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Brief report

Are Grey Plovers true Jelly Bon lovers? First record of Grey Plovers (*Pluvialis squatarola*) deliberately feeding on barrel jellyfish (*Rhizostoma pulmo*) in the Western Palearctic

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Coelenterates are not considered important food items for waders such as Grey Plovers (*Pluvialis squatarola*), although this has rarely been investigated in detail. During three days of fieldwork on the Bulgarian Black Sea coast in October 2020 Grey Plovers were documented deliberately choosing and swallowing barrel jellyfish *Rhizostoma pulmo* (Scyphozoa: Rhizostomatidae) while foraging on sand seashore where Scyphozoan jellyfish are often stranded. According to peer-reviewed literature, there is to-date no evidence of Grey Plovers consuming scyphozoan medusae, particularly as a specific choice for their food components. As a result of the present study, it is concluded that barrel jellyfish is part of the diet of Grey Plovers on the Black Sea coast and is purposely chosen by them. So far, this is the first video-recorded observation and published record of such an event in Europe and Western Palearctic. It suggests that coelenterates may be more important food items for waders than previousely believed and shows the potential of medusae to become an important food alternative for them.

1. Introduction

The Grey Plover (*Pluvialis squatarola*, Linnaeus, 1758) is a cosmopolitan long-distance migratory bird. It visits the Bulgarian Black Sea coast mostly in spring, autumn and winter on the way to its African winter quarters and back to its Arctic breeding grounds (Michev & Profirov 2003, Nankinov *et al.* 2016). The world population of Grey Plovers shows a decreasing trend according to the IUCN Red List of Threatened Species 2019 (BirdLife International 2019). The species is protected by Bulgarian biodiversity legislation. In Bulgaria, Nankinov (1989) reported the species to be usually encountered singly or in gatherings of less than ten birds. However, gatherings of Grey Plovers of 421 and 344 birds were counted in November 1979 and November 1981 at Lake Atanasovsko (near Burgas Bay). The 1996–2002 assessment of the Grey Plover population in the Burgas wetland area yielded stable numbers, with an absolute maximum of

159 birds recorded in winter stages, including 149 at Lake Atanasovsko in January 1999 and 41 at Lake Pomorie in January 2001 (Dimitrov *et al.* 2005). Kostadinova & Gramatikov (2007) reported a wintering population in Bulgaria reaching 171 individuals.

Already in the 19th Century, Mackay (1892) described the Grey Plover primarily as a tideline bird, seeking a large proportion of its food on the extensive sand flats left by the receding waters which may be adjacent to marshes. Grey Plovers are known to feed on insects and other terrestrial invertebrates on their arctic tundra breeding grounds (Cramp & Simmons 1983). The species seems to be a generalist rather than a specialist on a particular prey type (Pienkowski 1982). The main foraging strategy of the Grey Plover is a visual inspection of the substrate, with running, stopping and pecking, as well as occasionally probing (Pienkowski 1982, Message & Taylor 2005). Outside the breeding season the main prey includes polychaetes, molluscs, and crustaceans along with small quantities of plant materials (Cramp & Simmons 1983). Poole *et al*. (2020) presented polychaetes and small bivalves as the favourite foods of the species, but also suggested that its diet is variable. They concluded that insects are the main prey at breeding grounds consisted of adult and larval Diptera (Tipulidae, Chironomidae, Culicidae), Coleoptera (Carabidae, Dytiscidae, Curculionidae), larval Lepidoptera (Tortricidae), Ephemeroptera, Trichoptera, and on rare occasions also Hemiptera, Hymenoptera, amphipods, isopods, and other freshwater crustaceans. On the other hand, polychaetes (especially slender worms), bivalves, and crustaceans were described as the main prey on wintering quarters, with diet variations depending on location and substrate (Poole *et al.* 2020).

