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Another Novel Feeding Mode in the Labridae: Juvenile Tuskfish Fan Sand With Vigorous Single Pectoral Fin Swipes

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ABSTRACT

Fishes exhibit a range of feeding modes and strategies to forage in and on sand habitat. Here, we describe a novel feeding mode, whereby small juvenile baldchin groper, *Choerodon rubescens* (~65–100 mm TL), vigorously forward sweeps the benthos with a single pectoral fin to reveal small benthic prey and visually scans the immediate benthos on the swept side of the body. The behaviour was not exhibited by larger conspecifics (140–180 mm TL) presumably because they had progressed to larger and hard-shelled benthic prey and/or perhaps because the small juveniles foraged more or less continuously to obtain enough very small prey. These records confirm yet another mode of prey capture in the evolution of the highly variable feeding repertoire of the Labridae.

1 | Introduction

Ontogenetic dietary shifts are commonplace in marine and freshwater fauna, with multiple mechanisms proposed and studied to explain how they come about (Kinlan et al. 2005; Sánchez-Hernández et al. 2019; Neves et al. 2024). In addition to the major transition from pelagic larval to sedentary adult phase in many aquatic taxa (i.e., bipartite life history strategy), there can be considerable shifts in diet within each phase. For instance, prey availability and risk of predation scenarios present opportunities or niches that fish occupy as juveniles, which differ from those occupied later in adult life. Juveniles sometimes occupy small structure-rich areas until they reach sufficient size or physical speed and strength to access larger prey and counter predation. Specialist foraging strategies are occasionally exhibited by individuals or phenotypes, specific developmental stages, or species of fish to access prey in ways that contrast conventional or generalist feeding (Jensen 2005; Sánchez-Hernández et al. 2021; Pryor and Milton 2023).

Pectoral fin ecomorphology has been a particularly fertile aspect of study in investigating and explaining swimming ability and habitat associations of labrids, including wrasses and parrotfishes, on coral reefs (Blake 1979; Walker and Westneat 2000; Fulton et al. 2001; Aiello et al. 2018). It has led to an understanding of niche partitioning by labrids as a function of their swimming morphology (e.g., fins, pectoral muscle, and body length and shape) and feeding morphology (e.g., primary teeth and pharyngeal jaws) and their combined use during swimming whilst feeding (Collar et al. 2008; Rice et al. 2008; Burress and Wainwright 2019). Notably, pectoral fins are key to the success of certain genera (e.g., *Thalassoma*, *Stethojulis*) in dominating turbulent reef flat and crest environments where predation rates are high (Wainwright et al. 2002; Fulton et al. 2017; Bellwood

et al. 2018). Much of this research provides an explanation for the distribution of species across the flow continuum on reefs.

Notably, there have been negligible reports of direct use of pectoral fins by labrids to manipulate prey. However, Rice et al. (2008) did demonstrate that pectoral fins are used for braking by labrids feeding close to the benthos. Bernardi (2012) mentions that pectoral fins are used by wrasses to expose and dig out hard-shelled prey prior to transporting these items to an anvil for processing. However, detailed accounts of using pectoral fins to expose prey have not been afforded in contrast to the detailed accounts of anvil use in wrasses (e.g., Brown 2012; Pryor and Milton 2023; Tariel-Adam et al. 2025 and references therein). In contrast, several other teleosts (e.g., Jensen 2005; Davenport and Wirtz 2019) and rays (batoids) (Mulvany and Motta 2013 and references therein) are known to use single pectoral fins or modified pectoral fin structures (e.g., fingers, lobes) to dig, startle, or expose benthic prey. Paired fin movement to expose benthic prey has been recorded in cichlid species aiding their progeny in foraging during parental care (Zworykin et al. 2000; Wisenden et al. 1995; Zworykin 1998) and by gobies (e.g., Choi and Gushima 2002).

