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# NEW NORTHERNMOST RECORD OF THE BLUNTHEAD PUFFERFISH, *SPHOEROIDES PACHYGASTER* (OSTEICHTHYES: TETRAODONTIDAE) IN THE MEDITERRANEAN SEA

*Lovrenc LIPEJ & Borut MAVRIČ*
Marine Biology Station, National Institute of Biology, SI-6330 Piran, Fornače 41, Slovenia
E-mail: lipej@mbss.org

*Dejan PALISKA*
University of Ljubljana, Faculty of Maritime Studies and Transport, SI-6320 Portorož, Pot pomorščakov 4, Slovenia

## *ABSTRACT*

*A specimen of blunthead pufferfish* Sphoeroides pachygaster *(Müller & Troschel, 1848) was caught in waters off Piran on 22 November 2012. This record represents the first catch in Slovenian waters and the northernmost occurrence of this species in the Adriatic and the Mediterranean Sea, as well. The blunthead pufferfish began its rapid spread from the east Atlantic towards the Mediterranean in 1979 reaching its northernmost extent in the northern Adriatic Sea thirty years later.*

**Key words:** blunthead pufferfish, *Sphoeroides pachygaster,* northern spread, Adriatic Sea

# NUOVA SEGNALAZIONE A NORD DEL PESCE PALLA LISCIO, *SPHOEROIDES PACHYGASTER* (OSTEICHTHYES: TETRAODONTIDAE), NEL MARE MEDITERRANEO

## *SINTESI*

*Un esemplare di pesce palla liscio,* Sphoeroides pachygaster *(Müller & Troschel, 1848), è stato catturato nelle acque al largo di Pirano, il 22 novembre 2012. Si tratta della prima cattura di tale specie in mare sloveno e della sua segnalazione più settentrionale nell'Adriatico e nel Mediterraneo. Il pesce palla liscio si sta velocemente espandendo dall'Atlantico orientale al Mediterraneo dal 1979, raggiungendo la sua massima estensione a nord, nell'Adriatico settentrionale, trent'anni più tardi.*

**Parole chiave:** pesce palla liscio, *Sphoeroides pachygaster,* espansione settentrionale, mare Adriatico

## INTRODUCTION

Mediterranean fish fauna has faced many changes over the last decades. Many fish species were recorded for the first time in the Mediterranean Sea after the opening of the Suez Canal in 1865 while other newcomers arrived through the Gibraltar Strait. Some authors have considered the Mediterranean Sea to be one of the main hotspots of marine bioinvasion on the planet (Quignard & Tomasini, 2000).

The continuous arrival of new species has also been confirmed, although to a much lesser extent, in the Adriatic Sea (see for example Dulčić *et al*., 2003; Lipej & Dulčić, 2004; Dragičević & Dulčić, 2010; Dulčić & Dragičević, 2011). During the same period, native fish fauna experienced some changes as well. Some thermophilous southern species extended their area of distribution to the north. The northward spread of southern species is caused by the ongoing phenomenon of global warming (Francour *et al.,* 1994; Massutí *et al*., 2010).

The aim of this paper is to describe a specimen of blunthead pufferfish *Sphoeroides pachygaster* (Müller & Troschel, 1848) from the Gulf of Trieste in order to provide an overview of species spatial distribution in the Mediterranean and Adriatic Seas and analyze the spread of the blunthead pufferfish in both areas. The species is circumglobally distributed in the temperate and tropical Atlantic, in the Indian Ocean, in waters off Japan and the Hawaiian archipelago (Tortonese, 1986) and in the seas off Australia and New Zealand (Hardy, 1981). It is also present in the Mediterranean Sea; however the number of reports of this species is still rather low.

## MATERIAL AND METHODS

The specimen of the blunthead pufferfish (Fig. 1) was caught in waters 5 nm west of Piran (45°35′43 N, 13°29′01 E) on 22 November 2012. It was caught from the muddy bottom at 22 m of depth. It was readily identified as the blunthead pufferfish (Müller & Troschel, 1848) according to the identification key of Tortonese (1986). It was accurately measured to the nearest millimetre and weighed to the nearest gram. All measurements (according to Jardas, 1996) and meristic counts are presented in Table 1. The specimen is housed in the ichthyological collection of the Marine Biology Station (National Institute of Biology) in Piran.