Polychaetes, crustaceans and bivalves have been reported as the Grey Plover's most common prey during the non-breeding season in studies in Western Europe (Goss-Custard *et al.* 1977, Pienkowski 1982, Dit Durell & Kelly 1990, Moreira 1996, De Smet *et al.* 2013). Additionally, Perez-Hurtado *et al.* (1997) found Coleoptera remains in pellets collected in Spain.

In the Western Black Sea, Kirikova (2017) reported Grey Plovers intensively forage for ragworm (*Hediste diversicolor*) and lagoon sand shrimp (*Gammarus insensibilis*) when their densities are high. Polychaetes, bivalves, gastropods, dipteran larvae, amphipods and isopods were determined to be the main prey for the Grey Plover in Sivash brackish lagoon, bordered by the Black and the Azov Seas (Verkuil *et al.* 1993).

Wader diet composition information from Bulgaria is still scarce (Nankinov *et al.* 2016). Prostov (1964) found remains of Coleoptera (Hydrophilidae), Mollusca and gastroliths in stomach contents of three Grey Plovers shot in the Burgas region. Nankinov *et al.* (2016) listed insects (adults and larvae), worms, molluscs, seeds, and small berries as part of the Grey Plover diet, but did not name specific taxa. Grey Plover has been found searching for food on sandy, muddy, or shell shores of both sea and inland bodies of water, being most frequently recorded on lakes near Burgas (Nankinov 1989).

Jellyfish and their coelenterate relatives are reported as part of the diet of multiple invertebrate and vertebrate species (Ates 1991, Arai 2005, Ates 2017, Hays *et al.* 2018). A recent review on the predation on pelagic coelenterates suggested that coelenterates may provide a source of energy comparable to better recognized prey such as arthropods (Arai 2005). Arai (2005) listed numerous vertebrate predators, such as fish, marine turtles, birds and mammals. From 23.5% (Short-tailed Shearwater *Puffinus tenuirostris*) to 27.27% (Fork-tailed Storm-petrel *Oceanodroma furcata*) to more than 42% (Northern Fulmar *Fulmarus glacialis*) in some bird species stomachs contented scyphozoan tissues, which is to be considered as a quite large extent. Harrison (1984) examined stomach contains of 17 marine bird species and found that 11 of them had eaten scyphozoan jellyfish.

There are several observations in the literature on various wader species feeding on coelenterates, for example Variable Oystercatchers (*Haemotopus unicolor*) and Pied Oystercatchers (*H. finschi*) feeding on Lion's Mane jellyfish (*Cyanea* spp.) (Melville 2013), and Sanderlings (*Calidris alba*) feeding on common jellyfish (*Aurelia aurita*, Linnaeus, 1758) in the Baltic Sea (Grimm 1984, Ates 1991). Multiple photographs of this wader species feeding on jellyfish were found on photo stocks (Ouwerkerk 2008, Cottele n.d., Ellington n.d.). Rock Sandpipers (*Calidris*

ptilocnemis) feeding on gonads of beached hydromedusae in Alaska (Gill *et al.* 2002), and Grey Plovers feeding on beached hydromedusae on the Alaskan Peninsula (Robinson 2016).

A more detailed literature search revealed that Fraser (1933) (mistakenly cited as 1939 in some publications) actually reported remains of *Sertularia pumila* (Cnidaria: Hydrozoa) found in Grey Plovers stomachs in Pine point, Maine, in September 1914. *Sertularia pumila* is part of Hydrozoan Class and its valid species name today is *Dynamena pumila*. As the phylum Cnidaria is made up of six different accepted classes: Hydrozoa (hydrozoans), Scyphozoa (scyphozoans), Anthozoa (anthozoans), Cubozoa (cubozoans), Myxozoa (Myxozoans) and Staurozoa (Staurozoans) (WoRMS Editorial Board 2022), Fraser's data were unfortunately wrongly interpreted in Melville's (2013) Short note as scyphozoan jellyfish (instead of hydrozoan) while citing Ates 1991 (Ates 1991, Melville 2013).

