Regional Risk Assessment ‘The case of lionfish in the Mediterranean’

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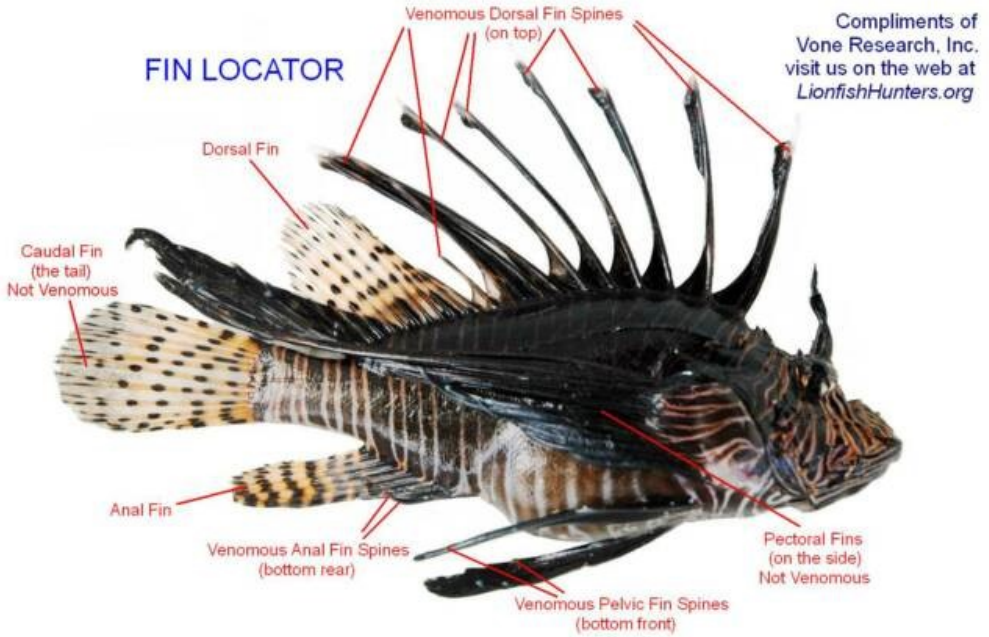
«Preventing a lionfish invasion in the Mediterranean through early response and targeted removal (LIFE16 NAT/CY/000832). With the contribution of the LIFE financial instrument of the European Union / www.ec.europa.eu/life»

Biological features of the lionfish
***Pterois miles* (Bennett, 1828)**

- Venomous
- High consumption rate
- Generalist and tolerant species
- Early maturity
- High reproduction

Albins, 2016, Biological Invasions and Animal Behaviour

- Impacts on foundation species
- Reductions in native biodiversity
- Decrease of commercial species
- Degradation of important habitats
- Public health threat



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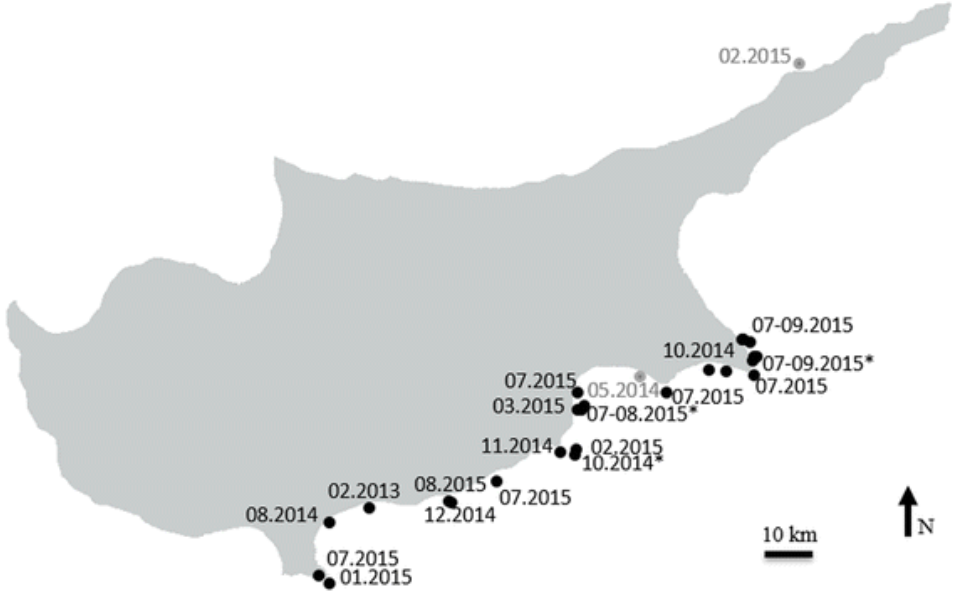
Smithsonian
CHANNEL

