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IDENTIFICATION, INVASION AND POPULATION DEVELOPMENT OF THE PONTO-CASPIAN ISOPOD *JAERA ISTRI* VEUILLE (JANIRIDAE) IN THE LOWER RHINE, THE NETHERLANDS

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ABSTRACT

The Ponto-Caspian isopod, *Jaera istri* Veuille, 1979, an endemic species of the river Danube, invaded the lower river Rhine in 1997. This paper provides notes on its identification and first records in the lower Rhine, and documents its subsequent population development.

INTRODUCTION

In line with the lower Rhine's ecological recovery, its present physico-chemical characteristics and its largely increased degree of connectivity with other European river systems, like the Meuse, Rhône and Danube, has led to a high colonisation rate by invasive macroinvertebrates in recent decades. Ponto-Caspian species have been the most rapid and frequent colonisers of the system. In 1987, the tubiculous corophiid, *Corophium curvispinum* Sars invaded and has since had a great effect on the functioning of the ecosystem (Van der Velde et al., 1998). This species has since been joined by other Ponto-Caspian amphipods such as *Echinogammarus ischnus* (Stebbing) in 1991 (Van den Brink et al., 1993) and *Dikerogammarus villosus* Sowinsky in 1994 (Bij de Vaate & Klink, 1995). As indicated above, the river Danube is an increasingly important source from which exotic species have extended their range into Northwest Europe. For example, the polychaete *Hypania invalida* (Grube) (Klink & Bij de Vaate, 1996) and the mysids *Limnomysis benedeni* Cznerniavsky 1882 (Kelleher et al., 1999) and *Hemimysis anomala* Sars (Ketelaars et al., 1999) have all arrived in the lower Rhine since 1995 following the invasion of the upper and middle Rhine by populations probably originating from the Danube system via the Main-Danube canal (Van der Velde et al., 2000).

This paper deals with an endemic member of the Danube fauna, *Jaera istri* Veuille, 1979 which has recently been found in the Dutch part of the

Table 1. The average densities (± s.d.) per m^2 of *J. istri* in artificial substrate trays at Lobith between April and October from 1997 to 1999. Two trays were sampled on each date. S.d.'s are not shown for 1999 as values are derived from the total of two trays. * Indicates no sampling.

	1997	1998	1999
April	0.0	5.1 (0.8)	23.4
May	0.2 (0.1)	47.6 (0.5)	112.1
June	0.4 (0.1)	83.1 (2.8)	96.5
July	0.9 (0.5)	116.0 (36.0)	71.0
August	2.1 (0.3)	98.6 (18.0)	127.6
September	7.7 (0.3)	*	129.1
October	5.0 (1.0)	*	169.0

lower Rhine. Unlike the other two Ponto-Caspian species of *Jaera*, *J. sarsi* Valkanov 1938 and *J. caspica* Kesselyak 1938, *J. istri* is well adapted to freshwater, while the others occur only in brackish water (Nesemann et al., 1995). *J. istri* is a typical riverine species that feeds on algae and detritus (Schmidt et al., 1998). It is lithophilous and, like most of the *Jaera* genus, is well adapted to high stream velocities and wave action. Following the opening of the Main-Danube canal, *J. istri* was first found in the river Main, a tributary of the Rhine, in 1994 and had become well established along the entire length of the river by 1996 (Schleuter & Schleuter, 1995; Schmidt et al., 1998). It entered the main channel of the Rhine in 1995 (Tittizer, 1996). In 1999, it was recorded from the river Elbe in northern Germany (Schöll & Hardt, 2000).

