THE DISTRIBUTION OF THE CRAYFISHES *ORCONECTES LIMOSUS* (RAFINESQUE) AND *ASTACUS ASTACUS* (L.) (CRUSTACEA, DECAPODA) IN THE NETHERLANDS

by

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With 3 text-figures, 2 tables and 2 plates

INTRODUCTION

According to Holthuis (1950a) the family Astacidae is represented in the Netherlands only by one species, *Astacus astacus* (L., 1758). Apart from a detailed description of the external anatomy, he gave the following data.

The average size of the adults amounts to 80 mm, however, the maximum size sometimes reaches up to 250 mm; the colour is brown-green or olive-green. *Astacus* lives in running as well as in stagnant water with good shelter. The food consists of Mollusca, Crustacea, worms, insect larvae, tadpoles and sometimes of vegetable matter or dead organisms. Fertilization takes place between medio October and the end of November; the female carries her eggs from November up to June or July.

Holthuis (1950a) recorded 38 localities, situated all in the southern and eastern part of the country, where *Astacus* has been found during the period from 1660 to 1947. In his opinion *Astacus astacus* was formerly rather to very common, but as a result of the pollution of brooks and perhaps also of the crayfish-pest, it has disappeared in many places. However, Holthuis (1950b) got the impression that the population of *Astacus* was improving again in the Netherlands as well as in Belgium and France.

Mohren (1970) reported that he had observed in the Julianakanaal (province of Limburg, Netherlands; see fig. 2) thousands of crayfishes when the water level was lowered for repairs of sheet-pilings. At Urmond on the Julianakanaal these animals were sucked in by a pump for industrial cooling water of "De Staats Mijnen" (D.S.M. = The Netherlands National Mining Company).

At the end of 1972 Mr. F. van Herp and I discovered that these crayfishes did not belong to the native crayfish *Astacus astacus*, but to the American crayfish *Orconectes limosus* (Rafinesque, 1817) (synonym *Cambarus affinis* (Say, 1817)). This identification was confirmed by Dr. L. B. Holthuis, Leiden (Geelen & Oomen, 1973; Geelen, 1975).

From Feburary 1973 until January 1975 6 students were engaged in the study of the distribution of this second species as well as the distribution of *Astacus* in the Netherlands. The aim of this study was: (1) to check the distribution of crayfishes in the Netherlands, especially that of *Orconectes limosus*; (2) to examine the ecology of *Orconectes limosus* compared with that of *Astacus astacus*; (3) to establish the origin of the Dutch *Orconectes limosus* population.

Methods

The following methods were employed to obtain the desired data:

1. Assembling references concerning data on the biology, distribution and extension of *Orconectes limosus* mainly in Germany, Belgium and France.

2. Obtaining information on the occurrence of crayfishes by questioning people and by means of calls for information via the press.

3. Continuous sampling at the suction pump for cooling water of the D.S.M. at Urmond, to obtain data on population structure (e.g., sex-ratio, age, size, etc.).

The area of study was restricted to the southern and eastern part of the Netherlands. The main work was done in the river Maas (Meuse), the Julianakanaal and some gravel-pits and adjacent waters in the province of Limburg in 1973 (Van der Putten & Lebbink, 1973).

In 1974 special attention was paid to the rivers Linge and Dommel (Janssen & Van Maris, 1974) and to the river Vecht (Driever & Hendriks, 1975).

Description of Orconectes limosus compared with Astacus astacus

According to Bott (1950) the main differences between the two species (see pls. 1 and 2) can be described as follows:

Astacus astacus (L.)	*Orconectes limosus* (Rafinesque)
colour: olive-green to brown without dark spots on the abdominal segments	darkbrown to olive-green with dark red spots on the dorsal side of each abdominal segment
stature: stout, area of gill chamber broadened	slender, area of gill chamber narrow
chelipeds: long, inner edges of dactylus and propodus verrucose, carpus with a small spine	short, inner edges of dactylus and propodus smooth, carpus with a larger spine
rostrum: broad with an indistinct median carina	with distinct margins, no median carina
carapace: with anterior and posterior postorbital ridges, the sides covered with small tubercles of which 1 or 2	with 1 postorbital ridge, the sides with a group of spines in front of the cervical groove

just behind the cervical groove form sharp spines	
ischium of third pereiopod in ♂ : without a basal hook	with a basal hook used during copulation
annulus ventralis of ♀ absent	annulus ventralis of ♀ (= seminal receptacle) present, a grooved, elliptical, calcified area in the midline between the fourth and fifth pereiopods
first pleopods ♂ : simply rolled at tips	bifid, short, straight and divergent
first pleopods ♀ : absent	present
branchial formula: 17+ep.	18+ep.

Generally *Orconectes* is much smaller than *Astacus*. The length of the specimens of the population of *Orconectes* caught at Urmond (DSM) averaged about 80 mm. The tallest specimen caught at Borgharen was a female of 134 mm (Van der Putten & Lebbink, 1973). According to Hofmann (1971) males of *Orconectes* very seldom attain a length of 120 mm, whereas females only reach a length of 100 mm. The length of *Astacus astacus* amounts in its first year to 40-50 mm, in its second year to 80-90 mm, and in its third year to 100-110 mm. The males of *Astacus* grow faster than the females, and reach a length of 100 to 120 mm in 3 to 4 years. The maximum length of a male *Astacus* is about 150 mm and that of a female about 130 mm.

