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OWLS ON THE ADRIATIC ISLAND OF LASTOVO AND THE DIET OF THE TAWNY OWL *Strix aluco* (SOUTHERN DALMATIA, CROATIA)

Sove Lastova i ishrana šumske sove Strix aluco (Južna Dalmacija, Hrvatska)

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ABSTRACT

This paper reviews the owl fauna of the remote Adriatic island of Lastovo and its archipelago, and reports for the first time on the Tawny Owl *Strix aluco* diet analysis from the Lastovo island. In the field survey on Lastovo and the islet of Mrčara in July 2017, the occurrence of four owl species was confirmed: the Eurasian Scops *Otus scops*, the Little *Athene noctua*, the Long-eared *Asio otus* and the Tawny Owl, while the occurrence of the Eagle Owl *Bubo bubo* is uncertain according to the literature review. The most frequently recorded owl species was the Eurasian Scops Owl. The successful breeding of the Tawny Owl on Lastovo was confirmed for the first time. Its diet was dominated by mammals, with 97% of prey by number, and 99% by biomass. By far the most common prey was the Long-tailed Field Mouse *Apodemus sylvaticus*, as well as the Black Rat *Rattus rattus* in terms of biomass. Birds were of marginal importance as prey of the Tawny Owl, at least in the summer months.

Keywords: owls, Lastovo island, Tawny Owl, diet, small mammals

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INTRODUCTION

Nocturnal raptors of remote Adriatic islands are still poorly known. The most commonly reported owl species are the Eurasian Scops Owl *Otus scops,* the Little Owl *Athene noctua* and the Eurasian Eagle Owl *Bubo bubo*. Contrary to this, reports of breeding pairs for the Barn *Tyto alba* and the Tawny Owl *Strix aluco* are scarce (Rucner 1998, Bordjan 2002, Janžekovič & Kryštufek 2005, Bordjan & Rozoničnik 2010). Other species are quite seldomly reported during migration or as vagrants, i.e. the Long-eared Owl *Asio otus* (Vrezec & Vrezec 2017), the Boreal Owl *Aegolius funereus* (Denac & Vrezec 2005), and the Ural Owl *Strix uralensis* (Štumberger 2000). Here we report on owls from one of the most remote Adriatic islands, the island of Lastovo, which is situated 26 km from the mainland and 13 km from the nearest larger island. This distance across open sea is hardly manageable for the majority of non-migratory owl species.

Owls are mainly predators of small mammals and heavily depend on their populations. However, Kryštufek & Kletečki (2007) reported that small mammal fauna on the Adriatic islands lacks voles (Arvicolinae), which are the main prey for the majority of owls in mainland Europe (Mikkola 1983). Moreover, in the diet of the Barn Owl from the island of Korčula, the introduced and synantropic small mammals predominated (Janžekovič & Kryštufek 2005), indicating the lack of suitable prey in non-anthropogenic environments. Among the islands in the southern Adriatic, Lastovo was reported to have low diversity in small mammal community - only five species that can potentially be preyed upon by the most of the owl species (Kryštufek & Kletečki 2007).

Our aim was to review the owl fauna of the remote Lastovo Island with the adjacent islets. This survey is based both on the published and on the newly acquired information. Furthermore, we provide first data on owl diet on the island, which is based on classical pellet analysis.

STUDY AREA AND METHODS

The island of Lastovo (42°45'N, 16°52'E) is one of the most remote inhabited island in the Adriatic Sea, situated along the coast of South Dalmatia with the surface of 40.8 km^2 (Duplančić Leder *et al.* 2004). The climate is Mediterranean with mean monthly temperatures ranging from -1.2 to 34.8°C, mean annual temperature being 15.8°C, with the average annual precipitation of 666 mm (Bonacci 2019). The island is rich in subterranean freshwater sources. The landscape is karstic ranging from sea level up to 417 m a.s.l. at Sv. Juraj (Buljan *et al.* 2006). Characteristic for the area are karst poljes. The Lastovo Island is one of the most forested islands among the Adriatic islands. Forests extend also to some close islets like Prežba and Mrčara (Riđanović 1972). The main tree species are *Pinus halepensis* and *Quercus ilex*, while in maquis shrubland, *Quercus ilex* and *Rosma-*

rinus officinalis predominate (Trinajstić 1968). There are five smaller settlements on the island with 800 inhabitants, but the number of people fluctuates seasonally. In the summer tourist season, the number of people on the island increases significantly to 2500 (Buljan *et al*. 2006). A unique but impoverished insular fauna was recorded on the island (Trilar & Bedjanič 1999, Vervust *et al.* 2009, Koren & Lauš 2020), with only seven species of mammals (Janžekovič & Kryštufek 2005, Kryštufek & Kletečki 2007): *Erinaceus roumanicus, Crocidura suoveolens, Rattus rattus, Apodemus sylvaticus, Mus musculus, Eliomys quercinus* and *Martes foina*.

