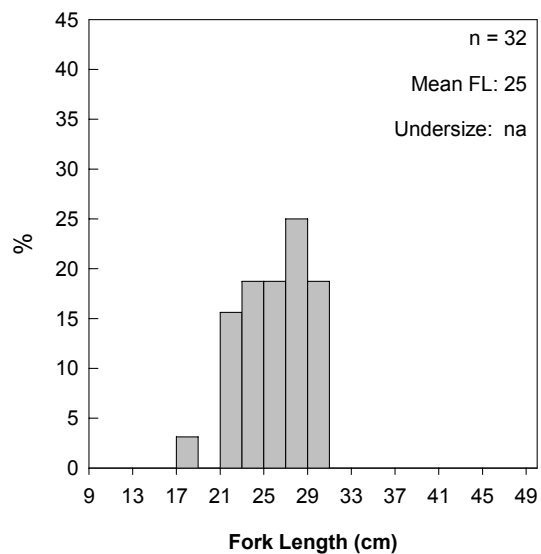
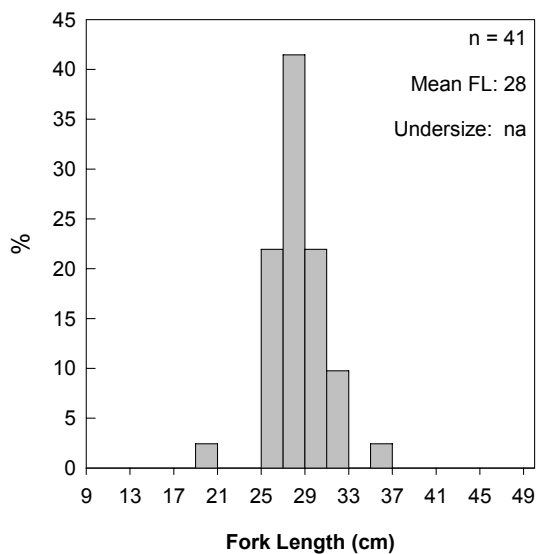


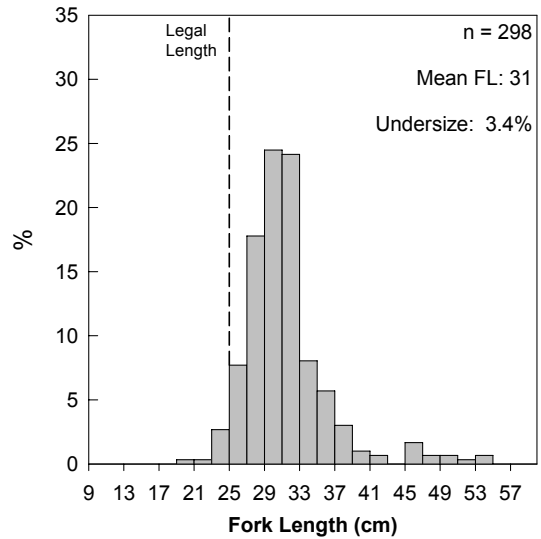
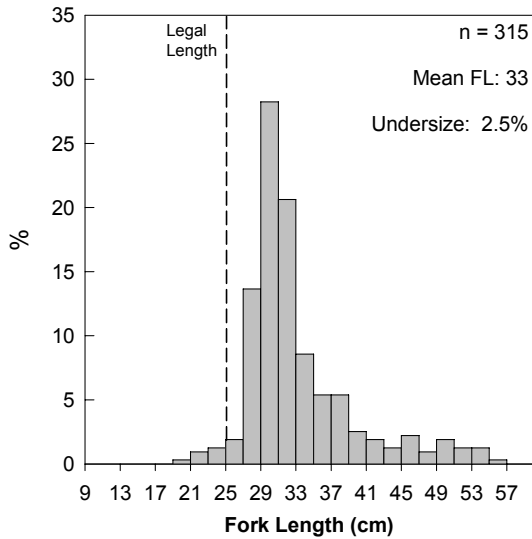
Figure 38. Annual length frequency distributions for silver trevally and silver sweep taken by recreational trailer boat fishers in the coastal marine waters adjacent to the Hawkesbury River system.

LONG REEF

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Silver Trevally



Silver Sweep

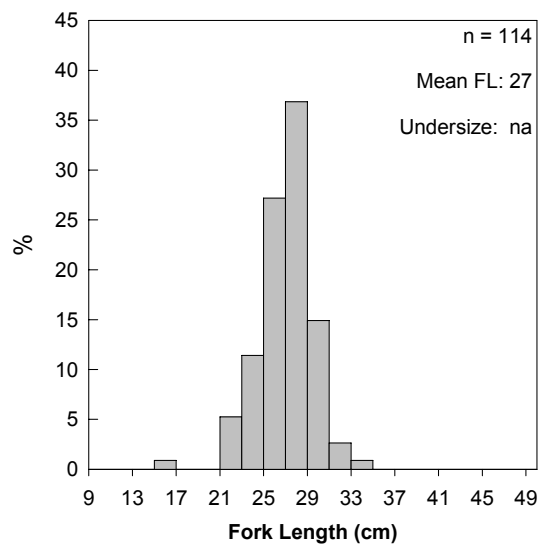
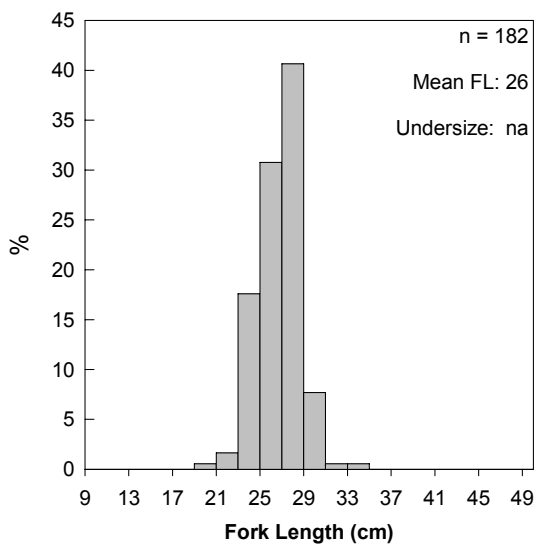


