Conservation Action Implementation Strategy

Deliverable for Action A3

RELIONMED Action Plan

Deliverable Leader

Deliverable Team

August 2018

Preventing a LIONfish invasion in the MEDiterranean through early response and targeted REmoval (RELIONMED-LIFE) - LIFE16 NAT/CY/000832

Contents

Background

The Mediterranean Sea is highly affected by the presence of marine non-indigenous species, with the number being one order of magnitude higher in the eastern basin compared to other subregions (Zenetos *et al*., 2012). Specifically, 775 alien species were recorded from the eastern Mediterranean until 2012, whereas only 308 were recorded from the western Mediterranean, 249 from the central Mediterranean and 190 in the Adriatic sub-region. Most of the species introduced in the eastern basin are Lessepsian immigrants; of Indo-Pacific origin that were introduced through the Suez Canal. A recent invader, the lionfish *Pterois miles* (Bennett, 1828), has been recognised in the Atlantic as one of the most ecologically and economically harmful marine bioinvasions to date; able to cause detrimental impacts to the local biota and series of trophic cascades in the ecosystem with ecological and socio-economic implications (Green *et al*., 2012). Thus, its invasion and alarming expansion off the coasts of Cyprus (Jimenez *et al*., 2016, Kletou *et al*., 2016), raised concerns among stakeholders and the scientific community (Jimenez *et al*., 2017).

The **RELIONMED-LIFE** project 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 capacity and mechanisms in Cyprus so the country can act promptly and effectively against the lionfish, and other invasive species from the Red Sea;
- Demonstrate the effectiveness of a range of prevention measures against lionfish; such as the development and implementation of an early surveillance and detection system, and of a removal response system;
- Build capacity and knowledge which can be transferred and replicated by other countries of the Mediterranean, so that they can use the best-effective practices to control the lionfish in their waters.

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The strategic framework of the RELIONMED project is separated in six themes (Figure 1), targeting the major actions of the project; namely, the (i) early detection, (ii) rapid response, (iii) sustainability of removal pressure, (iv) monitoring, (v) management, and (vi) public awareness and dissemination of the project. Their content and their interconnections are shown in Figure 1. Through the conservation actions, an early detection and surveillance system is foreseen that will provide data for the rapid response and commercial exploitation of lionfish. Ecological and socio-economic indicators will be monitored throughout the project. The result of these actions will provide valuable tools and guides for researchers, managers and policy makers of Cyprus and neighbouring countries. For all actions suitable dissemination and transferability activities are planned so to raise public awareness about lionfish and invasive species and share the identified best-practices to the wider scientific and management community.
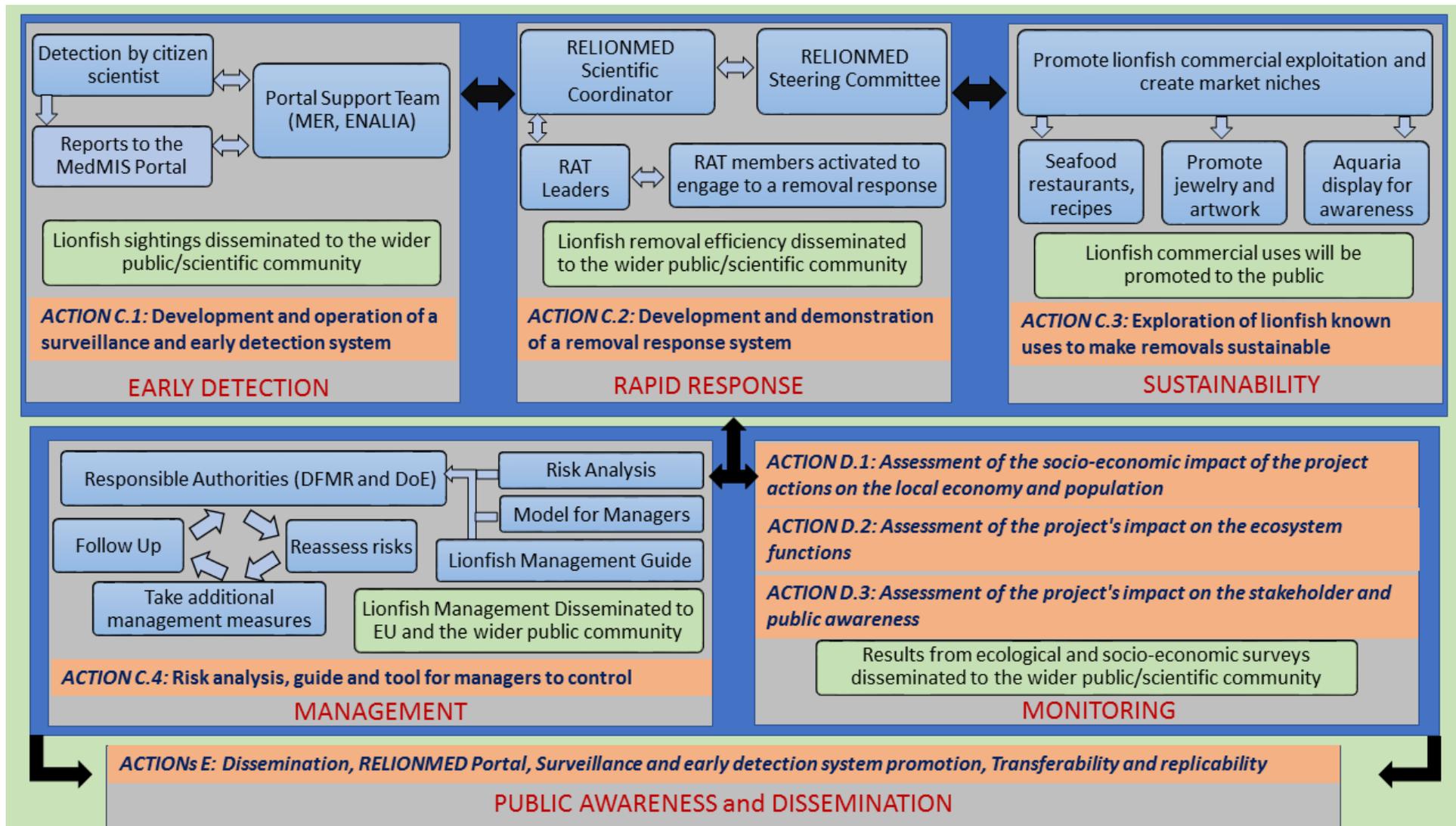
Figure 1. Schematic representation of the strategic framework for the early detection, rapid response, management, monitoring, and public awareness and dissemination of the RELIONMED.

