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New classification system for the family Physidae

(Pulmonata: Basommatophora).

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With 2 figures.

A seven year comprehensive systematic study of the family Physidae was recently completed. The study resulted in a proposal for a new classification system for the family Physidae. Systematic tasks undertaken in the study involved the delineation of basic taxa and the search, standardization and scoring of characters, which culminated in the construction of a data matrix consisting of 85 operational taxonomic units (OTU) and 71 characters. Two numerical taxonomic procedures were then employed in the analyses and synthesis of the data matrix. The phenetic relationships between the basic taxa were estimated with a similarity graph clustering procedure, while the cladistic relationships were estimated by the method of character compatibilities. Finally, eight auxiliary character surveys constituted the external tests for the systematic conclusions drawn from the numerical taxonomic evaluations.

Characters numerically evaluated consisted of 25 qualitative shell characters, 12 quantitative shell characters and 34 anatomical characters. Anatomical structures studied were the tentacles, mantle surface, mantle edge, kidney, bursa copulatrix, digestive tract and the penial complex. The auxiliary surveys covered the jaw, radula, oral lappets, foot terminus, presence of white pigment, egg capsules, foot muscle esterase patterns, and foot muscle protein immunological reactions.

The results of the phenetic and cladistic evaluations, as well as the auxiliary studies, reinforced each other and provided the basis for an overall systematic synthesis. Based on this overall synthesis, a revision of the Physidae was proposed on December 16, 1977. The Physidae can be grouped into 48 species in four genera and two subfamilies. The subfamily Aplexinae consists of the genera *Aplexa* and *Stenophysa*; while the subfamily Physinae consists of the genera *Physa* and *Physella*. The genus *Physella* is composed of three subgenera: *Physella* s. s., *Petrophysa* and *Costatella*. The subgenus *Costatella* is subdivided into two sections, *Costatella* s. s. and *Alampetista*.

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The 48 species recognized in the revised classification are *Aplexa hypnorum, Aplexa elongata, Stenophysa marmorata, Stenophysa peruviana, Stenophysa impluviata, Stenophysa panamensis, Stenophysa maugeriae, Physa skinneri, Physa jennessi, Physa fontinalis, Physella (Physella) microstriata, Physella (P.) traskii, Physella (P.) columbiana, Physella (P.) virginea, Physella (P.) lordi, Physella (P.) hordacea, Physella (P.) cooperi, Physella (P.) utahensis, Physella (P.) boucardi, Physella (P.) propinqua, Physella (P.) gyrina, Physella (P.) vinosa, Physella (P.) magnalacustris, Physella (P.) parkeri, Physella (P.) ancillaria, Physella (P.) globosa,* OTU-82 unnamed (new species), *Physella (Petrophysa) zionis, Physella (Costatella) costata, Physella (C.) bermudezi, Physella (C.) cubensis, Physella (C.) hendersoni* (the preceding four species are placed in the section *Costatella* s. s.), *Physella (Costatella) spelunca, Physella (C.) conoidea, Physella (C.) polakowskyi, Physella (C.) elegans, Physella (C.) patzcuarensis, Physella (C.) osculans, Physella (C.) bottimeri, Physella (C.) humerosa, Physella (C.) virgata, Physella (C.) heterostropha, Physella (C.) johnsoni, Physella (C.) acuta, Physella (C.) squalida, Physella (C.) venustula, Physella (C.) integra,* OTU-85 unnamed (new species) (the preceding 16 species are placed in the section *Alampetista*).

