

review article
received: 2003-10-01

UDK 597.5:591.9(262.3-12)

LESSEPSIAN FISH MIGRANTS REPORTED IN THE EASTERN ADRIATIC SEA: AN ANNOTATED LIST

Jakov DULČIĆ & Armin PALLAORO

Institute of Oceanography and Fisheries, HR-21000 Split, P.O.BOX 500

E-mail: dulcic@izor.hr

Lovrenc LIPEJ

National Institute of Biology, Marine Biology Station, SI-6330 Piran, Fornače 41

ABSTRACT

At least nine Lessepsian fish migrants have been so far recorded in the eastern part of the Adriatic: Pampus argenteus, Hemiramphus far, Paraexocoetus mento, Saurida undosquamis, Sphyræna chrysotaenia, Epinephelus coioides, Leiognathus klunzingeri, Stephanolepis diaspros and Siganus rivulatus. The Adriatic Sea is becoming an area of the Lessepsian migrants' westward distribution path, which has provided us with some important information on their westward spreading.

Key words: ichthyofauna, Lessepsian migration, eastern Adriatic, Mediterranean, Red Sea

PESCI MIGRANTI LESSEPSIANI RITROVATI IN ADRIATICO ORIENTALE: LISTA INTEGRATA

SINTESI

Il ritrovamento di almeno nove specie ittiche lessepsiane è stato fin'ora segnalato nella parte orientale del mare Adriatico: Pampus argenteus, Hemiramphus far, Paraexocoetus mento, Saurida undosquamis, Sphyræna chrysotaenia, Epinephelus coioides, Leiognathus klunzingeri, Stephanolepis diaspros e Siganus rivulatus. Il mare Adriatico sta diventando una delle aree di espansione verso occidente dei migranti lessepsiani e sono state fornite alcune importanti annotazioni e studi riguardo l'espansione verso occidente di nove specie.

Parole chiave: ittiofauna, migrazione lessepsiana, Adriatico orientale, Mediterraneo, Mar Rosso

INTRODUCTION

According to various marine biological surveys, at least 60 exotic fish species of Indo-Pacific origin have been recorded for the Mediterranean after the opening of the Suez Canal (Orsi Refini, 2001; Golani *et al.*, 2002). Fish and decapod crustaceans as well as molluscs have advanced beyond the limits of the Levant basins. The term "Lessepsian migrant" was coined by Por (1969) to characterize the Red Sea species that have passed through the Suez Canal and settled in the Eastern Mediterranean. The spreading of lessepsian fish migrants has already been recorded for the Aegean and Ionian Seas and considerable numbers have reached the Greek, Turkish and Cyprus coasts (Papaconstantinou, 1990; Golani, 1998, 2000; Corsini & Economidis, 1999; Taskavak *et al.*, 2000; Basusta *et al.*, 2002), while only a few species have been recorded further west and north (Tortonese, 1967; 1970; Papaconstantinou, 1988; also in Golani, 1998; Golani *et al.*, 2002).

Certain changes have been recorded in the Adriatic ichthyofauna, and some Lessepsian fish species were recently reported (in Dulčić *et al.*, 1999; Dulčić & Grbec, 2000; Dulčić *et al.*, 2002; Lipej & Dulčić, *in press*). Owing to the several studies recently carried out in the Adriatic, we now have a fairly accurate overview of the exotic species in this basin. On the basis of the above considerations, the purpose of this paper was to examine the distribution and abundance of Lessepsian migrants (immigrants) in the Adriatic Sea, especially along the eastern coast (Albanian, Montenegrin, Croatian, Slovenian and Italian waters), taking into account some data on their presence and abundance and on the variation of some abiotic parameters in recent years.

MATERIAL AND METHODS

This study was based mainly on scientific literature and material collected within the framework of research projects conducted by various national research institutions. Other data sources were sports and professional fishermen who have supplied specimens for identification. During this study, data from literature concerning the spreading of Lessepsian migrants in the Mediterranean were also analysed. The greater part of the material is being kept by different Adriatic institutions.

AN ANNOTATED LIST OF LESSEPSIAN MIGRANTS
IN THE ADRIATIC SEA*Pampus argenteus* (Euphrasen, 1788)

A specimen of butterfish (Stromateidae) was caught off Rijeka (northern Adriatic) in 1896 and was initially identified as *Stromateus fiatola* (Fig. 1). This specimen (Fig. 2), which is kept in the collection of the Zoological

Museum in Zagreb, was identified as *Pampus argenteus* by Šoljan (1948); however, he was doubtful about his identification because *P. argenteus* is an Indo-Pacific species, occurring mainly in South-east Asia and in the East China Sea. Also, Šoljan did not provide any description of the specimen to justify his identification, which remained doubtful until a recent examination of the specimen allowing to confirm Šoljan's provisional identification. It is suggested that the specimen could have entered the Mediterranean Sea by following slow-moving vessels or with pelagic medusae, floating wreckages or drifting seaweed. This record, which dates from 1896, represents the first Lessepsian migrant in the Mediterranean Sea (Dulčić *et al.*, *in press*).

