Small-scale Fisheries in New Ireland Province: Landing, Market and Buyer Surveys in Kavieng

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Contents

Acronyms & Terms

ADB	Asian Development Bank
CBM	community-based management
CFMDP	Coastal Fisheries Management & Development Project
ENB	East New Britain Province
EU	European Union
FADs	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-government organisation
NIP	New Ireland Province
PNG	Papua New Guinea
NSP	North Solomons Province
SDA	Seventh Day Adventist
UPNG	University of Papua New Guinea
VDC	Village Development Committee
VPC	Village Planning Committee
WDC	Ward Development Committee
WFG	Women's Fellowship Group

INTRODUCTION

Background

The purpose of this report is to present the findings of surveys of small-scale fisheries undertaken in New Ireland Province between May 2004 and May 2005 as part of the National Fisheries Authority's (NFA's) Coastal Fisheries Management and Development Project (CFMDP). This report is part of a series focused on fisheries catches, market sales, buyers and socio-economic surveys designed to characterise small-scale fisheries and to monitor project outcomes in New Ireland (NIP), Morobe (MOR) and Milne Bay (MBP) Provinces of Papua New Guinea.

Characterisation of small-scale fisheries and its role in these three provinces forms a part of the CFMDP being implemented by NFA with loan funding provided from the Asian Development Bank (ADB) (1925 PNG-SF). The overall aim of the CFMDP is to contribute to the reduction of poverty in rural areas through increasing, or preventing a further decline in, the incomes of coastal communities. This will be done by promoting improved management of resources, 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 existing historical data collected by the Provincial Fisheries Office and by buyers under the conditions of their licences obtained through NFA. The data collected and/or collated by the project include:

1. Surveys of marine products landed by small-scale fishers, usually using canoes or banana boats
2. Surveys of deepwater and pelagic fishes landed by small-scale fishers and people involved in the European Union (EU) scheme for purchasing longer-range vessels (the so-called "Ducklings") (The Rural Coastal Fisheries Development Project)
3. Surveys of marine products sold at local markets and their relative importance in relation to other items sold; including direct surveys of marine products purchased by buyers
4. Existing buyer receipts retained by the Provincial Fisheries Office
5. Purchasing data collected and made available to the project by buyers and NFA
6. Household surveys examining socio-economic conditions and contribution of small-scale fisheries undertaken in the northern LLGs of NIP
7. Focus Group and Key Informant surveys undertaken in conjunction with the household surveys.

These surveys and data collections were undertaken to provide basic information on the relative importance of fisheries to the livelihoods of people in NIP. They were also designed 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 to identify threats and opportunities for the future.

Aims of CFMDP Small-scale Fisheries Surveys

These surveys were designed to access information from fishers, seafood sellers in markets around Kavieng, and from commercial buyers to gather information we could use to characterise the small-scale (income-related) 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 Kavieng township by fishers living there or in surrounding areas. This information included some profiling of the fishers, including costs and effort, the general location of fishing grounds and their home village;
- Describe the marine products being sold in Kavieng Main Market and other informal markets in the township. This information included some profiling of sellers, the source of the products, processing and prices for which they are being sold; and
- Obtain information on the activities of buyers, including identification and quantities of marine products they buy, and the prices being paid.

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

Approach and Methods

Design of the study

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 Kavieng town, but the marine products they describe may have been caught as far afield as other provinces (Manus, North Solomon and East New Britain provinces) being brought to New Ireland by buyers.

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

1. Landings of catches brought in to Kavieng either for sale at markets or to buyers by small-scale fishers
2. Marine products offered for sale through local informal markets around Kavieng
3. Purchases of marine products by buyers located in Kavieng.

Survey of fishers landings

A survey of landings of marine products in Kavieng was carried out between May 2004 and May 2005 by a team of enumerators trained by the project. Teams of enumerators were placed on a roster system to ensure they were able to move around Kavieng and intercept fishers as they came to a range of sites around town to land their catch. The survey was focused on intercepting at least 20 boats per month at the fisheries wharf and other commonly-used landing sites for each main target group of: reef fish, deepwater and pelagic fish, lobsters and crabs.

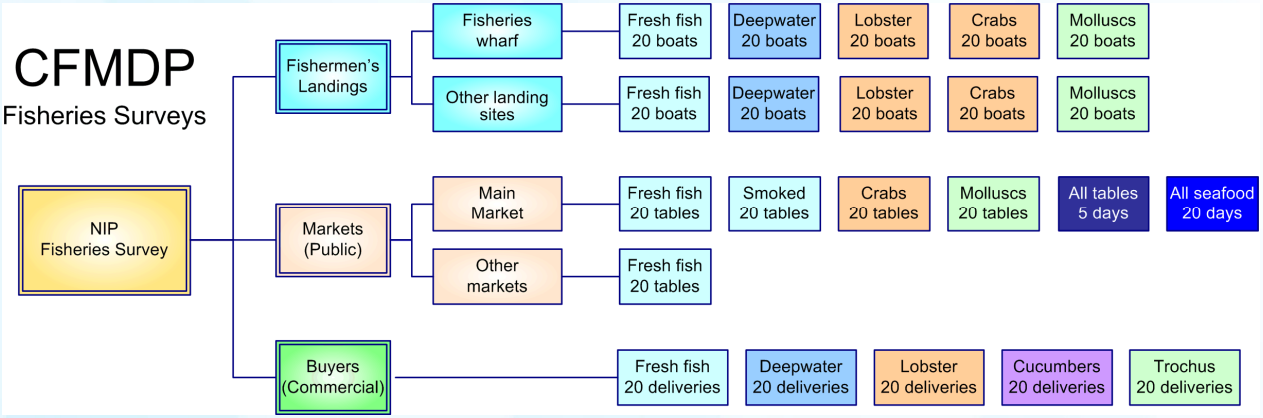
For each boat intercepted, enumerators interviewed the fishers and identified and measured their catch. Information was collected on (1) the location of the landing, (2) name, age, home village of the fisher, (3) the areas fished, (4) the fishing methods used, (5) the effort expended per fishing trip (including the number of fishers in the boat, hours spent fishing etc) and (6) the cost of each trip. All marine products brought in were identified to species level, measured (fork length for fishes, carapace and/or tail length or width for lobsters and crabs, 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 around Kavieng were carried out by the same trained enumerators and included Kavieng Main Market as well as other roadside seafood markets. The survey targeted 3 levels of information:

- Overall information on all sellers' tables at the market (including sellers who were offering goods for sale on mats placed on the ground) to characterise all products being sold and the relative importance of marine products (5 replicate surveys of the entire market per month)
- More detailed information on those tables offering seafoods (20 replicate surveys of the market per month)
- Detail surveys of at least 20 tables per month on which all seafoods were identified, measured and details of sex and reproductive conditions recorded where possible. The sellers themselves were also interviewed.

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



Buyer data

Buyer data were obtained either directly from the buyers themselves, or from receipt records held by the Provincial Fisheries Office in Kavieng. These records contained information on the date of each transaction, the seller and his or her village, the marine product being sold, the weight in kilograms and total payment.

Database

All of the 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.

Weaknesses in the surveys

The landings and markets surveys were undertaken by newly-trained local enumerators who had little experience in undertaking surveys of this type. As a result, the surveys contain errors that would be eliminated with experience. These results should be interpreted with caution, and could be considered a useful pilot survey of seafood landings and markets in Kavieng. The main problems encountered were:

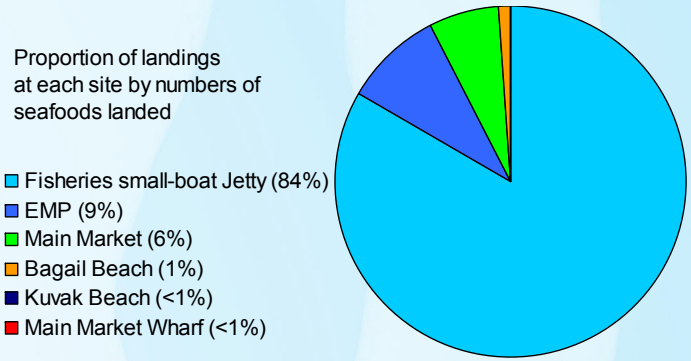
1. Identifications of fishes, crustaceans and molluscs were sometimes suspect. The enumerators we employed included port samplers, observers and fisheries officers, in addition to others. The team was given species identification cards, and repeated training but still appear to have missed some identifications.
2. Enumerators generally failed to collect sex and berry condition data for crustaceans, despite repeated efforts to have them do so.
3. A significant bias was introduced into the fishers' landings data through unequal effort of sampling through months. In the period October 2004-mid January 2005 several untrained enumerators were employed on the project, resulting in greater numbers of samples being taken at lower quality. This problem affects the landings data much more than the market sampling which was mostly done by the same people throughout the survey.
4. The buyer data were discontinuous and incomplete. They spanned a period of 56 months between February 2001 and September 2005 (inclusive), but within that time frame provided data for only between 19 and 33 months (depending on the target seafood species). The inconsistency of data collection meant that interpretation of the results was difficult and trends in buying hard to identify. These results should be used with caution.

Analysis of Fishers' Landings

General information

Where were marine products landed?

Fish and other marine products were landed at a minimum of 5 main landing sites around Kavieng between May 2004 and May 2005. Landings would have occurred elsewhere, particularly where fishers landed at their own or relatives' houses, but these landings were not captured in this survey. Enumerators intercepted the most landings (84%) at the small-boat jetty adjacent to the Provincial Fisheries Office, where people sell directly to a buyer. Fuel and ice are also available at the small boat jetty. About 9% of the landings were measured at the site of one of the buyers (Emirau Marine Products, EMP), which makes them strictly "buyer samples" and so were not included in this survey. In those cases, landings made at sites on the Kavieng waterfront were quickly collected by the buyer and transferred to the buyer's premises. The enumerators were required to make their measurements at that site, rather than at the original landing site. Most such samples were landed either at Kuvak Beach or at the Fisheries small-boat jetty. Around 6% of the landings were made at Kavieng Main Market, and only very small numbers at other sites in Kavieng.



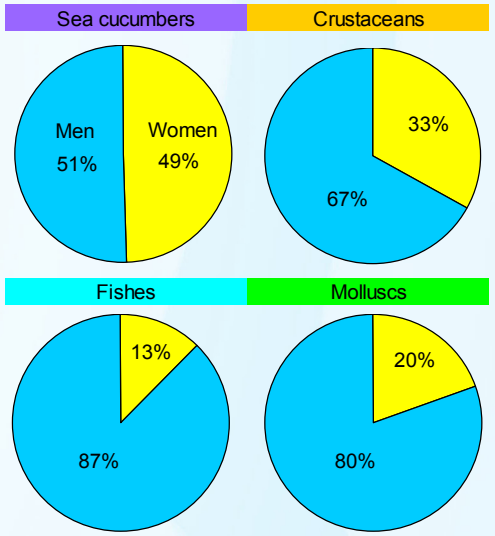
↗ proportion of landings at different locations around Kavieng during the survey. Percentages are calculated on the total number of marine animals landed and recorded over the survey (n=51,634).

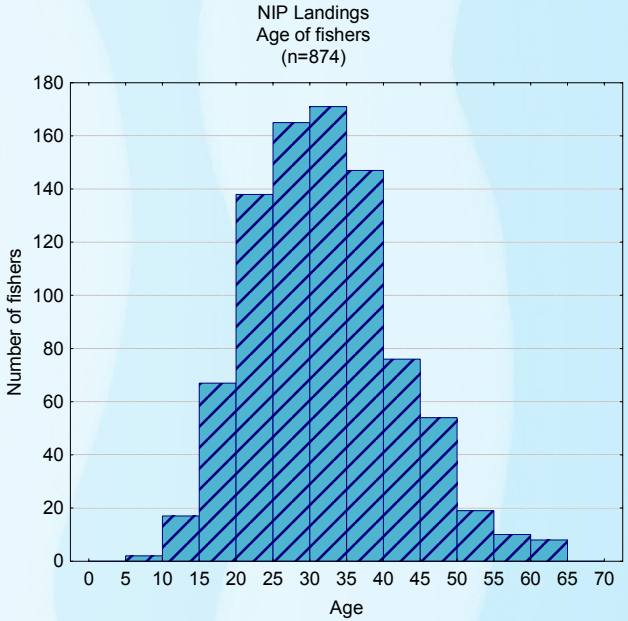
Who are the fishers?

The enumerators carried out a total of 1,813 interviews of fishers over the period of the survey, reaching approximately 953 fishers who landed marine products and were interviewed as part of this survey.

The average age of the fishers was 33 years, but ranged between 10 and 64 years of age. The most common age for fishers was between 25 and 35, with numbers tapering off at younger and older ages. Overall, most of the fishers we interviewed were men (86%) and the proportion of women and men varied with the type of marine product being landed. There was a relatively even gender balance among people who landed sea cucumbers. The proportions of people landing crustaceans were 1/3 female and 2/3 male, while men dominated landings of fishes and molluscs.

↓ Proportion of women and men involved in landings of the 4 main groups of marine products in Kavieng during the survey.





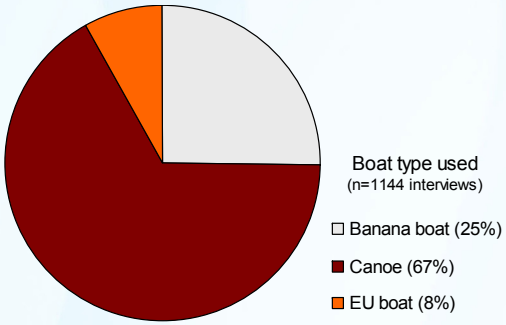
↑ Age distribution of fishers interviewed during the landings survey (n=874 fishers who provided their age).

What gears and effort are used?

Most of the fishers surveyed during this study were interviewed only once over the period of the survey. The maximum number of times we interviewed a single fisher was 31, who was one of the people who signed-up to the European Union Coastal Fisheries Project and obtained a vessel. Overall it appears that people's involvement in fishing as seen from the landing data has a high turnover, with few dedicated fishers and broad involvement by a large number of people who may not specialise in fishing.

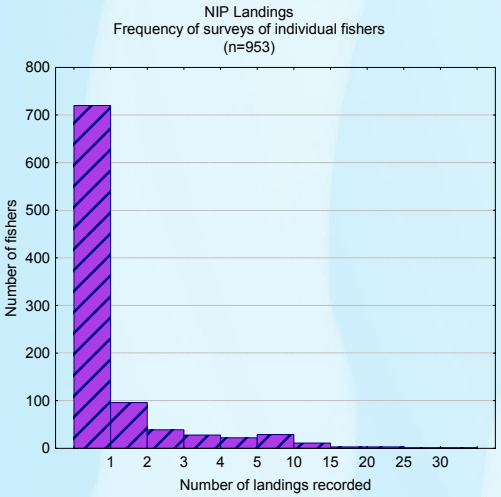
The most common boats used for landing seafoods in Kavieng were canoes (67%), followed by banana boats (25%). The European Union Coastal Fisheries Project boats ("EU boats") were recorded in only 8% of samples (these are a modification on the banana boat hull with inboard diesel engine, a small cabin and 1 tonne of ice storage capacity).

In terms of effort, fishers spent the most hours and fuel fishing on EU boats. This included separately recorded fuel used for fishing and for steaming to and from the fishing grounds. The raw returns for fishing in terms of the number of fish (or other seafoods) caught per hour or litre of fuel used was superficially the best for people using canoes. These results do not, however, take into account the total weight of fishes caught and it is likely that the returns from EU boats would in reality be better than shown here because they target larger and higher value fishes (deepwater snappers and tunas). By raw numbers, it appears that people using canoes are catching fishes more economically and efficiently than those using banana boats.



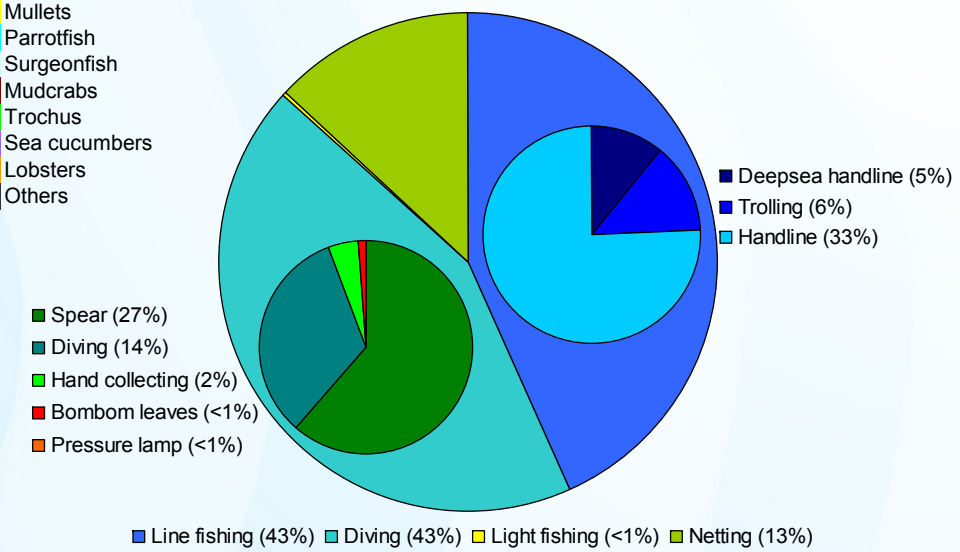
← Boat types recorded with landed seafoods. Note that 36% of interviews were not accompanied by boat information. Percentages are relative proportions among samples that had boat information (n=1,144).

↓ The number of times that individual fishers were interviewed during the survey (n=953 unique fishers' names).



↑ Main species caught using selected fishing methods.

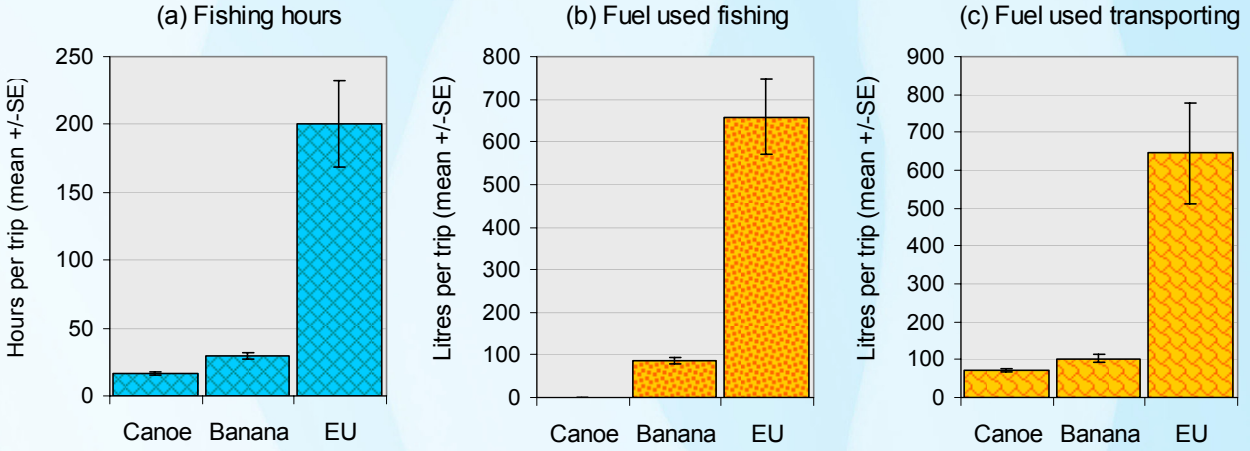
→ Summary and breakdown of fishing methods reported by fishers landing in Kavieng (n=13,144 methods recorded over 1,813 interviews). Percentages given for all pie charts are overall percentages of each method.



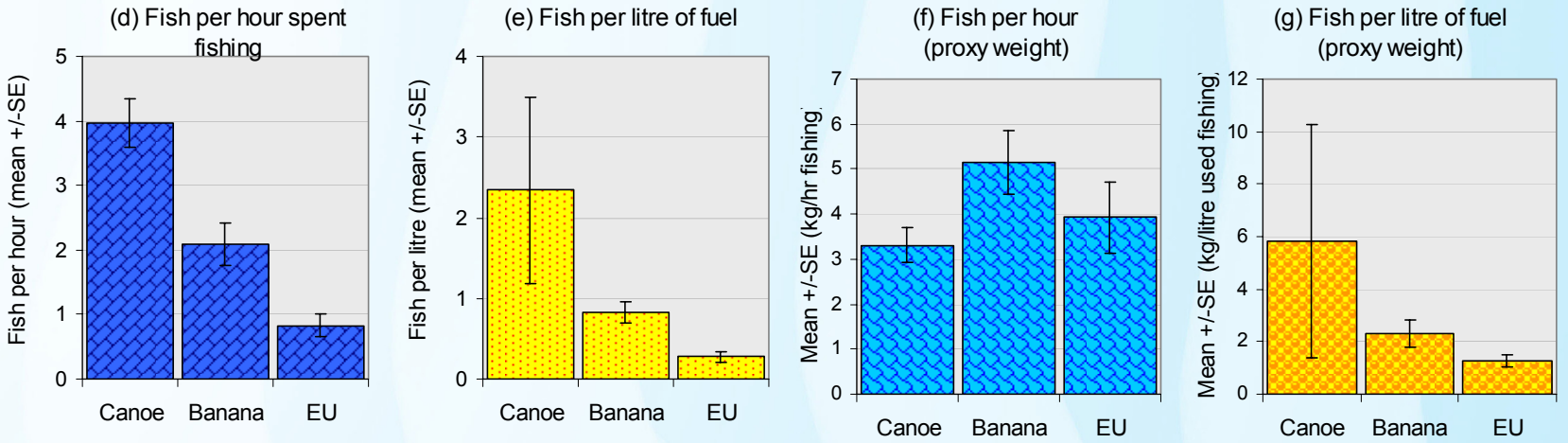
We calculated a measure of weight from the length data collected during the survey to re-examine the relationship between boats, time and fuel used and returns. Proxy weight here is calculated as the cubed fork length multiplied by 2.5% to produce an estimate of weight in kilograms. In terms of proxy weight, canoes, banana boats and EU boats return approximately the same weight of fishes per hour spent fishing (errors are overlapping). The EU boats may be returning lower weights of fish per litre of fuel used.

The most common fishing methods used by fishers were forms of line fishing and diving. Line fishing included deepsea handlining for deepwater snappers, trolling and handlining for reef fishes. Diving included spearfishing (27%) in addition to hand collecting for sea cucumbers, trochus and lobsters.

Gillnets were used in 13% of landings recorded, and two forms of light fishing accounted for around 1% of samples. One of these, termed "bombom" refers to the use of rolled coconut fronts which are burned and used as lights for spearing or hand collecting at night. The main species targeted are fishes, lobsters and shellfish. A small number of fishers reported using pressure lanterns in place of bombom.



↑↓ Comparison of fishing effort and returns for each of the boat types used by fishers landing their catches in Kavieng. The top three graphs (a) to (c) show relative use of resources for fishing, and the bottom graphs (d) to (g) the relative returns in numbers of fish 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. Although there appears to be little difference between the species caught by canoes and banana boats, the EU boats do target larger and more valuable fish (deepwater snappers and pelagic species). In graphs (f) and (g) we calculated a proxy for the weight of fish caught by cubing the fork length and multiplying by 2.5%. This gave a rough approximation for weight caught as "proxy weight" in kilograms. These data should be interpreted with caution. (n>1700 but varies slightly for each graph).



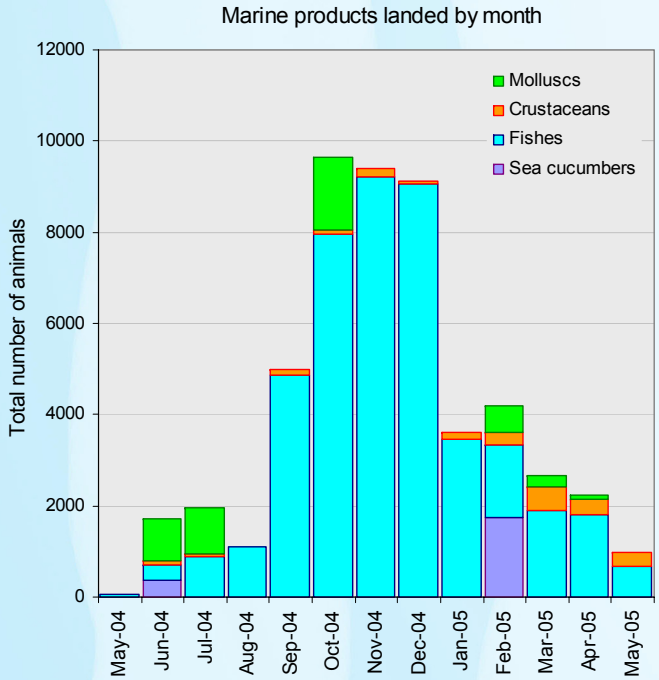
THE CATCHES: ALL GROUPS

A total of 51,634 marine products were landed during the 13-month survey from May 2004 to May 2005. This number included 2,111 sea cucumbers, nearly 43,000 fishes, 2,081 crustaceans and 4,473 molluscs. The total number of species recorded over the survey was around 390.

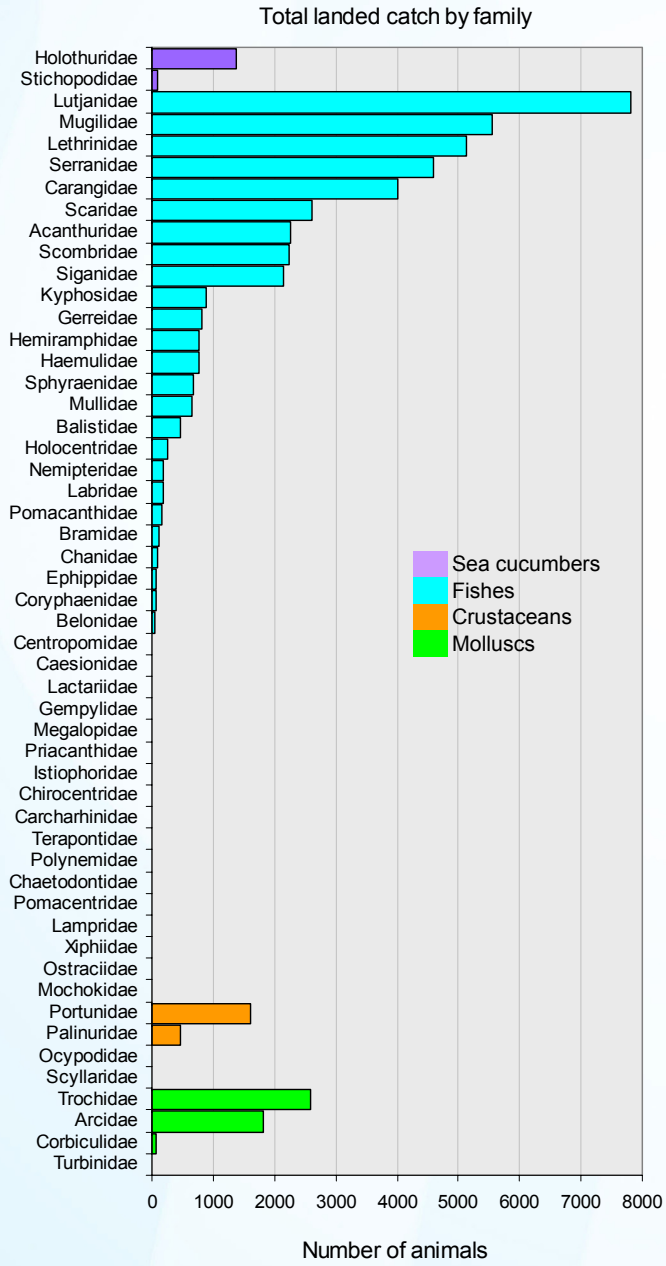
Landings were greatest during the period October to December 2004, and lowest in the period May to August 2004. These results are largely related to the sampling effort expended in the form of the number of enumerators and boats met, and suggest that a greater sampling effort may be required to characterise these fisheries. The data presented in this report on landings give a preliminary characterisation of the types of organisms landed, and the effort and information on the fishers but is insufficient for calculating total catches. Most of the fishers involved (76%) only appeared once in the survey, with very low numbers (5%) appearing more than 5 times, pointing to a truly subsistence, multi-species fishery.

Group	Total number
Sea cucumbers	2,111
Fishes	42,969
Crustaceans	2,081
Molluscs	4,473

Totals of marine products landed per month (n=51,634).



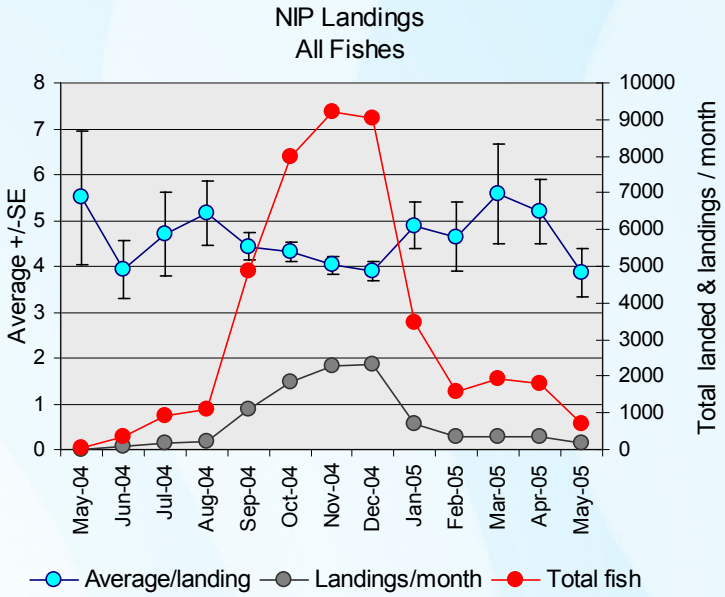
Most of the marine products landed were fin fishes, with only small numbers of molluscs, sea cucumbers and crustaceans. The most common groups of fishes landed were snappers (including deepwater and reef species), mullets, emperors, groupers and trevallies. Most of the molluscs landed were trochus shells destined for buyers and cockles (*Anadara* spp.) often sold at the local market. Most of the crustaceans landed were mudcrabs and lobsters.



Total landed catch of marine products broken down into families for each group.

Fishes

A total of 42,955 fin fishes from 42 families comprising over 259 species were measured between May 2004 and May 2005 during the survey of fish landings in Kavieng. The large number of species involved in the fishery is typical of a tropical multi-species fishery. Although the number of fishes landed per day did not vary greatly, the number of each individual species tended to be small and varied significantly throughout the survey.



The average number of fishes landed by individual boats was small. The overall average was 4.3 fishes landed per boat, and ranged between 1 and 346. The average number of fishes landed remained relatively steady over the period of the survey. In contrast, the total number of fishes landed and total number of boats intercepted was significantly higher in the period October to December 2004. The average number of landings intercepted per month during the survey was 116 boats, ranging up to 370 during December 2004. The average number of fishes landed per month was 3,305 and ranged between 55 and 9,225, with the greatest number of fishes landed during November 2004.

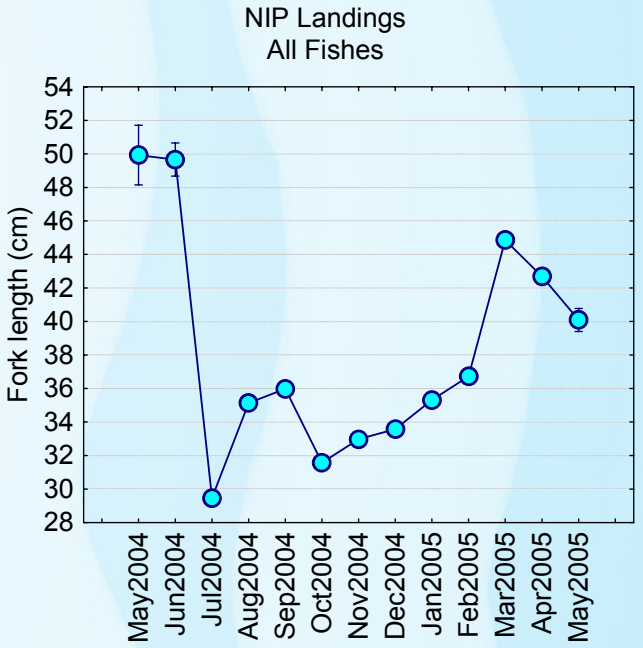
This result is largely due to an increase in sampling effort at that time and probably does not reflect and overall increase in catches or landings, particularly given the results of the socio-economic survey, which suggests that people prefer to fish less during the north-west monsoon (October-April). At that time, the number of enumerators was increased and extra sampling effort expended. These results suggest that a greater sampling effort may be required to characterise these fisheries, particularly because most fishers appear only once in our samples and there are few dedicated 'fishermen' in the population. It is likely that a large part of the population participates in fishing and collecting but only some of the time.

↑ Average number of fishes per landing, number of landings per month of the survey and total number of animals landed for all fishes (n=1503 landings involving fishes).

➔ Average size of fishes landed by month during the survey. Data are means +/-SE.

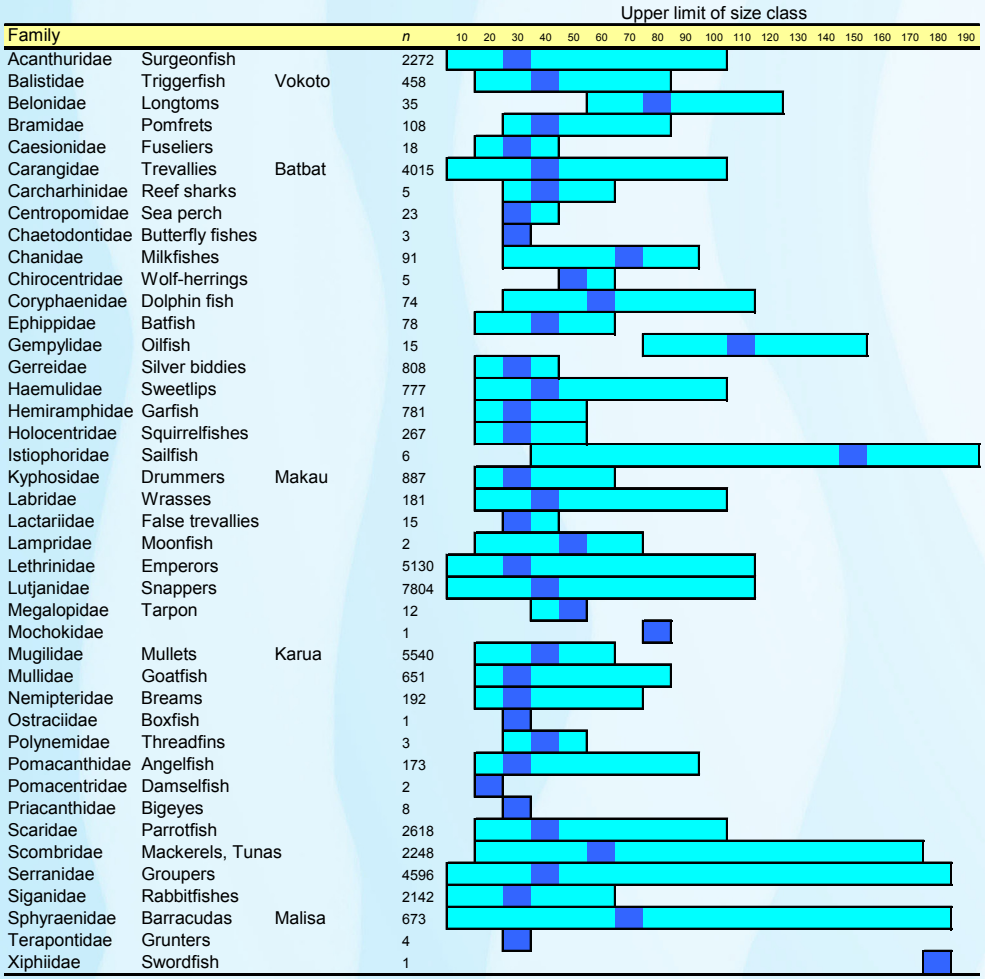
The overall mean size of fishes was just under 35 cm (fork length), with the median at 30 cm (that is, half of the fish were 30cm or less). The minimum size of fishes measured was 3 cm and ranged up to 184 cm. The families contributing the largest fish to those landed were the oilfishes, sailfishes, tunas, groupers, barracudas and swordfishes (see next page).

The average size of fishes landed was greatest in May-June 2004 (around 50 cm) and dropped to between 32 and 36 cm between July 2004 and February 2005. This result is likely to be related to uneven sampling of fishers in the early part of the survey (focused on deep-sea snappers). In later parts of the survey, the surveyors began to include landings from the new EU boats which focus on pelagic and deepwater species.

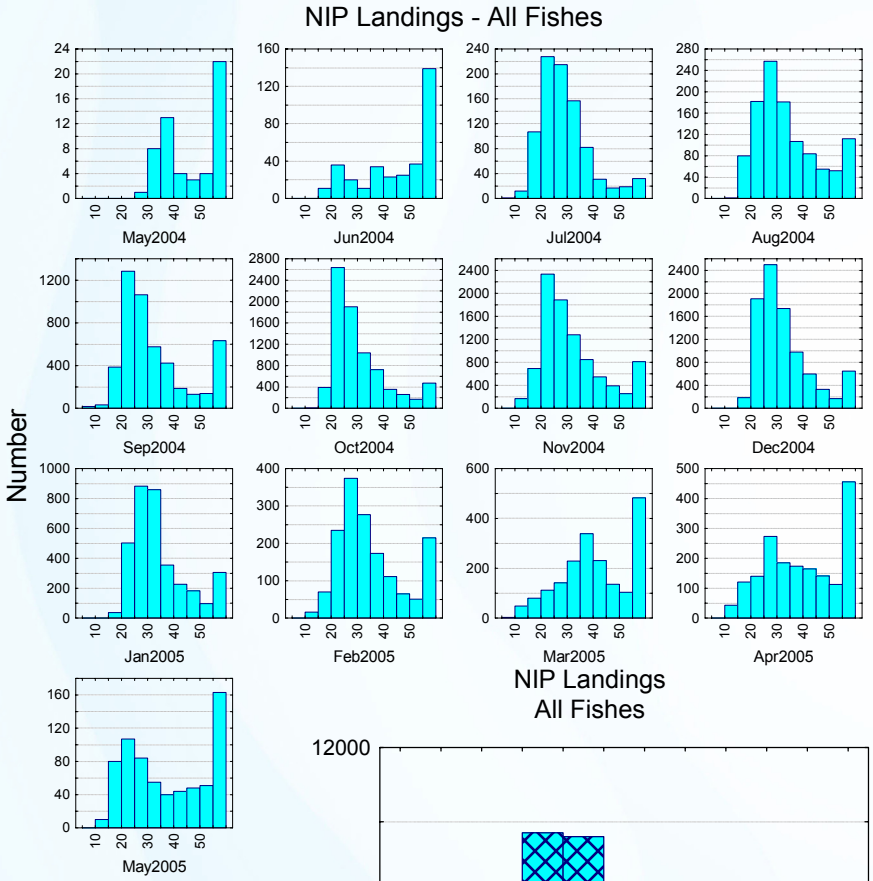


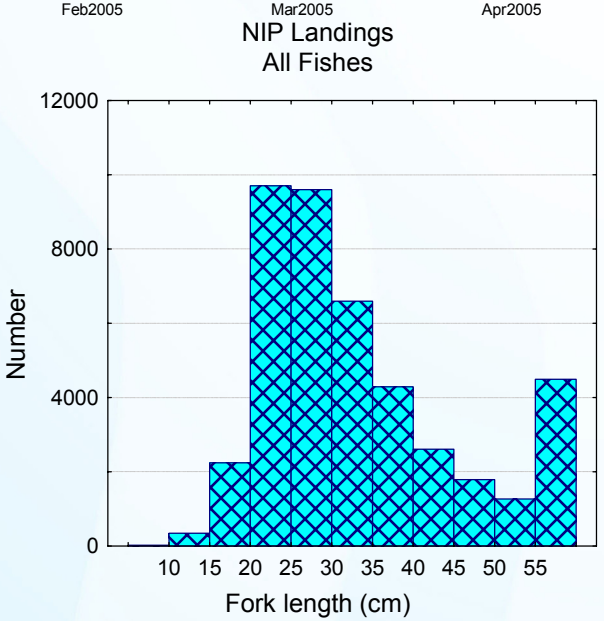
The mean and maximum sizes of fishes landed (shown below) usually included individuals of up to the largest size ranges recorded for species. This result suggests that for most species of fishes, there is little evidence of growth overfishing and that there are likely to be good numbers of reproductive individuals in many populations.

🡻 Summary of size ranges and average sizes recorded across all landings in each family. Light blue bars show range and darker squares the overall averages, n= the total number of fish sampled in each family.



Family			n
Acanthuridae	Surgeonfish		2272
Balistidae	Triggerfish	Vokoto	458
Belonidae	Longtoms		35
Bramidae	Pomfrets		108
Caesionidae	Fuseliers		18
Carangidae	Trevallies	Batbat	4015
Carcharhinidae	Reef sharks		5
Centropomidae	Sea perch		23
Chaetodontidae	Butterfly fishes		3
Chanidae	Milkfishes		91
Chirocentridae	Wolf-herrings		5
Coryphaenidae	Dolphin fish		74
Ephippidae	Batfish		78
Gempylidae	Oilfish		15
Gerreidae	Silver biddies		808
Haemulidae	Sweetlips		777
Hemiramphidae	Garfish		781
Holocentridae	Squirrelfishes		267
Istiophoridae	Sailfish		6
Kyphosidae	Drummers	Makau	887
Labridae	Wrasses		181
Lactariidae	False trevallies		15
Lampridae	Moonfish		2
Lethrinidae	Emperors		5130
Lutjanidae	Snappers		7804
Megalopidae	Tarpon		12
Mochokidae			1
Mugilidae	Mullets	Karua	5540
Mullidae	Goatfish		651
Nemipteridae	Breams		192
Ostraciidae	Boxfish		1
Polynemidae	Threadfins		3
Pomacanthidae	Angelfish		173
Pomacentridae	Damselfish		2
Priacanthidae	Bigeyes		8
Scaridae	Parrotfish		2618
Scombridae	Mackerels, Tunas		2248
Serranidae	Groupers		4596
Siganidae	Rabbitfishes		2142
Sphyraenidae	Barracudas	Malisa	673
Terapontidae	Grunters		4
Xiphiidae	Swordfish		1



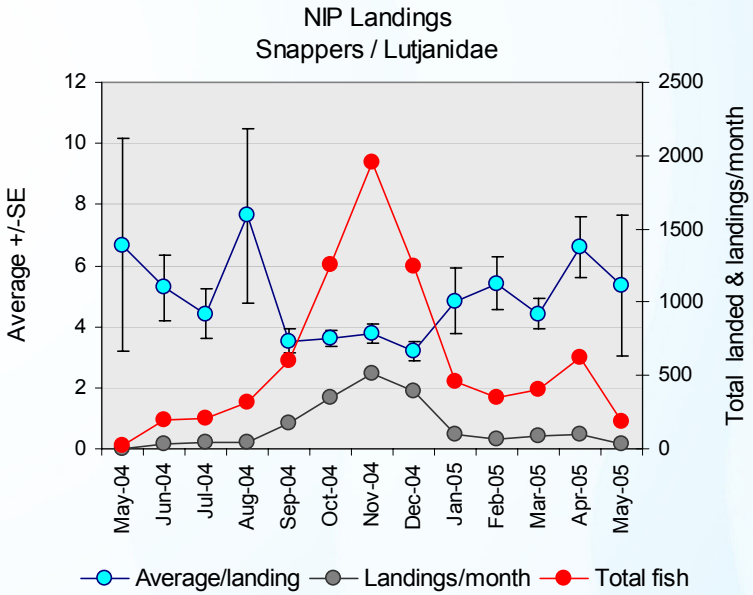


Size distribution of all fin fishes landed during the survey. 🡹 The size distribution of fishes sampled each month, and 🡺 Sizes overall. For this and all following size distribution graphs, the x-axis shows size groupings and the y-axis the number landed in a grouping.

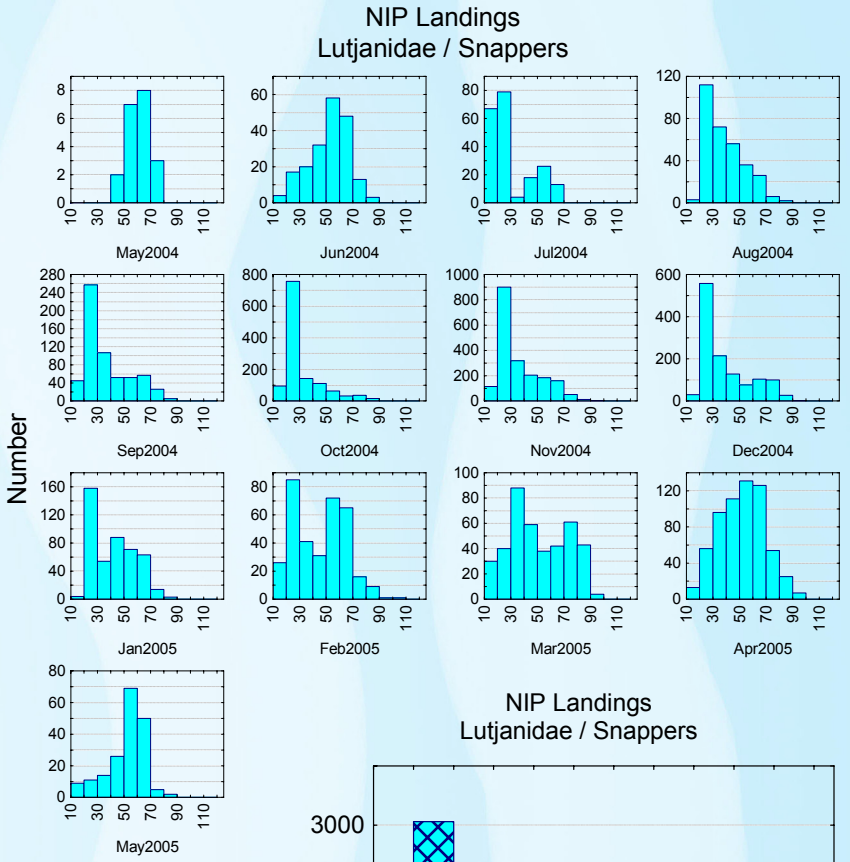
Fishes > Lutjanidae / Snappers

Snappers were the most common group of fishes recorded in the fish landings during the survey, accounting for 15% of all marine products landed, and 18% of all fishes. This included snappers of 9 genera and more than 40 species, and a total of 7,804 animals recorded during the survey. The average number of snappers landed per boat was 4 fishes, and ranged up to 8 fishes per landed catch. Over the survey period, the number of landings per month that included snappers ranged between 3 and 518. The maximum number of snappers landed in a month (1,954) was during November 2004.

