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THE AVIFAUNA OF THE LASTOVO ARCHIPELAGO AND SURROUNDING SEA AREA, CROATIA

Ornitofauna Lastovskog arhipelaga i okolnog morskog područja, Hrvatska

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ABSTRACT

The Lastovo archipelago comprises 46 remote islands in the Middle Adriatic Sea which are also a Nature Park and Natura 2000 Special Protection Area (SPA). Between 2019 and 2024, bird species presence lists were collected on 618 days, based on observations done on land and at sea. Overall, 179 taxa were recorded, encompassing 39 breeding species. New nesting species are Northern Long-eared Owl, Eurasian Sparrowhawk, Common Buzzard, Red-rumped Swallow and White Wagtail. On the contrary, 16 formerly claimed breeding species were not found, including SPA target species Tawny Pipit and Olive-tree Warbler. We provide explanations for changes in species' occurrences or discrepancies from other sources and suggest revising some of the SPA conservation targets. The archipelago continues to be the most important site for several globally threatened seabirds in Croatia, and systematic boat-based observations also highlighted the importance of the surrounding sea area for the foraging and resting of Yelkouan and Scopoli's Shearwaters, as well as large groups of migrating Little Gulls. The archipelago is generally important for migratory birds, including soaring species such as European Honey-buzzard and Western Marsh-harrier, although future studies are needed to better quantify their migration, as well as for filling knowledge gaps concerning wintering birds.

Keywords: South Dalmatian Islands, bird census, raptor migration, European Seabirds at Sea (ESAS), Adriatic Flyway, Special Protection Area (SPA)

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INTRODUCTION

Islands are often known for their unique ecosystems and biodiversity, a result of their size and distance from the mainland (MacArthur & Wilson 1967). The Lastovo archipelago comprises 46 of the most remote islands and islets in the Adriatic Sea, situated in the south of the Republic of Croatia (Figure 1). As most of its islands are uninhabited and were off limits for foreign tourists until 1988, the archipelago's nature is relatively well preserved. In 2006, it was declared a Nature Park (IUCN category V) in order to protect its marine and terrestrial biodiversity, and in 2013 the Lastovo Islands Nature Park also became part of the European Union's Natura 2000 network of protected areas, both as a Special Protected Area (SPA Lastovsko otočje - HR1000038) and a Special Area for Conservation (SAC - HR5000038) (Natura 2000 reference portal 2024).

Geographically positioned between the Gargano peninsula in Italy and the Croatian mainland, the archipelago forms an important part of the migratory route for birds flying across the Adriatic (Figure 1). The islands provide soaring migrant birds with thermal updrafts during the day and a place to roost during the night or in adverse weather conditions. For this reason, the SPA Lastovsko otočje is considered an important site for migrating European Honey-buzzard *Pernis apivorus* (> 1000 ind.) and Common Crane *Grus grus* (> 3000 ind.) (Natura 2000 reference portal 2024), although more species are known to use this route (Adojaan *et al*. 2019, Tomik *et al.* 2019, Škrábal *et al.* 2023, Škrábal *et al.* 2024, Laji 2024).

The SPA is also important for several breeding bird species, in particular seabirds. The islands hold at least half of the Croatian national populations of Scopoli's Shearwater *Calonectris diomedea*, as well as of the globally threatened Yelkouan Shearwater *Puffinus yelkouan* and Audouin's Gull *Larus audouinii* (Radović *et al.* 2005, Tutiš *et al.* 2013, Natura 2000 reference portal 2024). Other seabirds breeding around Lastovo are the Common Tern *Sterna hirundo* and Mediterranean Shag *Gulosis aristotelis desmarestii*. Furthermore, the archipelago is one of the only two sites in Croatia where Eleonora's Falcon *Falco eleonorae* breeds and is also home to a few pairs of Peregrine Falcon *F. peregrinus* and one pair of Short-toed Snake-eagle *Circaetus gallicus* (Natura 2000 reference portal 2024). Lastly, the SPA is important for breeding European Nightjar *Caprimulgus europaeus*, Tawny Pipit *Anthus campestris*, Red-backed Shrike *Lanius collurio* and Olive-tree Warbler *Hippolais olivetorum* (Natura 2000 reference portal 2024).

The first ornithological study on Lastovo was carried out in the mid-1960s, recording 85 bird species, of which 25 species were breeding birds (Krpan 1970). Subsequent studies covered only short periods or focused on specific species and often only on the main island of Lastovo (Čulina *et al.* 2008, Radović 2011, Vrezec & Jernejc Kodrič 2021). The last updated avifauna list stems from 2011 and includes 116 species, of which 46 were considered breeding birds (Budinski

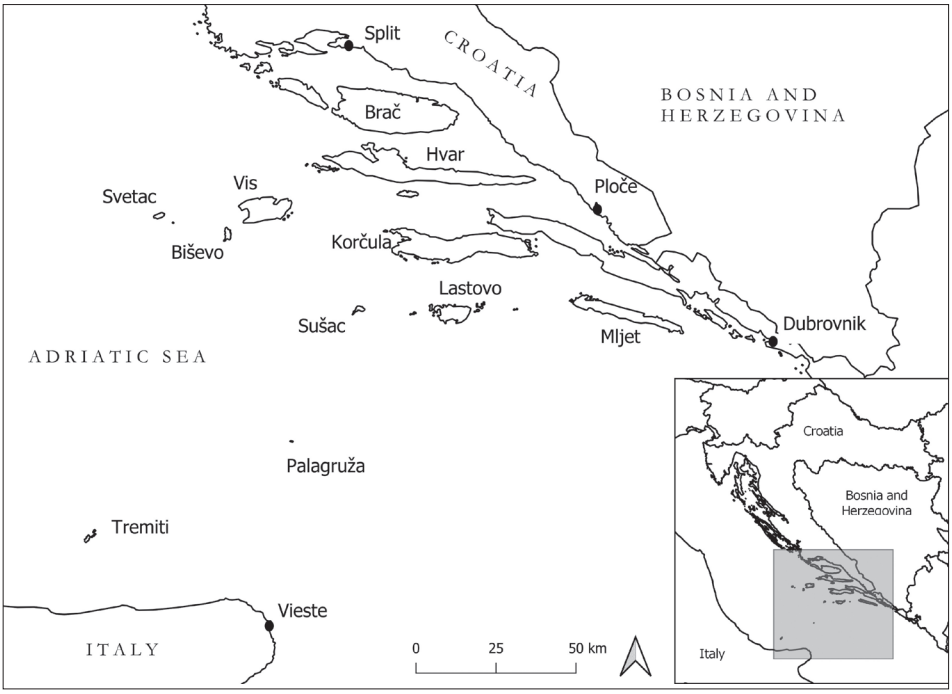

Figure 1. Geographic location of the South Dalmatian islands, including the Lastovo archipelago. Situated between the Croatian mainland and Italy, they form an important part of the Adriatic Flyway for migratory birds crossing the Adriatic Sea. Map created using the Free and Open Source QGIS.

Slika 1. *Geografski položaj južnodalmatinskih otoka, uključujući Lastovsko otočje. Smješteni između hrvatskog kopna i Italije,* čine *važan dio jadranskog preletničkog puta za migratorne ptice koje prelaze Jadransko more. Karta je izrađena pomoću besplatnog i otvorenog softvera QGIS.*

2011). However, it must be noted that many of the observations were still based on the short eight-day study carried out by Čulina *et al.* (2008).

In this study we present a complete ornithological survey of the Lastovo archipelago, including all islands of the archipelago as well as the surrounding sea area, covering the entire breeding season of birds. It provides an updated avifauna list based primarily on more than 600 days of field observations gathered between 2019 and 2024, as well as records taken from literature and other available data sources. We compare the breeding species found during this study with data from the literature and, where possible, provide explanations for changes in the occurrence of species or discrepancies from other sources. It is expected that the species composition may have changed over the last decades due to changes in habitat, as already observed on Lastovo by Budinski (2011), and elsewhere

along the Croatian coast (Budinski *et al.* 2010). Besides observations from land, this study includes the main results of two years of boat-based observations carried out around the SPA Lastovsko otočje as part of the LIFE Artina project (www.lifeartina.eu). This survey was the first of its kind in Croatia and had the primary aim to better assess the importance of the surrounding seas for migratory and locally breeding seabird species. As Lastovo is the most important site for several species of seabird in Croatia, it is assumed that the surrounding sea is frequently used for their foraging and resting.

