New data on the spread of the "barnacle disease of Mor-Bihan"

Auguste Le Roux
[1] 1 impasse des Mouettes, 56000 Vannes, France

Abstract

Samples of *Chthamalus montagui* taken at 16 points along the coasts of the Bay of Biscay and Brittany reveal that the "Mor-Bihan barnacle disease" extending from the Bay of Arcachon to the northern shores of Brittany. However, contamination has not been observed at Pointe de Saint-Gildas in Loire-Atlantique, nor at the two stations of the tip of Brittany (Blockhaus de Kermabec in Tréguennec and Petit Dellec in Plouzané) as well as at Pointe de La Varde in Saint-Malo.

Keywords: *Austrominius*; barnacle; *Chthamalus*; disease; *Lagenidium*; Morbihan gulf; Oomycota; parasite

Nouvelles données sur l'extension de la maladie des balanes du Mor-Bihan

Résumé

Des prélèvements de *Chthamalus montagui* effectués en 16 points le long des côtes du golfe de Gascogne et de la Bretagne révèlent que la « maladie des balanes du Mor-Bihan » est présente depuis le Bassin d'Arcachon jusqu'au rivage nord de la Bretagne. La contamination n'a cependant pas été observée à la pointe de Saint-Gildas en Loire-Atlantique, aux deux stations de la pointe bretonne (blockhaus de Kermabec en Tréguennec et le Petit Dellec en Plouzané) et à la pointe de La Varde en Saint-Malo.

Mots-clés : *Austrominius* ; balanes ; *Chthamalus* ; golfe du Morbihan ; *Lagenidium* ; maladie ; Oomycète ; parasite

Corresponding author:
Auguste Le Roux (e-mail : auguste.le-roux@wanadoo.fr)
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Introduction

The Mor-Bihan barnacle disease, first described in 2022 and attributed to an oomycota presumed to be *Lagenidium callinectes* (Couch, 1942), is not strictly confined to the Morbihan Gulf (47.5°N 2.8°W). Instances of contamination have been documented at two locations outside this small area (Pointe de Penvins and Fort de Penthièvre) (Le Roux 2022). These observations suggest that the disease might have a broader distribution along the French coastline.

Material and technique

The author enlisted the help of colleagues, friends and relatives to take samples of chthamales [*Chthamalus montagui* Southward, 1976 and/or *C. stellatus* (Poli, 1791)] or *Austrominius modestus* (Darwin, 1854), downshore to the *Pelvetia canaliculata* (Linnaeus) Decaisne & Thuret, 1845 and *Fucus spiralis* Linnaeus, 1753 belts, from points scattered along the coast stretching from the bassin d'Arcachon in the south to Saint-Malo in the north. The primary objective of this survey was to identify the presence of parasites. Approximately one hundred individuals were sampled at each site, with samples taken at intervals of a few meters apart in order to enhance the likelihood of detecting any discontinuous distribution of the parasite. The individuals preserved in ethanol were dissected under a dissecting microscope and the suspect egg masses studied under a light microscope in order to ascertain the presence of the parasite. In total, 14 points outside the Morbihan Gulf were sampled, in addition to the above mentioned two. These points are depicted on the map in Figure 1, corresponding to their numbering in Table 1.

Results

Only *Chthamalus montagui* and *Austrominius modestus* appeared in the samples.

Chthamalus montagui

Table 2 displays the count of individuals examined, the presence of egg masses, and signs of parasitosis. The morphological characteristics observed align entirely with those documented in 2020: unaffected egg clutches exhibit clear outlines, while contaminated clutches contain dead embryos invaded by hyphae, forming a dense felting that obscures the egg outlines, as illustrated in Figure 2A–D.

Table 1: List of the sampling sites.

