The distribution of the snail Aplexa hypnorum in Zuid-Beveland in relation to soil and salinity

by

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The water snail *Aplexa hypnorum* (L., 1758) is considered to be characteristic for ditches and small ponds which temporarily dry out during the summer. As such ditches can be found everywhere in this country and the species on the other hand is rather uncommon, it is clear that the usual definition of the habitat must be incomplete and other factors as well must be involved in determining the local distribution of *A. hypnorum*. For this reason the distribution of the species in Zuid Beveland was investigated to find a correlation between its distribution and some ecological factors, such as soil, degree of dessication and salinity.

KUIPER (1944) in his enumeration of the non-marine mollusca of Zeeland does not record *A. hypnorum* from Zuid Beveland. The species, however, is rather common there and this increases the value of a comparison of the distribution map with detailed soil and salinity maps, the working-method used in this investigation.

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LIST OF LOCALITIES:

In Zuid Beveland *A. hypnorum* has been found in 29 localities, which are listed below. The number of each locality refers to the number on the distribution map (Fig. 1).

1. Ditch along the Frederikadijk east of Krabbendijke, 5-VI-1962.
2. Ditch along the railway in the Nieuw Krabbendijkse polder near Krabbendijke, 15-V-1962.
3. Yerseke, ditch in the Molenpolder (see Den Hartog & De Wolf, 1962).
4. Yerseke, drinking pool for cattle in the Bernhardstraat, 2-III-1961.
5. Yerseke, in ditch along the Zoute Weg, 15-V-1962.
6. Yerseke, ditch along the Breedse Dijk, 23-VI-1961, 2-V-1962.
7. Wemeldinge, ditch along the Breede Weg, 15-V-1962.
8. Kapelle, ditch along the Hillewerfweg, near the Plasweg, 2-V-1962.
9. Kapelle, Den Bok, ditch, 4-VI-1962.
10. Biezelinge, ditch between "Veldzicht" and "Smokkelhoek", 4-VI-1962.
11. Biezelinge, ditch along the Eversdijkse Weg, 8-V-1962.

12. Kloetinge, Noordeinde, in ditch, 2-V-1962.
13. Goes, ditch along the Pijkesweg, 15-V-1962.
14. Goes, ditch near the Television tower, 8-IV-1962.
15. 's Gravenpolder, ditch in the Oosterzwakepolder, opposite the Nieuwe Hoondertpolder, 13-V-1962.
16. Wilhelminapolder, ditch along the Oude Zeedijk, opposite the "Blauwe Wijk", 8-V-1962.
17. Wolphaartsdijk, ditch along the Oostweg, opposite the Oosterschenge, 28-IV-1962.
18. Wolphaartsdijk, ditch in the western part of the Perponcherpolder, 8-V-1962.
19. Wolphaartsdijk, ditch near Oost Nieuwland in the Oosterlandpolder, 9-V-1962.
20. Wolphaartsdijk, ditch in the eastern part of the Nieuw Sabbingepolder, 8-V-1962.
21. Wolphaartsdijk, ditch along the Nieuwe Veerweg near the junction with the Bolleweg, 9-V-1962.
22. Ditch in the Westerlandpolder west of Oud-Sabbinge, 13-IV-1961.
23. Lewedorp, ditch in the West Kraayertpolder near the railway, 9-V-1962.
24. Lewedorp, ditch near the former railway-station, 4-VI-1962.
25. Nieuwdorp, ditch along the Noord Kraayertse weg, 9-V-1962.
26. 's Heer Arendskerke, ditch north of the main road, 8-V-1962.
27. Ditch along the main road Heinkenszand-'s Heerenhoek, 15-V-1962.
28. Ovezande, ditch in the south-western part of the Louisepolder, 3-V-1962.
29. Ovezande, ditch south of the Kruiningerpolder, 24-VII-1962.

