

## STATUS OF TUBENOSE SEABIRDS PROCELLARIIFORMES BREEDING IN THE EASTERN ADRIATIC

### Status cevonoscev Procellariiformes, gnezdečih v Jadranskem morju

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Three species of the seabird order Procellariiformes are regular in the Adriatic: Cory's Shearwater *Calonectris diomedea*, Yelkouan Shearwater *Puffinus yelkouan* and Storm Petrel *Hydrobates pelagicus*. They have all been considered breeders on some offshore Croatian islands. The breeding of Cory's Shearwater *Calonectris diomedea* was confirmed for the first time in June 1984 on Svetac Island when three adults and one egg were found. On the west slope of the island two occupied nest holes with one egg in each were found in July 1998, while in June 1999 a brooding adult and an egg in nest hole were discovered. Five occupied nest holes of Cory's Shearwater were found on the island of Palagruža in August and September 1997, from which three nestlings and two adult birds were extracted. We estimate that at least 20 pairs breed on this particular island. The plumage development of fledglings from Palagruža indicates the start of egg laying between April and May and departure of full-grown juveniles between September and October. The presence of Cory's Shearwater is more confined to the southern Adriatic. The breeding of Yelkouan Shearwater *Puffinus yelkouan* on the island of Svetac presumed on the basis of two females found in crevices by fishermen in 1962. From summer to autumn, rafts of 500 to 1,000 Yelkouan Shearwaters regularly move along the eastern Adriatic and concentrate in the Gulf of Kvarner (June), in the Gulf of Trieste (September) and in northern Dalmatia (October). The concentration of Yelkouan Shearwaters in the top corner of the Adriatic takes place in the areas of the eastern Adriatic with strong input of freshwater that attracts huge shoals of small pelagic fish. The summer/autumn distribution of Yelkouan Shearwater reveals the importance of the highly productive northern Adriatic as a foraging and post-breeding moulting area for birds from the Adriatic colonies and other parts of the Mediterranean. Storm Petrel *Hydrobates pelagicus* was found between June and November along the eastern Adriatic and has been claimed to breed on the islet of Jabuka on the basis of a single observation.

**Key words:** *Calonectris diomedea*, Cory's Shearwater, *Puffinus yelkouan*, Yelkouan Shearwater, *Hydrobates pelagicus*, Storm Petrel, status, eastern Adriatic

**Ključne besede:** *Calonectris diomedea*, rumenokljuni viharnik, *Puffinus yelkouan*, sredozemski viharnik, *Hydrobates pelagicus*, strakoš, status, vzhodni Jadran

### 1. Introduction

Among the 9 species of tubenosed seabirds recorded in the Adriatic (FRUGIS *et al.* 1993), three breed on

Adriatic islands. In the eastern Adriatic Croatian waters only Cory's Shearwater *Calonectris diomedea*, Yelkouan Shearwater *Puffinus yelkouan* (former east Mediterranean race "Levantine" Shearwater *Puffinus*

*puffinus yelkouan*, e.g. BOURNE *et al.* 1988, HARRISON 1989, WALKER *et al.* 1990, HAZEVOET 1995, HEIDRICH *et al.* 1998, MAYOL 1998) and Storm Petrel *Hydrobates pelagicus* have been recorded (KRALJ 1997, LUKAČ 1998). They are all supposed to breed on Dalmatian offshore islands (CRAMP *et al.* 1977, KRALJ 1997, LUKAČ 1998) but there is still no adequate confirmation as to their breeding (e.g. breeding colonies, eggs, nestlings). The Croatian population's status is unknown, and some other aspects of their biology have not been studied as yet. Breeding is merely presumed (MASSA & LO VALVO 1986, AKRIOTIS & HANDRINOS 1986) or established on the basis of the observations by KRPAJ (1965, 1970, 1977 & 1980). The main source of evidence as far as breeding is concerned are local fishermen who have been traditionally hunting Cory's and Yelkouan Shearwaters on several islands for food. The size of the Croatian Cory's Shearwater's population has been estimated by TUCKER & HEATH 1994 and LUKAČ 1998, and the Yelkouan Shearwater's population by LUKAČ 1998.

The pattern of seasonal migration or feeding movements inside the Adriatic has not been ascertained as yet. Some observations of Cory's Shearwaters and the occurrence of Yelkouan Shearwater rafts in the northern Adriatic (BERNHAEUER 1957, RUCNER 1957, ŠTROMAR 1975, GJERKEŠ 1986, BOŽIČ 1994, TOME 1986, RUBINIČ 1996, SOVINČ 1997) indicate regular movements along the eastern Adriatic.

The recent data has been gathered since 1983 during the ornithological investigations in the Croatian Adriatic. In the paper some new information on the status of all three tubenose seabirds breeding in the

Adriatic, including breeding distribution, population estimates and seasonal occurrences, is presented. We reviewed the so far existing historical information as well as the new data collected during recent field work carried out in the Adriatic to get a better insight into the status and distribution of these seabirds in the eastern Adriatic.

