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Short term colonization and subsequent extinction of a population of Lithoglyphus naticoides (Pfeiffer) (Gastropoda, Prosobranchia, Hydrobiidae) in the IJsselmeer, the Netherlands

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The freshwater snail *Lithoglyphus naticoides* (Pfeiffer) was found in bottom samples from an area in the southern part of the lake IJsselmeer in 1984. From August 1984 to November 1985 a permanent site was sampled with monthly intervals as far as possible. Average density increased from 35 specimens per m^2 in August 1984 to 95 in December 1984. However, at the end of 1985 density had reached the limit of detection. In 1984 and 1985, two generations could be distinguished. After the growth period average shell sizes of both generations were approximately 2.5 and 5-6 mm respectively. A new generation could be expected in the population from the second part of June onwards. Possibilities of subsequent extinction are discussed.

Key words: Gastropoda, Prosobranchia, Hydrobiidae, *Lithoglyphus*, population dynamics, growth, the Netherlands.

INTRODUCTION

From 1981 to 1985 an intensive bottom fauna sampling programme was executed throughout the IJsselmeer area (Bij de Vaate, in prep.). In a shallow part of one of the lakes in the area, the IJsselmeer, the freshwater snail *Lithoglyphus naticoides* (Pfeiffer, 1828) was suddenly observed in August 1984. The species was found on a sandy bottom, on the border of a former sand-bank built up in the period before 1932, when the lake was part of an estuary named Zuiderzee (De Jong & Bij de Vaate, 1989). In the entire area *L. naticoides* was never collected before until an intensive bottom fauna sampling programme was started in 1981. No records of this species in the IJsselmeer from the preceding period could be found in the literature.

A limited survey showed that the area in which the animals were found, was relatively small, measuring about 2 km^2. The numbers in which they occurred, however, allowed a study on population dynamic aspects to increase the meagre knowledge of the ecology of this freshwater snail in the Netherlands.

From August 1984 to November 1985 a permanent site in the IJsselmeer was sampled with monthly intervals as far as possible. During an exceptionally long period in the winter of 1984/1985, sampling was impossible due to ice cover.

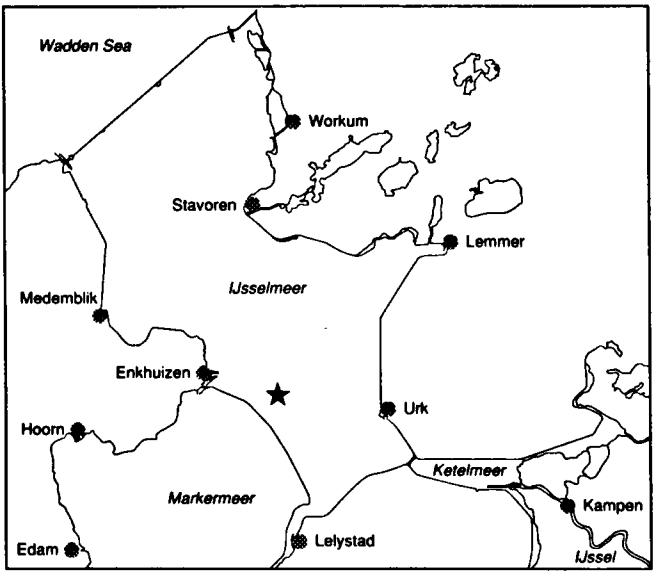

Fig. 1. Lake IJsselmeer, the permanent sampling site marked with an asterisk.

STUDY AREA

Detailed information about the Zuiderzee damming, followed by land reclamation in the IJsselmeer, has been given by De Jong & Bij de Vaate (1989). After 1975, when the construction of a dike between Enkhuizen and Lelystad was completed (fig. 1), no changes were made in the area. At that moment the then existing freshwater lake was divided into two parts: a northern part called IJsselmeer and a southern part called Markermeer. IJsselmeer area is the name for the total area which covers approximately 2,000 km^2. Both lakes are very shallow, the depth of the Markermeer varies from 2.5 m near the west bank to 4.5 m in the eastern part. In the IJsselmeer average depth is about 5.0-5.5 m. Gullies form the deeper parts, eroded sand-banks the shallow parts. As a result of wave action, some of the shallow parts are subject to erosion and the gullies are gradually filling up. The most important freshwater supply is the discharge of the river IJssel, a branch of the river Rhine. Via the Ketelmeer (fig. 1) the river water enters the IJsselmeer. In the dam, separating the freshwater lake from the Wadden Sea, two sluices provide for the overflow of lake water into the Wadden Sea.

