PREDATOR MANAGEMENT AND BIOSECURITY REPORT FOR SPA LASTOVSKO OTOČJE

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LIFE Artina, Association Biom (BirdLife Croatia)

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Seabird Conservation Network in the Adriatic

Action C.2: Implement effective predator management and/ or biosecurity across all targeted sites with seabird colonies where this management is necessary and feasible.

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PREDATOR MANAGMENT AND BIOSECURITY REPORT FOR SPA LASTOVSKO OTOČJE

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Front cover illustration: A Yelkouan shearwater egg found during a nest check on Sušac in May 2019, with signs of rat predation. Martin Austad

This report is part of Action C.2: Implement effective predator management and/ or biosecurity across all targeted sites with seabird colonies where this management is necessary and feasible

Contents

1. INTRODUCTION

Islands are known to be great places for evolutionary studies, just as for the general lack of predatory mammals. Species evolving in such places usually develop, island tameness, where they lose the anti-predator behavior due to the island insolation. Yelkouan and Scopoli's shearwater are some of those birds affected with island tameness. Introduced, invasive brown (*Rattus norvegicus*) and black rats (*Rattus rattus*) can have serious impact on many such species, among them small to medium-sized seabirds (Towns et al. 2006). Black rats are known to be the major invasive species associated with seabird declines in the Mediterranean (Martin et al. 2000) and both Yelkouan and Scopoli's shearwater are known to be affected by them (Bourgeois & Vidal 2008). Rats are known to readily predate on seabird eggs, chicks and even the adults of smaller species (Jones et al. 2008). One of the methods of improving the status of burrowing seabirds is complete rat eradication from islands they nest on, which has proven to improve the survival rates of nestlings. Furthermore, previous projects in the Mediterranean Sea showed that small islands can be eradicated and kept rat free for extended period of time (Canale et al. 2019). Also, it is known that rat eradication can have significant beneficial impact on shearwater breeding populations, for instance in Zembra archipelago in Tunisia, tenfold increase in Yelkouan shearwater breeding pairs was recorded only three years after successful eradication (Bourgeois et al. 2013).

One of the main objectives of the LIFE Artina project is to eradicate invasive mammals, primarily black rats, from parts of the Lastovo Archipelago in order to secure the breeding populations of Yelkouan shearwater, Scopoli's shearwater and Audouin's gull. As part of action A3, the LIFE Artina project carried out a predator assessment in 2019 and 2020 on all seabird colonies in the Lastovo Archipelago (Ječmenica et al. 2020) and confirmed the presence of rats for all islands except Crnac, Pod Mrčaru, Veli Tajan and Obrovac. Their presence was recorded by observations of bones, faeces and evidence of feeding events (such as punctured olive seeds with specific bitemarks). Rats were also observed with camera traps, including their disturbance of seabird nests, as well as their predation of seabird eggs and chicks. Therefore, the implementation of predator management at important sites for Yelkouan and Scopoli's shearwater, as well as Audouin's gull was carried out under Action C2: Implement effective predator management and/ or biosecurity across all targeted sites with seabird colonies where this management is necessary and feasible. This report shows the results of the rat eradication work carried out during for the LIFE Artina project in 2019 and 2020. The eradication work will continue throughout 2021 and 2022 and the final report will be written afterwards.

2. METHODS

The initial plan for the LIFE Artina project was to trial rat control/ eradication on all islands by using mechanical traps only, thus without the use of rodenticides. Therefore, during the first year of implementing the C2 Action, in 2019, rat eradication work was conducted using cage traps, snap traps and automatic, self-resetting Goodnature traps. In doing so, rat populations on Zaklopatica were controlled and complete rat eradication was attempted on the island of Donji Vlašnik (Smokvica). This approach however, proved to be unfeasible, because it was highly labour-intensive and particularly difficult to conduct on more remote islands that are difficult to reach (for instance, due to bad weather conditions). Also, as we wanted to eradicate rats from as many islands with seabird colonies as possible, thus maximizing our conservation efforts, we changed this approach after the first year and switched to using rodenticide in 2020 (except for Zaklopatica where we chose to continue with cage trapping due to its vicinity to a settlement). Islands where rat eradication work was carried out, were selected according to their importance for breeding shearwaters and Audouin's gull, as well as their accessibility and feasibility considering available human resources and budget. Additionally, a few minor islands without breeding seabirds were included in the eradication work as well, due to their vicinity to important islands in which case they could serve as a stepping stone for rat reinvasions. The islands were further divided into 4 groups depending on the rat eradication/ control method that was preferred for them. These different methods are 1) full eradication attempt via rodenticide baiting, 2) seasonal rat control via rodenticide baiting, 3) seasonal rat control via cage trapping, 4) monitoring of rat-free status, and are each described in detail in the A3 deliverable report 'Rat eradication/ control plan for SPA Lastovsko otočje' (Engelen et al. 2020).

During 2020 full eradication attempts via rodenticide baiting were conducted on a total of 12 islands in the Lastovo Archipelago, namely: Veli and Mali Maslovnjak (Maslovnjaci); Veli and Mali Rutvenjak (Rutvenjaci); Srednji, Gornji and Mali Lukovac (Lukovci); Pod Kopiste; Donji, Srednji and Gornji Vlašnik (Vlasnici) and Obrovac. As part of the Adriatic Seabird Guardians project, rat eradication work on the island of Petrovac also took place in 2020. The eradication work on islands with breeding Yelkouan shearwaters (Maslovnjaci and Rutvenjaci), as well as breeding Audouin's gull (Vlasnici and Obrovac) was started in February, while eradication work on islands with only Scopoli's shearwater commenced later: March for the Lukovci and June for Pod Kopište. Furthermore, seasonal rat control via rodenticide baiting was carried out around known Yelkouan shearwater colonies on Sušac between February and June 2020. Finally, rat control via live trapping was conducted on Zaklopatica, both in 2019 and 2020, prior to and during the breeding period for Yelkouan shearwater. Figure 1 shows the locations of all these islands in the Lastovo Archipelago. Figures A1 to A7 in the Appendix of this report show the exact locations of the baiting stations or cage traps on each of the islands.