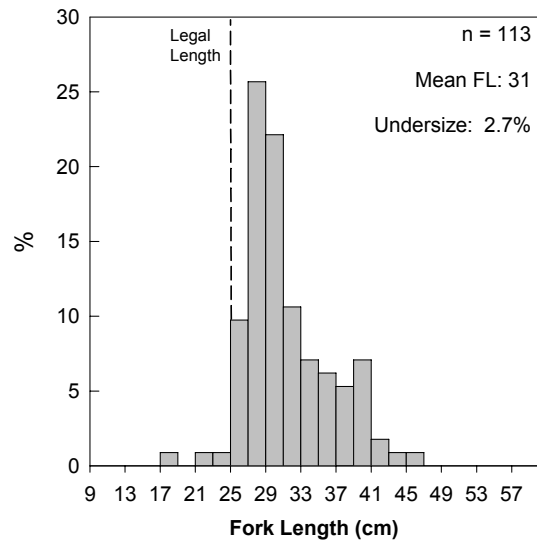
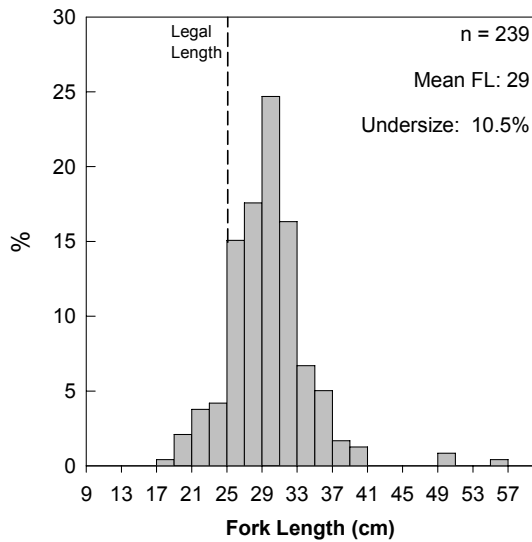
Figure 39. Annual length frequency distributions for silver trevally and silver sweep taken by recreational trailer boat fishers in the coastal marine waters adjacent to Long Reef.

PORT HACKING - COASTAL MARINE

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Silver Trevally



Silver Sweep

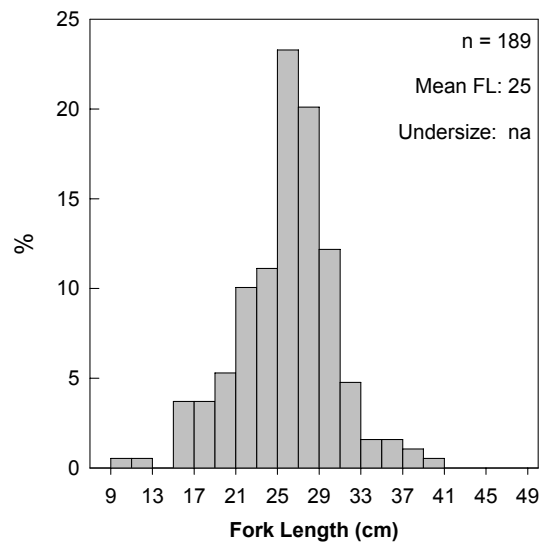
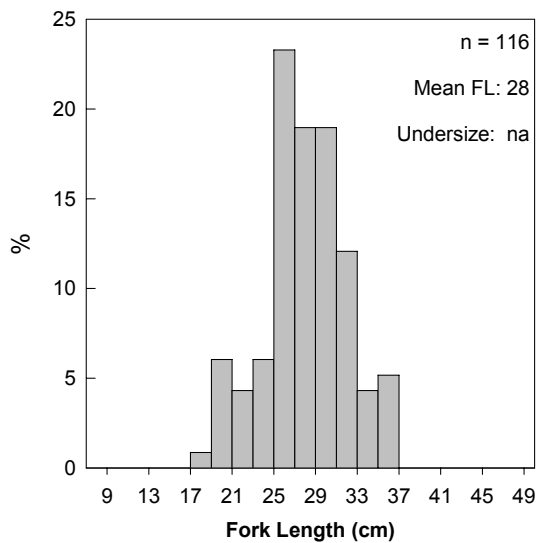


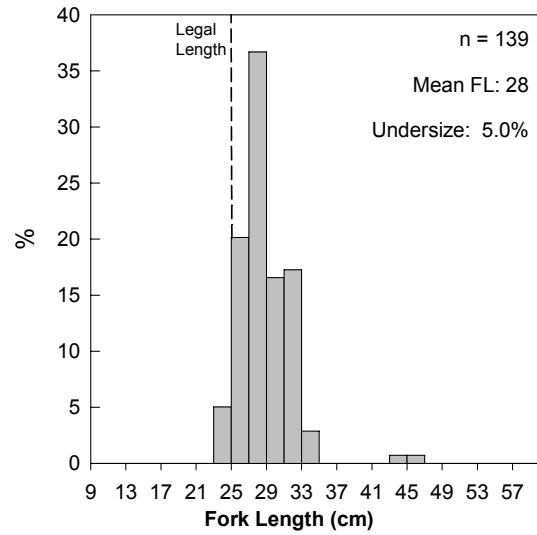
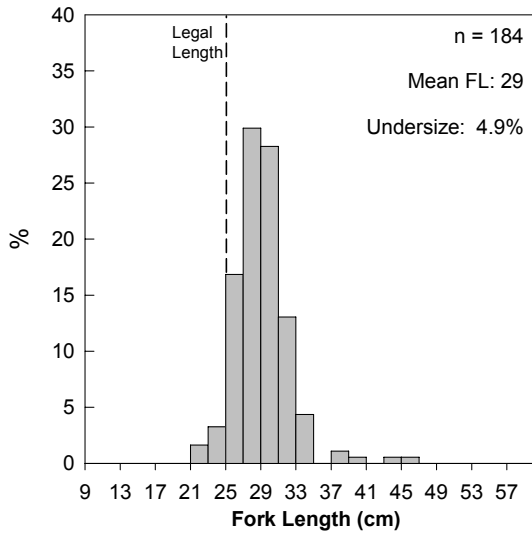
Figure 40. Annual length frequency distributions for silver trevally and silver sweep taken by recreational trailer boat fishers in the coastal marine waters adjacent to the Port Hacking system.