We conducted field research during night and daytime observations in July 2017 on the main island, as well as on the nearby islet of Mrčara. Owls were recorded from vocalising individuals and by searching for pellets and discarded feathers. Additional data were extracted from the recent European Breeding Bird Atlas (Keller *et al.* 2020), and from the online global bird database eBird (https://ebird.org/).We analysed the pellets in the laboratory following standard procedure. For the identification of osteological and feather remains, we used the reference collection of the Slovenian Museum of Natural History.

RESULTS AND DISCUSSION

The owl fauna

The existing data review revealed that owl assemblage on the island of Lastovo and its archipelago is extremely poorly known. In his overview of birds of the Adriatic coast, Rucner (1998) did not mention any owl species for Lastovo. The global eBird database included only two records for the Eurasian Scops Owl from the villages Lastovo (date 1.6.2016; observer Gareth Jones) and Pasadur (date 1.5.2019; observer Martin Austad), while the European Breeding Bird Atlas (Keller *et al.* 2020) marked for Lastovo only the Eurasian Scops and possibly the Eagle Owl (Table 1). The status of the Eagle Owl is unclear, since the resolution of the European Breeding Bird Atlas is insufficient to be certain about the species occurrence in the Lastovo archipelago, although the species breed on the nearby islands of Korčula and Mljet (Rucner 1998, B. Kryštufek pers. comm., own data).

The field observational study on the island of Lastovo and the islet of Mrčara was made between 10th and 20th July 2017, when 10 records of four owl species were obtained (Table 1).

Table 1. A summary of owls occurring in the Lastovo Archipelago based on existing and field data. The status indicates owl breeding (B) and non-breeding status (NB).

Tablica 1. *Pregled pojavljivanja sova na Lastovskom otočju temeljem postojećih i terenskih podataka. Status prikazuje je li vrsta gnjezdarica (B) ili negnjezdarica (NB).*

Owl species	Status	European Breeding Bird Atlas 2 (Keller *et al.* 2020)	eBird database (accessed on 23 March 2021)	Field data (July 2017)
Little Owl *Athene noctua*	B			x
Eurasian Scops Owl *Otus scops*	B	x	x	x
Long-eared Owl *Asio otus*	NB			x
Tawny Owl *Strix aluco*	B			x
Eagle Owl *Bubo bubo*	B?	x		

The Little and the Tawny Owl are reported for the Lastovo archipelago for the first time. The Long-eared Owl was already reported earlier by Vrezec & Vrezec (2017). The most frequently recorded owl species was the Eurasian Scops Owl, a migratory species of which the bulk of European population was recorded in Southern Dalmatia (Vrezec 2001). The species was recorded on Lastovo and Mrčara (Figure 1), but is probably more widespread across the island. The Little Owl was found less widespread than the Scops Owl, with vocalising birds recorded on Lastovo and Mrčara (Figure 1). The Little Owl is a common owl found on the Adriatic islands (Rucner 1998), and it occurs in the area of Southern Dalmatia, e.g. on the Pelješac Peninsula (Vrezec 2000). The rarest owl breeder found was the Tawny Owl, which was found in a Pine wood near Skrivena Luka in the south of the island of Lastovo (Figure 1). In the wood, the pellets and downy feathers of young were found, indicating that the Tawny Owl was successfully breeding on the island. The Tawny Owl is an extremely rare owl species on the Adriatic islands reported from the islands of Krk, Cres, Brač, and Mljet (Rucner 1998, Kralj *et al.* 2013), indicating that the species is recently spreading due to population increase on the mainland (Budinski *et al*. 2010). Despite its low mean dispersal power (<20 km; Valkama *et al.* 2014), it is apparently capable of colonising even the remote Adriatic islands and breeding there successfully. The Long-eared Owl was recorded only on the islet of Mrčara (Figure 1), where several feathers were found. The find indicates the species was on the island only on migration or wintering but not breeding (Vrezec & Vrezec 2017). The island of Lastovo is an important step stone on the Adriatic flyway for migrating diurnal raptors (Schneider-Jacoby 2001), and apparently for nocturnal raptors as

well. Besides the Long-eared Owl, the Short-eared Owl *Asio flammeus* would be expected on migration since the species is known to migrate across the sea, and migrants were for example also found on the remote Canary Islands (Valkama *et al.* 2014).

