Lauterbornia 70: 11-17, D-86424 Dinkelscherben, 2010-12-06

The Japanese fish louse *Argulus japonicus* new for The Netherlands

D. M. Soes, P. D. Walker and D. B. Kruijt

With 5 figures and 1 table

Keywords: Argulus, Branchiura, Crustacea, The Netherlands, identification, distribution, faunistics, ecology
Schlagwörter: Argulus, Branchiura, Crustacea, Niederlande, Bestimmung, Verbreitung, Faunistik, Ökologie

To date only the common fish louse (*A. foliaceus*) had been recorded in The Netherlands. This paper presents the first findings of the Japanese fish louse (*A. japonicus*), an exotic species from East-Asia. Four locations are known, all eutrophic waters in or in close proximity of urban areas. Its identification and biology are briefly discussed.

1 Introduction

The fish lice (Argulidae) are a well known group of crustacean fish parasites. In Europe these Argulidae are relatively species-poor with only three freshwater species having been confirmed: *Argulus coregoni* (Thorell, 1864), *A. foliaceus* (Linnaeus, 1758) and *A. japonicus* Thiele, 1900 (Fryer 1982). To date only the common fish louse (*A. foliaceus*) has been recorded in The Netherlands (Van Nieukerken & Van Loon 1995). This paper presents the first findings of the Japanese fish louse (*A. japonicus*), an exotic species from East-Asia.

2 Identification

Fish lice with their dorso-ventraly flattened bodies and characteristic appendages are unmistakable. In particular, their ventral suckers are a unique, and conspicuous feature which can, in larger specimens, even been seen with the naked eye (fig. 1, 2). *A. coregoni*, a mainly boreal species not yet recorded from the Netherlands, can be recognized by its sharply pointed abdominal lobes with smooth edges, rather than rounded lobes with spinule bearing edges.

Differentiating between *A. foliaceus* and *A. japonicus* is easiest for male specimens which can be identified by the presence of a small coxal process, or clasper, located at the base of their swimming appendages. The shape of this process is quite distinct for each species making it easy to separate them (Fig. 3). Females, who lack these claspers, are much more difficult to identify and in some cases it may be impossible to determine which species a female specimen is.