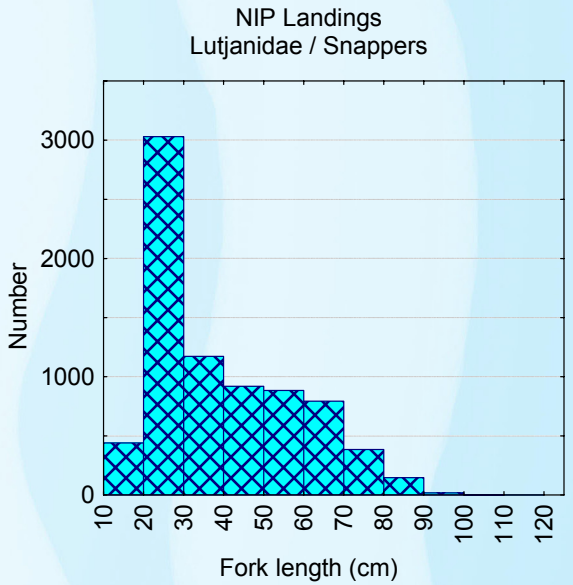
The average size of all snappers landed was 39.5 cm and varied between 8 and 104 cm fork length. More than 3,000 of the snappers landed were between 20 and 30cm long. In some months during the survey, the snappers landed were within a narrow size and species range (e.g. May 2004), while in others they ranged broadly (e.g. February-April 2005).



➔ Average number of snappers per landing, number of landings per month of the survey and total number of snappers landed over the survey (n=1,813 landings).



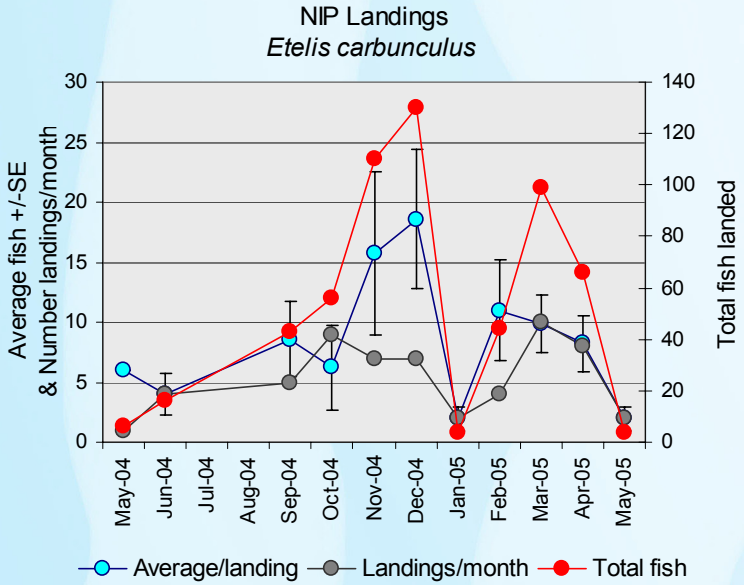
➔ Size distribution of Lutjanidae (snappers) landed during the survey, and ↗ broken down by sampling month (n=7,798).



Fishes > Lutjanidae > *Etelis carbunculus* / Deepwater red snapper

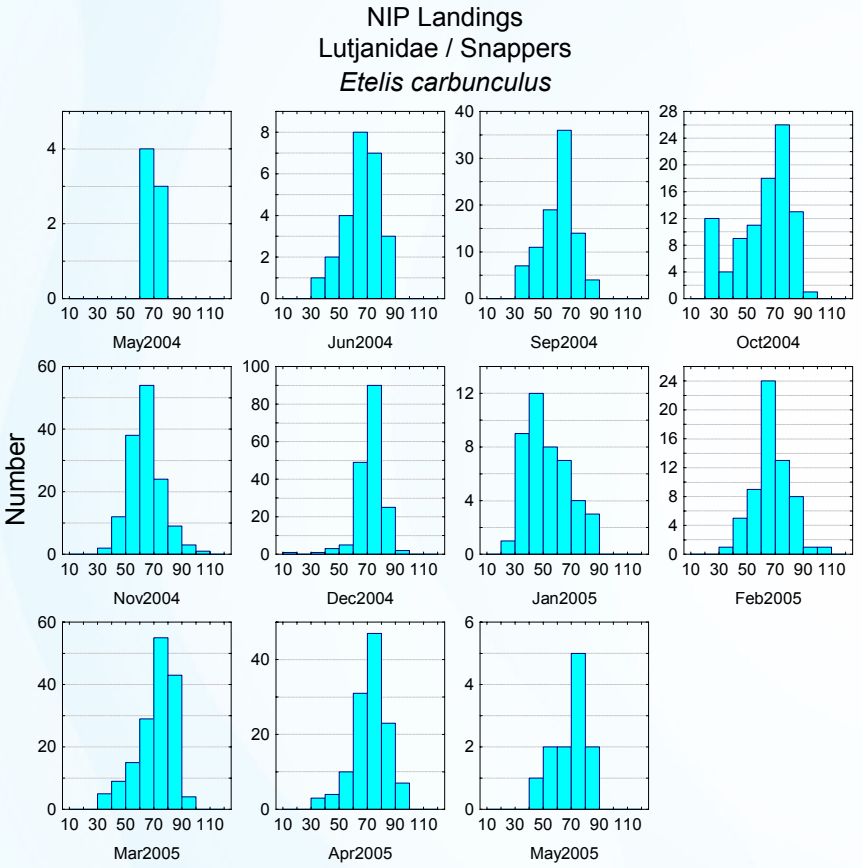
A total of 578 deepwater red snappers were recorded during the survey. Most of these were landed in the period November and December 2004 and during March 2005. The average number landed per month overall was around 52 fish, with an average of 10 fish per landing overall. The average number of fish of this species per landing did change through the survey. Although the variance was high, there were more deepwater red snapper per landing in November and December 2004 and in February 2005 than at other times during the survey. The maximum number of fish landed in a month was during December 2004 at 130 fish. Very few fish of this species were landed during January and May 2005.

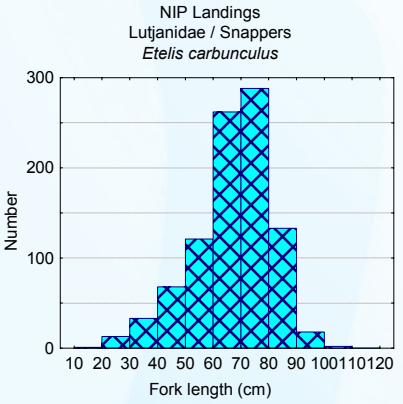
The mean size of *Etelis carbunculus* landed was 67 cm, and ranged between 19 and 104 cm during the survey. A wide range of sizes of this species tended to be landed in every month, with the most common sizes falling between 60 and 80 cm fork length overall.

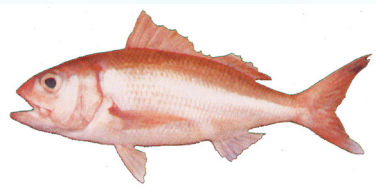


➘ Size distribution of *Etelis carbunculus* (Deepwater red snapper) landed during the survey, and ➚ broken down by sampling month (n=939).

🡐 Average number of deepwater red snappers per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).



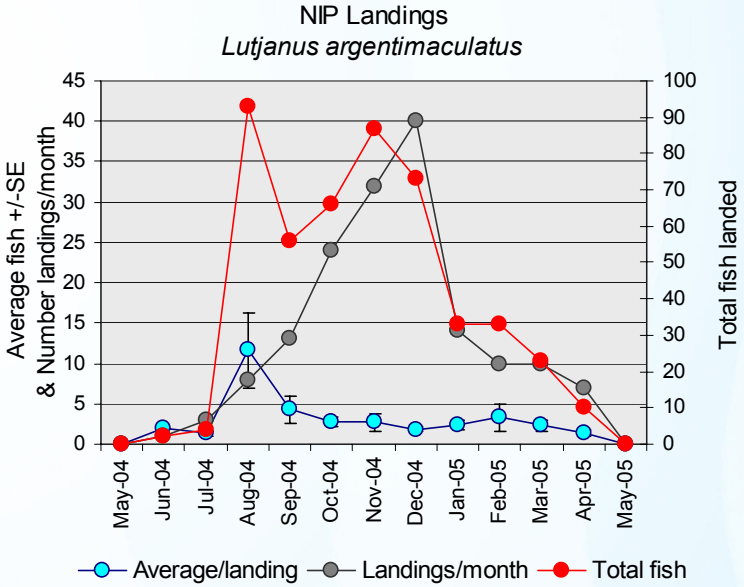




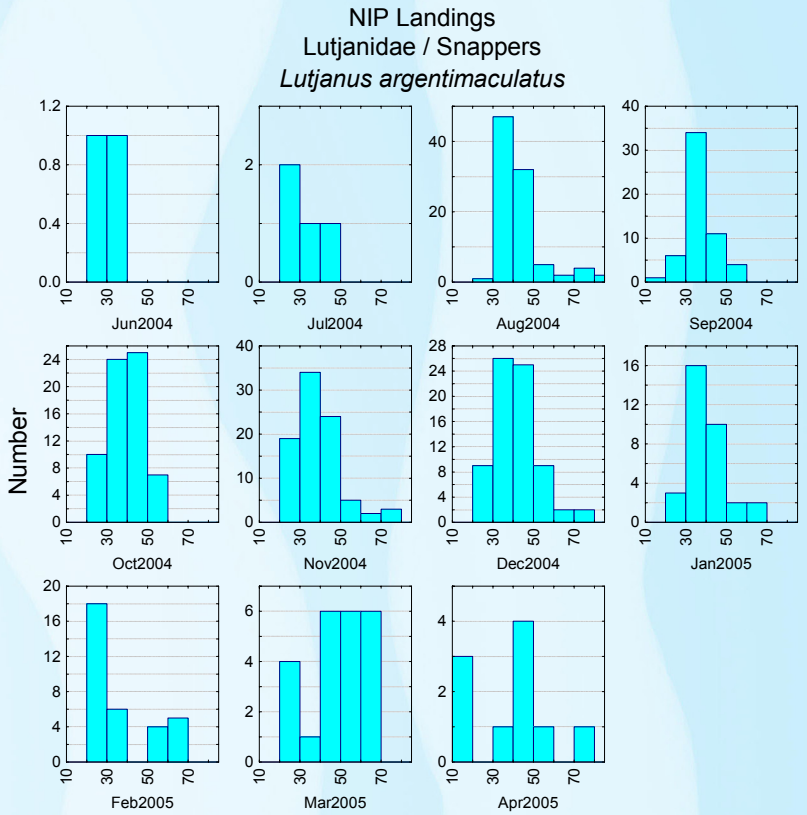
Fishes > Lutjanidae > *Lutjanus argentimaculatus* / Mangrove jack

Overall, 480 mangrove jack were recorded during the survey, with an average of 3 fish per landed catch, and ranging between 1 and 34 fish per boat. The most landings that included this species were made in December 2004, but the most landings in a month were made in August 2004, with 93 fish landed.

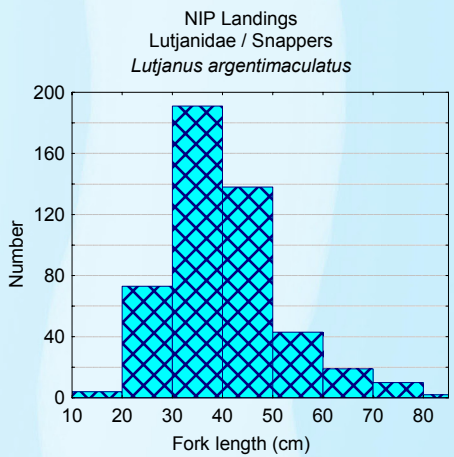
The average recorded size of *Lutjanus argentimaculatus was* 40 cm, but ranged between 15 and 81 cm fork length. The largest fish were captured in August 2004.



← Average number of mangrove jack per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).



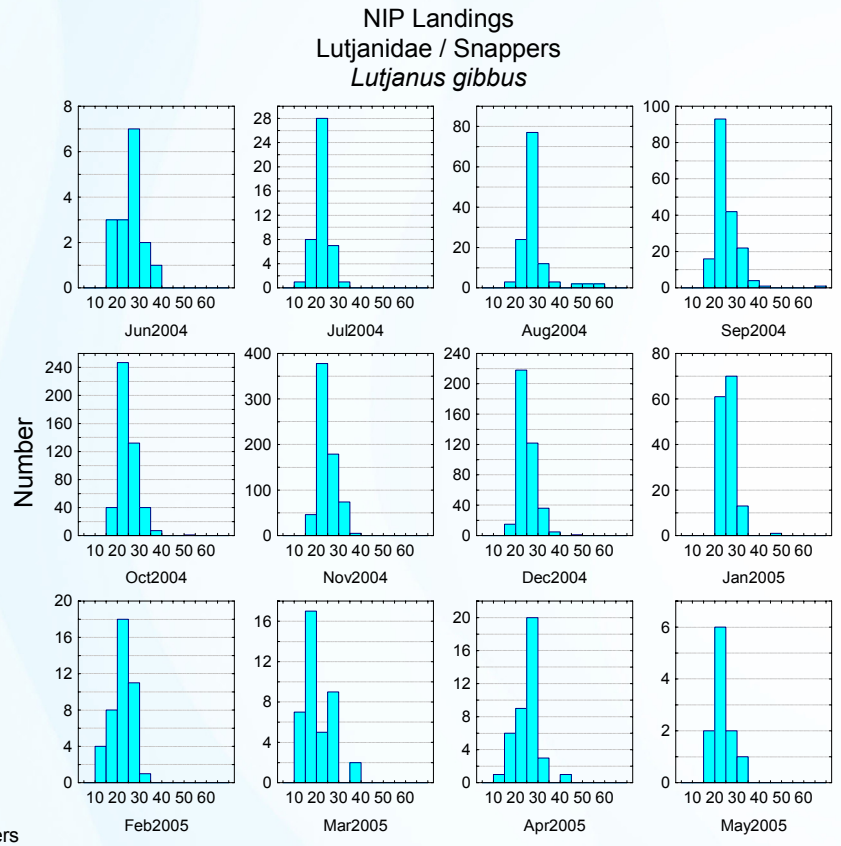
➔ Size distribution of *Lutjanus argentimaculatus* (mangrove jack) landed during the survey, and ↑ broken down by sampling month (n=480).



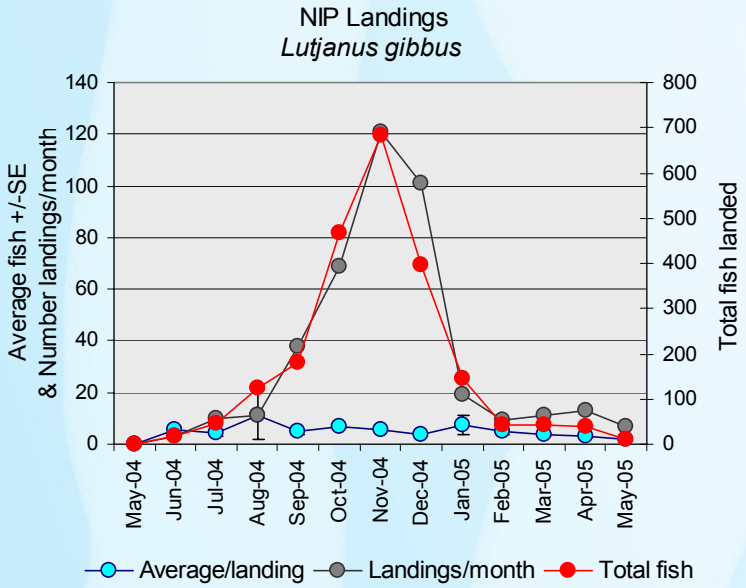
Fishes > Lutjanidae > *Lutjanus gibbus* / Paddletail snapper

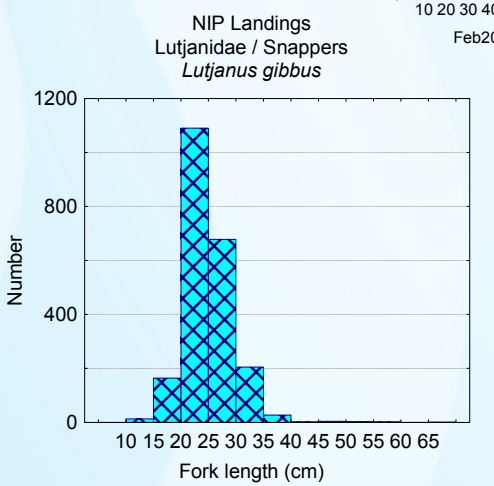
A total of 2,190 paddletail snappers were recorded during the survey, with an average of around 5 fish landed per boat and 412 per month. The maximum number recorded in any one landing was 107 fish. Most paddletail snappers were landed during December 2004, corresponding with a greater number of boats intercepted during that month that included them. The average number landed per catch did not however vary significantly during the survey.

The average size of *Lutjanus gibbus* landed was 25 cm, and ranged between 12 and 82 cm fork length. Most fishes caught were between 20 and 30 cm in length throughout the survey, except during March 2005 when the landings tended to be of smaller fish.



↓ Average number of paddletail snappers per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).



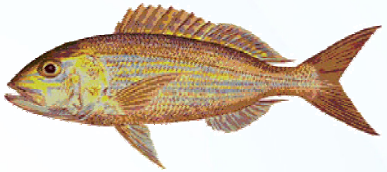


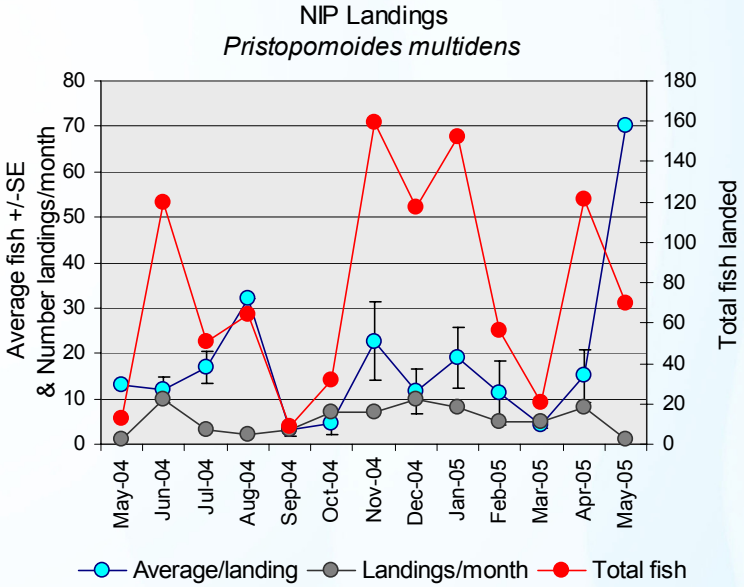
← Size distribution of *Lutjanus gibbus* (paddletail snapper) landed during the survey, and ↑ broken down by sampling month (n=2,190).

Fishes > Lutjanidae > *Pristopomoides multidens* / Gold-banded jobfish

Gold-banded jobfish were recorded in only 4% of landings (70) during the survey, yielding a total of 985 fish. The catch of this species was highly variable throughout the survey, with an average of only 5 landings per month including this species. The average number of fish per landing was 14 overall, but ranged up to 70 fish in a single boat load.

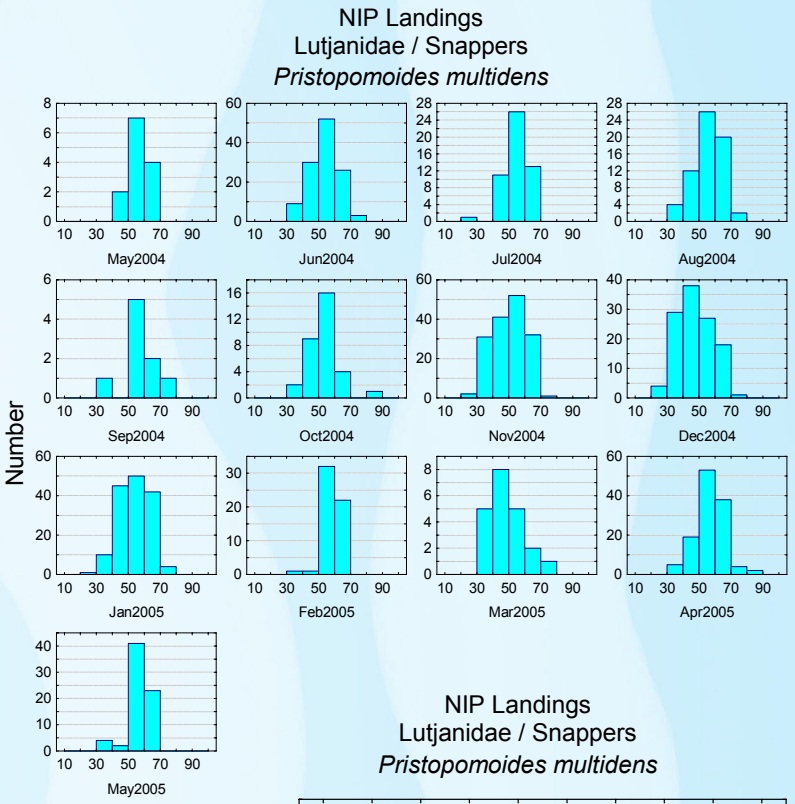
The average length of *Pristopomoides multidens* landed was 53.7 cm, and ranged between 21 and 87 cm. Most fish were between 50 and 60 cm, with a few smaller and much larger fish landed in most months.

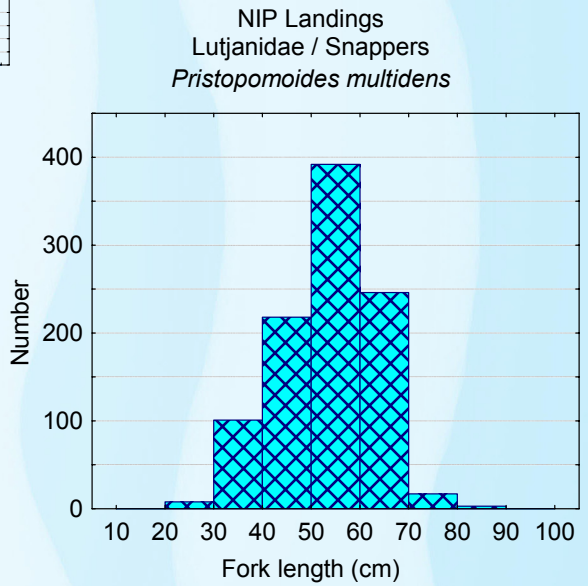




← Average number of gold-banded jobfish per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

➔ Size distribution of *Pristopomoides multidens* (gold-banded jobfish) landed during the survey, and ↗ broken down by sampling month (n=985).



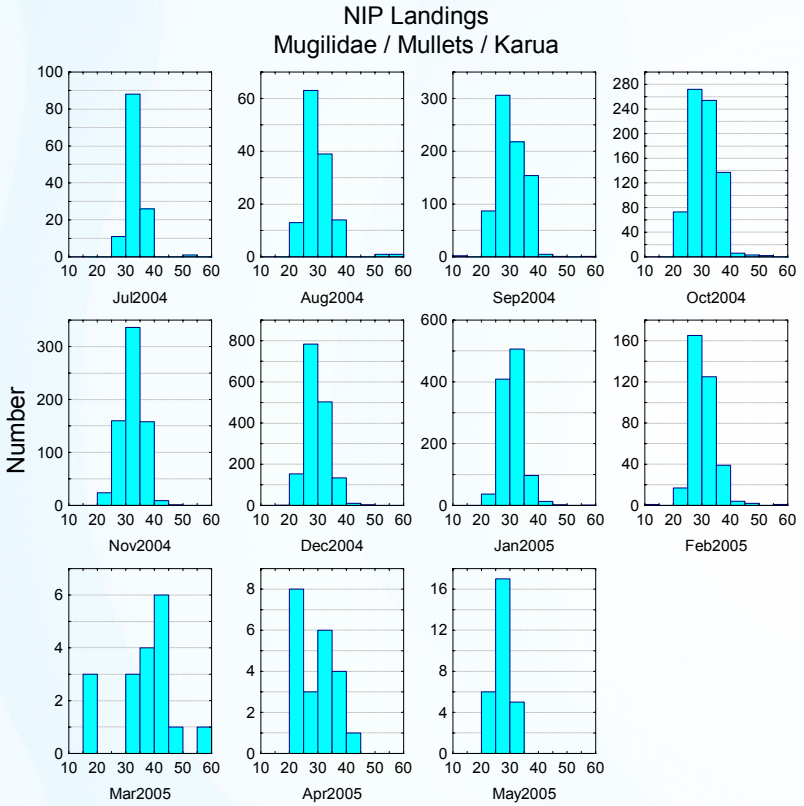


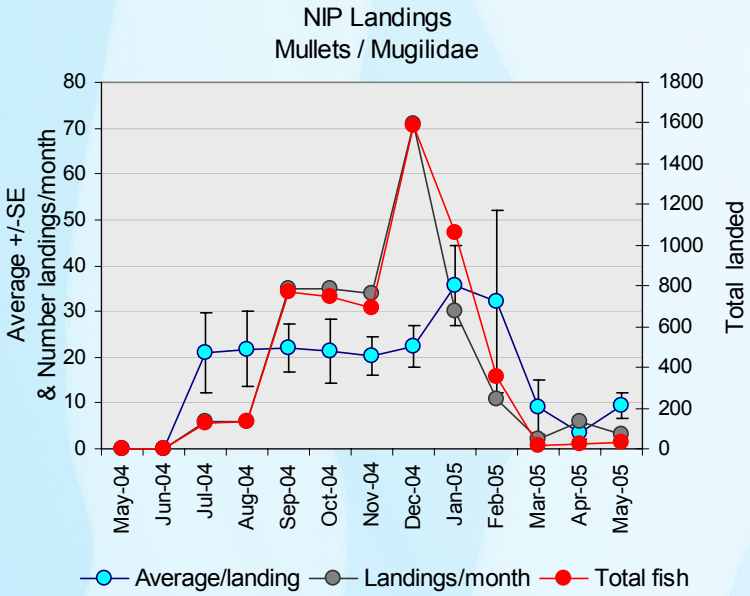
Fishes > Mugilidae / Mullets / Karua

Mullets were the second most important family of fishes in terms of numbers recorded during the survey of landings in Kavieng, with 5,540 fishes identified and measured. Mullets of 5 genera and 8 species were recorded, comprising 13% of all fishes and 11% of the total catch of all marine products during the survey.

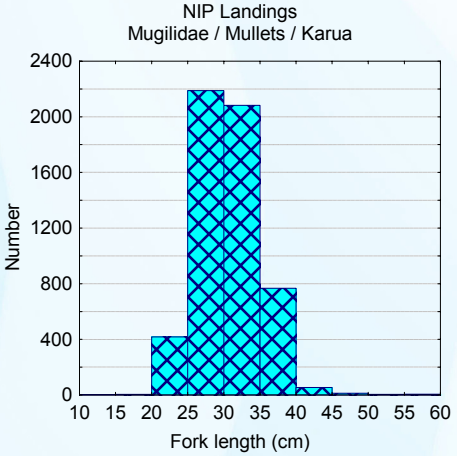
The greatest number of mullets was recorded during December 2004, with very few found in landings during the March-August months of the survey. On average 23 fishes of this family were included in landed catches, ranging up to 228 fishes in a single boat load. The average number of fishes per catch varied slightly among the months of the survey, appearing to be highest during January 2005.

The average length of mullets landed during the survey was 31 cm and ranged between 10 and 59 cm. The size of mullets landed was relatively stable in most months, but variable after March 2005.





← Average number of mullets per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).



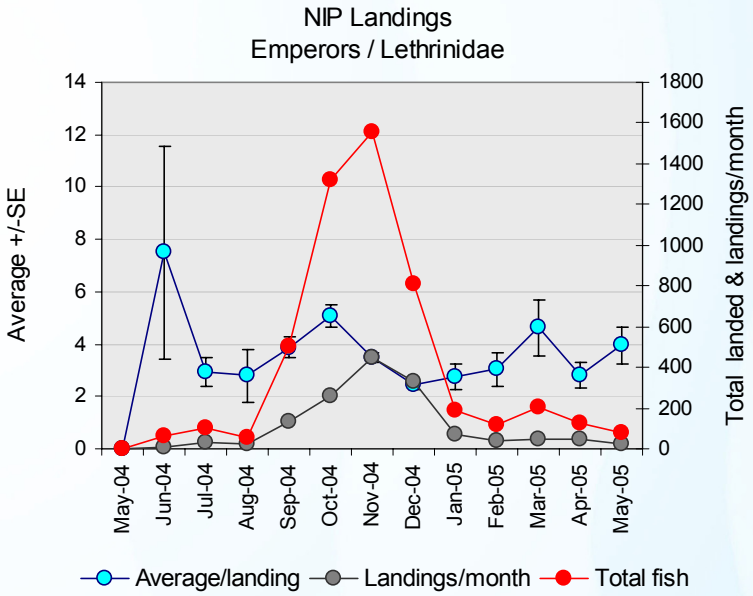
← Size distribution of *Mugilidae* (mullets) landed during the survey, and ↑ broken down by sampling month (n=5,540).

Fishes > Lethrinidae / Emperors

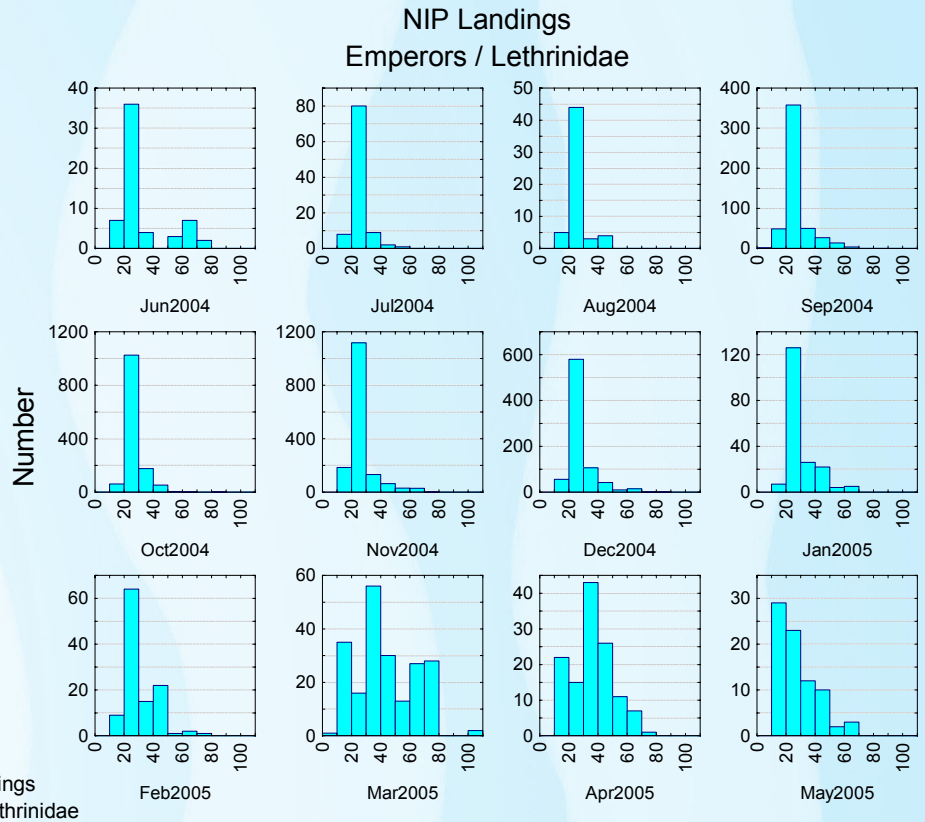
Lethrinids were the third largest group of fishes in terms of numbers recorded in landings in Kavieng, amounting to 5,130 fishes, 12% of the fish catch, or 10% of the total catch of all marine products by number. The emperors we recorded were of 6 genera and 22 species.

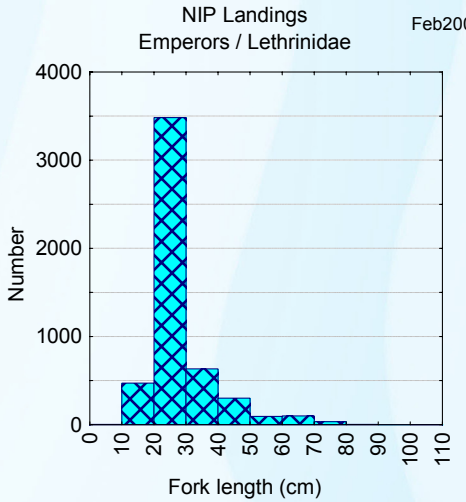
The greatest number of emperors landed was recorded during October-November 2004 (1,558 fishes in November). The average number of emperors per landing was 3.5 fishes and ranged up to 49 fishes, varying significantly throughout the survey.

Fishes of this family averaged 27.5 cm fork length, and varied between 3 and 110 cm. Between June 2004 and February 2005, most emperors landed were between 20 and 25 cm fork length. After March 2005, their size ranges broadened, with larger numbers of small and larger fishes being recorded.



Average number of emperors per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).



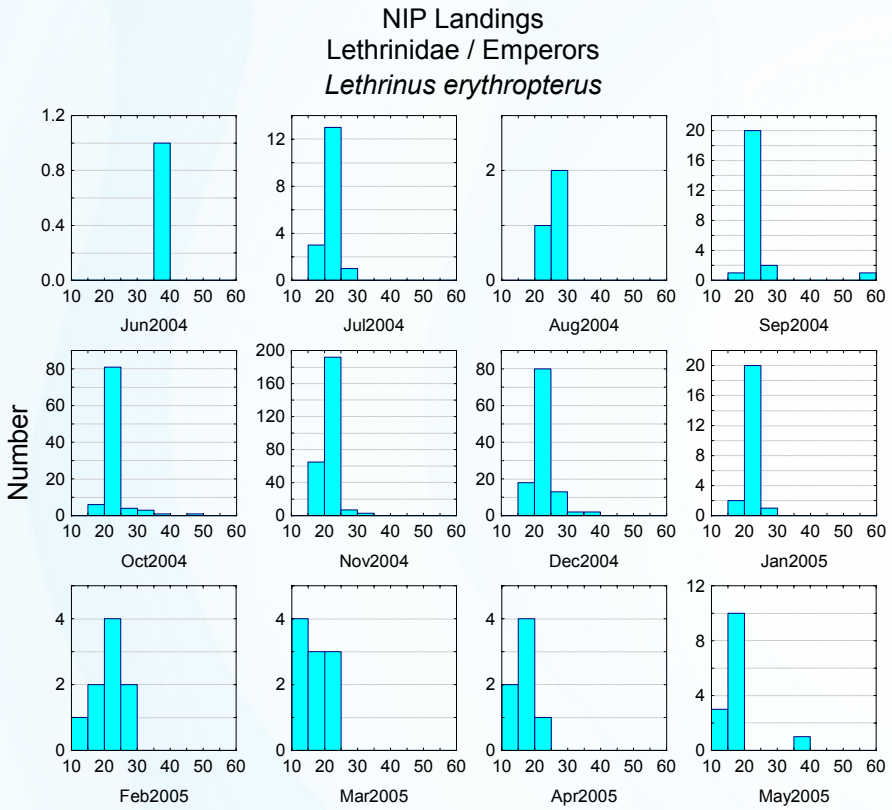


Size distribution of Lethrinidae (emperors) landed during the survey, and broken down by sampling month (n=5,127).

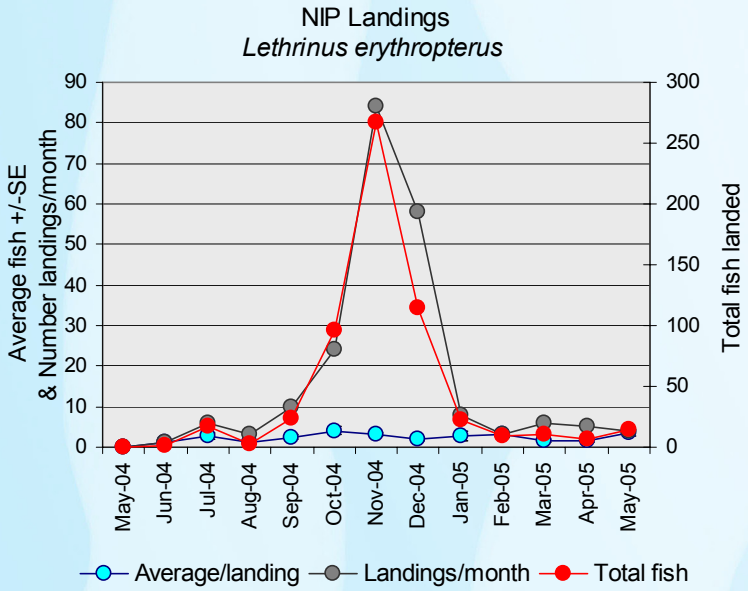
Fishes > Lethrinidae > *Lethrinus erythropterus* / Long-fin emperor

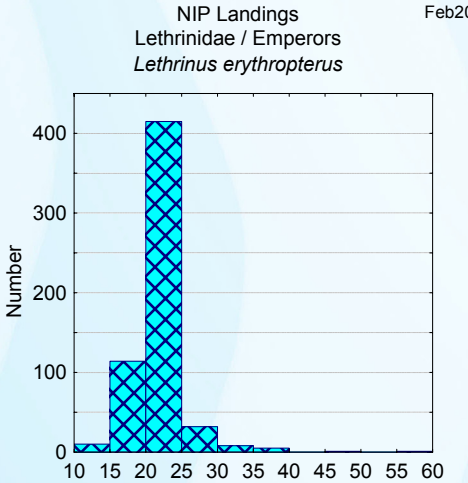
A total of 586 long-fin emperors were recorded during the landings survey. The largest number of this species was landed during November 2004 (267 fish). The average number of fishes of this species found in landings that included them was 2.8 fishes per boat, ranging up to 18.

The average size of fishes landed of this species was 22 cm fork length, and varied between 13 and 55 cm. The size distribution of this species appears to be stable over the period of the survey, with little change in size of landed fishes from month to month over the survey.



Average number of long-fin emperors per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).



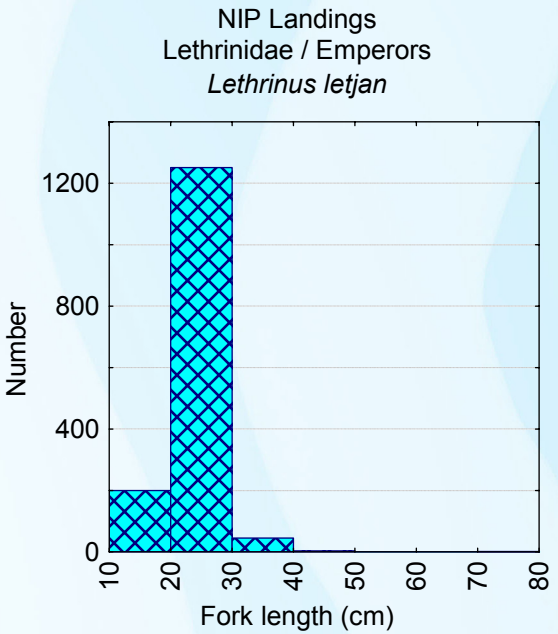


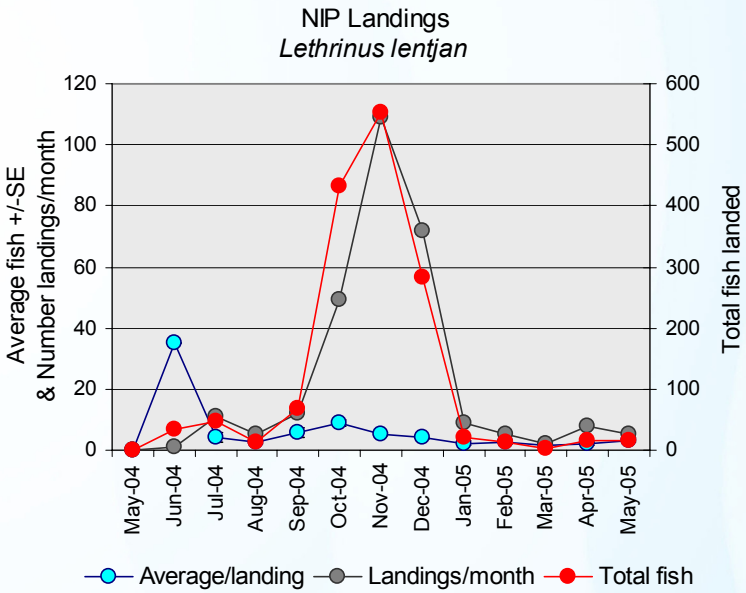
Size distribution of *Lethrinus erythropterus* (long-fin emperors) landed during the survey, and broken down by sampling month (n=586).

Fishes > Lethrinidae > *Lethrinus lentjan* / Red spot emperor / Sui

Lethrinus lentjan were found in 288 landings throughout the survey. A total of 1,500 fishes was recorded, with an average of 5 fishes per catch and a maximum of 37 fishes landed in a single boat load. The average number of fishes per catch varied during the survey, with the greatest number per catch during June 2004. The greatest number of fishes landed by month was during November 2004.

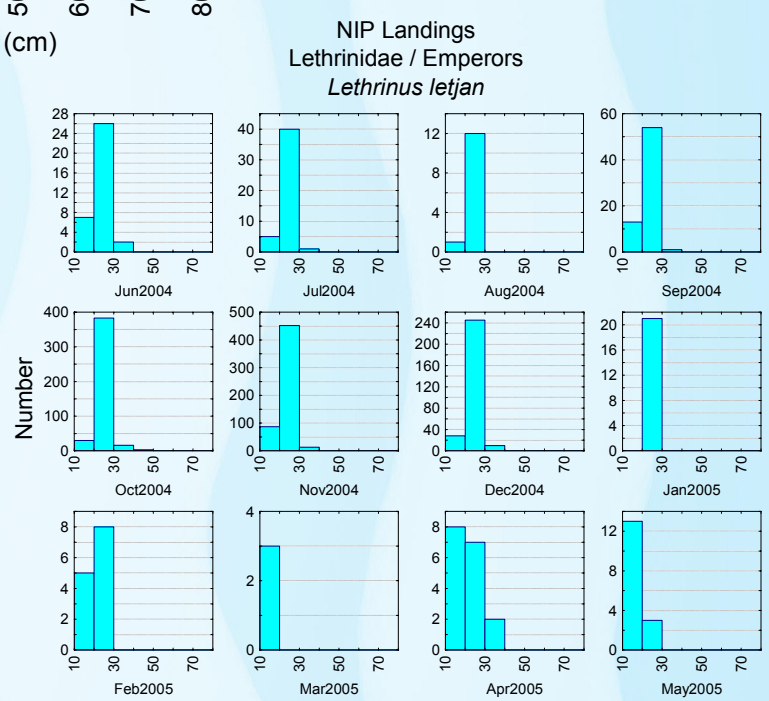
The average length of *Lethrinus lentjan* landed was 23 cm, and ranged between 12 and 78 cm. Although small fishes of this species were landed in small numbers throughout the survey, the proportion of small fishes tended to be higher between February and May 2005.





↗ Size distribution of *Lethrinus lentjan* (red spot emperor) landed during the survey, and ➔ broken down by sampling month (n=1,500).

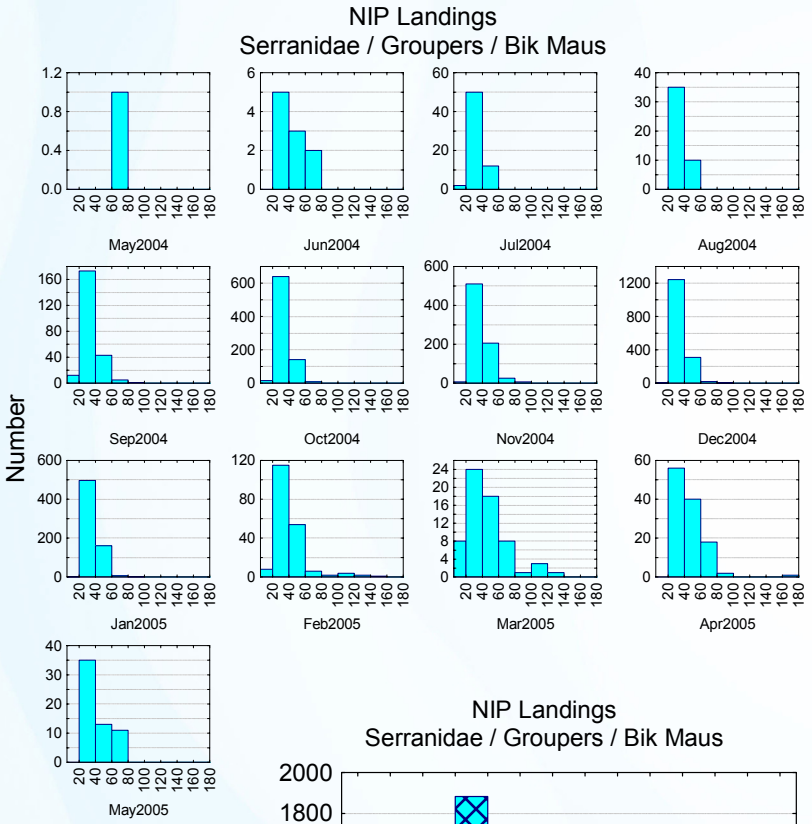
← Average number of red spot emperors per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

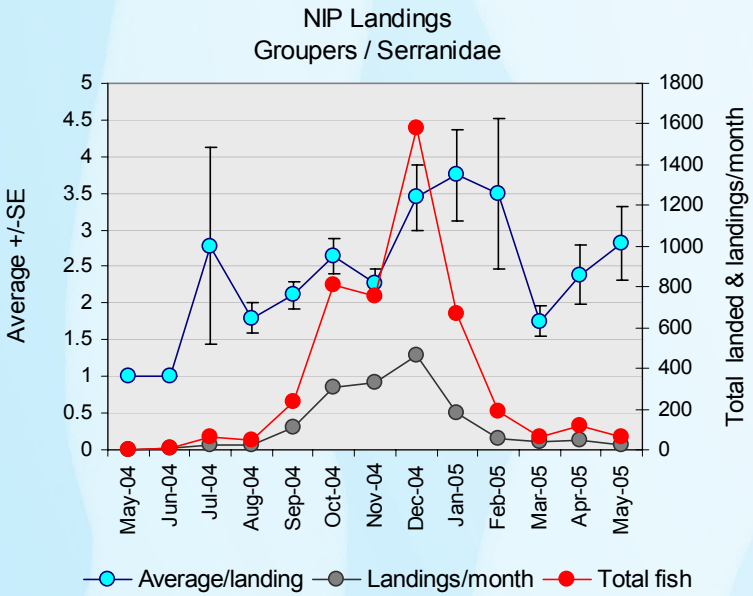


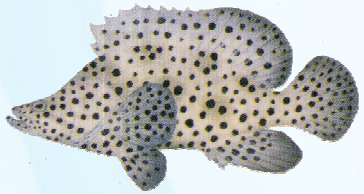
Fishes > Serranidae / Groupers / Bik maus

Groupers were the fourth-most abundant family of fishes recorded during the landings survey. They accounted for 10.6% of all fishes landed or 9% of all marine products recorded. The total number of groupers recorded was 4,596 animals in 1,608 landings. The average landing of groupers was just under 3 fishes per boat, and reached a maximum of 108 fishes in a single landing, varying significantly over the survey period. The average number of groupers per catch landed was greatest during December 2004 and February 2005. The greatest number of groupers landed in a single month was during December 2004 when 1582 fishes of this family were landed.

