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Study of the Characteristic of Neritidae: Shell and Operculum

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Abstract. Neritidae is one of Gastropoda family called the Nerites. The shell is thick and the shape is mostly in the hemisphere with calcareous D shape of operculum. Some genus has polymorphism variations, causing a problem to recognize the species. The primary identification used the shell characters such as columellar deck and its sculpture, included the number of teeth on aperture. The shell features are still confusing for some reasons. This study proposed another way to identify Nerites member based on the shell and operculum morphometric. It is very rare for using operculum as a useful identification feature. This research investigated 3 033 individual Nerites of 19 species from the intertidal zone of seven beaches and two mangroves of Alas Purwo National Park and estuarine-fresh water Nerites from South-region of Banyuwangi District. In this study, the author introduced the terms of the shell, operculum features and the morphometric formula. The operculum features are very specific on the inner and outer side: peg-like projection, apophysis, striae, apophysis striae, longitudinal groove, the granular-small bumps, and lines or ridges. The operculum coloration is similar in some species but very specific to the other. This research found the age lines on the striae, but in some *Nerites*, it cannot see because the age was not more than 1 year.

Keywords: morphometric, neritidae, operculum, shell, terminology

INTRODUCTION

Identification of Gastropoda member is common by the shell characters, except for the member of subclass Ophistobranchia (slugs and hares). Although the molecular identification is used in the recent research, conventional identification by shell characters is still so important to recognize them in the field for ecological assessment and much easier and faster. Neritidae is a name of family level, member of superfamily Neritacea, order Archaeogastropoda, superclass Prosobranchia and class Gastropoda [1]. Neritidae distributed in freshwater, estuary, and marine. Some of them are in very specific distribution [1–5]. Neritidae is commonly called nerites snail. Its shell morphology is firm in a half moon shape (hemisphere) and it is easier to recognize them in nature, but some characters are almost alike due to the similarity of its shape. The primarily shell characters used for identification are columellar callus, columellar folds, sculpture on the columella, number of teeth on aperture, shell thickness, and operculum shape. The polymorphism of shell coloration and pattern on same species are a problem of identification on the field. Especially, it can happen when it was lost its shell and only left the operculum. Nerites identification is still in the very complicated problem to solve. Some of the problems such as shell polymorphism, synonyms or multiple names that are used by the author, then it has not been published and identified [6]. Due to those reasons,

taxonomist is finding the easier way to recognize them in the field. While Purwo National Park and Banyuwangi district are blessed with many beaches, nerites are the most abundant species of intertidal Gastropod.

Morphometric is a concept that may be defined encompasses of statistical procedures for analyzing variability in size and shape of organisms and organs. This is useful to many fields of science such as biology and evolutionary [7], to solve ecological problems, genetical problems and many more all about organism's size. Traditional morphometric data are measurement based on the lengths, masses, widths, angles, ratios, and areas. The systematic work should have a clear terminology of morphometric data to avoid the identification problem. Therefore, this study purposed the terms to identify nerites member based on the shell and operculum morphometric.

MATERIALS AND METHODS

This research investigated 3 033 individual Nerites of 19 species from the intertidal zone of seven beaches (Pancur, Trianggulasi, Plengkung, Tanjung Sekeben, Perpat, Slenggrong and Tanjung Batu) and two mangroves (Bedul and Jati Papak) of Alas Purwo National Park, East Java and estuarine-fresh water nerites from South-region of Banyuwangi District. The data sampling was from July 2016 to Mar 2017 during the low spring tide. This research used the Nerites shells and the operculum for this study for shell morphometric term and operculum terminology, and using references identification [2–5, 8–10] and internet guides as Hardy's Internet Guide to Marine Gastropod (& Near Classes) and World Register of Marine Species (WoRMS). The shell and operculum size were measured with a digital caliper and binocular microscope.