People involved in the project

Four out of five beneficiaries are based in Cyprus. These include: The University of Cyprus; the research-performing SME - Marine & Environmental Research (MER) Lab; the local NGO - Enalia Physis Environmental Research Centre (ENALIA); and the responsible authority - Department of Fisheries and Marine Research (DFMR). University of Plymouth (UoP) based in the United Kingdom, complements the rest of the consortium.

Core project team

The Core Project Team consists of the Project Management Team (PMT), composed of the Project Manager (UCY), the Scientific Coordinator (MER) and the Assistant Project Managers (UCY). The core PMT is responsible to manage the project and guarantee its smooth implementation; solve problems, report to the Commission and keep the team in line with the time frames and financial expenditure. Additionally, the Steering Committee of the project, composed by one representative from each beneficiary, assures the achievements of the intended results and the timely submission of the deliverables. The Core Project team works closely together and ensures that the project actions are implemented as planned.

Project management team members

- Project Coordinator: Prof. Spyros Sfenthourakis
- Scientific Coordinator: Mr. Demetris Kletou
- Assistant Project Managers: Dr. Yianna Samuel & Mrs. Monica Demetriou

Steering Committee members

- Prof. Spyros Sfentourakis (UCY)
- Prof. Jason Hall-Spencer (University of Plymouth)
- Mr. Demetris Kletou (MER)
- Mr. Nikolas Michailides (DFMR)
- Mr. Louis Hadjioannou (ENALIA)

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Full project team

Further from the Core Project Team, a more expanded group of scientists is employed and is responsible for the successfully delivery of RELIONMED's tasks. The researchers who are employed by the RELIONMED are the following:

UCY – Prof. Spyros Sfendourakis, Dr. Niki Chartosia, Dr. Yianna Samuel, Mr. Andreas Dimitriou and Mrs. Monica Demetriou

MER – Mr. Demetris Kletou, Mr. Ioannis Savva and Mr. Charalampos Antoniou

ENALIA – Mr. Louis Hadjioannou, Dr. Carlos Jimenez, Mr. Yiannis Christodoulides, Mr. Vasilis Andreou, Mr. Andreas Georgiou and Mr. Antonis Petrou

DFMR – Mr. Nikolas Michaelides and Mr. Charis Mavrokordatos

UoP: Prof. Jason Hall-Spencer, Dr. Sian Rees and Mr. Periklis Kleitou.

This main team of experts may change depending on the implementation phase of the project and the skills required.

Wider project team

Different experts will also be sub-contracted at different phases of the project to carry out specific tasks. These include the surveillance and early warning system to be developed in Action C1, the modelling tool that will be developed in Action C4 as well as otolith analyses in sub-action A2.2. Action C1 relies on the strong citizen participation while Action C2 Removal Action Teams (RATs) will be composed by volunteer divers and led by MER to demonstrate the efficiency of coordinated removals in MPA and marine protected areas. Eight removal competitions will be carried out in C2 to attract more divers and fishermen volunteers in removal activities. RELIONMED will also engage with other stakeholders (e.g. Actions A2, C3, C4, D1 and D3) such as citizens, managers, restaurant owners and artists to participate in lionfish control activities, dissemination activities and exploration of lionfish market niches to make removals sustainable.

