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Hyala vitrea (Montagu, 1803) (Caenogastropoda, Iravadiidae), new for the Dutch coastal fauna

P. DE WOLF

Netherlands Institute for Sea Research, P.O. Box 59, NL 1790 AB, Den Burg, Texel, The Netherlands [e mail: pdw@nioz.nl]

Since 1978 living *Hyala vitrea* have been collected on the Oyster Ground (North Sea) and in 1997 at four stations near the Frisian Islands. Empty shells of this species were discovered in shell grit from the beach of Texel (The Netherlands) in 1993 and 1998. Data from the literature indicate that the species generally has a patchy distribution. *H. vitrea* is rare in beach samples. It is argued, following Jeffreys (1867), that post-larvae and adult animals use mucus drifting for their dispersal.

Keywords: Gastropoda, Iravadiidae, *Hyala vitrea*, North Sea, mucus drifting

INTRODUCTION

Four empty shells of *Hyala vitrea* (Montagu, 1803) (Iravadiidae) were found in beach drift collected on Texel, near the Hoornderslag, at beach post 10, on 10.ii.1998; an additional adult and a juvenile specimen were found in a sample of shell grit taken 400 m more to the north on 26.iv.1998. Later on it turned out that four shells and a fragment had been collected by Raad, at the same place on 21.vi.1993, also in beach drift (Raad, 1994; Verkuil, 1994; Dijksen-Overbeeke, 1995).

It cannot be excluded that the shells have been carried to the beach by currents or with dredged sea sand; in that case they could be Eemian fossils. However, although the apices of the shells are slightly eroded, they are shiny and clear and this indicates Recent material. Furthermore, Raad's shells have been found in 1993, before from elsewhere sand had been added to the beach in 1994.

Shells of *Hyala vitrea* are very rare on the Dutch coast, and living animals are not reported from the coastal waters. In the literature they are not mentioned (Van Benthem Jutting, 1933; Van Regteren Altena, 1937; Kaas & Ten Broek, 1942; Eisma, 1966; De Boer & De Bruyne, 1991). Empty shells had never been mentioned for Texel before 1994 (not in Kaas, 1948; Visser et al., 1967). Janssen (1975) stated that the species does not belong to the Dutch fauna. Fossil *H. vitrea* have been found in the Netherlands: one young-Pleistocene specimen was mentioned by Van Regteren Altena et al. (1954) from Ritthem (Walcheren). Spaink (1958) found about 100 Eemian specimens in North Sea sand, supplied to Slotermeer and Slotervaart in Amsterdam West, and De Bruyne (personal communication) found one shell at the beach of Ouddorp (Goeree). De Bruyne et al. (1994) regard the species as fossil and transported to the coast. The aim of this paper is to argue that *H. vitrea* does belong to the Recent Dutch fauna.

ON THE NAME OF *HYALA VITREA*

Montagu (1803) described this species under the name *Turbo vitreus*. Later authors used *Rissoa vitrea*, *Onoba vitrea*, *Cingula vitrea*, and *Hyala vitrea*. Various generic assignments are still in use. Thus for example Nordsieck (1968) and Poppe & Goto (1991) cite *Cingula vitrea* and Seaward (1982, 1990) refers to *Onoba vitrea*, whereas Ankel (1936) had already used *Hyala vitrea*. According to Howson & Picton (1997), *Hyala vitrea* is the correct name. Daan et al. (1990) incorrectly used *Cingula nitida*. According to De Bruyne et al. (1994) the species has two Dutch names, viz. "doorschijnende spiraalhoren" and "glasachtig drijfhorentje".

DESCRIPTION

Hyala vitrea is a small prosobranch gastropod from the family Iravadiidae (Rissoacea). Shells are 3 mm (Graham, 1988) or 4 mm (Nordsieck, 1968) high, and 1.5 mm broad. The shells found on 10.ii.1998 (figs 1-2) have a height of 3.0, 2.8, 2.5 and 1.9 mm, respectively. They are rather transparent, slender, cyrtoconoid and have a deep suture. The last whorl takes 63-67% of the shell height and the aperture 32-33.4%. At a magnification of 36x, very fine costae and a mere indication of spiral striae can be seen. Jeffreys (1867: 40) indicated that the species has "extremely fine regular and close-set spiral striae". Living snails from off-shore areas very often carry an iron-oxyde coloured deposit on their shells, similar to that on the bivalve *Montacuta ferruginosa* (Montagu, 1808) (see also Gillan & Cadée, 2000).