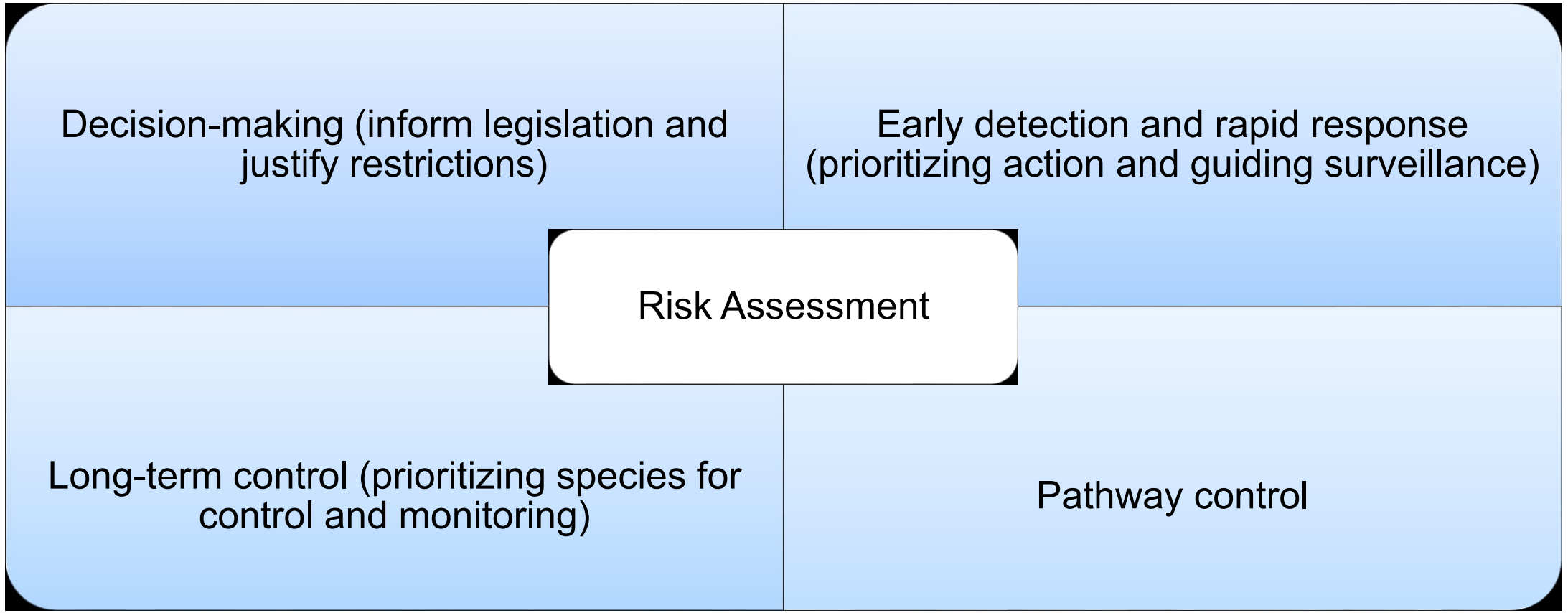
Invasion threats

- One of the **worst fish invasive species** ever recorded
- Lionfish has been **ranked** by EU experts as the **second highest priority** Invasive Alien Species for Risk Assessment (Roy *et al.* 2015, *European Commission*)
- **Since 2014**, their population has been **dramatically expanded** in Cyprus and lionfish reached central Mediterranean



Kletou, D., Hall-Spencer, J. M., & Kleitou, P. (2016)m *Marine Biodiversity Records*.

Risk Assessment underpins IAS Regulation (EU) 1143/2014)