Fig. 1: *Argulus japonicus.* Male, SEM-picture. Photo P.D. Walker

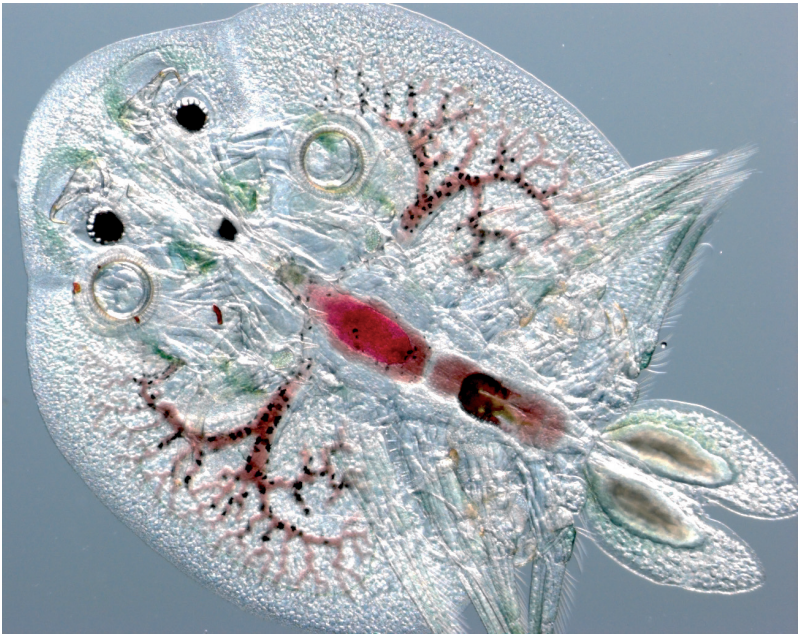

Fig. 2: *Argulus japonicus*. Male, living specimen. Photo P.D. Walker

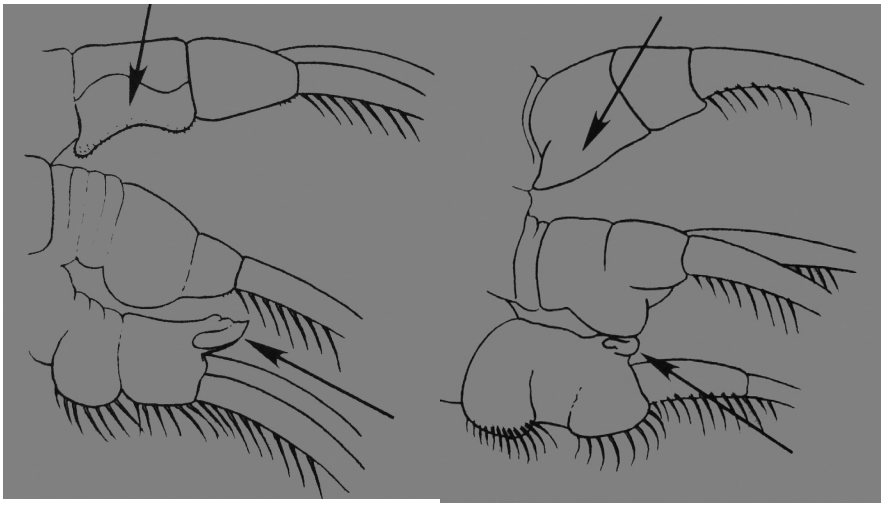

Fig. 3: The male claspers of *Argulus japonicus* (left) and *A. foliaceus* (right). Taken from Fryer (1982)

With females you must first examine the legs looking for the presence or absence of pigment. *A. japonicus* will never have this pigment and specimens with pigment can be identified as *A. foliaceus*. Specimens lacking pigment however may be either *A. japonicus* or *A. foliaceus*. Particularly in older, poorly preserved material the pigment in *A. foliaceus* might no longer be distinguishable. In these cases one needs to rely upon the shape of the abdominal lobes and the length of the carapace (see Tab. 1). These characters are quite variable however and only typical specimens with all four characters fitting one of the species descriptions should be considered as identified quite reliably. In more doubtful cases the help of an expert with knowledge of the variation in the characters might be useful, but in some cases this also may not be of help and a specimen might remain unidentified.

Tab. 1: Key features for the separation of female *A. foliaceus* and *A. japonicus*. Largely based on Fryer (1978,1982)

species	Argulus foliaceus	Argulus japonicus
leg pigment	mostly present	always absent
abdominal lobes	broadly rounded	acutely rounded
abdominal incision	less than half abdominal length	more than half abdominal length
carapace	not covering fourth pair of legs	covering fourth pair of legs

3 Distribution

A. japonicus is native to East-Asia, but is now known from every continent except Antarctica. This wide distribution is believed to have been facilitated primarily via the trade (and thus movement) of host fishes, predominately ornamental fishes such as goldfish (Carassius auratus), koi carp (*Cyprinus rubrofuscus*) and grass carp (*Ctenopharyngodon idella*) (Lester & Roubal 1995). Within Europe *A. japonicus* was first recorded in 1921 in Spain. Since then it has been found in Bosnia, Britain, France, Germany, Italy, Croatia, Poland, Serbia and Slovakia (Stammer 1959; Holdich & Pöckl 2007). It so far appears to be absent in Belgium and Fennoscandinavia.

