Lionfish invasion of the Mediterranean Sea

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Introduction | MPAs under threat | Visual census surveys | Citizen science surveys | Socioeconomic dimensions | Conclusion

Pterois miles is native to the western Indo-Pacific region.

It invaded the Western Atlantic in the 1980s and has now had major impacts on native biodiversity and habitats throughout the region.

This was one of the 'fastest and most ecologically harmful fish invasions worldwide' (Albins & Hixon 2013).

It invaded the Mediterranean Sea in 2012 via the Suez Canal and has since had one of the fastest invasive fish spreads ever reported.

Several traits favour its dominance; generalist predator, matures early, has venomous defensive spines, naïve prey, lack of predators...

Figure 1. Lionfish (*Pterois miles*) in the Mediterranean

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Marine Protected Areas can:
- Improve fish biomass
- Restore ecosystem complexity
- Improve ecosystem resilience
- Enhance local fisheries
- Generate new incomes

(Sala & Giakoumi, 2017)

But they can't defend against lionfish

- Lionfish dominate in Cyprus MPAs
- Lionfish have higher abundance/biomass than adjacent unprotected sites

(Kleitou in prep.)

Figure 2. Training and lionfish removal activities

Small targeted removals

- Special permit for lionfish removals with SCUBA gear
- Trained divers about lionfish, removal activity, and safe handling

Monitored removals efficiency with

(i) underwater visual census surveys

(ii) citizen science

Monitored socioeconomic dimensions with questionnaires

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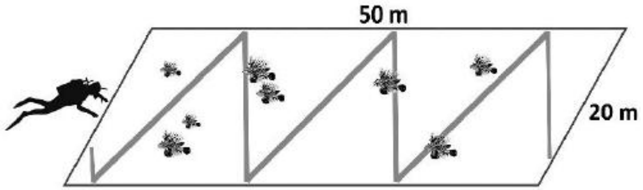
Two rocky reef sites – Site A cleaned twice and Site B cleaned once