Records and population development

The first record of *J. istri* in the Dutch part of the lower Rhine was in May 1997 in standardised artificial substrate trays at Lobith (river km 861) (see De Pauw et al., 1994 for methods). Over the remainder of the year, the numbers of *J. istri* ranged from 1 individual per tray in April/May to a peak of 55 per tray in August/September (Table 1). In August 1997 during routine sampling of groynes near Ewijk (river km 891) on the lower Rhine's main branch, the river Waal, *J. istri* was found at average densities of 3 individuals per m^2. This site had also been sampled earlier in June and July but no specimens were collected in these months. In December 1997, samples of gravel substrates along the main channel's littoral zone were collected close to the Bizonbaai (river km 879) near Nijmegen. The average densities of *J. istri* measured were 25 individuals per m^2. Also collected were *D. villosus*, *C. curvispinum*, *E. ischnus* and *Hydropsyche contubernalis* MacLachlan.

In April 1998, stones at breakwaters at Ewijk (river km 891) were again sampled. The average densities of *J. istri* were dramatically higher than in 1997, (629 per m^2) and densities increased steadily thereafter (Fig. 1). The highest average density recorded until now is 2814 per m^2 on stones sampled in June 1998, although the highest maximum density of 5110 per m^2 was recorded in August 1998. As was also described by Pöckl (1988), *J. istri* was frequently seen to be distributed on the stones in tightly packed groups. Its abundance on all sides of a stone, either sheltered or unsheltered is fairly similar, in contrast to species like *E. ischnus*, *D. villosus* and *Bithynia tentaculata* (L.) which are found mainly on more sheltered areas and crevices of stones.

J. istri has also been recorded further downstream along the river Waal. In March 1998, 28 specimens were found on a piece of rope taken from a breakwater near the Nieuwe Merwede canal, on the northern side of the Biesbosch (52°00'N 05°06'E). In the river foreland, 'Gamerense Waard' between river km's 937 - 939 (51°49'N 05°12'E), 44 specimens were sampled from stones and woody debris taken from its westerly channel in April 1998. At Opijnen (51°49'N 05°19'E), a side arm of the Waal between river km's 929 - 931, 30 specimens were sampled in June 1998 and 17 were found in September of the same year. Van Beek & Munts (1998) also recorded *J. istri* in the littoral zone of the Waal in 1998 at densities ranging from 9 to 26 m^2 (mean

