

3D-anatomy of the rhipidoglossate heterobranchs *Hyalogyrina depressa* Hasegawa, 1997 and *Xenoskenea pellucida* Monterosato, 1874 (Gastropoda, Ectobranchia)



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Introduction & Methods

The discovery of marine representatives of the Valvatoidea (Ectobranchia) by Ponder in 1990 established this clade as basal Heterobranchia, formerly known only from freshwater habitats.

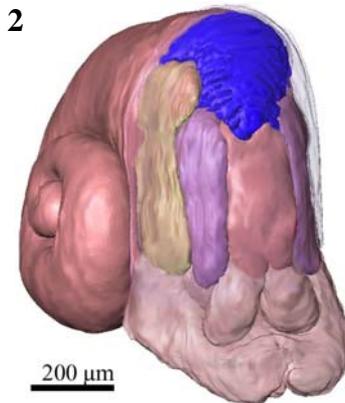
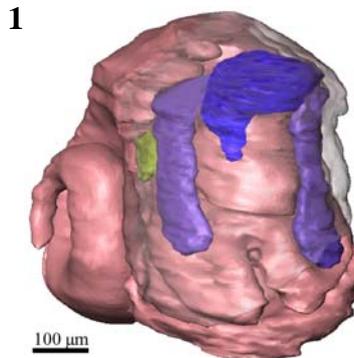
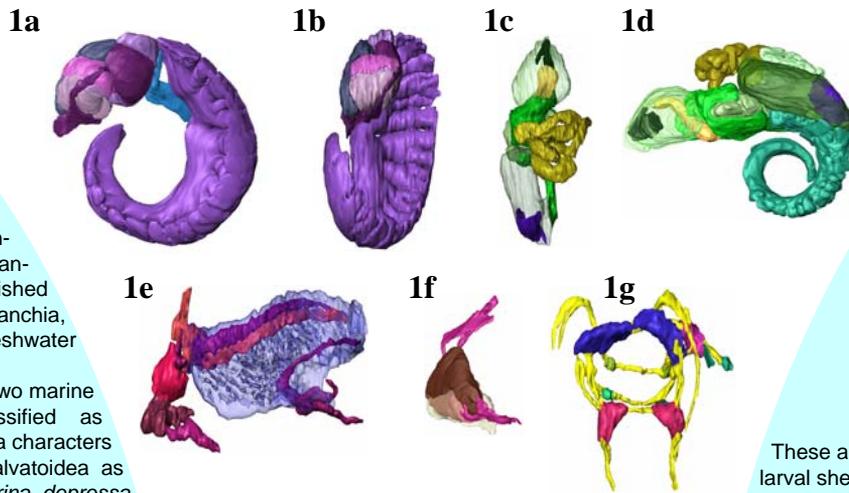
We investigated the anatomy of two marine microgastropods originally classified as Skeneidae by shell and radula characters and later transferred to the Valvatoidea as family Hyalogyrinidae: *Hyalogyrina depressa* from deep waters off Japan and *Xenoskenea pellucida* from Mediterranean shallow water. We applied computer aided 3D-reconstructions (software: AMIRA™) based on semithin section series.

Results

Both species have a tapered snout with a pair of tentacles, an anteriorly bifurcate foot, and a metapodium With a large mass of calcium cells. The mantle cavity contains an osphradium, a bipectinate, ciliated gill Without bursicles or skeletal rods, and a left, pallial kidney. The rectum bypasses the monotocardian heart and shows several loops in the pallial roof. A complex, hermaphroditic genital system suggests internal fertilisation. The rhipidoglossate radula apparatus lacks cartilages, the salivary glands are long and tubular, the stomach shows a gastric shield. The nervous system is epiathroid and streptoneurous, each statocyst contains a single statolith. The eyeless *Hyalogyrina depressa* has a ciliated pallial tentacle at the right side. *Xenoskenea pellucida* has a small copulatory organ behind the right cephalic tentacle, a metapodial tentacle, and simple lens eyes.

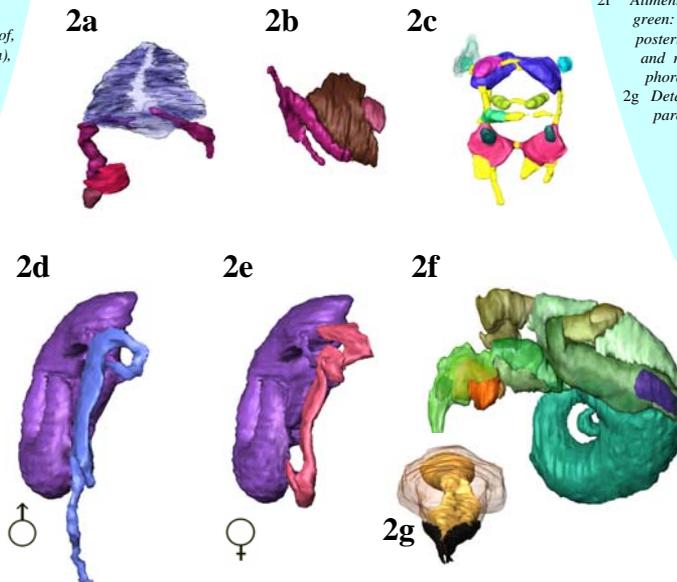
(1) 3D-reconstructions (surface renderings) of *Hyalogyrina depressa*

- 1 Soft body of *Hyalogyrina depressa* with transparent mantle roof, gill (blue), cephalic tentacles (violet), pallial tentacle (light green), frontal view.
- 1a/b Hermaphroditic genital system with lobate gonade (violet), view from the left/frontal view.
- 1c/d Alimentary system (dorsal view/view from the left) with transparent pharynx (light green) and stomach (dark green), gastric shield (purple), salivary glands (pastell green), rectal loops (olive), anterior and posterior digestive glands (pastell green and turquoise) only in lateral view.
- 1e Transparent gill (blue) with blood sinus (pink), heart (light red: auricle, aubergine: ventricle) and retractor muscle (red), dorsal view.
- 1f Kidney (brown) and transparent pericard containing the heart, lateral left view.
- 1g Nervous system with coloured ganglia (dark blue: cerebro-pleural ganglia, red: pedal ganglia, chartreuse: buccal ganglia, pink: supra-intestinal ganglion, green: sub-intestinal ganglion, turquoise: osphradial ganglion with osphradium, dark green: statocysts, frontal view.