Hemiramphus far (Forsskal, 1775)

Hemiramphus far is widely distributed in the Indo-Pacific from the Red Sea and east Africa to the Philippines and Samoa (Golani, 2002). In the Mediterranean, it was recorded first in the Eastern Levantine Basin as *H. marginatus* (Steinitz, 1927), and then successively off Syria, Rhodes and Egypt (in Golani *et al.*, 2002). A specimen of this species was also recorded along the Albanian coast (Colette & Parin, 1986).

Paraexocoetus mento (Valenciennes, 1846)

Paraexocoetus mento is widely distributed in the Indo-Pacific from the Red Sea to Fiji (Golani *et al.*, 2002). In the Mediterranean, it was first recorded in the Eastern Levantine Basin (Bruun, 1935) and then successively in the waters of Rhodes and Libya (in Golani *et al.*, 2002). This species, too, was recorded in Albanian coastal waters (Parin, 1986).

Saurida undosquamis (Richardson, 1848)

Saurida undosquamis is widely distributed in the Indo-Pacific from the Red Sea and eastern Africa to Australia and southern Japan (Golani *et al.*, 2002). In the Mediterranean, it was first of all recorded in Israel (Ben-Tuvia, 1953) and then successively in the waters of Cyprus, Turkey, Greece, Libya, Dodecaneses, Crete and Egypt (in Golani *et al.*, 2002). It is very important commercial fish, caught by trawl in large quantities in the eastern Basin. A single specimen (28 cm total length) has been recorded off the Albanian coast by Rakaj (1995).

Sphyræna chrysotaenia Klunzinger, 1884

The obtuse barracuda *Sphyræna chrysotaenia* has a wide distribution and is found in the eastern Mediterranean (Israel, Lebanon and Egypt), in the Indo-Pacific, from the Red Sea, Persian Gulf and East Africa through-

