

Aquila a-Life

Reintroduction of Bonelli's Eagle in Sardinia

Action D.1 Post-release monitoring



ISPRA

December 2020



LIFE PROJECT “AQUILA a-LIFE” (LIFE16 NAT/ES/000235)

BONELLI’S EAGLE (*Aquila fasciata* Vieillot, 1822) REINTRODUCTION IN SARDINIA

Azione D1. Post release monitoring, 2020 - Elisabetta Raganella Pelliccioni, Massimiliano Di Vittorio, Riccardo Nardelli, Lorenzo Serra, Fernando Spina.

Cover photo: Antonello Lai

Responsibility for the information and views set out in this report lies entirely with the authors. The content of this report does not reflect the official opinion of the European Union. Responsibility for the information and views expressed in this report lies entirely with the authors.

Summary

1. SURVIVAL	4
2. MOVEMENT AND DISPERSION	6
2.1 Eagles from the 2018 and 2019 hacking seasons.....	6
2.2 Eagles from the 2020 hacking season.....	8
2.2.1 Release and monitoring of the two adult males (Mantzena and Dure).....	11
3. FEEDING POINTS MONITORING	12

Annex I: Radiography and photos - Zoseppe

1. SURVIVAL

By the end of 2020 (15 December), seven animals (five constantly monitored by GPS tags) out of the 20 released are surely alive (Tab.1).

Signal was completely lost for two eagles (Helmar and Illiorai) probably due to tags malfunctioning; Ichnusa keeps on contacting the server up to December 2020 for download, without transmitting any data.

On 20th September, Prenna was supposed to be dead in a small island (La Vacca) in south-west Sardinia, based upon both positions and accelerometer pattern. The tag stopped transmitting after a few days, probably sunk in the sea. Sea conditions allowed the Forestry Corp to carry on a survey in the island on 29 September but nothing was found. On 22th November, during another survey, aimed at monitoring Arroyto that in the meantime had reached the same island, the Forestry wardens spotted two Bonelli's eagles both recognized also by the yellow rings. Besides Arroyto, the other animal is without any doubt Prenna, which has consequently lost the tag.

Currently, no data are available on these two animals (Ichnusa and Prenna), but by 22th November they were both alive (Ichnusa up to 29th December).

On 2020 several animals died from different causes, the most recurring being electrocution.

On 24th April, Abbaluchente was recovered dead in north west Sardinia by electrocution. On 3th July, Posada, that was roaming in Corsica, was found dead by the wardens of Scandola Natural Reserve. The necropsy, carried on by the public Laboratoire Départemental d'analyses - Haute-Corse, couldn't assess the cause of death, even if the radiography excluded illegal killing or trauma. However, according to the picture of the carcass, it is highly probable that the Bonelli's eagle has been killed by a golden eagle, known to nest within 2.5 km from the recovery site. Posada was the last surviving eagle of hacking season 2018.

On 7th January, Muscatoglio was recovered severely injured but alive by the Forestry Corp. Forestas vet stated the eagle had suffered electrocution, causing severe motor deficiency of the left wing and injuries to muscles, tendons and tissues of the wing itself. Following the amputation of the leg up to metacarpus due to dry gangrene, it was euthanized on 17th February.

Two eagles –Zoseppe and Sadonna from the last hacking season died shortly after release. Zoseppe was recovered on 27th September by the Forestry Corp in a private garden within a densely populated area in southern Sardinia. It had several injuries, included a deep scar in the throat with necrotic tissue. This condition probably caused the death following a septicemia (Annex I). These injuries might have been caused by collision with vineyard line or by a fight with a big prey like *Buteo buteo*, quite often consumed by the released eagles. Sadonna died shortly after Battore due to electrocution. The first part of December was characterized by heavy rain in Sardinia that has increased the risk of electrocution.

During the hacking season 2020, two adult males were also released. These males, originally from Andalucia where they were extracted from their nests as chicks, spent most of their life in captivity in Grefa, as breeders. Due to their low reproductive performance, Grefa decided to give them a second chance and they were released in Sardinia. Unfortunately, shortly after release, both displayed limited movements and were recaptured on 16th and 15th September, respectively. Although supplementary food was provided, they did not eat or hunt. After another period in the aviary, we decided that only Dure could be possibly released again, while Mantzena has been sent to the CRAS (wild animals' rehabilitation centre) of Bonassai for educational purposes. Dure was released in the area of Coghinas lake, from where it moves within 10 days to die on 14th November.

