

Preventing lionfish invasion in Cyprus through early response and targeted removal ^[1]

Image from Climate Adapt about this case study

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Lionfish (*Pterois miles*), a generalist and voracious mesopredator native of the Indian Ocean, is rapidly spreading in the Mediterranean Sea, demonstrating the fastest invasion ever recorded in the region. Seawater warming, as effect of global climate change, is projected to offer increasingly favourable habitat for lionfish diffusion that could threaten almost the entire Mediterranean Sea by the end of this century. Lionfish invasion heavily affects the marine ecosystem and biodiversity, causing the decline of local species and biodiversity. It can also reduce commercial fish species, with potential disruption of fisheries, while their venomous features can pose a health threat and decrease the attractiveness of tourism destinations and diving sites.

The EU-funded [RELIONMED-LIFE](#) ^[3] project aims to make Cyprus, due to its geographical position, the 'first line of defence' against the invasion of the lionfish in the Mediterranean. With the active involvement of the general public and local stakeholders, the project team, coordinated by the University of Cyprus, tested the effectiveness of several actions to control lionfish diffusion in Cypriot Natura 2000 sites, Marine Protected Areas (MPAs) and diving sites (wrecks and artificial reefs). The implemented actions included: the analyses of lionfish biology and distribution patterns; the formulation of a risk assessment analysis of lionfish to include this species in the list of Invasive Alien Species of Union concern (the Union list -EU Regulation 1143/2014); the development of an early detection system for lionfish with an online dedicated portal and a phone application; the training of SCUBA and free divers and the implementation of targeted removal events including competitions; the training and motivation of fishers; the promotion of new niche markets for lionfish commercialisation; and the development of a regional management plan.

Though removal actions can be very effective, the reproduction and recolonization rate of lionfish are very rapid, calling for frequent actions, more coordinated effort and legislative regulation changes to cull its diffusion in the long term in Cyprus and across the Mediterranean Sea. The new opportunities for local businesses explored during the project that involved restaurants (with innovative menus) and jewel makers (by using discarded non-venomous fins), revealed strong interest. They can act as an economic incentive for lionfish catches. Major social benefits are produced by the project since it acts as an educational platform for better knowledge and management of invasive species in the marine environment, allows for active participation, promotes public collaboration in the scientific research, raises awareness, encourages behavioural changes, and develops social capital able to tackle other possible environmental issues.

Case Study Description

Challenges:

The eastern Mediterranean Sea is a hotspot of marine invasive species. Most are Indo-Pacific species entering through the Suez Canal. Among them, lionfish have been reported in multiple regions of the Mediterranean Sea, especially after 2012. Lionfish are becoming alarmingly abundant around Cyprus, one of the first EU states affected by "Lessepsian" migration, the movement of marine species across the Suez Canal, from the Red Sea to the Mediterranean Sea. Lionfish concentrate at the eastern, warm side of Cyprus Island around Cape Greco. The potential threats of lionfish in the Mediterranean were recognized in an EU horizon-scanning initiative conducted in 2014 which listed lionfish as second in a list of 95 new or emerging Invasive Alien Species (IAS) that should be prioritised for their possible inclusion in the "Union List" according to the Regulation EC/2016/1141

With the current climate and sea temperature conditions, all southern Mediterranean regions offer potential habitat for lionfish, and they are highly likely to further spread through larval dispersal and active adult movement. Sea water warming, occurring both globally and even faster in the eastern part of the Mediterranean Sea, as effect of climate change, offers an increasingly suitable environment for the distribution of this species. Considering the IPCC emission scenario RCP 6.0 and a sea water threshold temperature of 15°C for potential lionfish habitat, the species is projected to expand towards the northern Mediterranean (i.e. northern Aegean, Adriatic, Ligurian and northern Balearic Seas). This means that in almost the entire Mediterranean Sea, seawater temperature could become suitable for lionfish ([Kleitou et al., 2021](#) ^[5]), while the effective success of their colonisation in different areas strictly depends on site specific local conditions.