***Fig. 1: Blunthead pufferfish** (Sphoeroides pachygaster) **caught in waters off Piran in November 2012 (Photo: B. Mavrič).***
***Sl. 1: Riba napihovalka** Sphoeroides pachygaster**, ujeta v vodah pri Piranu novembra 2012 (Foto: B. Mavrič)***

In order to understand the phenomenon of the blunthead pufferfish spread to the northernmost area of the Adriatic Sea and in the Mediterranean Sea as well, all available literature records of this species in the Mediterranean Sea and the adjacent eastern Atlantic were gathered. On the basis of more than 100 records (from 69 reported sources; see Appendix I) of the blunthead pufferfish in the eastern Atlantic and in the Mediterranean Sea we produced a map of the area with all records presented (Fig. 2). In many sources catchment locations were only approximately defined *e.g.* Sicily channel, Sušac Island *etc*. In those cases the coordinates have been chosen either within the centre of the area or territory or randomly near the territory. Although the data contain measurement errors in terms of coordinates, these errors are not problematic in this particular study of the wide area spread of the blunthead pufferfish. Another important consideration regarding the data set, when studying spatial distributions and their evolution over time, is that multiple records are reported at the same location in different time periods. This could mean that the species had settled down and is constantly present in the area. Using such data in the process of modelling leads to an inclusion of uncertainty in the data and produces errors in prediction location/trends (more in Gabrosek & Cressie, 2002). To deal with this problem a raster grid with cell size 0.5 degree latitude/longitude was created in ArcGis 9.3 and overlaid on sample data. If a single cell occupied more than one catchment location, the minimum value (year of the first record in the area) was assigned to the cell. For each single raster cell the centroid with minimum value as an attribute was extracted. The transformed dataset, year of first records within the 0.5 degree grid, were used in further analysis. This procedure has also positively influenced the effect of preferential sampling, since for the areas with dense concentrated samplings only one value was assigned, making a sample more evenly distributed in the whole area. A drawback of such a procedure is that the data on species spatial density were partially lost (32% of the original records were lost mostly in the area of high records density).

Our aim was to seek indices that could help us reveal the spatial pattern of the blunthead pufferfish population and its change over time. A good index for detecting change in spatial distribution over time is a distributional centroid and the variance of spatial distribution (Hollowed, 1992). The standard deviation ellipse is one of the tools incorporated in Esri ArcMap 9.3 software and has been used to demonstrate shifts in spatial