Year	Name	Origin	Sex	Birth date	Arrival date	Release in nature	Date of death/SL
2018	Abbaluchente	LPO	F	04-5-18	29-6-18	20-ago-18	24-4-2020
2018	Helmar	LPO	M	05-5-18	29-6-18	20-ago-18	SL ¹
2018	Posada	LPO	F	07-5-18	29-6-18	20-ago-18	3-7-2020
2018	Tepilora ²	LPO	F	09-5-18	29-6-18	20-ago-18	26-9-2019
2018	Nurasè	Grefa	F	29-5-18	24-7-18	20-ago-18	7-11-2018
2018	Saccaia	Andalucia	F	10-4-17	15-7-18	21-dic-18	27-4-2019
2019	Muscatoglio	Andalucia	M	02-3-19	27-4-19	15-giu-19	7-01-2020
2019	Artaneddu	Andalucia	M	27-2-19	27-4-19	15-giu-19	6-7-2019
2019	Prenna	Andalucia	F	25-2-19	27-4-19	15-giu-19	SL ³
2019	Illiorai	Andalucia	M	11-3-19	27-4-19	15-giu-19	SL ⁴
2019	Pratteri	Grefa	M	09-3-19	27-4-19	15-giu-19	
2019	Battore	Agrigento	M	17-3-19	12-5-19	15-giu-19	4-12-2020
2019	Ichnusa	Valencia	F	19-3-19	13-7-19	26-lug-19	SL ⁵
2019	Inoche	Grefa	F	19-4-19	13-7-19	26-lug-19	
2020	Mantzena ⁶	Grefa	M		04-8-20	02-set-20	-
2020	Dure ⁷	Grefa	M		04-8-20	02-set-20	14-11-20
2020	Sadonna	Andalucia	F	14-4-20	04-8-20	02-set-20	08-12-20
2020	Arcantzelu	Grefa	M	02-5-20	04-8-20	02-set-20	
2020	Zoseppe	Grefa	M	14-4-20	04-8-20	02-set-20	27-09-20
2020	Minnena	Grefa	F	05-5-20	04-8-20	02-set-20	
2020	Arroyto	LPO	F	29-4-20	04-8-20	02-set-20	

¹ Signal lost on 21/1/2019

² Recaptured on 12/9, second release on 27/9/2018

³ Signal lost on 20/9/2020

⁴ Signal lost on 4/7/2019, probably seen on 13/7/2019

⁵ Signal lost on 23/4/2020, still alive at December (see text)

⁶ Recaptured on 16/9/2020, no longer released

⁷ Recaptured on 15/9/2020, second release on 29/10/2020

Tab. 1 List of the Bonelli's eagles hacked and released in Tepilora Regional Park since 2018, first selected release site of the project. Eagles were also fitted with metal/aluminum rings and GPS-tags (data omitted). Green lines: SL (signal lost), animals known to be alive. Grey lines: animals whose fate is unknown. In red, individual history of the two adult males (see par. 2.2.1). SL: signal lost.

Currently, four eagles from 2019 hacking and three from 2020 hacking are still alive, with a sex ratio of 5F:2M. Excluding the two adult males, whose release success was doubtful, and the two males, whose fate is unknown, the overall survival is 41%.

A synthesis of the mortality events by sex is reported in table 2.

Sex	N	Events	Days from the release	0.95LCL
F	11	6	613	127
M	8	4	202	26

Tab.2 Mortality events per sex (2018-2020). Days from the release: median; 0.95LCL: lower confidence limit. The upper limit is undefined due to skewed data. The two adult males are excluded; eagles with unknown fate are not considered among the deaths.

Carcasses were always recovered by the Regional Forestry Corp thanks to an agreement with ISPRA. Forestry corp promptly check the status of the birds also in all cases where positions suggest little or no movement. During 2020 the Forestry Corp intervened several times as well as Anthus (local society subcontracted by Ispra) which is in charge to check animals' positions in worrying cases.

2. MOVEMENT AND DISPERSION

To check for any settlement up to 31 December, net squared displacement (NSD – net squared Euclidean distance between the release site and all subsequent locations) was used, to highlight movements up to 31 December. NSD highlights quite clearly the movement away from the release site as well as any settlement at a certain distance from it.

2.1 Eagles from the 2018 and 2019 hacking seasons

During 2020, 2 out of six animals released in 2018 were regularly monitored.

