

AUDOUIN'S GULL BREEDING HABITAT IMPROVEMENT REPORT

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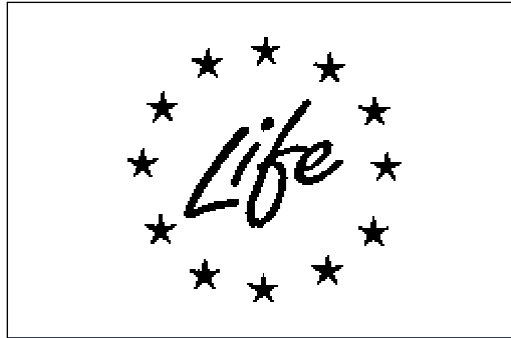
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December 2022



LIFE Artina (LIFE 17 ANAT/HR/000594)
Seabird Conservation Network in the Adriatic

Action C.3: Audouin's gull breeding habitat improvement



AUDOUIN'S GULL BREEDING HABITAT IMPROVEMENT REPORT

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Report completed on:	December 2022
Data Project	
Project location:	Croatia & Malta
Project start date:	01/09/2018
Project end date:	31/08/2023
Total budget:	€ 1,921,387
EU contribution:	€ 1,152,832
(%) of eligible costs:	60 %
Data Beneficiary	
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Suggested citation: Jurinović, L. & Engelen, D. 2022. Audouin's gull breeding habitat improvement report - as part of Action C.3: Audouin's gull breeding habitat improvement. LIFE Artina (LIFE 17 ANAT/HR/000594) report for action C3. Association Biom (BirdLife Croatia). 15 pp.

Front cover illustration: Audouin's gull pair with their nearly-fledged chick. Biljana Ječmenica.

Disclaimer: The original title for the report deliverable was 'Yellow-legged gull nesting prevention report'. However, after changing the activities to also include mitigation of other threats, the report name was changed to 'Audouin's gull breeding habitat improvement report'. The specific measures taken to prevent the nesting of Yellow-legged gulls are included in this overall report.

Confidentiality disclaimer: As this report discloses specific information of colony locations, it should be treated as highly confidential and be kept for internal use within the partner institutions and relevant authorities. It should not be shared with third parties without consent of the authors.

Table of contents

1. Introduction.....	1
1.1. Audouin’s gull	1
1.2. Yellow-legged gull.....	3
2. Revision of the activities proposed in the LIFE Artina project plan.....	3
3. Breeding overview of gulls in Nature Park Lastovo Islands during 2019-2022	5
3.1 Audouin’s gull	5
3.2. Yellow-legged gull.....	6
4. Results of recommended breeding habitat improvement activities.....	8
5. Conclusions and recommendations	10
6. Bibliography.....	12

1. Introduction

1.1. Audouin's gull

Audouin's gull, *Larus audouinii*, (AG) is a medium sized gull that breeds mainly in the Mediterranean but reaches the coasts of northern and western Africa in winter. With long dark legs, pale grey upperparts (with only slight contrast to white head) and dark coral-red bill it is an



unmistakable species throughout its range (Olsen & Larsson 2004). It feeds mainly on fish (Figure 1), occasionally aquatic and terrestrial invertebrates and even small birds. Unlike most other gulls in the area, it almost never feeds on rubbish tips (Cramp & Simmons, 2006).

Figure 1: Adult Audouin's gull eating fish (Photo: L. Jurinović)

AG breeds on small uninhabited islands, usually alongside Yellow-legged gulls, *Larus michahellis* (YLG). In Croatia they mostly lay three eggs during the second half of May (Tutiš et al. 2013). Incubation lasts for 28 days and chicks are fully independent of their parents by the middle of July. They are known for their low breeding performance and very sensitive to any kind of disturbance (Cramp & Simmons, 2006).