Using Graham (1988: 206, fig. 78) for identification gave a few difficulties. The key mentions for *Hyala vitrea* a "pointed apex" and the figure shows such an apex indeed. According to the main text, however, the shell has "a flattened, blunt apex", and "a rather blunt apex". In our material (figs 1-2) the apex is more like that figured for *Ceratia proxima* (Forbes & Hanley, 1850) by Graham (1988: fig. 79). However, in *C. proxima* the spiral ridges are much more prominent than in *H. vitrea*.

DISTRIBUTION

According to Nordsieck (1968), *Hyala vitrea* lives in European seas at depths of 10-120 m, and Poppe & Goto (1991) mentioned the species from Norway southwards to the Mediterranean. Ankel (1936) found empty shells in the neighbourhood of Helgoland and reporded *H. vitrea* from along Norwegian and Swedish North Sea coasts as far as the Kattegat. Thorson (1946), however, mentioned that the species is very common in the SE Kattegat as far as Hornbæk. Ziegelmeier (1966: 34) summarized the distribution as English eastcoast, Kattegat, Norwegian coasts, and from the European Atlantic coasts to the Mediterranean.

Montagu (1803) described *Hyala vitrea* as a rare species from Whitsand Bay (Cornwall, between West Looe and Devonport). Forbes & Hanley (1850: 126) called it "scarce and local", and remarked that the snails live mainly in deeper water (two records from 40 fathoms). Jeffreys (1867: 41) gave 14 localities in English and Irish waters, and noted that the animals occur locally on mud bottoms "in the coralline zone", and rather rare. The Marine Biological Association (1957) reports empty shells for Torbay and Ply-

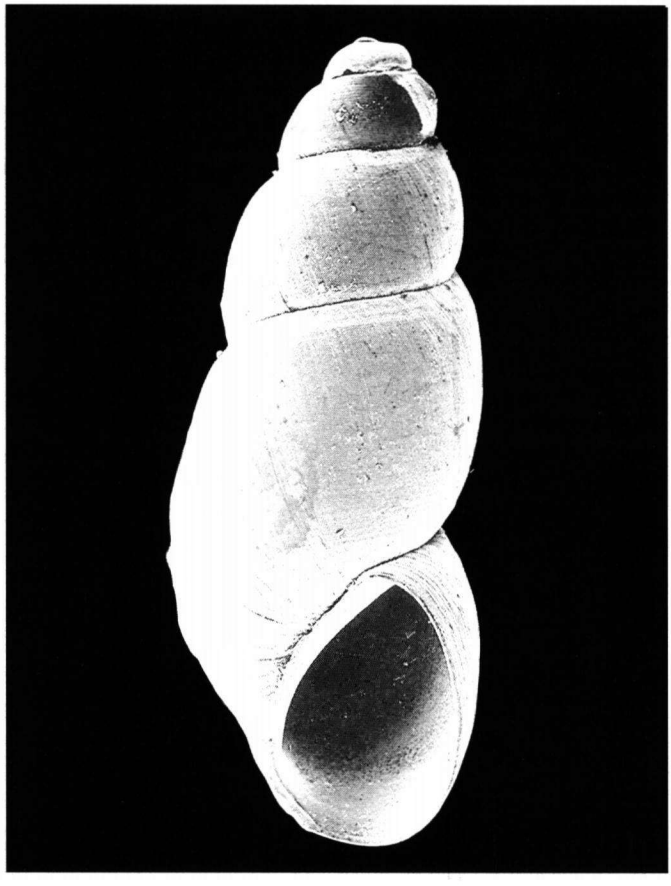

Fig. 1. *Hyala vitrea*, SEM-photograph (36 x). Note the very fine spiral striae.

mouth, at a depth of 15-20 fathoms, but Hayward & Ryland (1990, 1995), in their handbooks on the marine fauna of NW Europe did not mention a *Hyala* species. Bachelet et al. (1990) reported *H. vitrea* for the Chenal de Courbey, near Arcachon, on a bottom of fine sand with much silt, at a depth of 5-6 m.

