Changing Diversity of Mollusks in Zion Canyon

Is This Fauna Recovering From a Prehistoric Flood?

By Wayne L. Hamilton

Sometimes valuable ecosystem data are just waiting to be found in some file folder in an out-of-the-way cabinet. Deciding what deserves closer scrutiny requires "pure" thoughts, because the significance of small components is often overshadowed by the "popular" fauna of the day. When I saw the file containing data on snails in the library at Zion in 1974, I didn't immediately know that I was interested, or that mollusks could help me interpret ancient sediments of ponds and lakes preserved in the canyons of the park. Not long after, I remembered a course I'd taken and recalled that the different species of mollusks have different habitat preferences. I quickly decided to become better acquainted with these tiny creatures and see how their shells could be used as fossil indicators of past environments in the canyons of the park. Later, it came as no surprise that their living descendants could also tell a story about very recent changes in Zion Canyon.

"The Snails of Zion National Park" is an undated manuscript by Angus Woodbury, a park naturalist at Zion, probably written as a draft of his report later published in *The Nautilus* (Woodbury 1929). This report represents the earliest molluskan inventory of which I am aware, for Zion Canyon. He listed 15 species collected in Zion Canyon, discussed numbers, and described collecting localities (8) and habitats. That study collection is kept in the park museum.

Following closely on Woodbury's inventory, Chamberlin and Jones (1929) collected in the canyon and confirmed all but one of the earlier finds and added a new terrestrial species. Shortly thereafter, Chamberlin and Berry (1930) added another terrestrial snail. The collections of the 1920s constitute, in my opinion, a relatively complete inventory.

In 1935, Wendell O. Gregg collected and identified mollusks at all of Woodbury's locations, plus three others, in Zion Canyon, adding five new species to the earlier list (Gregg 1940). By collecting in May, June, and July, he was assured that most species were active. Gregg's work was the basis for the handout given to visitors in the 1970s. His list qualifies as an inventory.

The next data were provided in a letter from C. L. Richardson (1965) who collected in the park in late May 1965, concentrating on aquatics. Richardson mentioned only three collecting localities.

My collection dates from 1974 to 1977, and it includes both species presently living in the canyon (at most of the locations surveyed earlier) and fossils collected from 4,000-year-old sediments of a slide-dammed lake there (Hamilton 1979, 1992 and forthcoming). My first tutor in identifying mollusks was Alice Lindahl (then at Utah State University), discoverer of an unnamed, probably *Amnicola* sp., at Grapevine Spring. These first identifications were checked, and in several cases corrected, by Jerry Landye (Flagstaff). Thereafter, I worked on my own, but the identifications listed here were further checked (and corrected) by R. Hanley (University of Michigan). All specimens have been deposited in the park museum.

In this update I present in graphical form (fig. 1--page 23) these earlier lists, indicating nomenclature changes conforming to Burch (1962 and 1989), with more emphasis on aquatic species collected in Zion Canyon. Table 1 shows all species and the localities of aquatics. Underlining indicates that a species was collected by the investigator. Very few of these mollusks have common names.

Figure 1 illustrates the changing number of aquatic mollusk species (including one seed clam) and terrestrial snails found in Zion Canyon over time. Aquatic species require pond, stream, or spring habitat while terrestrials live on moist surfaces near flowing water, under logs and in leaf litter, depending partly on precipitation for moisture. The total number of aquatic species appears to have increased since the time of the earliest inventory. The number of terrestrial species observed has declined slightly. Are these changes in diversity, or simply a result of observational bias?

