BULLETIN
ZOÖLOGISCH MUSEUM

UNIVERSITEIT VAN AMSTERDAM

Vol. 11 No. 24 1989

THE POSITION OF TWO INTRODUCED AMPHIPOD CRUSTACEANS, *GAMMARUS TIGRINUS* and *CRANGONYX PSEUDOGRACILIS* IN THE NETHERLANDS DURING THE PERIOD 1987-1988.

Dirk **PLATVOET**, Maarten **SCHEEPMAKER** & Sjouk **PINKSTER**

SUMMARY

During two and a half decades periodic survey programs have been carried out to follow the dispersal of *Gammarus tigrinus*. Since the last survey in the period 1985-1986 the species consolidated its position and showed a minor range extension in the southeastern part of the country. *Gammarus* specimens from the island Terschelling were electrophoretically investigated and compared with known *G.tigrinus* and *G.zaddachi* from the mainland. These experiments demonstrated the presence of *G.tigrinus* on this island.

Crangonyx pseudogracilis which showed some range extension in the 1985-1986-survey, again was found outside its hitherto known distribution area.

INTRODUCTION

Apart from one study by Bulnheim (1985), all studies on the distribution of *Gammarus tigrinus* Sexton, 1939, in the Netherlands were focussed on ecology and population dynamics of the species, and identifications were based on morphology only. Hautus & Pinkster (1987) summerized and discussed the research so far done. When the species was found on the Frisian islands of Texel, Terschelling, and Ameland doubt arose about its identity. To solve this problem starch gel enzyme-electrophoresis was used in order to make a clear distinction between the local species, *Gammarus zaddachi* Sexton, 1912, *Gammarus duebeni* Liljeborg, 1852, and the alien *Gammarus tigrinus.*

To monitor the range extension of the species 156 samples were taken with emphasis on localities at the periphery of its hitherto known distribution area (fig. 1).

Crangonyx pseudogracilis Bousfield, 1958, continued its spreading throughout the province of Groningen in the north of the country.

THE PRESENT POSITION OF *GAMMARUS TIGRINUS*

In the river Meuse the species was taken as far upstream as Roermond.

In the Zuid Willemsvaart the species was found as far north as Helmond.

A positive sample was taken in the Noordoostpolder. No new data are available from the provinces of Zuid-Holland and Zeeland, as well as the western part of Noord-Brabant, the island of Texel and the Frisian islands of Ameland and Schiermonnikoog.

In all other formerly inhabited areas the species consolidated its position (see Discussion).

THE PRESENCE OF *GAMMARUS TIGRINUS* ON THE ISLAND OF TERSCHELLING

Uncertainty about the identity of several specimens from inland waters of Terschelling made it necessary to look for other than morphological characters. Especially the smaller specimens of *G. zaddachi* are hard to discriminate from *G. tigrinus*. For this reason samples of two localities (Plas Hee en Seerijp) were electrophoretically compared with one sample of *G. tigrinus* (Veluwe Meer) and one sample of *G. zaddachi* (Petten). This resulted in a clear distiction between the three species (see table 1) for seven out of twelve enzymes used in this study. In Plas Hee solely *G. tigrinus* was found, in Seerijp the species was accompanied by *G. duebeni*.

Electrophoresis

Genetic variation was examined at 12 presumed enzyme loci. Electrophoresis and staining procedures were identical to those of Scheepmaker et al. (1988). The following enzyme systems were assayed: ALP - Alkaline posphatase. E.C. No. 3.1.3.1; APK - Argininephosphate kinase, E.C. No. 2.7.3.3; GOT - Glutamic oxaloacetic transaminase, E.C. No. 2.6.1.1; GPI - Glucose phosphate isomerase, E.C. No. 5.3.1.11; MDH - Malate dehydrogenase, E.C. No. 1.1.1.37; ME - Malic enzyme, E.C. No. 1.1.1.40; MPI, Mannosephosphate isomerase, E.C. No. 5.3.1.8; PEP - Peptidase, E.C. No. 3.4.11/13; 6PGD - 6 Phosphogluconate dehydrogenase, E.C. No. 1.1.1.44; PK - Pyruvate kinase, E.C. No. 2.7.1.40.