MATERIAL AND METHODS

Study area

The Lastovo archipelago consists of 46 islands and islets which are part of the south Dalmatian islands in the Dubrovnik-Neretva county in southern Croatia. The entire archipelago stretches from the island of Sušac in the west (42°45'30.5"N, 16°52'18.6"E) to Glavat in the east (42°45'57.0"N, 17°08'49.1"E) (Figure 2). It has a typical Mediterranean climate with hot, dry summers and mild, wet winters (average annual temperature of 15°C, and precipitation of 687 mm). The Nature Park Lastovo Islands covers an area of 195 km^2, of which 52 km^2 consists of terrestrial habitats. Lastovo is the largest island (40.82 km^2) in the archipelago, followed by Sušac (4.03 km^2), Prežba (2.81 km^2), Mrčara (1.45 km^2), and Kopište (0.74 km^2) (Duplančić Leder *et al.* 2004). The islands situated just east of the main island of Lastovo are collectively known as the Lastovnjaci, while the ones further east, halfway to Mljet, are known as the Vrhovnjaci (Figure 2). A total of 748 inhabitants live on the two main islands of Lastovo and Prežba (which are connected by a bridge), divided over the towns of Lastovo, Ubli, Pasadur, Zaklopatica, and Skrivena Luka (Figure 2).

The islands' karst relief is fairly rugged, containing several caves, and their coastline topography is relatively steep. The highest peak, Pleševo Brdo (417.8 m), is found on the main island (Magaš 2021). On Lastovo island, the limestone hills are interspersed by typical karst fields ('polja') of dolomitic origin (Figure 2). The largest ones are the Prgovo complex southeast of the town of Lastovo and Vinopolje northeast of Ubli (Magaš 2021). As these karstic fields contain the most fertile soil on the island, they are generally used for self-sustenance farming and the cultivation of vines and olives. Nowadays, however, some of them are abandoned and are either partially or entirely overgrown. A handful of ponds across the main island provide the only natural source of water, but only a few of these are present all year round. The largest one is located in the Lokavje field below the town of Lastovo, which, during heavy rains in fall or spring, can flood the surrounding meadows. The only other pond found in the archipelago outside of Lastovo is located on the island of Mrčara and is of non-permanent nature.

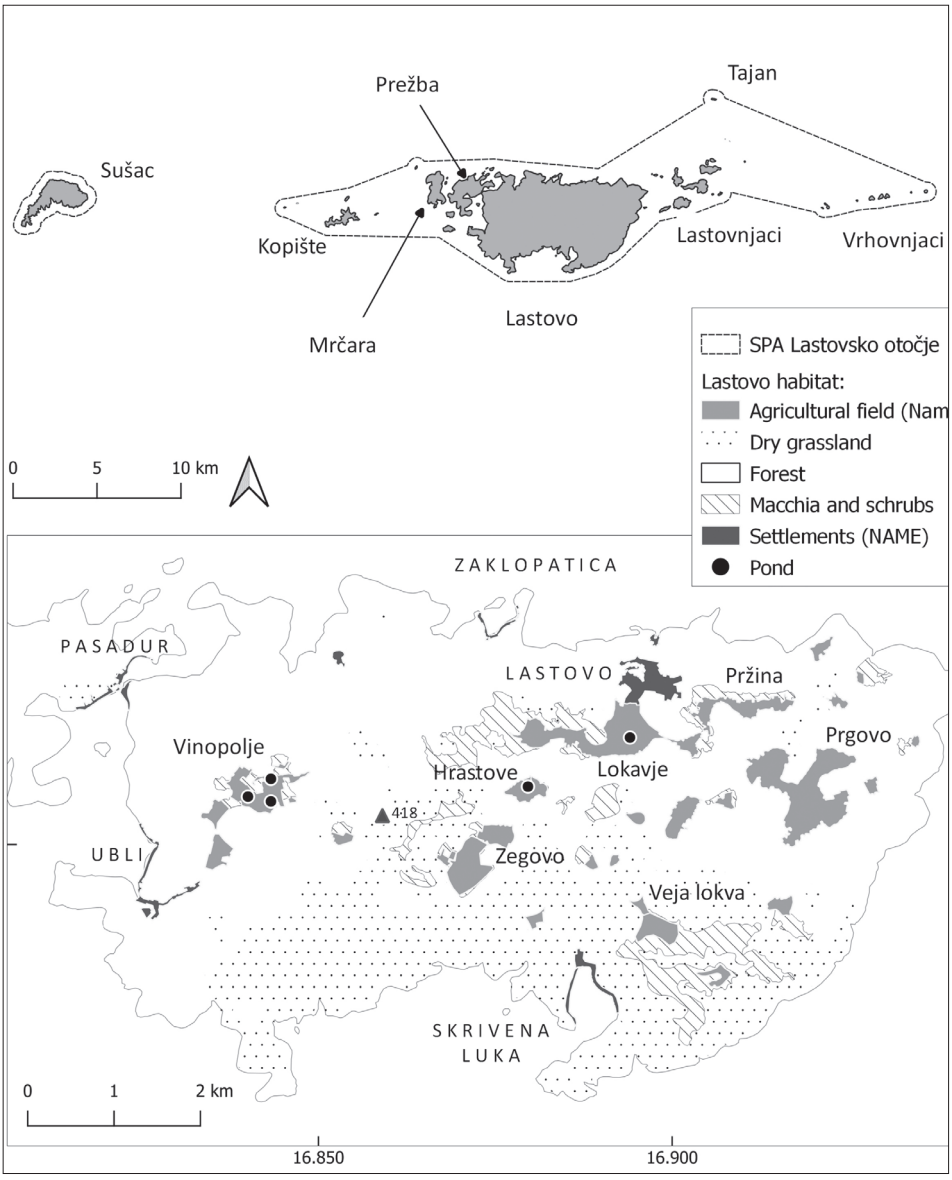

Figure 2. Overview of the SPA Lastovsko otočje (up) and map of Lastovo main island (down) showing the main habitat types, main towns, largest fields 'poljes', biggest ponds and the highest peak of the island at 418 m. Settlement names are written in caps and other localities in lowercase. Map created using the Free and Open Source QGIS.

Slika 2. *Pregled POP-a Lastovsko otočje (gore) i karta matičnog otoka Lastova (dolje) koja prikazuje glavne tipove staništa, glavna naselja, najveća polja, najveće lokve i najviši vrh otoka na 418 m. Nazivi naselja pisani su velikim slovima, a ostali lokaliteti malim slovima. Karta je izrađena pomoću besplatnog i otvorenog softvera QGIS.*

The hills of Lastovo island are mostly covered by forests of Holm Oak *Quercus ilex*, Aleppo Pine *Pinus halepensis* and Strawberry Tree *Arbutus unedo*. These forests are more pronounced on the north side of the island (Figure 2), as the south side has seen several major forest fires during the last decades (most notably in 1971, 1998 and 2003). Most other islands in the archipelago are covered with macchia in various stages of succession, where, besides Aleppo Pine, the dominant trees and shrubs include Olive *Olea europaea*, Lentisk *Pistacia lentiscus,* Phoenician Juniper *Juniperus phoenicea*, Mediterranean Buckthorn *Rhamnus alaternus* and Rosemary *Rosmarinus officinalis*. On the island of Sušac Tree Heather *Erica arborea* and Tree Spurge *Euphorbia dendroides* are also common, while only few individuals of Aleppo Pine exist. Smaller islands in the archipelago, in particular the Tajan and the Vrhovnjaci, are more barren and their vegetation mostly consists of Mediterranean herbs (e.g. Sea Fennel *Crithmum maritimum,* Sculpit *Silene inflata,* Edible Lotus *Lotus edulis,* Little Hogweed *Portulaca oleracea,* Goosefoot *Chenopodium* spp., Bermuda Grass *Cynodon dactylon*) (Vervust *et al.* 2009).

