

Anvil use by the bird wrasse, *Gomphosus varius*,  
on an Okinawan coral reef

|       |   |
|-------|---|
| メタデータ | 言語: English<br>出版者:<br>公開日: 2025-06-24<br>キーワード (Ja):<br>キーワード (En):<br>作成者: 名波, 敦<br>メールアドレス:<br>所属: |
| URL   | <a href="https://fra.repo.nii.ac.jp/records/2014631">https://fra.repo.nii.ac.jp/records/2014631</a>   |



# Anvil use by the bird wrasse, *Gomphosus varius*, on an Okinawan coral reef

Atsushi Nanami<sup>1</sup>

Received: 6 May 2025 / Revised: 21 May 2025 / Accepted: 22 May 2025

© The Author(s), under exclusive licence to Senckenberg Gesellschaft für Naturforschung 2025



**Fig. 1** **a** *Gomphosus varius* individual grasping a prey item in the mouth (white arrow); **b–d** three photographs of anvil use; **b** third strike on the dead coral; **c** sixth strike on the rock; **d** eighth strike on

the rock (can be observed at the 21-s, 24-s, and 32-s mark in Video S1, respectively). Yellow arrows in (**b–d**) represent the directions of striking by shaking the head from right to left

Communicated by B. W. Hoeksema

✉ Atsushi Nanami  
nanami\_atsushi71@fra.go.jp

<sup>1</sup> Yaeyama Field Station, Coastal and Inland Fisheries Ecosystem Division, Environment and Fisheries Applied Techniques Research Department, Fisheries Technology Institute, Japan Fisheries Research and Education Agency, Ishigaki, Okinawa, Japan

Tool use has been widely reported in primates and birds. Tool use by aquatic animals (e.g., octopuses, cuttlefishes, hermit crabs, and fishes) has also been reported (Mann and Patterson 2013). In particular, wrasses (family Labridae), which is a major group of marine fishes, show anvil use for effective foraging (Brown 2012; Dunn 2016; Pryor and Milton 2023; Jaishankar et al. 2024; Tariel-Adam et al. 2025). Anvil use is defined as “a fish taking a prey item in its mouth and striking it on a hard surface.” (Tariel-Adam et al. 2025). To date,

anvil use has been reported in 29 wrasse species belonging to nine genera (*Cheilinus* Lacepède, 1801, *Choerodon* Bleeker, 1847, *Coris* Lacepède, 1801, *Halichoeres* Rüppell, 1835, *Lachnolaimus* Cuvier, 1829, *Pseudolabrus* Bleeker, 1862, *Semicossyphus* Günther, 1861, *Symphodus* Rafinesque, 1810, and *Thalassoma* Swainson, 1839). By contrast, considering that wrasses consist of diverse species, anvil use by other genera needs to be explored to examine its evolutionary origin and ecological drivers (Tariel-Adam et al. 2025).

This study is the first to observe anvil use in the bird wrasse *Gomphosus varius* Lacepède, 1801, in subtropical southern Japan, on an Okinawan coral reef (Fig. 1, Video S1). The observation was conducted at Yaeyama Islands, Okinawa, on October 2, 2021, by using SCUBA. One individual with initial-phase coloration was grasping a crab in its mouth and striking it on dead corals and rock. The total number of times anvil use was applied (number of strikes) was nine (Appendix), and the duration from the first strike to the last strike was 15 s. Among the nine strikes, two could not be observed because they were conducted out of sight behind substrates. By contrast, seven strikes could be clearly observed, including where (anvil substrate selection) and how (anvil laterality) the fish individual used the substrates to crush the prey item. For anvil substrate selection, dead corals and rocks were used three and four times, respectively. All strikes were observed at different points, that is, the fish individual did not use a fixed point to crush the prey item. For anvil laterality, six out of the seven strikes showed that the fish individual shook the head from right to left, that is, the fish individually used the left side of its body six times (Appendix). A “laterality index” was calculated as follows (Tariel-Adam et al. 2025):  $(R - L)/(R + L)$ , where  $R$  and  $L$  are the number of strikes using the right side and left side of its body, respectively. The value of the laterality index was  $-0.71$ , indicating a preference for the left side to some extent. The fish individual could eat the prey item (Video S1), indicating that this anvil use was successful. Considering that *G. varius* has an extreme protrusive snout (Wainwright et al. 2004), this study might provide some insights about potential morphological constraints of anvil use.