One probable new arrival is *Physella virgata*. Woodbury (1930) identified it at a locality west of the park in 1926, yet he did not report this species in Zion Canyon. Similarly, Chamberlin and Jones (1929) and Gregg (1940) failed to report any Physid other than *Physa zionis* (discovered by Pilsbry in 1925) in the canyon. The first record of another Physid was from Richardson (1965), who reported *Physa ancillaria* Say ". . . in the stream near Weeping Rock, at the Amphitheater, and in springs along the Narrows Trail." In the mid-1970s, I identified the Physid common at this and other locations where clear, spring-fed tributaries descend to the valley floor, as *Physella virgata* Gould. Bequaert and Miller (1973) do not list *P. ancillaria,* and I believe that Richardson may have actually seen *P. virgata,* which resembles and which is now common at exactly those locations. I suggest that earlier collectors would simply not have missed seeing *P. virgata* if it had been as abundant then as it was in the 1970s. It probably moved into the canyon between 1935 and 1965.

P. virgata was found as a fossil in 4,000-year-old shoreline sediments of Sentinel Lake in Zion Canyon (Hamilton 1979). If suitable habitat existed then, why was this snail later extirpated?

Gregg (1940) reported *Lymnaea bulimoides* in a stream at Saddle Nook in 1935, but when Woodbury visited that stream before 1929 he failed to find it. This too suggests immigration. I did not attempt to verify this *Fossaria* colony.

Fossaria obrussa Say (Golden Fossaria) was identified west of the park as *Lymnaea obrussa* by Woodbury (1929), but it was not known in Zion Canyon until I found numerous shells in a spoil bank along a drainage ditch at Temple of Sinawava. This suggests either that the species occupied that site in the recent past and has been extirpated, or that it is a recent immigrant. If living specimens were to be found, this question would be resolved.

The *Fossaria dalli* in Table 1 (see page 24) was collected along with other Lymnaeids and identified long after being collected, therefore its locality is given as Temple of Sinawava (?), the query indicating uncertain locality.

The number of terrestrial snail species has remained relatively constant over time, or decreased slightly (fig. 1). Yet, because of their small size, obscure habitat, much greater diversity, and wider distribution in relation to aquatics, it is difficult to exclude observational factors as the cause of apparent changes in species diversity. Terrestrials are capable of surviving dry periods, but prolonged drought can have

