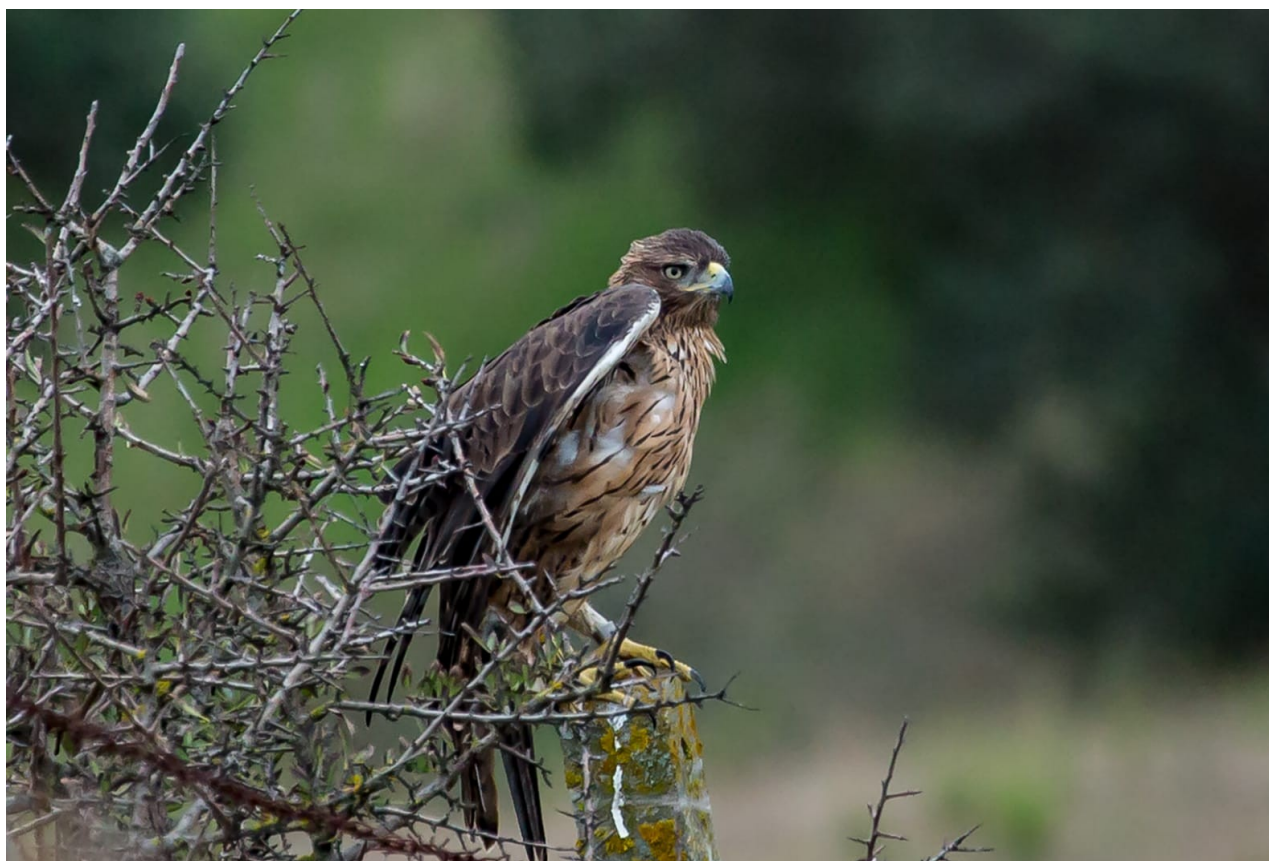


Aquila a-Life

Reintroduction of Bonelli's Eagle in Sardinia

Action D.1 Post-release monitoring



ISPRA

December 2021



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

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

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Cover photo: Antonello Lai

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1. SURVIVAL

By the end of 2021 (15 December), eleven animals (nine constantly monitored by GPS tags) out of the 26 released are surely alive (Tab.1).