METHODS

Bottom samples were taken with a Van Veen grab; the sampling surface of this grab was 440 cm^2. Every bottom sample was immediately washed on board the research vessel on a sieve with a mesh width of 1 mm. All material staying behind on

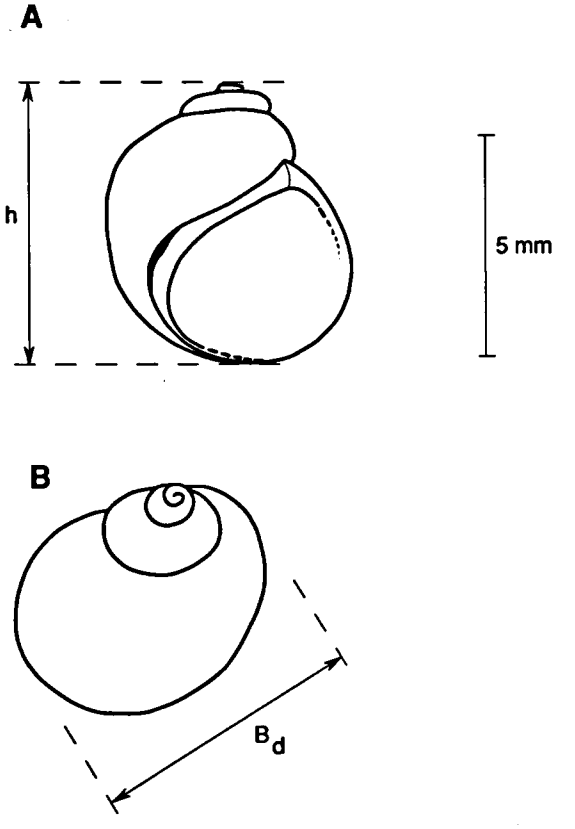

Fig. 2. Shell of *Lithoglyphys naticoides*, A: ventral side (h is shell height); B: dorsal side (B_d is the measured width).

the sieve was collected. The washed contents of five grabs were treated as one sample and preserved alive in lake water until sorting of the animals was possible. On each sampling date at least ten series of five bottom samples were taken. Sorting of the samples followed immediately after sampling had been completed. The samples were washed again with tap water and then put into white plastic trays with tap water. During the following days all the active snails were collected. This method to collect creeping animals proved to be very effective; as shown by some tests, over 90% could be detected easily in this way.

Accuracy in sampling in the IJsselmeer was possible with the help of an accurate radio location system (Thomson-CSF, type Trident III) on board the research vessel. According to the manufacturer's statement the maximum deflection of the system is 3 m. The sampling site was situated on 52°41'30.747" N and 5°24'24.730" E, as given in fig. 1. Depth on the sampling site varied between 3 and 4 meters.

Shell length of *L. naticoides* was measured with a binocular microscope supplied with an ocular micrometer. Shell height is generally chosen to indicate the size of a shell.

However, because of the shape of the shells, it was impossible to measure shell height in a simple and repeatable way. Therefore maximum width of the dorsal side of the shell (fig. 2), which appeared to be identical to the shell length in the total measuring range, was selected as alternative parameter for size.

To distinguish between the year-classes of *L. naticoides* in the samples, length/frequency distributions were calculated on probability paper (Harding, 1949; Cassie, 1954; Tanaka, 1962).

RESULTS

The texture of the top layer of the bottom in the sampling area varied from pure sand to light silt containing sand. During the total sampling period at least seven species of molluscs were found in the samples: five species of gastropods, the others were bivalves. These are the following — (Gastropoda) *Valvata piscinalis* (Müller, 1774), *Potamopyrgus jenkinsi* (Smith, 1889), *Lithoglyphus naticoides* (Pfeiffer, 1828), *Bithynia tentaculata* (L., 1758), *Lymnaea peregra* (Müller, 1774) f. *ovata* (Draparnaud, 1805); (Lamellibranchia) *Dreissena polymorpha* (Pallas, 1771), *Pisidium* spp. The species *L. naticoides*, *P. jenkinsi*, *V. piscinalis* and *D. polymorpha* were found on each sampling date, while the other ones only occurred incidentally in the samples in very low numbers.