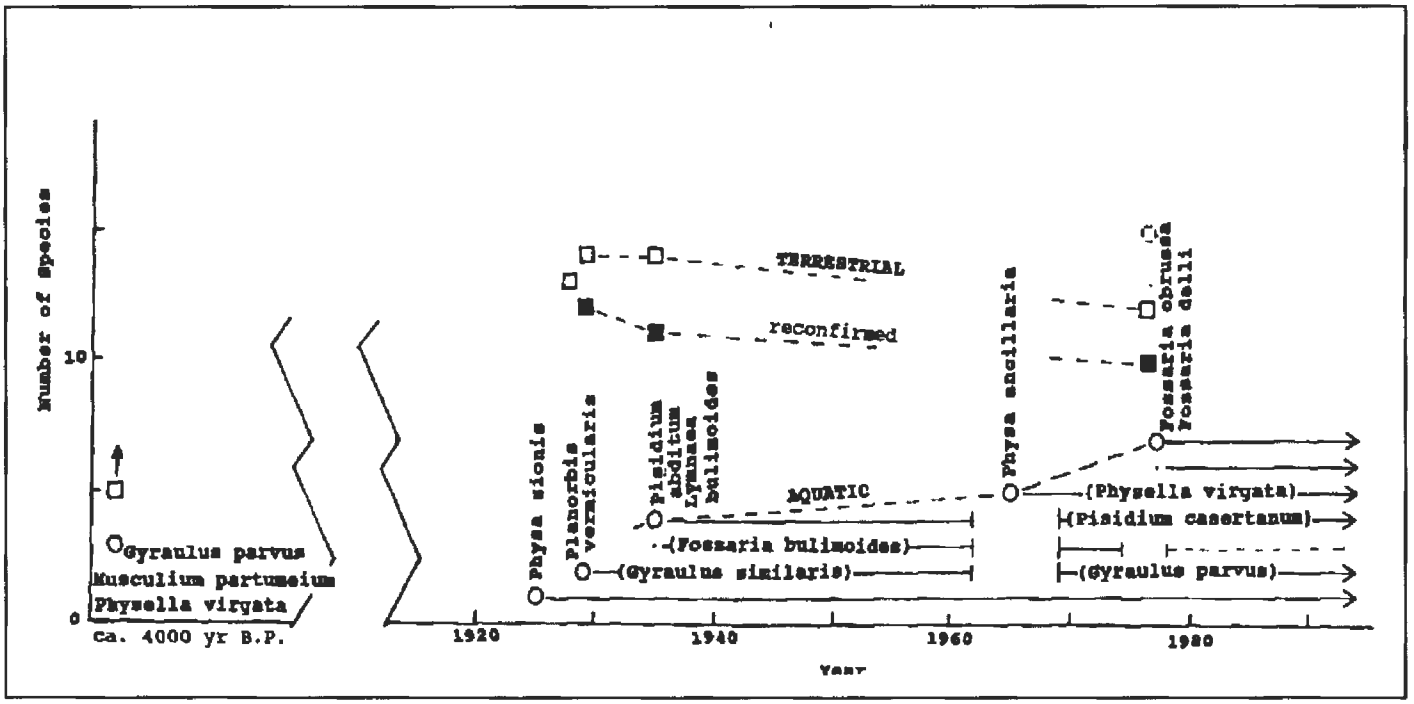


Figure 1. Number of terrestrial and aquatic mollusk species in Zion Canyon versus time. Species name changes are noted in parentheses. Lower half of diagram shows aquatic species, with totals represented by open circles. Terrestrial species are shown by squares. Solid squares represent number of species reconfirmed from earliest survey. Hollow squares show totals including new discoveries. Open, dashed square includes species in earlier surveys represented only by fossils in the 1970s.

serious consequences when springs stop flowing. The trend is interesting enough to warrant further investigation.

In the case of the apparent influx of *Physella virgata* and the possible recent immigration of *Fossaria obrussa* and *F. bulimoides*, what agencies might be considered? The Zion localities are all connected to the North Fork of the Virgin River, in which brown trout (and other fish) are common. Introduction of eggs or juvenile forms by fish seems a reasonable explanation for the arrival of new species. Water birds have also been suggested as a vector for snail introduction at isolated ponds at Badlands (Beetle-Pillmore 1994).

And what may have removed *P. virgata* and extirpated other species that are now established in the canyon? Most of the habitat lies within the 100-year floodplain of the North Fork of the Virgin River. Moreover, most spring-fed tributaries are situated at the base of hanging canyons cut in the Navajo Sandstone, having sizeable watersheds (Hamilton 1992). This puts such habitat in range of torrential flooding when waterfalls scour drainages that are usually placid. We may be seeing a recovery, supported by natural dispersal, from such a disturbance early in the century. Perhaps such episodes are a normal part of the dynamic canyon ecosystem.

Physella zionis, an endemic species, is better adapted to survive floods in Zion Canyon because its habitat is on near-vertical surfaces where springs issue from the Navajo Sandstone above the canyon floor. Seed clams might similarly survive if the sediments where they burrow were not excised or deeply buried by flooding. A small population of *Gyraulus parvus* persisted in the 1970s only at a spring-fed bog well above the floodplain at Birch Creek. This may have been the only surviving population from ancient Sentinel Lake. The bog (once a pond) at Birch Creek is vulnerable to drying because it has been tapped as a water supply source.

These small invertebrates are an important constituent of the canyon ecosystem. They are a valuable food source for birds and other small vertebrates and insects. In contrast, and in spite of their seeming insignificance, they also play a role in limiting other inhabitants of the canyon. When accidently ingested with forage, *Z. arboreus* can infect sheep with lungworm. *C. lubrica* similarly acts as a vector for the lancet liver fluke that infects deer and wild sheep (Burch 1962). Some aquatic species carry schistosomes that are transmitted to humans who wade in infested waters.