RESULTS AND DISCUSSION

The member of Neritidae which is found from the beaches are genus *Nerita* (16 species), *Neritina* (one species), *Clithon* (one species) and *Vittoida* (one species). The main genus discussed here is *Nerita* Linnaeus, 1758 shells and operculum feature for morphometric procedures to learn about the plasticity in nature. The specimens of *Nerita* are: *Nerita (Amphinerita) polita* Linnaeus, 1758; *Nerita (Theliostyla) ocellata* Le Guillou, 1841; *Nerita (Ritena) costata* Gmelin, 1791; *Nerita (Theliostyla) exuvia* Linnaeus, 1758; *Nerita (Ritena) plicata* Linnaeus, 1758; *Nerita (Theliostyla) albicilla* Linnaeus, 1758; *Nerita (Amphinerita) insculpta*, Récluz, 1842; *Nerita (Amphinerita) incerta* Von dem Busch in Philippi, 1844; *Nerita (Ritena) chamaeleon* Linnaeus, 1758; *Nerita (Ritena) spengleriana* Récluz, 1843; *Nerita (Ritena) maxima* Gmelin, 1791; *Nerita (Ritena) grossa* Linnaeus, 1758; *Nerita (Ritena) squamulata* Le Guillou, 1841; *Nerita (Ritena) signata* Macleay in Lamarck, 1822. Those specimens were from the intertidal zone of the Alas Purwo National Park beach and two species from mangrove zone are *Nerita (Ritena) balteata* Reeve, 1855 synonym *Nerita lineata* Gmelin, 1791 [11] and *Nerita (Theliostyla) planospira* Anton, 1839. The *Nerita* shell description: the shell is thick and solid, a half-moon shape (hemisphere) or ear shape according to [8] categories, smooth/concentric ridged/spirally ribbed/sculpturing dorsal surface, columellar deck is quite large columellar callus or parietal wall [6] often sculptured with ridges/ wrinkles or granular/small bumps/nodules in colored or without colour; spire generally low or very low. The dentes and serrations of columellar edge and aperture very specific for each species but it was unclear in some specimens for certain reasons. The amount of dentes can be used for identification term to several species.

Based on the terminology terms of *Nerita* shells, the author made a morphometric term for finding the plasticity shape and size. The main terms fixed for each species, but the size might be in range ratio; in normal shape and size. It means there was no anomaly shape. This features (Fig. 2 and Fig. 3) are using of all shell side (ventral/aperture side, dorsal side, and apex side) and operculum (inner and outer side), shell dorsal side: the sculptures, ridges/ribs, and color.

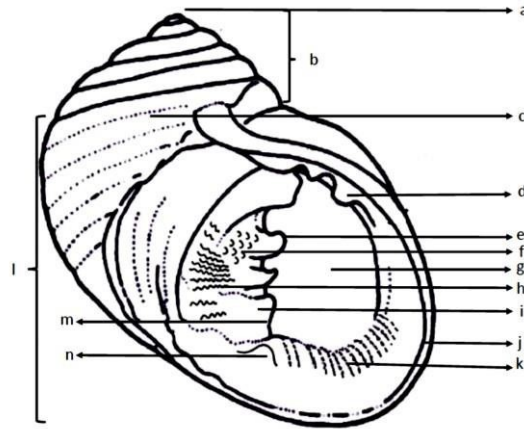
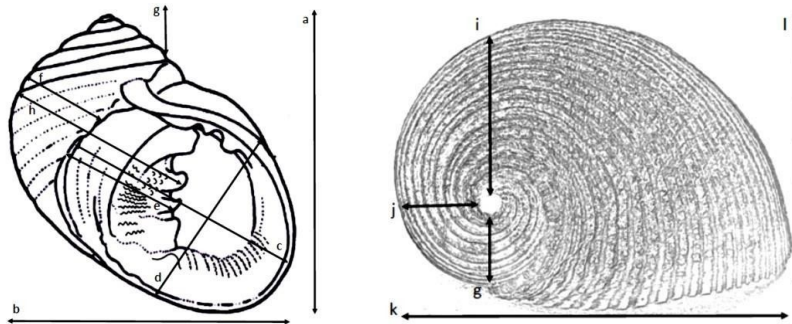


FIGURE 1. Terminology terms of *Nerita* shell was modified from Leal (3 and 4), a. Apex, b. Spire, c. spiral ribs/concentric ridges, d. outer lip dentes, e. aperture dentes, f. columellar nodules on columellar deck, g. Aperture, h. serrations or wrinkles on columellar deck, i. columellar deck, j. outer lip, k. outer lips serrations, l. Body whorl, m. Inner lip, and n. dentes.



A.

B.

