

Small-scale Fisheries in Milne Bay Province: Landing, Market and Buyer Surveys in Alotau



NATIONAL FISHERIES AUTHORITY

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ACRONYMS AND TERMS

ADB	Asian Development Bank
ASM	Alotau Supermarket
CBM	community-based management
CFMDP	Coastal Fisheries Management & Development Project
ENB	East New Britain Province
EU	European Union
FAD	fish aggregating devices
GIS	geographic information system
GPS	global positioning system
LLG	local-level government
MAS	Manus Province
MBP	Milne Bay Province
MOR	Morobe Province
NFA	National Fisheries Authority
NGO	non-governmental organisation
NIP	New Ireland Province
PNG	Papua New Guinea
NSP	North Solomons Province
UPNG	University of Papua New Guinea

INTRODUCTION

Background

This report presents the findings of small-scale fisheries surveys undertaken in Milne Bay Province between December 2005 and December 2006, as part of the National Fisheries Authority (NFA) Coastal Fisheries Management and Development Project (CFMDP). This report is part of a series focused on fisheries catches, market sales, buyers and socioeconomic surveys designed to characterise small-scale fisheries and to monitor project outcomes in the PNG provinces of New Ireland, Milne Bay and Morobe.

The characterisation of small-scale fisheries, and their role in these three provinces, form a part of the CFMDP, which is implemented by NFA with loan funding from the Asian Development Bank (ADB) (1925 PNG-SF). The overall aim of the CFMDP has been to contribute to the reduction of poverty in rural areas through increasing, or preventing, a further decline in the incomes of coastal communities. This is being done by promoting improved management of resources, and by creating sustainable earning and employment opportunities for coastal communities, improving access to information on the types and scale of fisheries being undertaken, and constructing wharves and jetties.

This report is based on surveys undertaken by enumerators employed by the project and the collation of data collected previously and includes:

1. Surveys of marine products landed by small-scale fishers, usually using canoes or banana boats.
2. Surveys of marine products sold at local markets

- and their relative importance in relation to other items sold.
3. Surveys of marine products purchased by buyers.
4. Household surveys examining socioeconomic conditions and the contribution of small-scale fisheries undertaken in several LLGs in each province.
5. Focus group and key informant surveys undertaken in conjunction with household surveys.
6. Additional information on the activities of buyers recorded by NFA and provincial fisheries departments, where available, for some provinces.

These surveys and data collections were undertaken to provide basic information on the relative importance of fisheries to the livelihoods of people in PNG, and in this report, specifically Milne Bay Province. They were developed to provide information on the types and quantities of marine organisms being collected/caught in the province with a view to assessing the status of the resources and identifying threats and opportunities for the future.

Aims of CFMDP small-scale fisheries surveys

These surveys were designed to gather information from fishers, seafood sellers in markets around Alotau, and commercial buyers so that we could use the information to characterise the small-scale fisheries of the area. The purpose of the surveys was to:

- characterise the types, numbers and sizes of fishes, invertebrates and other marine products landed in Alotau township by fishers living there or in surrounding areas. This information included some profiling of fishers, including costs and effort, general location of fishing grounds, and fishers' home village;

- describe the marine products sold in markets around Alotau. This information included some profiling of sellers, the source of their products, processing and prices for which they the products are being sold; and
- obtain information on the activities of buyers, including identification and quantities of marine products purchased, and the prices paid.

These three aspects of small-scale fishing were included to cover the supply and marketing of marine products in Alotau, with a view to understanding the types and scales of fisheries being undertaken. The study did not include purely commercial fishing, but instead focused on small-scale fishers who provide food for their households, and sell fishes and other marine products to earn cash.

APPROACH AND METHODS

Study design

Data on fish landings, market sales and buyer purchases were collected separately for this survey to characterise the capture and use of marine products in the province. All information collected was centred on Alotau township, but the marine products described may have been caught from anywhere in the province and in some cases came from outside of it. The focus was on those products brought to Alotau by fishers or market sellers, and occasionally buyers.

The three survey/data collections included in this report are:

1. landings of catches brought to Alotau, either for sale at markets or to buyers by small-scale fishers;
2. marine products offered for sale through local markets in Alotau; and
3. purchases of marine products by buyers in Alotau.

Survey of fishers' landings

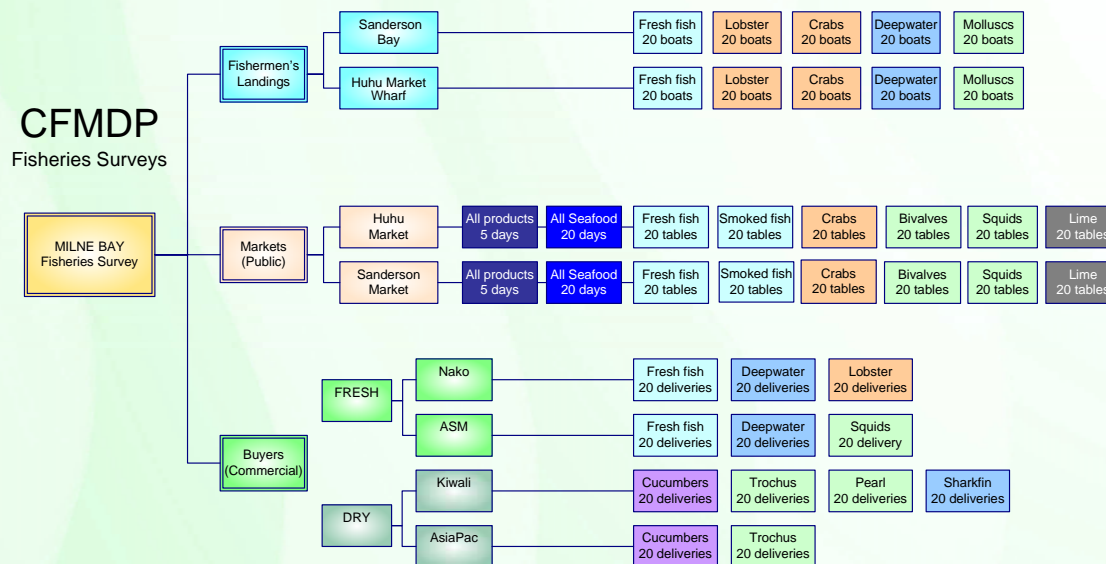
A survey of marine product landings in Alotau was carried out between December 2005 and December 2006 by a team of enumerators trained by the project. Teams of enumerators were placed on a roster system to ensure that fishers were intercepted as they came to two main sites to land their catch. The survey focused on intercepting at least 20 boats per month at each of the two sites.

For each boat intercepted, enumerators interviewed the fishers and identified and measured their catch. Information was collected on 1) landing location, (2) fisher's name, age, and home village, (3) areas fished, (4) fishing methods used, (5) effort expended per fishing trip (including the number of fishers in the boat, hours spent fishing, etc.) and (6) cost of each fishing trip. All marine products were identified to species level, measured (fork length for fishes, carapace and/or tail length or width for lobsters, and shell dimensions for molluscs) and, in the case of crustaceans, their reproductive condition recorded (i.e. sex, whether they were in berry).

Market survey

Market surveys in Alotau focused on the Huhu Main Market, but included at least some information from the Sanderson or Nako Market in Sanderson Bay. Data were collected by the same trained enumerators. The survey targeted three levels of information:

- General information regarding sellers' market tables (including sellers who offered goods for sale on mats placed on the ground) to characterise all products being sold, and to determine the relative importance of marine products (five replicate surveys of the entire market per month);



↑ Sampling design for each survey component in Milne Bay Province. This was the sampling plan for the survey, but its completion depended on cooperation from the fishers, sellers and buyers involved. In practice, Nako Fisheries had ceased buying fish by the time of this survey and Alotau Supermarket (ASM) did not participate. This meant we were unable to collect information on the purchase of fresh fish by buyers as we did in other provinces.

- More detailed information on those tables offering seafood (20 replicate surveys of the market per month); and
- Detailed surveys of at least 20 tables per month on which all seafood was identified, measured, and details of sex and reproductive condition of marine products recorded where possible. Sellers themselves were also interviewed.

To ensure good coverage of the main types of marine seafood products being offered, enumerators targeted at least 20 tables per month, separately for fresh and smoked fishes, crustaceans and molluscs.

Buyer data

Buyer data were obtained by enumerators visiting buyers each month to record details of transactions, including sellers, areas fished, species, length and/or weight, and other characteristics. We were, however, unable to obtain comprehensive monthly records from buyers that would provide a context for the flow-through of marine products. The information in this report therefore focuses on characterising the catches being brought in by sellers, but does not contain the information necessary to estimate volumes of seafood, or the overall revenue involved.

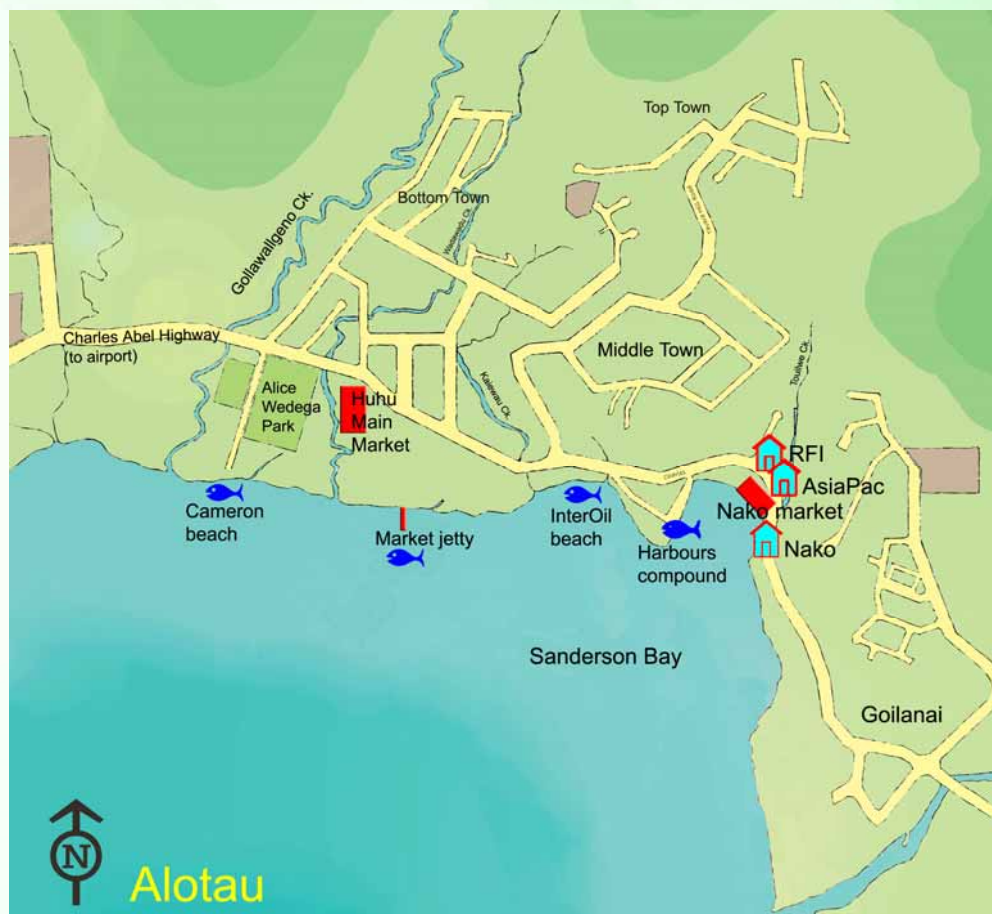
Database

All data from these surveys were collected onto datasheets and entered by trained data entry staff into a purpose-built Microsoft Access database. All data were exported into separate Excel "flat files" for analysis using either Excel or Statistica.

SURVEY WEAKNESSES

Landings and market surveys were undertaken by newly-trained local enumerators who had little experience in implementing surveys of this type. As a result, the surveys contain errors that would be eliminated with experience. These results, therefore, should be interpreted with caution, but they are a useful pilot survey of seafood landings and markets in Alotau. The main problems encountered are outlined below.

1. Identification of fishes, crustaceans and molluscs were sometimes suspect. Enumerators included those with at least some relevant training, but not always including fish taxonomy. The survey team was given species identification cards, and repeated training but members still appear (understandably) to have missed some identifications.
2. Buyer data were discontinuous and incomplete, and did not include estimates of what was coming through the door to each buyer. These limitations in data collection meant that interpretation of the results was difficult, and trends in buying hard to identify. These results should be used with caution, therefore, and cannot be used to estimate total revenues and total tonnages being put through buyer channels.



← Sampling sites, landings, markets and main buyers in Alotau.

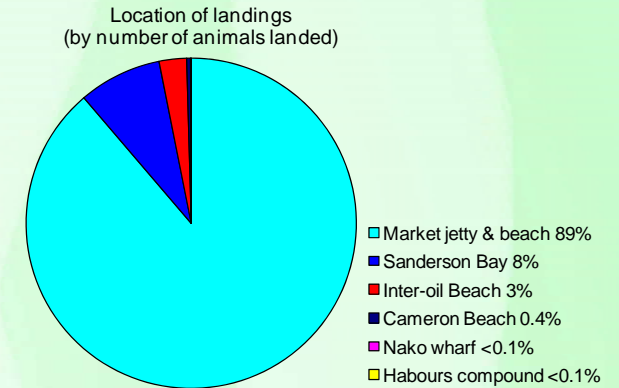
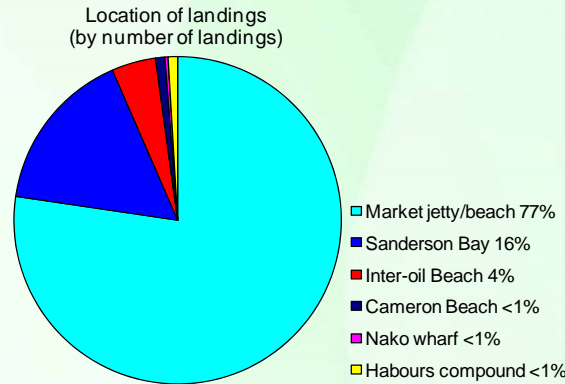
Fishers' Landings



GENERAL INFORMATION

Where were marine products landed?

Fishes and other marine products were landed at 6 sites around Alotau township and Sanderson Bay between December 2005 and December 2006. Landings may have occurred elsewhere as well, but these are likely to have been few and were not captured in this survey. Enumerators intercepted the most landings (77%) at the Huhu Main Market jetty and beach, while 16% of landings were intercepted at Sanderson Bay. Both of these areas are also heavily used by marketers and private small-boat transporters who shuttle people and goods between Alotau and the surrounding areas and islands. The remaining 6.5% of landings was distributed among 4 other sites around the town shoreline. The Huhu Market jetty and beach was the most important landing site (in terms of the total numbers of marine products landed), accounting for almost 89% of all animals counted. Landings made directly at the door of buyers were considered "buyer samples" and not included in the landings section of the survey (note the <1% of landings at the Nako Fisheries Wharf). However where fishers landed their catch at the door of buyers, enumerators recorded measurements as part of the buyer portion of the survey (later in this report).



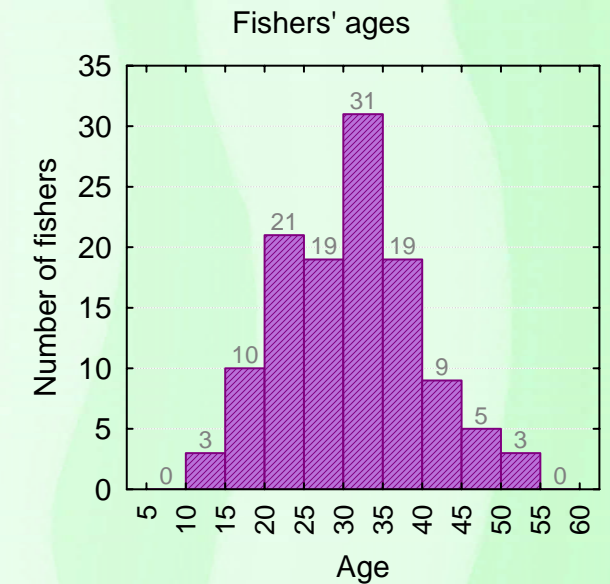
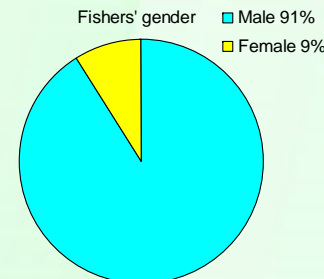
↑ Proportion of landings at different locations around Alotau. Percentages are calculated on the actual number of landings at each place, and on the total number of marine animals landed and recorded over the survey (n=322 landings and 21,835 animals).

Who are the fishers?

Enumerators carried out 1,012 interviews with fishers over the survey period, reaching 122 individual fishers who landed marine products and were interviewed as part of this survey. The average age of fishers was 31 years, but ranged between 12 and 55 years. The most common age for fishers was between 30 and 35 years (26% of all fishers). Ninety-one percent of fishers interviewed were men.

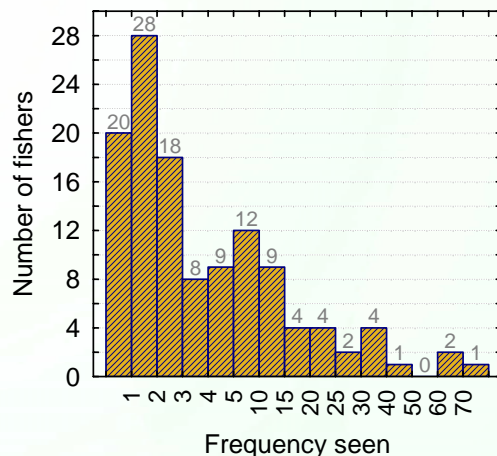
← Frequency that individual fishers were intercepted and interviewed in Alotau (n=122 individual fishers). Note the variable x-axis scale.

→ Proportion of women and men involved in landing marine products in Alotau during the survey (n=122 individual fishers).



↑ Age distribution of fishers interviewed during the landings survey (n=120 fishers who provided their age).

Frequency that fishers were intercepted



What gear and effort are used?

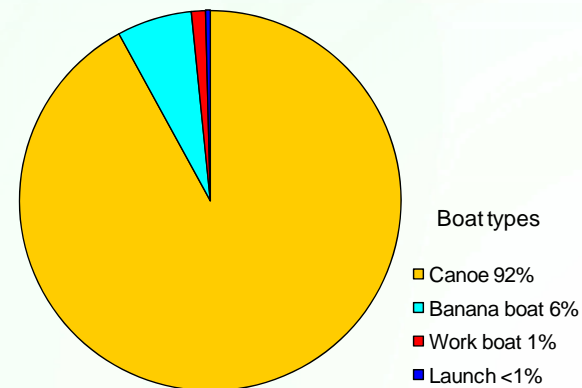
There was some range in the frequency with which individual fishers were interviewed during the survey (see figure on page 11). This suggests that the population of fishers includes dedicated fishers, and broader involvement by people who fish only occasionally. About 20% of all fishers were only interviewed once, and 66% were interviewed 3 times or less. The average number of times an individual fisher was intercepted over the year was 8. There were also some very frequent fishers, with about 8% being intercepted 25 times or more over the survey. The maximum number of times a single fisher was interviewed was 77 occasions over the 13-month-long survey.

The most common fishing method was handlining, which was used, at least as one of the fishing methods, in 53% of all landings. The second most common fishing method was "pressure lantern". The light from a pressure lantern is used both for illumination and for attracting baitfish and other species. In Alotau, this method often involves fishers from villages around the town who fish at night for scads from small canoes. Lantern fishing can also include hand collecting, spearing in shallow waters, and scoop net fishing at night. Netting and some of the more specialised forms of handlining were only minor forms of fishing.

Four types of boats were used by small-scale fishers who landed their catch in Alotau. Canoes were by far the most frequently used boat type, and were reported in 92% of landings for which boat data were available. About 11% of the canoes in use were motorised. Commercially manufactured boats were reported in only 8% of landings.

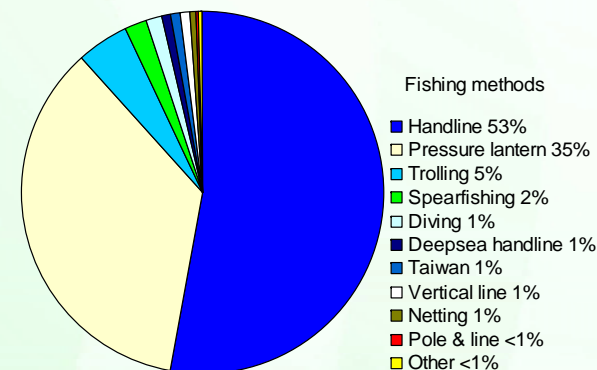


In terms of effort, fishers using motorised boats spent more hours fishing and used more fuel in fishing and transporting to and from the fishing grounds and home or markets, than did people who used canoes. The number of fish caught per litre of fuel used was also highest in canoes and declined with an increase in boat size. Some canoes reportedly use small motors in addition to paddles, so fuel use is relevant for them. In contrast, the



➤ Boat types recorded with landed marine products. Note that 22% of interviews were not accompanied by boat information. Percentages are relative proportions among samples that had boat information (n=251).

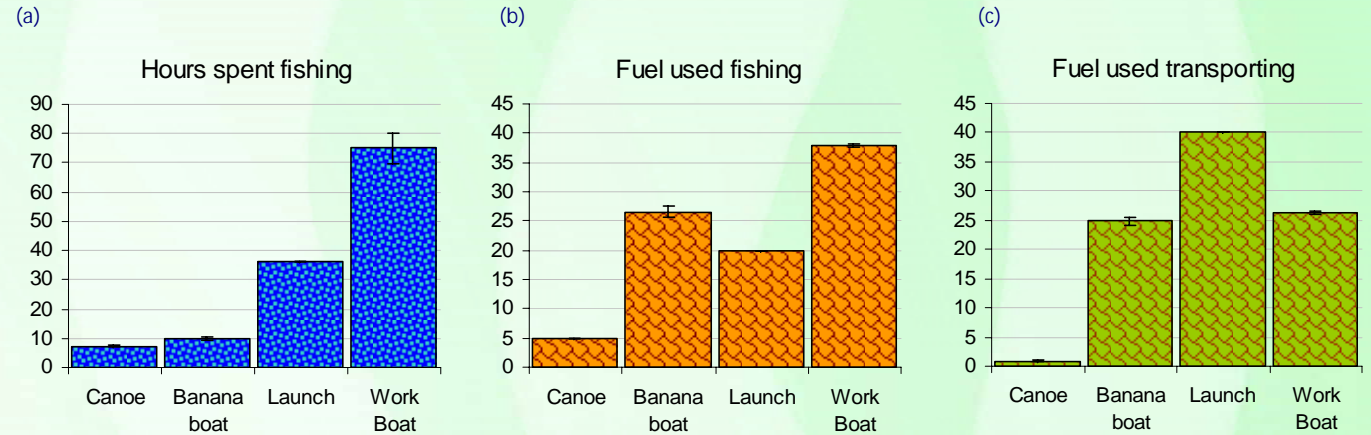
➤ Fishing methods recorded with landed marine products. Note that a mix of fishing methods was usually reported with each catch (n=551 methods reported over 322 landings).



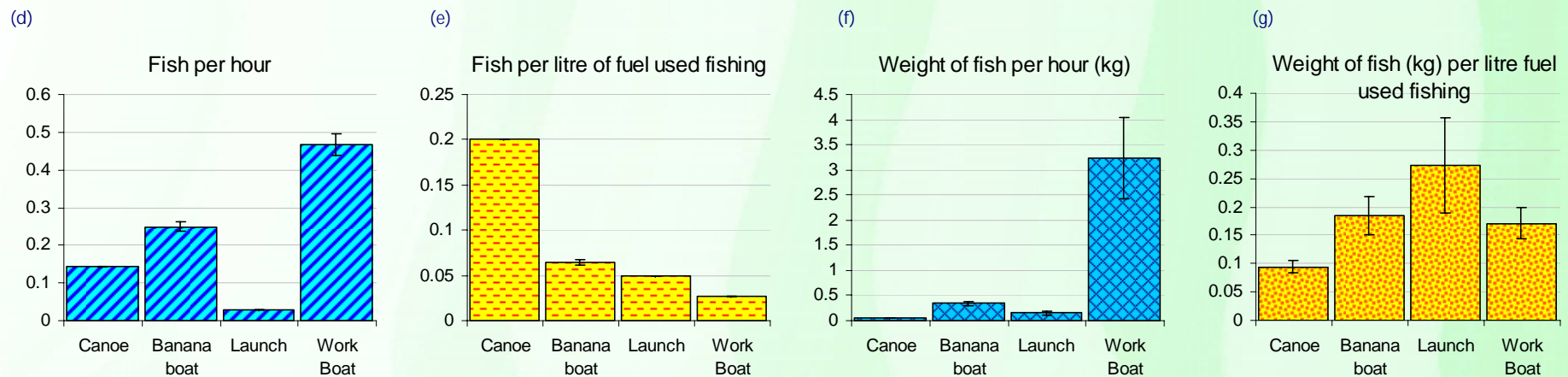
average number of fish caught per hour was highest from work boats and lowest from canoes.

A weight measure (based on fork length data collected during the survey) was calculated in order to re-examine the relationship between type of boat, time spent and fuel used, and returns as weight of fish. Proxy weight here is calculated as the cubed fork length multiplied by 2.5%, divided by 1,000 to produce a weight estimate in kilograms.

In terms of weight of fishes caught per hour and per litre of fuel, larger boats were more efficient than canoes, returning significantly greater weights of fishes. These results suggest that canoes are targeting smaller fishes and obtaining larger numbers of them. The larger boats are probably targeting larger and higher value fish, because these boats can travel farther.



Comparison of fishing effort and returns for each boat type used by fishers landing their catches in Alotau. The top three graphs (a to c) show relative use of resources for fishing; the bottom graphs (d to g) show the relative returns in numbers of fishes or proxy weight for each hour and litre spent fishing. Graphs d and e do not take into account the size and weight of fishes caught, and report only raw numbers. In graphs f and g, a proxy for the weight of fishes caught was calculated by cubing the fork length and multiplying by 2.5%/1,000. This provides a rough approximation for weight caught as “proxy weight” in kilograms — these data should be interpreted with caution as they are estimated from a standard calculation and not the specific length-weight relationships for each species. Note also that canoes have some fuel usage associated with them as some have small motors. The number of fishes on which each graph was based was: a=17,556; b=755; c=950; d=17,556; e=755; f=17556; g=755.