This study is the first to report anvil use in the labrid genus *Gomphosus* Lacepède, 1801, indicating an extension of the taxonomic range among wrasse species and fishes from an Okinawan coral reef. In the eastern Asian region, Tribble (1982) observed anvil use by *Coris dorsomaculata* Fowler, 1908, at a temperate region (Miyake Island, Izu Islands, Japan). By contrast, this study is the first to report anvil use from a subtropical region in Japan, indicating an extension of the geographical range of anvil use. The number of anvil use of *G. varius* was nine, which was similar to other wrasse species (*Halichoeres* spp. and *Thalassoma* spp.), showing that the number of anvil use was less than ten in most cases (Jaishankar et al. 2024; Tariel-Adam et al. 2025). The large number of 29 labrid species reported to show anvil use, so far, suggests that additional species of wrasses and individuals at other locations should be studied in order to obtain a more

complete overview of this behavior. Species not known to show anvil use should also be noted and included in evolutionary models, which may help to detect whether anvil use evolved only once or multiple times in the evolution of the Labridae.

**Supplementary Information** The online version contains supplementary material available at <https://doi.org/10.1007/s12526-025-01537-w>.

**Acknowledgements** The author expresses grateful thanks to Masato Sunagawa and Sho Sunagawa for their field guide and piloting of the research boat YAEYAMA. Constructive comments from two anonymous reviewers were much appreciated. The authors would like to thank Enago ([www.enago.jp](http://www.enago.jp)) for the English language review.

## Declarations

**Conflict of interest** The author declares no competing interests.

**Ethical approval** No animal testing or animal sampling was performed during the study.

**Sampling and field studies** All data was obtained only by field observations, which do not require a field permit in Okinawa.

**Data availability** The datasets generated during and/or analyzed during the current study are available from the corresponding author upon reasonable request.

**Author contribution** Atsushi Nanami conceptualized and designed the study and conducted all formal analysis, data curation and writing.

## References

- Brown C (2012) Tool use in fishes. *Fish. Fisheries* 13:105–115
- Dunn RP (2016) Tool use by a temperature wrasse, California sheep-head *Semicossyphus pulcher*. *J Fish Biol* 88:805–810
- Jaishankar S, Nair R, Alcoverro T, Arthur R (2024) Anvil use by three wrasse species: *Halichoeres hortulanus*, *Thalassoma janseni*, and *Thalassoma lunare*. *Coral Reefs* 43:483–487
- Mann J, Patterson EM (2013) Tool use by aquatic animals. *Phil Trans Royal Soc B* 368:20120424
- Pryor KJ, Milton AM (2023) Tool use involving a different prey type, microhabitat and location, and long-term anvil use, by the graphic tuskfish *Choerodon graphicus* (De Vis 1885). *Mar Ecol* 44:e12768
- Tariel-Adam J, Toledo JG, O'Brien CE, Floeter SR, Brown C (2025) Tool use by new world *Halichoeres* wrasses. *Coral Reefs*. <https://doi.org/10.1007/s00338-025-02633-w>
- Tribble GW (1982) Social organization, patterns of sexuality, and behavior of the wrasse *Coris dorsomaculata* at Miyake-jima, Japan. *Environ Biol Fish* 7:29–38
- Wainwright PC, Bellwood DR, Westneat MW, Grubich JR, Hoey AS (2004) A functional morphospace for the skull of labrid fishes: patterns of diversity in a complex biomechanical system. *Biol J Linn Soc* 82:1–25

**Publisher's Note** Springer Nature remains neutral with regard to jurisdictional claims in published maps and institutional affiliations.

Springer Nature or its licensor (e.g. a society or other partner) holds exclusive rights to this article under a publishing agreement with the author(s) or other rightsholder(s); author self-archiving of the accepted manuscript version of this article is solely governed by the terms of such publishing agreement and applicable law.