

DEVELOPMENT OF A SMALL GILLNET FISHERY FOR ROUNDSCADS IN PAPUA NEW GUINEA

Introduction

Little is known about most subsistence coastal fisheries in Papua New Guinea despite their importance as a source of animal protein for much of the population that lives near the sea. This article describes a small-scale gillnet fishery for roundscads on Bali or Unea Island, one of the Vitu Islands which lie to the north of West New Britain Province (Figure 1). Besides its importance as a subsistence food source, the roundscad fishery may also be a source of bait for longline tuna fishing which is being developed in neighbouring East New Britain.

Bali is the second largest island of the Vitu Group, with a population of about 3,400 people. Virtually all men, women and children around the coast are actively involved in fishing activities. The roundscad fishery is known locally as the 'tin-pis' fishery due to the fish's similarity in size and appearance to the canned mackerel that are a staple protein for many Pacific Islanders.

What makes this fishery interesting is that until recently roundscads were not a traditional target species for subsistence fishers on Bali. The fishery developed following observations by fishermen on the schooling behaviour of roundscads above the barrier reefs around the island, and without reference to similar fisheries elsewhere or the assistance of government fisheries extension officers.

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During this survey the main objectives were to identify the species of roundscad caught in the fishery, describe the fishing operations, record local knowledge and observations about the fishery and the target species, and comment on the potential for further development of roundscad fishing at Bali Island.

Bali Island

The nearshore marine environment of Bali is diverse. There are extensive inshore seagrass beds in waters of less than 2 m, and shallow fringing reefs surround most of the island. These inshore waters are quite turbid, especially in times of high rainfall due to run-off from the clay-like soil which typifies the area. Between one and two kilometres offshore are a series of submerged steep-sided barrier reefs, and it is on these reefs that roundscads are caught.

The roundscad or 'Tin Pis' fishery

During 1984 two local fishermen were diving on the barrier reefs at dusk and saw the roundscads schooling above the reefs. These two men, from the villages of Kumburi and

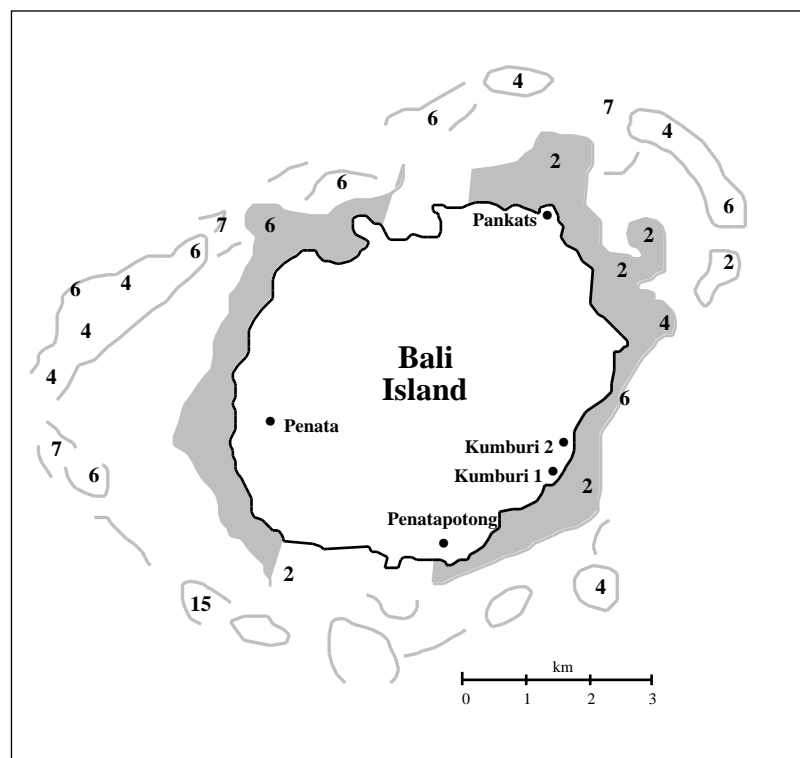


Figure 1: Map of Bali Island, showing locations of major fishing villages and reefs (approximate depths shown in metres)

Penata, set out to develop a technique to catch the fish, eventually refining a gillnetting method that has been catching small but consistent numbers of the fish for at least ten years. The fish are sold locally for food at a cost of 10 toea (US\$0.08) for three fish. They are also sometimes used for bait for handline fishing and fishers report that good catches are guaranteed when using roundscad bait is used.