The world population of AG had a huge increase from 1 000 breeding pairs in 1966 to more than 17 000 breeding pairs in 1996 (Lambertini 1996). After huge conservation activities, the Spanish population reached its maximum in 2006. The estimated 21,264 breeding pairs mostly belonged to two colonies: Chafarinas Islands and the Ebro Delta. Around 2010 the world's biggest colony started to crash and it went from 15,396 pairs in 2006 to 1,355 pairs in 2019. It was mainly due to reproductive failure caused by the presence of mammalian predators and the decline in fishery discards (Birdlife International 2022). In the same period a single colony on the Deserta Island in southern Portugal started growing and reached 2663 pairs in 2019. The number of breeding pairs is still increasing and by now it is the largest colony in the world with over 5000 breeding pairs (Ledger et al. 2022). Besides Iberia, only Italy has a more or less stable population with more than 1000 pairs (1,190-1,384 breeding

pairs (BirdLife International 2022)). On the contrary, in the eastern half of the Mediterranean, the breeding population size is much smaller and declining rapidly, possibly indicating a less healthy population in this part of the region (Ledger et al 2022). The Croatian breeding population of AG was discovered in 1997 (Rubinić & Vrezec 2000) and was 6-7 pairs at that time. During the period from 2000 to 2006, a few censuses of the breeding population were carried out in the Lastovo, Korčula, Pelješac and Mljet archipelagos, after which the breeding population estimated at 56-69 pairs. It is listed as an endangered breeding species according to The Red Data Book of Birds of Croatia (Tutiš et al. 2013). These days the vast majority of breeding pairs of AG in Croatia breed in the Nature Park Lastovo Islands.

After the establishment of this park in 2006, the monitoring of birds was mainly done by Robert Crnković (Crnković, 6 reports 2009-2017). According to his reports around 30-70 pairs of Audouin's gulls were breeding in the park area between 2009 and 2017. Although his methodology looks good on paper, the number of breeding pairs as well as the breeding success differ greatly from those of other experts (Jurinović et al. 2019a). For example, in several reports Crnković reported a breeding success of 95%, which is unrealistic for AG, as the species usually has less than 1 fledged chick per breeding pair, occasionally more, but certainly less than 2 (Cramp & Simmons, 2006). Also, in 2017 he reported the breeding success of 30-35 pairs of Audouin's gull on Smokvica to be 90%, which would mean at least 80 fledged chicks. In the same year the colony was visited for chick ringing by other researchers and only four chicks were found (pers. obs. Luka Jurinović). Therefore, his data, at least on gulls, should not be considered for any serious analyses.

Besides Lastovo, there are systematic data for the AG population in National Park Mljet from 2007 until today (Jurinović et al. 14 reports 2008-2022). In the beginning of 2000s, 10-20 pairs of AG bred in NP Mljet, but in 2009 they stopped. After that, only occasional breeding was observed with 1 pair in 2013, 2018 and 2020 (Jurinović et al. 14 reports 2008-2022). Furthermore, occasional breeding is observed around Korčula and Pelješac during some years, but annual monitoring in this area is currently not in place. However, it would be good practise to do this in general, as AGs tend to change the location of their breeding colonies between years (Martinez-Abraín et al. 2003) and the same is expected in Croatia, where the species is at the northern most limits of its distribution range.

1.2. Yellow-legged gull

Yellow-legged gull is a big gull with yellow legs and light grey mantle (Figure 2). It has strong stubby yellow bill with red gonys mark. It is breeding in the Mediterranean and Black Sea Basin, but small colonies can be found at inland lakes, around rivers and on rooftops in continental Europe (Adriaens et al. 2022).



Figure 2: Adult Yellow-legged gull (Photo: L. Jurinović)

It is the most abundant breeding gull species in Croatia with an estimated population of 50 000 - 100 000 breeding pairs (Dumbović et al. 2019). It breeds along the whole Croatian coast of the Adriatic, mostly on small uninhabited islets, but, during the last 10-20 years, also on rooftops in Istria and Dalmatia. In Croatia, they usually lay 3-4 eggs in the middle of April and most chicks hatch in the first half of May. The species is known for its aggressive behaviour against other seabirds, and as such possess a threat to breeding AGs (Martinez-Abraín et al. 2003a, Oro et al. 2005).

2. Revision of the activities proposed in the LIFE Artina project plan

The project proposal under point C.3 'Audouin's gull (AG) breeding habitat improvement' lists various methods of scaring and disturbing Yellow-legged gulls (YLG) to prevent them from breeding on certain islets. This primarily refers to inflatable puppets (scarecrows), laser distraction and frequent drone flights. The time frame to implement these actions was set from January to March. However, after consulting with a gull expert, it was decided not to carry out these actions because there is no timeframe when AGs are not present in the breeding area and the YLGs are, which would always result in disturbing both species (Jurinović 2019).