Visual observations and prey sampling from the littoral and supralittoral Western Black Sea coast in 2019–2021 suggest that Grey Plovers feed mainly on amphipods and bivalves (*Donacilla cornea*) (unpublished data). However, the information provided in the present study is focused specifically on the scyphozoan jellyfish as food diet composition for this wader species, which can contribute to widen Grey Plover's diet composition knowledge. Further investigation into the annual and seasonal variation in the abundance of jellyfish washed up on the Black Sea beaches, and how that influences Grey Plover use of these beaches and their diet, would help quantify the importance of jellyfish as a dietary component and its importance as a resource for migratory waders visiting the Black Sea, such as the Grey Plover.

2. Material and methods

The study area (42°36'17.9"N 27°37'50.0"E, Fig. 1) is situated at the Pomorie sand shore between Lake Pomorie (or Pomoriysko Lake)

Fig. 1. The study area in relation to Europe and Bulgaria (Esri Topographic Basemap). Colour figure is available in the online version of the article at https://doi.org/10.51812/of.12124.

and the Black Sea. Lake Pomorie is a salt lagoon located at Burgas Bay, between the towns of Pomorie and Aheloy, about 25 km north-east from the town of Burgas. It covers a surface of 921.5 ha and is part of the Burgas lake complex (Kostadinova & Gramatikov 2007). An artificial dyke and natural sand dunes separate the lake and the saltpans from the sea.

Lake Pomorie is a Ramsar site of international importance since 2003 (code 3BG009), and a Corine site since 1998 (code F00007800), as well as an Important Bird Area in the BirdLife International system (code BG037) (Kostadinova & Gramatikov 2007). The wetland has a designated protected area status since 2001 and is part of the Bulgarian national ecological network Natura 2000 since 2007 (code BG0000620 under the Habitat Directive, and BG0000152 under the Birds Directive) (Natura 2000 protected areas 2022). The sand shore and the adjacent marine area are part of the protected site.

According to the Red Data Book of the Republic of Bulgaria (Biserkov *et al.* 2015) the natural habitats on the studied area are as follows: Pal. Class.: 44.8141 Pontic *Tamarix* stands; Pal. Class.: 16.2124 Pontic white dunes; Pal. Class.: 16.2113 Pontic embryonic dunes; Pal. Class.: 11.27 Soft sediment littoral communities, 14.1 Mud flats and sand flats.

Photographs and video material for this article were collected during three days in October 2020, during an autumn survey and data collection for a PhD project. Wader species were observed and video recorded since August 2019 on a larger scale to assess their time budget and diet composition during migration time (spring and autumn).

Two parallel transects were walked for the whole length of the sand shore at daylight: one on the dyke and the second one on the sand strip itself. Transect length is approximately seven to eight kilometres long.

Video data were recorded with a Canon PowerShot SX70 HS digital camera with 65x optical zoom and Full HD (1920 x 1080), 50 fps. A tripod was used for stability because of strong winds. Some of the events were photographed on a cell phone Lenovo Vibe Shot (Z90a40).

3. Results

Grey Plovers (*Pluvialis squatarola*) foraging on stranded barrel jellyfish (*Rhizostoma pulmo*, Macri, 1778) on the sand shore were observed

