ELMINIUS MODESTUS DARWIN: A RECENT EXTENSION OF THE DISTRIBUTION AND ITS PRESENT STATUS ON THE SOUTHERN PART OF THE FRENCH ATLANTIC COAST.

by

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Résumé

Elminius modestus a été trouvé dans plusieurs endroits des côtes françaises atlantiques où l'espèce n'était pas connue jusqu'à présent. Elle est présente « sans interruption » dans des endroits favorables du sud du Pyla. Il se produit alors une brèche — due à la nature de la côte et à l'exposition — jusqu'à Saint-Jean-de-Luz. Le Bassin d'Arcachon est aujourd'hui densément peuplé.

The opportunity recently arose to carry out a further survey of the more southerly part of the French Atlantic coast for the presence of *Elminius modestus*. A marked extension of the distribution and in places a gross increase in abundance prompts the following account. A brief description of the present situation at several places proceeding southwards from Pornic will first be given; the records will then be compared with those of earlier surveys.

Pornic.

The situation is little different from that previously reported. *Elminius* is still common even on the reefs outside the harbour. There is constant competition from *Chthamalus stellatus,* the recovery of which from the severe winter of 1962-1963 is now complete: *Balanus balanoides* remains at its former level (Barnes and Barnes. 1966).

Croix-de-Vie and Saint-Gilles-sur-Vie.

Only a boat slip and the inner harbour wall were examined. *Elminius* was common; rather more was present within the harbour than reported previously (Barnes and Barnes, 1965).

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Les Sables d'Olonne.

Elminius is now quite frequent both on the outside wall of the entrance to the harbour (above the sandy bay) and on the masonry further up the channel leading to the harbour, on pilings, boat slips, and the sloping stone embankment. In some places, particularly where *Chthamalus* has broken away, it reaches a density of 4-8/10 cm^2, but elsewhere is less common. It is, however, only in patches; the increase since 1963 is only moderate.

La Rochelle.

Elminius is now easily found, although by no means abundant, on the main stonework (sloping embanked sides) of the avant-port at the entrance to the Quai du Perré; it tends to be below the abundant *Chthamalus stellatus;* the animals were in the main small, suggesting a relatively recent colonization.

Saint-Georges-de-Didonne (entrance to the Gironde).

Saint-Georges is situated at the wide entrance to the Gironde. *Elminius* was abundant on the 'harbour' wall.

Talmont (entrance to the Gironde).

The town wall and the reefs to north were examined; these reefs extend seaward at a very low angle and are separated by sandy areas. On the uppermost reefs, *Elminius* was largely restricted to vertical or overhanging faces covered by weeds. At lower levels it was still most abundant in such places but was also quite common on the reef flats. *Balanus improvisus* was also common at these lower levels, but there was no evidence that it was being smothered by *Elminius*. All size groups of the latter, including large corroded adults were present; at low levels 25 p. 100 had egg-masses.

Bassin d'Arcachon.

Arcachon

Elminius was present in abundance on the piles of La Jetée d'Eyrac, mixed with and extending as high as the *Chthamalus stellatus*. All size groups and corroded adults were present; 2 p. 100 had egg-masses. It is interesting to note that about 2 p. 100 of the *Elminius* has a parasite resembling *Hemioniscus*. On the sloping wall between La Jetée Lagallais and La Jetée de la Chapelle, *Elminius* was restricted to lower levels and was most abundant under the weeds; *Chthamalus stellatus* (which alone reached the uppermost levels) was

abundant and some *Balanus balanoides* (1) and a little *B. improvisus* were present. On the pier piles of the former jetty *Elminius* was much more abundant and virtually formed a distinct 'zone' some 60 cm deep between the lower *Balanus perforatus* and the upper *Chthamalus;* in such places there were far fewer weeds and much more shade. On the open wall 5 p. 100 of the *Elminius* had egg-masses, but in the most sheltered places under the pier this value reached 19 p. 100.