Throughout the LIFE Artina project proposal, the premise was that it is the YLG that are the main reason for the low breeding performance of the AG population, through feeding competition, nest site selection and chick predation. This is certainly largely true, but the problem of (too) large numbers of YLG is not something that can be solved in a short period of time (Alvarez 1992, Guillemette & Brousseau, 2001), such as during a 5-year LIFE project (Jurinović 2019). The biggest impact on the

YLG population can be obtained by reducing their food sources, which in this case (and in the vast majority of habitats) are landfills (Bosch et al. 1994). This is a long term and greatly impossible action for this kind of project (Oro & Martínez-Abraín 2007). In addition to Croatia, surrounding countries should also be involved in such work as the tracking data showed us that adult YLG normally feed on landfills in Bosnia and Herzegovina (Jurinović 2019).

Based on the input of the gull expert it was decided to try and control Yellow-legged gull numbers in AG colonies by means of egg culling. This method is known known to benefit AGs breeding success when done in remote and isolated colonies (Paracuellos & Nevado 2010) and Vrhovnjaci (east of Lastovo) are as close as it gets to that description in the Adriatic context. More specifically, the islets Smokvica, Srednji and Gornji Vlašnik were chosen for culling because Smokvica at that time was home to the biggest AG colony in the Lastovo archipelago, while Srednji and Gornji Vlašnik are the nearest (200 m) other, large YLG colonies. Also, as Srednji Vlašnik has been an important breeding site for Audouin's gull in recent years (Radović 2011), conservation actions carried out on this island could be beneficial in case AG decides to return here for breeding.

Besides the control of YLG, it was also decided to control rat numbers on these islands. Although rats do not pose a major threat to AGs, it can have strong effects locally (Gallo-Orsi 2003), and camera footage from AG breeding colonies in Croatia recorded rats eating AG eggs in 2018 (Figure 3). All three islands are within rat swimming distance from one another, so rat removal should be implemented on all three of them simultaneously. Also, as the islands are far away from other rat-infested islands in the Lastovo archipelago (> 8.5 km), they have very high chances of staying permanently rat-free in the future (unless they are intentionally brought back), which makes the effort worthwhile in the long run.



Figure 3: Camera trap still of a rat eating an Audouin's gull's egg

Finally, it was suggested to use a bigger number of camera traps so that we can better understand the breeding ecology of our target species.

3. Breeding overview of gulls in Nature Park Lastovo Islands during 2019-2022

Yellow-legged and Audouin’s gulls were censused in the Lastovo archipelago around May 1st every year. It is the perfect period to count both species because AGs should have full clutches at that time, while the incubation period for YLG is coming to an end. The gull census was done by a small group of observers from a boat by encircling each islet at a distance of around 50m from the coast (Bibby et al. 1992), and counting the number of breeding pairs with the help of binoculars. In case AGs were observed the island was subsequently visited to search and count the number of nests more precisely and mark them. The breeding success of AG was assessed in the middle of June, when an effort was made to find and ring all the chicks in the colony, by dividing the number of chicks found by the number of breeding pairs.

3.1 Audouin’s gull

Nature Park Lastovo Islands overlaps with the SPA Lastovsko otočje for which AG is a target species. In the period between 2019 and 2022 an annual census of breeding AG was carried out in the Lastovo archipelago. The number of breeding pairs observed per year are shown in Table 1. The data shows that numbers fluctuate a lot per year per island and that AG often changes the positions of its colonies in the archipelago. This behaviour is also known from other places in the Mediterranean (Martinez-Abraín et al. 2003).

Table 1: Number of breeding pairs of Audouin’s gull and their breeding success (as number of chicks per breeding pair) in the Nature Park Lastovo Islands during 2019-2022

Island ↓ / Year →	2019	2020	2021	2022
	23		8-9	4
	6	23	6	
		4	5-6	
		2	9	
		4-5		15-17
		1		
		1		
			1	
			3	
				5-6
Σ	29	35-36	32-34	24-27
Breeding success	0	0.62-0.64	0.26-0.28	0.14-0.20

Throughout the project period, AG in the study area had very low breeding success in terms of fledged chicks per breeding pair. The lowest was in 2019 when there were no fledged chicks in any colony and the highest was in 2020 when the mean breeding success was 0.62-0.64 fledged chicks per breeding pair (Figure 4). In 2021 the reproductive output was 0.26-0.28 and in 2022 0.14 to 0.20 fledglings per pair. All found chicks were banded with metal and colour ring, totalling to 32 chicks during the implementation of the project (16 in 2020; 8 in 2021; 4 in 2022). At least two chicks were re-sighted during their 1st winter migration, one in Spain in 2020, and one in Malta in 2021.



