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CONQUERING THE NORTH: NEW OCCURRENCE OF THE COMMON LIONFISH, *PTEROIS MILES* (BENNETT, 1828), IN THE ADRIATIC SEA

Adrian BRAJKOVIĆ & Iris MATULJA
Faculty of Mathematics, Natural Sciences and Information Technologies, Glagoljaška 8, 6000 Koper, Slovenia
e-mail: adrian.brajkovic7@gmail.com

Neven IVEŠA
Faculty of Natural Sciences, Juraj Dobrila University of Pula, Zagrebačka 30, 52100 Pula, Croatia

ABSTRACT

The devil firefish, also known as the common lionfish, Pterois miles *(Bennett, 1828), was first recorded in the Mediterranean Sea in 1991, which it likely entered through the Suez Canal. Here, we present the northernmost record of the non-indigenous devil firefish in the Adriatic Sea since its first appearance in 2019. The specimen was observed by snorkelling at Sakarun Bay (Dugi Otok, Croatia) in June 2025 and was caught with a speargun. The immature specimen measured 149.0 mm in total length (106.8 mm standard length) and weighed 36.1 g.*

Key words: devil firefish, northernmost record, non-indigenous species, Sakarun Bay

CONQUISTANDO IL NORD: NUOVA SEGNALAZIONE DEL PESCE LEONE, *PTEROIS MILES* (BENNETT, 1828), NEL MAR ADRIATICO

SINTESI

Il pesce leone, noto anche come pesce scorpione, Pterois miles *(Bennett, 1828), è stato segnalato per la prima volta nel Mediterraneo nel 1991, dove probabilmente è entrato attraverso il Canale di Suez. Gli autori presentano il ritrovamento più settentrionale di questa specie non indigena nell'Adriatico, dalla sua prima comparsa nel 2019. L'esemplare è stato osservato durante attività di snorkeling nella baia di Sakarun (Dugi Otok, Croazia) nel giugno 2025 ed è stato catturato con un fucile subacqueo. L'esemplare immaturo misurava 149,0 mm di lunghezza totale (106,8 mm di lunghezza standard) e pesava 36,1 g.*

Parole chiave: pesce leone, ritrovamento più settentrionale, specie non indigena, baia di Sakarun

INTRODUCTION

The increasing occurrence of tropical and subtropical biota in the Mediterranean Sea is largely driven by climate change and various anthropogenic pressures (Bianchi & Morri, 2003). This process is manifested through the spreading of thermophilic native and non-indigenous species (NIS) across the progressively warming Mediterranean basin (Shaltout & Omstedt, 2014). In addition to overfishing, pollution and sea warming, invasive NIS are the greatest threat to biodiversity in the region (Costello *et al.*, 2010). A species is considered invasive when it causes harmful effects on ecosystem diversity and/or socio-economic values in the invaded area (Kuhlenkamp & Kind, 2017). One such species is the devil firefish, also known as the common lionfish, *Pterois miles* (Bennett, 1828). This fish species was first recorded in the Mediterranean Sea in 1991, which it likely entered through the Suez Canal, although introduction via ballast waters or aquarium trade has also been suggested (Golani & Sonin, 1992; Dimitriou *et al.*, 2019). *P. miles* is an opportunistic demersal mesopredator that feeds on a wide range of teleost fishes and crustaceans, some of which have economic importance (Savva *et al.*, 2020). Its native range spans the Indian Ocean, from South Africa to the Red Sea and eastwards to Sumatra (Schultz, 1986). Its introduction to the western Atlantic was confirmed in 2007, where it is present alongside its congener, the red lionfish *Pterois volitans* (Linnaeus, 1758) (Hamner *et al.*, 2007). The two species share the number of dorsal fin spines (13), anal fin spines (3) and pectoral fin rays (14), but usually differ in the number of dorsal and anal fin rays: *P. miles* has 10 and 6, while *P. volitans* has 11 and 7, respectively (Schultz, 1986). Due to its rapid spread and ecological impacts, the common lionfish has recently been recognized as invasive in the Mediterranean Sea (Kletou *et al.*, 2016). Moreover, further invasion has been predicted to occur along the eastern coast of the Adriatic Sea (Bakiu *et al.*, 2024), alongside a likely occupation of the northern Adriatic niches, which resemble the niches already occupied by the species within its native range (Poursanidis *et al.*, 2020).