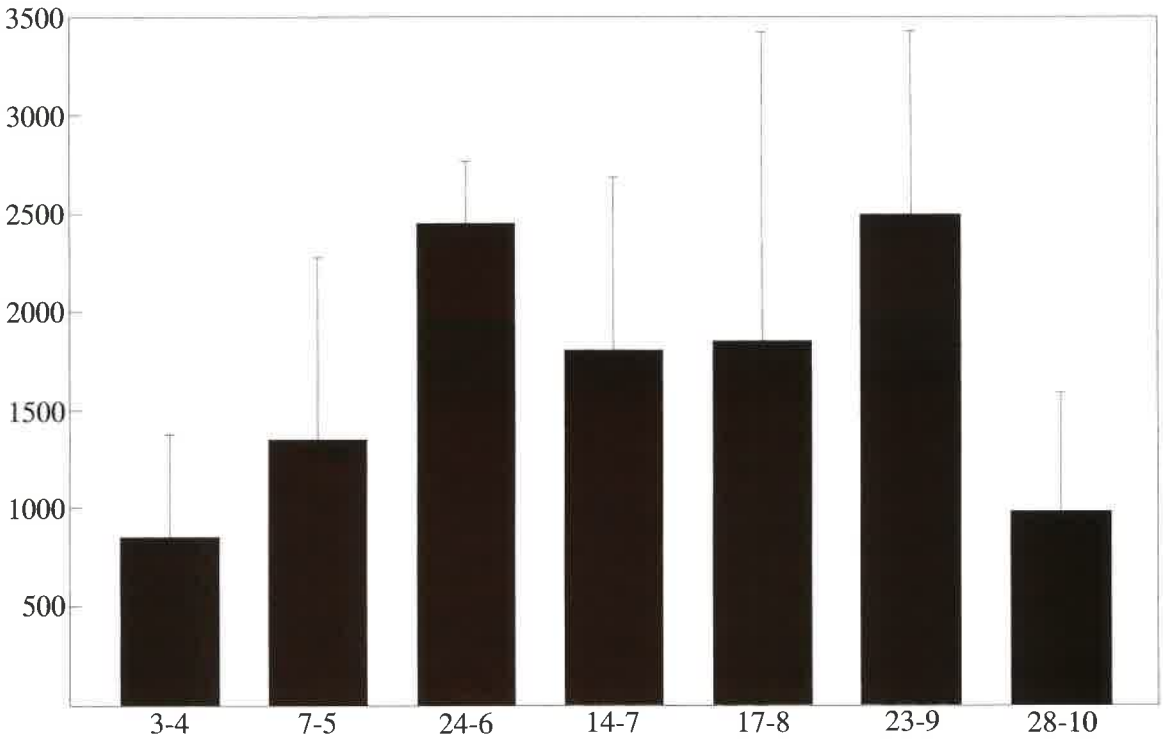

Fig. 1. Average densities per m^2 (± s.d.) of *Jaera istri* on stones (n = 6 per month) of groynes in the lower Rhine between April and October 1998.

18 m^2) on 4 out of 6 breakwaters sampled in May, but observed none at a later date in August. In the summer bed of the river, Munts & Van Beek (1998) found *J. istri* in greater densities (mean 27, max. 61, min. 7), but was found in only 8% of the total number of samples taken. These densities were similar to those of other crustaceans like Gammaridae and Corophiidae in the sands of the summer bed, but the comparatively more patchy distribution of *J. istri* can be explained by its lithophilous habit, lack of mobility and the great degree of disturbance experienced the river bed due to high water velocities and turbulence caused by shipping which act to constantly shift and disturb the river's sands. These factors probably hinder the ability of *J. istri* to colonise the river bed from the littoral zone on a large scale compared to the more mobile Crustacea. Munts and Van Beek (1998) suggest that *J. istri*, as has been observed with other exotes, will expand its distribution to the river Maas via the connection at the Maas-Waal canal (river km 887). However, given the slow flowing nature of the Maas, *J. istri* may be unable to colonise this river. Its preference for high stream velocities is indicated by its absence from the Main-Danube canal, which also infers that it reached the river Rhine via vessels.

It has been found in other channels of the Rhine delta. Stones in the river IJssel were sampled at various localities in September of 1997 and 1998. Average densities per m^2 (± s.d.) in Velp (river km 886) were 45 (± 69) in 1997 and 40 (± 18) in 1998. At De Steeg (river km 890), average densities of 3 (± 4) in 1997, rose to 154 (± 200) in 1998. Two other sites at Olst (river km 957) and Wijhe (river km 966) were also sampled, but no specimens were found in either year.

Diagnostic features

The Ponto-Caspian *Jaera* group differ from the other groups of *Jaera* in the absence of secondary sexual dimorphism, although Veuille (1979) does mention large males of *J. istri* having short straight spines on the anterior side of the pereopods. Their probable function is to grasp the

