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Life among crevices: osteology of *Nannophrys marmorata* (Anura: Dicroglossidae)

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Nannophrys Günther, 1868, a group of flat-bodied frogs, is an endemic Sri Lankan genus bearing three extant and one extinct species, adapted to live among narrow and horizontal rock crevices adjacent to clear water streams. One of these species, *Nannoprhys marmorata* Kirtisinghe, 1946 is mostly restricted to the rock strewn streams of the Knuckles region (200–1200 m asl). Here, we re-describe the osteology of *Nannophrys marmorata* highlighting apomorphies and adaptations for life between narrow spaces. Previous studies on skeletal morphology of the genus *Nannophrys* include Gunther (1869), Boulenger (1882, 1890), Noble (1931), Kirtisinghe (1946), Clarke (1983) and Scott (2005). Basic descriptions of the skeleton of *N. marmorata* have been done (Kirtisinghe 1946; Clarke 1983), on which we build and elaborate. We describe the osteology using three adult specimens (SVL= 35.2–36.5 mm) of *N. marmorata*, stained differentially for bone and cartilage following the procedure by Taylor and Van Dyke (1985); we follow the osteological terminology of Trueb (1973), Duellman and Trueb (1986), and Pugener and Maglia (1997, 2009).

*Cranium***.** The heavily-ossified, well-articulated skull of *Nannophrys marmorata* has a length of 73% of its width and exhibits cranial exostosis (also seen in *N. ceylonensis*; Clarke 1983, Scott 2005). Quadrangular-shaped frontoparietals are paired; they are not medially fused. Posterolateral margins of the frontoparietals reach prootics dorsally and fuse synostotically; anterior margins extend towards the posterior margins of the nasals. Paired nasals are trapezoidal-shaped, unfused and large (Fig. 2A). Parasphenoid is azygous, ventral and T-shaped. Cultriform process (furcated) of the parasphenoid extends anteriorly; anterior half overlaps the posteromedial portion of the sphenethmoid (Fig. 2B). Alae of the parasphenoid extend laterally and have blunt ends. These are perpendicular to the anterior cultriform process, and overlay prootics and exoccipitals. Sphenethmoid is not visible in dorsal view because of the heavy ossification of the nasals, and nasals overlap the sphenethmoid in a transverse plane. Vomers possess four processes: dentary, anterior, prechoanal, and postchoanal. Dentary processes are dentate (bear blunt teeth; 5/6). Anterior process has a pointed terminal end and articulates with the premaxillary-maxillary junction. Prechoanal and postchoanal processes extend laterally from the anterior process (Fig. 2B). Postchoanal process is well developed and is not in the same plane as the prechoanal process; it does not articulate with the sphenethmoid (however, this is noted as a character in other amphibians with heavily-ossified skulls; Scott 2005). Palatines (=neopalatines; Scott 2005) are paired bones, which invest the posterior margins of the planum antorbitale. Lateral blunt ends of the palatines reach the medial face of the pars dentalis of maxillae, but do not articulate. Medial ends of the palatines are slightly expanded but do not overlap one another. Pterygoids are paired bones and possess three rami; they invest the skull ventrally (Fig. 2B). Anterior ramus, the longest, is in contact with the dentary process of the maxillae but is notably separated by its cartilaginous epiphysis. Posterior ramus extends towards the quadrate and has a cartilaginous epiphysis. Medial ramus, the shortest among the three rami, reaches the anterior margins of the otic capsule ventrally, but is not fused with the lateral alae of the parasphenoid. Squamosals have three distinct rami: ventral, zygomatic and otic. Zygomatic process is considerably expanded and plate-like in lateral view, and is not connected with the pars facialis of maxilla (Fig. 2A). Bend between otic and zygomatic rami is clearly distinguishable. Otic ramus is the narrowest. Exoccipitals are paired bones and form the posteriormost portions of the neurocranium. Occipital condyles are well ossified and articulate with atlantal cotyles. Exoccipitals are fused with prootics; they constitute lateral and posterior portions of the otic capsules. Prootics are paired and overlay frontoparietals anteriorly and exoccipitals posteriorly. Ossifications of prootics extend along dorsal, lateral and anterior margins of the auditory capsules (Fig. 2A, B).

Auditory apparatus. Well-ossified pars medial plectri (with a pointed end) and small, rod-like pars external plectri and cartilaginous pars internal plectri are present. The apparatus ends with a cartilaginous oval-shaped (complete) tympanic annulus (Fig. 2A).

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