Six fixed belt transects (50 x 20 m) at each site

Surveyed following a zig-zag pattern



Significant lionfish abundance or biomass drop after removals

High miss rates

High recolonization rates

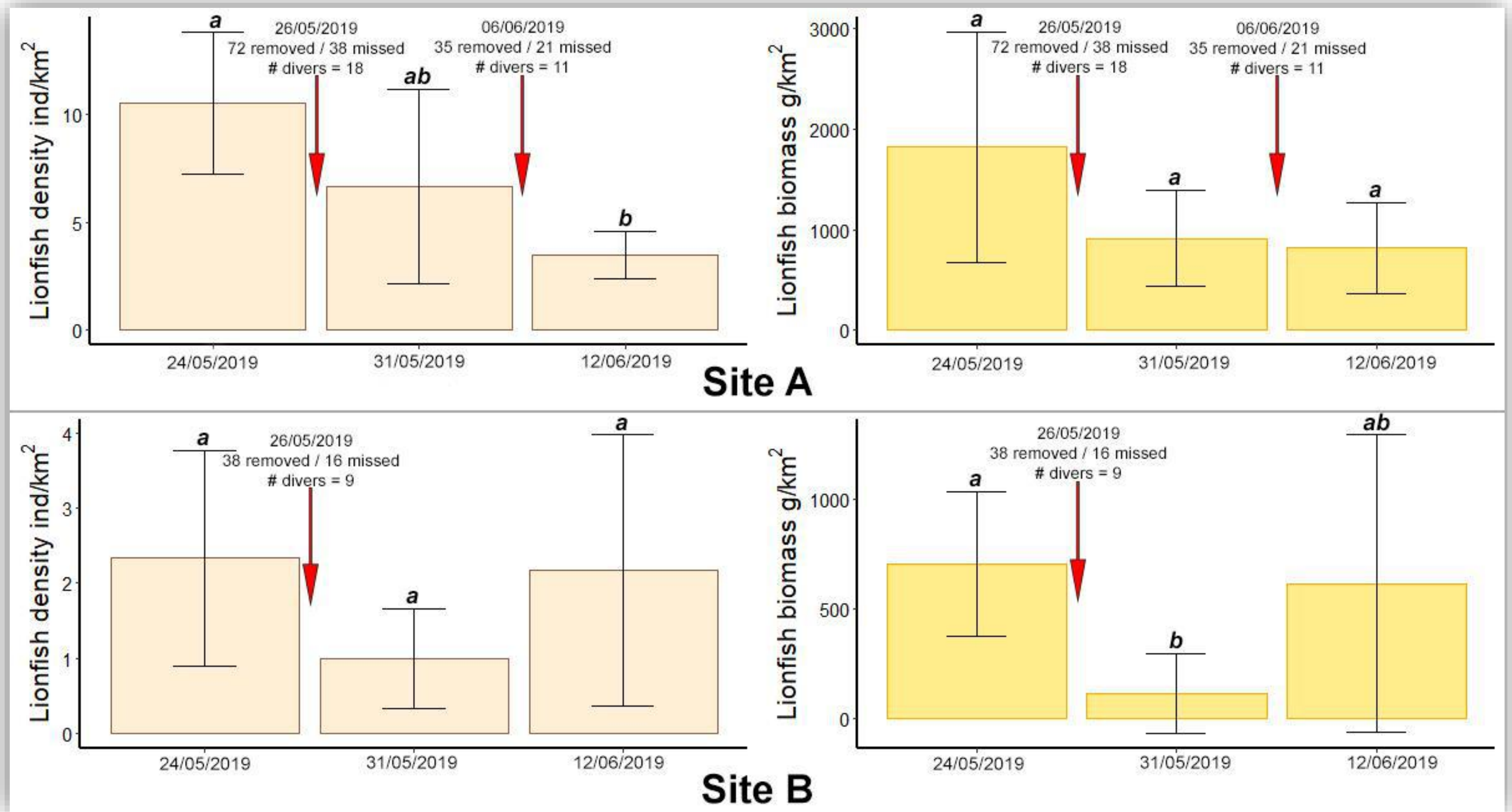


Figure 3. Average (+/- SE, n=6) lionfish density and biomass at two sites in Cavo Greco marine protected area, Cyprus, 2019. Red arrows indicate removal events. Surveys that do not share a letter are significantly different at $p < 0.05$.

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Citizen science monitoring of a popular dive wreck (Zenobia)

With logbooks, or via email, phone, or social network platforms.

- Removals lowered lionfish densities
- Slow recolonization (due to low habitat connectivity)
- Citizen science can be effective
- Electronic logbook was the most widely used tool
- High variability was recorded and careful interpretation of CS data is needed