BELLAMBI

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Silver Trevally



Silver Sweep

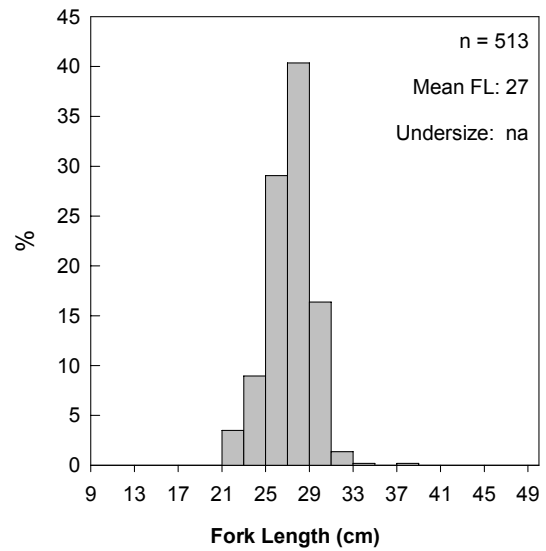
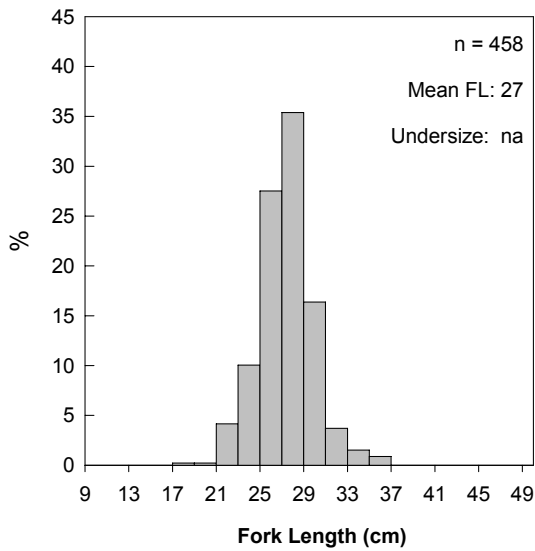


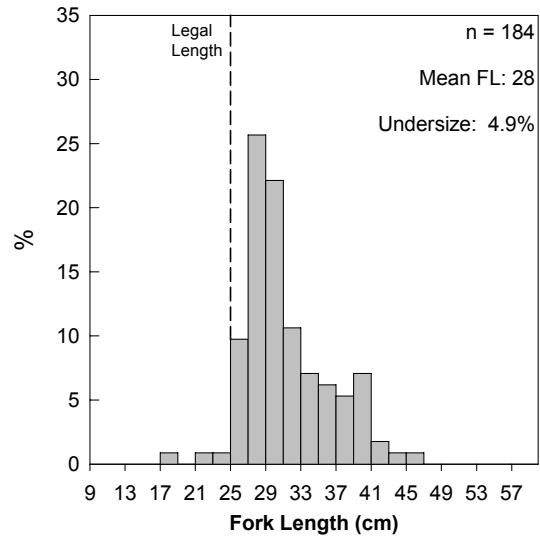
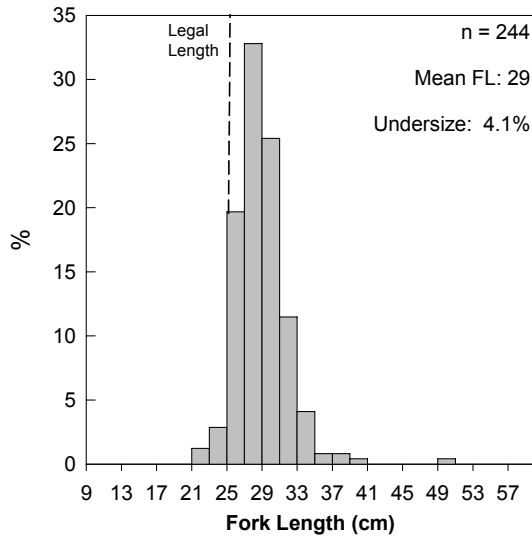
Figure 41. Annual length frequency distributions for silver trevally and silver sweep taken by recreational trailer boat fishers in the coastal marine waters adjacent to Bellambi.