Results

I. The distribution of *Astacus astacus* in the Netherlands. — Thanks to the activity of Dr. Holthuis and myself a large number of localities of *Astacus* in the Netherlands is known (Holthuis 1950a, 1950b, 1951a, 1951b, 1952). The data are divided into 3 groups, namely references from before 1950, those from 1950-1970 and those from 1971-1975, i.e. own observations (see table I and fig. 1). The group of data from before 1950 consists of 66 localities of which 14 from before 1900, 25 from 1900-1930 and 29 from 1931-1950. In the second group from 1950-1970 35 localities are known, of which 32 from the period 1950-1960 and 7 from the period 1960-1970. (If a locality in table I or II is not cited from a publication, the following abbreviations are used: p.c., personal communication; NHME, in Natural History Museum, Eindhoven; NHMM, in Natural History Museum, Maastricht; NHMT, in Natural History Museum, Enschede; ZMA, in Zoological Museum, Amsterdam).

The number of recent localities amounts only to 10, in spite of active searching. The decline of *Astacus astacus* in the Netherlands in the recent years is very clearly demonstrated by these figures. The danger of extinction of this species becomes even more obvious from the further information about these 10 localities. In the Slinge near Winterswijk crayfishes merely

TABLE I (1)

Localities of *Astacus astacus* in the Netherlands	literature	before 1950	1950 — 1970	1971 — 1975
Halfweg 1956	21		+	
IJssel, 's Heerenbroek 1950	17		+	
IJssel, Deventer 1934, 1948	15, 17	+		
Buurserbeek, Buurse 1935	15	+		
Berkel, Eibergen 1931, 1940, 1944, 1952	15, p.c.	+	+	
Berkel, Zutphen ± 1778, 1874?	15	+		
Apeldoornskanaal?, Eerbeek	15	+		
Ratumse beek, Winterswijk 1927, 1949	15, 16	+		
Boven-Slinge (Slingerbeek, Kottensebeek, Winterswijk near Bekkendelle) 1936, 1938, 1947, 1948, 1949, 1950, 1957, 1960, 1968	17, 21, ZMA	+	+	
Boven-Slinge, Winterswijk near Stemerdinck 1950	17		+	
Boven-Slinge, Winterswijk near Brinkheurne 1950	17		+	
Boven-Slinge, Winterswijk near "Den Helder" 1952	21		+	
Boven-Slinge, Winterswijk near Korle 1950	17		+	
Boven-Slinge, Winterswijk near café Berenschot 1957	21		+	
Boven-Slinge, Winterswijk near the Huitinkbrug 1957	21		+	
Boven-Slinge, Winterswijk near Miste 1964	ZMA			+
Boven-Slinge, Winterswijk near the Grote Pieriksbrug 1971	p.c.			+
Slinge, Aalten?, 1951	15, 19	+	+	
A-strang (Oude IJssel), Dinxperlo 1905?, 1945	15, 17	+		
Oude IJssel, Gendringen	15	+		
Oude IJssel, Doetinchem ± 1900	15	+		
Ponds, Enghuizen near Hummelo 1904	15	+		
Grote Beek, Hummelo 1904	15	+		
Oude IJssel, Laag Keppel up to 1951	17	+	+	
Oude IJssel, Hummelo 1958	21		+	
Kasteel Ulenpas, Hoog Keppel ± 1903	15	+		
Oude IJssel, Doesburg	15	+		
Beek, Angerlo 1863	15	+		
Sonsbeek ponds, Arnhem 1904	15	+		
Warnsborn, Arnhem 1951, 1972	19, 21		+	+
Klarenbeek, Arnhem 1903	15	+		
Rozendaalse beek, Arnhem 1903, 1972, 1974	15, 21	+		+
Rijn, Arnhem and Wageningen 1874?	15	+		
Ponds, Oosterbeek 1944, 1965	15, 34	+	+	
Pool, Driel before 1940, 1974?	21	+		+?
Rijn, Wageningen 1874?	15	+		
Linge, Opheusden before 1940	16	+		
Linge, Tiel 1890	15	+		
Linge, Zoelen 1969	ZMA		+	
Linge, Geldermalsen 1938, 1949	16	+		
Linge, Beesd outlet Renooipolder 1950	16		+	
Linge, Acquoy 1952	21		+	
Linge, Asperen ± 1900, 1949	16	+		

TABLE I (2)