FIGURE 2. Morphometric term of genus *Nerita*, A) ventral side: a. Shell length, b. Shell width, c. aperture length, d. aperture width, e. columellar deck width, f. columellar protrude, g. spire height (Modified from [4]), B) *Nerita lineata* shell specimen; h. columellar thickness, j. Spire width, k. ventral length, and shell height.

Morphometric measurement gave information about the size range of the population [12]. It might be a formula as a result of the measurement because there is specific range between terms for each species. For example, the ratio value of shell length versus shell width, the ratio value of aperture length versus aperture width. The size of columellar deck and the ornamentation of it are used to compare for plasticity shape. There was no ornamentation of columellar deck for certain reasons. Specimen of nerites shells of Alas Purwo National Park is an example for this terminology (Fig. 3 and Fig. 4). *Nerita insculpta* is more elongate for the ratio of shell length versus shell width than the other species, but there was elongate shape for *Nerita exuvia* and *Nerita albicilla* (Pancur site) and *Nerita polita* (Tanjung Sekeben site). Plasticity shape in population is exceptional which need to look for the cause of it.

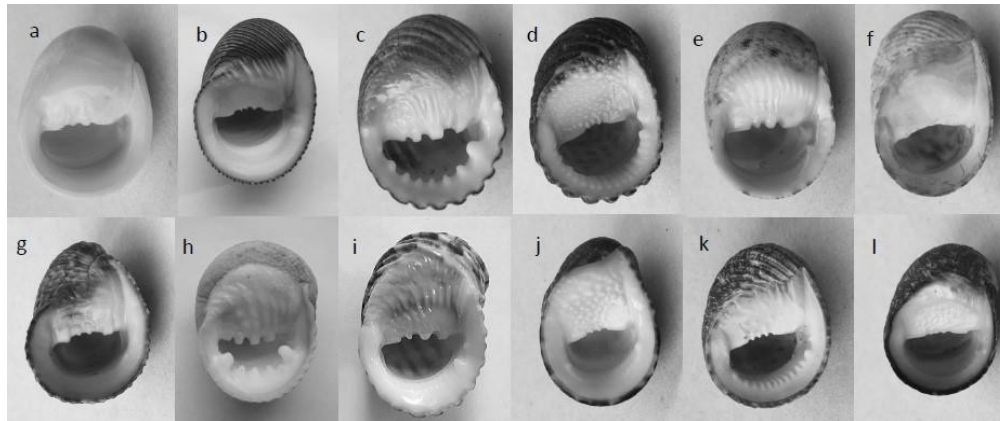
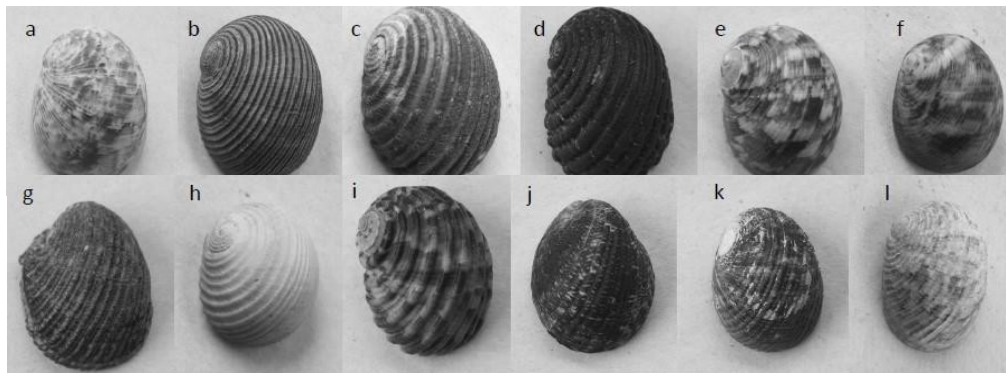
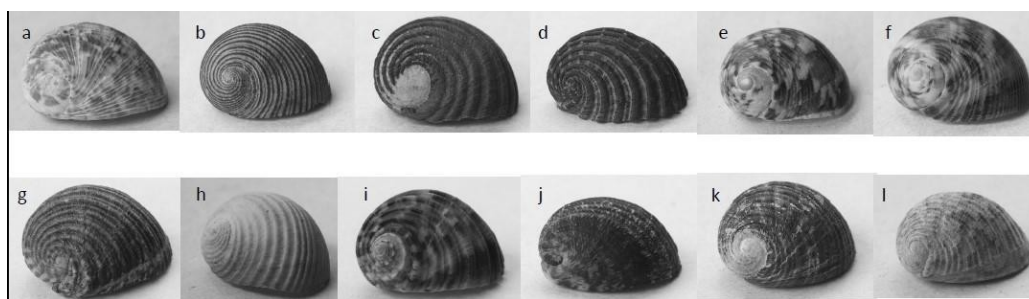