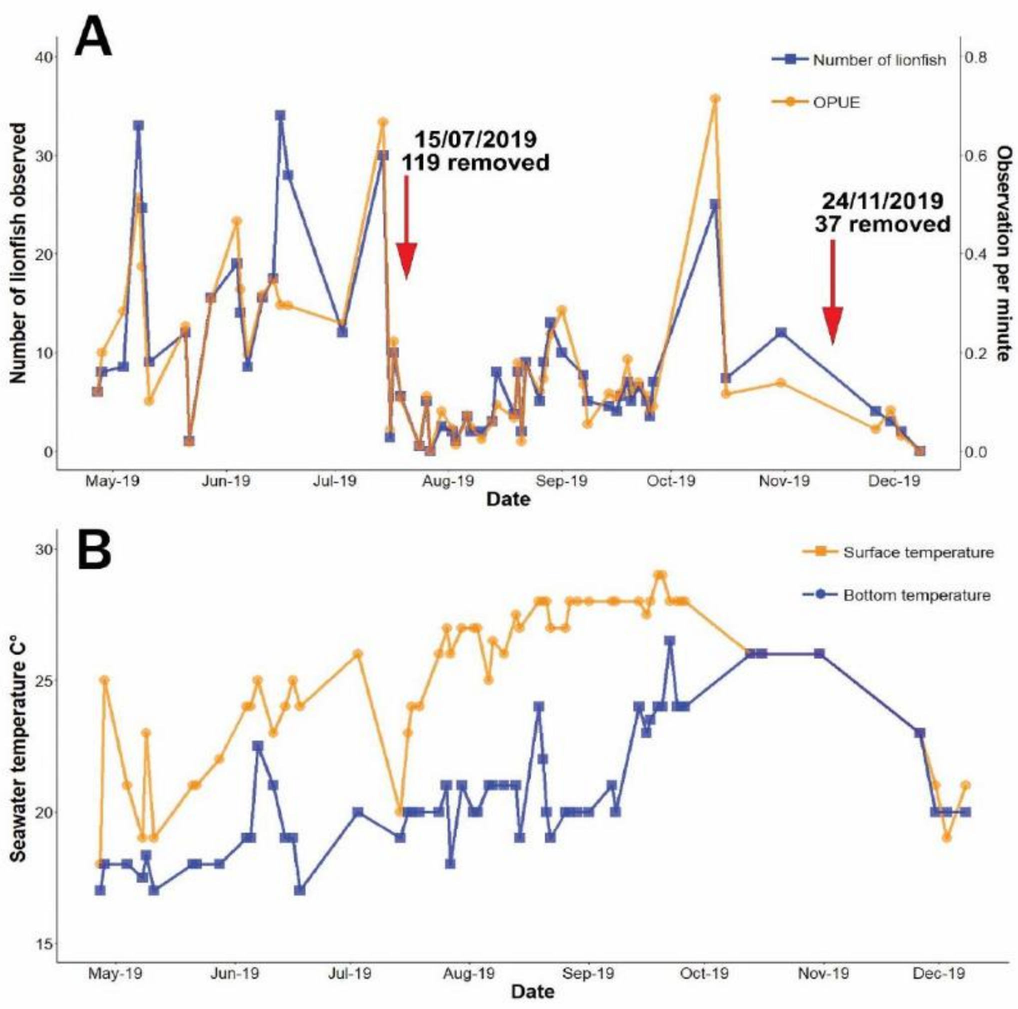

Figure 4. A. Average number of lionfish observed per dive (blue) and average number of observations per minute during on the Zenobia wreck. Red arrows show removal events. B. Average bottom and surface seawater temperatures provided by citizen science SCUBA divers using their dive computers

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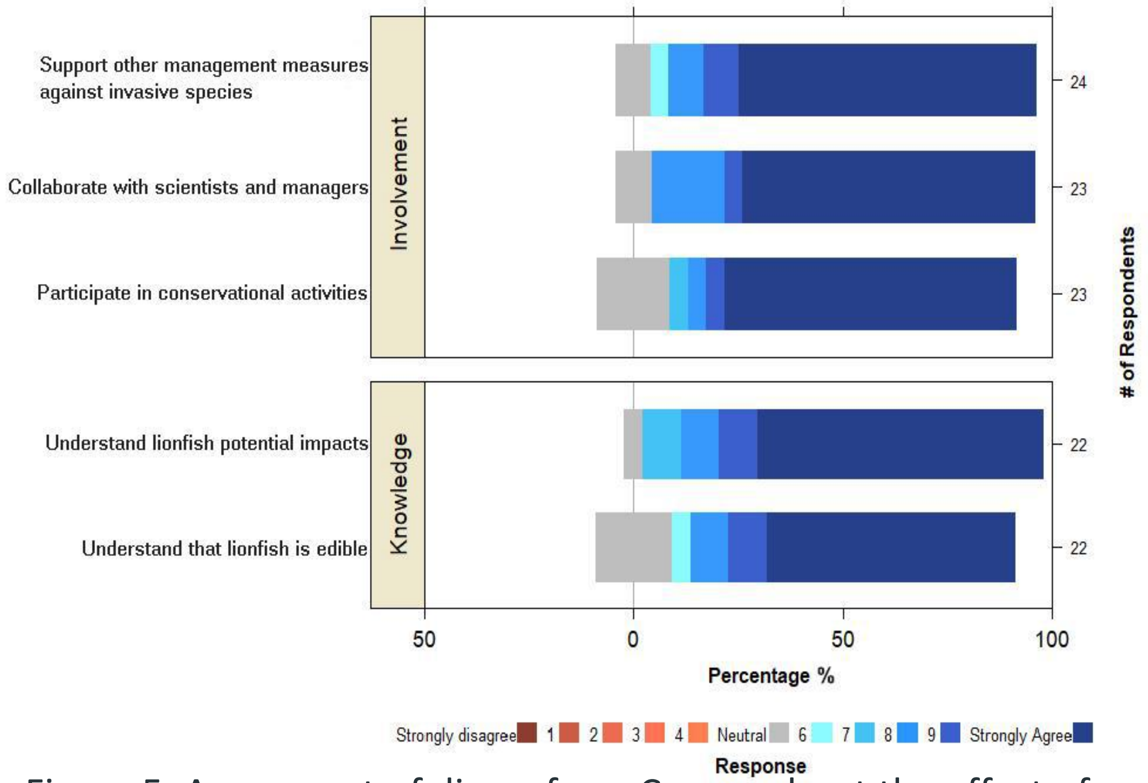