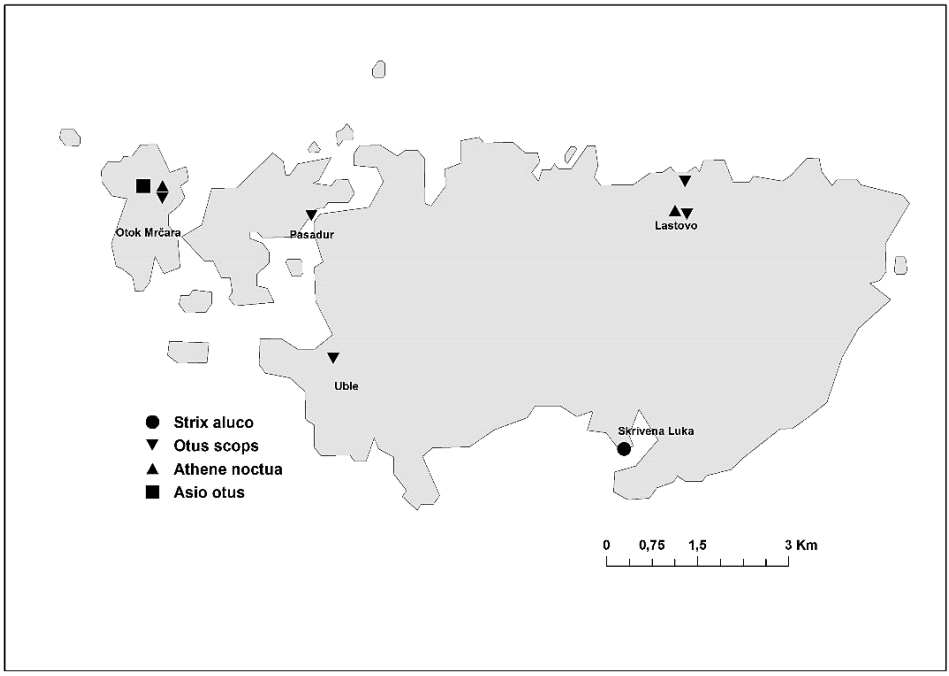

Figure 1. Sites of owl records from the island of Lastovo and the islet of Mrčara collected in the period 2016–2019.

Slika 1. *Mjesta bilježenja sova na otocima Lastovo i Mrčara u razdoblju od 2016. do 2019. godine.*

The diet of the Tawny Owl

Successful breeding of the Tawny Owl on the Lastovo island is probably the most noteworthy find. We may speculate from the data from Southern Dalmatia that this bird is a newcomer to the island. As a generalist predator, the Tawny Owl can affect the owl community in general, especially the smaller species (Vrezec & Tome 2004, Zuberogoitia *et al.* 2005, Sergio *et al.* 2009). In July 2017, we collected 41 complete and some partial pellets under the roost of young owls in the Pine wood near Skrivena Luka. The average length of pellets was 43.0 ± 9.0 mm (max 64.3 mm), the width was 19.9 ± 2.7 mm (max 26.7 mm), and the height was 16.1 ± 2.5 mm (max 22.4 mm). There was on average 1.5 ± 0.8 (max 4) prey items per pellet. We extracted altogether 61 prey items. The mammal prey

dominated with 97 % of individuals and 99 % of biomass (Table 2). There were only two bird remains found - of the size of small passerine, and no insects. By far the most frequent prey was the Long-tailed Field Mouse *Apodemus sylvaticus*. The Black Rat *Rattus rattus* presented a significant portion of the diet too, at least when considering the biomass. There was no Edible Dormouse *Glis glis* taken, although the species was recorded in the island woods during field observations and since dormice are also frequently taken prey by Tawny Owls on the mainland (Tutiš 1986, Lipej & Gjerkeš 1996, Obuch 2011).

Table 2. The diet of the Tawny Owl *Strix aluco* on the Lastovo island near Skrivena Luka in July 2017 (for the biomass calculation the average weight was taken for *Apodemus sylvaticus* 23 g, *Rattus rattus* 177 g, and *Sylvia cantillans* 12 g; Kryštufek & Janžekovič 1999). N – number of items, B – biomass.

