

The Morphological Evolution of Elongated Snouts in Coral Reef Fish

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Abstract

Reef fish demonstrate diverse morphologies shaped by feeding adaptations. This study quantified snout morphology in 3,422 reef-associated fish across 1,385 species to explore patterns of snout elongation. Principal Components Analysis (PCA) explained 82.08% of total variation, distinguishing short from long snouted species. The most elongated snouts were observed in *Forcipiger flavissimus*, *Forcipiger logirostris*, *Aulostomus chinensis*, and *Oxymonacanthus logirostris*, all specialized feeders. These findings highlight a link between snout elongation and trophic specialization and suggest that elongated morphologies evolved independently across reef fish families.

Introduction

Coral reef fish demonstrate remarkable morphological diversity that reflects adaptation to feeding in complex environments (Perevolotsky et al., 2025). Snout elongation is an adaptation that plays an important role to obtain food in a variety of coral structures (Bellwood, et al., 2014). Despite its ecological importance, the nature of snout elongation in reef fish species remain understudied. Our study addresses this gap by quantifying snout morphology across 1,385 reef fish species to better understand the evolutionary patterns and ecological significance of snout elongation.

Figure 1.1



Figure 1. Long-snouted reef fish using elongated snouts to feed on or within corals. (1.1) *Oxymonacanthus logirostris*; (1.2) *Forcipiger flavissimus*. Photos © Victor Huertas.

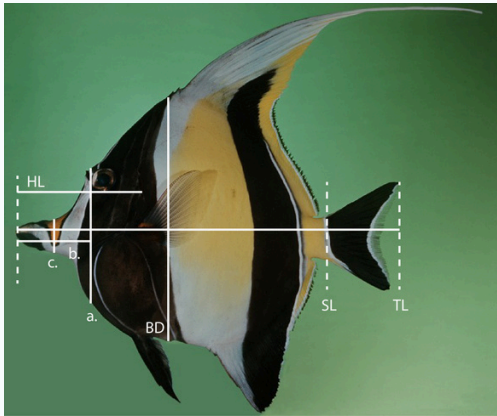


Figure 2. Morphometric measurements taken from lateral-view photographs.

Materials & Methods

Sample: 3,422 reef-associated fish from 1,385 species across multiple families.

Measurements: Snout length, snout width, head length (HL), and body depth (BD) were measured from standardized lateral-view photographs using ImageJ. Three specific head regions were measured: (a) head depth, (b) distance from the upper jaw to the eye margin, and (c) snout depth. All measurements were calibrated to total length (TL). When a TL was not provided, we referenced standard length (SL) for calibration.

Analysis: A Principal Components Analysis (PCA) identified the main axes of morphological variation.

Figure 1.2

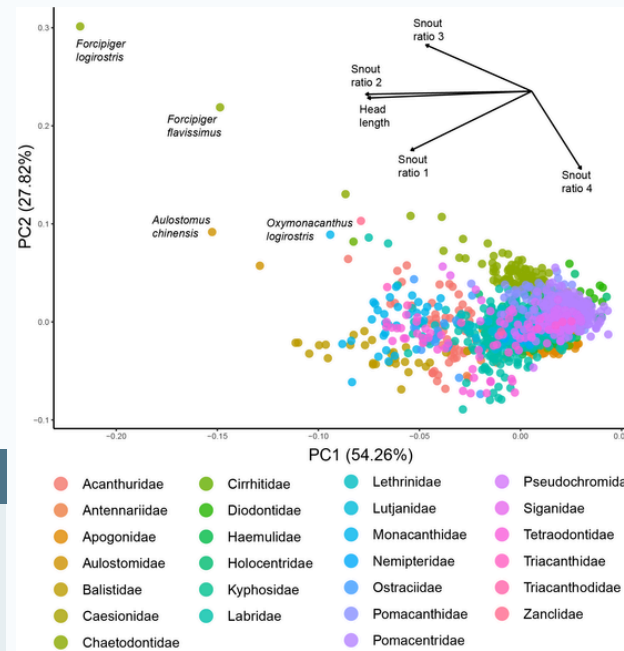


Figure 3. Principal Components Analysis (PCA) illustrating variation in head and snout morphology across reef fish families. Each point represents a species, color-coded by family. HL ratio = B/HL; SN ratio = B/BD; SN ratio 2 = B/SL; SN ratio 3 = B/C; SN ratio 4 = C/A.

Results

- PCA explained 82.08% of total variation:
- PC1 = 54.26% and separated short snouted species from long snouted species.
- PC2 = 27.82% and associated with snout length relative to snout width.
- Most elongated snouts were observed in: *Forcipiger flavissimus*, *Forcipiger logirostris*, *Aulostomus chinensis*, and *Oxymonacanthus logirostris*.

Discussion & Conclusion

- These findings highlight a link between snout elongation and feeding specialization, with elongated species such as *Forcipiger flavissimus*, *Forcipiger logirostris*, *Aulostomus chinensis*, and *Oxymonacanthus logirostris*, adapted to feed in narrow coral crevices or specialized suction feeding.
- Snout elongation evolved multiple times independently across reef fish families, forming an axis of variation from narrow, elongated snouts to shorter, deeper ones.
- Our results suggest that this morphological specialization is associated with increasing habitat complexity, enabling multiple taxa to feed effectively in more structurally complex reef environments.

References

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