Systematic research on the family of land snails Bulimulidae

The Bulimulidae form a relatively large family, mainly confined to South America. At present the family includes 144 genera and subgenera. The number of specific and subspecific names available is estimated at about 3000. A critical revision might reduce these numbers to about 100 and 1000, respectively.

The family is subdivided into five subfamilies, viz. Bulimulinae (the largest subfamily with approx. 90 (sub)genera; mainly in South America, but also found in Central America and SW-Australia), Amphilinulinae, Odontostominae (both confined to S. America/West Indies), Orthalicinae (S. and C. America) and Placostyliniae (Melanesia and New Zealand).

The aim of the present project is to carry out a revision of the (sub)genera of the Bulimulinae and to establish the phylogenetic relationships of these genera and of the five subfamilies. The resulting phylogeny and the ecological observations made during field research will form the basis for zoogeographical work.

As pointed out above one of the main purposes of the taxonomic part of the project is to construct a phylogenetic system of this family. To obtain this Hennig’s theory will be used. This theory is characterized by the use of monophyletic groups, which are ‘groups of species that arose by species cleavage, ultimately from a common stem species that is the stem species only of those species included in the group in question’. Within such a monophyletic group it must be established which characters belong to one and the same phylogenetic transformation series, or which are homologous, and whether they are plesiomorphous (‘primitive’) or apomorphous (‘derived’). Only the joint possession of apomorphic characters (synapomorphy) corroborates the assumption that the species in question belong to the same monophyletic group.

As the cleavage of a species ultimately leads to the formation of (theoretically not more than) two daughter-species, which each form part of a monophyletic group, it follows that each monophyletic group will have one sister-group to which it is most closely related.

The present classification of the Bulimulidae is entirely based on morphological characteristics of the shell. The most important one is the sculpture of the protoconch (the protoconch is the upper part of the shell, made up by 1 ½-2 whors, and is formed in the egg). Although this is certainly a helpful criterion for classification it does not always lead to an unambiguous identification. The following characteristics will now be used to base the phylogeny on: 1) the morphology of the genitalia; 2) the internal structure of the genitalia, especially of the penis complex; 3) the morphology of the radula and mandibula; 4) the sculpture of the protoconch; 5) the morphology of the pallial organs (excretory system and roof of the lung); 6) the morphology of the muscle system.

At present the results have not yet led to the recognition of a complete phylogenetic transformation series for any of the above-mentioned characteristics. But such characters as the morphology of the radula and the internal structure of the genitalia already show a certain pattern in which parts of a transformation series may be recognized. Preliminary
Schematic reconstructions of the penis complex (P, penis; PS, penis sheath; EP, epiphallus; FL, flagellum).
A: Bulimus guadalupensis (Bruguère, 1789), B: Rabdopus moorecanus (Binney, 1859), C: Bostryx ignobilis (Philippi, 1867), D: Bostryx tumidulus (Pfeiffer, 1842), E: Geoceras extensus (Haas, 1955), F: Simulopsis miersi (Pfeiffer, 1856)

Results are, for example, that Bulimus (Rabdopus) has to be treated as a separate genus and that most subgenera of Bostryx are liable to be synonymized with the nominate subgenus (see figures A-B, C-E respectively).

Up to now, the ecology of these animals was poorly known. Nearly eight months of field research has led to the observation of the following generalized habitats: a) species which are ground-dwellers and which are probably living on detritus found among leaf litter, etc.; b) idem, but only under or in the immediate vicinity of (large) stones; c) species living on rock-faces; d) species living on (low) shrubs; e) species living in trees. As a rule species (of a certain genus) have been found only in one of these habitats, although they may occasionally be found in another one.
An anatomical characteristic in which the habitat is reflected is the morphology of the radula, viz., ground-dwelling species have straight rows in the radula, whilst species living in trees have V-shaped rows.

When the phylogenetic relationships have been worked out the analysis of the zoogeographical pattern of the group in question may be undertaken. At this stage of the research I only want to point out the theoretical background.

There are several theories to explain intra- and intercontinental distribution. The most suitable one seems to be the theory of Croizat; his concept of biogeography is one of a dynamic process in time and space, in which the idea of vicariant species (viz., closely related species which are geographically isolated) plays an important role. When plotting the distribution of a monophyletic group (which will include several vicariant species) one may draw a ‘track’ which will connect the disjunct distribution areas. A number of congruent tracks will form a generalized track that estimates an ancestral biota that, because of changing geography, has become subdivided into descendant biotas.

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Scanning electron microscope photographs of the radula. The radula is symmetrical with regard to the central teeth (C); the lateral and marginal teeth (1, 2 . . . n) are asymmetrical. (Left) Auris illheocola (Moricand, 1836), 240 x. (Right) Bostryx ignobilis (Philippi, 1867), 640 x

Scanning electron microscope photographs of the protoconch. (Left) Bostryx spec., apical view showing the sculpture of both the proto- and teleoconch. Note the marked difference between the two types of sculpture. (Right) Neopetraeus spec. In all there are about 20 types of protoconch sculpture in the Bulimulidae
During 8 months of field research the habitat of many species could be observed. (Left) Scutalus proteus (Broderip, 1832) in hibernation, clinging to large rocks. (Right) Bostryx obeliscus Zilch, 1954, clinging to the twigs of low shrubs. Both photographs were taken in the Río Santa Eulalia valley above Lima, Peru, in February 1975.