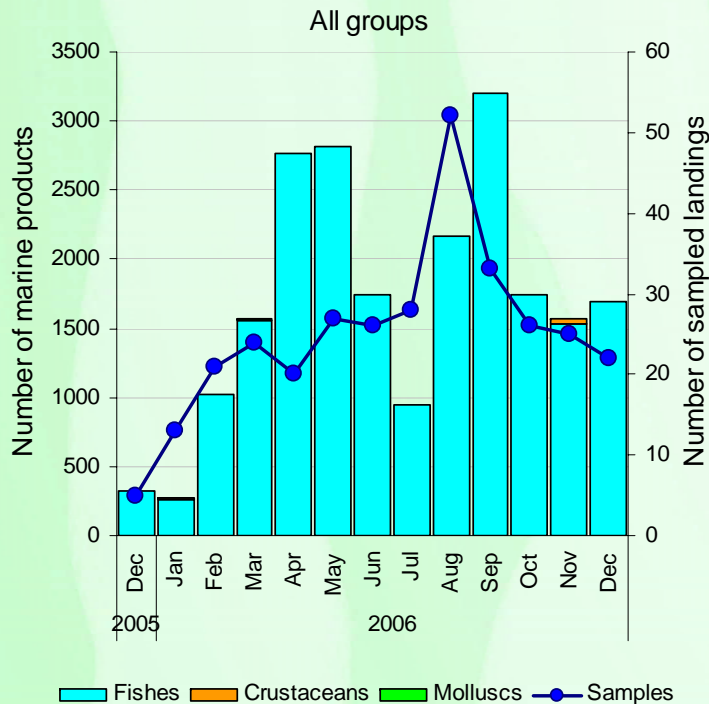


THE CATCHES: ALL GROUPS

A total of 21,835 marine products were landed during the survey period December 2005 to December 2006. Catches were dominated by fishes for which, 21,772 were recorded, accounting for 99.7% of all marine products landed. Only 49 crustaceans (35 lobsters and 14 mud crabs) and 14 molluscs (squids) were recorded in the landings sampled. At least 172 unique species were recorded over the survey (some unidentified species were also present), comprising at least 169 species of fishes, 2 species of crustaceans, and 1 species of mollusc. No sea cucumbers, trochus, turtles or other marine products were reported in the landings.

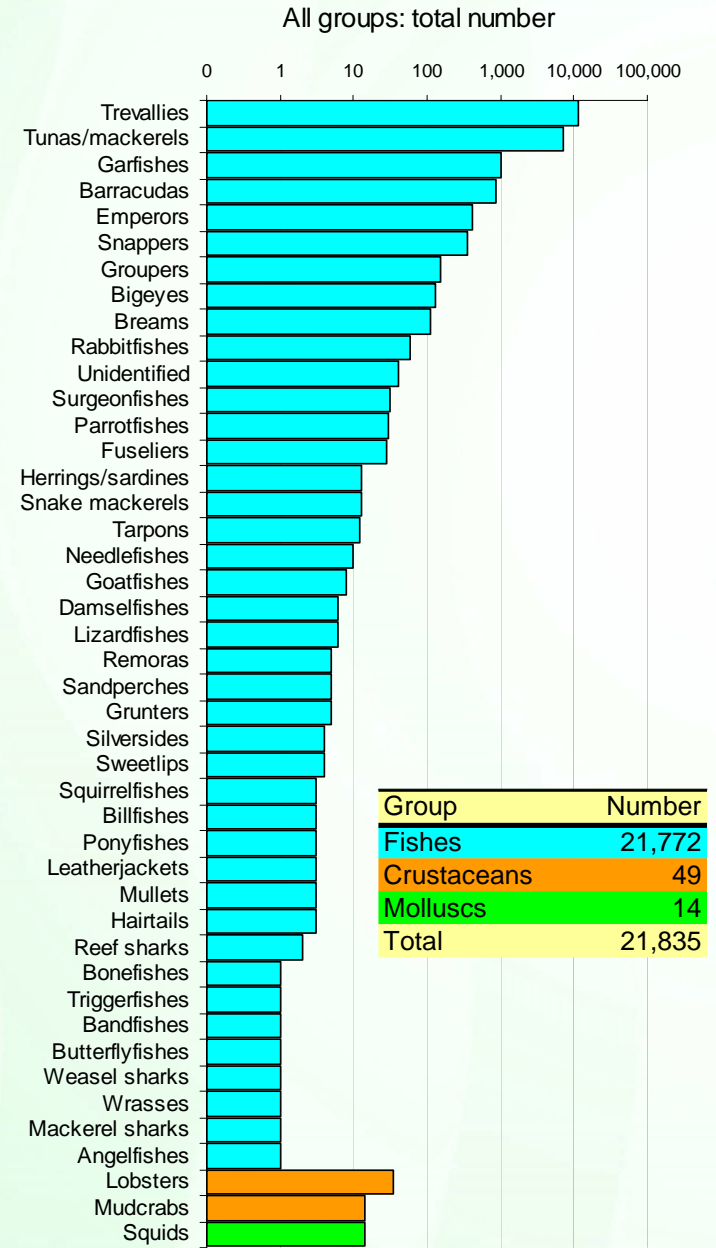
The highest number of landings were in April, May and September 2006, and the fewest in December-January 2005-2006. These results are partly related to the sampling effort expended (i.e. the number of boats met) during different months of the survey. The sampling year was also characterised by frequent poor weather conditions. That is, the team was unable to meet the same number of boats each month

so, to some extent, months with low numbers are correlated with months with smaller numbers of sampled landings. It is not clear whether the lower sampling was related to smaller numbers of fishers working at those times, but the results suggest that a greater sampling effort may be required to better characterise these fisheries. These data give a preliminary characterisation of the types of organisms landed, and the effort and information on the fishers, but are insufficient for calculating total catches and effort.



← Total marine products landed per month (n=21,835) and number of landings intercepted (n=322).

↗ Total landed catch of marine products broken down into families for each group. Note that the scale is logarithmic.



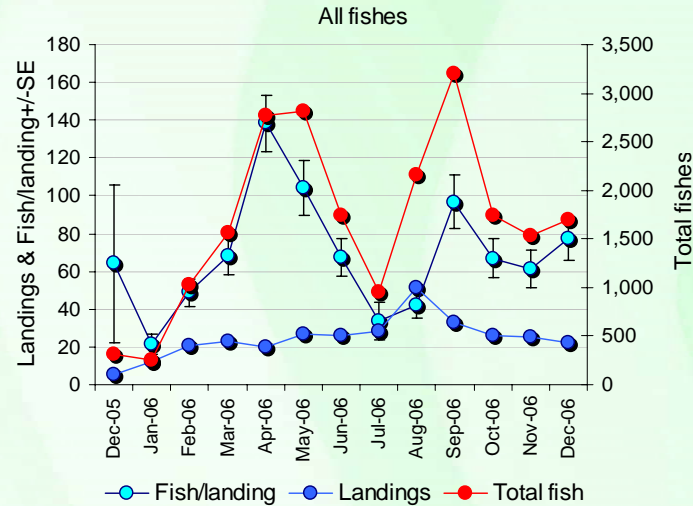
FISHES

A total of 21,772 finfishes belonging to 41 families and over 169 species were recorded and measured during the survey of fish landings in Alotau. The large number of species involved includes reef, deepwater, pelagic, coastal and estuarine fishes.

The average number of fishes landed in a day by individual boats was 68, and ranged between 1 and 358. The average number of fishes landed per boat in each month varied significantly over the survey period from high values in April, May and September 2006 (97-138 fish per landing), to low values in January and July (21-34 fish per landing). The total number of fishes landed followed a similar pattern and was highest in September 2006, with 3,195 fishes landed in that month. The lowest was in January 2006, with only 257 fishes landed in that month. The average number of fishes landed per month was 1,675.

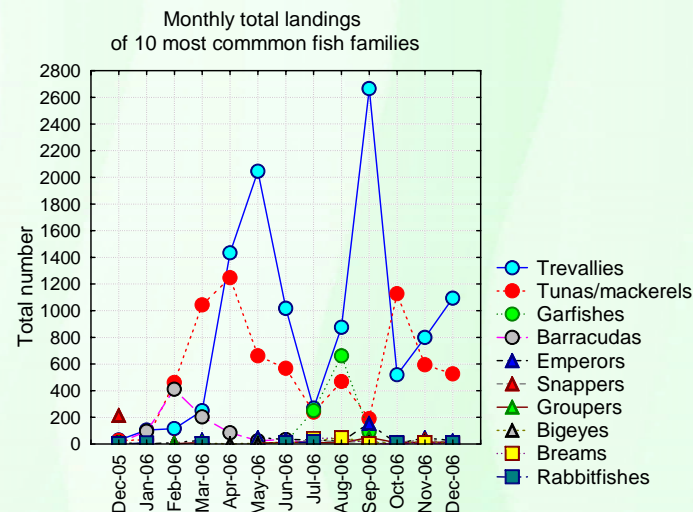
The number of fishing boats intercepted and carrying fishes was low at the beginning of the survey in December 2005 and January 2006 (5-12 landings) but peaked in August 2006 (at 51 landings). The average number of landings intercepted was 25 per month over the entire survey. September 2006 had the highest overall landings of fishes, even though it was the month with the least number of boats intercepted (33 in that month).

To some extent, these results are related to sampling effort and the number of boats available for sampling, and probably do not reflect overall patterns in catches or landings. The few number of boats intercepted in December 2005 and January 2006, and higher number in August 2006, probably explain some of the



↑ Average number of fishes per landing, number of landings per month of the survey, and total number of animals landed for all fishes (n=319 landings involving fishes).

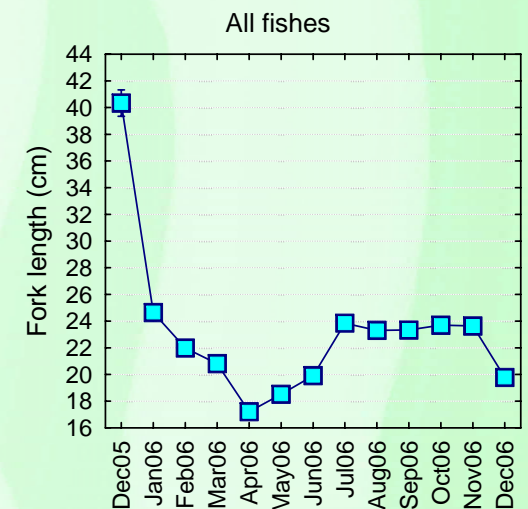
↘ Average size of fishes landed by month during the survey. Data are means +/- SE and ↓ Monthly totals for the 10 most common families.



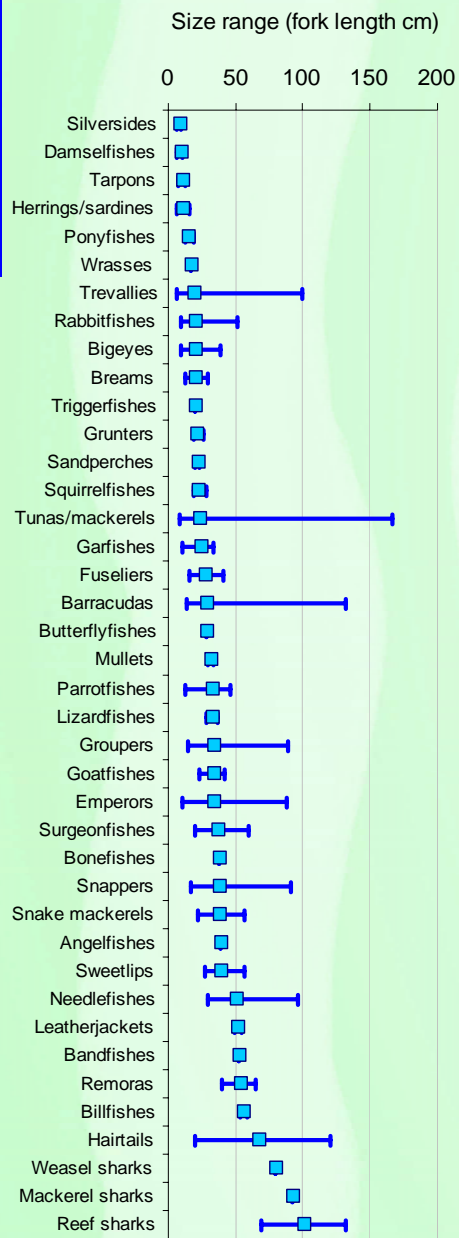
monthly patterns observed, but not all. These results suggest that a greater sampling effort may be required to characterise these fisheries, particularly because there is a mix of fishers who appear only once or twice in the samples and some who are dedicated "fishermen".

The overall mean size of fishes was around 21 cm (fork length), with the median at 20 cm (i.e. half of all fish were 20 cm or less). The minimum size of fishes measured was 6.2 cm (a blue-stripe herring and yellowtail scad) and the maximum was 166 cm (a Spanish mackerel). The families contributing the largest fishes to those landed were the sharks, hairtails and billfishes.

The average size of fishes landed was greatest in December 2005 (40 cm) and dropped to around 17 cm in April 2006.



LANDINGS

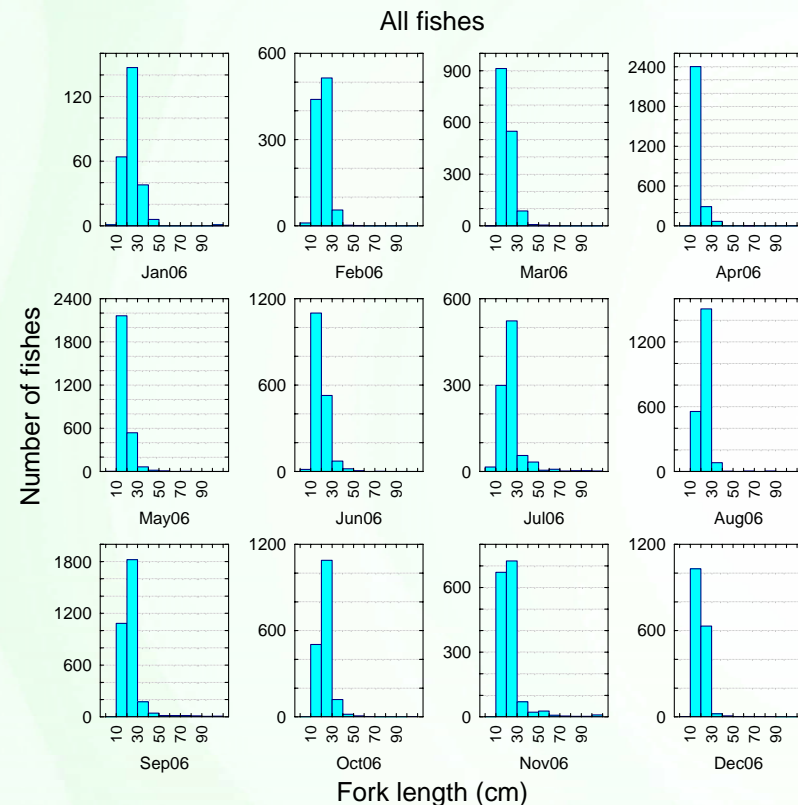


The mean and maximum sizes of fishes landed (seen at left) showed broad size ranges for some families, and very narrow ranges for others. The maximum sizes found in several families tended to be significantly smaller than the maximum sizes known (e.g. for billfishes, wrasses and triggerfishes). This may be related to the habitats fished, methods used, or a range of other factors. A more complete analysis of fish sizes caught is recommended for these fisheries to determine whether there are signs of overfishing for some groups.

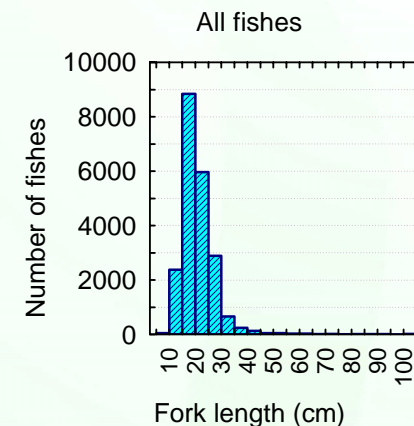
Although trevallies, tunas and mackerels (which constitute larger species) dominated catches (in number), the overall size distribution of fishes was small. There were few individuals over 30 cm fork length reported across all landings (about 7%). There was little change in size frequency of fishes caught over the year.



← Summary of size ranges and average sizes recorded across all landings in each family. Dark blue bars indicate range, and lighter squares indicate overall averages.



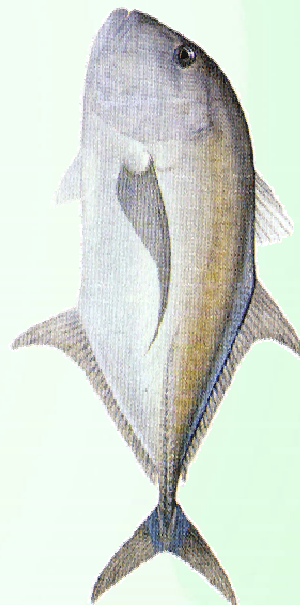
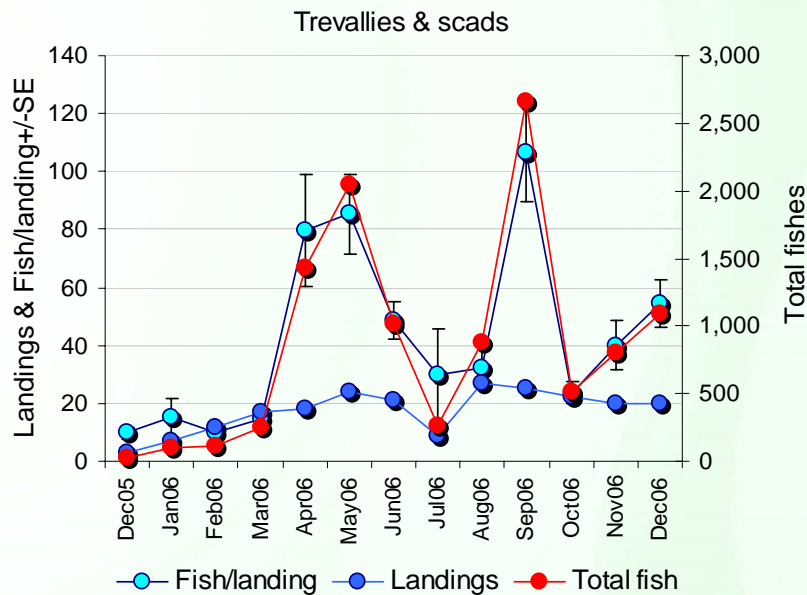
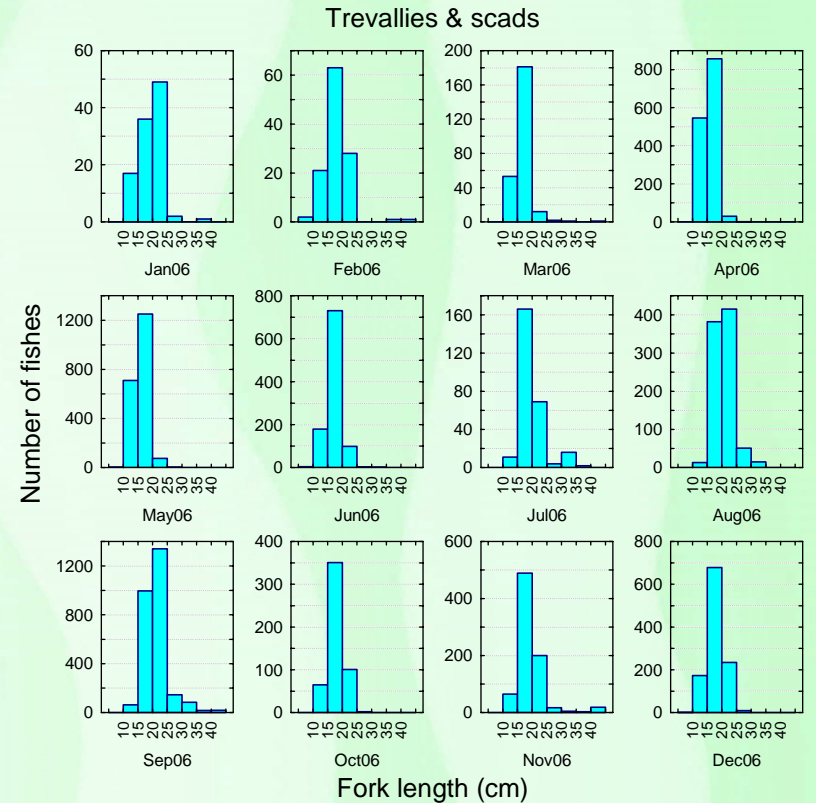
Size distribution of all fishes landed during the survey. ↑ The size distribution of fishes sampled each month, and → sizes overall. For this and all following size distribution graphs, the x-axis shows size groupings and the y-axis the number landed in a grouping. (n=21,452)



FISHES > Carangidae / Trevallies & scads

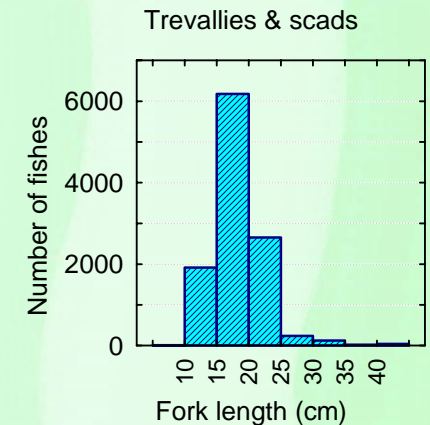
Fishes in the family Carangidae include trevallies, scads and rainbow runners. These were the most abundant fishes recorded during this survey. A total of 11,219 carangids (51% of all landed catches) were recorded during the survey. Carangids landed included trevallies, scads, darts, queenfish, and rainbow runners, in 12 genera and 22 species. Overall, 225 landings that included these fishes were recorded during the survey, with an average of 17 landings and 863 fishes per month. The average number of fishes per landing was 42 overall and ranged between 10 and 107. Carangids accounted for much of the peak in fishes landed in September, April and May 2006.

The average size of carangids was 18 cm fork length, and ranged between 6.2 cm and 99.2 cm. Most fish caught were between 15 cm and 20 cm in length, and there were few fish over 25 cm (4% of all measured).



➔ Size distribution of carangids landed during the survey, and ⬆ broken down by sampling month (n=11,190).

⬅ Average number of fishes from the family Carangidae per landing, number of landings per month of the survey, and total number of individuals landed over the survey (n=11,219 fish and 225 landings that included these fishes).



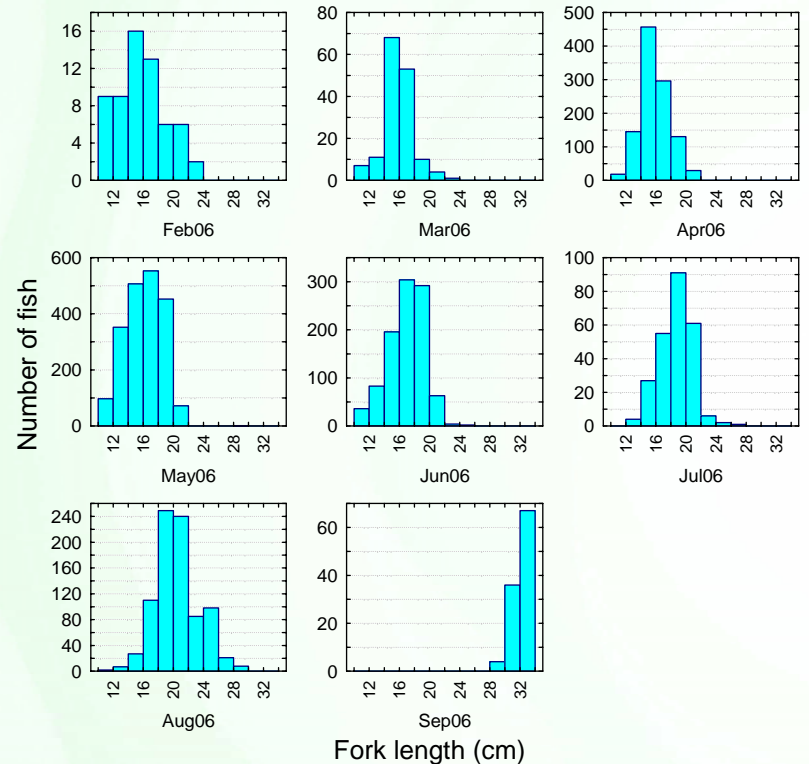
FISHES > Carangidae > *Atule mate* - Yellowtail scad

Yellowtail scad was the second most abundant species recorded in landings during the survey. A total of 5,506 of these fish were landed, accounting for 25% of all fishes. Yellowtail scad was present in 31% of all landings. These fish only appeared in samples between February and September 2006, and peaked in total abundance in May, during which over 2,000 were recorded.

The average number of fish per landed catch was 55, ranging between 9 and 107 fish per boat per day. The average catch per month was 688 fish, with the lowest monthly total of 61 fish recorded in February 2006.

The average length of yellowtail scads was 17 cm, ranging between 6.2 cm and 43 cm. Most of the fish measured were between 14 cm and 20 cm, with a small group of fishes at more than 30cm in September 2006.

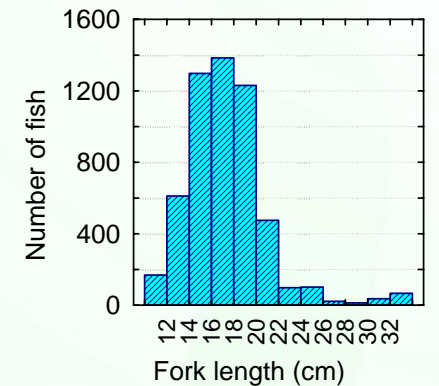
Atule mate - Yellowtail scad



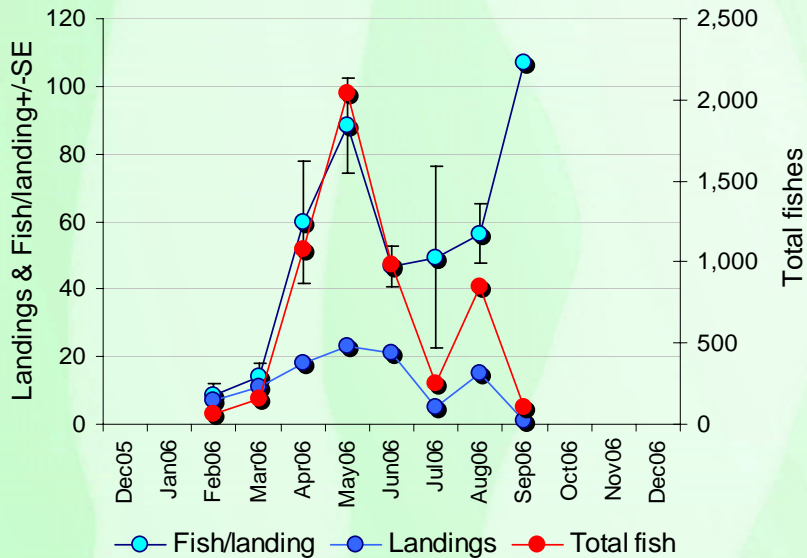
↘ Size distribution of yellowtail scads landed during the survey, and ↗ broken down by sampling month (n=5,506).