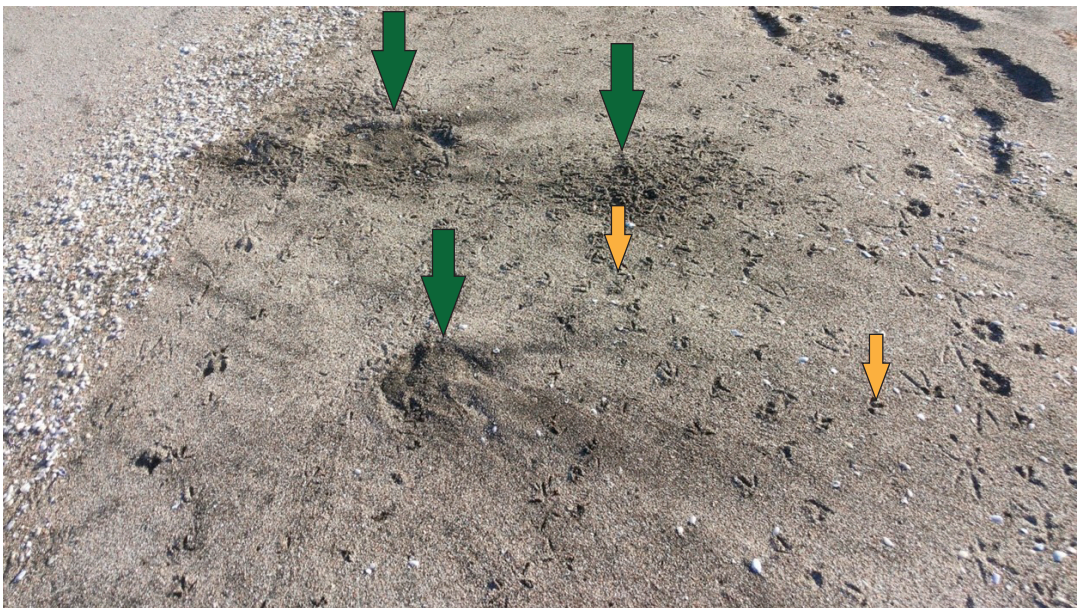

Fig. 2. The barrel jelly (*Rhizostoma pulmo*) stranded on the shore and already consumed by birds; smaller orange arrows indicate Grey Plover's footprints; larger green arrows indicate barrel jelly remains. Colour figure is available in the online version of the article at https://doi.org/10.51812/of.12124.

and filmed on three separate days (October 23, 26 and 28 in 2020).

The first observation on October 23 was on a single bird ripping apart washed ashore jellyfish remains. It was clearly seen that the bird was tearing apart fragments of the jellyfish remains (Fig. 2). The second observation was documented on October 26 when two plovers scavenged two separate freshly stranded jellies. On a separate video, one bird dismembers multiple times and washes the prey in the sea before swallowing it (Fig. 3). The third record was taken on October 28, when one of two birds dismembered and swallowed parts of different *Rhizostoma* specimens spread on the sand shore (Fig. 4).

Additional video material can be found as supplemental material. Eleven video clips demonstrating Grey Plovers feeding on barrel jellyfish are deposited to Zenodo open repository (Vassileva 2023).

4. Discussion

Prey quality and availability is vital for bird survival. Hence, foraging behaviour and diet composition are of key importance for understanding the ecological role and trophic relations of birds. The multiple video-documented observations in the present study provide evidence that scyphozoan jellyfish *Rhizostoma pulmo* are deliberately chosen and taken by Grey Plovers as food items. Therefore, true jellies can be considered part of the diet of Grey Plovers on the Black Sea coast. This is the first report of proven consumption of

Fig. 3. Screenshots from video, depicting how a Grey Plover is feeding on barrel jellyfish. Colour figure is available in the online version of the article at https://doi.org/10.51812/of.12124.

Fig. 4. Specimens of barrel jellyfish partially eaten by a Grey Plover. Colour figure is available in the online version of the article at https://doi.org/10.51812/of.12124.

scyphozoan medusae by Grey Plovers in the Western Palearctic.