Project stakeholders

During the preparation of the deliverable for the 'Dissemination strategy', the relevant stakeholders were identified. These are groups, individuals, or institutions who have a vested interest in the natural resources of the project area and/or who potentially will be affected by the project activities, and/or have something to gain or lose if conditions change or remain the same. RELIONMED identified stakeholders include: 1) governmental bodies, 2) the fishing industry (professional and recreational fishermen), 3) the diving industry (will participate in Removal Action Teams), 4) research organizations (universities, SMEs and NGOs), 5) local government authorities (Department of Fisheries and Marine Research; Department of Environment), 6) established networks of researchers, 7) beach users, 8) lionfish potential markets (e.g. fish-restaurants, souvenir shops), and 9) media.

Action Strategies

Table. 1. The Conservation Action Plan (CAP) as developed for the RELIONMED project. In parenthesis the relevant actions/sub-actions are noted (the asterisk * indicates that a more detailed explanatory text follows the table).

Target	Objectives	Strategic actions (HOW)	Monitoring Tasks
1. Early detection system	a. Development, establishment, and demonstration of an interactive surveillance and reporting mechanism powered by citizen scientists, that will track the distribution of the lionfish in the Mediterranean both over time and space (even after the end of the project, 2021).	I. MEDMIS online platform with a stand-alone section focusing on lionfish, will be available to public/stakeholders through which they will have the ability to report their sightings (C1.1). II. MEDMIS Smart Phone Application recruited for the same purpose (C1.2). III. The monitoring team (scientists) will validate sightings, communicate with citizen scientists, update the interactive map and will monitor existing social media marine networks collecting additional information for MEDMIS (C.1.3).	1. Continuous assessment of the lionfish presence along the island's coast. Through this procedure the public and stakeholder awareness will be raised as they will be actively involved. 2. The project's consortium will be able to monitor the progress and to identify hot-spots. 3. RATs will participate in lionfish coordinated removals and demonstrate rapid response guided by the surveillance system in which the leaders of RATs will have direct access (emphasizing in priority habitats such as Natura 2000 sites and Marine Protected Areas, MPAs). 4. Some statistics e.g. filtered by time, space, frequency of sightings will be obtained automatically by the platform that will allow monitoring of lionfish sightings. 5. Management actions by the national authorities, which can be revised regularly, according to the platform data.

Target	Objectives	Strategic actions (HOW)	Monitoring Tasks
2. **Rapid response**	a. Targeted removal actions will reduce the number of lionfish individuals (at least in some high-risk areas) and will moderate/minimise the impact on the local biodiversity. b. Equipped and motivated stakeholders will remove lionfish from the sea constantly and limit the abundance of existing populations. c. Develop a long-term national capacity for combating more marine invasive species. d. Lower the risk of envenomation from lionfish through training and increasing awareness.	I. <u>Response Plan</u> for Cyprus including details such as personnel and directions to facilitate removal efforts (C2.1). II. At least fifty (50) removal toolkits will be developed to equip RAT members (C2.2). III. To prevent or lower the risk of envenomation incidents, teams of fishermen and RATs will follow training workshops to demonstrate how to safely handle and remove lionfish (C2.3). IV. Selected motivated stakeholder volunteers will develop 4 Removal Action Teams (RATs) in different coastal regions of Cyprus. RAT members will be composed of at least 50 – 100 scuba and free-divers and will be trained and equipped with the RELIONMED toolkit (C2.4). V. <u>Eight seasonal</u> (in 2 consecutive years) <u>removal events in the form of competitions</u> will be organized, in MPAs and Natura 2000 sites in the eastern Cyprus. VI. A hundred of removed individuals will be stored for future research and collaborations (C2.6). VII. <u>Removals of other invasive species</u> during the competitions, to explore the possibility of potential lionfish biological controllers (through stomach content analysis) (C2.7).	1. Use of lionfish catches from coordinated and opportunistic removals to update the surveillance system 2. Assess the removal efficiency of the selected removal groups by monitoring the lionfish recruitment rates (D.2). 3. Number of lionfish removed from priority habitats in protected areas in specific days. 4. Number of volunteers participating in removal events.