PORT KEMBLA

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Silver Trevally



Silver Sweep

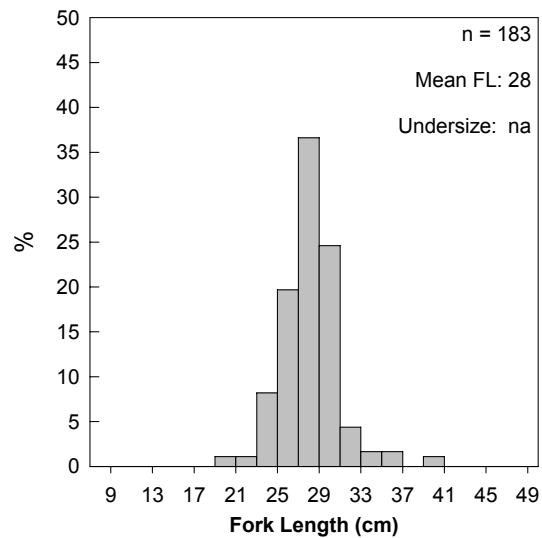
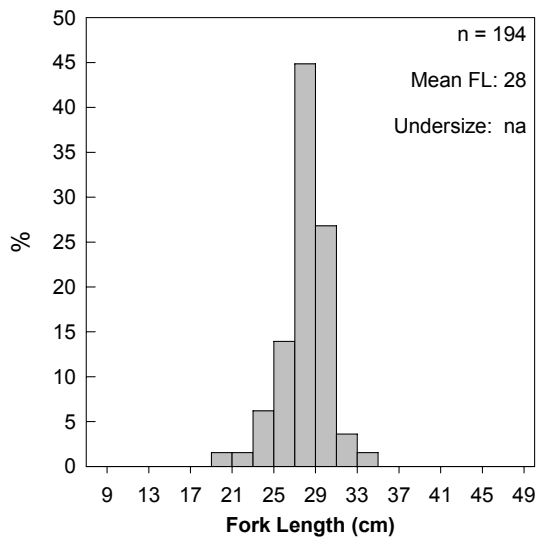


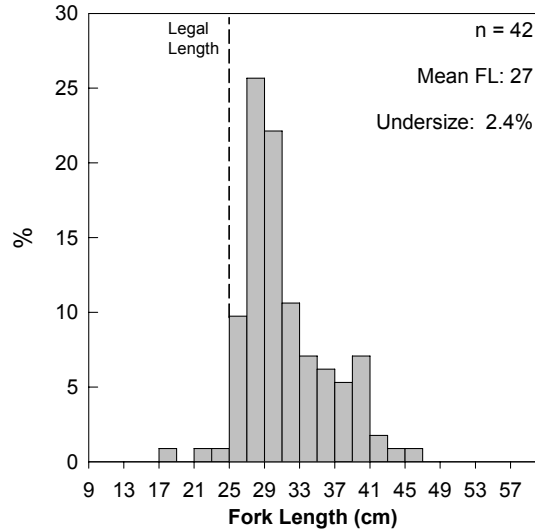
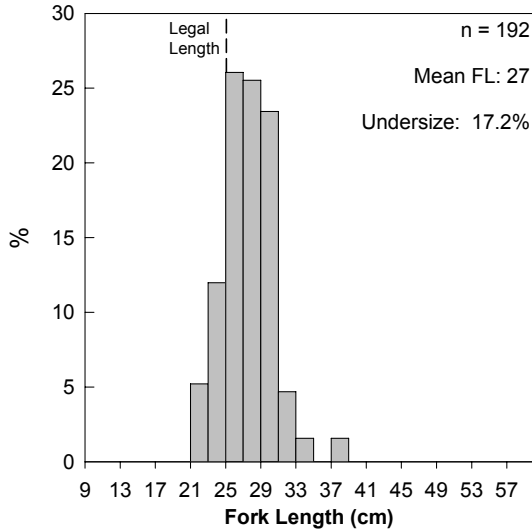
Figure 42. Annual length frequency distributions for silver trevally and silver sweep taken by recreational trailer boat fishers in the coastal marine waters adjacent to Port Kembla.

SHELLHARBOUR

SURVEY YEAR 1
(March 2007 to February 2008)

SURVEY YEAR 2
(March 2008 to February 2009)

Silver Trevally



Silver Sweep

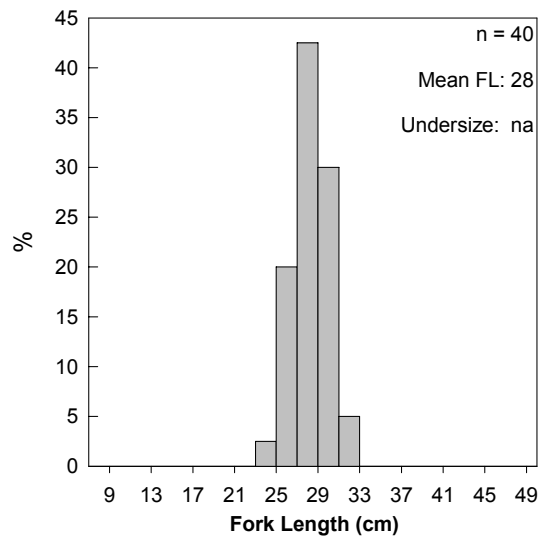
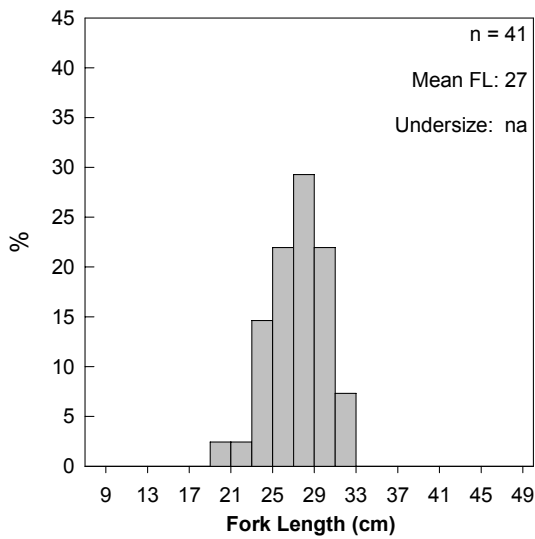


Figure 43. Annual length frequency distributions for silver trevally and silver sweep taken by recreational trailer boat fishers in the coastal marine waters adjacent to Shellharbour.