Data collection

Between 2019 and 2024, bird species occurrence lists were created during a total of 618 days (122 days in 2019, 198 in 2020, 147 in 2021, 84 in 2022, 33 in 2023, and 34 in 2024; Figure 3). The observations were made by 1 to 3 persons and covered the breeding period of all bird species in the archipelago between February and October. Most cumulative coverage was achieved between late February and mid-July, whereas November, December, and January were not covered at all (Figure 3). Data was collected opportunistically by recording every bird species observed anywhere in the archipelago during each day, mostly while carrying out fieldwork for the LIFE Artina project (LIFE Artina LIFE17 NAT/HR/000594). Observations include both bird species seen on the islands as well as those present at sea. Additional notes were taken to document sightings in more detail if needed.

During the survey period, all islands in the SPA were visited at least once, but Sušac, Kopište, Pod Kopište, Bratin, Vlašnik, Mrčara, Veli and Mali Rutvenjak, Veli and Mali Maslovnjak, Zaklopatica, Srednji and Gornji Lukovac, Petrovac, Kručica, Tajan, and Donji, Srednji and Gornji Vlašnik were each visited at least 20 times. All marked trails on the islands of Lastovo, Mrčara, and Sušac were walked at least once during the survey period. On the main island of Lastovo, all of the ponds and fields have been visited multiple times, most frequently to Prgovo, Vinopolje, Lokavje, Zegovo, Pržina, Veja Lokva, and Hrastove (Figure 2). The peak of Hum was also visited more often, in particular during the periods of spring and autumn migration. Finally, extra efforts were put into recording the presence of nocturnal breeding birds, focusing most of all on Eurasian Eagle-owl *Bubo bubo* and Tawny Owl *Strix aluco* (including the use of playback calls; Vrezec & Bertoncelj 2018).

While data on breeding population sizes was collected opportunistically, the numbers for Yelkouan and Scopoli's Shearwater, and for Yellow-legged and Audouin's Gull were based on four years of systematic surveys carried out as part of LIFE Artina between 2019 and 2022.

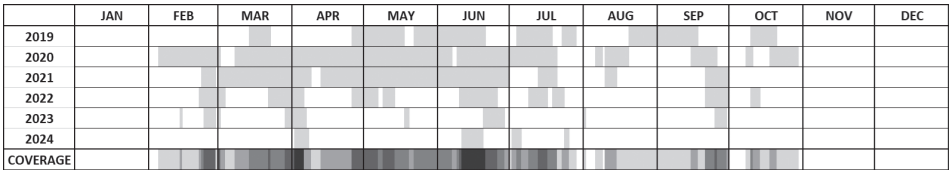

Figure 3. Dates per year (2019 – 2024) for which bird presence lists were created while on Lastovo (618 days in total). The coverage row shows the cumulative presence during each specific date (darker parts having higher coverage).

Slika 3. *Datumi po godinama (2019. – 2024.) za koje su izrađeni popisi prisutnosti ptica na Lastovu (ukupno 618 dana). Redak pokrivenost („coverage") prikazuje ukupnu prisutnost tijekom svakog određenog datuma (tamniji dijelovi imaju veću pokrivenost).*

Sea transects

Another activity carried out as part of the LIFE Artina project was a series of systematic at-sea surveys, following the standardized protocol of the 'European Seabirds at Sea' (ESAS) database (Tasker *et al.* 1984, Camphuysen *et al.* 2004). These transects were carried out monthly between March and October during a two-year timespan (May 2019 – May 2021), following a petal shape within a 9 nautical mile radius around the SPA Lastovsko otočje (Figure 4). A total of 12 transects, varying in length from 35 to 50 km, were surveyed by two observers on a semi-inflatable boat with a skipper, going at a speed of 15 km/h. Only birds flying on the port side of the boat (left side) were counted. Birds were identified to species level where possible, otherwise using larger overarching species groups. For each observation, the number of birds and their age (if possible) were noted, as well as notes on their behaviour (e.g. foraging/ feeding, resting, flying by) and their distance to the boat. To mitigate the possible effects of weather on species identification, sea transects were only conducted 1) during the early morning or late afternoon (when the sun is less strong), 2) during days with favourable weather forecast (little to no wind, no large waves, no rain or fog), and 3) by choosing the starting point of the transect based on the location of the sun (to avoid being blinded). Changes in sea state, visibility and cloud cover were also recorded. The full LIFE Artina sea transect dataset is made available open-access through the Global Biodiversity Information Facility (Engelen *et al*. 2024).

The final list of bird species recorded in the SPA Lastovsko otočje was created based on our own observations, with the addition of species mentioned in existing literature (Rössler 1915, Krpan 1970, Budinski 2011), as well as records from GPS-tracking data, sightings shared on the social media channels of the Lastovo Islands Nature Park and consulting Observado.org, iNaturalist.org and eBird.org. Species which could not be verified or that were misidentified (based on accompanying photos), were not included in the final list.

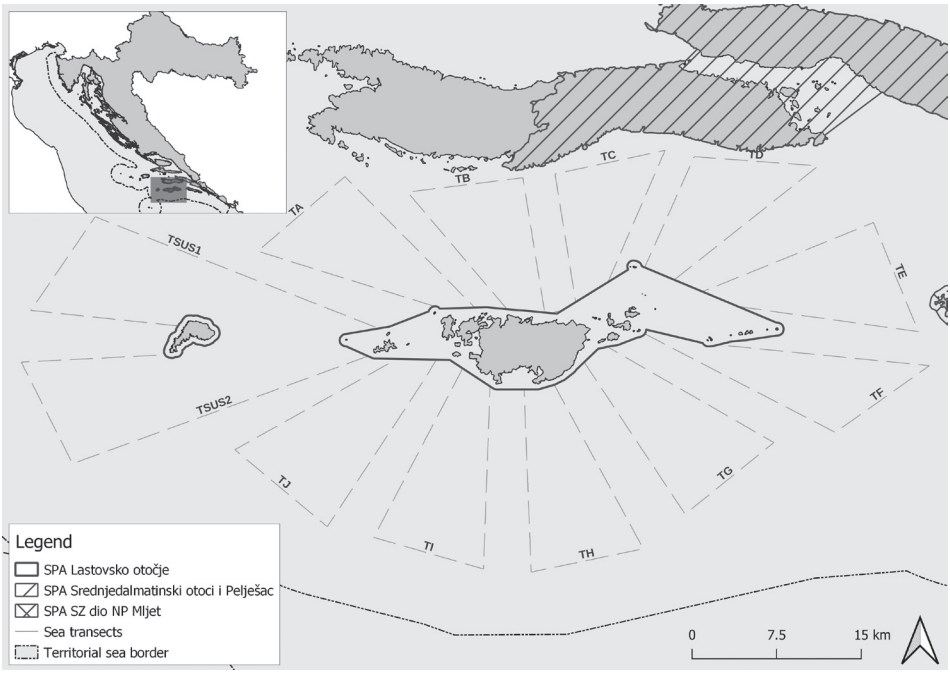

Figure 4. Locations of the 12 sea transects around the SPA Lastovsko otočje. Map created using the Free and Open Source QGIS.

Slika 4. *Lokacije 12 morskih transekata oko POP-a Lastovsko otočje. Karta je izrađena pomoću besplatnog i otvorenog softvera QGIS.*

RESULTS

A total of 199 bird species have been recorded in the SPA Lastovsko otočje, of which 179 were observed during this study (Supplementary Table 1). On average 17.2 bird species were seen per day, with a maximum of 44 observed on 26.03.2022. Breeding birds make up only 39 out of 179 species observed. The most commonly observed species were the Yellow-legged Gull *Larus michahellis* (on 99.4% of the

days), followed by Hooded Crow *Corvus corone cornix* (95.1%), White Wagtail *Motacilla alba* (72.7%), Eurasian Blackcap *Sylvia atricapilla* (71.4%) and Barn Swallow *Hirundo rustica* (69.7%). Out of the 30 most frequently encountered species, all are breeding species, except for the European Robin *Erithacus rubecula* (31.6%), Common Chiffchaff *Phylloscopus collybita* (26.9%) and Black Redstart *Phoenicurus ochruros* (19.9%), which are all three very common and abundant non-breeding species. The least often recorded breeding species was the Northern Long-eared Owl *Asio otus* (1.1%).

