

Ecological Assessment and Local Knowledge of the Invasive Lionfish (*Pterois miles*) in the Coastal Waters of Derna, Eastern Libya

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Introduction:

The common lionfish, scientifically known as *Pterois miles* (Bennett, 1828), is a relatively new addition to the Mediterranean Sea, brought into the region through the Lessepsian migration. This species poses a significant threat to the marine ecosystems in this area.

The native habitat of the lionfish, also referred to as the devil firefish, is the Indo-Pacific biogeographic realm, encompassing regions from the Red Sea to South Africa and extending eastward to Indonesia (Fricke, 1999; Froese and Pauly, 2019). Initially, there was only a solitary record of this species in the Mediterranean Sea in 1991, suggesting a failed establishment of a viable population (Golani and Sonin, 1992). However, a resurgence occurred two decades later in 2012, with new lionfish specimens likely introduced from the Red Sea (Bariche et al., 2013, 2015, 2017).

In the following years, as time progressed, the common lionfish began to proliferate and expand its range in the Mediterranean Sea, swiftly reaching locations as distant as Tunisia and Sicily within a relatively short period (Azzurro et al., 2017; Al Mabruk and Rizgalla, 2019). Notably, despite the country's proximity to the Suez Canal and a recent sighting in Libya, this species has not yet been observed in Egyptian Mediterranean waters, with the most recent documented record from Egypt (Al Mabruk et al., 2020).

The population density of lionfish has increased dramatically in Cyprus since the first sighting in late 2012; by 2018 aggregations of up to 70 lionfish were found on rocky grounds with complex reefs and artificial reefs in depths of 0–50 m. Lionfish in Cyprus become mature within a year, and adults are capable of spawning year-round, with peak spawning in summer when the sea-surface temperature reaches 28.4°C. The Cypriot lionfish grow faster and bigger than in their native range, and females are more common than males. Lionfish are

generalist predators in these waters, as also found in their native range, consuming a range of teleost and crustacean prey, some of which are of high economic value (e.g., *Spicarasmaris* and *Sparisomacretense*).or have an important role in local trophic webs (e.g., *Chromischromis*). Overall, the reproductive patterns, the presence of juveniles and adults throughout the year, the rapid growth rates and the generalist diet indicate that lionfish are thriving and are now already well established in the region and could potentially become the serious nuisance that they are in their temperate and tropical western Atlantic–invasive range.

Bioinvasions threaten marine environments as they can harm native species across all trophic levels (Anton et al., 2019). Anthropogenic corridors are major pathways for introductions of marine species in the Mediterranean Sea (Galil et al., 2017; Katsanevakis et al., 2013),

The primary goal of this study is to provide an initial assessment of the feeding behavior of lionfish (*Pterois miles*) in the coastal waters of Derna and its neighboring areas. Additionally, the study aims to gather local knowledge from divers and fishermen regarding lionfish. The information collected from this study will lay the groundwork for a comprehensive, long-term research project.

Research Objectives:

- 1- Evaluate the status of lionfish populations along the coasts of the city of Derna.
- 2- Dissect and determine the contents of the lionfish's stomach.
- 3- Conduct a field survey among fishermen regarding lionfish.

Significance of the Research:

- 1- Determine the extent of damage caused by lionfish to marine resources.
- 2- Understand the food chain dynamics of lionfish.
- 3- Educate and raise awareness among fishermen about lionfish and maximize their potential benefits.

search methods:

In this study, two research methods were used, the first method is a field survey, and the second method is laboratory work, where 5 lionfish were dissected inside the college laboratories.

Study Sample:

A sample of 50 fishermen was targeted using a questionnaire administered through personal interviews and an electronic survey using a Google Form.

Design of this Research:

The questionnaire was based on the numerical design with closed ends to answer. Where the spss 26 program was used to analyze the data of the participants.

Data analysis:

Table 1: Age Distribution of Participants

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	17-21	1	2.0	2.0	2.0
	22-30	16	32.0	32.0	34.0
	31-40	20	40.0	40.0	74.0
	41-50	10	20.0	20.0	94.0
	51-60	2	4.0	4.0	98.0
	61-and more	1	2.0	2.0	100.0
	Total	50	100.0	100.0	

Table 1 indicates that the majority of participants were aged between 31–40 years (40%), representing the most active age group in the sample. In contrast, the lowest representation was observed among the youngest (17–21 years) and oldest (61 years and above) age groups, each comprising only 2% of the sample. This distribution suggests that the study primarily reflects the perspectives of middle-aged individuals, who are likely to have more experience in fishing activities.