The current observations are aimed at contributing to the broader understanding of the functions that pectoral fins provide for labrids as a model aquatic group for studying niche partitioning. We also place our observations in the context of ontogenetic dietary shifts. The focal species of interest here is baldchin groper *Choerodon rubescens* (Günther 1862) (Family Labridae). Cure et al. (2015) mention the specialist feeding technique that juvenile *C. rubescens* exhibit but provide no further details. Here we aim to provide a detailed description of the behaviour. Although *C. rubescens* was historically considered a subtropical species, with a central distribution around the Houtman Abrolhos Islands (~28ºS), its range has experienced a relatively recent southward shift to the south-west of Western Australia (Cure et al. 2015), where it was previously considered rare (Hutchins and Pearce 1994; Hutchins 2001). First recorded at Rottnest Island in 2012, the species now appears quite common as juveniles in the shallows around the island (Cure et al. 2015), with larger individuals caught in deeper waters offshore (Whisson and Hoschke 2017). Although recent poleward shifts in the distribution of several subtropical fishes along this part of the coast have been attributed to the southerly flowing Leeuwin Current (Caputi et al. 2009), juvenile and larger *C. rubescens*, a highly prized recreational and commercial species, are clearly suited to foraging outside of their natural range.

2 | Methods and Results

On 27–28 December 2023, while snorkelling on two dives spanning 5.5 h in total, observations were made of five solitary small *C. rubescens* [65–100 mm total length (TL)] performing a novel feeding behaviour in shallow water (1.5–3 m depth) over sand and seagrass habitat at Rottnest Island, Western Australia (Figure 1, Video S1). Baldchin groper is a large-bodied tuskfish (>600 mm TL) (Family Labridae) endemic to subtropical Western Australian waters in the eastern Indian Ocean (Fairclough et al. 2008) and is a protogynous hermaphrodite (Fairclough et al. 2023). Since females mature at about 3 years of age and 250 mm TL (Fairclough et al. 2023), the fish we observed were most likely juveniles (Figure 2).

Filming and photography were performed by one of us (BCE) with a Canon GX7 II camera, and a dive belt was used to facilitate observation of the object-shifting behaviour of the focal individual close to the benthos. The specific location was the Army Jetty (32.0021ºS, 115.5499° E) in 1.5–4 m depth over mixed sand and seagrass habitat. The Army Jetty is actually a rock groin rather than a wooden structure, having been recently reconstructed. The nearby habitat is a mix of dense seagrass beds and open sand, with patches of detached and dying seagrass interspersed throughout the shallow water environment. Additionally, two larger baldchin groper individuals (~140 and 180 mm TL; see Figure 2) were observed on multiple occasions but did not exhibit the novel feeding behaviour.

Specifically, the novel feeding mode of the tuskfish (Video S1) involved each individual tilting its lateral surface downward on one side and applying rapid forward thrusts of the single pectoral fin on that side. This resulted in a slight backward movement of the body and noticeable lifting of sand and/or seagrass fragments from the benthos. Slow-motion playback of video enabled tracking of each fish's eye(s), which could be seen to search the dislodged fragments and the newly exposed sand. In a subset of cases, small prey were exposed and eaten. There was no obvious consistency in whether the right or left pectoral fin was used. Presumably, benthic invertebrate prey was targeted, but this could not be resolved with the naked eye nor confirmed from video replay.

3 | Discussion

The current study adds another nuance to the emergence of trophic novelty in fishes, providing yet another example from the Labridae (*cf.* Cowman et al. 2009). Specifically, our observations focus on the direct use of either, though not both, pectoral fins simultaneously, to dislodge or expose benthic prey from sand and seagrass fragments. We provide 'The how' underlying previous dietary studies where juvenile baldchin tuskfish feed on zoobenthos, especially copepods and gammarid amphipods associated with sand, seagrass habitat and seagrass fragments, especially (Fukuoka and Yamada 2015; Lek et al. 2018). The lone published study of baldchin groper diet revealed a distinct shift from feeding as small juveniles (<100 mm TL) mostly on small crustaceans and non-mytilid bivalves to mytilid and non-mytilid bivalves and echinoderms as adults (Lek et al. 2018). This dietary shift may in part be a consequence of ontogenetic increases in cranial reinforcement and jaw crushing power (e.g., Baliga and Mehta 2014; Neves et al. 2024).

