cryptogamie
Algologie
2024 • 45 • 8

Records of *Lophocladia trichoclados* (C.Agardh) F.Schmitz (Rhodophyta), a non-indigenous species, in eastern Provence and Corsica (France, Mediterranean Sea)

Charles-François BOUDOURESQUE, Aurélie BLANFUNÉ, Marie BORRIGLIONE, Claude LEFEBVRE, Briac MONNIER, Gérard PERGENT, Michèle PERRET-BOUDOURESQUE, Sandrine RUITTON, Delphine THIBAULT, Thierry THIBAUT & Marc VERLAQUE

art. 45 (8) — Published on 30 October 2024
www.cryptogamie.com/algologie

PUBLICATIONS SCIENTIFIQUES
MUSÉUM NAL HIST NATURELLE

Couverture / *Cover*:
Extrait de la Figure 3 / Extract of Figure 3

Cryptogamie, Algologie est indexé dans / Cryptogamie, Algologie *is indexed in*:
– Aquatic Sciences & Fisheries Abstracts Part I.
– Biological Abstracts
– Chemical Abstracts
– Current Contents
– Marine Science Contents Tables (FAO)
– Science Citation Index
– Publications bibliographiques du CNRS (Pascal)

Cryptogamie, Algologie est distribué en version électronique par / Cryptogamie, Algologie *is distributed electronically by*:
– BioOne® (http://www.bioone.org/loi/crya)

Cryptogamie, Algologie est une revue en flux continu publiée par les Publications scientifiques du Muséum, Paris
Cryptogamie, Algologie *is a fast track journal published by the Museum Science Press, Paris*

Les Publications scientifiques du Muséum publient aussi / *The Museum Science Press also publish*: ***Adansonia, Geodiversitas, Zoosystema, Anthropozoologica, European Journal of Taxonomy, Naturae, Comptes Rendus Palévol, Cryptogamie*** **sous-sections** ***Bryologie, Mycologie*****.**

Diffusion – Publications scientifiques Muséum national d'Histoire naturelle
CP 41 – 57 rue Cuvier F-75231 Paris cedex 05 (France)
Tél. : 33 (0)1 40 79 48 05 / Fax : 33 (0)1 40 79 38 40
diff.pub@mnhn.fr / http://sciencepress.mnhn.fr

ISSN (imprimé / *print*) : 0181-1568 / ISSN (électronique / *electronic*) : 1776-0984

Records of *Lophocladia trichoclados* (C.Agardh) F.Schmitz (Rhodophyta), a non-indigenous species, in eastern Provence and Corsica (France, Mediterranean Sea)

Charles-François BOUDOURESQUE
Aurélie BLANFUNÉ
Marie BORRIGLIONE
Aix-Marseille University and University of Toulon,
MIO (Mediterranean Institute of Oceanography),
CNRS, IRD, University campus of Luminy, 13009 Marseille (France)

Claude LEFEBVRE
Parc national de Port-Cros, Allée du Castel Sainte Claire, 83406 Hyères (France)

Briac MONNIER
Gérard PERGENT
Équipe Écosystèmes Littoraux,
CNRS, University of Corsica, 20250 Corte (France)

Michèle PERRET-BOUDOURESQUE
Sandrine RUITTON
Delphine THIBAULT
Thierry THIBAUT
Marc VERLAQUE
Aix-Marseille University and University of Toulon,
MIO (Mediterranean Institute of Oceanography),
CNRS, IRD, University campus of Luminy, 13009 Marseille (France)

Submitted on 5 September 2023 | Accepted on 13 May 2024 | Published on 30 October 2024

Boudouresque C.-F., Blanfuné A., Borriglione M., Lefebvre C., Monnier B., Pergent G., Perret-Boudouresque M., Ruitton S., Thibault D., Thibaut T. & Verlaque M. 2024. — Records of *Lophocladia trichoclados* (C.Agardh) F.Schmitz (Rhodophyta), a non-indigenous species, in eastern Provence and Corsica (France, Mediterranean Sea). *Cryptogamie, Algologie* 45 (8): 89-95. https://doi.org/10.5252/cryptogamie-algologie2024v45a8. http://cryptogamie.com/algologie/45/8

ABSTRACT
The Mediterranean Sea is worldwide the area most affected by introduced species. The Suez Canal (Lessepsian species) and shellfish aquaculture are the main routes for introduction, in addition to shipping (fouling, clinging and ballast waters). Two non-indigenous *Lophocladia* (Montagne) F.Schmitz species have been recorded from the Mediterranean Sea: the Red Sea and Indian Ocean *L. lallemandii* (Montagne) F.Schmitz and the western tropical Atlantic Ocean *L. trichoclados* (C.Agardh) F.Schmitz. On the basis of molecular data, Golo *et al.* (2023, 2024) concluded that the species which invaded the Mediterranean only belongs to the western Atlantic *L. trichoclados*. Until the mid-2010s, the north of the western basin was the only Mediterranean area not invaded by this species. In the present paper, we report for the first time the presence of *L. trichoclados* from this region in Provence and Corsica. Interestingly, *L. trichoclados* does not occur and bear reproductive organs in spring but in autumn and winter, although it is a species of tropical affinity.

KEY WORDS
Corsica,
Provence,
Mediterranean Sea,
invasive species,
new records.