FIGURE 3. Ventral or aperture side of Alas Purwo National Park *Nerita* specimens, a. *Nerita (Amphinerita) polita* Linnaeus, 1758, b. *Nerita (Ritena) balteata* Reeve, 1855 synonym: *Nerita lineata* Gmelin, 1791, c. *Nerita (Ritena) costata* Gmelin, 1791, d. *Nerita (Theliostyla) exuvia* Linnaeus, 1758, e. *Nerita (Ritena) maxima* Gmelin, 1791, f. *Nerita (Amphinerita) insculpta*, Récluz, 1842, g. *Nerita (Theliostyla) planospira* Anton, 1839, h. *Nerita (Ritena) plicata* Linnaeus, 1758, i. *Nerita (Ritena) grossa* Linnaeus, 1758, j. *Nerita (Theliostyla) albicilla* Linnaeus, 1758, k. *Nerita (Ritena) chamaeleon* Linnaeus, 1758, l. *Nerita (Theliostyla) ocellata* Le Guillou, 1841.



A.



B.

FIGURE 4: The comparison of *Nerites* shell shape: A. dorsal side and B. spire side; a. *Nerita (Amphinerita) polita* Linnaeus, 1758, b. *Nerita (Ritena) balteata* Reeve, 1855 synonym: *Nerita lineata* Gmelin, 1791, c. *Nerita (Ritena) costata* Gmelin, 1791, d. *Nerita (Theliostyla) exuvia* Linnaeus, 1758, e. *Nerita (Ritena) maxima* Gmelin, 1791, f. *Nerita (Ritena) spengleriana* Récluz, 1843, g. *Nerita (Theliostyla) planospira* Anton, 1839, h. *Nerita (Ritena) plicata* Linnaeus, 1758, i. *Nerita (Ritena) grossa* Linnaeus, 1758, j. *Nerita (Theliostyla) albicilla* Linnaeus, 1758, k. *Nerita (Ritena) chamaeleon* Linnaeus, 1758, l. *Nerita (Amphinerita) insculpta*, Récluz, 1842.

The operculum is attached to the posterior part of the muscular feet. Operculum may be helpful in avoiding predation, dehydration or physical disturbance of the environment. The operculum is made of calcium carbonate

(calcareous). The D shape and ornamentation of the operculum may be used to distinguish species. Operculum character is important to identify [13]. Operculum characters are different between inner and outer side. Operculum term was shown in Fig. 5. Morphometric of operculum is used to know the deepest ellipsoid shape. Some species have a similar ornament on its operculum (outer side). It was need to look for details in every ornament such as granules/nodules. Granules are small bumps on the outer side of operculum, the size of granules is smaller than nodules. *Nerita polita* has very special radial lines on operculum edge, only in this species.

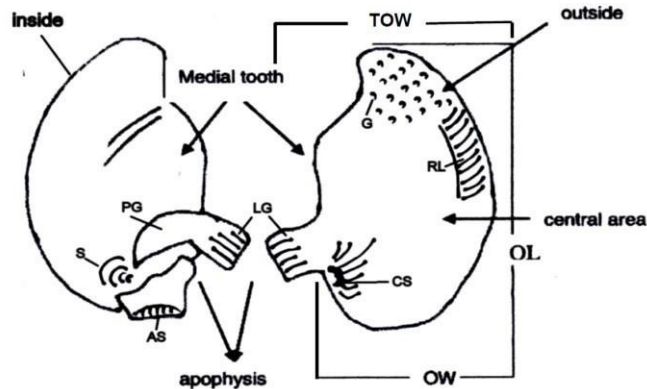


FIGURE 5: Nerites operculum terminology (modified from: [4] and [14]): G = granulae, CS = central spire, LG = longitudinal groove, PG = peg-like projection, S = striae, AS = apophysis striae, RL = radial line, OL = operculum length, OW = operculum width, TOW = total operculum width.