↙ Average number of yellowtail scads per landing, number of landings per month, and total number of individuals landed over the survey (n=5,506 fish, 101 landings).

Atule mate - Yellowtail scad



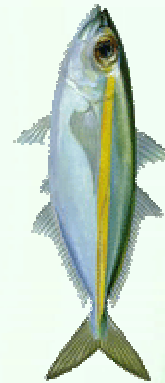
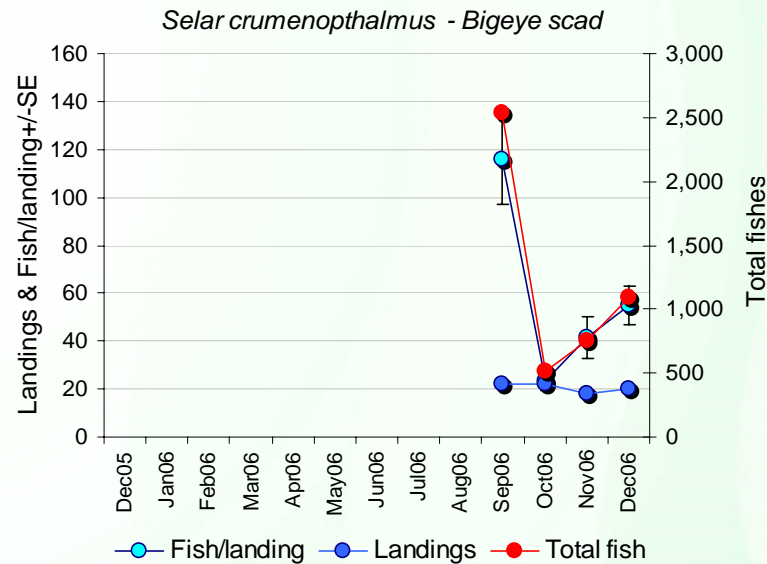
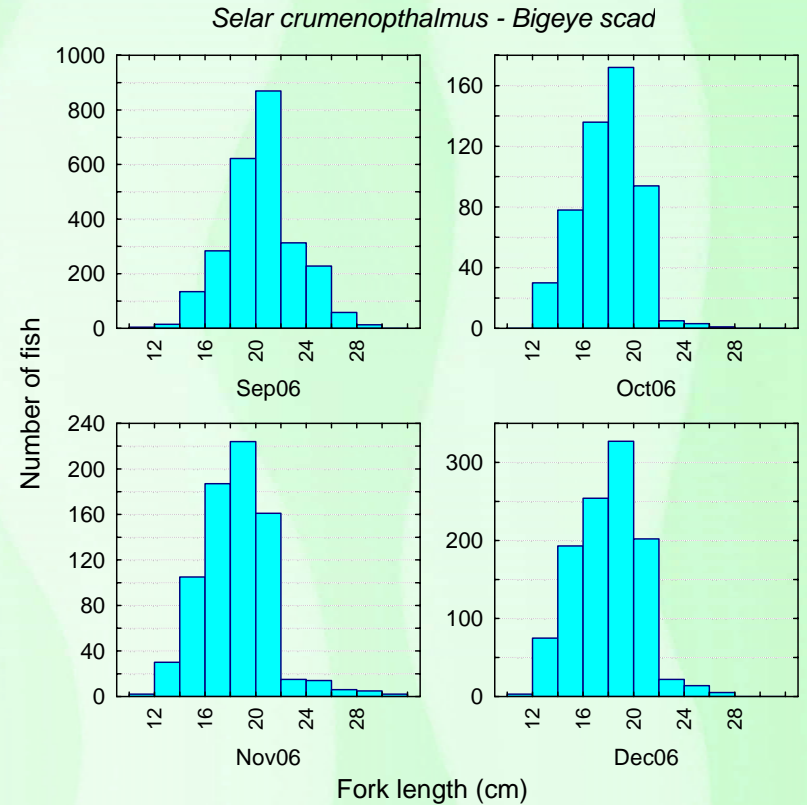
Atule mate - Yellowtail scad



FISHES > Carangidae > *Selar crumenophthalmus* / Bigeye scad

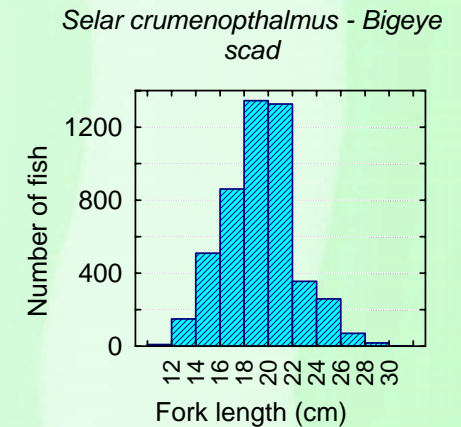
A total of 4,906 bigeye scads were recorded in landings, making them the third most abundant species caught. These fish appeared in 25% of all landings and accounted for 22% of all marine products landed during the survey period. The average number of bigeye scads landed per month was 1,227, and ranged between 519 and 2,541. Bigeye scads only appeared during the period September-December 2006 in 82 landings. The average number landed per boat per day was 60 fish, and ranged up to 116 fish per landed catch. Most individuals of this species were landed during September 2006.

The average size of all bigeye scads landed was 19 cm and varied between 10 cm and 31 cm fork length. About 54%, of all the bigeye scads landed were between 18 cm and 22 cm long. Sizes did not vary much during the short period they were surveyed.



➔ Size distribution of bigeye scads landed during the survey, and ➔ broken down by sampling month (n=4,906 fish).

➔ Average number of bigeye scads per landing, number of landings per month of the survey, and total number of fish landed over the survey (n=4,906 fish and 82 landings).

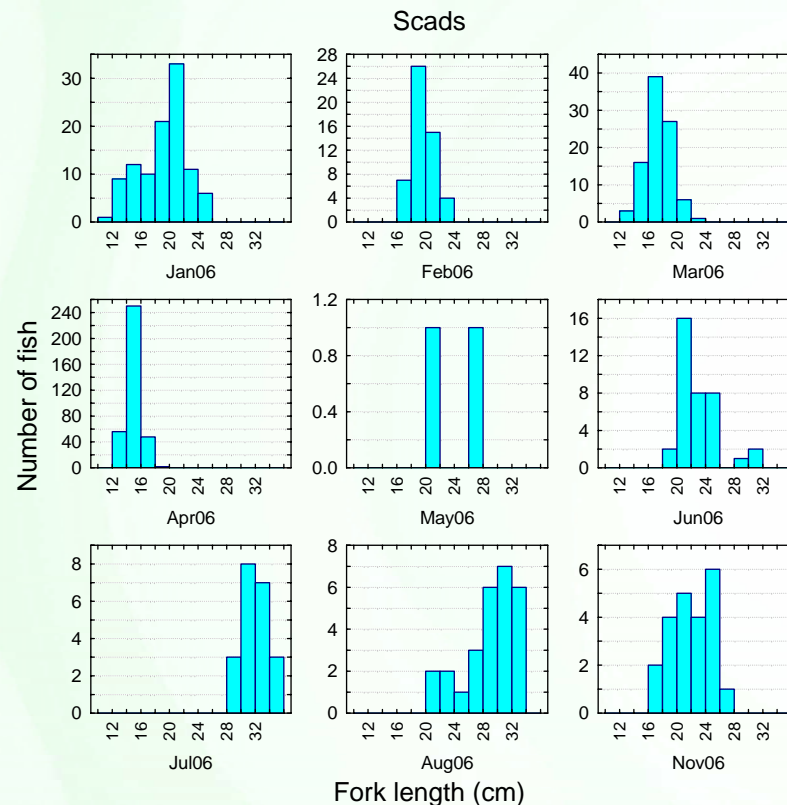


FISHES > Carangidae > *Decapterus* spp. / Scads

Scads belonging to the genus *Decapterus* included at least two identified species, *D. macarellus* (mackerel scad) and *D. tabl* (roughear scad) in addition to other unidentified members of the genus. Together these species accounted for 3.3% of all the fishes landed, and were present in nearly 16% of all landings. A total of 576 mackerel scads, 54 roughear scads, and 88 other scads in the genus were recorded over the survey.

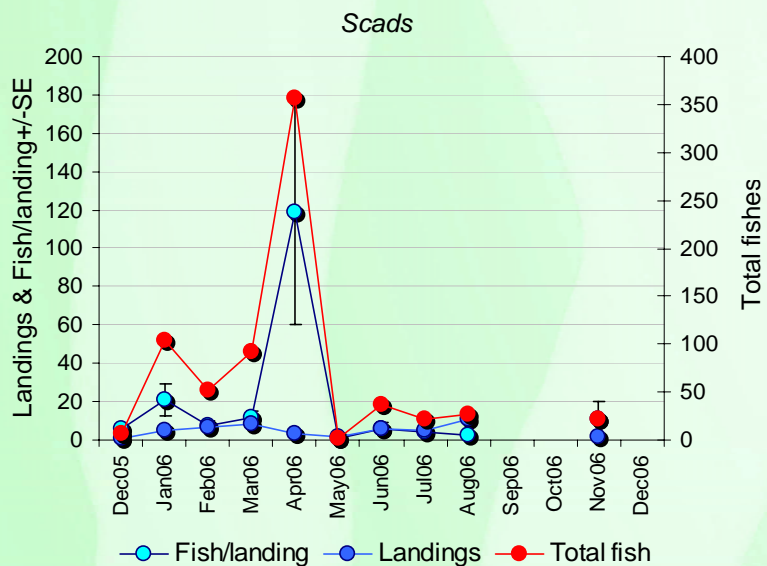
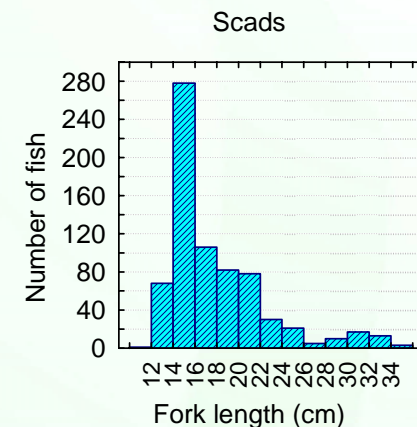
These scads were absent from landings in September, October and December 2006. The average number landed per month in the remaining months of the survey was 72 and ranged between 2 and 356. The highest number of scads were landed in April 2006, when the catch per boat was highest and the total number of landings low (3 landings). The average number of landings per month that included these scad species was 5 and was as high as 11. The average number of fishes per catch was 14 and ranged between 1 and 119 fishes per boat per day.

The average length of scads was 18 cm, ranging between 12 cm and 39 cm. A large proportion of these fishes (39%) was between 14 cm and 16 cm. Sizes observed varied by month of the survey, with the largest sizes of fish being recorded in August 2006.



↘ Size distribution of scads landed during the survey, and ↗ broken down by sampling month (n = 712 measured).

← Average number of scads per landing, number of landings per month, and total number of individuals landed over the survey (n = 718 fish, 50 landings).

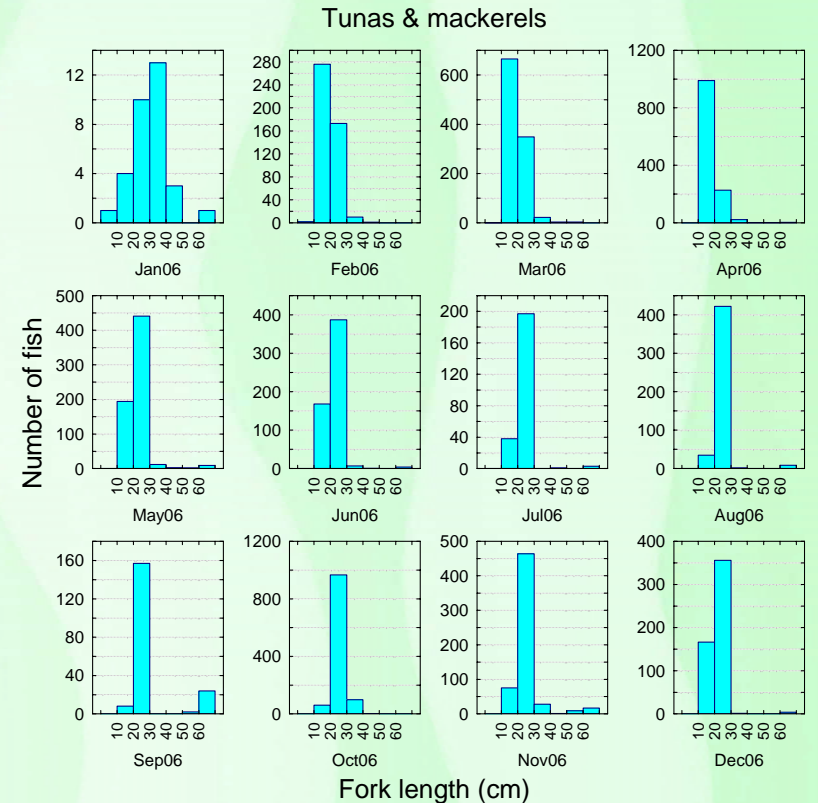


FISHES > Scombridae / Tunas and mackerels

During the survey, fishes belonging to the family Scombridae included a range of tunas and mackerels in 8 genera and 13 species. This group, the second most abundant family, accounted for 33% of all animals landed during the survey and appeared in 64% of all catches intercepted.

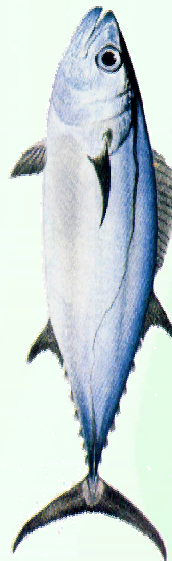
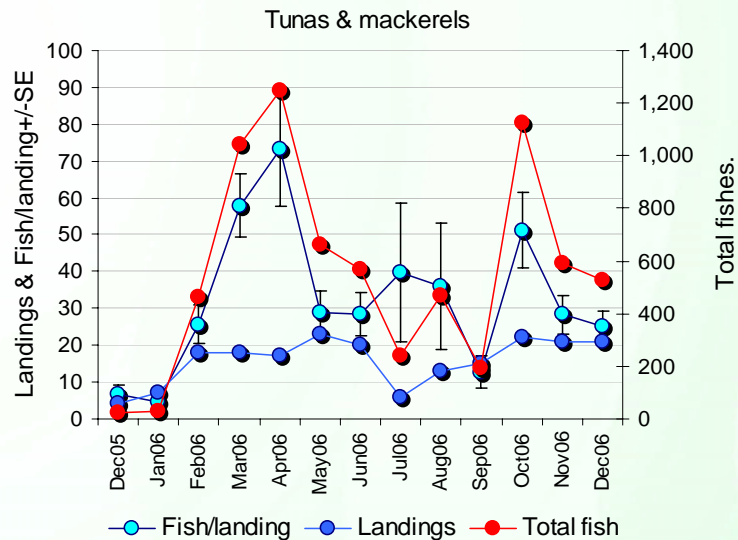
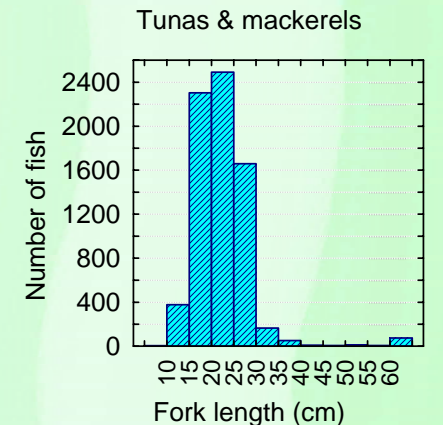
The average number of tunas and mackerels landed per boat per day was 35, and ranged between 5 and 73. These fishes were landed during every month of the survey and were present, on average, in 16 catches per month, and up to 23. A total of 205 landings included these fishes. Large numbers were landed during March-April and October 2006, with total numbers landed in those months reaching over 1,000 fishes. Total catches tended to fluctuate with number per landing, more than with number of landings in any month.

The average size of all tunas and mackerels landed was 23 cm and varied between 8.4 cm and 166 cm fork length. This is the greatest size range recorded during the survey for any family and is related to the diversity of species found in this family. More than 67% of all the fishes in this family were between 15 cm and 25 cm long. Sizes caught did not vary significantly with month of the survey.



➔ Size distribution of tunas and mackerels landed during the survey, and ➔ broken down by sampling month (n=7,158 fishes).

⬅ Average number of tunas and mackerels per landing, number of landings per month of the survey, and total number landed over the survey (n=7,184 fishes and 205 landings).

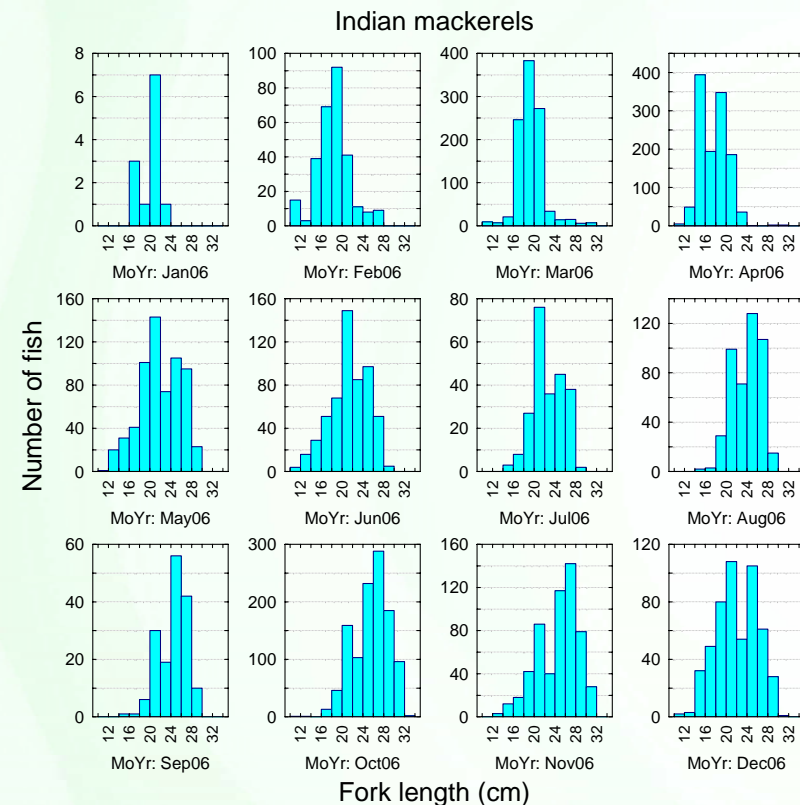
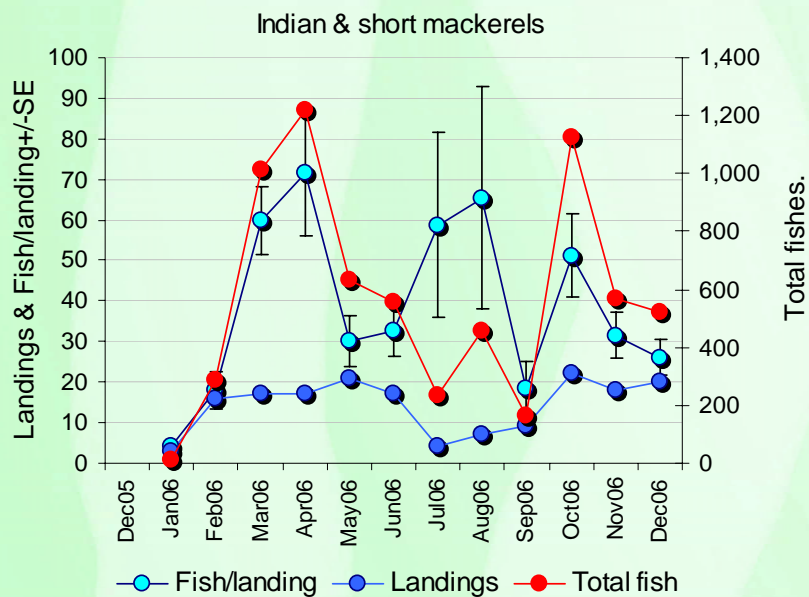


FISHES > Scombridae > *Rastrelliger kanagurta* - Indian mackerels

Two species belonging to the genus *Rastrelliger*, *R. kanagurta* (Indian mackerel) and *R. brachysoma* (short mackerel) were recorded during the survey. These two species constituted about 31% of all animals landed and were present in 53% of all landings. Most of the fishes were Indian mackerels, which accounted for over 99.9% of all fishes in this genus.

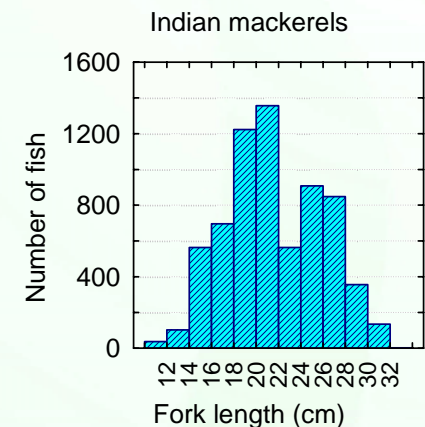
The total number of landings that included Indian mackerels was 169, with an average of 14 per month and a range of 3-22 landings per month. These mackerels appeared in samples in all months of the survey except December 2005. The average number per landing was 40 and ranged between 4 and 72 fishes per boat per day. Indian mackerels were most abundant overall in March-April and October 2006 when 1,000-1,200 were landed during the month. The average number of fishes landed per month was 566.

The average length of mackerels was less than 22 cm, and ranged between 9.4 cm and 39 cm. There were two size groups observed overall and in May and December 2006: one group consisted of smaller fishes 18-20 cm long, and the second group of larger fishes 24-28 cm long.



↘ Size distribution of mackerels landed during the survey, and ↗ broken down by sampling month (n=6,793 measured).

↙ Average number of mackerels per landing, number of landings per month, and total number of individuals landed over the survey (n=6,789 fishes and 169 landings).



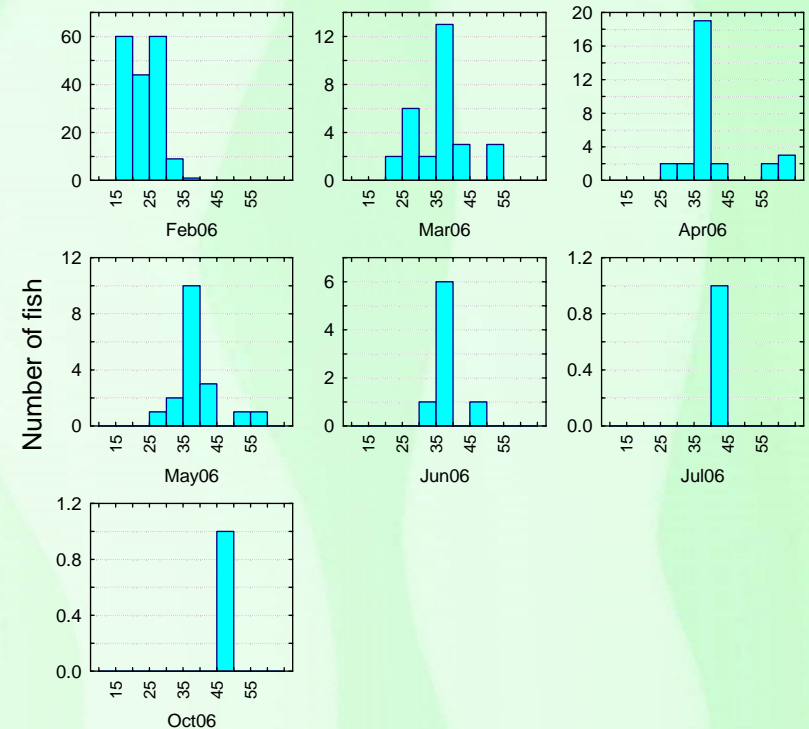
FISHES > Scombridae > *Katsuwonus pelamis* / Skipjack tuna

Skipjack tuna were the second most abundant fish from the family Scombridae recorded during this survey. A total of 261 fish were recorded in 38 landings, accounting for 1.2% of all landed catch and 12% of landings.

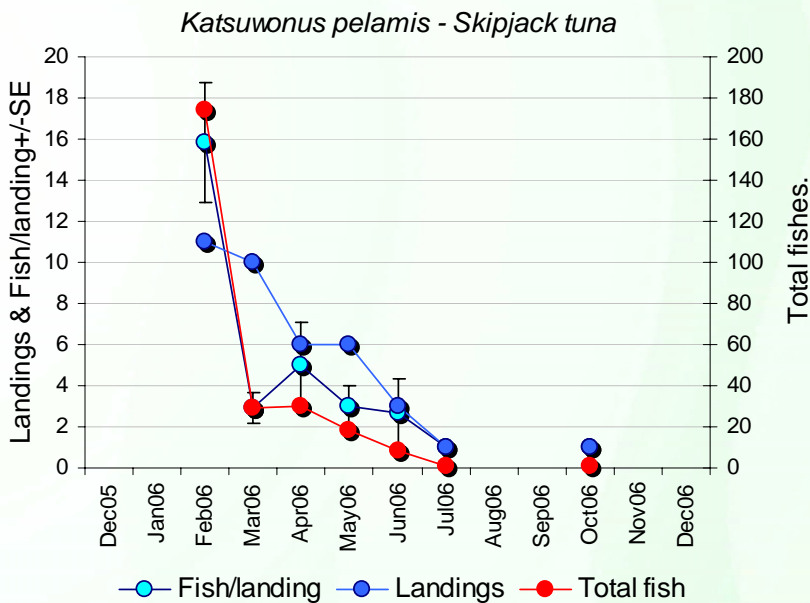
These tunas were recorded during 7 of the survey months, with the greatest total number landed per month in February 2006. The average number landed per month was 37 and ranged up to 174. The average number of fish per landing was 7 over the survey, and ranged between 1 and 16. On average, 5 landings per month included this species, with a maximum of 11 fish in a single boat load.

The average length of skipjack tuna was 28 cm fork length, and ranged between 15.3 cm and 65.5 cm. Many fish were between 15 cm and 30 cm, although there was a large spread in sizes.