Currently, fishing groups from four villages are exploiting the roundscad resource. These are: Kumburi with four active fishing groups, Penata and Penata Potong with two groups each, and Pankats with only one group.

There are up to 15 men or older boys in a fishing group. This number of fishermen is necessary to set the nets and later drive the fish into them. Not all villages have customary fishing rights on the barrier reefs where roundscads are caught, and this has led to disputes between fishing groups without traditional tenure on the reefs and the traditional reef owners.

Roundscads are caught by setting 2 in (stretched mesh) gillnets at dusk and dawn on top of the barrier reefs. Varying-sized nets were observed locally, mostly 50 m long by 1.5–2 m deep. When more than one net is used to fish, they are combined in various ways, including stringing them together lengthwise (2 x 1) or joining another two nets on top of these (2 x 2) to increase the depth of water fished.

If the tide or current is strong, the nets are set in line with the water flow, so that the water does not flatten the net. With no current, the nets are set in any

direction. The lead line (bolt) of the net is in contact with the seabed, tied around corals to keep it in place. Some groups attach extra floats to the top, so that a large catch will not sink the net.

There are variations in methods between local fishing groups which depend partly on the availability of gear. In general, the fishermen are not well equipped and the nets are in poor condition, particularly as nets must be imported from Lae or Port Moresby and are expensive compared with the average income of the Bali Islanders. Most other fishing gears used on the island are home-made (spearguns), or are cheaper gears such as handlines.

The tops or crests of the barrier reefs around Bali lie in depths varying between 5 and 15 m. The nets are set at any time from 17.30 hours and left for at least half an hour. The fish come on top of the reef at around 18.00 hours.

The fishers use a variety of methods to drive the fish into the nets, including splashing the water surface, shining torches to frighten the fish, bringing the net in a semi-circle to enclose the fish or some combination of these. All this may be done as soon as they see the fish or after some unspecified period of time.

Large single-hull canoes (known in Papua New Guinea as mons) or motorised dinghies are used to travel to the fishing grounds. Usually the former are used, as there are few outboard motors on Bali. Factors affecting the catch rate include the state of the moon and the prevailing current. Fewer roundscads are caught at the full moon and when there is little current.

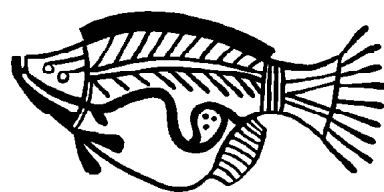
Survey results

During this survey, fishing was carried out in conjunction with two local fishing groups using three gillnets (100 m x 2 m: 2 in mesh). One of the Kumburi village fishing groups was encountered on the night of the survey and their catch was also sampled.

All catches were weighed on the night of capture and each species was identified, counted and weighed separately. A sample of 120 roundscads was purchased from the Kumburi fishing group to determine sexual maturity and to conduct some investigations into feeding behaviour of the roundscads.

The fishing groups employed very different fishing methods. The Kumburi fishers fished most of the water column above a 5 m deep reef by placing the nets in a 2 x 2 design and used torches to startle fish into the net, then closing the net around the catch.

The Penata group fished the lower 2 m of the water column above the reef on a deeper reef and did not use torches, but splashed the water surface to frighten fish into the net and simply pulled the nets into the boat after a catch was made. Both fished between 17.30 and 19.00 hours. The Penata Potong group set nets before dusk on reefs unsuitable for 'tin pis'.



