Using Taxonomic and Hybridization Data to Identify Lungless Salamander Kinds

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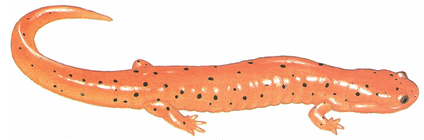

Pseudotriton montanus (Pfingsten & Downs, 1989)

Background

Baraminology is the study of God's created kinds as described in Genesis 1 (Wise, 1990). Holobaramins (groups of known organisms sharing continuity and bounded by discontinuity) are scientific approximations of these kinds identified by building up monobaramins (smaller, continuous groups) and dividing apobaramins (larger, discontinuous groups). The lungless salamanders (Caudata: Plethodontidae), composed of over 500 species in 29 genera, have been grouped together by herpetologists for almost 200 years. This consistent taxonomic history suggests that the family represents a cognitum (group of organisms recognized through the human cognitive senses as belonging together) and possibly apobaramin. The goals of the present study are to: 1) identify characteristics from the herpetological literature shared by all or most of the lungless salamanders; 2) survey three major taxonomic schemes from the past 60 years to identify consistent groupings of genera over time; and 3) compile records of hybridization to demonstrate continuity among various groups of species.

Research Question

- How many created kinds are found within the lungless salamander family based on taxonomic and hybridization data?

Methods

- We searched available literature to identify characteristics that are unique and/or shared by all or most of the lungless salamanders (Duellman & Trueb, 1986; Petranka, 1998; Heying, 2003).
- We surveyed literature related to three major taxonomic schemes from the past 60 years to identify consistent groupings of genera over time (Wake, 1966; Chippindale et al., 2004; Vieites et al., 2011).
- We also examined published hybridization records (Melander & Mueller, 2020) of lungless salamander species, and a hybridogram was constructed to help visualize relationships among species.

Eurycea lucifuga (Pfingsten & Downs, 1989)

Table 1. Characteristics from herpetological literature shared by all or most lungless salamanders (left) and consistent groupings of genera over time based on survey of three major taxonomic schemes from past 60 years (right).

Present in All	Common in Many
Bone & Muscle Structure	
Operculum replaced by columella footplate*	Premaxillae paired or fused
Pterygoid absent*	Maxillae and premaxillae present
Vertebrae opisthocoelous	Opercularis muscle derived from m. cucullaris major
All but first three spinal nerves exit intravertebrally	
Lacrimals absent	
Exoccipital, prootic, and opisthotic fused	
Internal carotid foramen absent	
Pedicellate teeth	
Palatal teeth extend posteriorly along medial edges of vomers	
Nasals ossified from lateral analgen	
One or more flexures of periotic canal from junction with protrusion of periotic cistern to fenestra ovalis	
Reproduction	
Tail straddle walk during courtship*	Egg-guarding
	Terrestriality and direct development
	Cirri (males)
	Papillose cloacal lips (males)
	Mental gland
Miscellaneous	
Nasolabial grooves near nares*	4 toes on forelimbs, 5 on hindlimbs
Lunglessness (also found in small number of Family Hynobiidae)	Projectile tongue and hyoid apparatus
Ypsiloid cartilage absent (associated with lunglessness)	Distribution in the Americas
Diploid number 26 or 28	

*Not present in other salamander families

Consistent Groups	Morphological 1960s-80s	Molecular 2000s	Molecular 2010s
Plethodontimin (MB): *Plethodon, Aneides,* and *Ensatina*	SF Plethodontinae Tribe Plethodontini	SF Plethodontinae+ (includes Desmognathimin and Hydromantimin)	SF Plethodontinae Tribe Plethodontini Tribe Aneidini Tribe Ensatinini
Desmognathimin (MB): *Desmognathus* and *Phaeognathus**	SF Desmognathinae	SF Plethodontinae+ (includes Plethodontimin and Hydromantimin) Supergenus Desmognathus	SF Plethodontinae Tribe Desmognathini
Hydromantimin (MB): *Hydromantes* and *Karsenia**	SF Plethodontinae Tribe Bolitoglossini Supergenus Hydromantes	SF Plethodontinae+ (includes Plethodontimin and Desmognathimin)	SF Plethodontinae Tribe Hydromantini+ (includes *Karsenia*)
Batrachosepimin (MB): *Batrachoseps**	SF Plethodontinae Tribe Bolitoglossini Supergenus Batrachoseps	SF Bolitoglossinae+ (includes Bolitoglossimin)	SF Hemidactyliinae Tribe Batrachosepini
Bolitoglossimin (MB): *Bolitoglossa, Bradytriton, Chiropterotriton, Cryptotriton, Dendrotriton, Ixalotriton, Nototriton, Nyctanolis, Oedipina, Parvimolge, Pseudoeurycea, Thorius, Aquiloeurycea,* and *Isthmura*	SF Plethodontinae Tribe Bolitoglossini Supergenus Bolitoglossa	SF Bolitoglossinae+ (includes Batrachosepimin)	SF Hemidactyliinae Tribe Bolitoglossini
Hemidactylimin (MB): *Hemidactylium**	SF Plethodontinae Tribe Hemidactyliini+ (includes Spelerpinimin)	SF Hemidactylinae	SF Hemidactyliinae Tribe Hemidactyliini
Spelerpinimin (MB): *Eurycea, Gyrinophilus, Psuedotriton, Stereochilus,* and *Urspelerpes*	SF Plethodontinae Tribe Hemidactyliini+ (includes Hemidactylimin)	SF Spelerpinae	SF Hemidactyliinae Tribe Spelerpini