Localities of *Astacus astacus* in the Netherlands	literature	before 1950	1950 — 1970	1971 — 1975
Loam-pit near Fort Asperen, Beesd 1958	21		+	
Linge, Leerdam 1973 (Astacus?)	21			+
Linge, Upstream from Ochten (Astacus?)	21			+
Pond in the Meerwijk, Groesbeek 1874?	15	+		
Oisterwijk ± 1769	15	+		
Bladel ± 1769	15	+		
Aa, Dinther ± 1769	15	+		
Aa, Erp 1916	17	+		
Groote Aa, Heeze 1904, 1959	15, ZMA	+	+	
Kleine Dommel, Heeze, 1900-1911	17	+		
Moat, Heeze 1900-1911	17	+		
Strijper Aa, Leende ± 1940, 1964, 1968, 1973	NHME, 34	+	+	+
Amselbeek, Eijsden 1940	15	+		
Voer, Eijsden 1940	15	+		
Maas, St. Pieter 1934, 1942	15	+		
Maas, Maastricht 1859, 1918, 1944, 1948, 1950	NHMM, 15, 36, 17	+	+	
Maas, Maastricht, Heugem 1949	17	+		
Jeker, Maastricht? ± 1925-1935, ± 1948	30, 36	+		
Maas, Borgharen 1949, 1950, 1951	21, 17, 19	+	+	
Maas, Itteren 1971, 1973	34			+
Maas, Meers-Elsloo 1934	15	+		
Maas, Stevensweert 1949	19	+		
Maas, Wessem 1950, 1951	18		+	
Kanaal Wessem-Nederweert, Wessem 1950	18		+	
Maas, Linne 1918, 1934, 1950, 1954, 1965	15, 17, 14, 34	+	+	
Vlootbeek, Linne 1918, 1949 or 1950	17	+	+	
Vlootbeek, Montfort 1952, 1956	26, 29		+	
Putbeek, (Vlootbeek), Montfort 1954	27		+	
Haelense beek, Grathem 1950	17		+	
Haelense beek, Haelen 1925	17	+		
Maas, Leeuwen (Maasniel) 1950	17		+	
Gravel-pit (Maas), Asselt 1973	34			+
Maas, Roermond, 1951	17		+	
Maas, Herten 1951, 1954, 1965	19, 41, 34		+	
Maas, Swalmen 1951	19		+	
Maas, Tegelen 1947, 1945-1951, 1952	15, 19, 21	+	+	
Tang Koel, Hout-Blerick (Venlo) 1950	17		+	
Boelderbeek, Hout-Blerick (Venlo) 1950	17		+	
Maas, Hout-Blerick (Venlo) 1972, 1973	34			+
Maas, Venlo 1949, 1950, 1965	17, 34	+	+	
Molenbeek, Grubbenvorst 1942	ZMA	+		
Maas, Grubbenvorst 1928	15	+		
Geijsterense beek, Geijsteren 1920	6	+		
Maas, Nijmegen ± 1660	3	+		
Maas, Dieden (Ravenstein) 1950	17		+	
Maas, Lith (weir) 1950	17		+	

TABLE I (3)

Localities of *Astacus astacus* in the Netherlands	literature	before 1950	1950 — 1970	1971 — 1975
Zieversbeek, Vaals 1903	15	+		
Rode Beek, Eygelshoven, 1927	15	+		
Geleen, Heerlerheide (Heerlen) 1920	17	+		
Geleen, Nuth 1910-1920	17	+		
Geleen, Schinnen 1914	37, 17	+		
Geleen, Sittard 1916	15	+		
Geul, Gulpen ± 1940	p.c.	+		
Geul, Terpoorten near Epen ± 1940	19	+		
Branch of Geul, Cottesen near Epen, 1950	43		+	
Roer, Vlodrop 1948, 1950, 1951	23, 17, 19	+	+	
Tungelroyse beek, Stamproy 1880-1910	16	+		
Aabeek (Molenbeek), Stamproy ± 1971	NHME			+

have been noticed after 1968. Apart from the information by Dr. J. van der Drift that he has seen some specimens near the "Grote Pieriksbrug" in 1971, Mrs. Nicolaï told us some specimens have been seen in 1973 near Bredevoort (Driever & Hendriks, 1975). *Astacus* still lives in the Roozendaalse Beek near Arnhem, but no longer in the ponds near Oosterbeek, because these ponds fell dry in 1973. In the river Linge it occurs perhaps still sporadically (Janssen & Van Maris, 1974). The locality of the Strijper Aa near Leende has been lost in 1974 by canalisation. The Grote Aa and Buulder Aa have been canalised in 1975 (W. Iven, personal communication). *Astacus* is still found sporadically in the river Maas (Van der Putten & Lebbink, 1973).

Possible explanations for the deterioration of *Astacus astacus* in the Netherlands are:

1. The progressing water pollution, especially by the increasing bio-industry. According to Hofmann (1971) *Astacus* is as sensitive to pollution as the grayling, *Thymallus thymallus* (L., 1758) which lived in the river Geul until 1885. One recent observation of the grayling in the A-strang near Winterswijk in 1967 is reported by Muus & Dahlstrøm (1968).

2. The so-called re-allotments, brook-improvements and other normalisations and canalisations, by which the habitat strongly deteriorates, especially by reduction of sufficient shelter and possibly of suitable food.

3. The crayfish-pest, caused by the thread-like fungus *Aphamomyces astaci* Schikora. The fungus affects the central nervous system and the skin and is able to destroy a large population of *Astacus* in a short time. This disease has strongly reduced the number of crayfishes in Europe (Hofmann, 1971).

In the Netherlands *Astacus astacus* has been protected by law since

October 1973. It seems doubtful that the recent small rest populations really can be protected by this legislation. Not catching of these animals but destruction of their natural environment (for instance by the so-called normalisations) and the pollution form the main danger for the crayfishes.

II. The distribution of *Orconectes limosus* in the Netherlands. — Since the end of 1972 it is known that a second crayfish occurs in the Nether-