The roundscad species known locally as 'tin pis' was identified as *Decapterus macarellus* [Fam: *Carangidae*] (Figure 2). This particular species of *Decapterus* is distinguished from others in the genus by its yellowish tail, narrow body shape and distinct white lining (emphysial membrane) on the inside of its upper lip.

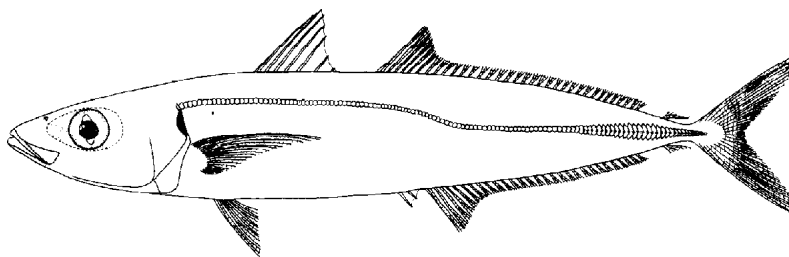


Figure 2: Illustration of *Decapterus macarellus*, tin pis

D. macarellus is a circumtropical species found in most tropical waters (Allen & Swainston, 1993). As this species is a recently discovered resource, there are no local (Tokples) names for it, unlike the other commonly caught fish in the area. A similar species caught in the Duke of York Islands, East New Britain, is known locally as 'salmon'.

A summary of the catch data from the observations conducted on Bali during the survey is contained in Table 1.

Catch per unit of effort (CPUE) for gillnet fisheries is conventionally expressed as the catch divided by the product of the net length and the time period the net is deployed. In this case the selection of an appropriate unit of CPUE is complicated by the fact that no standard nets were used. In addition, the fish are caught at a particular time of night when nets are left in the water for a short period. It is

unknown whether increasing the time left in the water would increase the catch, so the use of time as a measure of effort may be irrelevant. Catch per set for a unit length of net may be a more appropriate estimate of CPUE.

Two of the fishing groups, Kumburi and Penata, caught roundscads, but they used very different methods. Attempts to estimate catch rates would be inaccurate and misleading, comparisons difficult and would only tell us the obvious: that the Kumburi fishers made the largest catch overall and comprising only the target species, while the Penata group caught a few roundscads but mostly other reef species.

Differences in catch volume and composition may be due to fishing methods, skill, and other factors, such as location. It is not possible to comment further following these limited observations.

It is, however, important to determine an appropriate estimate of fishing effort and CPUE if this fishery is to be properly assessed. The by-catch of the roundscad fishery on this occasion was mostly fusiliers (family Lutjanidae), a common species caught by gillnets on reefs in other parts of the Pacific (e.g. Philippines; see Dalzell, 1993). These are also a good food fish, and are popular on Bali.

Other by-catch species included reef fish such as goatfish and surgeonfish. The large reef fish catch made by the Penata Potong group is not considered as by-catch as the nets had been set too early in the afternoon to target roundscads.

A summary of the length and weight data for roundscads is given in Table 2. There was very little variation in length between the sexes, however, female fish were about 10 g greater in average weight than male fish.

Table 1. Summary of gillnet fishing for roundscads on Bali Island during 1995

| Village | No. of nets | Net dimensions (m) | Net configuration | Species composition | No. of fish | Weight of fish (kg) |
|--------------|-------------|--------------------|-------------------|------------------------------|-------------|---------------------|
| Kumburi | 4 | 100 x 3 | 2 x 2 | <i>Decapterus macarellus</i> | 146 | 19 |
| Penatapotong | 1 | 100 x 2.5 | 1 | Reef species | 91 | N/A |
| Penata | 2 | 200 x 2.5 | 1 x 2 | <i>Caesio caerulea</i> | 68 | 9 |
| Penata | 2 | 200 x 2.5 | 1 x 2 | Reef species | 16 | 4.5 |
| Penata | 2 | 200 x 2.5 | 1 x 2 | <i>Decapterus macarellus</i> | 6 | 0.8 |