## 2. Study area and methods

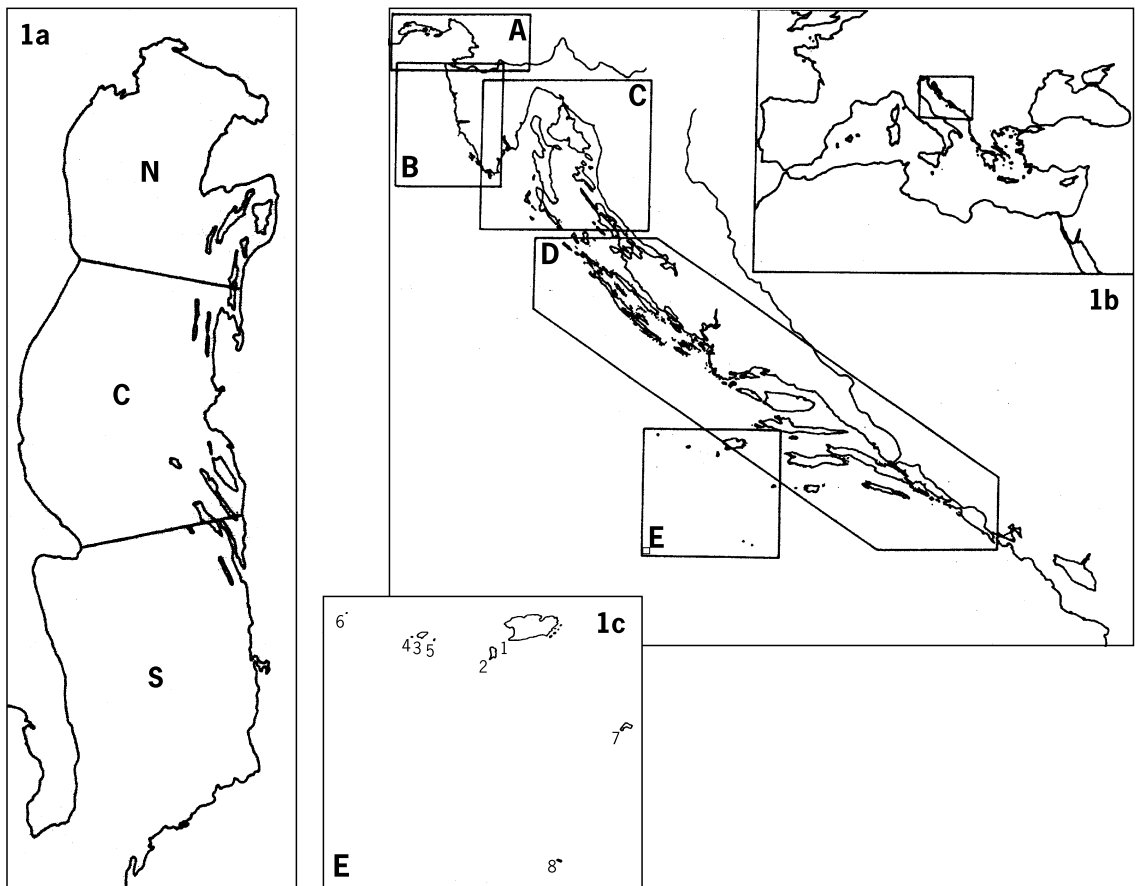
### 2.1. Study area

The study area covers the entire eastern Adriatic region from the Gulf of Trieste (including the north-eastern Italian coastline and the narrow coastline of Slovenia) to the coast of Montenegro, the greater part of which lies within the territory of Croatia. The Adriatic Sea, 783 km long and from 102 to 355 km wide, is in fact a gulf of the Mediterranean Sea between the Balkans and Apennine peninsula. The eastern Adriatic coast is mainly rocky, steep and one of the most indented in the Mediterranean. There are more than 700 scattered islands and islets along the eastern Adriatic, from the mouth of the Soča river in Italy down to the mouth of the Bojana river in Montenegro (POMORSKA ENCIKLOPEDIJA 1976). Almost all islands are Croatian and the greatest number of them lie along the eastern Adriatic close to the mainland ("coastal islands"). The group of the remotest Croatian islands ("offshore islands") in the central Adriatic region is the breeding area for regular Adriatic tubenose seabirds. Several uninhabited offshore islands and islets (Biševo, Sv. Andrija, Kamik,

**Table 1:** Principal division of the Adriatic Sea basin in view of its main physical, chemical and biological features (BENOVIĆ 1983)

**Tabela 1:** Osnovna razdelitev jadranskega bazena glede na njegove glavne fizične, kemijske in biološke značilnosti (BENOVIĆ 1983)

North Adriatic	Northern Adriatic region	
Gulf of Trieste, W Istra, Kvarner	Smaller depth (below 50m); Greater variation of temperature; Lower salinity; Lower biodiversity; Greatest biological production; Pelagic fish community – fewer species but greater biomass; Fishing industry well developed	
South Adriatic	Central Adriatic region	Southern Adriatic region
Dalmatia, offshore islands	Greater depth (100–200m); Lower variation of temperature; Greater salinity; Greater biodiversity; Lower biological production; Best fishing area around offshore islands (Jabučka Kotlina)	Greatest depth (200–1,300m); Lowest variation of temperature; Greatest salinity; Greatest biodiversity; Lowest biological production; Fishing industry scarcely developed



**Figure 1:** Main regions of the Adriatic Sea: 1a – Northern (N), Central (C), Southern (S) Adriatic regions; 1b – Northern Adriatic: Gulf of Trieste (A), W Istra (B), Kvarner (C); Southern Adriatic: Dalmatia (D); offshore islands (E): 1c – 1. Vis 2. Biševo 3. Sv. Andrija (Svetac) 4. Kamik 5. Brusnik 6. Jabuka 7. Sušac 8. Palagruža

**Slika 1:** Glavna območja Jadranskega morja: 1a – severno (N), srednje (C) in južno (S) območje; 1b – severni Jadran: Tržaški zaliv (A), zahodna Istra (B), Kvarner (C); južni Jadran: Dalmacija (D); oddaljeni otoki (E): 1c – 1. Vis 2. Biševo 3. Sv. Andrija (Svetac) 4. Kamik 5. Brusnik 6. Jabuka 7. Sušac 8. Palagruža

Brusnik, Jabuka, Sušac, Palagruža) are very suitable for the breeding tubenose birds. Some other islands and islets in the central Adriatic between the offshore islands and the mainland (Vis, Korčula, Lastovo) are often quoted as the breeding ground of tubenose seabirds (KRPAN 1965, 1970, 1977, 1980), although there is still no clear evidence of these birds breeding there. Cory's and Yelkouan Shearwaters also breed on some Italian islets in the western Adriatic (CRAMP & SIMMONS 1977). For data presentation, the Adriatic Sea basin was divided into the northern and southern Adriatic (Table 1) according to the main physical, chemical and biological features of the northern, central and southern regions of the Adriatic (e.g. BENOVIĆ 1983). For more detailed division of the study area see Figure 1.

## 2.2. Methods

All main parts of the Croatian inshore and offshore waters were surveyed in all seasons. Regular observations were also performed on the open sea from numerous boat trips, cruises and ferryboats. New data have been collected recently on the group of central Adriatic offshore islands where all three species are presumed to breed. We visited this group of remote Croatian islands on several occasions from 1996 to 1999, i.e. in March and the June–October period.

Other sources of information were various published papers and several bird collections kept by the Croatian Natural History Museum Zagreb (CNHM), Natural History Museum Split (NHMS), Institute of Ornithology Zagreb (IO), Institute of Biology

**Table 2:** Monthly number of fieldwork days in the northern and southern Adriatic and total number of records of Cory's and Yelkouan Shearwaters along the eastern Adriatic coast from 1985–1998 (number of days on which authors observed particular tubenose seabirds)

**Tabela 2:** Število terenskih dni v mesecu v severnem in južnem Jadranu in celotno število opažanj rumenokljunega in sredozemskega viharnika vzdolž južne obale Jadranskega morja med letoma 1985 in 1998 (število dni, v katerih sta avtorja opazovala določene vrste cevonoscev)

1985-1998	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Total
North Adriatic	26	3	23	38	43	27	21	32	16	15	9	6	259
<i>Calonectris diomedea</i>										1			1
<i>Puffinus yelkouan</i>					2	1			2	1			6
South Adriatic	112	52	91	87	85	62	64	96	85	91	65	92	982
<i>Calonectris diomedea</i>						7	6	6	7				26
<i>Puffinus yelkouan</i>						4	5	5	2	8		2	26
Total	138	55	114	125	128	89	85	128	101	106	74	98	1241

Dubrovnik (BID), and Museo Civico di Storia Naturale Trieste (MCSNT).

### 3. Results

#### Cory's Shearwater

In June 1984, two bird-ringers extracted, with the aid of local fishermen, three brooding adults and a single egg from nest holes on the southern part of Svetac Island. The adult birds were ringed (KLETEČKI 1988, IO). In July 1998, two active nest holes, including one egg, were found in the crevices with soft soil on the island's steep western slope (V.Š. & V.D.). In June 1999, we found an egg and a brooding bird in an occupied nest hole under a rock on the island's western slope (Figures 2a-c).



