

MULTIPATHOGEN/MULTIFACTORIAL PATHOGENESIS IN PINNA NOBILIS MASS MORTALITY
EVENTS: A CONSENSUS REPORT

Mass Mortality Events (MME) affected noble pen shell (*Pinna nobilis*), the largest native bivalve in the Mediterranean Sea, causing its near-extinction since 2016. Initial diagnostic investigations focused on a novel protozoan parasite, *Haplosporidium pinnae*. Although, several more recent studies indicated that *P. nobilis* MMEs are rather caused by polymicrobial infection patterns, even in the absence of *H. pinnae*. Moribund specimens collected during MMEs in the Tyrrhenian Sea (Campania, Italy) showed a systemic syndrome associated to the presence of the *Mycobacterium simiae* complex. Further reports published by other research groups from other Mediterranean coastal areas confirmed the presence of both *H. pinnae* and mycobacterial pathogens in multiple MMEs, even adding the concomitant occurrence of other pathogens. Nevertheless, it was recently demonstrated that *H. pinnae* is not specifically affecting *P. nobilis*, neither this infection is necessarily associated to animal disease. The initial misleading hypothesis of a single protozoan pathogen causing the extinction of *P. nobilis* populations in the Mediterranean Sea needs to be reconsidered. There is an urgent need for the scientific and environmental protection community to arrive to a consensus on research and conservation priorities, by taking into consideration a wider range of elements that may negatively affect the survival of *P. nobilis*. Therefore, it is the intention of all authors joining this consensus work to approach the growing body of science-based clinical, diagnostics and laboratory evidence to support the evidence that *P. nobilis* MMEs are caused by a complex pathogenesis elicited by polymicrobial infections in conjunction with abiotic factors. This study approach should pose the basis for establishing a broad foundation for future studies, aimed at preserving endangered populations of native bivalves.

PATHOGENS ASSOCIATED TO THE MMEs IN THE FIELD

2016: First MME of *P. nobilis* observed in Spain

2017: *Haplosporidium* sp. reported in Alicante

2018 A new species, *Haplosporidium pinnae* is described in *P. nobilis* and reported in Italy and Greece.

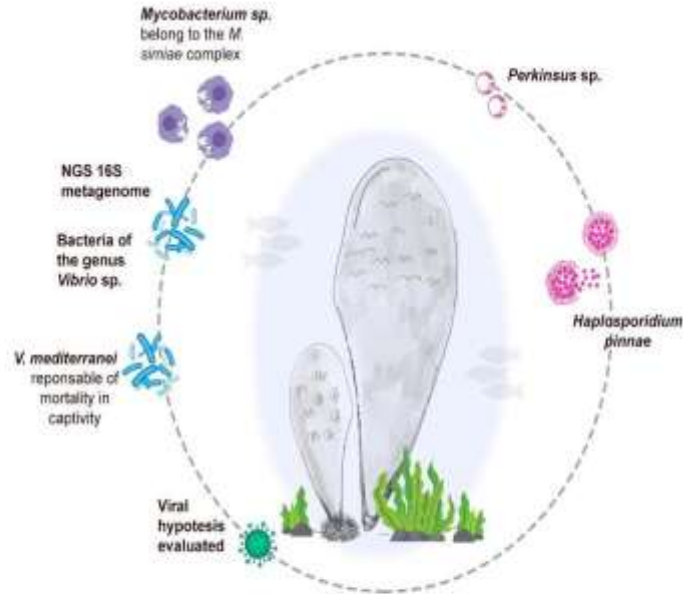
2019 a Mycobacterial disease (*Mycobacterium simiae* complex) is reported in Italy (Campania and Sicily) as the solely pathogen present in diseased animals.

2020 *Mycobacterium* sp. is reported in Greece, in other parts of Italy and in Spain along with *H. pinnae*, *Vibrio* sp and *Perkinsus* sp (island of Sardinia)

Mycobacterium sp. and *H. pinnae* are reported in the Adriatic Sea, Croatia

Haplosporidium pinnae is reported in other bivalve species in the island of Sardinia

2021 16S rRNA NGS report of gut's bacterial consortium in diseased animals



CURRENT STATE

Since 2016 different countries all over the Mediterranean Sea described episode of MMEs in *P. nobilis*. Currently, the species has become locally extinct in most of its previous range, reported as Critically Endangered by IUCN's Red List in 2019

References

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