A total of 34 species were only observed once during the entire survey period, including 7 out of 9 rarities. The recorded rarities were Arctic Skua *Stercorarius parasiticus* (01.05.2019, at-sea near the Vrhovnjaci; 03.05.2022, adult bird chasing a Yellow-legged Gull at-sea near Tajan), Common Rosefinch *Carpodacus erythrinus* (26.05.2020, singing immature male in Lastovo town), Pallas's Gull *Larus ichthyaetus* (15.06.2020, adult bird between Ubli and Pasadur), Storm Petrel sp. *Hydrobates sp.* 16.08.2020, at-sea south of Lastovo), Northern Fulmar *Fulmarus glacialis* (23.10.2020, adult bird at-sea west of Sušac; first for the Adriatic Sea), Semicollared Flycatcher *Ficedula semitorquata* (05.04.2021; 07.04.2021, male near the pond in Lokavje field), Northern Gannet *Morus bassanus* (18.04.2021, immature bird at-sea between the Lastovnjaci and Vrhovnjaci), Eurasian Dotterel *Eudromias morinellus* (25.09.2023, juvenile bird flying over Hum) and Richard's Pipit *Anthus richardi* (26.09.2023, heard migrating over Pasadur). Northern Gannets were also recorded in the archipelago on two occasions just prior to the start of this study (three adult birds on 09.02.2019, and two immature birds on 20.02.2019, in both cases near the Vrhovnjaci - observed by I. Budinski & B. Ječmenica). All rarities, except for the unidentified Storm Petrel, were submitted to and approved by the Croatian rarity committee.

Breeding birds

A total of 39 bird species were confirmed to breed in the SPA Lastovsko otočje, five of which were recorded breeding for the first time (indicated below with an asterisk). Among the nesting birds are three species which are listed as globally vulnerable on the IUCN red list, namely the Yelkouan Shearwater, Audouin's Gull, and European Turtle-dove *Streptopelia turtur* (IUCN 2024).

Common Pheasant *Phasianus colchicus* – Like elsewhere in Europe, this species was introduced to Lastovo. It is present year-round and can be found in most agricultural fields, only on the main island. The species is still occasionally hunted.

European Turtle-dove *Streptopelia turtur* – This elusive breeder occurs in small numbers on the main island, where adult birds and juveniles were observed in the vicinity of the larger fields (Vinopolje, Lokavje, Prgovo). The species is usually present from mid-April until late August.

Eurasian Collared-dove ***Streptopelia decaocto*** – A single pair is present in the town of Pasadur, while individuals have also been observed and heard in the towns of Lastovo and Zaklopatica. The species is present year-round.

European Nightjar ***Caprimulgus europaeus*** – This species is fairly common on the main island and can often be seen sitting on the gravel or macadam roads during the night. Singing males were also heard on the islands of Mrčara and Sušac. The first individuals arrive at the end of April and singing males can be heard late into July.

Alpine Swift ***Tachymarptis melba*** – Two colonies were observed in the archipelago. One in the cliffs below the lighthouse of Lastovo, where 40 to 50 individuals were frequently present in late May, and a smaller colony in the cliffs below the lighthouse of Sušac. The species arrives in the first half of April and individuals are often seen drinking from the pond in the Lokavje field, usually in mixed flocks with other swift and hirundine species.

Pallid Swift ***Apus pallidus*** – The most 'common' swift species in the archipelago with breeding colonies on several islands, including Sušac, Bratin, Tajan, Petrovac, Veli Golubinjak and the main island of Lastovo. It is usually present between late April and late September.

Common Swift ***Apus apus*** – This species is mostly found on the main island, although a small colony also exists on the island of Pod Mrčaru. It arrives to Lastovo in April and individuals were observed until (and including) July.

Common Cuckoo ***Cuculus canorus*** – This species arrives to Lastovo during the first half of April and calling males can be heard until mid-June. It breeds in very low numbers, mostly in the wooded areas around the larger field complexes of Vinopolje and Prgovo, and the Aleppo Pine forest of north-western Lastovo and Prežba. One juvenile was seen in Vinopolje on 12.10.2022, but this could have been a (late) migrant individual as well.

Scopoli's Shearwater ***Calonectris diomedea*** – The species was found breeding on 16 islands in the archipelago, ranging from Sušac to the Lastovnjaci. In 2022, a total of 369 nests were found. The species arrives in late February, but incubation does not start until the very end of May, and the chicks finally fledge in October. On 16.04.2020 a raft of approximately 250 individuals was seen to the east between Tajan and Korčula.

Yelkouan Shearwater ***Puffinus yelkouan*** – Breeding is restricted to eight islands located (north)west of Lastovo. In 2022, a total of 569 nests were found. The species returns from its non-breeding grounds in November/ December and starts breeding in early March, after which it leaves again during the second half of July.

Mediterranean Shag ***Gulosis aristotelis desmarestii*** – Breeding shags were observed on at least 15 islands across the entire archipelago. The population is estimated at 30 to 50 breeding pairs, which mostly lay their eggs in January and

early February. Individuals were observed during the entire study period (early February - late October).

Audouin's Gull *Larus audouinii* – The censuses carried out between 2019 and 2023 recorded a total of 20 to 35 breeding pairs. The species changed its breeding locations almost annually and was seen nesting on 10 different islands across the archipelago, both west and east of Lastovo. Several GPS-tracked individuals were also observed to regularly visit the Italian side of the Adriatic, joining the colonies found in Brindisi (Liuzzi *et al.* 2023).

Yellow-legged Gull *Larus michahellis* – This species breeds on almost every island in the SPA and the breeding population between 2019 and 2022 was estimated to be around 1600 - 1700 pairs.

Common Tern *Sterna hirundo* – One small breeding colony (5 to 10 pairs) exists on one of the Vrhovnjaci islands. The next closest colony is found near the island of Korčula. This species is generally present between May and August, with adult birds still incubating in early June.

Little Owl *Athena noctua* – This is a very localized breeder on the main island. Two calling individuals were heard annually in the town of Lastovo, and very rarely the species was recorded elsewhere, such as the Vinopolje field in April 2024.

Eurasian Scops-owl *Otus scops* – The most common owl species on Lastovo. It is found across the main island, and has also been heard calling on Mrčara, Bratin and Kopište. The first individuals usually arrive at the beginning of April.

Northern Long-eared Owl *Asio otus - Although this species was not regularly recorded during this study, breeding was confirmed at the end of June 2021, when begging calls of chicks were heard on three different locations during a single night. One west of Prgovo field, one east of it, and a third along the macadam road which emerges from the main road near Zegovo polje. In 2022, begging chicks were also heard from the wooded hills south of Zaklopatica.

Eurasian Sparrowhawk *Accipiter nisus – While plenty of individuals migrate through Lastovo in both spring and autumn, several observations of adult birds were made each year during late spring and summer as well. For instance, on 12.06.2022 an adult male was seen flying over Vinopolje while carrying prey. Also, in July 2024, an adult male was observed near the Lokavje pond, successfully hunting a juvenile Barn Swallow.

Common Buzzard *Buteo buteo - In 2019, adult birds were seen carrying food to a nest in the forest south of Vinopolje on Lastovo, and in the same year, a nest with a chick was found in the forested slopes on the north of Sušac. On Lastovo there is very likely a second pair on the southeast of the island as birds were regularly observed above the hills around the fields of Lokavje and Zegovo, as well as towards the town of Skrivena Luka.

European Bee-eater ***Merops apiaster*** – This species arrives to Lastovo in the second half of April. There is one colony in the Prgovo field, which holds around 10 to 20 breeding pairs. While usually successful, breeding failed in 2024. The biggest flock observed was seen on 11.08.2021 when ~80 individuals (possibly migrants) were feeding above the Lokavje field.