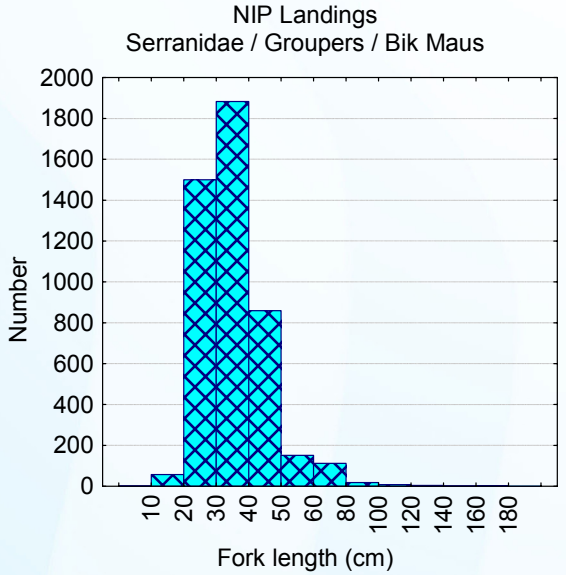
The average size of serranids landed was around 36 cm fork length, and ranged between 9.5 and 180 cm. Most animals were between 20 and 40 cm, with the greatest range in sizes recorded during March 2005.







← Average number of groupers per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

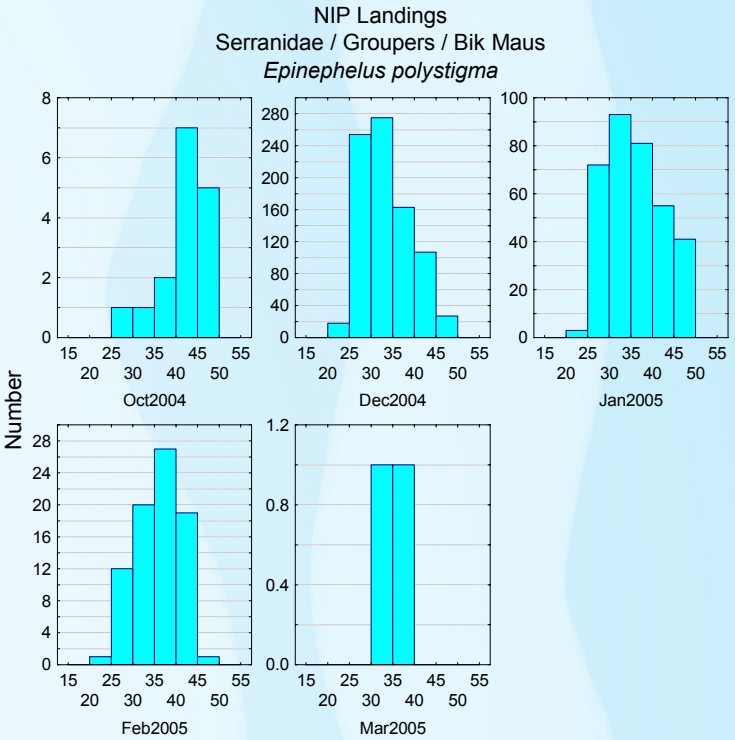


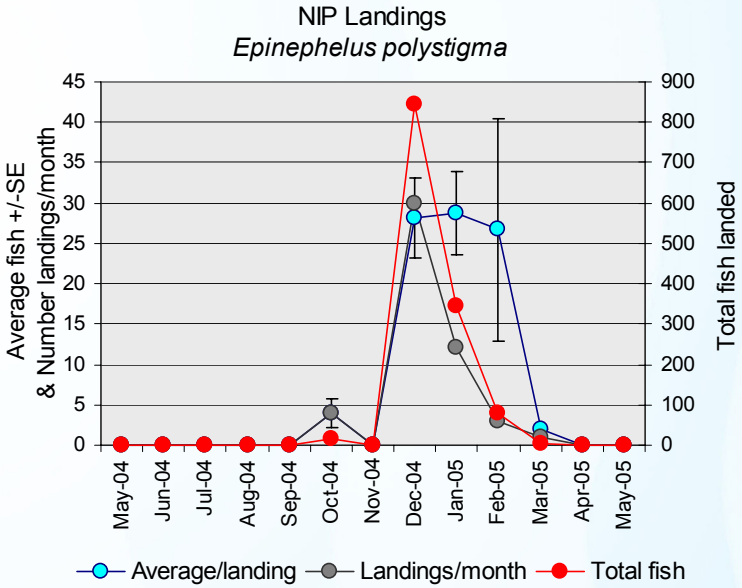
↗ Size distribution of groupers landed during the survey, and ↑ broken down by sampling month (n=586).

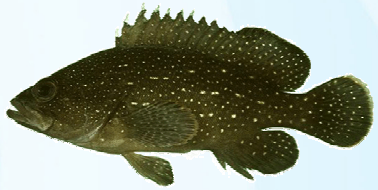
Fishes > Serranidae > *Epinephelus polystigma* / White-dotted grouper

The average number of white-dotted groupers in landings was 26 fishes, and ranged up to 108 fishes in a single catch. This species was only found in high numbers during 3 months of the survey from December 2004 to February 2005. The total number landed over the survey was 1,287 fishes.

The average size of fishes of this species during the survey was 34.5 cm fork length, and ranged between 20 and 50 cm. In the months during which large numbers of this fish were landed, there tended to be a broad spread of sizes caught across the range.

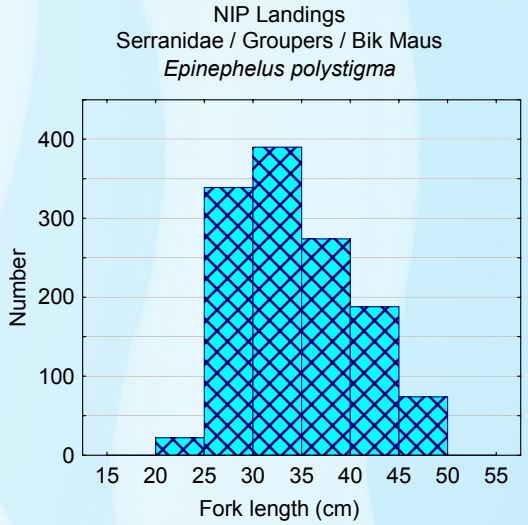




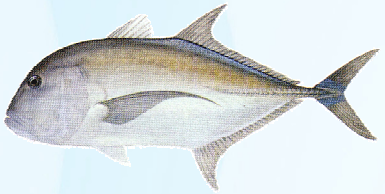


← Average number of white-dotted groupers per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

➔ Size distribution of white-dotted groupers landed during the survey, and ↗ broken down by sampling month (n=586).

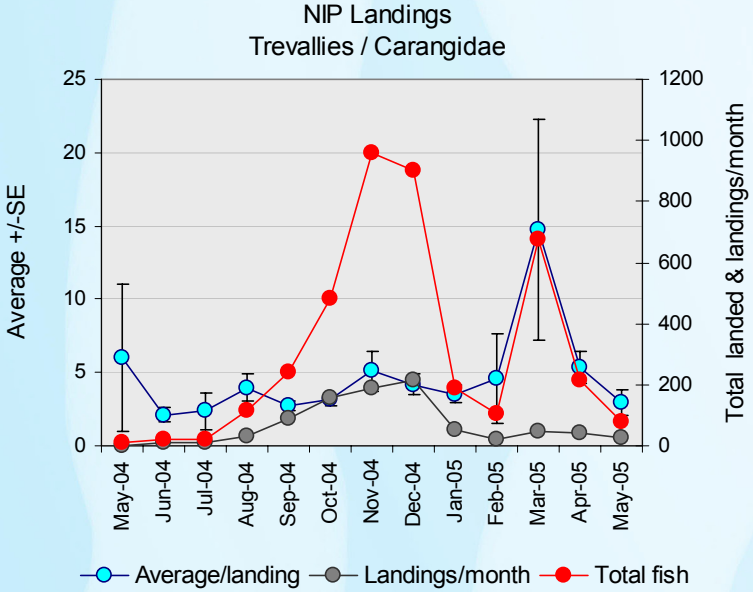


Fishes > Carangidae / Trevallies, Scads & Queenfish

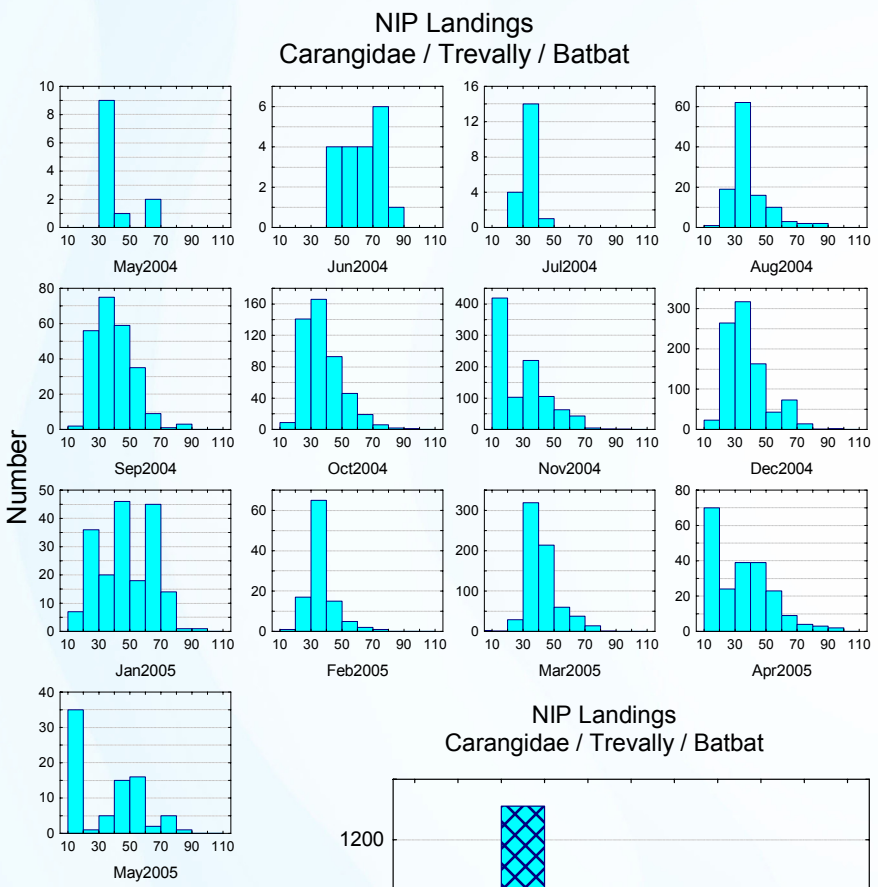


The family Carangidae accounted for 9% of all fishes landed during the survey and 8% of all seafoods. A total of 31 species in 10 genera was recorded, including species of trevallies (batbat), scads, queenfish and the rainbow runner. Carangids appeared in 884 landings during the survey, with a total of 4,015 fishes recorded. The average number of carangids landed per boat during the survey was 4.5 fishes, and ranged up to 346 fishes. The greatest number of carangids were landed in November and December 2004, with large numbers also recorded in March 2005.

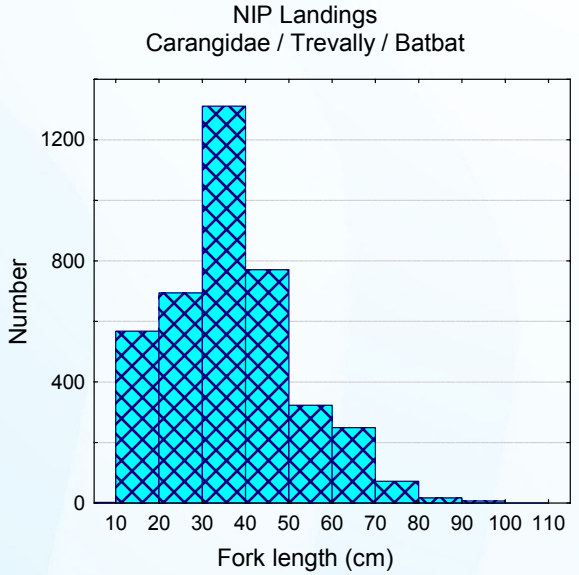
The mean length of the fishes in this family was 37 cm, but ranged between 3 and 98 cm fork length, as might be expected given the range of species, from small scads up to large *Caranx*. The sizes of carangids landed varied through time during the survey, with large numbers of small fishes being landed during some of the months (e.g. November 2004 and April-May 2005).



← Average number of carangids per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).



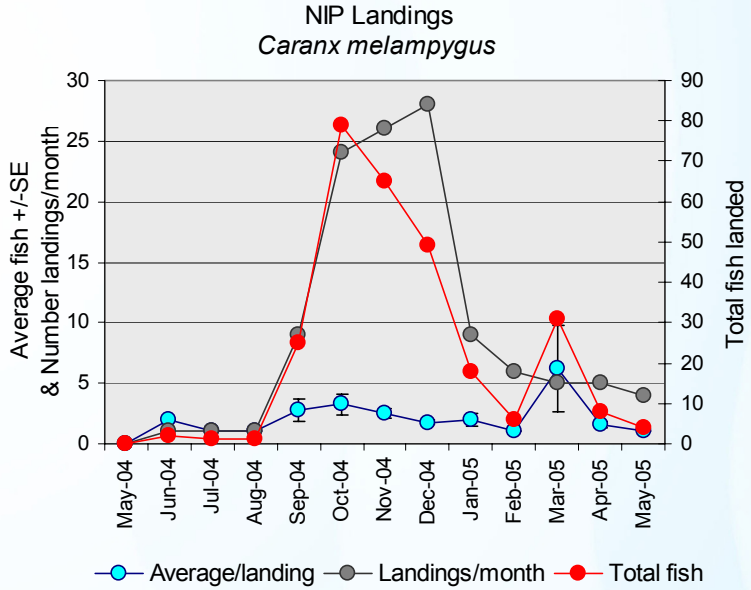
➔ Size distribution of carangids landed during the survey, and ↗ broken down by sampling month (n=4,014).



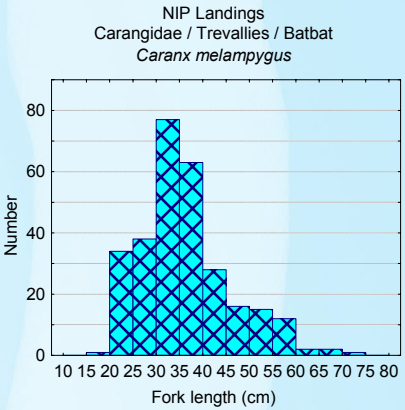
Fishes > Carangidae > *Caranx melampygus* / Blue-fin trevally

A total of 289 blue-fin trevallies was recorded over the survey in 119 (6.5%) landings. The average number of this species landed per boat was 2.4 fish, and reached a maximum of 20 fish in a single landing. The average number per landing did not vary much over the survey period, but the total number landed per month varied significantly. This fish was most abundant during October to December 2004.

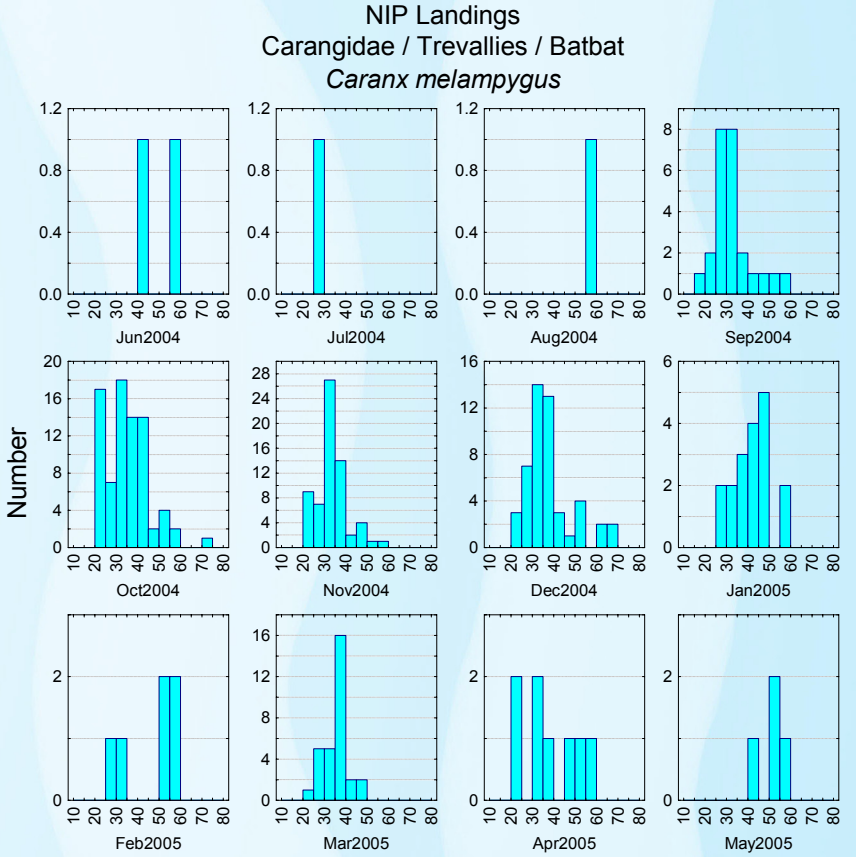
The mean length of *Caranx melampygus* landed was 36 cm, and varied between 20 and 73 cm. The sizes landed were variable throughout the survey, with the greatest number of small fishes recorded in October 2004.



← Average number of blue-fin trevally per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).



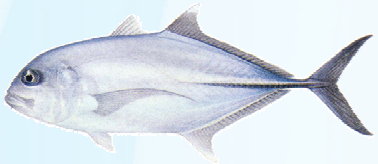
➔ Size distribution of *Caranx melampygus* (blue-fin trevally) landed during the survey, and ➔ broken down by sampling month (n=289).

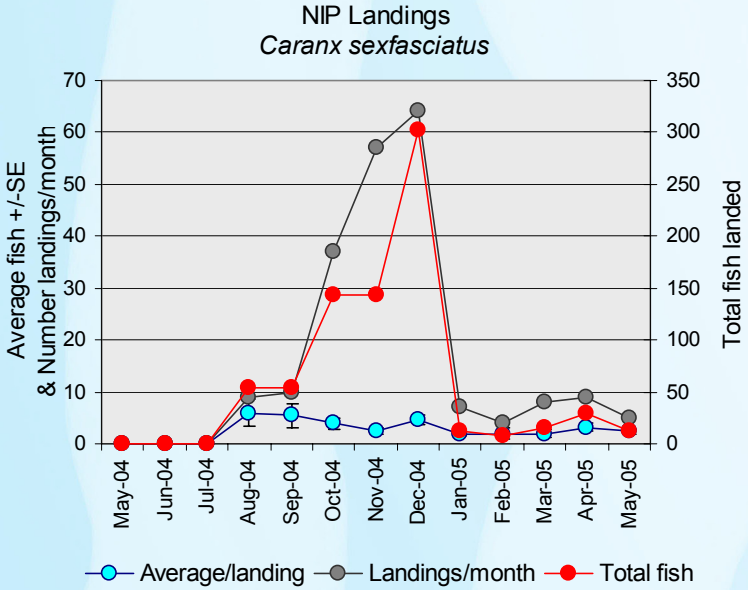


Fishes > Carangidae > *Caranx sexfasciatus* / Big-eye trevally

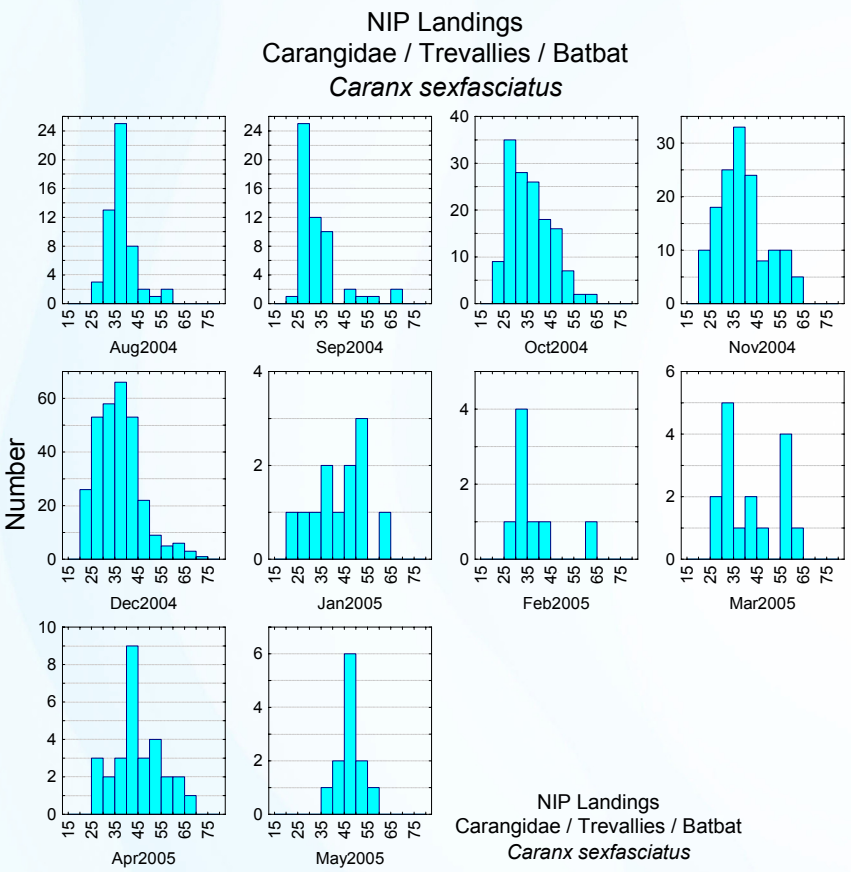
Big-eye trevallies were present in 210 landings or 11.5% of the boats landing in Kavieng and surveyed by us. We recorded 773 fish over the survey period, with an average of 3.6 fish landed per boat, and a maximum of 45 fishes in one landing. The greatest number of big-eye trevallies landed in a single month was in December 2004, but these fish were common in landings sampled between August and September 2004. The trevallies also occurred in small numbers over the rest of the survey.

The average length of big-eye trevallies was 38 cm, but ranged between 20 and 71 cm. The size distribution of these trevallies tended to be skewed towards the smaller sizes within their range, with relatively few large fish landed over the survey.

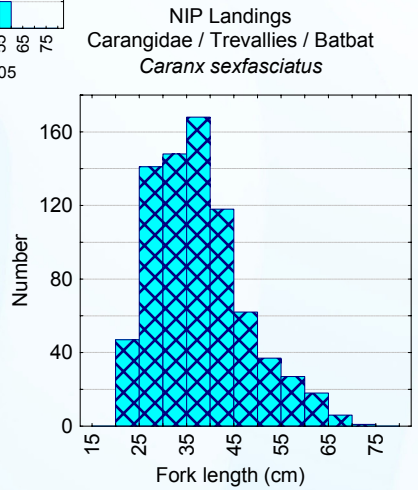




➔ Average number of big-eye trevally per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).



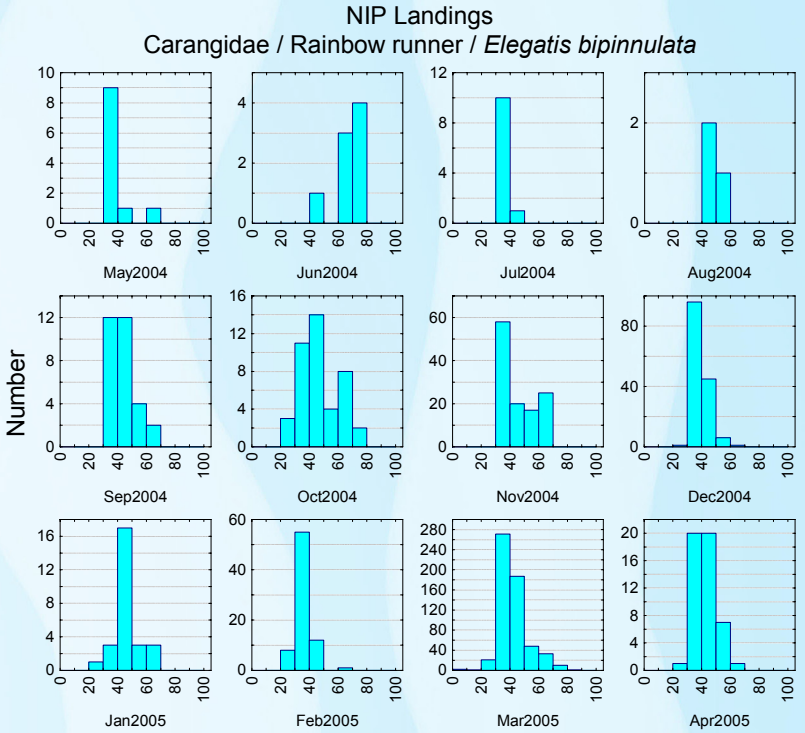
➔ Size distribution of *Caranx sexfasciatus* landed during the survey, and ↗ broken down by sampling month (n=773).

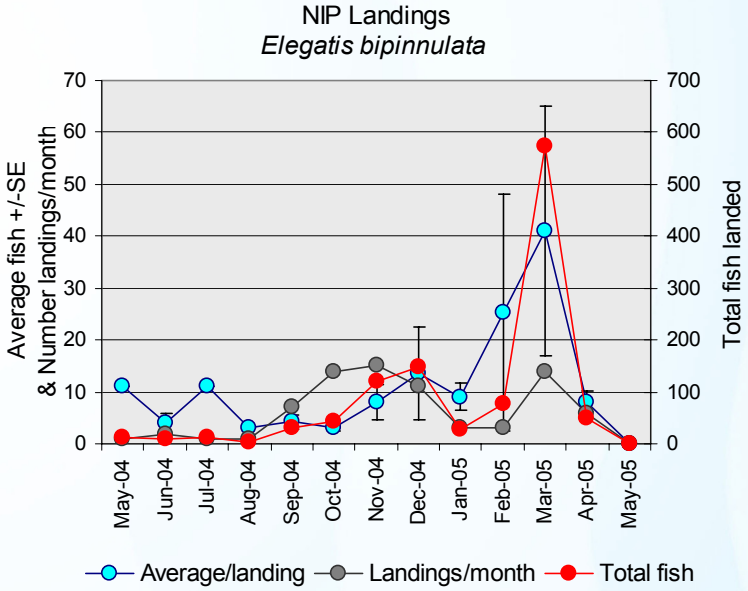


Fishes > Carangidae > *Elegatis bipinnulata* / Rainbow runner

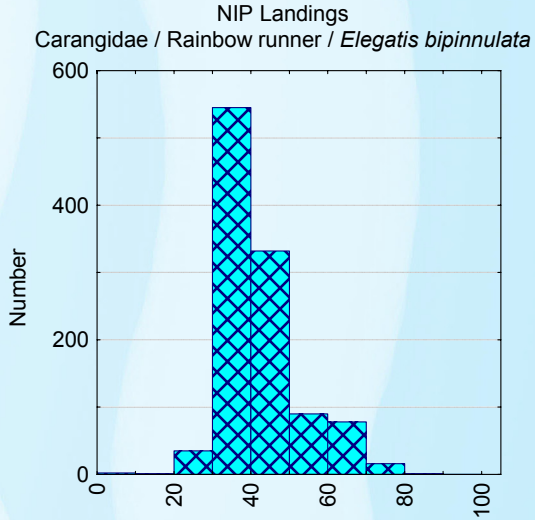
Rainbow runners were most commonly found in the landings between November 2004 and March 2005. They appeared in 78 landings over the survey (4% of samples) with 1,100 fishes recorded. The average number of fishes recorded was 14 per landing over the survey, and ranged up to 346 in a single boat. The greatest numbers were landed in March 2005, a time during which the average number per landing was highest.

The average length of rainbow runners was 42 cm, ranging up to 83 cm. Most fish measured between 30 and 40 cm, with small and large fish observed throughout the survey.



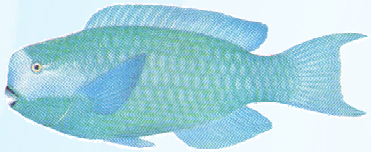


➔ Size distribution of *Elegatis bipinnulata* (rainbow runner) landed during the survey, and ↗ broken down by sampling month (n=1,100).



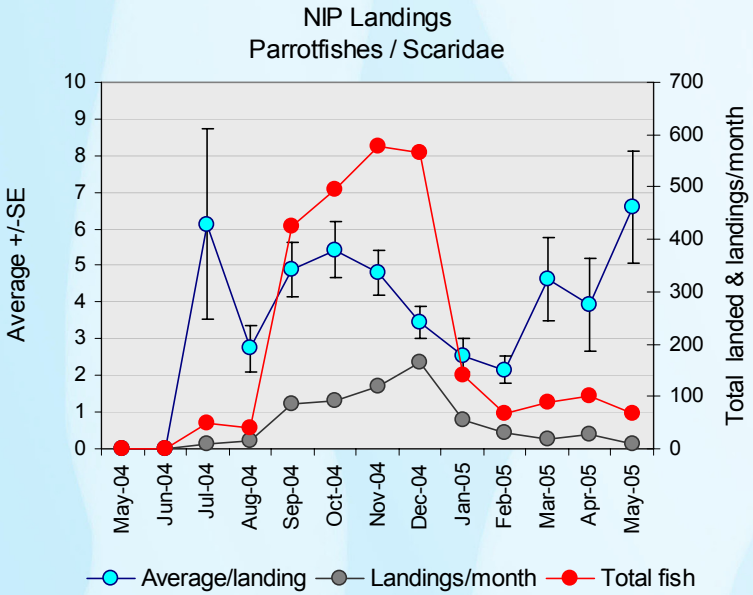
← Average number of rainbow runners per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

Fishes > Scaridae / Parrotfishes / Ulei

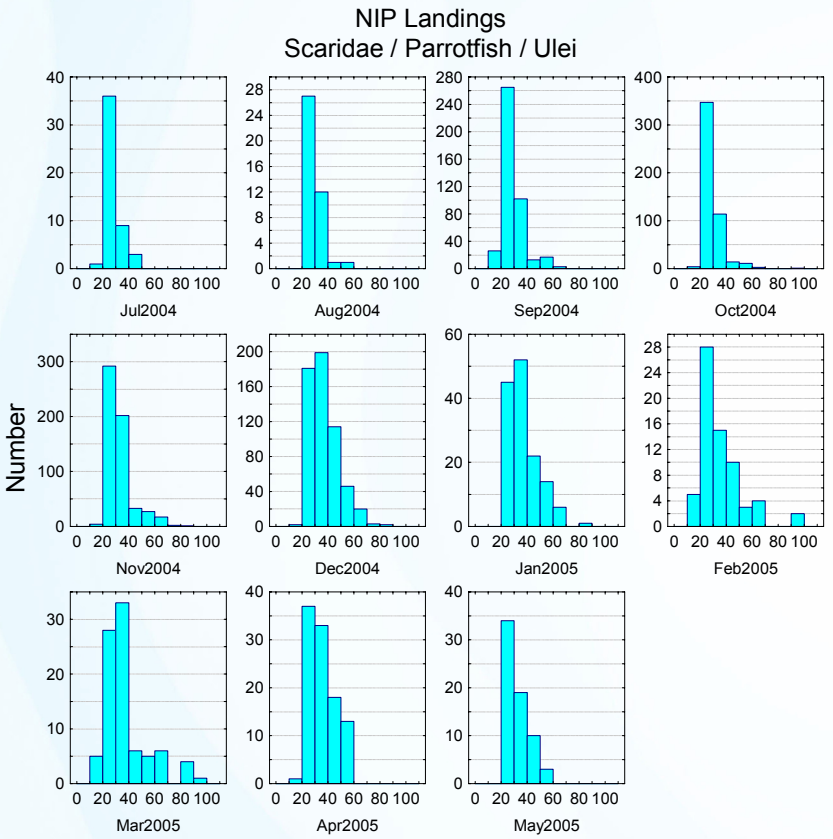


Thirty species of parrotfishes in 7 genera were recorded in landings during the survey. Parrotfishes accounted for 6% of the fish catches during the survey, and 5% of the landings of all marine products by number. A total of 2,618 fishes in this family were recorded. An average of 4 parrotfishes was recorded per landing, with a maximum of 56 in a single landing. Parrotfishes were present in 626 of the boats surveyed (35% of landings). Most scarids were landed between September and December 2004.

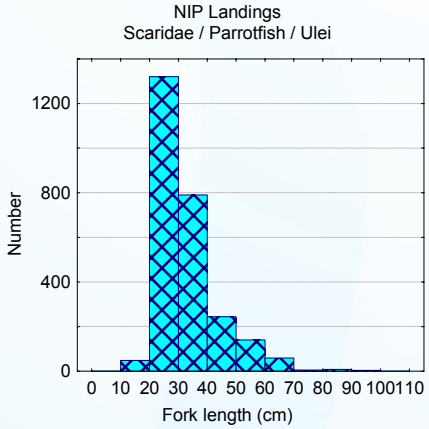
The average size of scarids was 33 cm, ranging between 14 and 96 cm fork length. The sizes of this fish remained similar throughout the survey, except during February-March 2005 when a greater spread of sizes was recorded.



← Average number of parrotfishes per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).



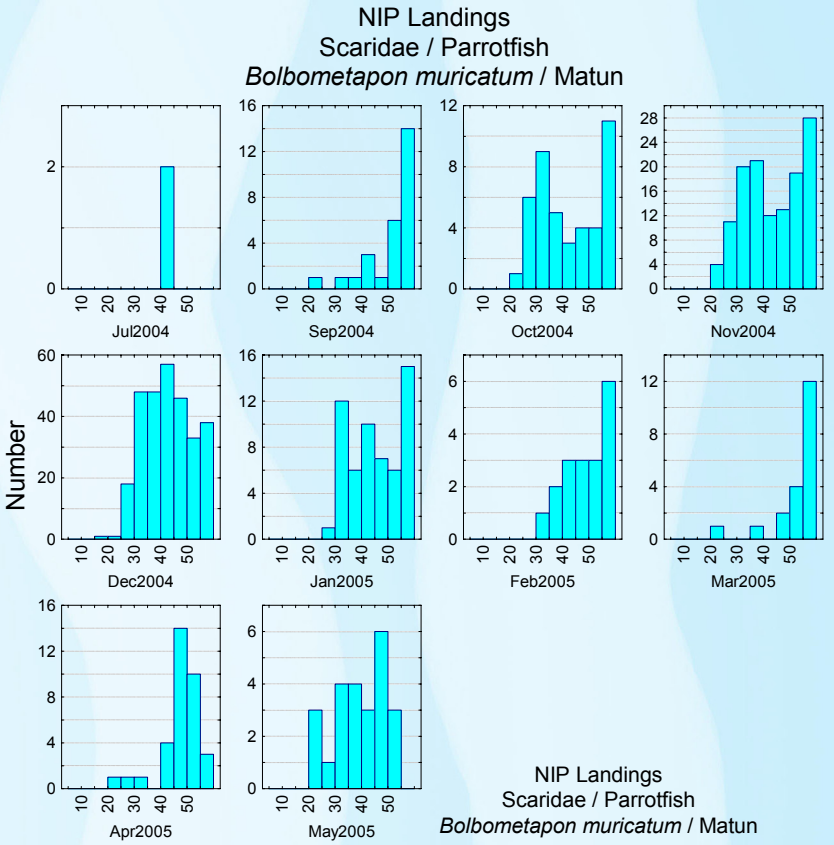
➔ Size distribution of Scaridae (parrotfishes) landed during the survey, and ↗ broken down by sampling month (n=2,618).

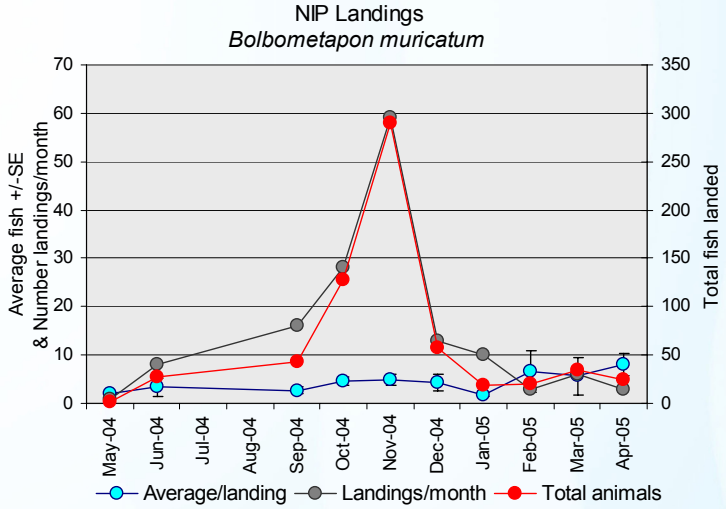


Fishes > Scaridae > *Bolbometapon muricatum* / Hump-headed parrotfish / Matun

The average number of hump-headed parrotfishes found in catches landed during the survey was 4.3 and ranged up to 56 in a single boat. A total of 643 fishes were recorded across the survey in 147 landings that included them (8%). The greatest numbers of this species were landed in December 2004.

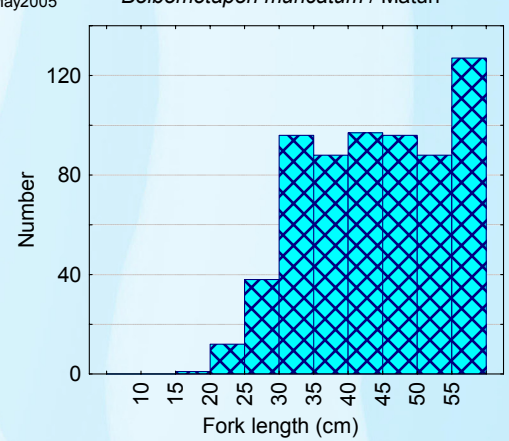
Hump-headed parrotfishes ranged in size between 20 and 96 cm fork length, with an average size of 46 cm. Unlike most species, relatively even numbers of fishes of a wide range of sizes was generally landed, with the greatest number of fishes caught in the largest size category.



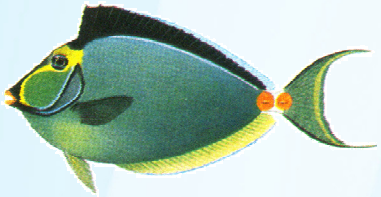


← Average number of hump-headed parrotfishes per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

➔ Size distribution of *Bolbometapon muricatum* (hump-headed parrotfishes) landed during the survey, and ↗ broken down by sampling month (n=2,618).

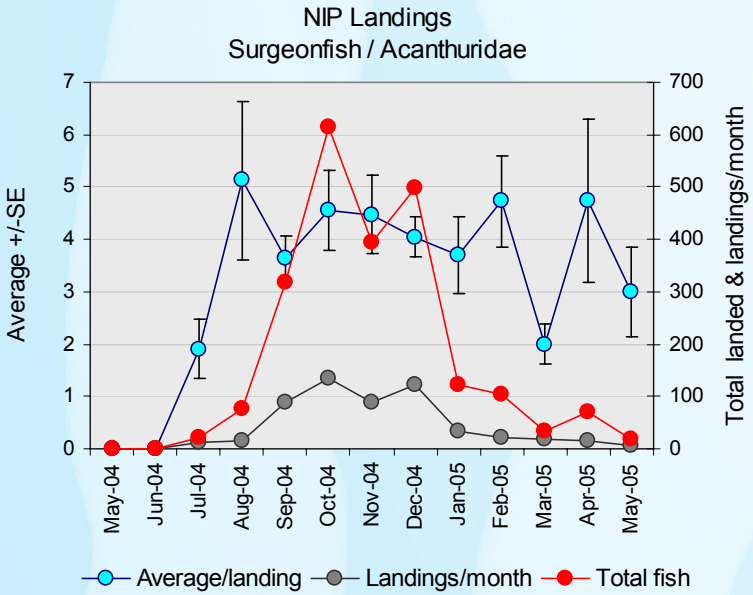


FISHES > ACANTHURIDAE / SURGEONFISHES

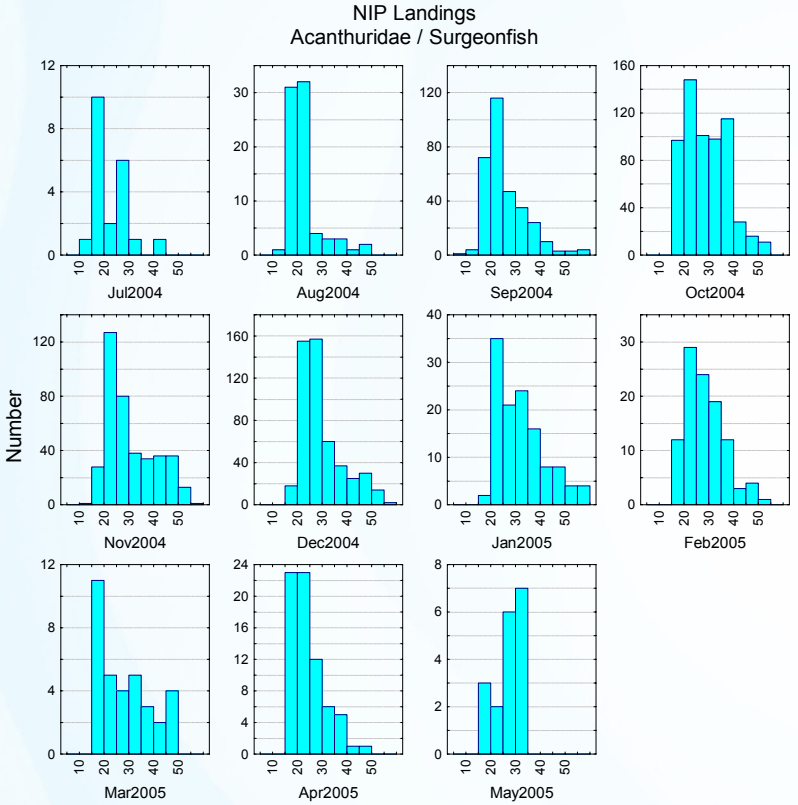


A total of 22 species of surgeonfishes belonging to three genera (*Acanthurus*, *Ctenochaetus* and *Naso*) were recorded during the survey. This included 2,272 fishes, around 5.3% of the total fishes landed and 4.4% of all marine products landed. Surgeonfishes were present in 31% of all landings. The average landing of surgeonfishes was 4 fish per boat, ranging up to 91 for a single landing. Most surgeonfishes were landed between October and December 2004.

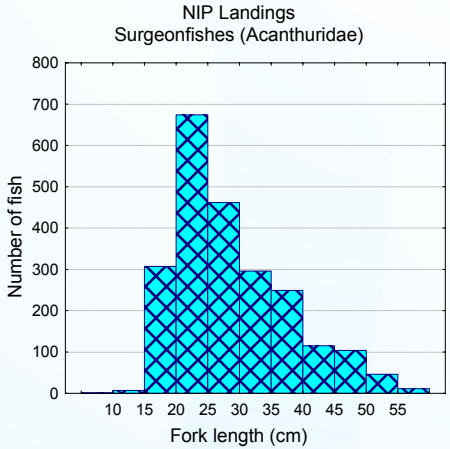
The average fork length of all surgeonfishes was 29 cm. The largest fish were recorded in the period October 2004 to February 2005. There is no clear pattern of recruits appearing or any growth progression in the landed fishes over the period of the study.



← Average number of surgeonfishes per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).



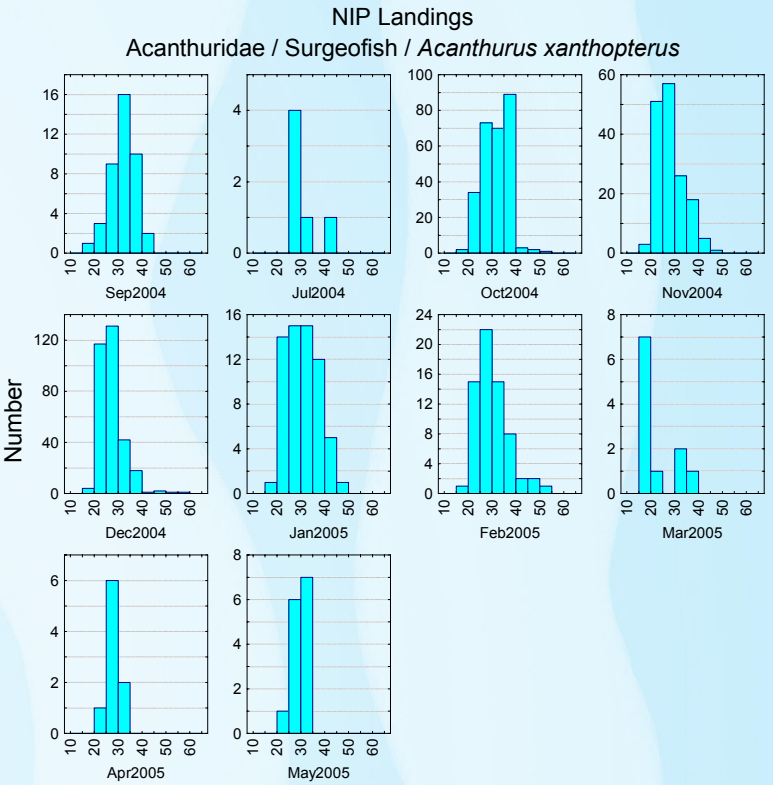
➔ Size distribution of surgeonfishes landed during the survey, and ↗ broken down by sampling month (n=2,272).

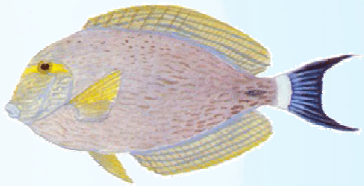


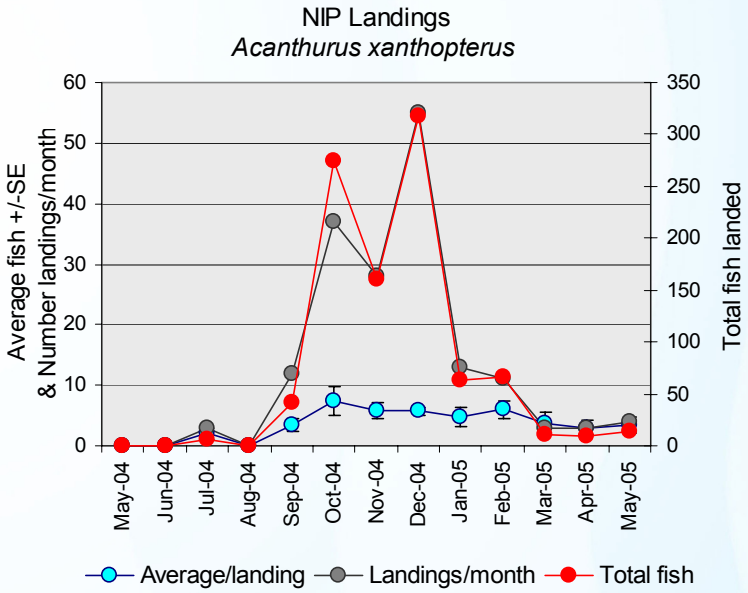
Fishes > Acanthuridae > *Acanthurus xanthopterus* / Yellowfin surgeonfish

Yellowfin surgeonfishes were present in 169 samples of landings during this survey, with 962 fishes. The average number of this species per landing was 5.7 fishes, and ranged up to 91 in a single sample. The greatest numbers were landed between October and December 2004.