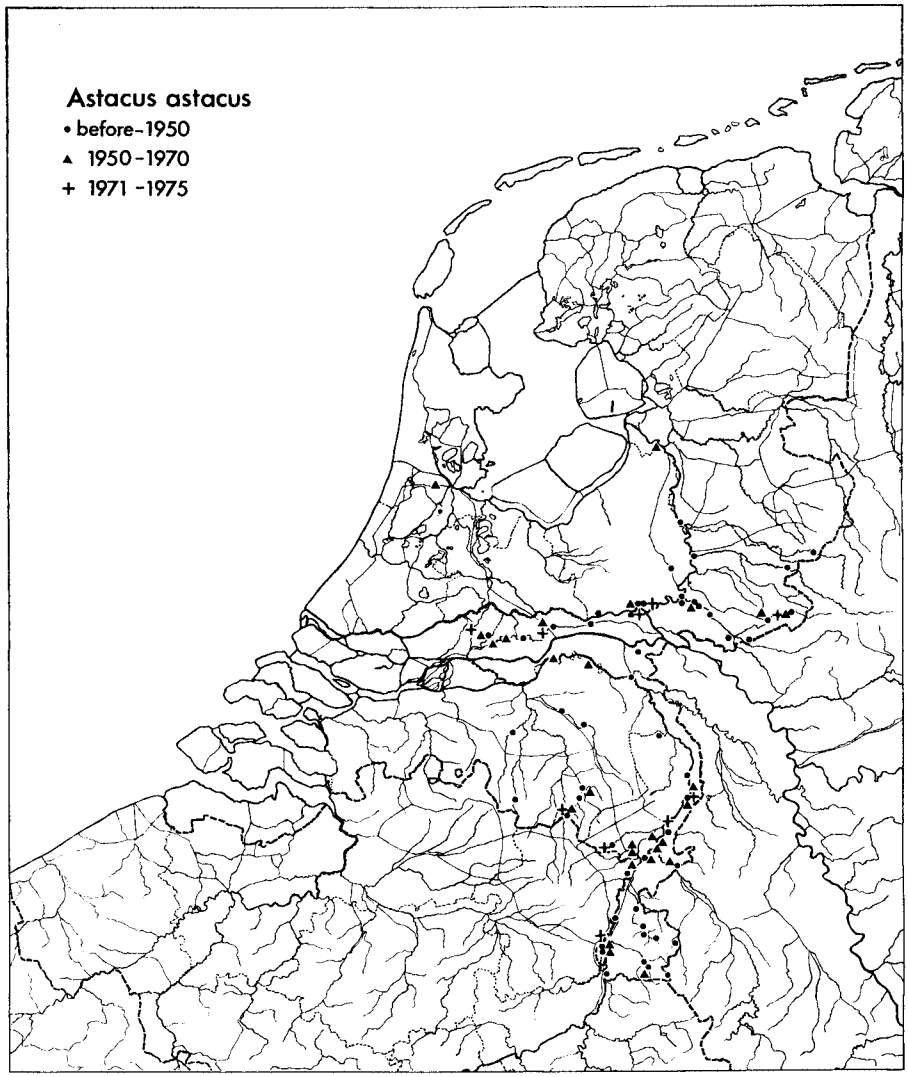

Fig. 1. Distribution of *Astacus astacus* (L.) in the Netherlands.

lands. From the data in figure 2 and table II it is clear that *Orconectes limosus* is mainly found in the river Maas (= Meuse), the Julianakanaal and the gravel-pits and waters in open connection with them. Further there are some confirmed, outlying records from the Amer, the pool near Ochten along the river Waal and the port of the Maas-Waal Kanaal near Nijmegen, where they regularly have been seen and caught in 1976.

The river Vecht (prov. Overijsel) seems to be a second centre, although

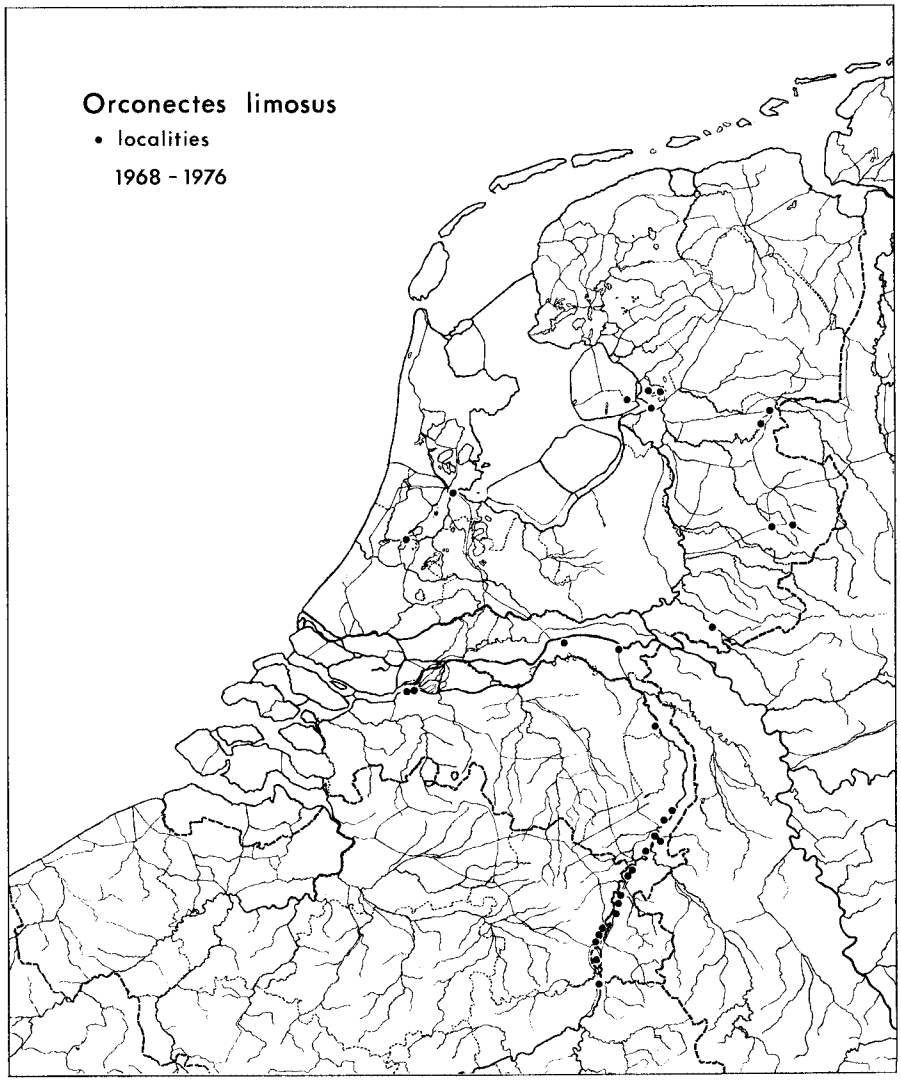

Fig. 2. Distribution of *Orconectes limosus* (Rafinesque) in the Netherlands.

