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BALANUS TINTINNABULUM (LINNAEUS, 1758) AUTOCHTHONOUS IN THE NETHERLANDS, WITH NOTES ON SIZE AND GROWTH RATE OF OTHER OPERCULATE BARNACLES (CIRRIPEDIA, BALANOMORPHA)

D.A.G. BUIZER

ABSTRACT

Balanus tintinnabulum (Linnaeus, 1758) is recorded as autochthonous from buoys in the coastal waters of the Netherlands. Dimensions reached within a limited time, giving an indication of growth rate, are given for *Balanus tintinnabulum*, *Balanus perforatus* Bruguière, 1789, *B. improvisus* Darwin, 1854, *B. crenatus* Bruguière, 1789, and *Elminius modestus* Darwin, 1854.

AUTOCHTHONOUS RECORD

In an area at approximately 53° 30' N, 5° E - about fifteen kilometers north of the Dutch coast - a number of barnacles living attached to buoys of the Pilotage Service were collected. Two of the species - *Balanus perforatus* Bruguière, 1789, and *Conchoderma auritum* (Linnaeus, 1767) (Cirripedia, Lepadomorpha) - concerned first autochthonous records for the Dutch coast (Buizer, 1978). The barnacles mentioned in that publication have been reexamined and have been found to belong for the greater part to *Balanus tintinnabulum* (details Table II) instead of *B. perforatus*, only two specimens being true *B. perforatus*. Larvae of *B. tintinnabulum* must have settled in the area mentioned because the buoys are cleaned and replaced freshly painted every year. Eleven specimens were collected alive in December 1976 and January 1977 (Tables I, II and the next chapter).

The species is known to have a world-wide tropical distribution (Southward & Crisp, 1963). It occurs attached to a variety of substrates, even hulls of ships and floating timber, on which the species regularly washes ashore on the Dutch coast (Holthuis & Heerebout, 1972). It is not impossible that the present autochthonous record can be associated with an occasional release of larvae from adult barnacles on ships passing along the coast (A.J. Southward, personal communication). As discussed in my earlier paper in relation to *B. perforatus* and *Conchoderma auritum* it is not really probable that these records constitute genuine extensions of the geographical range of the species. Up till now (spring 1980) there have been no new records.

SIZES AND GROWTH RATE

Records of organisms attached to buoys are of special interest, because in the Netherlands buoys are replaced almost every year. The time of replacement is registered accurately. The buoys are cleaned and painted. When the attached organisms are collected at the time of replacement, their approximate growth rate can be derived. The following data give some more details of the species collected in this way. Almost all the specimens were collected alive.

Balanus tintinnabulum (Table II, fig. 1).

Eleven specimens were collected in December 1976 and January 1977. Their shells are of conical shape and rather thin; the surface is smooth. The wall plates are purple with lighter radii. The minimum, mean and maximum sizes (mm) recorded for these specimens are as follows:

rostro-carinal length	19 - 27 - 32
breadth	18 - 27 - 31
height	14 - 19 - 24

Buoys 2, 3, 4 and 5 (Table I) stayed respectively 429, 370, 108 and 148 days in the water; this means that the barnacles cannot possibly be older than that.

Balanus perforatus (Table II)

Two specimens were collected in September 1976. Their sizes are as follows:

rostro-carinal length	12 - 21
breadth	12 - 21
height	7 - 16

These dimensions do not deviate from literature data, in which a rostro-carinal length up to 30 mm is given (Southward & Crisp, 1963). Yet, the present specimens deviate from the general description. *B. perforatus* is usually described as being very strong and thick, with a steeply conical form and with a small opening. The surface of the shells is easily corroded. The shell of the present specimens is very smooth and very thin. The opening is large. The colour is in accordance with the general description: purple with lighter radii. According to Southward & Crisp (1963) settlement of *B. perforatus* larvae takes place in August and September. Buoy 1 (Table I) was placed in the water in September and stayed there for 364 days, so these barnacles cannot possibly be older than that.

Other field observations on the growth of *B. perforatus* in the Mediterranean were made by Dr. Steven Weinberg (Institute of Taxonomic Zoology, personal communication). For his field research on gorgonians he used plastic tags, which remained in the water for about 120 days. These tags, clean when placed in the water, were covered with *B. perforatus* at the time of retrieval. The mean basal rostro-carinal length was about 11 mm (n = 20). The shape of these specimens was more typical for the species than the present Dutch material: steeply conical with a small opening.

Balanus improvisus (Table II).