P. miles was first recorded in the Adriatic Sea in 2019 (Di Martino & Stancanelli, 2021), after which a documented northwards progression along the eastern Adriatic coast is reflected in an increasing number of sightings in recent years (Crocetta *et al.*, 2021; Dragičević *et al.*, 2021; Fortič *et al.*, 2023; Bakiu *et al.*, 2024; Dulčić *et al.*, 2024; Dragičević & Ugarković, 2025). The northernmost record of the devil firefish in the available literature so far was near Mali Garmenjak Island in Telašćica Nature Park in August 2024 (Dragičević & Ugarković, 2025). Here, we provide a new northernmost record of *P. miles* in both the Adriatic Sea and the Mediterranean

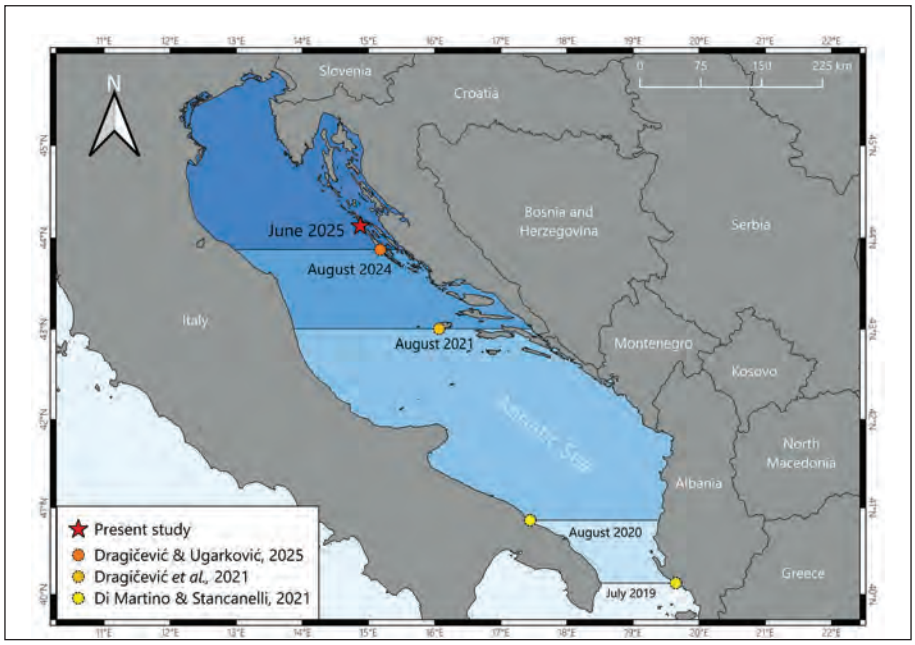

Fig. 1: *Pterois miles* ***northwards range expansion in the Adriatic Sea, from July 2019 to June 2025.***
Sl. 1: Širjenje areala vrste *Pterois miles* ***proti severu v Jadranskem morju, od julija 2019 do junija 2025.***

Sea (Fig. 1). This represents the first record in the northern Adriatic region north of the Ancona-Zadar line, according to the traditional division of the Adriatic Sea proposed by Cushman-Roisin *et al.* (2001).

MATERIAL AND METHODS

Specimen collection and analysis

The specimen of *P. miles* was recorded on June 18, 2025, in the western periphery of the Sakarun Bay (44°07′53.8″N; 14°52′21″E) (Fig. 2). It was identified according to the meristic and morphometric features described in Schultz (1986). The individual was observed over rocky substrate at a depth of 1.9 m, and a sea temperature of 22 °C. At the time of observation, the fish was resting on a section of discarded fishing gear; however, it was neither entangled nor otherwise obstructed by it. The individual was positioned vertically, with the anterior oriented downward, and remained motionless while being observed and photographed. Following a brief observation of its behaviour, the specimen was collected using a speargun and subsequently transported in an ice box to the laboratory of the Faculty of Natural Sciences in Pula for further analysis.