Figure 4: Camera trap still of Audouin's gull with 3 successfully hatched chicks

3.2. Yellow-legged gull

As for AG, YLG breeding activities were also monitored annually during the four-year period between 2019 and 2022. The number of breeding pairs for each year is given in Table 2. It must be noted that, unlike other years, the 2019 census of islands west of Lastovo (Table 2: Bijelac – Mali Maslovnjak), and the entire 2022 census were done from a small semi-inflatable boat, where the observer is almost at sea level and not as steady as on the bigger boat which was used in 2020 and 2021. As a result, some island estimates might differ somewhat more between years than expected.

In general, however, the data in Table 2 shows that the YLG population on Lastovo has been pretty stable throughout the surveyed period.

Table 2: Number of breeding pairs of Yellow-legged gull in the Nature Park Lastovo Islands during 2019-2022

Island ↓ / Year →	2019	2020	2021	2022
Bijelac	*	15	*	8 to 10
Kopište	152	120	*	141
Pod Kopište	62	140	30	136
Crnac	6	15	*	12
Pod Mrčaru	75	70	35	101
Bratin	62	*	*	48
Vlašnik	9	*	*	19
Mali Rutvenjak	2	6	*	1
Veli Rutvenjak	2	2	*	2
Veli Maslovnjak	20	34	*	17
Mali Maslovnjak	1	*	*	2
Zaklopatica	0	0	0	0
Tajan	27	25	18-20	25
Srednji Lukovac	34	20	20	50
Gornji Lukovac	39	31	31	45
Stomorina	93	*	66	44
Mali Arženjak	55	55	54	26
Veli Arženjak	76	90	54	79
Saplun (Mladine)	314	220	200	107
Češvinica	150	*	71	69
Petrovac	32	90	27	42
Kručica	-	*	*	65
Mali Golubinjak	16	25	12	13
Veli Golubinjak	29	55	33	43
Bratac	0	0	0	0
Mala Sestrica	11	17	15	18
Velja Sestrica	33	35	50	76
Obrovac	3	*	*	3
Smokvica (Donji Vlašnik)	151**	225**	280	166
Srednji Vlašnik	81	155**	80	117
Gornji Vlašnik	86	148**	120	95
Glavat	*	65	85	63

* Islets skipped because of bad weather

** Islets censused by means of egg culling

4. Results of recommended breeding habitat improvement activities

Control of Yellow-legged gulls on the island of Smokvica was attempted by means of egg culling. On the 10th of April 2019, a total of 388 Yellow-legged gull's eggs were culled from 151 nests. Despite all the efforts, the breeding success for AGs on Smokvica that year was zero. The following year, culling of Yellow-legged gull eggs was carried out on 9th and 10th of April on all three Vlašnik islets to create an “isolated” area with very low or no breeding success for YLG in order to reduce pressure on AG. All together 1373 eggs from 528 YLG nests were culled. Unfortunately, in 2020 no AGs were found breeding in this area at all. Thereafter it was decided that this measurement is not something that will give any results over a short period of time and, given AG's habit to change the place of its breeding colonies in the archipelago each year, it was pointless to carry on with this activity.

The first efforts to control rat numbers were carried out in 2019, before the start of the AG breeding season. Rat numbers were reduced on the islet of Smokvica by means of live trapping and setting up several automatic rat traps (A24 GoodNature). Overall, 65 rats were killed in February. For the 2020 breeding season it was decided to expand the area for the proposed measures to include also the neighbouring islets of Srednji and Gornji Vlašnik. Rats were successfully removed from all three islands between February and April by means of rodenticide baiting (described in Engelen et al. 2020).