only a few specimens have been seen. Of the remaining records it is obvious, from the descriptions given by the people who caught them, that they also belong to *Orconectes*. The same applies to the specimens from the Beulaker Wijde and the Twente kanaal. The Twente kanaal has an open connection with the Vecht and the waters in Germany, from which *Orconectes* could easily penetrate. The identification of two of the specimens from the Twente kanaal in 1975 was confirmed by Mr. G. M. Roding, Director of the Natural History Museum in Enschede.

The most recent data have been gathered from Amsterdam and surroundings in 1975 and 1976 by Prof. Dr. J. H. Stock and Mr. W. Cazimir (RIVO, IJmuiden), see table II and figures 2 and 3.

III. The origin of *Orconectes limosus*. — *Orconectes limosus* originates from the eastern part of the U.S.A. According to Hobbs (1974) this species occurs in the Atlantic watershed from Maine to the lower James River in Virginia.

Orconectes limosus has a wider ecological range than *Astacus astacus*. It is an inhabitant of lakes, rivers, canals and brooks, where it lives among water plants or under stones. In cold weather they withdraw in deeper water. Just as *Astacus*, *Orconectes* is omnivorous; dead food only is eaten when it is fresh, they are not carrion-eaters.

In 1890 100 specimens of *Orconectes limosus* (under the name *Cambarus affinis*) were stocked in a fish-pond at Berneuchen near Berlin by Max von dem Borne. This pond was connected with the river Mietzel and from there on the American crayfish expanded fast into the rivers Oder, Warthe and Netze. A second area of distribution developed in the rivers Havel and Spree (Pieplow, 1938).

In 1896 Raveret-Wattel tried in vain to introduce *Orconectes* near Fécamp in France (André, 1934). About 1912 American crayfishes were imported by Lesaule, who released 2000 specimens from Germany near St. Florent in the river Cher, a tributary of the Loire (Pieplow, 1938). From there it has extended all over France (Laurent & Suscillon, 1962). In 1911 Seligo reported the introduction of *Orconectes* in lake Junno in Poland.

In the opinion of Pieplow (1938) all European *Orconectes limosus* populations descend from the 100 specimens released by Max von dem Borne. However, André (1960) asserts that the crayfishes of the Seine and the Marne probably originate from specimens that undoubtedly came from the Saint Lawrence River in North America.

In all cases the import of American crayfishes took place with the purpose to fill the gap which came in existence after the native crayfish species

were destroyed by the crayfish-pest; *Orconectes* is immune to this disease (Pieplow, 1938).

Until about 1940 *Orconectes* did not occur in Germany west of the Elbe according to Schweng (1973). He also mentioned that in 1947 this species was found in the Main near Frankfurt and in the Mittelland canal north of