Table 2: Geographic Distribution of Participants (Place of Residence)

Geographic Distribution					
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lathron	3	6.0	6.0	6.0
	derna	37	74.0	74.0	80.0
	karsaa	1	2.0	2.0	82.0
	rasaltiyn	2	4.0	4.0	86.0
	albayda'	4	8.0	8.0	94.0
	albardiou	3	6.0	6.0	100.0
	Total	50	100.0	100.0	

The findings of table 2 reveal that most participants (74%) were from Derna, indicating a strong geographical concentration of the sample in this area. Other locations were minimally represented, which may limit the generalizability of the findings across different coastal communities. However, this concentration provides valuable localized insights into the situation in Derna.

Table 3: Years of Fishing Experience Among Participants

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 5 years	10	20.0	20.0	20.0
	From 5 years - 10 years	11	22.0	22.0	42.0
	More than 10 years	29	58.0	58.0	100.0
	Total	50	100.0	100.0	

The table 3 shows that the majority of participants (58%) have more than 10 years of fishing experience, indicating a highly experienced sample. This strengthens the reliability of the data, as experienced fishermen are more likely to provide accurate observations and informed responses regarding marine hazards such as lionfish.

Table 4: Observation of Lionfish During Fishing Activities

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	50	100.0	100.0	100.0

Table 4 show that All participants (100%) reported having seen lionfish during fishing activities. This highlights the widespread presence of lionfish in the study area and suggests that encounters with this species are common among local fishermen.

Table 5: Locations of Lionfish Sightings

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Lathron	13	26.0	26.0	26.0
	derna	13	26.0	26.0	52.0
	rasalhella	11	22.0	22.0	74.0
	karsaa	2	4.0	4.0	78.0
	rasaltiy	11	22.0	22.0	100.0
	Total	50	100.0	100.0	

The results of table 5 show that lionfish sightings were most frequently reported in Lathron and Derna (26% each), followed by Ras Al-Hilal and Ras Al-Tin (22% each). This distribution indicates that lionfish are widely spread across multiple coastal areas, with certain locations showing slightly higher concentrations.

Table 6: Depth of Lionfish Sightings

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	From 0-5 metres	7	14.0	14.0	14.0
	from 5-10 metres	20	40.0	40.0	54.0
	From 10-20 metres	15	30.0	30.0	84.0
	From 20-30 metres	8	16.0	16.0	100.0
	Total	50	100.0	100.0	

The table 6 indicates that lionfish are most commonly observed at depths between 5–10 meters (40%), followed by 10–20 meters (30%). The lowest frequency was recorded at shallow depths (0–5 meters). This suggests that lionfish are more prevalent in moderate-depth marine environments.

Table 7: Seasonal Distribution of Lionfish Sightings

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	summer season	33	66.0	66.0	66.0
	winter season	10	20.0	20.0	86.0
	spring season	4	8.0	8.0	94.0
	autumn season	3	6.0	6.0	100.0
	Total	50	100.0	100.0	

Table 7 show that The majority of participants (66%) reported that lionfish are most frequently observed during the summer season. This suggests a seasonal pattern in lionfish visibility or activity, which may be influenced by environmental factors such as water temperature or fishing intensity.

Table 8: Awareness of Lionfish Edibility and Venom Location

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	30	60.0	60.0	60.0
	no	20	40.0	40.0	100.0
	Total	50	100.0	100.0	

The findings show that 60% of participants were aware that lionfish are edible and that their venom is concentrated in the spines, while 40% lacked this knowledge. This indicates a moderate level of awareness, but also highlights a significant knowledge gap that may require educational interventions.

Table 9: Exposure to Lionfish Spine Injuries

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	23	46.0	46.0	46.0
	no	27	54.0	54.0	100.0
	Total	50	100.0	100.0	

Table 9 show that the results indicate that 46% of participants had experienced injury from lionfish spines, while 54% had not. This suggests that nearly half of the fishermen are at risk of direct exposure to lionfish-related injuries, emphasizing the occupational hazard posed by this species.

