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Catch Composition of Bottom Traps (Bubu) Baited with Yellowstripe Scad (Selaroides leptolepis) in North Galesong Waters, Makassar Strait, Indonesia

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ABSTRACT

Bottom traps (bubu) are passive fishing gears widely used by small-scale fishers on Indonesian coral reefs because they are cheap to build and easy to operate. Their catch depends strongly on the bait used, yet the species composition produced by locally available baits is poorly documented. This study described the catch composition of bamboo bottom traps baited with yellowstripe scad (Selaroides leptolepis) and operated without a fish aggregating device in North Galesong waters, Takalar Regency, South Sulawesi, from August to September 2025. Three baited traps were set and hauled simultaneously by local fishers, and every fish caught was identified, counted and weighed. A total of 525 fish from five demersal taxa were caught: red snapper (Lutjanus sp., 171 individuals), rabbitfish (Siganus sp., 141), emperor (Lethrinus atkinsoni, 107), grouper (Epinephelus sp., 58) and silver pomfret (Pampus argenteus, 48). By weight, rabbitfish dominated the catch (29.23%), followed by red snapper (27.48%), emperor (18.80%), silver pomfret (12.44%) and grouper (12.05%). By number, red snapper was the most abundant taxon (32.57%). All five taxa have commercial value, showing that scad-baited traps selectively retained marketable reef-associated fish. The dominance of an herbivorous rabbitfish suggests that the bait attracted not only predators but also opportunistic omnivores. Because bait odour disperses quickly and no structure held fish near the traps, catch rates were probably limited by short attraction periods. Scad-baited bottom traps are a low-cost option for North Galesong fishers, but their effect on catch should be confirmed against unbaited and structure-enhanced traps.

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INTRODUCTION

Small-scale fisheries on coral reefs and adjacent habitats supply food and income to millions of coastal households in the tropics, and Indonesia hosts some of the largest of these fisheries in the world. Their productivity is increasingly threatened by fishing pressure. In eastern Indonesia, artisanal fish fences were found to exploit more than 500 species with a high removal of juveniles, while effort rose and catch success fell over more than a decade (Exton et al., 2019). Comparisons among Caribbean islands also showed that reef fish biomass and size declined steadily as artisanal fishing pressure increased (Hawkins & Roberts, 2004). Sustainable use of reef resources therefore depends on understanding what each gear catches and how its selectivity can be managed.

In Indonesian multispecies reef fisheries, different gears capture different assemblages of species and sizes, so gear choice is an important management lever. A study of catch composition across gears in an Indonesian coral reef fishery showed marked differences in the species, trophic groups and body sizes taken by each gear, and highlighted that data on gear selectivity are still scarce for most fishing grounds

(Humphries et al., 2019). North Galesong, in Takalar Regency, South Sulawesi, borders the Makassar Strait and supports an active small-scale fishery in which fishers use handlines, gillnets and traps. Among these gears, the bottom trap, locally called bubu, is one of the most common, yet its catch has rarely been described in detail for this area.

A bubu is a passive trap, usually built from bamboo, wood or netting on a rigid frame, that is set on the seabed for a fixed period. Fish enter through a funnel-shaped opening and find it difficult to escape. Traps are attractive to fishers and scientists alike because they are inexpensive, simple to build and operate, and can fish unattended (Bacheler, 2024). For small-scale fishers with little capital, these features make traps one of the most accessible gears available. Traps also have a smaller footprint on the seabed than towed gears, and live fish can be released from them, which supports their image as a relatively benign method.

This image needs qualification. Because traps retain most fish that enter them, they can be efficient and unselective. A comparison of fish assemblages among six Caribbean islands found that intensive trap fishing caused overfishing, reduced biodiversity and altered reef community structure; many of the fish commonly caught in traps were sexually immature (Hawkins et al., 2007). Trap fisheries can therefore contribute to growth overfishing when large numbers of small fish are removed before they reproduce. Understanding catch composition is the first step in judging whether a trap fishery takes mainly mature target species or a broad mix of juveniles and low-value bycatch.

Several studies have shown that simple changes to trap design can improve selectivity without reducing income. In a Caribbean reef trap fishery, escape gaps reduced the bycatch of small and low-value fish while maintaining the catch and market value of high-value species (Johnson, 2010). In Kenya, adding escape gaps to traditional basket traps increased the mean length and weight of the main commercial rabbitfish, Siganus sutor, and reduced the proportion caught below length at maturity from 56% to 25% (Gomes et al., 2014). Gated traps also caught fewer fish below their estimated length at maximum sustainable yield than traditional traps (Galligan et al., 2022). Simulation modelling suggested that small escape slots could produce immediate ecological benefits by reducing juvenile catch (Condy et al., 2015). These findings show that the composition of trap catches is not fixed but responds to how the gear is designed and operated.