Target	Objectives	Strategic actions (HOW)	Monitoring Tasks
3. Sustainability of removals	a. Exploration of lionfish known uses to make removals sustainable b. To raise motivation of fishermen and divers to hunt lionfish by promoting its potential uses and its economic value, until the end of the project. c. Long-term participation of the general public and stakeholders beyond the lifetime of the project. d. To control the lionfish population size by creating sustainable market niches to provide economic incentives to the harvesters beyond the project.	I. Non-venomous lionfish fins will be used for the production of 100 handmade jewellery pieces that will be made available to local touristic and souvenir shops (C3.2). II. Promotion of the lionfish for consumption in seafood restaurants that will incorporate lionfish recipes into their menu (C3.3). III. Financial assessment will be carried out to report on the financial viability of each market.	1. The willingness of buyers to purchase the jewel sets will be recorded to assess the market potential of this niche. 2. The market potential and consumer willingness to pay for a lionfish dish will be evaluated.

Target	Objectives	Strategic actions (HOW)	Monitoring Tasks
4. Monitoring	Monitor the impacts of the project's actions on economy, population, ecosystem functions and stakeholder and public awareness.	I. Assessment of the socio-economic impact of the project actions on the local economy and population (D1). II. Assessment of the project's impact on the ecosystem functions (D2). III. Assessment of the project's impact on the stakeholder and public awareness (D3).	1. The socio-economic impacts will be monitored on an annual basis, throughout the remaining period of project implementation, by monitoring the certain indexes for the following groups*: 　a. Fisheries 　b. Dive businesses 　c. Recreational fishermen 　d. Beach visitors. 　e. Pet shop / aquarium shop owners 　f. Restaurants (fish taverns) 　g. Jewellery and artwork shops. 2. The ecological monitoring will be conducted primarily in the areas that were found most susceptible by the lionfish invasion and which the RELIONMED is targeting for coordinated removals. The indicators that will be monitored are*: 　a. Mean fish length in targeted species which will be selected based on stomach content analyses (Action A2 and supplementary work carried out) 　b. Proportion/biomass of functional group (predatory fish) in the surveyed community 　c. Large Fish Indicator (LFI): ratio between the biomass of demersal fish above a length threshold over the total biomass 　d. Macroalgae index (Multimetric index using species number, evenness, and diversity) 　e. Species richness 　f. Biomass and abundance 　g. Simpsons diversity index 　h. Shannon diversity index 　i. Lionfish abundance/biomass. 3. The stakeholder's and public's awareness level will be monitored as follows*: 　a. <u>Public Awareness survey:</u> Telephone survey to record public awareness on invasive alien species (IAS) & lionfish (A1) (300 questionnaires). Repetition of the same methods during the midst of the project (D3) and the end of the project (D3) 　b. <u>Stakeholder consultations:</u> Five consultation meetings (100-200 participants, A1) 　c. <u>Stakeholder Questionnaire:</u> 100 questionnaires from stakeholders around the island of Cyprus (M5, A1). Repetition of the same methods during the midst of the project (D3) and the end of the project (D3)

Target	Objectives	Strategic actions (HOW)	Monitoring Tasks
5. Management	a. Risk analysis, guide and tool for managers to control the lionfish. b. Decision support tool (model). c. Development of an Integrated Lionfish Management Guide.	I. Data from the Risk assessment (Action A2) and other Actions of the project will be integrated within a risk management which will assess the removal measures implemented to reduce the risk imposed by a lionfish invasion. The risk management analysis will also assess elements of the articles 4(3) and 4(6) of the IAS Regulation which should be met for inclusion of an IAS in the Union List. It will take into consideration the implementation cost for Cyprus, the cost of inaction, the cost-effectiveness and the socio-economic aspects. II. Development of a <u>model</u> for managers incorporating the lionfish life history traits, oceanographic conditions, fishing pressure, predation and climate change scenarios that will be used as a decision support tool which will indicate the intensity/frequency of removal effort that will be needed to control lionfish population. III. Through practical examples the identification of cost-effective practices, will weigh major ecological and socio-economic impacts to assess the ecosystem services and will make recommendations of an integrative efficient management strategy (detection, removal response and control). It will include a cost-benefit analysis to determine the costs to the of eradication.	1. Inclusion of lionfish into the Union List of priority IAS, after the project's risk analysis. 2. Evaluation of the number of stakeholders involved in the co-development of the decision support tool, including the number of 'new' collaborations. 3. Evaluation of the number of stakeholders engaged with the development and dissemination of the final product: The Integrated Lionfish Management Guide. 4. Evaluation of the number of instances that the risk analysis and decision support tool is applied to support evolving management decisions throughout the duration of the project.