**Figure 2a:** Svetac Island, NE slope, 11. June 1999 (photo: K. Leskovar)

**Slika 2a:** Otok Svetac, SV pobočje, 11.6.1999 (foto: K. Leskovar)



**Figure 2b:** Western slope of Svetac Island on which the nest hole was found, 11. June 1999 (photo: K. Leskovar)

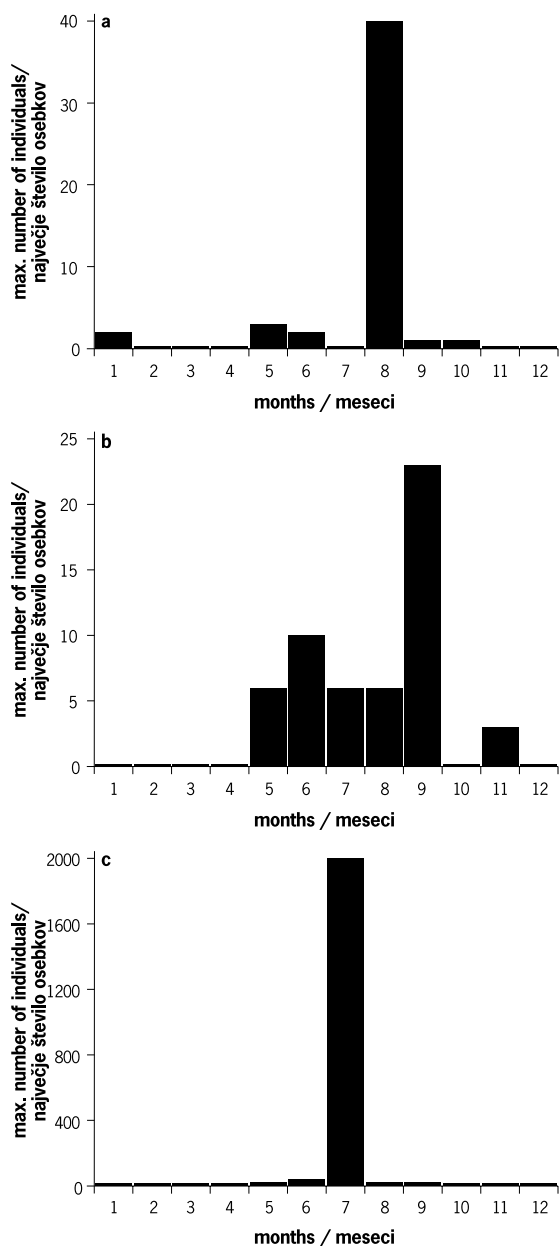
**Slika 2b:** Zahodno pobočje otoka Svetac, na katerem je bil najden gnezdilni rov, 11.6.1999 (foto: K. Leskovar)



**Figure 2c:** Brooding Cory's Shearwater *Calonectris diomedea* in a nest hole under a rock on the western slope of Svetac Island, 11. June 1999 (photo: K. Leskovar)

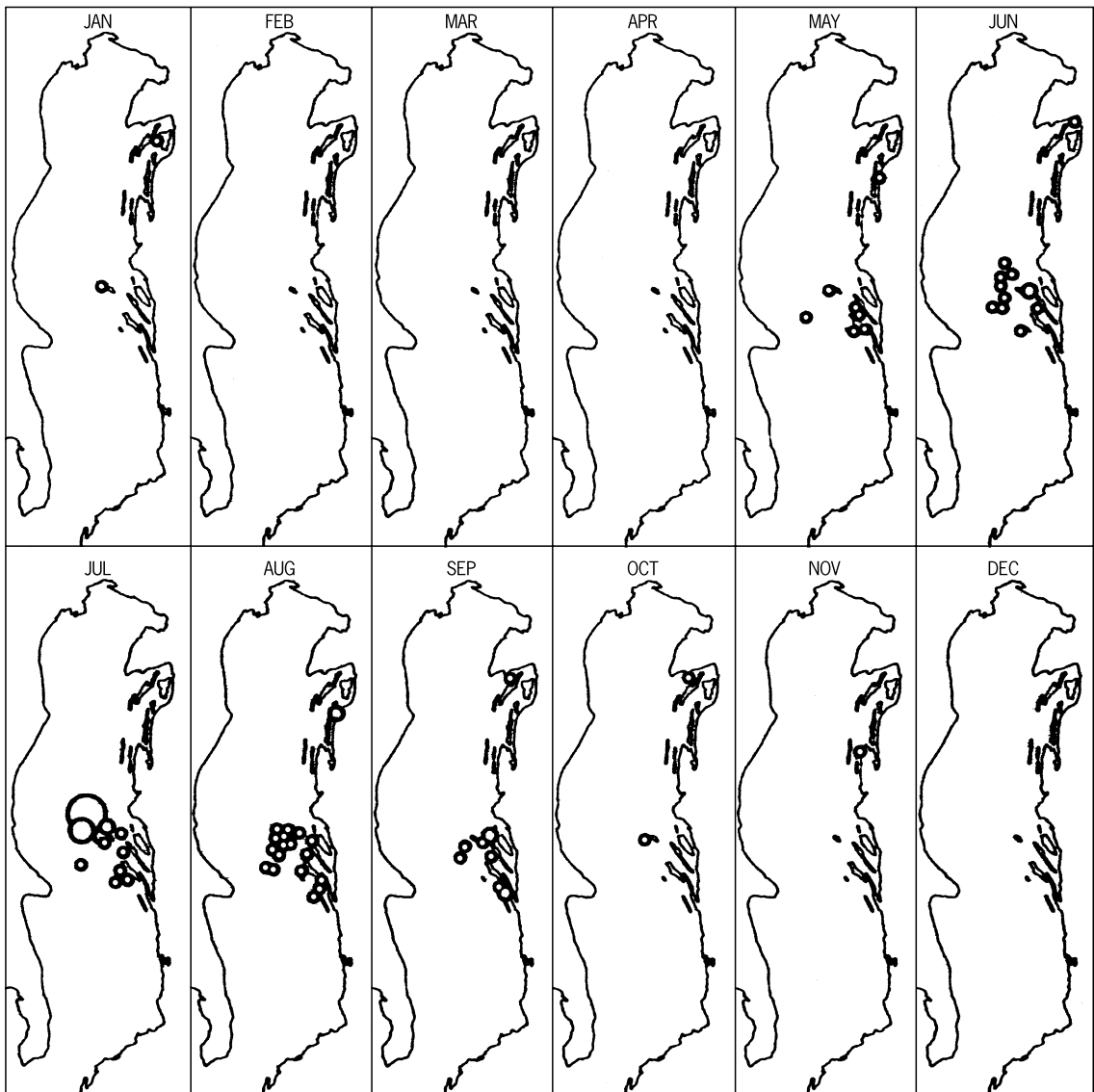
**Slika 2c:** Valeči rumenokljuni vihanik *Calonectris diomedea* v gnezdilnem rovu pod skalo na zahodnem pobočju otoka Svetac, 11.6.1999 (foto: K. Leskovar)

On the remotest Croatian offshore island of Pala-gruža, five occupied nest holes were found in 1997. The first active nest hole was found beneath a rock on 22<sup>nd</sup> August in the inlet of Stara Vlaka. The length of the hole was about 70 cm with a sharp right curvature. During the evening, both adults visited the hole from which a nestling responded with calls. During the evening at least 6 more calls were heard from the surrounding rocks in the inlet. On 28/29<sup>th</sup> August two adults were caught and ringed at the previously discovered nest hole. Their wing length (354 mm, 328 mm) suggested a male and female *C. d. diomedea*. From 18<sup>th</sup> to 21<sup>st</sup> September, the ringers found another two nest holes and eventually three fledglings were extracted from the three nest holes. Another two occupied nest holes were found on the following few days. Altogether, five nest holes were



**Figure 3 a-c:** Maximum daily number of observed individuals of Cory's Shearwater *Calonectris diomedea* per months along the eastern Adriatic (a – northern Adriatic, b – Dalmatia, c – offshore islands). The data are combined from the authors' fieldwork, data published from 1876 on, and from other sources.