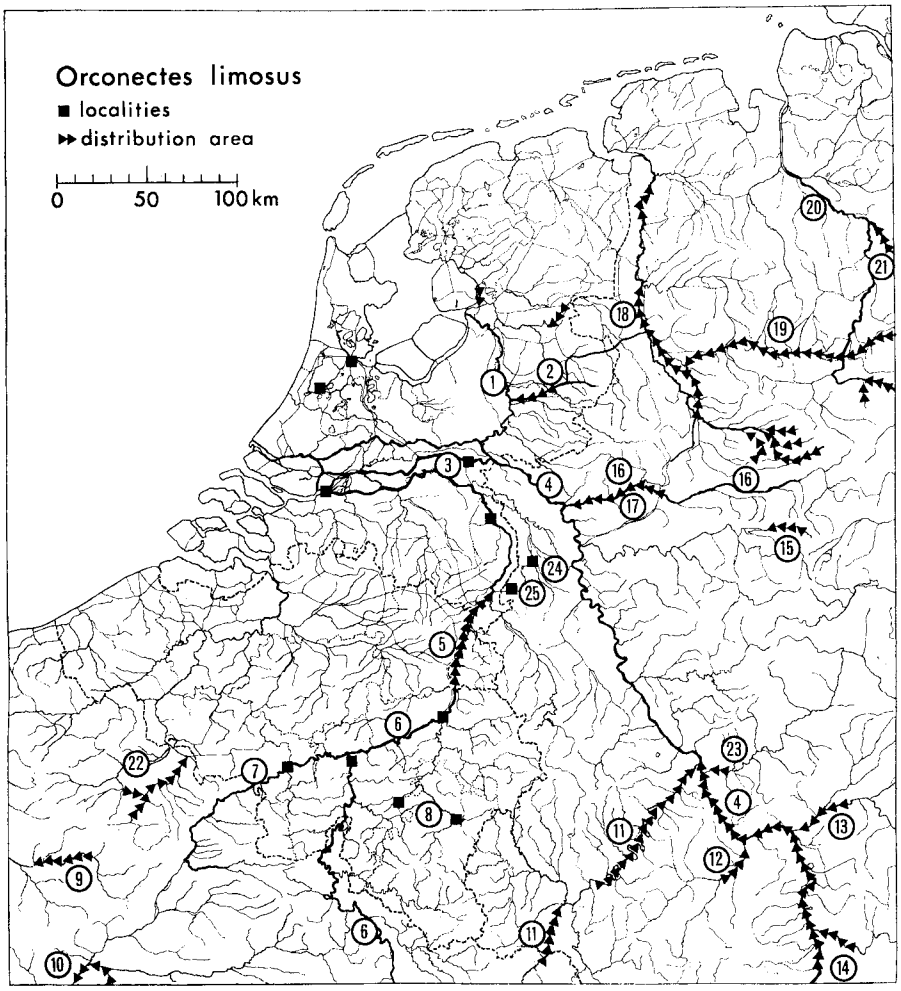

Fig. 3. Distribution of *Orconectes limosus* (Rafinesque) in the Netherlands and neighbouring countries. 1, IJssel; 2, Twente kanaal; 3, Waal; 4, Rijn; 5, Julianakanaal; 6, Maas; 7, Sambre; 8, Ourthe; 9, Somme; 10, Oise; 11, Mosel; 12, Nahe; 13, Main; 14, Neckar; 15, Möhnetalsperre; 16, Lippe; 17, Wesel-Datteln-Kanal; 18, Ems; 19, Mittelland-Kanal; 20, Weser; 21, Aller; 22, Schelde; 23, Lahn; 24, Nette; 25, Schwalm.

Braunschweig and westwards to Hannover in the branch-canal Linden. Recent data are known from rivers, canals and reservoirs: Neckar (Ludwig, 1957); Mosel, Nahe, Main, Aller, Ems and Elbe (Hofmann, 1971); Rhein (= Rhine), Lahn, Mittelland Canal (Boettger, 1953; Schweng, 1968, 1971, 1973); Lippe, Lippe-Seiten-Canal, Dortmund-Ems Canal, Möhne-reservoirs (Grünwald, 1972, 1975). In a letter, dated 8 July 1975, H. Grünwald recorded localities of *Orconectes* in the Nette near Wachtendonk in 1970-1973 and in the Schwalm near Schwalmtal in 1972. Mr. K. M. Strempel of the fishfarm Platjenwerbe near Bremen informed me in a letter, dated 22 December 1974, that his experimental *Orconectes* came from Ratzeburger See and that *Orconectes* also lives in the Lower Weser and Lower Ems and their branches. Dr. R. König at Kiel send us in his letter, dated 15 May 1975, a list of localities in Schleswig-Holstein were American crayfish where released: Kossau and Grosser Binnensee, Süseler See, Ratzeburger See, Wakenitz, Grosser Plöner See, a pond near Mölln and Muggesfelder See near Seegeberg (see Driever & Hendriks, 1974). According to Jungbluth (1975) *Orconectes limosus* has been found in Hessen in the Upper Fulda and in the Rhine and the Main. These localities are indicated on the map in fig. 3.

In France *Orconectes limosus* is known from the rivers Cher, Loire, Seine, Marne, Rhône, Somme and Oise (Laurent & Suscillon, 1962). Hofmann (1971) wrote that specimens from France came already into the Mosel via the Rhine-Marne Canal, and also via the Rhine-Rhône Canal they may have invaded the Rhine. Recent data from France are unknown.

According to Prof. M. Huet (Groenendaal-Hoeiaart) and Dr. R. Kaiser (Liège) (personal communication) *Orconectes* has been observed in Belgium in the Sambre, the eastern branch of the Ourthe, in the Meuse near Namur and Liège, in the lake of Niramont and in small streams in the surroundings of Marche-en-Famenne. In January 1975 a specimen of *Orconectes* has been recorded from ponds of the recreation area "De Luysen" in Bree (Belgium) near Weert.

Orconectes limosus belongs to a large group of foreign species, that have been able to invade the waters of the Netherlands. Through drastic changes of the Western European surface waters (among other canalisation) and through the pollution a situation developed, in which several alien species have been able to establish themselves in newly formed niches while the native species, no longer fitting the changed situation, became extinct. The invasion of alien species mostly happens artificially, i.e., they are released or they accidentally appear here by shipping.

Especially the euryoecious organisms, highly resistant to oxygen deficit,

to raised chlorinity and high temperatures are able to maintain themselves and to spread very fast.

Many invaders of a river-area are in course of time only to be found again in tributaries, gravel-pits, backwaters, etc. and no longer in the large rivers themselves, according to Kinzelbach (1972) because they too do not survive the increased heavily poisonous drainings. According to Rademacher (1972) *Orconectes limosus* nowadays has become rare in the lower course of the river Main as a result of the deteriorated quality of the water.

It seems most likely that *Orconectes limosus* invaded the Netherlands via the river basin of the Maas (Meuse). Pieplow (1938) made a judgement of the speed of distribution of the species in Germany and came to about 5 km per annum in one direction of a river. This estimation of course is very rough because all kinds of factors determine the velocity of the expansion of an area such as increase of population, current velocity, natural and artificial barriers and many unpredictable factors. If Pieplow's valuation is correct and also should hold for the population, which we have found in the Julianakanaal and if the last named really followed the Meuse from France, than it should be at least 15 years ago that *Orconectes limosus* entered the Netherlands. Although there are many observations supporting this assumption according to Grünwald (1972), certainty about this cannot be obtained. The recent records of crayfish from the eastern part of the country point to a possible invasion from Germany via the Mittelland Canal, where this species has been observed already since 1947 (Boettger, 1953) or via the Lower Rhine or the branches of the Ems (Strempel, personal communication).