Port de Larros

The wooden facings at the entrance to the channel were examined. *Elminius* was abundant (15-25/10 cm^2), all size groups, including much spat, being present: it extended 1.5 m above the surface of the mud; 33 p. 100 of the animals had egg-masses. *Elminius* was equally abundant on old wooden structures further seaward and also on any scattered available substrata in the mud surrounding the area; near the harbour entrance 50 p. 100 had egg-masses. Only a single *Chthamalus* was found in this area during several hours searching the shore.

Cassy

Few substrata are available for settlement: *Elminius* only was present, being fairly common on few stakes at side of channels; 10 p. 100 had egg-masses.

Arès

Small concrete jetty; only *Elminius* present and it was abundant: 17 p. 100 of the animals had egg-masses.

Piraillon

Small harbour; only *Elminius* present; common on a small boat slip and any other suitable substrata.

Bélisaire

Elminius was abundant on the pier piles—particularly in any 'bare' area where the *Chthamalus* or *Balanus perforatus* had been removed; adults 10-20/10 cm^2 and spat 40/10 cm^2. *Elminius* did not reach such high levels on this side of the Basin as on the eastern side: competition from the other two species seemed much more severe. On the pignots near the pier, *Elminius* was much more abundant and *Chthamalus* less so; 32 p. 100 of the former had egg-masses.

La Pointe Lavergne

This is near Cap Ferret and at the entrance to the Bassin. A broken concrete blockhouse is reached by the tide and this is densely populated with *Chthamalus.* Where this species had broken away

(1) It is worth noting that on this wall *Balanus balanoides* is now far more common than indicated in Barnes and Powell (1966). It is still only present under *Fucus,* but easy to find and in places sufficiently dense to allow copulation.

there was a good deal of *Elminius* spat and adults up to 5 mm; this seemed probably to be the current year's settlement.

Pignots in the Bassin

The pignots in several areas were examined by boat. In the upper part of the Chenal de Gujan (Estey de Larros, Gaillard, Betet) the stakes were densely covered with *Elminius*, spat and adults of all sizes. *Chthamalus* was absent and at the lowest levels small *Balanus perforatus* were present often deeply embedded in sponges together with a few *B. improvisus*. Pignots which had been set for only 2 months had abundant *Elminius*. The situation was similar on pignots from Sableyre de Comprian; 50 p. 100 of the *Elminius* had egg-masses. At Mapouchet very old pignots had some *Chthamalus* which was being crowded out by the abundant *Elminius* and a similar situation was apparent at Congre, Les Mouettes (opposite Pointe de Garrèche), Grastères, Matte de Bouca, Maubin, and Pointe de Chevaux. At all these stations *Chthamalus* is being crowded out on those pignots which have been in over long periods. On newer pignots only *Elminius* is present above the *Balanus perforatus*. Off Piraillan and Le Canon more *Chthamalus* was present. At Courbey—a much more exposed place with a considerable mussel population—*Chthamalus stellatus* was well established; there was much *Elminius*, some very old and corroded. Here and at the southern tip of the Grand Banc de Muscla new pignots had only crowded *Elminius* above *Balanus perforatus*.

Pyla-sur-Mer

A few stakes and wooden structures were available for settlement. *Elminius* was present in moderate numbers; 15 p. 100 had egg-masses.

Near Camp de Petit Nice

At this point, and nearby, there are several fallen concrete blockhouses at various levels on the shore. They are densely covered with *Chthamalus*, in places breaking away. No *Elminius* was seen even though the 'bare' places were examined carefully for spat or young. At the lower levels of the more seaward blocks, mussels and much *Balanus perforatus* were present, the latter showing a marked preference for overhangs even though present on vertical surfaces. This situation is exposed to wave action and the lower levels to much sand scour.