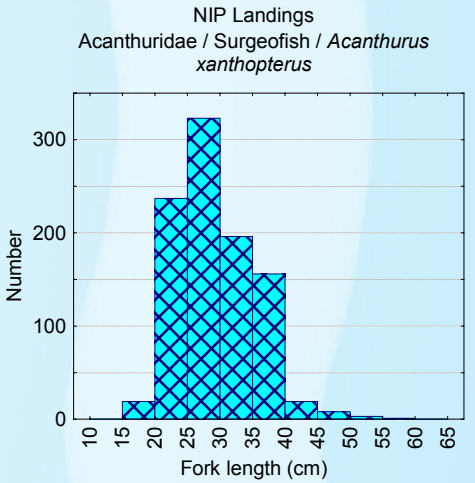
The average size of *Acanthurus xanthopterus* recorded during the survey was 30 cm over 962 fishes measured between July 2004 and May 2005. Note that no individuals of this species were recorded during August 2004. This species tended to be a small part of the catch over most of the survey, peaking in the period October-December 2004. The size distribution for about half of the survey is therefore based on few measurements, and there are no obvious patterns in size other than a possible increase in juveniles caught during March 2005.







➔ Size distribution of *Acanthurus xanthopterus* (yellowfin surgeonfish) landed during the survey, and ↗ broken down by sampling month (n=962).

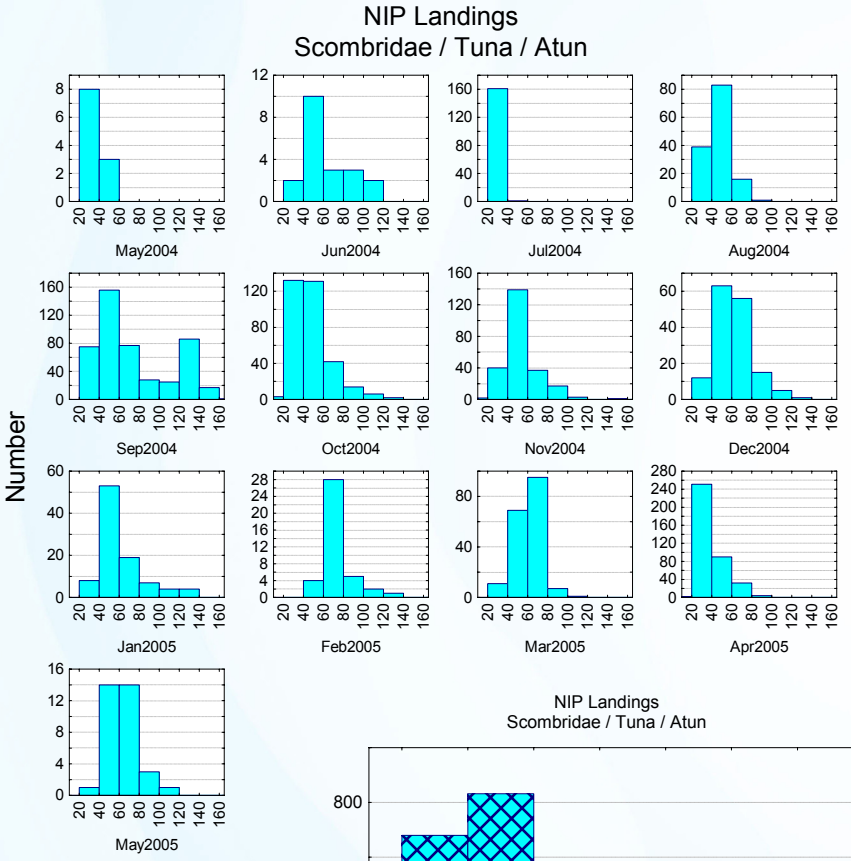


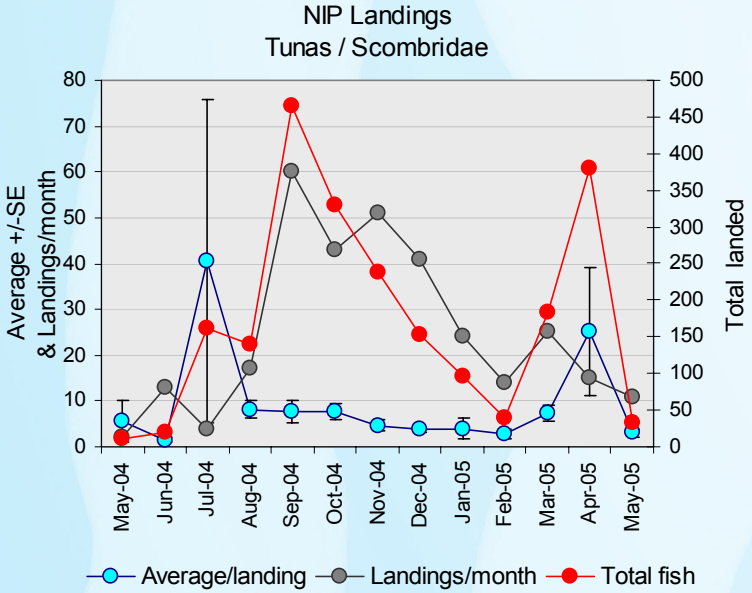
← Average number of yellow-fin surgeonfishes per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

Fishes > Scombridae / Tunas & Mackerels

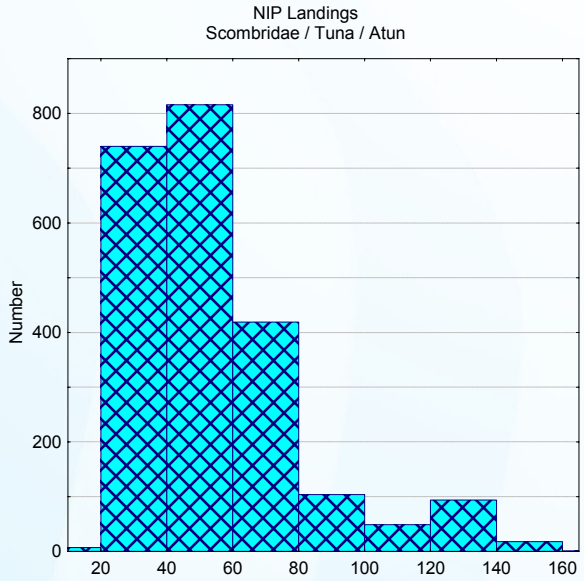
A total of 13 species in 9 genera of tunas, mackerels and wahoos were identified in landed catches during the survey. The total number landed was 2,248, accounting for 4% of all landed marine products and 5% of the fish catch. Scombrids were present in around 18% of all landings recorded, with an average of 7 fishes landed per boat (that included fishes in this family) over the period of the survey. The average catch varied over the period of the survey, with greater average catch sizes, and greater variance among boats in July 2004 and April 2005.

The average length of scombrids landed was 54 cm, ranging between 11 and 161 cm over all of the fishes sampled.





➔ Size distribution of scombrids landed during the survey, and ➚ broken down by sampling month (n=2,248).

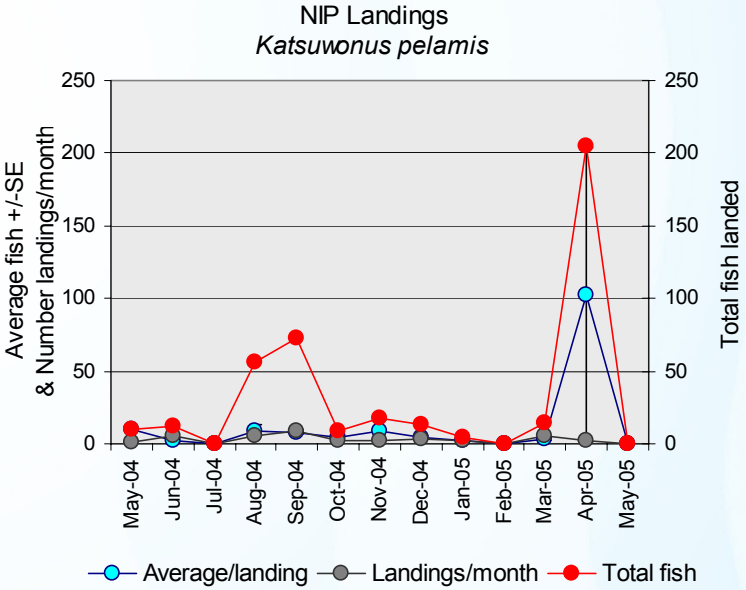


➔ Average number of scombrids per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

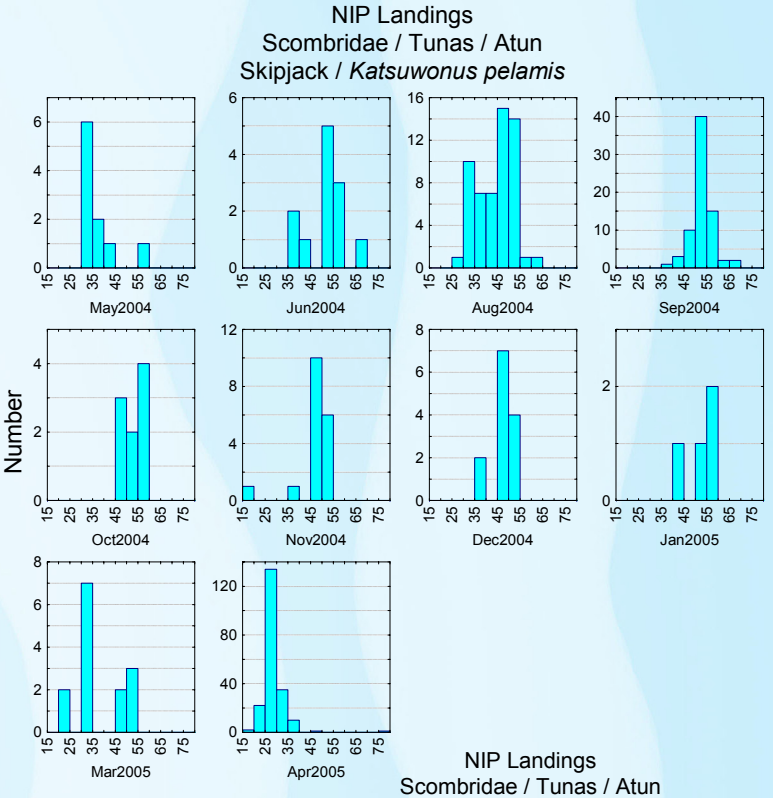
Fishes > Scombridae > *Katsuwonus pelamis* / Skipjack tuna

A total of 414 skipjack tunas were landed and recorded during the survey. Most of these were brought in by fishers in August and September 2004 and April 2005. The average size of landings of skipjack tunas was 11 fishes per boat, and ranged up to 204 in a single landing. Skipjack were landed in only 2% of the boats surveyed, and the number of landings per month remained steady at between 1 and 9 over the period of the survey.

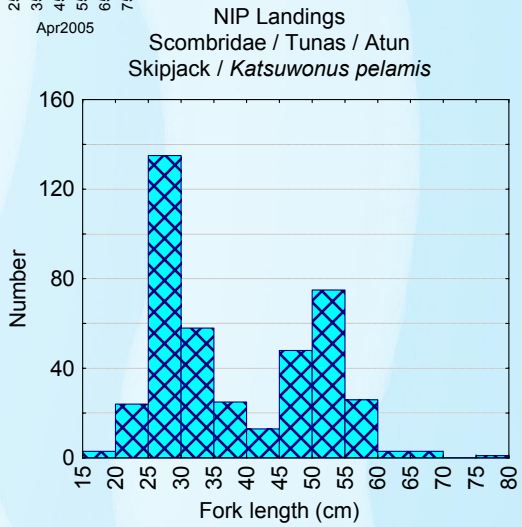
The average size of skipjack was 54 cm, but appeared to fall into two distinct ranges, one centred on a 25-30 cm size range, and the other centred on the 50-55 cm size range. The sizes caught varied among months, with the smallest fish tending to be caught in May 2004 and March-April 2005.



➔ Average number of skipjack tunas per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

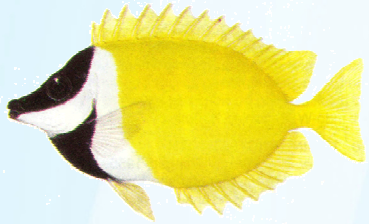


➔ Size distribution of skipjack tunas landed during the survey, and ↗ broken down by sampling month (n=414).

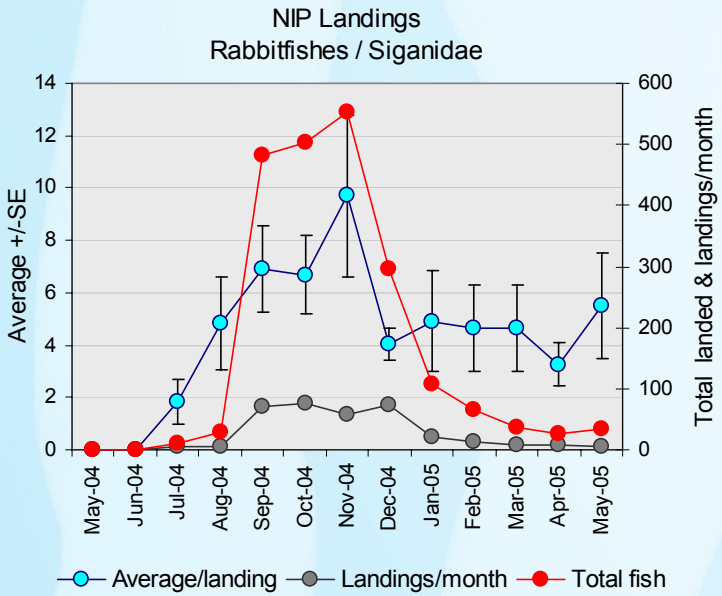


Fishes > Siganidae / Rabbitfishes / Nilpis

A total of 2,142 rabbitfishes were landed during the survey, which is about 4% of the total catch of marine products and 5% of the fish catch. The fishes were from 12 species, all in the genus *Siganus*. The average number of fishes landed per catch over the survey was 6.2 fishes, ranging up to 145. The average number landed did, however, vary significantly with the month of sampling. Very low average numbers were landed prior to July 2004, increased monthly to a peak of 9.7 in November 2004 and dropped to an average of 4.5 fish per catch over the remainder of the survey period.

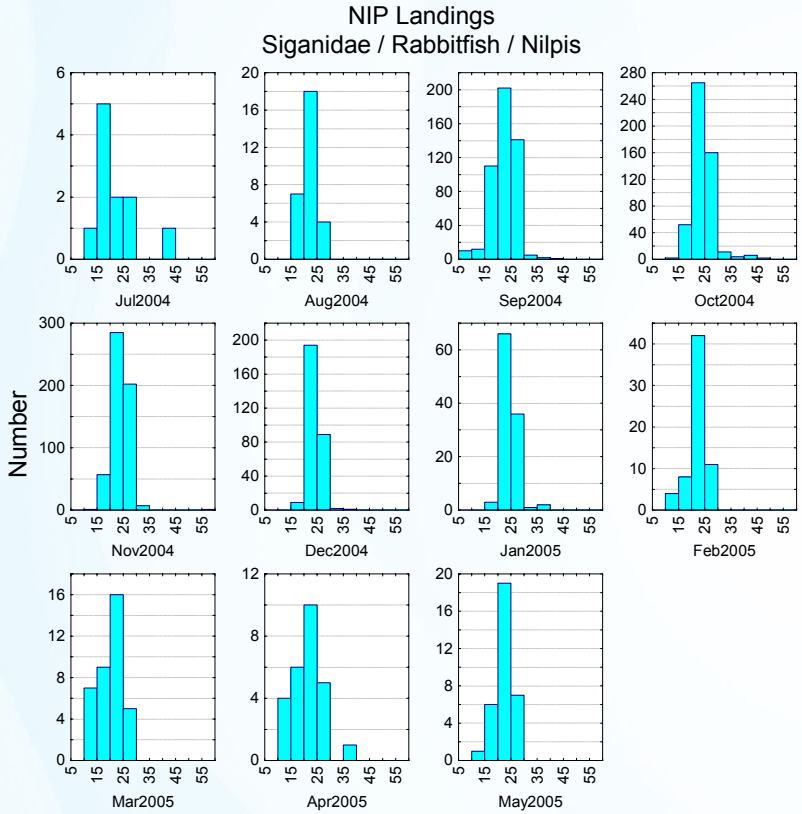


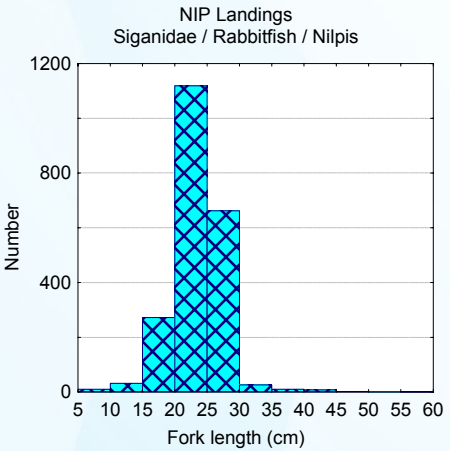
The average length of rabbitfishes landed was 24 cm and ranged between 7 and 57 cm. Most fishes landed and recorded were between 20 and 25 cm fork length.



➔ Size distribution of rabbitfishes landed during the survey, and ↗ broken down by sampling month (n=2,142).

← Average number of rabbitfishes per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

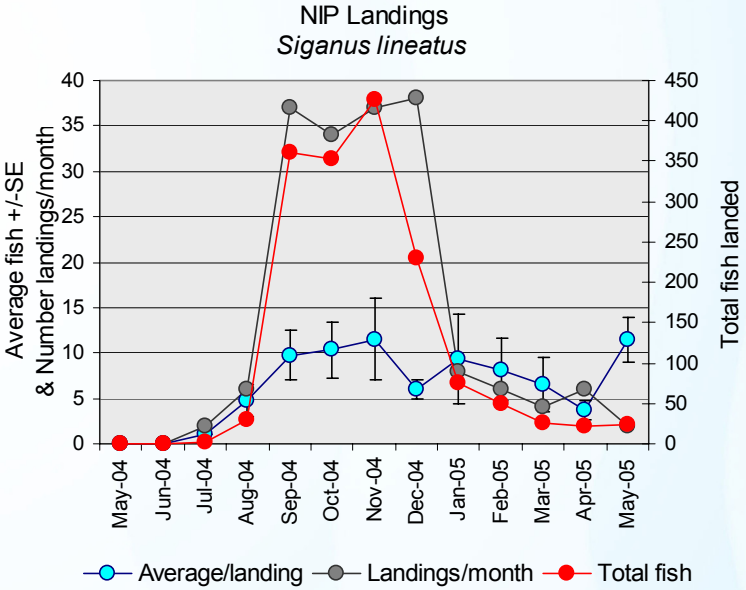




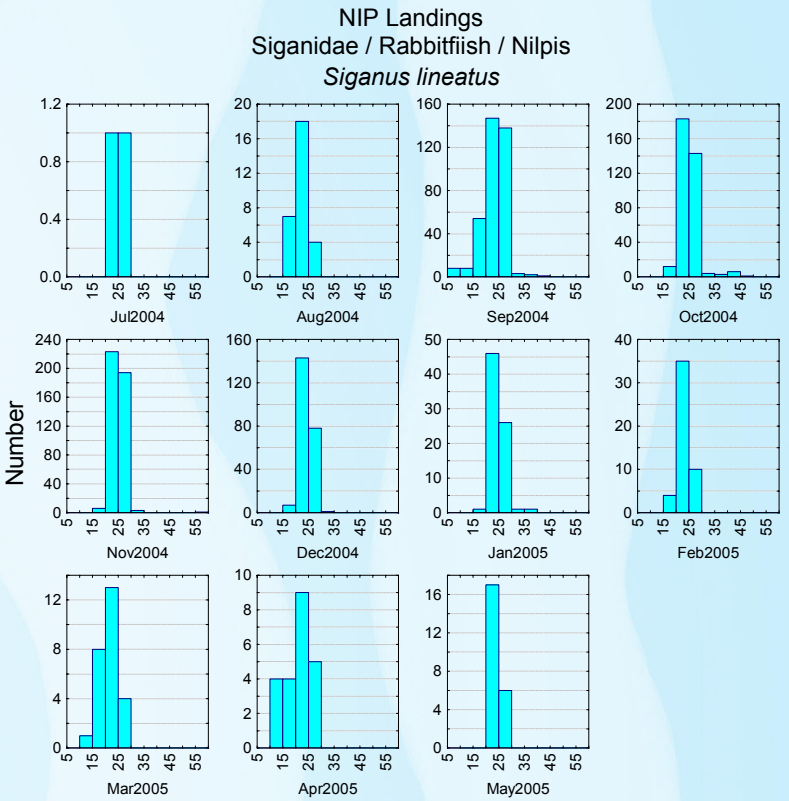
Fishes > Siganidae > *Siganus lineatus* / Golden-lined rabbitfish

A total of 1595 golden-lined rabbitfishes were recorded in the landings over the period of the survey, most of them caught in September through November 2004. The average number landed per boat was 9 fishes, but ranged up to 145 fishes in a single boat. The average number landed varied slightly during the survey, with few rabbitfishes landed in the period up to August 2004.

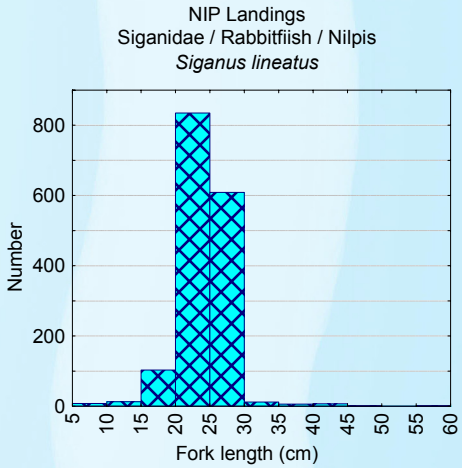
The average size of golden-lined rabbitfishes landed was 24 cm, and ranged between 9 and 57 cm. Most of the fishes landed were between 20 and 25 cm long, and there was no clear pattern relating to the size of fishes landed throughout the survey period.



← Average number of golden-lined rabbitfishes per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).



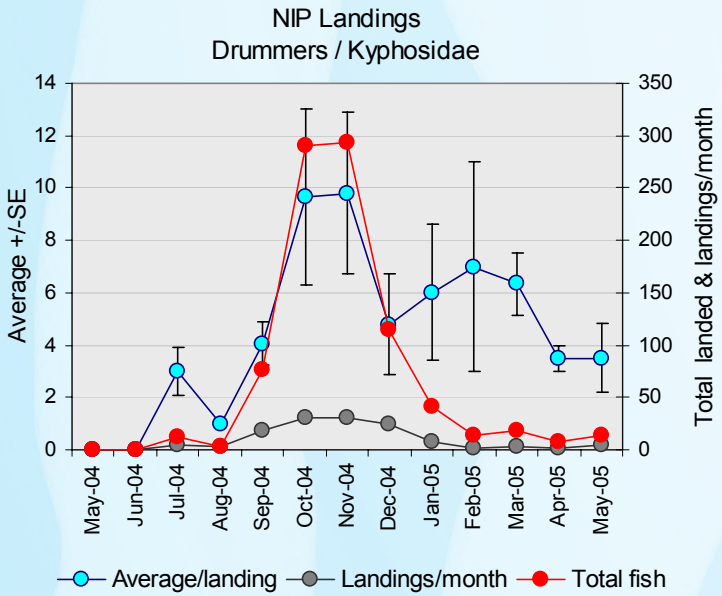
➔ Size distribution of *Siganus lineatus* (golden-lined rabbitfishes) landed during the survey, and ↗ broken down by sampling month (n=1,595).



FISHES > KYPHOSIDAE / DRUMMERS / MAKAU

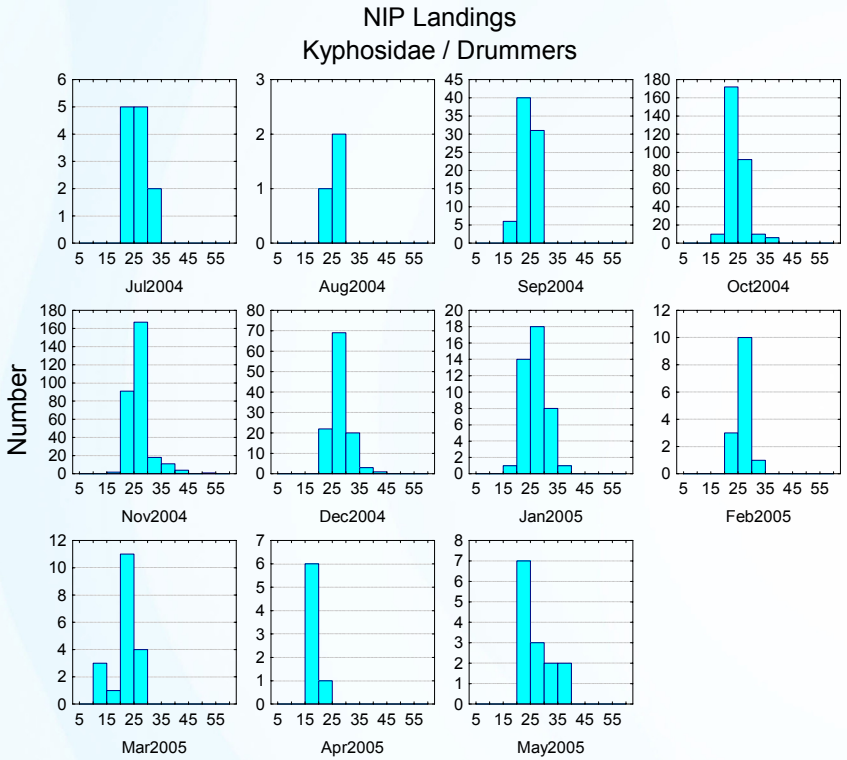
A total of 887 drummers were recorded in the landings, which was about 2% of the fish catch. These were of two species, *Kyphosus cinerascens* and *K. vaigiensis*. Most of these were landed in October and November 2004, with an average number of fishes per landing of 7, ranging up to 96 per boat. A total of 128 landings included drummers (around 7%). The average number landed per boat varied significantly among boats and months during the survey. There appears to have been fewer fishes per landing up to September 2004, than during the October-November 2004 period.

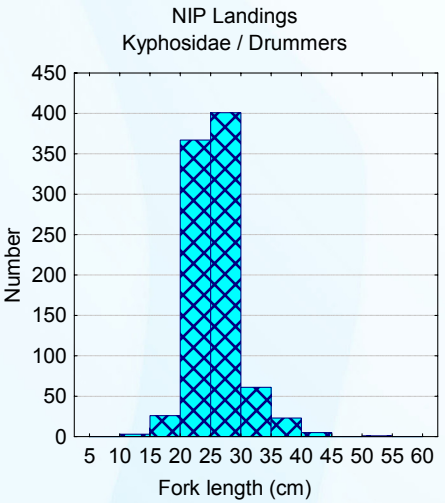
The mean size of all drummers landed was 25.9 cm fork length over the period of the survey. Their sizes ranged between 13 and 53 cm, with the smallest fish being landed during March 2005.



➔ Size distribution of kyphosids (drummers) landed during the survey, and ↗ broken down by sampling month (n=887).

← Average number of drummers per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).





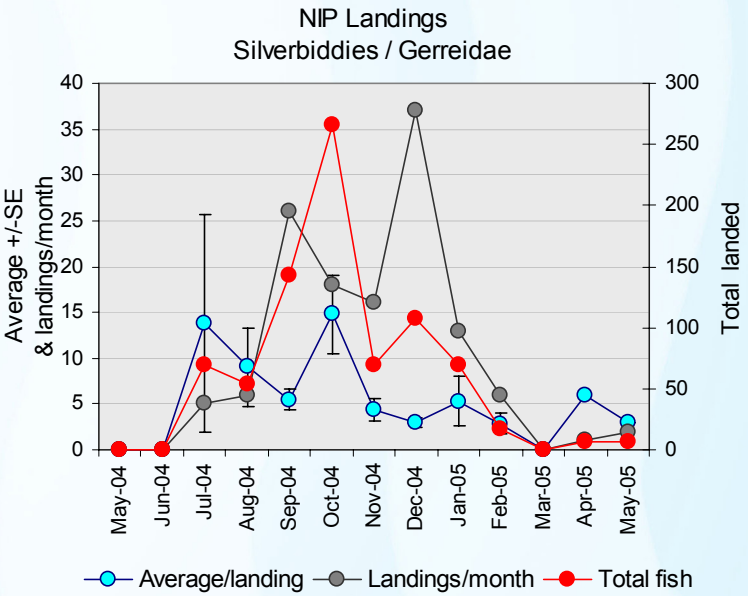
Fishes > Gerreidae / Silverbiddies / Rangan

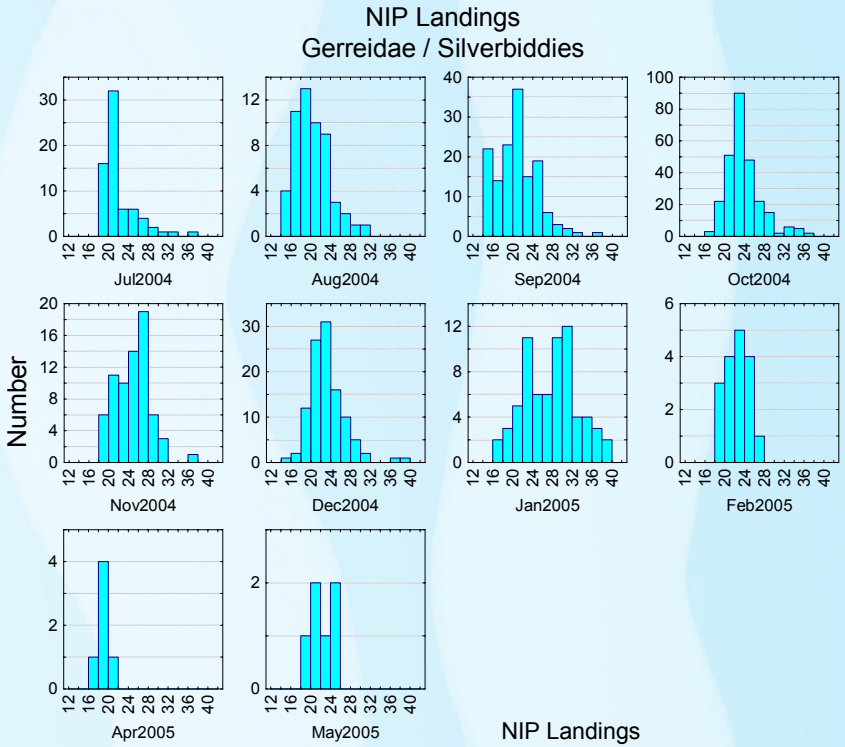
Four species of silverbiddies were recorded in the survey of fish landings, *Gerres erythrourus (syn: abbreviatus)*, *G. filamentosus*, *G. longirostris* and *G. oyena*. The total number of silverbiddies landed and recorded during the survey was 808, accounting for around 2% of the total of fish landings. Silverbiddies were found in 130 (7%) landings. The month with the largest total catch was October 2004, but the month with the greatest number of silverbiddy landings was December 2004. The average number of fish landed per boat was 6.2 and ranged up to 72.

Fish in this family averaged 23 cm fork length, over 808 individuals measured, but ranged between 15 and 39 cm. Landings of silverbiddies were greatest between July and December 2004, reducing to very low levels in 2005. The size distribution of fishes landed is suggestive of size class progression, with an initial input of juveniles in July 2004.

🡻 Maximum size and size at first maturity for the species of *Gerres* landed during this survey. Data are from Reef Base and may be from areas very different from Kavieng. The sizes should only be used as a very rough guide.

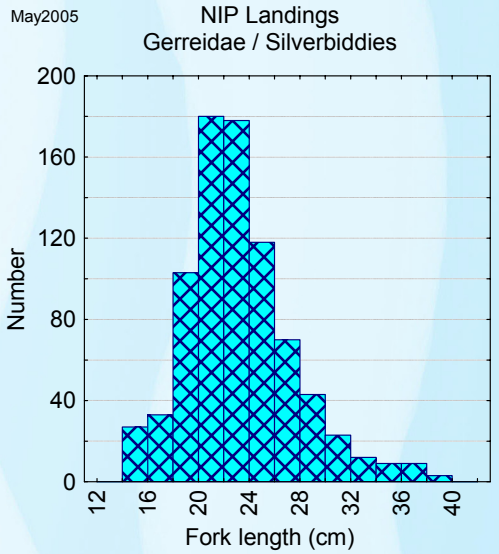
Sizes (cm) >>	Maximum	Maturity
G. erythrourus	30	
G. filamentosus	35	8-10
G. longirostris	37	
G. oyena	30	19-22





🡺 Size distribution of silverbiddies landed during the survey, and 🡹 broken down by sampling month (n=808).

🡸 Average number of silverbiddies per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

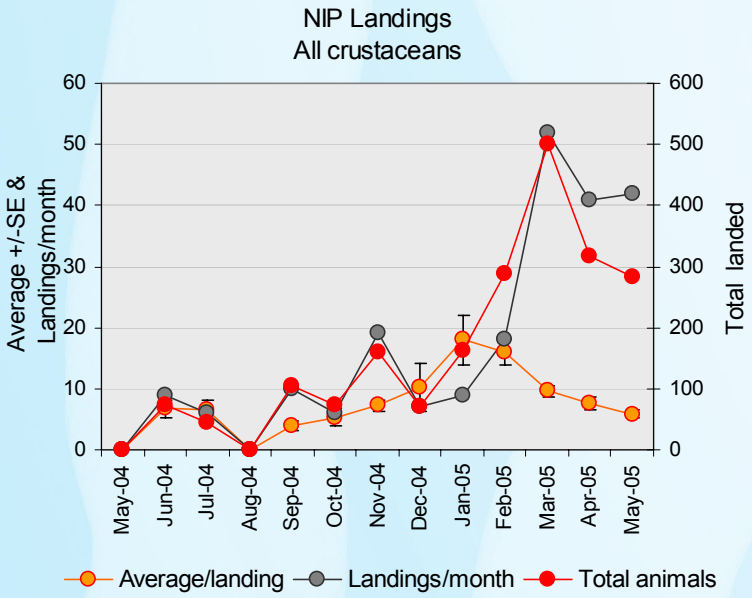


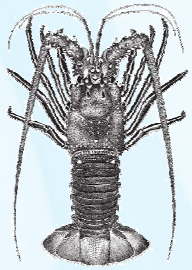
Crustaceans

A total of 2,081 crustaceans were landed and recorded during the survey, accounting for 4% of the total catch of all marine products by number of individuals. Crustaceans included mudcrabs, land crabs, mitten lobsters and spiny lobsters in 4 families, 4 genera and 7 species.

Crustaceans were present in 257 of all landings (14%). The greatest number of crustaceans were landed during March 2005, and the average number per landed catch varied significantly throughout the survey. The overall average number landed per boat was 8 animals, but ranged up to 36. The largest numbers landed per boat were recorded between December 2004 and February 2005 when landings were twice the overall average.

↙ Average number of crustaceans per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).



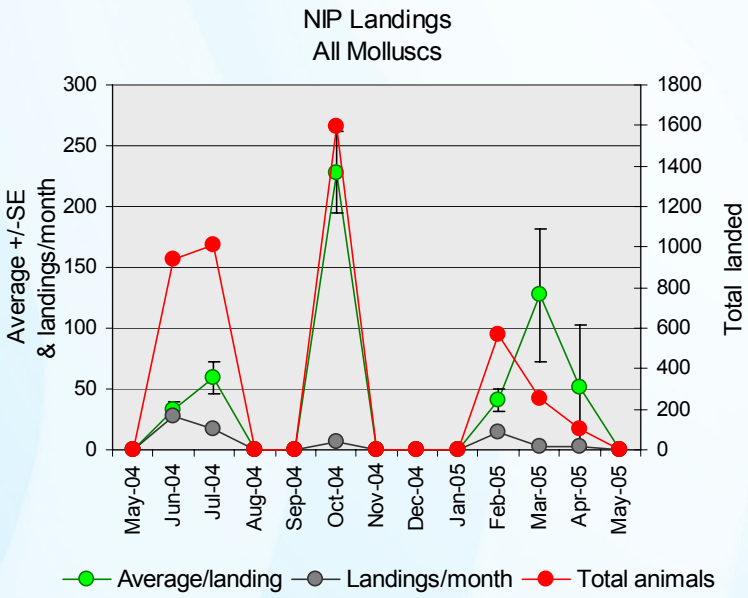


Molluscs

A total of 4,473 molluscs belonging to 4 species in 4 families were recorded during the survey of landings, accounting for 8.7% of all marine products landed. The molluscs landed included bivalves (*Anadara* and kina) as well as gastropods (trochus shells and greensnails). Molluscs were present in 4% of all landings (70 boats) during the survey.

Landings of molluscs were very variable throughout the survey, with significant landings recorded only during a few of the sampling months: June-July 2004, October 2004 and February-April 2005. The average number of animals landed per boat was 64 over the survey, and ranged up to 392.

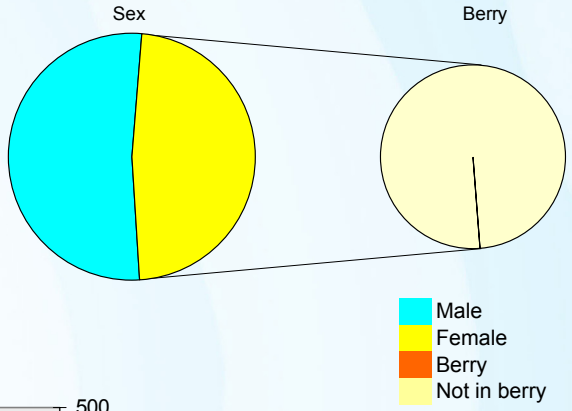
↘ Average number of molluscs per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

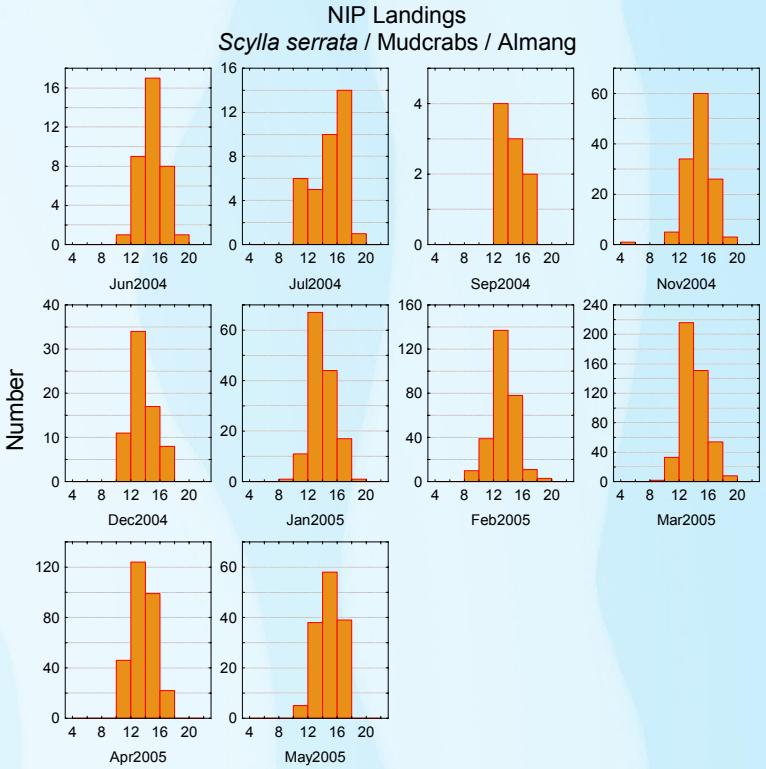


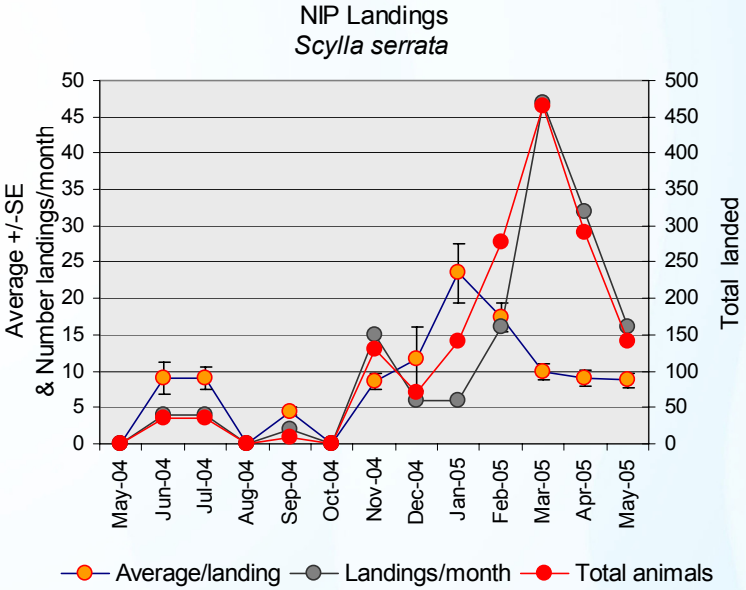
Crustacea > Portunidae > *Scylla serrata* / Mudcrabs / Almang

In total, 1,594 mudcrabs were recorded in 148 landings during the survey. Most of the mudcrabs were recorded during the second half of the survey from November 2004 to May 2005, peaking during March 2005. The average number landed per boat was 11 crabs, but ranged between 2 and 36 in a single landing. The average number landed per boat varied with month, with the most crabs per landing recorded in January and February 2005. In January 2005, the average number of crabs landed per boat was 23.5.

The average size of mudcrabs landed was 14 cm across the carapace (width of the main body), and ranged between 5.6 and 19.8 cm. The sex of the crabs landed was 51:49 male:female. Over the period of the survey only 1.2% of the crabs was recorded as in berry.

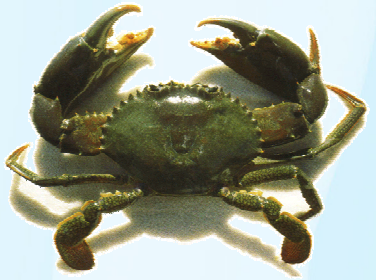




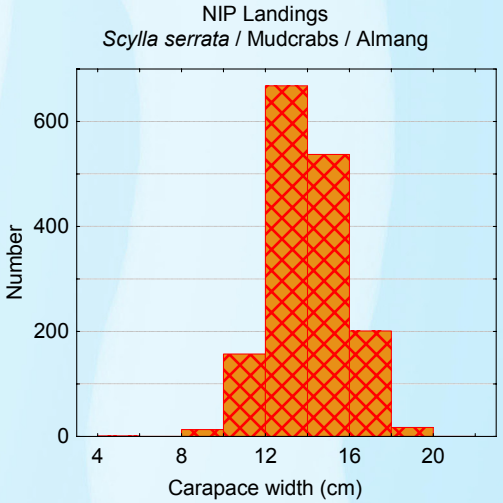


← Average number of mudcrabs per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

↑ Sex of mudcrabs landed and proportion in berry (n=1,565 for sex; 745 for berry). Very few crabs were recorded in berry, so this section of the graph is very small.



→ Size distribution of mudcrabs landed during the survey, and ↑ broken down by sampling month (n=1,594).

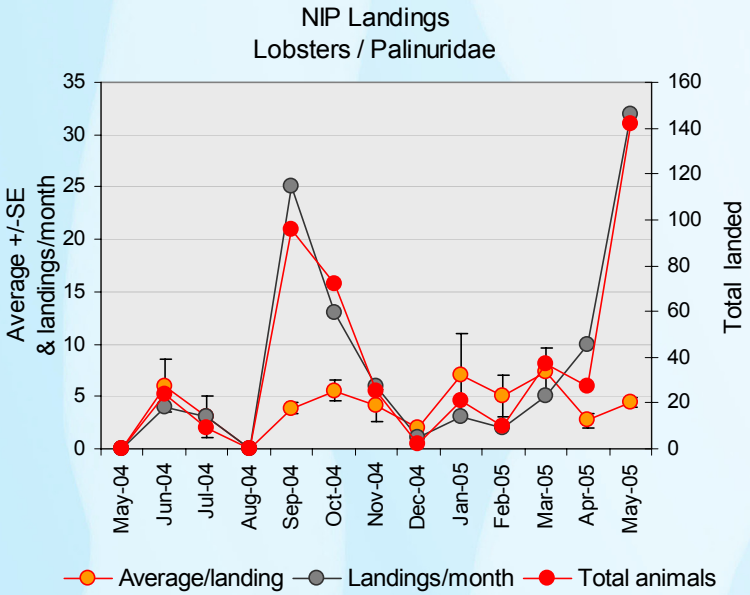


CRUSTACEA > PALINURIDAE / LOBSTERS / KINDAM

Lobsters accounted for less than 1% of the total catch monitored during this survey of landings. Three species were identified: *Panuliris ornatus* (44 animals landed), *P. penicillatus* (178) and *P. versicolor* (55). The greatest numbers of lobsters were landed in September 2004, most of them *P. penicillatus*. A total of 104 of all landings recorded had lobsters as at least part of the catch, just under 6% of all landings.

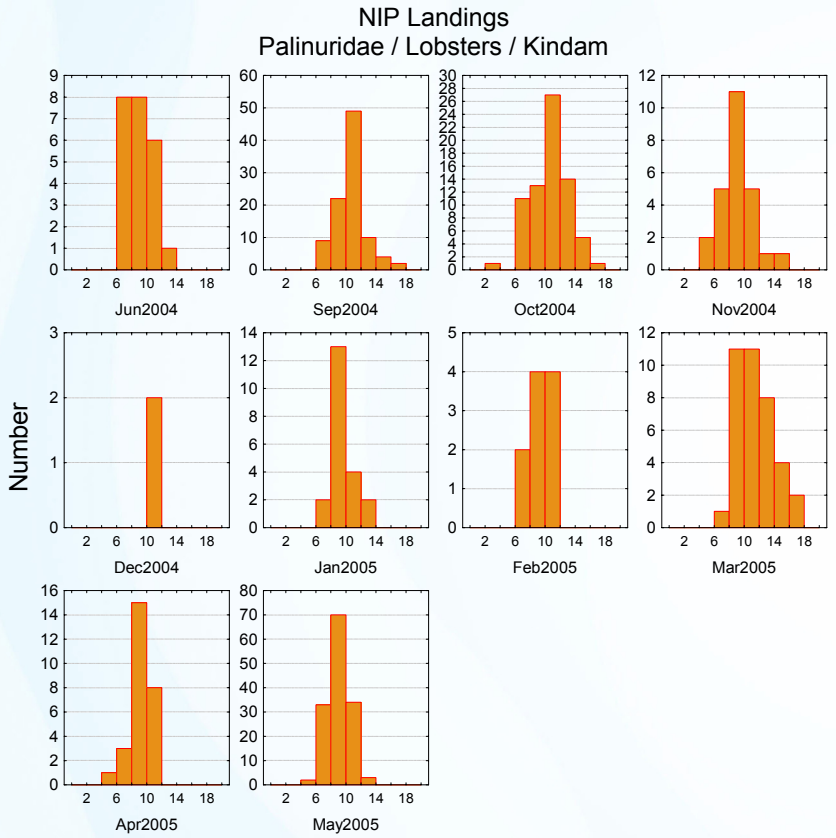
The average number of lobsters in each landed catch that included them was 4.5, but ranged up to 15. Catch rates varied significantly among boats and months of the survey, with zero or very low catches in May, July, August and December 2004. The highest average catch landed per boat in a month was during March 2005, during which 7.4 lobsters were landed per boat.