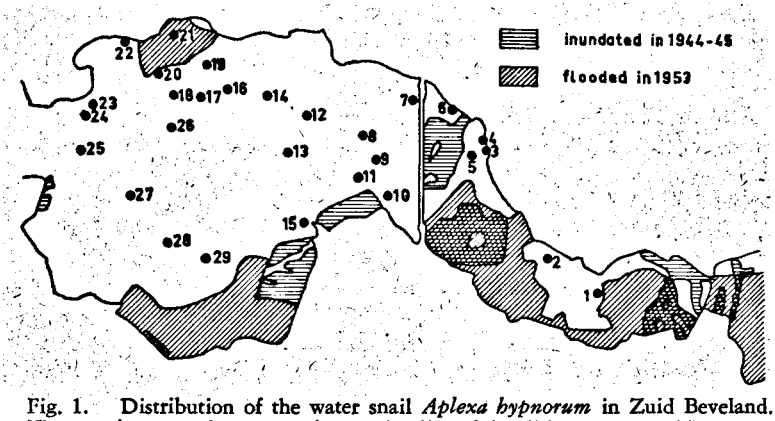

Fig. 1. Distribution of the water snail *Aplexa hypnorum* in Zuid Beveland. The numbers on the map refer to the list of localities on p. 8. The areas inundated with salt water in 1944-45 or 1953 are indicated by hatching.

DISTRIBUTION OF *Aplexa hypnorum* IN RELATION TO THE SOIL

According to the very detailed soil map of the Netherlands (1960, map 7) 10 different types of soil occur in Zuid Beveland. These are described in Table 1, in accordance with the legends of this map,

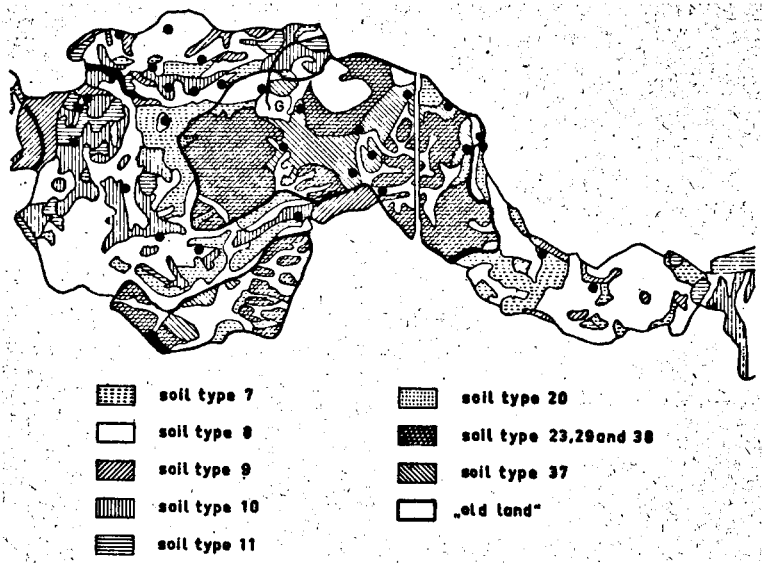

Fig. 2. Soil map of Zuid Beveland (according to the Soil Map of the Netherlands) and the distribution of *Aplexa hypnorum*. The "old land" is outlined with a heavy line. G is the town of Goes.

and mapped in Fig. 2. A comparison of the soil map with the distribution map of *A. hypnorum* shows that this species has a marked preference for some types of soil, as although it was found 15 times on type 8 and 8 times on type 37 it could not be found on the types 9, 11, 23, 29 and 38, even though it was carefully looked for. Only type 20 which is very rare in the region was not studied.

The types 23, 29 and 38 have in common the fact that the superficial layers are resting on salty peat or heavy sea clay. They are known as the "poelgronden" and are characterized by their unfavourable water balance. The phreatic level lies in winter close to the surface and in summer because of the impermeable subsoil it falls only some decimeters. Moreover, as a result of the salty subsoil the water in the ditches is always more or less brackish.

The species has not been found on heavy sea clay (soil type 9), which is unsuitable for it, as, although the yearly fluctuation of the water level in this type is better balanced, the ditches contain mostly brackish water. On the light soils *Aplexa* is found only occasionally. It has been found on clayey sand and on clay resting on clay-poor sand but only when the clayey layer was thicker than 50 cm

Table 1:
SURVEY OF THE SOILS IN ZUID BEVELAND, ACCORDING TO THE SOIL MAP OF THE NETHERLANDS (1960), AND THE FREQUENCY OF APLEXA HYPNORUM IN RELATION TO THE SOIL.