RÉSUMÉ

Signalements de Lophocladia trichoclados *(C.Agardh) F.Schmitz (Rhodophyta), une espèce non-indigène, en Provence et en Corse.*

La Méditerranée est la région la plus affectée, dans le monde, par les invasions biologiques. Le canal de Suez (espèces dites 'lessepsiennes') et la conchyliculture constituent les principaux vecteurs d'introduction, en plus de la navigation (espèces transportées sur la coque des bateaux et eaux de ballast). Deux espèces non-indigènes du genre *Lophocladia* (Montagne) F.Schmitz ont été signalées en Mediterranée : l'espèce de mer Rouge et de l'océan Indien *L. lallemandii* (Montagne) F.Schmitz, et l'espèce de l'Atlantique tropical occidental *L. trichoclados* (C.Agardh) F.Schmitz. Sur la base de données moléculaires, Golo *et al.* (2023, 2024) ont conclu que l'espèce invasive en Méditerranée correspond à l'espèce de l'Atlantique occidental, *L. trichoclados*. Jusqu'au milieu des années 2010, le nord du bassin occidental constituait la seule région méditerranéenne non envahie par cette espèce. Nos observations en Provence et en Corse comblent cette lacune. Curieusement, la prolifération et la reproduction de *L. trichoclados*, une espèce d'affinité tropicale, ne s'observent pas au printemps, mais en automne et en hiver.

MOTS CLÉS
Corse,
Provence,
mer Méditerranée,
espèce invasive,
signalements nouveaux.

The Mediterranean Sea is the area most impacted worldwide by introduced species (Schaffelke *et al.* 2006; Lejeusne *et al.* 2010). A thousand or so non-indigenous species (NIS) have been reported, with more than 600 of them definitely introduced, i.e., self-reproducing in their new quarters (Zenetos *et al.* 2010; Galil *et al.* 2018). The two major routes for introduction are the Suez Canal (in the eastern basin), which allows warm water species from the Red Sea and the Indian Ocean to enter the eastern basin of the Mediterranean (the so-called Lessepsian species), and the shellfish aquaculture industry, mainly of the Japanese oyster *Magallana gigas* (Thunberg, 1793), through spat import, in the western basin, which has allowed cold affinity species from the north-eastern Pacific (mainly Japan and Korea) to colonize the Mediterranean. In addition, shipping (fouling and clinging on ship hulls and ballast water) is an important vector throughout the Mediterranean (Por 1978; Boudouresque 1999; Verlaque 2001; Boudouresque & Verlaque 2002a; Verlaque *et al.* 2007; Boudouresque *et al.* 2011, 2016; Verlaque *et al.* 2015; Galil *et al.* 2018).

The red alga *Lophocladia lallemandii* (Montagne) F.Schmitz (Ceramiales, Rhodomelaceae) is native to the Red Sea (where the type specimen comes from) and the Indian Ocean (Montagne *et al.* 1849; Einav *et al.* 2021). It was assumed to have entered the Mediterranean Sea *via* the Suez Canal, thus being referred to as a Lessepsian species (Por 1978) and was first recorded in 1908 in Greece and Libya (Petersen 1918). It was then observed in Algeria (Feldmann & Feldmann 1938) and subsequently steadily spread to the whole of the eastern and south-western Mediterranean Sea (Boudouresque & Verlaque 2002b; Cebrian & Ballesteros 2007, 2010a; Occhipinti-Ambrogi *et al.* 2011; Bedini *et al.* 2014; Kersting *et al.* 2014; Verlaque *et al.* 2015; El Zrelli *et al.* 2021; Tiberti *et al.* 2021).

Another species of *Lophocladia, L. trichoclados* (C.Agardh) F.Schmitz, was originally described as *Griffithsia trichoclados* C. Agardh from "India Occidentali", i.e., the western tropical Atlantic Ocean (Agardh 1828). It is also present in Macaronesia, western Africa and in the Mediterranean Sea, where it is considered as having been introduced (Golo *et al.* 2023, 2024). In Corsica, the species has been tentatively reported from Calancone (Punta Ciuttone, near Galeria, western Corsica) by Boudouresque & Verlaque (1976) and Boudouresque & Perret (1977). The morphological difference with *L. lallemandii* is slight: in *L. trichoclados*, the daughter axes would be of endogenous origin and born next to a trichoblast, which would not be the case in *L. lallemandii*.

On the basis of molecular data, Golo *et al.* (2023, 2024) concluded that the species of *Lophocladia* which invaded the Mediterranean was not the Red Sea and Indian Ocean *L. lallemandii*, but the western Atlantic *L. trichoclados*. Phylogenetic reconstruction based on *rbc*L sequences (> 600 number of bases) from specimens from the western Atlantic Ocean, Macaronesia (eastern Atlantic) and the whole of the Mediterranean Sea (Menorca, Cabrera, Catalonia, western Italy, Croatia and Israel) were included in a well-supported clade (> 99.7% of similitude) (Golo *et al.* 2023).

Until the mid-2010s, the north of the western basin was the only uninvaded Mediterranean area (Verlaque *et al.* 2015). In December 2021, a small population of *L. trichoclados* (as *L. lallemandii*) was recorded at La Gabinière Islet, Port-Cros National Park (eastern Provence, France), between 3 and 8 m depth, dwelling in a photophilous rocky reef (Boudouresque *et al.* 2022) (Fig. 1). For the authors, the question arose: "Is the occurrence transients, with the population unlikely to survive the winter, or does it indicate permanent establishment?".