Further inventory is recommended as a means of testing the hypothesis of immigration of aquatic snails proposed here. Habitat is also subject to encroachment by exotic competitors, and a lookout should be maintained for them. In the late 1980s, the exotic species *Helix aspersa* was poised for immigration in irrigation ditches near the park boundary at Rockville.

Some terrestrial snail habitat is vulnerable to acid precipitation, which can hypothetically reduce soil alkalinity to the point where the organism can no longer maintain its protective calcium carbonate shell. More generally, the niches occupied by mollusks are subject to loss through drought, flood, and fire. The mollusks discussed here depend on a variety of habitats, and their presence or absence implies something of the health of the ecosystem. Future inventorying may shed light on the significance of the small reduction of terrestrial species over time.

Hamilton worked in Zion NP beginning in 1974 as a ranger and, on contract with the Zion Natural History Association, as a naturalist producing a geologic map, a book on the park's geology, and several other publications. He moved to Yellowstone NP in 1980 where he now works as a geologist with NBS. He is at the Greater Yellowstone Field Station, National Biological Survey, Yellowstone National Park, WY 82190, (307) 344-7381.

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Table 1

Woodbury 1, Pilsbry 2, Chamberlin & Jones 3, Chamberlin & Berry 4 (1925-30)		Gregg (1935)	Richardson (1965)	This Work (1974-77)
				Oreohelix cf. subrudis ("Pfeiffer"Reeve?)
Oreohelix cooperi 1,3	[common]	*Oreohelix strigosa depressa*		*Oreohelix strigosa depressa* (Cockerell)
Microphysula ingersolli 2				*Microphysula ingersolli* (Bland) F
Econulus fulvus 1,3	[v. rare]			*Econulus fulvus alaskensis* (Muller) F
Glyphyalina indentata 1,3	[uncom.]	*Retenilla indentata* (Say)		*Glyphyalinia indentata paucilirata* Morelet
		Hawaii minuscula neomexicana		
Zonatoides arborea 1,3	[common]	———	———	*Zonatoides arboreus* (Say) F
Vitrina alaskana 1,3	[widespread]			*Vitrina pellucida alaskana* Dall a,g
Agriolimax campestris 1,3	[common]	———		*Deroceras laeve* (Muller)
Gonyodiscus cronkhitei 1,3	[widespread]	———		*Discus cronkhitei* (Newcomb) F,d
Succinea avara 1,3	[common]	———		*Catinella avara* (Say) F,a
Gastracapta ashmuni 4				
Pupoides marginatus 1,3	[v. rare]			*Pupoides albilabris* (Adams) ?
Pupilla syngenes dextroversa 1,3			*Pupilla blandi*	———
				Pupilla muscorum (Linne) f
Pupilla syngenes 1,3		———		
		Vallonia pulchella [introd?]		
		Vallonia perspectiva		*Vallonia perspectiva* Sterki F
Vallonia gracilicosta 1,3	[rare]	[v. common]	———	*Vallonia excentrica* (Sterki 1893) f
Cochlicopa lubrica 1,3	[widespread]	[v. common]	———	*Cionella lubrica* (Muller) f
				Fossaria dalli (Baker) ?
				Fossaria obrussa (Say) d
		Fossaria bulimoides b		
			Physa ancillaria c,d,e	*Physella virgata* (Gould) c,d,e F
Physa (Petrophysa) zianis 2,3,d		———	———	*Physella (Petrophysa) zionis* d
Gyraulus vermicularis 1,3,a		*Gyraulus similaris* a		*Gyraulus parvus* (Say) a F
		Pisidium abditum a		*Pisidium (cyclocalyx) casertanum* (Poli) d

a. Birch Creek pond, b. Saddle Nook, c. Amphitheater, d. Temple of Sinawava, e. Weeping Rock stream, f. Oak Creek, g. Lava Pt., F. fossil, ?, location uncertain (see text)

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