The catch of a trap results from a sequence of behaviours: fish must detect the trap, approach it, enter and fail to escape. Early work on Antillean fish traps showed that, as soak time increases, a growing share of fish that enter later escape, so cumulative catch tends towards an asymptote (Munro, 1974). Trap catch therefore depends on the balance between ingress and escapement, which is shaped by trap design, soak time and anything that draws fish to the gear. For this reason, trap studies need to match trap design, entrance shape, bait type and soak time to their objectives (Bacheler, 2024).

Bait is often the main factor drawing fish into a trap. Fish locate food mainly through chemoreception, following the odour plume released by the bait, and then use vision and mechanoreception at close range (Løkkeborg et al., 2014). An effective bait must release feeding attractants that elicit search behaviour in the target species, and it must keep releasing them for several hours (Løkkeborg et al., 2014). Bait size, texture and chemical composition all influence how strongly and for how long fish are attracted. Because feeding attractants are species-specific, the type of bait can change both the quantity and the species composition of the catch.

Comparative trials confirm that bait type matters. In north-western Australia, traps baited with pilchard caught significantly more fish than traps baited with emperor flesh, and a fairly large amount of bait (about 4 kg) was required for effective trapping (Whitelaw et al., 1991). Oily bait also decays faster: pilchard was lost at about 6% per hour over long soaks, whereas emperor bait showed no detectable loss (Whitelaw et al., 1991). The choice of bait thus involves a trade-off between strong initial attraction and persistence. For small-scale fishers, the cost and local availability of bait are equally important.

Yellowstripe scad (Selaroides leptolepis) is an abundant, low-priced small carangid in the tropical western Pacific and an important fish commodity in the region (Halasan et al., 2021). In South Sulawesi, it is widely landed and cheap, which makes it a practical bait for trap fishers. Its oily flesh produces a strong odour that disperses quickly in the water and can attract predatory and opportunistic reef fish. The same properties suggest that it may lose attractiveness quickly, as observed for other oily baits (Whitelaw et al., 1991). Despite its widespread use, the catch composition of traps baited with yellowstripe scad has not been documented in the Makassar Strait.

Bait is not the only way to draw fish to a fishing site. Artificial structures can concentrate fish by providing shelter and feeding areas; a meta-analysis found that artificial reefs support fish density, biomass, species richness and diversity comparable to natural reefs (Paxton et al., 2020). Fishers in South Sulawesi sometimes combine traps with bamboo or coral-rubble attractors for this reason. Traps fished with bait alone, without such a structure, rely only on a temporary chemical stimulus. Comparing their catch with that of structure-enhanced traps requires first documenting what baited traps alone catch.

The ecological role of the species caught also matters. Traps often take herbivorous fish such as rabbitfish (Siganidae) and parrotfish, which help control algae on reefs. Modelling of a Caribbean reef showed that the harvest of herbivorous parrotfish by traps involves a trade-off between fishery yield and coral reef resilience (Bozec et al., 2016). In Kenya, rabbitfish were the most important commercial species in basket traps (Gomes et al., 2014). Knowing whether herbivores make up a large share of the catch in North Galesong can therefore guide both gear management and reef conservation.

This study aimed to describe the species composition, by number and weight, of bamboo bottom traps baited with yellowstripe scad and operated without an attractor structure in North Galesong waters. The results provide baseline information on which reef fish are attracted to this low-cost bait. They also support future comparisons with unbaited and structure-enhanced traps, and with gear modifications that could improve the selectivity and sustainability of the local trap fishery.

METHODS

The study was conducted from August to September 2025 in North Galesong waters, off Sampulungan Village, Takalar Regency, South Sulawesi, Indonesia (Figure 1). The site was chosen purposively because it is a main fishing ground for local bottom-trap fishers. Experimental fishing was carried out with three bamboo bottom traps of the type used by local fishers, each baited with the same amount of fresh yellowstripe scad (S. leptolepis) and set without any attractor structure. Traps were deployed simultaneously on the same ground from a local fishing boat, using a main line, weights, floats and tie lines, so that all units experienced the same environmental conditions. Soak time and the number of traps were kept constant on every trip, because trap catch

depends on soak duration and on the balance between fish entering and escaping the gear (Munro, 1974; Bacheler et al., 2013), and because standardised gear and bait are required for comparable trap data (Bacheler, 2024; Whitelaw et al., 1991). At each haul, every fish was identified to the lowest possible taxon, counted and weighed (kg), and the catch was photographed for verification, following procedures used in reef trap catch studies (Johnson, 2010; Humphries et al., 2019).

