

Global diversity of fishlice (Crustacea: Branchiura: Argulidae) in freshwater

William J. Poly

© Springer Science+Business Media B.V. 2007

Abstract The Branchiura of freshwater habitats, consisting of the valid genera *Argulus*, *Chonopeltis*, *Dipteropeltis*, and *Dolops*, presently contains 113 valid species and 12 undescribed species. The entire group is composed of ectoparasitic species that usually live on fishes. The highest diversity of genera and species occurs in the Afrotropical and Neotropical regions. The diversity of the freshwater species surpasses that of species in marine and brackish waters, but this could be due to inadequate study of the fauna of the latter habitats. One species, *Argulus japonicus*, has been introduced from east/southeast Asia to all other continents, except Antarctica. Studies of higher level relationships place the

Branchiura with either Pentastomida or Ostracoda. Hypotheses about phylogenetic relationships of either the genera or species in this group have not been proposed.

Keywords Fishlice · Fishlouse · Parasites · Nonindigenous species · Biogeography

Introduction

The subclass Branchiura contains a single family, the Argulidae, and four valid genera: *Argulus* Müller, 1785, *Chonopeltis* Thiele, 1900, *Dipteropeltis* Calman, 1912, and *Dolops* Audouin, 1837. Yamaguti (1963) erected subfamilies within the Argulidae as well as the family Dipteropeltidae; however, neither subfamily designations nor the family group name Dipteropeltidae are used herein. Branchiurans are ectoparasites of fishes primarily but occasionally live on amphibians or invertebrates, and they can move about freely on their hosts (Stuhlmann, 1891; Yamaguti, 1963; Cressey, 1978; Jackson & Marcogliese, 1995; Poly, 2003). Species of Branchiura are known by the common name, fishlouse (plural: fishlice).

Branchiurans are compressed dorsoventrally with a circular to oval shield-like carapace, a pair of compound eyes anteriorly, four pairs of swimming legs on the thorax, and a short, unsegmented abdomen posteriorly (Fig. 1). Total length of adults ranges from a few millimeters to just over 30 mm, and adult females tend

Guest editors: E. V. Balian, C. Lévêque, H. Segers & K. Martens

Freshwater Animal Diversity Assessment

The present paper was intended as a very brief overview of the known diversity of the Branchiura in freshwaters only, and regrettably is deficient in mention of much information and many relevant citations pertaining to the group.

W. J. Poly (✉)
Aquatic Biodiversity Research Institute, 11205 Schroeder
Road, Saint Marys, OH 45885, USA
e-mail: wpoly@calacademy.org

W. J. Poly
Department of Ichthyology, California Academy of
Sciences, Golden Gate Park, San Francisco, CA 94118,
USA

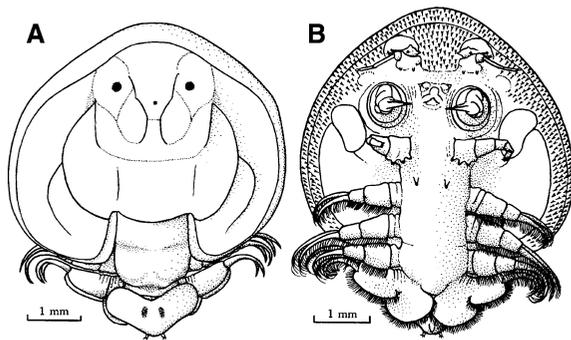


Fig. 1 Typical body form of a branchiuran. Dorsal (A) and ventral (B) views of the female holotype of *Dolops tasmanianus* Fryer, 1969. Copyright © CSIRO; Reproduced from the Australian Journal of Zoology 17: 49–64 (Fryer, 1969) with permission of CSIRO PUBLISHING, Melbourne, Australia (<http://www.publish.csiro.au/journals/ajz>)

to be larger than males. *Argulus*, *Chonopeltis*, and *Dipteropeltis* possess a pair of suction cups (modified first maxillae) in late juvenile and adult stages, whereas *Dolops* retains the larval, claw-like appendages as adults (Fig. 1). On legs 2–4, male *Argulus* spp. and *Chonopeltis* spp. may have secondary sexual modifications that are absent on females. Other differences between the sexes include the presence of a pair of testes in the male's abdomen and a pair of spermathecae in the female's abdomen, a greater number of support rods in suction cups of females, and also usually a higher number of sclerites in the support rods of females (*Argulus*). Eggs often can be seen in the thorax of an adult female, and in some species eggs occur in the thorax and in the lobes of the carapace as well. Shapes of respiratory areas, shapes of carapace and abdomen, number of sclerites in suction cup support rods and number of support rods per suction cup (*Argulus*), features of the second maxillae (especially basal plate), pigmentation, and secondary sexual characters of males are some of the most useful taxonomic characters for distinguishing species (Wilson, 1902, 1944; Sikama, 1938; Meehan, 1940; Poly, 2005).