4 Dutch records

Province of Gelderland, Nijmegen, Archipelstraat, artificial pond (Amersfoort-coordinates 187.906-427.380), 2005, leg. & det. P. Walker, voucher specimens lost
Province of Gelderland, Nijmegen, Schoutstraat, artificial pond (Amersfoort-coordinates 187.410-425.359), 2005, leg. & det. P. Walker, voucher specimens lost
Province of Zuid-Holland, Hekelingen, near pumping station Schuddebeursedijk, small channel (Amersfoort-coordinates 82.783-426.026), 14-08-2006, 1 female, leg. Bureau Waardenburg, det. D.M. Soes, P. Walker & G.B. Boxshall, col. Waterschap Hollandse Delta
Province of Zuid-Holland, Rotterdam, Oud-Mathenesse, near Hoekersingel, small channel (Amersfoort-coordinates 88.535-437.149), 23 June 2009, 1 male, leg. Bureau Waardenburg, det. D.M. Soes & D.B. Kruijt, col. Hoogheemraadschap Delfland

The first Dutch specimens were found in 2005 in two large artificial ponds in the city of Nijmegen (P. Walker pers. obs.). The first pond is bordering the Archipelstraat and is approximately 125 m long and 40 m wide (fig. 4).

Fig. 4: The pond bordering the Archipelstraat in the city of Nijmegen. Photo D. M.Soes

This eutrophic pond had virtually no vegetation probably because of the murky water and the high density of fish. The fish species found present were common carp (*Cyprinus carpio*), goldfish/Prussian carp (*Carassius* sp.), pike (*Esox lucius*) and nine-spined stickleback (*Pungitius pungitius*). The second pond near the Schoutstraat is about 100 m long and 60 m wide. A small stand of emergent macrophytes (reeds/rushes) is present on one side of the pond extending for approximately 1.5–2m into the water body from the pond margin. The pond margin is entirely surrounded by bank reinforcements. Several species of fish have been caught in this pond including common carp, tench (*Tinca tinca*), roach (*Rutilus rutilus*), gudgeon (*Gobio gobio*) and perch (*Perca fluviatilis*). In both ponds prevalence was especially high in carp with almost every specimen infected. The other species of fish were less infected. Voucher specimens of *A. japonicus* from these ponds have been lost together with the exact dates of the sampling.

A female specimen was found in 2006 in a macrozoobenthos sample from a channel near Hekelingen. This channel receives water from both urban and agricultural areas. The water is eutrophic, murky and contained no submerse vegetation. The fish fauna was a typical fauna for eutrophic channels with species such as bream (*Abramis brama*), silver bream (*Blicca bjoerkna*), common carp and pikeperch (*Sander lucioperca*) being dominant (Soes et al. 2006).

In 2009 a male specimen was also found in a macrozoobenthos sample. This time from a man-made, standing water body in a built-up area in western Rotterdam. This water body (fig. 5) is approximately 300 m long and 12 m wide, and up to 0,5 m deep. The water was eutrophic, due to the large number of ducks present, and turbid with very few macrophytes observed. No information pertaining to the fish fauna is available.

Fig. 5: *Argulus japonicus*. Location in the city of Rotterdam. Photo Bureau Waardenburg

5 Biology

A. japonicus is an obligate fish parasite, although it periodically leaves hosts for mate searching, change of host and egg laying. It feeds as an adult on the red blood cells of their hosts (Walker 2004; Walker 2008). Host specificity is low although their appears to be a preference for cyprinids such as common carp, goldfish/Prussian carp and roach, but the actual variety is much higher including species such as perch, tilapia (*Tilapia* sp.), pike and channel catfish (*Ictalurus punctatus*) (Hoffman 1999).

Reproduction in *A. japonicus* is sexual and has a high output. Copulation typically occurs on the body surface of their host, but for egg laying the females will leave the host and deposit their eggs on hard substrates. Newly hatched larvae survive for few days on the nutrition of their yolk but soon need to feed upon a host. A. japonicus produces eggs continuously, although eggs laid in winter may stay dormant until the temperature rises again in the spring (Walker 2004).

A. japonicus is more thermophilic than *A. foliaceus*. Already Stammer (1959) pointed this out on the basis of the greater abundances of *A. japonicus* in southern parts of Europe. Also experiments on the survival time of both adults and nymphs outside their hosts showed that *A. japonicus* performed better at higher temperature (Walker 2008a).