It appears that *Hyala* has become rarer since Jeffreys' days. Graham (1988) noted that the species has been found recently only at a few places in Scotland and west of Ireland. Seaward (1982) indicated five areas with living animals (S5, S7, S9, S29, S36) and 18 with empty shells only. Later on, after 1982 (Seaward, personal communication, 1999) living animals were found additionally in areas S25, S38 en S50. Most recently, Smith (1999) mentioned *H. vitrea* from the Firth of Lorn (Scotland), and remarked that the species "is surprisingly rare elsewhere". Thorson (1946) stated that in Denmark it is very common in the SE Kattegat, but Jensen & Knudsen (1995) gave only one locality, in the northern part of the Sont (which is presumably why Seaward records *H. vitrea* for area S50).

DISTRIBUTION ON THE DUTCH PART OF THE CONTINENTAL SHELF

As will be shown, contrary to the relative scarcity around the United Kingdom, *Hyala vitrea* is numerous on the Oyster Ground and the Frisian Front. These data, obtained from colleagues at the Netherlands Institute for Sea Research (NIOZ) are nearly all about living specimens, and are largely unknown in the faunistic literature.

Cadée (1984) was the first to collect living *Hyala. vitrea* in 1978 on the Oyster Ground (fig. 3) with a Van Veen grab of 0.18 m². He found the snails in 9 of 21 stations, with a mean population density 29/m². All localities have a bottom rich in silt, and depths of over 30 m. *H. vitrea* was not found in the shallower, sandy stations, which are poorer in silt. In samples obtained with a Reineck Boxcorer of 0.06 m² in 1979 he observed densities in stations 6 and 12 of 97 and 75 living *H. vitea* per 10 cores (= 0.6 m²), that is 161/m² and 125/m², respectively (Cadée, 1984). In station 6, in addition to the living animals, 93 empty shells were found, but none at station 12. The data of boxcores and Van Veen grabs show that in 40 of 80 samples no *H. vitrea* were found. Many of the positive samples have low numbers of *H. vitrea*, and only a few have higher numbers (table 1).

Station	Period	Number of samples	Number of positive samples	Number of shells	
				Range	/ total
6	Oct.-Nov. '78	5 Van Veen	5	3-9	24
12	Oct.-Nov. '78	5 Van Veen	2	11-13	24
6	May 1979	10 boxcores	3	1-4	6
6	Sept. 1979	10 boxcores	5	1-12	25
6	Oct. 1979	5 Van Veen	5	1-13	39
6	Oct. 1979	10 boxcores	2	1-2	3
12	March 1979	5 boxcores	2	1-2	3
12	May 1979	10 boxcores	6	1-5	13
12	Sept. 1979	10 boxcores	7	1-9	21
12	Oct. 1979	10 boxcores	3	1-2	4

Table 1. Numbers of *Hyala vitrea* in Van Veen grabs and boxcores at stations 6 (54°15' N, 4°20' E) and 12 (53°45' N, 4°20'E) (Cadée, 1984; Cadée, personal communication, 1999).

A series of NIOZ-reports (Mulder et al., 1987, 1988; Daan & Mulder, 1995; Daan et al., 1990, 1991, 1992, 1993, 1995) on the effects of oil and gas mining on the bottom fauna, contains data on *Hyala vitrea*. Samples were taken at distances varying from 0 to 5000 m from platforms L4a, L5.5, K12a, F18.8 en F18.9 (fig. 3); on the more southern platforms K14.13, and P6b no *H. vitrea* was found. At all platforms samples were taken in a standard pattern; eight stations at distances from 0 to 5000 m on a transect downstream the residual current, and six stations at 0-3000 m on a transect beginning at the platform and perpendicular to the first transect. The number of samples (Van Veen grabs of 0.2 m²) per station varied from 3 to 10. The mean densities found per station are given in table 2. *H. vitrea* was found in 203 out of 956 Van Veen grabs. On most stations the number of negative samples prevailed, but on a few stations *H. vitrea* was found in all samples.

Platform	Period	Positive samples	Negative samples	Mean number/m² in positive stations	Authors
L4a	May 1986	34	64	0 - 17	Mulder et al., 1988
	Sept.1986	10	28	0 - 45	Mulder et al., 1988
	Febr. 1987	11	19	0 - 15	Daan et al., 1990
	June 1987	8	40	0 - 3.0	Daan et al., 1990
		1	27	0.8	Daan et al., 1990
	July 1994	33	9	7.4 - 21.3	Daan & Mulder, 1995
L 5.5	May 1989	39	15	4.2 - 19.2	Daan et al., 1991
	April 1990	12	40	0 - 17.5	Daan et al., 1992
K12a	1985	0	62	--	Mulder et al., 1987
	Sept. 1986	0	47	--	Mulder et al., 1988
	Sept. 1987	1	36	0.5	Daan et al., 1990
		0	24	--	Daan et al., 1990
	Sept. 1988	1	29	1,0	Daan et al., 1990
	Sept. 1992	1	47	0.6	Daan et al., 1993
F18.8	May 1986	12	48	0 - 0.3	Mulder et al., 1988
F!8.9	June 1988	19	37	0.6 - 20	Daan et al., 1990
		21	31	0 -18.6	Daan et al., 1990
K14.13	July 1993	0	30	--	Daan et al., 1995
P6b	1985	0	82	--	Mulder et al., 1987