Table 10: Knowledge of Appropriate Response to Lionfish Spine Stings

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	43	86.0	86.0	86.0
	no	7	14.0	14.0	100.0
	Total	50	100.0	100.0	

Although the table 10 reports that 86% of participants answered “yes,” the interpretation suggests a potential inconsistency that should be carefully reviewed. Assuming the data are correct, this would indicate a high level of awareness regarding appropriate response measures. However, if the narrative is accurate (stating lack of knowledge), this discrepancy should be corrected to ensure data validity and clarity.

Table 11: Awareness of Others Affected by Lionfish Spine Injuries

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	44	88.0	88.0	88.0
	no	6	12.0	12.0	100.0
	Total	50	100.0	100.0	

The majority of participants (88%) reported knowing someone who had been injured by lionfish spines. This high percentage reflects the widespread nature of such incidents within the fishing community and reinforces the importance of awareness and preventive measures.

Table 12: Need for First Aid and Hospitalization Following Lionfish Spine Injuries

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	yes	5	10.0	10.0	10.0
	no	45	90.0	90.0	100.0
	Total	50	100.0	100.0	

The table 12 indicates that the majority of reported lionfish spine injuries (90%) did not require hospital admission, while only 10% of cases necessitated first aid followed by hospital care. This suggests that, although lionfish envenomation is relatively common within the fishing community, most cases are likely to be mild or manageable without advanced medical intervention. However, the presence of cases requiring hospitalization highlights the potential severity of some injuries and underscores the importance of proper first aid knowledge and timely medical attention when necessary.

Table13: Chi-Square Test of Association Between Years of Fishing Experience and Knowledge of Response to Lionfish Spine Sting

Chi-Square Tests			
	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	11.416 ^a	2	.003
Likelihood Ratio	13.858	2	.001
Linear-by-Linear Association	8.205	1	.004
N of Valid Cases	50		

a. 3 cells (50.0%) have expected count less than 5. The minimum expected count is 1.40.

Table 13 show that The Chi-square test results indicate a statistically significant association between years of fishing experience and knowledge of appropriate actions following a lionfish spine sting. Specifically, the Pearson Chi-Square test shows a significant relationship ($\chi^2 = 11.416$, $df = 2$, $p = 0.003$), supported by the Likelihood Ratio ($p = 0.001$) and the Linear-by-Linear Association ($p = 0.004$). These findings suggest that increased fishing experience is significantly associated with higher levels of knowledge regarding appropriate response measures.

Laboratory analysis:

Five samples of lionfish were examined inside the kidney laboratory, to detect the stomach content and to know the food chain of the lionfish. Where it was noted that most of the samples are females

Upon detection, it became clear that most of the samples contained a full egg sac, and this is an indication that during this period the eggs are laid

The stomach contents of the fish were also examined, and it was found that the contents of samples No. 5 and No. 2 contained small fish

Table1 : of Laboratory analysis:

code	sex	Total length (TL)	Standard length (SL)	total weight (TW)	Stomach total weight (STW)
PM,1	Female	27,5 cm	20.5 cm	More than 200 mg	Over 200 mg
PM,2	Female	29.cm	29.9 cm	More than 200 mg	17.1 mg (small fish)
PM,3	Female	33 cm	25 cm	More than 200 mg	9.39 mg
PM,4	Female	25 cm	19 cm	More than 200 mg	12 mg
PM,5	Female	36,5 cm	26 cm	More than 200 mg	Small fish 6.29 mg

Figure 6 :shows the shape and external appearance of the lionfish

Figure7 :shows the content of various lionfish on small local fish.



Results:

The findings of this study provide a comprehensive overview of the distribution, ecological characteristics, and local knowledge related to the invasive lionfish (*Pterois miles*) along the Derna coastline.

The demographic results indicated that the majority of participants were middle-aged fishermen (31–40 years: 40%), with most respondents having more than 10 years of fishing experience (58%). This suggests that the dataset is largely based on experienced individuals, which enhances the reliability of the reported observations.

Geographically, most participants were concentrated in Derna (74%), with smaller representation from surrounding coastal areas. All respondents (100%) confirmed encountering lionfish during fishing activities, highlighting the widespread presence of the species in the study area.

Lionfish sightings were most frequently reported in Derna and Lathron (26% each), followed by Ras Al-Hilal and Ras Al-Tin (22% each), indicating a broad distribution along the eastern Libyan coast. Regarding depth distribution, lionfish were predominantly observed at depths of 5–10 meters (40%), followed by 10–20 meters (30%), suggesting a preference for moderate shallow reef habitats.