Katsuwonus pelamis - Skipjack tuna



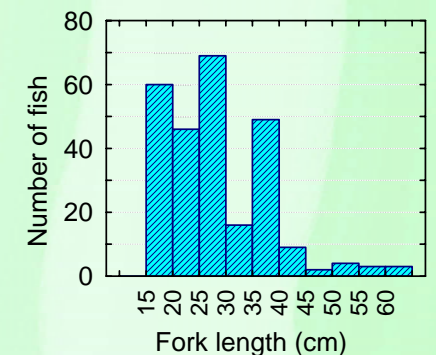
Fork length (cm)



→ Size distribution of skipjack tuna landed during the survey, and ↗ broken down by sampling month (n=261).

← Average number of skipjack tuna per landing, number of landings per month of the survey, and total number landed over the survey (n=261 fish and 38 landings).

Katsuwonus pelamis - Skipjack tuna



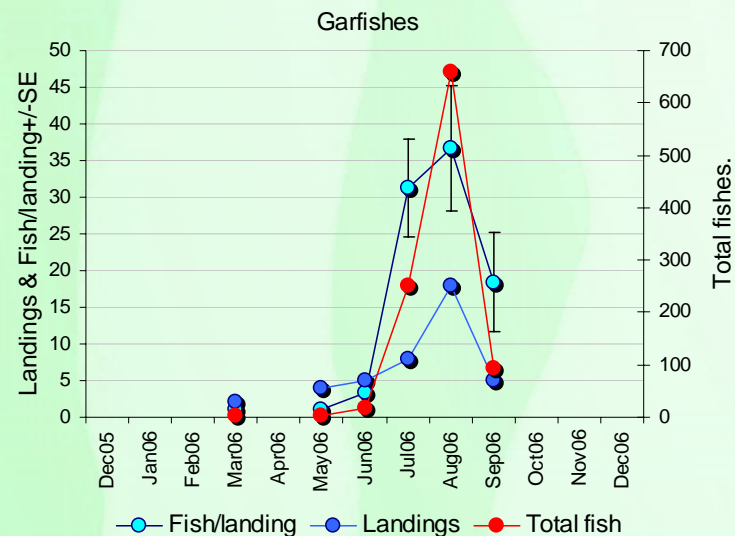
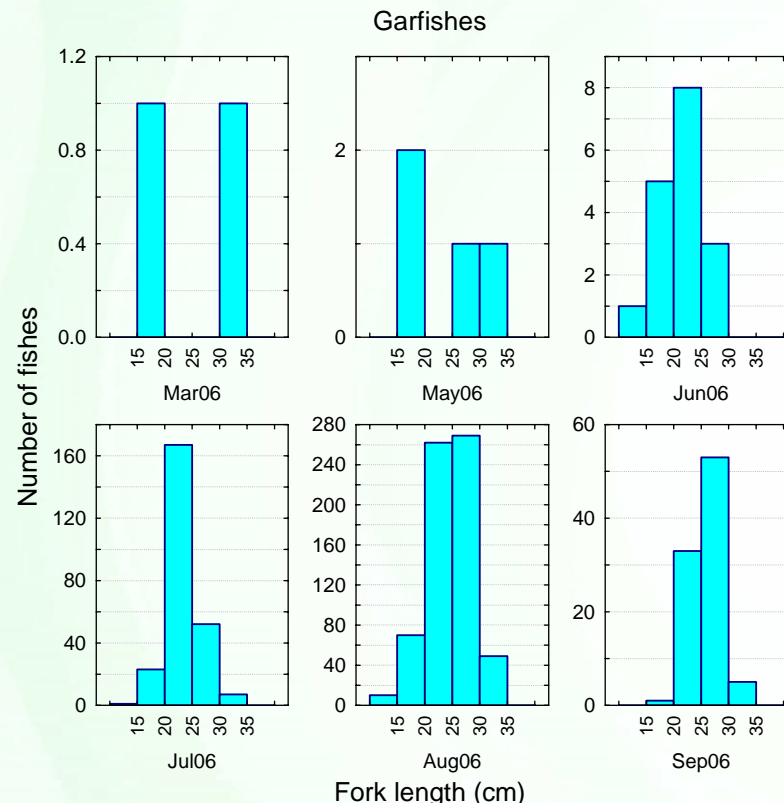
LANDINGS



FISHES > Hemiramphidae > Garfishes

A total of 1,025 garfishes were recorded during the survey period. Garfishes belonging to 3 genera and 4 species were recorded, comprising 715 *Hyporhamphus dussumieri* (Garfish), 116 *H. affinis* (tropical halfbeak), 180 *Hemirhamphus far* (black-barred halfbeak) and 14 *Zenarchopterus dunckeri* (Dunker's halfbeak). Garfishes comprised 5% of the total landed catch and appeared in 13% of all landings intercepted.

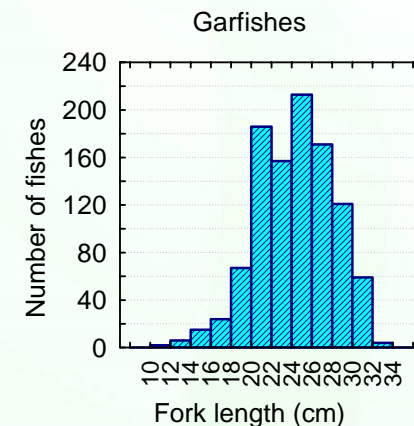
Garfishes were most abundant in samples between July and October 2006, when the catch per boat was highest. Garfishes were absent from samples during 7 months of the survey. The average number per landed catch was 24 fishes, and ranged up to 37. There was an average of 7 landings per month that included species in this family and an average of 171 fishes landed per month overall.



The average length of garfishes was 24 cm, and ranged between 10 cm and 33 cm. The majority though were between 20 cm and 26 cm long.

Size distribution of garfishes landed during the survey, and broken down by sampling month (n=1,025 fishes measured).

Average number of garfishes per landing, number of landings per month, and total number landed over the survey (n=1,025 fishes and 42 landings).

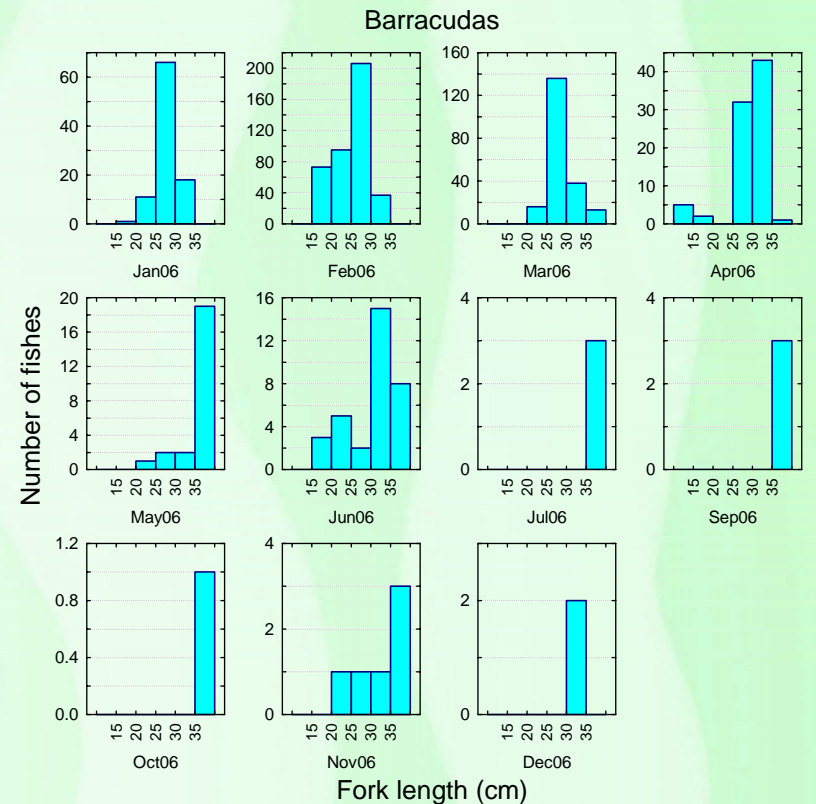


FISHES > Sphyraenidae / Barracudas

Barracudas accounted for 4% of the total recorded catch in Alotau during the survey and were present in 25% of all landings. A total of 874 fishes in this family were recorded in 5 species from the genus *Sphyraenia*. *Sphyraenia genie*, blackfin barracuda, was the most common species, comprising 855 fishes to the total count.

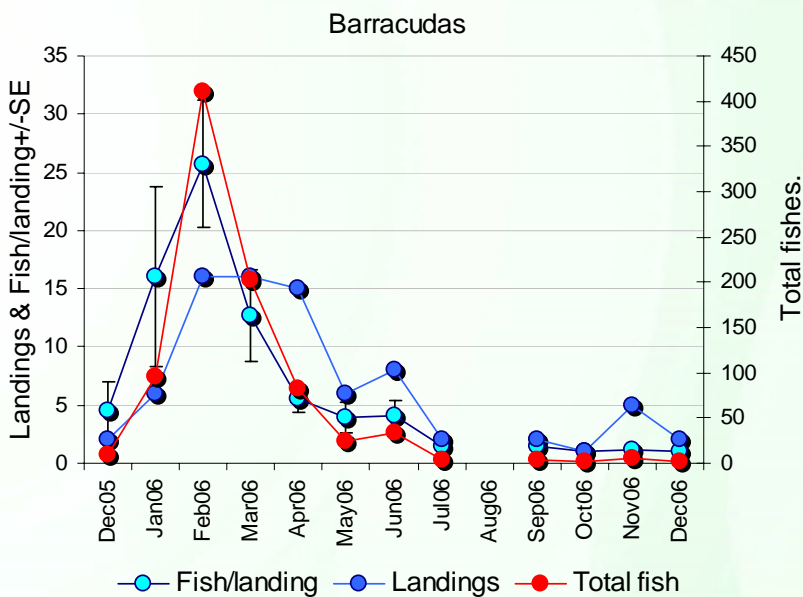
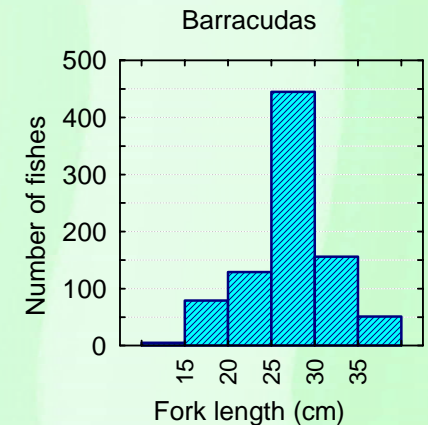
The greatest number of barracudas landed was during February 2006, with moderate numbers recorded in January and March-April 2006. The average number of barracudas per landing was around 11 fishes, with a maximum of 26 in a single boat. An average of 73 barracudas werelanded in each month in an average of 7 landings per month.

Fishes in this family averaged 28 cm in length (fork length), and varied between 14 cm and 132 cm. Most fishes were between 25 cm and 30 cm.



➔ Size distribution of barracudas landed during the survey, and ⬆ broken down by sampling month (n=865 fishes measured). Note that no barracudas were landed in August 2006.

⬅ Average number of barracudas per landing, number of landings per month, and total number landed per month over the survey (n=874 fishes and 81 landings).

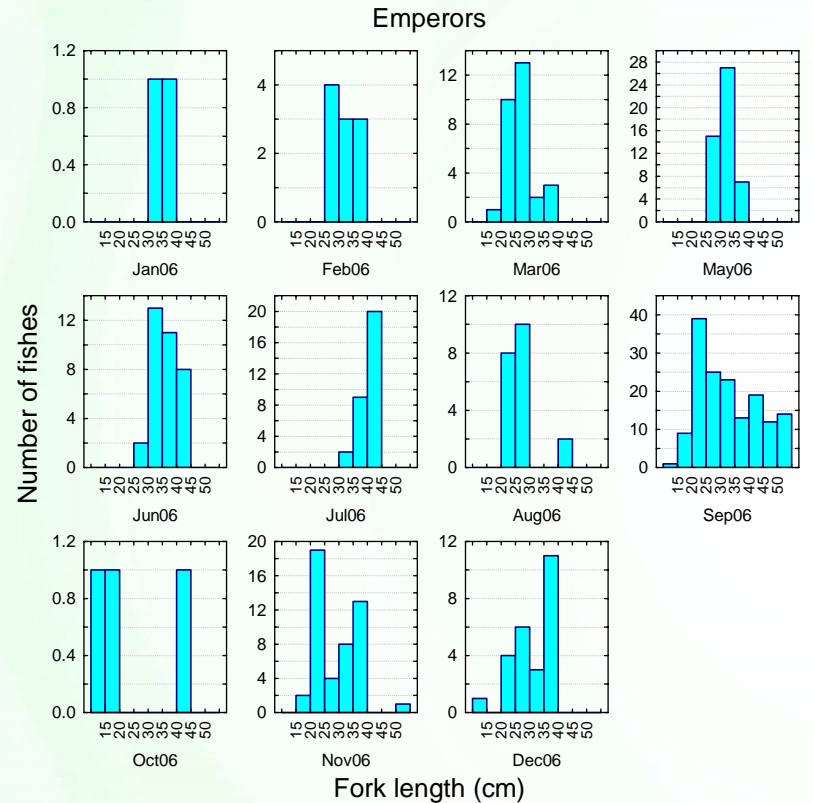


FISHES > Lethrinidae / Emperors

Emperors of 3 genera and 12 species were recorded from landed catches during the survey. A total of 415 fishes were recorded, including 177 *Lethrinus lentjan* (redspot emperor), 109 *L. xanthurus* (yellowlip) and 39 *Monotaxis grandoculus* (bigeye bream). Emperors accounted for 2% of the total recorded landed catch over the survey, and were present in 7% of all landings.

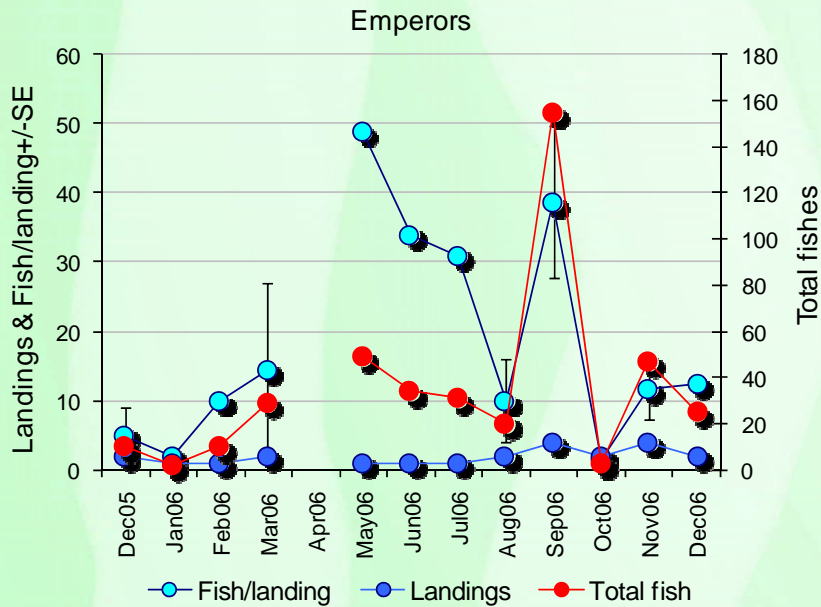
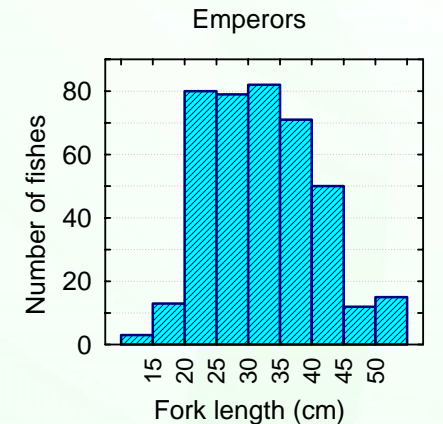
The largest numbers of emperors were landed during September 2006. The average number landed per month was 35 and ranged between 2 and 155 fishes. Emperors were present in 1 to 4 landings per month. The average number per landing was 18 fishes and ranged up to 49 per boat.

The average size of fishes in this family that were landed was 33 cm (fork length), and varied between 10.2 cm and 88 cm. Fishes were broadly distributed by size, with roughly even numbers of individuals spread across sizes between 20 cm and 45 cm.



→ Size distribution of emperors landed during the survey, and ↑ broken down by sampling month (n=405 fishes measured). Note that there were no landings of emperors in April 2006.

← Average number of emperors per landing, number of landings per month and total number of individuals landed over the survey (n=415 fishes and 23 landings).

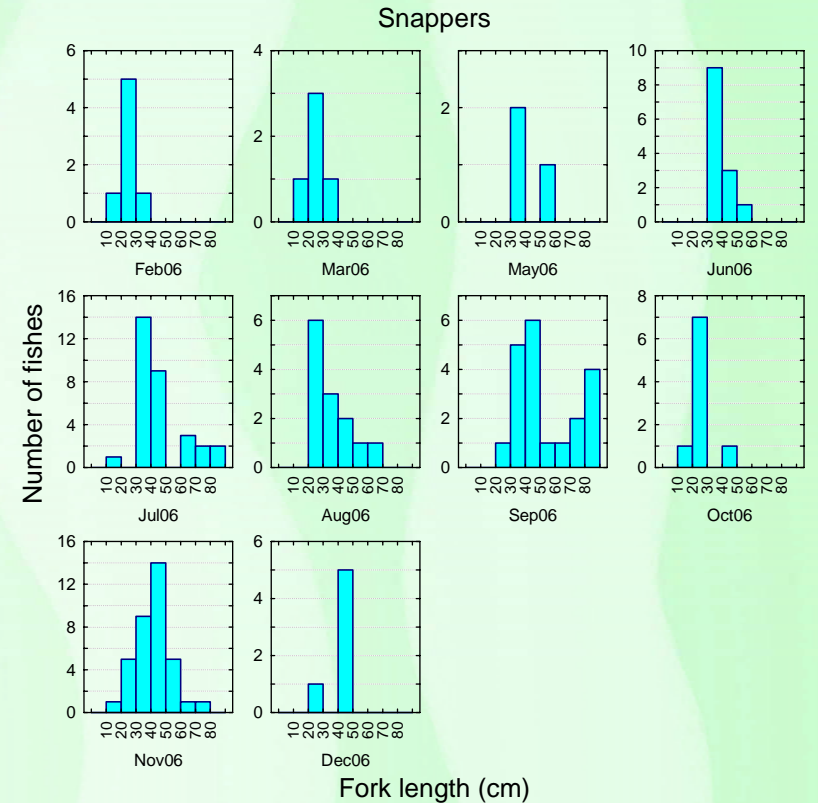


FISHES > Lutjanidae / Snappers

Snappers belonging to 5 genera and 19 species were recorded in the survey's fish landings. Snappers accounted for 1.6% of the catch landed, and were present in 7% of all landings. Snappers included deepwater and reef types. The most common were *Lutjanus gibbus* (paddletail) – 194, followed by *Aprion virescens* (green jobfish) – 47. The remaining species were represented by between 1 and 17 individuals.

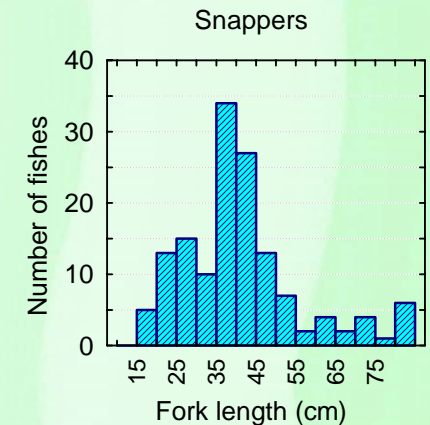
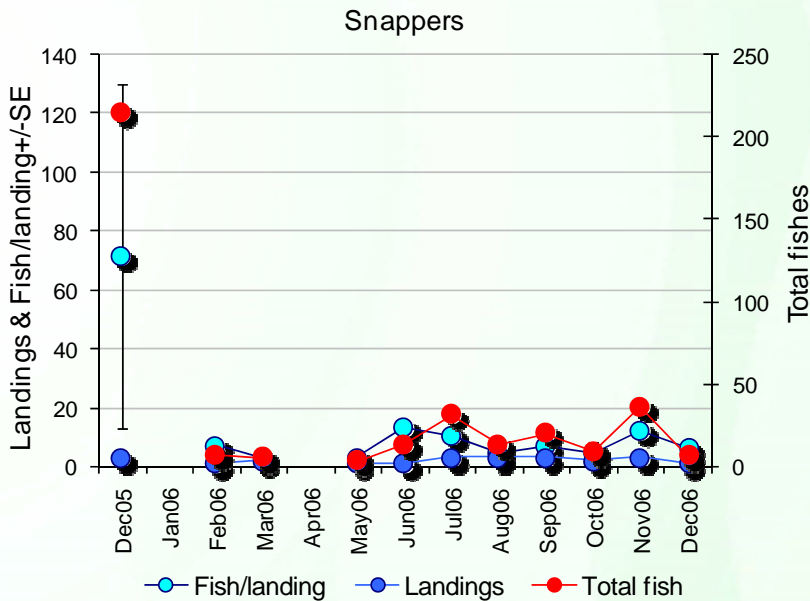
Most snappers were landed in December 2005, with no other periods of high abundance during the survey. The average number per landing was 16, with an average of 28 fishes landed per month.

The average size of all snappers landed was 42 cm and ranged between 16.5 cm and 91.6 cm (fork length). A large number of the snappers landed were between 35 cm and 45 cm, but the size range for this family was great, with significant numbers of smaller and larger fishes being recorded over the survey period.



→ Size distribution of snappers landed during the survey, and ↑ broken down by sampling month (n=143 fishes measured).

← Average number of snappers per landing, number of landings per survey month, and total number of snappers landed over the survey (n=358 fishes and 23 landings).





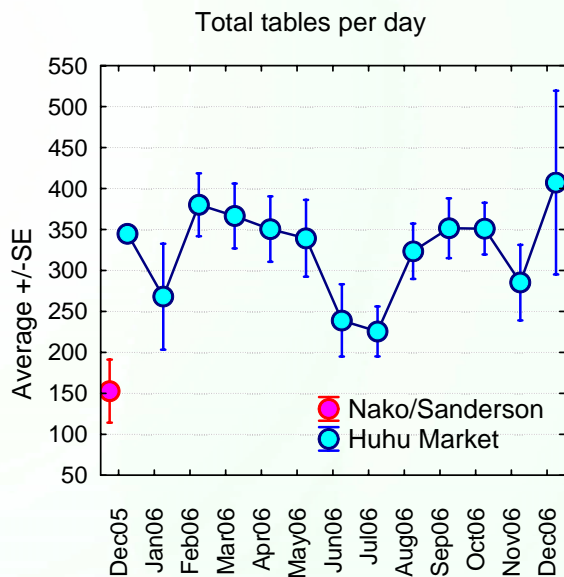
Market Survey

PRODUCTS ON OFFER AT ALOTAU MARKETS

Data were collected from two markets operating in Alotau during the survey. Although there other markets were operating from time to time in the area, they tended to be unpredictable and difficult to survey. The most important market in operation during the survey period was the Huhu or Alotau Main Market (to the west of the town). This market offered 96% of all products over the survey. A smaller and less formal market located on the shores of Sanderson Bay, close to Nako Fisheries (Nako/Sanderson Market), was surveyed during the first month of the survey, after which the market closed temporarily. When the market was re-opened as a late afternoon-night-time market, no further samples were taken there by the team. As a result, the Nako market contributed only 4% of products (by occurrence) recorded during the survey.

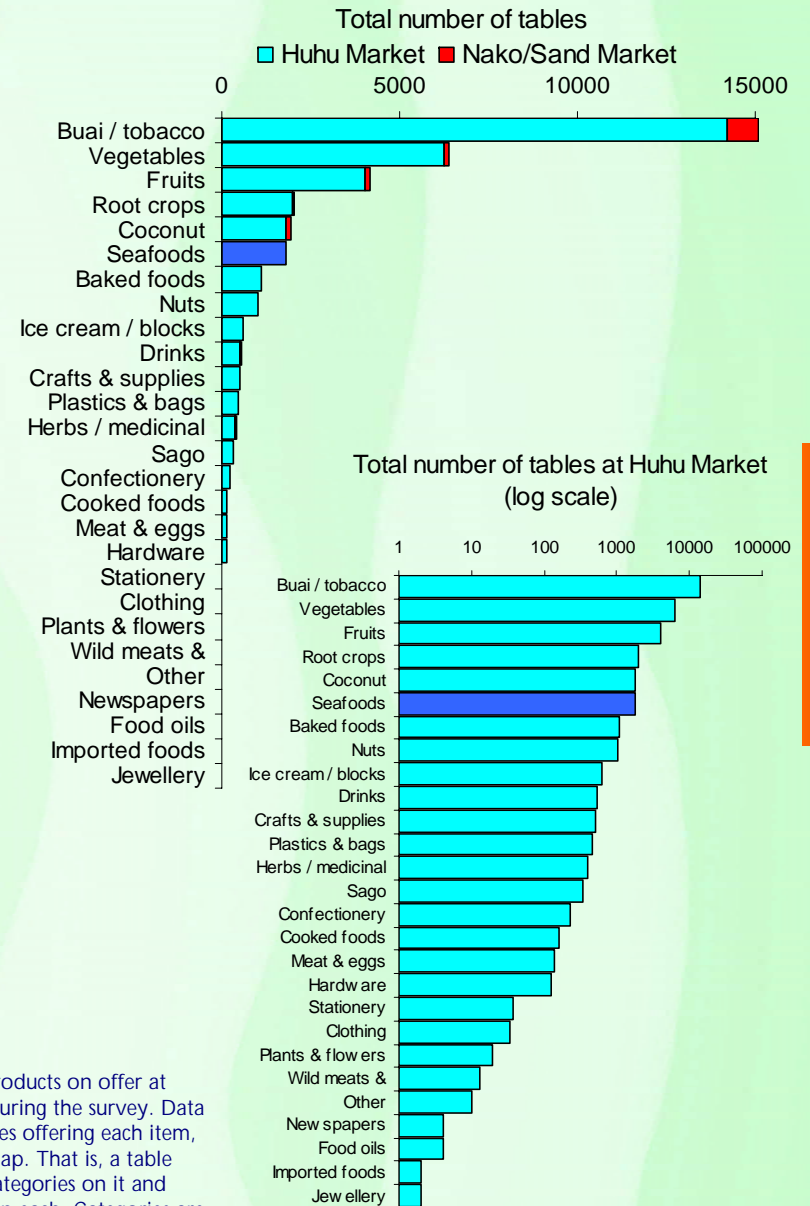
Over the survey period, Huhu Main Market had an average of 325 tables operating each day between Monday and Saturday. The number of tables operating at the market varied over time, from a low of 225 tables per day in July 2006 to a high of over 400 in December 2006. The maximum number of tables operating on any one day was 763 and the minimum was 33.