The Black Sea is known to have small insignificant daily level tidal fluctuations. Tidal range is between 4 cm and 9 cm (Valkanov & Rozhdestvenski 1978). Wind waves have their registered maximums in February, October and December (Grozdev 2006). Consequently, wind-tides and storms, caused by coastal winds, produce beach wrack on the drift line. The two species of the Black Sea scyphozoan jellyfish: the barrel and the common jellyfish (or moon jelly) *Aurelia aurita* (Linnaeus, 1758) are often part of the wrack (Valkanov & Marinov 1978, Zaitsev 2008). It is likely that this small tidal range may affect the abundance and availability of benthic invertebrate prey relative to other sites where Grey Plover diet has been studied. Further work is required to quantify prey availability at the Black Sea coasts and to compare their findings with data from other sites. This would enable us to understand whether the foraging on beached jellyfish is related to a potentially low abundance of other potential prey compared to other sites, or simply reflects opportunistic foraging on a novel unknown prey.

Knowledge of the distribution, phenology, life cycle and abundance of barrel jellyfish on a local and global scale, will aid in building hypotheses about its importance as a food resource for Gray Plovers and other similar wader species. The barrel jellyfish is distributed in the Mediterranean and the Black Sea from the Alboran Sea to Libya in the Mediterranean, east to Russia and north to Ukraine, the Black Sea (Göthel 1992, Palomares & Pauly 2022). Campbell (2004) stated far wider distribution of the species: the Mediterranean, the Atlantic, the North Sea and the West Baltic, providing that he considered *R. pulmo* same as *Rhizostoma octopus*. Additionally, the species was first recorded in Pakistani waters in 2008 (Muhammed & Sultana 2008).

The barrel jellyfish is considered the biggest bloom-forming jellyfish inhabiting southern European seas: the Mediterranean Sea, the Black Sea and the Sea of Marmara (Leoni *et al.* 2021). Leoni *et al.* (2021) provide evidence that bloom events are favoured by coastal eutrophication and climate warming, due to higher food abundance and enhanced reproduction rates. Over the long term, Leoni *et al.* (2021) expected that the

rising temperatures in the region will alter the timing of bloom events, promoting earlier and possibly massive blooms under high temperature regimes.

This study thus brings reason to believe that jellyfish as a growing sea resource will become an important food alternative for seastrand-feeding waders. More studies are needed in this direction. Given recently developed methods, such as stable isotope analysis, DNA metabarcoding and animal-borne cameras, assessing the jellyfish content and its nutritive importance in wader diet will provide valuable data for future ecological studies (Sato *et al.* 2015, Hays *et al.* 2018).

Herkuttelevatko tundrakurmitsat (*Pluvialis squatarola*) meduusoilla? Ensimmäinen havainto tundrakurmitsoista ruokailemassa tynnyrimeduusoilla (*Rhizostoma pulmo*) Länsi-Palearktisella alueella

Meduusoja ei tavallisesti pidetä tärkeänä ravintona kahlaajille, kuten esimerkiksi tundrakurmitsoille (*Pluvialis squatarola*). Ilmiötä ei ole kuitenkaan juuri tutkittu aiemmin. Lokakuussa 2020 havaitsin ja dokumentoin kolmena päivänä tundrakurmitsojen tietoisesti valitsevan ja käyttävän ravintonaan tynnyrimeduusaa (*Rhizostoma pulmo*). Tein havainnot Bulgarian Mustanmeren rannikolla, missä tundrakurmitsat etsivät ravintoa hiekkarannalta. Rannalle ajautuu usein Scyphozoa-luokkaan kuuluvia meduusoja (joihin myös tynnyrimeduusa kuuluu), esimerkiksi voimakkaiden tuulien seurauksena. Tutkimuskirjallisuudessa ei tähän päivään mennessä ole todisteita siitä, että tundrakurmitsat käyttäisivät tynnyrimeduusoja tarkoituksenmukaisesti ravintonaan. Mustanmeren rannikkolla tehtyjen havaintojen perusteella kuitenkin päättelen, että tundrakurmitsat hyödyntävät niitä osana ravintoaan. Tietämykseni mukaan tämä on ensimmäinen Euroopassa ja Länsi-Palearktisella alueella videoitu ja julkaistu havainto. Tutkimuksen tulokset viittaavat siihen, että onteloeläimet voivat olla tärkeämpää ravintoa kahlaajille kuin aiemmin on uskottu, ja lisäksi tutkimus myös osoittaa meduusojen potentiaalin osana kahlaajien ravintoa.