Mating takes place on the host fish, and later, the female leaves the host to lay eggs, which are attached with an adhesive substance to objects, such as rocks, plants, or sticks. Sperm are stored in the spermathecae of females in *Argulus* and presumably in *Chonopeltis* and *Dipteropeltis*, whereas males of the genus *Dolops* deposit a spermatophore on the females (Carvalho, 1941; Fryer, 1958, 1960). Further information on the

ecology and morphology of argulids can be found in Jurine (1806), Clark (1902), Wilson (1902), Calman (1912), Tokioka (1936), Loro (1964), van Niekerk & Kok (1989), Rushton-Mellor & Boxshall (1994), and Van As & Van As (1999).

Species diversity

Dipteropeltis contains one valid species and occurs only in South America, *Chonopeltis* has 14 valid species and is found only in Africa, and *Dolops* holds 13 valid species with all but two species in South America. Species within the three aforementioned genera live in freshwater only. *Argulus* contains about 129 valid species and occurs on or around all continents, except Antarctica, in marine and estuarine ($n = 44$) and freshwater habitats ($n = 85$). In total, the diversity of freshwater Branchiura stands at 113 species. In addition, the author is describing at least 12 new species from freshwaters of North America and Australia. The highest diversity of genera and species occurs in the Afrotropical and Neotropical regions (Fig. 2, Table 1). The Nearctic and Oriental regions contain nearly equal numbers of species, whereas the Palearctic and Australasian regions have much less diversity.

Phylogeny and historical processes

Phylogenetic studies concerning the Branchiura pertained to higher level relationships only. Results of several studies supported a sister group relationship between the Branchiura and the Pentastomida or the Ostracoda (discussed in Martin & Davis, 2001; Wingstrand, 1972; Lavrov et al., 2004; Regier et al., 2005 and references therein). Phylogenetic studies of the generic and specific relationships have not been attempted yet. Further detailed taxonomic study of the group will provide much of the data needed for more meaningful and complete phylogenetic analyses.

Present distribution and main areas of endemism

Biogeographic analyses of the Branchiura were made by Fryer (1969) with regard to *Dolops*, which displays a Gondwanan distribution (South America,

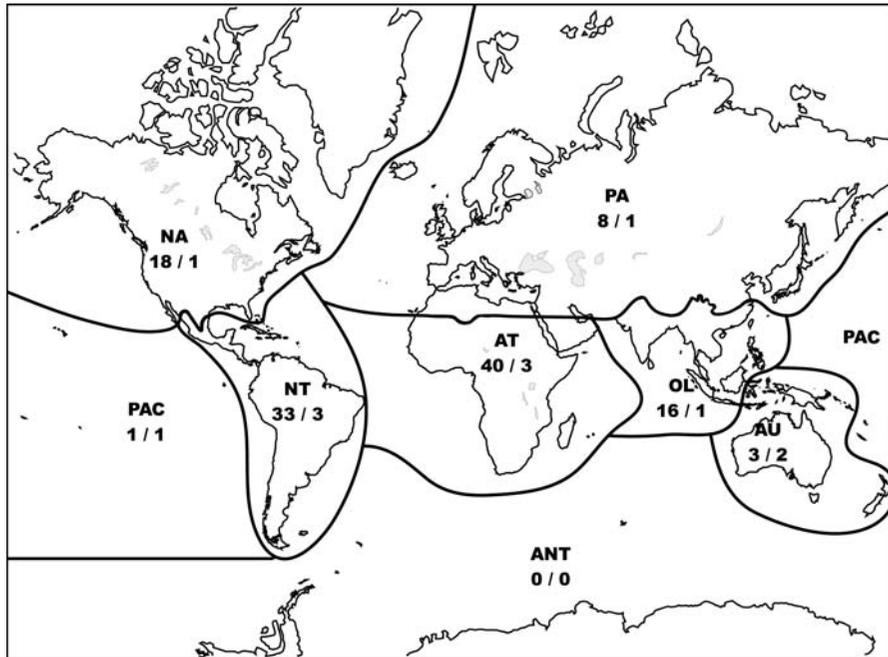


Fig. 2 Distribution of species of Branchiura occurring in freshwater habitats in each of the biogeographic regions of the world. *Argulus japonicus* was included in the number of species for all regions where it is either native (east/southeast