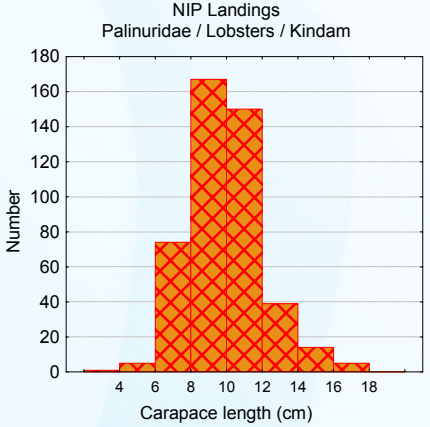
The average carapace length of the lobsters landed was 10 cm over the survey period. The size range recorded was between 2.8 and 18 cm, with most lobsters between 8 and 9 cm carapace length.



➔ Size distribution of lobsters landed during the survey, and ↗ broken down by sampling month (n=455).

➔ Average number of lobsters per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

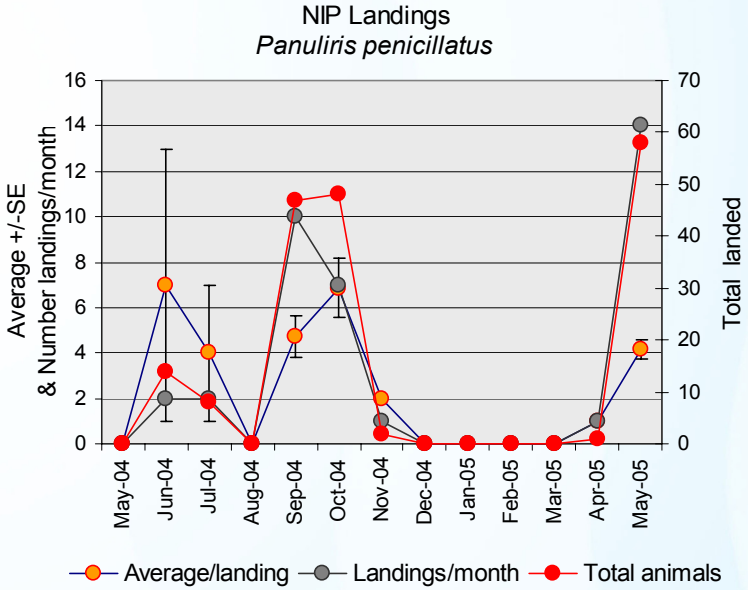


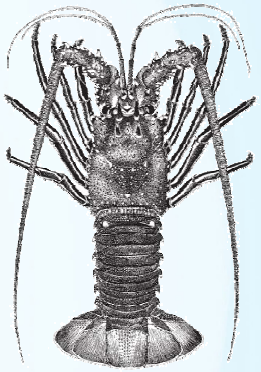


Crustacea > Palinuridae > *Panuliris penicillatus* / Pronghorn spiny lobster

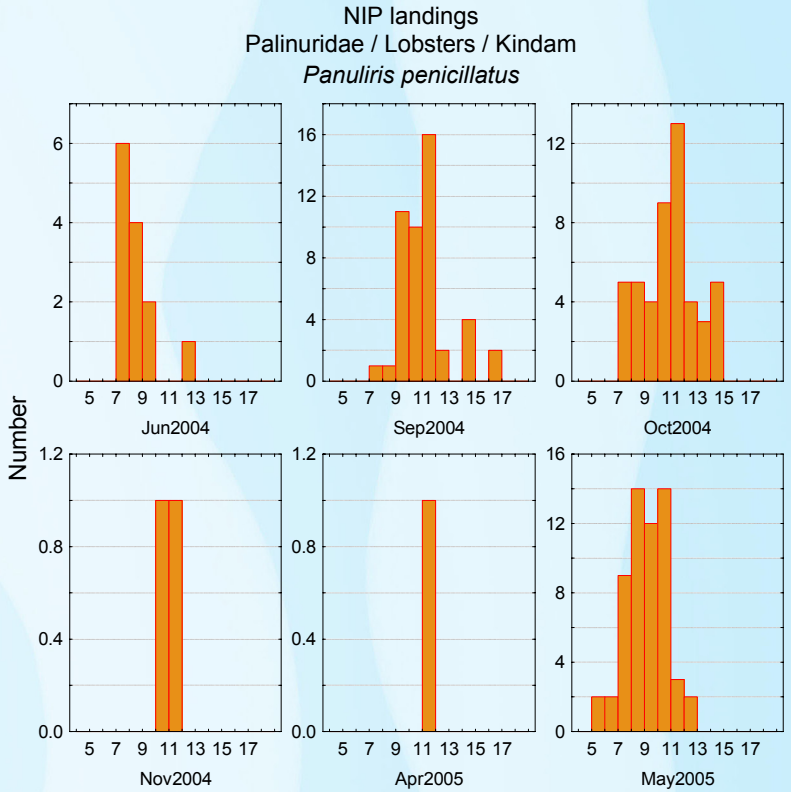
The pronghorn spiny lobster was the most common lobster species landed during this survey, and was present in 37 landings. The greatest numbers were landed during September and October 2004, and in May 2005, at the same time that boats containing them was also high. The average number landed per boat overall was 4.8 per boat, and ranged up to 13 per boat.

The average size of *P. penicillatus* landed was 10.3 cm carapace length, and ranged between 5.9 and 17 cm. Most of the smallest individuals were captured during May 2005.

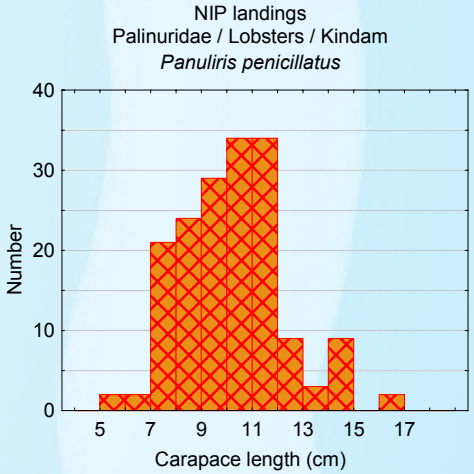




← Average number of pronghorn spiny lobsters per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).



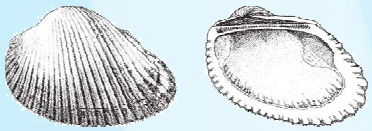
➔ Size distribution of pronghorn spiny lobsters landed during the survey, and ↗ broken down by sampling month (n=169).

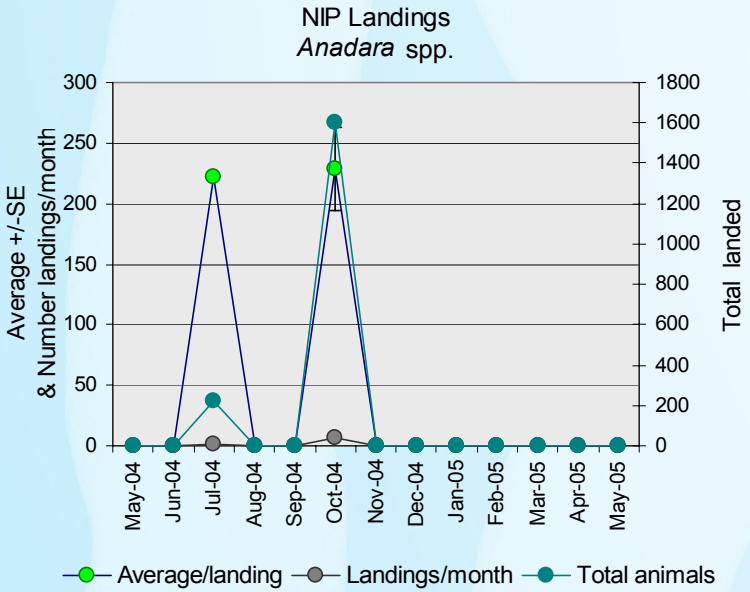


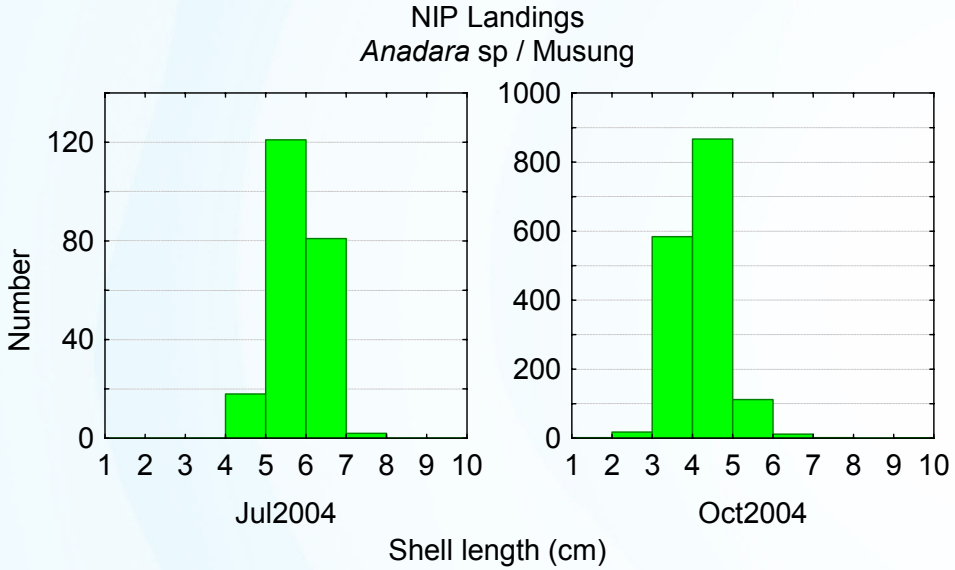
Molluscs > Arcidae > *Anadara* spp. / Cockles / Musung

The cockles *Anadara* were recorded in 8 landings during July and October 2004, with a total of 1,820 shells. Although they were present in only a few landings, the average number in each catch was high at 228 animals per boat and ranged between 136 and 392 per boat.

Cockles averaged a shell length of 4.6 cm, and a minimum and maximum size of 1.5 and 9.3 cm, respectively. The sizes landed in July 2004 were larger than those in October of the same year.

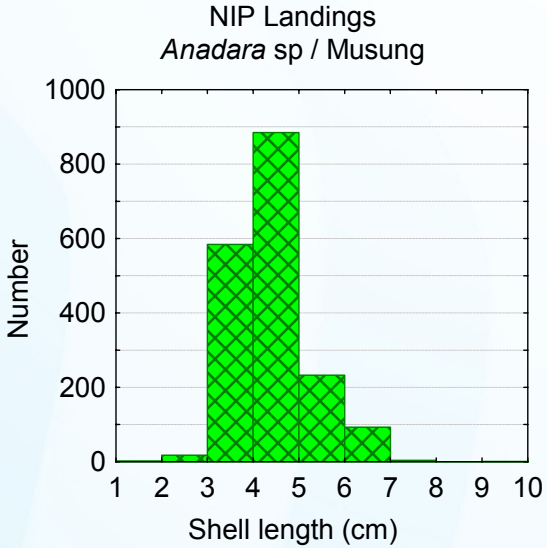






➔ Size distribution of cockles landed during the survey, and ↗ broken down by sampling month (n=1,820).

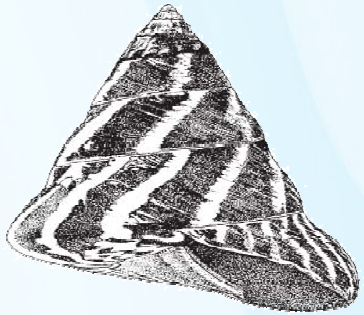
➔ Average number of cockles per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

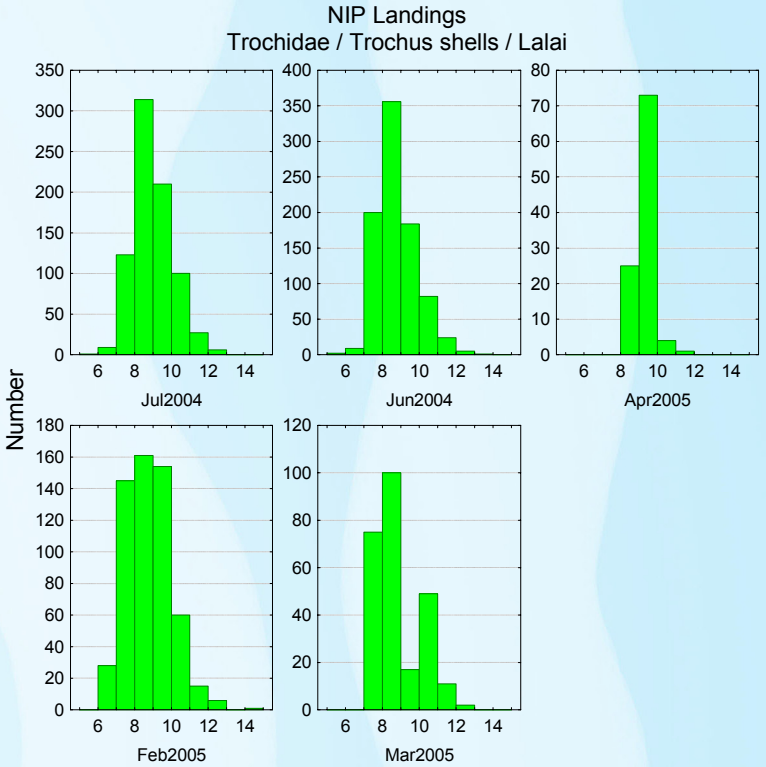


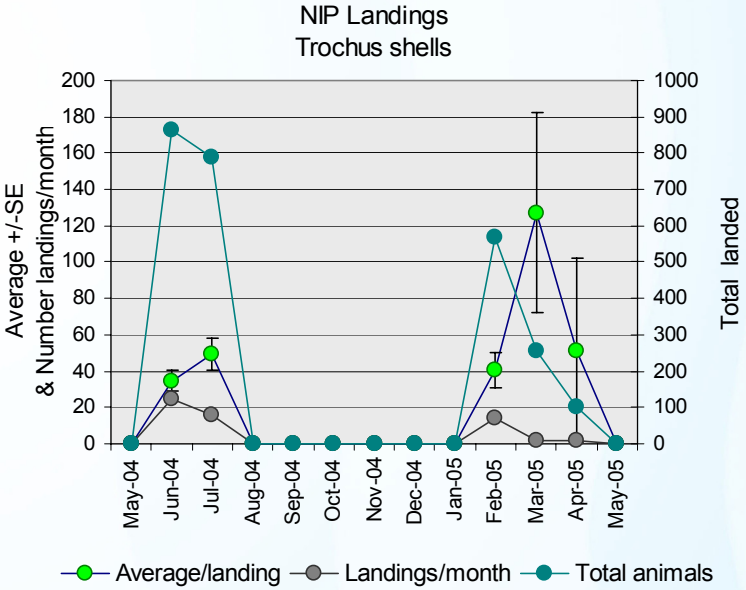
Molluscs > Trochidae > *Trochus* spp. / Trochus shells / Lalai

Trochus shells were landed sporadically during the survey, appearing in the period June and July 2004 and again in February through April 2005. A total of 2,580 shells were recorded over 59 landings (3.3% of all landings). The average number landed per boat was 44 animals, but ranged between 1 and 182 animals per boat over the survey.

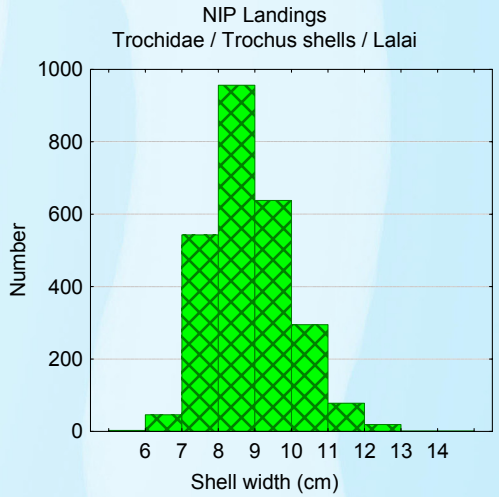
The average basal shell width was 9 cm, and ranged up to 20.7 cm. Most animals were 8-10 cm in width, with approximately the same size ranges being caught in all months of the survey.







➔ Size distribution of Trochus landed during the survey, and ➚ broken down by sampling month (n=2,580).



➔ Average number of Trochus per landing, number of landings per month of the survey and total number of individuals landed over the survey (n=1,813 landings).

Analysis of Market & Roadside Sales

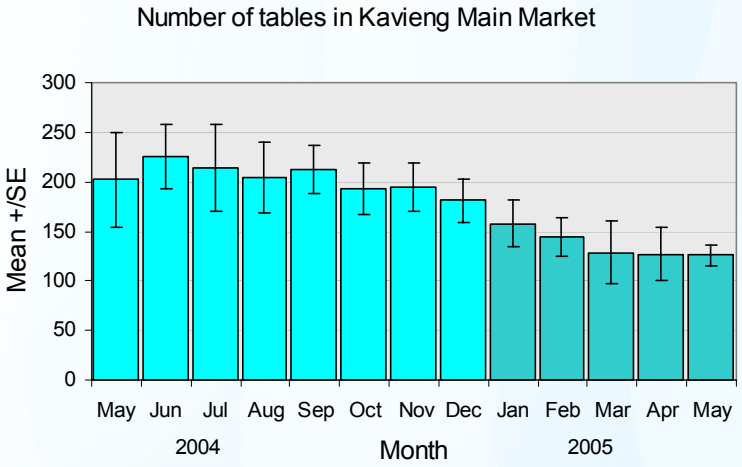
Kavieng Main Market

Kavieng Main Market had an overall average of 186 tables operating per day (between Monday and Saturday) over the survey period. The number of tables operating at the market varied with time, dropping from around 211 tables in 2004 to an average of 154 tables in 2005. The maximum number of tables operating on any one day was 360.

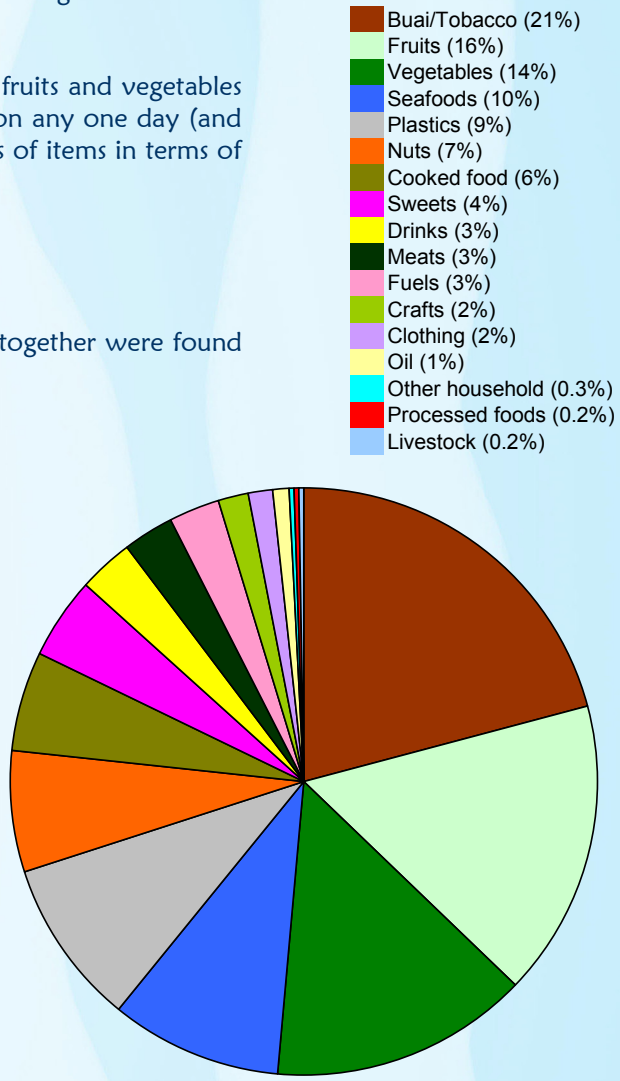
The most common items on offer were buai (betel nut) and tobacco (together amounting to 21% of all tables), fruits and vegetables (16% and 14% respectively). These figures were calculated on the basis of total number of incidences on tables on any one day (and averaged over all samples), regardless of the presence of other items. There appeared to be generally 4 categories of items in terms of the frequency with which they occurred on tables at the market:

1. Buai & tobacco which were found on more than 1/5th of all tables;
2. Basic raw food items which accounted for just over 1/2 of the tables;
3. Plastic bags for shopping accounted for 9% of tables; and
4. A range of cooked and processed foods and drinks, fuels, oils, clothing, household items and crafts which together were found on 17.8% of tables.

Seafoods were found on 10% of all tables overall, but varied widely in importance throughout the survey. The lowest number of tables selling any seafood items on any one day was 1, and the highest over the period of the survey was 84.



← Number of tables offering all goods at Kavieng Main Market during the period may 2004 to may 2005. Data are mean number of tables, regardless of the goods on offer +/- standard errors.



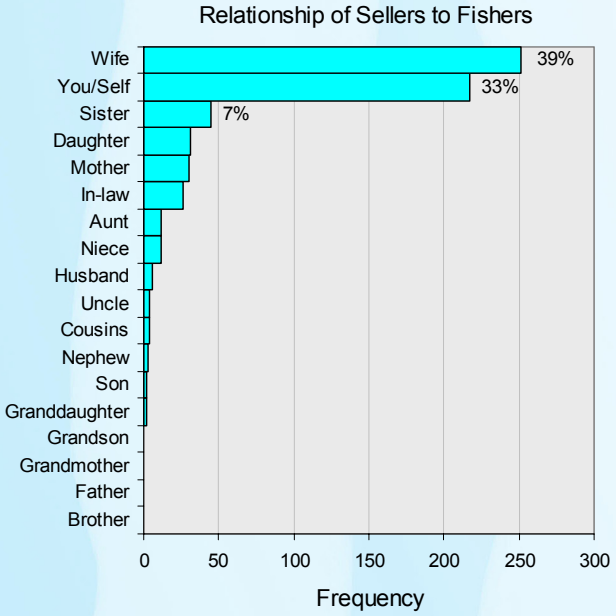
↗ Breakdown of the products on offer at Kavieng Main Market during the survey. Categories are in rank order.

Who are the Sellers?

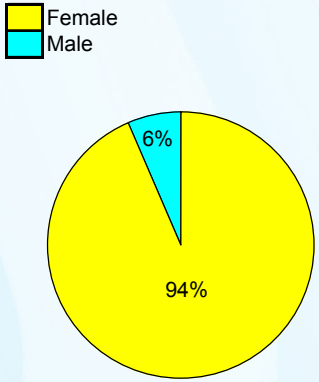
A total of 4,557 tables at Kavieng Main market and Bagail Roadside Market were sampled between 22 May 2004 and 30 May 2005. Details of sellers and the marine products they were offering were recorded.

Women accounted for 94% of all seafood sellers during the survey. Overall, many of the sellers were the wives of the fishers (39%) or were themselves the fishers or collectors of the produce they were selling (33%). The remaining 28% of sellers was mostly made up of the sisters, mothers, daughters, or in-laws of fishers, but included a smaller number of other close family relationships. None of the sellers reported they were selling for friends, neighbours or under any kind of commercial agreement.

There was a broad range of ages among sellers at both markets, with ages between 4 and 66 recorded. The younger age groups appear to comprise young children who accompany related sellers and who may assist the adults. The average age of a seller was around 34 years, but there were fairly even numbers of sellers between the ages of 20 and 40 years.



The composition of sellers changed constantly. We recorded 588 sellers over the survey, most of whom (69%) were only recorded once over the 169 sampling days. About 95% of the people we surveyed were recorded at the market 5 times or less over the period of this survey. The average number of times an individual seller was recorded in our samples was twice, with the maximum recorded being 33 times.



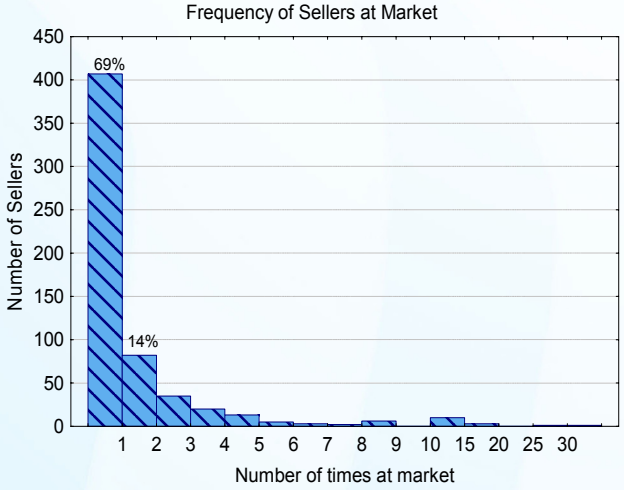
Gender of Sellers

↑ Gender of sellers at Kavieng and Bagail Markets. Values are percentages of all sellers interviewed over the survey (n=588).

↑ Age of all sellers interviewed across the market survey (n=550).

↙ Relationship between the sellers we interviewed and the fishers / collectors who gathered the seafoods being offered for sale (n=649 roles across 588 sellers).

↓ Frequency with which different sellers were recorded at market (n=588).



Seafood Tables

A total of 38,505 marine products and seafoods were identified, measured and recorded for sale at Kavieng Main and roadside markets during the period May 2004 and May 2005. During that time 4,557 tables on which seafoods were being sold were surveyed.

Between April 2004 and May 2005 (112 sampling days) the number of tables at Kavieng Main Market offering seafoods and other marine products for sale averaged over 15 per day. The maximum number of tables offering seafoods on any one day was 32 (on 16th September 2004) and the minimum number was zero (on 22 May 2004). These figures excluded lime sold with buai (betelnut) and which in Kavieng is usually made from corals.

Group	Family	Genus	Species	Number
Fishes	32	100	243	12,917
Crustaceans	3	4	4	2,887
Molluscs	4	4		22,701
Total				38,505

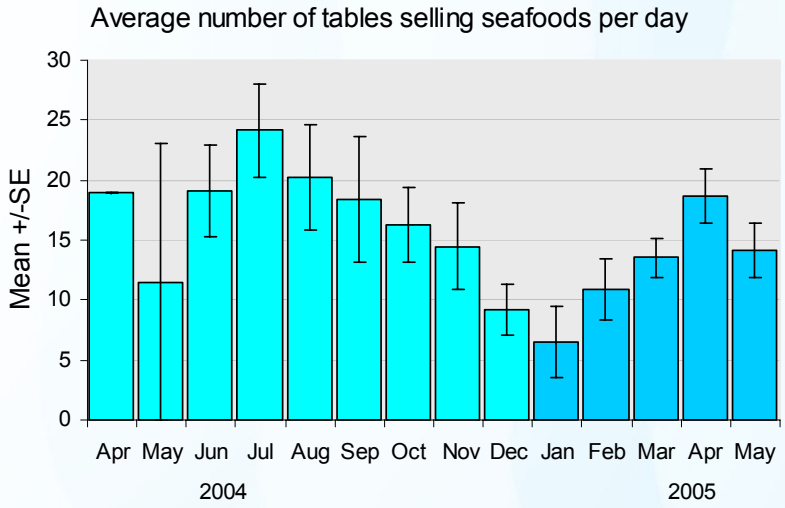
The greatest number of seafood tables was observed in the period July to September 2004, and the lowest number during December 2004 and January 2005. These results may correspond with fishing seasons identified during the socio-economic survey and/or the prevailing monsoon periods. Mid year is usually dominated by the SE trade winds and relatively drier, more stable conditions. The NW Monsoon during November-April is usually associated with stormy weather and rough seas.

The largest share of seafoods for sale at the Kavieng Main Market are fishes (70% overall). Crustaceans, mostly mudcrabs, account for a further 20% of the seafood products offered for sale, with molluscs and seaweeds (*Caulerpa*) accounting for 10%. Turtle meat, which was recorded on very few occasions, forms a negligible part of the produce sold at the market. The types of seafoods offered for sale varied over time. Fishes and crabs were almost always available, while molluscs and seaweeds were only available part of the time. During October 2004 and the period December 2004 to March 2005, seaweeds were not recorded at all in the market.

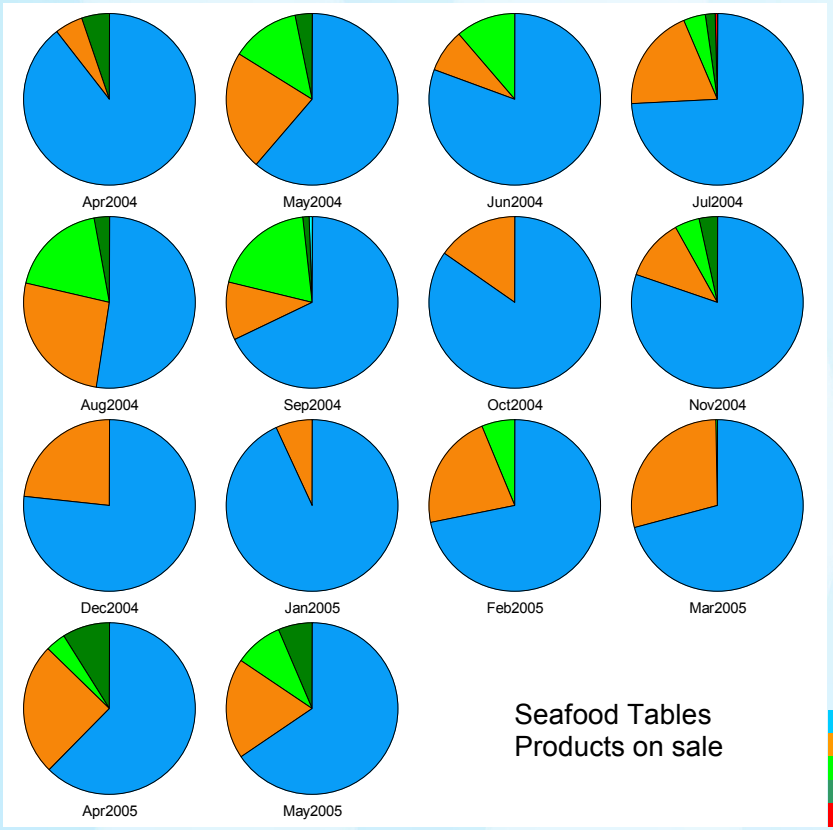
We recorded 12 main groups of organisms offered for sale at the main market, including (i) fresh, smoked and cooked fish, (ii) mudcrabs, landcrabs and lobsters, (iii) cockles (*Anadara* sp.), bivalves, mangrove snails (*Telescopium* sp.) and giant clams (*Tridacna* spp.), (iv) algae (*Caulerpa* spp.) and (v) turtle eggs or meat.

Fishes were usually sold whole and may have been gutted and gilled, though occasionally, pieces of smoked fish were offered for sale. Mudcrabs were usually offered live with their claws tied. Most of these seafoods were sold individually. Landcrabs were usually sold cooked, mostly only as claws, and lobsters sold either raw or cooked, either whole or as tails. Most molluscs and seaweed were sold in packages. *Anadara* were often sold live and seaweeds sold fresh, both in locally-made baskets. *Anadara*, bivalves, mudsnails and clams were also sold smoked on skewers or strings.

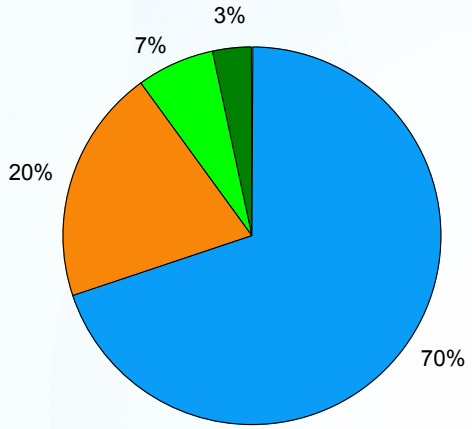
Number of tables in Kavieng Market offering seafoods for sale during each month of the survey. Values are means +/- standard error.

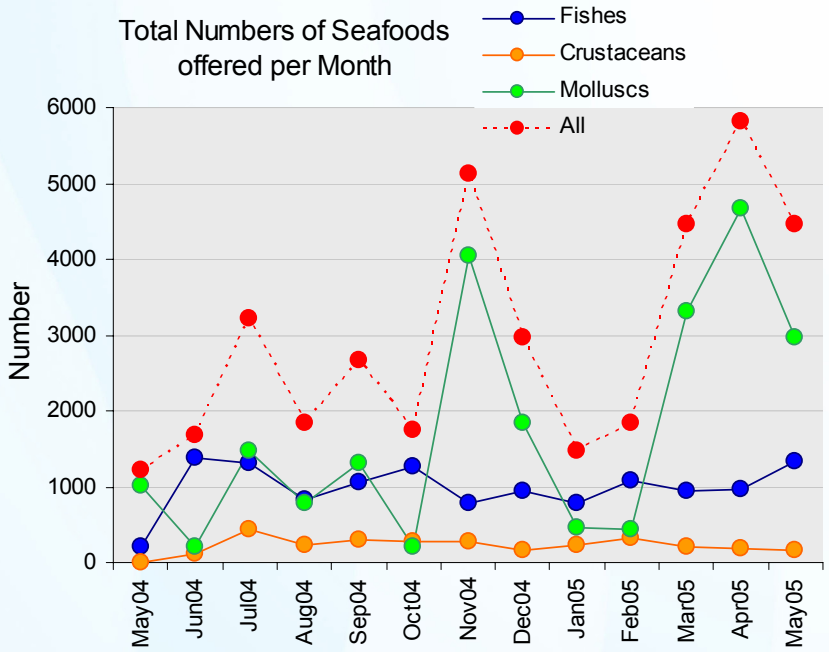


The availability of each type of seafood fluctuated significantly throughout the survey. For most groups, the number of tables on any one day was very small (e.g. between 2 and 9 tables offering mudcrabs on any one day), though could be significantly higher for molluscs (*Telescopium*, the mangrove snail). The most interesting pattern observed was in the fishes. Whenever the number of tables offering fresh fishes for sale tended to decline, the number offering smoked fishes increased, and vice versa. This pattern suggests that regardless of how the total daily number of fish being offered may have changed throughout the survey, there may have been a swap at times between fresh and smoked fish by some vendors. It is not clear why this may have occurred.



Breakdown of the types of marine resources sold at Kavieng Main Market over the survey period. ➔Top graph is overall, ↙ lower graph shows values broken down by month.

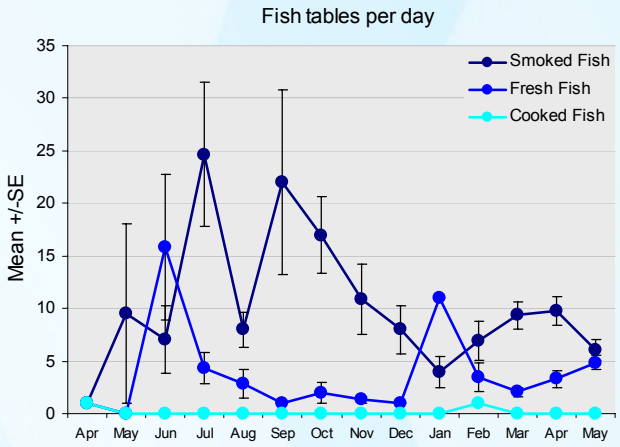


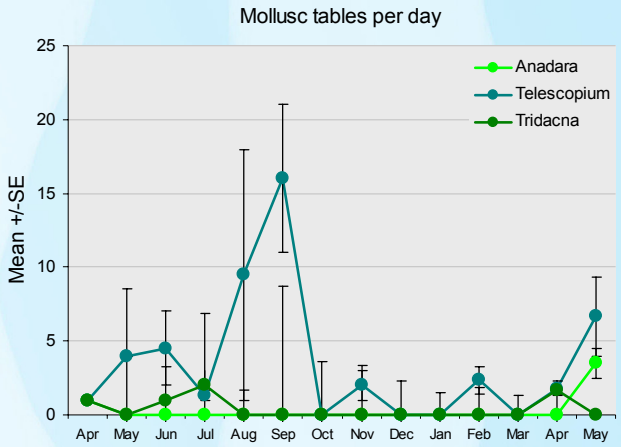


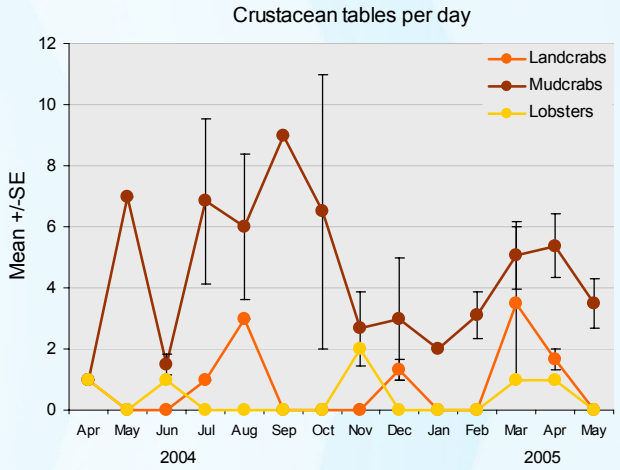
↑ Total numbers of seafoods offered for sale at the Kavieng Main Market per month of the survey. Values are broken down by main group of animals. Note that the average monthly amount of fishes and crustaceans remained relatively stable over the time of the survey. The overall peaks in numbers of seafoods for sale is driven by sporadic numbers of molluscs, usually *Anadara*.

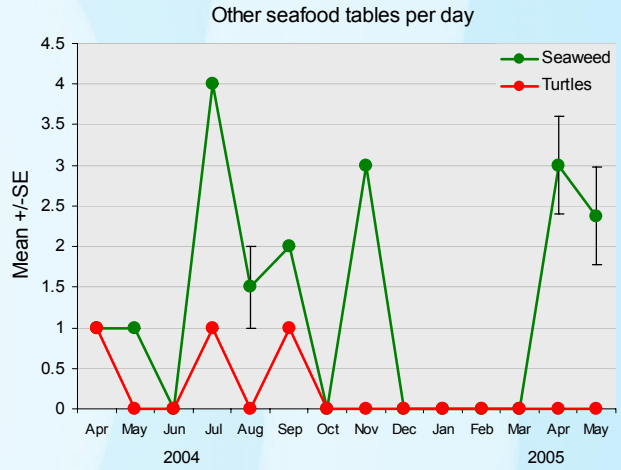
Preliminary estimates of the volume of seafoods that could be moving through Kavieng Main Market were calculated. These calculations were based on the number of tables selling each type of seafood per day and the number of units for sale per table.

There may have been as many as 73,000 reef fishes and over 11,000 mudcrabs sold through the market over the past one-year period. These figures should be used with caution, particularly for the molluscs, as they are based on numbers of seafoods in a range of units. Days were multiplied by 24 to obtain an average monthly estimate and by 257 for a yearly one.









	Tables/day	Units/table	Units/day	Units/mo	Units/yr	Units
Cooked Fish	0.14	4.50	1	15	165	Whole
Smoked Fish	10.29	20.01	206	4,944	52,941	Whole
Fresh Fish	3.86	20.23	78	1,873	20,055	Whole
Landcrabs	0.82	13.60	11	268	2,871	Pieces/whole
Lobsters	0.43	1.60	1	16	176	Whole
Mudcrabs	4.47	9.71	43	1,041	11,146	Whole
Anadara	0.32	7.57	2	58	625	Baskets
Bivalves	0.36	13.33	5	114	1,224	Baskets/whole
Telescopium	3.51	10.55	37	888	9,512	Whole/Baskets/Skewers
Tridacna	0.40	4.64	2	45	482	Whole/Skewers
Seaweed	1.28	8.61	11	264	2,824	Baskets
Turtles	0.21	28.00	6	144	1,542	Pieces

↑ Number of tables in Kavieng Main Market offering different types of seafoods for sale during each month of the survey. Values are means +/-SE for different groups of marine resources.

← Summary of calculated volumes of seafoods that may be moving through Kavieng Main Market per day, month and year. Units can include more than one types for each seafood, so values are very approximate.

FISHES

A total of 12,921 fishes were recorded and measured during the market survey. The fish belonged to 32 families, and included approximately 257 species. The most common fishes offered for sale at the market were snappers, emperors, trevallies and scads, rabbitfishes, groupers, parrotfishes and mullets.

The average number of fishes for sale per table, and total number of fishes for sale per month fluctuated over the survey, but did not appear to be changing overall.

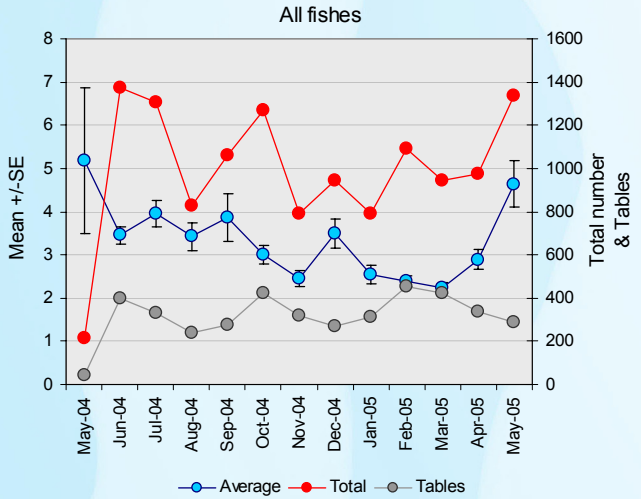
Overall, about 1/2 of the fishes for sale were fresh and 1/2 smoked (with a very small percentage cooked). There was a tendency for more of the fishes for sale at the main market to be smoked, while many of the fishes for sale at other locations were fresh.

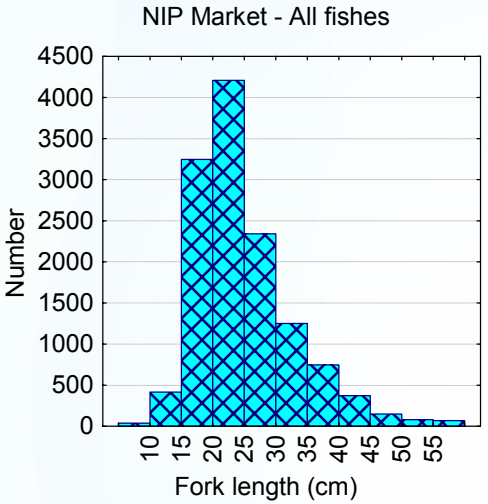
➔ Size distribution of all fishes recorded for sale at markets the survey across all months (n=12,921).

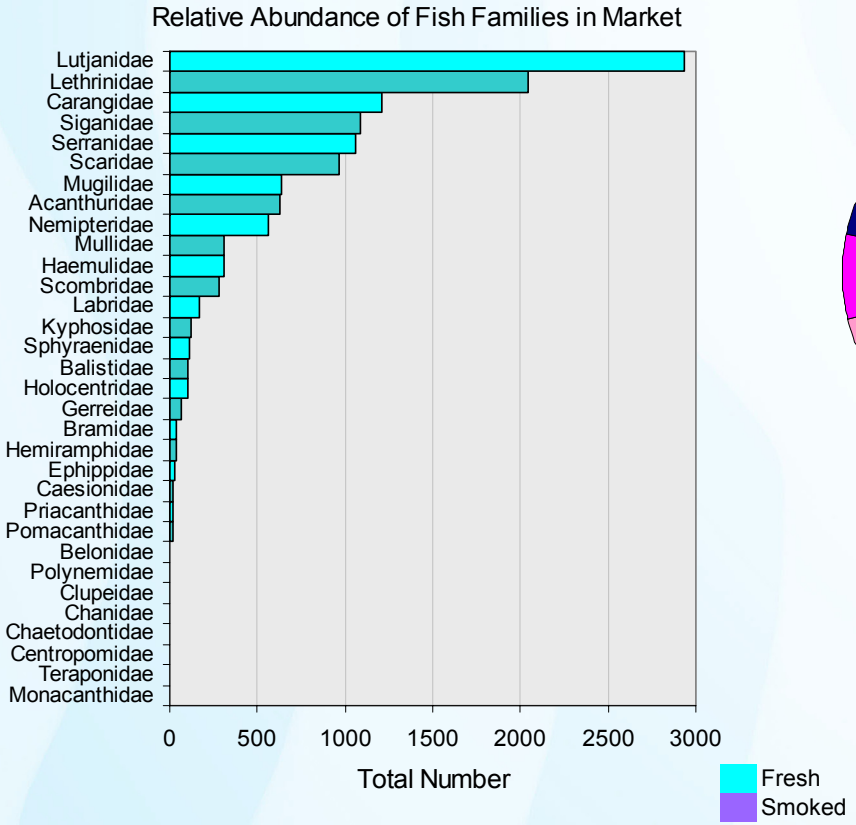
➔ Relative abundance of all fish families recorded during the survey of markets in Kavieng.

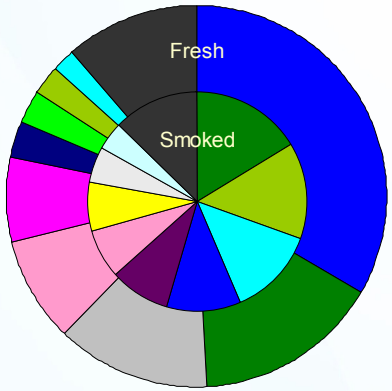
➔ Most common fish families offered for sale either fresh or smoked. Also shown is the breakdown of proportions of fresh and smoked fish overall.

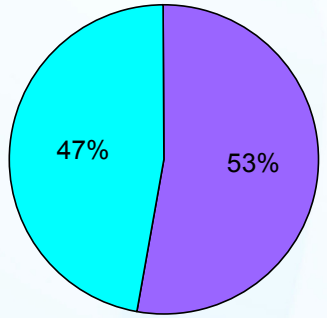
➔ Total number of fishes per month, average number per table and number of tables offering fishes during the survey.



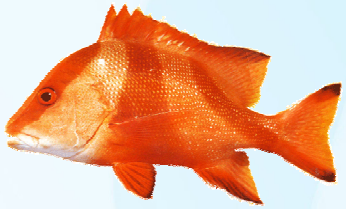








Fishes > Lutjanidae / Snappers

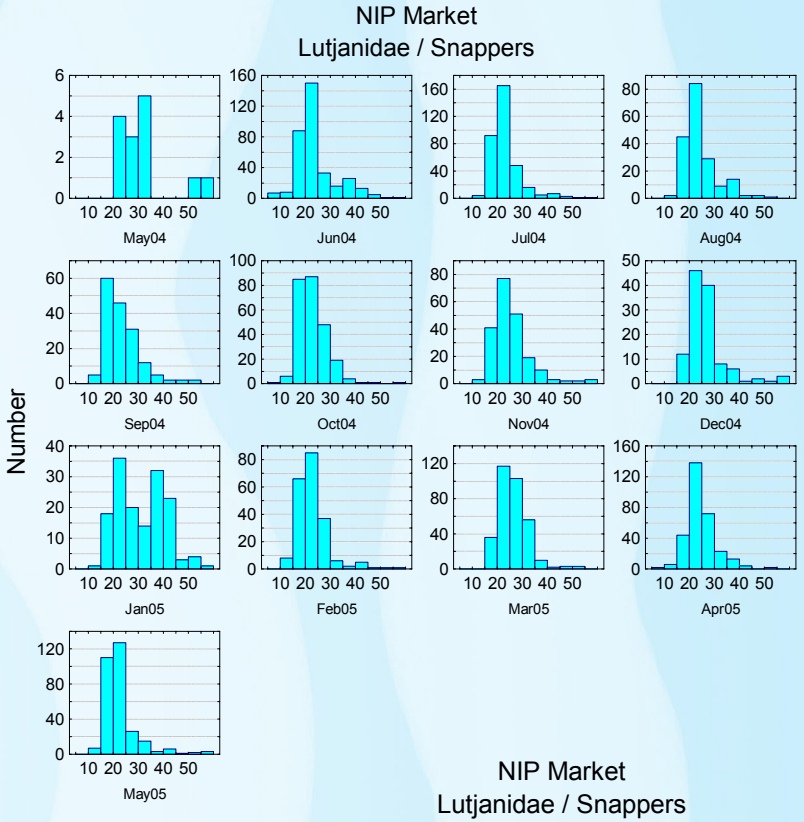


Snappers were the most common fishes for sale in the markets around Kavieng, with 2,938 fishes being offered on 929 tables during the survey, accounting for 23% of all fishes. On average around 3 snappers were for sale on tables that offered fishes of this family, or an average of 0.6 snappers per table across all tables surveyed.