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References

Arai, M. N. 2005: Predation on pelagic coelenterates: a review. — Journal of the Marine Biological Association of the United Kingdom 85(3): 523–536. https://doi.org/10.1017/S0025315405011458

Ates, R. M. L. 1991: Predation on Cnidaria by vertebrates other than fishes. — Coelenterate Biology: Recent Research on Cnidaria and Ctenophora 216/217: 305–307. https://doi.org/10.1007/978-94-011-3240-4_44

Ates, R. M. L. 2017: Benthic scavengers and predators of jellyfish, material for a review. — Plankton and Benthos Research 12(1): 71–77. https://doi.org/10.3800/pbr.12.71

BirdLife International 2019: *Pluvialis squatarola*. — Available at: https://www.iucnredlist.org/species/22693749/154513104#assessment-information. Accessed 25 April 2021.

Biserkov, V., Gussev, C., Popov, V., Hibaum, G., Roussakova, V., Pandurski, I., Uzunov, Y., Dimitrov, M., Tzonev, R. & Tsoneva, S. (eds.) 2015: Natural Habitats. — In Red Data Book of the Republic of Bulgaria: 458. BAS and MoEW, Sofia.

Campbell, A. 2004: Seashores and shallow seas of Britain and Europe. — Bounty Books, London.

Cottele, B. n.d.: Sanderling (*Calidris alba*) eating a jellyfish at the beach of Texel (The Netherlands). — Shutterstock. Available at: https://www.shutterstock.com/image-photo/sanderling-calidris-alba-eating-jellyfish-beach-1845442180. Accessed 23 October 2021.

Cramp, S. & Simmons, K. E. L. (eds.) 1983: The Birds of the

western Palearktic, Waders to gulls. — Oxford University Press, Oxford.

De Smet, B., Godet, L., Fournier, J., Desroy, N., Jaffré, M., Vincx, M. & Rabaut, M. 2013: Feeding grounds for waders in the Bay of the Mont Saint-Michel (France): the *Lanice conchilega* reef serves as an oasis in the tidal flats. — Marine Biology 160(4): 751–761. https://doi.org/10.1007/s00227-012-2130-3

Dimitrov, M., Michev, T., Profirov, L. & Nyagolov, K. 2005: Waterbirds of Bourgas Wetlands. Results and Evaluation of the Monthly Waterbird Monitoring 1996–2002. — Bulgarian Biodiversity Foundation and Pensoft Publishers, Sofia–Moscow.

Dit Durell, S. E. A. L. V. & Kelly, C. P. 1990: Diets of Dunlin *Calidris alpina* and Grey Plover *Pluvialis squatarola* on the Wash as determined by dropping analysis. — Bird Study 37(1): 44–47. https://doi.org/10.1080/00063659009477037

Ellington, K., n.d.: Sanderling eating a jellyfish on seashore — Dreamstime. Available at: https://www.dreamstime.com/stock-photo-sanderling-bird-eating-jellyfish-beach-seashore-image63234506. Accessed 23 October 2021.

Fraser, C. M. 1933: Hydroids as a food supply. — Proceedings and transactions of the Royal Society of Canada 27(5): 259–264.

Gill, R. E., Tomkovich, P. S. & McCaffery, B. J. 2002: Rock Sandpiper (*Calidris ptilocnemis*). — In The birds of North America. (eds. A. Poole & F. Gill): 686. The Academy of Natural Sciences, Philadelphia, and the American Ornithologists' Union, Washington DC. http://dx.doi.org/10.2173/bna.686

Goss-Custard, J. D., Jones, R. E. & Newbery, P. E. 1977: The ecology of the Wash. I. Distribution and diet of wading birds (Charadrii). — Journal of Applied Ecology: 681–700. https://doi.org/10.2307/2402803

Göthel, H. 1992: Guide de la faune sous-marine: La Méditerranée. Invertébrés marins et poissons. — Eygen Ulmer GmbH & Co.