Saint-Jean-de-Luz—Ciboure

The Saint-Jean-de-Luz side of the harbour was examined. At the entrance, banked with large blocks of stone, *Chthamalus stellatus* is abundant at all upper levels with much *Balanus amphitrite* and some *B. perforatus* below. In the main harbour, which seems to be heavily polluted, there is a wide band of intertidal *B. amphitrite*; here *Elminius* is present and, though by no means abundant, is not difficult to find. There are scattered individuals and small groups —quite dense enough to copulate, but only a few old individuals. *Elminius* is also present in the newer part of the inner harbour—where it is commonest in more shaded situations.

DISCUSSION.

The colonization of the French coast by *Elminius modestus* has been followed in some detail by a number of investigators (see Barnes and Barnes, 1965 for references). By 1963 suitable places as far south as Les Sables d'Olonne had been colonized at a moderate density (Barnes and Barnes, 1965) as was confirmed in 1964 by Fischer-Piette (1964). It is curious that Fischer-Piette failed to find it in May 1964 in the Saint-Gilles-Croix-de-Vie area since Barnes and Barnes (*loc. cit.*) had found it there in some abundance in the summer of 1963: Fischer-Piette (*loc. cit.*) suggested that it may be approaching its southern limit near to this point. It may be, however, that the population is considerably decimated during the winter months as has been found to be the case at Cuxhaven by Kühl (1963).

Both Barnes and Barnes and Fischer-Piette examined suitable areas further to the south, in particular La Rochelle, Arcachon, Ciboure and Hendaye without finding it. The further extension by April 1965 to La Rochelle which was recorded by Fischer-Piette (1965) must have taken place between 1963-1965; he again examined places to the south, especially at Royan, Talmont and elsewhere in the Gironde estuary without finding it and again suggested that the species was approaching its southern limit; that this is not the case is evident from the present survey.

The situation at Pornic in 1967 seems little different from that recorded in 1963, with *Elminius* common along the channel leading out of the harbour and further seaward at the entrance. At Les Sables d'Olonne there has been some, but not a marked, increase; the higher population densities recorded above refer to isolated patches, largely where *Chthamalus* has broken away. At La Rochelle the situation seems much as described by Fischer-Piette (1965) for April 1965.

The places further south where *Elminius* has now been found, namely, Saint-Georges-de-Didonne, Talmont, Arcachon and Saint-Jean-de-Luz—Ciboure represent a southward extension of the species. The conditions at Talmont are, as pointed out by Fischer-Piette, very favourable and *Elminius* is now present in some abundance both there and at the somewhat more exposed Saint-Georges-de-Didonne. Accepting Fischer-Piette's records, this colonization has taken place between March 1965 and August 1967.

Elminius was absent at Arcachon in June 1963; a single specimen was found in a preserved sample collected in the Bassin for other purposes in September 1964 (Barnes and Powell, 1966); it was predicted that once a breeding population became established, conditions were so suitable that rapid expansion would take place. During a brief visit in 1966 it was found to be present in some abundance as spat and adults (with ripe egg-masses) on the piles of the Jetée d'Eyrac: it was already well established (personal observations not previously recorded). The above new records for the summer of 1967 show that the expansion has indeed been rapid, extensive and intensive: it is now present in considerable quantity on the shores of the inner part of the Bassin where suitable substrata exist and covers

most of the pignots surrounding the oyster banks. In the areas of low salinity and little wave action *i.e.*, inner northern part of the Bassin, the pignots are densely covered from the level of low water upwards; in such places *Chthamalus stellatus* was rarely present and *Elminius* is now 'additional' at the higher levels. At lower levels it competes with both *Balanus improvisus* and *B. perforatus*: there is evidence that at least the former is in danger of extinction in some localities; *B. perforatus* is quite abundant and, being a massive and gregarious species, it seems at present to be less threatened. *Elminius* does not extend to the outer shores of the Bassin; apart from the almost complete absence of suitable substrata the exposure on the outer Côte d'Argent or to the south is severe. On the western side of the Bassin it is abundant at Bélisaire and appears recently to have reached La Pointe Lavergne. On the southern side it is common to abundant on structures near to Arcachon and has reached Pyla. Further south it was not found.