Target	Objectives	Strategic actions (HOW)	Monitoring

6. Public awareness and Dissemination	a. Engage the participation and cooperation of the stakeholders and general public in the implementation of conservation actions.
	b. By the end of the project (2021) lower the unawareness of the targeted groups concerning lionfish and invasive species
		1. Through <u>Internet</u>:
		  a. Project's Website
		  b. Intranet
		  c. MEDMIS application
		  d. Mailing list
		  e. Social networking tools (i.e. Facebook, Twitter)
		2. <u>Publications</u>
		  a. Publication activities via specialised journals and the general public using traditional Media
		  b. Scientific journals publications
		  c. Press releases
		  d. Development of Media and technical publications: Layman's report
		  e. Notice boards
		  f. Leaflets
		  g. Posters
		3. Network, Events and Training
		  a. Videos:
		    i. TV Spots, Training Videos
		  b. Exhibitions
		    a. Lionfish Photo Exhibition
		    b. Lionfish Aquarium Exhibition
		  c. Conferences:
		    a. a scientific conference regarding the lionfish invasion in the Mediterranean will be organised in Month 46
		  d. Events:
		    a. Biodiversity events in Cyprus
		    b. Policy influencing events
		  e. Participation in TV and Radio shows
		  f. Networks
		  g. Workshops for teams: 1 day long workshops will be organised in Cyprus per year.
		  h. Networking with other projects/ teams
			Evaluation of the awareness of all targeted groups mainly through the other actions (C & Ds)

Remarks

* Socioeconomic Monitoring (D1)

The Action D1 (socio-economic monitoring) will provide the framework against which to assess the changes caused by the lionfish invasion and project removal actions.

The monitoring protocol, indicators and intensity of surveys have been already set up. More precisely, it was decided that the socioeconomic impact of the project will be monitored on an annual basis, throughout the remaining period of project implementation. The first year collected data will be used for the assessment of the socio-economic impacts of lionfish invasion on local communities. This initial assessment will be used as the baseline reference point for understanding the current situation/perception in the various stakeholder groups and for estimating the socioeconomic impacts of the projects actions on the local economy and population. The collected data in the second and third year will be used for the preparation of the mid-term and final assessment of the socio-economic impact of the project's actions on the local economy and population. A regional input-output model will be constructed in the fourth year to estimate the total, i.e., direct and indirect, effects of project's actions on local economy in terms of economic output and employment generation.

The data will be collected from the south-eastern tip of the island (Ammochostos district) where anecdotal evidences and RELIONMED monitoring indicate that lionfish is more abundant.

The indicators for the Action D1 (see Deliverable 9) have been defined and include the following for each stakeholder group:

Fisheries

(i)   Change in the wet weight of landings / harbour

(ii)   Change in the value of landings / harbour

(iii) Change in the number of fishing trips

(iv) Change in the number of lionfish stinging accidents

(v) Perceptions of fishermen to elucidate impact of lionfish (invasion and removal) in terms of the quantity of the catches, conflicts and interferences of lionfish with fishing gear/activities, and alteration of fishing grounds due to the presence of lionfish.

Dive businesses

(i) Change in the dive sites due to lionfish infestation or because lionfish acts as an attraction

(ii) Change in the number of divers per annum

(iii) Change in the annual turnover

(iv) Perception of divers and dive shop owners regarding the lionfish impact (invasion and removal) on the quality/biodiversity of the dive sites and the lionfish as an attractant for the divers or as a deterrent if considered a safety hazard.

Recreational fishermen

(i) Change in the wet weight of catches

(ii) Change in the number of lionfish stinging accidents

(iii) Perception of different groups of recreational fishermen (e.g. anglers, spearfishermen, longliners) to elucidate impact of lionfish (invasion and removal) in terms of the quantity of the catches, conflicts and interferences of lionfish with free diving/spearfishing or other fishing activities.

Beach visitors

(i) Change in the number of envenomation incidents

(ii) Change in the number of people not entering the water because they are afraid of the lionfish.

(iii) Perception of beach visitors regarding the invasion and project removal actions of lionfish and their potential to affect their beach choice due to safety issues.

Pet shop / aquarium shop owners

(i)   Change in the sales of lionfish

(ii)   Change in the selling price of lionfish.

Restaurants (fish taverns)

(i)   Incorporation of lionfish dishes in seafood menus

(ii)   Change in the annual turnover

(iii)   Number of new jobs

(iv)   Perception of restaurant owners regarding the lionfish impact (invasion and removal) on restaurants' profitability and attractiveness.

Jewellery and artwork shops

(i)   Number of lionfish jewellery products made and sold

(ii)   Change in the annual turnover

(iii)   Number of new jobs

(iv)   Perception of shop owners regarding.

Primary data will be collected by conducting semi-structured questionnaires with stakeholder groups to elicit the socio-economic impact of lionfish invasion (1st year) and project's actions (2nd and 3rd year). The surveys will be conducted during the summer months (June-July) of each year from the Ammochostos district. The first collection of data has already been accomplished and the preliminary analysis of the data is presented in Deliverable 9.