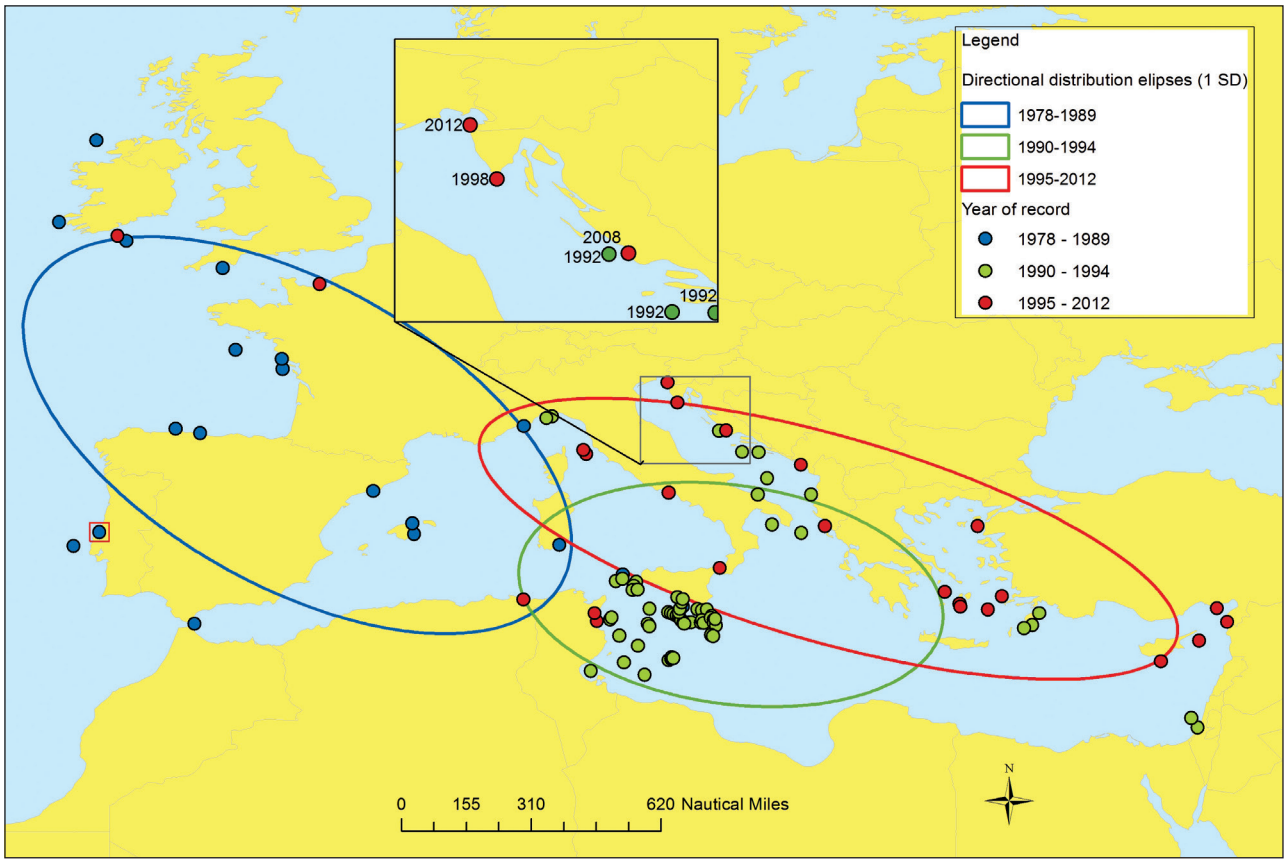


***Fig. 2: Records of the blunthead pufferfish** (S. pachygaster) **in the Mediterranean Sea and eastern North Atlantic. The three directional distribution ellipses, calculated for three different time periods, indicate the shift in spatial distribution in time. The red square represents the first record off the European Atlantic coast.***
***Sl. 2: Zapisi o pojavljanju ribe napihovalke** S. pachygaster **v vzhodnem Atlantiku in Sredozemlju. Tri elipse, izračunane za tri različna časovna obdobja, kažejo prostorsko smer širjenja v posameznih obdobjih. Rdeči kvadrat prikazuje prvi zapis ob atlantski obali Evrope.***

distribution over time. Spatial autocorrelation, within the entire study area, was tested using Global Morans I statistics (Anselin, 1995). In order to get a better insight into how local variations are clustered, Getis-Ord Gi statistics were also calculated (Getis & Ord, 1992). Getis-Ord Gi statistics (hereafter called Ord Gi) indicate, for any given location, how individual location is associated with the values of surrounding locations. Ord Gi statistics calculate standardized Z scores for any single location. High negative or positive Z scores indicate statistically significant spatial clustering formed by low or high values (Getis Ord, 1992; Ord & Getis, 1995). Absolute values higher than 1.96 are statistically significant for spatial clustering at the 0.05 level. Values around zero indicate that no apparent spatial clustering exists (neighbours in the selected area have almost random values). The ESDA (Explanatory Spatial Data Analysis) was carried out using GeoDa ver.0.95 (Anselin, 1995). All the parameters that have been used to demonstrate spatial spreading were calculated either in Esri ArcGis 9.3 or in GeoDa.

## RESULTS AND DISCUSSION

### Description and identification

All measurements and meristic counts are presented in Table 1. The studied specimen is among the biggest pufferfish caught in the Adriatic Sea to date, second only to the specimen, caught off Montenegro in 2008 (Joksimović & Mandić, 2008), which measured 450 mm in total length (Tab. 2). The specimen was identified by its typical stout and inflatable body with rounded snout, big head and skin without scales. In the mouth four large teeth (two in each jaw) form a beak. Eyes are rather big and oval in shape. A small dorsal fin is placed above the anal fin of similar size and shape. The caudal fin is slightly concave. The pelvic fin is absent. The body has smooth skin, without any scales, prickles or spines (as typical for the other species of this genus, recently confirmed in the Mediterranean Sea, namely *Sphoeroides marmoratus*). The colour of the dorsal surface and the flanks is greyish to olive green with many pale dots. The

***Tab. 1: Morphometric data and meristic characters of the blunthead pufferfish specimen caught in waters off Piran in November 2012.***
***Tab. 1: Morfometrični in meristični podatki o primerku napihovalke, ujete novembra 2012 v vodah pri Piranu***

| **Morphometric parameter** | **mm** | **% of Total length** |
|---|---|---|
| Total length | 348 | 100 |
| Standard length | 300 | 86.21 |
| Head length | 99 | 28.45 |
| Head height | 72 | 20.69 |
| Head width | 77 | 22.13 |
| Eye horizontal diameter | 23 | 6.61 |
| Eye vertical diameter | 16 | 4.60 |
| Interorbital space | 38 | 10.92 |
| Snout length | 49 | 14.08 |
| Postorbital length | 34 | 9.77 |
| Width of peduncle | 49 | 14.08 |
| Width of gill opening | 15 | 4.31 |
| Predorsal length | 220 | 63.22 |
| Preanal length | 232 | 66.67 |
| Dorsal fin length | 35 | 10.06 |
| Dorsal fin base length | 16 | 4.60 |
| Anal fin length | 37 | 10.63 |
| Anal fin base length | 15 | 4.31 |
| Pectoral fin length | 39 | 11.21 |
| Caudal fin length | 40 | 11.49 |
| Body thickness | 93 | 26.72 |
| Body height | 93 | 26.72 |
| Internarial space | 30 | 8.62 |
| Meristic counts | | |
| Dorsal fin rays | 8 | |
| Anal fin rays | 8 | |
| Pectoral fin rays | 14 | |
| Caudal fin rays | 10 | |

ventral side is whitish. The meristic counts and morphometric data agree well with previously published data on the Mediterranean Sea (for example Dulčić, 2002).