Abbaluchente kept on moving around Sardinia, approaching the release site several times, with cyclical movements around north Sardinia, where it was finally found dead (Fig. 1).

From the time it first arrived in Corsica, Posada roaming around, with a preference with south and notably north west areas (Scandola Natural Reserve) of the island where it spent most of the time in 2020. Abbaluchente wasn't clearly settled yet, while Posada showed restricted movements for periods of months in the north west area of Corsica.

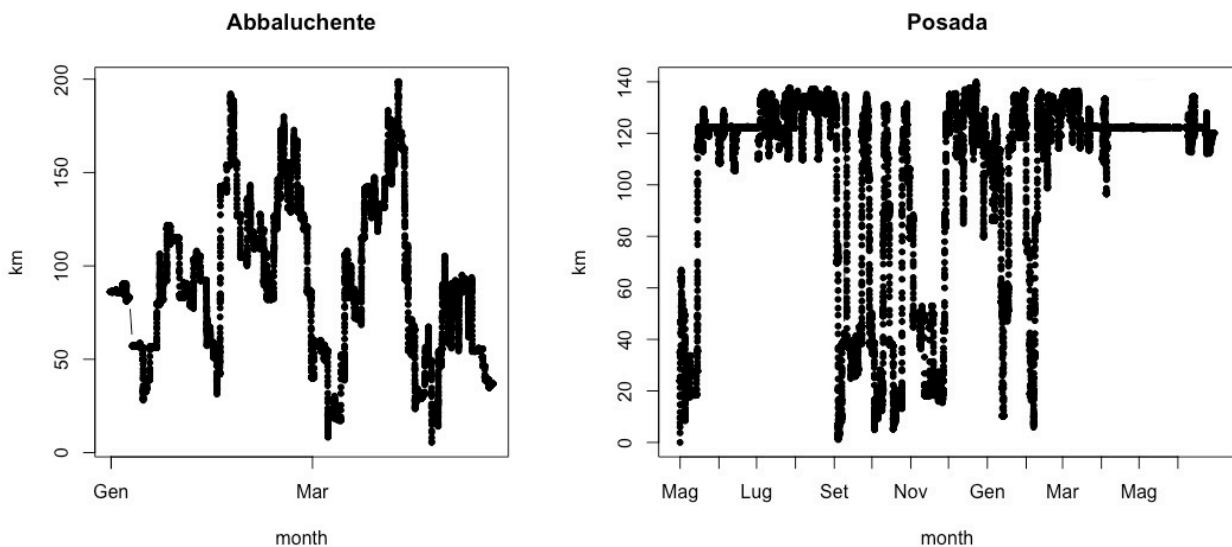


Fig. 1 SND for animals released in 2018 and survived in 2020. Abbaluchente: from January to April, 2020; “0” marks the release site. Posada: NSD of movements in Corsica are reported, from May 2019 until July 2020; “0” marks the first position in Corsica (south tip of Corsica).

Plot for Muscatoglio are not presented due to very few data available in 2020, since it died on 7th January.

As for the eagles released in 2019, some of them kept on moving around Sardinia (Fig.2 and 3). Pratteri is, among all eagles released, the one who didn't roam extensively as the others did. It remains in north-central Sardinia (Coghinas lake), within 14 km north-west from the release site.