For the rodenticide baiting, a second-generation anticoagulant bait was used (based on the availability in Croatia): paraffin blocks with 0.005% concentration of bromadiolone. These rodenticide blocks were placed in special bait stations, which were installed on each of the islands according to a 40x50 grid. After the initial bait placement, rebaiting visits were attempted on day 3 or 4, day 7, day 10 and day 14 (as described in the A3 rat eradication/ control plan), but this was not always possible due to bad weather conditions. Table 1 shows the bait placement date for each island, as well as the dates when rebaiting took place. During each rebaiting visit, we carefully monitored for fresh rat signs (such as faeces or toothmarks) and replaced stale, mouldy, wet or otherwise unattractive bait, as well as

rodenticide blocks that were only partially eaten. Afterwards bait consumption was calculated using the following formula:

*previously placed bait blocks * 20 g – non-replaced bait blocks * 20 g - what was replaced in exact grams*

non-replaced bait blocks = present bait blocks - replaced bait blocks

what was replaced in exact grams = the exact remaining weight of the replaced block(s)

When no bait was eaten and no fresh rat signs had been observed for at least 2 weeks, the bait was removed from the islands and replaced by wax blocks (a mixture of candle wax and cacao). These wax blocks were monitored for bitemarks once per month on average (Table 1) to see if rats had reinvaded the islands. Additionally, footage of camera traps installed on the islands, was checked for rat presence. After the breeding season, between the middle of October and the middle of February, A24 Goodnature traps were installed on islands where rats had been successfully eradicated, as means of biosecurity for rat reinvasions. Although these smart traps will not keep an island rat-free, they could prevent reinvasions occasionally or slow down population growth after reinvasions take place.

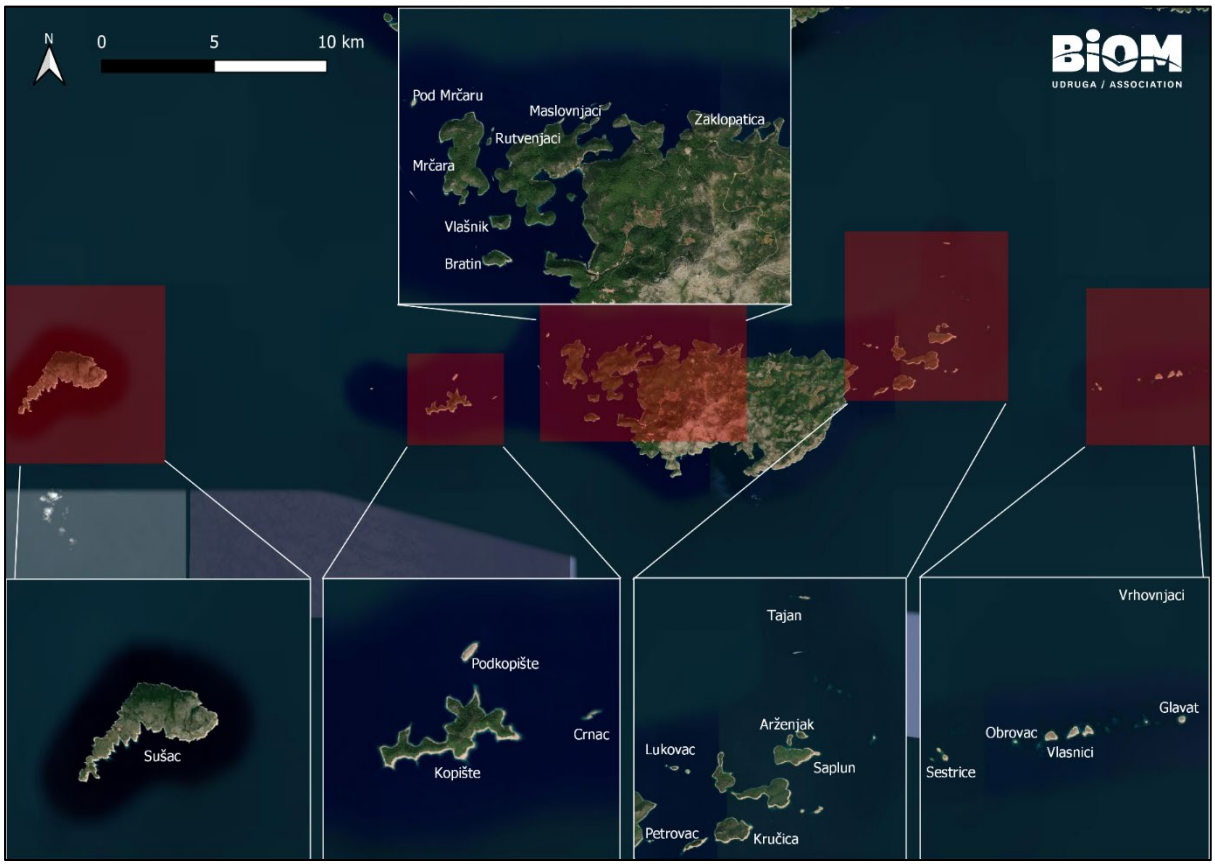

Figure 1: Overview of the Lastovo Archipelago with smaller island groups highlighted.

Table 1: Detailed overview of visits per island showing the state of the eradication work.

Island	Bait placed/ visit	1st	2nd	3rd	4th	5th	6th	7th	8th	9th	10th	11th	12th
Gornji Vlašnik	7.2.2020	16.2.2020	19.2.2020	23.2.2020	9.3.2020	16.3.2020	29.3.2020	9.4.2020	27.4.2020	3.5.2020	8.5.2020	20.5.2020	
Srednji Vlašnik	7.2.2020	16.2.2020	19.2.2020	23.2.2020	9.3.2020	16.3.2020	29.3.2020	9.4.2020	27.4.2020	3.5.2020	8.5.2020	20.5.2020	
Donji Vlašnik	7.2.2020	16.2.2020	19.2.2020	23.2.2020	9.3.2020	16.3.2020	29.3.2020	9.4.2020	27.4.2020	3.5.2020	8.5.2020	20.5.2020	
Obrovac	7.2.2020	16.2.2020	19.2.2020	23.2.2020	9.3.2020	29.3.2020	3.5.2020						
Veli Rutvenjak	12.2.2020	16.2.2020	19.2.2020	23.2.2020	10.3.2020	13.3.2020	19.3.2020	28.3.2020	15.4.2020	30.4.2020	21.5.2020	12.6.2020	20.9.2020
Mali Rutvenjak	12.2.2020	16.2.2020	19.2.2020	23.2.2020	10.3.2020	19.3.2020	28.3.2020	15.4.2020	30.4.2020	21.5.2020	20.9.2020		
Veli Maslovnjak	12.2.2020	16.2.2020	19.2.2020	23.2.2020	10.3.2020	13.3.2020	19.3.2020	28.3.2020	15.4.2020	30.4.2020	21.5.2020	13.6.2020	21.9.2020
Mali Maslovnjak	12.2.2020	16.2.2020	19.2.2020	23.2.2020	26.2.2020	10.3.2020	19.3.2020	15.4.2020	30.4.2020	21.5.2020	21.9.2020		
Mali Lukovac	17.3.2020	21.3.2020	28.3.2020	2.4.2020	8.4.2020	3.5.2020	9.6.2020						
Srednji Lukovac	17.3.2020	21.3.2020	24.3.2020	28.3.2020	2.4.2020	8.4.2020	15.4.2020	23.4.2020	3.5.2020	12.5.2020	9.6.2020	17.9.2020	
Gornji Lukovac	17.3.2020	21.3.2020	24.3.2020	28.3.2020	2.4.2020	8.4.2020	15.4.2020	23.4.2020	3.5.2020	9.6.2020	17.9.2020		
Pod Kopište	16.6.2020	19.6.2020	23.6.2020	27.6.2020	1.7.2020	5.7.2020	13.7.2020	19.7.2020	27.7.2020	7.8.2020	15.9.2020	18.10.2020	