Initially the density of the *L. naticoides* population seemed to increase very rapidly as shown in fig. 3. The average density increased from 35 specimens per m^2 in August 1984 to 95 in December 1984. After the winter, when the lake was covered with ice during an exceptionally long period of about ten weeks, the average number on the permanent sampling site had fallen to approximately 40 specimens per m^2.

Leaving the observation of June 1985 out of consideration, when the number of animals was about twice that in the previous and in the following month, average numbers of *L. naticoides* decreased slowly during that year. At the end of 1985 the study was stopped because density had reached the limit of detection. Repeated sampling on the same site in the summer of 1986 produced not a single living specimen. Only empty shells were found, showing that the population was completely extinct.

Increase of the population density in 1984 could be attributed to the new generation of that year. In fig. 4 the numbers of each year class are summarized. Animals of the 1985 generation, which were observed in the population from August onward, remained very low in numbers, compared to those of the previous year, in spite of a higher density of the breeding population. At the end of that year the generation of 1984 disappeared without leaving sufficient recruitment for a new generation in the population.

During 1984 and 1985, two generations in the population of *L. naticoides* could be distinguished. After the growth period average shell sizes of both generations were approximately 2.5 and 5-6 mm respectively. In 1985, the growth period started in April and stopped in October. Water temperature rose from 7.0° to 11.0 °C in April 1985, continuing to a maximum of 20.5 °C in July. In October water temperature dropped from 17.0° to 7.5 °C (fig. 6). Extrapolating the results of shell growth in 1985 (fig. 5), a new generation could be expected in the population from the second part of June onwards.