The answer to the above question is now known. The abundance of *L. trichoclados* actually decreased considerably in May 2022, following low winter temperatures. But the species was not only still present, on November 27th, 2022, but had an extended area (La Gabinière Islet, east, west and north) and an extended depth range, between at least 7 and 20 m depth. It formed a dense and seemingly monospecific turf carpeting rocky reefs (Fig. 2). The collected specimens (H8358 – Marseille University Herbarium – HCOM)

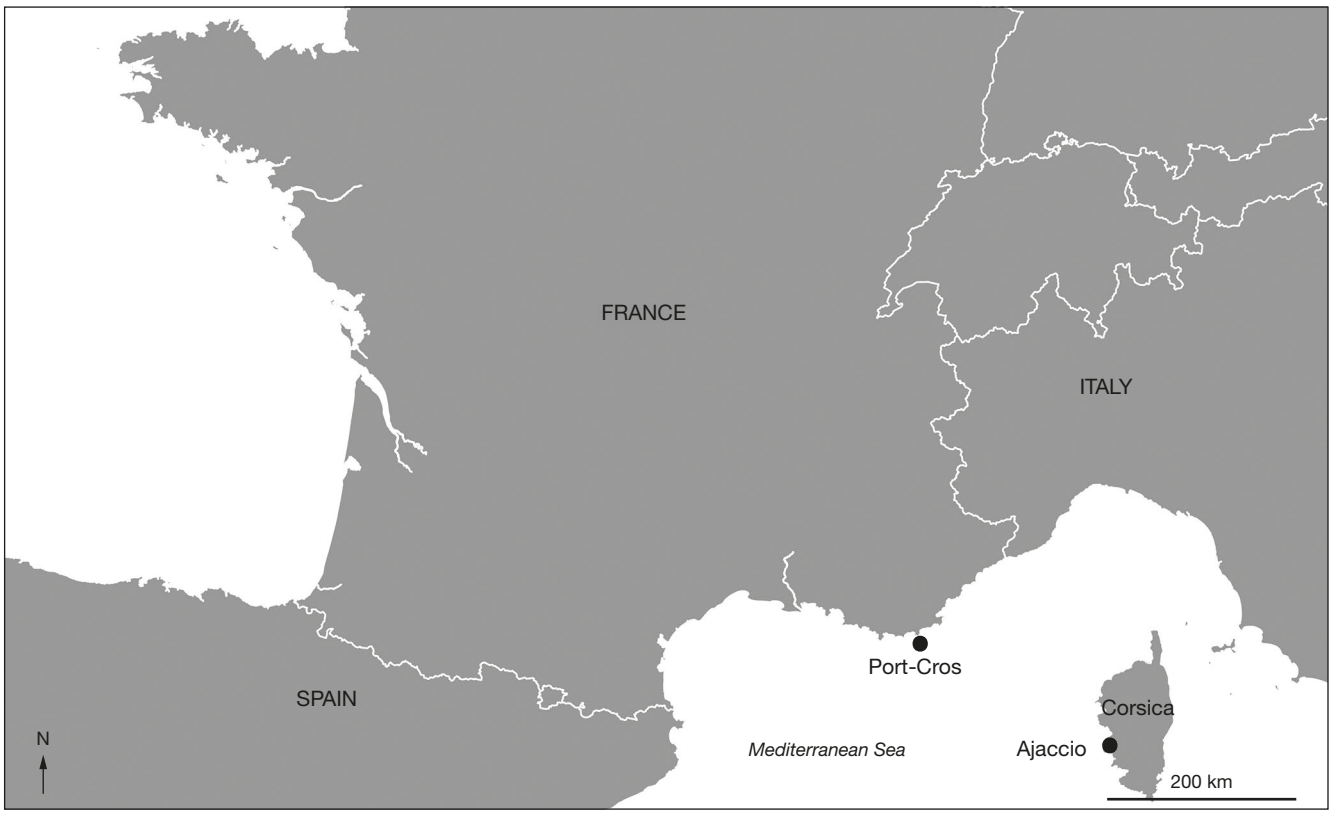

Fig. 1. — New records of *Lophocladia trichoclados* (C.Agardh) F.Schmitz, in the northwestern Mediterranean Sea.