The examination included measurements of body mass, meristic and morphometric characteristics, stomach content analysis to assess dietary habits, and sex determination. Morphometric measurements were adapted for this species (Fig. 3) following the guidelines presented in Lipej & Trkov (2024). All morphometric characters were measured using a digital calliper with a precision of 0.1 mm, while the specimen was weighed on a digital scale with a precision of 0.1 g.

Habitat description

Sakarun Bay is located on the outer coastline of the northwestern part of Dugi Otok Island, in the Zadar Archipelago of the eastern Adriatic Sea (Croatia). This area has been designated as a significant landscape since 1967 (MINGOR, 2022). Although Sakarun Bay lies within a protected area, it is subject to considerable anthropogenic pressure due to its popularity as a tourist destination. The bay is sheltered from NE, N, NW, and W winds, while being significantly exposed to S and SE winds. Exposure to SE wave action results in the seasonal accumulation of banquettes formed by the seagrass *Posidonia oceanica* along the approximately 300 m long beach. These banquettes play a crucial role in preventing coastal erosion of the sandy

Fig. 2: The specimen of** Pterois miles **photographed and caught on June 18, 2025, in Sakarun bay. (Photo: Adrian Brajković)
Sl. 2: Primerek vrste** Pterois miles**, fotografiran in ulovljen 18. junija 2025 v zalivu Sakarun. (Foto: Adrian Brajković)

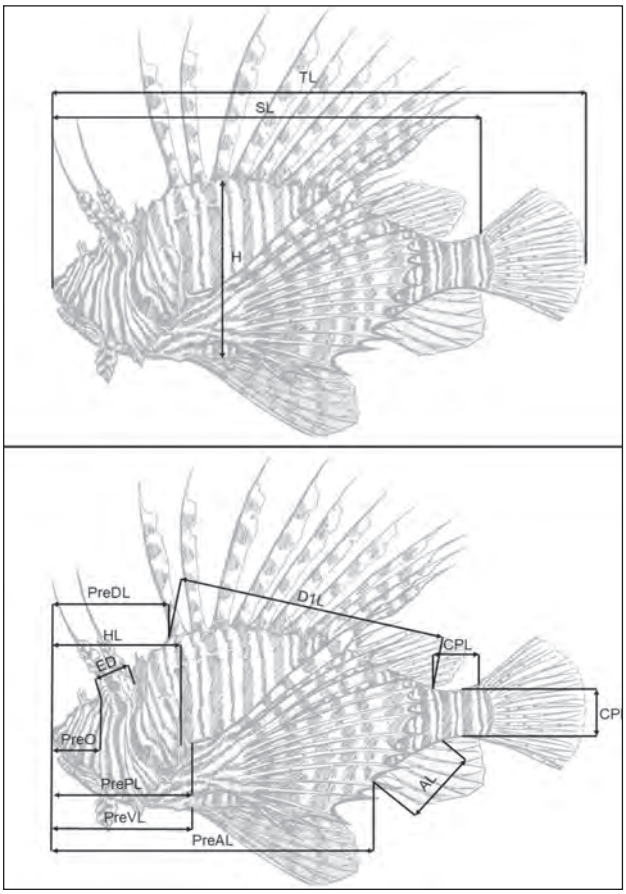

Fig. 3: The morphometric measures of *Pterois miles*, ***adapted from Lipej & Trkov (2024): TL – Total length, SL – Standard length, H – Body height, PreDL – Predorsal length, HL – Head length, ED – Eye diameter, PreO – Preorbital length, PrePL – Prepectoral length, PreVL – Preventral length, PreAL – Preanal length, D1L – Dorsal fin base length, AL – Anal fin base length, CPL – Caudal peduncle length, CPH – Caudal peduncle height.***
Sl. 3: Morfometrične meritve vrste *Pterois miles*, ***prilagojeno po Lipej & Trkov (2024): TL – celotna dolžina, SL – standardna dolžina, H – višina telesa, PreDL – predhrbtna dolžina, HL – dolžina glave, ED – premer očesa, PreO – predorbitalna dolžina (dolžina gobca), PrePL – predprsna dolžina, PreVL – predtrebušna dolžina, PreAL – predpodrepna dolžina, D1L – dolžina osnove hrbtne plavuti, AL – dolžina osnove podrepne plavuti, CPL – dolžina repnega pedunkla, CPH – višina repnega pedunkla.***

substrate, which led to the discontinuation of their removal during the tourist season as of 2020 (Pikelj *et al.*, 2022).