Grimm, P. 1984: Gonaden der Ohrenqualle (*Aurelia aurita*) als Nahrung des Sanderlings (*Calidris alba*). — Seevögel 5(2): 24. (In German)

Grozdev, D. 2006: Wind wave climate along the Bulgarian Black Sea coast. — *s.l.*, *s.n.*: 296–299. (In Bulgarian)

Harrison, N. M. 1984: Predation on jellyfish and their associates by seabirds. — Limnology and Oceanography, 29(6): 1335–1337.

Hays, G. C., Doyle, T. K. & Houghton, J. D. R. 2018: A paradigm shift in the trophic importance of jellyfish? — Trends in Ecology & Evolution 33(11): 874–884. https://doi.org/10.1016/j.tree.2018.09.001

Kirikova, T. A. 2017: On the Diet and Foraging Strategy of Tundra Waders at Sivash. — Vestnik zoologii 51(6): 509–516. http://dx.doi.org/10.1515/vzoo-2017-0061

Kostadinova, I. & Gramatikov, M. (eds.) 2007: Important Bird Areas in Bulgaria and Natura 2000. — Conservation Series. Bulgarian Society for the Protection of Birds, Sofia.

Leoni, V., Bonnet, D., Ramírez-Romero, E. & Molinero, J. C. 2021: Biogeography and phenology of the jellyfish *Rhizostoma pulmo* (Cnidaria: Scyphozoa) in southern European seas. — Global Ecology and Biogeography 30(3): 622–639. https://doi.org/10.1111/geb.13241

Mackay, G. H. 1892: Habits of the Black-Bellied Plover (*Charadrius squatarola*) in Massachusetts. — The Auk: 143–152.

Melville, D. S. 2013: Variable (*Haematopus unicolor*) and Pied Oystercatchers (*H. finschi*) feeding on Lion's Mane jellyfish (*Cyanea* sp.). — Notornis 60: 309–310.

Message, S. & Taylor, D. 2005: Waders of Europe, Asia and North America. — Gardners Books.

Michev, T. & Profirov, L. 2003: Mid-winter Numbers of Waterbirds in Bulgaria (1977–2001): Results from 25 Years of Mid-winter Counts Carried Out at the Most Important Bulgarian Wetlands. — Pensoft.

Moreira, F. 1996: Diet and feeding behaviour of Grey Plovers *Pluvialis squatarola* and Redshanks *Tringa totanus* in a southern European estuary. — Ardeola 43(2): 145–156.

Muhammed, F. & Sultana, R. 2008: New record of edible jellyfish, *Rhizostoma pulmo* (Cnidaria: Scyphozoa: Rhizostomitidae) from Pakistani waters. — Marine Biodiversity Records 1: e67. https://doi.org/10.1017/S1755267207007294

Nankinov, D. 1989: The status of waders in Bulgaria. — Wader Study Group Bulletin 56: 16–25.

Nankinov, D., Ivanov, S. K., Dimitrov, N. & Popov, K. 2016: The Grey Plover *Pluvialis squatarola* in Bulgaria. — Russian Journal of Ornithology 25(1353): 4006–4013.

Natura 2000 protected areas 2022: Natura 2000 protected areas. — Natura 2000, Information system for protected areas from the ecological network. Available at: https://natura2000.egov.bg/EsriBg.Natura.Public.Web.App/Home/Natura2000ProtectedSites. Accessed 11 November 2023.

Ouwerkerk, A. 2008: High key first-winter with Jellyfish — Buiten-Beeld, Alamy Stock Photo. Available at: https://www.alamy.com/stock-photo-high-key-first-winter-with-jellyfish-high-key-eerste-winter-met-kwal-29375178.html. Accessed 23 October 2021.