Tablica 2. *Prehrana* šumske *sove Strix aluco na otoku Lastovu pokraj Skrivene Luke u srpnju 2017. godine (za izračun biomase korištena je prosječna masa za Apodemus sylvaticus 23 g, Rattus rattus 177 g, i Sylvia cantillans 12 g; Kryštufek & Janžekovič 1999). N – broj primjeraka, B – biomasa.*

Prey species	N	N (%)	B (g)	B (%)
Apodemus sylvaticus	52	85.2	1196	58.6
Rattus rattus	7	11.5	819	40.2
Sylvia cantillans	2	3.3	24	1.2
Total	61	100.0	2039	100.0

Compared to Kryštufek & Kletečki (2007), our field observations added one species to the small mammal fauna of Lastovo - the Edible Dormouse. The absence of dormice from the Tawny Owl diet might indicate their low abundance on the island. It seems that the Tawny Owl relied on an abundant Long-tailed Field Mouse population, as well as on the introduced Black Rat; and low diversity of prey items indicates high population densities of both main prey species. The less profitable alternative prey, i.e. birds, presented only an insignificant part of the diet. We may conclude that despite the low diversity of small mammal assemblage on the island, the population at least of mice is abundant enough to sustain the breeding of the Tawny Owl on the remote Lastovo Island. With a further increase in the Tawny Owl population on the mainland, the colonisation of the Adriatic islands will probably continue, and the island population of the Tawny Owl will increase. There is however no monitoring of small mammal populations present either on the islands or on the mainland in Southern Dalmatia, which could confirm such trends, but increasing mice and rat popula-

tions due to garbage increase and other resource inputs might have a key role in cascading trophic effects across food chain on the islands. With the Tawny Owl, we might further expect an increase in other small mammal eating predators like the Eagle Owl, a superpredator species that can limit the Tawny Owl spread and population increase (Sergio *et al.* 2007). However, all these changes might have a detrimental effect on the island strongholds of other smaller species, especially of the Eurasian Scops and Little Owl (Budinski *et al.* 2010). Further studies of owl assemblages in connection with monitoring of owls and their small mammal prey are highly needed if certain conservation actions in connection with resource management (i.e. landfill regulations) are to take place.

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References

Bonacci, O. (2019): Air temperature and precipitation analyses on a small Mediterranean island: the case of the remote island of Lastovo (Adriatic Sea, Croatia). Acta hydrotechnica 32/57: 135-150.

Bordjan, D. (2002): Density of the singing Eagle Owl *Bubo bubo* males on the island of Dugi otok (N Dalmatia, Croatia). Acrocephalus 23 (115): 189-191.

Bordjan, D., Rozoničnik, A. (2010): Breeding density of the Scops Owl *Otus scops* in urban settlements on the island of Brač (Central Dalmatia). Acrocephalus 31 (144): 15-20. doi: 10.2478/v10100-010-0002-9

Budinski, I., Čulina, A., Mikulić, K., Jurinović, L. (2010): Bird species that have significantly changed breeding range on Croatian coastal area: comparison of 30 years old data and recent knowledge. Bird Census News 23: 49-58.

Buljan, R., Marković, T., Zelenika, M. (2006): Vodonosnik zapadnog dijela Prgovog polja na otoku Lastovu. Rudarsko-geološko-naftni zbornik 18: 15-27.

Denac, D., Vrezec, A. (2005): Tengmalm's Owl *Aegolius funereus* found in bare karst area of Pag island (N Dalmatia, Croatia). Acrocephalus 26 (127): 187-190.

Duplančić Leder, T., Ujević, T., Čala, M. (2004): Coastline lengths and areas of islands in the Croatian part of the Adriatic Sea determined from the topographic maps at the scale of 1 : 25 000. Geoadria 9: 5-32.

Janžekovič, F., Kryštufek, B. (2005): Non-volant terrestrial mammals (Mamalia) on the Adriatic island of Korčula. Annales 15: 121-128.

Keller, V., Herrando, S., Voříšek, P., Franch, M., Kipson, M., Milanesi, P., Marti, D., Anton, M., Klvanova, A., Kalyakin, M.V., Bauer, H.G., Foppen, R.P.B., eds. (2020): European Breeding Bird Atlas 2. Lynx Edicions, Barcelona.

Koren, T., Lauš, B. (2020): Butterflies (Lepidoptera: Papilionoidea) of the Lastovo archipelago, Croatia. Entomologist's Gazette 71: 61-67. doi: 10.31184/G00138894.711.1746

Kralj, J., Baršić, S., Tutiš, V., Ćiković, D., eds. (2013): Atlas selidbe ptica Hrvatske. HAZU, Zavod za ornitologiju, Zagreb.

Kryštufek, B., Janžekovič, F., eds. (1999): Ključ za določanje vretenčarjev Slovenije. DZS, Ljubljana.

Kryštufek, B., Kletečki, E. (2007): Biogeography of small terrestrial vertebrates on the Adriatic landbridge islands. Folia Zoologica 56: 225-234.