Common Kestrel ***Falco tinnunculus*** – Several pairs are breeding on the island of Lastovo, as well as at least one pair on Sušac. Fighting individuals were also observed above Mrčara island.

Eleonora's Falcon ***Falco eleonorae*** – This species arrives to Lastovo during May, and during spring small groups of up to 10 birds can often be seen foraging above the field of Vinopolje. During a cliff mapping fieldwork in September 2021, around 15 pairs were counted on the island of Sušac, where the species was first discovered in 2011. In 2022, one nest with a chick was found on the southside of the island of Bratin. In 2023, a second pair started breeding, this time on the northern side of the island. Both pairs successfully raised a chick and in the same year, one new pair near the lighthouse on Lastovo raised two chicks as well. All new nests were active again in 2024. The population estimate for the entire archipelago is 15 to 25 pairs.

Peregrine Falcon ***Falco peregrinus*** – It starts breeding in February and is found across the Lastovo archipelago. The species bred annually on Sušac (1 to 2 pairs) and Lastovo (≥ 2 pairs) and regularly in the Lastovnjaci. For instance, in 2022, when a nest with a chick was found on Petrovac. Begging juvenile birds were also observed on Kopište during the spring of 2021.

Red-backed Shrike ***Lanius collurio*** – One of the last breeding species to arrive each year to Lastovo, usually from May onwards. Quite some individuals can be seen during passage, but only a few stay around to breed. Breeding pairs have been observed on the main island in the fields of Lokavje and Prgovo, as well as near the town of Skrivena Luka. Occasionally singing males were also seen in Vinopolje and Zegovo Polje.

Common Raven ***Corvus corax*** – This corvid breeds on the main island of Lastovo and on Sušac, with each island housing 1 to 2 pairs. Adult birds are on the eggs from late February. Individuals were also regularly seen on islands between Lastovo and Sušac (e.g. Kopište, Vlašnik, Mrčara).

Hooded Crow ***Corvus corone cornix*** – A common breeding species which is present year-round. The species mostly breeds on the main island, where many individuals are regularly visiting the island's landfill, but nesting also occurs on Mrčara, Bratin, Veli Maslovnjak and probably Kopište. It is also regularly associated with Yellow-legged Gull colonies, like for instance the one on Pod Kopište or those in the Vrhovnjaci.

Northern House Martin ***Delichon urbicum*** – Common breeder associated with towns on the main island. The largest colony (15 to 20 nests) is located along the main street (Pjevor) in the town of Lastovo, while smaller colonies were

found in the lower town of Lastovo, in Zaklopatica and Ubli. The first individuals arrive in the second half of March.

Red-rumped Swallow** ***Cecropis daurica – Although an actual nest of the species was not found, it is often seen in small numbers (2 to 4 individuals) above the town of Lastovo or drinking at the pond in the Lokavje field during late afternoons in spring and summer (April - July), mixed in flocks of Barn Swallow and House Martins. Adult birds feeding a fledged chick were also seen in September 2024.

Barn Swallow ***Hirundo rustica*** – Very common breeding bird on the main island, associated with towns and fields. The species also breeds in small numbers on the island of Sušac. Individuals can be seen from March to October.

Eurasian Blackcap ***Sylvia atricapilla*** – Very common breeding bird on the main island, which can be heard singing all day, even on hot summer days. It is also found on surrounding islands which contain a lot of woody vegetation, such as Mrčara. During autumn many hundreds can be seen in bushes surrounding agricultural fields due to large influxes of migrant individuals.

Sardinian Warbler ***Curruca melanocephala*** – Very common breeding species of bushes and shrubs found on many vegetated islands across the Lastovo archipelago (from Sušac to the Lastovnjaci). It's more elusive than the Subalpine Warbler, as singing individuals do not often perch atop bushes.

Subalpine Warbler ***Curruca cantillans*** – This species arrives to Lastovo at the end of March or the first days of April. It is a common breeder of bushes and shrubs in and near agricultural fields on the main island, as well as in more open areas with macchia. It is also present on some of the surrounding islands and on Sušac.

Eurasian Blackbird ***Turdus merula*** – Common breeder of wooded areas on Lastovo island, as well as on the surrounding woodier islands (e.g Mrčara) and Sušac. The species is present year-round.

Common Nightingale ***Luscinia megarhynchos*** – Common summer breeder on the main island of Lastovo, where it can be heard from thickets, shrubs and bushes surrounding nearly all agricultural fields. It arrives in April and singing individuals can be heard until early July.

White Wagtail** ***Motacilla alba – There are several breeding pairs on the main island, where nesting has been confirmed in the towns of Pasadur, Ubli and Zaklopatica. In the latter location, the observed pair was breeding in the top of a pine tree, and the nest was active for several consecutive years.

Common Chaffinch ***Fringilla coelebs*** – Very common breeding species, especially in the more wooded parts of the main island. Singing males were also recorded on the islands of Mrčara, Kručica and Sušac. The species is very likely also present on other woody islands, such as Kopište and Bratin.

European Greenfinch ***Chloris chloris*** – A few pairs are present on the main island, at least in the towns of Lastovo and Ubli and the nearby fields of Lokavje and Vinopolje respectively. It is often associated with cypresses.

Common Linnet ***Linaria cannabina*** – Regular breeder on Lastovo main island, often found perched on the electricity lines in the fields below the old town. Besides Lastovo, it was also found breeding on the islands of Zaklopatica and Veli Maslovnjak and is quite possibly present on a few more islands in the archipelago.

Cirl Bunting ***Emberiza cirlus*** – Breeding in very low numbers on the main island, where only a few breeding pairs have been observed in the fields of Lokavje and Prgovo.

Other noteworthy observations

Common Woodpigeon ***Columba palumbus*** – This species is generally a wintering bird for Lastovo, present on the island between October and March. However, one singing individual was heard on 02.06.2019 in the Aleppo Pine forest surrounding Vinopolje.

European Honey-buzzard ***Pernis apivorus*** – Secretive species for which it is hard to confirm breeding, also because it is generally a late migrant. However, several observations done during this study possibly suggest that the species has started to breed on Lastovo. The observations include a bird flying below the forest canopy along the road to Zaklopatica (16.07.2019), an adult male and female circling over Vinopolje before landing in the surrounding forests (15.06.2021), a perched bird seen in the woods along the road between Ubli and Lastovo (01.08.2023), and a few individuals seen flying over the wooded hills surrounding the Lokavje field in early summer (02 - 05.07.2024).

Common Stonechat ***Saxicola torquatus*** – This is a common wintering species on Lastovo, but on 25.03.2022 a pair was seen on the island of Sušac. The female had food in her beak and both birds did not move far from their perch when being approached. The habitat type was garrigue with plenty of Rosemary and Tree Heather. This species is known to do pair formations during stopovers (BWP1 2006), so it could just have been that.

Spanish Sparrow ***Passer hispaniolensis*** – No direct breeding was observed, but individuals and occasional small flocks are seen during spring and early summer. The majority of sightings was done during late April and May, when the species is also observed on neighbouring islands (even on Palagruža on 29.05.2021), but on the main island of Lastovo the species continues to be observed in small numbers during June and July, which could indicate the presence of a small breeding colony somewhere.

Migration of raptors and other soaring birds

A total of 17 migrant diurnal raptor species were observed during the study period. The most commonly observed species were the Western Marsh-harrier *Circus aeroginosus* (on 99 days) and the European Honey-buzzard (83 days). The largest single flock of European Honey-buzzards consisted of ~250 individuals and was observed near Zaklopatica at the end of August 2019. The biggest group observed during spring migration, 105 individuals, was seen near Zegovo polje on 05.05.2021. Marsh Harriers were usually observed migrating singly or in small groups (up to 5 birds), but a group of ~50 individuals was coming down to roost around Hum on 26.09.2023. On some days, both during spring and autumn, up to 25 Western Marsh-harriers could be observed passing Hum within one hour. During autumn, both species start arriving to Lastovo at the end of August, and while Honey-buzzard migration usually ceases at the end of September, Western Marsh-harrier can still be seen far into October. Other common migrant raptors that were regularly observed during short periods atop Hum were the Eurasian Sparrowhawk and Common Kestrel. All four species were also commonly observed passing over Sušac during their migration periods.