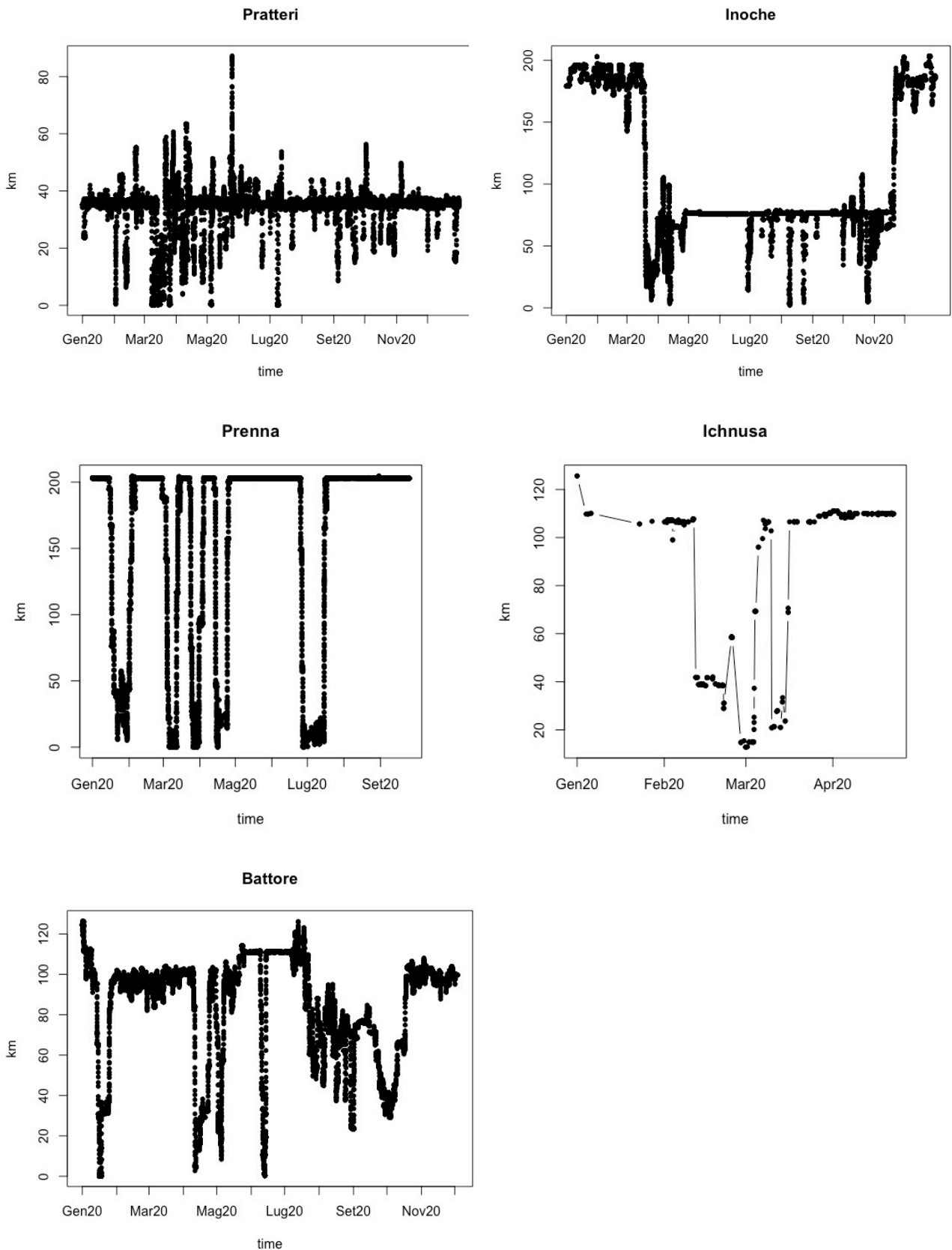


Fig. 2 NSD for eagles released in 2019, from 1/1/2020. “0” marks the release site.

This male has probably chosen the lake area as a hunting range, thanks to the high availability of potential prey species. Till 2019, soon after the release, Inoche (Fig. 3) is moving basically between two main areas, north and south-west Sardinia. Interestingly, the south-west part is the same intensively occupied by Nurasè (hacking 2018) until its death. Moreover, Inoche particularly liked

the Maddalena Archipelago (north-west Sardinia), where it stayed from the end of March to the end of September 2020.

Prenna also has clearly defined frequented areas, notably south-west and north Sardinia, some km south from the release site. In south-west Sardinia, Prenna spent most of the time in the islands of Sulcis Archipelago where it stayed, from the end of September 2019 to September 2020, with few visits to the mainland, spending most of the time in La Vacca island (0.6 ha) and never visiting the smaller island off it (Il Toro).

Battore was one of the few eagles that never visited Sulcis (south Sardinia). It moved mainly in central Sardinia with a preference for the western part (Oristano province), where it always came back (almost flat part in fig.2), corresponding to the area at north of Oristano).

Due to tag malfunctioning, data for Ichunsa are scattered and highly irregular. This eagle moved north-west and also visited Sulcis, flying along the western coast. Last locations (April 2020) correspond to the north western tip of Sardinia, within the Asinara National Park. The area north of Oristano was also frequented.