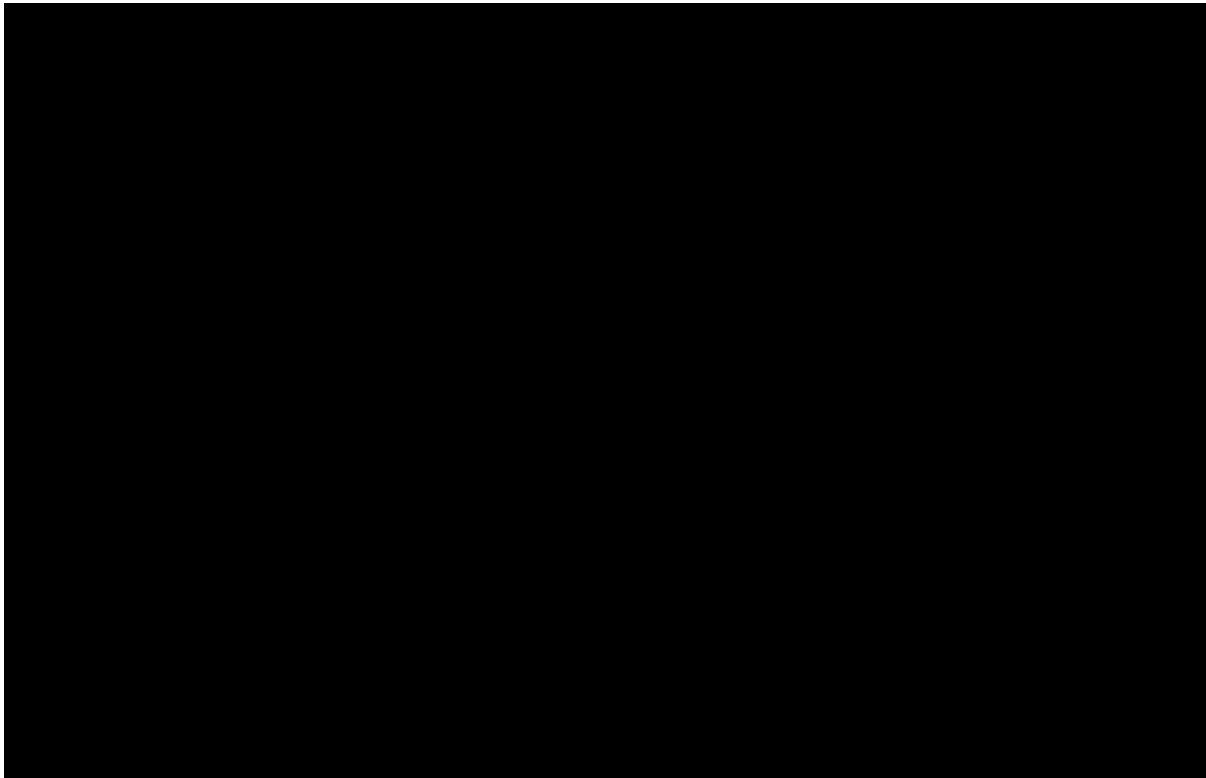


Figure 5: Rat presence on Audouin's gull colony locations in the Lastovo archipelago 2019 and 2022

During 2021 and 2022, check-up visits were carried out on all three islands to check for rat signs (search for faeces; installing camera traps; bitemark monitoring by means of wax blocks) and no signs were detected, meaning no rats had survived or returned and the islands are now permanently rat free. The rat status of other important islands frequently used by AG for breeding (e.g. Crnac, Pod Mrčaru, Tajan), was also assessed and most of them appeared to be naturally free of rats (Figure 5).

Despite this fact, most of the AG colonies on these islands had no or low breeding success, indicating that rat predation is not the main cause of their low reproductive output. This is supported by footage gathered from the camera traps installed on several breeding islets between 2019 and 2022. Although the footage shows that rats were present around AG nests and occasionally disturbed the adult birds (Figure 6), actual predation of the eggs or chicks was never recorded during the project.