The most common items on offer were betelnut (buai), tobacco and related items (lime and mustard). At Huhu Market these items appeared on 40% of all tables surveyed, even if other items were also present. Vegetables and fruits appeared on 17% and 11% of all tables, respectively. Seafood, including fresh and smoked fish, shellfish and seaweed, appeared on 5% of all tables surveyed and ranked sixth overall. Overall, marine animals were found on only 1% of tables, but this figure was highly variable on a day-to-day basis.



← Number of tables offering all goods at Alotau markets between December 2005 and December 2006. Data are mean number of tables per day for each month, regardless of the goods on offer (n=68 sample days at 4-5 per month; 21,218 individual tables over the entire period).

↗ Breakdown of products on offer at markets in Alotau during the survey. Data are numbers of tables offering each item, but allows for overlap. That is, a table may have several categories on it and would appear within each. Categories are in rank order (n=35,756 observations).



WHO ARE THE SELLERS?

A total of 3,236 tables were sampled at the two main markets in Alotau between 15 December 2005 and 30 December 2006. Details of sellers, their age and gender, home village, relationship to fishers, and the marine products they offered for sale were recorded.

Women accounted for 76% of all seafood sellers during the survey. The majority of sellers were either the fishers themselves (35%) or the wives of fishers (29%). The remaining 36% of sellers mostly consisted of sisters, children or parents of fishers, with more distant relationships contributing very little. None of the sellers sold for friends, neighbours, or under any kind of commercial agreement.

Sellers ranged in age from 9 to 72. There was some inconsistency in the age reported for individuals where they

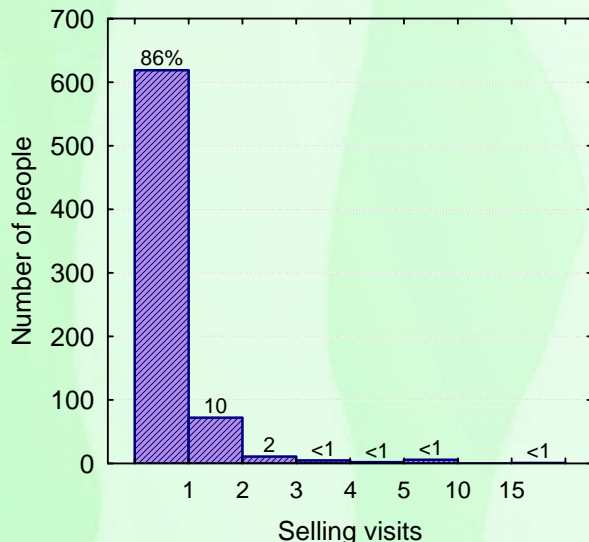
appeared more than once in the survey, probably because many were not sure of their age. The average age of a seller was around 32 years, and the most common ages were between 25 and 35 years. Only 3% of sellers were over 50 years old.

The identity of sellers changed constantly. Enumerators recorded 716 unique sellers' names over the survey, many of whom (86%) were only recorded once over the survey period. Only 2% of the people surveyed were recorded at the market more than twice over the period of this survey. The average number of times an individual seller was recorded in our samples was 1.24 times, with the maximum recorded being 20 times.

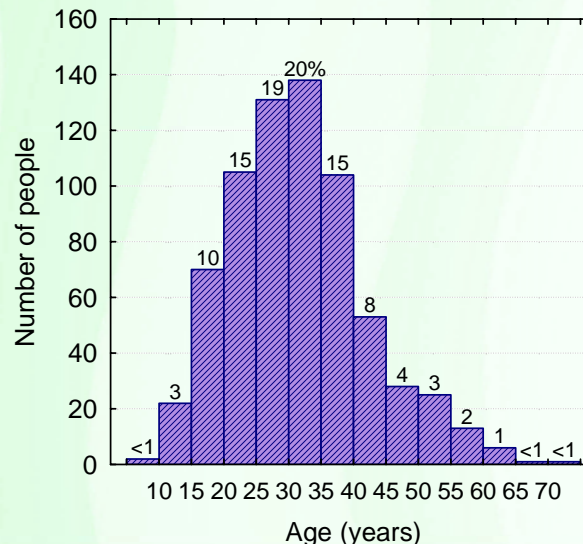
← Frequency with which different sellers were recorded at markets (n=889 records from 716 sellers).

MARKET

Frequency of sellers at markets



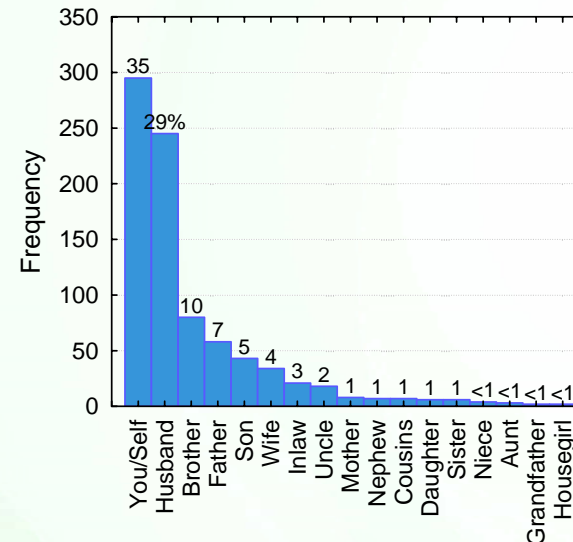
Age of sellers



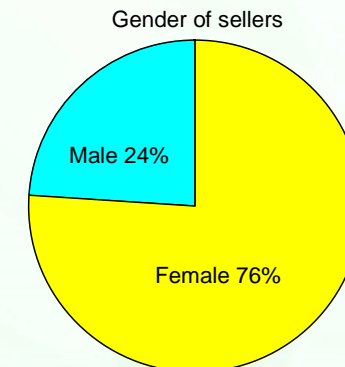
← Age of all sellers interviewed across the market survey (n=699).

↘ Relationship between the sellers interviewed and the fishers/collectors who gathered the marine products on offer for sale (n=839 relationships reported).

Relationship of fisher to seller



→ Gender of sellers at Alotau markets. Values are percentages of all sellers interviewed over the survey (n=714 people).



SEAFOOD TABLES AT Huhu MAIN MARKET

Between December 2005 and December 2006 the number of tables offering seafood and other marine products for sale at Huhu Main Market averaged around 23 per day. The minimum number recorded was just 1 seafood table, observed on 23 July 2006, and there were no sampling days where there were no seafood tables present. The maximum number of tables offering seafood on any one day was 47 (on 2 May 2006). These figures excluded lime sold with buai (betelnut).

There was little fluctuation in the average number of seafood tables available per day throughout the year, although there were slightly lower averages in mid-2006 (June, July and August), and in January and December 2006. The overall average number of seafood tables operating over 24 market days per

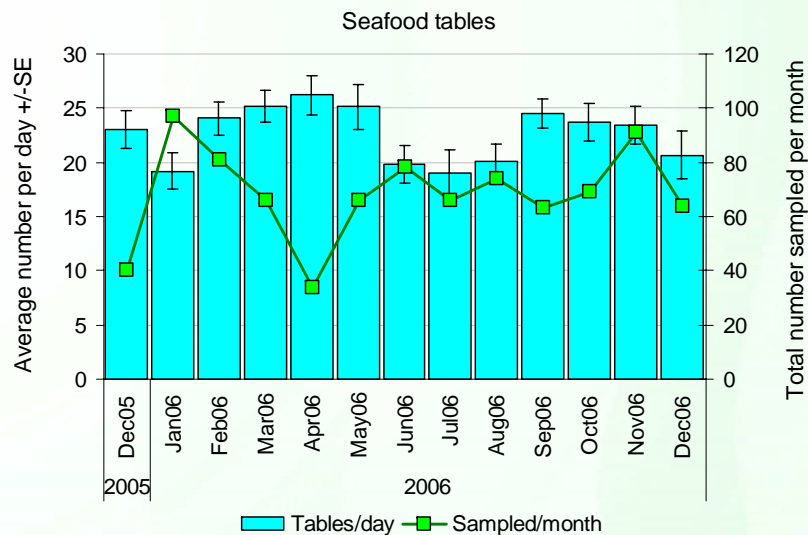
month was around 543. Between 34 and 97 tables were sampled in detail each month by collecting data over several days. These samplings focused on species on offer, sizes, processing and sale price.

A total of 14,216 marine products on seafood tables were identified and measured in the detailed surveys between 15 December 2005 and 30 December 2006 (a total of 248 sampling days). During that time, 889 tables (on which seafood was sold) were surveyed. Most seafood tables that were surveyed were at Huhu Market, although some were recorded at Nako/Sanderson Bay Market.

The greatest proportion of seafood for sale at the markets in Alotau were fishes (42%), although there were also large numbers of molluscs (33%) and crustaceans (25%). Seaweeds, turtle meat and turtle eggs were also recorded in the table counts, but were not included in the detailed table counts and measurements.

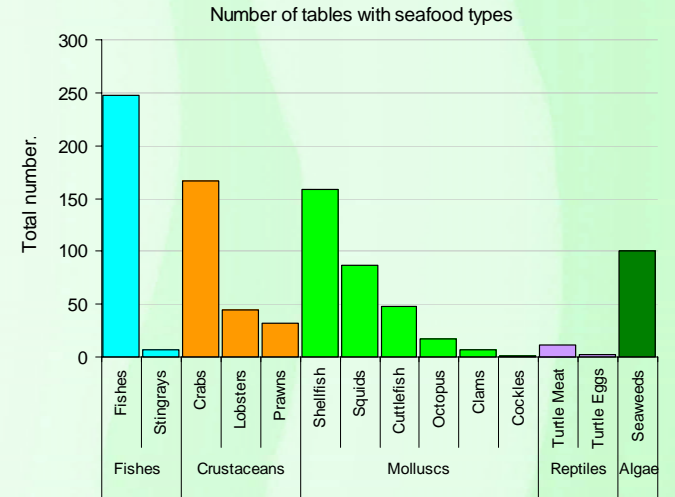
The most abundant types of marine animals offered for sale at the markets were mud crabs, mangrove mussels, cockles and snails, Indian mackerels, and scads. Most other types of seafood products were present in much smaller amounts (less than 300 recorded over the entire survey).

← Average number of seafood tables per day (+/- SE) at Huhu Main Market for each month of the survey (left axis) and total number of tables sampled per month (right axis).



Group	Families	Genera	Species	Number
Fishes	43	123	315	5,926
Crustaceans	7	8	12	3,540
Molluscs	21	28	38	4,750
Total	71	159	365	14,216

Fishes were usually sold whole (96%), with about 4% sold by the kilogram and a few by the "box". About half of all fishes were offered for sale fresh, and half smoked. Between 66% and 71% of all fishes were gutted and/or gilled.



↑ Relative importance of seafood types at Huhu Main Market by total number of seafood tables on which each was found (n=969 occurrences, 247 unique tables).

MARKET

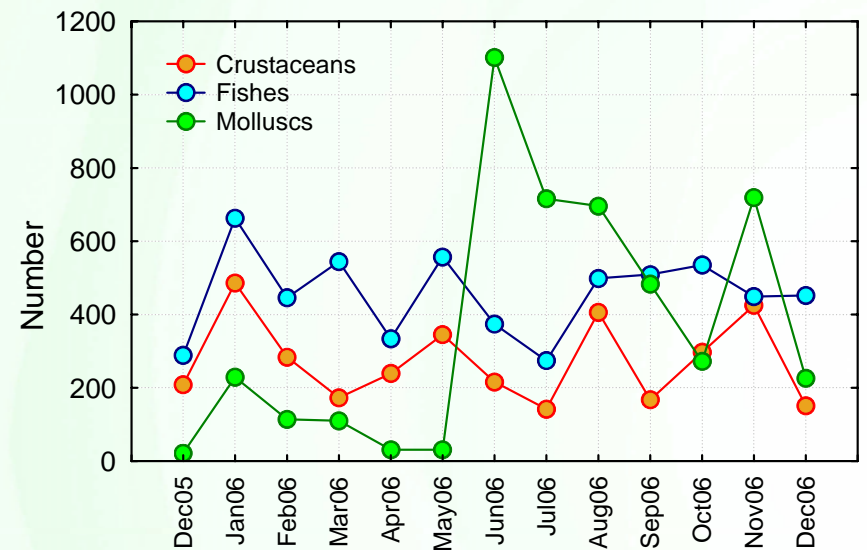
MARKET

Overall, tables offering fishes were the most common of those selling seafood, and accounted for 54% of all tables throughout the survey (481 tables). The availability of tables offering each type of seafood fluctuated throughout the survey. For molluscs, the number of tables offering them before June 2006 was small, but increased in the latter part of the survey. Although molluscs were significantly more abundant than crustaceans overall, they were present on similar numbers of tables as crustaceans (227 tables of molluscs and 217 tables of crustaceans over the survey). Seafood tables were most common in June 2006, mostly as a result of the large number of mollusc tables.

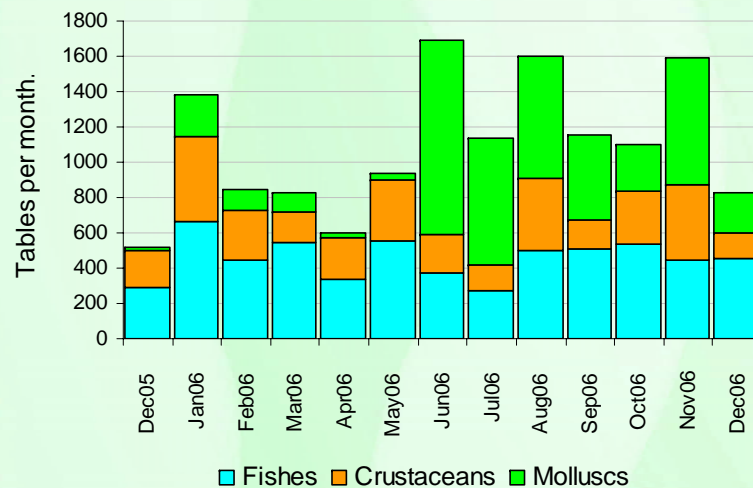
The most common sub-types of seafood, based on the number of tables (and therefore sellers) were lobsters, squids and crabs. In contrast, prawns and shellfishes tended to be present on one-half to one-third as many tables as other crustaceans and molluscs.

Preliminary estimates of the volume of seafood products that move through Alotau markets were calculated. These calculations were based on the number of tables selling each type of seafood per day and the number of units for sale per market table.

Total number of seafood products offered per month



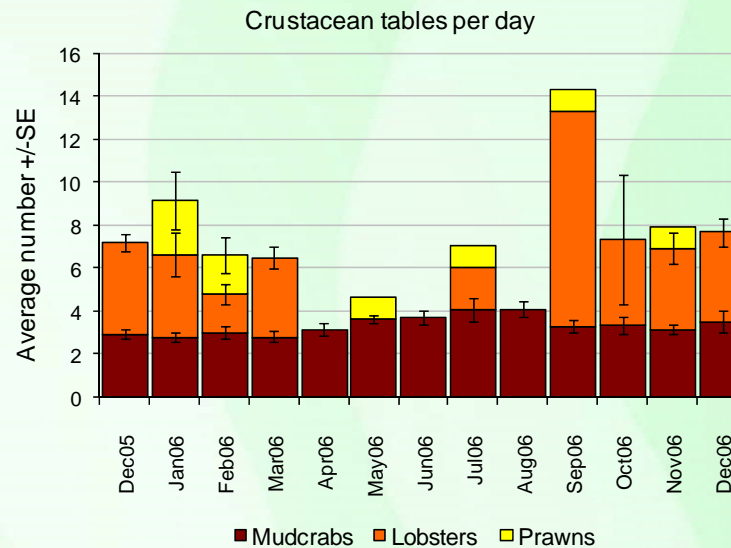
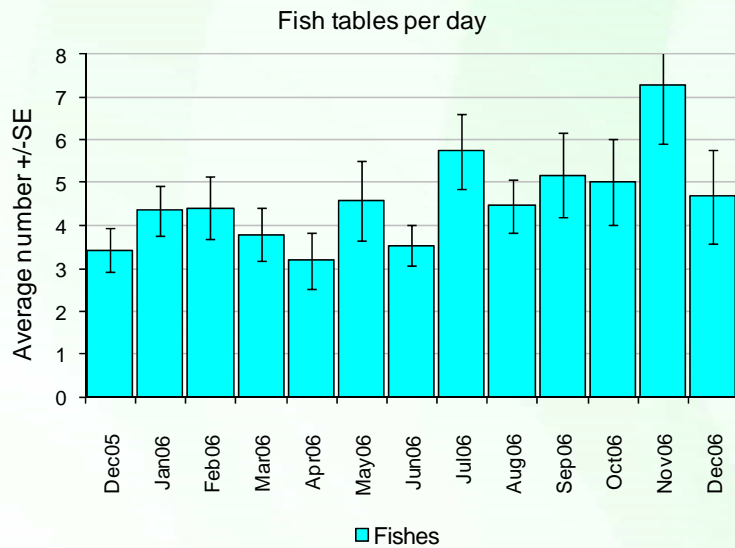
Tables with seafood groups



➤ Total numbers of seafood items offered for sale at Alotau Main Market per survey month. Values are broken down by main group of seafood products. Note that the monthly amount of fishes and crustaceans remained relatively stable over the survey. The overall peaks in numbers of seafood products for sale is driven by sporadic numbers of molluscs, usually freshwater clams.

➤ Breakdown of the percent of tables selling different types of seafood at Alotau markets over the survey period.



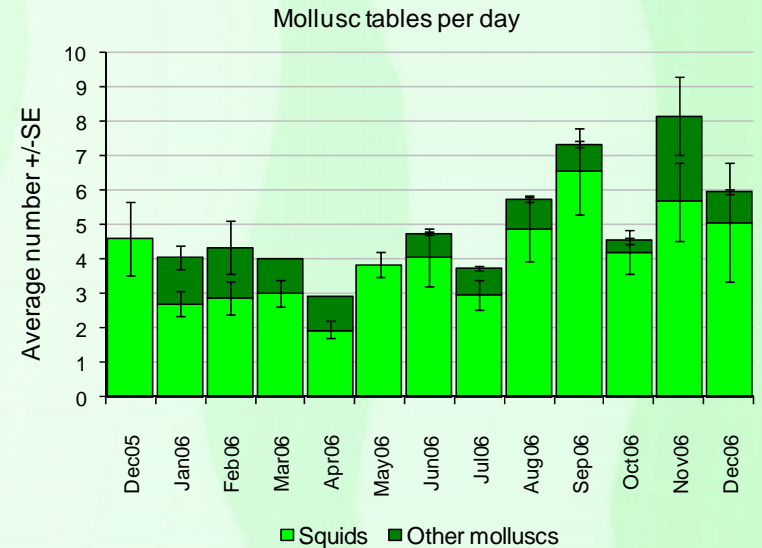


↙ Number of tables in Alotau markets offering different types of seafood products for sale during each month of the survey. Values are means +/-SE for different groups of marine resources.

Over the 13-month survey period, as many as 16,322 reef and pelagic fishes, over 54,000 crustaceans, and over 34,500 molluscs may have been sold through the market. These figures, particularly those for molluscs (because they were so variable), should be used with caution as they include estimates of numbers of seafood offered in pieces, heaps or on skewers in addition to whole individual animals that were easily counted.

↓ Summary of calculated volumes of seafood products that may be moving through Alotau markets per day, month and year. Units refer to the number of fishes, crustaceans or molluscs, regardless of species. Estimates were calculated for each month to incorporate high and low seasons, but remain approximate. Note that columns are not necessarily multiples of each other as they are independently calculated from the best available (and therefore not necessarily the same) information for each measure.

	Tables	Price/unit (K)	Total units	Units/table	Tables/day	Units/day	Units/month	Units/year
Fishes	481	4.63	5,926	12	4.6	57	1,360	16,322
Crustaceans	217	3.38	3,540	16	3.4	55	1,331	15,974
Molluscs	227	2.39	4,750	21	2.4	50	1,205	14,463
Totals	925	3.79	14,216		10	162	3,897	46,759



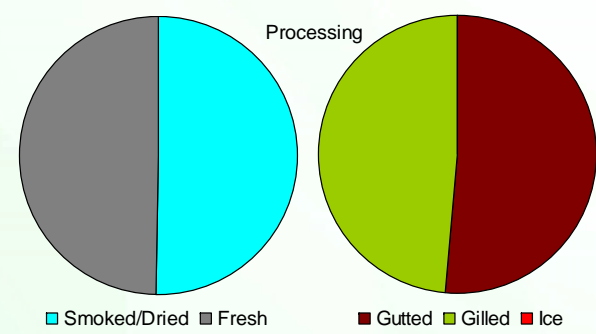
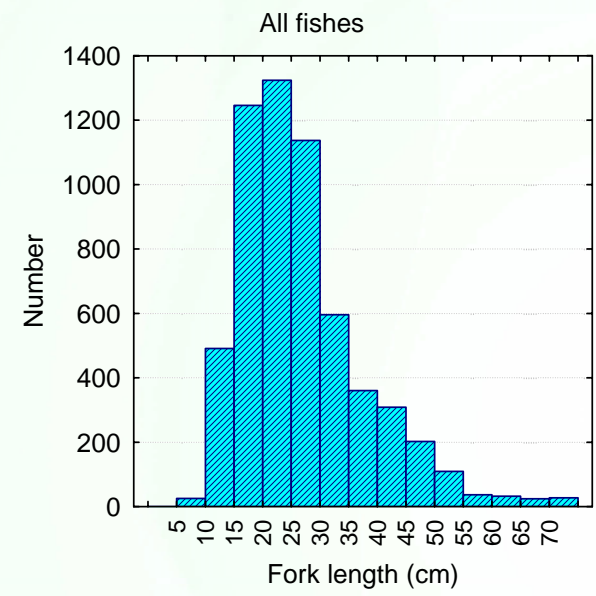
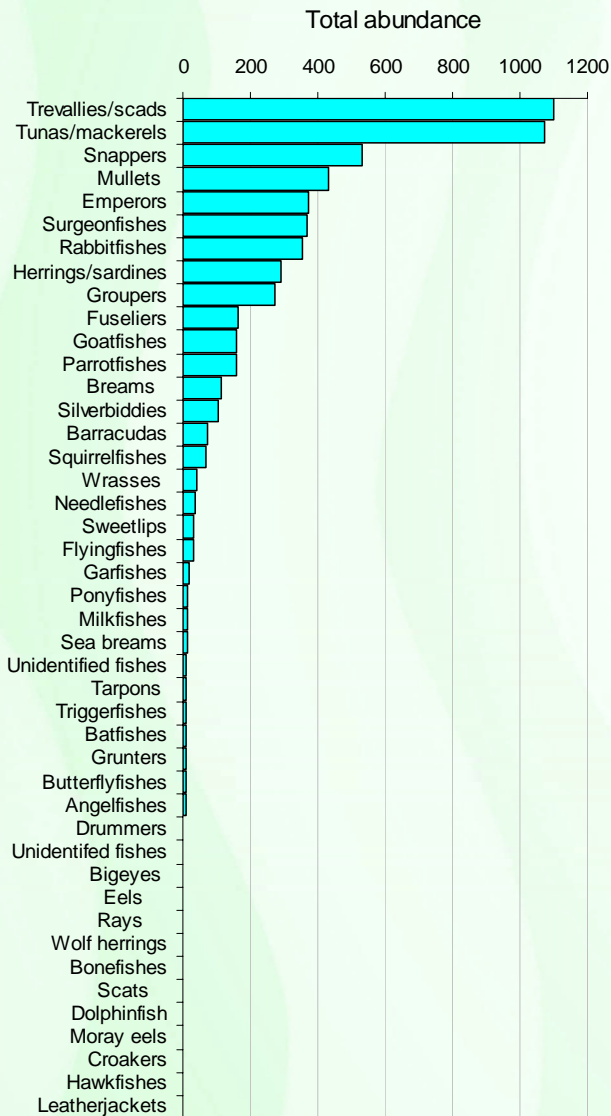
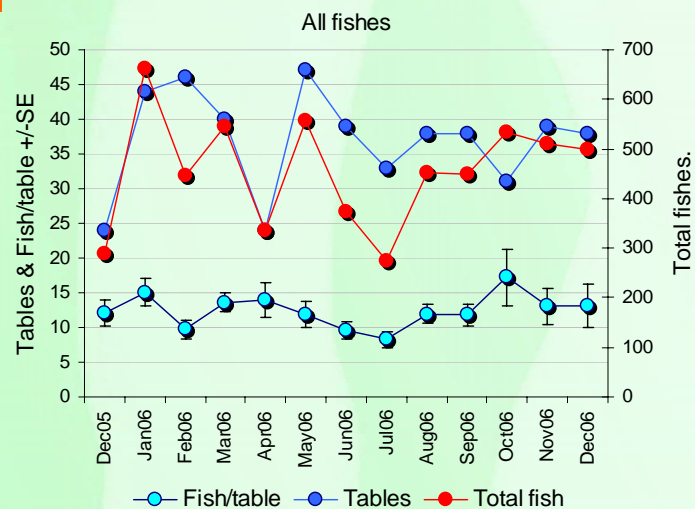
MARKET

FISHES

A total of 5,926 fishes were recorded and measured during the market survey. The fishes belonged to 44 families, and included approximately 315 species. The most common groups of fishes offered for sale at the market were scads, mackerels, snappers and mullets.

The average number of fishes for sale per table, and total number of fishes for sale per month fluctuated very little over the survey period, and did not appear to be changing overall. About 51% of all fishes for sale were smoked, 71% were gutted and 67% were gilled. Other forms of processing were generally not reported, although there were two cases in which ice was used.

The sizes of fishes sold ranged between 7.8 cm and 95.8 cm, with an average size of 27 cm (fork length) recorded during the survey. About 61% of all fishes for sale were between 15 cm and 30 cm, with few over 55 cm.



- ↑ Size distribution of all fishes recorded for sale during the survey across all months (n=5,926).
- ↗ Relative abundance of all fish families.
- ↗ Types of processing used for fishes sold at Alotau markets. Note these are overlapping categories as any single fish may be subjected to more than one treatment (e.g. fresh and gutted, gilled, etc.).

← Total number of all fish species per month, average number per table, and number of tables offering fishes during the survey.