**Slika 3 a-c:** Maksimalno dnevno število opazovanih rumenokljunih vihanikov *Calonectris diomedea* v posameznih mesecih vzdolž vzhodne obale Jadranskega morja (a – severni jadrán, b – Dalmacija, c – oddaljeni otoki). Podatki so kombinacija terenskega dela obeh avtorjev, podatkov, objavljenih od leta 1876 dalje, in drugih virov.



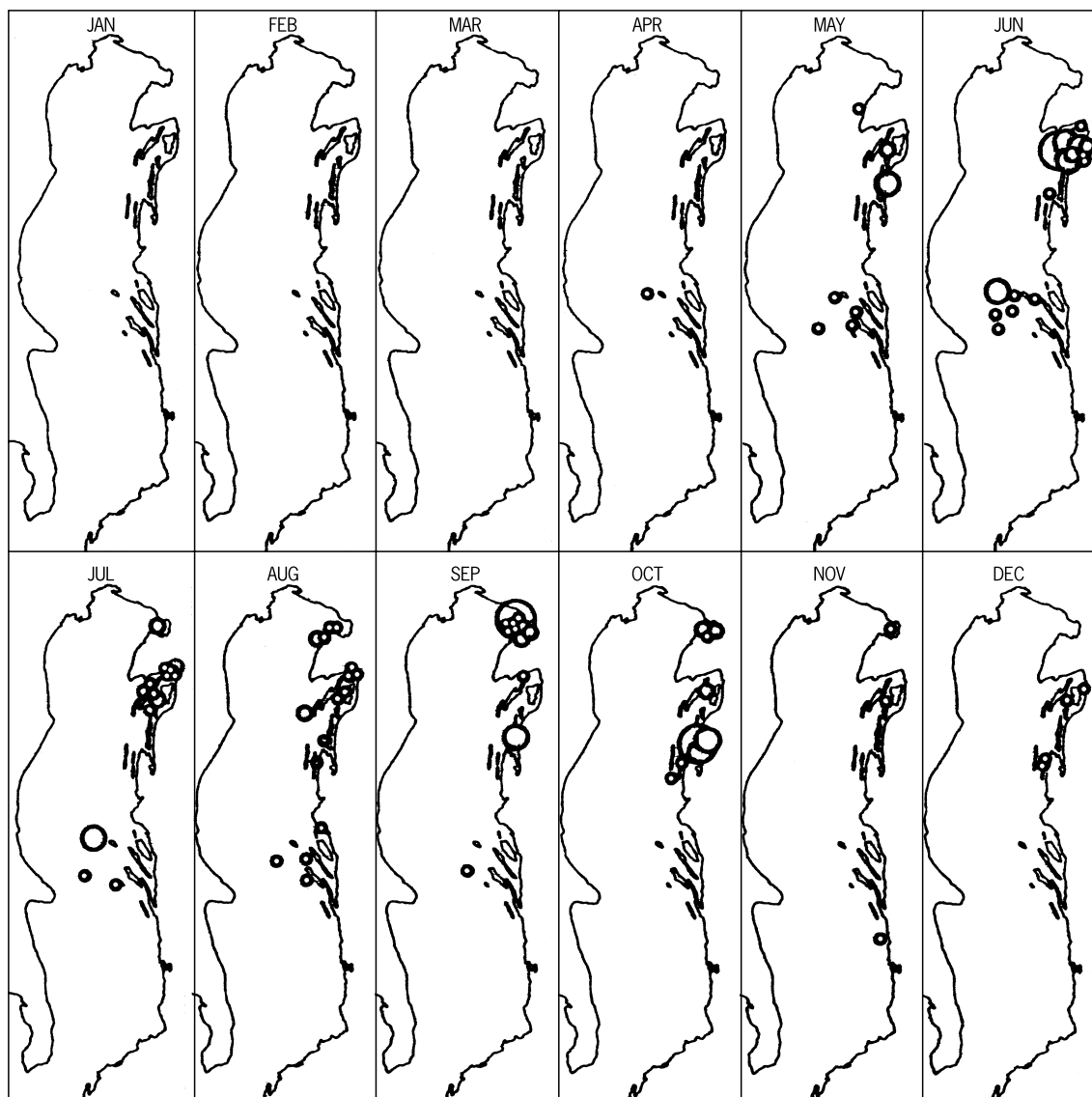
**Figure 4:** Distribution of the Cory's Shearwater *Calonectris diomedea* records (combined data published from 1876 on and the authors' data) along the eastern Adriatic coast. The key for the four symbol sizes from the smallest to the largest circle is 1–10, 11–100, 101–500, 2,000 birds.

**Slika 4:** Opažanja rumenokljunega viharnika *Calonectris diomedea* (kombinacija podataka, objavljenih od leta 1876 dalje, in podatkov avtorjev pričujočega članka) vzdolž vzhodne jadranske obale. Posamezni krogi ponazarjajo skupine po 1–10, 11–100, 101–500 in 2.000 ptic.

found in 1997 in crevices with soft soil at the foot of steep cliffs and in burrows beneath rocks.

The seasonal distribution of observations (Figures 3 & 4) shows a regular presence of dispersed birds or smaller rafts in the southern Adriatic, on the open sea around offshore islands and along the group of the great Dalmatian coastal islands (Brač, Hvar, Mljet, Korčula, Lastovo). Greater rafts of up to 100 birds appeared

from June to September mainly in the southern Adriatic between Dalmatian offshore and inshore islands. An exceptionally huge raft of 2,000 birds assembled about 2 hours before the sunset off the island of Svetac in July 1998 (V.Š. & V.D.) In the northern Adriatic, a small number of Cory's Shearwater was recorded from May to October, including a raft of 30–40 birds in Kvarner in August 1912 (SCHIEBL 1914).



**Figure 5:** Distribution of the Yelkouan Shearwater *Puffinus yelkouan* records (combined published data from 1888 and the authors' data) along the eastern Adriatic coast. (The key for the four symbol sizes from the smallest to the largest circle is 1–10, 11–100, 101–500, 501–1,000 birds).