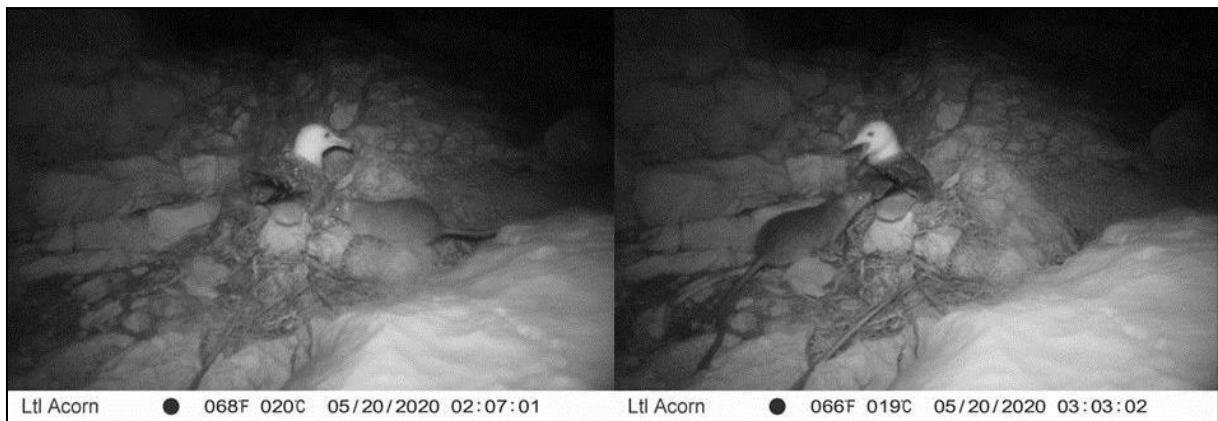


Figure 6: Camera trap stills of a ship rat disturbing an Audouin's gull on its nest

On the other hand, egg and chick predation by YLGs was filmed on several occasions (Figure 7a & b), namely on Smokvica in 2019 and on Petrovac and Tajan in 2020. This strongly affected the breeding success of AG, sometimes even to such an extent that colonies had no fledged chicks at all, like each year on Tajan. In fact, when retrieving the camera from Tajan in 2020, we even found a dead adult Audouin's gull next to the nest, which was possibly killed by a YLG while trying to defend its chick.

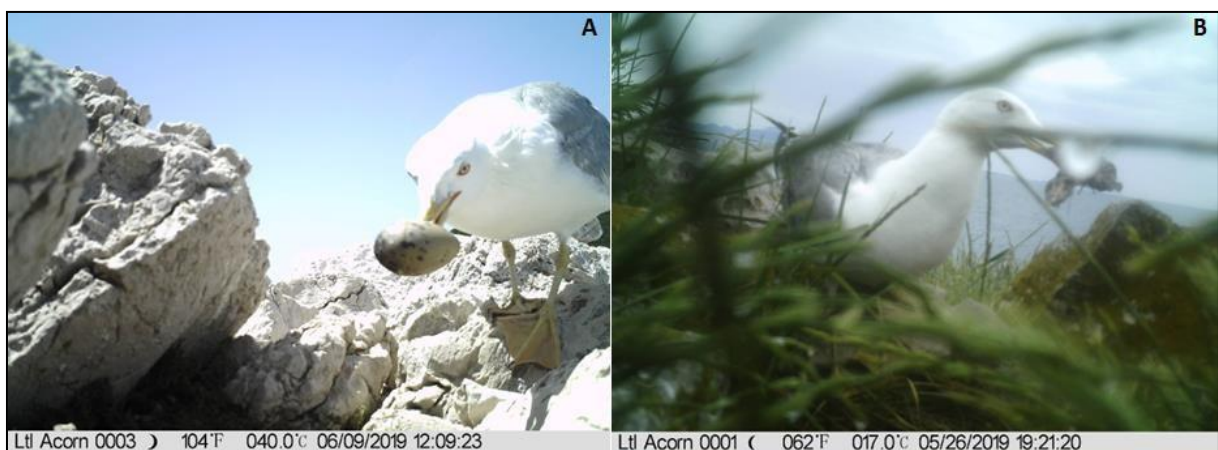


Figure 7: Camera trap stills showing the predation of Audouin's gull egg (A) and chick (B) by Yellow-legged gull

5. Conclusions and recommendations

The population size of AG in the Lastovo archipelago during the study period (2019-2022) was around 30 breeding pairs (24-36). The breeding success of these colonies was low on average (0.28-0.64 chicks per breeding pair), but this is not uncommon for the species and can often be even lower (Oro et al. 1996). Also, due to the fact that the Croatian population of Audouin's gull is on the very margin of its breeding range, it is not surprising that this population is generally not the strongest and fluctuates in numbers. The two main threats identified prior to and during the implementation of the LIFE Artina project are

1) Monitoring of and preventing disturbance on breeding colonies

Annual monitoring to determine the breeding sites of Audouin's gull should be carried out by an expert, following the method described in section 3 of this report. As the species tends to change its breeding locations interannually, it is important for the monitoring to be carried out in the three most important areas for the species in Croatia, namely Lastovo Nature Park, Mljet National Park and the islands between Korčula and Pelješac (all part of existing SPAs). Only then will it be possible to follow the status and trend of the Croatian population. Furthermore, human activities should be banned in the close vicinity of and on each active colony until the end of AG's breeding season (around July 15th). This is very important as AGs are very sensitive to disturbance during the breeding season.