Table 2. Densities of *Hyala vitrea* near drilling platforms in the North Sea. Positions of the platforms are given in fig. 3.

More data on *H. vitrea* can be found in NIOZ-reports on the zoobenthos of the Dutch part of the continental shelf (for references, see table 3). Duineveld (1992) and Duineveld & Belgers (1993, 1994) found *H. vitrea* at three stations on the Oyster Ground; they collected five boxcores at each station on an (estimated) area of 100 m² (fig. 3). Holtmann et al.(1996a, b) mention *H. vitrea* from seven localities, but found later a great number of further stations (Holtmann, 1996a, b, 1997, 1998). Holtmann's stations are indicated in fig. 3 and the data (one boxcore of 0,068 m² per station) in table 3.

Year	Area	Number of stations neg.	pos.	Author(s)
1991	Dutch part of shelf	24	1	Duineveld, 1992
1992	Dutch part of shelf	23	2	Duineveld et al., 1993
1993	Dutch part of shelf	24	2	Duineveld et al., 1994
1988	Southern Bight	177	0	Groenewold et al., 1989
1989	Wadden coast	121	0	Groenewold et al., 1990
1991	Oyster Ground and Frisian Front	81	1	Holtmann et al., 1992
1992	Broad Fourteens	28	0	Holtmann & Groenewold, 1994
1992	Brown Bank	29	0	
1993	Western Frisian Front	29	0	
1995	Dogger Bank	7	0	Holtmann et al., 1996a, b
1995	Oyster Ground	32	10	
1995	Offshore	36	0	
1995	Coast	15	0	
1996	Dogger Bank	7	0	Holtmann et al., 1997
1996	Oyster Ground	25	17	
1996	Offshore	36	0	
1996	Coast	12	0	
1997	Dogger Bank	7	0	Holtmann et al., 1998
1997	Oyster Ground	30	12	
1997	Offshore	35	1	
1997	Coast	9	3	

Note: Duineveld sampled 24 stations, four of which were located on the Oyster Ground.

Table 3. Numbers of positive and negative stations of living *Hyala vitrea*.

DISCUSSION

The distribution on the Dutch part of the continental shelf

From the results of Cadée (1984), Duineveld et al. (1992, 1993, 1994), Daan & Mulder (1990, 1991, 1992, 1993, 1995), Daan et al. (1995), Mulder et al. (1987, 1988), and Holtmann et al. (1994, 1996a, 1996b, 1997, 1998) follows that the distribution of *Hyala vitrea* on the Dutch part of the continental shelf in de period 1980-1997 was nearly limited to the area on the Oyster Ground north of the 30 m isobath. In 1997 the species was also found at five stations near the Frisian Islands.

In all other areas, viz. Southern Bight, Wadden Coast, Broad Fourteens, Brown Bank

Fig. 2. *Hyala vitrea*, shell with a deep suture; height 2.8 mm.

and Dogger Bank, *Hyala vitrea* was not even found at nearly a thousand stations. Furthermore, on the Oyster Ground the species is not really common. The, by far, highest density found is 59/0.068 m². However, *H. vitrea* has been found in three new 'atlas areas' of the British Conchological Society (Seaward, 1982, 1990), viz. S10 Dogger, S51 German Bight, and S52 Texel.

Patchy distribution

The authors cited above used sampling schemes with varying length-scales. Sampling at sea, either by Van Veen grab, or by boxcorer, is subject to considerable variation in place. In earlier years the positioning of the ship itself was not better than hundreds of meters; after introduction of satellite navigation and Dynamic Positioning of the ship, this became much better (to about 2.5 meter). But still the sampling device at the end of a 30 m long line can be out of place. Duineveld (1992) estimates that his five replicates are usually within an area of 100 m². Cadée (1988) sampled from a free floating ship returning to the same position after each sample, and estimates that the area from which a series of samples was taken is > 300 m² (Cadée, personal communication). From 1990 on Daan & Mulder used Dynamic Positioning. Even that could be problematic, as it happened (though only once) that a second core was taken from an earlier hole (Daan, personal communication). Holtmann took one boxcore at each station, and worked on the Oyster Ground approximately 45 stations on an area of 1200 km²; the mean distance between her samples is thus 5-6 km.