Fig. 3 Left: Pratteri (photo A. Lai) and Inoche (photo Mirko Ugo) photographed in 2020

2.2 Eagles from the 2020 hacking season

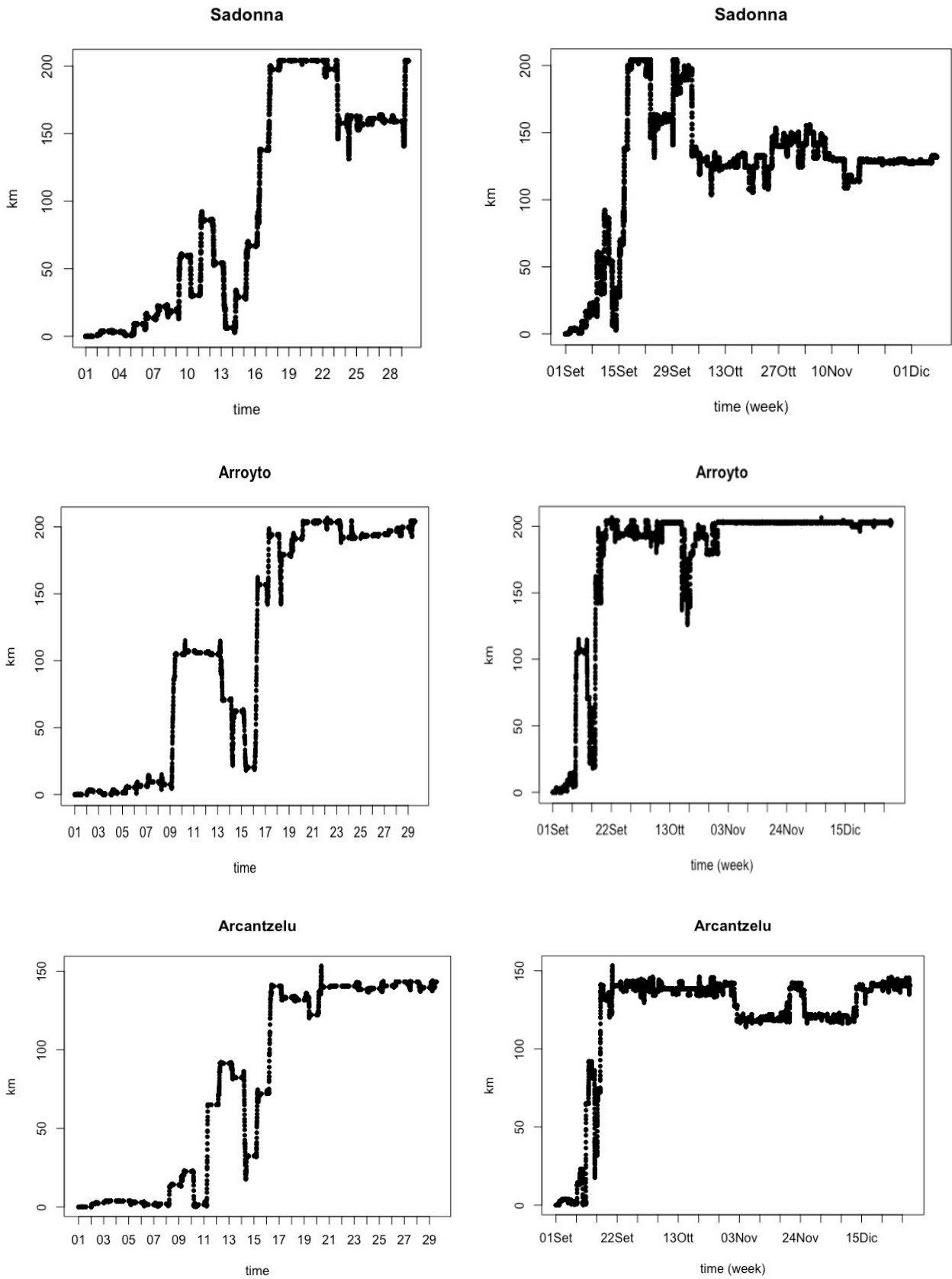
In 2020 eagles were released in nature on the 2nd September, by far the latest date of the three hacking seasons. In general, all eagles stayed close to the release site for few days, all leaving shortly after between 9 and 14 September (Fig. 4).

Within five days from release Sadonna started exploring the release site surroundings, regularly coming back before definitively leaving the area on September 14. Apart from crossing the north, Sadonna moved to the south, through the western part of the island. The main frequented areas are Sulcis (including S. Antioco in Sulcis Archipelago), Capoterra (west) and Cagliari, Sarrabus (east). Its movements concentrated in Campidano, where she was finally found dead due to electrocution.