Genetic interpretation was inferential. Electromorph frequencies and relative mobilities of the loci coding for the above enzymes are given in table I. Number of loci and subunit structures resolved are the same as in Scheepmaker et al. (1988).

THE PRESENT POSITION OF *CRANGONYX PSEUDOGRACILIS*

Three new localities were found for this species: Jonkersvaart near De Wilp, Leeksterhoofddiep near Leek, Slochterdiep near Eemskanaal (fig. 2). At all formerly inhabited localities the species consolidated its presence.

DISCUSSION

With the occurrence of *Gammarus tigrinus* in the large rivers and canals in the south of the Netherlands as well as on the Frisian islands, the species probably has reached the limits of its range extension. A complex of factors such as water-composition, nutrition, competition, pollution and climate may induce future changes in distribution.

The reappearence of the species in the river Meuse after a period of absence (probably due to the severe winter of 1985), possibly indicates a "distribution limit". Lowering of the number of specimens in the Tjeukemeer over a 15-year period, most likely a result of further eutrophication (Chambers, 1987), may also indicate such a "limit".

Slow range extension might take place in the southern and eastern part of the province of Noord-Brabant when progress is made in solving the immense pollution problem caused by bio-industries and others.

As predicted by Platvoet & Pinkster (1985) *Crangonyx pseudogracilis* slowly continues its progress in southern direction. It will be a matter of time before the species will be found in other parts of the country, since it established itself as a stable faunal element.

The results of the biochemical study clearly show that this technique gives valuable additional information in cases of uncertainty. Since taxonomy in many groups is based on morphological characters such as setation, size ratio of appendages etc., and since Pinkster (1988) gave examples of confusion within another genus (*Echinogammarus*), the use of techniques like electrophoresis, ultramicroscopy etc. is likely to become indispensable in these studies.

ACKNOWLEDGEMENTS

The authors are indebted to the Beyerinck-Popping

Fonds of the Royal Academy of Sciences, Amsterdam, for their financial support.

REFERENCES

BULNHEIM, H.P., 1985. Genetic differentiation between natural populations of Gammarus tigrinus (Crustacea, Amphipoda) with reference to its range extension in European continental waters. Arch. Hydrobiol., 102: 273-290.

CHAMBERS, M.R., 1987. The status of the alien amphipod Gammarus tigrinus Sexton in Friesland twenty-five years after its introduction into the Netherlands.- Bull. zool. Mus. Amsterdam, 11(7): 65-68.

HAUTUS, T., & S. PINKSTER, 1987. Range extension in the period 1985-1986 of the alien amphipods, Gammarus tigrinus, 1939, and Crangonyx pseudogracilis Bousfield, 1958, in the Netherlands (Crustacea, Amphipoda).- Bull.zool. Mus.Univ. Amsterdam, 11(6): 57-64.

PINKSTER, S., 1988. Problems in the taxonomy of the freshwater gammarids with special emphasis on the genus Echinogammarus in Italy.- Crustaceana, Suppl. 13: 245-255.

PLATVOET, D., & S. PINKSTER, 1985. The present position of the alien amphipods Gammarus tigrinus and Crangonyx pseudogracilis in the Netherlands (Crustacea, Amphipoda).- Bull. zool. Mus. Univ. Amsterdam, 10 (16): 125-128

SCHEEPMAKER, M., F.van der MEER & S. PINKSTER, 1988. Genetic differentiation of the Iberian amphipods Gammarus ibericus Margalef, 1951 and G. gauthieri S. Karaman, 1935, with reference to some related species in France. Bijdr. Dierk., 58(2): 205-226.

Table I

Electromorph frequency distribution at 12 enzyme loci of four populations of *Gammarus* (Seerijp and Plas Hee from the island Terschelling; Petten and Veluwemeer from the mainland). N = sample size; a = fastest moving electromorph. Dominant electromorph in bold-face.

