Paterson
MacLeod
1979

Reprinted from

Canadian Journal of Zoology

Réimpression du

Journal canadien de zoologie

Observations on the life history of the water mite, *Unionicola formosa* (Acari: Hydrachnellae)

C. G. PATERSON AND R. K. MACLEOD

Volume 57 • Number 10 • 1979

Pages 2047–2049

National Research Council Canada
Conseil national de recherches Canada

Observations on the life history of the water mite, *Unionicola formosa* (Acari: Hydrachnellae)

C. G. PATERSON AND R. K. MACLEOD
Department of Biology, Mount Allison University, Sackville, N.B., Canada E0A 3C0
Received May 11, 1979

PATERSON, C. G., and R. K. MACLEOD. 1979. Observations on the life history of the water mite, *Unionicola formosa* (Acari: Hydrachnellae). Can. J. Zool. 57: 2047–2049.

Under laboratory conditions larvae of the water mite, *Unionicola formosa*, can transform to the nymphal stage in the absence of an aquatic insect host.

PATERSON, C. G., et R. K. MACLEOD. 1979. Observations on the life history of the water mite, *Unionicola formosa* (Acari: Hydrachnellae). Can. J. Zool. 57: 2047–2049.

En laboratoire, les larves de l'hydracarien *Unionicola formosa* peuvent atteindre le stade nymphe même en l'absence de tout insecte aquatique hôte.

[Traduit par le journal]

Watermites of the genus *Unionicola* are unusual in that they have developed parasitic associations with unionid bivalves, snails, and sponges in fresh water (Mitchell 1955, 1957; Davids 1973). The parasitic association follows an evolutionary sequence from species that use the host only as a site for the egg or transformation stages to species that are parasitic in the host as the nymph and adult. Mitchell (1955, 1957) argues that *Unionicola* larvae are free living, although the majority of Hydrachnellae larvae are parasitic on aquatic insects. Jones (1965, 1978) reported larval *Unionicola* on adult *Chironomus plumosus* (Diptera: Chironomidae), but Davids (1973) questions the validity of these findings and argues that in the species he studied the larvae are not parasitic on aquatic insects. Whitsel and Schoppner (1973) also reported finding *Unionicola* larvae on two species of chironomids. Smith and Oliver (1976) reported unidentified *Unionicola* larvae on adult Tricoptera and on 21 genera within the family Chironomidae. Böttger (1976) summarized the findings of Jones (1965) and Böttger (1972) and concluded that all species of *Unionicola* that have received detailed study are parasitic on aquatic insects in the larval stage. Hevers (1978) conducted laboratory experiments that revealed that larvae of *U. aculeata* and *U. ypsilophora* are parasitic on *Chironomus thummi*. Field studies (Hevers 1978) found *U. aculeata* larvae on eight species of adult chironomids.

It now appears certain that many species of *Unionicola* have a larval stage that is parasitic on insects, but it is not as yet known whether all species show this characteristic of the life cycle or if the parasitic stage is necessary for successful completion of the life cycle for all species. As part of a study (Gordon *et al.* 1979) of the biology of *Unionicola formosa* (Dana and Whelpley), which is found as nymphs and adults in the unionid bivalve, *Anodonta cataracta* (Say) in Morice Lake, N.B., a study was undertaken to determine whether *U. formosa* has the ability to transform from the newly hatched larval stage to the nymphal stage without an insect intermediate.