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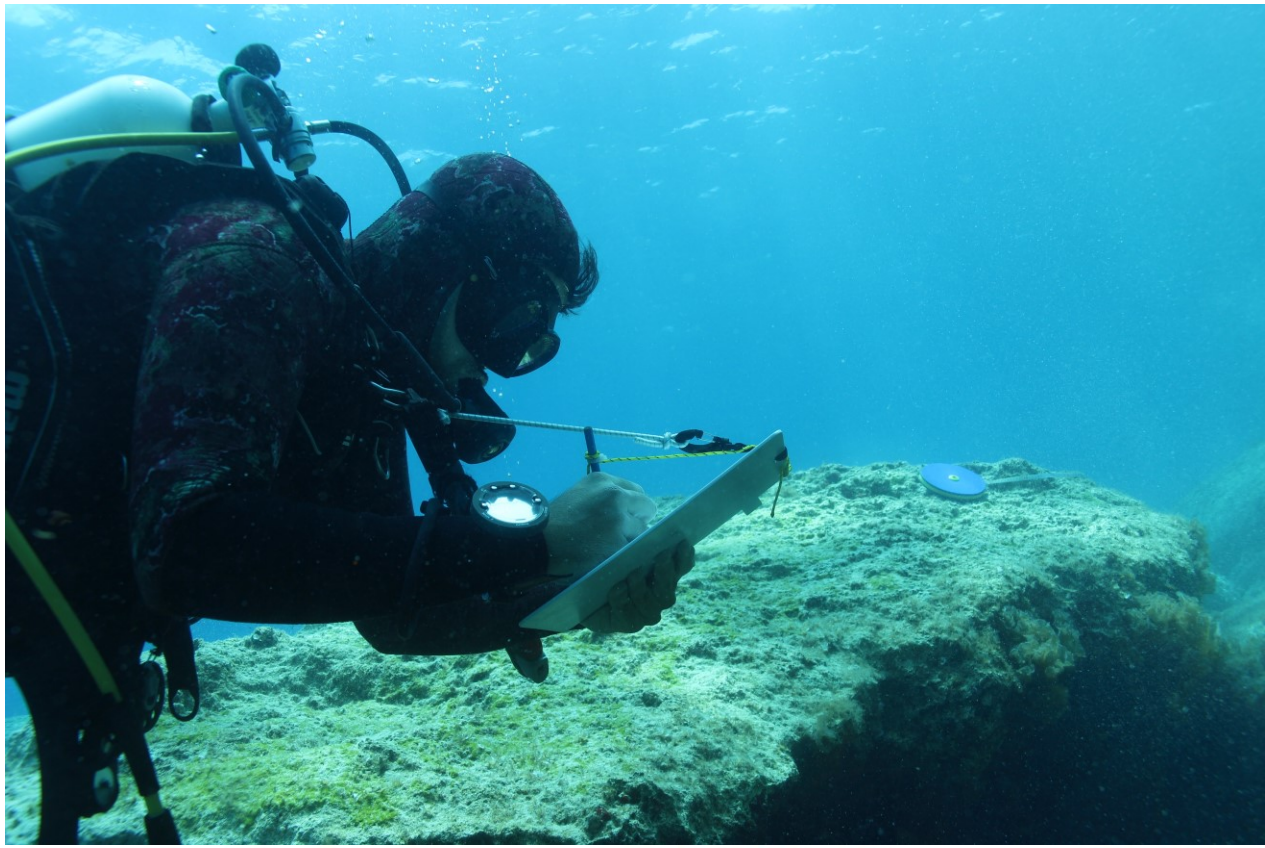
Major bottlenecks – lack of data

- Limited capacity to act due to lack of finance, expertise, appropriate funding mechanisms
- By the time that impacts of alien species are identified, these are spread – late response
- Uncertainty on the (cost)-effectiveness of management measures



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Risk Assessment outline

- Description of the species with its taxonomic identity, its history, and its natural and potential range;
- Description of its reproduction and spread patterns and dynamics including an assessment of whether the environmental conditions necessary for its reproduction and spread exist;
- Description of the potential pathways of introduction and spread of the species, both intentional and unintentional, including where relevant the commodities with which the species is generally associated;
- A thorough assessment of the risk of introduction, establishment and spread in relevant biogeographical regions in current conditions and in foreseeable climate change conditions;
- A description of the current distribution of the species, including whether the species is already present in the Union or in neighbouring countries, and a projection of its likely future distribution;
- A description of the adverse impact on biodiversity and related ecosystem services, including on native species, protected sites, endangered habitats, as well as on human health, safety, and the economy including
- An assessment of the potential future impact having regard to available scientific knowledge;
- An assessment of the potential costs of damage;
- A description of the known uses for the species and social and economic benefits deriving from those uses.