		Seerijp/tigr	Veluwe/tigr	Hee/tigr	Petten/zadd	Seerijp/dueb
Apk	(N)	7	10	10	10	3
	a	**1.00**	**1.00**	**1.00**	0.00	0.00
	b	0.00	0.00	0.00	**1.00**	0.00
	c	0.00	0.00	0.00	0.00	**1.00**
Alp-1	(N)	-	1	10	10	-
	a	-	**1.00**	**1.00**	0.00	-
	b	-	0.00	0.00	**1.00**	-
Gpi	(N)	6	10	10	10	3
	a	**1.00**	0.95	**1.00**	0.50	0.00
	b	0.00	0.05	0.00	0.50	**1.00**
	c	0.00	0.00	0.00	0.00	0.00
Got-1	(N)	7	10	10	10	3
	a	0.93	**1.00**	**1.00**	0.00	0.00
	b	0.00	0.00	0.00	**1.00**	0.00
	c	0.07	0.00	0.00	0.00	0.00
	d	0.00	0.00	0.00	0.00	**1.00**
Got-2	(N)	7	10	10	10	3
	a	0.00	0.00	0.00	0.00	**1.00**
	b	**1.00**	**1.00**	**1.00**	**1.00**	0.00
Mdh-1	(N)	7	10	6	10	3
	a	0.00	0.00	0.00	0.65	**1.00**
	b	**1.00**	**1.00**	0.00	0.35	0.00
	c	0.00	0.00	**1.00**	0.00	0.00

		Seerijp/tigr	Veluwe/tigr	Hee/tigr	Petten/zadd	Seerijp/dueb
Mdh-2	(N)	7	10	1	10	3
	a	0.00	0.00	0.00	**1.00**	0.00
	b	**1.00**	**1.00**	**1.00**	0.00	0.00
	c	0.00	0.00	0.00	0.00	**1.00**
Me	(N)	7	10	10	10	3
	a	0.00	0.00	0.00	**1.00**	0.00
	b	**1.00**	**1.00**	**1.00**	0.00	**1.00**
Mpi	(N)	6	10	10	10	3
	a	0.00	0.00	0.00	0.00	**1.00**
	b	0.00	0.00	0.00	0.50	0.00
	c	0.25	0.05	0.00	0.50	0.00
	d	0.50	0.90	0.80	0.00	0.00
	e	0.08	0.00	0.05	0.00	0.00
	f	0.16	0.00	0.10	0.00	0.00
	g	0.00	0.05	0.05	0.00	0.00
Pep-2	(N)	5	9	9	10	3
	a	0.00	0.00	0.00	**1.00**	0.00
	b	0.00	0.00	0.00	0.00	**1.00**
	c	0.20	0.67	0.67	0.00	0.00
	d	0.80	0.33	0.33	0.00	0.00
Pep-4	(N)	7	10	10	10	3
	a	0.00	0.00	0.00	0.50	**1.00**
	b	**1.00**	**1.00**	**1.00**	0.50	0.00
6Pgd	(N)	7	10	10	10	3
	a	**1.00**	**1.00**	**1.00**	0.00	0.00
	b	0.00	0.00	0.00	**1.00**	**1.00**

D. Platvoet,
M. Scheepmaker,
S. Pinkster,
Instiuut voor Taxonomische Zoölogie,
(Zoölogisch Museum)
P.O. Box 4677,
1009 AT Amsterdam,
The Netherlands

Received: 9 February 1989
Distributed: 31 - III - 1989

**This periodical is regularly published by the Institute of Taxonomic Zoology (Zoölogisch Museum), of the University of Amsterdam. Requests for exchange or sale of this publication may be addressed to the Administration.
This periodical may be quoted in abbreviation as Bull. zool. Mus. Univ. Amsterdam.
ISSN 0165 - 9464**

