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Alderia modesta (Gastropoda, Sacoglossa) in northern Norway

WIM VADER

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The sacoglossan slug *Alderia modesta* is a common species in northern Norway. During the summer months it is characteristically confined to patches of *Vaucheria* on muddy substrates in a narrow belt around MHWN. Densities may be very high, up to 5000 per m^2. The seasonal periodicity of the species is still unknown and deserves further research, especially during the winter months.

Wim Vader, Tromsø Museum, Zoologisk Avdeling, N-9000 Tromsø, Norway.

INTRODUCTION

The sacoglossan slug family Alderiidae is monotypic (Gascoigne 1976); the number of valid species of the type genus, *Alderia* Allman, 1845 is uncertain (cf. Engel et al. 1940, Marcus 1977). Western European material has universally been identified as belonging to the type species, *Alderia modesta* (Lovén, 1844) (Fig. 1). Gould (1870) described *A. harvardiensis* from Massachusetts, but this taxon has by most authors been treated as synonymous with *A. modesta* (Marcus 1972). The late dr. Henning Lemche (Copenhagen) obviously intended to redescribe *A. harvardiensis* as a valid species on material from Disco, W. Greenland; an unfinished manuscript was found among his papers (H. Just, pers. comm.). Lemche also considered Canadian material, recorded by Bleakney and Bailey (1967) as *A. modesta*, to be *A. harvardiensis* (For a good photograph of a large male from this population, see Bleakney (1971)). The genus *Alderia* also exists on the Pacific coast of N. America, where it traditionally has been called *A. modesta* (Hand & Steinberg 1955, Steinberg 1963, Millen 1980).

In the eastern Atlantic, *A. modesta* is common along the coast of western Europe N. to Danmark and in the Baltic area (for references see Hartog 1959); recently it has also been shown to occur in Iceland (Sigurdsson 1979). Prior to the present investigation, the only published record from the Norwegian coast was one by Norman, (1893, see also Odhner 1940) who had found a single specimen near Rödberg in the outer Trondheimsfjord «in a shallow pool into which the sea only broke at spring tides». One further Norwegian record was found among Dr. Lemche's unpublished notes, viz. «Hunsøy (67°59'N, 15°24'E), near low water, several small specimens, 21. July 1966». (Fig. 2 loc. 2).

RESULTS

Occurrence and biotope in northern Norway

Alderia modesta was first discovered on the mudflats of Botn, Sør-Lenangen, Ullsfjord in Troms (Fig. 2 loc. 4) in August 1976. Here creeklets drain through a saltmarsh on to extensive mudflats with abundant *Hydrobia ulvae*. Although *Vaucheria* species are also common along the shallow pools and cattle tracks in the saltmarsh proper, *Alderia modesta* was restricted to *Vaucheria* mats on the muddy banks of the creeklets just below the saltmarsh proper, where they were common. Dr. A. Gascoigne (London) kindly corroborated my identification of the slugs and noted that virtually all specimens I had sent to him (c. 100) were of roughly the same size (c. 5 mm long in fixed condition) and probably immature.

During field-work in Troms and W. Finnmark in the summer of 1977 I paid special attention to the possible occurrence of *A. modesta* and the slugs were found in several localities, often in large numbers (Tab. 1, Fig. 2). Most biotopes were similar to the one in Botn: more or less extensive mats of *Vaucheria* on mudflats, usually around MHWN and along a creek or creeklet, at or slightly below the lower level of phanerogame growth (Fig. 3). I have never found *Alderia* more than 1 m from *Vaucheria* mats, but not all *Vaucheria* mats hold the slugs, even in apparently favourable habitat. Den Hartog

Fig. 1. The sacoglossan slug *Alderia modesta* and its egg-capsules (K. Felsted photo), c. 10 x magn.

(1959) has found differences between *Vaucheria* species in their suitability as food for *Alderia*; unfortunately, I have not been able to identify the *Vaucheria* species in the present study.