Thus the sampling schemes used varied a great deal. But in all schemes it is clear that there are a very large number of samples without *Hyala vitrea*, a high number of samples with a low number of these animals and only very few with relatively high numbers of *H. vitrea*. This is sufficient to assume a patchy distribution of *H. vitrea* at each scale of sampling (De Wolf, 1989, 1996).

The numbers of *Hyala vitrea* per sample vary from 1 to 59 animals per 0.06 m². Holtmann sampled 42 stations three times, and found *H. vitrea* at 10, 12 and 17 of these stations, respectively. It must be noted that these are partly the same places in different

years. But the species was found (in one or more years) at 19 (out of 42) stations; at four stations in one year only, at ten stations in two years, and at five stations only in all three years. Holtmann had eight stations with densities of > 10 (to 59) animals per sample, and Duineveld found *H. vitrea* in three consecutive years at one station (out of four), and has one grab station of 12, 15, and 14 + 16 animals per 0.068 m² in three consecutive years, and, within the same 100 m², eight grabs with less than ten *H. vitrea* and three grabs with none. This suggests that at least at a few localities the population is rather stable.

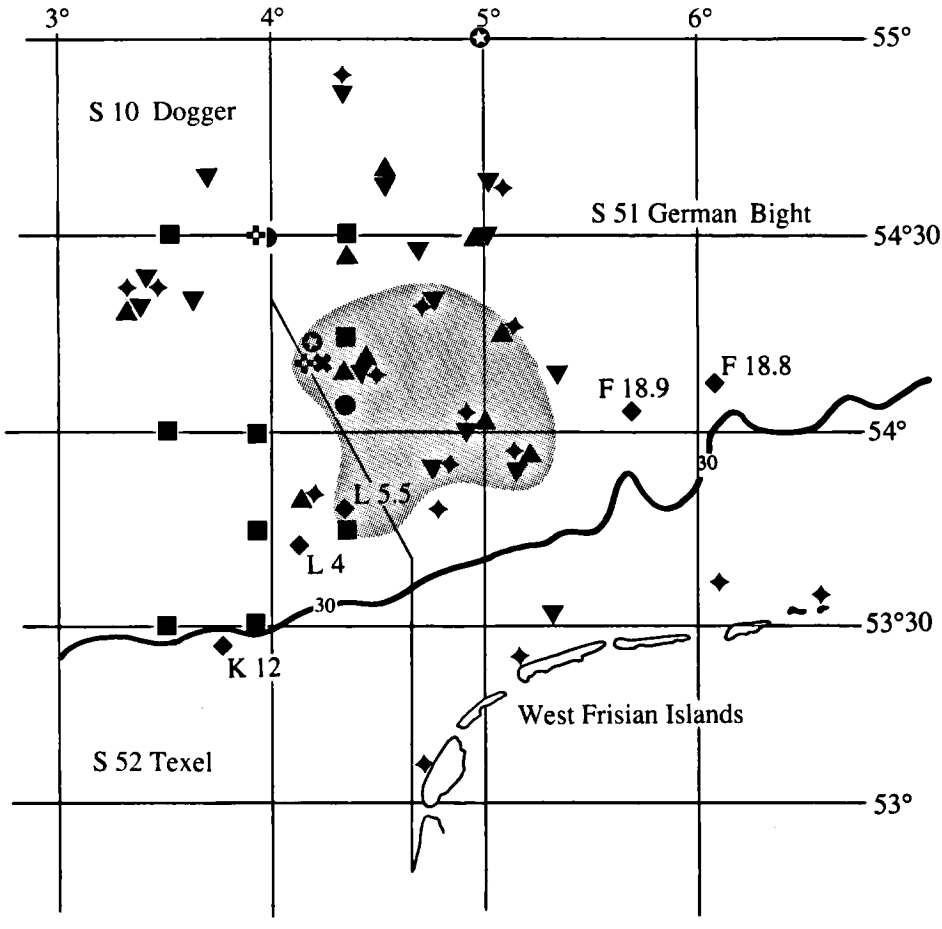

Fig. 3. Stations with living *Hyala vitrea*. Data after Cadée (1984, ■); Daan et al.. (1990, 1991, 1992, 1993, 1995) and Daan & Mulder (1995) (◆); Duineveld (1992, ✖), Duineveld et al. (1993, ✜) and Duineveld et al. (1994, ✪); Holtmann et al. (1991, ●); Holtmann (personal communication ◗); Holtmann et al. (1996, ▲); Holtmann et al. (1997, ▼), Holtmann, (1998, ✦). The areas marked "S 10 Dogger", "S 51 German Bight" and "S 52 Texel" are 'atlas areas' after Seaward (1982, 1990). The 30 m isobath is indicated. The shaded area contains all samples with a density > 9 *Hyala vitrea* per 0.068 m².

All samples with high (>10 *Hyala vitrea*) densities, from all authors, are located in a relatively small area around 5 °E and 54 °N (see fig. 3), but also in this area there are many stations with low densities, or no *H. vitrea* at all. Therefore, it must be concluded that despite the large efforts, in terms of ship time and personnel, more accurate results cannot be obtained for scarce and patchily distributed organisms, as has been argued earlier for other species (De Wolf, 1989).

The occurrence near the Frisian Islands.

Holtmann (1998) discovered living *Hyala vitrea* in 1997 at four stations in North Sea coastal waters off Texel, Terschelling and Schiermonnikoog, while the species had not been recorded at these stations in earlier years. Maybe this is the result of the interaction of a patchy distribution and the sampling scheme, but the very fact that this happened at four coastal stations at the same time is peculiar. Therefore I am inclined to assume that living *H. vitrea* can be transported over long distances from the place where it normally occurs, i.e. the Oyster Ground.