Methods

Between May 13 and 17, 1977, samples of *Anodonta cataracta* (Say), *Elliptio complanata* (Solander), and *Lampsilis ochracea* (Say), were collected by dragging in Morice Lake, a 1.5 km² polymictic, mesotrophic reservoir located 3 km north of Sackville, N.B. (45°56′N, 64°21′W). The maximum anterior–posterior length of each bivalve was measured and then the shells were opened by severing the adductor muscles. The tissues were searched for adults, nymphs, and larvae of *U. formosa*. The bivalve was then repeatedly rinsed in a jet of water and the rinse water examined under magnification for further specimens. Mantles were dissected out and placed in lactophenol for clearing, after which the number of eggs was counted. On May 22, 1977, 38 *A. cataracta* with a length of 6.0–8.0 cm were placed in a glass aquarium (59.5 cm × 29.5 cm), which was filled to a depth of about 15 cm with 26 L of aerated water obtained from a deep drilled well. The water was continually aerated while the aquarium was held in a controlled environmental room at a temperature of 20°C under a 16 h light : 8 h dark photoperiod. A second identical tank was also established, but because of the difficulties in obtaining specimens of the rare *L. ochracea* and the even rarer *A. implicata* (Say), this tank was not completely colonized until June 5, 1977. When established this tank contained 13 *A. cataracta* (5.9–7.1 cm), 10 *E. complanata* (6.7–8.4 cm), 16 *L. ochracea* (4.2–6.2 cm), and 8 *A. implicata* (8.4–11.1 cm).

Every few days after establishment, the contents of each tank were vigorously stirred and 3 L of the water passed through a 10-μm mesh plankton net. The concentrated samples were placed in counting chambers and examined under a dissecting microscope for the presence of developmental stages of *U.*

0008-4301/79/102047-03$01.00/0

TABLE 1. Abundance of *Unionicola formosa* in *Anodonta cataracta*, *Elliptio complanata*, and *Lampsilis ochracea* collected from Morice Lake, N.B., May 13–17, 1978

Species	No.	Size range, cm	*U. formosa*			
			Adults		Eggs	
			Range	$\bar{x} \pm 1$ SE	Range	$\bar{x} \pm 1$ SE
Anodonta cataracta	15	4.60–7.30	0–4	1.47 ± 0.35	10–635	220.8 ± 44.9
Elliptio complanata	15	5.40–7.90		0	0–57	21.7 ± 4.3
Lampsilis ochracea	7	4.30–7.30		0	208–865	486.6 ± 103.9

TABLE 2. Stages of *Unionicola formosa* recovered from filtering 3 L of water from 26-L experimental tanks

	Tank 1[a]			Tank 2[b]		
	Larvae	Nymphs	"Nymphochrysalis"	Larvae	Nymphs	"Nymphochrysalis"
May 24	0	3	0			
26	5	15	0			
28	4	13	1			
30	2	34	1			
June 1	2	30	0			
6	2	9	0	19	18	0
9	1	4	0	11	6	0
13	9	1	0	20	2	0

[a]Established May 22, 1977, with 38 *A. cataracta*.
[b]Established June 5, 1977, with 13 *A. cataracta*, 10 *E. complanata*, 16 *L. ochracea*, and 8 *A. implicata*.

formosa. The tanks were then returned to their original volume by the addition of 2 L of aerated well water plus 1 L of a laboratory algal culture. This was a mixed culture of Morice Lake algae that had been cultured in the laboratory for a period of 1 year.

To substantiate initial results, 32 *A. cataracta* were collected on May 22, 1979, and placed in one of the glass aquaria. At irregular intervals between May 31 and June 23 samples of the aquarium water were searched for larvae and the quiescent nymphochrysalis stage. These were individually transferred to 6-cm diameter culture dishes containing 25 mL of lake water and were periodically examined over a period of several days.

Results and Discussion

The abundance of adults and eggs of *U. formosa* in *Anodonta cataracta*, *Elliptio complanata*, and *Lampsilis ochracea* collected in May are shown in Table 1. Larvae or nymphs were not encountered in any of the specimens. Although no specimens of *A. implicata* were included in this examination, six specimens examined between April 20 and June 15, 1976, did not contain larvae, nymphs, or adults but contained an average of 310.5 ± 104.9 eggs.

The recovery of immature stages of *U. formosa* from 3 L of water filtered from 26-L experimental tanks is shown in Table 2. In a tank containing only *A. cataracta* and a further tank containing a mixture of the four species found in Morice Lake, larvae and nymphs were abundant. In addition, a dormant stage, which was assumed to be the nymphochrysalis, was recovered on two occasions. When these were isolated in small culture dishes, they hatched within a very few hours into the nymph.