	Bait consumed
	No bait consumed, but rat signs present (faeces, bitemarks on trap, etc.)
	No bait consumed and no rat signs
	No bait consumed and no rat signs; bait removed and wax blocks installed for monitoring
	No rat signs, wax blocks untouched
	Eradication unsuccessful; work aborted

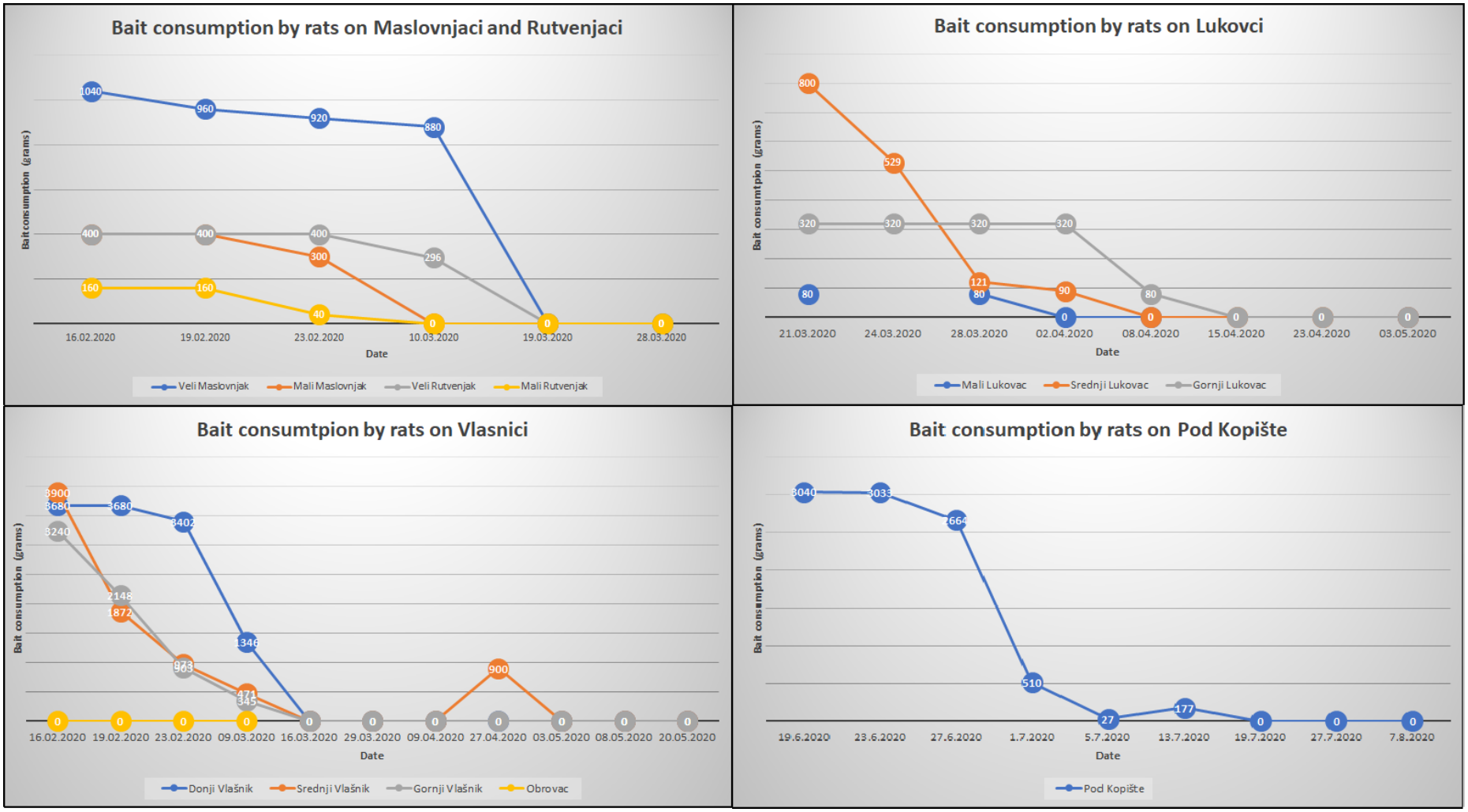

Figure 2: Bait consumption on islands in the Lastovo Archipelago where full rat eradication was attempted during 2020 via rodenticide baiting.

3. RESULTS AND DISCUSSION

3.1. Full eradication attempts via rodenticide baiting

During the 2020 fieldwork season, full eradication of rats via rodenticide baiting was attempted on 12 islands. Across these 12 islands 133 bait stations were placed and a total of 46.13 kg of rodenticide bait was consumed (Table 2, excluding Sušac). In the end, eradication work was successful on 9 islands, but had to be aborted on the 3 Vlasnici islands.

The exact visiting dates per island are presented in Table 1, which also presents the progress of the eradication work on each occasion. Initial bait consumption was typically high for each site as existing rat populations quickly consumed the bait deployed (Figure 2). Bait consumption usually started declining after 2 to 3 weeks and reached 0 after a month more or less, as the rat population was knocked down. On the Maslovnjaci and Rutvenjaci islands bait consumption dropped to zero within a month. After two more weeks with no signs of rats whatsoever all rodenticide cubes were replaced with wax blocks for reinvasion monitoring. Similarly, on the Lukovci, bait consumption dropped to zero in less than a month and after no signs of rats were observed for another 2 to 3 weeks wax blocks were installed in all bait boxes. For Pod Kopište, even though eradication work started in early summer, once again a similar pattern is observed. After installing wax blocks all islands were monitored until the end of September for rat reinvasions/ presence and in October A24 Goodnature traps were installed (see section 3.4).

Table 2: Total bait consumption per island during the 2020 rat eradication work.