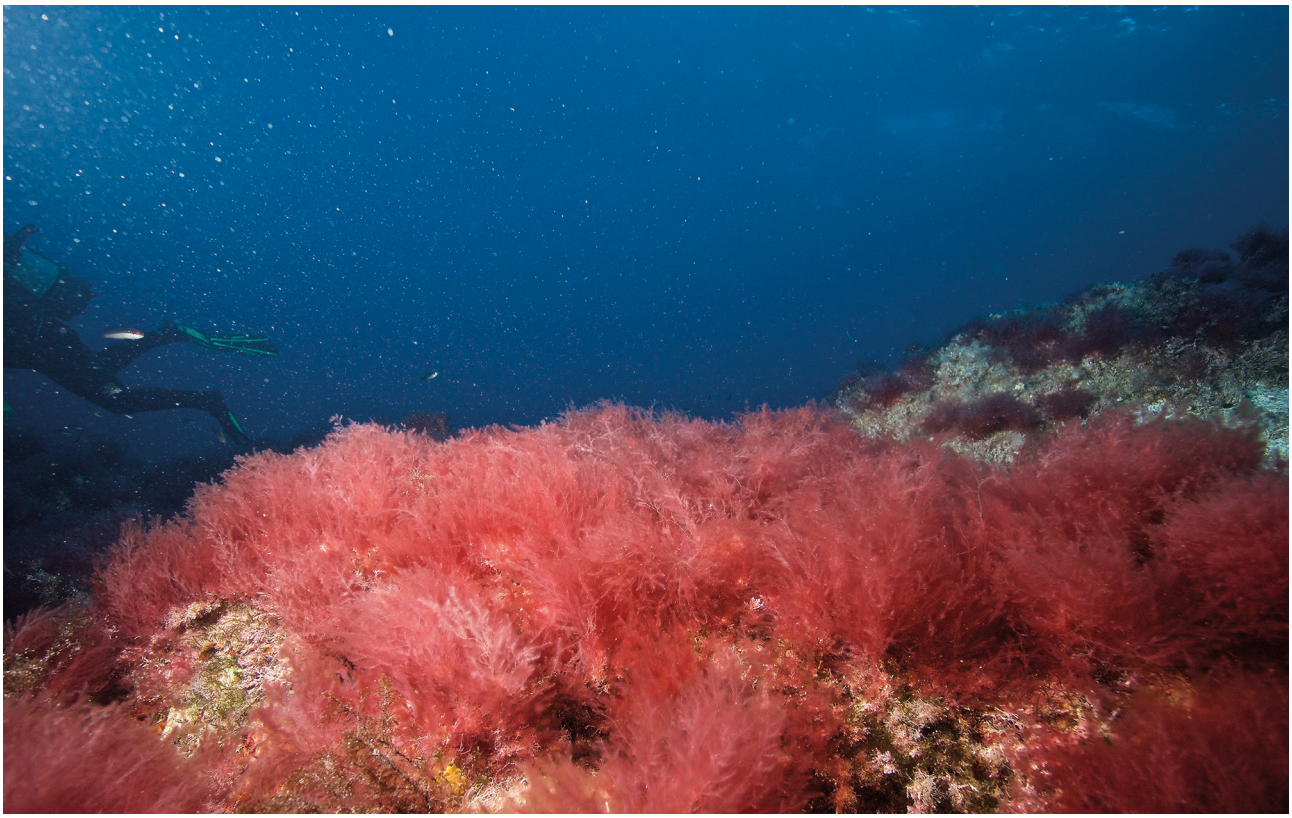

Fig. 2. — *Lophocladia trichoclados* (C.Agardh) F.Schmitz carpeting a rocky reef, 7 m depth, west side of La Gabinière Islet, Port-Cros National Park, eastern Provence, on November 27th, 2022. Photo: © Claude Lefebvre.