The sample size (i.e. individuals surveyed) for the semi-structured surveys has been set to 20 for commercial fishermen, 6 for dive businesses, 20 for recreational fishermen, 10 for restaurant owners, 100 for beach visitors, and 5 for aquarium/pet shops. Two jewellery shops will be surveyed only during the second and third year respectively. Furthermore, secondary data will be provided by the Department of Fisheries and Marine Research (DFMR) to supplement the data regarding the fishery catches, while secondary data will be also provided by the Lifeguard Association, the

Cyprus Professional Fishermen Association, the Cyprus Dive Centre Association (CDCA), and technical publications to monitor the lionfish envenomation accidents throughout the RELIONMED project.

* Ecological Monitoring (D2)

The ecological monitoring is critical for evaluating the lionfish invasion extent, intensity and dynamics, in order to effectively deal with its management and control. Monitoring sheds light on potential species decline, enables the evaluation of ecosystem structure and function, and informs effective ecosystem management. Action D2 aims to assess the project's impacts on ecosystem functioning, providing a basis for the evaluation of the removal response system; allowing its evaluation in terms of intended effects and cost-effectiveness, and formulation of science-based environmental policy.

Similarly, to Action D1, this Action has already set up the monitoring protocol, indicators, type and frequency of the surveys that will be conducted and data collection is underway. The ecological monitoring will be conducted primarily in the areas that were found most susceptible by the lionfish invasion and which the RELIONMED is targeting for coordinated removals. Specifically, nine monitoring sites have been selected along the Natura sites 2000 Nisia and Cape Greco. Six of the sites are located at 20 m (± 2 m) depth and three are located at 7 m (± 2 m).

Three short-scale experiments will be conducted in three consecutive summers during the summer months July - August. Each short-scale experiment will be composed of four samplings that will be conducted in Day 0, Day 15, Day 30 and Day 45. The sites have been separated in the following three categories and monitored based on the removal frequency allocated to each area:

(i)   High frequency removal: All lionfish will be monitored and removed in each sampling day. The surrounding fish biota and lionfish presence will be monitored.

(ii)   Mid-frequency removal: All lionfish will be monitored and removed only at the first sampling day of each short experiment. On the following sampling days, monitoring of lionfish presence and its surrounding fish biota will be conducted.

(iii)   No removal: Removal of lionfish will not be applied and monitoring of lionfish and its surrounding fish biota will be conducted.

Two deep sites (i.e. 20 m) and one shallow site (i.e. 7 m) will be monitored for each category respectively. Currently, the first experiment is underway (two samplings have been carried out until late-August) and it is anticipated to finish before the end of September 2018.

Together with the lionfish abundance and biomass, two surrounding taxa groups will be surveyed during the entire ecological monitoring, fish and macroalgae. Macroalgae will be monitored once a year, while lionfish and surrounding fish during all the samplings of each annual experiment. Different techniques of underwater visual census (UVC) with SCUBA diving have been chosen for the monitoring of fish and lionfish while for the macroalgae, photoquadrat sampling will be carried out.

A range of indicators have been selected. These will be analysed after the first experiment, and the most promising to assess changes caused by the lionfish will be monitored in the second and third experiment. They include:

(1)   Mean fish length in targeted species which will be selected based on stomach content analyses (Action A2 and supplementary work by the University of Plymouth)

(2)   Proportion/biomass of functional group (predatory fish) in the surveyed community

(3)   Large Fish Indicator (LFI): ratio between the biomass of demersal fish above a length threshold over the total biomass

(4)   Macroalgae index (Multimetric index using species number, evenness, and diversity)

(5)   Species richness

(6)   Biomass and abundance

(7)   Simpsons diversity index

(8)   Shannon diversity index

(9)   Lionfish abundance/biomass

* Assessment of the project's impact on the stakeholder and public awareness (D3 and complementary data from A1)

The participation of both stakeholders and general public are essential for the effective early detection and response against the ongoing invasion of IAS in the Mediterranean. The first step to ensure the participation and cooperation of the stakeholders and the general public in the implementation of conservation actions is to assess the awareness of the targeted groups. In the framework of sub-actions A1.1, and A.1.2, in October and November of 2017 questionnaires were used to assess knowledge and perceptions of lionfish amongst the general public and marine stakeholders of Cyprus (Table 2). The general public was contacted using a telephone survey of a representative cross section of adults. Marine stakeholders filled in questionnaires at meetings held in five towns across the country. Results from 300 public telephone surveys revealed limited awareness of lionfish, limited ability to recognise these fish, and limited knowledge of the potential impact of lionfish on the environment, economy and human well-being. The public survey also showed strong support for local management of this species. Results from 108 stakeholder questionnaires demonstrated a rapid rise in the numbers of stakeholders observing lionfish around Cyprus since 2012; with hard substrata reported as the main habitat for this species. The stakeholders reported a high level of awareness about lionfish, very strong support for management measures and 70% of them supported complete eradication through culling. The surveys revealed lower level of support for marketing lionfish products and only about half of respondents would consider them for personal consumption. Whilst the majority of marine stakeholders had not experienced any

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positive or negative effects of lionfish, some thought that lionfish were having a negative effect on biodiversity and the economy. Five of the 108 marine stakeholders surveyed perceived benefits to dive tourism.