Island name	Bait consumed/g
Obrovac	0
Donji Vlašnik	12108
Srednji Vlašnik	8116
Gornji Vlašnik	6636
Gornji Lukovac	1360
Srednji Lukovac	1540
Mali Lukovac	160
Mali Maslovnjak	1100
Veli Maslovnjak	3800
Mali Rutvenjak	360
Veli Rutvenjak	1496
Podkopište	9451
Sušac	19200
TOTAL	**65327**

On the other hand, rat eradication work on Obrovac and the 3 Vlasnici Islands turned out a little different. Rodenticide blocks on Obrovac never showed any signs of consumption and wax blocks remained unaffected, indicating that the island has probably never had any rats on it. Donji, Srednji and Gorni Vlasnik, however, continued showing new, fresh signs of rat activity, even though the consumption of rodenticide blocks initially dropped in a similar pattern to other islands. On Srednji Vlašnik bait consumption shortly picked up again after a month of being untouched (Figure 2). Although it is not clear why rats started avoiding the bait on these islands, it could be that our inability to frequently visit the islands for rebaiting during the crucial first weeks of eradication (Table 1), prevented some rats from ingesting enough bait and thus becoming weary if it. Finally, after more than 3 months of eradication work, it was decided to abort the effort and try again in 2021. Despite this setback, the remoteness of the Vlasnici to other islands poses a good chance that the islands will remain rat-free in the future after successful rat eradication has been carried out. To make sure the frequency of visits will be higher during a next eradication effort, the work will likely be conducted later in the season when the weather is generally more stable.

3.2. Seasonal rat control via rodenticide baiting

On the island of Sušac a total of 20 bait stations was placed around known Yelkouan shearwater nests on the 24th of February 2020. Throughout the breeding season, bait boxes were checked six times, roughly once every three weeks, with the last visit being on 13th of June 2020. All 20 boxes had to be rebaited entirely during each visit and a total of 19.2 kg of rodenticide was consumed (Table 2; Figure 3). As Sušac is also home to Wood Mice *Apodemus sylvaticus*, it could be that the bait was not exclusively ingested by rats.

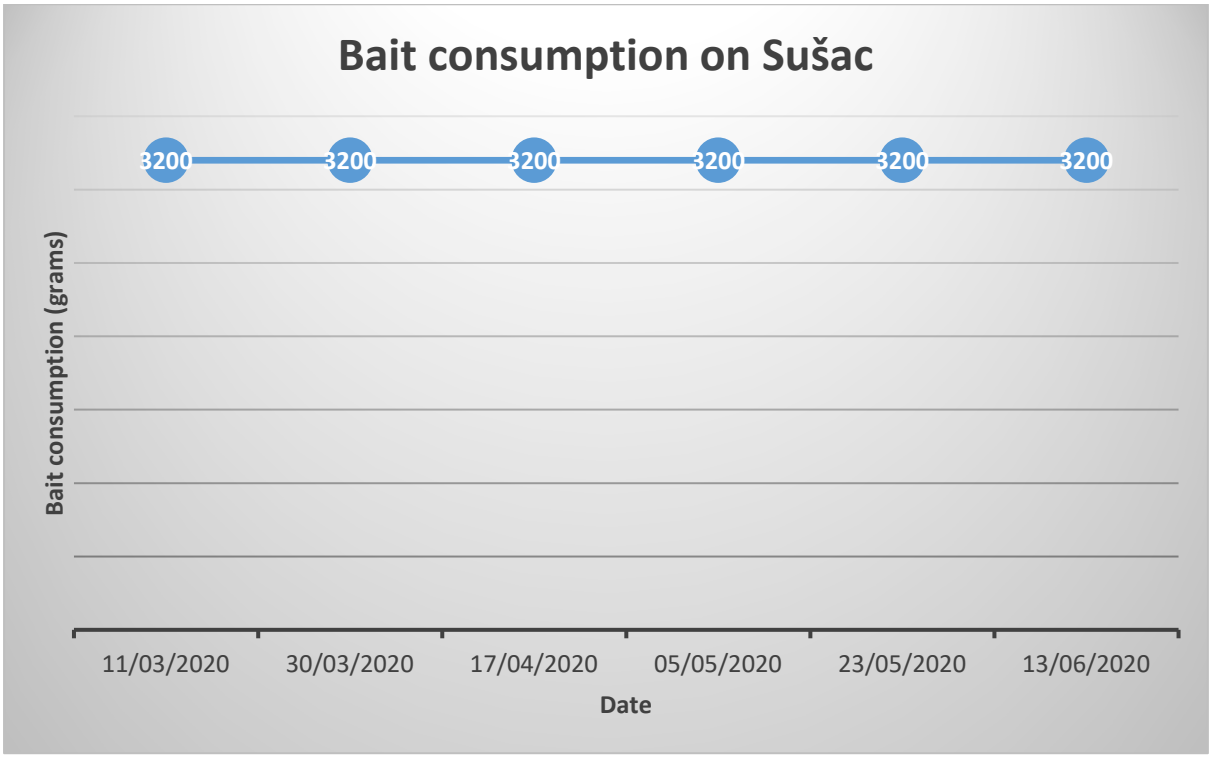

Figure 3: Bait consumption on the island of Sušac during seasonal rat control between February and June 2020.

3.3. Seasonal rat control via live trapping/ cage trapping

In 2019 and 2020 rat control via cage trapping was implemented on the island of Zaklopatica prior to and during the breeding season of Yelkouan shearwater with an average of 30 to 40 traps set up per night. At first a combination of cage traps and snap traps was used, but later only cage traps were set up, because of the possibility of killing or injuring other species than rats with the snap traps. In 2019, six trapping nights were conducted during February and March and a total of 35 rats was killed (Figure 4). During the first night alone, 23 rats were killed (Figure 5), and after that the numbers dropped rapidly to 8, 3, 1, 0 and 0 rats respectively. In 2020, cage trapping was carried out during 16 nights in February, April and May and saw a total of 24 rats trapped (Figure 4). Although the highest number of rats was trapped again during the first trap night (5 individuals), it was a lot less than during 2019. In parallel to cage trapping, 5 Goodnature traps were installed on Zaklopatica during 2019 and 2020 as well (see section 3.4).