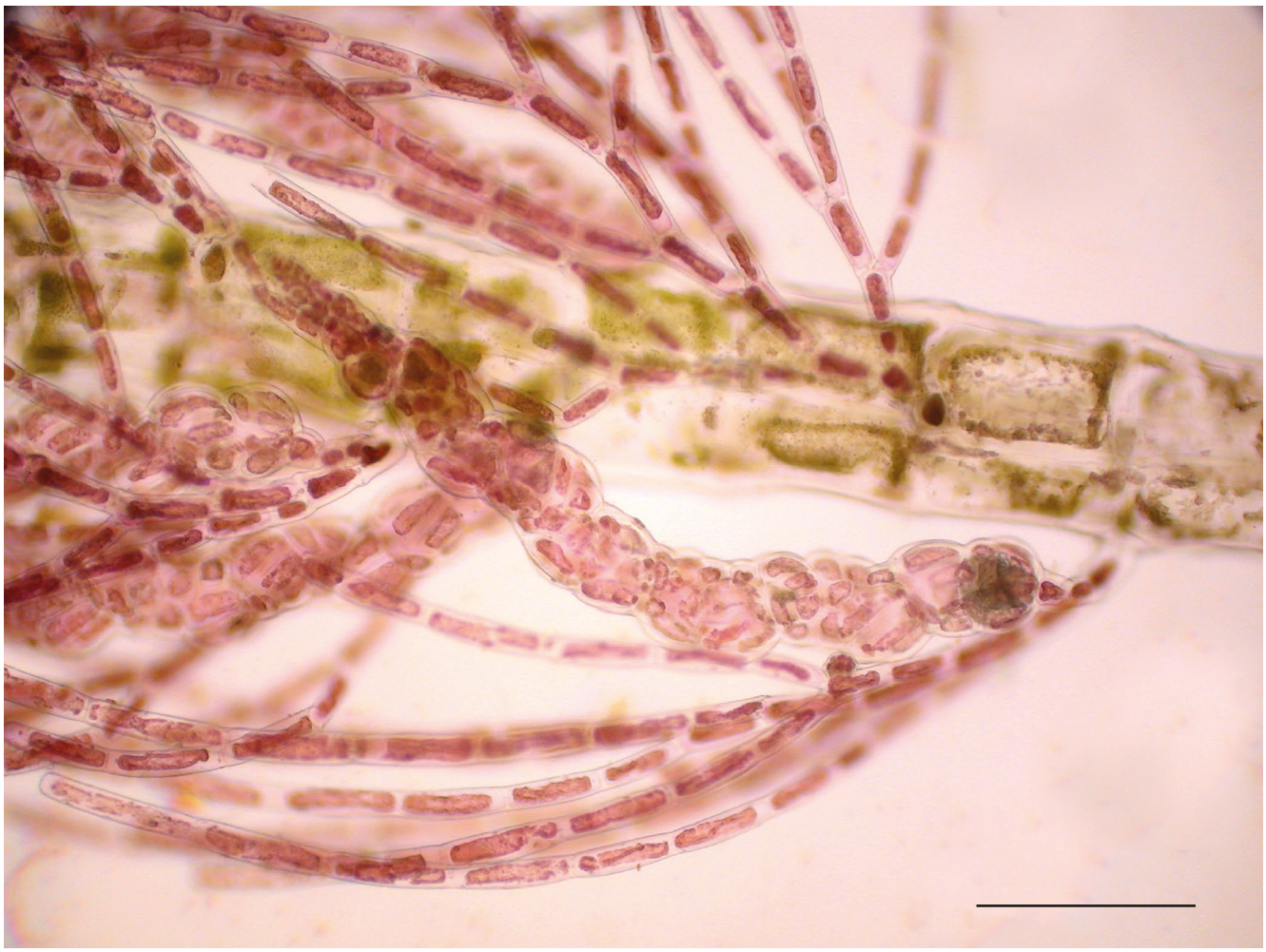

FIG. 3. — Portion of the axis of *Lophocladia trichoclados* (C.Agardh) F.Schmitz showing, on the bottom right side, the insertion of a twisted stichidium on the basal cell of a coloured trichoblast. From specimen H8344 (Marseille University Herbarium – HCOM). La Gabinière Islet, 6 m depth (December 15th, 2021). Photo: © Marc Verlaque in Boudouresque *et al.* (2022), as *L. lallemandii* (Montagne) F.Schmitz. Scale bar : 200 µm.

presented all the distinguishing characteristics of the taxon, as listed by Feldmann & Feldmann (1938), Rodríguez-Prieto *et al.* (2013), Verlaque *et al.* (2015) and Golo *et al.* (2024): 1) monopodial growth; 2) the branching exogenous, with branches replacing a trichoblast (replacing a trichoblast, or not: this character could be non-discriminant); 3) the axes with four pericentral cells; 4) the axial cell narrow in transverse section; 5) the segments short; 6) the trichoblasts coloured and persistent; and the tetrasporangial stichidia inserted on the basal cell of the trichoblast, slightly spirally twisted and with one tetrasporangium per segment (Fig. 3). Only the specimens dwelling at 9 m depth, on the west side of La Gabinière Islet, bore tetrasporangial stichidia.

In addition to La Gabinière site (eastern Provence), *L. trichoclados* was also recorded by Karine Lerissel from the Gulf of Aiacciu (Ajaccio) (I Scuglietti, 41°55'5"N, 8°45'43"E) in western Corsica, on November 6th, 2021. It was dwelling between 5 and 10 m depth, in a photophilous rocky reef habitat (specimens H8345 and H8346 – Marseille University Herbarium – HCOM) (Fig. 4).

The maritime traffic, such as yachting, between already invaded Mediterranean areas (e.g. Tuscany, Sardinia and Balearic Islands), together with the current increase of sea surface temperature in the Mediterranean Sea, probably facilitated the spread of *L. trichoclados*, a thermophilic species, towards Provence and Corsica. However, according to Golo *et al.* (2023), the main limiting factor for the survival of *L. trichoclados* is the winter lower temperature (below 12°C): the species requires mild winters.

Lophocladia trichoclados is strongly defended against herbivorous species by toxic chemicals, namely the alkaloid lophocladine (Gross *et al.* 2006; Tomas *et al.* 2011a, b). Herbivores, such as the sea urchin *Paracentrotus lividus* (Lamarck, 1816), strongly avoid grazing on it (Cebrian *et al.* 2011; Tomas *et al.* 2011a). It invaded and became dominant in Fucales forests in Tuscany (Bedini *et al.* 2011, 2014), taking advantage of its greater invasiveness in highly structured and biodiverse algal assemblages (Cebrian & Ballesteros 2010b; Cebrian *et al.* 2018) (as *L. lallemandii*). In the *Posidonia oceanica* (Linnaeus) Delile seagrass meadow at Formentera

FIG. 4. — *Lophocladia trichoclados* (C.Agardh) F.Schmitz (as *L. lallemandii* (Montagne) F.Schmitz)). Specimen H8345 (Marseille University Herbarium – HCOM). Collected in the Gulf of Aiacciu (Ajaccio) by Karine Lerissel on November 6th, 2021. We have chosen not to modify the original label of the voucher. Scale bar : 1 cm.

(Balearic Islands), the mat of *L. trichoclados* (as *L. lallemandii*) can become so thick and dense that new *P. oceanica* leaves are entrapped within the mat, display chlorosis and sometimes die, together with the shoots they are attached to (Ballesteros *et al.* 2007). *Lophocladia trichoclados* (as *L. lallemandii*) is also a stress factor for the giant pen shell *Pinna nobilis* Linnaeus, 1758 (Box *et al.* 2008, 2009) and *P. oceanica* (Sureda *et al.* 2008). *Lophocladia lallemandii* is, however, a photophilic species that prefers shallow environments, decreasing its abundance in deep waters and showing almost no impact in deep water assemblages (Cebrian & Ballesteros 2007; Kersting *et al.* 2014).

Golo *et al.* (2023) predicted, on the basis of an ecological distribution model, that *L. trichoclados* should occur in Provence, French Riviera and Corsica. Our records fully confirm the outputs of their model.