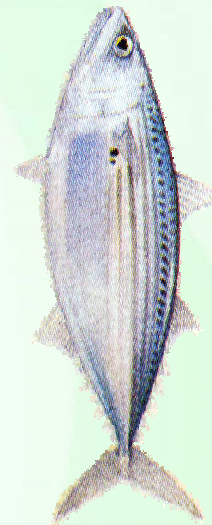
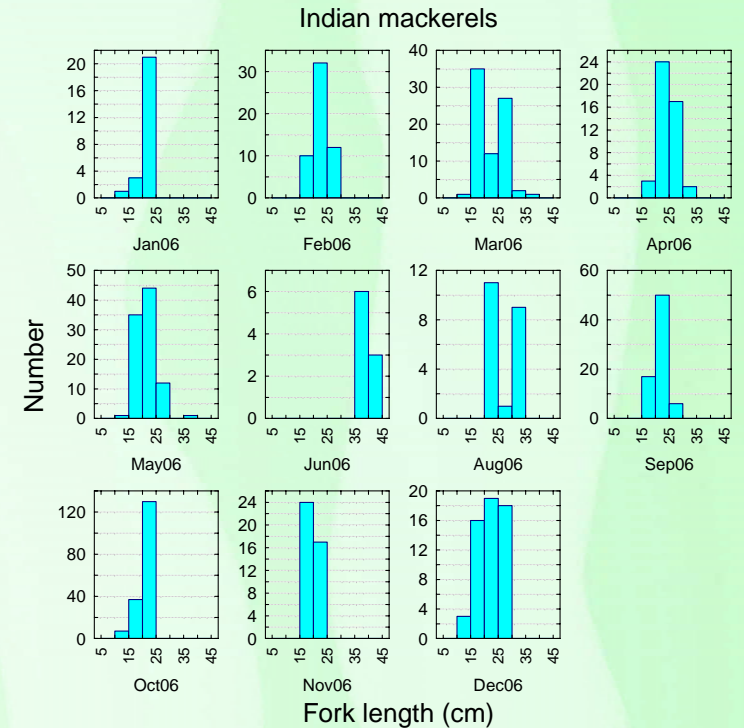
FISHES > Scombridae - Tunas and mackerels > *Rastrelliger kanagurta* - Indian mackerel

Indian mackerels were the most common fishes for sale in Alotau markets, with a total of 670 being offered on 45 tables during the survey. This species accounted for 11% of all fishes sold.

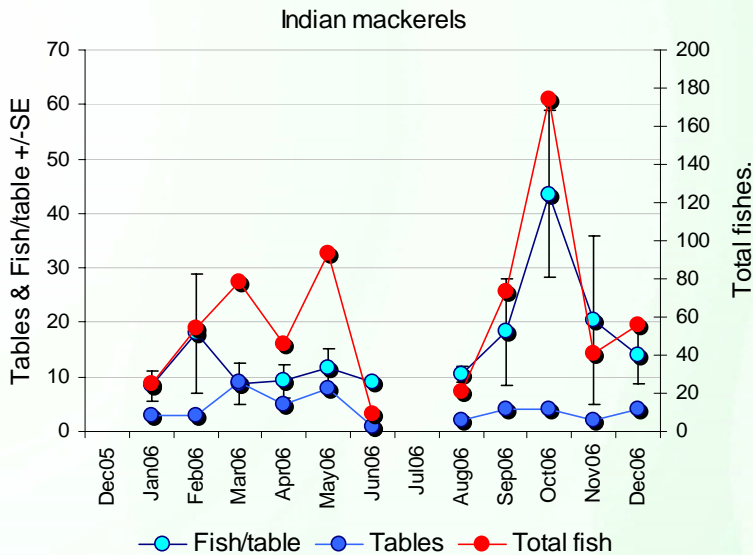
On average, there were about 15 Indian mackerels for sale on each table that offered this fish. Overall, 5% of all seafood tables included Indian mackerels, and this varied by month. The greatest total number of fish in a single month was recorded in October 2006. This fish was absent from the market in December 2005 and July 2006.

The average size of Indian mackerels was 22 cm (fork length), and ranged up to 41 cm. About one-third of all fish measured were between 20 cm and 22 cm. Most fish were offered for sale smoked (60%).

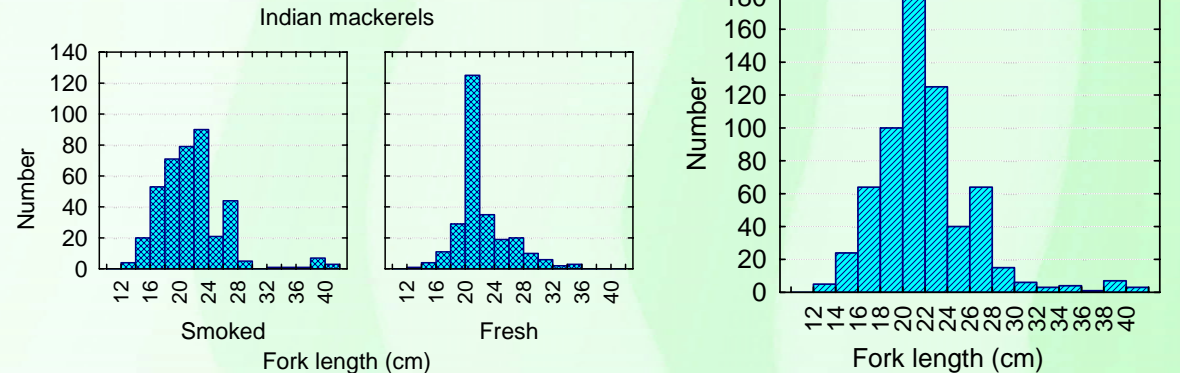
↗ Size distribution of fish during the survey overall, and broken down by sampling month (n=670 fish).



↙ Average number of fish per table, number of tables per month, and total number of individuals offered in the markets over the survey (n=45 tables).



↘ Sizes of fresh and smoked fish offered in Alotau markets.



MARKET

FISHES > Carangidae - Trevallies & scads > *Atule mate* - Yellowtail scad

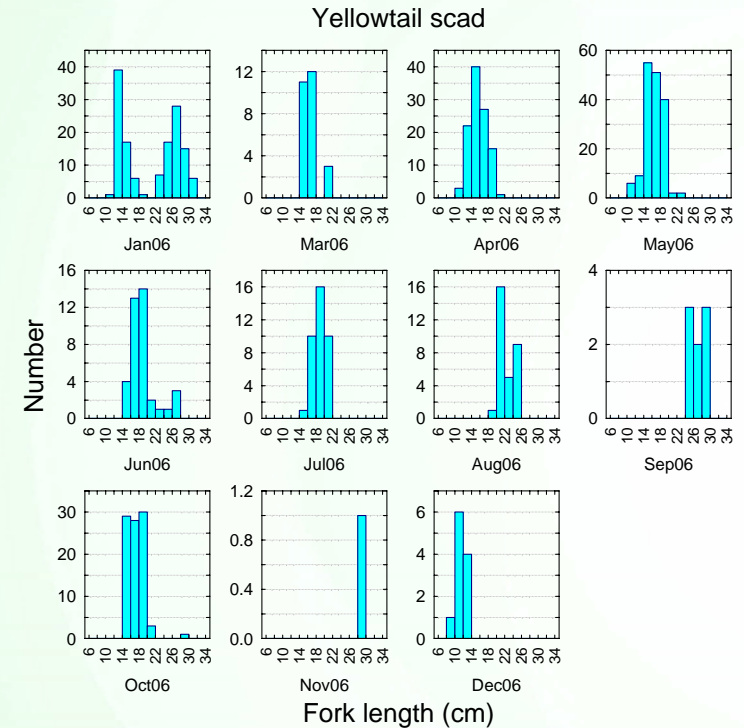
Yellowtail scads were the second most common species of fish offered for sale at Alotau markets. They were found on 4.4% of all tables surveyed and accounted for 11% of all fishes. There was an average of 4 tables per day offering these fish, with an average of 16 fish per table. The maximum number of fish on a single table was 64. A total of 653 of these fish were recorded over a total of 41 tables throughout the survey period, with the greatest monthly total recorded in May 2006.

Yellowtail scads ranged in size between 9.9 cm and 31.2 cm (fork length), averaging 18 cm. About half of these fish were offered for sale smoked and half were sold fresh.

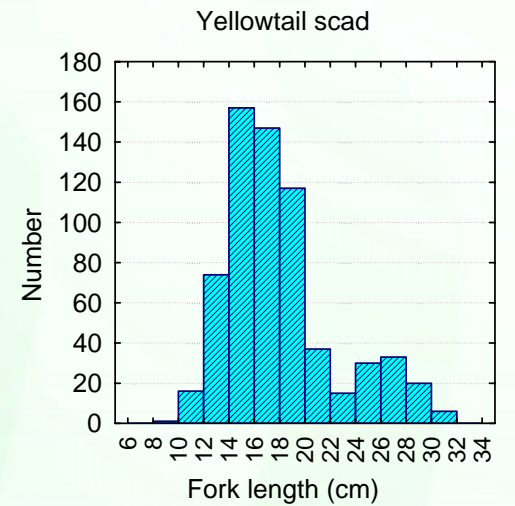
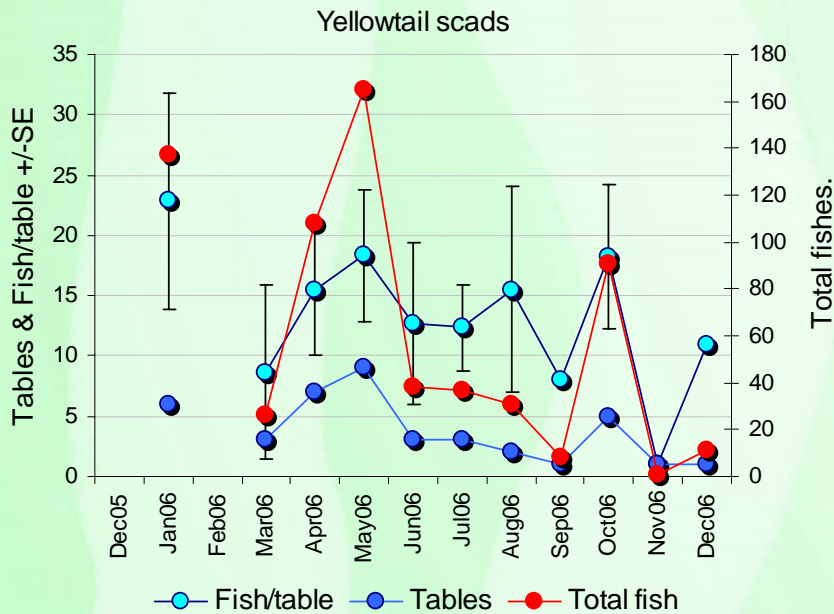
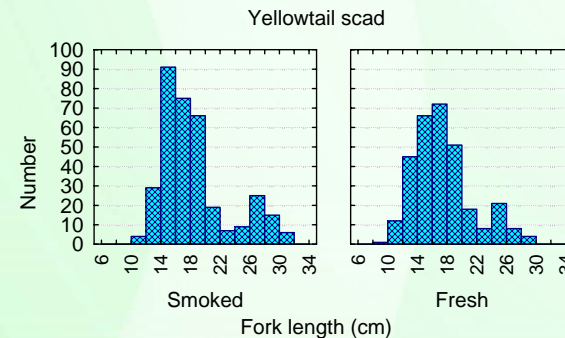
MARKET

Size distribution of fish in the markets during the survey overall and broken down by sampling month (n=653 fish).

Average number of fish per table, number of tables per month, and total number of individuals over the survey period (n=41 tables).



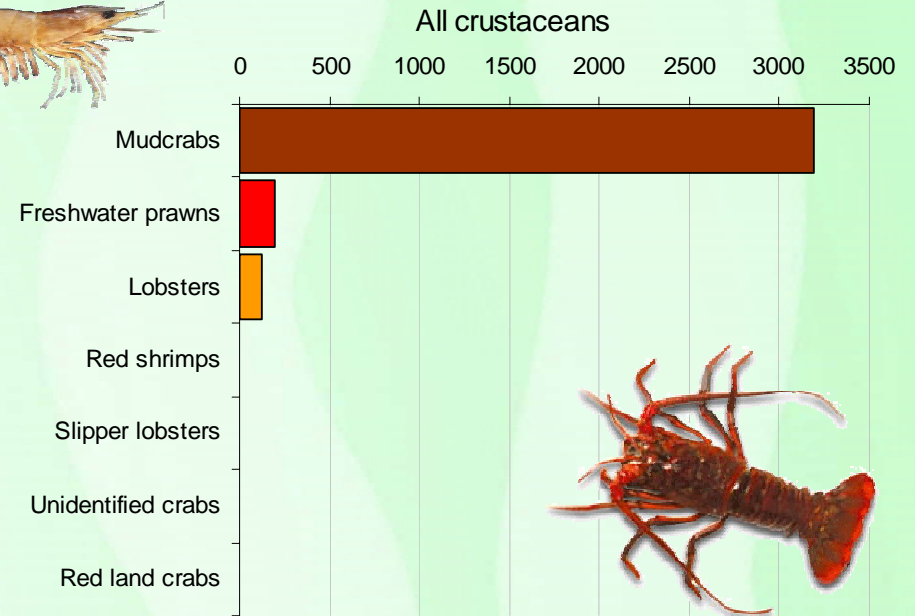
Sizes of fresh and smoked fish offered in Alotau markets.



CRUSTACEANS

A total of 3,540 crustaceans, belonging to at least 6 families, were recorded and measured during the market survey. These included mud crabs, prawns and lobsters belonging to 11 species. Species included: mud crab (*Scylla serrata*), freshwater prawn (*Macrobrachium* spp.), painted, ornate and pronghorn spiny lobsters (*Panulirus versicolor*, *P. ornatus* and *P. penicillatus*), red land crabs (*Macrotholmus depressus*), and giant red shrimp (*Aristaeomorpha foliacea*).

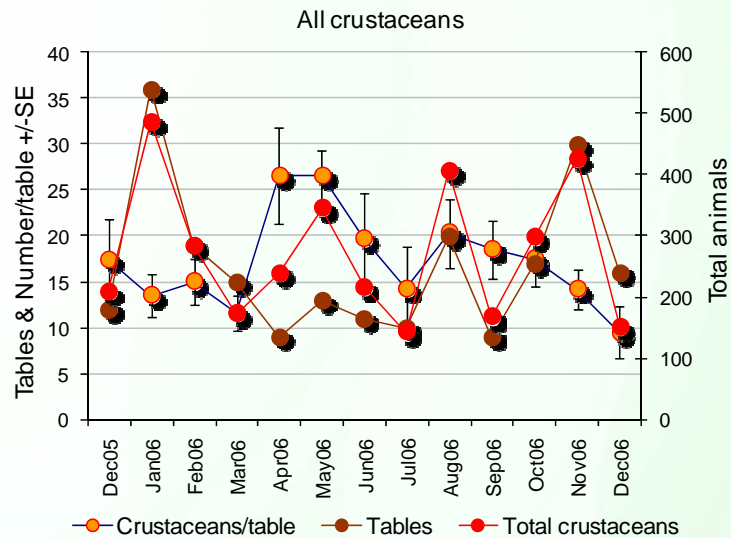
The average number of crustaceans for sale per table was 16 over the entire survey (and ranged between 1 and 72). Total numbers sold each month fluctuated significantly, with low total numbers (142-173) in March, July and August 2006, and high numbers (486) in January 2006. The large differences in total numbers available per month appears to have been driven by both changes in the number of tables selling crustaceans and the mean number of crustaceans available per table. The sizes of crustaceans for sale varied depended on the family and species, and the measurement taken. Tail length was measured for lobsters and prawns, and carapace width for crabs.



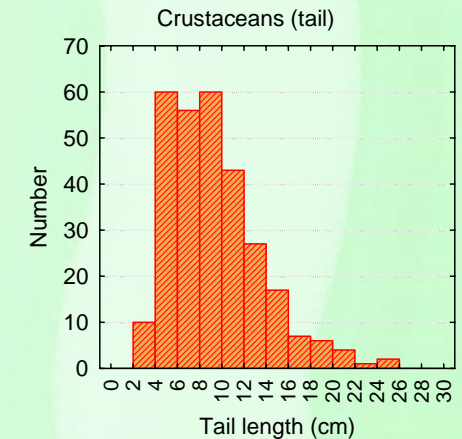
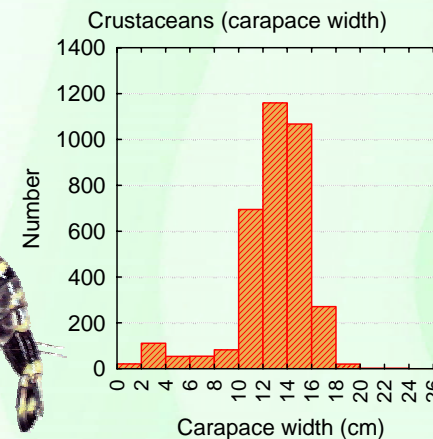
MARKET

↑ Abundance of different groups of crustaceans recorded for sale during the survey (n=3,540).

↓ Sizes of all crustaceans using carapace width and tail length (cm) recorded during the survey. These graphs give only a rough representation because very different groups have been combined to produce them. Detailed breakdowns are available on the following pages.



← Total number of all species of crustaceans per month, average number per table and number of tables offering them during the survey (n=3,540 crustaceans and 217 tables).



CRUSTACEANS > Portunidae - Swimming crabs > *Scylla serrata* - Mud crabs

Ninety percent of all crustaceans recorded at Alotau markets during the 13-month survey were mud crabs. A total of 3,195 mud crabs were recorded on 152 tables. Mud crabs were on offer on 16% of all seafood tables and accounted for 22% of all seafood products for sale by count. The number of mud crabs for sale fluctuated by month during the survey, with the greatest numbers being recorded during January and June 2006. Fluctuations in the available number were most related to the number of tables offering crabs per month, rather than differences in the number on offer per table.

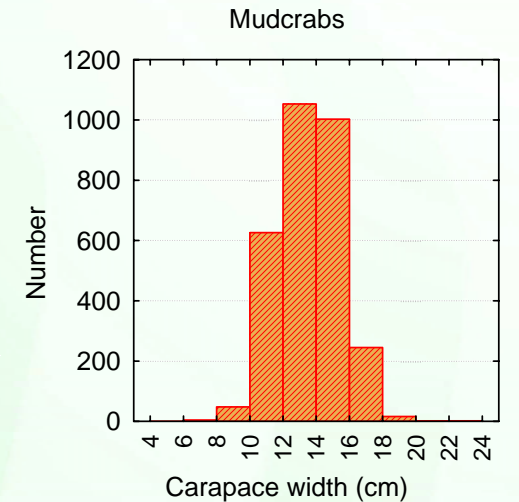
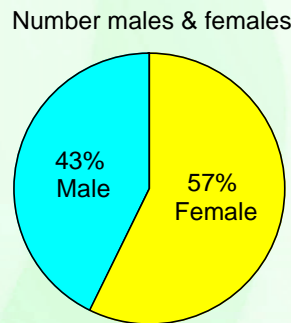
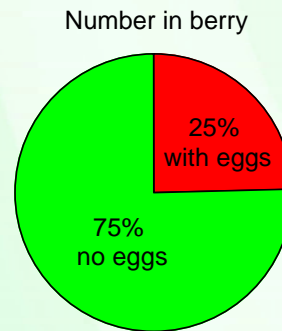
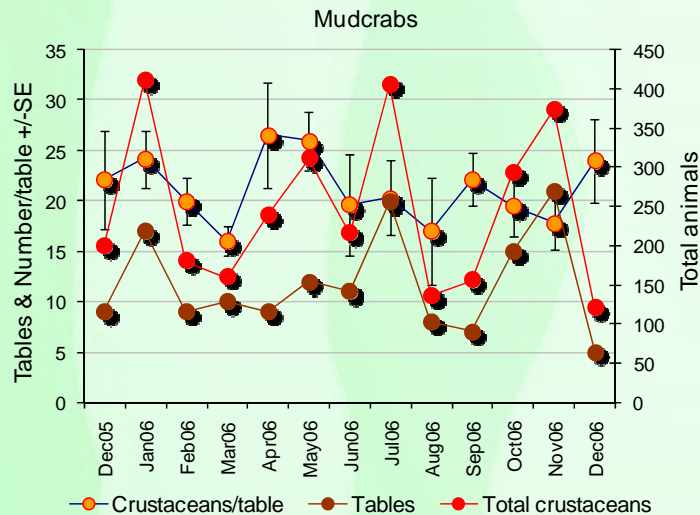
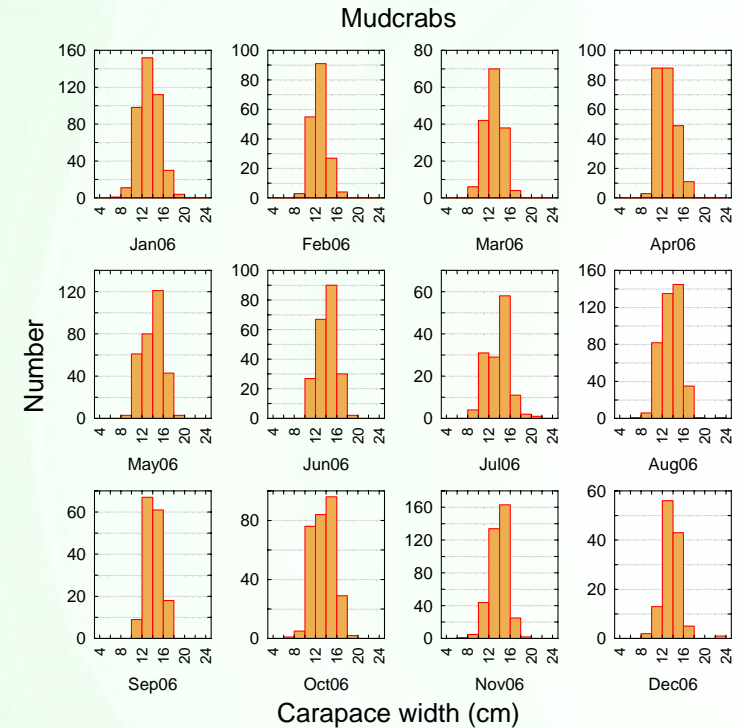
The average number of crabs per table was 21, but ranged up to 27. The average size of crabs was 13.6 cm across the carapace, and ranging between 7.4 cm and 22.3 cm. The majority of crabs recorded at Alotau markets were females, with about 25% of these in berry at the time they were collected.

MARKET

Size distribution of mud crabs in Alotau Main Market during the survey, and broken down by sampling month (n=2,998 crabs measured).

Average number of mud crabs per table, number of tables per month, and total number of individuals offered over the survey (n=3,195 crabs and 152 tables).

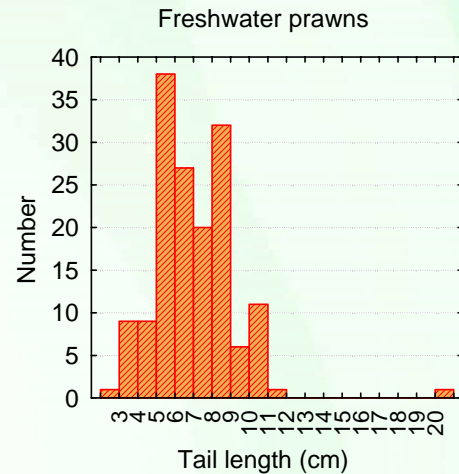
Sex ratio (n=3,183) and reproductive state (berry) (n=833) of mud crabs for sale at Alotau markets.



CRUSTACEANS > Palaemonidae - Freshwater prawns > *Macrobrachium* spp. - River prawns

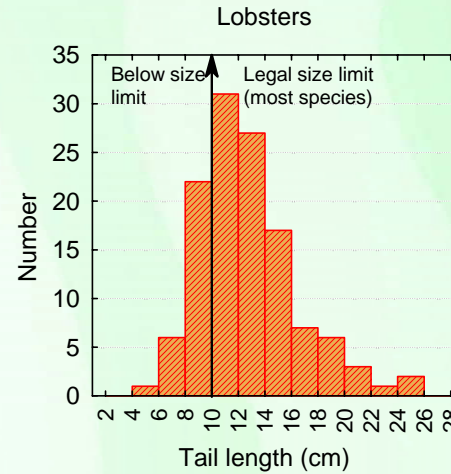
A total of 192 freshwater prawns were counted and measured at markets in Alotau during the survey. They were present on 1.4% (13) of all seafood tables and accounted for 1.4% of all seafood products recorded. Prawns were only available in 5 months of the survey period, and only on a few days. The greatest total number on offer in a month was 96 animals in February 2006.

The average size of prawns was 7 cm (tail length) and ranged from 3 cm up to 21 cm. Most prawns were between 5 cm and 9 cm long (tail length only).



CRUSTACEANS > Palinuridae - Lobsters

Three species of lobsters were recorded during the survey, amounting to 133 individuals over the entire survey. Lobsters were recorded on 50 tables with an overall average of 3 animals per table in a day. Lobsters accounted for <1% of all the seafood by count and were present on 4% of tables. Lobsters were absent from survey counts between April and August 2006, except for 1 animal recorded in May. The largest numbers were seen in November 2006, with a total of 36 animals recorded in the market in that month.



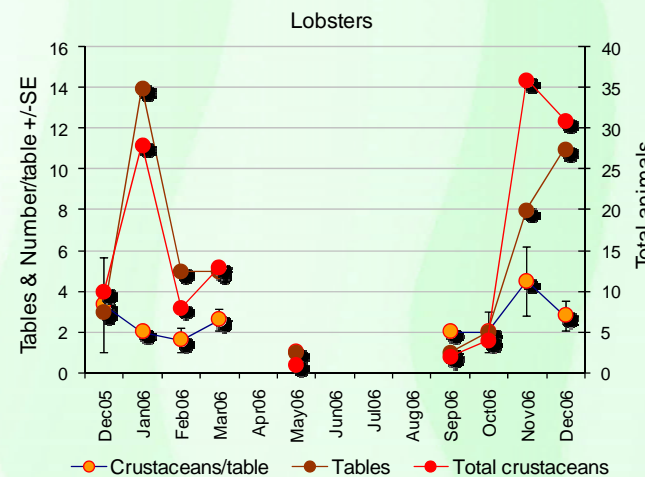
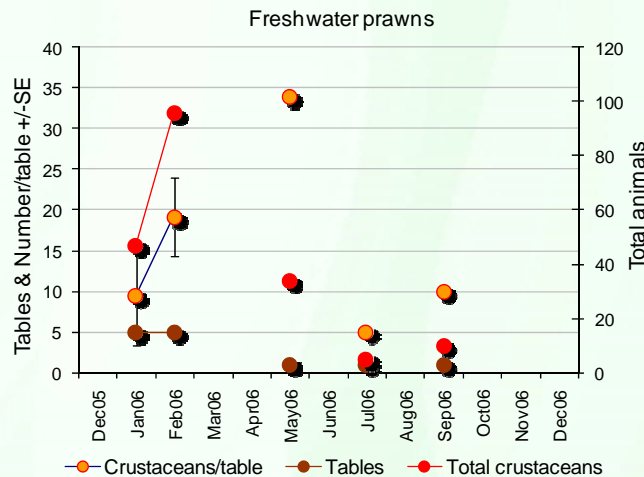
←← Size distribution of freshwater prawns and lobsters in Alotau markets during the survey (n=155 prawns and 123 lobsters measured).