Migratory birds of prey that were annually recorded in the archipelago, but less frequently and often less numerous, include Black Kite *Milvus migrans*, Common Buzzard, Short-toed Snake-eagle, Montagu's Harrier *Circus pygargus*, and Hen Harrier *C. cyaneus*. Besides flying over, harriers were often seen making stopovers and hunting in the larger fields on Lastovo (Prgovo, Lokavje and Vinopolje), and on the island of Sušac. Eight other migrant raptor species were observed during this study, although less than annually (Supplementary Table 1). Among the observations was a group of three Red Kites *Milvus milvus* on 27.09.2023.

Besides raptors, other migrant soaring birds passing through the archipelago include cranes and storks. Although our study period does not cover most of the migration period for Common Crane, the species was observed annually during early spring, mostly in flocks of up to 20 individuals. Black Stork *Ciconia nigra* was also seen almost every year, though only during autumn, with the biggest group seen on 26.09.2023 (10 ind.).

At-sea observations

Between May 2019 and May 2021, a total of 192 sea transects were carried out around the SPA Lastovsko otočje, covering a total distance of 8273.6 km. Overall, 8791 birds were observed during 3725 observations. While 4957 individuals were identified to species level, belonging to 41 different species, the rest of the birds were identified to overarching species groups. The five most frequently observed taxa were all seabirds, first of all unidentified large gulls with 2795 individuals in 1380 observations (31.7% of all individuals seen), followed by Yellow-legged

Gull (1418 ind. in 985 obs.; 16.1 %), Scopoli's Shearwater (1197 ind. in 623 obs.; 13.6 %), Little Gull *Hydrocoleus minutus* (1110 ind. in 50 obs.; 12.6 %) and Yelkouan Shearwater (651 ind. in 210 obs.; 7.4 %). Other seabirds seen during the sea transects include the three other species breeding in the SPA Lastovsko otočje, namely Mediterranean Shag (33 ind.), Audouin's Gull (3) and Common Tern (3), as well as the Black Tern *Chlidonias niger* (110), Mediterranean Gull *Larus melanocephalus* (44) and Black-headed Gull *L. ridibundus* (5), Northern Fulmar (1) and an unidentified Storm Petrel (1).

Seabirds made up 87% of the birds observed, and the rest were waterbirds (e.g. herons, ducks, waders), raptors and other, mostly passerine, birds (e.g. wagtails, larks and hirundines). Among the most interesting sightings were Short-eared Owl *Asio flammeus*, European Nightjar, Woodlark *Lullula arborea*, Common Hoopoe *Upupa epops*, Black-necked Grebe *Podiceps nigricollis*, Common Shelduck *Tadorna tadorna* and Garganey *Spatula querquedula*. Nine species of raptors were observed, with Western Marsh-harrier and European Honey-buzzard being the most common ones, with flocks of up to 10 and 16 individuals respectively.

Table 1. Total number and percentage of observed (sea)birds seen feeding/foraging vs resting vs flying during the sea transects. The categories 'all birds' and 'seabirds' also include birds that were not identified to species level, but only to overarching species groups. In bold are the largest values for each 'species'.

Tablica 1. *Ukupan broj i postotak opaženih (morskih) ptica koje se hrane/traže hranu, odmaraju ili lete tijekom morskih transekata. Kategorije "sve ptice" i "morske ptice" uključuju i ptice koje nisu identificirane na razini vrste, već samo na razini* šire *skupine vrsta. Podebljane su najveće vrijednosti za svaku "vrstu".*

Species↓ Behaviour →	**Feeding/ foraging**		**Resting**		**Flying**	
All birds	2130	24%	2350	27%	4289	**49%**
Seabirds	2127	28%	2338	31%	3133	**41%**
Yellow-legged Gull	93	7%	319	22%	1004	**71%**
Scopoli's Shearwater	658	**56%**	406	34%	120	10%
Little Gull	605	**55%**	460	41%	45	4%
Yelkouan Shearwater	245	38%	270	**41%**	136	21%
Black tern	61	**60%**	2	2%	38	38%
Mediterranean Gull	0	0%	5	11%	39	**89%**
Black-headed Gull	0	0%	0	0%	5	**100%**
Common Tern	0	0%	1	33%	2	**67%**
Audouin's Gull	1	33%	1	33%	1	33%
Mediterranean Shag	3	9%	8	24%	22	**67%**
Great Cormorant	0	0%	0	0%	2	**100%**
Northern Fulmar	0	0%	0	0%	1	**100%**
Storm Petrel sp.	0	0%	0	0%	1	**100%**

The largest flocks were formed by gulls, especially Little Gulls. Of the six flocks recorded which had 100+ individuals, three were formed by Little Gulls, including the largest flock seen of around 275 individuals. The largest flocks observed which were not made up of gulls, consisted of Yelkouan Shearwater (65 ind.), larks (53 ind.) Scopoli's Shearwater (50 ind.) and Black Tern (40 ind.).

Considering the behaviour of all birds recorded, 49% of all observed individuals were flying by, while 27% were resting (incl. preening) on the water and 24% were actively foraging or feeding (Table 1). When considering only seabirds the percentages shift somewhat towards a more active usage of the sea, with 41% of the birds flying by, 31% resting, and 28% foraging or feeding. There is quite a large variation between individual seabird species in terms of their behaviour. Whereas most gull species were mostly observed flying, both Yelkouan and Scopoli's Shearwaters were more often seen resting or foraging (Table 1). Two of the species most often observed foraging were the migratory Little Gull (55% of the individuals) and Black Tern (60%).

DISCUSSION

As observed on many remote islands in the world, their breeding species assemblages can be fairly different from the nearest mainland sites. The same applies to Lastovo where several bird species are missing which are generally common breeders in most of Croatia (e.g. tits, woodpeckers, and Eurasian Jay). Although these species occasionally occur on the island during late autumn and winter, they do not stay to breed. During this study, a total of 39 breeding species were confirmed for the archipelago, which is higher than the number recorded in the mid-1960s (25; Krpan 1970), but lower than listed in 2011 (46; Budinski 2011). Species that were absent from Lastovo some decades ago, but which have become very common breeding birds since then are Common Pheasant, European Nightjar, Pallid Swift, Eurasian Scops-owl, Eurasian Blackcap, Common Nightingale, and Common Chaffinch. Other species that settled on the island, although more localized and in lower numbers are Eurasian Collared-dove, European Bee-eater, Eleonora's Falcon, Peregrine Falcon, Northern House Martin, European Greenfinch, and Cirl Bunting. Both the European Nightjar (a target species for the SPA) and the Eurasian Collared-dove are missing from the archipelago in the recent second edition of the European Breeding Bird Atlas (Keller *et al*. 2020), as is the Little Owl, despite it being listed as a breeding species for Lastovo already since the 1960s (Krpan 1970, Budinski 2011).

Of the five new breeding species confirmed for the archipelago, three are species of wooded habitats, namely Common Buzzard, Eurasian Sparrowhawk, and Northern Long-eared Owl. These were all common wintering birds on Lastovo in the mid-60s (Krpan 1970) and it fits the trend already observed by Budinski (2011), where former wintering bird species which prefer wooded habitats have

increasingly started nesting on Lastovo, such as Common Chaffinch and Eurasian Blackcap. Their initial wintering presence could have supported the expansion into these areas (Budinski *et al.* 2010). Our observation of a singing Common Woodpigeon in June could indicate another common wintering species that may start breeding on the island in the near future. The same is already observed on the Italian side of the Adriatic, on San Domino (Tremiti Islands), where the Common Woodpigeon started breeding in 2020, while before that being only a wintering species (Liuzzi, C. pers. comm.). Unlike the previously listed birds, the European Honey-buzzard does not winter on Lastovo, but instead goes to sub-Saharan Africa. Nevertheless, it is another woodland species which has possibly started to breed on Lastovo based on various observations during this study. The species has been breeding on the neighbouring island of Mljet already for many years (Jurinović *et al.* 2008), so a range expansion into Lastovo is a relatively small step.