5. DISCUSSION

The estimates of fishing effort, harvest and the size frequency information presented in this report were derived from a series of highly replicated surveys conducted at many sites within the Greater Sydney region. The two surveys of estuarine fishing in the Hawkesbury River and Port Hacking generated more than 14,400 interviews with fishing parties over the two year survey period. Over 28,400 individual fish, crabs and cephalopods were identified and more than 15,700 length measurements taken during these estuarine interviews. In comparison, the surveys of coastal marine angling generated more than 9,100 interviews with fishing parties over the two year survey period. Over 57,500 individual fish, crabs and cephalopods were identified and more than 44,800 length measurements taken during these interviews of coastal marine angling.

The levels of recreational fishing effort expended in each estuarine fishery were similar between survey years. We estimated that about 653,600 and 670,000 fisher hours of daytime recreational effort (boat and shore combined) were expended in the Hawkesbury River estuarine fishery during the two survey years respectively. The much smaller Port Hacking estuary received an estimated 219,000 and 217,800 fisher hours of daytime recreational effort (boat and shore combined) during the two survey years respectively. These levels of fishing effort are less than the 993,300 fisher hours (boat and shore combined) recorded from Lake Macquarie in 2003/04 (Steffe *et al.* 2005a) but more than the 76,200 fisher hours (boat only) recorded from Tuross lake in 2003/04 (Steffe *et al.* 2005b).

Most of the recreational fishing effort in the Hawkesbury River estuary was boat-based. We found that boat-based fishing accounted for about 78.7% and 77.7% of the annual effort in this estuary during the two survey years respectively. The low levels of shore-based fishing effort recorded in this estuarine system are probably due to the lack of shoreline access throughout the system. The Hawkesbury River estuary has extensive tracts of terrestrial National Park and nature reserves along both of its shorelines. In contrast, most of the recreational fishing effort in the Port Hacking estuary was shore-based. We found that shore-based fishing accounted for about 58.8% and 56.3% of the annual effort in this estuary during the two survey years respectively. The relatively high levels of shore-based fishing effort recorded in this estuarine system are probably due to the extensive shoreline access, mainly along the northern shore. The Port Hacking estuary has an extensive tract of terrestrial National Park along its southern shoreline, however, there are also many access points along this shoreline that can be used to reach the fishery.

Overall, we recorded 87 taxa during the surveys of estuarine fishing (Tables 5 – 12). The Hawkesbury River estuary yielded 79 taxa over the course of the two year survey period, whilst 60 taxa were recorded from the Port Hacking estuary (Tables 5 – 12). The higher number of taxa recorded in the Hawkesbury survey occurred because of the presence of marine habitats and their associated fish fauna in the survey area. The area around Lion Island is essentially marine in character and provides opportunities for boat-based fishers to target marine reef-associated species.

We estimated that about 134,000 and 134,900 fish, crabs and cephalopods were harvested by daytime recreational fishers from the Hawkesbury River estuary during each of the two survey years respectively (Tables 5 – 8). In contrast, we estimated that about 77,800 and 82,100 fish, crabs and cephalopods were harvested by daytime recreational fishers from the Port Hacking estuary during each of the two survey years respectively (Tables 9 – 12). These levels of harvest are less than the 497,500 fish, crabs and cephalopods (boat and shore combined) recorded from Lake Macquarie in 2003/04 (Steffe *et al.* 2005a) but more than the 27,800 fish, crabs and cephalopods (boat only) recorded from Tuross Lake (Steffe *et al.* 2005b). The ten most commonly harvested taxa in the current estuarine surveys, by number, were yellowfin bream, dusky flathead, yellowtail,

sand whiting, sand mullet, tailor, blue swimmer crab, silver trevally, luderick and yellowfin leatherjacket. These ten species accounted for most of the harvest in the Hawkesbury River and Port Hacking estuarine fisheries, ranging between 78.5% and 88.1% of the total harvest on an annual basis. The composition of the ten most commonly harvested species and their relative contribution to the total annual harvest was similar to that observed in the Lake Macquarie and Tuross Lake estuarine fisheries (Steffe *et al.* 2005a & 2005b).

Graphical comparisons of annual size frequency for eight recreationally important species (Figures 5 – 12) are presented for each estuarine fishery survey (boat and shore fisheries combined). These figures provide summary information to describe the numbers of fish measured, the mean size of retained fish and the proportion of undersize fish in the retained catch. For example, size frequency comparisons for dusky flathead are similar between years within each estuary but differ markedly between estuaries (Figures 5 & 6). The mean sizes of dusky flathead taken in the Hawkesbury River estuary (ranging annually between 42 and 43 cm) were much smaller than for fish taken from the Port Hacking estuary (ranging annually between 47 and 48 cm). These data show that there are proportionally more large dusky flathead being taken from the Port Hacking estuary even though it is a much smaller estuarine system. These differences in the size structure of dusky flathead between estuaries may reflect differences in relative fishing pressure and hence fishing-related mortality in the two estuaries. Commercial fishing is permitted in the Hawkesbury system but not in the Port Hacking estuary. Also, the amount of recreational fishing effort recorded from the Hawkesbury system was much higher than that estimated from the Port Hacking estuary.

