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A case of mything teeth: on the presence of vomerine and palatine teeth in the Pomacanthidae (Teleostei)

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The presence or absence of teeth on the vomer and palatoquadrate bones has a long history in fish systematics. Dentition of these bones is often consistent across families, and is often included in keys to families and family diagnoses. The angelfish family Pomacanthidae has been almost consistently diagnosed as lacking both vomerine and palatine teeth (e.g., Günther 1860; Day 1875; Jordan & Fowler 1902; Herre & Montalban 1927; Fowler & Bean 1929; Pyle 2001, 2003; McEachran & Fechhelm 2005); the only exceptions I am aware of are Munro (1967) and Jones and Kumeran (1980) who note that vomerine teeth may be present or absent in pomacanthids, Blum (1988) who alludes to vomerine teeth being present in the family, and Lindberg and Krasyukova (1971) who note that weak vomerine teeth may be present in species of *Chaetodontoplus* Bleeker. I am aware of no accounts that mention palatine teeth in pomacanthids. During a survey of pomacanthid skeletal preparations for a study of relationships of pomacanthids to other fishes (Gill & Leis in prep.), I noticed that species of the genus *Pomacanthus* Lacepède, type genus of the family, consistently have a narrow band of villiform teeth on the vomer and a small patch of villiform teeth on the anterior part of the palatines (Figure 1). A broader survey of pomacanthids (25 species, including representatives of all but one of the major clades given in Gaither *et al.* 2014; the missing clade consists of *"Apolemichthys" arcuatus, "Centropyge" colini* and *"C." narcosis*, for which the name *Desmoholacanthus* Fowler is available) revealed that these bones are otherwise edentate in the family (although only two species of *Chaetodontoplus* were examined).

It is not clear when or where the myth of palatine and vomerine teeth absence as a diagnostic character of the Pomacanthidae originated, but it was presumably based on either an incomplete survey of pomacanthid genera, or worse, extrapolation from surveys of genera in the Chaetodontidae (in which family the Pomacanthidae were historically classified; chaetodontids do lack palatine teeth, though some have vomerine teeth, Blum 1988). Pomacanthids have relatively small mouths, making observation of the palatine and vomer difficult without dissection. Not surprisingly, then, most descriptions of pomacanthid species lack details on dentition of these bones, and those that do may have been based on assumption rather than observation (which may account for the report of no vomerine or palatine teeth in *Pomacanthus imperator* by Golani *et al.* 2010). However, it is surprising that palatine and vomerine dentition were not included in reviews of pomacanthid generic classification by Fraser-Brunner (1933), Shen and Liu (1978) or Heemstra (1984). Pyle (2003) did note the absence of palatine and vomerine teeth in his extensive study of pomacanthid systematics, but incorrectly considered it diagnostic for the entire family.

Although I have not examined all species of *Pomacanthus* (only nine of the 13 species currently recognised in the genus), my survey includes representatives of each of the subgenera recognised by Pyle (2003): *Acanthochaetodon* Bleeker, *Arusetta* Fraser-Brunner, *Euxiphipops* Fraser-Brunner and *Pomacanthus* Lacepède. Shen and Liu (1978) placed *Pomacanthus* and *Chaetodontoplus* in the subfamily Pomacanthinae, with the remaining pomacanthid genera in the subfamily Holacanthinae. Recent molecular studies have supported the monophyly of the Holacanthinae, but have not consistently recovered the Pomacanthinae. Bellwood *et al.* (2004) recovered a paraphyletic Pomacanthinae, with *Pomacanthus* forming the sister-group of a clade consisting of *Chaetodontoplus* and the Holacanthinae. By contrast, Gaither *et al.* (2014) retrieved *Chaetodontoplus* as the sister-group of a clade consisting of *Pomacanthus* and the Holacanthinae. The presence of palatine teeth in *Pomacanthus* might be seen as providing evidence for Bellwood *et al.*'s hypothesis, with loss of the teeth serving as a synapomorphy of *Chaetodontoplus* + Holacanthinae. However, current morphological evidence nests the Pomacanthidae within a clade of fishes that lack palatine teeth, suggesting the presence of palatine teeth could be apomorphic, but certainly their presence diagnoses the genus *Pomacanthus*. In species of the Atlantic-east Pacific subgenus *Pomacanthus* the palatine tooth patch is tiny, consisting of just a few teeth. In the

