



**CESAB**  
CENTRE FOR THE SYNTHESIS AND ANALYSIS  
OF BIODIVERSITY

# Project summary

## GASPAR

A general approach to Species-Abundance relationships in a context of global change, reef fish species as a model

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Start and Finish: 2010-2013

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**As part of the GASPAR research project, three of the 12 researchers of this international team of 12 researchers have studied the adaptation of invasive fishes in the Mediterranean Sea by analyzing more than 5300 Indo-Pacific species, in which more than 700 are present in in the Red Sea.**

### Context and objectives

The invasion of non-indigenous species is considered one of the main threats to biodiversity, leading to significant changes in the structure and functioning of ecosystems.

In the context of globalization, research on invasive species has become increasingly important due to the growing number of species moved by human activity -- transport, trade, etc. -- and the need to understand the causes of these species. Invasive species are often a source of problems because they compete with local flora and fauna. They thus often disrupt the density and quality of native species. The result is a loss of biodiversity which, over time, can lead to significant losses of ecosystem services, such as reduced fishing yields.



**Since the opening of the Suez Canal in 1869, the Eastern Mediterranean has undergone an unprecedented transformation in the composition of its species, with the massive arrival of non-native species, known as lessepsians, from the Red Sea.** These species already make up more than a quarter of the catches in the eastern Mediterranean, and sometimes much more. Some of these species are now arriving as far as the western Mediterranean.

### **Methods and approaches used for the project**

The GASPAR project has particularly studied the mechanisms that allow the adaptation of a species to a new environment, in the context of biological invasion and the adaptation of species to climate and global changes. For the first time, the GASPAR project has conducted a study on all species living in adjacent systems to identify the processes that select those that will become invasive. This information is rarely available and until now this approach had never been used.

In this study, GASPAR collected data on the specific traits, geographic distribution, and environmental affinities of all coral fishes in the Red Sea, and more generally in the Indo-Pacific. GASPAR is working on 6,300 species of fish (40 % of known marine species) and has censuses of several million fish (identified individuals, whose numbers and sizes they know) at more than 100 sites worldwide. GASPAR used this large database to identify the main characteristics that differentiate invasive and non-invasive species among Red Sea species.

### **Principal conclusions**

The GASPAR group notes that **all the Red Sea species that invade the Middle-East occupy a greater diversity of environments in their original space.** These species would therefore already have a great capacity to adapt in their native environment, facilitating their subsequent adaptation in a new environment.

Moreover, Red Sea species naturally subjected to temperature changes in their native environment have a greater chance of becoming invaders. In fact, species that can withstand higher thermal amplitude are more malleable in the choice of their environment than others. The causes are unknown, but scientists hypothesize that this is partly due to physiological and behavioural adaptations.

However, thermal amplitudes are greater in the Mediterranean than in the Red Sea, and an increase in these amplitudes is predicted, with record temperatures in the extreme south-east of the Méditerranéa. This seasonal warming in the Mediterranean is likely to be a hindrance to the establishment of Red Sea species.

This study also shows that lesseptic species have a wider range of biological characteristics than other Red Sea fish. **This result suggests the intervention of additional adaptive processes such as competition, which would encourage the ecological diversity of invasive species.** For example, a species may have all the right characteristics to become invasive, but the presence of competitors in the Mediterranean will block its establishment. On the contrary, a species that is less adapted but does not encounter any competitors may succeed in establishing itself.

### **Anticipated (or actual) impact of these results for science, society, and public and private decision making**

**The GASPAR group used these results to present a first quantitative classification of lesseptic species that could become established in the Eastern Mediterranean.**

This work also allows a distinction to be made between the different regions of the Mediterranean Sea: the number of species that could arrive and become established in the Western Mediterranean is lower than in the Eastern Mediterranean because the climatic conditions there are less favorable (and therefore presuppose a stronger adaptation of invasive species), and competition between species is greater there. However, the installation of less competitive species would be favored if they were to colonize an ecological niche not occupied by local species.

Although it is not yet possible to propose completely reliable scenarios on the future of invasive and native species in the Mediterranean, it is certain that the current disturbances due to over-fishing, pollution, coastal development, etc., are weakening natural populations in the Mediterranean. **Remedying these disturbances should strengthen the capacity of natural stands to resist invasive species, which, once established, can no longer be eradicated.**

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