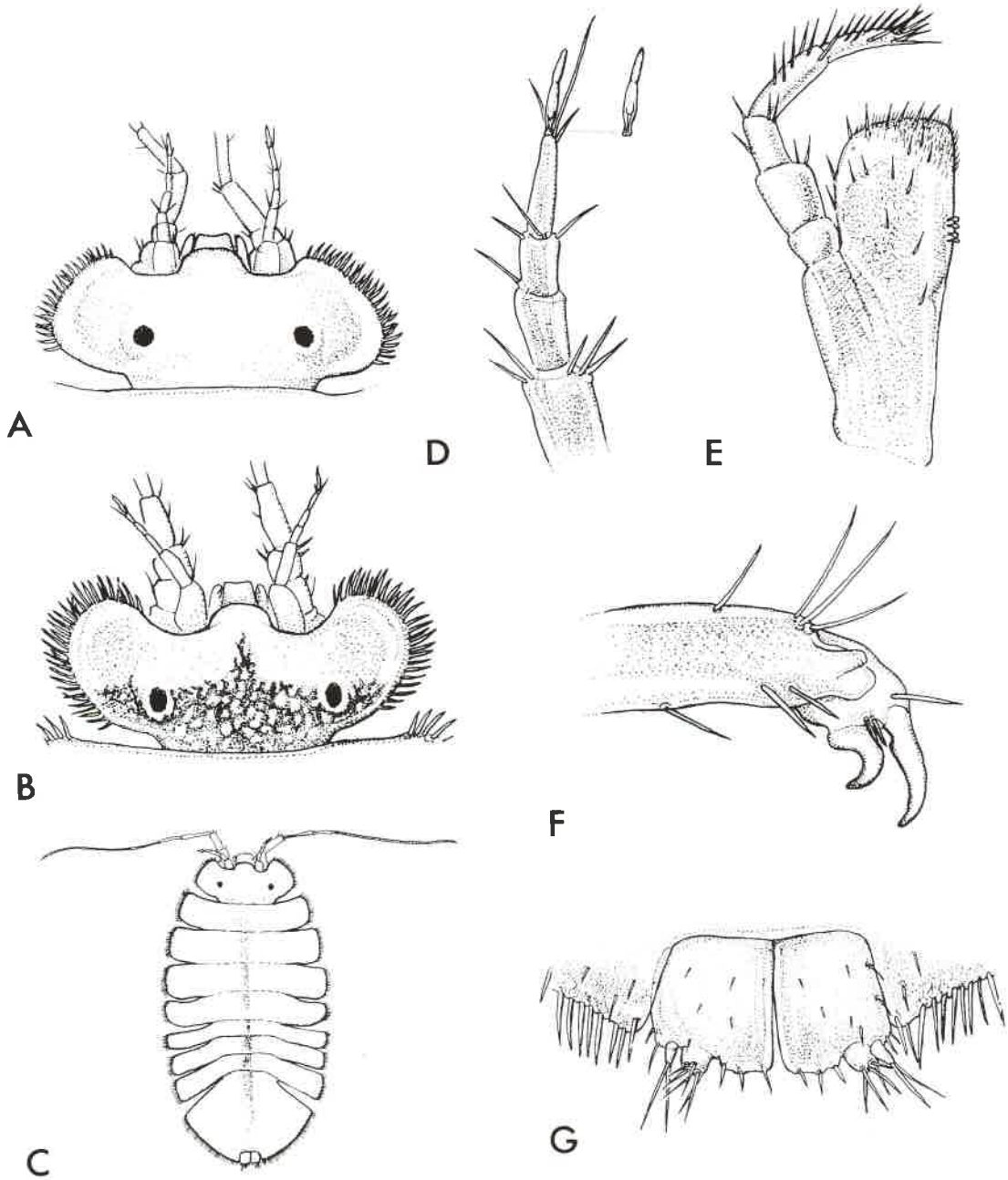

Fig. 2. Body features of *Jaera istri*. Specimens collected at the river Waal near Nijmegen, 7-V-1998. A, head ♀. B, head of darkly pigmented ♂. C, habitus ♀. D, antennula. E, maxillipes without epipodite. F, tip of pereopod 6 of ♀. Dactylus has two claws, as in *J. sarsi*. G, posterior of pleotelson showing uropods.

female during copulation, which occurs in a head-to-tail position. The respiratory chamber is cordiform in the Ponto-Caspian *Jaera* group, and especially so in *J. istri*.

A complete overview of the *Jaera* genus is provided by Veuille (1979), but Figs. 2 and 3 illustrate some body features of *J. istri*. The most reliable diagnostic features are:

- The pleotelson is short and oval in shape (Fig. 2C). There is a small difference regarding this