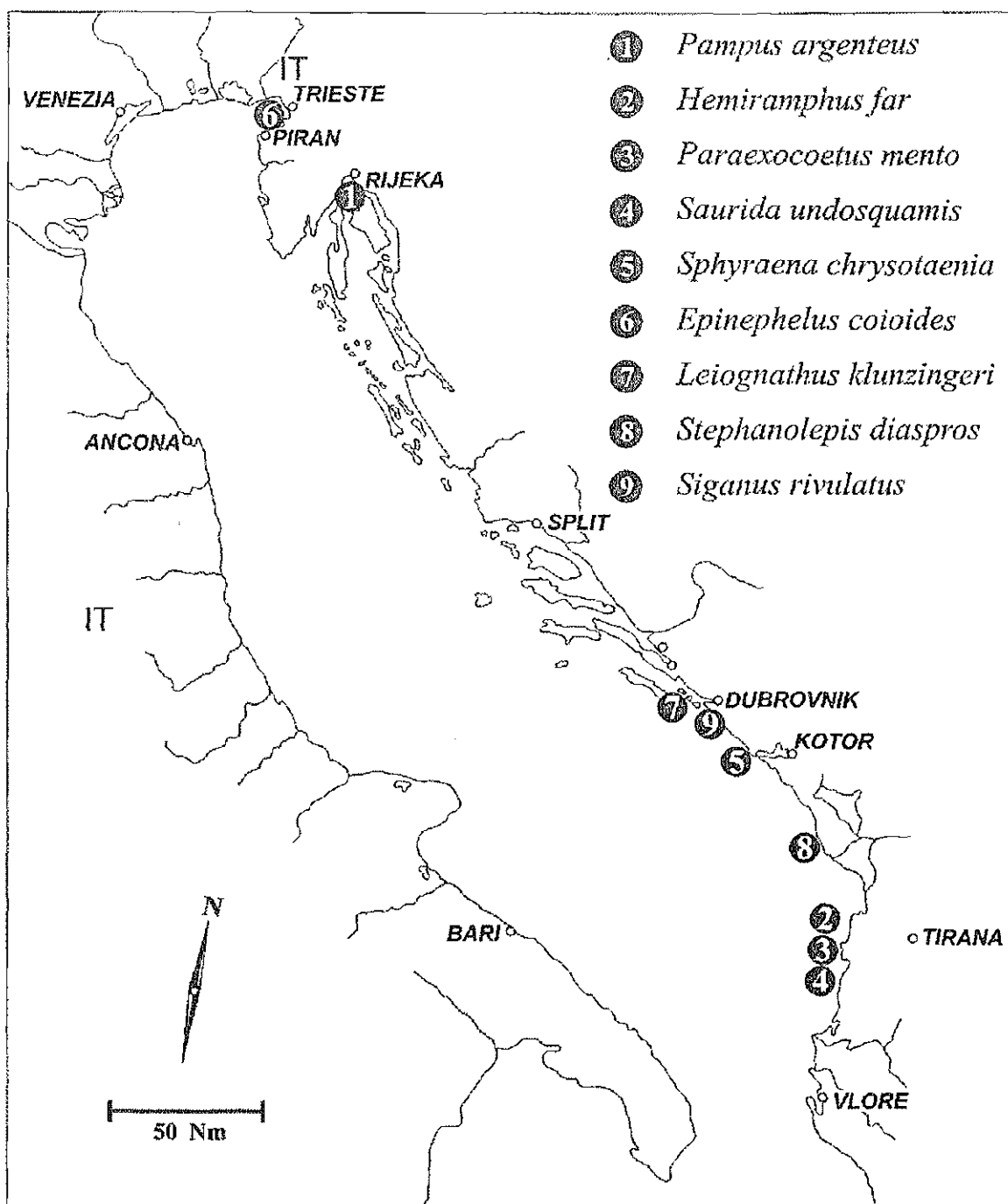


Fig. 1: Records of nine Lessepsian migrants found in the Adriatic Sea.
Sf. 1: Podatki o devetih lesepskih migrantih, ugotovljenih v Jadranskem morju.

out Indian Ocean to Australia and Japan (Ben-Tuvia, 1966). It has also been observed in Turkish waters, from Malta, Eastern Aegean Sea, Western Aegean Sea, Ionian Sea and in the Italian and Tunisian coastlines (Golani, 1998). On 10 August 2000, a 123 mm total length specimen of this species was captured with a small beach seine in the Bay of Gornji Molunat (southern

Adriatic) at a depth of 6 m together with several specimens of *S. sphyraena* (Pallaoro & Dulčić, 2001). The specimen was preserved in formalin and deposited in the collection of the Institute of Oceanography and Fisheries in Split. This is the northernmost record of this species in the Mediterranean area.

***Epinephelus coioides* (Hamilton, 1822)**

The orange-spotted grouper *Epinephelus coioides* occurs in the Red Sea, southwards to (at least) Durban, and eastwards to Ryukyu Islands, Palau, and Fiji (Golani *et al.*, 2002). The first specimen recorded in the Mediterranean Sea was misidentified by Ben-Tuvia & Lourie (1969) as *Epinephelus tauvina*. Another specimen was also caught in Haifa Bay; the local fishermen claimed that this species was caught only on rare occasions (Golani, 1998). It is very rare and only few specimens have been collected in the Mediterranean (Golani *et al.*, 2002). An orange-spotted grouper specimen of 12 cm total length was caught by fishing net on 16 May 1998 about 0.9 km from Trieste, northern Italy, and then maintained at the Civic Marine Aquarium of Trieste (presently the specimen measures 52 cm total length) (Parenti & Bressi, 2001). This is the northernmost record of this species in the Mediterranean Sea.

***Leiognathus klunzingeri* (Steindachner, 1898)**

The ponyfish *Leiognathus klunzingeri* has been reported only from the Red Sea, but as *Leiognathus* badly needs taxonomic revision, the distribution range might change (Golani *et al.*, 2002). In the Mediterranean, it was first recorded in Syria (Gravel, 1931); successively in the waters of Israel, Rhodes, Turkey, Lampedusa Island, NE Greece and Egypt (in Golani *et al.*, 2002). It is very common in the Eastern Mediterranean and caught in large numbers as bycatch in trawl. On 29 June 2000,

an 85 mm total length specimen of ponyfish was captured by beach seine in Sapunara Bay (Mljet Island, southern Adriatic) at a depth of 4 m on sandy bottom (Dučić & Pallaoro, 2002). It has been deposited in the ichthyological collection of the Institute of Oceanography and Fisheries in Split. This is the northernmost record of this species in the Mediterranean Sea.