### Records of *S. pachygaster* in Mediterranean

Among the newcomers in the Mediterranean and the Adriatic Seas, the blunthead pufferfish deserved appropriate scientific attention over the last decades, beginning with its first Mediterranean appearance in 1979 in waters off the Balearic Islands (Oliver, 1981) (Fig.2 and Appendix I). After that time many records from various areas of the western Mediterranean Sea were published (see Dulčić, 2002 for site locations). This circumglobal temperate and tropical species rapidly dispersed throughout the Mediterranean Sea (Ragonese *et al.,* 1997) and it is considered as rather common in the western basin and in certain areas of the eastern basin (Golani *et al.*, 2002). In the eastern Mediterranean, the species was first reported by Golani (1996), who mentions a specimen collected by a trawl off Ashdod (Israel) in 1991 (Golani, 1996). In the eastern Mediterranean Sea the species was also recorded off Cyprus (Katsanevakis *et al.*, 2009), Turkey (Eryilmaz *et al.,* 2003; Bilecenoglu, 2010) and Greece (Zachariou-Mamallinga & Corsini, 1994; Peristeraki *et al*., 2006).

The species is now considered as established in Greek waters (Zenetos *et al.*, 2007) and waters off Malta (Schiberras & Schembri, 2006). After the first record of the blunthead pufferfish in the Ionian basin in 1991 (Tur-

si *et al.*, 1992), this species showed a significant increase in abundance with time and there is now a steady population with the presence of spawning females (Maiorano *et al.*, 2010).

According to Ragonese *et al*. (1992, 1997) the area between Sicily and Malta hosts an established population of the blunthead pufferfish. Ragonese *et al*. (1997) reported that 403 specimens of *S. pachygaster* were collected in the Sicily Strait in the period 1990-1994. Orsi Relini (2010) supposed that such a number of pufferfish probably arrived in the Sicily Strait before the date of the first record in the Mediterranean in the eighties (Oliver, 1981). In fact the area could probably be considered as a centre from which the population is spreading in different directions. However, nowadays, according to the data obtained by experimental surveys, the population in the waters of southern Sicily (and probably in the channel, too) is rather small (Ragonese & Murara, 2012).

## Blunthead pufferfish in Adriatic waters

The first records of this species date from 1992 when Bello (1993) reported the occurrence of this species in southern Adriatic waters, in waters off Albania and close to Mola di Bari (Fig. 2). At about the same time Jardas & Pallaoro (1996) reported records of many blunthead pufferfish in 3 different localities in the southern part of the Adriatic Sea: the Island of Sušac (altogether 3 records with 5 specimens), Glavat (single record with 3 specimens) and Blitvenica (1 record with 1 specimen) (Jardas & Pallaoro, 1996). The previous northernmost extension of the range of the species was close to the very tip of the Istrian Penninsula – Cape Kamenjak (northern Adriatic Sea), when a specimen of blunthead pufferfish was captured on 8 November 1998 (Dulčić, 2002). The studied specimen from the waters off Piran represents the northernmost record of this species in the Adriatic and Mediterranean Sea, as well (Fig. 2).

In the Adriatic Sea three species of the family Tetraodontidae have been recorded to date (Tab. 2). In addition to the blunthead pufferfish, the other two species are *Lagocephalus lagocephalus* and *L. sceleratus*. The first is a Mediterranean species and it was first reported in the Adriatic Sea by Dulčić at Molunat in 2004 (Dulčić & Pallaoro, 2006). The second species is a Lessepsian migrant, which is rapidly spreading throughout the eastern Mediterranean and to other areas. The first record of this species is from November 2012, when a specimen was caught in waters off Dubrovnik (HINA, 2012).

## Dispersal of *S. pachygaster* into the Mediterranean

There are two main hypotheses regarding the presence of the blunthead pufferfish in the Mediterranean Sea. The first deals with the recent immigration of the puffer-

***Tab. 2: Records of pufferfish species in the Adriatic Sea. Legend: Cro – Croatia, Ita – Italy, Alb – Albania, Mtg – Montenegro, Slo – Slovenia.***
***Tab. 2: Zapisi o pojavljanju različnih vrst rib napihovalk v Jadranskem morju. Legenda: Cro – Hrvaška, Ita – Italija, Alb – Albanija, Mtg – Črna gora, Slo – Slovenija***

| Species | Locality | Country | Date | n | Depth (m) | TL (mm) | Source |
|---|---|---|---|---|---|---|---|
| *Sphoeroides pachygaster* | Sušac Island | Cro | 16.3.1992 | 1 | | | Jardas & Pallaoro, 1996 |
| *S. pachygaster* | Sušac Island | Cro | 11.4.1992 | 2 | | 101, 120 | Jardas & Pallaoro, 1996 |
| *S. pachygaster* | Sušac Island | Cro | April 1992 | 2 | | | Jardas & Pallaoro, 1996 |
| *S. pachygaster* | Glavat Islet | Cro | August 1992 | 3 | 120 | 147 | Jardas & Pallaoro, 1996 |
| *S. pachygaster* | Blitvenica | Cro | 15.11.1992 | 1 | 130-150 | 213 | Jardas & Pallaoro, 1996 |
| *S. pachygaster* | Mola di Bari | Ita | 1992 | some | | | Bello, 1993 |
| *S. pachygaster* | S Adriatic Sea | Ita | 1992 | many | 30-130 | | Bello, 1993 |
| *S. pachygaster* | Albania | Alb | 1992 | 1 | 85 | | Bello, 1993 |
| *S. pachygaster* | Kamenjak (Pula) | Cro | 8.11.1998 | 1 | 125 | 45 | Dulčić, 2002 |
| *S. pachygaster* | Budva | Mtg | 5.1.2008 | 1 | 80 | 450 | Joksimović & Mandić, 2008 |
| *S. pachygaster* | Šibenik | Cro | 20.12.2008 | 1 | | | Grubač, 2008 |
| *S. pachygaster* | Piran | Slo | Nov 2012 | 1 | 20 | 348 | This work |
| *Lagocephalus lagocephalus* | Molunat | Cro | 2004 | 1 | 70 | 181 | Dulčić & Pallaoro, 2006 |
| *L. sceleratus* | Off Dubrovnik | Cro | Nov 2012 | 1 | | 660 | HINA, 2012 |