Figure 5. Agreement of divers from Cyprus about the effect of their participation in removal activities on their involvement and knowledge about lionfish. Proportions were acquired based on the categorization of the ordinal scores (0−10) to disagree (0–4), neutral (5) and agree (6−10).

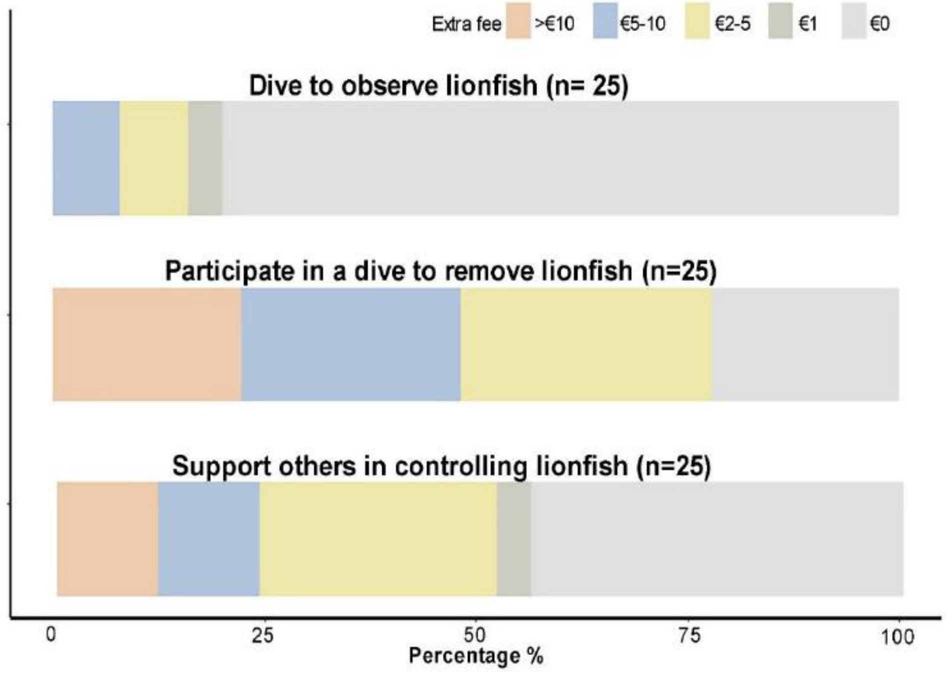

Figure 6. Percentage divers from Cyprus asked if they would be willing to pay extra to (a) dive to observe lionfish, (b) participate in a dive to remove lionfish, and (c) support other people in controlling lionfish.

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- ✓ Targeted removals can be effective in protecting marine protected areas from lionfish
- ✓ Lionfish recolonization varied based on the habitat connectivity
- ✓ Divers were willing to pay extra to participate in lionfish removal events
- ✓ Citizen science has proved useful and effective
- ✓ Removal events had manifold social benefits
- ✓ The consistency of the removals needs to be assured with governmental reforms
- ✓ A lack of biosecurity in the recently expanded Suez Canal is a major regional risk