Interestingly, the bloom of *L. trichoclados* does not occur in spring but in autumn and winter. As stressed by Mayoub (1976), in spring and summer, the alga is only present as a low stratum of vegetative filaments, difficult to recognise as they bear neither tetrasporangial stichidia nor sexual organs. In Algeria, Feldmann & Feldmann (1938) collected the species, with stichidia, in October and November. In Sicily (Italy), stichidia were present in winter (December through February) (Cormaci *et al.* 1984; Cormaci & Motta 1985). In Formentera (Balearic Islands), coverage and biomass were very low or even nil in spring, while they represented up to over 25% of the total biomass in autumn (Cebrian & Ballesteros 2007, 2010a). Our results fully confirm this unexpected behaviour, for a species with obvious warm affinity, namely blooming and reproducing during the coldest season.

Acknowledgements
The authors are grateful to Michael Paul, a native English speaker, for proofreading the text and to the Port-Cros National Park's wardens for field assistance. They also thank two anonymous reviewers and the editor, Line Le Gall, for valuable suggestions.

REFERENCES

AGARDH C. A. 1828. — *Species algarum rite cognitae cum synonymis, differentiis specificis et descriptionibus succinctis*. Voluminis secundi: *Gryphiae*: lxxvi + 189 p.

BALLESTEROS E., CEBRIAN E. & ALCOVERRO T. 2007. — Mortality of shoots of *Posidonia oceanica* following meadow invasion by the red alga *Lophocladia lallemandii*. *Botanica Marina* 50: 8-13. https://doi.org/10.1515/BOT.2007.002

BEDINI R., BONECHI L. & PIAZZI L. 2011. — Spread of the introduced red alga *Lophocladia lallemandii* in the Tuscan Archipelago (NW Mediterranean Sea). *Cryptogamie, Algologie* 32 (4): 383-391. https://doi.org/10.7872/crya.v32.iss4.2011.383

BEDINI R., BONECHI L. & PIAZZI L. 2014. S — Mobile epifaunal assemblages associated with *Cystoseira* beds: comparison between areas invaded and not invaded by *Lophocladia lallemandii*. *Scientia Marina* 78 (3): 425-432. https://doi.org/10.3989/scimar.03995.28B

BOUDOURESQUE C.-F. 1999. — The Red Sea – Mediterranean link: unwanted effects of canals, *in* SANLUND O. T., SCHEI P. J. & VIKEN A. (eds), *Invasive species and biodiversity management*. Kluwer Academic publisher, Dordrecht: 213-228.

BOUDOURESQUE C.-F. & PERRET M. 1977. — Inventaire de la flore marine de Corse (Méditerranée): Rhodophyceae, Phaeophyceae, Chlorophyceae et Bryopsidophyceae. *Bibliotheca Phycologica* 25: 1-171.

BOUDOURESQUE C.-F. & VERLAQUE M. 1976. — Sur quelques Rhodophycées intéressantes des côtes de Corse. *Société phycologique de France, Bulletin* 21: 56-64.

BOUDOURESQUE C.-F. & VERLAQUE M. 2002a. — Assessing scale and impact of ship-transported alien macrophytes in the Mediterranean Sea, *in* BRIAND F. (ed.), *Alien Marine Organisms Introduced by Ships in the Mediterranean and Black Seas.* CIESM publisher, Istanbul: 53-61 (CIESM Workshop Monographs; 20).

BOUDOURESQUE C.-F. & VERLAQUE M. 2002b. — Biological pollution in the Mediterranean Sea: invasive versus introduced macrophytes. *Marine Pollution Bulletin* 44: 32-38. https://doi.org/10.1016/S0025-326X(01)00150-3

BOUDOURESQUE C.-F., KLEIN J., RUITTON S. & VERLAQUE M. 2011. — Biological Invasion: the Thau Lagoon, a Japanese biological island in the Mediterranean Sea, *in* CECCALDI H. J., DEKEYSER I., GIRAULT M. & STORA G. (eds), *Global Change: Mankind-Marine Environment Interactions.* Springer publisher, Dordrecht: 151-156. https://doi.org/10.1007/978-90-481-8630-3_27

BOUDOURESQUE C.-F., PERRET-BOUDOURESQUE M., VERLAQUE M. 2016. — Donor and recipient regions for exotic species of marine macrophytes: a case of unidirectional flow, the Mediterranean Sea. *Rapports et P.V. des Réunions de la Commission Internationale pour l'Exploration de la Méditerranée* 41: 426.

BOUDOURESQUE C.-F., PERRET-BOUDOURESQUE M., RUITTON S. & THIBAULT D. 2022. — The invasive thermophilic red alga *Lophocladia lallemandii* reaches the Port-Cros National Park (northwestern Mediterranean). *Scientific Reports of Port-Cros National Park* 36: 59-66.

BOX A., SUREDA A., TERRADOS J., PONS A. & DEUDERO S. 2008. — Antioxidant response and caulerpenyne production of the alien *Caulerpa taxifolia* (Vahl) epiphytized by the invasive algae *Lophocladia lallemandii* (Montagne). *Journal of Experimental Marine Biology and Ecology* 364: 24-28. https://doi.org/10.1016/j.jembe.2008.06.029

BOX A., SUREDA A. & DEUDERO S. 2009. — Antioxidant response of the bivalve *Pinna nobilis* colonised by invasive red macroalgae *Lophocladia lallemandii*. *Comparative Biochemistry and Physiology, Part C* 149: 456-460. https://doi.org/10.1016/j.cbpc.2008.10.107

CEBRIAN E. & BALLESTEROS E. 2007. — Invasion of the alien species *Lophocladia lallemandii* in Eivissa-Formentera (Balearic Islands), *in Proceedings of the 3rd Mediterranean Symposium on marine vegetation*, *Marseille, 27-29 March 2007*. Regional Activity Centre for Specially Protected Areas, Tunis: 34-41.