fish into the Mediterranean Sea from the Atlantic Ocean due to the gradual warming of the Mediterranean Sea. In fact the first records of this species originated only at the beginning of the eighties of the last century (Oliver, 1981). The second hypothesis is based on a painting by an Italian illustrator in 1558 in which the depicted fish could be identified as the blunthead pufferfish (Relini & Orsi Relini, 1995). The fish specimen, which was used as the model for the illustration came from the Delta of the Nile. Relini & Orsi Relini (1995) suggest that this fish was possibly present in the southern Mediterranean since ancient times. Obviously, since the opening of the Suez Canal was two centuries later, the blunthead pufferfish could not be related to Lessepsian migration.

Quéro *et al*. (1998) studied the phenomenon of the occurrence of tropical fish species along the eastern Atlantic coast of Europe. According to their results there is a clearly visible trend of the spread of the blunthead pufferfish towards northern regions (from latitudes 40° to 55°) over the time period 1975-1995. These data clearly favour the first hypothesis of the recent immigration, related to water warming, into the Mediterranean Sea.

Many studies have confirmed that one of the main ecological parameters known to affect fish population is temperature (*sensu* Francour *et al.*, 1994; Dulčić *et al.*, 1999). Many thermophilous species of southern Mediterranean origin have been recently recorded in the Gulf of Trieste, such as *Plectorhinchus mediterraneus* (Lipej *et al.*, 1996), *Mola mola* and *Ranzania laevis, Luvarus imperialis* and others (Lipej *et al.*, 2007). Some alien fish species originating from the Indian Ocean were also reported, such as *Siganus luridus* (Poloniato *et al.*, 2010) and *Terapon theraps* (Lipej *et al.*, 2008).

The blunthead pufferfish is listed as a vulnerable species in the IUCN (Roberts, 1996); however its placement in this category probably needs a revision based on updated records. On the basis of available data we produced a map of the area with all records presented (Fig. 2). We tried to analyse the change in spatial pattern and its evolution over time in the Mediterranean Sea. For this purpose the reduced dataset were used, and year of first record within the 0.5 degree lat/long grid were analysed. For the whole study area the results indicate a statistically significant high clustering of the data and weak spa-