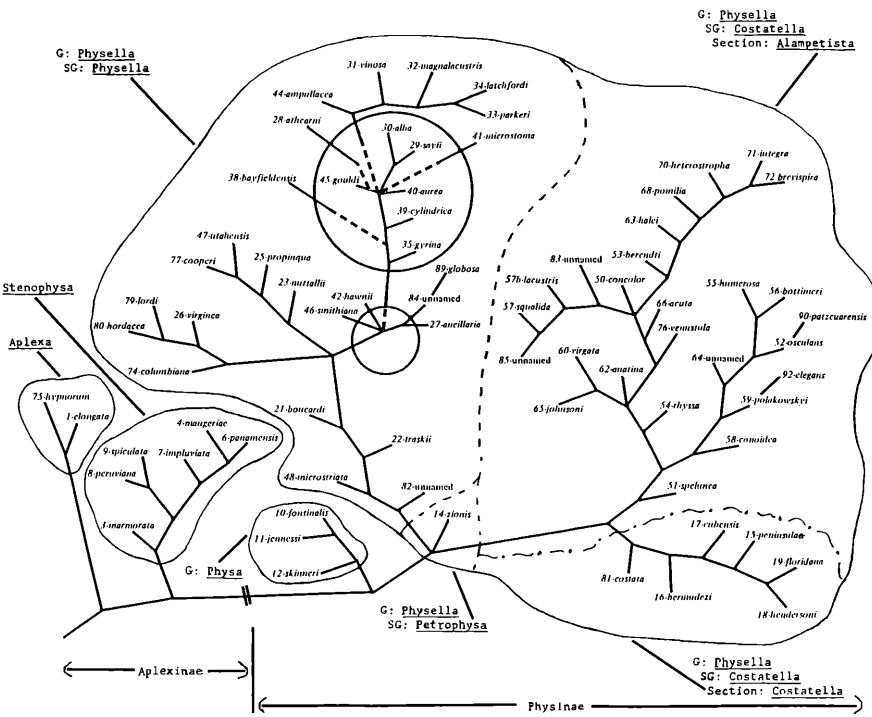

Fig. 1. Cladogram showing the boundaries of the supraspecific taxa in the Physidae. Numbers refer to OTU numbers, which correspond to lower taxa as listed in Table 2.

The Physidae show a New World distribution pattern with extensions into the Palaearctic region. The genera *Aplexa* and *Physa* are Holarctic, the genus *Stenophysa* is Neotropical, and the genus *Physella* is mainly Nearctic. North America has the highest density and diversity of physid species.

With the systematic synthesis at hand, and taking fossil records and zoogeographic relationships into consideration, several postulates were made in regard to the evolutionary history of the Physidae.

(a) *Aplexa* and *Stenophysa* are the oldest groups, while *Alampetista* is the youngest.
(b) North America has been the main theatre of evolution for the physids.
(c) The physids emerged and diversified in a post-Pangaean era and probably came from a bulinoid stock in the late Cretaceous.
(d) The following sister group relationships are apparent:
Aplexa / Stenophysa-Physinae; *Stenophysa* / Physinae; the genera *Physa / Physella*; the subgenera *Physella / Costatella-Petrophysa*; sections *Costatella / Alampetista.*
(e) Lastly, the Physidae as a group and the non-planate Planorbidae are probably sister groups.

Table-1 shows an outline of the proposed higher taxa classification within the family Physidae, while Table-2 shows the lower taxa delineation within the family. Figure-1 shows the mapping of the higher taxa on the family clado-

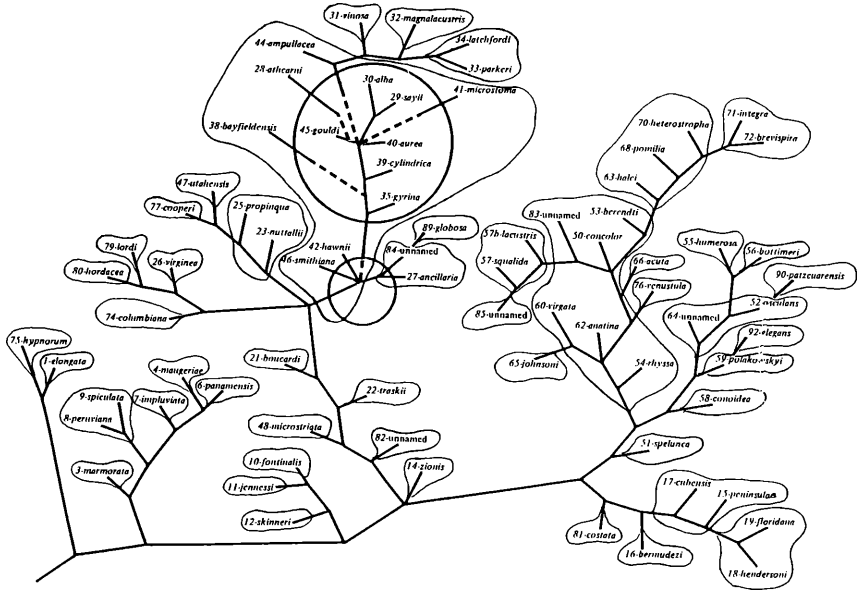

Fig. 2. Cladogram showing the boundaries of the species in the Physidae. The 48 species are indicated by OTU-numbers and taxa names separately encircled; the species units are also listed in Table 2.