The above results will be used as baseline and will be compared with technical publications (e.g. Jimenez et al. 2017) and additional surveys during the implementation of the project in order to assess the impact of the project on the awareness of the targeted groups (Action D3). Particularly, surveys will be carried out at two intervals during the project duration: a) at the midst of the project (Month 26) to monitor the progress of the project and make necessary adaptations in the project activities if justified; b) at the end of the project (Month 45) to assess the overall impact of the project. Except of the assessments on the awareness level of citizens and stakeholders, the surveys will seek information on the impacts of RELIONMED activities and will identify any gaps and opportunities. This will provide insights on which activity had the highest impact, and where managers / researchers should focus to effectively increase public awareness and create the incentives to combat the lionfish invasion or invasive species in general. The principal reason of the impact monitoring is to evaluate the extent to which the invested resources and the developed activities have contributed to increased knowledge and awareness regarding the lionfish issue, as well as to opening the way to mainstreaming the approach to invasive species management outlined in RELIONMED.

Table 2. Broad topics covered in lionfish questionnaires to the public and to marine stakeholders in Cyprus, Oct-Nov 2017.

Public telephone surveys (n=300)	Marine stakeholder meetings (n=108)
Perception of the threat of lionfish as an invasive species.	Perception of the threat of lionfish as an invasive species
Perception on future strategies	Perception on future strategies
Socio-demographics	Abundance of lionfish
	Effects of lionfish
	Management of lionfish
	Project and communications

Using results to adapt & improve

Through the implementation of the project, the results will be revised by the Steering Committee at least once a year (usually around the end of each year). The rationale is to use the empirical learning to adapt and achieve the maximum desirable impacts of the project actions.

Share the results of the project

The lionfish presence in the Mediterranean is a regional problem which needs a multi-national strategic approach in order to effectively tackle the invasion pathway and control the lionfish at larger scales around the basin. The RELIONMED project aims to demonstrate and assess various tools for preventing / controlling the establishment of lionfish and therefore, protecting the coastal productive and biodiverse ecosystems. In the context of the multinational character of the project, a transferability and replicability strategy will be developed through the E4 action in order to allow the replication and transfer / exchange of best practices / methods against the lionfish and other invasive species.

Regarding the dissemination and sharing of knowledge in Conservation Actions, the following activities are planned:

For C1 Action all the available knowledge and information gathered from the lionfish removals will be circulated to the local and national authorities. Dissemination of such information may direct and guide management efforts to buffer the invasion and its impacts. Additionally, such information can be acquired by other European institutions, to inform their countries on the efficacy of the management options applied and aid early response measures. At this point, leaflets, scientific reports and peer-reviewed publications are being produced to inform the scientific community and the wider public about the invasion status and potential management practices.

C2 Action will be promoted by dissemination activities of action E1. As part of the transferability character of the project, deliverables will provide guidelines for developing a similar system in another geographical region or for a different invasive species. Replicability/transferability activities include:

- The development of a 'Lionfish Removal Toolkit Production Manual' so that anyone can construct his own toolkit or built on our design;
- Development of a 'Fisherman's Lionfish Handling Guide' and a 'Diver's Lionfish Handling Guide' to minimise risks to health hazards;
- Development of a 'Lionfish Removal Action Team Development Guide';
- Development of a 'How to implement a Lionfish Removal Competition Guide'

Further, in the framework of C2, lionfish tissue will be stored as part of the replicability and transferability activities of the project. At least 100 lionfish specimens collected from the removals will be stored to form a tissue databank. This databank will allow access to the lionfish biological data to any other research project targeting the lionfish. It will facilitate future research collaborations and networking with other entities.

The Risk Analysis, Decision Support Tool and the Integrated Lionfish Management Guide (Action C4) will include practical examples for controlling the lionfish and will become freely available on the RELIONMED portal by Month 45 of the project.

These will then be strategically disseminated to managers and policy-makers of the Mediterranean countries.

Timeframe

The timeframe of the Conservation Action Strategy with the responsible beneficiary for each action is displayed in Appendix 1.