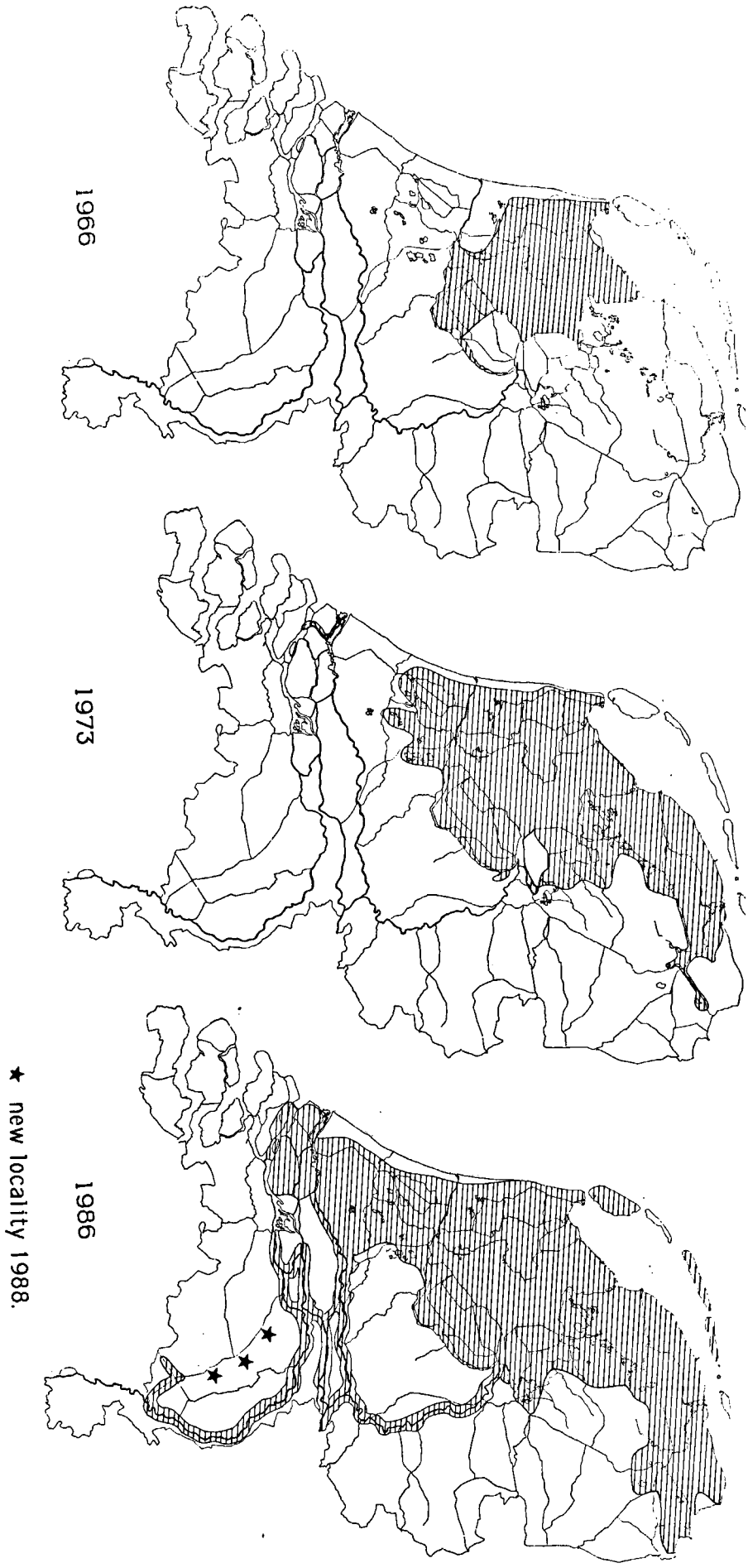

Fig. 1. Range extension of *Gammarus tigrinus* Sexton, 1939, in the period 1966-1988.