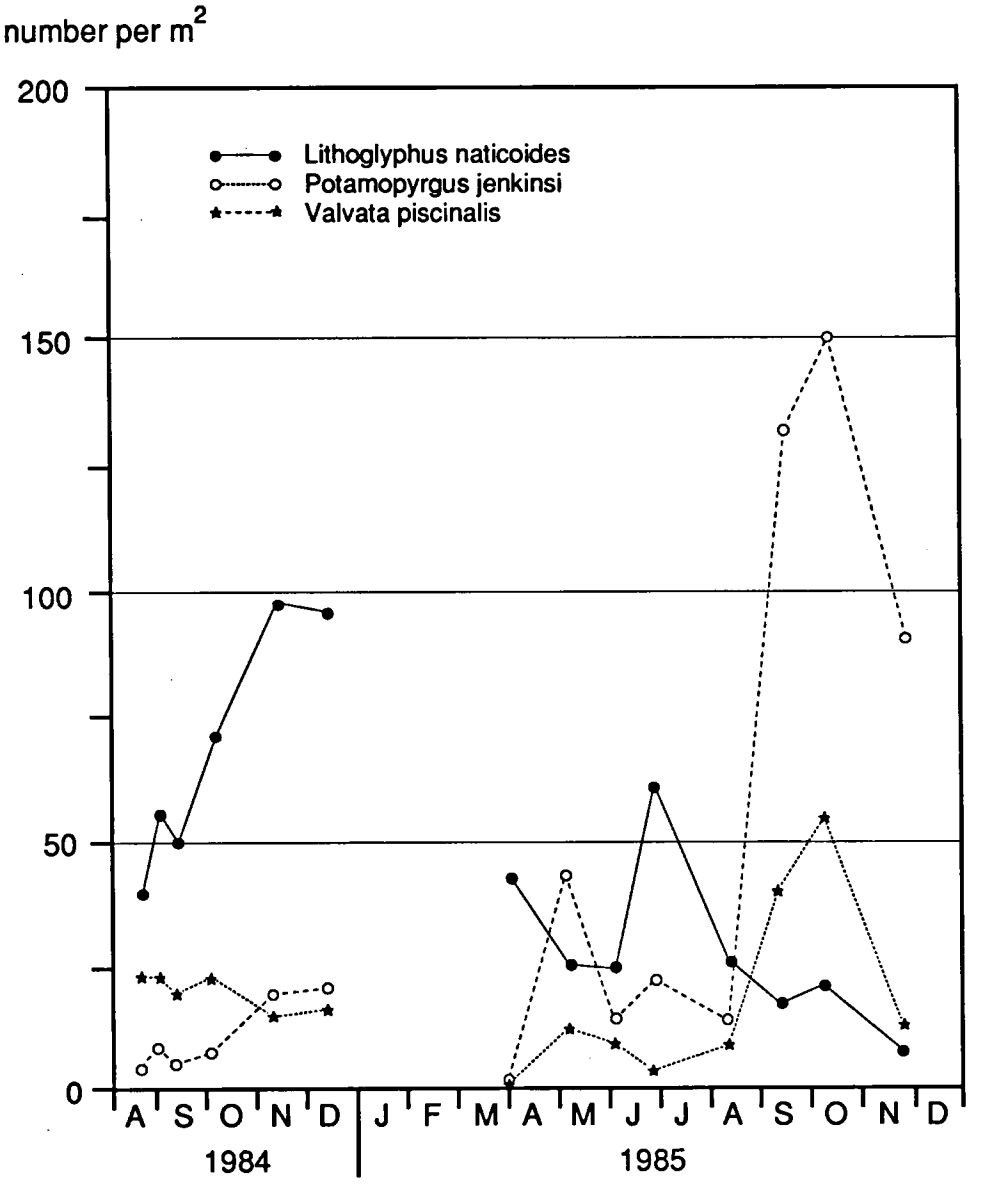

Fig. 3. Density of the most important gastropods in relation to time on the permanent sampling site in the IJsselmeer.

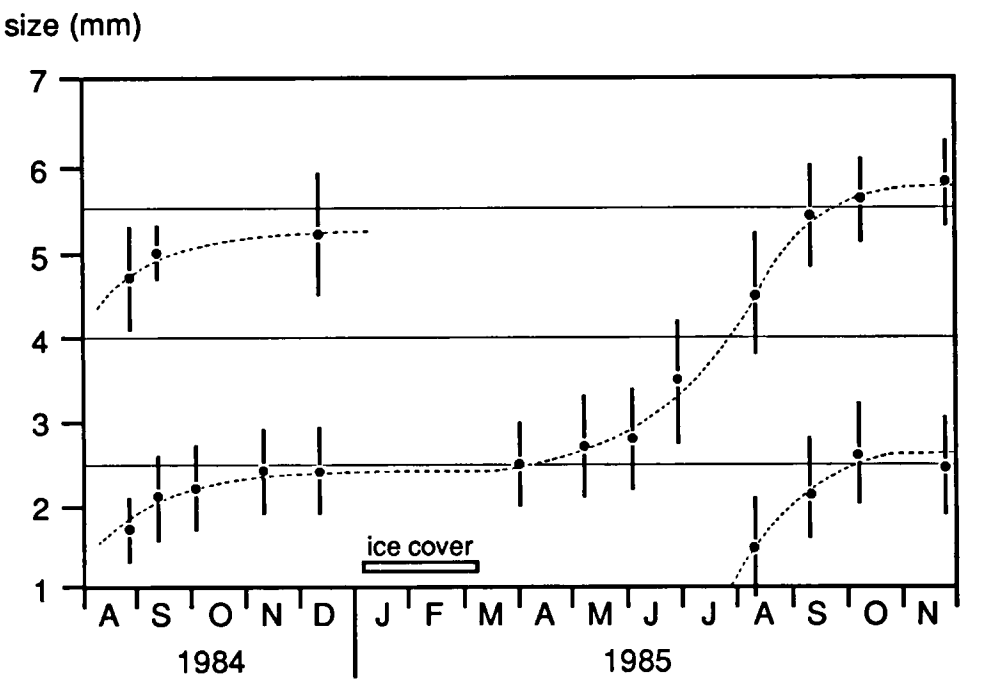

Fig. 4. Growth of the different generations of *Lithoglyphus naticoides* in the IJsselmeer. Vertical bars indicate standard deviation.