Asia) or introduced. PA—Palearctic, NA—Nearctic, NT—Neotropical, AT—Afrotropical, OL—Oriental, AU—Australasian, PAC—Pacific Oceanic Islands, ANT—Antarctic

Table 1 Number of species per genus of Branchiura occurring in freshwater habitats in each of the biogeographic regions of the world

	PA	NA	NT	AT	OL	AU	PAC	ANT	World
<i>Argulus</i>	8	18	21	25	16	2	1		85
<i>Chonopeltis</i>				14					14
<i>Dipteropeltis</i>			1						1
<i>Dolops</i>			11	1		1			13
Total Argulidae	8 (1)	18 (1)	33 (3)	40 (3)	16 (1)	3 (2)	1 (1)	0	113

The Japanese fishlouse, *Argulus japonicus*, was included in all regions where it is either native or introduced, but in the overall total, this species was counted only once. Hence, the total from adding all separate regions is 119, minus 6 occurrences of *A. japonicus* equals 113. Number of genera per region in parentheses. PA: Palearctic, NA: Nearctic, NT: Neotropical, AT: Afrotropical, OL: Oriental, AU: Australasian, PAC: Pacific Oceanic Islands, ANT: Antarctic

Africa, and Tasmania), and the biogeography of African species of *Argulus*, *Chonopeltis*, and *Dolops* was discussed by Fryer (1968). *Chonopeltis* and *Dipteropeltis* are endemic to Africa and South America, respectively. Little else has ever been published on biogeography of this group. *Argulus japonicus* Thiele, 1900 has been introduced from east/southeast Asia to all other continents, except Antarctica (Table 1). Native species do not occur

across great distances in most cases, except for some species in the Afrotropical region, such as *Dolops ranarum* (Stuhlmann, 1891) and *Argulus africanus* Thiele, 1900 (Fryer, 1968), and for *Argulus foliaceus* (Linné, 1758) in the Palearctic region. Definitive discussions about species' distributions cannot be made until additional species are described and further collecting and taxonomic study reveal true diversity more accurately.

Human related issues

Branchiurans occasionally attain high densities on their hosts, resulting in fish kills in natural bodies of water (rarely; usually lentic waters) or fish hatchery/aquaculture operations (more commonly). Fishlice also appear at times in large public aquaria, home aquaria, or small outdoor ponds and can contribute to mortality of ornamental fishes.

Acknowledgments The author expresses much appreciation to the organizers of the meeting on Freshwater Animal Diversity Assessment held in Mechelen, Belgium for their careful planning, logistical support, and financial assistance, resulting in an immensely productive and enjoyable session, and for all their efforts to assemble this volume. The author also thanks Geoff Boxshall and an anonymous reviewer for their comments on the manuscript.