The average size of lobsters was 13 cm (tail length), but ranged between 6 cm and 26 cm. About 24% of all lobsters offered for sale were below the legal size limit of 10 cm tail length, which applies to most species.

MARKET



→→ Average number of freshwater prawns and lobsters per table, number of tables per month, and total number of individuals offered over the survey (n=13 tables for prawns and 50 tables for lobsters).



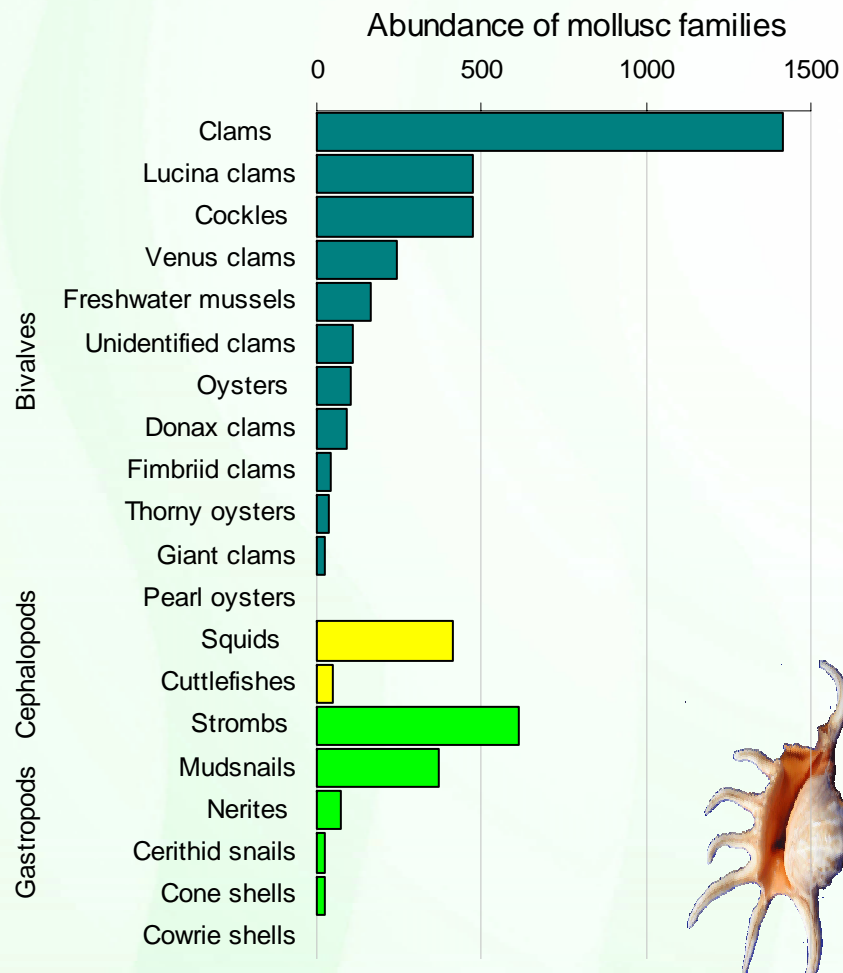
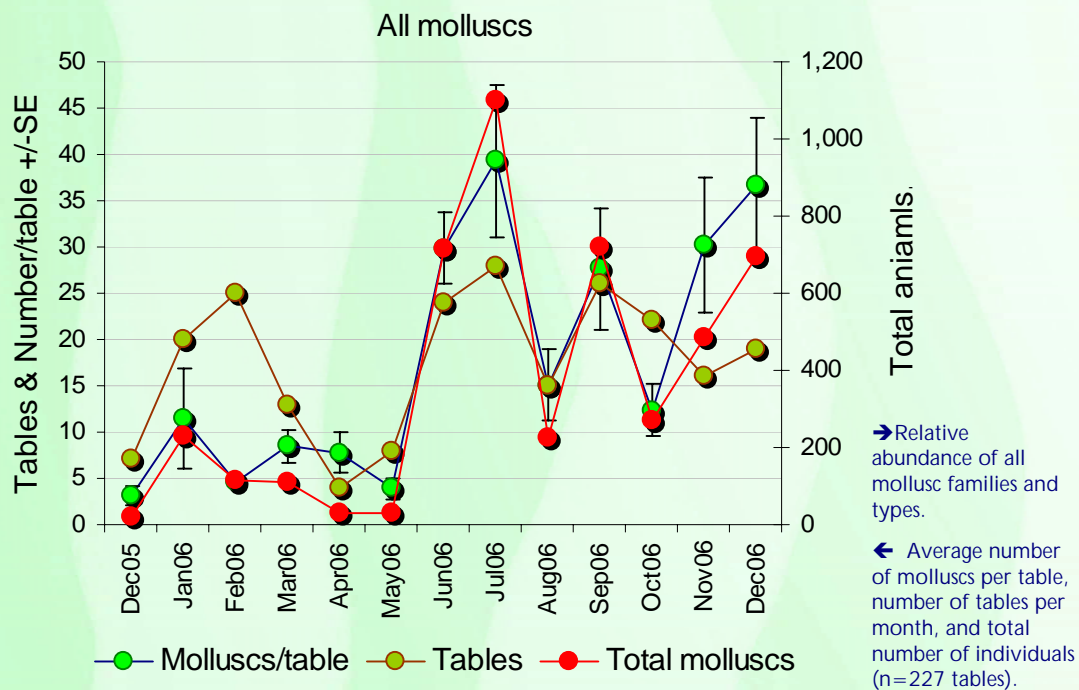
MOLLUSCS

A total of 4,750 molluscs were recorded and measured during the market survey. These belonged to at least 20 families and included species of clams, oysters, cockles, squids, cuttlefishes and a variety of snails. Molluscs were found on a total of 227 seafood tables (25%) during the survey and accounted for 33% of all seafood products.

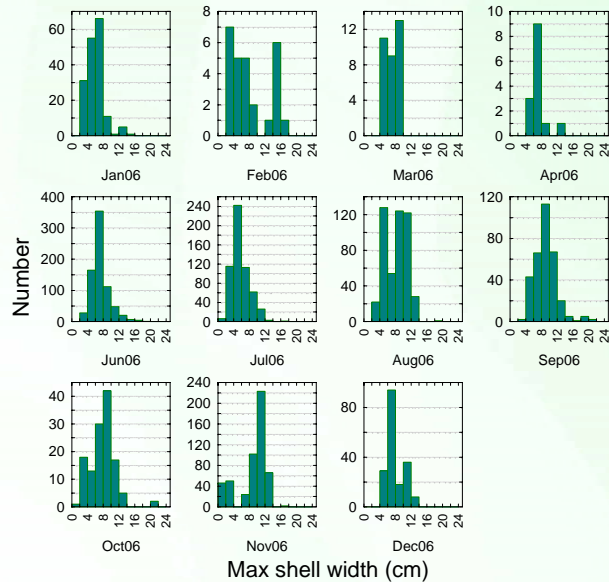
The average number of molluscs for sale per table, and the total number for sale per month, fluctuated over the survey, with generally greater numbers recorded during the second half of the survey. The average number of molluscs per table was 21 and ranged between 3 and 39. The average number of mollusc tables operating per day was 17 and the average number of molluscs offered for sale per month was 365. In July 2006 over 1,100 molluscs were offered for sale.



MARKET



Bivalves



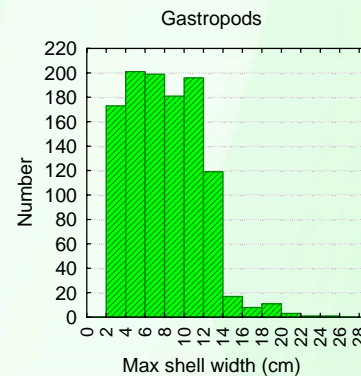
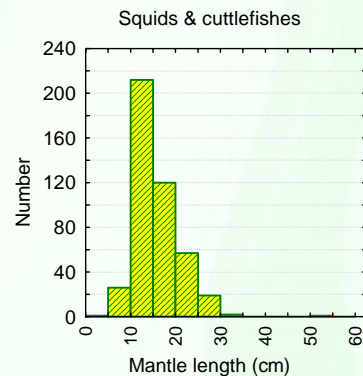
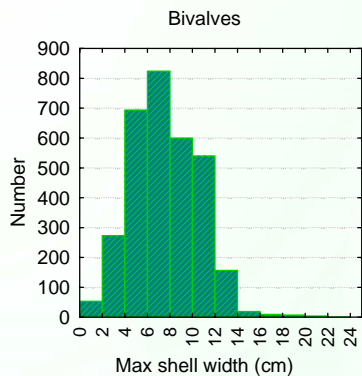
The bivalves on sale at the markets were from 11 families and at least 18 species (some were unidentified). Over the survey period, 3,180 bivalves were recorded. The most common types were small mud and sand clams and cockles. Several types of oysters were recorded, including mangrove, thorny and pearl oysters. The average size of bivalves was 7.6 cm (maximum shell width), ranging from 1.1-21.8 cm. Bivalves were absent from the market during May 2006.

The total number of cephalopods (squids and cuttlefishes) recorded over the survey was 460. Their mean size, as measured by mantle length was 15.7 cm and ranged between 4 cm and 54 cm. Cephalopods were present in the markets during every month of the survey.

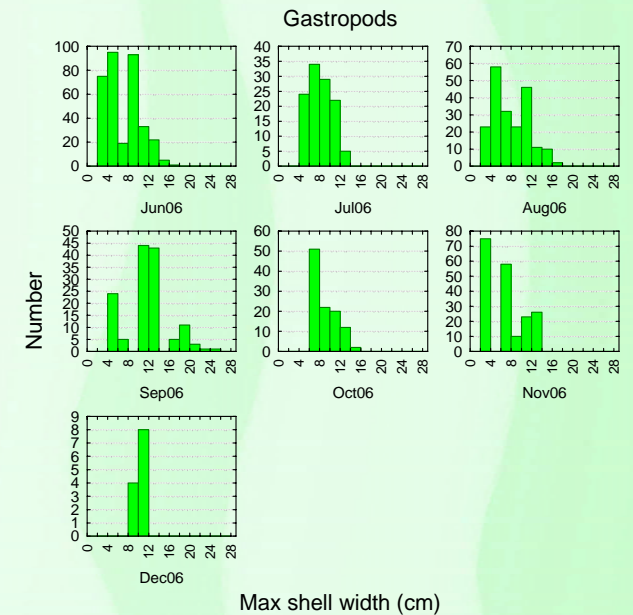
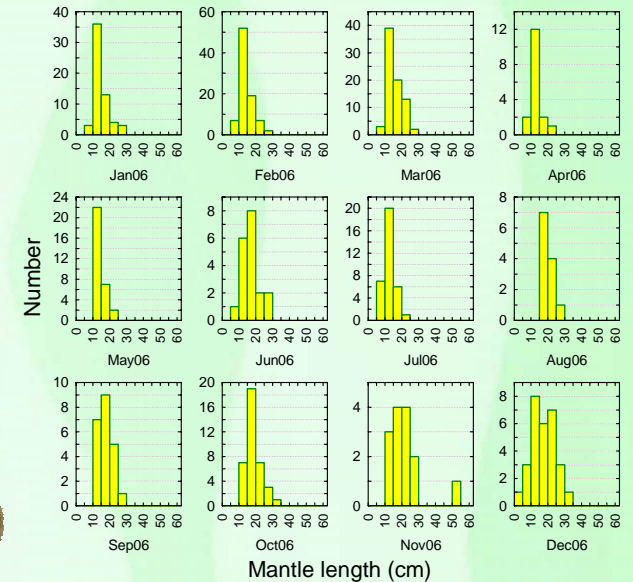


Gastropods included sand and mud snails, cone shells, cowries, nerites, strombs and spider shells of 15 species and 8 genera in 6 families. They were found in a range of sizes between 2 cm and 24 cm, with many animals between 2 cm and 14 cm in maximum shell length. The wide range of sizes relates to the many species included in this group.

↕↔ Size distribution of molluscs recorded for sale during the survey across all months (n=3,180 bivalves, 438 cephalopods and 1,110 gastropods measured).



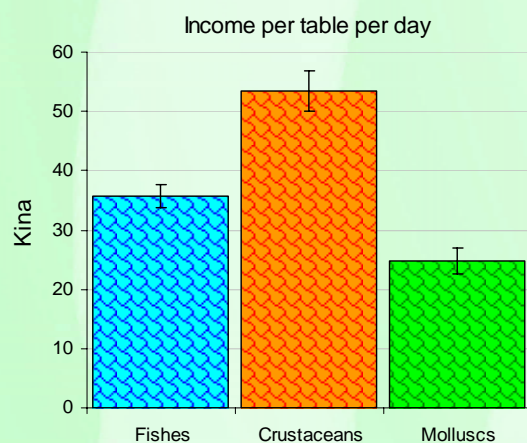
Squids & cuttlefishes



MARKET



↕ Average price per unit of sale and average income per table per day for the major groups of seafood products offered in Alotau markets. These are 'potential' figures, and would depend on the products on offer being sold (n=14,093).



PRICES AND INCOME FROM MARKET SEAFOOD SALES

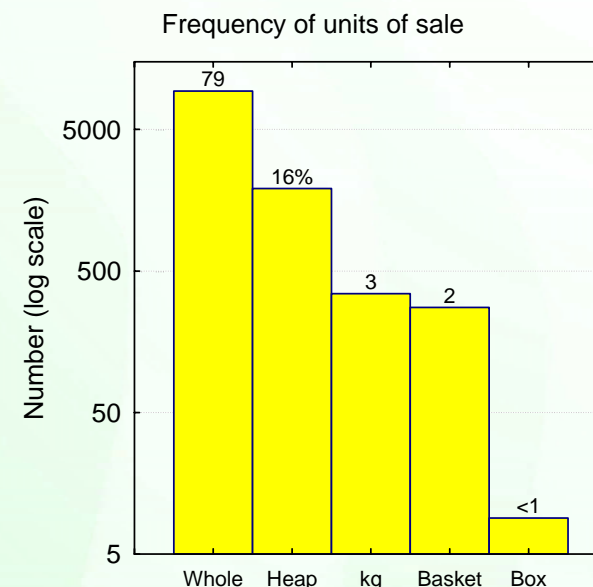
	Tables	Price/unit (K)	Total units	Total value/year (K)
Fishes	481	4.63	5,926	75,621
Crustaceans	217	3.38	3,540	54,060
Molluscs	227	2.39	4,750	34,544
Totals	925	3.79	14,216	164,225

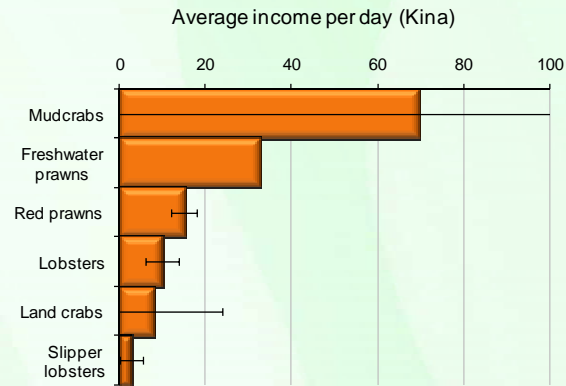
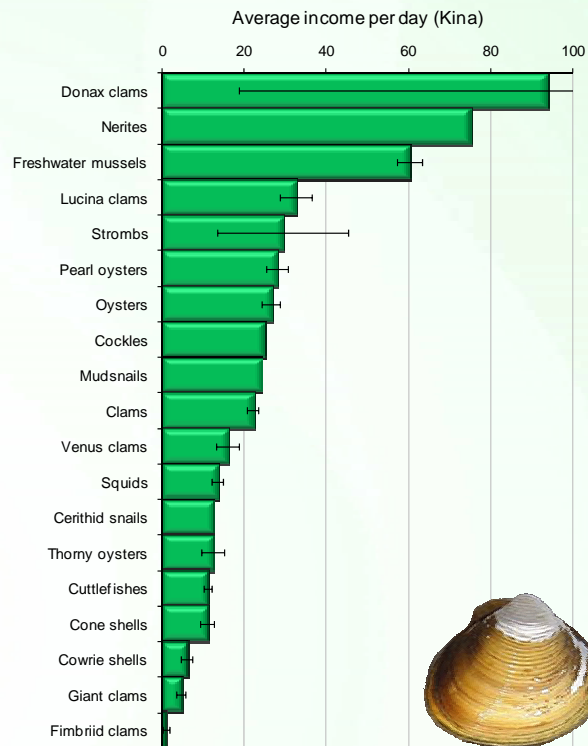
Price information was collected for 14,093 seafood products on offer in Alotau markets during the survey. Most seafood products on sale were sold as individual animals (whole single fish or crabs), with a price per item quoted. Molluscs and prawns tended to be sold in baskets, heaps or boxes, with a price quoted referring to variable numbers of animals forming a single unit of sale.

The average price of seafood products was highest for molluscs, on average, and lowest for crustaceans for the particular units of sale used for each. The most valuable seafood products, in terms of income for a single table in a day, came from small fishes (herrings, *Herklotsichtys quarimaculatus*), and from mud snails sold in heaps. Taking into account the number on a table and the price per unit of sale, the greatest income per day on average was derived from herrings, clams, small snails (sold in heaps) and mud crabs (sold individually). These are the seafood types that contributed the most to the daily income of sellers at average availability. By group, crustaceans produced the most income per table per day (K53/table/day) and the most income per unit of sale, selling for K3.25 per unit.

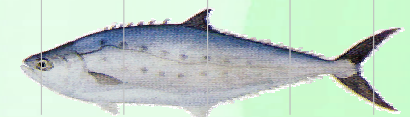
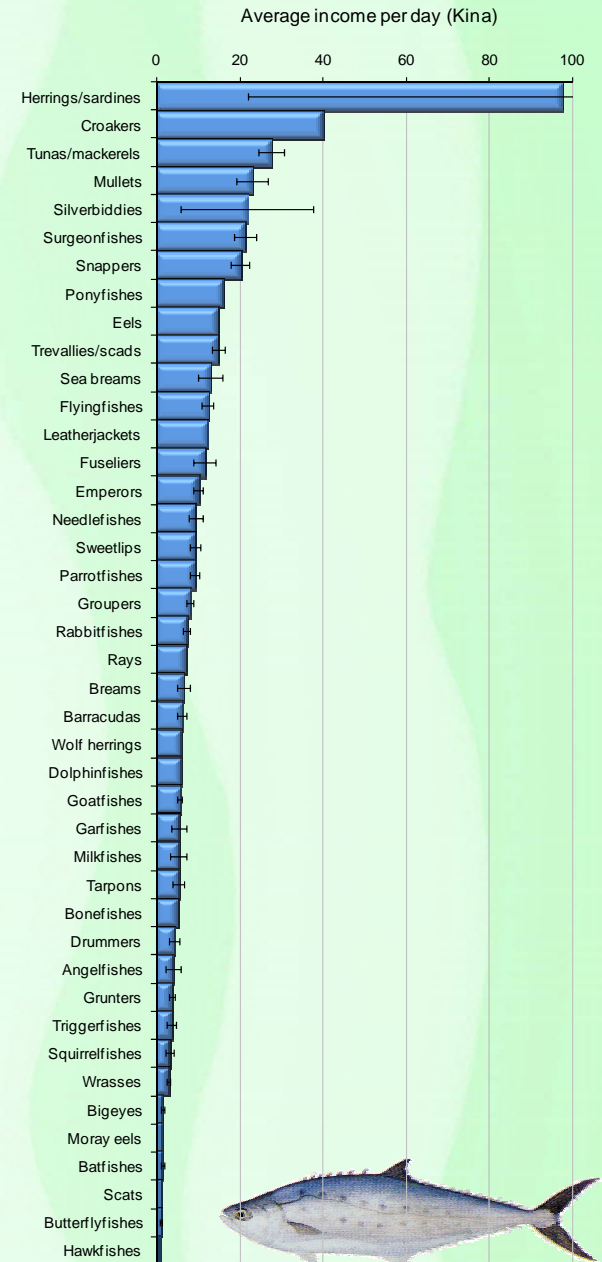
Preliminary estimates of the value of seafood products that could be moving through Alotau markets were calculated. These calculations were based on the number of tables selling each type of seafood per day, the number of units for sale per table, and the asking price (based on 24 selling days per month). Note that sellers may sell at the end of a day for a lower price, although this was not incorporated into the calculations shown in the table here.

The total estimated value of these seafood products in the local economy was around K164,000, based on the prices collected during the survey. Over half of that, about K75,600 (46% of the revenue) came from fishes that comprised 42% of all seafood products on sale. Molluscs only contributed 21% to the revenue generated, but comprised over 33% of all seafood products by count.





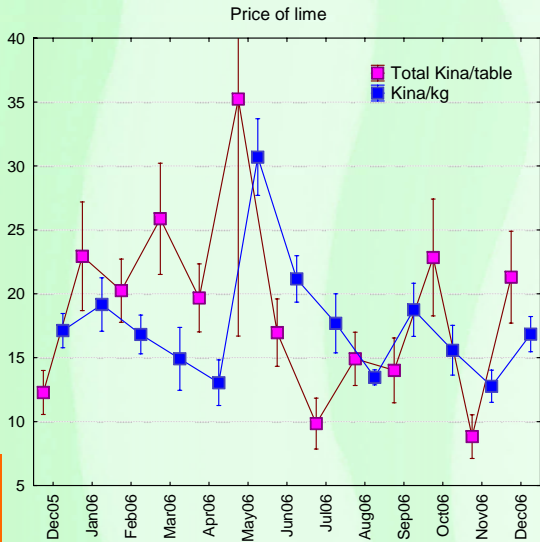
-  Fishes
-  Crustaceans
-  Molluscs



MARKET

↑ Average income per day derived from different groups and families of marine products. Values are average total incomes that would be derived through each group, based on average prices and numbers normally offered per table. These are "potential" figures and would depend on all the products on offer being sold. People selling fishes, normally offer more than one group / species per day, so values do not reflect incomes across a whole table (n=1,693).

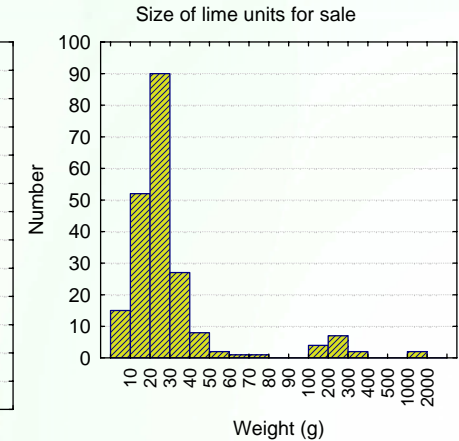
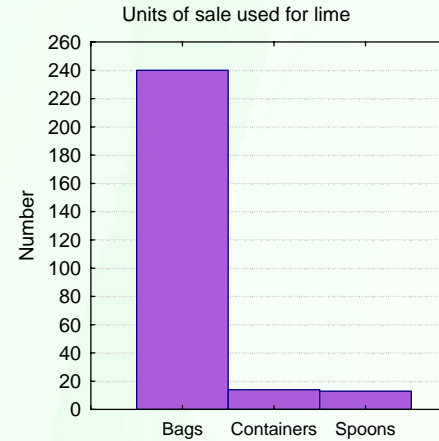
← Relative importance of the units of sale used in the market by occurrence (n=11,875).



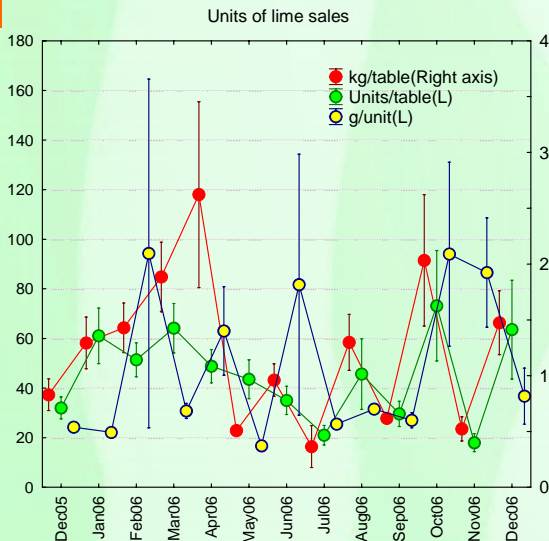
Summary of lime sales at Alotau markets between December 2005 and December 2006 (n=267 tables).

LIME

Lime produced from corals and used for betelnut chewing was available at roadside markets around Alotau as well as the main Huhu market all year around. Over the survey, information was collected from 267 tables on which lime was being offered for sale. Lime was packaged in a range of materials and sizes, and was sold in small plastic bags or containers or sold by the spoonful, with sellers often offering several sizes on a single table. The most common amounts being sold were between 20 g and 30 g per container, although the range was 9-1,500 g. Because lime is far less perishable than seafood, the information that follows is given on a per table per day basis. It should be understood that any unsold lime can be offered over many days until it sells. These results cannot therefore be added to determine total revenue from lime sales.



Size and frequency of use for containers of lime for sale over the survey (n=211 tables).



The average number of units (bags or containers) of lime for sale per table per day was about 44 (including selling it by the spoonful). The average total weight of lime for sale on tables was about 1.28 kg, ranging up to 17.5 kg. On any one day, the total kina value of lime on sale averaged about K18, with a maximum recorded value of K420 (if all lime stocks were sold on that day). There were significant fluctuations in available lime stocks over the survey, with the least amount of stock during July 2006, and peaks during April and October 2006. The price of lime fluctuated significantly during the survey, with the highest prices recorded in May 2006, which coincided with the time that stocks were at their lowest. The price of lime appeared to oscillate on about a 4-month cycle during the survey.



Marine Products Sold to Buyers



WHICH SEAFOOD PRODUCTS ARE BEING PURCHASED?