Sakarun Bay beach is classified as a large pocket beach characterized by mixed pebbly-sandy sediments and a gently sloping seabed that does not exceed a depth of approximately 20 m. The bay is enclosed by a coastal margin composed of biogenic carbonate rock, which forms the rocky substrate along the periphery of the bay, while the central seabed primarily consists of sandy deposits (Pikelj & Juračić, 2013; Pikelj *et al.*, 2022). The rocky substrate is an extension of the island's karstic terrain and supports an infralittoral algal biocenosis dominated by species such as *Dictyota* sp., *Padina pavonica*, *Laurencia obtusa* and *Halimeda tuna*. Additionally, this habitat forms structurally complex microhabitats associated with a pre-coralligenous biocenosis. Numerous crevices and cavities provide shelter for benthic fish species, including the dusky grouper *Epinephelus marginatus* (Lowe, 1834) and the cardinalfish *Apogon imberbis* (Linnaeus, 1758). Most of the seabed within Sakarun Bay is covered by extensive *P. oceanica* seagrass meadows, while shallow areas, particularly those shallower than 3 m, represent an exception to this general pattern.

RESULTS AND DISCUSSION

The examined specimen measured 149.0 mm TL (106.8 mm SL) and weighed 36.1 g (Tab. 1). The meristic traits were taken for dorsal (D) and anal (A) fins, which represent identifying features of *P. miles* (Schultz, 1986): D XIII+10; A III+6. The specimen had a moderately compressed body marked with a pattern of narrow light brown, narrow white and wide red alternating bars. A similar pattern covered the dorsal, pectoral and pelvic fins, while the soft rays of the anal, caudal and dorsal fins were transparent and adorned with black dots. There were multiple cirri (skin flaps) on the head: an antenna-like pair above the eyes, a pair above the nostrils and six of unequal size along each side of the upper jaw. The stomach contents could not be reliably identified through visual examination due to the highly digested state of the material at the time of analysis. The sex of the specimen could not be determined, possibly due to the fact that it had not yet reached sexual maturity. For example, a study from Cyprus has shown that the smallest males and females capable of reproducing had a TL of 154 mm and 158 mm, respectively (Savva *et al.*, 2020). More recent studies from the eastern Mediterranean have shown that the onset of sexual maturity occurs at even larger TL. Kondylatos *et al.* (2024) suggested a size of 219.2 mm and 229 mm for males and females respectively, while Yıldız *et al.* (2025) gave an estimate of 201 mm for female lionfish.

Pterois spp. are opportunistic predators capable of exploiting a wide range of teleost fishes and crustaceans associated with rocky habitats (Savva *et al.*, 2020; Bottacini *et al.*, 2024). Their presence in such environments may therefore increase predation pressure and competition within native fish assemblages, as previously documented in other invaded regions

(Albins & Hixon, 2013), and could potentially influence trophic dynamics in Adriatic coastal ecosystems. This finding confirms the ongoing northward expansion of *P. miles* along the eastern Adriatic coast. Until recently, the northernmost documented occurrence of the species in the Adriatic Sea was reported near Mali Garmenjak Island in Telašćica Nature Park (Dragičević & Ugarković, 2025). The finding of a specimen at Sakarun Bay therefore represents a further extension of the known distribution range and the first confirmed occurrence of *P. miles* in the northern Adriatic. This northwards expansion of approximately 20 NM is a subtle, but noteworthy addition to the existing knowledge and understanding of the distribution of the devil firefish. Eddy *et al.* (2019) discuss the possibility of western Atlantic juvenile lionfish using nursery habitats such as mangroves and seagrass beds and later migrating to different habitats. The site fidelity characteristic for this species (Bottacini *et al.*, 2024) might therefore be developed in later life stages. While the possibility of this specimen's settlement being caused by larval dispersal should not be excluded, active migration could be a likely vector of the species' northwards expansion (Morris *et al.*, 2009). The seabed of Sakarun Bay is included in the Natura 2000 ecological network as the marine site HR3000069 – Uvala Sakarun, designated under the Habitats Directive for the conservation of valuable marine habitats such as *Posidonia oceanica* meadows and reefs. The detection of *P. miles* within this protected area highlights the importance of incorporating targeted monitoring of this NIS into existing management frameworks. Early detection and, where feasible, removal of individuals may help limit further spread and reduce potential impacts on native food webs and biodiversity within this ecologically valuable habitat.