Table 2. Summary of the length and weight data for *D. macarellus* from Bali Island

| Sex | Average length (± SE) (n) (mm) | Average weight (± SE) (n) (g) |
|------------|-----------------------------------|----------------------------------|
| Female | 214.5 ± (3.2) (70) | 131.7 ± (4.4) (67) |
| Male | 216.3 ± (3.5) (38) | 121.9 ± (4.1) (37) |
| Both sexes | 215.1 ± (1.8) (108) | 128.2 ± (3.2) (104) |

The length-weight equation for *D. macarellus* at Bali Island was as follows:

$$Wt = 4.245LnL - 17.940$$

where L is length in millimeters and W is weight in grams.

Most of the fish caught ranged in size between 188 and 238 mm (Figure 3), with a mode at 215 mm and a mean length of 213 mm.

Two larger specimens, with lengths of 330 and 338 mm, were also caught and are probably representative of an older year class, possibly between 3 and 4 years of age (Dalzell, 1993).

Male and female roundscads are identical in external appearance, and can only be separated on the basis of gonad examination. The majority of the sample consisted of female fish, which were twice as abundant than males (females=70: males=38).

Most of the fish examined (80%) were in a pre-spawning condition as indicated by the presence of large ovaries with well developed eggs in the females and white maturing testes in the males.

The stomach contents of 15 roundscads were examined and found to contain plankton (tiny crustaceans, fish eggs and larvae, etc.). Most of the stom-

achs were not very full, but this may reflect capture shortly after the onset of feeding behaviour. The fish school above the barrier reef to feed at dawn and dusk, when there is increased plankton abundance on top of the reef, and possibly to escape predation.

Concluding remarks

Decapterus macarellus is found in all tropical waters and is harvested by gillnets, handlines, purse seines and trawls.

Roundscads are classed as small pelagic fishes, species which occupy the upper surface layers of the water column and feed mostly on plankton (Dalzell, 1993). As roundscads increase in size they tend to move towards a more demersal habitat where they are vulnerable to trawling.

In the Pacific Islands roundscad gillnet fisheries are small-scale operations, similar to the Bali Island fishery. In some locations such as Niue and the Cook Islands, specialised handline fisheries have developed to catch roundscads by chumming them near to the surface with coconut pulp where they will also take a hook baited with coconut.

In Hawaii, a handline and hoopnet fishery for *Decapterus macarellus* captures 122 t per annum and Hawaiian hoopnet fishing was proven to be effective for roundscad stocks in Niue and Tonga (Gillett, 1987, 1989).

The roundscad fishery of Bali Island is the product of an enthusiastic and committed fishing community. Two fishermen took the initiative to harvest a new resource, and developed fishing methods with no out-

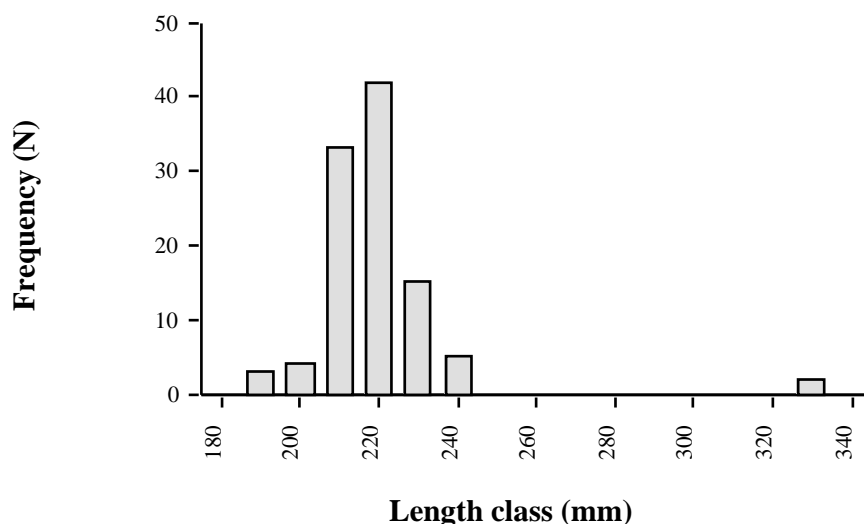


Figure 3: Length frequency of *D. macarellus* from gillnet catches at Bali Island

side help or knowledge of similar fisheries and without the assistance of extension officers.