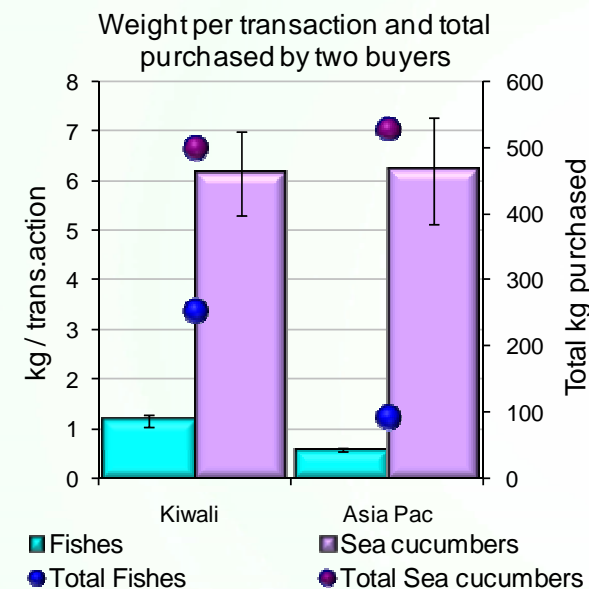
Buyer data were collected over the period December 2005 to December 2006. Data included fresh and dried marine products from three major groups: fishes, molluscs and sea cucumbers. Crustaceans, although common in the markets, did not appear in the samples at any time during the survey. Overall 5,335 kg of seafood products were recorded by weight over the survey. This figure includes molluscs that were counted and measured by the team but not individually weighed. All weights for this group are based on totals measured by the buyer at the time of purchase.

About 36% of the total number of seafoods sold to buyers were fishes as dried shark fins, which accounted for 16% of the number of transactions made over the survey. Sea cucumbers accounted for 23% of all transactions and 37% of the total number of seafood products.

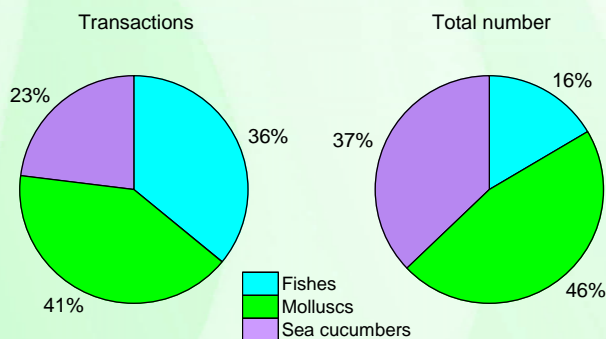
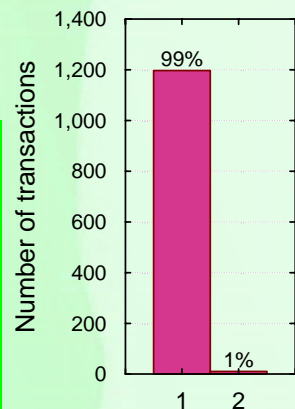
Molluscs were the most abundant seafood items sold to buyers, accounting for 46% of all seafood products sold and accounting for 41% of all transactions. Transactions made with buyers tended to be limited to one group of seafood products at a time, with only 1% of all transaction involving more than one group (i.e. fishes, molluscs or sea cucumbers).

A total of 1,219 transactions were recorded and 42,926 seafood products counted and measured during the survey. These results characterise the types of seafood brought to buyers, the average prices, sizes and quality of the marine products, and provides an indication of incomes for fishers per transaction (but not per period of time). These figures are not sufficient for calculating the volumes of products going through buyers because it was not possible to obtain good estimates of buyer intakes (or to obtain such data from them). The CFMDP buyer database includes data from two buyers, both of whom focused on dried products. On average, buyers bought around 35 items per transaction. The minimum number of seafood products bought was 1 and ranged up to 680 items (31 g up to 71.7 kg).

↓ Mean weight per transaction and total weight of seafood products purchased by buyers. Data are in kg for fishes and sea cucumbers only. Molluscs were not weighed during this survey (n=541 weighed transactions).

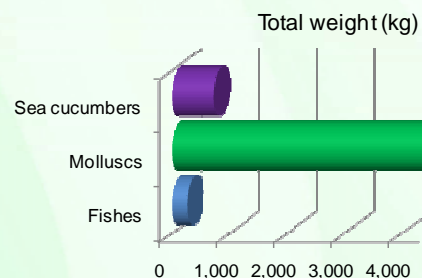


Transactions involving the three seafood groups



← Frequency with which sellers brought more than one seafood group to buyers in a single transaction (n=1,208) ↗ Breakdown of seafood products purchased by buyers by group. Data are total transactions and number purchased (n=4,104 records).

Number and weight of seafood products purchased by buyers and species group. Data are mean number per transaction, number of transactions, and total number of animals purchased during this survey ↗ overall and → by buyer.



	Mean per trans	Transactions	Total
Fishes	16	438	7,077
Molluscs	40	500	19,903
Sea cucumbers	57	281	15,946
All groups	35	1219	42,926

Buyer	Group	Mean per trans	Transactions	Total
Kiwali	Fishes	17	269	4,591
	Molluscs	37	269	9,823
	Sea cucumbers	55	154	8,417
Asia Pac	Fishes	15	169	2,486
	Molluscs	44	231	10,080
	Sea cucumbers	59	127	7,529
All groups		35	1219	42,926

Sellers brought an average of 7.3 kg of marine products to buyers for each transaction).

Molluscs were the most important seafood product purchased by weight, totalling just over 4.3 tonnes (t) during the survey, and averaging 9.6 kg per transaction. Molluscs accounted for nearly 81% of all seafood products purchased by buyers by weight. The total amount of fishes sold to buyers was 247 kg of shark fins and 714 kg of sea cucumbers, accounting for 4.6% and 13.3% of the total weight, respectively. Shark fins and sea cucumbers were recorded as dry weight. In the case of sea cucumbers, this represented 10 times the amount as fresh weight, or around 7.1 t. Information is lacking on how many or what total weight of sharks would have been harvested to yield 247 kg. Using a conversion of dry fin weight to wet whole shark weight of 1.44%, the total weight of whole sharks harvested could have been as much as 17.1 t in samples recorded during this survey.

Overall, K90,541 were paid out by buyers over the survey period for the seafood that project enumerators intercepted. The real amount would have been far higher than this as our values are only the totals from a subs-sample of the seafood

products sold to buyers. Of this amount, 48% (over K44,000) was paid for molluscs and 38% (K34,430) for sea cucumbers. The total amount paid for shark fins was just over K12,000.

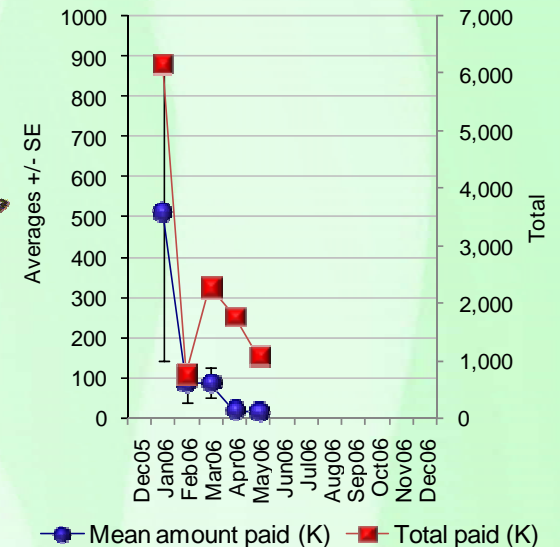
FISHES (SHARKFINS)



Sharkfin purchases were recorded in all months of the survey, but data on prices paid, total revenue and weights are available only for the first few months.

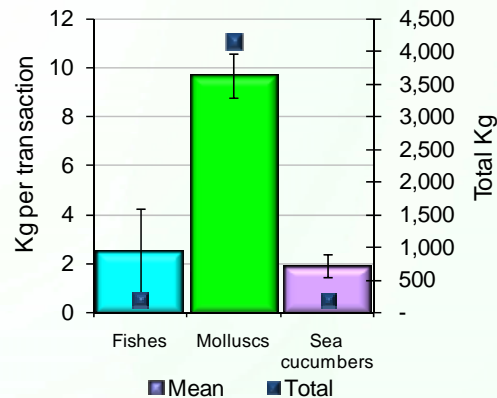
The average price paid by buyers to sellers was K94/kg, with an overall average of K55 paid out to sellers at each transaction. The maximum amount paid in a single transaction was K4,500. The greatest amount of sharkfins by count was recorded in November 2006, when 1,043 pieces were sold to buyers for an average of K86/kg. An average of 41 kg was sold to buyers during each month overall, with 206 kg sold in January 2006.

Amount paid

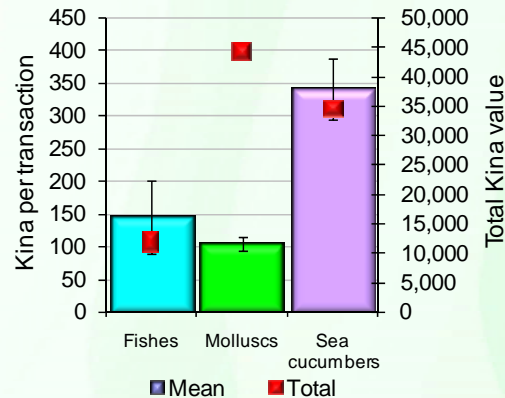


Averages per transaction and survey totals of amount paid by buyers, weights and numbers of sharkfins recorded by month during the survey (n=1,536 transactions).

Mean and total weight bought (kg)

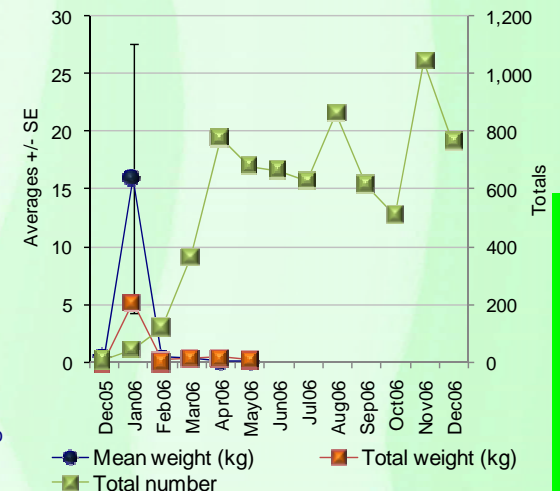


Mean and total Kina paid



Breakdown of seafood products purchased by buyers over the survey period. Data are means (+/-SE) and totals for prices paid for seafood products and weight purchased. Note that fish weights were estimated from length information, so results are only indicative.

Weight and number purchased



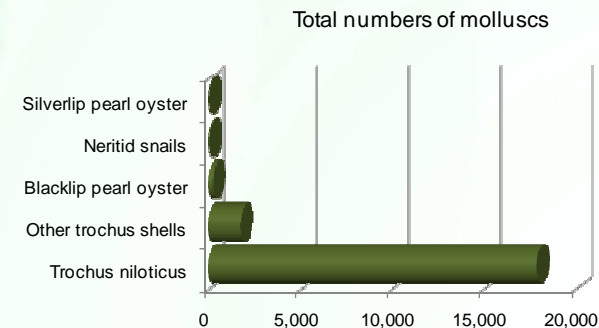
BUYER

MOLLUSCS

Five different types of molluscs were recorded during the survey and 19,903 animals were counted. The most common mollusc sold to buyers was *Trochus niloticus*, which accounted for 89% of all molluscs and contributed nearly 91% of all the payments made to sellers for molluscs during the survey. Other species of trochus shells contributed 8.7% of the molluscs counted and a further 9% to revenue. The remaining 3 species, an intertidal neritid snail (*Neritodryas subsulcata*) used for crafts, and pearl oysters accounted for 1.4% of the numbers of molluscs and <0.3% of the revenue recorded during the survey.

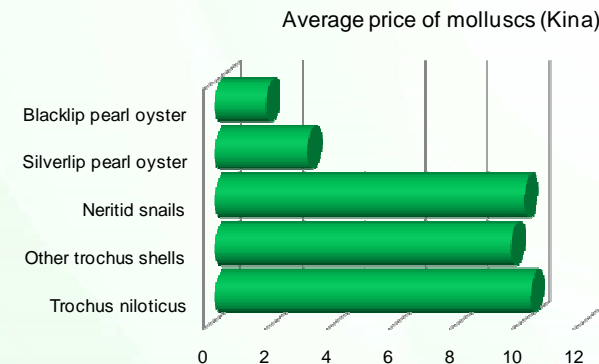
The most valuable molluscs in terms of price were trochus shells and neritid snails, which sold to buyers at around K9 to K10/kg. Pearl oysters sold for much lower values, K1.6 to K3/kg (but there were low numbers of transactions involving these).

Molluscs were sold to buyers over the entire period of the survey with significant fluctuations in the total weight, number, and total kina paid out on a monthly basis. The greatest numbers of molluscs were traded between September and December 2006.

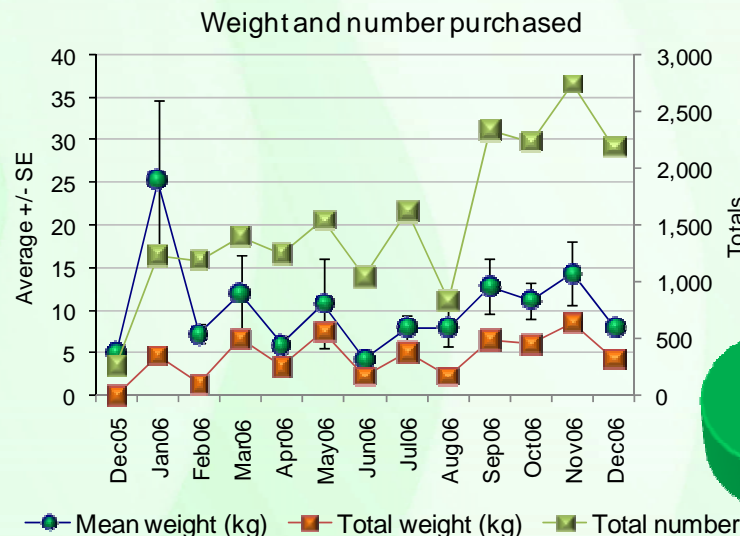
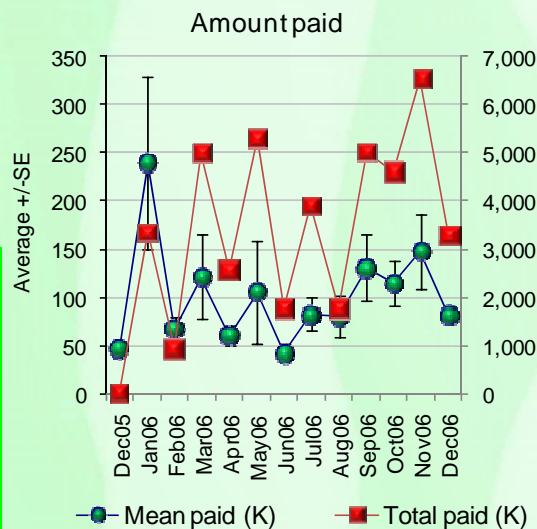
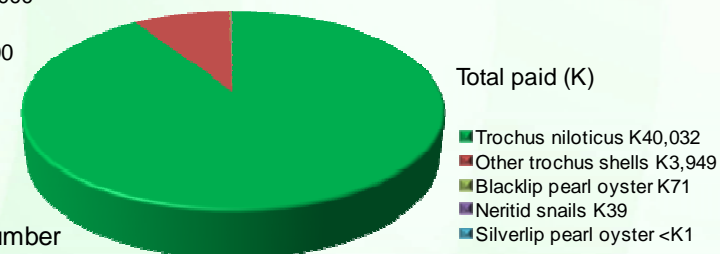


↑ Total number of each species of molluscs recorded during the survey. ↓ Average price for molluscs paid by buyers during the survey.

↙ Breakdown of amounts paid, weights, and mollusc counts per month. Data include averages per transaction and totals (n=434 transactions).



↓ Relative contribution to the economy by different species of molluscs during the survey. Values are total kina paid.

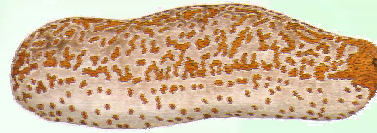


BUYER

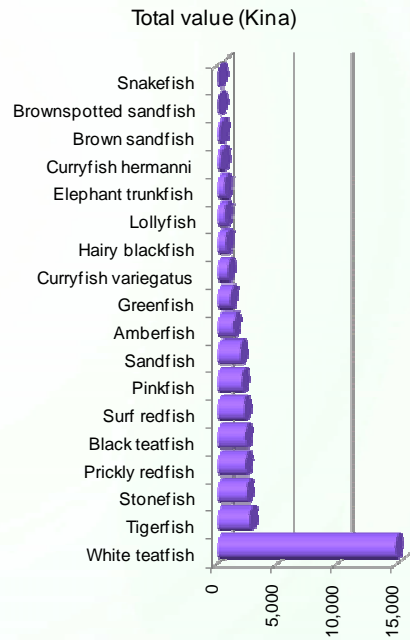
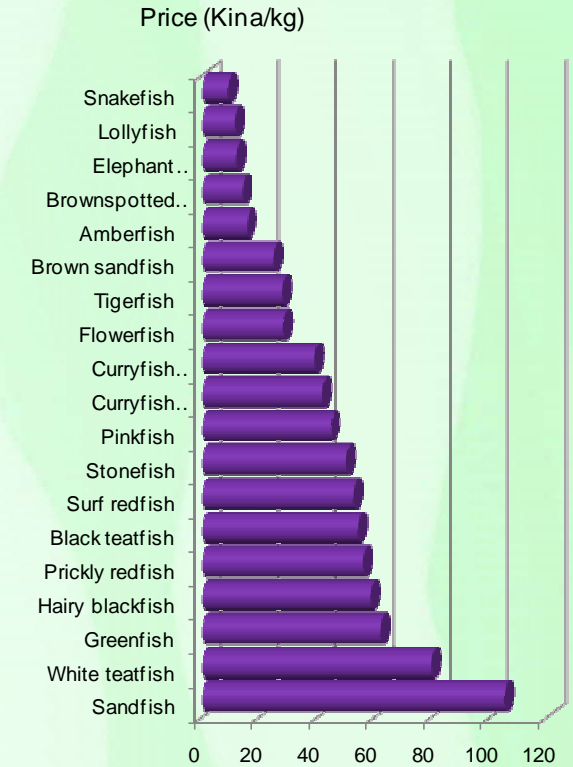
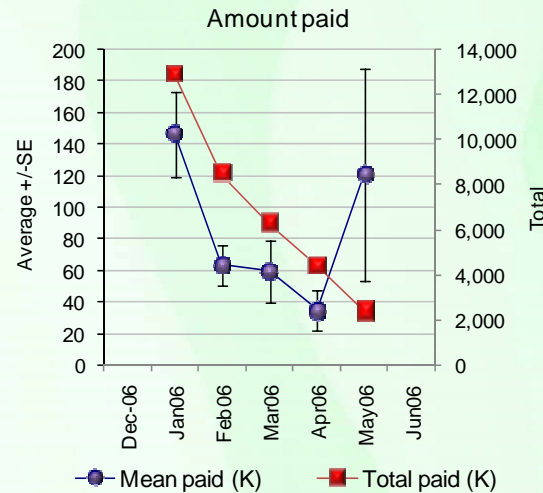
SEA CUCUMBERS

A total of 714 kg of sea cucumbers (dry weight) were recorded over the period December 2005 to December 2006. This included 15,946 individuals sold to buyers in 1,501 transactions. Sea cucumber purchases included at least 19 species from 2 families and 6 genera. Amounts purchased per month varied significantly as a result of closed seasons. Peak numbers and weights were recorded in March 2006.

The most common species recorded (by number) was the lollyfish, which accounted for 18% of all sea cucumbers sold to buyers. This was also the second least valuable species in terms of kina paid per kilogram. White teatfish was the second most abundant species, the second most valuable, and yielded the most in terms of total income from sea cucumbers during the survey.



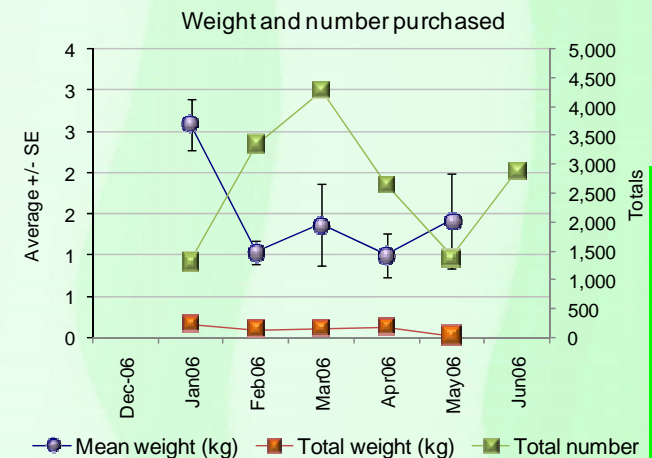
Average price paid per kilogram for species of sea cucumbers.



Total kina amount paid by buyers for species of sea cucumbers during the survey.

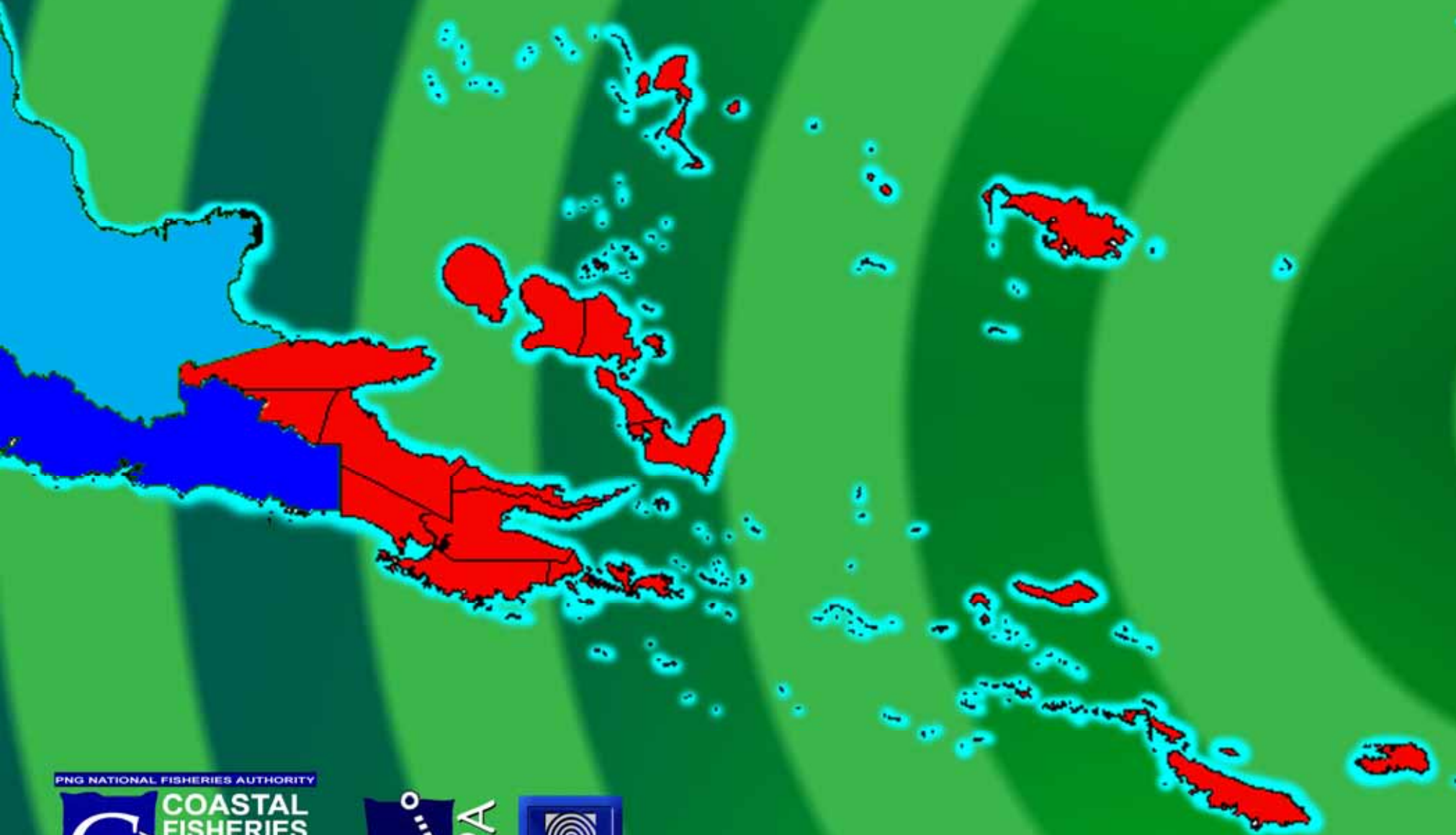
Average and total amounts paid, weight and numbers per month. Number of sea cucumbers purchased by species.

Family	Scientific name	Common name	Total	
Holothuridae	<i>Holothuria atra</i>	Lollyfish	2,897	
	<i>Holothuria fuscogilva</i>	White teatfish	1,745	
	<i>Actinopyga lecanora</i>	Stonefish	1,729	
	<i>Bohadschia argus</i>	Tigerfish	1,196	
	<i>Holothuria scabra</i>	Sandfish	915	
	<i>Holothuria fuscopunctata</i>	Elephant trunkfish	771	
	<i>Bohadschia vitiensis</i>	Brown sandfish	667	
	<i>Bohadschia similis</i>	Brownspeckled sandfish	596	
	<i>Holothuria nobilis</i>	Black teatfish	522	
	<i>Actinopyga mauritiana</i>	Surf redfish	469	
	<i>Holothuria edulis</i>	Pinkfish	408	
	<i>Actinopyga miliaris</i>	Hairy blackfish	179	
	<i>Holothuria coluber</i>	Snakefish	60	
	<i>Pearsonothuria graeffei</i>	Flowerfish	41	
	Stichopodidae	<i>Thelenota anax</i>	Amberfish	1,302
		<i>Stichopus variegatus</i>	Curryfish variegatus	1,166
<i>Thelenota ananas</i>		Prickly redfish	602	
<i>Stichopus chloronotus</i>		Greenfish	495	
<i>Stichopus hermanni</i>		Curryfish hermanni	181	
Total			15,946	



BUYER

NATIONAL FISHERIES AUTHORITY



PNG NATIONAL FISHERIES AUTHORITY



COASTAL FISHERIES
Management and Development Project

ASIAN DEVELOPMENT BANK



GPA



Tautai