Fifteen specimens were collected in September and December 1976. The minimum, mean and maximum sizes (mm) of the specimens are as follows:

rostro-carinal length	11 - 15 - 18
breadth	11 - 14 - 17
height	6 - 8 - 10

These dimensions deviate from the data given by Darwin (1854): maximum 15 mm; Gruvel (1905): average 12 mm; Southward & Crisp (1963): 10-15 mm and Nilsson-Cantell (1978) 10-17 mm, height 5-6 mm. In Dutch water settlement of this species takes place in August and September; larvae are recorded from the end of June to early September (De Wolf,

1973). Three specimens were collected from buoy 3 (Table I), placed in sea in December 1975 and recovered from the water in December 1976. Therefore we assume the maximum age of these specimens to be about 140 days. Twelve specimens were collected from buoy 1 (Table I), placed in sea in September 1975 and recovered from the water in September 1976; the present specimens cannot be older than about 1 year.

Balanus crenatus (Table II, fig. 1).

Thirty-six specimens were collected in September and December 1976. The minimum, mean and maximum sizes (mm) recorded for these specimens are as follows:

rostro-carinal length	15 - 23 - 29
breadth	15 - 22 - 27
height	9 - 13 - 20

Specimens of this size never have been observed in European waters (A.J. Southward, personal communication). Dimensions according to Southward & Crisp (1963): 15-20 mm; Holthuis (1961): 17 mm; Darwin (1854): largest British specimens about 14 mm; specimens from Greenland and the northern United States: almost 19 mm and 1 specimen 40 mm; Nilsson-Cantell (1978): 41 mm. According to Southward & Crisp (1963) time of settlement of the larvae in British waters is from May to July and sometimes in August and September; late settlement may be obtained further north. Specimens on buoys 1 and 2 (Table I) could have settled short after placement in September respectively October. These buoys stayed 364 respectively 429 days in the water and the barnacles cannot possibly be older than that. Specimens from buoy 3 (Table I) have probably not settled in December. Earliest settlement could have taken place in May. The specimens are possibly not older than about 230 days.

Data on the growth rate in Dutch specimens of *B. crenatus* were provided by Van Benthem Jutting (1946), who described the settlement and growth of this species during the inundation of part of the southwestern part of the Netherlands in the period October 1944 - October 1945. Specimens of *B. crenatus* retrieved in October 1945 from the inundated area had a rostro-carinal length between 15 and 24 mm. The observation of young barnacles in the flooded area at the very beginning of the inundation indicates that the specimens of 24 mm are most probably 1 year old.

Elminius modestus (Table II)

Seventeen specimens were collected in September 1976. The minimum, mean and maximum sizes (mm) recorded for these specimens are as follows:

rostro-carinal length	12 - 14 - 15
breadth	10 - 13 - 14
height	5 - 6 - 7

These dimensions deviate from literature data given by Darwin (1854): less than 10 mm; Gruvel (1905): maximum 10 mm; Den Hartog (1953): 12.2 mm; Southward & Crisp (1963): usually from 5 to 10 mm, but larger specimens may be obtained from ships, or in estuarine localities with strong currents; Nilsson-Cantell (1978): 6-7 to 12 mm. According to Southward & Crisp time of settlement of the larvae is from May to October; some settlement occurs in the winter months in the northern part of the area of distribution. Buoy 1 (Table I) stayed 364 days in the water so specimens collected from this buoy cannot possibly be older than that. Buoy 3 (Table I) stayed about the same time in the water.

DISCUSSION

Because the data presented here are based on field observations it is only suggested that the fast growth and the large dimensions are due to the absence of competition and predation as existing in the tidal zone. Permanent submersion - all the collected specimens originate from parts of the buoys under the water line - will possible stimulate the development of smooth and thin shells. It would be interesting to study these features under controlled conditions.

Parts of the material is preserved in the collections of the Zoological Museum at Amsterdam (ZMA) and the Rijksmuseum van Natuurlijke Historie (RMNH) at Leiden.

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D.A.G. Buizer
c/o Instituut voor Taxonomische Zoölogie
(Zoölogisch Museum)
Universiteit van Amsterdam
Postbus 20125
1000 HC Amsterdam
The Netherlands

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Table I. Data on the buoys.

buoy number / code of Pilotage Service	location latitude N	location longitude E	date of placement	date of replacement (= record date)	maximum immersion time in days
1. TE 7	53 31'15"	05 17'36"	8.IX.1975	4.IX.1976	364
2. TE 4	53 33'50"	14 52'52"	11. X.1975	14.XII.1976	429
3. wreck buoy Kuetanhaya	53 30'48"	05 12'18"	11.XII.1975	15.XII.1976	370
4. TE 14	53 43'06"	05 40'38"	29.IX.1976	mid I.1977	108
5. TE 1	53 25'09"	04 50'00"	20.VIII.1976	mid I.1977	148

Table II. Data on specimens; records date: see Table I.