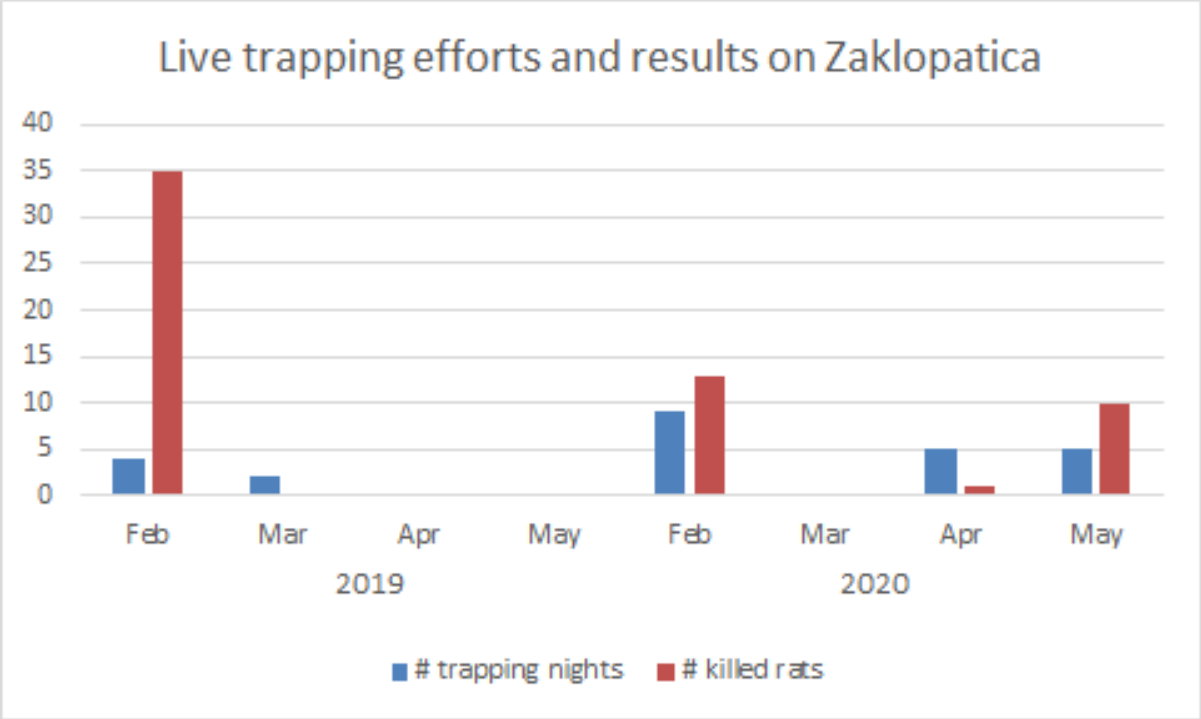

Figure 4: Number of trapping nights and number of rats killed per month on Zaklopatica in 2019 and 2020.

Figure 5: Rats killed after the first night of live trapping on Zaklopatica on 6th of February 2019.

In 2019, prior to the decision of shifting to rodenticide baiting as the main method for rat eradication, cage trapping was also attempted on the island of Donji Vlašnik. A total of 61 rats was killed, with a steady decline in the number of rats trapped during each consecutive night (Figure 6). However, ultimately rats could not be entirely eradicated from the island with cage trapping, because days with bad weather and the remoteness of Donji Vlašnik made it impossible to visit the island frequently enough to complete the trapping effort.

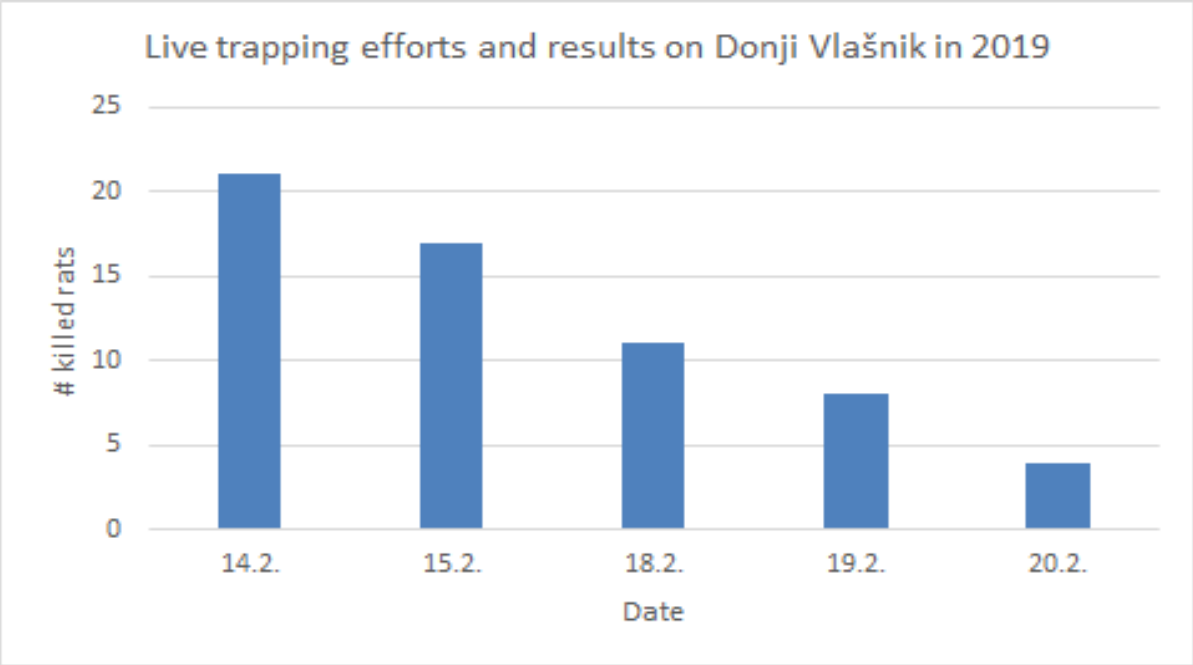

Figure 6: Number of rats killed during cage trapping nights on Donji Vlašnik in February 2019.

3.4. Biosecurity using A24 Goodnature traps

In 2019 a total of 5 Goodnature traps were set up on the island of Zaklopatica as a way to control rat numbers next to cage trapping efforts conducted on the island. Although it is not possible to say how many rats were killed exactly by these automatic traps, camera footage shows the traps were successful on several occasions. During 2020 an effort was made to monitor the smart traps more accurately (with camera traps and frequent visits) and between February and April 14 rats were shot by 5 smart traps on Zaklopatica (with cage trapping being conducted in parallel during this period). Several difficulties with monitoring the exact number of rats shot by Goodnature traps, which we encountered over the last two field seasons are: 1) the shot counter is very sensitive and registers more movements than just shots fired; 2) the counters can be eaten by rats; 3) shot rats don't necessarily end up next to the trap, because they sometimes twitch and move away from the trap before dying, or get carried away from the trap by other rats; 4) the impact can happen so suddenly that the camera trap does not start in time to record the kill.

After successfully eradicating rats with rodenticide baiting from 8 islands (see section 3.1) Goodnature traps were installed to monitor and/ or prevent rat reinvasions to these islands. Next to the 5 smart traps which were already set up on Zaklopatica, an additional 17 Goodnature traps were placed on Veli Maslovnjak (5), Mali Maslovnjak (2), Veli Rutvenjak (3), Mali Rutvenjak (1), Srednji Lukovac (3), Gornji Lukovac (1) and Pod Kopište (2).

4. CONCLUSION

As rat predation was identified as a major threat to breeding seabirds, particularly both shearwater species, in the Lastovo Archipelago, the implementation of predator management at important sites for Yelkouan shearwater, Scopoli's shearwater and Audouin's gull was carried out under Action C.2: Implement effective predator management and/or biosecurity across all targeted sites with seabird colonies where this management is necessary and feasible.