Lipej, L., Gjerkeš, M. (1996): Diet of the Tawny Owl *(Strix aluco)* in the Karst environment near Škocjanske jame (SW Slovenia). Acta Carsologica 15: 351-363.

Mikkola, H. (1983): Owls of Europe. T & AD Poyser, Calton.

Obuch, J. (2011): Spatial and temporal diversity of the diet of the tawny owl *(Strix aluco)*. Slovak Raptor Journal 5: 1-120. doi: 10.2478/v10262-012-0057-8.

Riđanović, J. (1972): Prirodno-geografske značajke otoka Lastova. Geografski glasnik 33/34: 159-175.

Rucner, D. (1998): Ptice hrvatske obale Jadrana. Hrvatski prirodoslovni muzej, Ministarstvo razvitka i obnove, Zagreb.

Schneider-Jacoby, M. (2001): Lastovo – a new bottleneck site for the migratory Honey Buzzards *Pernis apivorus*? Acrocephalus 22 (108): 163-165.

Sergio, F., Marchesi, L., Pedrini, P., Penteriani, V. (2007): Coexistence of a generalist owl with its intraguild predator: distance-sensitive or habitat-mediated avoidance? Animal Behaviour 74: 1607-1616. doi:10.1016/j.anbehav.2006.10.022

Sergio, F., Marchesi, L., Pedrini, P. (2009): Conservation of Scops Owl *Otus scops* in the Alps: relationships with grassland management, predation risk and wider biodiversity. Ibis 151: 40–50.

Štumberger, B. (2000): Kozača *Strix uralensis*. Acrocephalus 21 (98/99): 93.

Trilar, T., Bedjanič, M. (1999): Contribution to the knowledge of the dragonfly fauna of Lastovo island, Dalmatia, southern Croatia. Exuviae 6: 1-6.

Trinajstić, I. (1968): Šumska vegetacija otoka Lastova. Acta Botanica Croatica 26/27: 43-51.

Tutiš V. (1986): Sisavci zapadnog dijela Karlovačkog Pokuplja i njihova uloga u ishrani nekih sova. Diplomski rad. Sveučilište u Zagrebu, Zagreb.

Valkama, J., Saurola P., Lehikoinen A., Lehikoinen E., Piha M., Sola P., Velmala W. (2014): The Finnish Bird Ringing Atlas. Volume II. LUOMUS - Finnish Museum of Natural History, Helsinki.

Vervust, B., Grbac, I., Brecko, J., Tvrtković, N., Van Damme, R. (2009): Distribution of reptiles and amphibians in the nature park Lastovo Archipelago: possible underlying biotic and abiotic causes. Natura Croatica 18: 113–127.

Vrezec, A. (2000): Veliki skovik *Otus scops* in čuk *Athene noctua*. Acrocephalus 21 (98-99): 85.

Vrezec, A. (2001): The breeding density of Eurasian Scops Owl *Otus scops* in urban areas of Pelješac Peninsula in southern Dalmatia. Acrocephalus 22 (108): 149-154.

Vrezec, A., Tome, D. (2004): Habitat selection and patterns of distribution in a hierarchic forest owl guild. Ornis Fennica 81: 109-118.

Vrezec, E., Vrezec, A. (2017): Mala uharica *Asio otus*. Acrocephalus 38 (172/173): 73-74.

Zuberogoitia, I., Martinez, J. A., Zabala, J., Martinez, J. E. (2005): Interspecific aggression and nest-site competition in a European owl community. Journal of Raptor Research 39: 156-159.

SAŽETAK

Rad donosi pregled faune sova jadranskog otoka Lastova i njegovog arhipelaga, a prvi put je prikazana analiza prehrane šumske sove *Strix aluco* s otoka Lastova. Terenskim istraživanjem na Lastovu i otočiću Mrčara u srpnju 2017. godine potvrđena je pojava četiri vrste sova: ćuk *Otus scops*, sivi ćuk *Athene noctua*, mala ušara *Asio otus* i šumska sova, dok je ušara *Bubo bubo* temeljem literature nesigurna vrsta. Najčešće zabilježena vrsta sove bio je ćuk. Po prvi put je potvrđeno uspješno gniježđenje šumske sove na Lastovu. U prehrani šumske sove sisavci su prevladavali s 97% plijena brojnošću i 99% biomasom. Daleko najčešći plijen bio je šumski miš *Apodemus sylvaticus*, a s obzirom na biomasu i kućni štakor *Rattus rattus*. Utvrđeno je da su ptice samo od rubne važnosti kao plijena šumske sove na otoku, barem u ljetnom razdoblju.