The substrate on which *Alderia* is found is almost invariably muddy; on very soft mudflats the species is confined to the slightly raised banks of the creeklets. The slugs are not found near the mouth of larger rivers with their delta of sandy or even gravelly sediment; in the Nordreisa deltaic area, for example, I have found *Alderia* only in the outermost and thus muddiest parts i.e. near Nordbotn and near the Sørkjosen airport.

Exceptionally, as on the Valddak saltmarshes in Porsangen (Fig. 2 loc. 10) the slugs are found

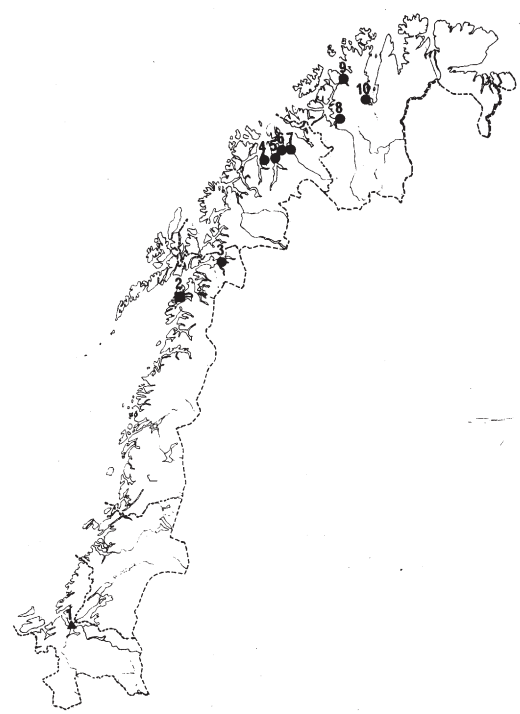

Fig. 2. Known distribution of *Alderia modesta* in Norway. Symbols: ▲ collected by Norman (1893), ■ collected by Lemche (unpublished), ● collected by Vader 1976—78. The numbers correspond with the numbers in Table 1.

Table 1. Survey of known Norwegian localities of *Alderia modesta* (see Fig. 2)

1.	*Sør-Trøndelag*, Rødberg	63°30'N, 10°E	shallow pool near MHWS	single specimen	Norman (1893)
2.	*Nordland*, Hundsøy	67°59'N, 15°24'E	near low water	several small speciemens	Lemche 1966
3.	*Nordland*, Ankenes	68°25'N, 17°22'E	high-lying mudflat with very dense *Vaucheria*-mats	very common	WV VIII-78
4.	*Troms*, Botn, Ullsfjord	69°47'N, 20°E	extensive mudflats, *Vaucheria* confined to creek-bank	common	WV VIII-76 WV VIII-77
5.	*Troms*, Spåkenes, Lyngen	69°46'N, 20°28'E	soft mudflat, sparse *Vaucheria* on banks of creeks	a few small specimens	WV VIII-77
6.	*Troms*, Sørkjosen, Nordreisa	69°48'N, 20°57'E	sandy mudflats, large areas near MHWS covered with *Vaucheria* (Fig. 3)	common (cf. Table 2)	WV VIII-77
7.	*Troms*, Nordbotn, Nordreisa	69°47'N, 21°03'E	*Vaucheria*-mats along creek through mudflat	rather common	WV VIII-77
8.	*Finnmark*, Rafsbotn, Alta	70°N, 23°30'E	*Vaucheria*-mats just below saltmarsh, on very soft mud	common, very large specimens	WV VIII-77
9.	*Finnmark*, Klubbukt, Kvalsund	70°33'N, 24°06'E	Very thin *Vaucheria*-cover on muddy banks of small river, near its outflow in fjord (Fig. 5)	extremely common	WV VIII-77
10.	*Finnmark*, Valddak, Porsangen	70°10'N, 24°55'E	*Vaucheria*-mats in *Puccinellia* saltmarsh (Fig. 4)	rather uncommon	WV VIII-77

Fig. 3. Biotope of *Alderia modesta* near Sørkjosen (loc. 6), as seen from the c. 10 m high cliffside. The dark fields are the *Vaucheria*- patches where the transect of Table 2 was taken.

on *Vaucheria* mats in the saltmarsh proper (Fig. 4). Here most slugs occurred along the edge of shallow pools, but scattered specimens also live on *Vaucheria* in the *Puccinellia* meadow. At Valddak the mudflats are very clayey and suitable habitats for *Alderia* seem to be absent below the saltmarsh.