During the 2020 fieldwork season, full rat eradication was attempted on 11 islands in the Lastovo Archipelago with seabird colonies, while rat control was carried out on 2 locations. Overall, the eradication work was successful in reducing the rat populations on all these islands. On Veli and Mali Maslovnjak; Veli and Mali Rutvenjak; Srednji, Gornji and Mali Lukovac; and Pod Kopište rats were entirely removed and the islands showed no signs of being reinvaded until the end of the breeding season for Scopoli's shearwater (and of September). However, as all these islands are within 750 meters (the known swimming distance of rats) of other rat-infested islands or the main island of Lastovo, it is very likely that these sites will get reinvaded again in the (near) future. Eradication work will therefore need to be repeated every year in order to keep a permanent positive effect on the breeding success of the 3 species of seabird.

The Vlasnici, on the other hand, have a high chance of remaining rat-free after successful eradication work has been conducted, because the nearest rat-infested island is almost 2 kms away from them. Unfortunately, rat eradication attempts on these 3 islands during 2020 were not successful. After more than 3 months of baiting, rats did not show an interest anymore in the bait, but were still present on the islands (based on observations of faeces, etc.). Their remoteness and exposure to the open sea makes it very difficult to visit the islands frequently enough during periods of bad weather, which could be one of the reasons why eradication work failed. If bait gets stale or is missing from the bait stations for longer period of time, rats can lose their interest or became wary of it. Because of the possibility of remaining rat-free for a long time, eradication work on the Vlasnici will definitely be re-attempted in 2021, but probably later in the season when weather conditions are more stable.

On the islands of Zaklopatica and Sušac rat control took place throughout the breeding season of Yelkouan shearwater, from the middle of February until the middle of June. Rat control on these two islands was carried out by means of cage trapping and rodenticide baiting respectively. As Sušac is too big for a full eradication attempt during LIFE Artina (and would need a project of its own to try and deal with that) and Zaklopatica is only 20 meters away from a settlement on the main island of Lastovo, both islands will need continuous eradication work to be executed during most of the breeding season of Yelkouan shearwater in order to positively affect its breeding success. The rat control programme on the island of Zaklopatica showed that it is possible to keep rat populations low without the use of rodenticides, but only if the island is small enough and easily accessible (under all weather conditions). The use of A24 Goodnature traps can be a nice addition to cage trapping to keep rat numbers low or to occasionally halt rat reinvasions.

Whether implementing rat eradication/ control by means of rodenticide baiting or via cage trapping, it requires a lot of time and people to be able to visit sites often enough. It should also be timed carefully, in order not to disturb the seabirds breeding on the colony.

5. LITERATURE CITED

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6. APPENDICES

Maps showing the locations of baiting stations (A1 – A6) and cage traps (A7) during rat eradication work in the Lastovo Archipelago in 2019 and 2020.

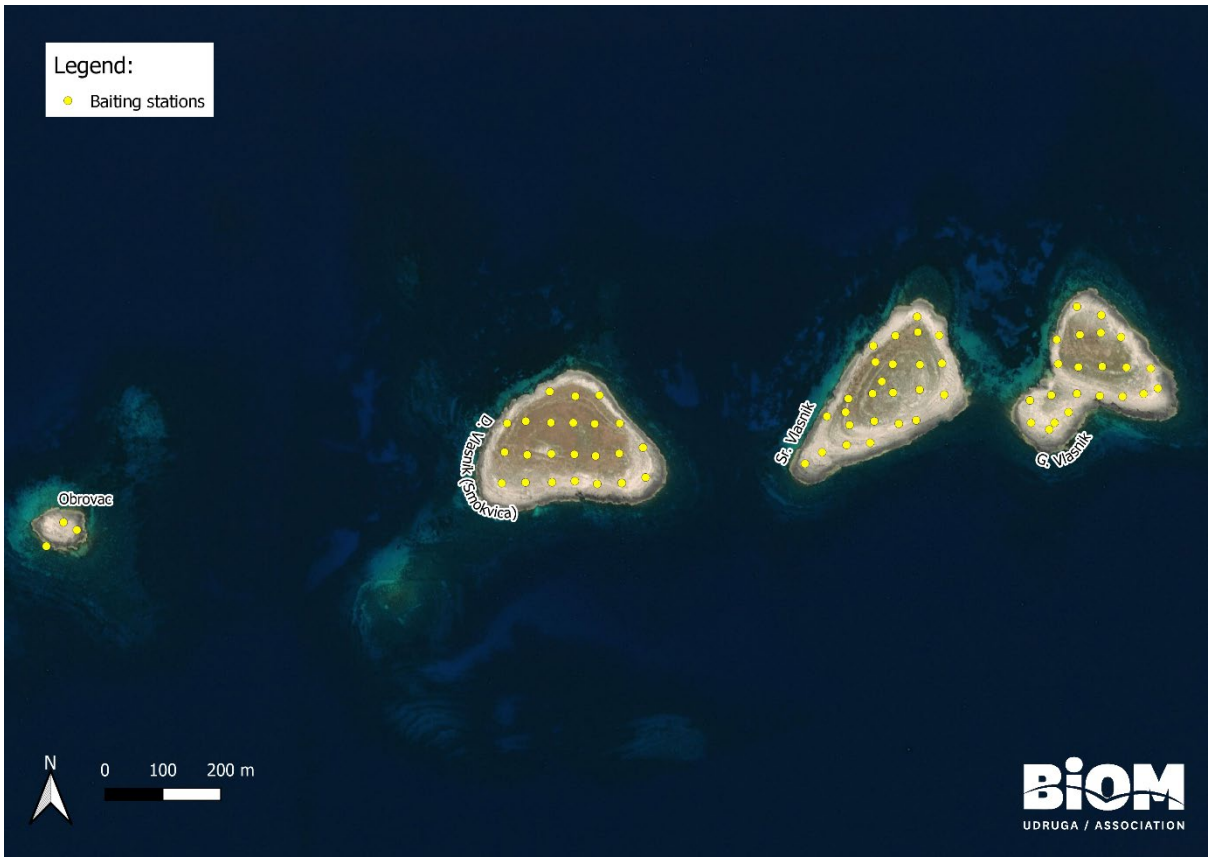

Figure A1: Locations of baiting stations on Obrovac and the Vlasnici.