Although several marine NIS have been recorded in the Adriatic Sea, many have not yet been formally classified as invasive. In the European Union, invasive NIS are regulated under Regulation (EU) No. 1143/2014, which establishes criteria for their assessment and listing. However, many marine NIS occurring in European seas, including the Adriatic, have not yet been evaluated within this framework. This is also the case for *P. miles*. Although widely regarded as invasive in parts of the Mediterranean Sea due to its rapid spread and documented ecological impacts, the species has not yet been formally classified as invasive in the Adriatic region. Nevertheless, its ongoing northward expansion highlights the need for continued monitoring and further research on its potential establishment and ecological impacts in Adriatic marine ecosystems.

Tab. 1: Morphometric measures of the analysed *Pterois miles* ***specimen.***
Tab. 1: Morfometrične meritve preiskanega primerka vrste *Pterois miles***.**

Morphometric values	Abbreviation	Length (mm)
Total length	TL	149
Standard length	SL	106.8
Body height	H	37.2
Predorsal length	PreDL	32.6
Head length	HL	34.7
Eye diameter	ED	8.4
Preorbital length	PreO	14.6
Prepectoral length	PrePL	40.3
Preventral length	PreVL	39.3
Preanal length	PreAL	73.3
Dorsal fin base length	D1L	60.2
Anal fin base length	AL	18.3
Caudal peduncle length	CPL	14.5
Caudal peduncle height	CPH	11

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OSVAJANJE SEVERA: NOVI ZAPIS O POJAVLJANJU NAVADNE PLAMENKE, *PTEROIS MILES* (BENNETT, 1828), V JADRANSKEM MORJU

Adrian BRAJKOVIĆ & Iris MATULJA
Faculty of Mathematics, Natural Sciences and Information Technologies, Glagoljaška 8, 6000 Koper, Slovenia
e-mail: adrian.brajkovic7@gmail.com

Neven IVEŠA
Faculty of Natural Sciences, Juraj Dobrila University of Pula, Zagrebačka 30, 52100 Pula, Croatia

POVZETEK

Navadna plamenka, Pterois miles *(Bennett, 1828), je bila v Sredozemskem morju prvič zabeležena leta 1991, kamor je verjetno vstopila skozi Sueški prekop. Avtorji predstavljajo najsevernejšo najdbo te tujerodne ribe v Jadranskem morju od njenega prvega pojava leta 2019. Primerek so opazili med potapljanjem na vdih v zalivu Sakarun (Dugi otok, Hrvaška) junija 2025 in ulovili s podvodno puško. Nedorasli osebek je v dolžino meril 149,0 mm (standardna dolžina 106,8 mm) in tehtal 36,1 g.*

Ključne besede: plamenka, najsevernejše pojavljanje, tujerodna vrsta, zaliv Sakarun

REFERENCES

Albins, M.A. & M.A. Hixon (2013): Worst case scenario: potential long-term effects of invasive predatory lionfish (*Pterois volitans*) on Atlantic and Caribbean coral-reef communities. Environ. Biol. Fish., 96(10), 1151–1157.

Bakiu, R., A. Soldo & I. Ćetković (2024): Potential invasiveness of devil firefish *Pterois miles* (Bennett 1828) in the eastern Adriatic Sea. Croat. J. Fish., 82(1), 9–18.

Bianchi, C.N. & C. Morri (2003): Global sea warming and "tropicalization" of the Mediterranean Sea: biogeographic and ecological aspects. Biogeogr., 24(1), 319–327.