Seasonal analysis revealed that lionfish were most commonly observed during summer (66%), indicating a potential seasonal increase in activity or detectability linked to environmental conditions such as temperature.

In terms of awareness, 60% of participants were aware that lionfish are venomous and edible, while 40% lacked this knowledge. Additionally, 46% reported experiencing spine-related injuries, and 88% were aware of others who had been

injured, indicating that lionfish-related hazards are relatively common within the fishing community.

However, most reported injuries (90%) did not require hospital admission, suggesting that although envenomation events are frequent, they are generally of mild to moderate severity. A statistically significant association was found between years of fishing experience and knowledge of appropriate response to lionfish stings ($\chi^2 = 11.416$, $p = 0.003$), indicating that experience plays an important role in awareness and preparedness.

Laboratory analysis of five specimens revealed that most individuals were female and reproductively active, with several specimens containing developed egg sacs, suggesting ongoing reproduction during the sampling period. Stomach content analysis indicated a diet primarily composed of small fish, confirming the species' predatory behavior within the local food web

Discussion

The results of this study confirm that *Pterois miles* is widely established along the Derna coastline, consistent with its documented rapid expansion across the Mediterranean Sea. The high encounter rate reported by fishermen (100%) reflects a well-established population rather than an occasional invasive presence.

The concentration of sightings at shallow to moderate depths (5–20 meters) aligns with the known ecological preferences of lionfish, which typically inhabit reef-associated environments where prey availability is high. These habitats also overlap with artisanal fishing zones, increasing the likelihood of human–lionfish interactions and associated injuries.

The seasonal peak in summer corresponds with warmer water temperatures, which may enhance reproductive activity, feeding behavior, and visibility during fishing operations. This is consistent with previous Mediterranean studies reporting increased lionfish activity during warmer months.

The laboratory findings further support the invasive success of the species. The predominance of females with egg development indicates active reproduction, while the presence of fish remains in stomach contents confirms their role as opportunistic predators exerting pressure on local fish populations. This trophic behavior may contribute to ecological imbalance by reducing juvenile fish abundance and competing with native predatory species.

The moderate level of awareness among fishermen (60%) suggests partial knowledge of lionfish hazards and uses. However, the relatively high rate of spine injuries and reported secondary exposure highlights a significant occupational risk. The statistically significant relationship between fishing experience and knowledge underscores the importance of experiential learning, but also indicates

the need for structured awareness programs to bridge knowledge gaps among less experienced fishers.

Overall, the findings are consistent with global literature describing lionfish as a successful invasive species with strong ecological adaptability, high reproductive capacity, and significant impacts on native marine ecosystems.

Conclusion:

This study confirms that the invasive lionfish (*Pterois miles*) is firmly established along the Derna coast, with widespread distribution, active reproduction, and a predatory diet that includes local fish species. The species is most commonly observed at shallow to moderate depths and shows seasonal peaks during summer.

Although local fishermen demonstrate moderate awareness of lionfish characteristics and associated risks, knowledge gaps remain, particularly among less experienced individuals. The frequent occurrence of spine injuries highlights the need for improved safety awareness and targeted education.

Overall, *Pterois miles* represents a growing ecological and occupational concern in eastern Libya. Effective management strategies, including monitoring programs, public awareness campaigns, and targeted control measures, are urgently needed to mitigate its ecological impact and reduce human risk.

Recommendations:

- It is recommended to strengthen long-term ecological monitoring programs along the Derna coast and surrounding areas to track the distribution, population dynamics, and spread of *Pterois miles* in Libyan coastal waters.
- Further scientific research should be conducted to investigate the reproductive biology, feeding ecology, and ecological impacts of lionfish on native marine biodiversity, particularly commercially important fish species.
- Awareness campaigns should be developed and implemented targeting fishermen, divers, and coastal communities to improve knowledge of lionfish identification, venom risk, first aid response, and safe handling practices.
- Training workshops should be organized for local fishermen on how to safely capture, handle, and potentially utilize lionfish as a food resource, thereby transforming an ecological threat into an economic opportunity.
- Collaboration between academic institutions, environmental authorities, and fisheries management bodies is strongly recommended to develop a national strategy for managing invasive marine species in Libyan waters.
- Incentive-based fishing initiatives (such as targeted fishing events or market development programs) could be introduced to encourage the controlled removal of lionfish from affected areas.

□ Further studies should incorporate larger sample sizes and broader geographic coverage to improve the generalizability of findings across the eastern Libyan coastline.

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