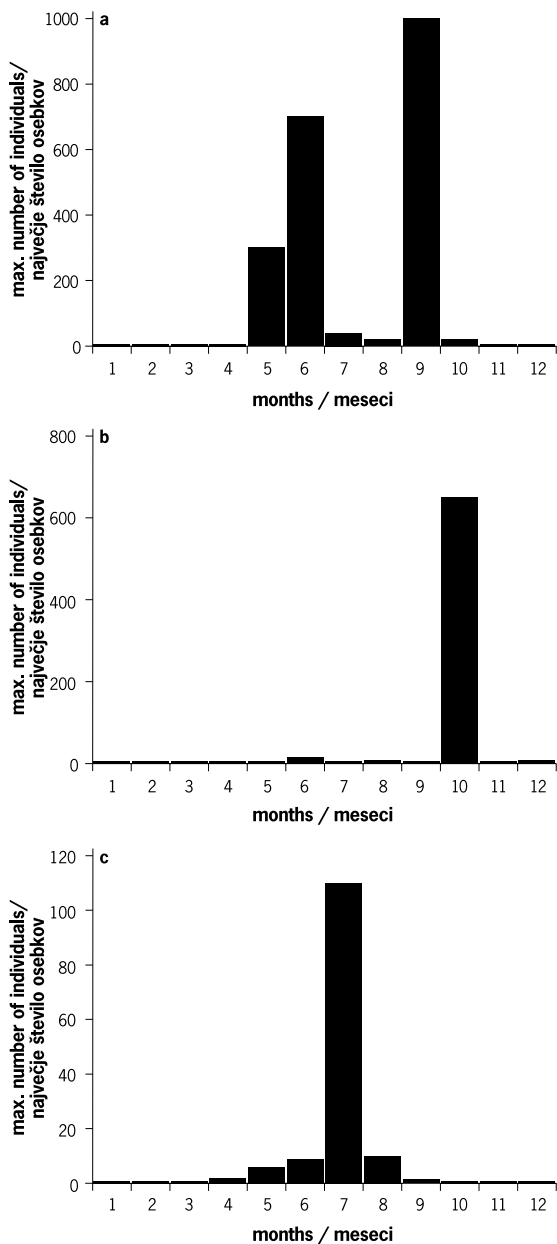
**Slika 5:** Opažanja sredozemskega viharnika *Puffinus yelkouan* (kombinacija podatkov, objavljenih od leta 1888 dalje, in podatkov avtorjev pričujočega članka) vzdolž vzhodne jadranske obale (posamezni krogi ponazarjajo skupine po 1–10, 11–100, 101–500 in 501–1.000 ptic).

There are only a few records from October to April along the offshore islands in Dalmatia and Kvarner.

#### Yelkouan Shearwater

The seasonal distribution of observations (Figs. 4 & 5) reveals regular presence of the Yelkouan Shearwater in the southern and northern Adriatic from April to December. Rafts of various sizes were seen mostly

along the offshore islands in Dalmatia, in Kvarner, along the west coast of Istra and in the Gulf of Trieste. Notable concentrations of rafts were recorded in summer and autumn between the offshore islands in the southern Adriatic (presumed breeding islands) and in the Gulf of Trieste in the northern Adriatic. The most remarkable were rafts numbering from few hundred to 1,000 birds (GJERKEŠ 1986) seen from



**Figure 6 a-c:** Maximum daily number of the observed Yelkouan Shearwater *Puffinus yelkouan* individuals per months along the eastern Adriatic (a – northern Adriatic, b – Dalmatia, c – offshore islands). The data are combined from the authors' fieldwork, the data published from 1876, and from other sources.

**Slika 6 a-c:** Maksimalno dnevno število opazovanih sredozemskih viharnikov *Puffinus yelkouan* v posameznih mesecih vzdolž vzhodne obale Jadranskega morja (a – severni jadrani, b – Dalmacija, c – oddaljeni otoki). Podatki so kombinacija terenskega dela obeh avtorjev, podatkov, objavljenih of leta 1876 dalje, in drugih virov.

June to October in the Gulf of Trieste, in Kvarner and in northern Dalmatia. In April and in the November–December period only few birds were observed along the eastern Adriatic.

#### Storm Petrel

There are only few published records on the Storm Petrel along the entire eastern Adriatic, all from June to November in Croatian waters. The first record was the specimen collected in August 1895, from the inshore Dalmatian island of Hvar (RÖSSLER 1902, MCSNT). The most important record indicating possible breeding were several smaller groups or singletons seen in June 1962 around the offshore volcanic islet of Jabuka (KRPAN 1965). Other records were the specimens collected all over Dalmatia (CNHM, BID), except one from western Istra (MCSNT). In the afternoon of 30<sup>th</sup> July 1998 a single bird alighted on an outcrop offshore the islet of Kamik (V.Š. & V.D.).

#### 4. Discussion

##### Cory's Shearwater

According to KRPAN (1965), the Cory's Shearwater breeds on Dalmatian offshore islands and islets around the islands of Vis as well as on Biševo, Sv. Andrija (Svetac), Jabuka and Kamik. Reports on the bird's breeding have come from other islands as well, including Vis, Palagruža, Sušac, Kopište (Lastovo) (KRPAN 1970, KRALJ 1997), but have not been confirmed until recently on the two offshore islands of Svetac and Palagruža.

Size and distribution of colonies are unknown, but rafts observed near the presumed breeding grounds on offshore islands indicate a few hundred pairs at least. On the island of Palagruža, three nestlings and two adults were extracted from five nest holes in September 1997. Considering that the search was not particularly successful we presume that many pairs breed on the island of Palagruža especially on inaccessible cliffs. For the entire island we estimated the size of the colony at 20 pairs at least. On the offshore island of Svetac, two active nest holes with one egg in each were found in July 1998, while in June 1999 a brooding adult with one egg in a single nest hole was discovered. However, the huge raft of 2,000 birds observed at sunset off the island of Svetac indicates greater size of the breeding population on the Croatian offshore islands. The size of Croatian breeding population was estimated at 1,000–5,000 pairs (TUCKER & HEATH 1994). Although such population size was not confirmed with a reliable colony census



or supported with appropriate counting data, it should be a realistic figure in view of the raft of 2,000 birds assembling off the island of Svetac in July 1998.

In general, the breeding cycle of the Palagruža birds is in accordance with the data of DEL HOYO *et al.* (1992), CRAMP *et al.* (1977) AND MASSA & LO VALVO (1986). The plumage development of the ringed fledglings indicates commencement of egg laying around April/May and departure of full-grown juveniles from nesting colonies during the September–October period.

### Movements

In the Adriatic, the Cory's Shearwater is more confined to the southern Adriatic as revealed by the gathered data. In the breeding season they occur off Dalmatia from May to September, around the offshore islands and great inshore islands, usually in small numbers or rafts reaching up to one hundred birds. Less often they have been encountered in the northern Adriatic. A small number of birds appearing in January and from May to November in Kvarner indicates movements along the eastern Adriatic.

The rare observations in the winter period indicate migratory habit of the Adriatic birds. In the winter, the Mediterranean Cory's Shearwater flies out into the Atlantic, occurring from November to May off South Africa (CRAMP *et al.* 1977, DEL HOYO *et al.* 1992). The departure from the Mediterranean takes place between mid-October and mid-November and the return from mid-February to late March (TELLERIA 1980 & 1981, FINLAYSON 1992). Scarce winter records in the Adriatic thus fits well with the migration scheme of the Mediterranean birds. The January records from Kvarner and offshore islands reveal that during the winter some birds remain in the Adriatic.

### Yelkouan Shearwater

Breeding of Yelkouan Shearwaters was claimed on the offshore islands of Vis, Biševo, Sv. Andrija, Jabuka, Palagruža and on the surrounding islets (KRPAN 1965). Findings are based on two females extracted by fishermen from nest holes on the offshore island of Svetac in April 1962 (KRPAN 1965), but breeding was not confirmed on other islands. The precise breeding distribution and colony size are still unknown. Due to the common occurrence in the north Adriatic, some authors wrongly reported on Yelkouan Shearwater's breeding in Kvarner (LOVRIĆ 1971, MAKOVEC 1995, RUCNER 1998). Indeed, the concentration of rafts in the top corner of the Adriatic result-

ed from the movements inside the Adriatic. Such trophic link between the northern and southern Adriatic enables Yelkouan Shearwaters to exploit the rich feeding zone in the northern Adriatic. The rafts observed during the breeding seasons around the offshore Dalmatian islands indicate a few hundred breeding pairs. This estimate is in accordance with the population of several hundred pairs presumed to breed off Croatia (LUKAČ 1998). We can presume that birds from other Mediterranean colonies enter the landlocked Adriatic for feeding. Most probably, a proportion of birds engaged in summer/autumn feeding movements between the offshore islands and the Gulf of Trieste are non-breeders visiting the Adriatic from unknown parts of the Mediterranean (YÉSOU *in lit.*).