Year	Name	Origin	Sex	Birth date	Arrival date	Release in nature	Date of death/SL
2018	Abbaluchente	LPO	F	4-5-18	29-6-18	20-ago-18	24-4-2020
2018	Helmar	LPO	M	5-5-18	29-6-18	20-ago-18	SL ¹
2018	Posada	LPO	F	7-5-18	29-6-18	20-ago-18	3-7-2020
2018	Tepilora ²	LPO	F	9-5-18	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	2-3-19	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	9-3-19	27-4-19	15-giu-19	
2019	Battore	Sicilia(AG)	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		4-8-20	2-set-20	-
2020	Dure ⁷	Grefa	M		4-8-20	2-set-20	14-11-20
2020	Sadonna	Andalucía	F	14-4-20	4-8-20	2-set-20	8-12-20
2020	Arcantzelu	Grefa	M	2-5-20	4-8-20	2-set-20	
2020	Zoseppe	Grefa	M	14-4-20	4-8-20	2-set-20	27-9-20
2020	Minnena	Grefa	F	05-5-20	4-8-20	2-set-20	
2020	Arroyto	LPO	F	29-4-20	4-8-20	2-set-20	
2021	Lia	Sicilia	F	18-3-21	16-5-21	1-ago-21	
2021	Prisco	Sicilia	M	23-3-21	16-5-21	1-ago-21	
2021	Nino	Sicilia	M	30-3-21	16-5-21	1-ago-21	
2021	Yorgi	Grefa	M	7-4-21	5-6-21	1-ago-21	
2021	Babbu Mannu	Grefa	M	11-4-21	5-6-21	1-ago-21	SL ⁸
2021	Bonaria	Grefa	F	9-4-21	5-6-21	1-ago-21	SL ⁹

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

⁸ Signal lost on 16/9/2021

⁹ Signal lost on 5/10/2021

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). Greenlines: SL (signal lost), animals known to be alive. Grey lines: animals whose fate is unknown. In red, the two adult males. SL: signal lost.

During the 2019, signal was completely lost for two eagles (Helmar and Illiorai) probably due to tags malfunctioning; Ichnusa keeps on contacting the server up to April 2021 for download, without transmitting any data. She was also spotted and photographed on May 21 in Asinara Island, a site frequently visited by this eagle.

Unfortunately, in 2021 we lost contact with two other animals from hacking 2021: Babbu Mannu and Bonaria. Babbu Mannu data transmission stopped on 16th September in west Sardinia, close to Arborea. The area was immediately surveyed because of the presence of dangerous electric lines, but no carcass was found. For what concerns Bonaria, we lost the signal while she was flying over the sea between Capo Ceraso and Tavolara Island (north-east Sardinia) on the 5th October. We requested the Coastal Guard support for a check and/or to eventually collect the carcass, but unfortunately nothing was found. Two main hypotheses were made to explain the disappearance: 1) a fatal attack by seabirds (possibly seagulls) or 2) hopefully, a jamming activity due to transmission from the military base in Tavolara, which could have compromised the tag functionality. However, this would be the first case of malfunctioning due to military radio transmission, since several other eagles have visited Tavolara before.

Currently (at 31/12/2021), four eagles from 2019 hacking season, three from 2020 and four from 2021 are still alive, with a sex ratio of 6F:5M (tab.2). Excluding the two adult males, and considering all the eagles whose fate is totally unknown as dead (4), except the two females not monitored but surely alive, a rough estimate of survival is 44%.

Year	Dead/Lost		Alive		Tot
	M	F	M	F	
2018	1	5			6
2019	4		1	3	8
2020	1	1	1	2	5
2021	1	1	3	1	6
	7	7	5	6	25

Tab. 2. Synthesis of the eagles released from 2018, according to sex and status

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. As usual, during 2021 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. These cases were mostly related to Minnena, which uses to rest in the same place long enough to trigger a check.

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 2019 and 2020 hacking seasons

During 2021, no eagle released in 2018 was left, while two eagles from 2019 (Pratteri and Inoche) were regularly monitored.

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. This male has probably chosen the lake area as a hunting range, thanks to the high availability of potential prey species. Both in 2020 and in 2021 this male moved to the release site while the hacking season was going on and in 2021 remained there after the release of the eagles from aviary. Several times it was captured by the camera trap on the feeding platform (Fig. 1), often with a young male fighting for food or simply resting together on the platform.



Fig. 1 Pratteri on the feeding platform outside the hacking cage

By the end of 2021, Pratteri seems to have established a territory in the area of Sos Littos Forest, around 6 km north from the release site, within Tepilora Regional Park. From here, he uses to move to Coghinas (west) and along the valley of Posada river (east, plateau in Fig. 2).