Lionfish are very effective medium size predators able to consume a large range of species (generalist mesopredators). They can continuously and rapidly feed when food is abundant, also tolerating prolonged periods of starving when the food is scarce. This facilitates their invasion in the oligotrophic waters of Cyprus that experience strong seasonal variations in the availability of biomass. Moreover, other lionfish characteristics such as early gonads maturation and high reproduction rates, as well as anti-predatory venomous defences make this species a ferocious and rapid invader. Consequently, lionfish invasion heavily affects the marine ecosystem they colonize, suppressing small native Mediterranean fish and invertebrate species with important roles in the ecosystem functioning and strongly competing with the native mesopredators.

Biodiversity loss in lionfish-affected ecosystems can have a severe socioeconomic impact on certain sectors, particularly fisheries (lionfish can prey on commercial fish species) and tourism (lionfish can make bathing areas and diving sites less attractive and even dangerous for tourists).

Objectives:

The [RELIONMED-LIFE](#) ^[3] project (Preventing a LIONfish invasion in the MEDiterranean through early response and targeted REmoval) aims to make Cyprus the 'first line of defence' against the invasion of the lionfish in the Mediterranean. Its specific objectives are to:

- Develop the necessary response capacity to promptly and effectively act against the lionfish invasion in Cyprus, setting the example for also managing other possible invasive species from the Red Sea;
- Demonstrate the effectiveness of a range of lionfish invasion prevention measures, such as the development and implementation of an early surveillance and detection system and a removal response system;
- Explore and encourage the market potential of lionfish products (seafood restaurants and jewellery);
- Develop an Integrated Lionfish Management Guide for policy makers of Mediterranean countries that will set the baseline for future coordinated and multi-national efforts in controlling lionfish.
- Build capacity and knowledge which can be transferred and replicated by other countries of the Mediterranean, to improve the control of lionfish expansion in their waters.

Importance and relevance of the adaptation:

PARTFUND_AS_CCA;

Additional Details

Stakeholder engagement:

Since the early stages of the project, the public and key stakeholders were involved in a wide consultation initiative to understand general knowledge and awareness about lionfish presence and associated threats. In particular, a telephone survey of 300 Cypriot permanent residents was conducted, while about 100 stakeholders were interviewed during meetings carried out across different districts of Cyprus. Additional stakeholder-focused questionnaire surveys were carried out with 20 commercial fishers, 6 dive business owners, 20 recreational fishers, 10 restaurant owners, 100 beach visitors, and 5 aquarium/pet shop owners. The same survey was repeated for three consecutive years.

More in general, several activities performed during the RELIONMED project are highly dependent on citizens and stakeholders' support:

- Citizens and tourists in Cyprus are called to contribute to the IUCN-MedMIS [Lionfish portal](#) [6], reporting their sightings of lionfish (with photograph and location information), after registering to the MedMis portal. Reports are contributing to the overall knowledge of lionfish distribution, guiding targeted removal actions. The portal will remain active after the project ends.
- About 200 fishers and expert divers requested to join the Removal Action Teams (RATs) coordinated by RELIONMED researchers. The RAT permit allowed for the registration of 100 SCUBA divers in the list. All have been trained, equipped and participated in coordinated removals targeting lionfish hotspots, Natura 2000 sites and Marine Protected Areas.
- The active involvement of local restaurants and local jewel makers is offering new opportunities for local economies as a new source of income and acts as incentive to continue with lionfish removal actions. Now about 20% of seafood restaurants across Cyprus offer lionfish in their menu and lionfish are becoming more frequent in fish markets. Recipes with lionfish are also disseminated through the RELIONMED project results, inviting the public to consume and appreciate new species.
- Finally, in order to stimulate public interest and stakeholder support, several dissemination campaigns were organised, using posts in social media and participation in TV and radio shows, and utilising produced posters, leaflets, banners, notice boards, videos, aquarium displays, photo exhibitions, scientific publications.