«Preventing a lionfish invasion in the Mediterranean through early response and targeted removal (LIFE16 NAT/CY/000832). With the contribution of the LIFE financial instrument of the European Union / www.ec.europa.eu/life»

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Project Name	Start Date	End Date
RELIONMED CAP Timeframe	01/09/2017	31/08/2021

Month: 1–48 (Sep-17, Oct-17, Nov-17, Dec-17, Jan-18, Feb-18, Mar-18, Apr-18, May-18, Jun-18, Jul-18, Aug-18, Sep-18, Oct-18, Nov-18, Dec-18, Jan-19, Feb-19, Mar-19, Apr-19, May-19, Jun-19, Jul-19, Aug-19, Sep-19, Oct-19, Nov-19, Dec-19, Jan-20, Feb-20, Mar-20, Apr-20, May-20, Jun-20, Jul-20, Aug-20, Sep-20, Oct-20, Nov-20, Dec-20, Jan-21, Feb-21, Mar-21, Apr-21, May-21, Jun-21, Jul-21, Aug-21)

Targets	Actions	Responsible	Participants	Start Date	End Date	Status
1. Early detection system	I. MEDMIS online platform	UCY	EXTERNAL/MER	01/06/2018	31/12/2018	Pending
	II. MEDMIS Smart Phone Application		EXTERNAL	01/06/2018	31/12/2018	Pending
	III. Validation from the monitoring team		MER/ENALIA	01/06/2018	31/03/2021	Pending
2. Rapid response	I. Response Plan for Cyprus			01/11/2018	02/09/2019	Pending
	II. Development of removal toolkits			01/11/2018	01/03/2019	Pending
	III.Training workshops for safely handle	MER	ENALIA	01/02/2019	28/02/2021	Pending
	IV. Development of 4 RATs		ENALIA	01/02/2019	28/02/2021	Pending
	V. Eight seasonal removal events.		ALL	01/02/2019	28/02/2021	Pending
	VI. Storage of 100 lionfish tissue		ENALIA, UCY	01/02/2019	28/02/2021	Pending
	VII. Removals of other invasive species			01/02/2019	28/02/2021	Pending
3. Sustainability of removals	I. Production of 100 jewelry pieces		EXTERNAL/MER	01/08/2019	01/09/2020	Pending
	II. Promotion of the lionfish for consumption	UCY	ALL	01/08/2019	01/09/2020	Pending
	III. Financial assessment.			01/08/2019	01/02/2021	Pending
4. Management	I. Risk management analysis.		MER/ENALIA	01/09/2017	01/06/2021	Pending
	II. Development of a model for managers.	UOP	UCY/EXTERNAL	01/02/2020	01/06/2021	Pending
	III. Development of an efficient management strategy		MER	01/02/2020	01/06/2021	Pending
5. Monitoring	I. Socio-economic impact on the economy & population	ENALIA	MER/UOP	01/02/2018	01/06/2021	Pending
	II. Project's impact on the ecosystem functions	UOP	MER/ENALIA	01/02/2018	01/06/2021	Pending
	III. Project's impact on the stakeholder & public awareness	UCY	MER/ENALIA	01/02/2018	01/07/2021	Pending
6. Public awareness and Dissemination	1. Through Internet:	UCY	ALL			
	a. project's Website,			01/09/2017	01/03/2018	Completed
	b. Intranet,			01/09/2017	01/03/2018	Completed
	c. MEDMIS application			01/06/2018	31/12/2018	Pending
	d. Mailing list.			01/09/2017	01/03/2018	Completed
	e. Social networking tools (i.e. Facebook, Twitter).			01/09/2017	01/03/2018	Completed
	2. Publications					
	a. Publication activities using traditional Media.			01/10/2017	31/08/2021	Pending
	b. Scientific journals publications.			01/10/2017	31/08/2021	Pending
	c. Press release (1)			01/05/2018	31/05/2018	Completed
	c. Press release (2)			01/05/2021	31/05/2021	Pending
	d. Layman's report,			01/08/2021	31/08/2021	Pending
	e. Notice boards			01/08/2021	31/08/2021	Pending
	f. Leaflets			01/08/2021	31/08/2021	Pending
	g. Posters			01/08/2021	31/08/2021	Pending
	3. Network, Events and Training					
	A. Videos:			01/08/2021	31/08/2021	Pending
	a. TV Spots, Training Videos			01/08/2021	31/08/2021	Pending
	B. Exhibitions					
	a. Lionfish Photo Exhibition.			01/02/2020	28/02/2020	Pending
	b. Lionfish Aquarium Exhibition			01/08/2020	31/08/2020	Pending
	C. Conferences:					
	a. scientific conference			01/06/2021	30/06/2021	Pending
	D. Events:					
	a. 3 biodiversity events in Cyprus			01/08/2018	31/07/2021	Pending
	b. Policy influencing events (1)			01/06/2018	30/06/2018	Completed
	b. Policy influencing events (2)			01/12/2020	31/12/2020	Pending
	E. Participation in TV and Radio shows.			01/09/2017	31/08/2021	Pending
	F. Networks:					
	a. Workshops for teams: 1 day workshops per year.			01/08/2018	31/07/2021	Pending
	b. Networking with other projects/ teams			01/01/2018	31/07/2021	Pending