RELIONMED project – filling the gaps early

Biology and ecology

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Market solutions

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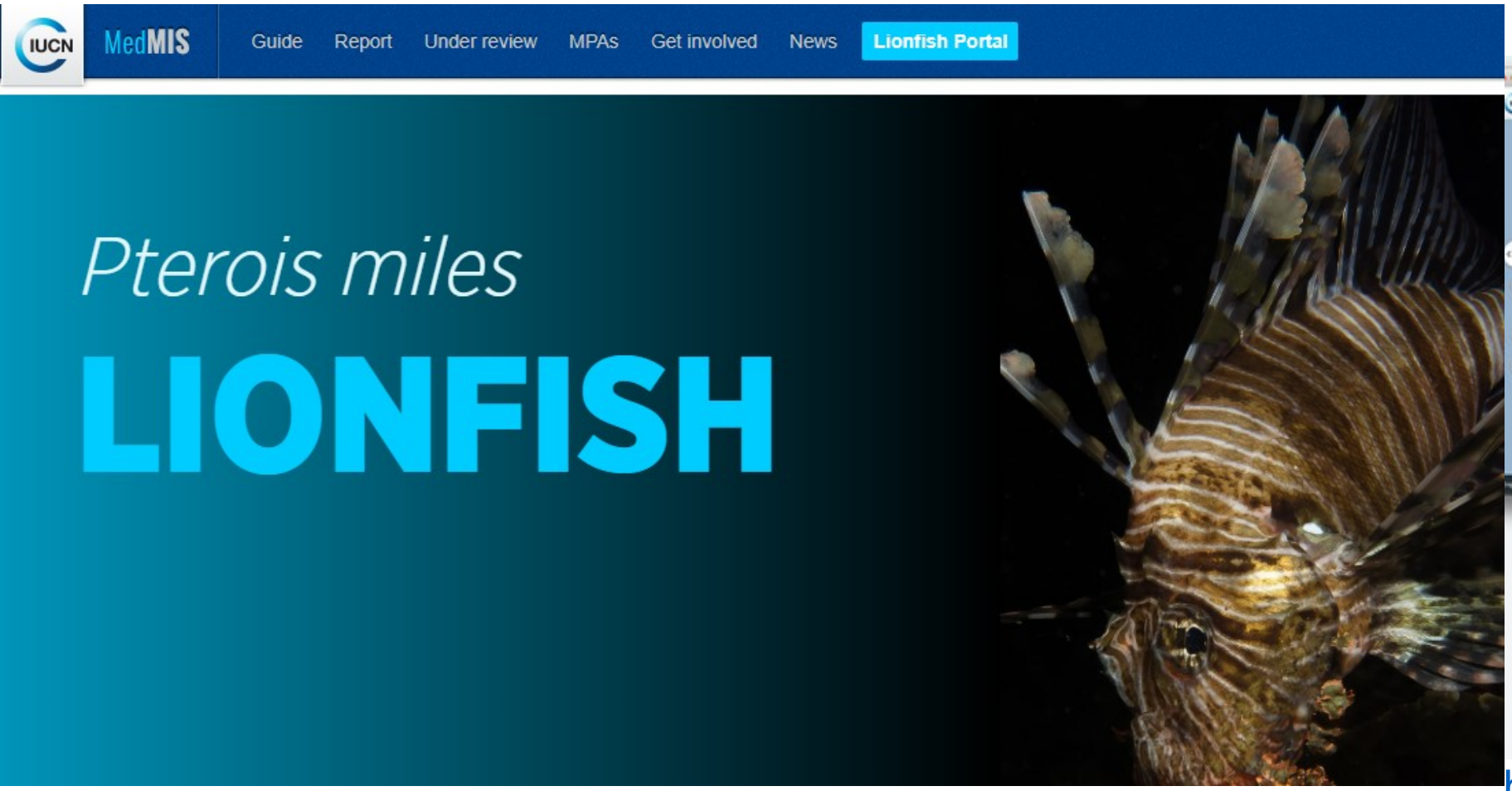
Distribution of lionfish



http://www.iucn-medmis.org

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Explore management solutions