In summer 1978 *Alderia modesta* was found in the Narvik area in northern Nordland (Fig. 2 loc. 3). Further collecting will no doubt show the species to occur all along the Nordland coast, possibly also in eastern Finnmark.

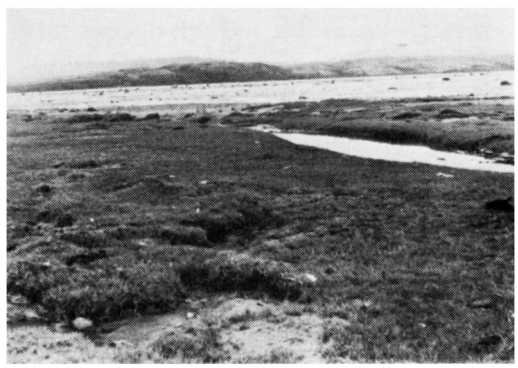

Fig. 4. Atypical biotope of *Alderia modesta* in the saltmarshes of Valddak, Porsangen (loc. 10). The slugs are most often found along the edges of depressions such as the ones in the foreground, but a few specimens can also be found in the saltmarsh proper.

Zonation and density

The vertical distribution of the slugs was studied at the Sørkjosen locality (Fig. 2 loc. 6) in August 1977 by counting the number of slugs and egg - capsules in squares of 1 dm^2. The results (Tab. 2) show a definite zonation within the belt of *Vaucheria* patches. Egg-capsules were only found in the middle part of the *Vaucheria* zone. At least two generations of snails appeared to be present, the large ones being 7—9 mm long when crawling. The egg-capsules varied much in size and stage of development.

At emergence the slugs are more or less randomly distributed over the *Vaucheria* patches, but in the course of the ebb period they seem to concentrate on the most humid spots (foot-tracks etc.); the egg-capsules too are concentrated in such small hollows. When I revisited the locality on 27 Augsut after some days with pouring rain, this concentration was still more clear. The slugs, which were crawling around actively, also had a distinctly swollen outlook (cf. Engel et al. 1940, p. 24).

At most localities the observed population densities were in the same range as at Sørkjosen, viz. c. 5—15 per dm^2. At Klubbukt (Fig. 2 loc. 9), however, *Alderia modesta* was exceptionally numerous (Fig. 5), and random squares of 1 dm^2 at this locality gave counts of 24, 67, 44, 47 and 59, viz. a mean of nearly 50 slugs per dm^2. Here again crawling adult slugs measured 7—9 mm and egg-capsules were numerous. The substrate consisted of very thin mats of a mixture of green algae and *Vaucheria* on muddy substrate along the outlet of a little river.

Predation

At the Sørkjosen locality the *Vaucheria* zone was regularly occupied by foraging Yellow and White Wagtails (*Motacilla flava* and *M. alba*), and Little Stints (*Calidris minuta*). The wagtails caught only flies, as far as I could ascertain, but the stints took quantities of *Alderia* and/or their egg-capsules.

DISCUSSION

The distribution and ecology of the NW European populations of *Alderia modesta* have been the subject of studies by Luther (1902), Gallien (1929), Engel et al. (1940), and especially den Hartog (1959, with references to earlier Dutch

Table 2. Vertical distribution of *Alderia modesta* and its eggcapsules at Sørkjosen (loc. 6), VIII-1977. Numbers are the mean of at least 10 counts of random squares of 1 dm^2.

		crawling *Alderia* p. dm^2	egg-capsules p. dm^2
A.	Near EHWS. Thick, uneven moss-like *Vaucheria*. A few phanerogam plants	1.7	0.2
B.	15 cm below A, but same *Vaucheria*-type. No phanerogams.	3.0	3.2
C.	15 cm below B. Browngreen «algae-like», dense *Vaucheria*-cover	5.3	2.8
D.	10 cm below C. Same *Vaucheria*-type as in C, but thinner mats.	2.3	0.1

work). Evans (1953) reported on the anatomy and feeding biology and Schulz (1935), den Hartog (1958) and Seelemann (1967) on the egg-capsules and larval development.