The larvae isolated in culture dishes in 1979 were observed to transform into the quiescent nymphochrysalis stage and, although mortality was relatively high, the nymphochrysalis was then observed to hatch into the nymph. When the nymphochrysalis was isolated it too would hatch rapidly into the nymph.

The results of this study indicate that in *U. formosa* the larvae can pass through a very brief nymphochrysalis stage and undergo metamorphosis to the nymph without the necessity of an aquatic insect host for the larvae. The only aquatic insect that the larvae could have encountered with any frequency would have been a limited number of specimens of the chironomid *Baeoctenus bicolor* Saether, which is parasitic in *A. cataracta* and *A. implicata* (Gordon *et al.* 1978). However, the 15 *A. cataracta* examined between May 13–17, 1977, only contained three larvae of this species. In addition, during a study (Gordon *et al.* 1978) of *B. bicolor* between 1974 and 1976, adults reared from tanks containing *A. cataracta* were never observed to be parasitized by larval mites.

The observation that the larvae of *U. formosa* can transform to the nymphal stage without the use of an aquatic insect host is in contradiction to the

conclusion of Böttger (1976) that all species of *Unionicola* require an intermediate host. However, it will be interesting to discover if other species of *Unionicola* are also capable of this direct, or non-parasitic, transformation, and it is also not known whether *U. formosa* is capable of using a host as a dispersal mechanism if such are available.

Acknowledgments

This study was supported by the Natural Sciences and Engineering Research Council through grant A-6299.

BÖTTGER, K. 1972. Vergleichend biologisch-ökologische Studien zum Entwicklungszyklus der Süsswassermilben (Hydrachnellae, Acari). II. Der Entwicklungszyklus von *Limnesia maculata* und *Unionicola crassipes*. Int. Rev. Gesamten Hydrobiol. **57**: 263–319.

——— 1976. Types of parasitism by larvae of water mites (Acari:Hydrachnellae). Freshwater Biol. **6**: 497–500.

DAVIDS, C. 1973. The relations between mites of the genus *Unionicola* and the mussels *Anodonta* and *Unio*. Hydrobiology, **14**: 37–44.

GORDON, M. J., B. K. SWAN, and C. G. PATERSON. 1978. *Baeoctenus bicolor* (Diptera:Chironomidae) parasitic in unionid bivalve molluscs, and notes on other chironomid–bivalve associations. J. Fish. Res. Board Can. **35**: 154–157.

——— 1979. The biology of *Unionicola formosa* (Dana and Whelpley): a water mite parasitic in the unionid bivalve, *Anodonta cataracta* (Say) in a New Brunswick lake. Can. J. Zool. **57**: 1748–1756.

HEVERS, J. 1978. Interspezifische Beziehungen zwischen *Unionicola*-Larven (Hydrachnellae, Acari) und Chironomidae (Diptera: Insecta). Verh. Ges. Okologie, Kiel. 1978: 211–217.

JONES, R. K. H. 1965. Parasitism by larvae of *Unionicola intermedia* Koenike and another *Unionicola* sp. (Acarina, Pionae) on chironomids. Nature (London), **207**: 317–318.

——— 1978. Parasitism by *Unionicola* spp. larvae on chironomids. Hydrobiology, **60**: 81–87.

MITCHELL, R. D. 1955. Anatomy, life history, and evolution of the mites parasitizing fresh-water mussels. Misc. Publ. Mus. Zool. Univ. Mich. **89**: 1–28.

——— 1957. Major evolutionary lines in water mites. Syst. Zool. **6**: 137–148.

SMITH, I. A., and D. R. OLIVER. 1976. The parasitic associations of larval water mites with imaginal aquatic insects, especially Chironomidae. Can. Entomol. **108**: 1427–1442.

WHITSEL, R. H., and R. F. SCHOEPPNER. 1973. Mites associated with aquatic and semi-aquatic Diptera from San Mateo County, California. Proc. Entomol. Soc. Wash. **75**: 71–77.