

Reintroduction of Bonelli's eagle in Sardinia

Action D.1
Post release monitoring





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

BONELLI’S EAGLE (*Aquila fasciata* Vieillot, 1822) HACKING SITE SELECTION

Azione D1: Post release monitoring

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1. SURVIVAL

By the end of 2019, eight animals (seven constantly monitored by GPS tags) out of the 14 released are alive (Tab.1). Signal from three eagles was lost due to tags malfunctioning, but A14 Ichnusa unpredictably transmits few data time by time.

On 27 April 2019, Saccaia was found dead in the area of Bolotana (central Sardinia). The necropsy revealed clear signs of heavy electrocution, that probably caused instant death.

On June 21, shortly after the release (June 19th) A08 Artaneddu was chased by three *Corvus corax* and forced to leave the release site in the following days. It never ate close to the cage after the release and moved in the area of Coghinas lake, where it kept on moving around. On 8 July, after half a day of restricted movements, this eagle was recovered dead. The necropsy revealed strong debilitation: the eagle didn't hunt enough (or at all) to maintain the good post-release physical conditions.

On September, the carcass of Tepilora was recovered, after the positions clearly showed no movements. It was illegally killed in the area of Monte Prano Lake (Sulcis), where it has settled, probably late in the afternoon, when it was already perching on a tree for the night. Although the investigation started soon after the discovery of the carcass, the poacher/s has/ve not been found.

Year	Name	PVC Ring	Origin	Sex	Birth date	Arrival date	Release in nature	Date of death/SL
2018	Abbaluchente	A01	LPO	F	04-5-18	29-6-18	20-ago-18	
2018	Helmar	A02	LPO	M	05-5-18	29-6-18	20-ago-18	SL ¹
2018	Posada	A03	LPO	F	07-5-18	29-6-18	20-ago-18	
2018	Tepilora ²	A04	LPO	F	09-5-18	29-6-18	20-ago-18	26-9-2019
2018	Nurasè	A05	Grefa	F	29-5-18	24-7-18	20-ago-18	7-11-2018
2018	Saccaia	A06	Andalucia	F	10-4-17	15-7-18	21-dic-18	27-4-2019
2019	Muscatoglio	A07	Andalucia	M	02-3-19	27-4-19	15-giu-19	
2019	Artaneddu	A08	Andalucia	M	27-2-19	27-4-19	15-giu-19	6-7-2019
2019	Prenna	A09	Andalucia	F	25-2-19	27-4-19	15-giu-19	
2019	Illiorai	A10	Andalucia	M	11-3-19	27-4-19	15-giu-19	SL ³
2019	Pratteri	A11	Grefa	M	09-3-19	27-4-19	15-giu-19	
2019	Battore	A12	Agrigento	M	17-3-19	12-5-19	15-giu-19	
2019	Ichnusa	A14	Valencia	F	19-3-19	13-7-19	26-lug-19	SL ⁴
2019	Inoche	A15	Grefa	F	19-4-19	13-7-19	26-lug-19	

Tab. 1 List of the Bonelli's eagles hacked in 2018 and 2019, in Crastazza, first selected release site for the project. PVC rings are yellow with black inscriptions. Eagles were also fitted with metal rings and GPS-tags (data omitted). SL: signal lost.

¹ Signal lost on 21-1-2019

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

³ Signal lost on 4-7-2019, probably seen on 13-7-2019

⁴ Signal lost on 14-10-2019, few data until 28 oct, then again on 30 December. Still alive in 2020

During 2019, Ispra set up a very effective alert system to promptly take action when eagle's positions suggest limited movements. Depending upon the area of intervention, Regional Forestry Corp or/and Anthus (recently subcontracted by Ispra) is alerted and they reach the site corresponding to last position of the concerned eagle. In most cases, this system has allowed to prompt recovery animals in difficulty or carcasses. In several occasion, however, only rest of big preys have been found (e.g. *Ardea cinerea*, *Buteo buteo* and several other prey species), suggesting that limited movements were due to abundant feeding.

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 movement 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 Hacking season 2018

During 2019, 4 out of six animals released in 2018 were regularly monitored. By the end of 2019, only two (A01 Abbaluchente and A03 Posada) were still alive.