Direct impact of fish lice on healthy host fishes is in general of no great concern. High numbers of fish lice in individual fish are almost exclusively reported from fishponds (Stammer 1959). In crowded ponds, which are often also relatively warm, optimum conditions are created for fish lice. In such situations stress and secondary infections can cause significant losses (Walker 2008b). Fish lice, including *A. japonicus*, are also known to be vectors for several viral, bacterial, fungal en nematod diseases (Stammer 1959, Walker 2008b).

6 Discussion

Although the authors and several analysts working on macrozoobenthos have been looking for this species for several years it has been found on only four sites. This suggests that it is not a common species (yet).

All four sites are eutrofic waters in or in close proximity of urban areas. In these urban waters water temperature is in general higher which might favor *A. japonicus*. Another explanation for the findings in urban areas might be that the main way of colonization is the use of a vector which is more likely to be found in urban areas, like e.g. koi carp or goldfish.

Acknowledgment

We like to thank G. B. Boxshall for his help with the identification.

References

Fryer, G. (1978): Das Zooplankton der Binnengewässer Teil 2, Branchiura.- In: Elster, H.-J. & W. Ohle (eds): Die Binnengewässer 26,2: 368-374, Stuttgart

Fryer, G. (1982): The parasitic Copepoda and Branchiura of British freshwater fishes. A handbook and key.- Freshwater Biological Association Scientific Publication 46, 87 pp., Ambleside, Cumbria

Hoffman, G. L. (..): Parasites of North American freshwater fishes.- **x pp.**, (Cornell University Press) Ithaca

Holdich, D. M., & M. Pöckl (2007): Invasive crustaceans in European inland waters. In F. Gherardi, F. (ed.): Biological invaders in inland waters: profiles, distribution and threats: 29-76, (Springer) Dordrecht

Lester, R. J. G., & F. R. Roubal (1995): Phylum Arthropoda.- In: Woo PTK (ed.) Fish diseases and disorders Vol 1. Protozoan and metazoan infections: 475-598, (CAB International) Wallingford

Nieukerken, E. J. van & A. J. van Loon (1995): Biodiversiteit in Nederland.- **x pp.**, (Nationaal Natuurhistorisch Museum) Leiden

Soes, D. M., R. van Eekelen & N. van Kessel (2006): Bittervoorns in het Welvliet.- Aanvullend onderzoek. Bureau Waardenburgrapport 06-119, Culemborg

Stammer, J. (1959): Beitrage zur Morphologie, Biologie und Bekämpfung der Karpfenläuse.- Zeitschrift für Parasitenkunde 19: 135-208, Berlin

Walker, P. D., G. Flik & S. E. Wendelaar Bonga (2004): The biology of parasites from the genus Argulus and a review of the interactions with its host.- In: Wiegertje, G.s & G. Flik (eds): Host-Parasite Interactions: 107-129, (Garland/BIOS Scientific Publishers) Abingdon

Walker, P. D. (2008a): Argulus. The ecology of a fish pest.- Thesis. Radboud University Nijmegen, Nijmegen

Walker, P. D. (2008b): Freshwater lice plague carp farms.- Fish Farming International 7: 17, Belapur

Addresses of the authors:
Ir. D. M. Soes, Bureau Waardenburg P.O. Box 365, 4100 AJ Culemborg, The Netherlands & National Museum of Natural History "Naturalis", P.O. Box 9517, 2300 RA Leiden, The Netherlands & E-mail: menno.soes@gmail.com.
Dr. P. D. Walker, APEM Ltd, Centre for Innovation & Enterprise, Oxford University Begbroke Science Park, Sandy Lane, Yarnton, Oxfordshire, OX5 1PF, UK. E-mail: p.walker@apemltd.co.uk
Drs. D. B. Kruijt Bureau Waardenburg P.O. Box 365, 4100 AJ Culemborg, The Netherlands. 4100 AJ Culemborg. E-mail: d.b.kruijt@buwa.nl

Received: 2010-07-24
Accepted: 2010-07-30