CEBRIAN E. & BALLESTEROS E. 2010a. — Invasion of Mediterranean benthic assemblages by red alga *Lophocladia lallemandii* (Montagne) F. Schmitz: depth-related temporal variability in biomass and phenology. *Aquatic Botany* 92: 81-85. https://doi.org/10.1016/j.aquabot.2009.10.007

CEBRIAN E. & BALLESTEROS E. 2010b. — Invasion susceptibility of Mediterranea rocky benthic assemblages to red alga *Lophocladia lallemandii* (Montagne) F. Schmitz, *in Proceedings of the 4rd Mediterranean Symposium on marine vegetation*, *Yasmine-Hammamet*, *2-4 December 2010*. Regional Activity Centre for Specially Protected Areas, Tunis: 61-65. https://doi.org/10.1016/j.aquabot.2009.10.007

CEBRIAN E., TOMAS F., LINARES C. & BALLESTEROS E. 2011. — Do native herbivores provide resistance to Mediterranean marine bioinvasions? *Biological Invasions* 13: 1397-1408. https://doi.org/10.1007/s10530-010-9898-1

CEBRIAN E., TOMAS F., LÓPEZ-SENDINO P., VILÀ M. & BALLESTEROS E. 2018. — Biodiversity influences invasion success of a facultative epiphytic seaweed in a marine forest. *Biological Invasions* 20: 2839-2848. https://doi.org/10.1007/s10530-018-1736-x

CORMACI M. & MOTTA G. 1985. — Osservazioni su *Lophocladia lallemandii* (Mont.) Schmitz (Ceramiales, Rhodomelaceae) in coltura. *Bolletino dell'Accademia Gioenia di Scienze Naturale, Catania* 18 (326): 797-808.

CORMACI M., DURO A. & FURNARI G. 1984. — On reproductive phenology of Ceramiales (Rhodophyta) in East Sicily. *Botanica Marina* 27: 95-104. https://doi.org/10.1515/botm.1984.27.3.95

EINAV R., GUIRY M. D. & ISRAEL A. 2021. — A revised list of seaweeds from the Red Sea (1756-2020). *Israel Journal of Plant Sciences* 68 (3): 175-247. https://doi.org/10.1163/22238980-bja10036

EL ZRELLI R., MANSOUR L., CROCETTA F. & RABAOUI L. 2021. — The macroalgae *Lophocladia lallemandii* and *Sarconema filiforme* and the spaghetti bryozoan *Amathia verticillata* in native seagrass beds in the Gulf of Gabès (southeastern Tunisia, Mediterranean Sea). *BioInvasions Records* 10 (1): 103-108. https://doi.org/10.3391/bir.2021.10.1.12

FELDMANN J. & FELDMANN G. 1938. — Présence du *Lophocladia lallemandi* (Mont.) Schmitz, aux environs d'Alger. *Bulletin de la Société d'Histoire naturelle de l'Afrique du Nord* 29: 479.

GALIL B. S., MARCHINI A. & OCCHIPINTI-AMBROGI A. 2018. — East is east and West is west? Management of marine bioinvasions in the Mediterranean Sea. *Estuarine, Coastal and Shelf Science* 201: 7-16. https://doi.org/10.1016/j.ecss.2015.12.021

GOLO R., VERGÉS A., DÍAZ-TAPIA P. & CEBRIAN E. 2023. — Implications of taxonomic misidentification for future invasion predictions: evidence from one of the most harmful invasive marine algae. *Marine Pollution Bulletin* 191 (114970): 1-10. https://doi.org/10.1016/j.marpolbul.2023.114970

GOLO R., CEBRIAN E., DÍAZ-TAPIA P., LUCIC P., HOFFMAN R. & VERGÉS A., 2024. — Phylogenetic analysis of invasive genus *Lophocladia* (Rhodomelaceae, Rhodophyta) reveals synonymy of *L. lallemandii* with *L. trichoclados* and first record of *L. kuetzingii* in the NE Atlantic. *European Journal of Phycology* 59 (1): 112-126. https://doi.org/10.1080/09670262.2023.2260443

GROSS H., GOEGER D. E., HILLS P., MOOBERRY S. L., BALLANTINE D. L., MURRAY T. F., VALERIOTE F. A. & GERWICK W. H. 2006. — Lophocladines, bioactive alkaloids from the red alga *Lophocladia* sp. *Journal of Natural Products* 69 (4): 640-644. https://doi.org/10.1021/np050519e

KERSTING D. K., BALLESTEROS E., DE CARALT S. & LINARES C. 2014. — Invasive macrophytes in a Marine Reserve (Columbretes Islands, NW Mediterranean): spread dynamics and interaction with the endemic scleractinian coral *Cladocora caespitosa*. *Biological Invasions* 16: 1599-1610. https://doi.org/10.1007/s10530-013-0594-9

LEJEUSNE C., CHEVALDONNÉ P., PERGENT-MARTINI C., BOUDOURESQUE C. F. & PEREZ T. 2010. — Climate change effects on a miniature ocean: the highly diverse, highly impacted Mediterranean Sea. *Trends in Ecology and Evolution* 25 (4): 250-260. https://doi.org/10.1016/j.tree.2009.10.009

MAYOUB H. 1976. — *Recherches sur la végétation marine de la côte syrienne. Étude expérimentale sur la morphogénèse et le développement de quelques espèces peu connues*. PhD thesis, University of Caen, France, 286 p.+ 1 map + 16 plates.