The colonization of the harbour at Saint-Jean-de-Luz—Ciboure is of particular interest; Bishop (1954) recorded a single large individual at Saint-Jean-de-Luz but is has never since been recorded even after careful search. It is now present in the harbour-widely distributed, easy to find, but not yet in any great abundance.

The relatively rapid southward spread along this coast together with the unsuitable nature of the coast for marginal dispersion suggests that most of the places south of Pornic have been infected by a vector, almost certainly local fishing craft. Except for the rocky headland north of Croix-de-Vie the coastline south of Pornic is sandy and, except for the estuaries, fully exposed to the ocean; yet *Elminius* reached Les Sables d'Olonne from Saint-Brévin between 1960 and 1963, colonizing Pornic and Croix-de-Vie *en route*; La Rochelle, some 80 kilometres to the south was reached in 1965 and Saint-Georges-de-Didonne and Talmont, about a further 80 kilometres by 1967; and Arcachon another 80 kilometres further south by 1964 (all distances measured coastwise). It is possible that La Rochelle and the mouth of the Gironde were infected by shipping from Arcachon to the south and not from the north, but this cannot be determined with certainty.

The spread and abundance at Arcachon is spectacular: in the Bassin as a whole *Elminius* is now by far the most abundant cirripede, both as regards numbers and area of distribution. It has colonized areas previously unoccupied because unsuitable to the other common species of the area, namely, *Chthamalus stellatus* and *Balanus perforatus*, while in the quieter regions of low salinity *B. improvisus* is under considerable competition pressure from *Elminius*. Conditions within the Bassin, quiet water with abundant nutrients, are most favourable to the immigrant and it can withstand the lowered salinity in the northern parts. The spread has without doubt been facilitated by the constant small boat traffic to and from the oyster pounds and the movement of various *Elminius* bearing substrata during the normal activities of oyster culture.

For some 140 kilometres south from Arcachon to the Bayonne estuary the coast is sandy and exposed, and for this reason, and remembering that it was not found at Camp de Petit Nice, it seems almost certain that the population at Saint-Jean-de-Luz—Ciboure has

been an independent colonization; search in the Bayonne estuary and near Biarritz may reveal the species. It seems unlikely, too, that the present population is in anyway ' descended ' from the single specimen (even though this represented a small infection) recorded by Bishop in 1954; *Elminius* was not found there in 1963. The origin of the present population cannot be determined—whether from say Arcachon to the north or from the northern Spanish coast; certainly the population is now far more dense at Arcachon than at localities at the eastern limit of the Spanish population, such as, Villaviciosa and Gijon where in 1963 it was present but not common. It is not known to what extent fishing craft pass between these ports. There seems no reason why the population at Saint-Jean-de-Luz—Ciboure should not become well established.

A survey of the records indicates that all the suitables places on the west coast of France have now been colonized by *Elminius modestus*.

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Abstract

Elminius modestus has now been found at several places where it was not previously known on the French Atlantic Coast. It is present ' continuously ' in suitable places south to Pyla. There is then a gap-due to the nature of the coast and the marked exposure-until Saint-Jean-de-Luz is reached. The Arcachon Basin is now densely populated.

Zusammenfassung

Elminius modestus ist nun an verschiedenen Standorten der französischen Atlantikküste gefunden worden, wo diese Art bisher nicht bekannt war. Man findet die Art 'kontinuierlich' an geeigneten Stellen im Süden von Pyla. Man stellt dann eine Lücke fest, bis Saint-Jean-de-Luz, die der Konstitution der Küste und der ungeschutzten Lage zuzuschreiben ist. Das Becken von Arcachon ist jetzt stark besiedelt.

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