2) Controlling numbers of Yellow-legged gulls

The YLG problem is ongoing and not solvable in a short time period. Despite egg culling efforts during the project implementation, the population of YLG in Nature Park Lastovo Islands remained pretty much stable. The numbers of YLG outnumber the AG by so many that it is generally not expected for egg culling to have any significant impact in the long run either. Other methods of scaring and disturbing YLGs (such as inflatable puppets (scarecrows), laser distraction and frequent drone flights) to prevent them from breeding on certain islets are not suitable either, because there is no timeframe when AGs are not present in these same breeding areas. Therefore, one would always end up disturbing AGs too.

The only thing that would probably decrease the number of YLG in the long run is to completely change waste management in the wider regional area (e.g. Croatia, Bosnia, etc.). An important first step would at least be to close landfills in existing SPAs, such as the one on the island of Lastovo.

3) Ensuring rat-free status of important breeding islands

As a result of the eradication work carried out through the LIFE Artina project, the entire Vrhovnjaci archipelago (9 islets) between Lastovo and Mljet are free of rats since April 2020 (Figure 5). As this area is one of the most important breeding areas for AG in Croatia, these results will benefit the species in the long-term. Furthermore, the Vrhovnjaci are home to a small colony (5 – 10 pairs) of breeding Common tern (*Sterna hirundo*), and a similar number of pairs of Mediterranean shag (*Phalacrocorax aristotelis desmarestii*), for which rat removal could possibly also ameliorate their breeding conditions (Aguilar & Fernández 1999; Amaral et al. 2010). Due to the large distance of these islands to other rat-infested islands, it is nearly impossible for rats to return here unless they are (un)intentionally brought back here by people. To maintain this status, it is important that these islets (at least the Vlasnici) are checked for the presence of rats annually, before the AG breeding season, and that potential rat reincursions are immediately dealt with. The same goes for the rat-free islands of Tajan, Pod Mrčaru and Crnac. The exact methods for detecting and eradicating rats are described in the 'Rat eradication/control plan for the SPA Lastovsko otočje' (Engelen et al. 2020).

For Audouin's gull breeding colonies around Mljet, permanent rat eradication will not be possible, as the islands are too close to Mljet main island. Seasonal rat control is an option here, but only if carried out well ahead of the start of the breeding season (late winter), to avoid disturbing AG itself. Some of the islands between Korčula and Pelješac, on the other hand, are good potential candidates for permanent rat eradication as they are far enough (> 750 m) from other islands. However, it needs to be established first which of the islands exactly are preferred breeding sites for Audouin's gull.

4) Further explore the potential threats related to fishing practises

Important threats recognized for AG in other parts of its breeding range are bycatch, lack of food due to overfishing and changes in fishing practises (Gallo-Orsi 2003; Genovart et al. 2017). Although a preliminary study in Croatia shows that Audouin's gull does not follow fishing ships (Jurinović et al. 2019b), this work mostly focused on purse seiners. Future studies should, however, look more closely at the interaction between AG and long line fishing vessels, as these are responsible for the vast majority of bycatch of (juvenile) Audouin's gull in Spanish waters (Genovart et al. 2017). To better understand foraging behaviour of AG in Croatia, diet analyses should also be considered. This will furthermore help in determining to what extent the species is affected by marine litter.

For all of the above-listed actions it is also important to raise awareness of the species and its threats among relevant stakeholders and the general public. Activities should primarily focus on the

sensitivity of the species during the breeding period, preventing the spread of rats to seabird colonies, the importance of documenting bycatch, and reducing accessible waste and marine litter.

Finally, as AG is considered to be scarce and declining in most of the eastern part of its breeding range (BirdLife International 2022; Ledger et al. 2022), it is perhaps best to aim for a joint regional approach for the monitoring and conservation of the species (e.g. entire Adriatic, or even entire eastern Med.). This would also better suit the nomadic breeding ecology of the species.

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