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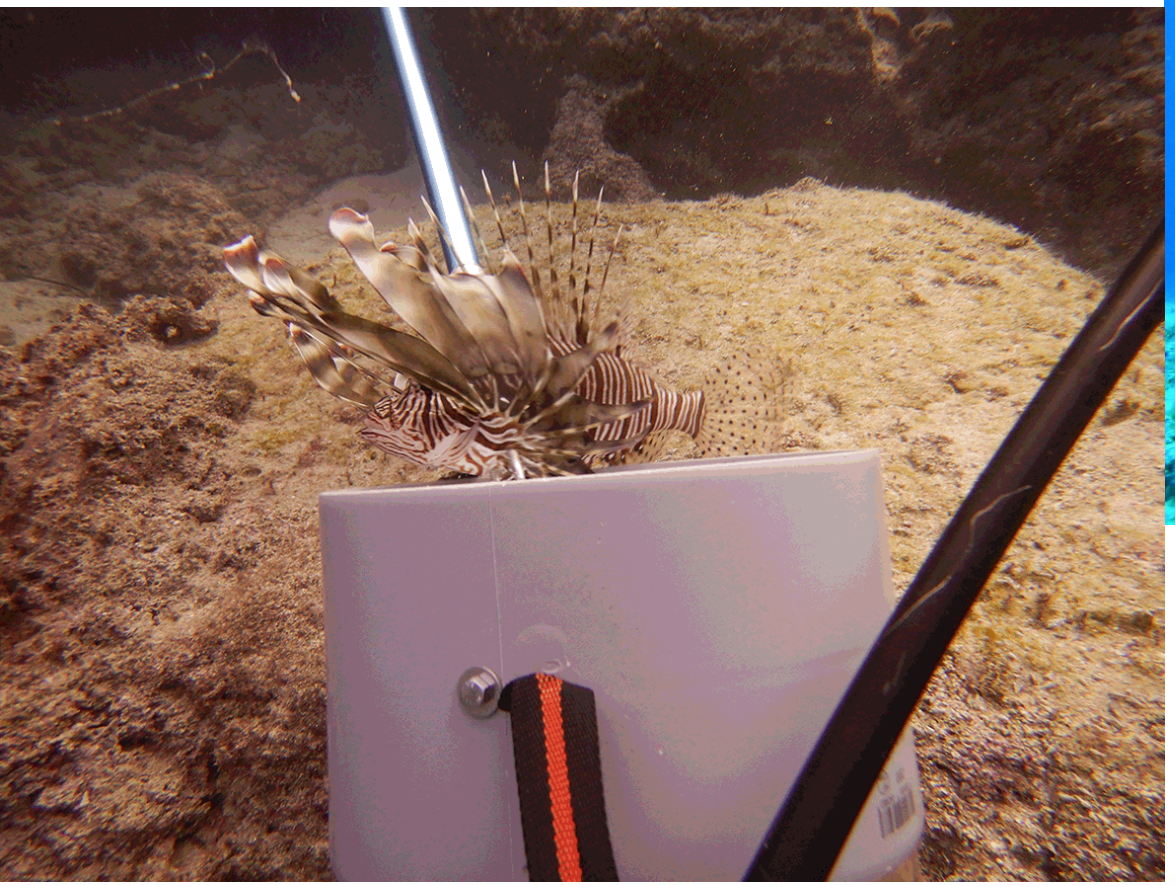
Understanding effectiveness of management measures



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Evaluation/Ranking

Score	Description	Frequency
Very unlikely	This sort of event is theoretically possible, but is never known to have occurred and is not expected to occur	1 in 10,000 years
Unlikely	This sort of event has not occurred anywhere in living memory	1 in 1,000 years
Possible	This sort of event has occurred somewhere at least once in recent years, but not locally	1 in 100 years
Likely	This sort of event has happened on several occasions elsewhere, or on at least one occasion locally in recent years	1 in 10 years
Very likely	This sort of event happens continually and would be expected to occur	Once a year

Taken from UK Non-native Organism Risk Assessment Scheme User Manual, Version 3.3, 28.02.2005

Confidence level	Description
Low	There is no direct observational evidence to support the assessment, e.g. only inferred data have been used as supporting evidence and/or Impacts are recorded at a spatial scale which is unlikely to be relevant to the assessment area and/or Evidence is poor and difficult to interpret, e.g. because it is strongly ambiguous and/or The information sources are considered to be of low quality or contain information that is unreliable.
Medium	There is some direct observational evidence to support the assessment, but some information is inferred and/or Impacts are recorded at a small spatial scale, but rescaling of the data to relevant scales of the assessment area is considered reliable, or to embrace little uncertainty and/or The interpretation of the data is to some extent ambiguous or contradictory.
High	There is direct relevant observational evidence to support the assessment (including causality) and Impacts are recorded at a comparable scale and/or There are reliable/good quality data sources on impacts of the taxa and The interpretation of data/information is straightforward and/or Data/information are not controversial or contradictory.
Very high	There is direct relevant observational evidence to support the assessment (including causality) from the risk assessment area and Impacts are recorded at a comparable scale and There are reliable/good quality data sources on impacts of the taxa and The interpretation of data/information is straightforward and Data/information are not controversial or contradictory.