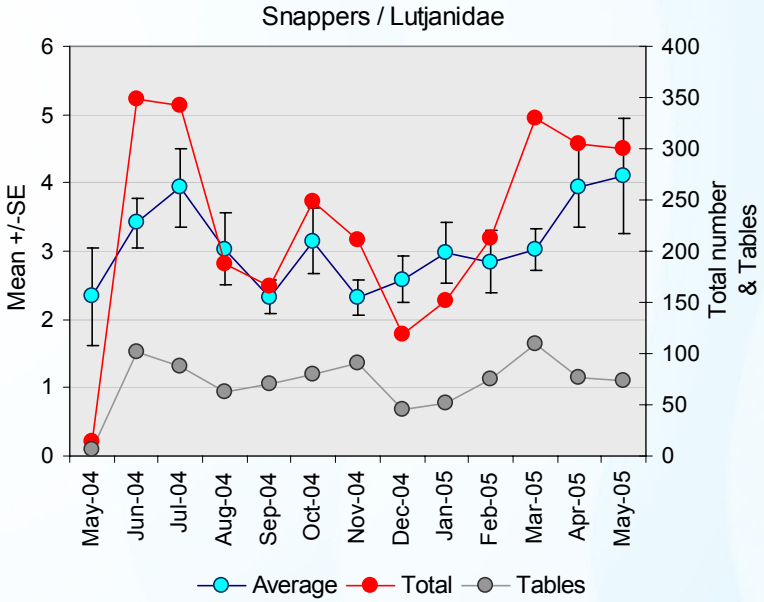
The average size of snappers offered for sale was 24.7 cm fork length, and ranged up to 74.5 cm. Most fishes were between 20 and 25 cm overall, but fish sizes offered for sale varied during the survey. The largest snappers offered in the market were recorded in January 2005.

The majority of snappers (76%) was offered for sale fresh, and most of the remainder smoked. There was no obvious difference in the size of fishes that were processed.

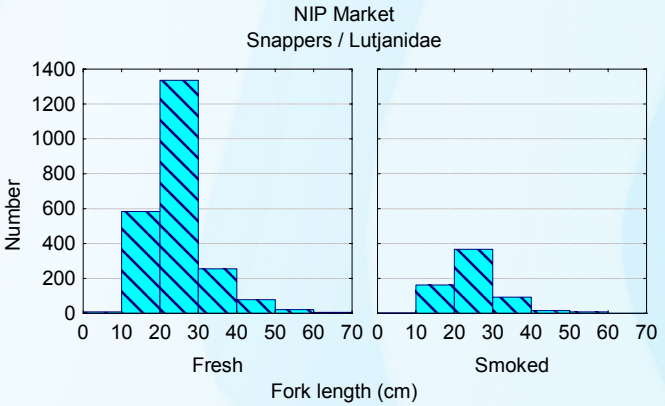
↘ Size distribution of snappers in markets during the survey, and ➔ broken down by sampling month (n=2,938 fishes).

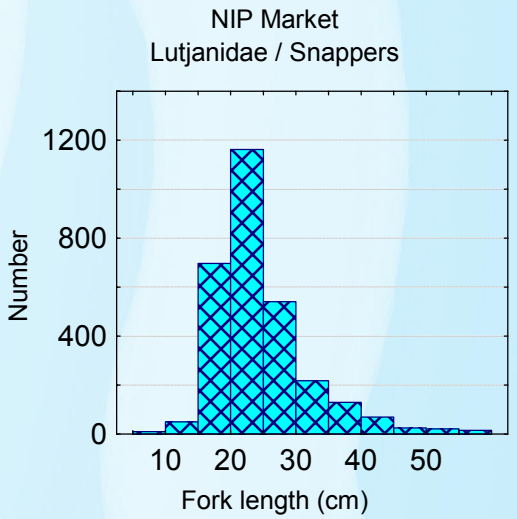


↙ Average number of snappers per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4,557 tables).



🡻 Sizes of fresh and smoked fishes offered in the markets.





Fishes > Lutjanidae > *Lutjanus argentimaculatus* / Mangrove jack

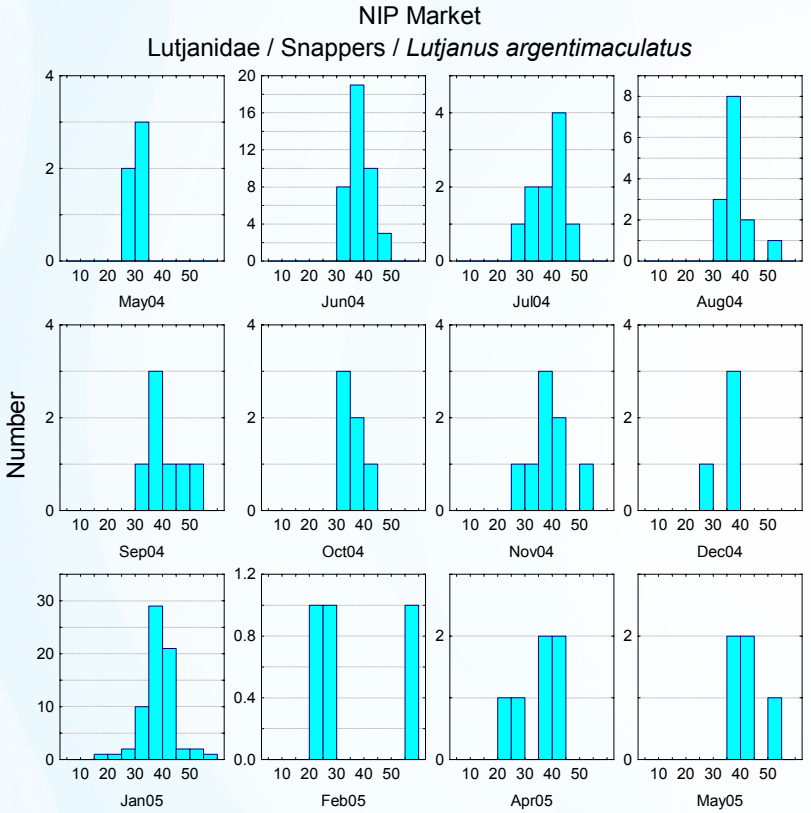
A total of 177 mangrove jacks were recorded over the survey of markets in Kavieng, with fishes of this species appearing on a total of 80 tables. The average number found on tables offering this fish was 2, and reached a maximum of 15. This fish was present in relatively low numbers throughout the survey, but was recorded in all months. The average number of fishes per table varied through time, with the highest averages in May and June 2004 and January 2005.

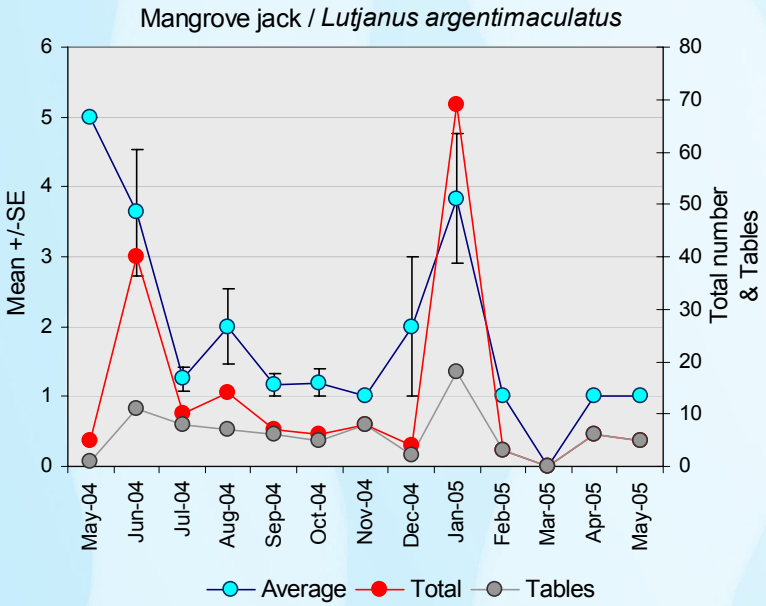
The mean size of fishes on offer was 38.2 cm and ranged from 19.5 to 65.3 cm. Most fishes were between 35 and 40 cm long, with no clear patterns in the sizes of fishes being offered through the months of the survey. Most of these fish were offered for sale fresh, with 26% offered in smoked form.

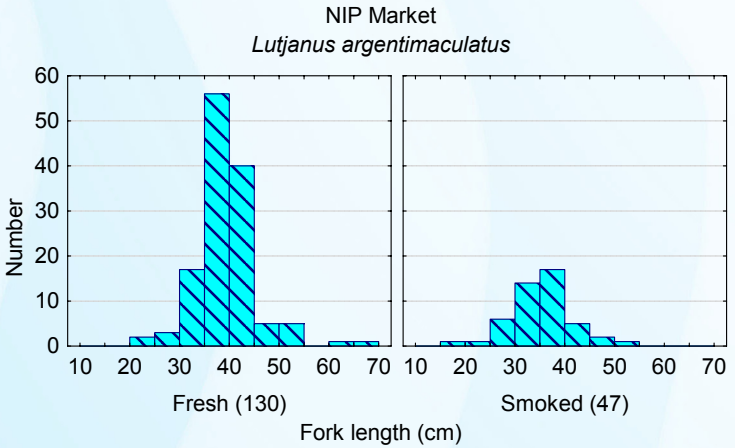
↘ Size distribution of mangrove jack in markets during the survey, and ➔ broken down by sampling month (n=177 fishes).

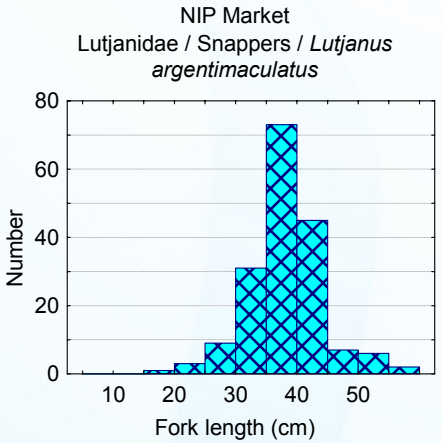
↙ Average number of mangrove jack per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4,557 tables, 177 fish counted).

🡻 Sizes of fresh and smoked fishes offered in the markets.





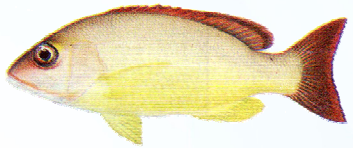




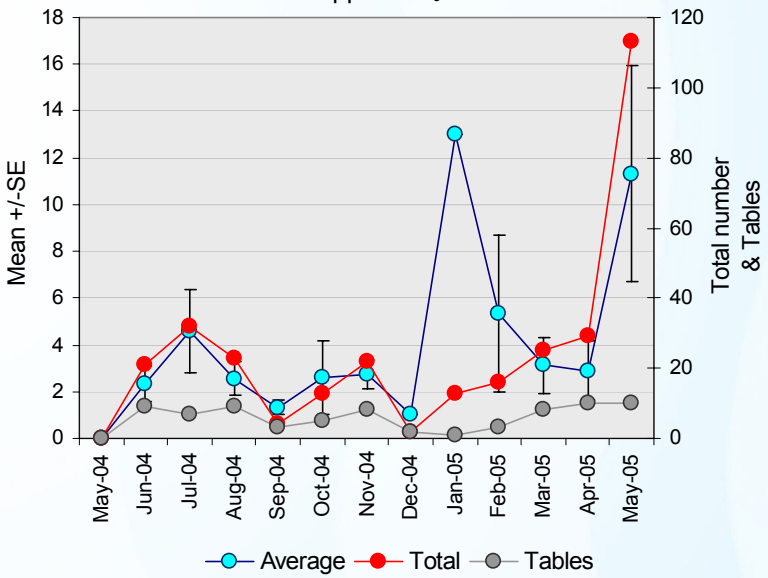
Fishes > Lutjanidae > *Lutjanus fulvus* / Blacktail snapper

An average of 4 and maximum of 49 blacktail snappers was found on market tables during the survey. A total 313 of these fishes was recorded over a total of 75 tables throughout the survey, with the greatest number and averages recorded in May 2005.

Blacktail snappers ranged in size between 10 and 36.4 cm fork length, averaging 22 cm. The most common sizes were between 15 and 20 cm. Most of these snappers were offered fresh, with only 22 individuals smoked.



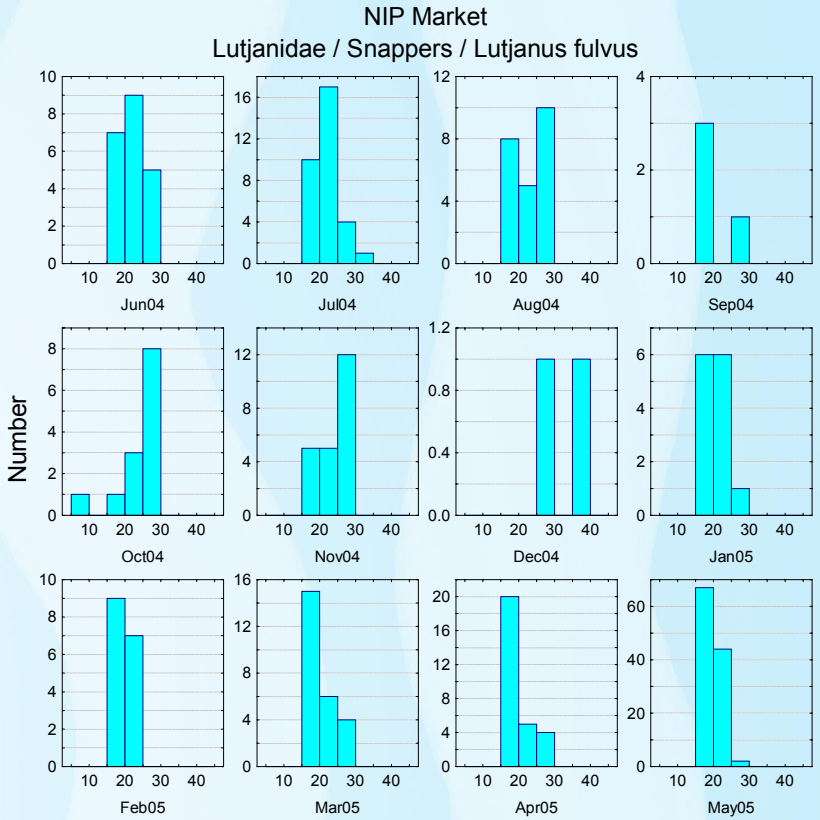
Blacktail snapper / *Lutjanus fulvus*

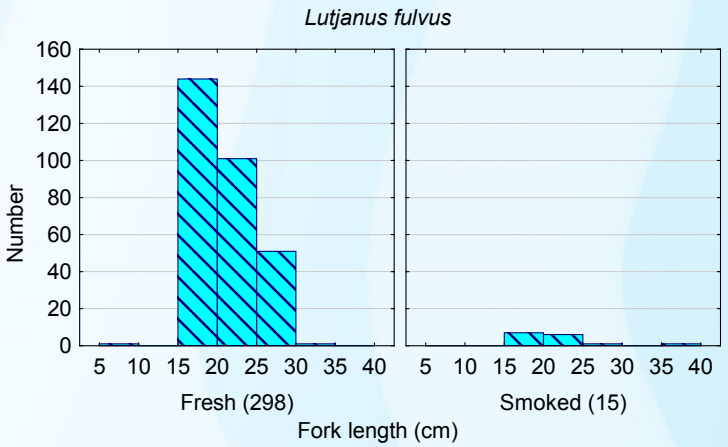


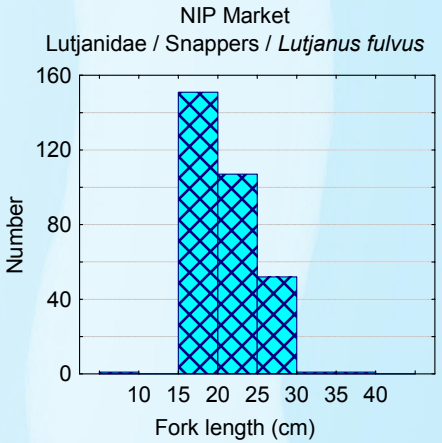
↘ Size distribution of blacktail snappers in markets during the survey, and broken down by sampling month (n=313 fishes).

↙ Average number of blacktail snappers per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4,557 tables, 313 fishes counted).

🡻 Sizes of fresh and smoked fishes offered in the markets.





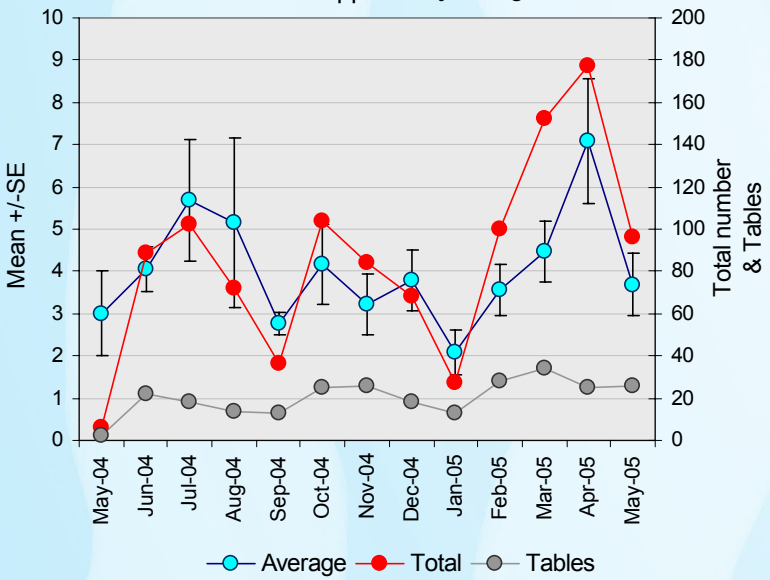


Fishes > Lutjanidae > *Lutjanus gibbus* / Paddletail

Overall, 1,117 paddletail snappers were counted across a total of 264 tables during the survey. The number of tables selling this species remained relatively steady throughout the survey, but the mean number per table and totals for sale appeared to peak approximately every 4 months.

The average size of these fishes was 24 cm, and ranged up to 55.5 cm. Most fishes were between 20 and 25 cm fork length, with larger numbers of smaller fish recorded between September and November 2004. Most of these fishes were offered for sale fresh, with about 25% offered smoked.

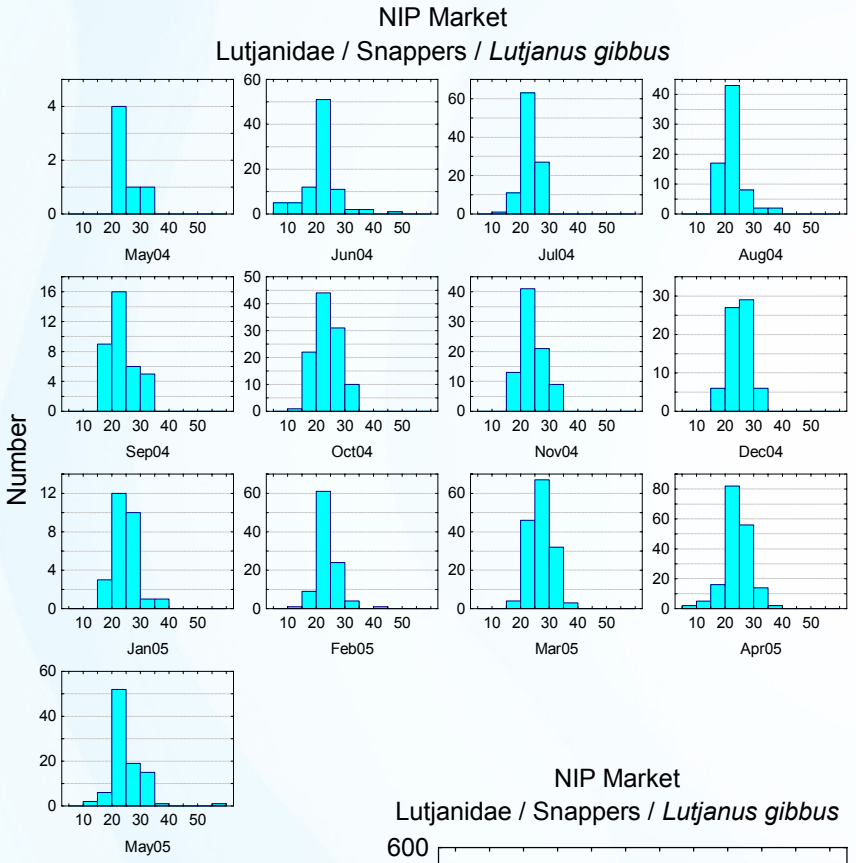
Paddletail snapper / *Lutjanus gibbus*

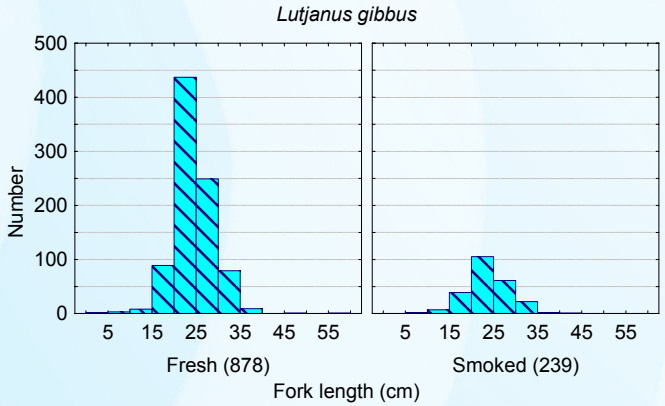


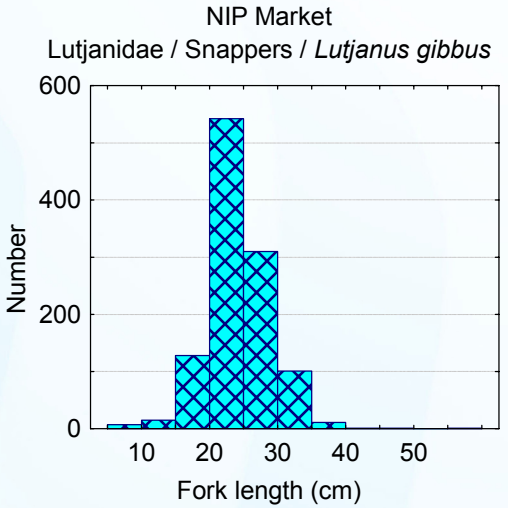
↘ Size distribution of paddletails in markets during the survey, and broken down by sampling month (n=1,117 fishes measured).

↙ Average number of paddletails per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4,557 tables).

↓ Sizes of fresh and smoked fishes offered in the markets.







Fishes > Lethrinidae / Emperors

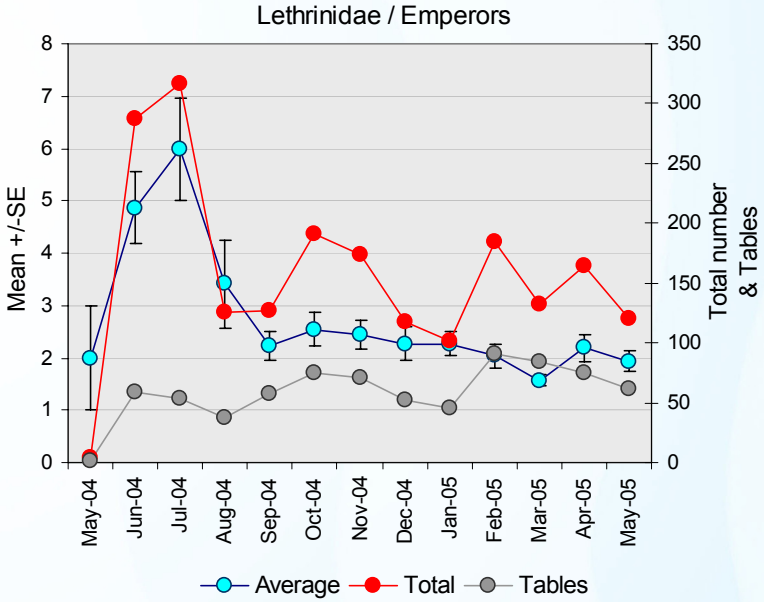
Emperors accounted for around 16% of the fishes offered for sale in markets around Kavieng, being the second most common family recorded. Emperors were present on around 17% of tables we surveyed. The total numbers offered for sale varied by month of the survey, with the greatest numbers on offer between June and July 2004. This peak appeared to be the result of greater numbers being available on individual tables, rather than a greater number of tables offering them.

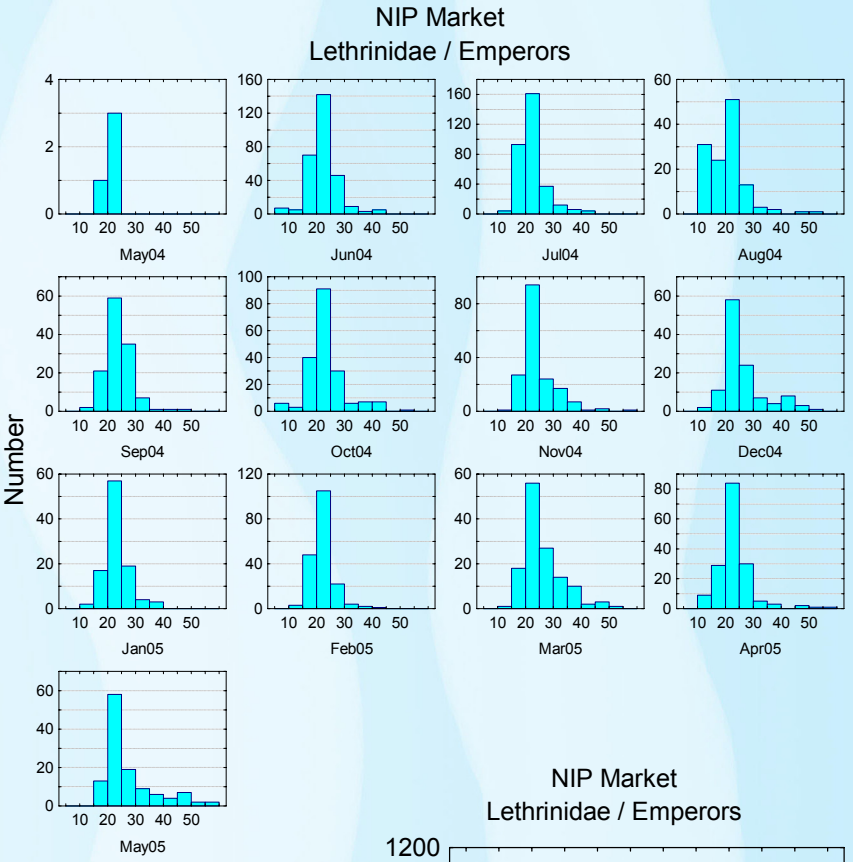
The average size of emperors being sold was 24 cm, and ranged between 8 and 69 cm over the survey. Most of the fishes measured were between 20 and 25 cm fork length. The largest number of small fishes was offered for sale in August 2004, and the largest fishes during December of that year. Roughly half of all emperors was offered for sale fresh and half smoked during this survey.

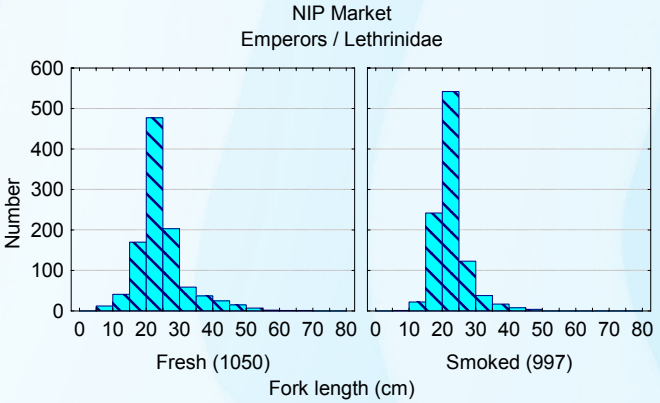
↘ Size distribution of emperors in markets during the survey, and broken down by sampling month (n=2,047 fishes).

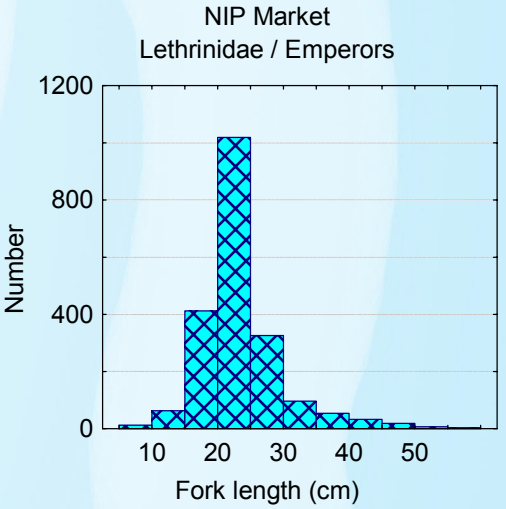
↙ Average number of emperors per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4,557 tables).

↓ Sizes of fresh and smoked fishes offered in the markets.









Fishes > Lethrinidae > *Lethrinus lentjan* / Redspot emperor

Redspot emperors were recorded on a total of 153 tables over the survey, averaging 3.3 fish per table over all, and with a maximum of 19 fish observed on an individual table. Although the number of tables offering this species varied slightly during the survey, averaging 12 per month, the number of fish being offered per table varied between 0 and almost 7.

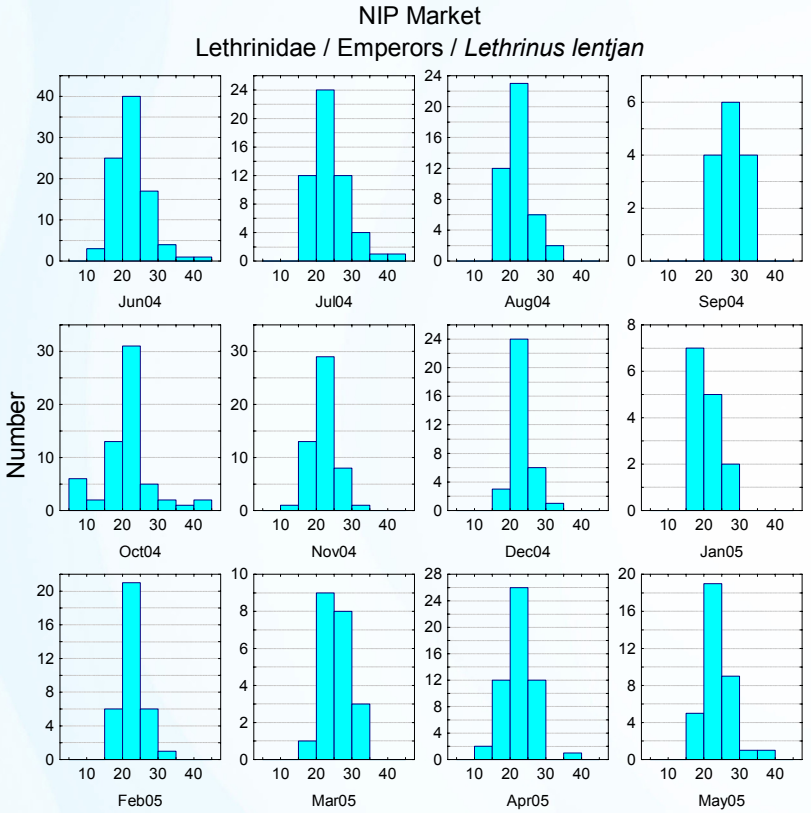
The average size of redspot emperors offered in markets around Kavieng was 23 cm and ranged between 10 and 45 cm. Most fishes were between 20 and 25cm, with the broadest range in sizes observed during October 2004.

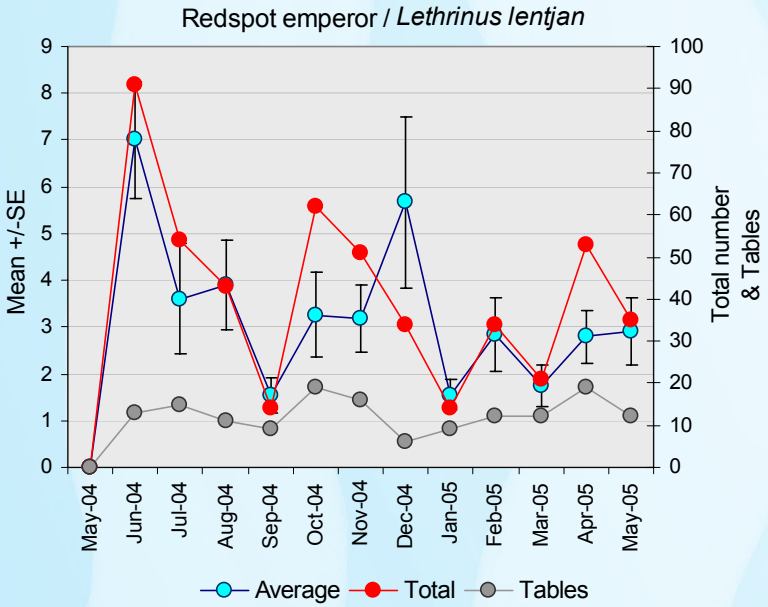
Although most fish of this species were offered for sale fresh, around 29% were smoked.

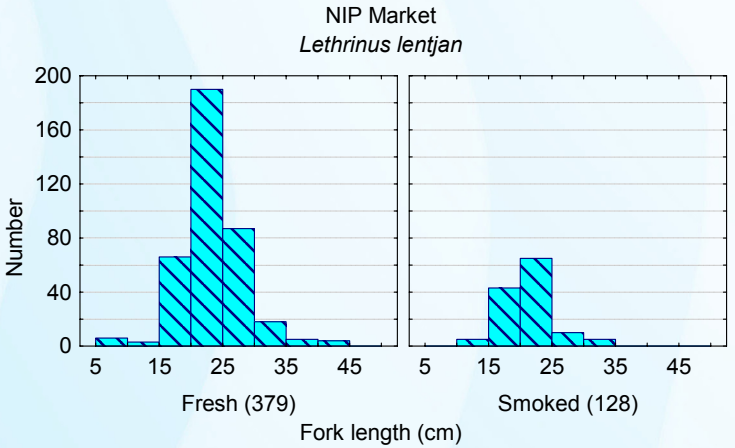
↘ Size distribution of redspot emperors in markets during the survey, and broken down by sampling month (n=507 fishes measured).

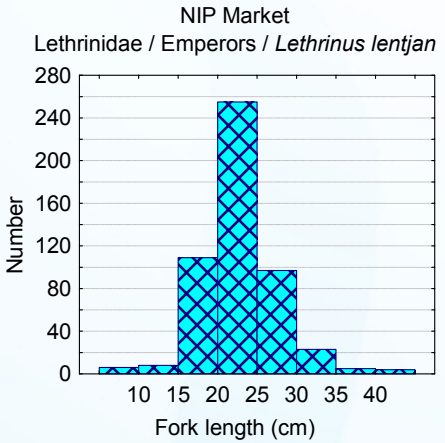
↙ Average number of redspot emperor per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4,557 tables).

↓ Sizes of fresh and smoked fishes offered in the markets.







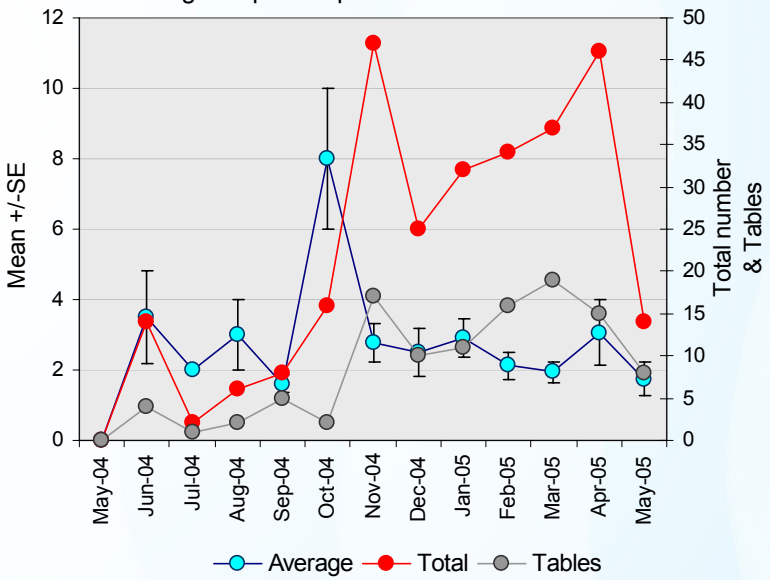


Fishes > Lethrinidae > *Lethrinus obsoletus* / Orange-striped emperor

A total of 281 orange-striped emperors were counted over a total of 110 tables during the survey. The greatest numbers of this species were observed during the period November 2004 to April 2005.

The average size of these fishes was 22 cm fork length, with the minimum size observed 9 cm, and the maximum 36 cm. A large number of small fishes of this species was recorded in June 2004, with most fishes after that time ranging between 20 to 25 cm. These fishes were offered either fresh or smoked, with about 60% of all fishes across the survey being offered for sale as smoked product.

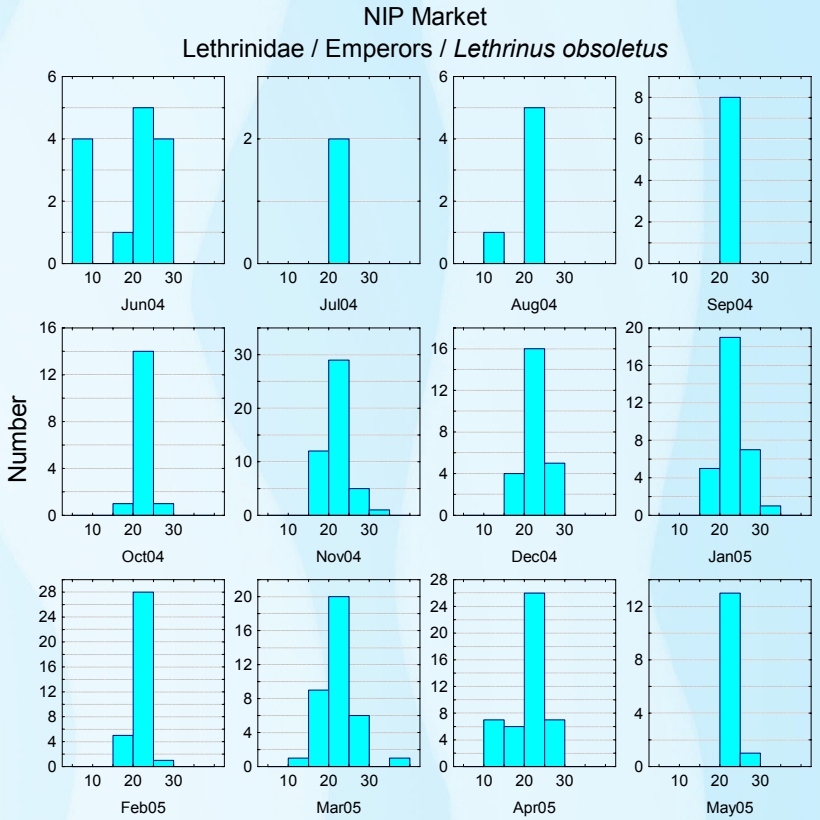
Orange-striped emperor / *Lethrinus obsoletus*

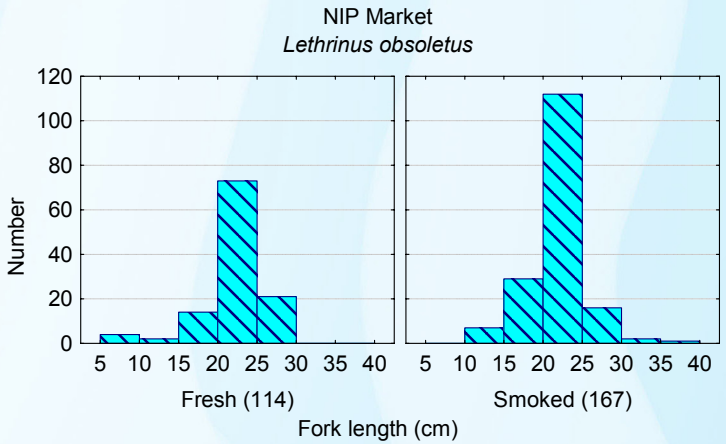


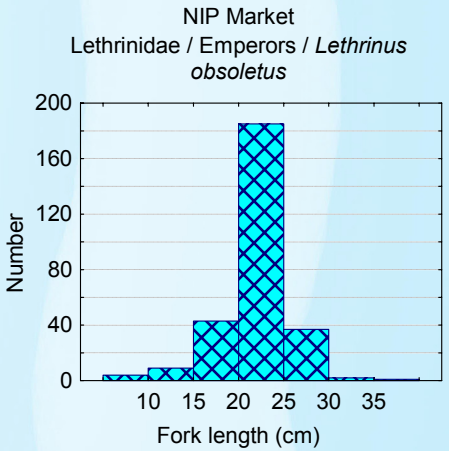
➘ Size distribution of orange-striped emperors in markets during the survey, and broken down by sampling month (n=281 fishes measured).

➙ Average number of orange-striped emperor per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4,557 tables).

➘ Sizes of fresh and smoked fishes offered in the markets.



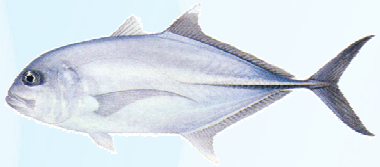




Fishes > Carangidae /Trevallies & scads / Batbat

Trevallies and scads were the third most common fishes found for sale in the markets of Kavieng during this survey. A total of 1,207 fishes were recorded in counts, accounting for 9% of all fish on offer. These fishes were found on 5% of all tables surveyed, a total of 223 tables. The average number of carangids found on tables was 5.4, but ranged up to 57.

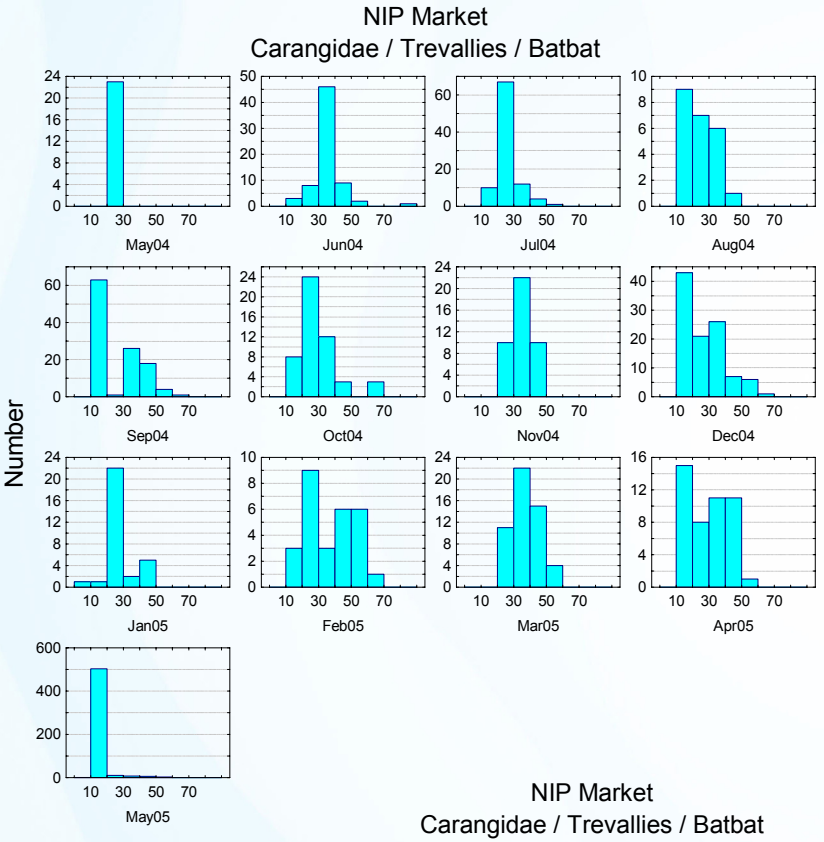
The average size of these fishes was 26 cm fork length, but was made up of a mixture of small scads and queenfish as well as larger trevallies. The size range was between 8 and 80.5 cm, but most fish were between 10 and 20 cm. Most of the fish in this family (>70%) were offered for sale fresh. The fishes offered fresh tended to be the smaller species and individuals, while the larger fishes were often smoked.

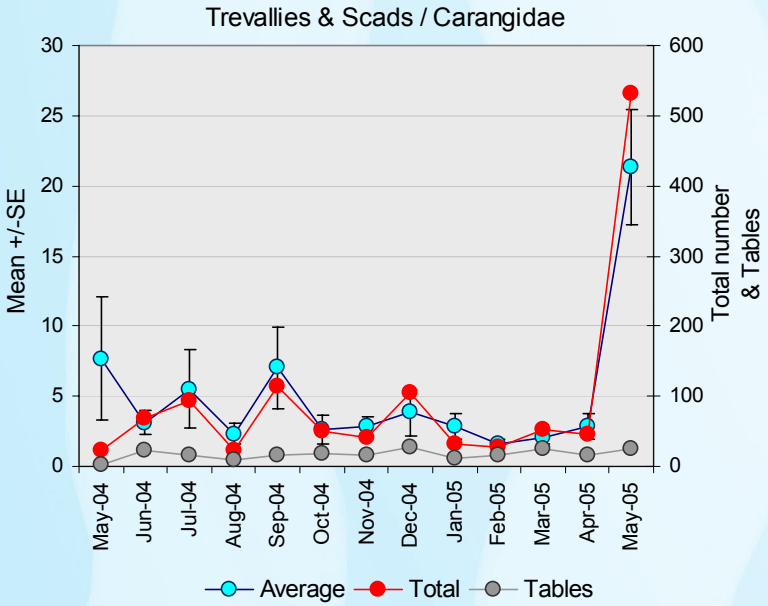


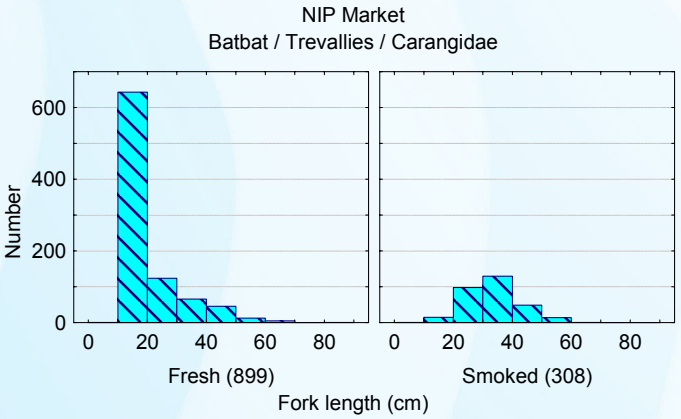
↘ Size distribution of trevallies & scads in markets during the survey, and broken down by sampling month (n=1,207 fishes).