***Stephanolepis diaspros* Fraser-Brunner, 1940**

The filefish *Stephanolepis diaspros* has been reported from the Red Sea to the Arabian Gulf (Golani *et al.*, 2002). In the Mediterranean Sea, it was first recorded in the Eastern Levantine Basin (Steinitz, 1927); successively in the waters of Syria, Cyprus, Rhodes, Gulf of Gabes (Tunisia), Gulf of Taranto (Italy), Crete, Saronikos Gulf and Gulf of Palermo (Sicily) (in Golani *et al.*, 2002). It is very common in the Mediterranean Sea. On 23 August 2002, a 77.3 mm total length specimen of *S. diaspros* was found at Ulcinj fish market (southern Adriatic, Montenegro) (Dučić & Pallaoro, *in press*, a). According to the Ulcinj fishermen, it had been captured with a beach seine in the area of Hrid Đeran, at a depth of about 20 m on the rocky-sandy bottom. The specimen was preserved in formalin and deposited in the ichthyological collection of the Institute of Oceanography and Fisheries in Split (Fig. 3). This is the northernmost record of this species in the Mediterranean area and the first record of a species from the family Monacanthidae for the Adriatic Sea.

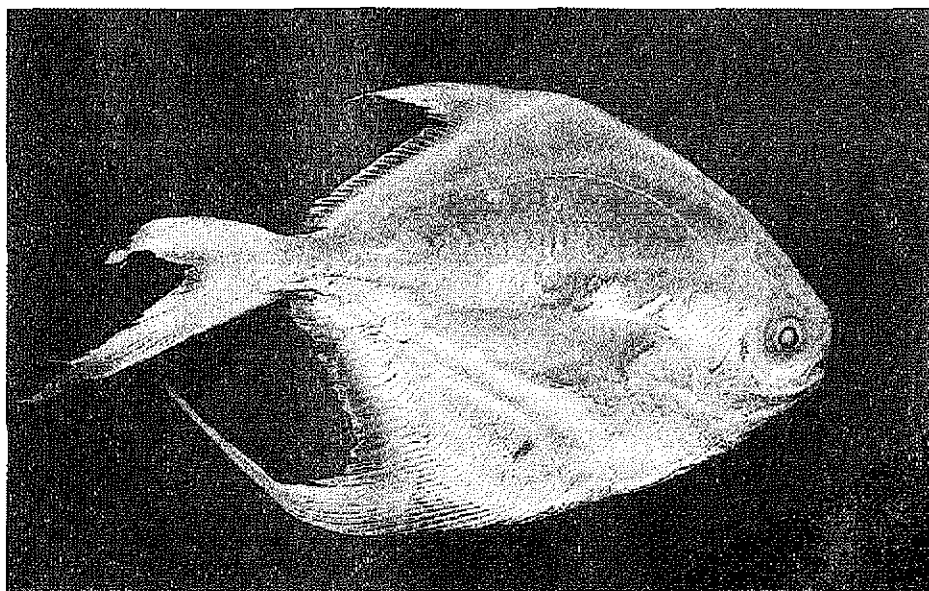


Fig. 2: A specimen of *Pampus argenteus* (Euphrasen, 1788) kept in the Natural History Museum in Zagreb. (Photo: I. Jardaš)
Sl. 2: Primerek vrste *Pampus argenteus* (Euphrasen, 1788), shranjene v zbirki Hrvatskega prirodoslovnega muzeja v Zagrebu. (Foto: I. Jardaš)

***Siganus rivulatus* Forsskål, 1775**

The rabbitfish *Siganus rivulatus* has been reported from the Red Sea and the Gulf of Aden (Golani et al., 2002). In the Mediterranean, it was first recorded in the Eastern Levantine Basin (Steinitz, 1927); successively in the waters of Syria, Cyprus, Aegean Sea, Libya, Tunisia and Ionian Sea (in Golani et al., 2002). It is very common in the eastern Mediterranean and caught in large quantities by trammel net and purse seine. On 5 October 2000, two specimens of *Siganus rivulatus* (111-149 mm total length) were captured by the beach seine between 07:00 to 09:00 near the islet of Bobara, southern Adriatic (Croatian coast, near Cavtat) at a depth of 15 m on sandy bottom covered by algae and seagrass (Đulčić & Pallaoro, *in press*, b). They were deposited in the Ichthyological Collection of the Institute of Oceanography and Fisheries in Split. This is the northernmost record of this species in the Mediterranean area.

DISCUSSION

Up to date, nine Lessepsian migrants (Tab. 1) have reached the Adriatic Sea. The importance of consecutive records in determining the rate of establishment of Lessepsian fish migrant populations cannot be overemphasized. It is natural for first records to be published immediately upon discovery and to receive a great deal of attention. But second and subsequent records can certainly add to our knowledge of a migrant species' establishment. There are seven Lessepsian migrant fish species that have been recorded only as single specimens: *P. argenteus*, *H. far*, *S. undosquamis*, *S. chryso-*

taenia, *E. coioides*, *L. klunzingeri* and *S. diaspros*. There have been no data on the number of recorded specimens for the species *P. mento*, while two specimens were observed for *S. rivulatus*. In order to understand whether these records constitute an abortive episode or rather the founder trailblazers of a sustainable population, it is necessary to report consecutive records. In those cases, where subsequent reports include an extension of the species' distribution, it is clear that there will be second and third records as well. There are still no such cases for the Lessepsian fish species found in the Adriatic Sea. However, second and subsequent records that do not extend the distribution often receive less attention and may not necessarily be published (Golani, 2002). Lessepsian fish migrant species may be characterized according to several traits, namely abundance, habitat, feeding habits and size (Golani, 2002).