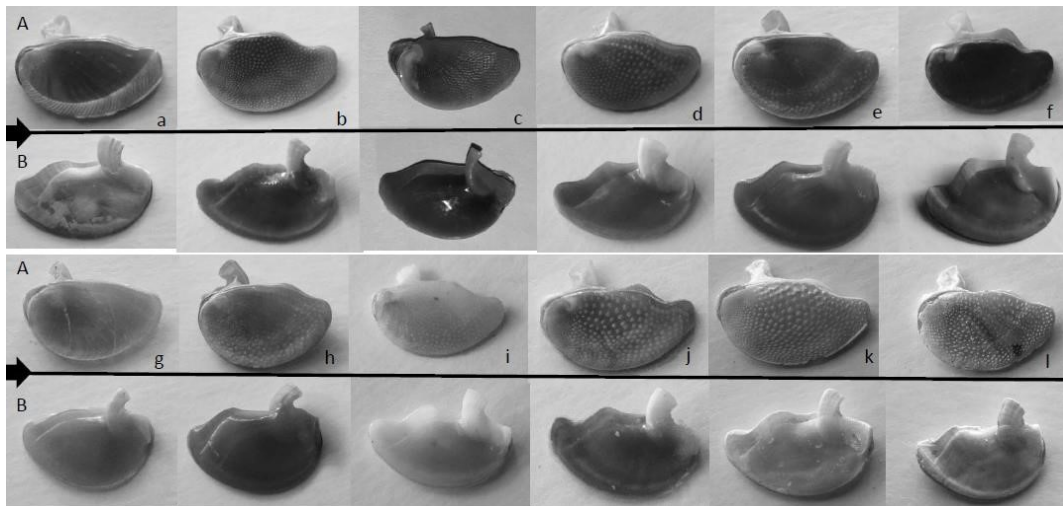


FIGURE 6: Nerita operculum, A) Outer side, B) Inner side. a. *Nerita (Amphinerita) polita* Linnaeus, 1758, b. *Nerita (Ritena) balteata* Reeve, 1855 synonym: *Nerita lineata* Gmelin, 1791, c. *Nerita (Ritena) costata* Gmelin, 1791, d. *Nerita (Theliostyla) exuvia* Linnaeus, 1758, e. *Nerita (Ritena) maxima* Gmelin, 1791, f. *Nerita (Ritena) spengleriana* Récluz, 1843, g. *Nerita (Theliostyla) planospira* Anton, 1839, h. *Nerita (Ritena) plicata* Linnaeus, 1758, i. *Nerita (Ritena) grossa* Linnaeus, 1758, j. *Nerita (Theliostyla) albicilla* Linnaeus, 1758, k. *Nerita (Ritena) chamaeleon* Linnaeus, 1758, l. *Nerita (Amphinerita) insculpta*, Récluz, 1842.

Nerita operculum of Alas Purwo National Park beaches was shown in Fig. 6. Every species has a very specific operculum, even in the same color for several species. In some species, the operculum forms growth lines around the nucleus. The growth lines are striae. The striae can be found on the inner side or outside of the operculum. The center of striae growth is called the nucleus. Commonly, nerites have fairly clear striae on the inner side of the operculum. However, if the striae is not visible, the age estimate may use other methods [1, 14–18]. Unvisible striae occur in some species because the age was not more than one year or because of another reason.

Peg-like projection could be short, thick or thin, straight or with angle. Peg-like projection of *Nerita costata* is thinner than the other. There is a longitudinal groove, causing the amount of the groove can be different in the same species. The medial tooth could be high or short. Medial tooth builds medial groove that is visible on both sides. Medial groove: shallow or deep, with lines or not. Longitudinal groove is visible on the inner side. Despite with ornament or not, operculum surface is still in flat, concave or convex. *Nerita planospira* has a smooth surface operculum. The convex surface of *Nerita costata* is very clear. The character of operculum must be determined together with the shell. It can help to recognize the species if the shell has an anomaly shape, broken or in shell erosion by the physical factors in their habitat. Old specimens might have a broken operculum because of this reason.

CONCLUSION

Terminology Nerites shell and operculum and its morphometric helped to identify and describe Nerites specimens. It made a specific formula for each species based on the value of morphometrics. Operculum terms of Nerites are very important to identify specimens, especially, if there is shell plasticity phenotype, shell erosion or broken.

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