Bottacini, D., B.J. Pollux, R. Nijland, P.A. Jansen, M. Naguib & A. Kotrschal (2024): Lionfish (*Pterois miles*) in the Mediterranean Sea: a review of the available knowledge with an update on the invasion front. NeoBiota, 92, 233–257.

Costello, M.J., M. Coll, R. Danovaro, P. Halpin, H. Ojaveer & P. Miloslavich (2010): A census of marine biodiversity knowledge, resources, and future challenges. PLoS One, 5(8), e12110.

Crocetta, F., S. Al Mabruk, E. Azzurro, R. Bakiu, M. Bariche, I. Batjakas, T. Bejaoui, J. Ben Souissi, J. Cauchi, M. Corsini-Foka, A. Deidun, J. Evans, J. Galdies, R. Ghanem, T. Kampouris, S. Katsanevakis, G. Kondylatos, L. Lipej, A. Lombardo, G. Marletta, E. Mejdani, S. Nikolidakis, P. Ovalis, L. Rabaoui, M. Ragkousis, M. Rogelja, J. Sakr, I. Savva, V. Tanduo, C. Turan, A. Uyan & A. Zenetos, (2021): New Alien Mediterranean Biodiversity Records (November 2021). Mediterr. Mar. Sci., 22(3), 724–746.

Cushman-Roisin, B., M. Gačić, P.M. Poulain & A. Artegiani (2001): Physical oceanography of the Adriatic Sea: past, present and future. Springer, Dordrecht, 304 pp.

Di Martino, V. & B. Stancanelli (2021): The alien lionfish, *Pterois miles* (Bennett, 1828), enters the Adriatic Sea, Central Mediterranean Sea. J. Black Sea Mediterr. Environ., 27(1), 104–108.

Dimitriou, A.C., N. Chartosia, J.M. Hall-Spencer, P. Kleitou, C. Jimenez, C. Antoniou, L. Hadjioannou, D. Kletou & S. Sfenthourakis (2019): Genetic data suggest multiple introductions of the lionfish (*Pterois miles*) into the Mediterranean Sea. Diversity, 11(9), 149.

Dragičević, B. & P. Ugarković (2025): Invasion underway: exceptional number of records of the devil firefish *Pterois miles* (Bennett, 1828) in the eastern Adriatic Sea (Croatian coast). Acta Adriat., 66(1), 69–81.

Dragičević, B., P. Ugarković, M. Krželj, D. Zurub & J. Dulčić (2021): New record of *Pterois* cf. *miles* (Actinopterygii: Scorpaeniformes: Scorpaenidae) from the eastern middle Adriatic Sea (Croatian waters): Northward expansion. Acta Ichthyol. Piscat., 51, 379–383.

Dulčić, J., R. Grgičević & B. Dragičević (2024): Additional record of *Pterois miles* (Scorpaenidae) in Croatian waters (Eastern Adriatic Sea). Annales, Ser. Hist. Nat., 34(1), 95–100.

Eddy, C., J. Pitt, K. Oliveira, J.A. Morris, J. Potts & D. Bernal (2019): The life history characteristics of invasive lionfish (*Pterois volitans* and *P. miles*) in Bermuda. Environ. Biol. Fish., 102, 887–900.

European Union (2014): Regulation (EU) No. 1143/2014 of the European Parliament and of the Council of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species. Off. J. Eur. Union, L 317, 4.11.2014, 35–55.

Fortič, A., R. Al-Sheikh Rasheed, Z. Almajid, A. Badreddine, J.C. Báez, A. Belmonte-Gallegos, N. Bettoso, D. Borme, F. Camisa, D. Caracciolo, M.E. Çinar, F. Crocetta, I. Ćetković, A. Doğan, M. Galiya, Á. García De Los Ríos Y Los Huertos, D. Grech, J. Guallart, G. Gündeğer, A. Kahrić, P.K. Karachle, D. Kulijer, A. Lombarte, O. Marković, E. Martínez Jiménez, E. Sukran Okudan, M. Orlando-Bonaca, S. Sartoretto, A. Spinelli, I. Tuney Kizilkaya & R. Virgili (2023): New records of introduced species in the Mediterranean Sea (April 2023). Mediterr. Mar. Sci., 24(1), 182–202.