Arroyto left site around 10 days after release, crossed central Sardinia to reach the south, Iglesias (M. Linas) but mostly Sulcis and Capoterra. It visited also Sulcis archipelago (only S. Antioco and La Vacca island). La Vacca seems to have been particularly attractive since it spent two months there, from November up to the end of December. On 11 September, Arcantzelu left the release site, crossing the north and moving to the south along western Sardinia. Its dispersal movements were limited: it soon stopped in the south west (Sarrabus) where it arrived on mid September (16). No other eagles spent more than few days in that area.

Minnena did almost the same: it gradually left the release site on 11 September, crossed the north to go to Campidano of Cagliari, in the same place used by Posada in 2018.

Zoseppe left the release site on 10th September going straight southwards, first in Campidano di Cagliari (south-west tip) and then in Sulcis and Capoterra (south-east tip). It was injured due to unknown causes, and then recaptured, not far from the area occupied by Minnena (Fig.5).



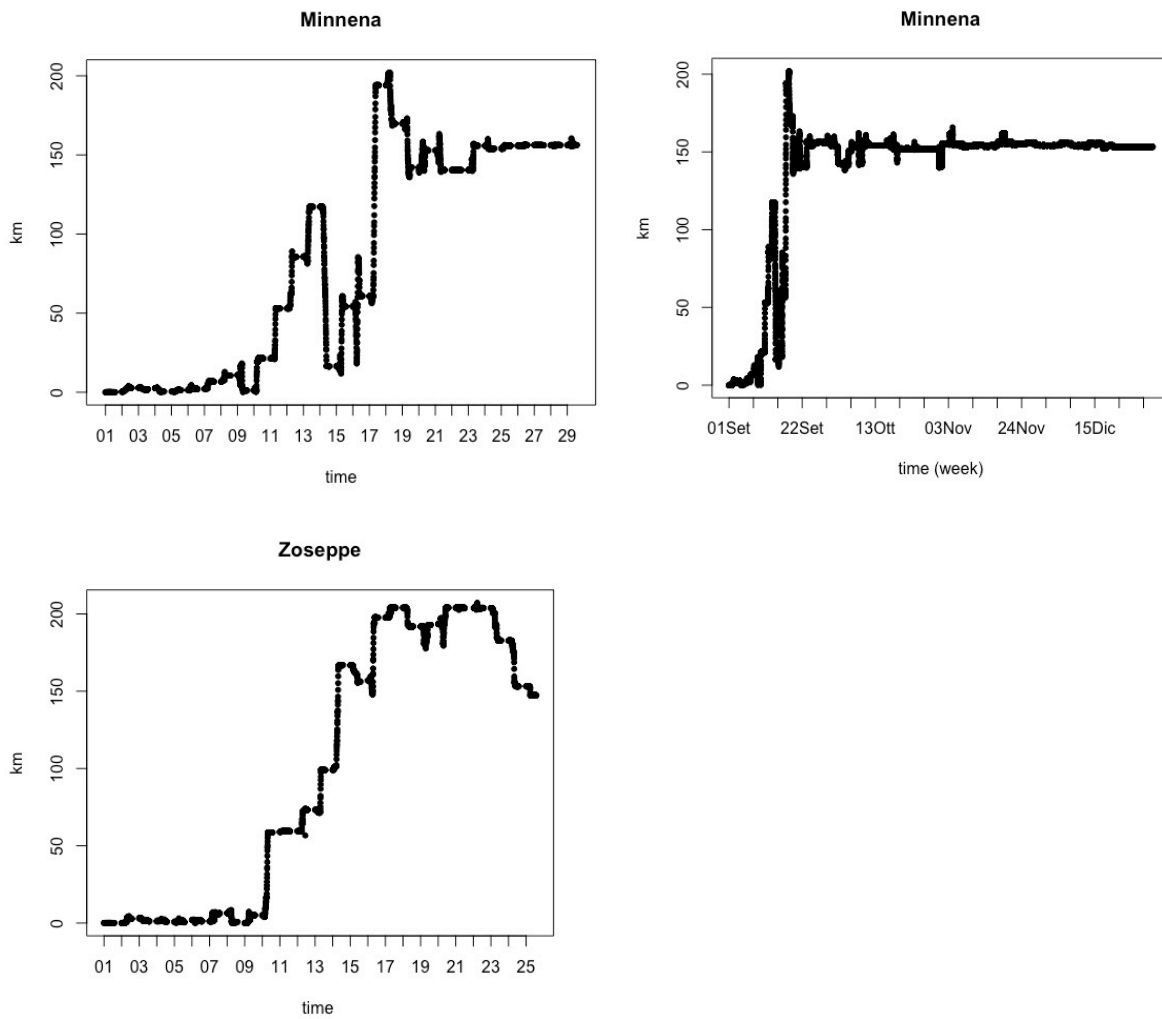


Fig.4 NSD for eagles hacked in 2020. On the left, movements from the release day (1st September) up to the end of September. On the right, movement up to the end of December.



