Outbreak of an unknown flagellate and a massive European conger eel mortality event in late summer 2024 in La Forêt Bay (Brittany France)

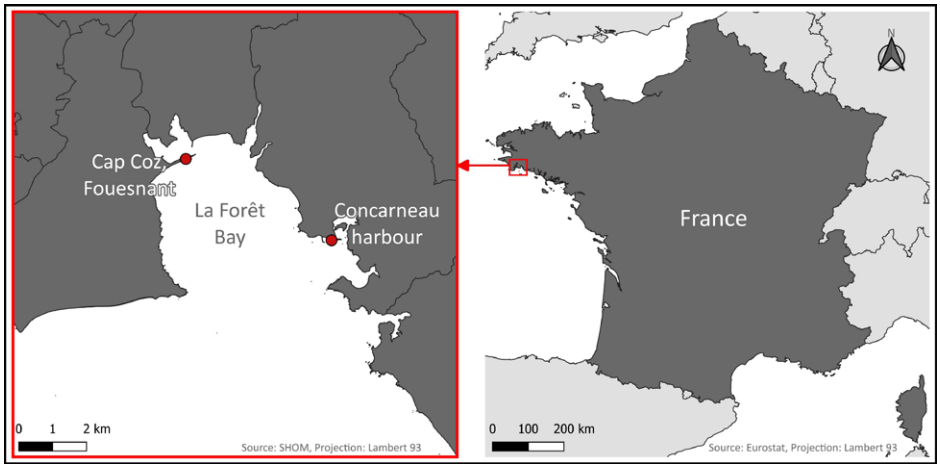

Fig. 1. Location of La Forêt Bay (47.878764 N, -3.961087 W), Atlantic coast, France.

Launched in 2013 by Ifremer (French Research Institute for Exploitation of the Sea), PHENOMER is a French citizen science programme designed to improve the detection and understanding of microalgal blooms by inviting citizens to report water discolourations along the French coast through a web application (*https://www.phenomer.org/*) [1]. PHENOMER has demonstrated its complementary value to the routine French phytoplankton monitoring network (REPHY) [2]. This programme leverages public participation to collect valuable data on the frequency, duration, and spread of blooms across the French coast.

On 18th and 21st August 2024, two reports of brown water discolourations at Cap Coz Beach and Concarneau Harbour in La Forêt Bay, Southern Brittany (Fig. 1) were submitted via the PHENOMER application. Water samples examined with an inverted microscope revealed a high concentration (several million cells per litre) of an unknown green-yellow flagellate species. Concomitant with this bloom, mass strandings of dead European conger eel (*Conger conger*) were reported along the beaches of La Forêt Bay and the surrounding area, mostly in Concarneau and Fouesnant (Fig. 2). More than 1,000 fish, mainly large specimens that had already started to decompose, were collected or counted along the coastline of the bay between 23rd and 28th August. Due to the public health risks associated with the degradation of dead fish, the Concarneau town council decided to ban access to its beaches from 23rd to 28th August 2024. The two phenomena — water discolourations and conger eel strandings — lasted for approximately twelve days.

Environmental conditions

Data on environmental conditions were collected as part of the French phytoplankton monitoring network (REPHY) in La Forêt Bay. Measurements of physicochemical parameters (CTD profiles) (Fig. 3), and surface water samples (1 m) and bottom water samples (23 m depth) were carried out off fortnightly in La Forêt Bay (47.789633°N, -3.954117°W). During August 2024, significant peaks of fluorescence, uncommon for this location and time of the year, were observed.

On 13th and 27th August, vertical profiles of temperature and salinity indicated slight stratification, with the base of the thermocline located at a water depth of 10 m. Below the thermocline, a fluorescent layer with an estimated chlorophyll a (Chl *a*) maximum of 36 µg·L^{-1} on the 13th August (Fig. 3A) and 60 µg·L^{-1} on the 27th August (Fig. 3B) was located between 15 m and the bottom water (23 m). The surface water temperature was between 18 and 19°C, while the bottom water temperature was around 15°C. Dissolved oxygen concentrations were normal for the season, at approximately 9 mg.L^{-1} at the surface and around 8 mg.L^{-1} at the bottom water. Salinity profiles (data not shown) were normal and homogeneous, around 35. A water sample collected at the depth of the fluorescent peak of 27th August revealed a bloom of the same unknown flagellate as that observed by the PHENOMER programme at Cap Coz beach and Concarneau harbour.

The unknown flagellate

The microalgal flagellate which bloomed in August 2024 in La Forêt Bay exhibited a distinct morphology. The naked, biflagellated specimens examined under the inverted light microscope exhibited some affinities with some raphidophycean species (Stramenopiles). Within the same sample, a variety of forms were observed, ranging from spherical to ovoidal (Fig. 4B) and bilobed, dividing cells (Fig. 4A). Their surface displayed many vesicle-like structures (verrucae), particularly in the bilobed dividing cells. Cell body diameters measured approximately 15 µm in length and 25 µm in width. Nu-

Fig. 2. Dead European conger eels stranded in Concarneau harbour in August 2024.