species	attached on buoy (no.)	number of specimens	mean dimensions (mm) rostro-carinal length	breadth	height
Balanus tintinnabulum	2	2	32	31	20.5
	3	4	25	25	18
	4	3	28	28	19
	5	2	24	24	19
Balanus perforatus	1	2	12, 21*	12, 21*	7, 16*
Balanus improvisus	1	12	15	14	8
	3	3	15	14	8
Balanus crenatus	1	11	26	26	15
	3	12	22	20	12
	2	13	22	21	15
Elminius modestus	1	12	13	12	6
	3	5	14	13	6

* dimensions of the only two recorded specimens are given, not the mean dimensions

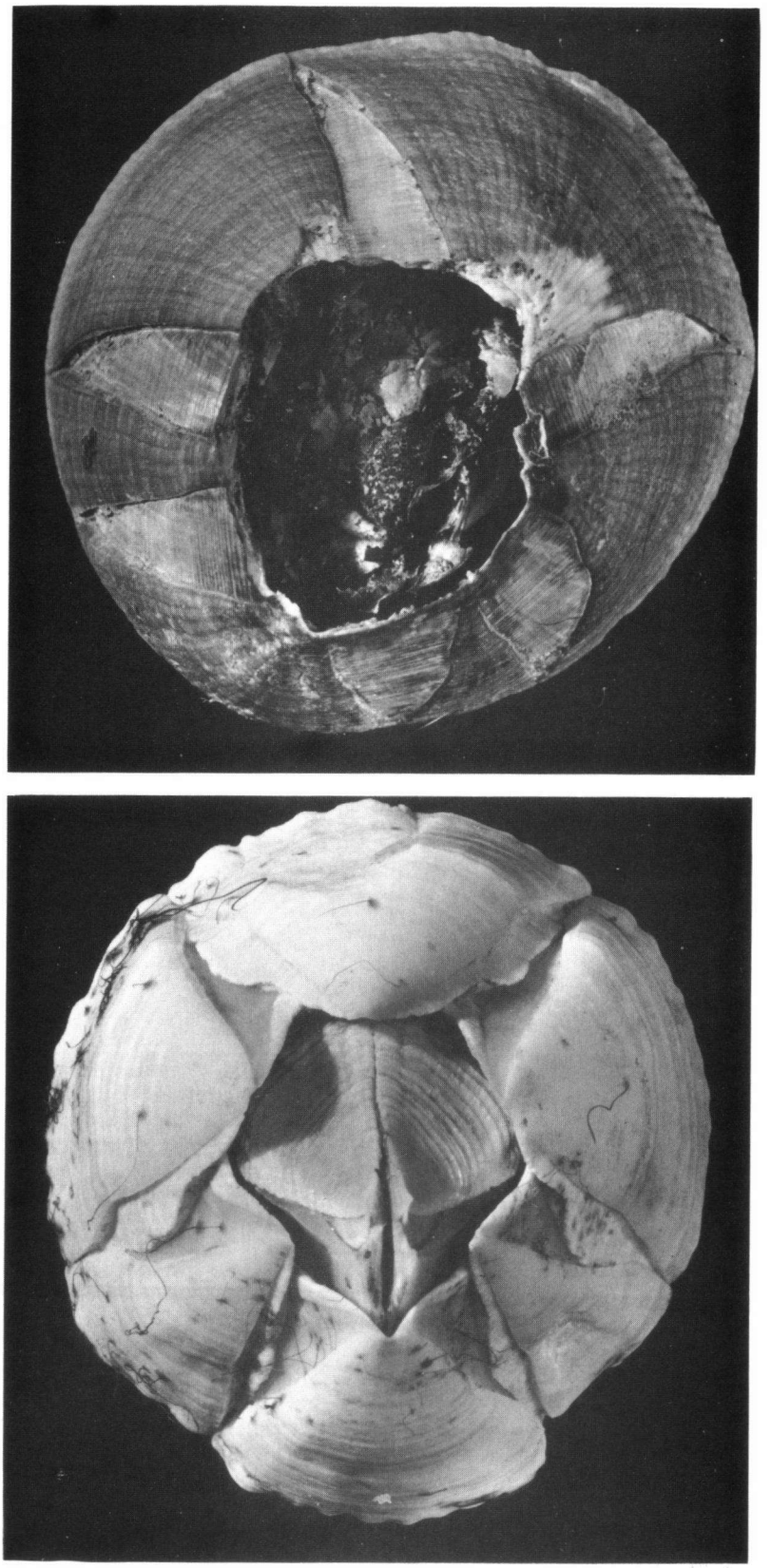

Fig. 1. Top: *Balanus tintinnabulum* (L.) (x 3.2). Bottom: *Balanus crenatus* Bruguière (x 3.5).