Nine Lessepsian fish migrants have brought up (together with previous mentioned species in Đulčić et al., 2002) the number of species recorded for the Adriatic to 432 and 122 families. The record of *P. argenteus* dated from 1896 represents the first Lessepsian migrant in the Mediterranean Sea. The occurrence of the orange-spotted grouper *E. coioides* in the Gulf of Trieste (Parenti & Bressi, 2001) is very interesting indeed, since it had been previously recorded only from the coastal waters of Israel and is considered a rare and recent invader (Golani, 1998). Other seven species were amongst the first Eritrean invaders of the Eastern Mediterranean more than thirty years ago, when recorded as common or very common fish species in the Aegean coastal waters and off Anatolian coast (Ben-Tuvia, 1966). Temperature is the most important abiotic factor in deter-

Tab. 1: List of Lessepsian migrants fished in the Adriatic Sea.

Legend: 1 - occurrence: VR - very rare; 2 - habitat: P - pelagic, IP - inshore pelagic, BP - benthopelagic, B - benthic, R - rocky; 3 - feeding habits: FI - feeders of fish and benthic invertebrates, PL - planktivores, BI - benthic invertebrates, H - herbivores; 4 - size: S - small, M - medium; 5 - area: GT - Gulf of Trieste, NA - northern Adriatic, MA - middle Adriatic, SA - southern Adriatic; 6 - first record; 7 - source.

Tab. 1: Seznam lesepskih selivk, ugotovljenih v Jadranskem morju.

Legenda: 1 - pojavljanje: VR - zelo redko; 2 - habitat: P - pelaški, IP - obalno pelaški, BP - bento-pelaški, B - bentoški, R - skalnati; 3 - prehranjevalne navade: FI - ribe in bentoški nevretenčarji, PL - planktivori, BI - bentoški nevretenčarji, H - rastlinojedi; 4 - velikost: S - majhne, M - srednje velike; 5 - območje: GT - Tržaški zaliv, NA - severni Jadran, MA - srednji Jadran, SA - južni Jadran; 6 - prvi zapis; 7 - vir.

Species	1	2	3	4	5	6	7
<i>Pampus argenteus</i> (Euphrasen, 1788)	VR	P	?	M	NA	1896	Đulčić et al. (<i>in press</i>)
<i>Hemiramphus far</i> (Forsskål, 1775)	VR	IP	PL	?	SA	?	Collette & Parin (1986)
<i>Paraexocoetus mento</i> (Valenciennes, 1846)	?	IP	PL	?	SA	?	Parin (1986)
<i>Saurida undosquamis</i> (Richardson, 1848)	VR	B	FI	?	SA	?	Rakaj (1995)
<i>Sphyræna chrysotaenia</i> Klunzinger, 1884	VR	BP	FI	M	SA	2000	Pallaoro & Đulčić (2001)
<i>Epinephelus coioides</i> (Hamilton, 1822)	VR	B	FI	M	GT	1998	Parenti & Bressi (2001)
<i>Leiognathus klunzingeri</i> (Steindachner, 1898)	VR	B	BI	S	SA	2000	Đulčić & Pallaoro (2002)
<i>Stephanolepis diaspros</i> Fraser-Brunner, 1940	VR	R	BI	S	SA	2002	Đulčić & Pallaoro (<i>in press</i> , b)
<i>Siganus rivulatus</i> Forsskål, 1775	VR	B	H	M	SA	2000	Đulčić & Pallaoro (<i>in press</i> , a)



Fig. 3: A specimen of *Stephanolepis diaspros* Fraser-Brunner, 1940 caught in the waters off Ulcinj (Montenegro). (Photo: A. Pallaoro)