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remaining subgenera (all from the Indo-Pacific) the palatine teeth are more numerous and arranged in relatively large round to ovoid patches. The relatively large tooth patches might be seen as a synapomorphy uniting the three Indo-Pacific subgenera, or alternatively as evidence for a monophyletic subgenus *Pomacanthus*. Although Bellwood *et al*. only included six species of *Pomacanthus* in their analysis, none of which represented the subgenus *Acanthochaetodon*, they nonetheless retrieved two well supported clades, one consisting of members of the subgenus *Pomacanthus* and the other of members of *Arusetta* and *Euxiphipops*. Presence or absence of vomerine teeth is even more difficult to evaluate cladistically, as they are variously present or absent within a number of related families and, as noted above, within *Chaetodontoplus.*

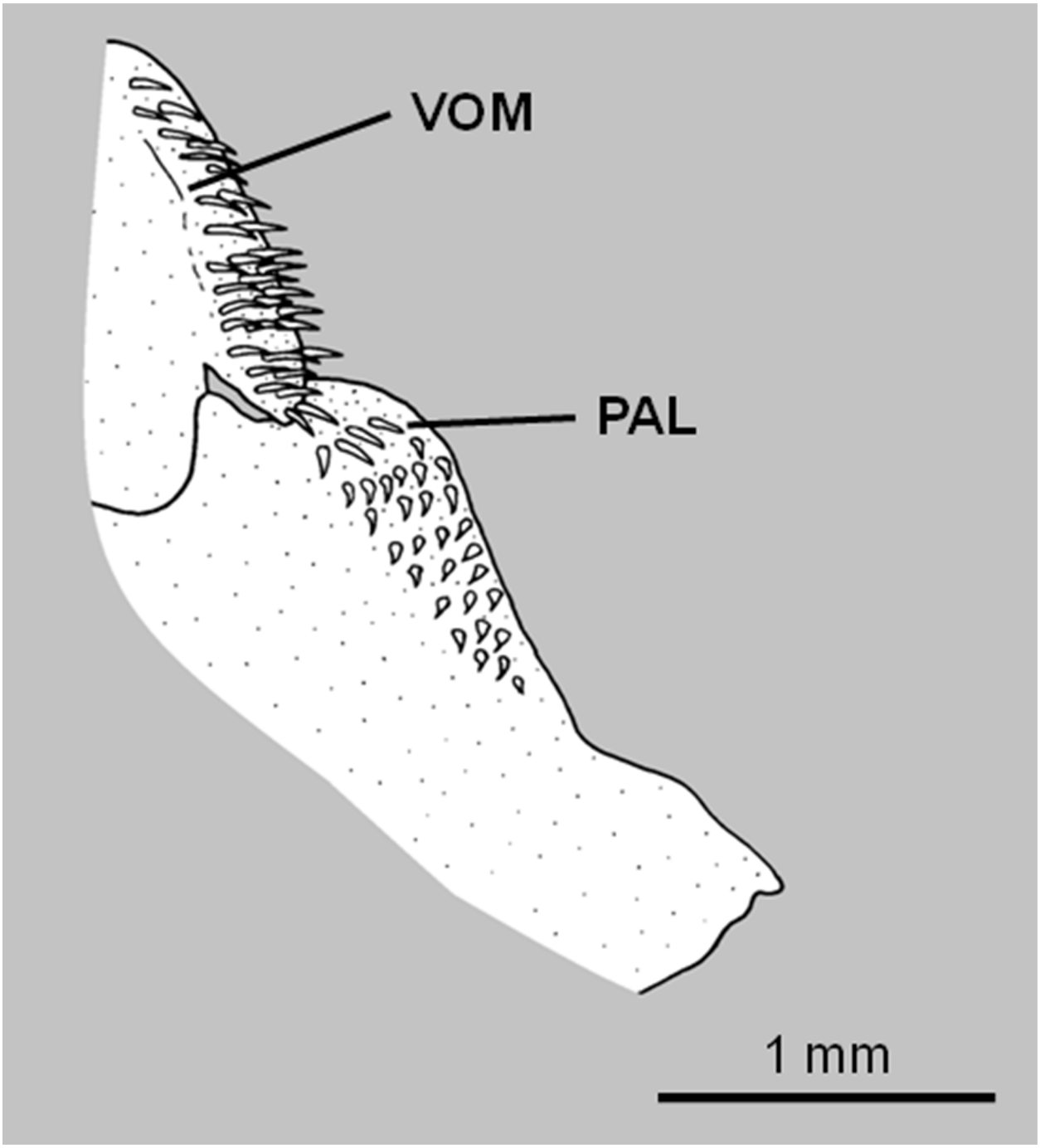

FIGURE 1. Slightly oblique ventral view of dentition on left palatine (PAL) and left portion of vomer (VOM) of *Pomacanthus xanthometopon*, ACG CS285, 55 mm SL.

Palatine and vomerine dentition was studied in the following specimens, which were cleared and stained following the methods of Taylor and Van Dyke (1985), and partially dissected. Subgeneric classification of *Pomacanthus* species

follows Pyle (2003). Codes for the specimens refer to my personal collection registry, although the specimens are in the process of being incorporated into the Australian Museum's ichthyology collection and will eventually receive Australian Museum numbers. All specimen