Palomares, M.L.D. & D. Pauly 2022: Rhizostoma pulmo, Barrel jellyfish (Macri, 1778) — SeaLifeBase, World Wide Web electronic publication, www.sealifebase.org, version (11/2023). Available at: https://www.sealifebase.se/summary/Rhizostoma-pulmo.html. Accessed 25 April 2022.

Perez-Hurtado, A., Goss-Custard , J. D. & Garcia, F. 1997: The diet of wintering waders in Cádiz Bay, southwest Spain. — Bird Study 44(1): 45–52. https://doi.org/10.1080/00063659709461037

Pienkowski, M. W. 1982: Diet and energy intake of Grey and Ringed Plovers, *Pluvialis squatarola* and *Charadrius hiaticula*, in the non-breeding season. — Journal of

Zoology 197(4): 511–549. https://doi.org/10.1111/jzo.1982.197.4.511

Poole, A. F., Pyle, P., Patten, M. A. & Paulson, D. 2020: Black-bellied Plover (*Pluvialis squatarola*), version 1.0. — In Birds of the World (ed. Billerman, S. M.). Cornell Lab of Ornithology, Ithaca, NY.

Prostov, A. 1964: Study of the avifauna in Burgas region. — Proceedings of the Zoological Institute with Museum at BAS 15: 5–67. (In Bulgarian)

Robinson, B. W. 2016: Black-bellied Plover (*Pluvialis squatarola*) Feeding on a Jellyfish — Ornithologi, A studio for bird study. Available at: https://ornithologi.com/2016/10/01/black-bellied-plover-pluvialis-squatarola-feeding-on-a-jellyfish/. Accessed 23 October 2021.

Sato, N. N., Kokubun, N., Yamamoto, T., Watanuki, Y., Kitaysky, A. S., & Takahashi A. 2015: The jellyfish buffet: jellyfish enhance seabird foraging opportunities by concentrating prey. — Biology Letters 11(8): 20150358. https://doi.org/10.1098/rsbl.2015.0358

Valkanov , A. & Rozhdestvenski, A. 1978: Hydrology and Hydrochemistry. — In The Black Sea: 66–68. Gueorgui Bakalov, Varna. (In Bulgarian with English summary)

Valkanov, A. & Marinov, T. 1978: Invertebrata. — In The Black Sea: 108–124. Gueorgui Bakalov, Varna. (In Bulgarian with English summary)

Vassileva, L. V. 2023: Supplemental material to the article 'Are Grey Plovers true Jelly Bon lovers? First record of Grey Plovers (*Pluvialis squatarola*) deliberately feeding on Barrel Jellyfish (*Rhizostoma pulmo*) in the Western Palearctic'. — Zenodo. https://zenodo.org/doi/10.5281/zenodo.10363478

Verkuil, Y., Koolhaas, A. & Van Der Winden, J. 1993: Wind effects on prey availability: how northward migrating waders use brackish and hypersaline lagoons in the Sivash, Ukraine. — Netherlands Journal of Sea Research 31(4): 359–374. https://doi.org/10.1016/0077-7579(93)90053-U

WoRMS Editorial Board 2022: WoRMS taxon details: Cnidaria. — World Register of Marine Species, www.marinespecies.org at VLIZ. Available at: https://www.marinespecies.org/aphia.php?p=taxdetails&id=1267. Accessed 26 April 2022.

Zaitsev, Y. 2008: An introduction to the Black Sea ecology. — Smil Editing and Publishing Agency Ltd., Odessa.

Online supplementary material

Supplementary material for this manuscript is deposited to Zenodo (https://zenodo.org/doi/10.5281/zenodo.10363478) and can be accessed throught the online version of the article. The material includes eleven video clips demonstrating Grey Plovers feeding on barrel jellyfish.