*Groups differently/inconsistently among taxonomic schemes

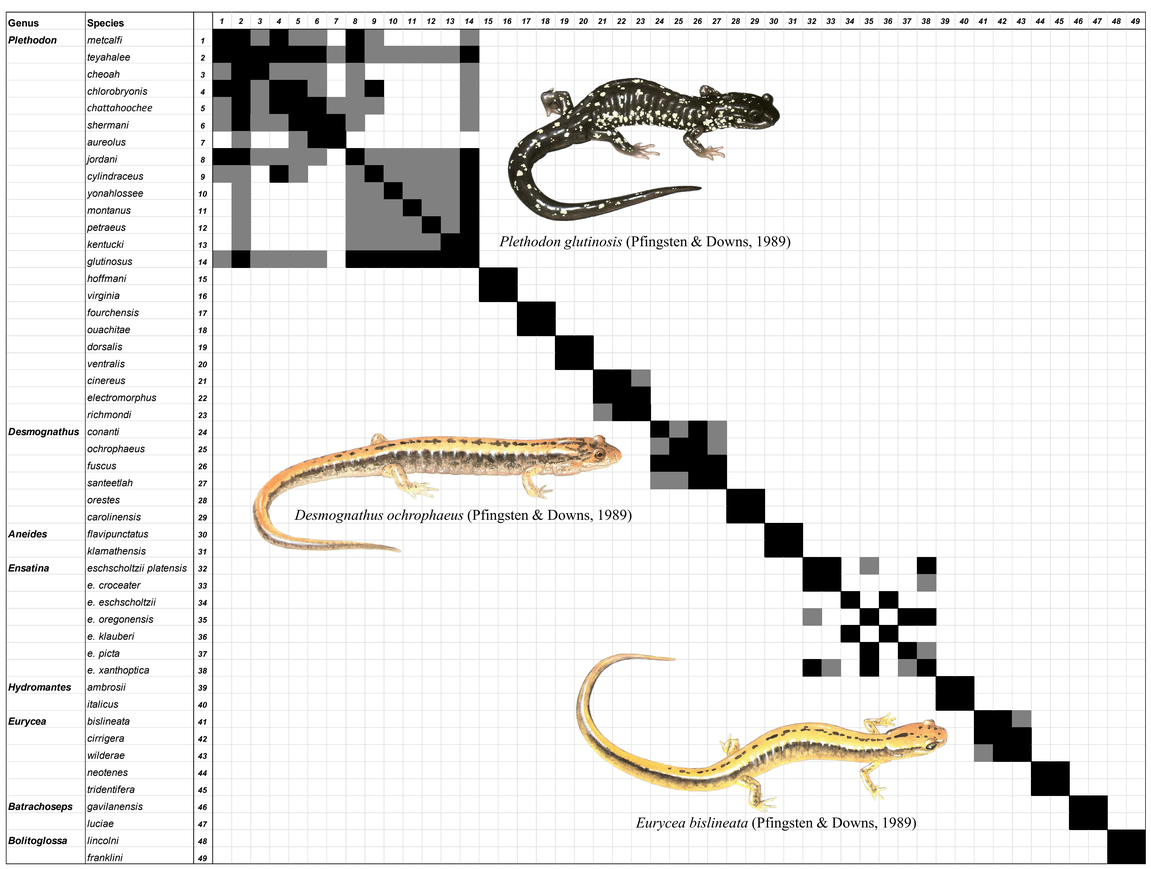

Figure 1. Hybridogram of plethodontid salamanders based on direct and indirect hybridization data. See Table 1 for additional taxonomic details. Black = two species hybridize directly; Gray = two species hybridize with same 3rd species.

Results and Conclusions

- Our literature search suggests that lungless salamanders share a tremendous number of characteristics, many of which are unique to the family. This combination of shared and unique characteristics suggests the family may represent a holobaramin (Table 1-left).
- The survey of taxonomic schemes from the past 60 years identifies seven monobaramins ranging from supergenus to tribe or subfamily level (Table 1-right).
- Many records of interspecific hybridization (but not intergeneric or intertribal) reveal fourteen monobaramins at the genus level ranging in size from 2-14 species (Fig. 1).
- These data suggest that lungless salamander holobaramin(s) range from genus to family levels (likely modern tribe level).

Conclusions – Other research by our team, utilizing morphological and molecular datasets, yields similar results. Despite the preliminary nature of our conclusions, we are the first to conduct baraminological analyses in this family of salamanders.

Future Work

- We will continue our attempts to identify holobaramin(s) by utilizing genetic distance data to expand our hybridization analysis.

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