During 2021, Inoche (Fig. 2) showed movements mostly concentrated in north-east Sardinia (Gallura), after a trip in Sulcis (south-west) where she was by the end of 2020 and from which she came back in NE Sardinia in the first day of 2021. In the north, Inoche also visited Maddalena National Park, moving among the islands of Caprera, Spargi, Corcelli but also the islets of Isola delle Bisce, Mortorio and Soffio, down up to Tavolara and Molara (from late January to July). Currently Inoche's tag shows some problems, namely the battery is never fully recharged and data download is irregular.

As for the eagles from hacking season 2020 (Fig. 3), Arroyto moved to Corsica on 9/4/21 and she is currently still there. Arroyto is the third eagle leaving Sardinia to Corsica. Here, she roamed all around the island but mostly frequented Scandola Regional Reserve (North west), Cape Corse (north) and the area between Aleria and Ghisonaccia (south-east coast), where she is currently located since the last months 2021. All of these areas, except Cape Corse, where also frequented by Posada during her stay in Corsica.

Minnena clearly clustered her movements between two different areas (Fig. 3): the first in the south, corresponding to a wetland already heavy used by another eagle from hacking 2018, where she was located from January to February 2021 and the second corresponding to the area surrounding Coghinas lake, where she also joined the eagles released in 2021 frequenting the same area. Minnena is currently roaming in the central - north Sardinia and for a short period she joined Pratterti around the release site.

During 2021, Arcantzelu roamed mostly in north-center Sardinia, leaving the south-est coast in January. This male is still moving on a broad area, even if by the end of 2021 he frequented preferentially the inland area behind the Gulf of Orosei (east coast).