Furthermore, wrasses and parrotfishes may be especially vulnerable to predators in the juvenile, as opposed to the adult phase of their life (Heminson et al. 2020; Neves et al. 2024). Interestingly, baldchin groper remain almost stationary and upright immediately prior to using the lean and single-fin-sweep-foraging technique whilst feeding in relatively still/negligible flow conditions. We speculate that the ability to maintain stillness close to the benthos combined with reasonably high visual acuity (Collin and Pettigrew 1989) is required in distinguishing

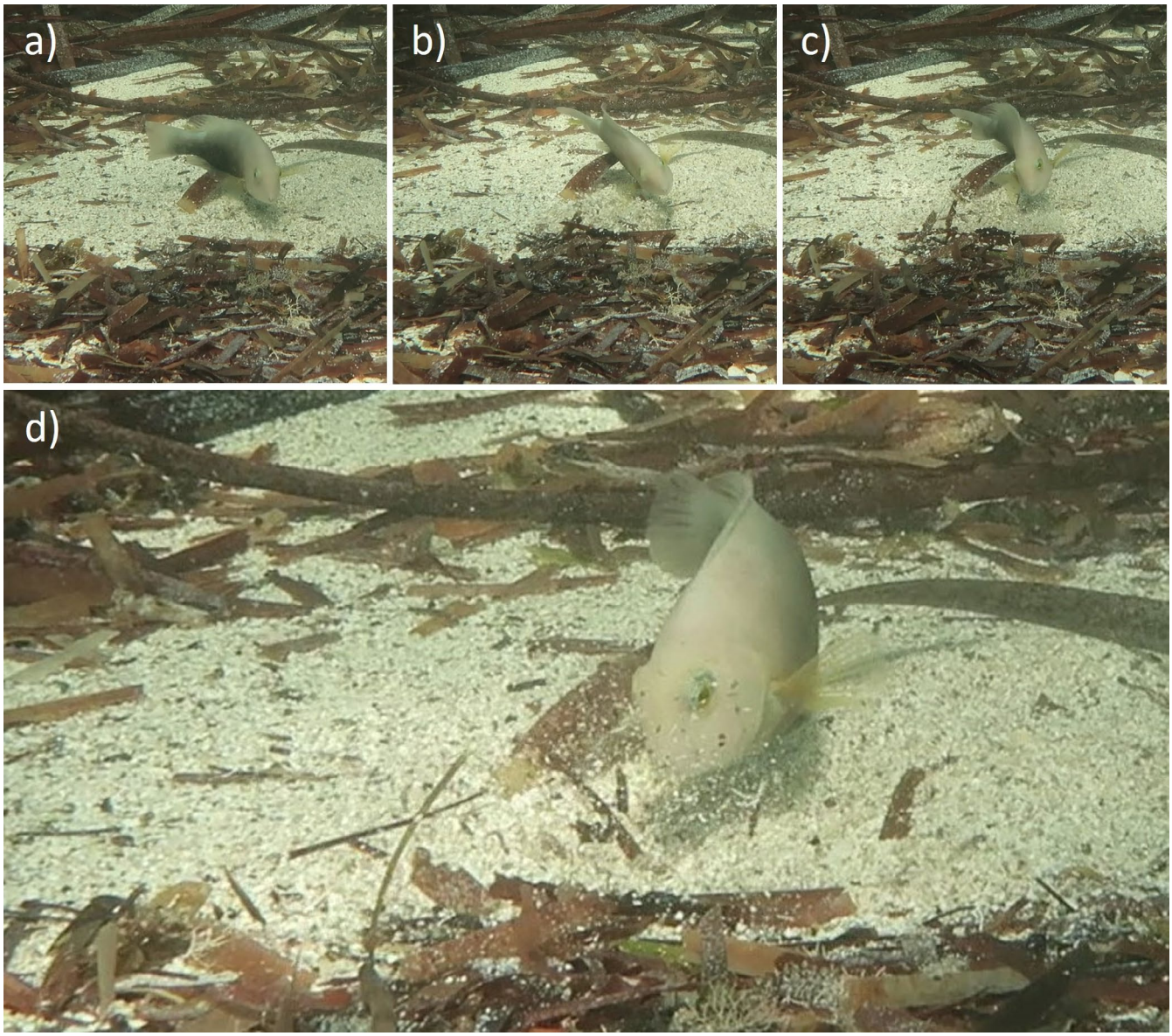

FIGURE 1 | (a) A Juvenile baldchin groper (95 mm TL) initially upright, (b) tilts to its right side and (c) swipes the right pectoral fin forward; (d) lifting sand and seagrass fragments in search of benthic prey.