References

- Calman, W. T., 1912. On *Dipteropeltis*, a new genus of the crustacean order Branchiura. Proceedings of the Zoological Society of London 74: 763–766, 1 pl.
- Carvalho, J. de P., 1941. Sobre *Dipteropeltis hirundo* Calman, Crustáceo (Branchiura) parasito de peixes d'água doce. Boletins da Faculdade de Filosofia, Ciências e Letras (Universidade de São Paulo, Brasil) 22 (Zoologia no. 5): 265–277.
- Clark, F. N., 1902. *Argulus foliaceus*. A contribution to the life history. South London Entomological & Natural History Society (for 1902) 12–21, 2 pls.
- Cressey, R. F., 1978. Marine flora and fauna of the northeastern United States. Crustacea: Branchiura. NOAA Technical Report Circular 413: 1–10.
- Fryer, G., 1958. Occurrence of spermatophores in the genus *Dolops* (Crustacea: Branchiura). Nature 181: 1011–1012.
- Fryer, G., 1960. The spermatophores of *Dolops ranarum* (Crustacea, Branchiura): their structure, formation, and transfer. Quarterly Journal of Microscopical Science 101: 407–432.
- Fryer, G., 1968. The parasitic Crustacea of African freshwater fishes; their biology and distribution. Journal of Zoology, London 156: 45–95.
- Fryer, G., 1969. A new freshwater species of the genus *Dolops* (Crustacea: Branchiura) parasitic on a galaxiid fish of Tasmania—with comments on disjunct distribution patterns in the southern hemisphere. Australian Journal of Zoology 17: 49–64.
- Jackson, C. J. & D. J. Marcogliese, 1995. An unique association between *Argulus alosae* (Branchiura) and *Mysis stenolepis* (Mysidacea). Crustaceana 68: 910–912.
- Jurine, A. [Jurine fils], 1806. Mémoire sur l'Argule foliacé (*Argulus foliaceus*). Annales du Muséum d'Histoire Naturelle (Paris) 7: 431–458, 1 pl.
- Lavrov, D. V., W. M. Brown & J. L. Boore, 2004. Phylogenetic position of the Pentastomida and (pan)crustacean relationships. Proceedings of the Royal Society of London (B) 271: 537–544.
- Loro, R., 1964. Morfologia degli stadi larvali e dell'adulto di *Argulus giordanii*. Archivio di Oceanografia e Limnologia 13: 387–418.
- Martin, J. W. & G. E. Davis, 2001. An updated classification of the Recent Crustacea. Natural History Museum of Los Angeles County, Science Series 39: 1–124.
- Meehan O. L., 1940. A review of the parasitic Crustacea of the genus *Argulus* in the collections of the United States National Museum. Proceedings of the United States National Museum 88: 459–522.
- van Niekerk, J. P. & D. J. Kok, 1989. *Chonopeltis australis* (Branchiura): structural, developmental and functional aspects of the trophic appendages. Crustaceana 57: 51–56.
- Poly, W. J., 2003. *Argulus ambystoma*, a new species parasitic on the salamander *Ambystoma dumerilii* from México (Crustacea: Branchiura: Argulidae). Ohio Journal of Science 103: 52–61.
- Poly, W. J., 2005. *Argulus yucatanus* n. sp. (Crustacea: Branchiura) parasitic on *Cichlasoma urophthalmus* from Yucatan, Mexico. Gulf and Caribbean Research 17: 1–13.
- Regier, J. C., J. W. Shultz & R. E. Kambic, 2005. Pancrustacean phylogeny: hexapods are terrestrial crustaceans and maxillopods are not monophyletic. Proceedings of the Royal Society of London (B) 272: 395–401.
- Rushton-Mellor, S. K. & G. A. Boxshall, 1994. The developmental sequence of *Argulus foliaceus* (Crustacea: Branchiura). Journal of Natural History 28: 763–785.
- Sikama, Y., 1938. On a new species of *Argulus* found in a marine fish in Japan. Journal of the Shanghai Science Institute, Section III 4: 129–134, pls. XI–XII.
- Stuhlmann, F., 1891. Zur kenntniss der fauna central-afrikanischer seen. II. ueber eine neue art der Arguliden-gattung *Gyropeltis*. Zoologische Jahrbücher. Abtheilung für systematik, geographie und biologie der Thiere 6: 152–154.
- Tokioka, T., 1936. Larval development and metamorphosis of *Argulus japonicus*. Memoirs of the College of Science, Kyoto Imperial University (Series B) 12: 93–114.
- Van As, L. L. & J. G. Van As, 1999. Aspects of the morphology and a review of the taxonomic status of three species of the genus *Chonopeltis* (Crustacea: Branchiura) from the Orange-Vaal and South West Cape river systems, South Africa. Folia Parasitologica 46: 221–228.
- Wilson, C. B., 1902. North American parasitic copepods of the family Argulidae, with a bibliography of the group and a systematic review of all known species. Proceedings of the United States National Museum 25: 635–742, 20 pls.
- Wilson, C. B., 1944. Parasitic copepods in the United States National Museum. Proceedings of the United States National Museum 94: 529–582, 15 pls.
- Wingstrand, K. G., 1972. Comparative spermatology of a pentastomid, *Raillietiella hemidactyli*, and a branchiuran crustacean, *Argulus foliaceus*, with a discussion of pentastomid relationships. Det Kongelige Danske Videnskabernes Selskab Biologiske Skrifter 19: 1–72.
- Yamaguti, S., 1963. Parasitic Copepoda and Branchiura of Fishes. Interscience Publishers, John Wiley & Sons, Inc., 1104 pp.