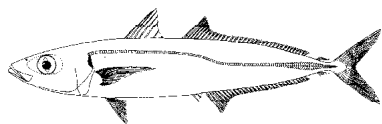
Other interesting features of the fishery are the precision of the schooling behaviour of the fish above the barrier reefs, and the use of torches to frighten the fish into nets, where, in many other fisheries, submerged lights are left in the water to attract baitfish.

Roundscads are reported to be abundant around the entire Vitu Islands group, although some areas remain inaccessible to fishermen without outboard motors. Local people reported that most inshore reef stocks in the area are already heavily exploited.

Underwater observations conducted during this survey revealed an absence of large fish on the reefs, while most of the fisheries production from Bali comprises a diverse range of small fish from shallow waters around the island. There is a need, therefore, to diversify fishing and to target more abundant pelagic species such as roundscads.

It is difficult to comment on the state of the roundscad resource on the basis of these limited observations. Current exploitation of roundscad stocks appears quite low and can only be classed as a mainly subsistence fishery, with part of the catch sold to Bali residents.

As such, roundscads are an important item to the members of the community not involved in fishing, and it is encouraging to see that this product is pre-



ferred to the tinned fish bought from trade stores.

Further development would depend upon many factors, one of which is the ability of the fishing communities to increase the catches so that there is an excess over subsistence requirements. Fishing would need to become more efficient, perhaps with new reefs exploited so that the same reefs are not constantly fished and exhausted.

Before encouraging any serious increases in fishing effort or efficiency, however, there is a need to develop a method to calculate fishing effort and CPUE, and to begin monitoring the fishery.

Given the remote location of Bali Island, the collection of data might be conducted by the local fishers with occasional assistance by Fisheries Officers from West New Britain.

A proposed data collection sheet would gather information on the time and conditions where fishing (tide, moon, sea, etc), gear used, total catch, weight of roundscad and by-catch, number of fish, etc. The Bali Islanders claim to have been taking consistent catches of round scads for ten years.

If catch rates are steady or increasing and stocks are plentiful, development is a viable option. Potential markets for roundscad as a bait species include the East New Britain Longlining Project, based at Kokopo, which currently imports saury from Japan.

Fishing trials could be carried out using roundscad to establish its suitability for longlining. While fish were being collected for the trials, more information could be gathered on the distri-

bution and abundance of the species. Local game fishers in Kimbe might also provide a market for small amounts of roundscad, as would Bali locals residing in Kimbe, who are accustomed to eating roundscad.

If the stock of roundscad is small, further development would be inadvisable. Some management measures might be introduced to preserve the stock, including; a closed season for spawning (which may occur around late September – October judging by the condition of female fish during this survey), or restriction of the number of nets per group, and so on.

There are substantial obstacles in the way of large-scale development at the moment. The catches observed during this survey were low and, although local fishermen claim to catch up to 500 fish per night (about 65 kg), it is not known how many nets were used and whether this is an accurate estimate. Few fishermen seem to fish consistently, and their gear is in poor repair. Further, there are disputes about reef tenure and fishing rights that require arbitration.

With respect to roundscads for longline bait, a pre-requisite for longline fishing is that bait supplies be consistent and reliable.

Given that this cannot be guaranteed by the Bali Island fishery, a more suitable strategy might be to aim at augmenting imported bait supplies for domestic longline fishing operations, rather than to try to provide total bait requirements. This would also assist in continuing the subsistence supply of roundscad to the island as well as reducing the costs of longline fishing operations

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