FIGURE 2 | An individual of each of the two juvenile size classes of baldchin groper that were observed in the current study.

small cryptic mobile benthic prey (e.g., amphipods, copepods). Maintaining an upright or partially upright position during scanning for prey may also facilitate a fast start (i.e., escape) at crucial moments should an ambush predator strike (though this is purely speculative). Then, only after locating prey, does the juvenile baldchin groper need to engage in riskier behavior—akin to parrotfishes and other non-herbivorous labrids (except for *Epibulus insidiator*), whereby they approach benthivory at a downward angle to the substratum upon approaching their prey before braking (Rice et al. 2008).

It is also interesting that Wainwright et al. (2002) found that the genus *Choerodon* has a wide range of pectoral fin aspect ratios relative to most labrid genera and suggested that pectoral fin shape may not be as strongly related to high swimming demands in *Choerodon* as other labrid genera. To this end, our

observations provide an example of how the pectoral fin is central to a specialist foraging strategy of at least one species of *Choerodon* and where high-speed manoeuvrability is irrelevant. Furthermore, a non-tapered and high pectoral fin (i.e., high drag design) may be better suited to transferring water and lifting substratum than are the low drag pectoral fin adaptations typical of some labrids (e.g., *Thalassoma*) that aid swimming in extreme turbulence (Blake 1979, 1981).

It will be informative to conduct further observations of diurnal foraging by *Choerodon* spp. on soft substratum habitat, particularly in sheltered waters. Juveniles of different species are candidates for the use of the single-pectoral fin-swipe-foraging technique, and attributes of the pectoral fin warrant consideration in such studies. Additionally, given some of the sophisticated feeding strategies, including tool use, which have been discovered in adult *Choerodon* spp. (e.g., Pryor and Milton 2019, 2023); it cannot be ruled out that fin-sweeping might at times be implemented by adult *Choerodon* species. Certainly, some *Choerodon* spp. continue to feed on prey inhabiting sandy substrates beyond the juvenile phase in addition to increasingly consuming hard-shelled prey that associate with reef structure (e.g., Lek et al. 2018). Under such circumstances, we predict nuclear-follower interactions are more likely to emerge as a function of more substantial disturbance to the substratum.

For completeness, it is unsurprising that as a function of their small body size and highly localized disturbance of the substrate during foraging, juvenile baldchin groper attracted minimal if any interest from would-be follower species in our observations (*cf.* Sazima et al. 2007; Pryor and Milton 2021). Presumably, with such small prey relative to predator size, having to share meals with follower species would be disadvantageous. Small juvenile baldchin groper, in targeting tiny cryptobenthic prey, must forage almost continuously throughout the day to gather sufficient dietary intake to maximize growth and apparently within a confined foraging area. This may explain how readily the single-pectoral fin-swipe behavior was observed, whereas larger juveniles had presumably progressed to other hunting strategies, including searching more extensive areas and digging for large, shelled prey such as molluscs. In this regard, it may be valuable in the field to focus attention on the prey-searching behavior of wrasses and *Choerodon* spp. particularly, broadening the scientific knowledge base from one focused heavily on tool use (and notably anvil use). Doubtless, large juveniles and adult *Choerodon* that encounter soft-bodied prey ingest items immediately, and therefore the chances of observing these events are substantially lower than detecting an individual that is transporting and/or smashing large, hard prey items. Additionally, aquaria-based observations and challenge tests involving buried food resources might accelerate our appreciation for the ontogenetic capability of *Choerodon* spp. by enhancing detection of large juveniles and adult fish that feed on soft-and hard-bodied prey (Zworykin et al. 2000).

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Conflicts of Interest

The authors declare no conflicts of interest.

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Supporting Information

Additional supporting information can be found online in the Supporting Information section.