Fig. 5 Minnena and the area frequented in December 2020

2.2.1 Release and monitoring of the two adult males (Mantzena and Dure)

Mantzena and Dure (10 and 13 years old) were kept in the aviary with all the other eagles and released on the same day.

After release, Mantzena only moved downhill in the valley up to 11 km from the release site and then came back close to it (Fig. 6). Due to very limited movements, it was recaptured on 16 September, stuck in dense vegetation along a river.

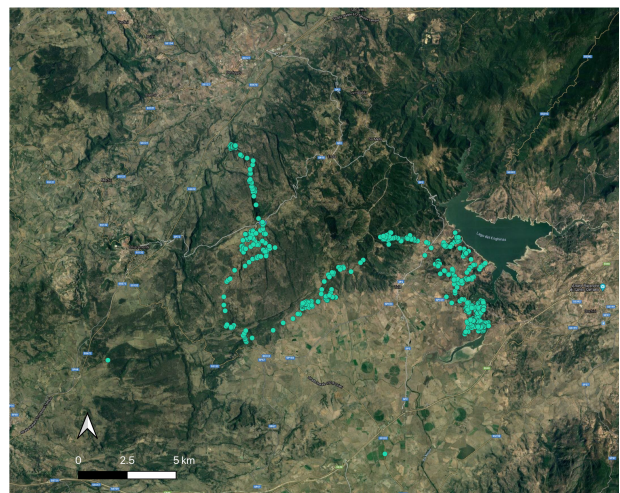
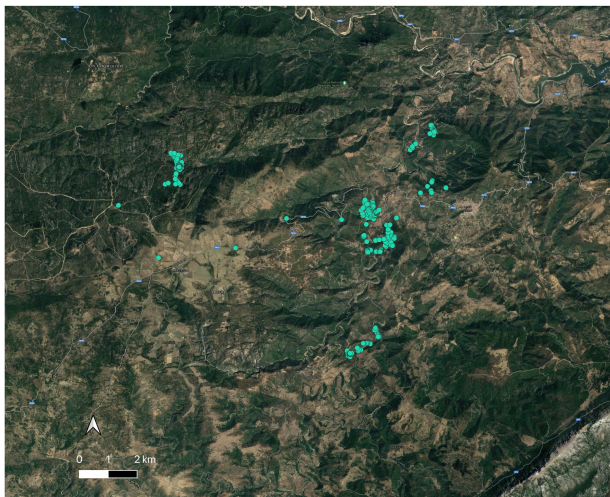
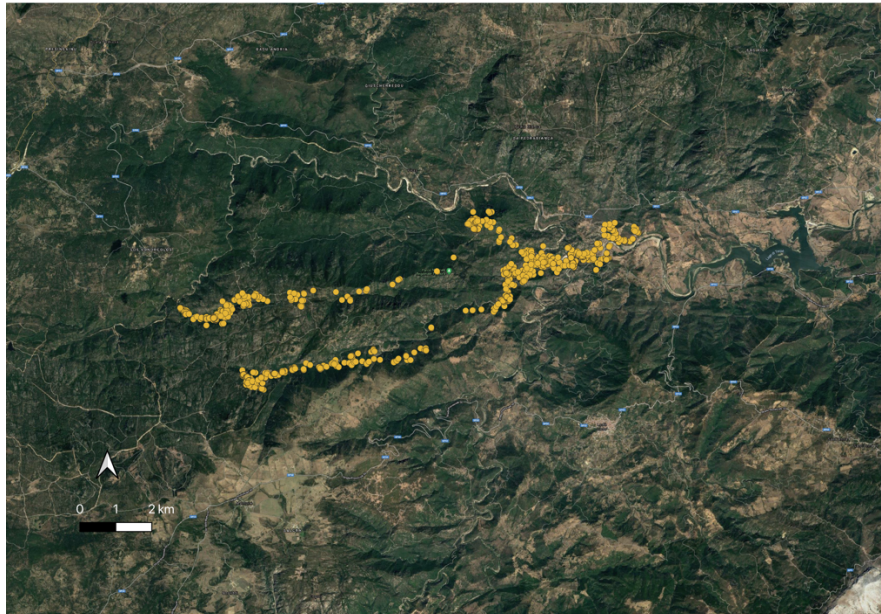


Fig. 6 Movements of Mantzena and Dure after the release in nature. Above, Mantzena; below Dure (left: first release; right: second release.)