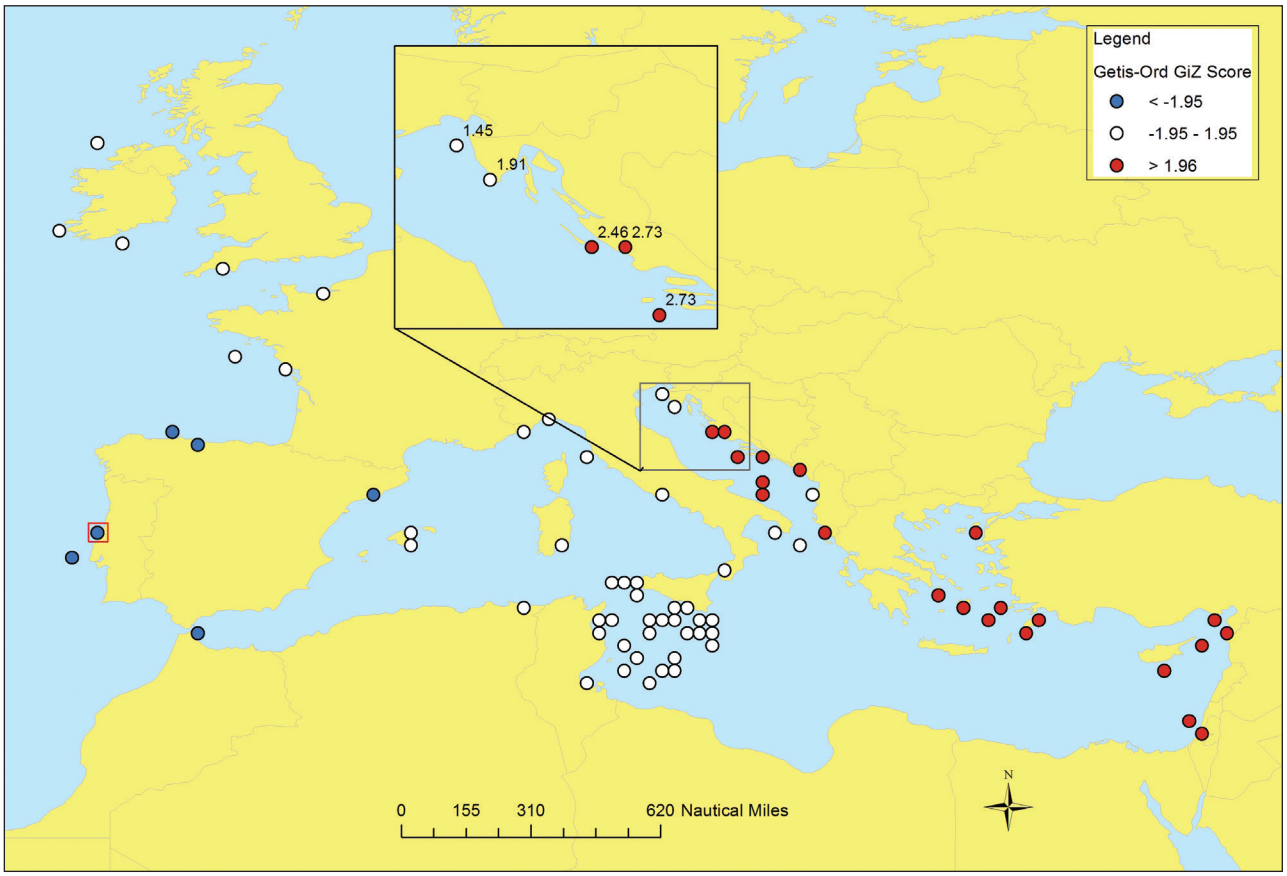


***Fig. 3: Getis – Ord Gi Z scores indicating areas with significant spatial clustering of the first records in 0.5 degree lat/long greed. The red square represents the first record off the Atlantic coast of Europe.***
***Sl. 3: Getis – Ord Gi Z vrednost prikazuje statistično značilno gručanje prvih zapisov v 0,5-stopinjski mreži. Rdeči kvadrat označuje prvi zapis ob atlantski obali Evrope.***

tial global autocorrelation (Morans I = 0.33, z = 3.61). Spatial autocorrelation occurs when the values of variables recorded at nearby locations are not independent from each other *i.e.* when adjacent geographic locations have very similar values (year of first records within the 0.5 degree grid in our case). Weak global spatial autocorrelation for the entire study area was expected and confirm the change in the spatial pattern of puffer fish records over time. It is common that the magnitude of spatial autocorrelation varies according to locations on a regional scale and exhibits significant clustering on a local scale. At local scale, Ord Gi statistics, with the search threshold for neighbours within 300 km, indicated few areas with statistically significant clustering. Figure 3 provides an overview of the calculated GiZ scores. As one can observe, high positive GiZ scores are clustered in the Adriatic, Aegean and Ionian Seas, indicating the directions of spread over the last two decades from the Sicily Channel (cluster with near zero values where the species had settled down and is constantly present over time). High negative values at the Atlantic coast of Europe and in the western Mediterranean represent the statistically significant cluster of earlier records and the direction of spread in the first decade after the very first record in 1978. It is quite evident that there is a clear eastward and northward spread of the blunthead pufferfish. Similarly, temporal dynamics can be observed from Figure 2. The three directional distribution ellipses, calculated for three different time periods, also indicate the expected spatial trend in time. As it is clearly evident from Figures 2 and 3 the donor centre of spread has its origin in the Sicily Channel where the great majority of all findings of the blunthead puffer were recorded.

According to the available data many trends of the northward extension of the blunthead pufferfish can be seen. The rather evident trend of spread along the western coast of Europe and northward to Great Britain and Ireland has already been described by Quéro *et al*. (1998).

In the Mediterranean Sea there are evident spread patterns in a north-easterly direction in the western Mediterranean, along the Levantine coast, in the Aegean Sea and finally in the Adriatic Sea, as well.

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***APPENDIX 1: Records of blunthead pufferfish in the eastern North Atlantic and the Mediterranean Sea Legend: Country: Por – Portugal, Esp – Spain, Ire – Ireland, Ita – Italy, GBr – Great Britain, Fra – France, Isr – Israel, Cro – Croatia, Mal – Malta, Gre – Greece, Alb – Albania, Tun – Tunisia, Alg – Algeria, Mtg – Montenegro, Slo – Slovenia, Cyp – Cyprus, Tur – Turkey. Region: ATL – Atlantic, W – West Mediterranean, e – east Mediterranean, c – central Mediterranean.***