The most extensive quantitative investigations on the biological distribution of *Alderia modesta* are those of den Hartog (1959), who found that in Dutch saltmarshes the slugs occurred in a quite narrow vertical belt around MHWN, in vegetations in the Salicornietum strictae and the initial phase of the Puccinellietum maritimae; within these vegetations the slugs were confined to the patchily distributed mats of *Vaucheria*. The slugs are not very dependent on shade (in contradiction to the related *Vaucheria*-living slug *Limapontia depressa* Alder & Hancock, with which *Alderia* often coexists), but in very hot and sunny weather need humid refuges (shady places, foot-tracks, shrinking rents etc.). *Alderia* has also been found under brackish conditions, where the salt marsh associations are replaced by a Scirpetum maritimae vegetation. In the Baltic the slugs have been found (Luther 1902) at salinities below 5‰ Cl near Helsinki. Also some of the populations in northern Norway are probably exposed to very low salinities in the snow-melting period in spring and after prolonged rainfall, as they live not far above the normal water-level of drainage creeklets and small rivers, which during ebb are nearly fresh. Several authors mention having collected *Alderia modesta* from pools which are only reached by the sea during exceptionally high floods (Norman 1893, Luther 1902, Schultz 1936, Fisher-McMillan 1949), i.e. even higher than the Valddak biotope.

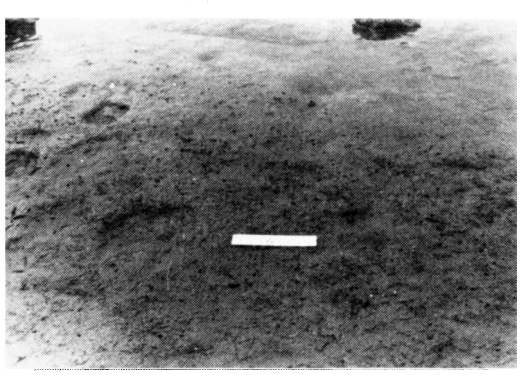

Fig. 5. Dense population of *Alderia modesta* near Klubbukt (loc. 9). The slugs are just visible as black dots (the ruler is 10 cm long).

The population densities found in this study are fully as high as those recorded by earlier authors: den Hartog (1959, p. 28) mentioned 31 slugs per dm^2 as an uncommonly high density in Holland and Seeleman (1967) reported 14 per dm^2 from the German Baltic coast. Mean density per dm^2 at Klubbukt (Fig. 2 loc. 9) was nearly 50 per dm^2, and maxima up to 90 per dm^2 have been counted (not included in the mean, which is based on random squares).

Most *Alderia* localities in northern Norway are covered by ice for several months in winter. Data on the seasonal activity pattern of *A. modesta* from other areas are somewhat contradictory. In Holland den Hartog (1959) found the

slugs on the saltmarshes from April to December. *A. modesta* has planktotrophic veliger larvae which require at least a month before metamorphosis (Seelemann 1967), but even so a period of three months is too long to allow wintering of the entire population as pelagic larvae. Den Hartog (loc. cit.) supposed that the slugs had «hibernated on the saltmarshes, hidden in the mud or covered by the algal layer» and also Seelemann (1967) stated that the slugs «seem to retreat in the muddy substratum of their habitat during the winter». These beliefs do not, however, seem to have been based on actual observations of hibernating specimens. An alternate possibility is that *Alderia modesta* survives the winter months in sublittoral pools, as found for *A.* cf. *harvardiensis* in eastern Canada by Bleakney and Bailey (1967). Also in Europe *A. modesta* has a few times been collected from sublittoral habitats (Odhner 1907, Levander 1914, Rasmussen 1951, 1973). These localities have usually been regarded as atypical, but they may in fact indicate a seasonal change of habitat also for *A. modesta*.

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