### Movements

Summer/autumn movements of Yelkouan Shearwaters along the eastern Adriatic reflect a general pattern of the feeding ecology of marine birds well adapted to highly pelagic lifestyle. From spring to autumn, lower salinity and inflow of nutrients through the river Po and other tributaries (especially after snow melts in the Alps) increase the primary production of the northern Adriatic, attracting huge shoals of small pelagic fish (Sardines *Clupea pilchardus*, Sprats *Sprattus sprattus*, Anchovies *Engraulius encrasicolus*). After wintering in deep offshore waters, shoals of small pelagic fish shift towards the shallow and nutrient rich north Adriatic to exploit summer planktonic blooms (GRUBIŠIĆ 1967, MILIŠIĆ 1994, JARDAS 1996). Seasonal occurrence of favourite fish prey attracted rafts of Yelkouan Shearwater in the area between the presumed breeding offshore islands in the southern Adriatic and in the northern Adriatic where abundance of pelagic fish shoals offer best fishing area in the entire Adriatic. The summer/autumn occurrence of Yelkouan Shearwaters along northern Dalmatia, Kvarner, west Istra and the Gulf of Trieste followed the main concentrations of pelagic fish stocks in the Adriatic Sea. Notable concentration of pelagic fish stocks were found around great inshore islands, in channels and bays of northern Dalmatia, Kvarner and the Gulf of Trieste, largely in areas with strong input of freshwater (GRUBIŠIĆ 1967, MILIŠIĆ 1994, JARDAS 1996). The Yelkouan Shearwater was also common on the Italian side of the Gulf of Trieste (PERCO *et al.* 1983).

The post-breeding movements by Yelkouan Shearwaters are not well known (CRAMP *et al.* 1977). After breeding, Yelkouan Shearwaters disperse widely in a nomadic and haphazard fashion, following their

main food source – huge shoals of Anchovies and Sardines, not leaving Mediterranean in winter (CRAMP *et al.* 1977, BROOKE 1990). Nomadism is an adaptive response of seabirds to the vast areas within which they must seek local concentration of food (NELSON 1980). A post-breeding moult of congeneric Balearic Shearwater *Puffinus mauretanicus* occurs at the nearest most productive area with a huge concentration of pelagic fish shoals (CRAMP *et al.* 1977, YÉSOU 1986, BROOKE 1990). Mediterranean Shearwaters, as Balearic *Puffinus mauretanicus*, that only undertake a restricted migration, moult immediately after breeding (BROOKE 1990). The summer/autumn distribution of Yelkouan Shearwater strongly indicates the role of the productive northern Adriatic as foraging and post-breeding moulting area for the Adriatic birds and probably for some birds from other parts of Mediterranean. The seasonal occurrence in the northern Adriatic seems to be identical with peak occurrence in extreme western Mediterranean from July to October (GARCIA 1973, CORTES *et al.* 1980, TELLERIA 1981, DE JUANA & PATERSON 1986), where many moult from August to September (HARRISON 1989). Although quoted in large numbers in the extreme western Mediterranean many years ago, such numbers no longer occur there (PATERSON 1997, YÉSOU *in lit.*).

Winter scarcity of Yelkouan Shearwaters in the Adriatic is also similar to the winter absence in the extreme western Mediterranean (CORTES *et al.* 1980). Scarce records of a few birds in November to December scattering over the inshore northern and southern Adriatic confirmed their winter presence in the Adriatic. Seasonal distribution of records suggests migratory habit of the Adriatic birds in the winter. Data for the winter occurrence indicate winter movements of Yelkouan Shearwaters in the areas around warmer southern Mediterranean along the North African coast or in the Black Sea (VAN IMPE 1975, CRAMP *et al.* 1977, JACOB 1979, DEL HOYO *et al.* 1992). Along the north African coast it was found to be common from October to February in Algeria (JACOB 1979), regular in varying numbers off Libya from December to March (BUNDY 1950), and was reported as numerous off Tunisian coast in winter (HEIM DE BALSAC & MAYAUD 1962). In the Black Sea, large flocks congregated near the eastern shore of Crimea from October to December (CRAMP *et al.* 1977).

### Storm Petrel

The first record was the specimen collected in August 1895 from the inshore Dalmatian island of Hvar

(ROSSLER 1902, MCSNT). Other records were the collected specimens scattered over Dalmatia (CNHM, BID), except one along west Istra (MCSNT). The breeding of Storm Petrel was reported along Dalmatian coast (CRAMP *et al.* 1977) on account of KRPAN (1965). In June 1962 he observed, around the small offshore volcanic islet of Jabuka, several small groups or singletons, including a “young bird trying to take off from the surface but incapable for a longer flight”. Published data suggested only a scarce presence of the Storm Petrel in the eastern Adriatic from June to November. As there is still not enough information on the occurrence of this bird in the eastern Adriatic, any statement on its status is unrealistic.

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### 5. Conclusion

Three tubenose seabirds regularly present off the eastern Adriatic have been claimed to breed on the remotest Croatian offshore island.

Cory's Shearwater *Calonectris diomedea* breeding has been recently confirmed on the two offshore islands of Svetac and Palagruža. The first evidence were three brooding adults and with a single egg each extracted by ringers from nest holes on the island of Svetac in June 1984. On the western slope of the same island, two nest holes with one egg in each were found in July 1998, and in June 1999 a nest hole with a brooding adult and an egg was discovered. On Palagruža, five occupied nest holes were found between August and September 1997, from which three nestlings and two adults were extracted. The size of the colony on the island of Palagruža is estimated at 20 pairs at least. The rafts observed near

the presumed breeding grounds on offshore islands indicate a range from few hundred to few thousand breeding pairs on Croatian islands.

The plumage development of ringed fledglings indicates the commencement of egg laying between April and May, and departure of full-grown juveniles from nesting colonies in Adriatic between September and October. The scarce winter records indicate that some birds remain in the Adriatic Sea during the winter, but it seems that majority of them have the same migratory habit as the Mediterranean population. The occurrence of Cory's Shearwaters is confined more to the southern Adriatic than to the northern Adriatic.

Yelkouan Shearwater *Puffinus yelkouan* has been claimed to breed on some offshore Croatian islands, but the only evidence has been the report on two females found in nest holes on the island of Svetac. Rafts of 500 to 1,000 birds regularly moving along the eastern Adriatic indicate size of several hundred breeding pairs in the Adriatic Sea. Some of the birds occurring in the Adriatic might be non-breeders or breeders visiting the Adriatic from unknown parts of the Mediterranean.