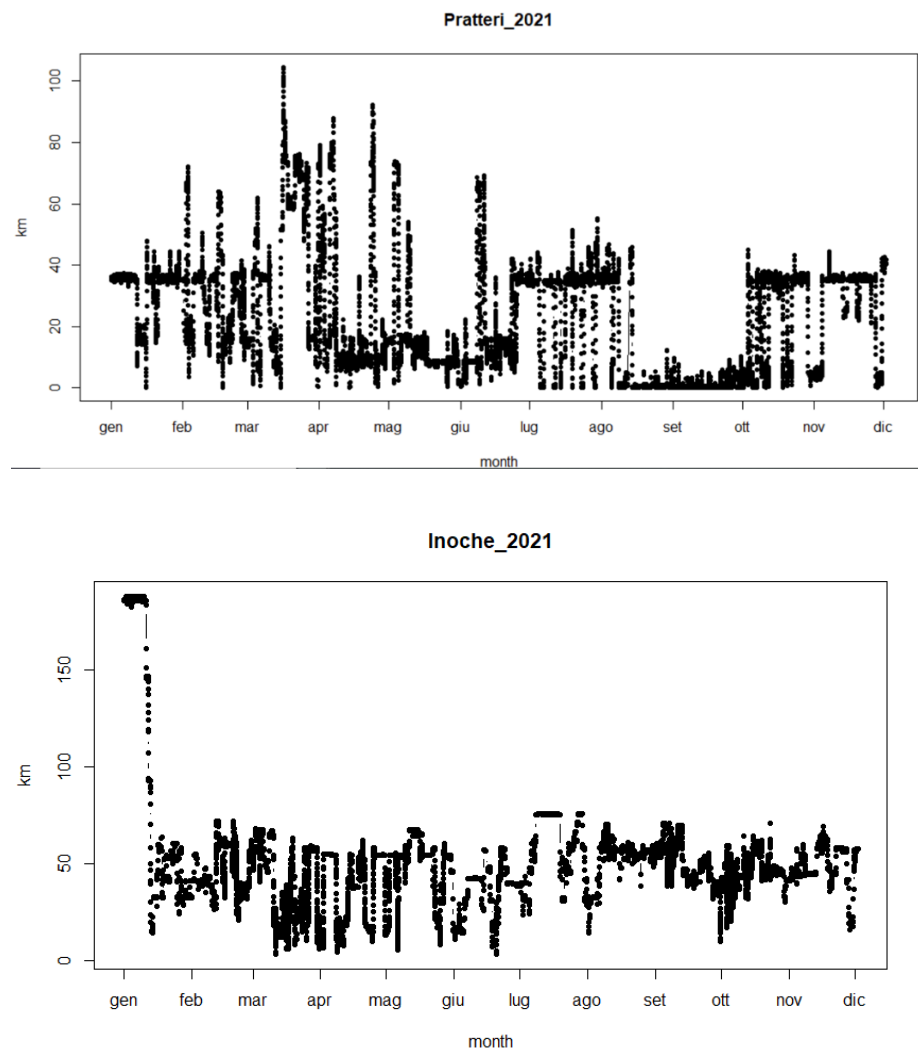


Fig. 2 NSD for eagles released in 2019 from 1/1/2021 up to 15/12/2021. “0” marks the release site.

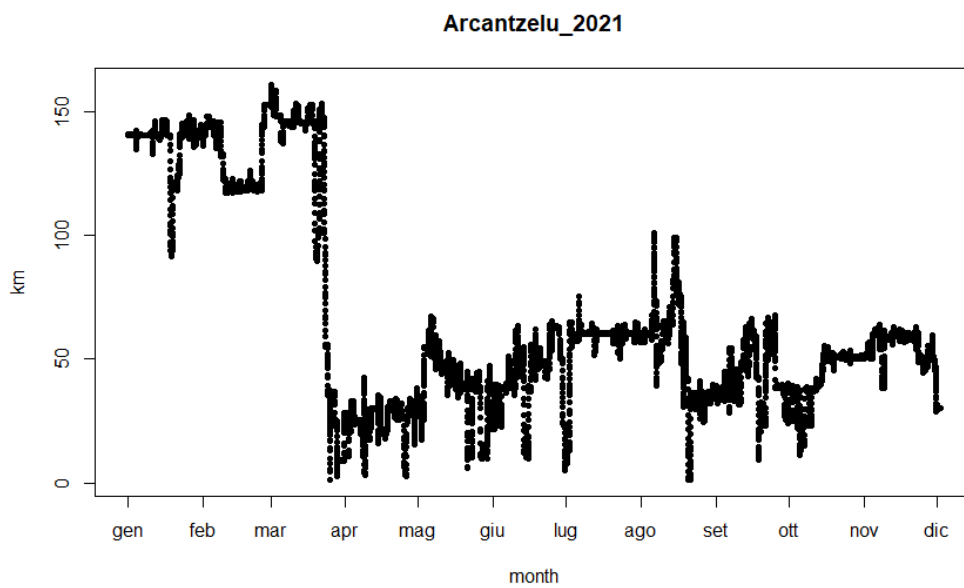
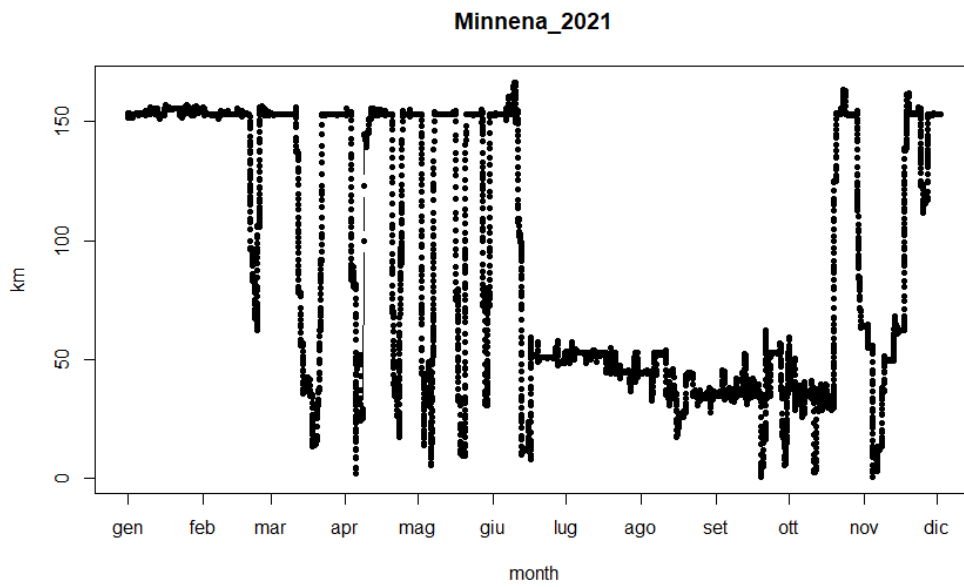
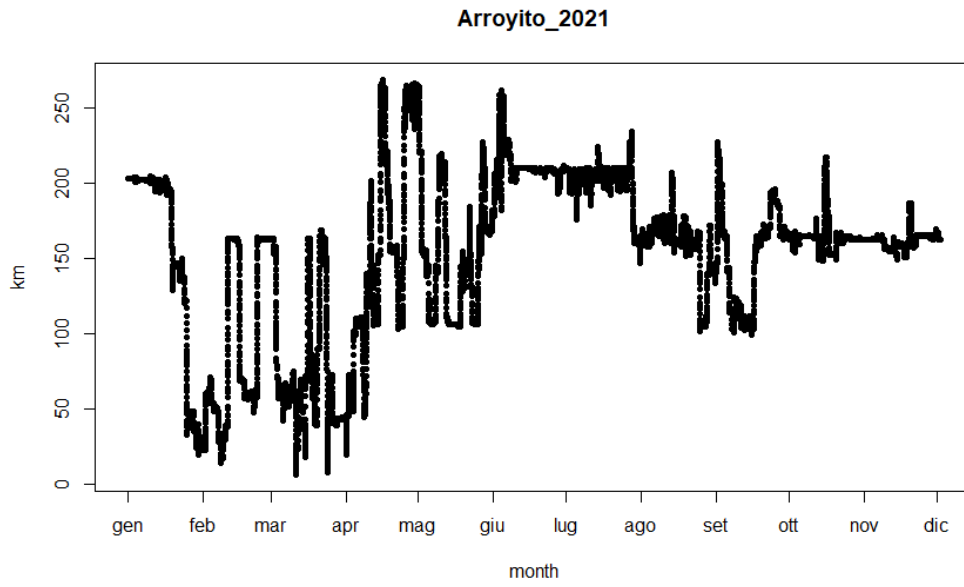