Golani, D. & O. Sonin (1992): New records of the Red Sea fishes, *Pterois miles* (Scorpaenidae) and *Pteragogus pelycus* (Labridae) from the eastern Mediterranean Sea. Jpn. J. Ichthyol., 39(2), 167–169.

Hamner, R.M., D.W. Freshwater & P.E. Whitfield (2007): Mitochondrial cytochrome b analysis reveals two invasive lionfish species with strong founder effects in the western Atlantic. J. Fish Biol., 71, 214–222.

Kletou, D., J.M. Hall-Spencer & P. Kleitou (2016): A lionfish (*Pterois miles*) invasion has begun in the Mediterranean Sea. Mar. Biodivers. Rec., 9(1), 46.

Kondylatos, G., A. Theocharis, M. Mandalakis, M. Avgoustinaki, T. Karagyaurova, Z. Koulocheri, S. Vardali & D. Klaoudatos (2024): The Devil Firefish *Pterois miles* (Bennett, 1828): Life History Traits of a Potential Fishing Resource in Rhodes (Eastern Mediterranean). Hydrobiology, 3(1), 31–50.

Kuhlenkamp, R. & B. Kind (2017): Introduction of non-indigenous species. In: Salomon, M. & T. Markus (eds.): Handbook on marine environment protection: Science, impacts and sustainable management, Springer, Cham, pp. 487–516.

Lipej, L. & D. Trkov (2024): Osnove morske ihtiologije. Nacionalni inštitut za biologijo, Morska biološka postaja, Ljubljana, 256 pp.

Ministarstvo gospodarstva i održivog razvoja (MINGOR) (2022): Zonacija rasprostranjenosti ciljnih staništnih tipova na područjima obuhvaćenih PU 6128. Government of the Republic of Croatia.

Morris, J.A., J.L. Akins, A. Barse, D. Cerino, D.W. Freshwater, S.J. Green, R.C. Muñoz, C. Paris & P.E. Whitfield (2008): Biology and Ecology of the Invasive Lionfishes, *Pterois mile*s and *Pterois volitans*. Gulf Caribb. Fish. Inst., 61.

Pikelj, K. & M. Juračić (2013): Eastern Adriatic Coast (EAC): geomorphology and coastal vulnerability of a karstic coast. J. Coast. Res., 29(4), 944–957.

Pikelj, K., P. Godec & B. C. Tešovic (2022): Sedimentological consequences of *Posidonia oceanica* banquette removal: Sakarun beach case study (Dugi otok, Croatia). Firenze University Press, Florence, 10 pp.

Poursanidis, D., S. Kalogirou, E. Azzurro, V. Parravicini, M. Bariche & H. Zu Dohna (2020): Habitat suitability, niche unfilling and the potential spread of Pterois miles in the Mediterranean Sea. Mar. Pollut. Bull., 154, 111054.

Savva, I., N. Chartosia, C. Antoniou, P. Kleitou, A. Georgiou, N. Stern, L. Hadjioannou, C. Jimenez, V. Andreou, J.M. Hall-Spencer & D. Kletou (2020): They are here to stay: the biology and ecology of lionfish (*Pterois miles*) in the Mediterranean Sea. J. Fish Biol., 97(1), 148–162.

Schultz, E.T. (1986): *Pterois volitans* and *Pterois miles*: two valid species. Copeia, 3, 686–690.

Shaltout, M. & A. Omstedt (2014): Recent sea surface temperature trends and future scenarios for the Mediterranean Sea. Oceanologia, 56(3), 411–443.

Yıldız, T., N. Demirel, A. Ulman, Ö. Çanak, M. Kesiktaş, H. Buyuran, U. Şahinoğlu, N. Cömert, L. Eryılmaz & E. Yemişken (2025): Growth and reproductive dynamics of the devil firefish, *Pterois miles* (Bennett, 1828), in the Eastern Mediterranean Sea. J. Fish Biol., 1–13.