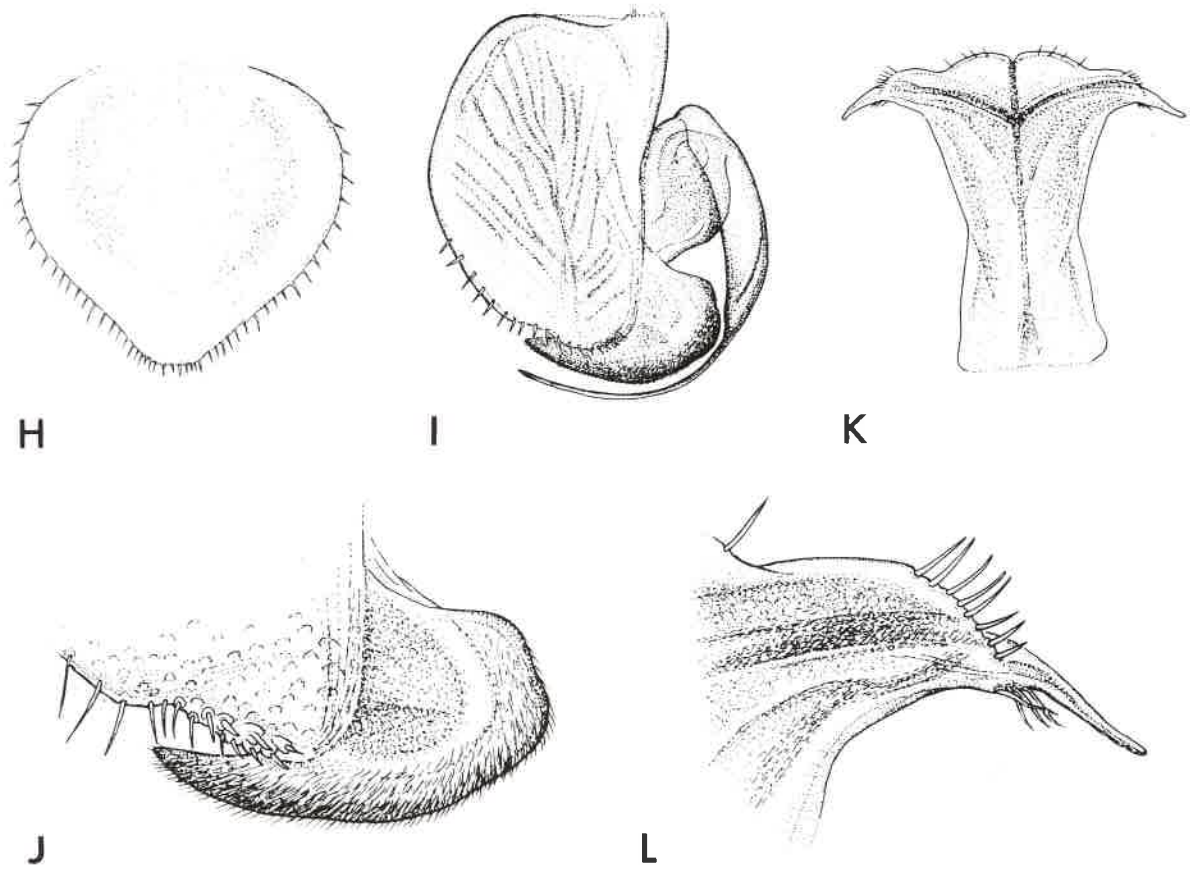

Fig. 3. Same as fig. 2. H, operculum of ♀. I, pleopod 2 of ♂, exopodite on left, endopodite on right. J, tip of endopodite of pleopod 2 ♂. K, pleopod 1 (preoperculum) of ♂. L, process at tip of pleopod 1 of ♂.

between male and female.

- A proximal appendage is present on the endopodite of pleopod 2, which possesses a spine that extends from the distal origin of the keel and covers precisely the entire length of the endopodite (Fig. 3I & J).
- The processes of the preopercule are rather short and extend perpendicularly from the body axis (Fig. 3K).

CONCLUSIONS

Since its invasion, *J. istri* has rapidly become a dominant member of the lower Rhine's fauna. Given the eutrophic nature of the Rhine, its large load of suspended matter, high stream velocities and the availability of suitable habitat, *J. istri* is likely to remain greatly abundant in the river's littoral zone. With this in mind, more investigations are needed to gain information on its little known life history, trophic role and its interactions with other Rhine fauna.

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