Station name, commune and French department number	Coordinates	Collector	Date
1 - Le Pyla (bassin d'Arcachon), La Teste-de-Buch (33)	44.610°N 1.26°W	Xavier De Montaudouin	2022-05-07
2 - Parc des Pères, La Rochelle (17)	46.136°N 1.161°W	Pierre-Guy Sauriau	2022-08-17
3 - Port du Plomb, L'Houmeau (17)	47.201°N 1.205°W	Pierre-Guy Sauriau	2022-08-18
4 - Sion-sur-l'Océan, Saint-Hilaire du Riez (85)	46.696°N 1.977°W	Yves Gruet	2022-08-11
5 - Pointe de Saint-Gildas, Préfailles (44)	47.134°N 2.249°W	Yves Gruet	2022-08-11
6 - Lérat, Piriac-sur-Mer (44)	47.364°N 2.253°W	Yves Gruet	2022-08-02
7 - Pointe de Penvins, Penvins (56)	47.492°N 2.683°W	Auguste Le Roux	2021-06-09
8 - Fort de Penthièvre, Saint-Pierre-Quiberon (56)	47.543°N 3.137°W	Auguste Le Roux	2021-11-09
9 - Porzh Gwenn, Le Palais (56)	47.334°N 3.146°W	Yves Brient	2022-05-09
10 - Malachappe, Moëlan-sur-Mer (29)	47.776°N 3.673°W	Auguste Le Roux	2022-07-31
11 - Pointe de Mousterlin, Fouesnant (29)	47.843°N 4.040°W	Anne Le Roux	2022-07-28
12 - Blockhaus de Kermabec, Tréguennec (29)	47.883°N 4.361°W	Thomas Burel	2022-07-31
13 - Petit Dellec, Plouzané (29)	48.353°N 4.566°W	Thomas Burel	2022-07-28
14 - Near Poulpry, Trévou-Tréguignec (22)	48.824°N 3.351°W	Florence Gully & Marc Cochu	2022-06-26
15 - Bec Douar, Plestin-les-Grèves (22)	48.684°N 3.616°W	Florence Gully & Marc Cochu	2022-06-28
16 - Pointe de la Varde, Saint-Malo (35)	48.68°N 1.98°W	Anne Dalmais	2022-06-30

Figure 1: Position of the sampling sites. GdM: golfe du Morbihan (Morbihan Gulf). 1: Le Pyla, La Teste-de-Buch; 2: Parc des Pères, La Rochelle; 3: Port du Plomb, L'Houmeau; 4: Sion-Sur-l'Océan, Saint-Hilaire du Riez; 5: Pointe de Saint-Gildas, Préfailles; 6: Lérat, Piriac-sur-Mer; 7: Pointe de Penvins, Penvins; 8: Fort de Penthièvre, Saint-Pierre-Quiberon; 9: Porzh Gwenn, Le Palais; 10: Malachappe, Moëlan-sur-Mer; 11: Pointe de Mousterlin, Fouesnant; 12: Blockhaus de Kermabec, Tréguennec; 13: Le Petit Dellec, Plouzané; 14: Near Poulpry, Trévou-Tréguignec; 15: Bec Douar, Plestin-les-Grèves; 16: Pointe de la Varde, Saint-Malo.

Along the coast of the Bay of Biscay (Figure 1) cases of contamination were recorded at all points, from Le Pyla (1) at the entrance of the Bay of Arcachon to the Pointe de Mousterlin (11) in southern Brittany except at Pointe de Saint-Gildas (5). Unfortunately at Porzh Gwenn (Belle-Île island, 9) no egg masses were found at, so it is impossible to draw any conclusion. In Malachappe differences in numbers of egg bearing animals in subsamples "a, b, c" and "d, e" result from the formers being collected at about or above the level of the *Pelvetia canaliculata*-*Fucus spiralis* belts on sunny south-facing rocks not or shortly covered by the tide in summer whereas the latters come from the *Fucus vesiculosus* belt in wet places visited by the sea every day. Many egg masses from sub-sample "d" contained dead embryos, however no intra or extra-matrical hyphae could be seen, consequently they were considered "healthy" i.e. free of oomycotan disease. High temperatures during July 2022 may be responsible for the embryos death. July was indeed marked by a particularly intense heatwave from 12 to 25 July (Météo-France 2023). According to observations from the Lann Bihoué

Table 2: Number of individual examined, and disease ratio for each sampling station. [1]probably positive however, see text.

Sampling site	Subsample if any	Examined	Egg masses present	Healthy	Diseased	Ratio diseased / egg masses
1 - Le Pyla (bassin d'Arcachon)	1a	74	59	31	28	35/50 = 39 %
	1b	41	31	24	07	
2 - Parc des Pères	2a	92	12	10	02	02/12 = 16 %
3 - Port du Plomb	3a	62	14	05	08	08/14 = 57 %
4 - Sion sur l'Océan	4a	43	06	04	02	03/13 = 23 %
	4b	29	07	06	01	
5 - Pointe de Saint-Gildas	5	40	17	17	0	0/17 = 0 %
6 - Lérat	6	33	22	20	02	02/22 = 9 %
7 - Pointe de Penvins	7	21	10	02	08	08/10 = 80 %
8 - Fort de Penthièvre	8	32	08	06	02	02/08 = 25 %
9 - Porzh Gwenn (Belle-Île)	9	116	0	0	0	-
10 - Malachappe	10a	80	2	2	0	06/57 = 11 %
	10b	51	1	1	0	
	10c	12	0	0	0	
	10d	59	33	31[1]	2	
	10e	48	21	17	4	
11 - Pointe de Mousterlin	11	38	22	9	13	13/22 = 59 %
12 - Blockhaus de Kermabec	12a	130	36	35	0	0/93 = 0 %
	12b	150	31	31	0	
	12c	126	27	27	0	
13 - Petit Dellec	13a	206	06	06	0	0/24 = 0 %
	13b	108	02	02	0	
	13c	70	16	16	0	
14 - Near Poulpry	14	24	15	15	0	0/15 = 0 %[1]
15 - Bec Douar	15	44	32	09	23	23/32 = 72 %
16 - Pointe de la Varde	16	100	42	42	0	0/42 = 0 %