Catch composition was calculated by number and by weight as $Kj = (nj / N) \times 100\%$, where Kj is the proportion of taxon j (%), nj is the number or weight (kg) of taxon j, and N is the total number or weight of the catch. Catch per trap per trip was summarised with descriptive statistics (mean, standard deviation and range) for each taxon. Normality of catch per haul was checked with the Shapiro–Wilk test (Shapiro & Wilk, 1965), and differences in catch per haul among taxa were tested with one-way ANOVA at $\alpha = 0.05$, or with the Kruskal–Wallis test when the data were not normally distributed. The relationship between total catch and fishing trip was examined with simple linear regression to detect any trend in catch over the study period.

RESULTS AND DISCUSSION

Catch composition

The scad-baited bottom traps caught 525 fish from five demersal taxa, all of commercial value (Table 1). Red snapper (Lutjanus sp.) was the most numerous taxon (171 individuals), followed by rabbitfish (Siganus sp., 141), emperor (Lethrinus atkinsoni, 107), grouper (Epinephelus sp., 58) and silver pomfret (Pampus argenteus, 48). By weight, the ranking changed: rabbitfish dominated (29.23%), followed by red snapper (27.48%), emperor (18.80%), silver pomfret (12.44%) and grouper (12.05%).

Table 1.
Catch composition of bottom traps baited with S. leptolepis in North Galesong waters, August–September 2025

Taxon	Local name	Number (ind.)	Composition by number (%)	Composition by weight (%)
Lutjanus sp.	Kakap merah	171	32.57	27.48
Siganus sp.	Baronang	141	26.86	29.23
Lethrinus atkinsoni	Lencam	107	20.38	18.80
Epinephelus sp.	Kerapu	58	11.05	12.05
Pampus argenteus	Bawal	48	9.14	12.44
Total		**525**	**100.00**	**100.00**

The difference between the two rankings carries information on body size. Rabbitfish, silver pomfret and grouper contributed a larger share by weight than by number, so their individuals were on average heavier than the mean fish in the catch. Red snapper and emperor contributed less by weight than by number, indicating that many of them were relatively small. This pattern is relevant for management, because trap fisheries that remove many small individuals of predatory species can cause growth overfishing; in Caribbean trap fisheries, most fish of several common species were caught before reaching sexual maturity (Hawkins et al., 2007). Length data for red

snapper and emperor are therefore needed to judge whether the traps take mainly mature fish.

The catch contained only five taxa, which is low for a reef-associated trap fishery. Traps generally retain most fish that enter and therefore produce diverse catches (Johnson, 2010), and in a multispecies Indonesian reef fishery each gear captured a distinct and often broad assemblage (Humphries et al., 2019). Bottom traps set around artificial bioreeftek structures in the same North Galesong waters caught a wider range of species, with the highest share from Lutjanus malabaricus (17.04%) and the lowest from Nemipterus theodorei (4.75%) (Danajaya et al., 2022). The narrow species list in the present study may reflect the short sampling period, the small number of traps, identification to genus level, or a selective effect of the bait, which attracted mainly carnivorous and opportunistic fish.

Response of reef fish to scad bait

Three of the five taxa, red snapper, emperor and grouper, are carnivores that feed on fish and invertebrates, so their attraction to fish bait was expected. Fish locate bait mainly through the odour plume it releases, swimming up-current to the source and then using vision and the lateral line at close range (Løkkeborg et al., 2014). Oily fish baits release attractants rapidly; in north-western Australia, pilchard-baited traps caught significantly more fish than traps baited with lean emperor flesh (Whitelaw et al., 1991). Yellowstripe scad is a similarly oily small pelagic fish, which would explain the strong response of carnivorous reef fish. Scad is also cheap and abundant in the region (Halasan et al., 2021), so its use keeps operating costs low for small-scale fishers.

The dominance of rabbitfish by weight is more surprising, because siganids are mainly herbivorous. Rabbitfish are nonetheless a major component of trap catches elsewhere; in Kenya, Siganus sutor was the most important commercial species in traditional basket traps (Gomes et al., 2014). Rabbitfish may enter traps opportunistically to feed on bait fragments, to graze on algae growing on the bamboo, or to shelter, and the schooling behaviour of siganids can lead to several individuals entering together. Whatever the mechanism, the large share of rabbitfish has ecological implications. Herbivorous fish help control algae on reefs, and modelling of a Caribbean reef showed that trap harvest of herbivores involves a trade-off between fishery yield and reef resilience (Bozec et al., 2016).