Sl. 3: Primerek vrste *Stephanolepis diaspros* Fraser-Brunner, 1940, ujet v vodah blizu Ulcinja (Crna gora). (Foto: A. Pallaoro)

mining the dispersal of Lessepsian fish (Golani, 2002). It is not really known what is the impact of the Lessepsian migrant in the Adriatic environment and at this stage it is very hard to perform any direct study to assess possible impact. According to Golani (1993), however, the impact of Lessepsian migration on the Levantine basin ecosystem has been immense. Some authors reported that the diet of Lessepsian predators, such as the brush-tooth lizardfish *S. undosquamis*, consisted mainly of other Lessepsian fish species (*L. klunzingeri*) and Lessepsian crustaceans (Golani, 1993). Golani & Galil (1991) compared the feeding habits of the two indigenous mullets *Mullus barbatus* and *M. surmuletus* to that of the two congeneric Lessepsian migrant *Upeneus mollucensis* and *U. pori*. The authors found a high rate of similarity in the diet of all four species. Golani (1994) showed that niche partitioning of the eastern Mediterranean mullets is achieved on the bathymetrical axis; Lessepsian mullets occupy shallow waters (20-50 m), while indigenous species dominate at greater depths. However, due to lack of knowledge concerning bathymetric distribution of the indigenous mullets in the eastern Levant, prior to the Lessepsian invasion, it cannot be determined whether a habitat displacement has taken place in this region. An opposite trend has been observed regarding lizardfishes (Synodontidae); the indigenous species *Synodus saurus* occupies shallower water than the Lessepsian migrant *S. undosquamis* (Golani, 1993).

Changes in the Adriatic ichthyofauna have been associated with climatic and oceanographic changes (Dulčić *et al.*, 1999; Dulčić & Grbec, 2000; Lipej & Dulčić, *in press*). Oceanographic changes in the Adriatic can be associated with the climate in the Mediterranean; this is a consequence of the changes in distribution of air pressure over the wider Mediterranean, which causes the horizontal air pressure to vary between the northern and southern Adriatic and hence influences the intensity of water exchange between the Adriatic and the eastern Mediterranean (Grbec *et al.*, 1998). Because the incoming Mediterranean water in the Adriatic carries nutrient-rich water that affects primary and secondary production, climate change, via its oceanographic influence, can play an important role in the Adriatic ecosystem. The incoming Ionian water (Adriatic ingression) is also warmer, and many fish species move towards higher latitudes. Therefore, the strong year-to-year changes in sea surface temperatures, which are closely related to climatic fluctuations, can well be responsible for such range extensions. A general summary of the occurrence of fish species in the Adriatic over the last 25 years is that numbers of thermophilous species have increased, that several species, fairly rare or very rare until now, are more abundant, while others are new to the zone (in Dulčić *et al.*, 1999; Dulčić & Grbec, 2000; Lipej & Dulčić, *in press*).

The last decade has witnessed an upsurge of comprehensive studies on the phenomenon of Lessepsian fish migration. The Adriatic Sea is obviously becoming an area of the Lessepsian migrants' westward distribution path, which has provided us with some important information on their westward spreading. We are looking forward to the continuation of this scientific effort and hope for further cooperation amongst ichthyologists of the Levant and Adriatic Sea in the study of Lessepsian migration.

ACKNOWLEDGEMENTS

The authors wish to thank Mr. Tihomir Makovec and Mr. Alen Soldo for their help in preparing photographs and figures. This contribution originated on the basis of the results of a bilateral Slovenian-Croatian "Climate change and Adriatic ichthyofauna" research project.

LESEPSKE RIBJE SELIVKE, UGOTOVLJENE V VZHODNEM JADRANU:
DOPOLNJEN SEZNAM VRST

Jakov DULČIĆ & Armin PALLAORO

Inštitut za oceanografijo in ribištvo, HR-21000 Split, P.O.BOX 500

E-mail: dulcic@izor.hr

Lovrenc LIPEJ

Nacionalni inštitut za biologijo, Morska biološka postaja, SI-6330 Piran, Fornače 41

POVZETEK

Na podlagi številnih bioloških raziskav so v Sredozemskem morju ugotovili vsaj 60 vrst ribjih lesepskih selivk po odprtju Sueškega prekopa leta 1869. Doslej je bilo v vzhodnem Jadranskem morju ugotovljenih devet vrst lesepskih selivk: *Pampus argenteus*, *Hemiramphus far*, *Paraexocoetus mento*, *Saurida undosquamis*, *Sphyræna chrysotaenia*, *Epinephelus coioides*, *Leiognathus klunzingeri*, *Stephanolepis diaspros* in *Siganus rivulatus*. Vrsta *Pampus argenteus* je bila šele pred kratkim potrjena kot lesepska selivka, čeprav je bila ujeta v vodah blizu Reke že davnega 1896. leta. Druge vrste so bile najdene v obdobju zadnjih dvajsetih let, večina med njimi pa v zadnjih nekaj letih. Vse vrste lesepskih rib so bile ujete posamič ali kvečjemu v dveh primerkih. Trenutno še nimamo nobenih podatkov o možnem vplivu lesepskih selivk na avtohtono ihtiofavno.