Modified from Bacher et al. 2017

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Evaluation/Ranking

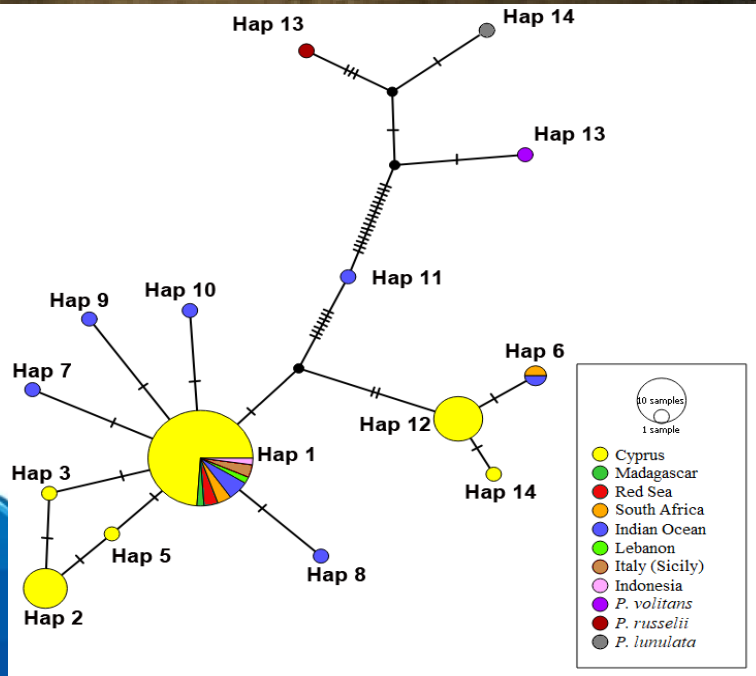
Score	Biodiversity and ecosystem impact	Ecosystem Services impact	Economic impact (Monetary loss and response costs per year)	Social and human health impact
Minimal	Local, short-term population loss, no significant ecosystem effect	No services affected	Up to 10,000 Euro	No social disruption. Local, mild, short-term reversible effects to individuals.
Minor	Some ecosystem impact, reversible changes, localised	Local and temporary, reversible effects to one or few services	10,000-100,000 Euro	Significant concern expressed at local level. Mild short-term reversible effects to identifiable groups, localised.
Moderate	Measureable long-term damage to populations and ecosystem, but little spread, no extinction	Measureable, temporary, local and reversible effects on one or several services	100,000-1,000,000 Euro	Temporary changes to normal activities at local level. Minor irreversible effects and/or larger numbers covered by reversible effects, localised.
Major	Long-term irreversible ecosystem change, spreading beyond local area	Local and irreversible or widespread and reversible effects on one / several services	1,000,000-10,000,000 Euro	Some permanent change of activity locally, concern expressed over wider area. Significant irreversible effects locally or reversible effects over large area.
Massive	Widespread, long-term population loss or extinction, affecting several species with serious ecosystem effects	Widespread and irreversible effects on one / several services	Above 10,000,000 Euro	Long-term social change, significant loss of employment, migration from affected area. Widespread, severe, long-term, irreversible health effects.

Modified from UK Non-native Organism Risk Assessment Scheme User Manual, Version 3.3, 28.02.2005)

Risk Assessment results
Probability of Entry and Spread

- **Primarily the Suez Canal** (accidental)
- Aquarium release (accidental and intentional)
- Transport by ballast waters cannot be completely ruled out (accidental), although unlikely