Jeffreys (1867: 41) noted that *Hyala vitrea* is "Very active, and suspends itself by a single byssal thread". He did not realize that what he observed was not byssus drifting but mucus drifting, but still was ahead of his time by nearly a century, as byssus drifting was (re)discovered only in the second half of the 20th century (Baggerman, 1953; De Blok & Geelen, 1958; Sigurdsson et al., 1976; De Blok & Tan-Maas, 1976; Cadée, 1989).

Snails of *Janthina* species even spend their entire life, hanging onto a mucus raft. Temporary mucus drifting has been described for *Hydrobia ulvae* (Pennant, 1777) by Newell (1962, 1964), but see comments by Vader (1964) and Little & Nix (1976). Cadée (1989) published a short review on the phenomenon. Lane et al. (1985) studied the structure of byssus threads, with a fibrous structure and a disc at the end, used for attachment, and the much longer mucus threads with a homogeneous structure, used for floating. There is by now a rather extensive literature on byssus drifting in juveniles and small specimens of a large number of species of Lamellibranchia, but Hooker (1995) found mucus drifting also in larger individuals of *Paphies australis* (Gmelin, 1792) , and three further species of bivalves. The majority of drifting *Paphies australis* were 4 - 20 mm long, but larger individuals were also found drifting, the largest being 58 mm. On the other hand, Cummings et al. (1995) found juveniles of many species as post-settlement drifters (all < 3 mm), among which the gastropod *Amphibola crenata* was most common. Sigurdsson (1980) observed byssus drifting in over 17 species of gastropods, and argued that "most bivalves and many gastropods do not loose their power of exploration at metamorphosis, but by means of byssusdrifting can go on searching for the right habitat for shorter or longer periods" and stated that for "Pyramidellidae searching for their hosts byssus drifting is likely more economical in terms of energy expenditure". Sigurdsson (1980) also cited earlier observations on the use of slime threads, pulished by Colgan (1909). Further examples of mucus drifting by gastropods were given by Vahl (1983) for *Helcion pellucidus* (L., 1758), Martel & Chia (1991) for *Lacuna vincta* (Montagu, 1803) and Armonies (1992) for *Hydrobia ulvae.* Martel (1988, 1991a,b) recorded 17 species (11 gastropods and 5 bivalves) drifting in the water column, seven of which have direct development. The species with direct development lack planktonic larvae, but nevertheless have a wide distribution. Thorson (1946) found that *Hyala vitrea* has planktonic larvae occurring in the Øresund from late August to early November. *H. vitrea* is thus also a species with more than one dispersal mechanism. It apparently has ample means of transport to explain its sudden appearance in Dutch coastal water near the Frisian Islands in 1997.

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