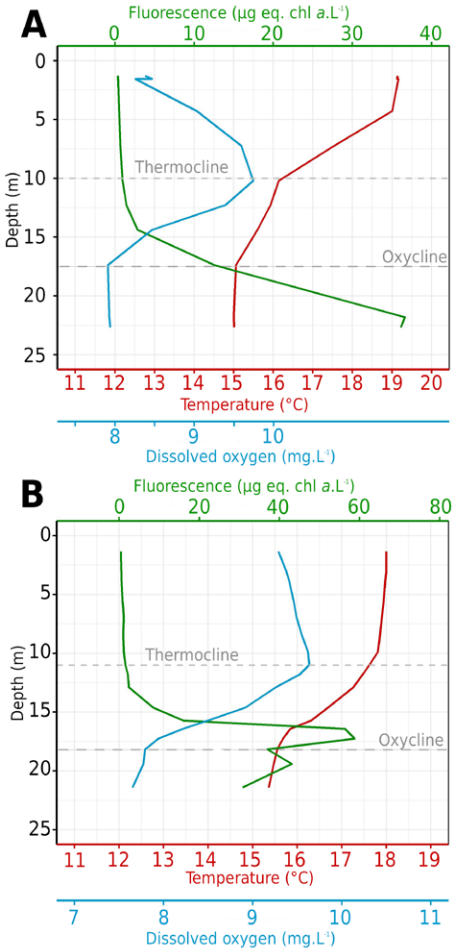

Fig. 3. Vertical profiles of Chl a fluorescence of Chlorophyll a, dissolved oxygen concentration and temperature profiles in La Forêt bay (REPHY data) obtained on (A) 13th August 2024, and (B) 27th August 2024.

merous green or green-yellow ovoid-shaped chloroplasts were located at the periphery of the cell. Swimming, controlled by two heterodynamic flagella — an anterior flagellum describing a forward sinusoidal trajectory and a posterior trailing flagellum — was relatively slow (Fig. 4). Preliminary sequences of ribosomal genes confirmed that the unknown flagellate belongs to the Stramenopiles (heterokonts) but it cannot be classified either within the Raphidophyceae or any other known taxonomic rank. Further studies are in progress to clarify its taxonomic position.

Several cultures of this organism have been established, enabling subsequent morphological, ultrastructural, and molecular analyses. Given its similarity to flagellates belonging to the class Raphidophyceae, which includes ichthyotoxic species, and its coincident occurrence with the conger eel mortality event, toxicity studies using available bioassays, such as the fish-gill cell line [3], should be conducted to assess the toxic potential of the unidentified flagellate.

Hypothetical link between the unknown flagellate bloom and the conger eel mortality

At present, and considering the limited amount of environmental data available from the fish mortality period, it is not possible to confirm the link between the conger eel mortality and the unknown flagellate bloom. However, Chl a fluorescence profiles indicated that the cell maximum occurred near the sea floor. Therefore, the primary hypothesis is that the fish mortality was caused by hypoxia associated with microalgal respiration at night or by the biological oxygen demand during the bloom decay. Indeed, the affected conger eels were primarily large individuals (up to 2.5 m in length and 40 kg), which have higher oxygen demands [4]. Additionally, European conger eels are demersal, nocturnal, and territorial fish, with sedentary behaviour [5]. Therefore, conger eels would have been particularly exposed to a bloom located near the seafloor and the putative hypoxia, explaining why this species was more affected than other organisms. Only a small number of dead specimens from a few other fish species, including sea bass (*Dicentrarchus labrax*) and ballan wrasse (*Labrus bergylta*), were reported.

There is only one previous report of a similar massive fish stranding event in summer during a microalgal bloom associated with hypoxia, dating back to July 1982 in Vilaine Bay (Southern Brittany, France) [6]. During that historic event, 30–50 tonnes of dead fish, mostly conger eels, were reported [6].

The remarkable similarities between the July 1982 and August 2024 fish mortalities events in Vilaine Bay and La Forêt Bay, Brittany, France, present an opportunity to compare environmental conditions associated with both events and to unveil the identity of a putative new harmful microalgal species and its impacts on the marine fauna.

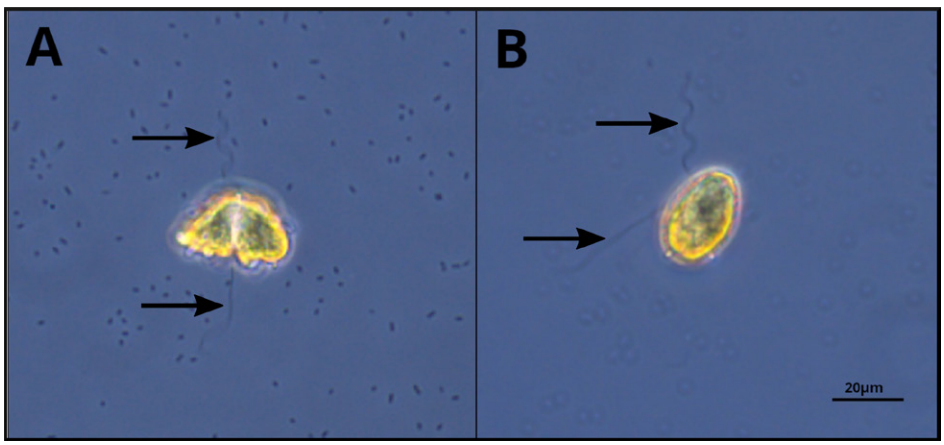

Fig. 4. Morphological variability of the unknown flagellate under the light microscope: (A) bilobed- and (B) ovoid-shaped specimen with two opposite flagella (arrows).

References

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