Dimitriou et al., 2019, *Diversity*

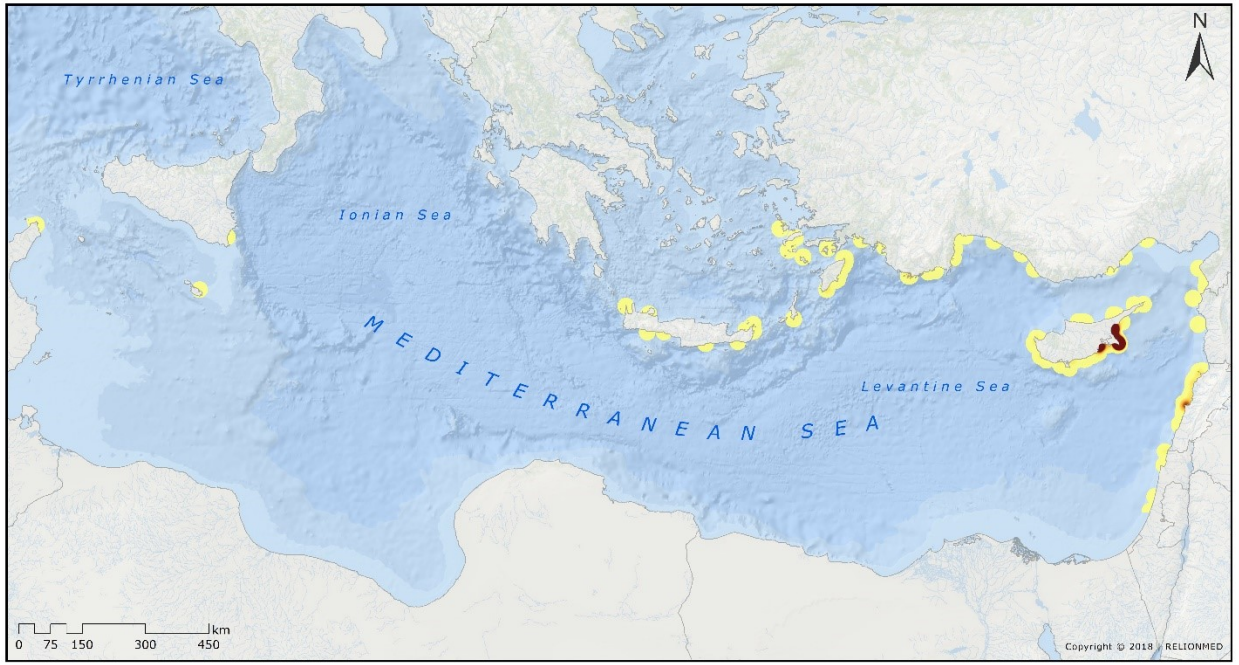


Probability of Establishment

- **Very likely to establish new countries, with low confidence**

Species distribution modelling shows lack of suitable areas but… niche unfilling/expansion

No management or biological factor will likely prevent establishment



Sub-Action A.2.5
Density of Lionfish in the Mediterranean Sea

LEGEND

1 Specimens per 15 km radius 4

Positions: Refered to World Geodetic System 1984 Datum
Projection: Mercator

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LIFE16 NAT/CY/000832

Probability of Spread

- **Massive spread is expected with low human assistance**

Major route: Unaided (natural dispersal – **rapid and massive**

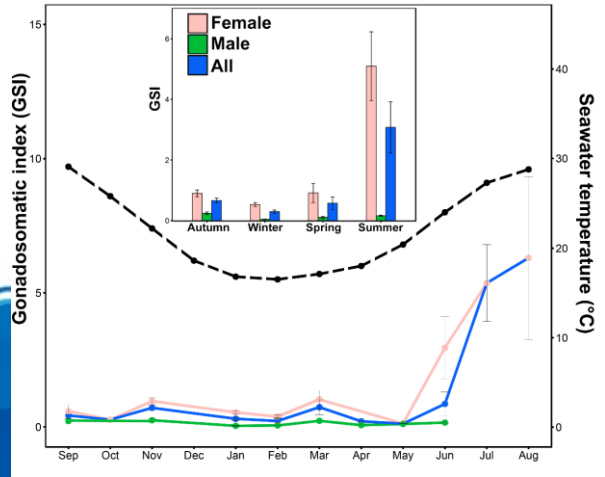
Other pathways such as aquarium releases and transport stowaway are possible but less likely