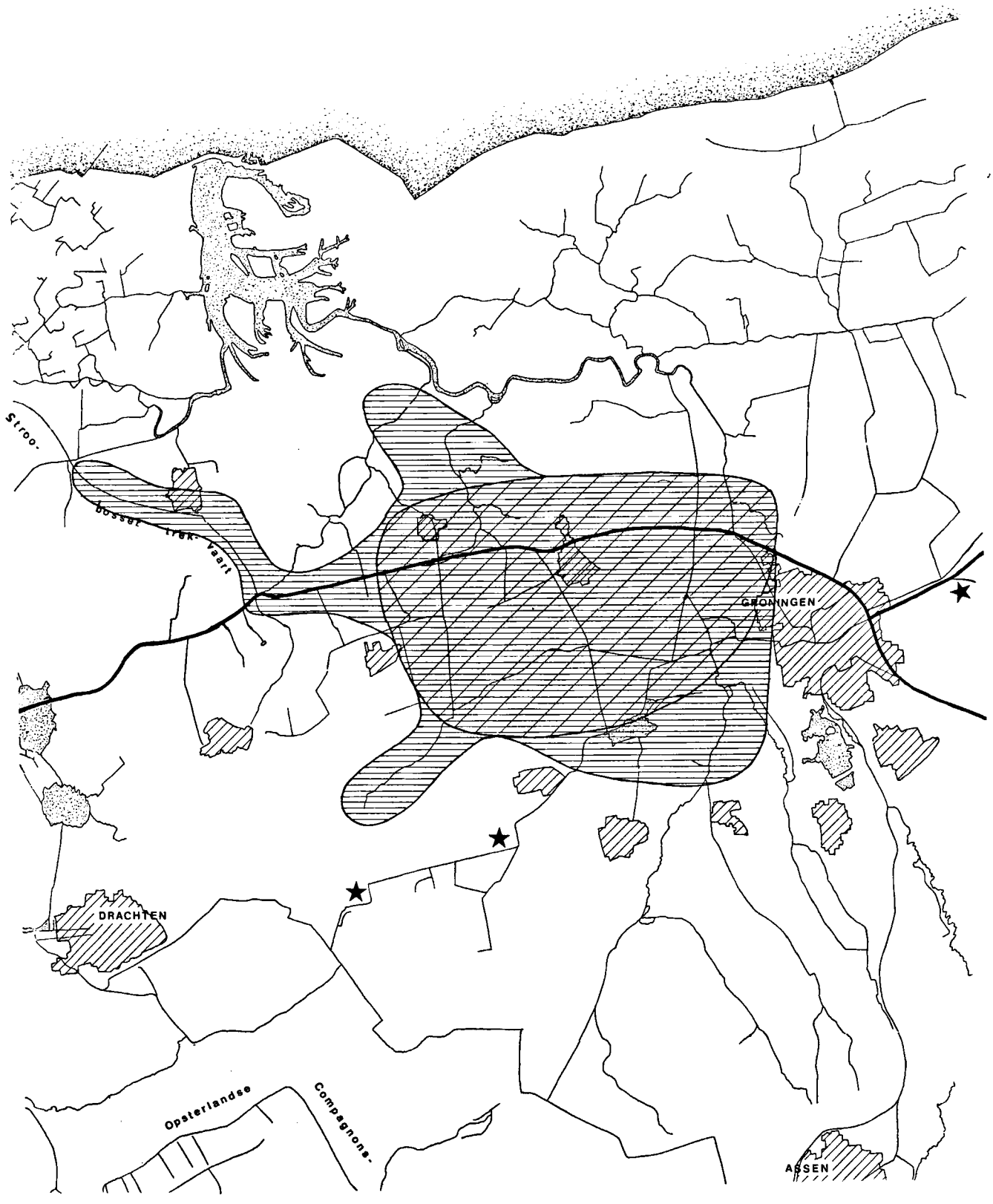

Fig. 2. Range extension of *Crangonyx pseudogracilis* Bousfield, 1958, in the period 1984-1988.