We estimated that about 65,600 and 67,100 daytime recreational fishing trips originated from the sites surveyed for coastal marine fishing during each of the two survey years respectively. The levels of coastal marine fishing effort expended at each survey site were similar between years (Figure 13). Not surprisingly, the largest amounts of fishing effort originated from the four large access sites in the Sydney metropolitan area (i.e., Hawkesbury estuary, Sydney Harbour, Botany Bay and Port Hacking). The three direct ocean access sites in the Illawarra area (i.e., Bellambi, Port Kembla and Shellharbour) had intermediate levels of fishing effort. The lowest levels of fishing effort were measured at the Long Reef, Terrigal and Norah Head ramps (Figure 13). These site-specific differences in fishing effort reflect the size of the populations that surround each access point.

Overall, we recorded 119 taxa during the surveys of coastal marine fishing. The first survey year yielded 103 taxa, whilst 99 taxa were recorded during the second survey year (Tables 13 – 28). We estimated that about 257,000 and 253,900 fish, crustaceans and cephalopods were harvested by daytime recreational fishers at the sites surveyed for coastal marine fishing during each of the two survey years respectively. The ten most commonly harvested taxa in the coastal marine surveys, by number, were eastern bluespotted flathead, ocean leatherjacket, snapper, silver trevally, southern calamari, blue mackerel, silver sweep, yellowtail, grey morwong and southern maori wrasse. These ten species accounted for most of the harvest (>80%) in the coastal marine fisheries. The recreational harvest (number of individuals) of some species varied considerably between survey years at some sites (e.g., ocean leatherjacket, Tables 13 – 28) despite the relatively stable levels of annual fishing effort. These inter-annual changes in harvest numbers may reflect natural fluctuations in fish abundance at these sites.

Graphical comparisons of size frequency information (Figures 20 – 43) are presented for six recreationally important species in the coastal marine fishery. The size frequency information summarises the numbers of fish measured, the mean size of retained fish and the proportion of undersize fish in the retained catch. For example, size frequency comparisons for eastern bluespotted flathead show latitudinal differences within the Greater Sydney region. The mean sizes of eastern bluespotted flathead taken in the northern part of the region (i.e., Norah Head, Terrigal, Hawkesbury River system, and Long Reef access sites) tended to be larger, ranging annually

between 40 and 45 cm (Figures 20 – 23), than the mean sizes of fish taken from access sites in the southern part of the region (i.e., Port Hacking system, Bellambi, Port Kembla and Shellharbour), which ranged annually between 39 and 41 cm (Figures 24 – 27). These differences in the size structure of eastern bluespotted flathead may reflect latitudinal differences in relative fishing pressure and hence fishing-related mortality within the Greater Sydney region.

The information in this report provides site-specific, baseline data on recreational fishing effort, catch (number of individuals) and the size structure of the retained catch within the Greater Sydney region. This information is vital because it provides a scientifically defensible, evidence-based framework for assessing any future changes in the recreational fisheries within this region. This extensive dataset will also allow us to determine the effectiveness of any future management changes in this region, whether they are spatial closures, changes in allocation among fishing sectors or modifications to existing bag and size limits.

6. REFERENCES

- Breen, D.A., Avery, R.P. and Otway, N.M. 2005. Broadscale biodiversity assessment of the Hawkesbury Shelf Marine Bioregion. Final report for the NSW Marine Parks Authority.
- Cochran, W.G. 1977. Sampling techniques, 3rd edition. John Wiley and Sons, New York.
- Hoenig, J.M., Jones, C.M., Pollock, K.H., Robson, D.S. and Wade, D.L. 1997. Calculation of catch rate and total catch in roving surveys of anglers. *Biometrics* 53: 306 – 317.
- Hoenig, J.M., Robson, D.S., Jones C.M. and Pollock K.H. 1993. Scheduling counts in the instantaneous and progressive count methods for estimating sportfishing effort. *North American Journal of Fisheries Management* 13: 723 – 736.
- Pollock, K.H., Hoenig, J.M., Jones, C.M., Robson, D.S. and Greene, C.J. 1997. Catch rate estimation for roving and access point surveys. *North American Journal of Fisheries Management* 17: 11 – 19.
- Pollock, K.H., Jones, C.M. and Brown, T.L. 1994. Angler survey methods and their applications in fisheries management. American Fisheries Society, Special Publication 25, Bethesda, Maryland.
- Steffe, A.S., Murphy, J.J., Chapman, D.J., Barrett, G.P. and Gray, C.A. 2005b. An assessment of changes in the daytime, boat-based, recreational fishery of the Tuross Lake estuary following the establishment of a 'Recreational Fishing Haven'. NSW Department of Primary Industries – Fisheries Final Report Series, No. 81, 70pp.
- Steffe, A.S., Murphy, J.J., Chapman, D.J. and Gray, C.A. 2005a. An assessment of changes in the daytime recreational fishery of Lake Macquarie following the establishment of a 'Recreational Fishing Haven'. NSW Department of Primary Industries – Fisheries Final Report Series, No. 79, 103pp.
- Steffe, A.S., Murphy, J.J. and Reid, D.D. 2008. Supplemented access point sampling designs: a cost-effective way of improving the accuracy and precision of fishing effort and harvest estimates derived from recreational fishing surveys. *North American Journal of Fisheries Management* 28: 1001 – 1008.

7. APPENDICES

Appendix 1. List of taxa retained by recreational fishers.