The increase of woodland habitat on Lastovo is partially the result of abandoned agricultural fields which are becoming overgrown (Magaš 2021) as well as a decrease in shepherding practices. While this transition of habitat benefits woodland species, it is detrimental to species which favour more open (agricultural) habitats. Budinski (2011) already noticed the disappearance of Black-headed Bunting from the island, a common breeder several decades earlier (Krpan 1970). During our study only a few migratory individuals of this species were observed. Cirl Bunting is still breeding in small numbers on the island, as are the somewhat more abundant Red-backed Shrike and European Turtle-dove. All these species were mostly recorded breeding in or near the larger agricultural complexes that still remain on the island (Prgovo, Vinopolje, Lokavje). Woodchat Shrike *Lanius senator* was only recorded as a migratory species during our study, but previous records of its breeding on Lastovo are scarce or unclear. Krpan (1970) saw one individual in June, concluding the species was probably breeding. Čulina *et al.* (2008) also listed it as a breeding species (seen in multiple fields), but their study only covered an eight-day stay in May when the species still migrates as well.

The observed differences in breeding species compositions between previous studies and this study can be partially attributed to habitat changes, but other reasons for the discrepancies are 1) species that disappeared from Lastovo despite available suitable habitat; 2) irregular breeding species which are absent during some years; 3) species which have been incorrectly listed as breeding birds while on migration.

The first category includes generally common, relatively sedentary species such as Blue Rock-thrush *Monticola solitarius*, Rock Dove *Columba livia*, and House Sparrow *Passer domesticus* for which the available habitat has not changed on Lastovo over the last decades, and which were recorded both by Krpan (1970) and

Budinski (2011). In this study House Sparrow was observed only once in 2019 in the town of Lastovo, suggesting either a very small colony or its extinction. The old town of Lastovo also used to be a key breeding site for the Blue Rock-thrush, but during our study not a single individual was seen there. Only on very few occasions was the species observed along the coast of some islands (Lastovo, Sušac and Petrovac), but all these encounters were during autumn, more likely suggesting dispersion from other populations. Rock Doves were not observed at all during our study, while plenty of coast and cliffs were visited during the seabird census work. Some feral individuals are present on the island, mostly tied to very specific houses in the villages of Ubli and Lastovo, and on a few occasions ringed individuals (most likely racing pigeons) were seen.

The second group includes species only observed breeding on Lastovo during more recent studies (Čulina *et al.* 2008, Budinski 2011, Vrezec & Jernejc Kodrić 2021), however not during our study. These possibly incidental breeders include Short-toed Snake-eagle, Eurasian Eagle-owl, Tawny Owl, European Goldfinch *Carduelis carduelis*, and Rock Bunting *Emberiza cia*. Neither the Rock Bunting, nor the Eurasian Eagle-owl were observed on Lastovo during our study. The status of the Eagle-owl on the island is generally unclear. Krpan (1970) mentions the presence of the bird on Lastovo in February (during the breeding season), but concludes it is likely a wintering specimen. I. Budinski found the species near Skrivena Luka in 2008 (pers. comm.), but did not list it as a breeding bird either (Budinski 2011). Tawny Owl, on the other hand, was listed as a breeding bird for the islands of Lastovo and Mrčara (Budinski 2011; Vrezec & Jernejc Kodrič 2021) even though the species was long considered a wintering bird along the Croatian coast (Rucner 1998). Annual dedicated efforts to detect both Eurasian Eagle-owl and Tawny Owl during this study did not result in any observation of either species. Only a single specimen of Tawny Owl was flushed during the day on 20.08.2020 in Pržina field. There is still a chance the species persists on Mrčara, but that site was not checked. Goldfinches were observed on a few occasions during our study, but all observations except for one, were from March or the first week of April (often mixed in flocks with other finches), most likely concerning wintering individuals. Short-toed Eagles were seen annually on Lastovo, mostly during April and May, sometimes even two birds at a time, and while the behaviour of some individuals indicates actively visiting birds (e.g. long periods of hovering/ foraging), no breeding was observed.

The last group of species for which breeding could not be confirmed during our study includes various migratory passerines, namely Eurasian Golden Oriole *Oriolus oriolus*, Olive-tree Warbler, Common Whitethroat *Curruca communis*, Eastern Black-eared Wheatear *Oenanthe hispanica melanoleuca*, Tawny Pipit and Western Yellow Wagtail *Motacilla flava*. As previous surveys on Lastovo mostly consisted of relatively short visits (Krpan 1970, Čulina *et al*. 2008, Budinski 2011),

it is possible that these migrant species were incorrectly identified as breeding birds, especially as some species are either late migrants or have long migration seasons. During our study, Eurasian Golden Oriole was recorded only between late April and late May, including several vocal individuals, but the species does not persist into June and July. Migration of the species until late May has also been recorded on other Mediterranean islands where the species does not actually breed (Dimaki *et al.* 2019). Two species with long migration seasons are the Common Whitethroat and Western Yellow Wagtail (BWPi 2006). We frequently observed Common Whitethroats on Lastovo during migration in April, May, late August and September, but not a single bird was singing or showing territorial behaviour. The species is generally considered rare on southern islands in Croatia (Rucner 1998), and our observations are in line with the status of Common Whitethroat on other nearby islands such as Vis (Krpan 1962) and Tremiti (Brichetti *et al.* 1988). For the Western Yellow Wagtail breeding was suggested for grassy islands with gull colonies, such as the Vrhovnjaci (Budinski 2011). Although individuals were indeed regularly observed during biweekly visits to those islands between February and June (including the *feldegg* ssp.), breeding was never recorded. The Eastern Black-eared Wheatear and Tawny Pipit were also recorded annually, but only during relatively short periods while on migration. Both species require very open, quite barren habitat with rock formations (Rucner 1998). Open habitat on Lastovo is generally grassier and even in the mid-1960s when more open habitat was available on the island (Magaš 2021), breeding of neither species was recorded (Krpan 1970). Lastly, no Olive-tree Warblers were observed during our study and previously it has also only been listed as a possible breeder based on few singing male observations (Čulina *et al.* 2008, Budinski 2011).

Implications for the SPA Lastovsko otočje

Based on our six-year study, the Tawny Pipit and Olive-tree Warbler should be removed as target species from the SPA Lastovsko otočje. For both species proof of their historical breeding is missing, and for Tawny Pipit the habitat has most likely never been suitable. On the contrary, adding the globally endangered European Turtle-dove to the list of target species (5-10 pairs) should be considered as a small breeding population has always been present. For Red-backed Shrike the current conservation target of 300-400 pairs is unrealistic since the species was never that abundant on Lastovo, even when the habitat was more open (Krpan 1970, Budinski 2011). A goal of 30-40 breeding pairs is much more realistic. At the same time, population targets for Eleonora's Falcon, Mediterranean Shag, and especially Yelkouan Shearwater should be increased. Eleonora Falcon seems to be increasing in number and to spread eastwards in the archipelago, while populations of Mediterranean Shag and Yelkouan Shearwater were likely underestimated before. We suggest setting the targets at 15-25 pairs, 30-50

pairs and 569-1100 pairs respectively for these species. Yelkouan Shearwater also greatly benefited from the rat control work carried out as part of LIFE Artina, and it is crucial that these efforts continue to be conducted to keep the positive trend. Two seabird species whose current breeding populations are below their conservation targets are Common Tern and Audouin's Gull. While the goals are good, both species are affected by negative interactions with the much more abundant and dominant Yellow-legged Gull. Audouin's Gulls also change their breeding locations regularly and the same population moves between Lastovo, Mljet and even the Italian side of the Adriatic (Liuzzi *et al.* 2023). Populations of the remaining four SPA target species - European Nightjar, Scopoli's Shearwater, Short-toed Eagle, Peregrine Falcon - are in line with the current conservation goals set out for them (Natura 2000 reference portal (2024).