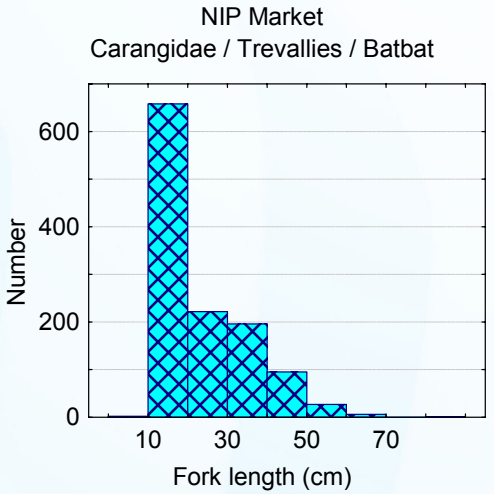
↙ Average number of trevallies & scads per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4,557 tables).

🡻 Sizes of fresh and smoked fishes offered in the markets.





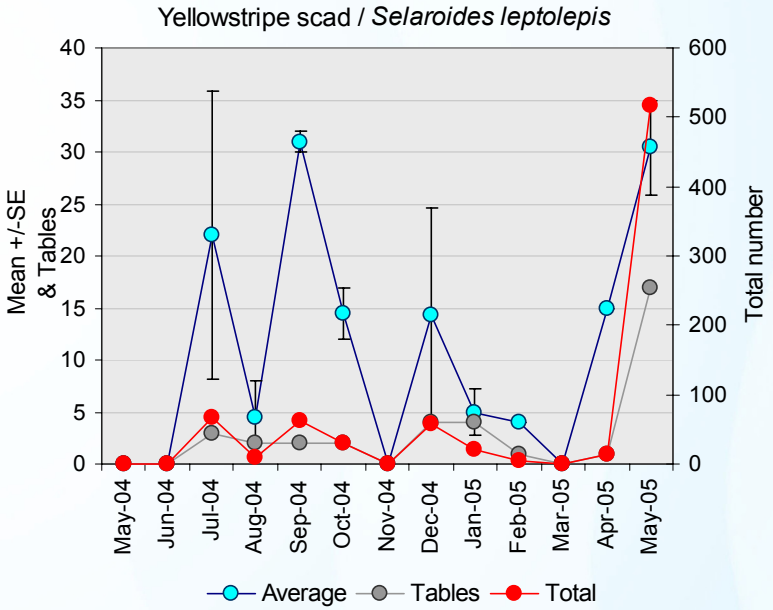




Fishes > Carangidae > *Selaroides leptolepis* / Yellowstripe scad

This species is one of the small common carangids being offered for sale fresh at the markets. The total number counted at markets was 779 animals recorded over 36 tables. The average number per table was 22 fishes, but reached a maximum of 57 over the survey. Most of the animals we counted were offered for sale in the markets during May 2005.

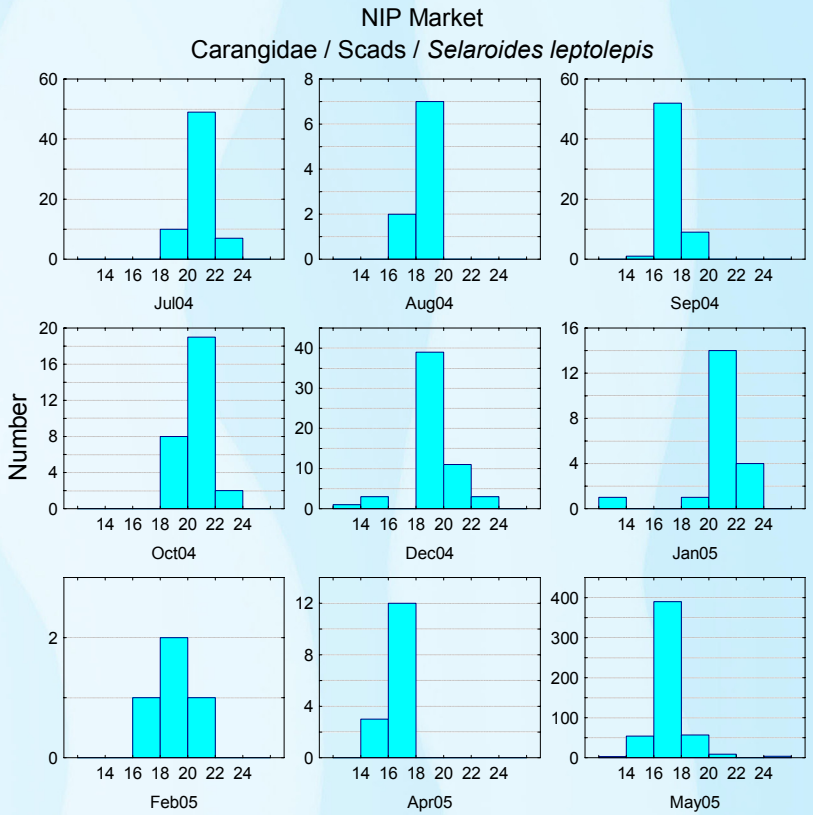
The average length of these fishes was 18.3 cm over the survey and most individuals ranged between 8 and 32 cm. There may be an issue of identification of this species, as the maximum size reported elsewhere is around 22 cm total length. These fishes were mostly sold fresh, with only 8% offered in smoked form.

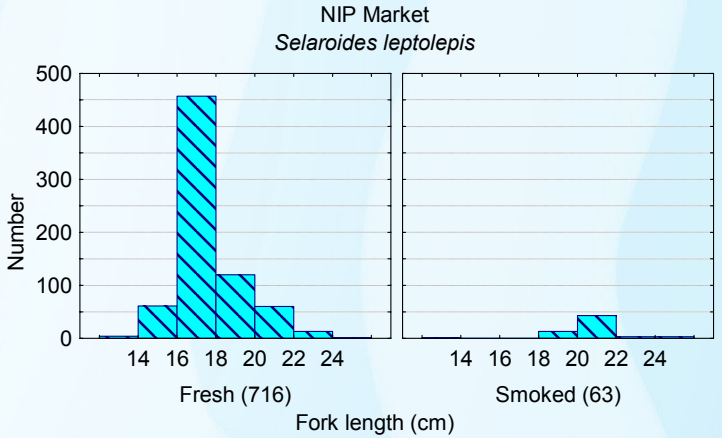


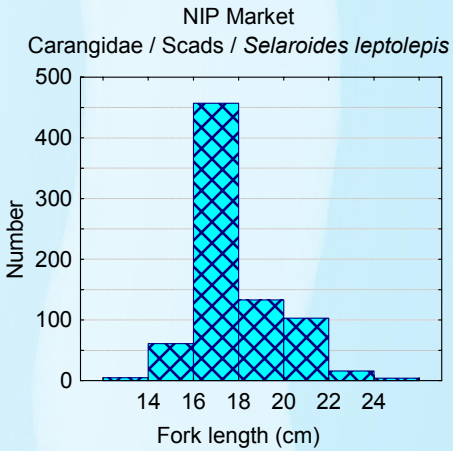
↘ Size distribution of yellowstripe scad in markets during the survey, and broken down by sampling month (n=779 fishes).

↙ Average number of yellowstripe scad per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4557 tables,

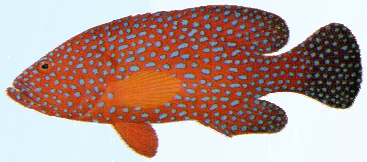
↓ Sizes of fresh and smoked fishes offered in the markets.







Fishes > Serranidae / Groupers, Trout & Rock cods / Bik maus



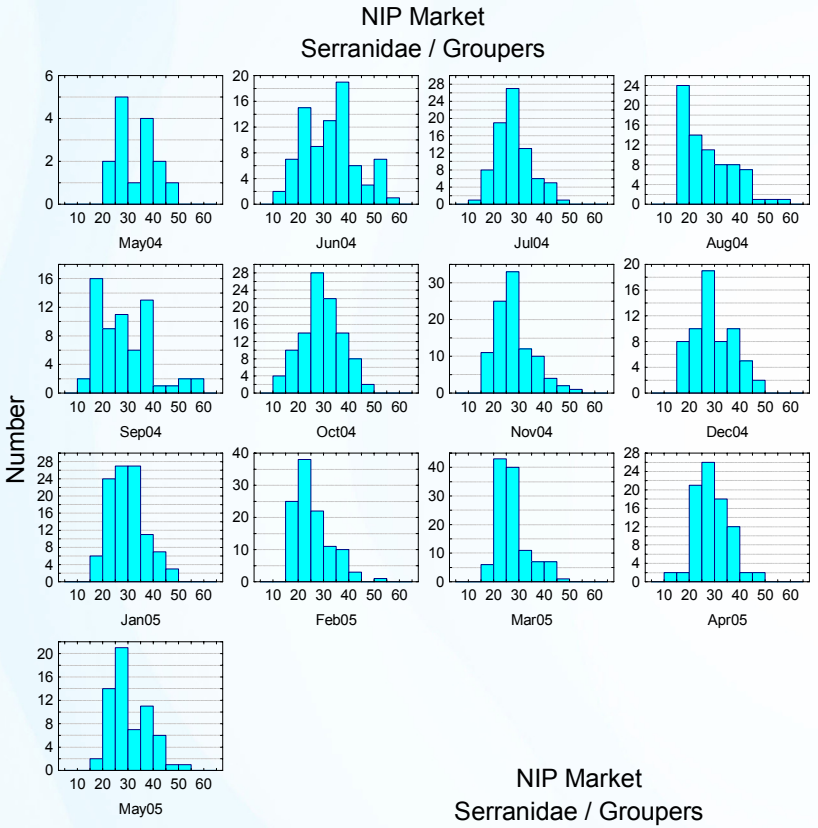
A total of 1,055 fishes over 622 tables were recorded during the survey. The average number of fishes on tables was 1.7 and ranged up to 22. The average number of fishes per table did not vary significantly over the monitoring period, but there were differences in the total numbers of fishes recorded in different months, and the numbers of tables that included fishes of this family. Serranids were most common in the markets around Kavieng in October and November 2004 and January to March 2005.

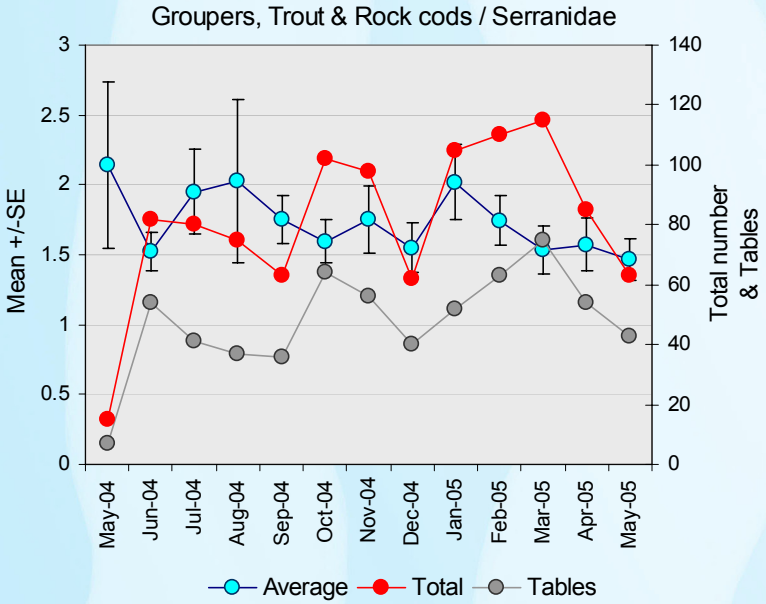
The average fork length of serranids was 29 cm during the survey, and ranged between 10.5 and 58 cm. Most fishes were between 25 and 30 cm long, and in several months during the survey were found in two size groups: one at around 25 cm, and another greater than 35 cm. 57% of the groupers and related species offered for sale in markets were sold fresh, and most of the remainder sold smoked.

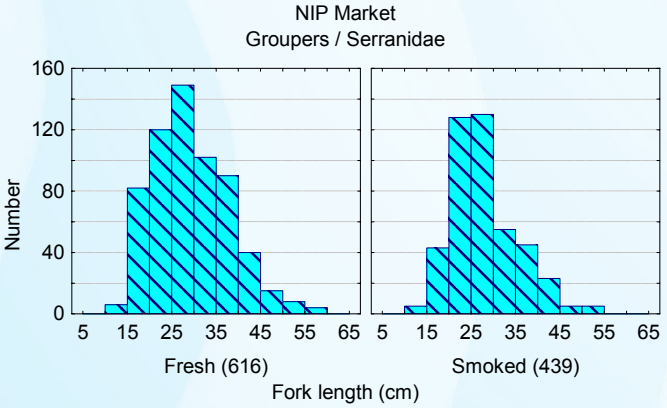
↘ Size distribution of groupers in markets during the survey, and broken down by sampling month (n=1055 fishes).

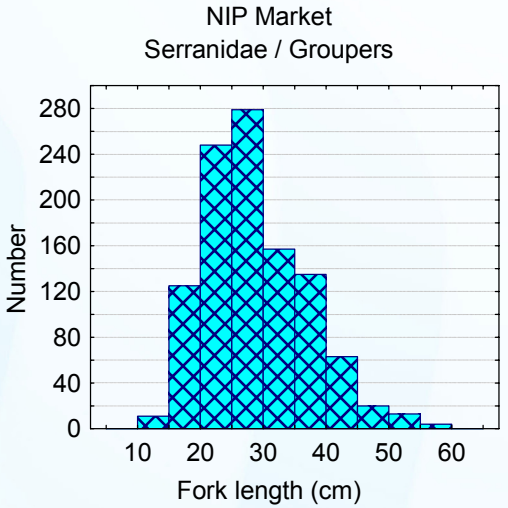
↙ Average number of groupers per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4557 tables).

↓ Sizes of fresh and smoked fishes offered in the markets.





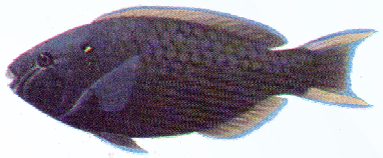




Fishes > Scaridae / Parrotfishes

In total, 961 parrotfishes were recorded over 262 tables during the survey. Parrotfishes were offered for sale at just under 6% of the tables at market. The total number in the market varied significantly by month, while the number of tables offering parrotfishes remained relatively steady. The average number of parrotfishes offered for sale on tables was around 3.7, and ranged up to 20, with the greatest number of fishes per table recorded in the period June-August 2004.

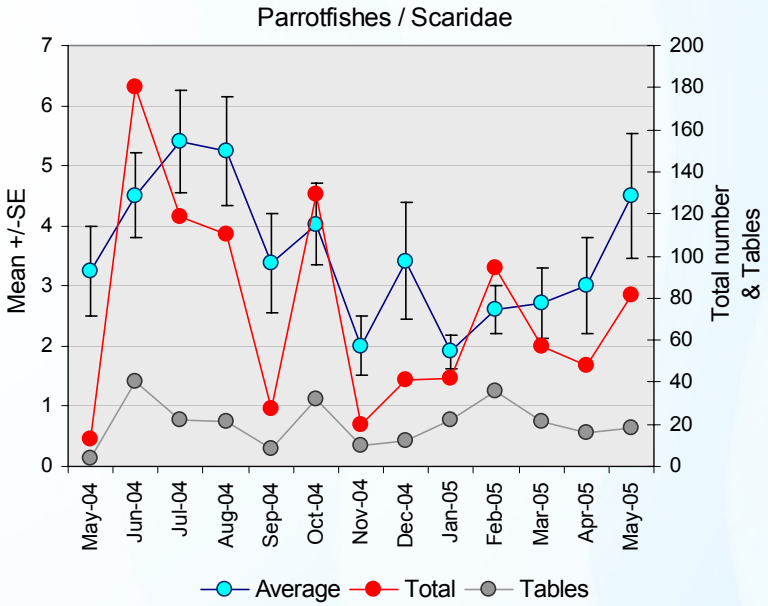
The average length of parrotfishes offered for sale was 26.5 cm, and ranged between 8.5 and 54 cm. Parrotfishes were generally smoked before being sold. Over 80% of all parrotfishes was offered for sale smoked.

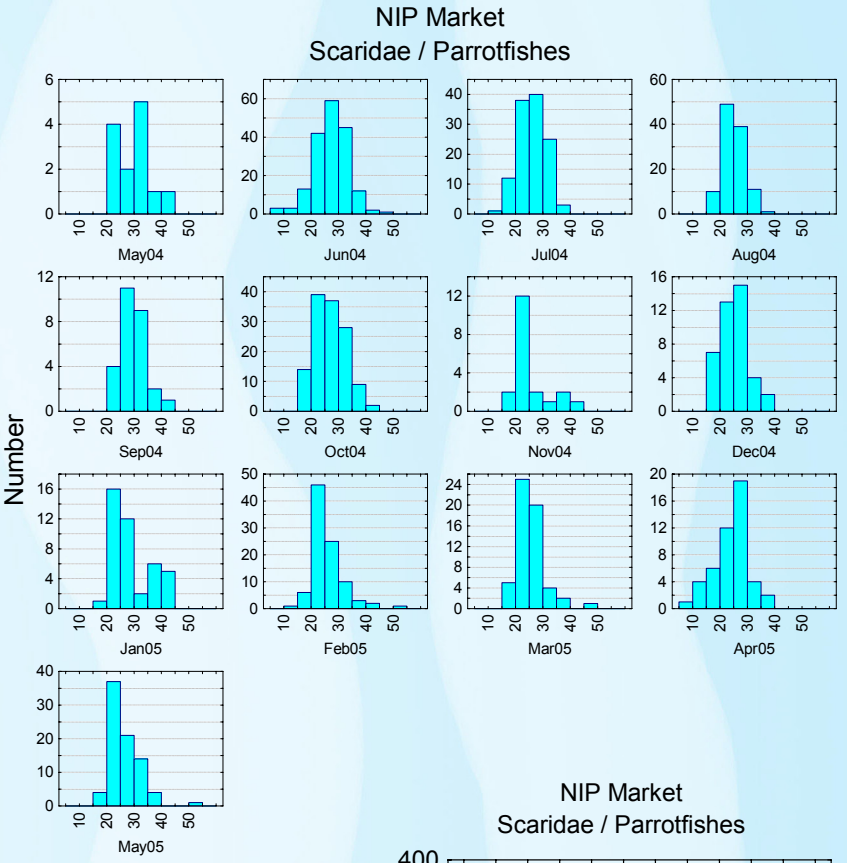


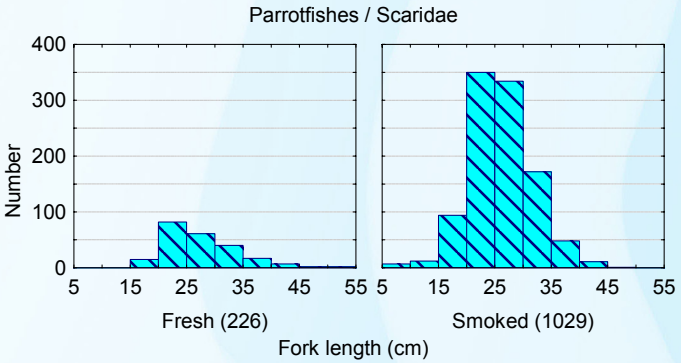
↘ Size distribution of parrotfishes in markets during the survey, and broken down by sampling month (n=961 fishes).

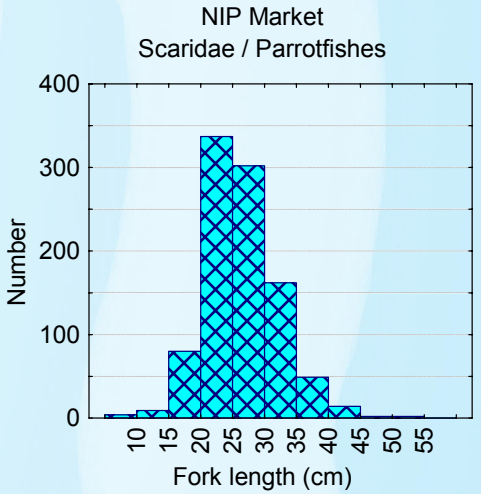
↙ Average number of parrotfishes per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4,557 tables).

↓ Sizes of fresh and smoked fishes offered in the markets.









Fishes > Mugilidae / Mullets

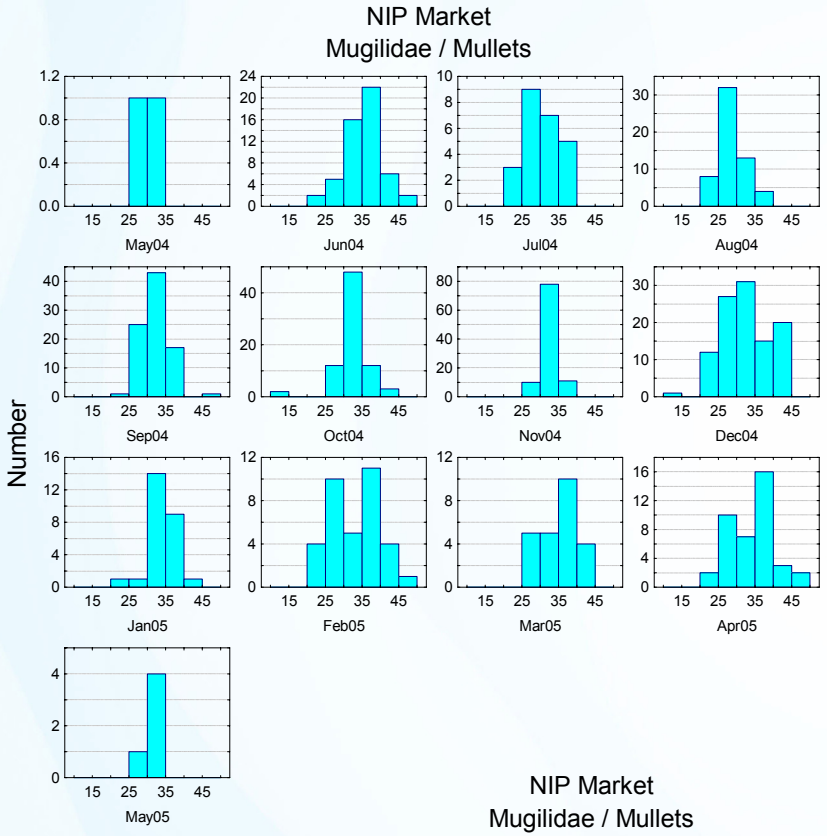
Mullets accounted for about 5% of all fishes offered for sale at markets, and were present on around 2% of tables (635 fish on 95 tables). The average number of mullets for sale on any one table was 6.7, ranging up to 33 fishes per table over the survey. Mullets were most common in the market from September to December 2004. Although the number of tables selling them did not fluctuate much over the survey, the number of mullets per table was higher during that period, averaging 13 fish per table.

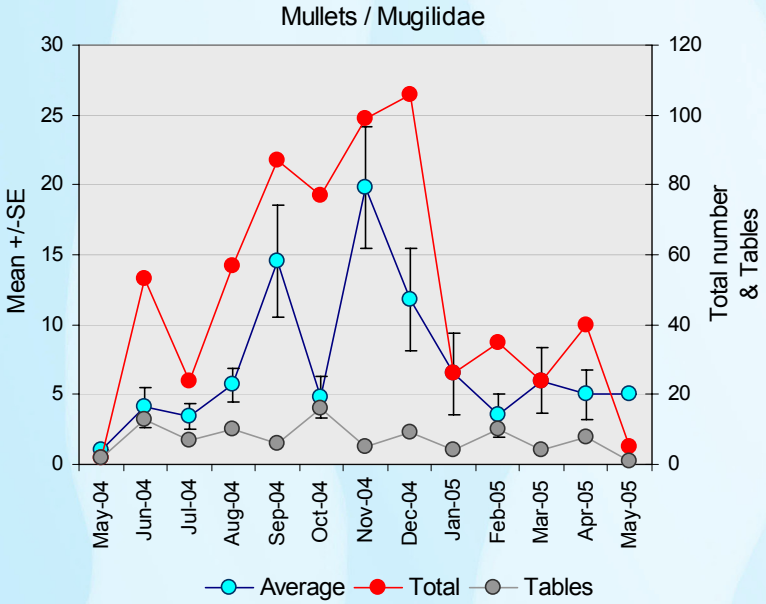
The average size of mullets was 33 cm, and ranged between 12 and 56.5 cm. Most mullets were offered for sale smoked, with only 17% being available as fresh fish.

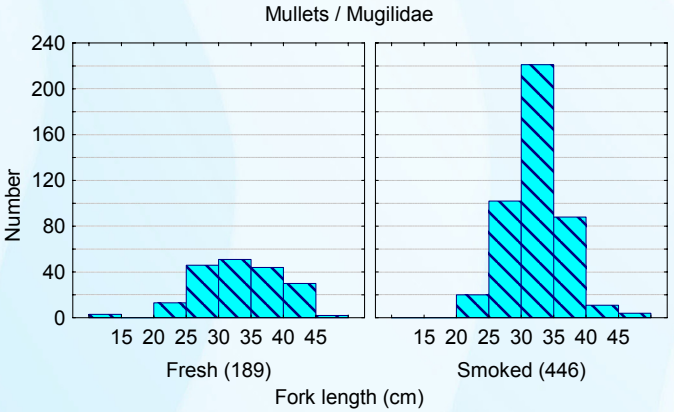
↘ Size distribution of mullets in markets during the survey, and broken down by sampling month (n=635 fishes).

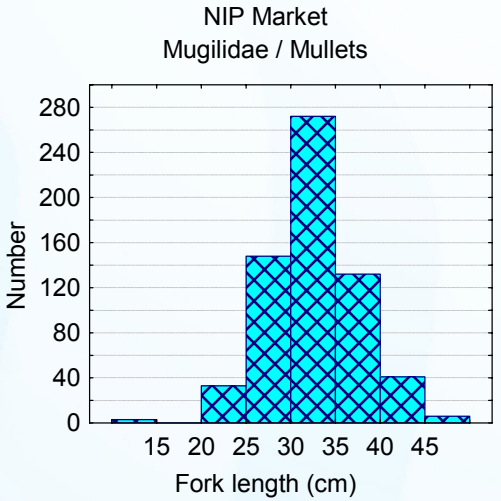
↙ Average number of mullets per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4,557 tables).

🡻 Sizes of fresh and smoked fishes offered in the markets.





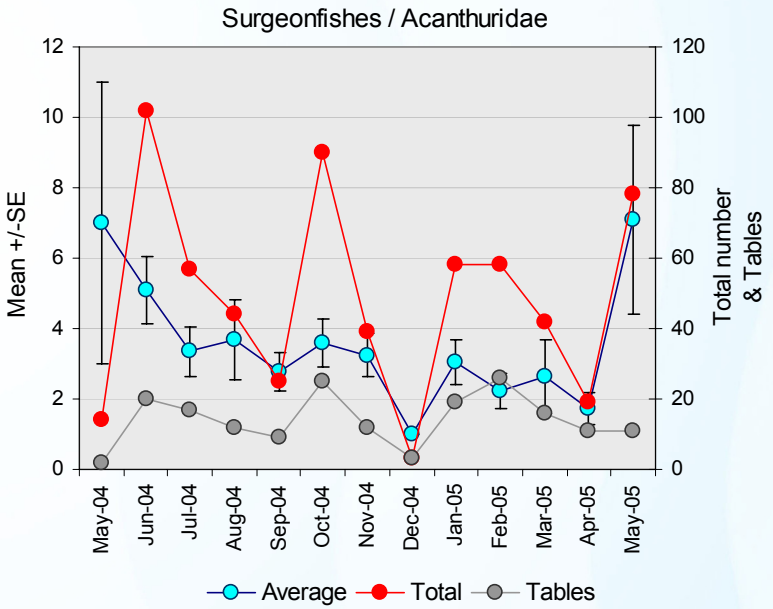


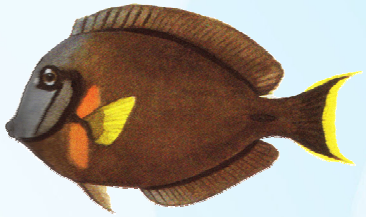


Fishes > Acanthuridae / Surgeonfishes

A total of 629 surgeonfishes were counted over the period of the survey, and were distributed on a total of 183 tables (around 4%). The total numbers offered for sale fluctuated significantly over the months of the survey. This appeared to be partly due to a fluctuation in the number of tables selling these fish, and differences in the number of fishes being offered per table. On average 3.4 surgeonfishes were found on tables offering this family, with a maximum of 29 on any one table. There was also considerable variance in the number of fishes offered for sale on tables within months.

The average length of surgeonfishes was 23.6 cm and ranged up to 57 cm. Most surgeonfishes were offered for sale smoked, with only 17.5% of fishes sold fresh.

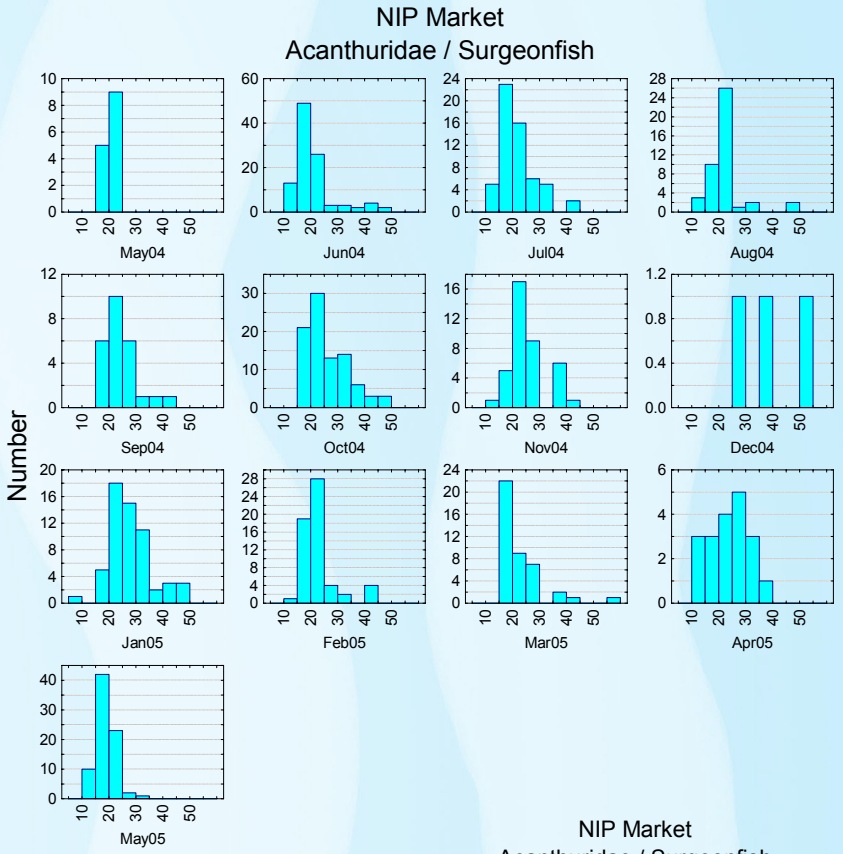


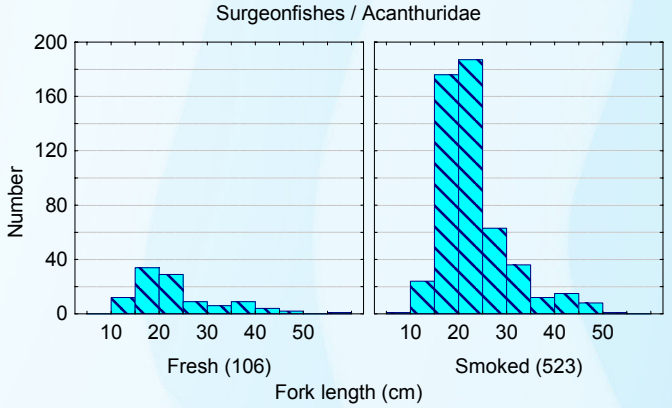


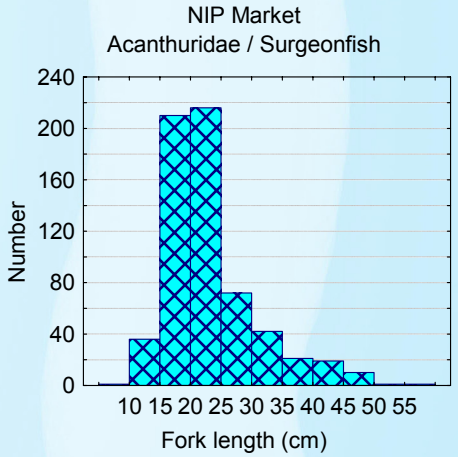
↘ Size distribution of surgeonfishes in markets during the survey, and broken down by sampling month (n=629 fishes).

↙ Average number of surgeonfishes per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4,557 tables).

🡻 Sizes of fresh and smoked fishes offered in the markets.







Fishes > Nemipteridae / Breams

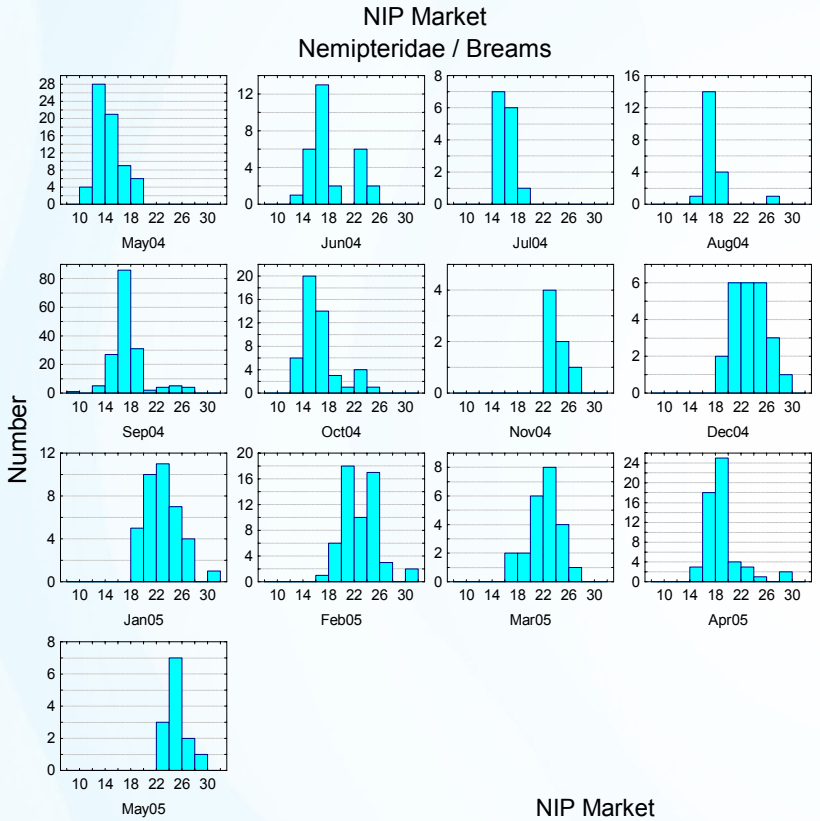
In total, 564 breams were recorded in market counts during the survey, on a total of 2.4% (110) of tables. There was an average of 5 fish offered per table, ranging up to 103. Most breams were recorded in the markets during September 2004, but the greatest number on a single table was recorded in May 2004.

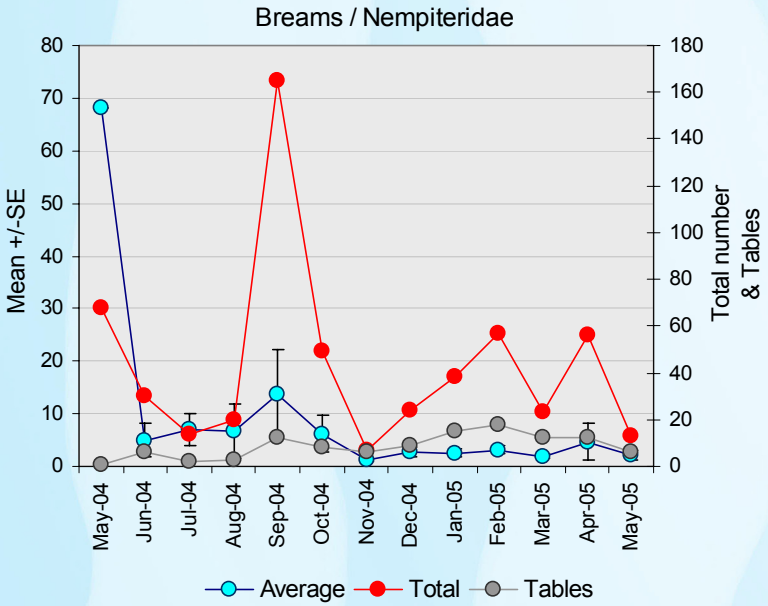
The average size of breams for sale at markets in Kavieng was 18.5 cm, with most individuals ranging between 14 and 26 cm. Over 88% of all breams were offered for sale fresh at the markets.

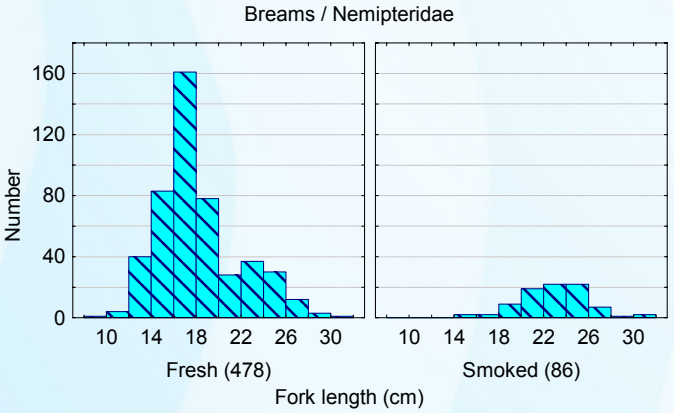
↘ Size distribution of breams in markets during the survey, and broken down by sampling month (n=564 fishes).

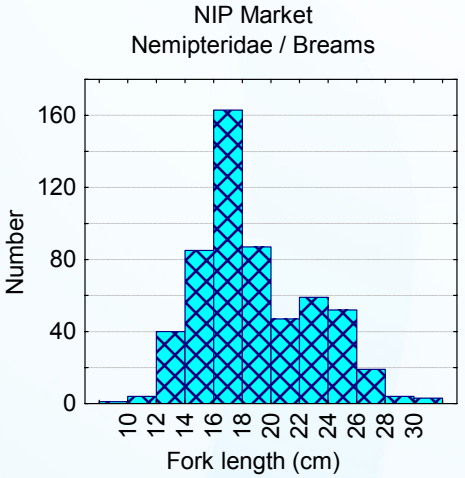
↙ Average number of breams per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4,557 tables).

🡻 Sizes of fresh and smoked fishes offered in the markets.







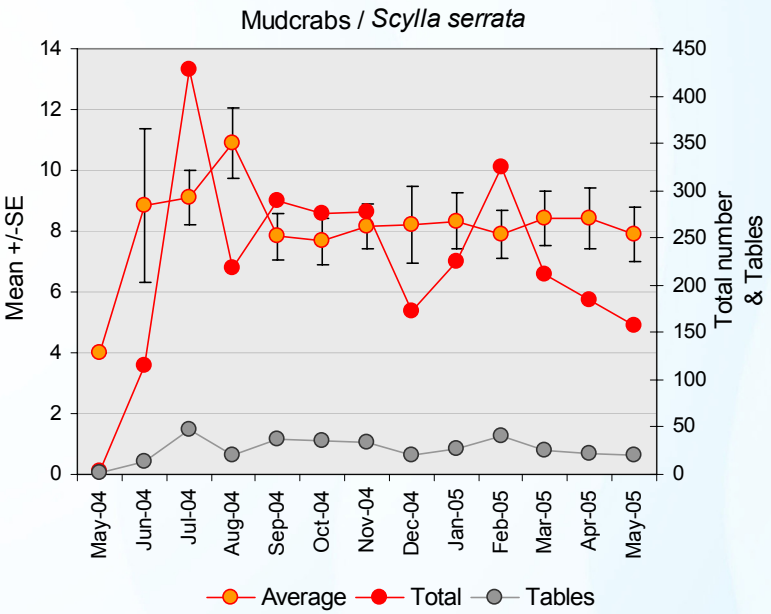


CRUSTACEANS > Portunidae > *Scylla serrata*

Almost all of the crustaceans recorded for sale at markets in Kavieng were mudcrabs, with very low numbers of landcrabs and lobsters recorded over the survey. All crustaceans were found only in Kavieng Main Market and not at any of the other market sites around town.

A total of 2883 mudcrabs were recorded in the markets, on a total of 344 tables. Mudcrabs were on offer on 7.5% of tables and accounted for 7.5% of all seafoods for sale by count. The number of mudcrabs for sale fluctuated by month during the survey, with the greatest numbers being recorded during July 2004 and February 2005.

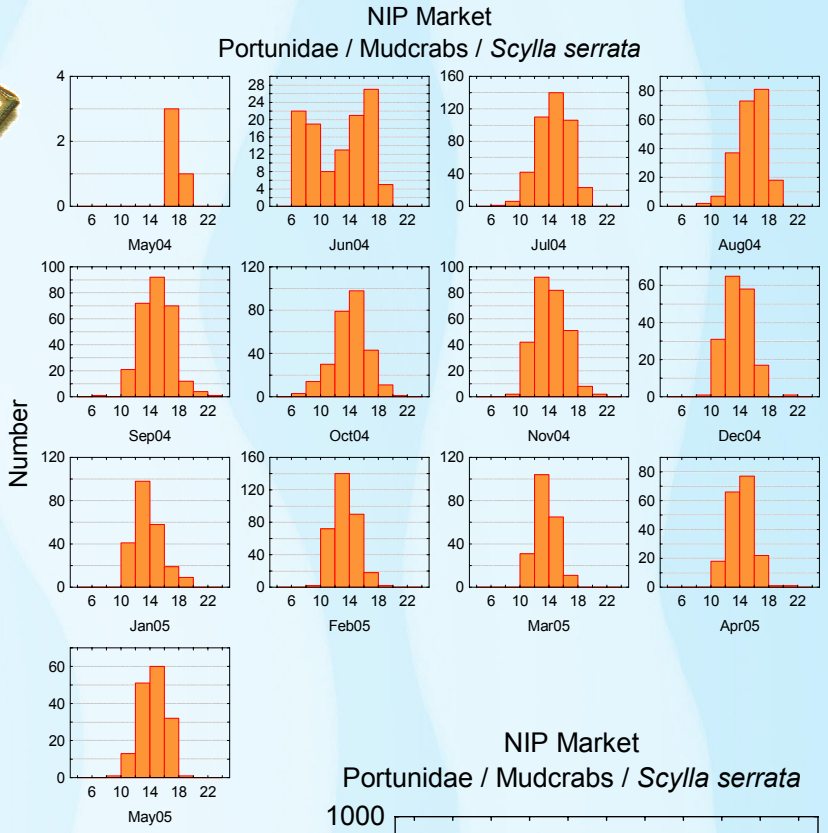
The average number of crabs per table was 8.4, but ranged up to 30. The average size of crabs was 14.3 cm across the body, ranging between 6.2 and 23.3 cm.

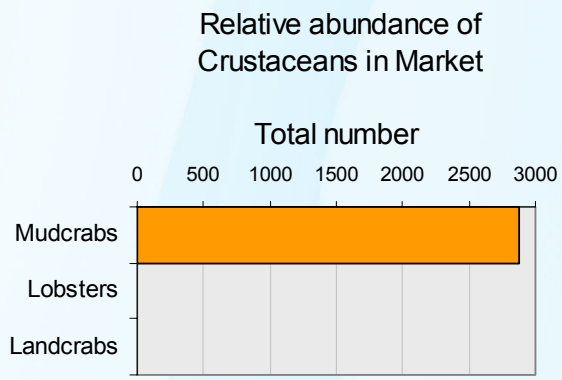


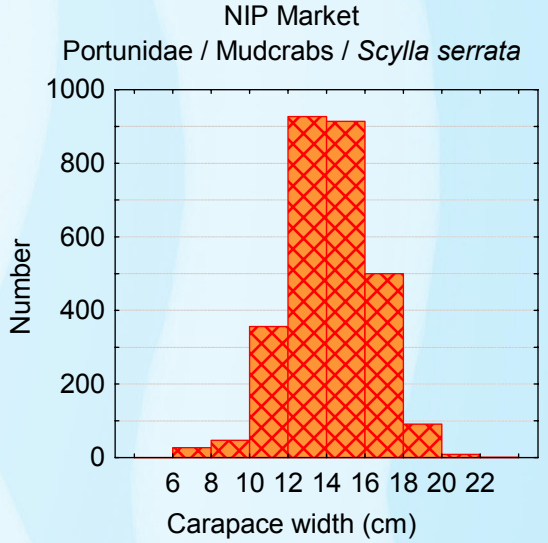
↘ Size distribution of mudcrabs in markets during the survey, and broken down by sampling month (n=2,872 crabs measured).

↙ Average number of mudcrabs per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4,557 tables, 2,883 crabs counted).

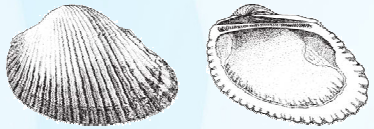
🡻 Relative abundance of mudcrabs, lobsters and landcrabs offered in the markets. Note that the numbers of lobsters and landcrabs were very low.





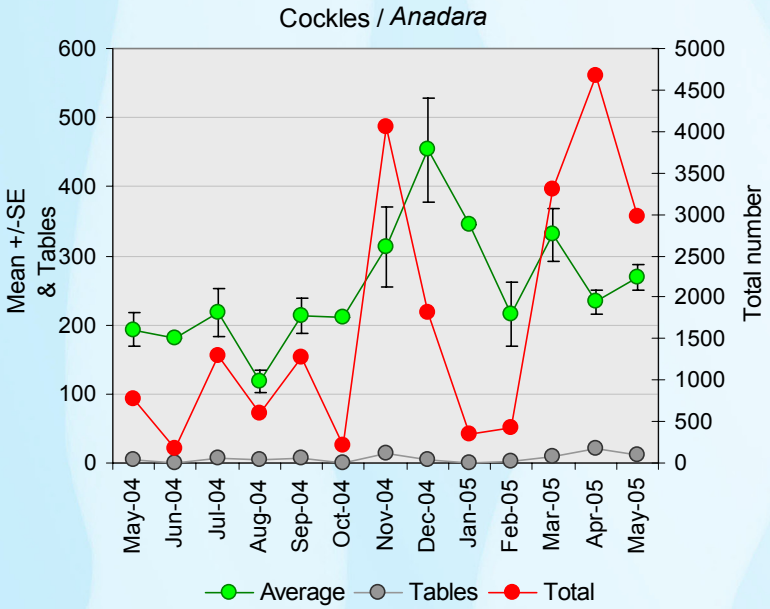


MOLLUSCS > Arcidae > *Anadara* spp.



Over 96% of all molluscs recorded during the market survey were cockles. We recorded 21,913 cockles over a total of 84 tables. Numerically, these were the single most common species found at the markets overall. The number of tables offering these molluscs was low and steady throughout the survey. Significant fluctuations in the number of cockles offered for sale were mostly due to large differences in the average number offered for sale at each table. The overall average number of cockles per table was 261, and ranged between 55 and 858 shells.