COMMON NAME	SCIENTIFIC NAME	HIGHER CLASSIFICATION
Port Jackson Shark	<i>Heterodontus portusjacksoni</i>	Heterodontidae
Shortfin Mako Shark	<i>Isurus oxyrinchus</i>	Lamnidae
Blind Shark	<i>Brachaelurus waddi</i>	Brachaeluridae
Wobbegong Sharks	<i>Orectolobus spp.</i>	Orectolobidae
Gummy Shark	<i>Mustelus antarcticus</i>	Triakidae
Whaler Sharks	<i>Carcharhinidae</i>	Carcharhinidae
Hammerhead Shark	<i>Sphyrna spp.</i>	Sphyrnidae
Gulper Sharks (Endeavour Dogfish)	<i>Centrophorus spp.</i>	Centrophoridae
Australian Angelshark	<i>Squatina australis</i>	Squatinidae
Shovelnose Ray	<i>Aptychotrema rostrata</i>	Rhinobatidae
Banjo Ray	<i>Trygonorhina sp. A</i>	Rhinobatidae
Stingrays	<i>Urolophidae & Dasyatidae</i>	Urolophidae & Dasyatidae
Moray Eel	<i>Gymnothorax prasinus</i>	Muraenidae
Conger Eel	<i>Conger spp.</i>	Congridae
Southern Herring	<i>Herklotsichthys castelnaui</i>	Clupeidae
Australian Sardine	<i>Sardinops sagax</i>	Clupeidae
Blue Sprat	<i>Spratelloides robustus</i>	Clupeidae
Sergeant Baker	<i>Hime purpurissatus</i>	Aulopidae
Lizardfish	<i>Synodontidae</i>	Synodontidae
Painted Grinner	<i>Trachinocephalus myops</i>	Synodontidae
Blue Catfish	<i>Neoarius graeffei</i>	Ariidae
Estuary Cobbler	<i>Cnidoglanis macrocephalus</i>	Plotosidae
Bearded Cods	<i>Lotella rhacina</i>	Moridae
Sea Garfish	<i>Hyporhamphus australis</i>	Hemiramphidae
River Garfish	<i>Hyporhamphus regularis</i>	Hemiramphidae
Stout Longtom	<i>Tylosurus gavioloides</i>	Belonidae
Imperador	<i>Beryx decadactylus</i>	Berycidae
Redfish	<i>Centroberyx affinis</i>	Berycidae
John Dory	<i>Zeus faber</i>	Zeidae
Reef Ocean Perch	<i>Helicolenus percoides</i>	Scorpaenidae
Eastern Red Scorpionfish	<i>Scorpaena cardinalis</i>	Scorpaenidae
Red Gurnard	<i>Chelidonichthys kumu</i>	Triglidae
Northern Sand Flathead	<i>Platycephalus arenarius</i>	Platycephalidae
Southern Sand Flathead	<i>Platycephalus bassensis</i>	Platycephalidae
Eastern Bluespotted Flathead	<i>Platycephalus caeruleopunctatus</i>	Platycephalidae
Dusky Flathead	<i>Platycephalus fuscus</i>	Platycephalidae
Longspine Flathead	<i>Platycephalus longispinis</i>	Platycephalidae
Marbled Flathead	<i>Platycephalus marmoratus</i>	Platycephalidae
Tiger Flathead	<i>Platycephalus richardsoni</i>	Platycephalidae
Tasselnout Flathead	<i>Thysanophrys cirronasa</i>	Platycephalidae
Eastern Wirrah	<i>Acanthistius ocellatus</i>	Serranidae
Butterfly Perch	<i>Caesioperca lepidoptera</i>	Serranidae
Longfin Perch	<i>Caprodon longimanus</i>	Serranidae

Appendix 1. Continued.

COMMON NAME	SCIENTIFIC NAME	HIGHER CLASSIFICATION
Maori Rockcod	<i>Epinephelus undulatostratus</i>	Serranidae
Halfbanded Seaperch	<i>Hypoplectrodes maccullochi</i>	Serranidae
Banded Seaperch	<i>Hypoplectrodes nigroruber</i>	Serranidae
Estuary Perch	<i>Macquaria colonorum</i>	Percichthyidae
Pearl Perch	<i>Glaucosoma scapulare</i>	Glaucosomidae
Fourline Striped Grunter	<i>Pelates quadrilineatus</i>	Terapontidae
Longfin Pike	<i>Dinolestes lewini</i>	Dinolestidae
King George Whiting	<i>Sillaginodes punctata</i>	Sillaginidae
Sand Whiting	<i>Sillago ciliata</i>	Sillaginidae
Eastern School Whiting	<i>Sillago flindersi</i>	Sillaginidae
Trumpeter Whiting	<i>Sillago maculata</i>	Sillaginidae
Tailor	<i>Pomatomus saltatrix</i>	Pomatomidae
Cobia	<i>Rachycentron canadum</i>	Rachycentridae
Rainbow Runner	<i>Elagatis bipinnulata</i>	Carangidae
Silver Trevally	<i>Pseudocaranx georgianus</i>	Carangidae
Amberjack	<i>Seriola dumerili</i>	Carangidae
Samsonfish	<i>Seriola hippos</i>	Carangidae
Yellowtail Kingfish	<i>Seriola lalandi</i>	Carangidae
Common Jack Mackerel	<i>Trachurus declivis</i>	Carangidae
Yellowtail	<i>Trachurus novaezealandiae</i>	Carangidae
Mahi Mahi	<i>Coryphaena hippurus</i>	Coryphaenidae
Salmon	<i>Arripis trutta</i>	Arripidae
False Fusilier	<i>Paracaesio xanthura</i>	Lutjanidae
Yellowfin Bream	<i>Acanthopagrus australis</i>	Sparidae
Snapper	<i>Pagrus auratus</i>	Sparidae
Tarwhine	<i>Rhabdosargus sarba</i>	Sparidae
Mulloway	<i>Argyrosomus japonicus</i>	Sciaenidae
Teraglin	<i>Atractoscion aequidens</i>	Sciaenidae
Blacksaddle Goatfish	<i>Parupeneus spilurus</i>	Mullidae
Bluestriped Goatfish	<i>Upeneichthys spp.</i>	Mullidae
Diamondfish	<i>Monodactylus argenteus</i>	Monodactylidae
Eastern Pomfred	<i>Schuettea scalaripinnis</i>	Monodactylidae
Black-Tipped Bullseye	<i>Pempheris affinis</i>	Pempheridae
Rock Blackfish	<i>Girella elevata</i>	Girellidae
Luderick	<i>Girella tricuspidata</i>	Girellidae
Silver Drummer	<i>Kyphosus sydneyanus</i>	Kyphosidae
Silver Sweep	<i>Scorpis lineolata</i>	Scorpididae
Mado	<i>Atypichthys strigatus</i>	Microcanthidae
Old Wife	<i>Enoplosus armatus</i>	Enoplosidae
Onespot Puller	<i>Chromis hypsilepis</i>	Pomacentridae
White-ear	<i>Parma microlepis</i>	Pomacentridae
Rock Cale	<i>Aplodactylus lophodon</i>	Aplodactylidae
Red Morwong	<i>Cheilodactylus fuscus</i>	Cheilodactylidae