lengths are standard length. *Apolemichthys xanthotis* ACG CS555 (1: 67 mm); *Centropyge aurantia* ACG CS122 (1: 51 mm); *C. bicolor* ACG CS630 (3: 45–71 mm); *C. bispinosus* ACG CS37 (1: 44 mm); *C. eibli* ACG CS265 (1 : 68 mm); *C. ferrugata* ACG CS657 (1: 48 mm); *C. flavissima* ACG CS96 (5: 52–63 mm); *C. heraldi* ACG CS855 (1: 34 mm); *C. loricula* ACG CS10 (1: 44 mm); *C. multicolor* ACG CS845 (1: 48 mm); *C. potteri* ACG CS40 (1: 76 mm); *C. tibicen* ACG CS691 (1: 48 mm); *C. vroliki* ACG CS726 (1: 49 mm); *Chaetodontoplus duboulayi* ACG CS312 (2: 90–162 mm), ACG CS863 (2: 41–47 mm); *C. meredithi* ACG CS682 (1: 82 mm); *Genicanthus melanospilus* ACG CS11 (2: 62–73 mm); *G. watanabei* ACG CS138 (1: 108 mm); *Holacanthus ciliaris* ACG CS76 (1: 61 mm); *H. passer* ACG CS267 (1: 86 mm) ; *H. tricolor* ACG CS577 (1: 76 mm); *Paracentropyge multifasciatus* ACG CS613 (2: 41–55 mm); *P. venusta* ACG CS728 (1: 61 mm); *Pomacanthus (Acanthochaetodon*) *annularis* ACG CS128 (1: 47 mm); *P. (Ac.*) *imperator* ACG CS148 (2: 111–112 mm), ACG CS625 (3: 51–70 mm); *Pomacanthus (Arusetta*) *asfur* ACG CS529 (2: 69–92 mm); *P. (Ar.) maculosus* ACG CS31 (1: 55 mm); *P. (Ar.*) *semicirculatus* ACG CS12 (4: 30–56 mm); *Pomacanthus (Euxiphipops) navarchus* ACG CS866 (2: 49–94 mm); *P. (E.*) *xanthometopon* ACG CS285 (2: 40–55 mm); *Pomacanthus (Pomacanthus) arcuatus* ACG CS586 (1: 143 mm); *P. (P.) paru* ACG CS877 (1: 76 mm); *Pygoplites diacanthus* ACG CS663 (2: 113–118 mm); *Xiphypops argi* ACG CS583 (1: 36 mm); *X. fisheri* ACG CS638 (1: 31 mm**).**

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