gram, while Figure-2 shows the mapping of the species taxa on the same cladogram. The details of the systematic study of the family Physidae are in TE (1978). A diagnostic guide (complete with illustrations) to the Physidae of the world is currently being prepared. Formal taxonomic description of all undescribed taxa listed in the revised classification are also presently being prepared by the author.

Table 1. A proposed systematic revision of the higher taxa of the family Physidae (Date: Dec. 16, 1977). (See Table 2 for the included species.)

Physidae	
Subfamily Aplexinae	
Genus *Aplexa*	2 species
Genus *Stenophysa*	5 species
Subfamily Physinae	
Genus *Physa*	3 species
Genus *Physella*	
Subgenus *Physella*	17 species
Subgenus *Petrophysa*	1 species
Subgenus *Costatella*	
Section *Alampetista*	16 species
Section *Costatella*	4 species
Total =	48 species

Table 2. A proposed systematic revision of the lower taxa of the family Physidae (Date: Dec. 16, 1977).

	OTU-number
Physidae.	
Aplexinae.	
Aplexa.	
hypnorum (LINNÉ 1758)	75
elongata (SAY 1821)	1
Morph 1 "tryoni"	2
Stenophysa.	
marmorata (GUILD 1828)	3
peruviana peruviana (GRAY 1828)	8
peruviana spiculata (MORELET 1849)	9
impluviata (MORELET 1849)	7
panamensis (KÜSTER 1839)	6
maugeriae (GRAY 1837)	4
Morph 1 "nicaraguana"	5

Physinae.

Physa.

(* = *jennessi*-complex)

Physella (Physella).

(* = *gyrina*-complex)

Physella (Petrophysa).

Physella (Costatella).

Section *Costatella.*

costata (Newcomb 1861)	81
bermudezi (Aguayo 1935)	16
(* = *cubensis*-complex)	
* *cubensis cubensis* (Pfeiffer 1839)	17
* *cubensis peninsulae* (Pilsbry 1899)	15
* *hendersoni hendersoni* (Clench 1925)	18
Morph 1 "ariomus"	20
* *hendersoni floridana* Pilsbry ms.	19

Section *Alampetista.*

spelunca (Turner & Clench 1974)	51
conoidea (Fischer & Crosse 1886)	58
polakowskyi (Clessin 1886)	59
elegans (Clench & Aguayo 1932)	92
patzcuarensis (Pilsbry 1891)	90
(* = *acuta*-complex)	
* *osculans* (Haldeman 1841)	52
Morph 1 "unnamed morph"	64
* *bottimeri* (Clench 1924)	56
* *humerosa* (Gould 1855)	55
* *virgata virgata* (Gould 1855)	60
Morph 1 "parva"	61
* *virgata anatina* (Lea 1861)	62
* *virgata rhyssa* (Pilsbry 1899)	54
* *virgata concolor* (Haldeman 1841)	50
Morph 1 "unnamed morph"	83
* *virgata berendti* (Fischer & Crosse 1886)	53
* *heterostropha heterostropha* (Say 1817)	70
* *heterostropha pomilia* (Conrad 1833)	68
* *heterostropha halei* (Lea 1864)	63
* *johnsoni* (Clench 1926)	65
* *acuta* (Draparnaud 1805)	66
* *squalida squalida* (Morelet 1851)	57
* *squalida lacustris* (Clessin 1885)	57b
venustula (Gould 1848)	76
unnamed species	85
integra integra (Haldeman 1841)	71
Morph 1 "walkeri"	73
integra brevispira (Lea 1864)	72

Literature cited.

Te, G. A. (1978): A systematic study of the family Physidae (Basommatophora: Pulmonata). — Ph. D. Thesis, The University of Michigan, Ann Arbor, Michigan; xii + 324 p.
[Available by Order No. 78-13,746. Univ. Microfilms International. 300 N Zeeb Rd., Ann Arbor, Mich. 48106].