Dure did almost the same, first moving downhill in the valley towards east, then towards west-southwest. Here it was reported by the police at the border of a main road. Therefore, it was recaptured (on 15th September) and put again in the aviary with Mantzena. Both eagles remained in the aviary for 44 (Dure) and 61 (Mantzena) days; during this period, they were fed regularly to gain weight and observed to verify any possibility of a second release. Mantzena was not enough reactive to have a chance in the wild, while Dure showed interest in the surroundings and quite a remarkable unrest. Therefore, Mantzena was given to the recovery center of Bonassai under the responsibility of Dr. Marco Muzzeddu; instead was released again at Coghinas lake (29 September)

site, characterized by high prey abundance and by the presence of another eagle (Pratteri). However, left very soon the lake to move in the forest, where it was recovered dead after 15 days (Fig. 6) due to under(mal)nutrition.

3. FEEDING POINTS MONITORING

During the 2019 and 2020, clusters of positions of several eagles were checked in order to assess main prey species consumed. The remains of 36 preys from seven eagles, belonging at least to 13 different species were found and determined (33 at a specific level, see Tab. 3); 97.2% of the whole sample was made up by birds remains, although the sample is highly biased towards larger preys, whose consumption takes longer and that are more likely to leave remains.

Name	Date	n	Prey
Abbaluchente	18/07/2019	1	<i>Gallinula chloropus</i>
	18/07/2019	4	<i>Bubulcus ibis</i>
	18/07/2019	1	<i>Nycticorax nycticorax</i>
Arcantzelu	23/07/2020	1	<i>Buteo buteo</i>
	23/09/2020	1	<i>Buteo buteo</i>
	19/10/2020	1	<i>Egretta garzetta</i>
Arroyto	12/09/2020	1	<i>Corvus cornix</i>
Battore	29/09/2020	1	<i>Buteo buteo</i>
	11/09/2020	1	<i>Buteo buteo</i>
	11/09/2020	1	<i>Corvus cornix</i>
	17/09/2020	1	<i>Buteo buteo</i>
	17/09/2020	1	<i>Corvus cornix</i>
	04/10/2019	1	<i>Buteo buteo</i>
	23/05/2020	1	<i>Buteo buteo</i>
	12/08/2020	1	<i>Buteo buteo</i>
	12/08/2020	2	<i>Corvus cornix</i>
Inoche	16/10/2019	1	<i>Ardea cinerea</i>
	31/01/2020	1	<i>Ardea cinerea</i>
	04/11/2020	1	<i>Columba palumbus</i>
Minnena	23/09/2020	1	<i>Buteo buteo</i>
	23/09/2020	1	<i>Columba palumbus</i>
Pratteri	19/09/2020	2	<i>Larus michahellis</i>
	19/09/2020	1	<i>Columbiformes</i>
	19/09/2020	1	<i>Anas sp</i>
	01/10/2020	1	<i>Anas sp</i>
	07/10/2020	1	<i>Chroicocephalus ridibundus</i>
	10/10/2020	1	<i>Corvus cornix</i>
	16/10/2020	1	<i>Columba palumbus</i>
	20/10/2020	1	<i>Chroicocephalus ridibundus</i>
	02/11/2020	1	<i>Columba palumbus</i>
05/11/2020	1	<i>Lepus capensis</i>	

Tab. 3 Prey species consumed by the released eagles

The most represented species were *Buteo buteo* (n=9, 25%), *Corvus cornix* (n=6, 16.67%), *Bubulcus ibis* and *Columba palumbus* (n=4, 11.11%), *Ardea cinerea*, *Larus michahellis* and *Chroicocephalus ridibundus* (n=2, 5.56% for all the three species).

ANNEX I RADIOGRAPHY AND PHOTOS – Zoseppe



Zoseppe was recaptured due to limited movements. It had several injuries, included a deep scar in the throat with necrotic tissue. This condition probably caused the death following a septicemia.