Summer and autumn concentrations of favourite pelagic fish prey in the northern Adriatic attract rafts of Yelkouan Shearwaters from their breeding grounds on offshore islands in the southern Adriatic to forage in the top corner of the Adriatic Sea. From spring to autumn, the primary production of the northern Adriatic increases and plankton growth enables a huge shoals of pelagic fish to concentrate in the top corner of the Adriatic, mainly around the areas with strong input of freshwater. Along the eastern Adriatic, the largest rafts from 500 to 1,000 birds were found to concentrate in the Gulf of Kvarner (June), the Gulf of Trieste (September) and in northern Dalmatia (October). The summer/autumn distribution of Yelkouan Shearwater indicates the role of productive top corner of the northern Adriatic as foraging and moulting area for the birds from the Adriatic and probably from other parts of the Mediterranean as well. The seasonal distribution of records suggests a migratory habit in the majority of the Adriatic birds in winter.

Storm Petrel *Hydrobates pelagicus* was found in the eastern Adriatic on several occasions from June to November. Although claimed to breed on the islet of Jabuka on the account of a single observation, there is still no adequate evidence of its breeding.

## 6. Povzetek

Na oddaljenih otokih v hrvaškem Jadranu naj bi redno gnezstile tri različne vrste cevonožcev.

Gnezdenje rumenokljunega viharnika *Calonectris diomedea* je bilo pred kratkim potrjeno na dveh oddaljenih otokih v Jadranu, in sicer na Svetcu in Palagruži. Prvi dokaz o tem so bili trije valeči osebki s po enim jajcem, ki so jih obročkarji potegnili iz gnezdilnih rogov na otoku Svetac junija 1984. Na zahodnem pobočju istega otoka sta bila julija 1998 odkrita dva gnezdilna rova s po enim jajcem, junija 1999 pa je bil najden gnezdilni rov z valečo ptico in enim jajcem. Na Palagruži je bilo med avgustom in septembrom 1997 odkritih pet zasedenih gnezdilnih rogov (3 odrasle ptice in dva mladiča). Ocenjujeva, da kolonija na Palagruži šteje najmanj 20 parov. Glede na skupine rumenokljunih viharnikov, opaženih v bližini otoških gnezdišč, bi na hrvaških otokih v Jadranu lahko gnezdilo od nekaj sto do nekaj tisoč parov teh ptic.

Po razvitosti perja speljanih obročkanih mladičev bi lahko sklepali, da te ptice začnejo valiti med aprilom in majem in da mladiči zapustijo kolonije, gnezdeče v Jadranu, med septembrom in oktobrom. Glede na redka zimska opažanja teh ptic bržkone drži, da nekatere izmed njih pozimi sicer ostanejo na Jadranu, a da ima večina izmed njih enake selitvene navade kot viharniki sredozemske populacije. Rumenokljuni viharniki se pogosteje pojavljajo v južnem Jadranu kot pa v severnem.

Tudi sredozemski viharnik *Puffinus yelkouan* naj bi gnezdil na nekaterih oddaljenih otokih hrvaškega Jadrana, toda edini dokaz o tem je poročilo o dveh samicah, najdenih v gnezdilnih rovih na otoku Svetac. Jate 500–1.000 sredozemskih viharnikov, ki redno letajo vzdolž vzhodne jadranske obale, dajejo misliti, da v Jadranu gnezdi več sto parov teh ptic. Sicer pa utegnejo biti nekateri izmed sredozemskih viharnikov, pojavljajoči se v Jadranu, negnezdilci ali pa gnezdilci, ki prihajajo v Jadran iz neznanih delov Sredozemlja.

Poletne in jesenske koncentracije površinskih rib v severnem Jadranu, ki so najljubši plen teh ptic, so razlog, da sredozemski viharniki zapustijo svoja gnezdišča na oddaljenih otokih v južnem Jadranu in se odpravijo na lov v zgornji del severnega Jadrana. Med spomladjo in jesenjo se primarna produkcija v severnem Jadranu poveča, z rastjo planktona pa se v gornjem kotu Jadrana zbirajo ogromne jate površinskih rib, predvsem v območjih z močnim dotokom sladke vode. Vzdolž vzhodnega Jadrana so bile opažene skupine sredozemskih viharnikov, ki so štejele od 500 do 1.000 osebkov, in sicer v Tržaškem zalivu (septembra), Kvarnerju (junija) in severni Dalmaciji (oktobra). Glede na poletno/jesensko razširjenost teh ptic je produktivni gornji kot Jadrana

pomembno območje prehranjevanja in golitve za jadranske ptice in najbrž tudi za ptice iz drugih območij Sredozemlja. Sezonska razširjenost opazanj kaže na selitvene navade pri večini jadranskih viharnikov v zimskem času.

Strakoš *Hydrobates pelagicus* je bil v vzhodnem Jadranu odkrit ob več priložnostih, in sicer med junijem in novembrom. Glede na eno samo opazovanje naj bi sicer gnezdil na otočku Jabuka, vendar pa o zanesljivem gnezdenju ni kakih utipljivejših dokazov.