It is possible that the American crayfish *Orconectes limosus* will occupy for the greater part the habitats formerly inhabited by *Astacus astacus*, because it is less sensitive to water pollution, tolerates a low amount of oxygen and is immune to the crayfish-pest.

TABLE II

Localities of *Orconectes limosus* in the Netherlands	literature
Gravel-pit, Eijsden 1973	34
Maas, Eijsden 1973	34
Gravel-pits, Oost-Maarland 1971, 1972, 1973	34
	NHMM
Outlet, Maastricht 1973	34
Jeker, Maastricht 1968	7
Maas, Borgharen 1969, 1973	34
Gravel-pit, Itteren 1971	34
Maas, Itteren 1973	34
Julianakanaal, Urmond 1972-1974	34, 21, 6

Localities of *Orconectes limosus* in the Netherlands	literature
Julianakanaal, Born 1970-1974	34, 21, 6
Berghaven Born, 1973	34
Julianakanaal, Roosteren 1970-1973	34
Julianakanaal, Echt 1970-1973	34
Molenbeek, Echt 1970, 1973, 1974	34, 6
Middelsgraaf, Echt 1970, 1973	30, 34
Julianakanaal downstream Maasbracht 1973	34
Gravel-pit, Maasbracht 1973	34
Maas, Herten 1973	34
Gravel-pit, Asselt 1973, 1975	34, 6
Maas, Buggenum 1975	6
Maas, Kessel 1973	34
Maas, Belfeld 1973, 1976, 1977	34, p.c.
Gravel-pit (Maas), Bergen 1974	21
Maas-Waalkanaal harbour, Nijmegen 1973, 1975, 1976, 1977	34, p.c.
Oude IJssel, Etten 1975	6
Beulaker Wijde near Walengracht, Wanneperveen 1974	6
Beulaker Wijde near Blauwe Hand, Wanneperveen 1974	6
Vecht, Gramsbergen 1974	6
Vecht, Hardenberg 1973, 1974	6
Vecht near Zwolle 1969 (*Orconectes*?)	6
Zwarte Meer, Genemuiden 1972, 1973	21, 6
Voorstersluis, Noord Oostpolder 1973 near Emmeloord	6
Twente Kanaal, Wiene 1970, 1971, 1973, 1974	21, 6
Twente Kanaal, Hengelo 1975	NHMT
Amer, Deneplaat 1971, 1974	21
Amer, Jacominaplaat 1974	6
Pool (Waal), Ochten 1974	21
Singelgracht outlet, Amsterdam 1975, 1976	p.c.
Ditch Brasemermeer-Ringvaart Haarlemmermeer, Oude Wetering 1976	p.c.

In the Netherlands *Orconectes limosus* has spread very fast in the last years; nowadays it occupies a larger area than *Astacus astacus* formerly did. Further, *Orconectes limosus* has a greater chance of survival than *Astacus astacus* because in *Orconectes limosus* ca. 100 eggs per female hatch 5 to 8 weeks after oviposition, whereas in *Astacus astacus* only 10 eggs develop ca. 5 months after oviposition. In both species there is one generation a year; however, *Orconectes limosus* is already sexually mature in its third year (Hofmann, 1971).

In 1960 a second North-American crayfish *Pacifastacus leniusculus* (Dana) has been introduced in Sweden (Hofmann, 1971) and later also in Germany, Austria and Luxemburg (Spitzy, 1972). One may expect that this new species will extend to the Netherlands too in the near future.

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Samenvatting

Tot voor kort was er slechts één Nederlandse zoetwaterkreeft bekend nl. *Astacus astacus* (L.). Eind 1972 werd ontdekt dat de kreeften, die sinds 1970 waargenomen werden in het Julianakanaal, behoorden tot de Amerikaanse zoetwaterkreeft *Orconectes limosus* (Rafinesque). Het duidelijkste verschil tussen de beide soorten is het bezit van rode vlekken op het achterlijf van *Orconectes*, die bij *Astacus* ontbreken.

Het aantal vindplaatsen van *Astacus* is in de laatste jaren sterk afgenomen. Mogelijke oorzaken voor deze achteruitgang zijn: (1) toenemende watervervuiling, (2) kanalisatie van waterlopen, (3) de kreeftenpest. Het valt te betwijfelen of de bescherming van *Astacus* nog wel zin heeft.

Orconectes komt, evenals vroeger *Astacus*, vooral in het Zuiden en Oosten van ons land voor. Deze soort breidt zich echter snel verder uit en is inmiddels ook waargenomen in de Biesbosch en de omgeving van Amsterdam.

Orconectes limosus is afkomstig uit het oostelijk deel van de U.S.A. en in 1890 uitgezet in een visvijver bij Berlijn omdat de *Astacus* populatie aldaar uitgeroeid werd door de kreeftenpest, waarvoor *Orconectes* immuun is. De Amerikaanse kreeft heeft zich vanuit Berlijn verspreid over Europa. Waarschijnlijk is *Orconectes* in eerste instantie via de Maas, vanuit Frankrijk en België, in Nederland gekomen en daarna via Duitsland in het Oosten van het land.