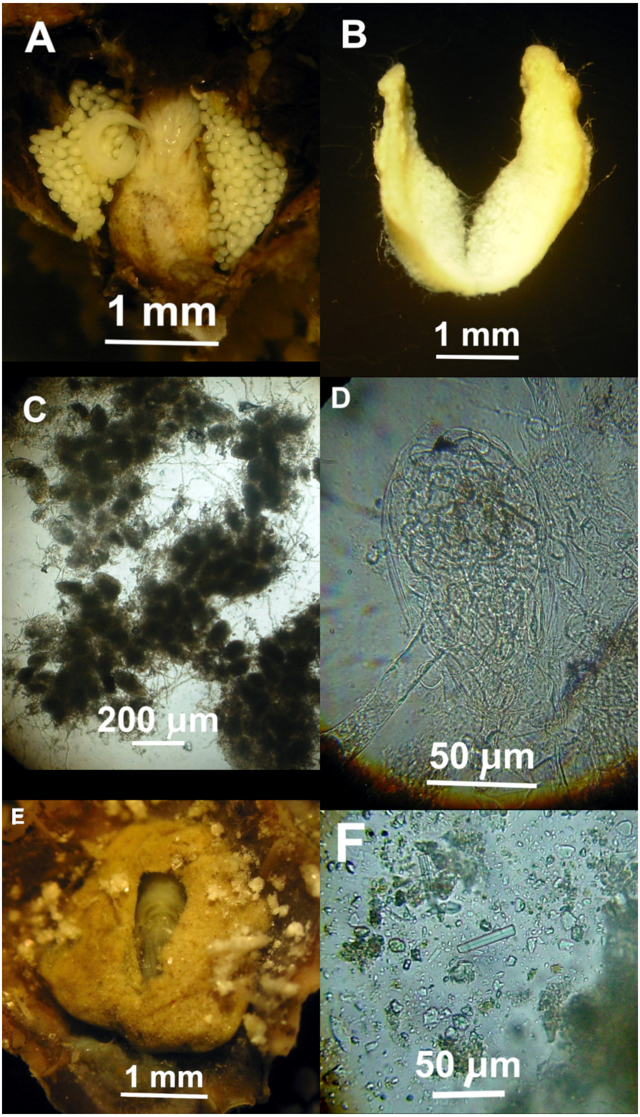

Figure 2: A: *Chthamalus montagui* Southward, 1976, two healthy egg masses either side of the body. Dorsal view. On the left the curved penis appears above the eggs. Pointe de la Varde. B: *Chthamalus montagui*, two diseased egg masses united by filamentous hyphae that appear at the periphery too. Dead eggs contours are blurred by hyphae. Le Pyla. C: *Chthamalus montagui*, dissociated diseased egg mass showing dead eggs and a dense hyphae network. Le Pyla. D: *Chthamalus montagui*, nauplius stuffed with hyphae. Malachappe. E: *Austrominius modestus* (Darwin, 1854), cushion surrounding the body, dorsal view. L'Houmeau. F: *Austrominius modestus*, microscopic view of a cushion constituents. L'Houmeau.

weather station, located 17.5 km east of Malachappe, July 2022 was characterised by exceptional sunshine (349.3 hours, or +57 ‰). The maximum temperature recorded was 37.6 °C on the 18th and the average temperature for the month, 20 °C, was 2 °C above average (https://www.infoclimat.fr/climatologie/annee/2022/lorient-lann-bihoue/valeurs/07205.html, accessed on 2024-02-29).

In northern Brittany, the presence of the parasite was confirmed at Bec Douar (Site 15). Near Poulpry (14) no parasitized egg masses were found in situ, but one was found at the bottom of the bottle containing the sample. Given that the barnacles were collected at Poulpry two days prior to Bec Douar (Table 1), it's unlikely that contamination occurred from the latter site to the former. Hence, it can be inferred that the parasite is present in both locations.

Analysis of the samples from the sites at the tip of Brittany (blockhaus de Kermabec, 12 and Petit Dellec, 13) gave negative results, though 3 subsamples were collected on both places, and the number of egg masses relatively high. Similarly, at Pointe de La Varde (16), all clutches were healthy and often (25 out of 42) in an advanced state of embryogenesis (well-formed nauplii), which increases the chances of contamination and spread of the disease within the clutch. In this context, contamination can be considered absent at this site as well.