Upošteva se devet novih vrst za Jadransko morje, šteje jadranska ribja favna 432 vrst, ki pripadajo 122 družinam. Pojavljanje lesepskih selivk v Jadranskem morju je bržkone treba pripisati istim dejavnikom, to je oceanografskim in klimatskim spremembam, zaradi katerih smo v zadnjih desetletjih v Jadranu zabeležili večje število termofilnih južnih vrst.

Ključne besede: ihtiofauna, selitev lesepskih vrst, vzhodni Jadran, Sredozemsko morje, Rdeče morje

REFERENCES

- Basusta, N., A. Girgin-Basusta & H. Torcu-Koc (2002): Distribution of Lessepsian fishes in the Turkish Mediterranean coasts. In: Ozturk, B. & N. Basusta (eds.): Workshop on Lessepsian Migration Proceedings. Published by Turkish Marine Research Foundation, Istanbul, Turkey, No. 9, p. 100-107.
- Ben-Tuvia, A. (1966): Red Sea fishes recently found in the Mediterranean. *Copeia*, 25, 254-275.
- Ben-Tuvia, A. & A. Lourie (1969): A Red Sea grouper *Epinephelus tauvina* caught on the Mediterranean coast of Israel. *Isr. J. Zool.*, 18, 245-247.
- Bruun, A. F. (1935): *Paraexocoetus*, a Red Sea flying fish in the Mediterranean. *Nature*, 136, p. 553.
- Collette, B. B. & N. V. Parin (1986): Hemiramphidae. In: Whitehead, P. J. P., M.-L. Bauchot, J. C. Hureau, J. Nielsen & E. Tortonese (eds.): Fishes of the North-eastern Atlantic and the Mediterranean. UNESCO, Paris, Vol. 2, p. 620-622.
- Corsini, M. & P. S. Economidis (1999): Distribution extension of two Lessepsian migrants found in the marine area of the Island of Rhodes (Aegean Sea, Greece). *Cy-bium*, 23, 195-199.
- Dulčić, J. & B. Grbec (2000): Climate change and Adriatic ichthyofauna. *Fish. Oceanogr.* 9, 187-191.
- Dulčić, J. & A. Pallaoro (2002): First record of the Lessepsian migrant *Leiognathus klunzingeri* (Pisces: Leiognathidae) from the Adriatic Sea. *J. Mar. Biol. Ass. U.K.*, 82, 523-524.
- Dulčić, J. & A. Pallaoro (*in press, a*): First record of the filefish, *Stephanolepis diaspros* (Monacanthidae), in the Adriatic Sea. *Cy-bium*.
- Dulčić, J. & A. Pallaoro (*in press, b*): First record of the marbled spinefoot *Siganus rivulatus* Forsskal, 1775 (Siganidae) in the Adriatic Sea. *Cy-bium*.
- Dulčić, J., B. Grbec & L. Lipej (1999): Information on the Adriatic ichthyofauna – effect of water warming? *Acta Adriat.*, 40, 33-43.
- Dulčić, J., L. Lipej & B. Grbec (2002): Changes in the Adriatic fish species composition. In: Ozturk, B. & N. Basusta (eds.): Workshop on Lessepsian Migration Proceedings. Published by Turkish Marine Research Foundation, Istanbul, Turkey, No. 9, p. 10-21.
- Dulčić, J., I. Jaldas, A. Pallaoro & L. Lipej (*in press*): On the validity of the record of silver pomfret *Pampus argenteus* (Stromateidae) from the Adriatic Sea. *Cy-bium*.