Fig. 3. NSD for eagles released in 2020 from 1/1/2021 up to 15/12/2021. “0” marks the release site.

2.2 Eagles from the 2021 hacking season

All the eaglets spent the early release period around the release site, exploring the surroundings. Only two of them fed on the external platforms. Then, they started dispersal, mostly moving around north-central Sardinia (Fig.4).

The first long movement toward north has been made by Yorgi, who kept on moving around but always coming back to the aviary. Exploring movements increased by frequency and distance covered up to mid October, when it definitively left the aviary, moving south up to Oristano. Babbu Mannu left the aviary on early September (5/9) exploring the north and moving south up to Oristano. Both these eagles were often spotted on the aviary when Bonaria was recovering inside, along with Pratteri (male released in 2019) often feeding together on the feeding platforms outside the aviary. Bonaria left the release valley very soon but she moved in a parallel valley where she was caught again on 12 august. At the second release, she soon left the release site, moving north and towards Tavolara, when the signal was lost before she reached the island.

All the other eagles (the ones from Sicily) left the aviary site few days after the release in nature. Prisco made the longest movement towards south up to Cagliari, while the other two (Lia and Nino) roamed in north Sardinia covering a remarkable amount of distance from the east coast (Bosa mountains) to northern Sardinia (Palau and Porto Cervo). By the end of August, they established in the southern part of Coghinas Lake (40 km west from the release site), a place that confirms its high suitability for Bonelli's eagles, due to the abundance and availability of several prey species. Nino left the release site before all the others, in 8/8/21.