No "cushions" were observed among the 1 627 individuals examined, of which 434 bore egg masses, including 98 diseased ones, in this species.

Austrominius modestus

This species was collected at sites 2, 3 and 4 (Table 3). Egg masses were scarce or absent with the exception of Station Port du Plomb (subsample 3b). While no instances of contamination were observed, cushions (Figure 2E) were found within the pallial cavity of seven animals, completely independent of egg masses. These cushions displayed a more or less distinct layered structure and appeared to be composed of particles such as fine sand grains, broken sponge spicules, and mud (Figure 2F).

Table 3: *Austrominius modestus* (Darwin, 1854). Results for each sampling station.

Sampling site	Subsample if any	Examined	Egg masses present	Healthy	Cushion present
2 - Parc des	2b	94	1	1	0
Pères	2c	87	1	1	0
3 - Port du Plomb	3b	84	10	10	7
4 - Sion-sur-l'Océan	4b	9	5	0	0

Discussion and conclusion

Despite the limited number of clutches collected in some samples, this survey reveals that the barnacle oomycete parasite is widely distributed along the coasts of the Bay of Biscay extending as far north as Brittany. Discontinuities in the distribution (at points 5, 12, 13 and 16) could be attributed to the limited scope of the sampling, which did not cover the entire shore. However, it is reasonable to assume that these discontinuities represent genuine absences of the parasite, particularly at the tip of Brittany, either due to unfavourable hydrological conditions or simply because the disease has not yet been transported to these areas.

Barnacles are a major element in the fouling of ship hulls, they also settle on oyster and mussel shells and are thus transported from one shellfish basin to another. Consequently, it is anticipated that the parasite will primarily be found in port areas and shellfish farming centers. Therefore, its absence from Pointe de Saint-Gildas and blockhaus de Kermabec that are sites remote from such infrastructures is understandable. However Petit Dellec, located at the entrance to the bay of Brest as well as in Pointe de la Varde, close to the Cancale oysterfarms and the Saint-Malo harbour, it may be assumed that this situation is only temporary.

No new evidence supporting the attribution of the parasite to the species *Lagenidium callinectes* were uncovered during this study. However, it is noteworthy to mention that Holt *et al.* (2018), in their study of European lobsters *Homarus gammarus* (Linnaeus, 1758) eggs collected from the coasts of British Cornwall and the Isles of Scilly, that were infected by the oomycete *Halioticida noduliformans* Muraosa, Morimoto, Nishimura, & Hatai (2009), demonstrated the presence of a DNA sequence in some eggs that was 98 % to 99 % identical to that of *L. callinectes*. This finding significantly strengthens the case for attributing the Mor-Bihan parasite to this species. Nevertheless, direct and convincing evidence confirming this attribution is still lacking.

Another hypothesis is that the parasite belongs to *Halioticida noduliformans*, whose hyphae also densely invade lobster eggs (Holt *et al.* 2018). Unfortunately, there is limited information available on the morphology and histology of this species. The figures given by Atami, Muraosa & Hatai (2009) depicting the parasite in the gill filaments of *Oratosquilla oratoria* (De Haan, 1844) and those of Muraosa *et al.* (2009) which shows the species parasiting *Haliotis* spp. do not support this hypothesis either. In the latter article, figures 13A and B, illustrating zoospore formation, do not correspond to any images observed in the barnacle parasite.

It appears that, as is often the case with oomycetes, only a molecular analysis of the DNA would make it possible to achieve a reliable identification in this case.

The absence of cushions in *C. montagui*, their presence independently of spawning in *A. modestus*, their composition, and other unpublished observations on this subject in the Morbihan Gulf suggest that contamination of the eggs by the parasite is not the cause of the formation of these cushions. The contaminated egg masses, partially or completely dead, are indeed be expelled at ecdysis. However, clutches of eggs may be laid at the surface of the cushions (Le Roux 2022) and eventually become incorporated into them. Nevertheless, the construction of the cushion appears to be a response to conditions of high water turbidity, which would explain their abundance in the Morbihan Gulf and their absence in *C. montagui* at all the sites surveyed in this study. A prolonged period without moulting (likely a terminal anecdysis) is required for the formation of these cushions.

The percentages displayed in the right-hand column of Table 2 are evidently only of relative value, given the low numbers in most cases. However, they do suggest a non-negligible level of contamination that is likely to noticeably reduce the quantity of larvae released. Despite this, no significant impact on the barnacle population density was observed in the field, at least in the Morbihan Gulf.

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