Soil type Number	Description	Number of Aplexa localities
	More or less calcareous, humus-poor or at a slight depth moderately humose, young sea-clay soils which are homogeneous or become lighter with increasing depth.	
7	Clayey sand and very sandy clay	2
8	Moderately sandy and light clay	15
9	Heavy clay	-
10	Complex of clayey sand to clay resting on clay-poor sand at 50-80 cm depth	4
11	Complex of clayey sand to clay resting on clay-poor sand at less than 50 cm depth	-
	Shallowly non-calcareous, humus-poor or at a slight depth humose, young sea-clay soils.	
20	Moderately sandy and light clay which is homogeneous or becomes lighter with increasing depth	-
23	Sandy clay and clay resting on heavy clay or peat, at 60-100 cm depth	-
29	Shallowly humus-rich to peaty clay becoming lighter with increasing depth and resting on a heavy subsoil	-
	Non-calcareous (or occasionally slightly calcareous below 50 cm depth), humus-poor or shallowly humose, young sea-clay soils.	
37	Sandy clay and clay resting on more or less slowly permeable clay beginning within 60 cm depth	8
38	Heavy clay resting on peat at a depth between 40 and 80 cm, occasionally deeper	-

(soil type 10). On soil type 7, which covers a considerable area, the species has been found only twice. On these light soils the desiccation in summer is considerable, as the phreatic level may fall to 2 m below ground level, and the water-fixing capacity of these soils is low.

The soil types 8 and 37 which are favoured by *A. hypnorum*, have in common the fact that they consist of sandy and light clay. The water-fixing capacity of these soils is high enough to enable the resting stages of *Aplexa* to survive the summer drought even when the phreatic level falls considerably.

The species does not seem to be very sensitive to the lime-content of the soil and of the water. Soil 8 is more or less calcareous, soil 37 in contrast non-calcareous. MACAN (1949, p. 42) classifies the species amongst the soft-water species, which in contradiction to the name of the group "are found in hard as well as in soft waters".

When the soils of Zuid Beveland are classified according to their origin two landscapes may be distinguished. The "old land" (comprising the oldest parts of the former island) consists of two different elements, the "poelgronden" and the "creek-ridge soils". The "poelgronden" (types 23, 29 and 38) were originally the highest areas but in the course of centuries they have become the lowest ones as a result of the continual shrinking of the peaty and clayey subsoil. The creek-ridge soils (types 8 and 37) represent the former creek beds, where the peat has been eroded and sand has been accumulated. These soils are now the highest in the landscape of the "old land" (EDELMAN, 1960). In Fig. 2 the main creek-ridge from Wemeldinge through Kapelle to 's Gravenpolder and Goes is easily recognizable, as is a second ridge running from Yerseke in a south-western direction. On the "old land" *A. hypnorum* occurs on the creek-ridge soils only.

The northern and western as well as the eastern part of the area are considered to be the "new land", as they were reclaimed after the 12th century, mostly even since the 17th century. These soils are known as the "young marsh soils" ("schor"- and "plaat-gronden") as they were originally salt-marshes and mud-flats. The composition of these soils varies from clayey sand to heavy clay. On the new land *A. hypnorum* obviously prefers the moderately sandy and light clay (type 8) to the lighter (types 7 and 11) and heavier (type 9) clayey soils.

DISTRIBUTION OF *Aplexa hypnorum* IN RELATION TO SALINITY:

Salinity is a very important factor for the delimitation of the area of distribution of *A. hypnorum* in Zuid Beveland as large parts

of this former island are more or less brackish. Therefore, a comparison of the distribution map of the species with the salinity maps, published by VAN 'T LEVEN, VAN DER WEERD and LINDENBERGH (1958) in their paper on the agricultural water economy in the province of Zeeland, may give valuable indications about the salt tolerance of the species. These salinity maps were prepared according to the circumstances in the years 1951-54, and for the areas flooded in 1953 only according to the situation in the years 1951-52. In the salinity map, reproduced in Fig. 3, I have made some alterations so that it will represent better the present circumstances. As the ditches in which *A. hypnorum* occurs dry up during the summer only a comparison with the winter salinity map is necessary. The result of the comparison is given in Table 2.

Table 2:

FREQUENCE OF *Aplexa hypnorum* IN RELATION TO SALINITY EXPRESSED IN ‰ Cl'