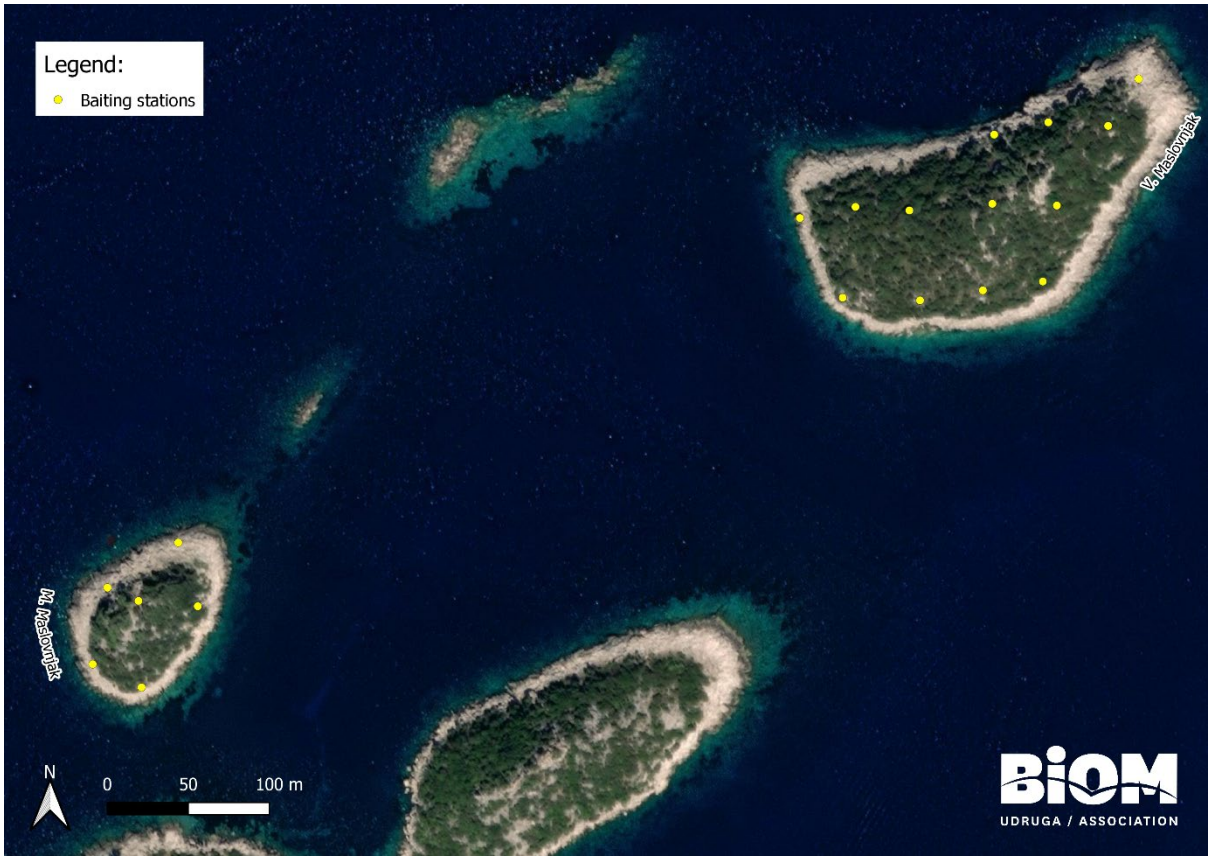

Figure A2: Locations of baiting stations on the Maslovnjaci.

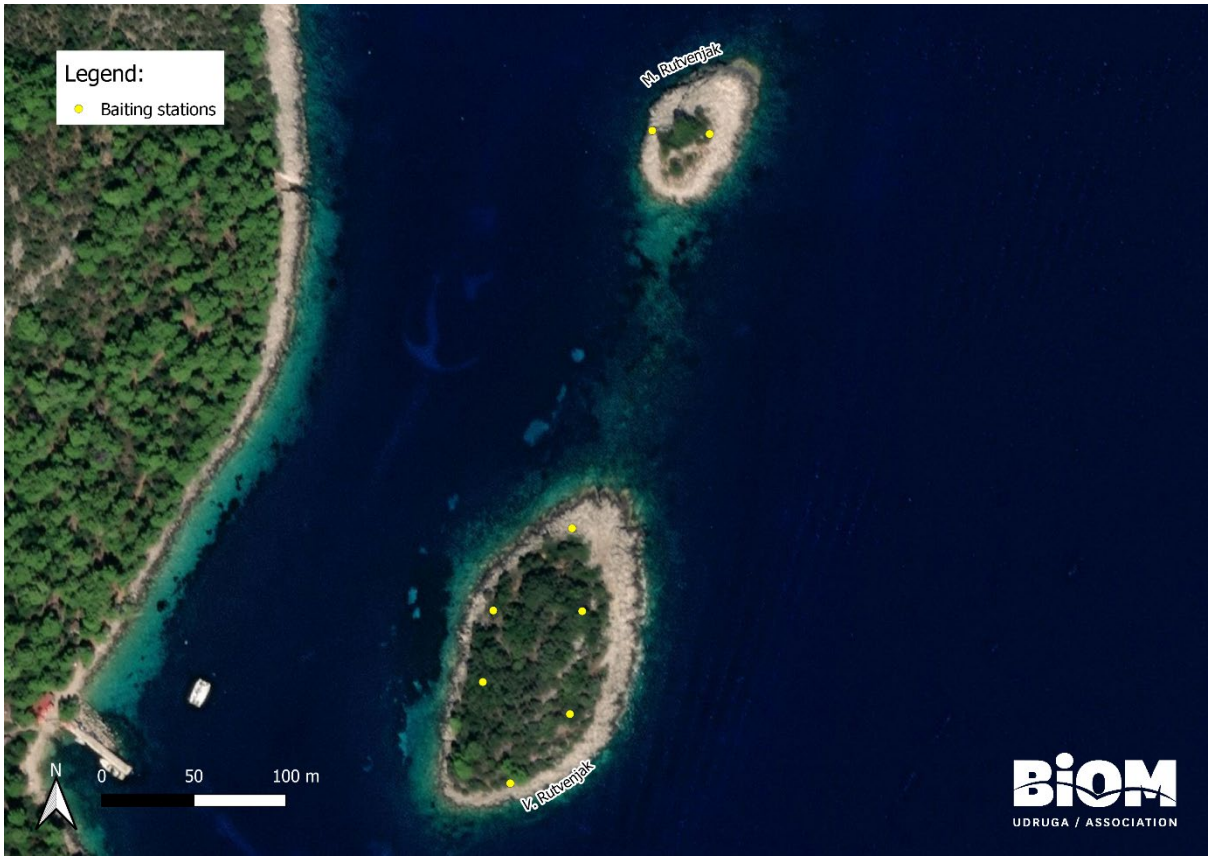

Figure A3: Locations of baiting stations on the Rutvenjaci.

Figure A4: Locations of baiting stations on the Lukovci.

Figure A5: Locations of baiting stations on Pod Kopište.