***DODATEK 1: Pojavljanje ribe napihovalke v vzhodnem severnem Atlantiku in Sredozemskem morju. Legenda: Država – Por – Portugalska, Esp – Španija, Ire – Irska, Ita – Italija, GBr – Velika Britanija, Fra – Francija, Isr – Izrael, Cro – Hrvaška, Mal – Malta, Gre – Grčija, Alb – Albanija, Tun – Tunizija, Alg – Alžirija, Mtg – Črna gora, Slo – Slovenija, Cyp – Ciper, Tur – Turčija. Regija – ATL – Atlantik, W – zahodno Sredozemlje, e – vzhodno Sredozemlje, c – osrednje Sredozemlje***

| N | Locus | Country | Region | Date | n | Source |
|---|---|---|---|---|---|---|
| 1 | Estuary of the river Tago | Por | ATL | Jun 1931 | 1 | Gonçalves, 1941 |
| 2 | Nazaré' | Por | ATL | May 1978 | 1 | Calvário *et al*., 1980 |
| 3 | Sintra, 34 Nm NW of Cap Roca | Por | ATL | Jun 1979 | 1 | Calvário *et al.,* 1980 |
| 4 | Ribadesella | Esp | ATL | 25.2.1980 | 1 | Ortea *et al*., 1981 |
| 5 | Cala Ratjada, Mallorca | Esp | W | 1979 | 1 | Oliver, 1981 |
| 6 | Bay de Donegal | Ire | ATL | Jan 1984 | 1 | Wheeler & van Oijen, 1985 |
| 7 | Comarca del Garraf, Catalunya | Esp | w | 1984 | 1 | Cerro & Portas, 1984 |
| 8 | Sicilian Channel | Ita | w | 1985 | 2 | Vacchi & Cau, 1985 |
| 9 | Cala Ratjada, Mallorca | Esp | w | 1984 | 1 | Moreno & Roca, 1984 |
| 10 | SW Spain Almeria | Esp | w | 1986 | 2 | Crespo *et al.,* 1986 |
| 11 | Gibraltar, Ceuta | Esp | w | 1986 | 3 | Crespo *et al.,* 1986 |
| 12 | Gulf of Cagliari, Sardinia | Ita | w | 1986 | 5 | Vacchi & Cau, 1986 |
| 13 | San Remo | Ita | w | 1986 | 1 | Barletta & Torchio, 1986 |
| 14 | Plymouth | GBr | ATL | 1.2.1987 | 1 | Quigley& Flannery, 1992 |
| 15 | NW Sicilia | Ita | w | Jul 1988 | 1 | Arculeo *et al.,* 1994 |
| 16 | Northern Spain | Esp | ATL | 22.11.1988 | 1 | Quéro *et al.,* 1997 |
| 17 | sud Gascogne | Esp | ATL | 21.12.1988 | 1 | Quéro *et al*., 1997 |
| 18 | Lorient | Fra | ATL | 2.5.1989 | 1 | Quéro *et al.,* 1997 |
| 19 | La Rochelle | Fra | ATL | 29.5.1989 | 1 | Quéro *et al*., 1997 |
| 20 | Concarneau | Fra | ATL | 25.8.1989 | 1 | Quéro *et al.,* 1997 |
| 21 | SW Ireland | Ire | ATL | 19.8.1989 | 1 | Quigley, 2002 |
| 22 | Dingle Bay SW Ireland | Ire | ATL | 18.10.1989 | 1 | Quigley, 2002 |
| 23 | Alboran Sea | Esp | w | 12.6.1905 | ? | Camiñas *et al*., 1990 |
| 24 | Imperia | Ita | w | 1990 | 1 | Fiorentino & Zamboni, 1990 |
| 25 | coast of Israel | Isr | e | 1990 | 1 | Golani, 1996 |
| 26 | Amendolara, Gulf of Taranto | Ita | c | 1991 | 1 | Tursi *et al.,* 1992 |
| 27 | Ashdod | Isr | e | 1991 | 1 | Psomadakis *et al.,* 2006 |
| 28 | Mola di Bari | Ita | a | 1992 | some | Bello, 1993 |
| 29 | south Adriatic sea | Ita | a | 1992 | many | Bello, 1993 |
| 30 | Gallipoli, Apulia | Ita | c | May 1992 | 1 | Matarrese *et al.,* 1996 |
| 31 | Sušac Island | Cro | a | 11.4.1992 | 5 | Jardas & Pallaoro, 1996 |
| 32 | islet Glavat | Cro | a | 22.8.1992 | 3 | Jardas & Pallaoro, 1996 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 33 | Blitvenica | Cro | a | 15.11.1992 | 1 | Jardas & Pallaoro, 1996 |
| 34 | Ligurian sea | Ita | w | 1992 | ? | Ragonese *et al*., 1992 |
| 35 | Malta | Mal | c | 1992 | 2 | Ragonese *et al.,* 1992 |
| 36 | Lindos, Rodos | Gre | e | 23.11.1992 | 1 | Zachariou-Mamallinga & Corsini, 1994 |
| 37 | Plimmiri, south of Lindos | Gre | e | 24.11.1992 | 4 | Zachariou-Mamallinga & Corsini, 1994 |
| 38 | Lindos, Rodos | Gre | e | Mar 1993 | 10 | Zachariou-Mamallinga & Corsini, 1994 |
| 39 | Gulf of Gabes | Tun | c | 1993 | 1 | Bradai *et al*., 1993 |
| 40 | Albania | Alb | a | 1993 | 1 | Bello, 1993 |
| 41 | Malta | Mal | c | 1994 | x | Schiberras & Schembri, 2006 |
| 42 | Gulf de Lion | Fra | w | 14.6.1995 | 1 | Quignard & Raibaut, 1993 |
| 43 | Strait of Sicily | Ita | w | 1990-1994 | 403 | Ragonese *et al*., 1997 |
| 44 | Elba | Ita | w | 8.8.1996 | 1 | Bedini, 1998 |
| 45 | cape Kamenjak, Istra | Cro | a | 8.11.1998 | 1 | Dulčić, 2002 |
| 46 | Saros bay TR | Tur | e | Oct 1999 | 1 | Eryilmaz *et al.,* 2003 |
| 47 | Serifos Island | Gre | e | 2000 | 1 | Zenetos *et al*., 2007 |
| 48 | South of Meganissi Island | Gre | e | 2000 | ? | Zenetos *et al*., 2007 |
| 49 | Bozcaada Island | Tur | e | May 2001 | 1 | Eryilmaz *et al*., 2003 |
| 50 | SW Ireland | Ire | ATL | 1.1.2002 | 1 | Quigley, 2002 |
| 51 | SE Sikinos | Gre | e | 26.8.2003 | 1 | Peristeraki *et al.,* 2006 |
| 52 | North of Lefkas Island | Gre | e | 2004 | ? | Zenetos *et al.,* 2007 |
| 53 | North of Lefkas Island | Gre | e | 2005 | ? | Zenetos *et al.,* 2007 |
| 54 | SE Serifos | Gre | e | 14.6.2005 | 1 | Peristeraki *et al.,* 2006 |
| 55 | Cyprus | Cyp | e | 2005 | 1 | Katsanevakis *et al.,*2009 |
| 56 | SE Sikinos | Gre | e | 12.6.2005 | 2 | Peristeraki *et al.,* 2006 |
| 57 | Elba | Ita | w | Aug 2005 | ? | Ligas *et al.,* 2006, 2007 |
| 58 | SW Leros | Gre | e | 4.7.2006 | 1 | Peristeraki *et al.,* 2006 |
| 59 | Serifos | Gre | e | Oct 2005 | 2 | Zenetos *et al*., 2007 |
| 60 | SW Astypalaia | Gre | e | 11.7.2006 | 1 | Peristeraki *et al.,* 2006 |
| 61 | Annaba | Alg | w | 2008 | 1 | Hemida *et al.,* 2009 |
| 62 | off Budva | Mtg | a | 5.1.2008 | 1 | Joksimović & Mandić, 2008 |
| 63 | N of Corfu | Gre | e | 16.3.2009 | 1 | lianaskerkyra.blogspot.com/2009/03/strange-fish-in-corfu-waters.html |
| 64 | Tyrrhenian sea | Ita | w | 2008-2009 | 1 | Guerriero *et al.,* 2010 |
| 65 | Gulf of Hammamet | Tun | c | 2009 | 2 | Chérif *et al.,* 2010 |
| 66 | Karatasas coast, Iskenderun Bay | Tur | e | 26.10.2010 | 1 | Eleftheriou *et al.,* 2011 |
| 67 | Samandag, Iskenderun Bay | Tur | e | 28.10.2010 | 1 | Eleftheriou *et al.,* 2011 |
| 68 | Strait of Messina | Ita | w | Mar 2012 | 1 | Giordano *et al.,* 2012 |
| 69 | Piran | Slo | a | Nov 2012 | 1 | This paper |