From August to December 2018, Abbaluchente widely roamed all over Sardinia. Although one year later (end of 2019) it doesn't seem to have settled yet, nevertheless it shows restricted movements within a broad area in central north Sardinia, between 36-60 km from the release site (Fig. 1). Several times it crossed the release site but never stopped there. During September-October 2019, it stayed close to Coghinas lake, where it was reached by Pratteri, a male released in summer 2019. The two stayed together for a short time and then Abbaluchente moved away.

As for Posada, it explored all Sardinia except the central-north mountainous area. On May the 2nd it left Sardinia to move to Corsica, from Bonifacio skirting Lavezzi and Cavallo islands and reaching directly the area north of Sant'Amanza gulf (south-western Corsica). This eagle is currently using south Corsica and north-western coast, including Scandola Natural Reserve, moving preferentially along the western coast.

Tepilora clearly selected an area (Monte Prano Lake, Sulcis) where it spent much of the time and from where she moved for short periods of exploration. On May the 1st it moved to Corsica (isolated spike in fig. 1) where it moved along the western coast. It was back in Sardinia after some days (9/5), directly reaching Monte Prano lake. Here, it has been illegally killed on 26/9/2019 (Annex I).

A couple of days after the release in winter (18 December), Saccaia left and moved about 30 Km apart toward the east coast. From the new area, it kept on moving out and back, increasing dispersal distances with time. On April the 27th it died because of electrocution in central Sardinia (Annex II).