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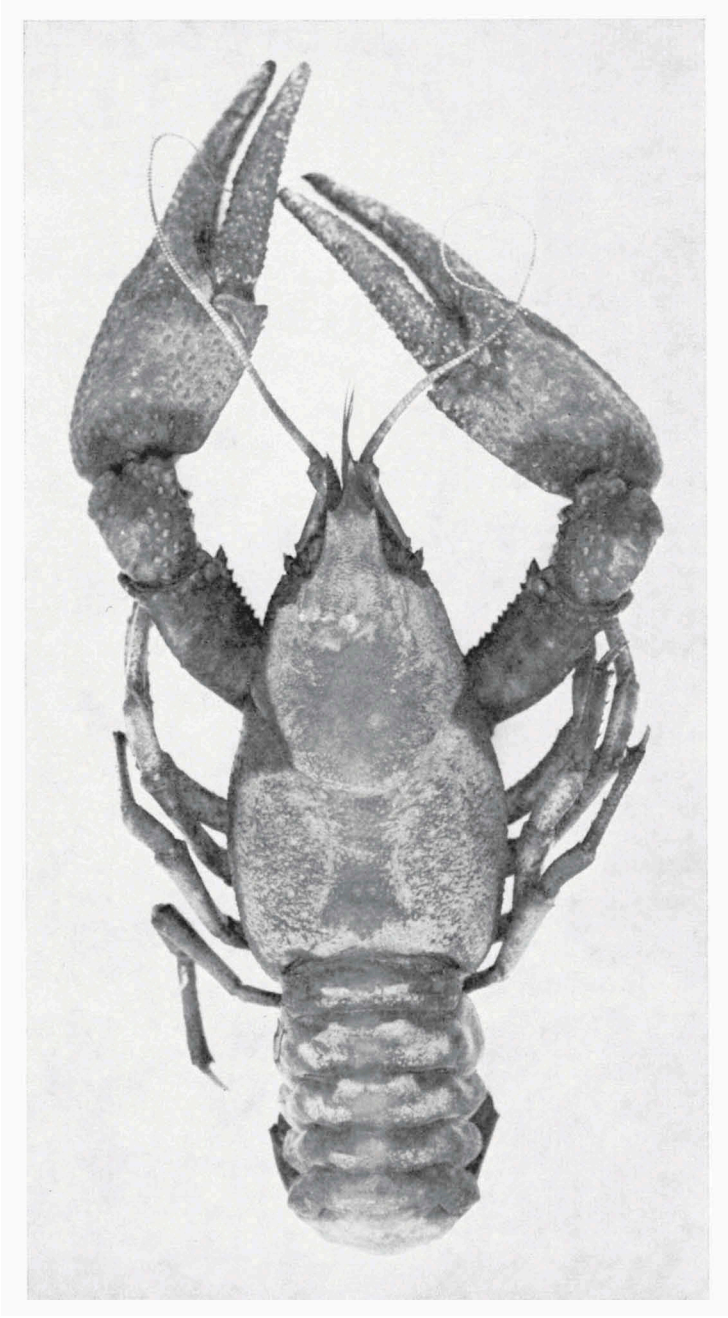
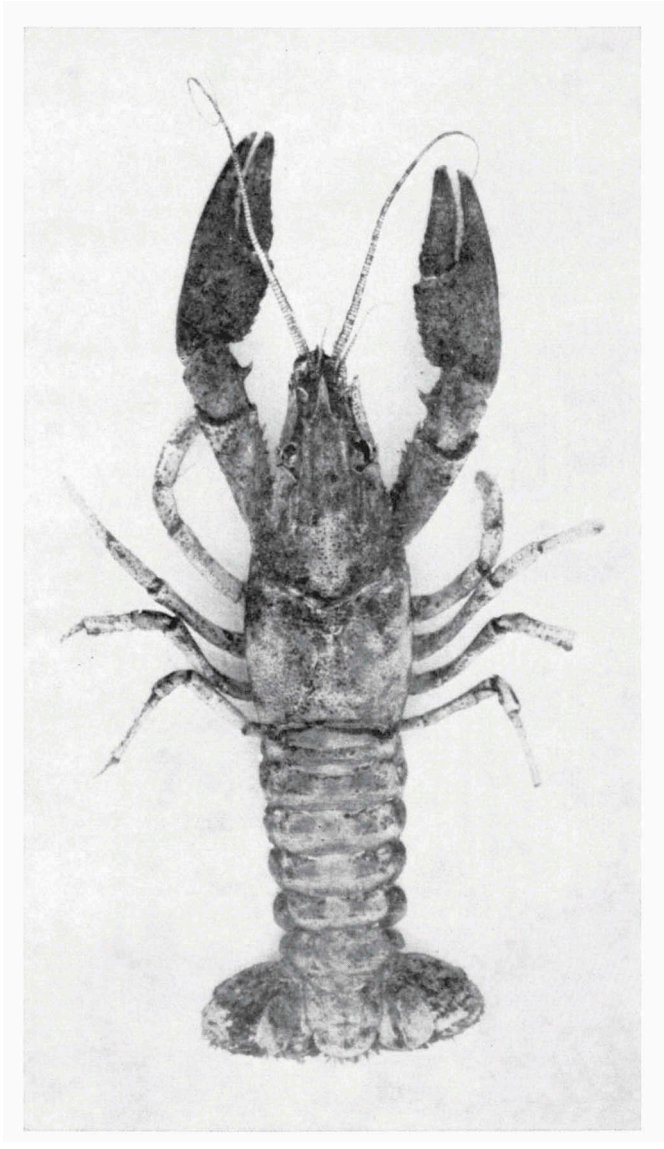


Astacus astacus (L.) ♀ from Maas or Julianakanaal near Borgharen, 1969, leg. P. Marquet. Total length (rostrum - telson) 140 mm. Collection Laboratory of Aquatic Ecology, Nijmegen.



Orconectes limosus (Raf.) ♂ from Julianakanaal near Urmond (D.S.M.), 1974. Total length (rostrum - telson) 70 mm. Collection Laboratory of Aquatic Ecology, Nijmegen.