Salinity	Number of localities
< 0.3	12
0.3 — 1.0	11
1.0 — 2.5	6
> 2.5	0

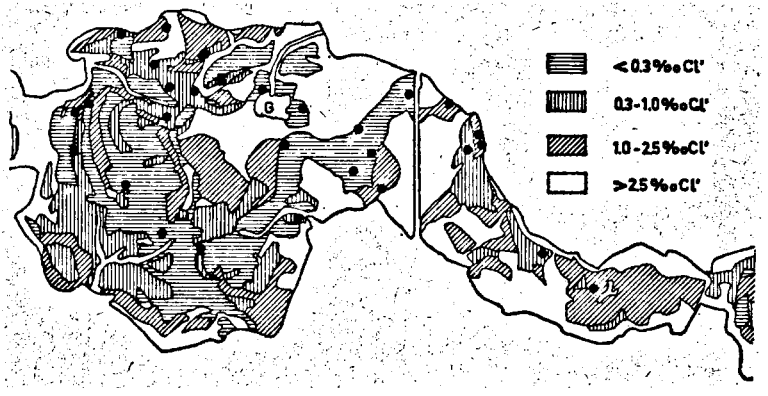

Fig. 3. The salinity in winter in Zuid Beveland (modified after Van 't Leven, Van der Weerd & Lindenbergh, 1958) and the distribution of *Aplexa hypnorum*. G is the town of Goes.

On the salinity map 23 of the 29 localities have a salinity below 1 ‰ Cl′ and in the other localities it is between 1 and 2.5 ‰ Cl′. These data agree very well with my own observations. The highest salinity ever measured by me in an *Aplexa* locality was 1.85 ‰ Cl′. Therefore, *A. hypnorum* has to be regarded as a characteristic species for the oligohaline brackish water as well as for the fresh water.

When Fig. 2 and Fig. 3 are compared it is evident that in the "old land" a correlation exists between soil type and salinity. The creek-ridge soils contain fresh or slightly oligohaline water even in summer, while in contrast the water of the "poelgronden" is much saltier. A correlation between salinity and soil does not exist in the "new land" polders. There are many places where the soil composition seems suitable for *A. hypnorum* but where salinity is too high for it.

As *A. hypnorum* has a low salt tolerance the inundations with brackish and sea water during the last 20 years must have greatly affected its distribution. In 1944-45 several polders in the eastern and southern part of Zuid Beveland were flooded deliberately by the Germans (WESTERHOF, 1947) and later, as a consequence of the storm flood of February 1st, 1953, extensive areas were flooded by sea water (Fig. 1). In the areas which were covered by salt water now salinity has returned to "normal" and reestablishment of the fresh-water fauna is taking place. *A. hypnorum* was found only in one place (21) amongst the recolonising species. Now, 10 years after the inundation, it is plentiful in this locality. Although in several other places in these formerly inundated areas the ecological circumstances seemed to be suitable for the species it has not been found. It is striking that in the eastern part of Zuid Beveland where the flooding was most serious the species was found only in the vicinity of Krabbendijke (1, 2) and Yerseke (3-6), the only areas which remained dry.

DISCUSSION:

A. hypnorum occurs only in places where soil composition and salinity are favourable for it. Using the data of Figs. 2 and 3 a map was drawn showing the supposed area of *A. hypnorum* in Zuid Beveland (Fig. 4). All areas with soil types 7, 8, 10 or 37 and where salinity does not exceed 2.5 ‰ Cl′ in winter were considered favourable for the species.

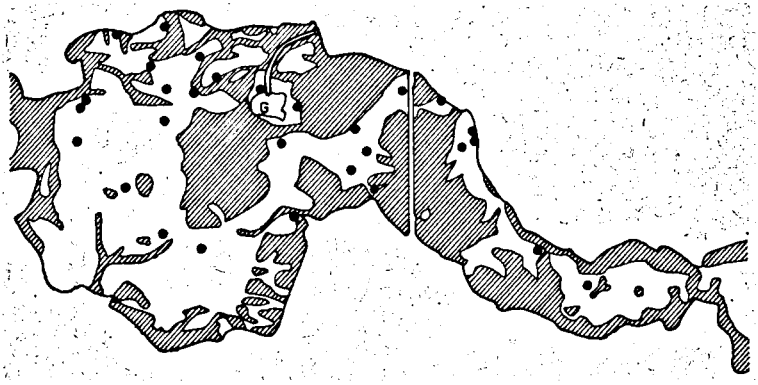

Fig. 4. The supposed distribution of *Aplexa hypnorum* in Zuid Beveland. The areas which are unsuitable for *Aplexa hypnorum* are indicated by hatching. G is the town of Goes.