DISCUSSION

L. naticoides is known from different sites in the Netherlands (Janssen & De Vogel, 1965). Occurrence in the IJsselmeer is new. Habitat preference of the animals appears to be restricted to hard bottoms. According to Gaidash & Lubjanov (1978) the species is pelophilic and occurs, in the Dneproderzhinsk reservoir, on a silty sand bottom. Toth & Baba (1980) found them on clayey mud bottoms, while Janssen & De Vogel (1965) described habitat preference in general to be solid substrates and sandy bottoms. In the IJsselmeer, where *L. naticoides* occurred on a silt-containing sand bottom, the habitat agreed well with the observations of Gaidash & Lubjanov (1978). At a distance of approximately 2 km north of the sampling site the top layer of the bottom consists of clay and during the whole investigation period *L. naticoides* was never observed there.

In general *L. naticoides* is considered to be a species of slowly running waters such as the downstream areas of rivers (Krause, 1949). Gontya (1978) found an abundant population in the downstream part of the river Dnjester. Janssen & De Vogel (1965) pointed out that empty shells could be found washed ashore regularly in the Dutch part of the river Meuse as well as in the branches of the river Rhine.

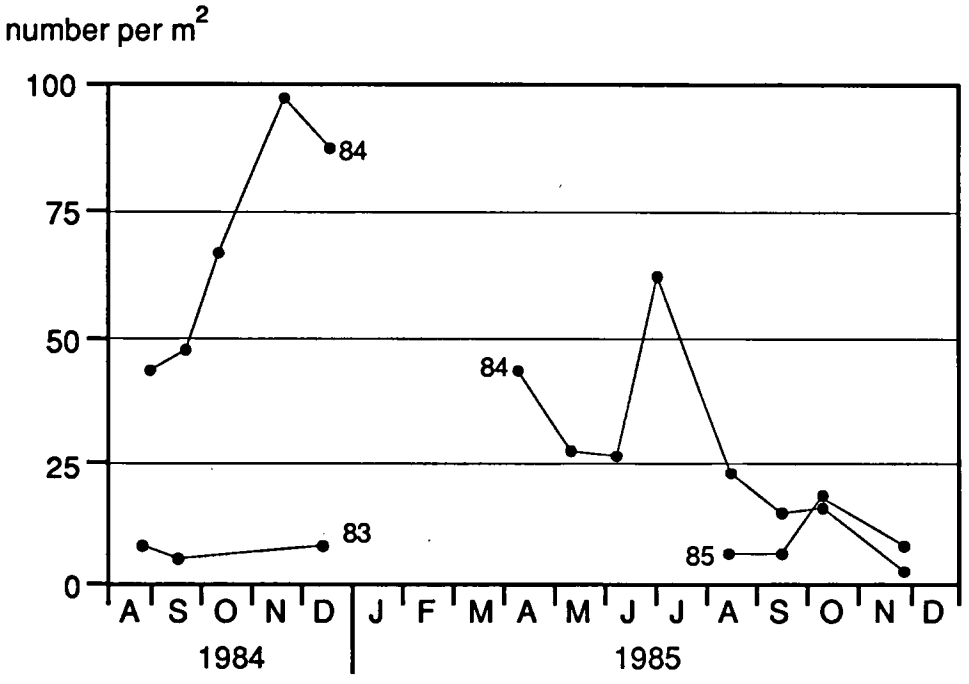

Fig. 5. Numbers of *Lithoglyphus naticoides* specimens of the generations 1983 (83), 1984 (84) and 1985 (85) in the population in the IJsselmeer.

Our knowledge of the occurrence and habitat preference of *L. naticoides* is scattered and incomplete; what we know about the population dynamics is even less. It is not clear what factors caused this species to colonize the IJsselmeer. The most realistic hypothesis is that when *L. naticoides* still lived in the rivers Rhine and IJssel (a branch of the river Rhine), eggs or juvenile specimens could have been transported from the IJssel into the lake during a very exceptional high summer discharge in the first part of June in 1983. In the spring of that year the discharge of the river Rhine was exceptionally high as well. Main stream direction of the river water is from the mouth of the river, via the Ketelmeer, to the northern part of the IJsselmeer. It is possible that the Enkhuizerzand, a former sand-bank in the IJsselmeer on which *L. naticoides* was found, could be reached in this way. Increase of the numbers on the sampling site in 1984 was probably caused by migration in the area by animals searching for optimum habitat.