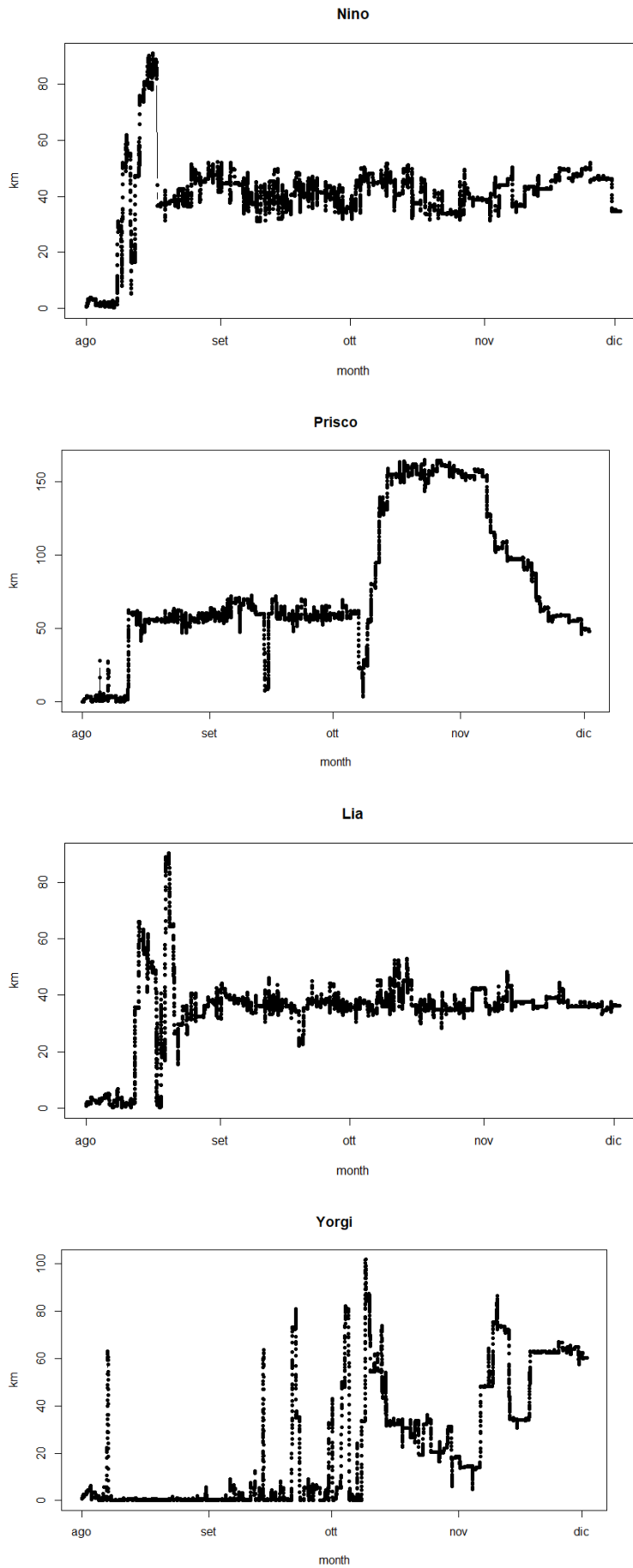


Fig. 4 NSD for eagles hacked and alive in 2021. Movements from the release (up to the 15th of December). Bonaria and Babbu Mannu are not reported due to short monitoring period.

3. FEEDING POINTS MONITORING

During the 2019, 2020 and 2021, clusters of positions of several eagles were checked in order to assess main prey species consumed. The remains of 39 preys from seven eagles, belonging at least to 13 different species were found and determined (36 at a specific level, see Tab. 3 and 4); more than 97 % of the whole sample was made up by birds remains, although the sample is highly biased towards larger preys, whose consumption takes longer and is more likely to produce leftovers. This might be the case of Minnena: clusters of points, likely corresponding to feeding periods, have been checked many times, but remains have been found only in two cases.

The most represented species are still *Buteo buteo* (n=9, 23%) and *Corvus cornix* (n=7, 18 %).

SPECIES	n
Anas sp	2
<i>Ardea cinerea</i>	4
<i>Bubulcus ibis</i>	4
<i>Buteo buteo</i>	9
<i>Chroicocephalus ridibundus</i>	2
<i>Columba palumbus</i>	4
Columbiformes	1
<i>Corvus cornix</i>	7
<i>Egretta garzetta</i>	1
<i>Gallinula chloropus</i>	1
<i>Larus michahellis</i>	2
<i>Lepus capensis</i>	1
<i>Nycticorax nycticorax</i>	1

Tab. 3 List and number of individuals of species preyed by eagles listed in tab.4

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>
	20/05/2021	1	<i>Corvus cornix</i>
Arroyto	12/09/2020	1	<i>Corvus cornix</i>
	06/12/2021	2	<i>Ardea cinerea</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. 4 Prey species consumed by the released eagles