It appears from this map that although circumstances seem favourable *A. hypnorum* is far less frequent in the western and south-western part of the "new land" of Zuid Beveland than in the northern part of the area. Several factors seem to be responsible for its scarcity in the former region. According to the desiccation map of VAN 'T LEVEN, VAN DER WEERD and LINDENBERGH (based by them on the practical experience of farmers and on information from agricultural research services) desiccation of the soil is considerable in the south-western and western part of Zuid Beveland. In summer the phreatic level lies generally 1½-2 m below ground level. The soil becomes lighter with depth and many ditches are deeper than the superficial clayey layer of the profile. Ditches with a sand bottom seem to be unsuitable for *A. hypnorum*, as my collaborators and I did not succeed in finding it in such biotopes.

The creek-ridge soil in the area of Wemeldinge, Kapelle and Biezelinge is regarded as being dry with a deep phreatic level in summer. In this connection it is noteworthy that the sites, in which *A. hypnorum* was found there, are all situated in the marginal part of the creek-ridges. This is clearly demonstrated in Figs. 2 and 3.

The reparcelling of the fields for the improvement of the yield is another factor which no doubt exercises its influence on the distribution of *A. hypnorum*. The "old land" in the southern part of Zuid Beveland was flooded and reclaimed in 1953, and reparcelled in the subsequent years. Although according to Fig. 4 some parts of this area seem suitable for the species, the new and more rational parcelling out of the fields has resulted in a decrease in number of

ditches which dry out in summer and in which *A. hypnorum* lives by preference.

The improvement of the water discharge system in the eastern part of Zuid Beveland is probably the reason why *A. hypnorum* did not extend into the previously flooded areas.

Another factor which is certainly of importance is water-pollution. According to my observations the species tolerates a rather strong contamination with household refuse but no data are available about the influence of industrial waste. The influence of pollution by agricultural poisons is difficult to trace.

Although the investigation has only been carried out in Zuid Beveland, the results are probably representative for the whole south-western part of the country, as the soil conditions there are very similar. In other parts of the country where pedological circumstances are quite different and where salinity does not play a deciding part in the presence or absence of *A. hypnorum* a study of the demands of the species has to be made. Nevertheless, I expect that the species will occur there also on more or less clayey soils.

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BODEMKAART VAN NEDERLAND 1:200,000 (Soil Map of the Netherlands), 1960, map 7. Soil Survey Institute Wageningen.

SAMENVATTING

Het waterslakje *Aplexa hypnorum* (L., 1758) is algemeen op Zuid Beveland in modderige slootjes die in de zomer uitdrogen. Het werd er op niet minder dan 29 plaatsen gevonden. Een vergelijking met de bodemkaart van Nederland leert, dat er een nauwe correlatie bestaat tussen de verspreiding van de soort en de diverse bodemtypen. Zo werd ze hoofdzakelijk gevonden in de typen 8 en 37, en minder frequent in de typen 7 en 10, maar in het geheel niet in de typen 9, 11, 23, 29 en 38. Uit deze gegevens blijkt, dat de soort een zavelige bodem verkiest. Zware klei alsmede zandige gronden worden vermeden. Eveneens blijkt uit de gegevens, dat de dieren ten opzichte van het kalkgehalte van de bodem indifferent zijn.

Op het „oudland" (de oorspronkelijke kernen van Zuid Beveland) komt *A. hypnorum* slechts voor op de zavelige, diep ontwaterde kreekruggronden; in de zware, natte poelgronden ontbreekt ze. Op het „nieuwland" is de soort slechts verspreid op de zavelige schorgronden.

A. hypnorum komt slechts voor in zoet en oligohalien brak water. Het hoogste zoutgehalte, waarbij ze werd aangetroffen, bedraagt 1,85 ‰ Cl′. In de gebieden, welke in 1944-45 en/of in 1953 overstroomd werden met zout water, ontbreekt de soort vrijwel geheel. Slechts op één plaats werd rekolonisatie waargenomen. Het niet terugkeren van de soort in deze gebieden wordt toegeschreven aan herverkaveling en verbeterde waterhuishouding. Ook het spaarzame voorkomen van *A. hypnorum* in het zuiden en zuidwesten van Zuid Beveland hangt samen met de diepe ontwatering van dit gebied; hierdoor liggen de slootbodems vaak dieper dan de oppervlakkige kleilaag, waardoor ze voor het slakje ongeschikt worden.

Verontreiniging van het biotoop met huisvuil wordt door *A. hypnorum* goed verdragen. Over de invloed van fabrieksafval en landbouwvergiften werden geen gegevens verzameld. De laatste zullen evenwel zeker plaatselijk een ongunstige invloed op de slakkenpopulaties uitoefenen.