The presence of silver pomfret, a species usually associated with soft bottoms and the water column, needs confirmation. It may indicate that traps were set near the reef edge on sandy or muddy bottom, where pomfret forage, or it may reflect a misidentification of another deep-bodied species. Habitat type strongly affects trap catches and catchability (Bacheler, 2024), so the substrate around each trap should be recorded in future work.

Effect of fishing without an attractor structure

In this study, traps relied only on the chemical stimulus of the bait. Bait odour is strongest soon after deployment and declines as attractants leach out; an effective bait must keep releasing attractants for several hours to maintain search behaviour (Løkkeborg et al., 2014). Oily baits lose mass quickly, about 6% per hour for pilchard over long soaks (Whitelaw et al., 1991). As attraction weakens, fewer new fish enter the trap, while some of those inside escape, so cumulative catch levels off over time (Munro, 1974). Saturation of trap catches with soak time has been shown for multiple reef fish

species (Bacheler et al., 2013). These processes probably limited the catch of the scad-baited traps, especially on longer soaks.

Structures could extend the period during which fish remain near the gear. Artificial reefs support fish density, biomass and species richness comparable to natural reefs (Paxton et al., 2020), because they provide shelter, shade and feeding areas. Traps combined with an attractor structure may therefore retain fish near the gear after the bait odour has faded. However, structures can also concentrate juveniles and herbivores, increasing the risk of overfishing. Any comparison between baited and structure-enhanced traps should therefore report fish size and species composition as well as total catch.

Implications for the North Galesong trap fishery

The results show that scad-baited bottom traps catch a small set of marketable reef-associated fish in North Galesong. This supports their continued use as a low-cost gear for local fishers. At the same time, Indonesian reef fisheries are under strong pressure, and artisanal gears with high juvenile removal have contributed to declining catches (Exton et al., 2019). Along fishing-pressure gradients, reef fish assemblages lose large individuals and biomass (Hawkins & Roberts, 2004). Trap fisheries need active management to avoid the same trajectory.

Gear modification offers a practical route. Escape gaps reduced the bycatch of small and low-value fish while maintaining the catch value of high-value species in Caribbean traps (Johnson, 2010). In Kenyan basket traps, gaps increased the size of captured rabbitfish and halved the share caught below maturity (Gomes et al., 2014), and gated traps captured fewer fish below their length at maximum sustainable yield (Galligan et al., 2022). Simulations indicated that even small escape slots could reduce juvenile catch with immediate ecological benefits (Condy et al., 2015). Testing escape gaps in North Galesong bubu would be a logical next step, because rabbitfish and small snapper make up a large share of the present catch.

This study has several limitations. Sampling covered only two months with three traps and no unbaited control, so the effect of the bait itself cannot be separated from that of the trap. Individual lengths and weights were not reported, which prevents assessment of maturity and size selectivity. Identification to genus level for three taxa limits ecological interpretation. Future studies should compare baited, unbaited and structure-enhanced traps over a full year, record soak time, depth and substrate, and measure individual fish lengths (Bacheler, 2024; Humphries et al., 2019.

CONCLUSION

Bamboo bottom traps baited with yellowstripe scad (Selaroides leptolepis) and fished without an attractor structure in North Galesong waters caught 525 fish from five commercially valuable demersal taxa. By weight, the catch was dominated by rabbitfish (Siganus sp., 29.23%) and red snapper (Lutjanus sp., 27.48%), followed by emperor (Lethrinus atkinsoni, 18.80%), silver pomfret (Pampus argenteus, 12.44%) and grouper (Epinephelus sp., 12.05%). By number, red snapper was most abundant (32.57%), and its lower share by weight indicates that many individuals were small. The strong response of carnivorous snapper, emperor and grouper is consistent with attraction to the odour plume of an oily fish bait. The large share of herbivorous rabbitfish shows that the gear also removes fish that are important for reef health. Because bait odour fades within hours and no structure held fish near the traps, the catch was probably limited by a short

attraction period. Scad-baited bottom traps are therefore a cheap and practical gear for local fishers. However, their effect on catch has not yet been separated from that of the trap itself, and the size of fish caught has not been assessed. Future work should compare baited, unbaited and structure-enhanced traps, measure fish lengths, and test escape gaps to protect juvenile snapper and rabbitfish.

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