In the second part of 1985 the contribution of the new year class in the total population was very small compared with that of 1984. The role of emigration of the young animals as a negative factor in the occurrence of the species on the sampling site can be rejected. In the surroundings of that site the numbers decreased as well and in 1986 the species was not observed any more.

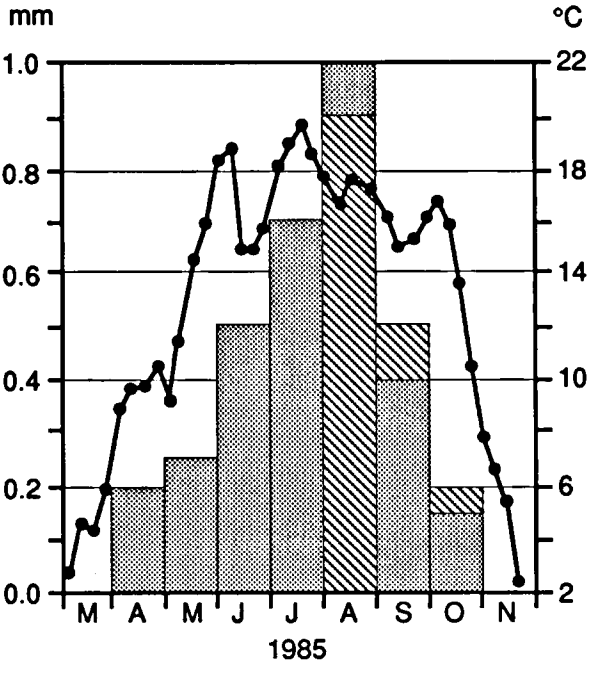

Fig. 6. Monthly shell size increase of the 1984 (stippling) and the 1985 (cross-hatching) generation (from August) of *Lithoglyphus naticoides* and the weekly average water temperature in the IJsselmeer.

Interspecific competition can be left out of consideration because the total number of snails per m^2 was relatively low in both years. Relatively low densities of other gastropods did not indicate extraspecific competition. Average numbers of the two most important gastropods species are given in fig. 3.

The reason for the extinction of the species must be the unsuitability of the colonized area in the IJsselmeer as habitat. No other plausible explanations for this small reproductive success and subsequent extinction can be given.

Predation as a factor in the extinction of a part of the population may have been caused by diving ducks and fishes. Predatory animals like the fish species roach (*Rutilus rutilus*) as well as tufted ducks (*Aythya fuligula*) occur in the area. Their activities mainly coincide during the summer months. The activity of the roach is highest then because of the water temperature; the tufted ducks gather benthos as food during moulting of the wing feathers in the period June-September. At this time the ducks are known to predate on gastropods like *V. piscinalis*, *P. jenkinsi*, the bivalves *Pisidium* spp. and *D. polymorpha*, as well as ostracods. They are able to sieve the top bottom layer to collect the small bottom dwelling organisms. Specimens of *L. naticoides* were found in the stomachs of some ducks which had drowned in fishermen's nets at the study site in the sampling period.

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SAMENVATTING

Op een bepaalde plaats in het zuidelijk deel van het IJsselmeer werd in 1984 het slakje *Lithoglyphus naticoides* in bodemmonsters aangetroffen. Van augustus 1984 tot november 1985 werd maandelijks, althans voor zover mogelijk, een vaste plek bemonsterd. De gemiddelde dichtheid van de individuen liep op van 35 per vierkante meter in augustus 1984 tot 95 per vierkante meter in december 1984. Echter, aan het eind van 1985 was de dichtheid dermate teruggelopen, dat de soort niet langer in de monsters voorkwam. In 1984 en 1985 konden twee generaties onderscheiden worden. Na de groeiperiode was de gemiddelde schelplengte van de twee generaties respectievelijk ca. 2,5 en 5-6 mm. Vanaf midden juni kon een nieuwe generatie in de populatie verwacht worden. De faktoren die het uiteindelijke uitsterven veroorzaakt kunnen hebben worden tenslotte afzonderlijk besproken.