Appendix 1. Continued.

COMMON NAME	SCIENTIFIC NAME	HIGHER CLASSIFICATION
Grey Morwong	<i>Nemadactylus douglasii</i>	Cheilodactylidae
Jackass Morwong	<i>Nemadactylus macropterus</i>	Cheilodactylidae
Bastard Trumpeter	<i>Latridopsis forsteri</i>	Latrididae
Sand Mullet	<i>Myxus elongatus</i>	Mugilidae
Snook	<i>Sphyraena novaehollandiae</i>	Sphyraenidae
Striped Barracuda	<i>Sphyraena obtusata</i>	Sphyraenidae
Eastern Blue Groper	<i>Achoerodus viridis</i>	Labridae
Eastern Foxfish	<i>Bodianus frenchii</i>	Labridae
Eastern Pigfish	<i>Bodianus unimaculatus</i>	Labridae
Comb Wrasse	<i>Coris picta</i>	Labridae
Purple Wrasse	<i>Notolabrus fucicola</i>	Labridae
Crimsonband Wrasse	<i>Notolabrus gymnogenis</i>	Labridae
Bluethroat Wrasse	<i>Notolabrus tetricus</i>	Labridae
Southern Maori Wrasse	<i>Ophthalmolepis lineolatus</i>	Labridae
Senator Wrasse	<i>Pictilabrus laticlavius</i>	Labridae
Rainbow Cale	<i>Odax acroptilus</i>	Odacidae
Black Trevally	<i>Siganus fuscescens</i>	Siganidae
Gemfish	<i>Rexea solandri</i>	Gempylidae
Barracouta	<i>Thyrsites atun</i>	Gempylidae
Largehead Hairtail	<i>Trichiurus lepturus</i>	Trichiuridae
Frigate Mackerel	<i>Auxis thazard</i>	Scombridae
Leaping Bonito	<i>Cybiosarda elegans</i>	Scombridae
Mackerel Tuna	<i>Euthynnus affinis</i>	Scombridae
Skipjack Tuna	<i>Katsuwonus pelamis</i>	Scombridae
Australian Bonito	<i>Sarda australis</i>	Scombridae
Blue Mackerel	<i>Scomber australasicus</i>	Scombridae
Spotted Mackerel	<i>Scomberomorus munroi</i>	Scombridae
Albacore	<i>Thunnus alalunga</i>	Scombridae
Yellowfin Tuna	<i>Thunnus albacares</i>	Scombridae
Black Marlin	<i>Makaira indica</i>	Istiophoridae
Striped Marlin	<i>Tetrapturus audax</i>	Istiophoridae
Blue-eye Trevalla	<i>Hyperoglyphe antarctica</i>	Centrolophidae
Blue Warehou	<i>Seriolella brama</i>	Centrolophidae
Large-tooth Flounder	<i>Pseudorhombus arsius</i>	Paralichthyidae
Small-tooth Flounder	<i>Pseudorhombus jenynsii</i>	Paralichthyidae
Black Sole	<i>Brachirus nigra</i>	Soleidae
Toothbrush Leatherjacket	<i>Acanthaluteres vittiger</i>	Monacanthidae
Unicorn Leatherjacket	<i>Aluterus monoceros</i>	Monacanthidae
Black Reef Leatherjacket	<i>Eubalichthys bucephalus</i>	Monacanthidae
Mosaic Leatherjacket	<i>Eubalichthys mosaicus</i>	Monacanthidae
Sixspine Leatherjacket	<i>Meuschenia freycineti</i>	Monacanthidae
Yellowfin Leatherjacket	<i>Meuschenia trachylepis</i>	Monacanthidae
Fanbelly Leatherjacket	<i>Monacanthus chinensis</i>	Monacanthidae

Appendix 1. Continued.

COMMON NAME	SCIENTIFIC NAME	HIGHER CLASSIFICATION
Ocean Leatherjacket	<i>Nelusetta ayraudi</i>	Monacanthidae
Rough Leatherjacket	<i>Scobinichthys granulatus</i>	Monacanthidae
Toadfish & Puffers	<i>Ostraciidae</i>	Ostraciidae
	<i>Tetraodontidae</i>	Tetraodontidae
	<i>Diodontidae</i>	Diodontidae
	<i>Triodontidae</i>	Triodontidae
Gould's squid	<i>Nototodarus gouldi</i>	Cephalopoda
Octopus	<i>Octopus spp.</i>	Cephalopoda
Giant Cuttlefish	<i>Sepia apama</i>	Cephalopoda
Estuarine Cuttlefish	<i>Sepia spp.</i>	Cephalopoda
Southern Calamari	<i>Sepioteuthis australis</i>	Cephalopoda
Common Squid	<i>Uroteuthis (Photololigo) spp.</i>	Cephalopoda
Blue Swimmer Crab	<i>Portunus pelagicus</i>	Crustacea
Giant Mud Crab	<i>Scylla serrata</i>	Crustacea

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