# NOVI NAJSEVERNEJŠI ZAPIS O POJAVLJANJU RIBE NAPIHOVALKE, *SPHOEROIDES PACHYGASTER* (OSTEICHTHYES: TETRAODONTIDAE) V SREDOZEMSKEM MORJU

*Lovrenc LIPEJ & Borut MAVRIČ*
Morska Biološka Postaja, Nacionalni Inštitut za biologijo, SI-6330 Piran, Fornače 41
E-mail: lipej@mbss.org

*Dejan PALISKA*
Univerza v Ljubljani, Fakulteta za pomorstvo in promet, SI-6320 Portorož, Pot pomorščakov 4

*POVZETEK*

*Primerek ribe napihovalke vrste* Sphoeroides pachygaster *(Müller & Troschel, 1848) je bil ujet v vodah pred Piranom 22. novembra 2012. Gre za prvi zapis o pojavljanju te ribe v slovenskih vodah, obenem pa tudi za najsevernejši zapis o pojavljanju te vrste tako v Jadranskem kot tudi v Sredozemskem morju. Intenzivnejše pojavljanje te vrste v Sredozemskem morju se je začelo leta 1979 po prihodu iz Atlantskega oceana, trideset let kasneje pa se je napihovalka pojavila v najsevernejšemu predelu Sredozemskega morja. V prispevku avtorji na podlagi zbranih razpoložljivih podatkov o pojavljanju ribe napihovalke razpravljajo o širjenju areala te vrste v smeri proti vzhodu in severu.*

**Ključne besede:** riba napihovalka, *Sphoeroides pachygaster,* širjenje proti severu, Jadransko morje

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