Success and limiting factors:

Citizen engagement revealed its great potential in monitoring lionfish distribution, thus supporting awareness raising and the control of lionfish expansion. Market promotion of the lionfish through the engagement of local restaurants and local craft has the potential to transform the threat of lionfish into an opportunity to develop local businesses, fostering the success of the removal initiatives. Despite some minor opposition in the beginning of the project, especially by SCUBA instructors, stakeholders provided unanimous support to the project, following training and educational seminars. The socioeconomic surveys showed that there was a significant increase of the general public that was aware of lionfish from about 4% to 26% indicating the success of the project in raising awareness, since the majority now supports management measures against lionfish. During the project, lionfish entered the market and its price is steadily increasing with variations among areas (ranging from 6 – 15 EU / kg); more promotion is needed to increase its market value, thus relieving other local species from fishing pressure.

RATs demonstrated being effective in removing lionfish individuals: large removal campaigns (including more than 10 divers) led lionfish populations to strongly decline. Given the distinctive features of lionfish, divers can easily identify the species, with very low possibility of fail. Health and safety issues due to the venomous spines of lionfish (that can limit diver engagement in removal actions) have been successfully faced through proper training activities about safe lionfish handling, first aid equipment for divers involved in removal actions and competitions.

The effective success of the implemented actions against the lionfish diffusion in the coastal waters of Cyprus and in other Mediterranean areas, strictly depends on the continuation of lionfish management actions beyond the duration of the RELIONMED Project. A potential driver for effective long-term management actions relies in

the inclusion of lionfish in the Union List of Alien Invasive Species, according to the EU Regulation 1143/2014. The lionfish inclusion could in fact lead to the establishment of more stringent and long-term provisions for prevention, early detection, rapid eradication and management as well as overcoming of legislative restrictions about lionfish fishing techniques. Legislation reforms are needed to allow for more consistent and larger removal events with the involvement of more divers. In this effort, regional collaboration between Mediterranean countries is pivotal in developing and implementing a strategic response. Some suggested reforms are given in [Kleitou et al. \(2021\)](#) [7].

Budget, funding and additional benefits:

Awareness and educational campaigns (events, workshops, training courses) required low investment cost (few thousands Euros) and enabled reaching high number of people. The approximate cost for organising a removal event with divers, under the scientific supervision of RELIONMED team, ranged between 500 and 1000 Euro. A competition event (“derby”) cost about 2 to 3 thousand Euro that covers personnel salaries, boat costs, prizes, first aid equipment and services, etc.

Benefits are related both to the improvement of the ecological conditions of marine ecosystems affected by the invasion of lionfish and to the socio-economic benefits associated with the awareness raising initiatives and with the involvement of local business to develop new niche markets, able to sell new products particularly targeted to environmentally aware consumers.

An assessment of cost-effectiveness of a wide range of measures that can be implemented to mitigate the invasion of lionfish in the Mediterranean waters ([Kleitou et al., 2021](#) [5]) revealed that diver-led culling of lionfish is successful in controlling this species in pre-selected areas, even if changes in the legislative framework need to be implemented. Citizen based- monitoring, awareness measures, and market promotion were assessed as very useful tools for the management of lionfish. Such measures can be also easily transferable to other Mediterranean areas and other invasive species.

Legal aspects:

Regulation (EU) 1143/2014 on invasive alien species (the IAS Regulation) entered into force on 1 January 2015, fulfilling Action 16 of Target 5 of the EU 2020 Biodiversity Strategy, as well as Aichi Target 9 of the Strategic Plan for Biodiversity 2011-2020 under the Convention of Biological Diversity. The core of the IAS Regulation is the list of Invasive Alien Species of Union concern (the Union list). For species included in the Union List, the Regulation identifies three distinct types of measures to combatting IAS: prevention, early detection and rapid eradication, and management.

The current legal framework in Cyprus as well as in other European countries poses strict restrictions to scuba spearfishing (for possible damages to the ecosystems) that is indeed the most successful and low-cost way to remove lionfish. A special temporary permit was specifically released for the project duration, under the strict supervision of the scientific RELIONMED team.

Reference Information

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[3] <https://relionmed.eu/>

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[5] <https://www.mdpi.com/2077-1312/9/3/325>

[6] <http://www.iucn-medmis.org/?c=LionFish/show>

[7] <https://doi.org/10.1016/j.jenvman.2020.111690>

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