(2) 3D-reconstructions (surface renderings) of *Xenoskenea pellucida*

- 2 Soft body with transparent mantle roof, gill (blue), cephalic tentacles (violet) and pallial lobe (transparent light green) enveloping the penis, frontal view.
- 2a Gill with afferent and efferent sinus (pink), heart (light red: auricle, aubergine: ventricle), dorsal view.
- 2b Heart and excretory system (brown: kidney, pink: blood sinus, aubergine: ventricle), lateral left view.
- 2c Nervous system with coloured ganglia (dark blue: cerebro-pleural ganglia, red: pedal ganglia, chartreuse: buccal ganglia, pink: supra-intestinal ganglion, green: sub-intestinal ganglion, turquoise: osphradial ganglion with transparent osphradium, light blue: eyes, dark green: statocysts), back view.
- 2d/e Genital system (purple: hermaphrodite gland, blue: male gonoduct, red: female gonoduct), dorsal view.
- 2f Alimentary system (light green: pharynx and oesophagus, pastell green: salivary glands and anterior digestive gland, turquoise: posterior digestive gland, dark green: stomach, olive: intestine and rectum, purple: gastric shield, orange: muscular odontophore), lateral left view.
- 2g Detail: Jaws (black) with radula (yellow) in radula sack (transparent), frontal view.



Discussion

These anatomical data and the hyperstrophic larval shells all reflect basal heterobranch conditions. The metapodial calcium cells and the looped pallial rectum are interpreted as synapomorphies for the Hyalogyrinidae. Their rhipidoglossate radula and the lack of cartilages suggest that the Heterobranchia as a whole emerged from the rhipidoglossate rather than from the taenioglossate level of gastropod evolution. Accordingly, a change of function in the supporting apparatus (replacement of cartilages by a muscular mass) predates the change of the radular type itself at the beginning of heterobranch evolution.

It provides a concise and accessible overview of the basic anatomy and physiology of some of the more commonly encountered exotic species. - Irish Veterinary Journal Vol. 59: March 2006. This book is written by an experienced exotic animal practitioner and lecturer for a veterinary surgeon in practice who deals with the occasional exotic patient. This will prove invaluable for locating sampling sites and internal and external anatomy for surgery, as well as necropsy. For quick reference the animal classes are divided by colour coded pages. Within each chapter there is information on general and clinical anatomy and physiology of class, followed by more detailed notes on individual species including some guidance on sexing, venepuncture sites and some clinical information. Ectobranchia are considered the first extant offshoot of the Heterobranchia; implications for the stem species of the latter are outlined.

Keywords: Gastropoda, Ectobranchia, Hyalogyrinidae, Interactive 3D anatomy, Systematics, Phylogeny, Heterobranchia.

Xenoskenea pellucida (Monterosato, 1874): The specimens investigated were collected in June 1988 during the mission by Serge F. Gofas in the East Atlantic. *Hyalogyrina depressa* Hasegawa, 1997: Two paratypes from the type locality, Western Pacific off Japan (Suruga Bay, 35° 00.4'N, 138° 43.9'E to 35° 00.3'N, 138° 42.6'E, 400m). Temporal anatomy and relevant steps for surgical approach during an anterior petrosotomy and discussed. Common indications include anterior petrosal cysts, chordomas, chondrosarcomas, meningiomas, trigeminal schwannomas, and intracisternal cysts. Please click on "Select an annotation" link at the bottom of the window and "Show annotations" so that the anatomical labels become visible. Technical Nuances for the Anterior Petrosal Approach. General Considerations. The middle fossa approach has been traditionally used for resection of small acoustic neuromas and meningiomas along the lip of the internal auditory canal (IAC). Anatomy of ilioinguinal and iliohypogastric nerves in relation to trocar placement and low transverse incisions. Am J Obstet Gynecol. 2003;189:1574-8. Nerve Injury During Uterosacral Ligament Suspension. Siddique SA, et al. Relationship of the uterosacral ligament to the sacral plexus and to the pudendal nerve. Int Urogynecol J Pelvic Floor Dysfunct 2006;17:642-5. Name the 7 Surgical and Anatomic Relationship Between the Vaginal Apex and the Bony Architecture of the Pelvis: a MRI Evaluation. Am J Obstet Gynecol 2005; Leffler KS et al. Patients completed olfactory and gustatory questionnaires based on the smell and taste component of the National Health and Nutrition Examination Survey, and the short version of the Questionnaire of Olfactory Disorders-Negative Statements (sQOD-NS). Results: A total of 417 mild-to-moderate COVID-19 patients completed the study (263 females). The most prevalent general symptoms consisted of cough, myalgia, and loss of appetite. Face pain and nasal obstruction were the most disease-related otolaryngological symptoms. 85.6% and 88.0% of patients reported olfactory and gustatory dysfunctions, respectively.