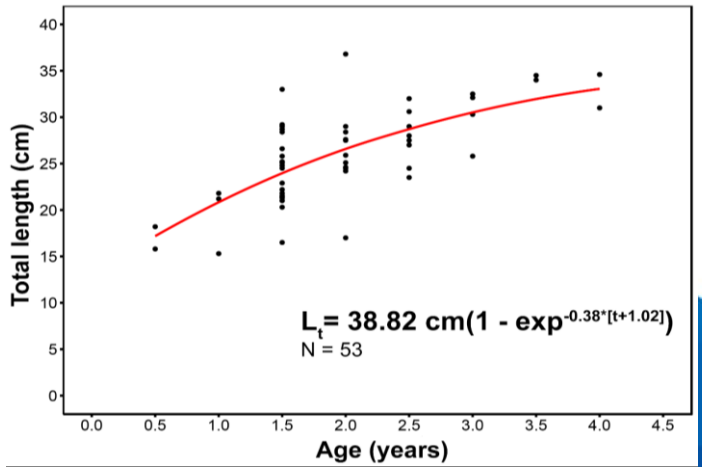
Magnitude of Impacts

- **Massive/major impacts are expected (with high confidence) to rise**

- Biodiversity
- Ecosystem services
- Economic costs

Moderate social and human health impacts





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Controlling the organism

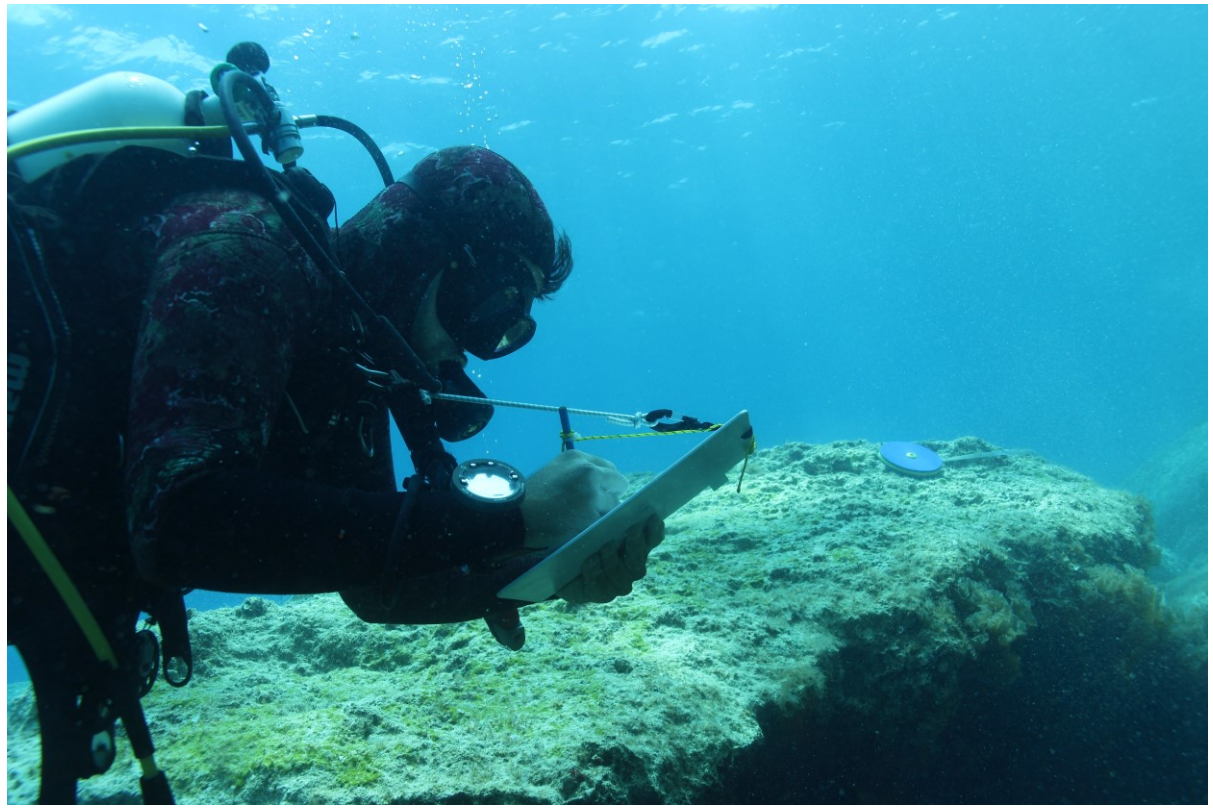
- **Very difficult to contain the organism**

Removals of RELIONMED have shown promising results in terms of dropping lionfish population in targeted areas, ***but their consistency and frequency needs to be assured (how?)***

RISK SUMMARIES	RESPONSE	CONFIDENCE	COMMENT
Summarise Entry	**very likely**	**very high**	Already entered the eastern Mediterranean Sea and exhibits a westwards expansion.
Summarise Establishment	**very likely**	**very high**	Already established in countries such as Cyprus and Greek islands including Crete and islands of the Dodecanese.
Summarise Spread	**very rapidly**	**very high**	Lionfish was able to spread very rapidly i.e. in 3-4 years after the first record in the Mediterranean Sea, it reached central basin (e.g. Tunisia, Sicily, and Greek Ionian islands) and expanding fast in the eastern region.
Summarise Impact	**massive**	**medium**	Significant ecological and socio-economic impacts observed in the western Atlantic invasive range, and similar pattern is expected in the Mediterranean Sea.
Conclusion of the risk assessment	**high**	**high**	There is high confidence that there is a high degree of risk (social, ecological and economic) associated withucurrent status of the future development of the Lionfish invasion in the Mediterranean. Initial evidence from RELIONMED shows increased abundance over time and shows the potential to cause detrimental damage to native taxa, including iconic endangered species and protected organisms and habitats in NATURA 2000 sites and MPAs. Socio-economic are also predicted for coastal communities, especially for the vulnerable sector of small-scale fishery.

Future research needs

- Additional studies focusing on lionfish impacts on ecosystem services and goods, and interactions within the ecosystem (e.g. dispersal capabilities and connectivity patterns, demography, interspecific interactions
- Socio-economic studies to estimate economic losses and gains relevant to the impacts of lionfish and management
- Species distribution modelling and ecophysiology to provide a better picture on the suitable areas for lionfish invasion



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Insights from this work

- Lionfish will likely (with high confidence) lead to **massive impacts** – its spread to the Western Mediterranean is yet uncertain
- Management of key areas **cannot be consistent** within the current legal framework
- Regulation **does not allow for effective** and fast response of marine IAS
- **Horizon scanning** of IAS like RIS-Ky workshops are crucial
- **Suez Canal** remains a major issue
- **Collaboration** with non EU-countries is essential
- Cyprus can have a **pioneer role** as the first EU country affected by Lessepsian immigrants
- Monitoring stations can be established

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RELION MEDLife

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