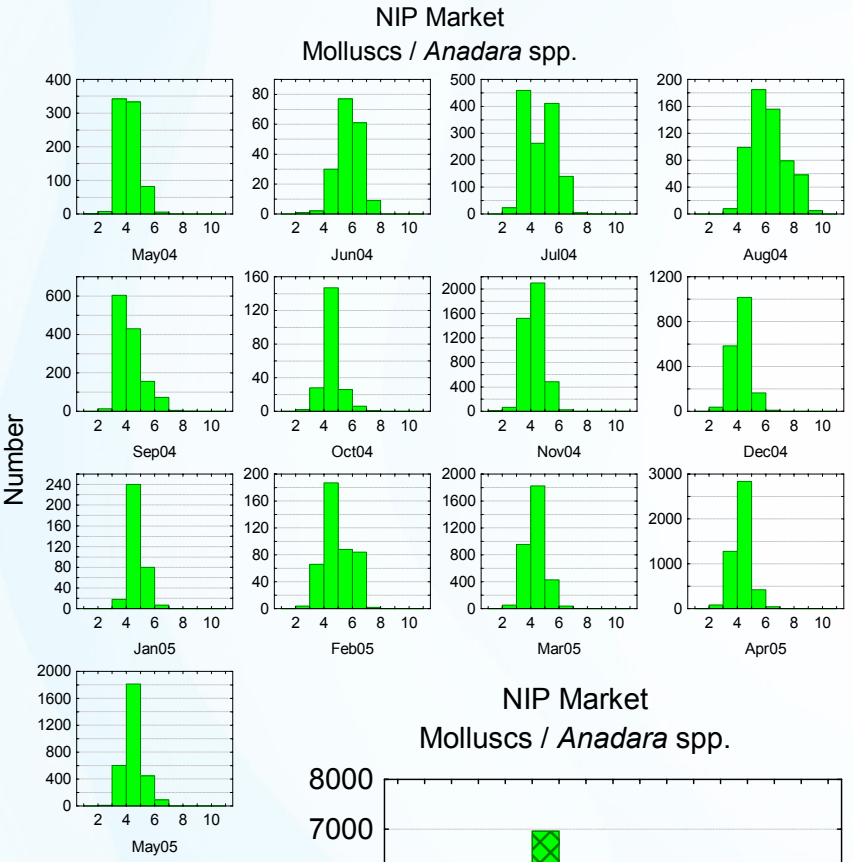
The average size of cockles was 4.6 cm, ranging between 2 and 9.9 cm (measured as maximum shell length). Most cockles were offered for sale at Kavieng main market, but around 3% were sold at other market locations around town.

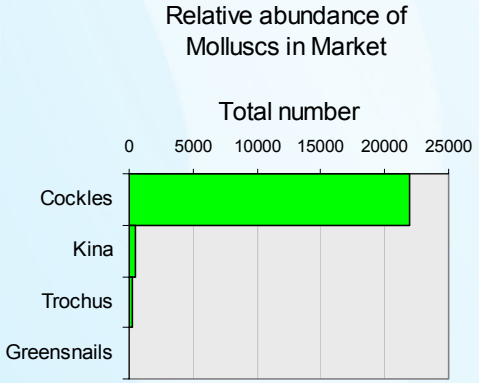


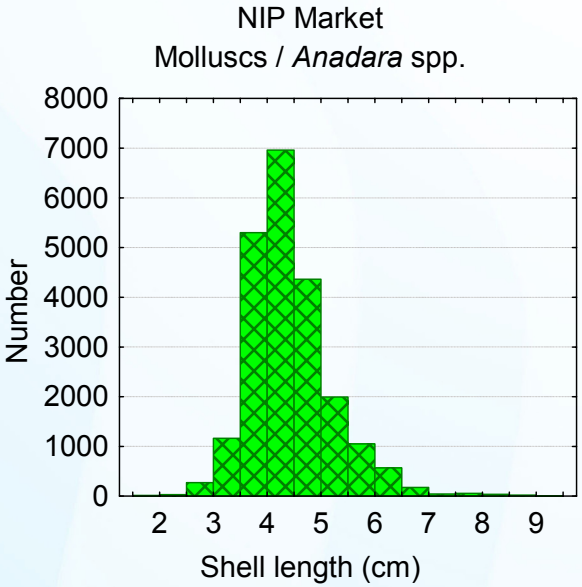
↘ Size distribution of *Anadara* in markets during the survey, and broken down by sampling month (n=22,072 cockles measured).

↙ Average number of *Anadara* per table, number of tables per month of the survey and total number of individuals offered in markets over the survey (n=4,557 tables, 21,913 cockles counted).

↓ Relative abundance of different types of molluscs offered in the markets. Cockles=*Anadara*; Kina=*Batissa violacea*.





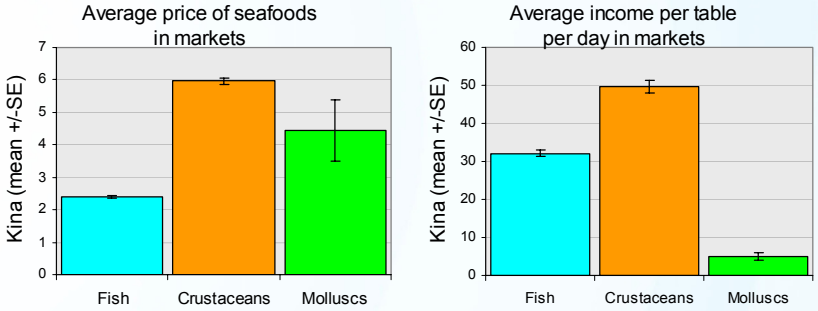


Prices and Income from Market Sales

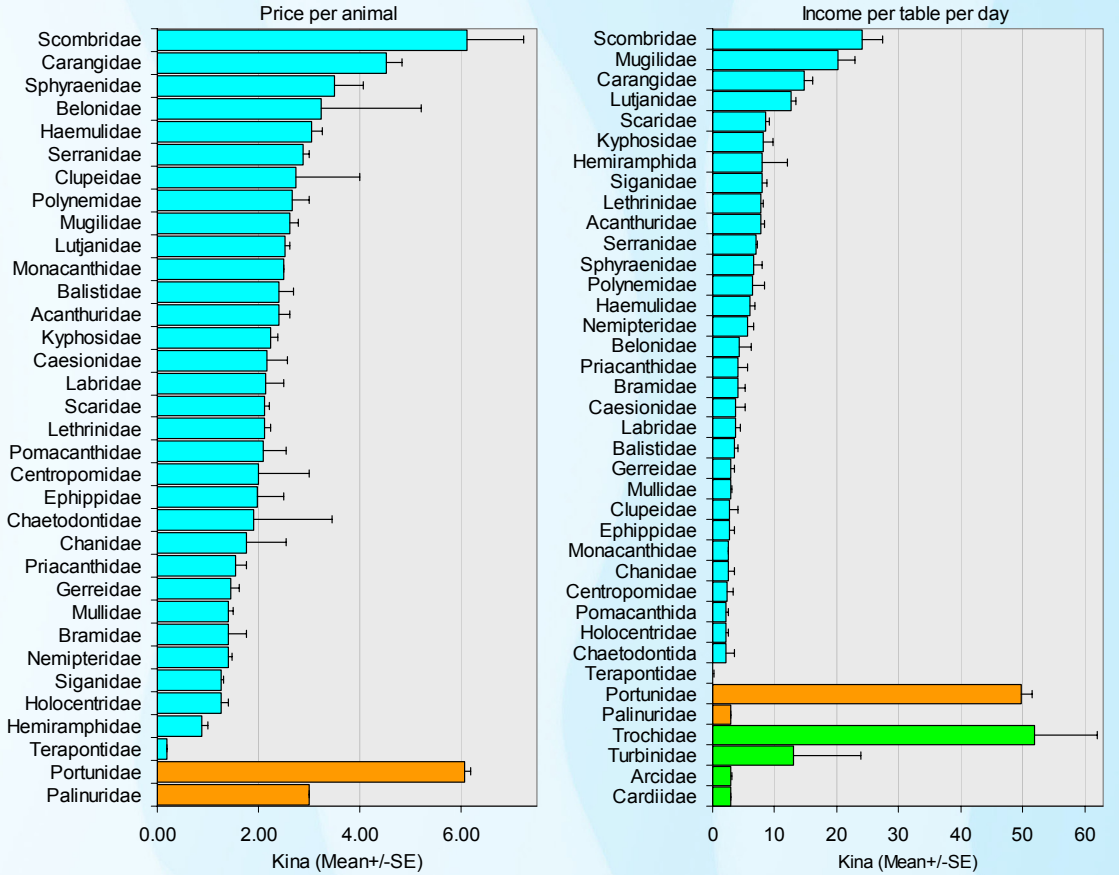
Price information was collected for 6,698 seafoods on offer in markets around Kavieng during this survey. Most of the seafoods on sale were sold as individuals (whole single fishes, crabs or lobsters) with a price per item quoted. Molluscs tended to be sold in baskets, with a price quoted referring to around 150-250 animals (*Anadara*) forming a single unit of sale.

The average price of seafoods was highest for crustaceans at almost K6 per individual, and ranging up to K20. Fishes varied in price between 10 toea and K41 per individual, and averaged K2.38 across the survey. The highest average prices per individual were for tunas (Scombridae) and mudcrabs at around K6 per animal. Trevallies, barracudas, longtoms, sweetlips and lobsters were the next most valuable seafoods, selling for K3 - 4.50 each.

The seafoods that contributed the most to the daily income of sellers were crustaceans, with people selling mudcrabs averaging a daily potential income of more than K49 (if all animals sold) compared with an average of K32 for people selling fishes. The families of fishes that contributed the most to income (taking average numbers on offer into account) were the tunas, mullets trevallies and snappers. People who sold only molluscs tended to make the least income from selling overall.



↑ Average (a) price and (b) income derived through the sale of seafoods in markets around Kavieng per day. Values are means +/- Standard errors and represent potential income if all items were sold. The income values are inclusive of the different species of seafoods on offer on tables. Generally people who sell fishes sell a range of species, while those who sell crustaceans or molluscs tend not to offer other types of seafoods. Income for any one table may also be augmented by the sale of vegetables or cakes (n=6698). Note that fishes and crustaceans were usually sold individually, while the values for molluscs are for baskets.



↓ Average (a) price and (b) income per day derived from different Families of marine products. For (b) values are average total income that would be derived through each group based on average prices and numbers normally offered per table. These figures are potentials 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 (but see Figure below-left) (n=3,233).

Analysis of Buyer Data

What seafoods are being purchased?

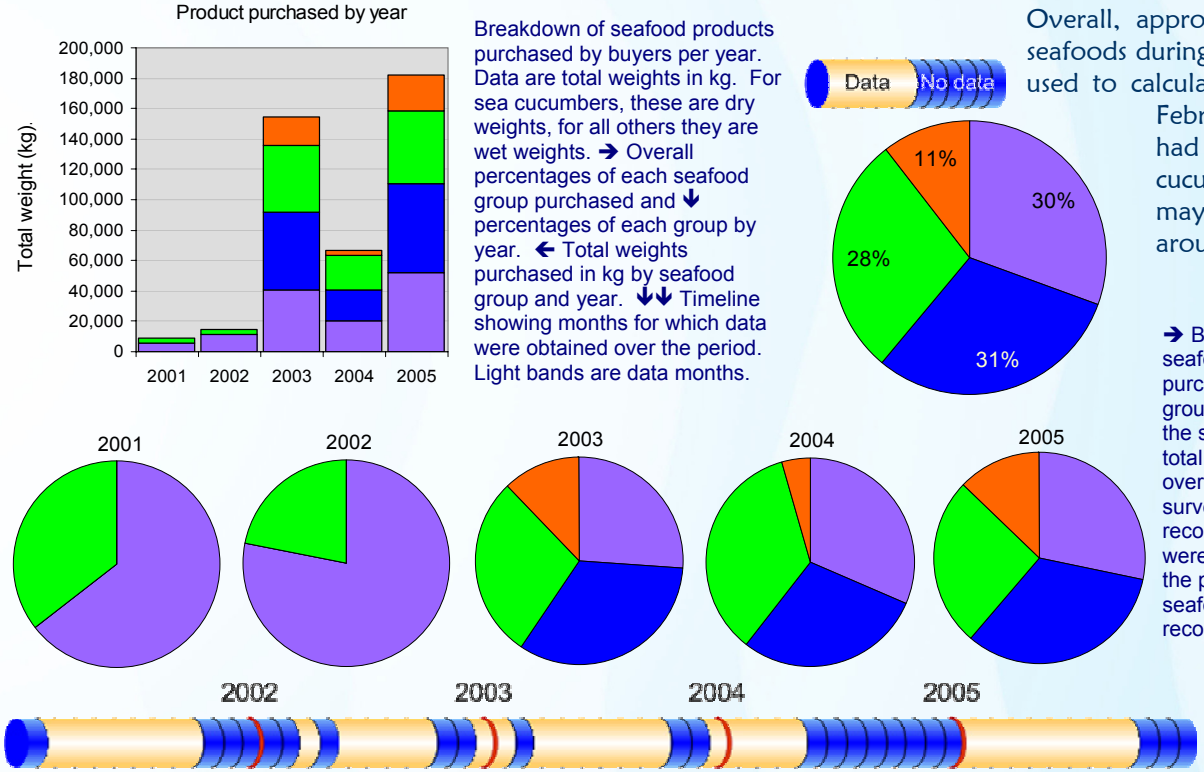
Buyer data were collected over the period from February 2001 through to September 2005. The data available over that period were discontinuous partly because purchasing for some species is seasonal (e.g. sea cucumbers have a closed fishing season) and partly because records were missing. The lack of data for some time periods means that these results need to be interpreted carefully. A period with low levels of buying could indicate low catches, low purchases, or just missing information.

Our buyer database includes data from three major buyers operating in the Kavieng area, but according to the Coastal Fisheries Management & Development Project (CFMDP) NIP Socio-economic Survey, there may be as many as 13 buyers in northern New Ireland.

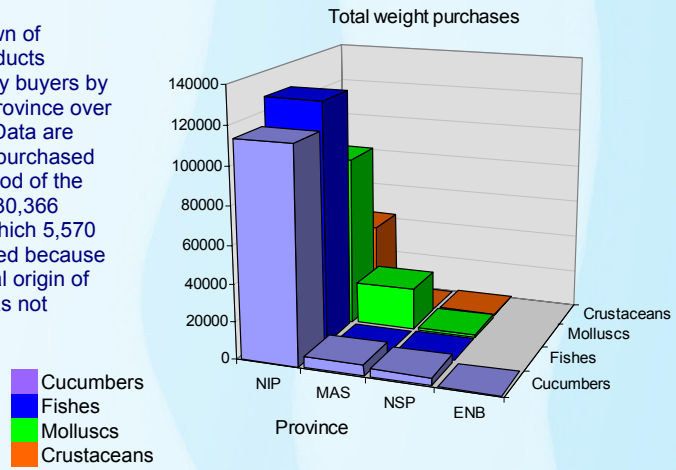
A total of 409 tonnes of purchased seafoods were recorded during the period covered by these data. Most of the seafoods purchased in Kavieng originated from within New Ireland Province (91%). There were, however, smaller quantities brought in from Manus (7%), North Solomons (1%) and East New Britain (<1%) provinces.

Overall, dried sea cucumbers, fishes and molluscs were evenly represented, each accounting for about 30% of the seafoods purchased by total weight. In terms of wet weight, however, the total quantity of sea cucumbers purchased would have been much higher, accounting for around 81% of all seafoods purchased. The total weight of crustaceans was significantly lower, accounting for about 11% of all seafoods. The quantity of seafoods purchased appears to have varied significantly by year, with greatest activity recorded in 2003 and 2005. It is likely that a large part of the year-by-year difference can be attributed to the discontinuous and incomplete data record.

Overall, approximately K 3.3 million was paid to local sellers by buyers for seafoods during the periods specifically covered by these data. These figures were used to calculate the total likely payments over the period from beginning of February 2001 to the end of September 2005 if records for all months had been held and allowing for closed seasons over that time for sea cucumbers. The total actual payments made to sellers over the period may have been closer to K 6.3 million, making the fisheries worth around K 1.2 million per year.



Breakdown of seafood products purchased by buyers per year. Data are total weights in kg. For sea cucumbers, these are dry weights, for all others they are wet weights. ➔ Overall percentages of each seafood group purchased and ↓ percentages of each group by year. ← Total weights purchased in kg by seafood group and year. ↓↓ Timeline showing months for which data were obtained over the period. Light bands are data months.



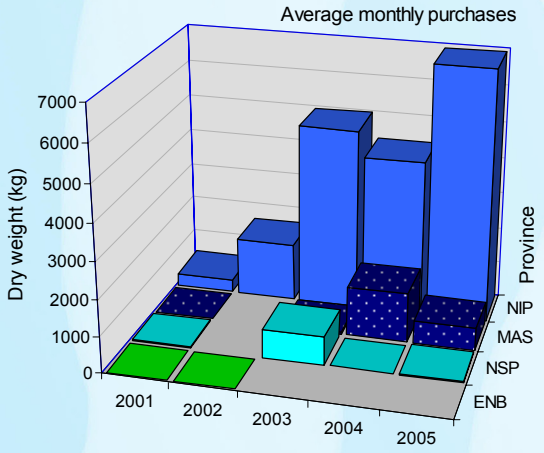
➔ Breakdown of seafood products purchased by buyers by group and province over the survey. Data are total weight purchased over the period of the survey (n=130,366 records of which 5,570 were excluded because the provincial origin of seafoods was not recorded).

Sea cucumbers

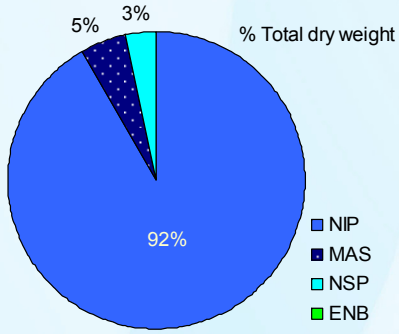
A total of 129.7 tonnes of sea cucumbers (dry weight) were recorded over the period from February 2001 to September 2005, with data derived from 4 buyers in Kavieng. These data are unlikely to be a complete record of purchases made by the buyers and should be interpreted with caution. Sea cucumber purchases included at least 20 species from 6 genera, as well as two unidentified forms.

Most of the sea cucumbers originated from within New Ireland Province (NIP) (92%), with small amounts (8%) brought in from North Solomons (NSP), Manus (MAS) and East New Britain (ENB) provinces. Amounts purchased per month also varied significantly among years, with 2005 being a peak year in New Ireland Province with 48 tonnes of sea cucumbers purchased over the 7 months of data collected.

The most common species recorded (by dry weight) were the unidentified "yellowfish", brown sandfish, white teatfish and surf redfish (species of *Actinopyga*, *Bohadschia* and *Holothuria*) which accounted for 42% of the sea cucumbers purchased. The species brought to buyers in the smallest amounts were prickly redfish and dragonfish.

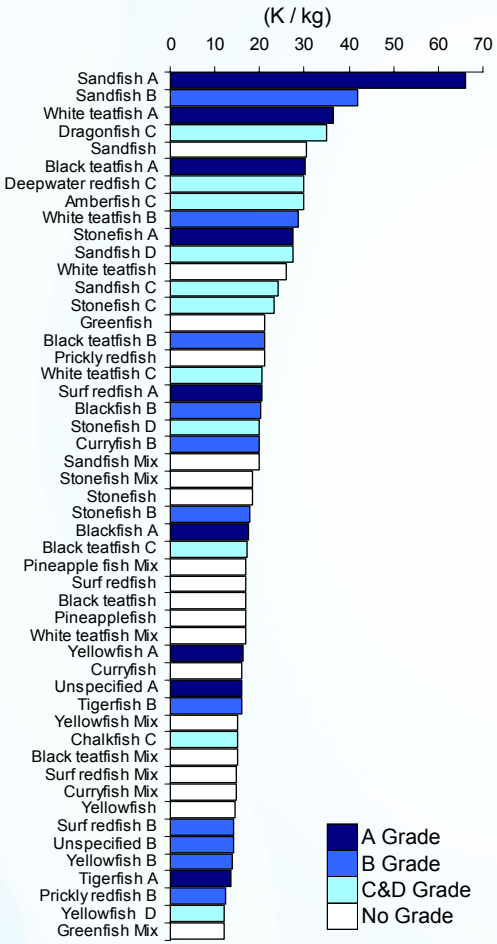


Dry weight of sea cucumbers purchased by province of origin and year. ↙ Monthly average for working months (7 per year for all except ENB with 6 months); ↓ Total over the entire survey.

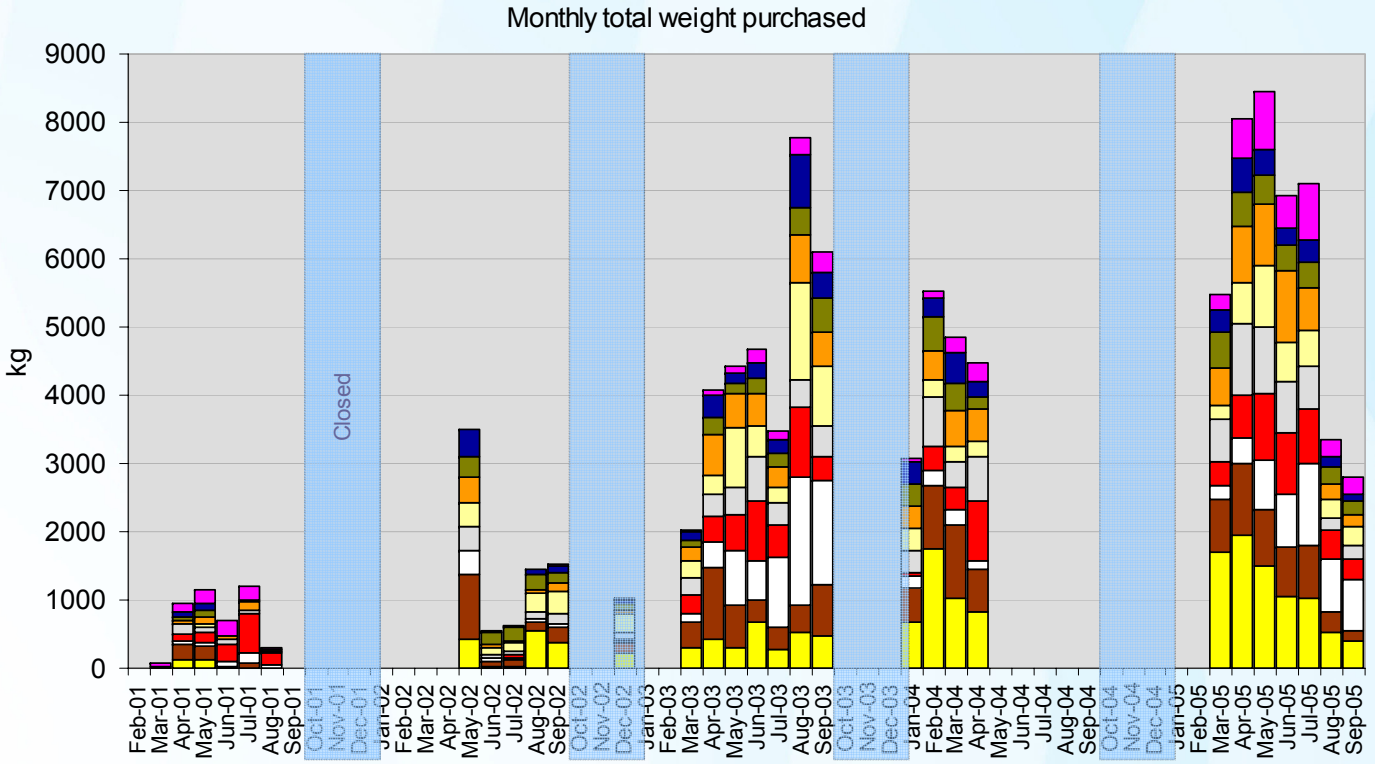


Species	Common name	kg
Actinopyga		
echinites	Deepwater redfish	1,200
lecanora	Stone fish	6,257
mauritiana	Surf red fish	11,204
miliaris	Black fish	860
Bohadschia		
argus	Tigerfish	10,333
similis	Chalkfish	10,429
vitiensis	Brown sand fish	13,641
Holothuria		
atra	Lollyfish	5,986
coluber	Snake fish	5,544
edulis	Pink fish	2,543
fuscogilva	White teat fish	12,805
fuscopunctata	Elephant trunkfish	2,886
nobilis	Black teat fish	1,483
scabra	Sandfish	10,337
Pearsonothuria		
graeffei	Flower fish	845
Stichopus		
chloronotus	Green fish	494
hermanni	Curryfish	7,219
horrens	Dragonfish	125
Thelenota		
ananas	Prickly red fish	292
anax	Amber fish	2,970
Unidentified	Yellowfish	17,389
	Pineapple fish	3,834
	Mixed	1,051
Total		129,725

↗ Average price paid per kilogram for selected species of sea cucumber. ↖ List of the species of sea cucumbers sold to buyers showing the total weight in kilograms purchased of each.



The highest average prices paid for sea cucumbers was K 66/kg for sandfish (*Holothuria scabra*) of grade "A" (highest quality). A reduction of quality to grade "B" resulted in a K 24 lower price per kg for this species, which dropped a further K 20/kg for grade "C" product. In white teatfish, the price difference between grades was around K8, with a top price of K 36/kg being paid for the highest quality dried product.



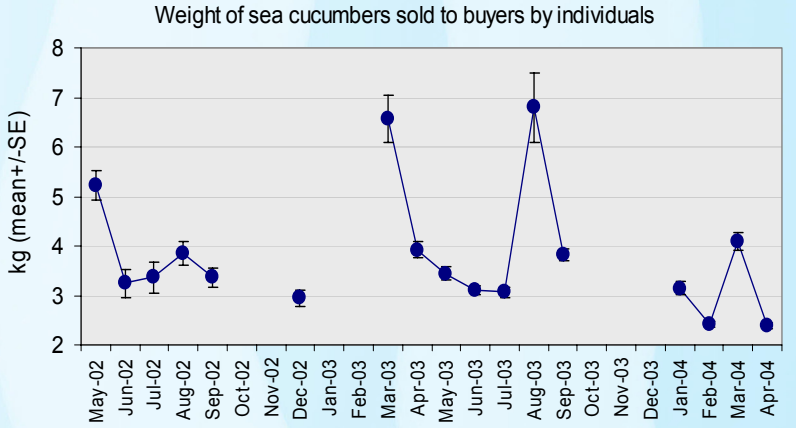
People selling their catches of sea cucumbers to buyers generally brought small amounts to each sale. During the period from May 2002 to April 2004, the overall average amount of product brought in by individual buyers was 3.68 kg per person per day and ranged between 20 g and 349 kg. The average amount of product (3.68 kg) could yield anywhere between K18 and K257 as income for the seller. Data on total paid to individuals were generally lacking, with some information available only during January 2004. At that time, the average payment made to sellers was K175 (n=113) per person per day.

↓ Average weight of sea cucumbers sold to buyers by individuals during each month over part of the survey period. Data are average dry weight (kg) sold by individuals +/-standard error.

The overall value of the sea cucumbers, assuming an average price per kilogram for graded species, was in the order of K 2 million over the period covered by these data (129.7 tonnes of dried product). The biggest earners were sandfish A and white teatfish A, worth K 202,000 and K 241,000 over the period sampled.

The diversity of sea cucumbers being sold to buyers tended to be high throughout the period covered by these data, declining only in months with low overall product recorded (e.g. June-December 2002). Surf redfish and white teatfish were insignificant parts of the catch during 2002, but were common in other time periods. Most other species tended to fluctuate in proportion with the overall catch.

↑ Species sold to buyers during each month over the period of this survey. Data are total dry weight (kg) for the 10 most common species overall. Shaded periods are closed seasons.



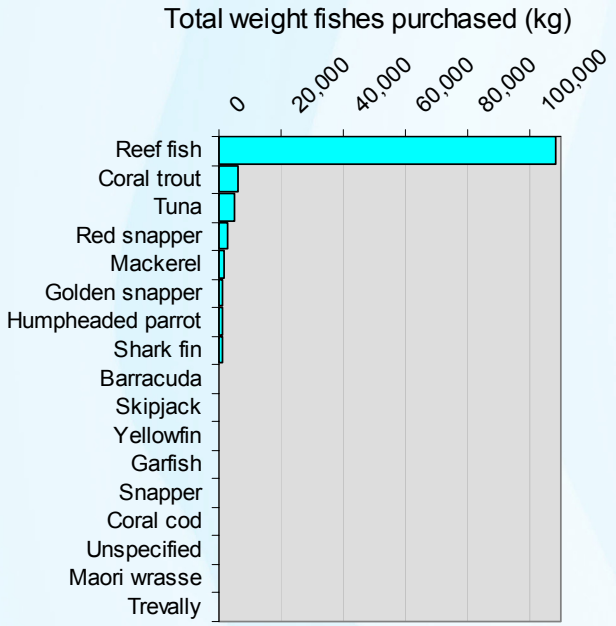
Fishes

Over 130 tonnes of fishes including reef fishes, tunas and other pelagic species, and shark fins were recorded in buyer data between April 2001 and September 2005. Most of these fishes originated in New Ireland Province, though there were small amounts recorded from Manus and North Solomons provinces. A total of 2,594 kilograms of the fishes recorded were not attributed to any province, so their source is uncertain.

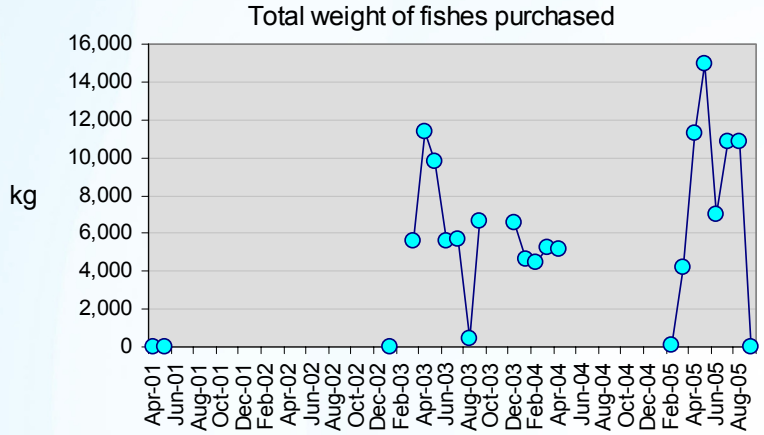
The data on fishes were generally poorly collected and did not allow for extensive analysis of species bought and patterns through time or place of origin. Most of the fishes by weight (83%) were recorded as "reef fish", but these are likely to have included fishes of all other categories recorded, except shark fins (0.66%) and tunas (4.8%).

The total weight of fishes purchased was relatively stable over most months, averaging 5.7 tonnes across the months with data. In May 2005 the amount of fishes purchased reached a peak of almost 15 tonnes, while in April and May 2001, January 2003 and February and September 2005, very small quantities of fishes were recorded.

Province	kg
New Ireland	127,658
North Solomon	29
Manus	81
Total	130,362

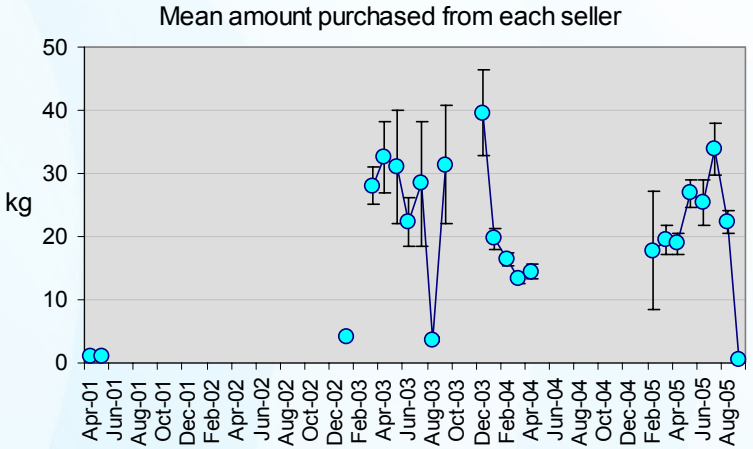


↑ Breakdown of fishes purchased by buyers over the survey period. The record-keeping is too poor to allow for analysis, with most fishes being lumped together in the category "reef fish".



↑ Total recorded weight in kilograms of fishes purchased by month between January 2003 and August 2005.

↓ Mean size of loads of fishes brought by individuals to buyers during each month of the survey (n=5,555 transactions which may have included more than one species group of fishes).



The size of loads of fishes brought to buyers varied between 100g and 2,713 kg per seller per day over the period of the survey. The average amount brought to buyers was 23.5 kg per person per sale. This fluctuated throughout the survey, but there was no trend for this to change over time over the past 5 years. Overall, the estimated payments made to sellers by buyers over the periods covered by these data totalled around K 418,500, with most income coming from reef fishes (more than K 297,000) and shark fins (K 49,000).

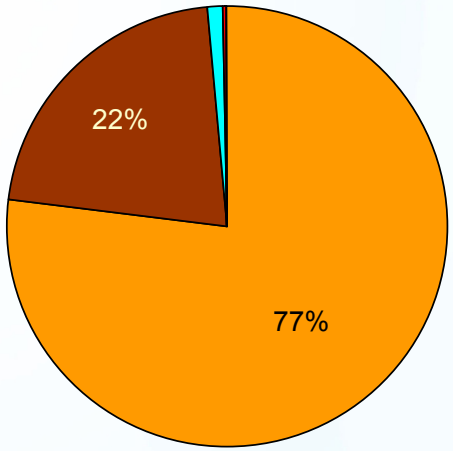
Crustaceans

Just over 45 tonnes of crustaceans were recorded as purchased by buyers over the period July 2001 to September 2005. Most of these originated from within New Ireland Province, though some purchases were made of catches from Manus and North Solomon Province. Most of the crustaceans purchased were lobsters (77%) and mudcrabs (22%) with very small amounts of coconut crabs, bugs and prawns (1.3% combined).

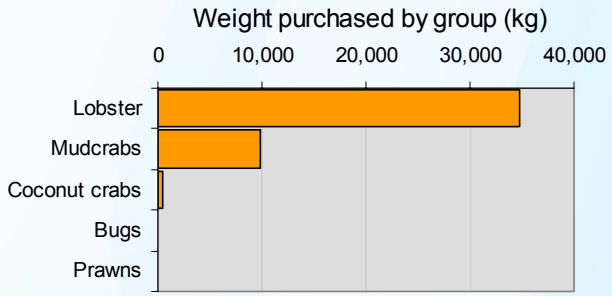
Province	kg
New Ireland	43,258
North Solomon	839
Manus	21
Total	45,139

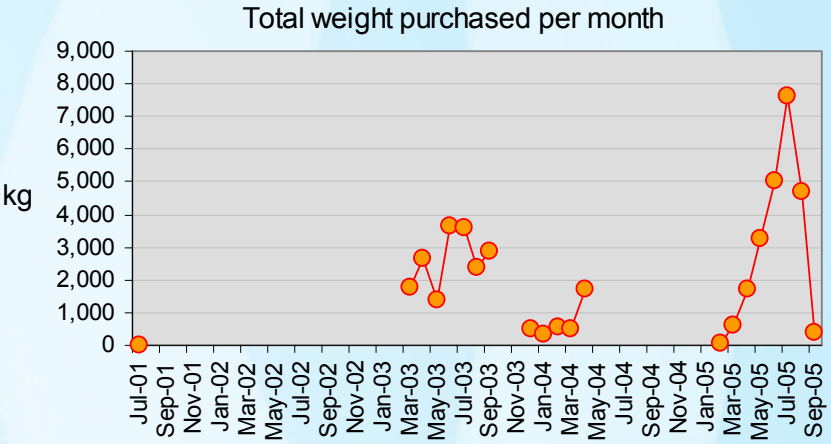
Purchases of crustaceans fluctuated through time averaging 2.1 tonnes per month for months with data overall. The highest monthly amount purchased was in July 2005, during which 7.6 tonnes of crustaceans were purchased. The months with the lowest total weights purchased were July 2001 (5 kg) and February 2005 (57 kg).

The amount of crustaceans (wet weight) sold by individuals to buyers tended to vary less, averaging 5.6 kg per individual per day overall, but ranging between 100g and 500 kg over the time of the survey. The total payments made to local sellers over the time periods covered by this survey for the purchase of crustaceans was around K 247,000. Most of this was paid for lobsters totalling around K 214,500.



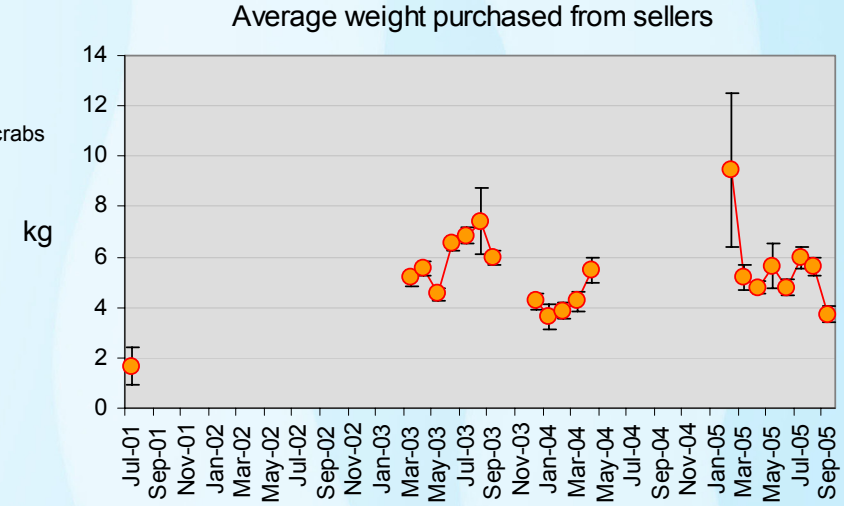
↙↓ Breakdown of crustaceans by (a) weight and (b) percentage purchased by buyers over the survey period (n=5,136 records of individual purchases).





↑ Total recorded weight in kilograms of crustaceans purchased by buyers by month between July 2001 and September 2005 (n=9,358 transactions).

↓ Mean size of loads of crustaceans brought by individuals to buyers during each month of the survey (n=8,096 transactions).



Molluscs

Most of the mollusc purchases recorded by buyers in Kavieng between December 2002 and April 2004 were sourced in New Ireland Province (74%). There was, however, a large percentage of molluscs sourced from outside the province in Manus (19%) and a small amount from North Solomon Province (1.2%). Around 6% of the molluscs were reported without information on their source province (6.9 tonnes).

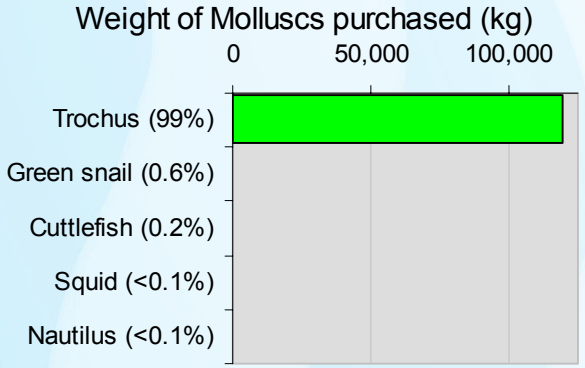
Province	kg
New Ireland	89,766
Manus	22,503
North Solomon	1,449
Total	120,694

↑ Source of purchases of molluscs made by buyers (n=12,974 transactions).

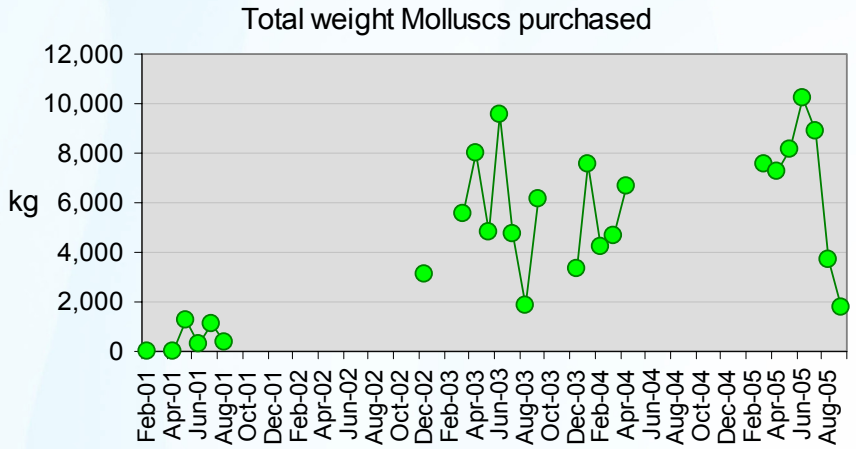
Most of the molluscs purchased were trochus shells (including species of *Trochus* and *Tectus*), which accounted for more than 99% of all molluscs by weight. Other molluscs purchased included green snails (*Turbo* spp.) in addition to several cephalopods (cuttlefish, squids and nautilus).

The total weight of molluscs purchased over the period covered by these data was over 120 tonnes. The average total purchases of molluscs was around 4.6 tonnes per month, and ranged as high as 10 tonnes (in June 2005). The average load size brought in by individuals to the buyers was just over 10 kg / person / day, but varied greatly. The minimum size of load people brought in to a buyer over the survey was 100g of molluscs, while the maximum was over 1.3 tonnes.

The price paid for trochus shells averaged K 5.24 per kilogram, while the average price paid for green snails was around K 4.71 / kg. Nautilus were purchased at an average price of K 20.50 / kg. Overall the total amount paid to sellers for molluscs during the sampled period was in the order of K 631,057.

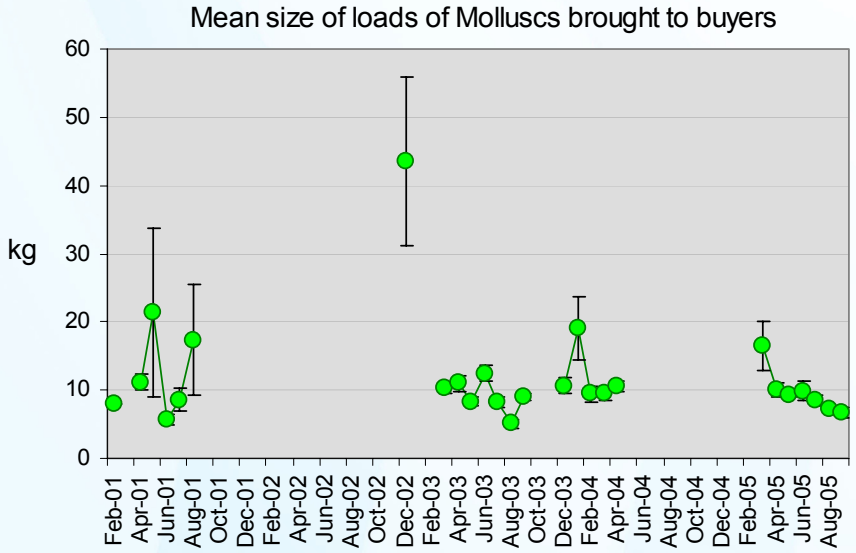


➔ Breakdown of molluscs by weight and percentage purchased by buyers over the survey period.

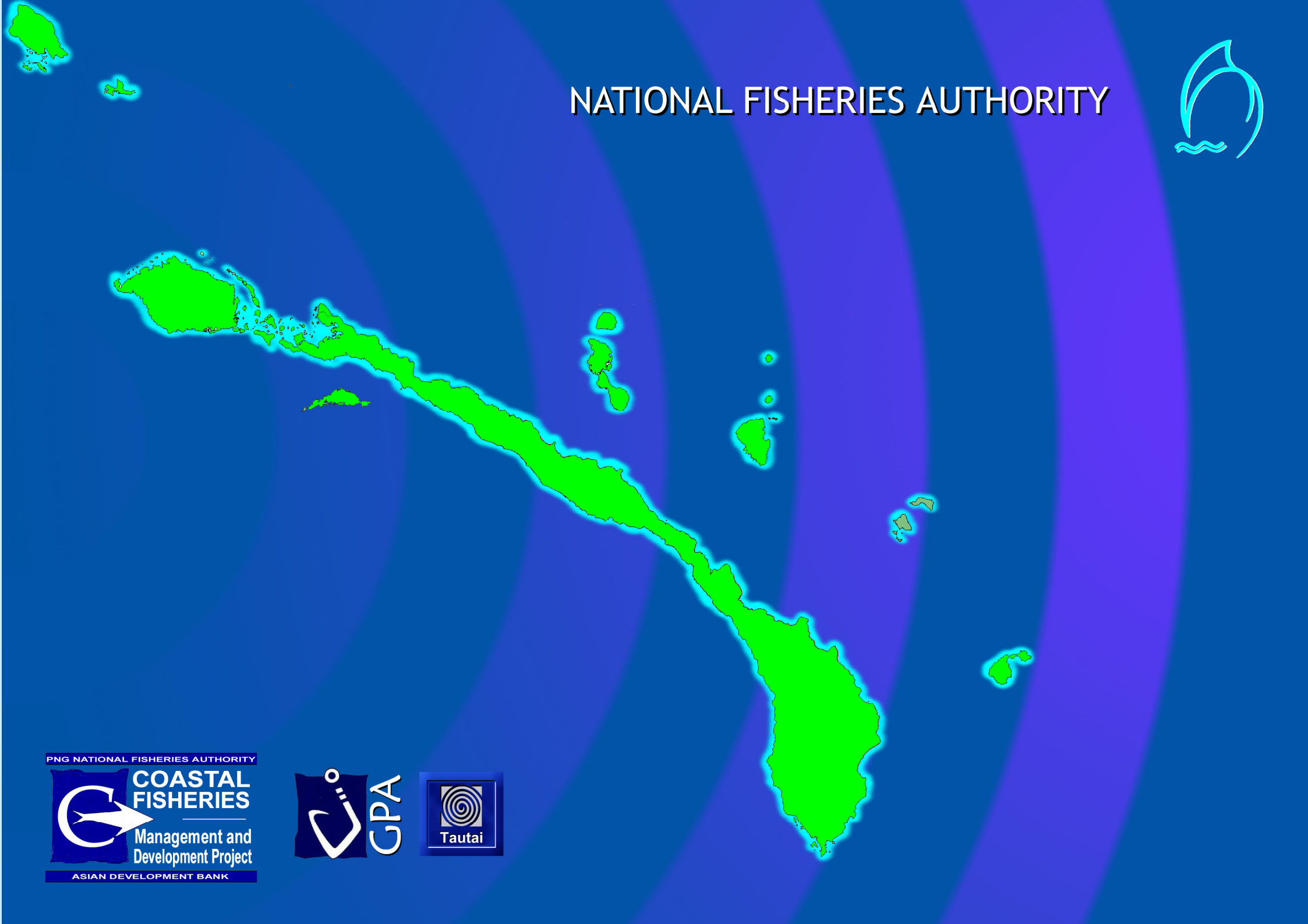


↑ Total recorded weight in kilograms of molluscs purchased by buyers by month between February 2001 and September 2005.

↓ Mean size of loads of molluscs brought by individuals to buyers during each month of the survey.



NATIONAL FISHERIES AUTHORITY



PNG NATIONAL FISHERIES AUTHORITY
COASTAL FISHERIES
Management and Development Project
ASIAN DEVELOPMENT BANK

GPA

Tautai