Besides targets for breeding species, SPA Lastovsko otočje is also important for migratory Common Crane and European Honey-buzzard using the Adriatic Flyway. Our study does not suffice to comment on these numbers as it did not cover the main (autumn) migration period for cranes (Adojaan *et al*. 2019), nor were any systematic migration counts carried out for other soaring birds. Our opportunistic efforts did, nevertheless, register 17 raptor species on passage, including especially many observations of Western Marsh-harriers. GPS-tracking studies further reveal the regular use of this migration route by Ospreys *Pandion haliaetus* breeding in Finland and the Baltic States (Adojaan *et al*. 2019, Laji 2024).

Our study also shows the importance of the surrounding sea area for migratory seabirds, in particular Little Gull and Black Tern, which were mostly seen foraging or resting. Little Gull was the fourth most observed species during the sea transects with 1110 individuals observed, accounting for 0.7-1.1% of the European breeding population (Birdlife International 2021). This passage happens mostly outside the existing borders of SPA Lastovsko otočje. Zec *et al.* (2023) propose to expand the borders of the protected area and to designate a new marine SPA between Lastovo and Korčula based on the analyses of foraging movements of locally breeding Yelkouan and Scopoli's Shearwater, as well as Audouin's Gull. Based on our results, Little Gull should be added as a migratory target species for conservation for this new SPA.

Recommendations for further study

Future ornithological studies in the Lastovo archipelago should primarly focus on quantifying the migration, especially of migratory raptors and other soaring species. Despite the increase in GPS-tracked birds (Adojaan *et al*. 2019, Tomik *et al.* 2019, Škrábal *et al.* 2023, 2024, Laji 2024), still relatively little is known about the species using this route, and less so about the magnitudes of their migrations. This is becoming even more important in current times which see an increase in the development of (offshore) renewable energy infrastructure. Ideally, both spring and

autumn migration are covered, although the wind conditions seem more favourable for sea crossing migrants during autumn (Škrábal *et al.* 2024). The migration counts could be supported by the use of radar technology. Several geographical features in the archipelago provide good opportunities for observing and monitoring migrant birds. For instance, in spring migratory soaring birds often arrive to the two south-facing peninsulas on the main island of Lastovo. The peak of Hum provides good panoramic views of most of the main island making it easy to detect birds and their flight paths. The area around the lighthouse on Sušac is another good location for observing migration as the site is elevated, and in autumn, birds naturally funnel there due to the island's north-south positioning whereby it gradually becomes narrower towards its southern tip.

Besides counts from vantage points, the 'island-in-island' effect (i.e. the sea surrounding the island, on which woodland habitat surrounds the (agricultural) fields, which themselves are positioned around a couple of freshwater ponds) naturally concentrates many migratory species to quite constricted areas, which makes good opportunities for standardized mist netting efforts. Monitoring nocturnal migration via acoustic studies is another good option as Lastovo has relatively little noise and light pollution.

Lastly, as our study did not cover the winter months, future studies should fill the knowledge gaps for wintering species, not only in terms of species compositions, but more importantly in terms of abundances. For instance for the Common Kingfisher, which was observed in many bays in the archipelago during autumn. Also, additional systematic boat surveys are needed between November and February in order to get full-year coverage of at-sea distributions of seabird species, as well as possible wintering concentrations.

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Supplementary Information

The online version contains supplementary material available at https://hrcak.srce.hr/supplement/787

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SAŽETAK

Lastovsko otočje obuhvaća 46 udaljenih otoka srednjeg Jadrana, a zaštićeno je u kategoriji parka prirode i kao područje ekološke mreže Natura 2000 - područje očuvanja ptica (POP) te područje očuvanja vrsta i staništa (POVS). POP je važan za dvanaest vrsta ptica gnjezdarica, uključujući nekoliko globalno ugroženih morskih ptica. Otoci su dio jadranskog preletničkog puta te pružaju mogućnost hranjenja i odmora migratornim vrstama pri prelasku Jadranskog mora između poluotoka Gargano u Italiji i hrvatskog kopna. Na temelju opažanja ptica koja su prikupljena tijekom 618 dana u periodu 2019. – 2024. izrađen je popis opažanja. Uz navedeni popis, u sklopu projekta LIFE Artina, između svibnja 2019. i svibnja 2021. provedena su 192 standardizirana istraživanja s broda u okolici POP-a. Skup podataka o morskim transektima dostupan je u otvorenoj bazi podataka "Global Biodiversity Information Facility". Ukupno je zabilježeno 179 vrsta ptica, čime je ukupan broj zabilježenih vrsta na otočju porastao na 199. Promatranja uključuju devet rijetkih vrsta ptica, među kojima je i prvo opažanje burnjaka *Fulmarus glacialis* na Jadranu. Utvrđeno je 39 gnjezdarica, od kojih je njih pet novih za otočje: mala ušara *Asio otus*, kobac *Accipiter nisus*, škanjac *Buteo buteo*, daurska lastavica *Cecropis daurica* i bijela pastirica *Motacilla alba*. Međutim, gnijezdeći status za 16 vrsta, koje su ranije navođene kao gnjezdarice, nije potvrđen. To se odnosi i na ciljne vrste POP-a primorsku trepteljku *Anthus campestris* i voljića maslinara *Hippolais olivetorum*. Dok se uočene razlike u sastavu gnjezdarica između prethodnih studija i naše studije mogu potencijalno pripisati promjenama u staništu (otoci postaju sve šumovitiji), drugi mogući razlozi odstupanja su: 1) izumrle vrste unatoč dostupnosti odgovarajućeg staništa; 2) neredovite gnjezdarice; 3) migratorne vrste koje su prethodno netočno navedene kao gnjezdarice. Na temelju studije predlažemo reviziju dijela ciljeva očuvanja za POP Lastovsko otočje. S popisa ciljnih vrsta trebalo bi ukloniti primorsku trepteljku i voljića maslinara jer njihovo gniježđenje nikada nije bilo potvrđeno. Umjesto toga, trebalo bi razmotriti dodavanje grlice *Streptopelia turtur* među ciljne vrste jer njena brojnost opada na globalnoj razini, a na Lastovu je već dugo prisutna s 5-10 parova. Cilj očuvanja za rusog svračka *Lanius collurio* trebao bi se smanjiti na 30-40 parova (10% trenutnog cilja), dok bi se ciljevi za eleonorina sokola *Falco eleonorae*, morskog vranca *Gulosis aristotelis desmarestii* i gregulu *Puffinus yelkouan* trebali povećati na 15-25, 30-50 i 569-1100 parova. Iako prikupljeni podaci nisu dovoljni za preciznije procjene brojnosti preletnica koje sele koristeći termale i prelijeću otočje, ona ukazuju na značajan broj preleta eje močvarice *Circus aeroginosus*, uz već poznatog škanjca osaša *Pernis apivorus*. Dodatno, tijekom istraživanja na moru, utvrđena je važnost okolnog mora za različite migratorne vrste. Tijekom provedbe morskih transekata opaženo je 8791 jedinki, ukupno 41 vrste ptica. Velik broj malih galebova *Hydrocoleus minutus* (oko 1% europske populacije) koristi more oko Lastovskog otočja za hranjenje i odmor tijekom proljetne selidbe

te predlažemo njegovo dodavanje na popis ciljnih vrsta potencijalnog budućeg morskog POP-a. Preporučuje se provedba detaljnijih istraživanja na ovom području, kako bi se bolje kvantificirala selidba nekoliko ključnih vrsta, na primjer organiziranim prebrojavanjem preletnica koje koriste termale (moguće u kombinaciji s korištenjem radara), zvukovnim praćenjem noćne selidbe ili standardiziranim hvatanjem ptica ornitološkim mreža. Osim Lastova, za takva istraživanja mogao bi se u obzir uzeti i otok Sušac zbog njegovog položaja u prostoru - od šireg sjevera prema užem jugu. Također, potrebno je provesti dodatna istraživanja tijekom zime, posebno na moru, kako bi se prikupio veći broj podataka i za to razdoblje.