MONTAGNE C. X., 1849. — Sixième centurie de plantes cellulaires nouvelles, tant indigènes qu'exotiques. Décades VIII à X. *Annales des Sciences naturelles, Botanique*, Troisième Série, 12 : 385-320.

OCCHIPINTI-AMBROGI A., MARCHINI A., CANTONE G., CASTELLI A., CHIMENZ C., CORMACI M., FROGLIA C., FURNARI G., GAMBI M. C., GIACCONE G., GIAGRANDE A., GRAVILI C., MASTROTOTARO F., MAZZIOTTI C., ORSI-RELINI L. & PIRAINO S. 2011. — Alien species along the Italian coasts: an overview. *Biological Invasions* 13 (1): 215-237. https://doi.org/10.1007/s10530-010-9803-y

PETERSEN H. E. 1918. — Algae (excl. calcareous algae), *in* SCHMIDT J. (ed.), *Report of the Danish Oceanographical Expeditions 1908-1910 to the Mediterranean and adjacent seas*. Vol. 2: *Biology*. Host and Sons, København: 1-20.

POR F. D. 1978. — *Lessepsian migrations. The influx of Red Sea biota into the Mediterranean by way of the Suez Canal*. Springer publisher, Berlin, viii + 228 p.

RODRÍGUEZ-PRIETO C., BALLESTEROS E., BOISSET F. & AFONSO-CARRILLO J. 2013. — *Guía de las macroalgas y fanerógamas marinas del Mediterráneo occidental*. Editiones Omega, Barcelona, 656 p.

SCHAFFELKE B., SMITH J. E. & HEWITT C. D. 2006. — Introduced macroalgae – a growing concern. *Journal of Applied Phycology* 18: 529-541. https://doi.org/10.1007/s10811-006-9074-2

SUREDA A., BOX A., TERRADOS J., DEUDERO S. & PONS A. 2008. —Antioxidant response of the seagrass *Posidonia oceanica* when epiphytized by the invasive macroalgae *Lophocladia lallemandii*. *Marine Environmental Research* 66: 359-363. https://doi.org/10.1016/j.marenvres.2008.05.009

TIBERTI L., IACONO G., GAMBI M. C. & MANNINO A. M. 2021. — Invasions of the nonindigenous red alga *Lophocladia lallemandii* (Montagne) F. Schmitz off the Island of Ischia (Tyrrhenian Sea, Italy). *BioInvasions Records* 10 (1): 91–102. https://doi.org/10.3391/bir.2021.10.1.11

TOMAS F., BOX A. & TERRADOS J. 2011a. — Effects of invasive seaweeds on feeding preference and performance of a keystone Mediterranean herbivore. *Biological Invasions* 13: 1559-1570. https://doi.org/10.1007/s10530-010-9913-6

TOMAS F., CEBRIAN E. & BALLESTEROS E. 2011b. — Differential herbivory of invasive algae by native fish in the Mediterranean Sea. *Estuarine, Coastal and Shelf Science* 92: 27-34. https://doi.org/10.1016/j.ecss.2010.12.004

VERLAQUE M. 2001. — Checklist of the macroalgae of Thau Lagoon (Hérault, France), a hot spot of marine species introduction in Europe. *Oceanologica Acta* 24 (1): 29-49. https://doi.org/10.1016/S0399-1784(00)01127-0

VERLAQUE M., BOUDOURESQUE C.-F. & MINEUR F. 2007. — Oyster transfers as a vector for marine species introductions: a realistic approach based on the macrophytes, *in* BRIAND F. (ed.), *Impact of mariculture on coastal ecosystems*. CIESM publisher, Monaco: 39-47 (CIESM Workshop Monographs; 32).

VERLAQUE M., RUITTON S., MINEUR F. & BOUDOURESQUE C.-F. 2015. — *CIESM Atlas of exotic species, in* BRIAND F. (ed.),Vol. 4: *Macrophytes*. CIESM publisher, Monaco, 362 p.

ZENETOS A., GOFAS S., VERLAQUE M., CINAR M. E., GARCÍA RASO J. E., BIANCHI C. N., MORRI C., AZZURRO E., BILECENOGLU M., FROGLIA C., SIOKOU S., VIOLANTI D., SFRISO A., SAN MARTÍN G., GIAGRANDE A., KATAĞAN T., RAMOS-ESPLÁ A., MASTROTOTARO F., OCAÑA O., ZINGONE A., GAMBI M. C. & STREFTAIRIS N. 2010. — Alien species in the Mediterranean Sea by 2010. A contribution to the application of European Union's Marine Strategy Framework Directive (MSFD). Part I. Spatial distribution. *Mediterranean Marine Science* 11 (2): 381-493. https://doi.org/10.12681/mms.87

Submitted on 5 September 2023;
accepted on 13 May 2024;
published on 30 October 2024.