## 7. References

- AKRIOTIS, T. & HANDRINOS, G. (1986): The First Breeding Case of the Storm Petrel in Greece. In: MEDMARAVIS & XAVER MONBAILLIU (eds.) Mediterranean Marine Avifauna, Population Studies and Conservation. NATO ASI Series, Series G: Ecological Sciences, Vol. 12. Springer-Verlag, London, Paris, Tokyo.
- BABIĆ, K. & RÖSSLER, E. (1912): Beobachtungen über die Fauna von Pelagosa. Verhandlungen der K.K. zoologisch-botanischen Gesellschaft in Wien 25: 220-233.
- BENOVIĆ, A. (1983): Biološko bogatstvo Jadranskog mora. In: Atti dell Convegno Internazionale "I Problemi del Mare Adriatico", 26/27 Settembre 1983: 275-292. Ed. Università degli Studi di Trieste.
- BERNHAEUER, W. (1957): Ornithologische Beobachtungen an der Adriaküste. Larus 9-10: 143-148.
- BOURNE, W.R.P., MACKRILL, E.J., PATERSON, A.M. & YÉSOU, P. (1988): The Yelkouan Shearwater *Puffinus (puffinus?) yelkouan*. British Birds 81: 306-319.
- BOŽIĆ, L. (1994): Iz ornitološke beležnice (From the ornithological notebook): Sredozemski viharnik *Puffinus puffinus*. Acrocephalus 65-66: 149.
- BROOKE, M. (1990): The Manx Shearwater. T & AD Poyser, London.
- BUNDY, G. (1950): Birds of Lybia. BOU, London.
- CRAMP, S. & K.E.L. SIMMONS (eds.) (1977): The Birds of the Western Palearctic, Vol. I. Oxford University Press.
- CORTES, J.E., J.C. FINLAYSON, M.A. MOSQUERA, E.F.J. GARCIA (1980): The Birds of Gibraltar. Gibraltar Bookshop, Gibraltar.
- FINLAYSON, C. (1992): Birds of the Strait of Gibraltar. T & AD Poyser, London.
- FRUGIS, S., GROPPALI, R., VICINI, G. (1993): Aves (generi 400-616). In: G. AMARI, F.M. ANGELICI, S. FRUGIS, G. GANDOLFI, R. GROPPALI, B. LANZA, G. RELINI, G. VICINI: Checklist delle specie della Fauna d'Italia 110, Vertebrata. Edizioni Calderini, Bologna.
- GARCIA, E.F.J. (1973): Seabird activity in the Strait of Gibraltar: a progress report. Seabird Report 3: 30-36.
- GRUBIŠIĆ, F. (1967): Ribe, rakovi i školjke Jadrana. Slobodna Dalmacija, Split.
- GJERKEŠ, M. (1986): Iz ornitološke beležnice (From the ornithological notebook): Črnokljuni viharnik *Puffinus puffinus*. Acrocephalus 7 (30): 58.
- HARRISON, P. (1989): Seabirds – an identification guide. Christopher Helm, A & C Black, London.
- HAZEVOET, C.J. (1995): Birds of the Cape Verde Islands. BOU Checklist 13. London.
- HEIDRICH, P., J. AMENGUAL, M. WINK (1998): Phylogenetic relationship in Mediterranean and North Atlantic shearwaters (*Aves: Procellariidae*) based on nucleotide sequences of mtDNA. Bio. Syst. Ecol. 26: 145-170.
- HEIM DE BALSAC, H. & MAYAUD, N. (1962): Les Oiseaux du North-Quest de l'Afrique. Editions Paul Lechevalier, Paris.
- DEL HOYO, J., A. ELLIOTT, & J. SARGATAL (eds.) (1992): Handbook of the Birds of the World. Vol. 1. Lynx Edicions, Barcelona.
- JACOB, J.P. (1979): Résultats d'un recensement hivernal de Laridés en Algérie. Le Gerfaut 69: 425-436.
- JARDAS, I. (1996): Jadranska ihtiofauna. Školska knjiga, Zagreb.
- DE JUANA, A.E. & A.M. PATERSON (1986): The Status of the Seabirds of the Extreme Western Mediterranean. In: MEDMARAVIS & XAVER MONBAILLIU (eds.) Mediterranean Marine Avifauna, Population Studies and Conservation. NATO ASI Series, Series G: Ecological Sciences, Vol. 12. Springer-Verlag, London, Paris, Tokyo.
- KLETEČKI, E. (1988): Results of Bird Ringing 1983-1985, XXVI Report. Larus 38-39: 7-24.
- KRALJ, J. (1997): Croatian Ornithofauna in the Last 200 Years. Larus 46: 1-112.
- KRPAN, M. (1965): Ptice otoka Visa i njemu bližih otočića (with German summary: Die Vögel der Insel Vis und ihr benachbarter Inselchen). Larus 16-18: 106-150.
- KRPAN, M. (1970): Prilog poznavanju ornitofaune otoka Lastova (with German summary: Beitrag zur Kenntnis der Vogelwelt von Lastovo). Larus 21-22: 65-83.
- KRPAN, M. (1977): Prilog ornitofauni otoka Korčule (with english summary: A Contribution to the Ornithofauna of the Island of Korčula). Larus 29-30: 93-121.
- KRPAN, M. (1980): Srednjodalmatinska ornitofauna (with english summary: Ornithofauna of Mid Dalmatia). Larus 31-32: 97-156.
- LOVRIĆ, A.Ž. (1971): Ornitogene biocenoze u Kvarneru. Larus 23: 39-72.
- LUKAČ, G. (1998): List of Croatian Birds – Spatial and Temporal Distribution. Natura Croatica Vol. 7, Suppl. 3. Croatian Natural History Museum, Zagreb.
- MAKOVEC, T. (1995): Pojavljanje sredozemskoga viharnika *Puffinus yelkouan* na slovenski obali. Falco 9: 17-20.
- MASSA, B. & M. LO VALVO (1986): Biometrical and Biological Consideration on the Cory's Shearwater. In: MEDMARAVIS & XAVER MONBAILLIU (eds.) Mediterranean Marine Avifauna, Population Studies and Conservation. NATO ASI Series, Series G: Ecological Sciences, Vol. 12. Springer-Verlag, London, Paris, Tokyo.
- MAYOL, J. (1998): Specific identity of the Balearic Shearwater: *Puffinus mauretanicus* (Lowe) 1921. (Catalan, English summary) An.Orn. Balear 1997: 3-11.
- MILIŠIĆ, N. (1994): Sva riba Jadranskog mora. NIVA, Split.
- NELSON, B. (1980): Seabirds – their biology and ecology. Hamlyn, London.
- PATERSON, A.M. (1997): Las Aves Marinas de Espana y Portugal. Lynx Edicions, Barcelona.

- PERCO, F., MUSI, F. & PARODI, R. (1983): L'oasi avifaunistica di Marano Lagunare. WW, Delegazioni del Friuli-Venezia-Giulia.
- POMORSKA ENCIKLOPEDIJA (1976). Jugoslavenski Leksikografski Zavod, Zagreb.
- RÖSSLER, E. (1902): Popis ptica hrvatske faune. Glasnik Hrvatskog naravoslovnog društva 14: 11-90.
- RUBINIČ, B. (1996): Ptice doline reke Mirne v Istri na Hrvaškem, 1 del *Gaviiformes–Charadriiformes* (Birds of the river Mirna Valley in Istria – Croatia, part 1. *Gaviiformes–Charadriiformes*). Falco 10: 5-42.
- RUCNER, D. (1957): Ptice otoka Krka. Larus 9-10: 71-142.
- RUCNER, D. (1998): Ptice hrvatske obale Jadrana. Croatian Natural History Museum & Ministry of reconstruction and development, Zagreb.
- SCHIEBEL, G. (1914): Über die Vögel der Insel Arbe, II teil: Ein Sommeraufenthalt im Jahre 1912. Ornithol. Jahrb. 24, 16-27.
- SOVINC, A. (1996): Redke vrste ptic v Sloveniji v letu 1994. Poročilo Komisije za redkosti (Rare bird species in Slovenia in 1994. Rarities Committee Report). Acrocephalus 75-76: 76-79.
- SOVINC, A. (1997): Redke vrste ptic v Sloveniji v letu 1995. Poročilo Komisije za redkosti (Rare bird species in Slovenia in 1995. Rarities Committee Report). Acrocephalus 84: 151-156.
- ŠTROMAR, L. (1975): Noviji podaci o pojavi zovoja malog (*Puffinus puffinus* Brunn.) u Kvarnerskom području. Larus 26-28: 83-88.
- TELLERIA, J.L. (1980): Autumn migration of Cory's Shearwater through the Straits of Gibraltar. Bird Study 27: 21-26.
- TELLERIA, J.L. (1981): La Migracion de las Aves en el Estrecho de Gibraltar. Vol. II: Aves no Planeadoras. Universidad Complutense, Madrid.
- TOME, D. (1986): Iz ornitološke beležnice (From the ornithological notebook): Črnokljuni viharnik *Puffinus puffinus*. Acrocephalus 30: 58.
- TUCKER, G.M. & M.F. HEATH (1994): Birds in Europe: their conservation status. BirdLife International (BirdLife Conservation Series no. 3), Cambridge.
- VAN IMPE, J. (1957): Sur les mouvements du *Puffinus p. yelkouan* en Mer Noire. Alauda 43: 185-187.
- WALKER, C.A., WRAGG, G.M. & HARRISON, C.J.O. (1990): A new shearwater from the Pleistocene of the Canary Islands and its bearing on the evolution of certain *puffinus* shearwaters. Historical Biology 3: 203-224.
- YÉSOU, P. (1986): Balearic Shearwaters in Western France. In: MEDMARAVIS & XAVER MONBAILLIU (eds.) Mediterranean Marine Avifauna, Population Studies and Conservation. Eds.. NATO ASI Series, Series G: Ecological Sciences, Vol. 12. Springer-Verlag, London, Paris, Tokyo.

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