- Francour, P., C. F. Boudouresque, J. G. Harmelin, M. L. Harmelin-Vivien & J. P. Quignard (1994):** Are the Mediterranean waters becoming warmer? Information from biological indicators. *Mar. Pol. Bull.*, 28, 523-526.
- Golani, D. (1993):** The biology of the Red Sea migrant, *Saurida undosquamis*, in the Mediterranean and comparison with the indigenous confamilial *Synodus saurus* (Teleostei: Synodontidae). *Hydrobiologia*, 271, 109-117.
- Golani, D. (1994):** Niche separation between colonizing and indigenous goatfishes (Mullidae) of the Mediterranean coast of Israel. *J. Fish. Biol.*, 45, 503-513.
- Golani, D. (1998):** Distribution of Lessepsian migrants fish in the Mediterranean. *Ital. J. Zool.*, 65 (suppl.), 95-99.
- Golani, D. (2000):** The Lessepsian migrant, the Red-eye round herring *Etrumeus teres* (De Kay, 1842), a new record from Cyprus. *Zool. Middle East*, 20, 61-64.
- Golani, D. (2002):** Lessepsian fish migration-characterization and impact on the eastern Mediterranean. In: Ozturk, B. & N. Basusta (eds.): *Workshop on Lessepsian Migration Proceedings*. Published by Turkish Marine Research Foundation, Istanbul, Turkey, No. 9, p. 1-9.
- Golani, D. & B. Galil (1991):** Trophic relationships of colonizing and indigenous goatfishes (Mullidae) in the eastern Mediterranean with special emphasis on decapod crustaceans. *Hydrobiologia*, 218, 27-33.
- Golani, D., L. Orsi-Relini, E. Massuti & J.-P. Quignard (2002):** CIESM Atlas of Exotic Species in the Mediterranean. Vol. 1. Fishes. CIESM Publishers, Monaco, 256 pp.
- Grbec, B., M. Morović & M. Zore-Armanda (1998):** Some new observations on the long-term salinity changes in the Adriatic Sea. *Acta Adriat.*, 39, 3-12.
- Gruvel, A. (1931):** Les États de Syrie. Richesses marines et fluviales. Exploitation actuelle, Avenir. Société des Editions Géographiques, Maritimes et Coloniales, Paris, p. 72-134.
- Lipej, L. & J. Dulčić (in press):** Fish diversity – what is new in the Adriatic Sea? In: Griffiths, H. I., B. Kryštufek & J. M. Reed (eds.): *Balkan Biodiversity. Pattern and Process in Europe's Biodiversity Hotspot*. Kluwer Academic Publishers B.V.
- Orsi Relini, L. (2001):** Pesci esotici nel Mediterraneo, un aggiornamento sugli immigranti di origine indopacifica ed atlantica. *Biol. Mar. Medit.*, 8(1), 84-93.
- Pallaoro, A. & J. Dulčić (2001):** First record of the *Sphyræna chrysotaenia* (Klunzinger, 1884) (Pisces: Sphyrænidae) from the Adriatic Sea. *J. Fish Biol.*, 59, 179-182.
- Papaconstantinou, C. (1988):** Fauna Graeciae. IV. Check-list of marine fishes of Greece. *Nat. Cent. Mar. Res., Hellenic Zool. Soc., Athens*, 257 pp.
- Papaconstantinou, C. (1990):** The spreading of Lessepsian fish migrants into the Aegean Sea (Greece). *Sci. Mar.*, 54(4), 313-316.
- Parenti, P. & N. Bressi (2001):** First record of the orange-spotted grouper, *Epinephelus coioides* (Perciformes: Serranidae) in the Northern Adriatic Sea. *Cybium*, 25 (3), 281-284.
- Parin, N. V. (1986):** Exocoetidae. In: Whitehead, P. J. P., M.-L. Bauchot, J. C. Hureau, J. Nielsen & E. Tortonese (eds.): *Fishes of the North-eastern Atlantic and the Mediterranean*. UNESCO, Paris, Vol. 2., p. 612-619.
- Por, F. D. (1964):** A study of the Levantine and Pontic Harpacticoidea (Crustacea, Copepoda). *Zool. Verh. Rijksmus Nat. Hist. Leiden*, 64, 128 pp.
- Por, F. D. (1969):** The Canalicidae (Copepoda, Harpacticoidea) in the waters around the Sinai peninsula and the problem of "Lessepsian" migration of this family. *Isr. J. Zool.*, 18, 169-178.
- Quignard, J. P. & J. P. Tomasini (2000):** Mediterranean fish biodiversity. *Biol. Mar. Medit.*, 7(3), 1-66.
- Rakaj, N. (1995):** Iktiofauna e Shqipërisë. Shtëpia Botuese "Libri Universitar", Tirana, 700 pp.
- Steinitz, W. (1927):** Beiträge zur Kenntnis der Küstenfauna Palästinas. I. Pubblicazioni della Stazione Zoologica di Napoli, 8(3-4), 311-353.
- Šoljan, T. (1948):** Ribe Jadrana. Fauna i flora Jadrana. Institut za oceanografiju i ribarstvo, Split, 437 str.
- Taskavak, E., M. Bilecenoglu, N. Basusta & S. Mater (2000):** Occurrence of *Pteragogus pelycus* Randall, 1981 (Teleostei: Labridae) and *Petroscirtes ancyllodon* Rüppell, 1838 (Teleostei: Blennidae) at the eastern Mediterranean coast of Turkey. *Acta Adriat.*, 41, 53-58.
- Tortonese, E. (1967):** Un pesce plettognato nuovo per i Mari Italiani: *Stephanolepis diaspros*, Fraser Brunner. *Doriana*, suppl., *Annali del Museo civico di storia naturale di Genova*, 4(181), p. 1-4.
- Tortonese, E. (1970):** On the occurrence of *Siganus* (Pisces) along the coast of North-Africa. *Doriana*, suppl., *Annali del Museo civico di storia naturale di Genova*, 4(191), p. 1-2.