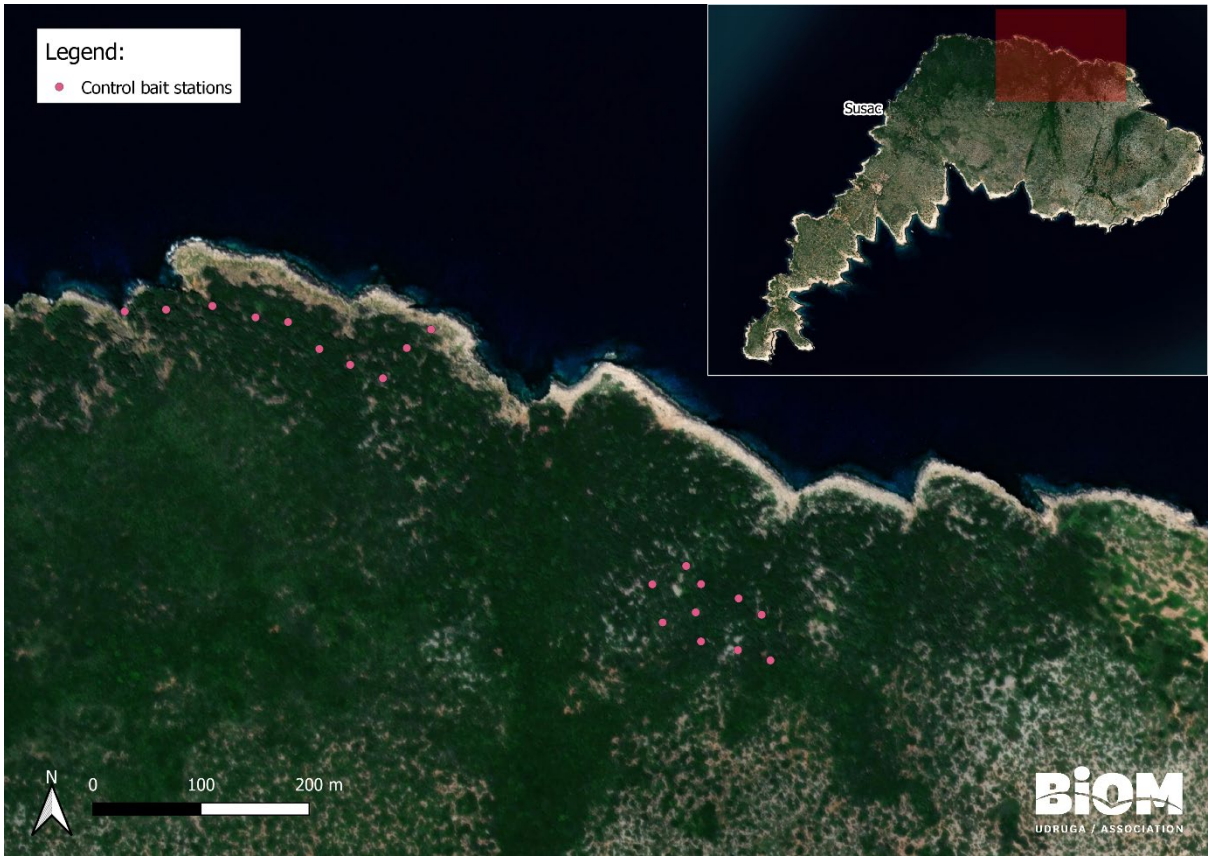

Figure A6: Locations of bait boxes for rat control around Yelkouan shearwater colonies on the island of Sušac in 2020.

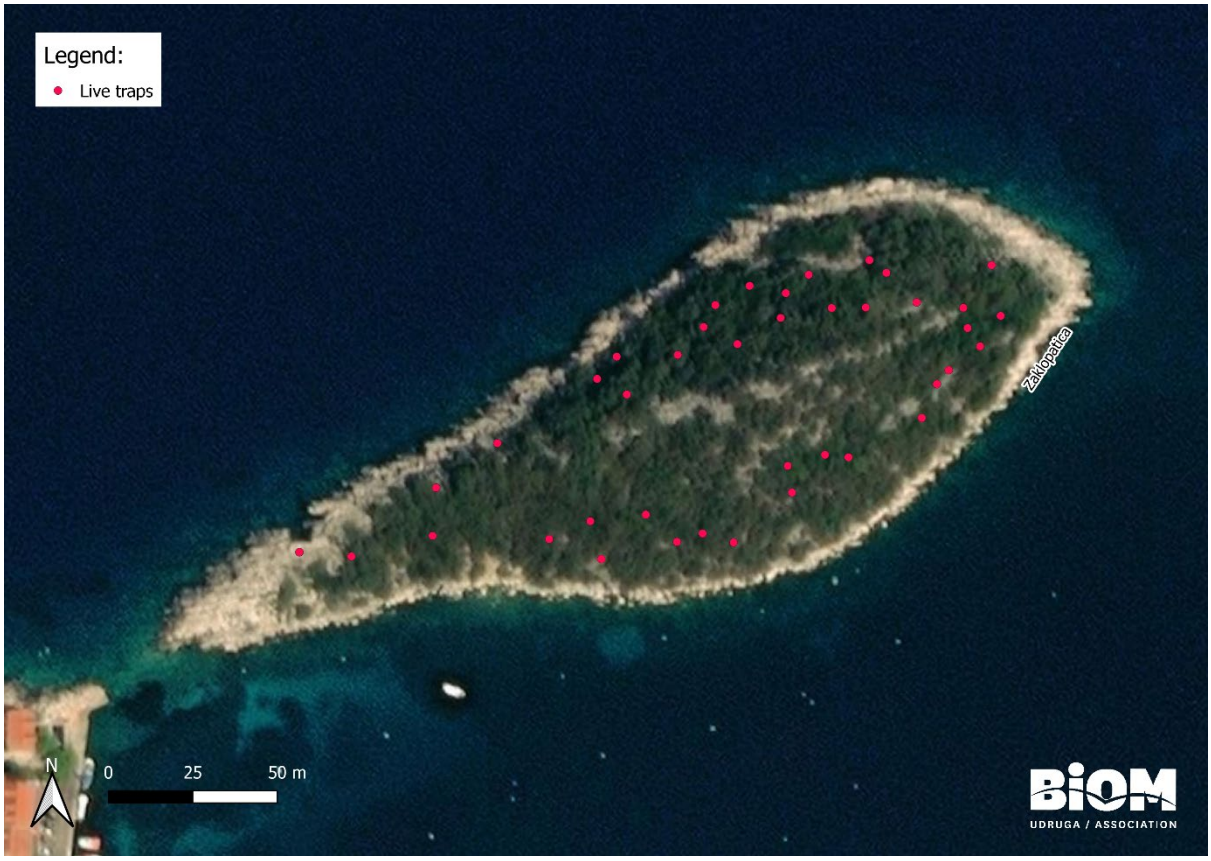

Figure A7: Locations of cage traps for controlling rat numbers on the island of Zaklopatica in 2019 and 2020.