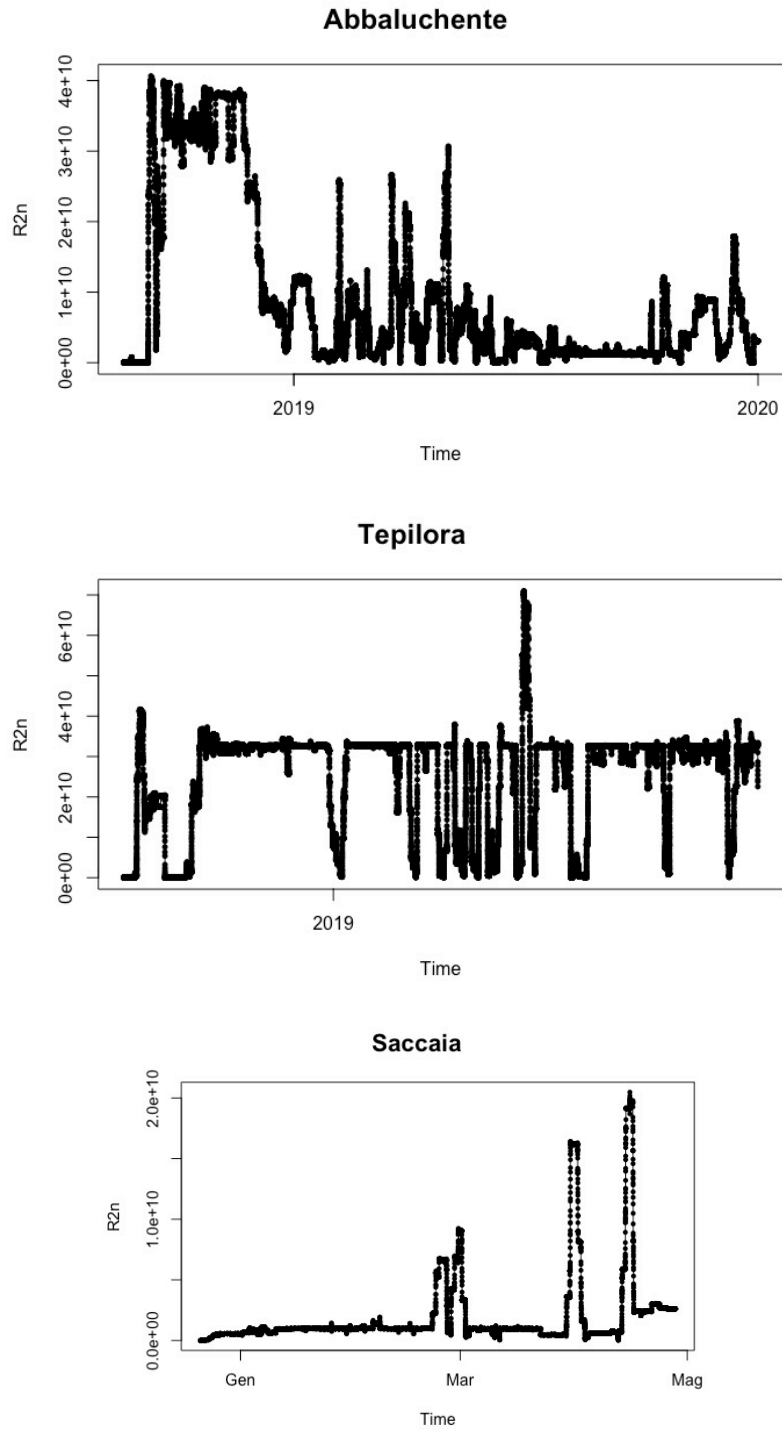


Fig. 1 NSD of 2018 released eagles, survived in 2019.

2.2 Hacking season 2019

Artaneddu was the first leaving the release site, making short movements on 26 June and leaving definitively the area on 27 to go north. It has been found dead on 6-7-2019, close to Coghinas Lake, probably because unable to hunt properly.

The first long movements of Battore have been recorded around mid August, but the eagle always came back to the release site while the dispersion started at the end of August; Pratteri did almost the same, exploring the release area in the second half of July and leaving on 26 August

Prenna started exploring the surroundings around the end of August leaving the area on 11 September. Muscatoglio left around the 3th of the same month, exploring almost all Sardinia but concentrating the movement around Oristano and in Sulcis (south-west Sardinia).

Ichnusa and Inoche were released together on late July. While they were in the hacking cage, almost all (4 out of six, A7, A9, A11, A12) the already released eagles interacted with them (Fig.2), always coming back to the aviary. To support these interactions, food was offered on the roof of the cage for the free animals. After the release, A15-Inoche joined the other eagles in the valley: it stayed longer around the release site, leaving on 17 September. Ichnusa did not join the group and soon started exploring the area, leaving progressively between 24 and 26 of August.

Within all eagles released in 2019, Battore and Muscatoglio seems to be still roaming in Sardinia, the first wondering mainly in central-western part of the island and never going south, the second moving also to the south.



Fig. 2. Inoche and Ichnusa inside the cage and other two eagles feeding on the roof

All the other eagles seem to have selected a “reference” area, from which they keep on exploring the whole island (Fig.3). The case of Pratteri is interesting: it seems to be established in Coghinas lake (35 km away from release site, north Sardinia) making short excursions and never moving south. “Reference” site for Prenna is a small (0.6 ha) island in south west Sardinia, off the coast of the bigger Sant’Antioco island (Sulcis Archipelago), where it spent long periods and often came back after explorations in main Sardinia. Inoche selected the Sulcis as a reference area too.

Nothing can be said about Ichnusa due to the scattered data from November to December the 31th; this eagle is however alive as the tag transmits scattered data, unpredictably.

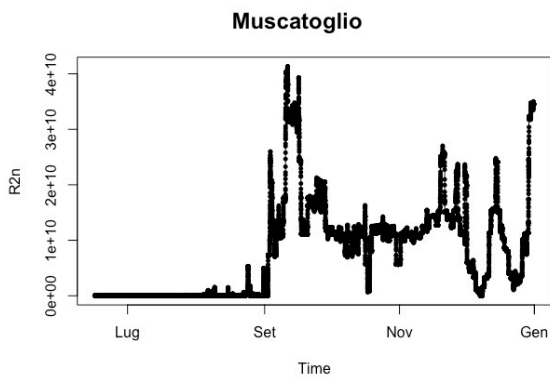
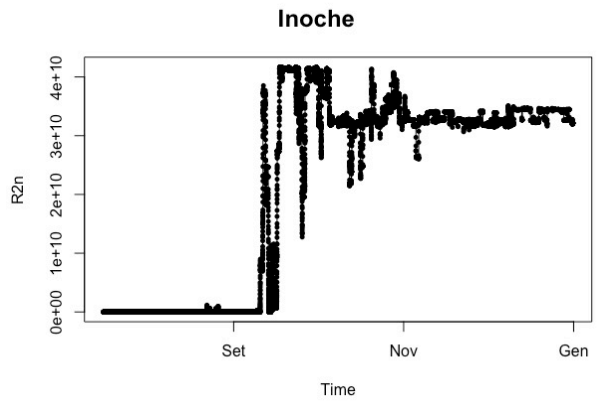
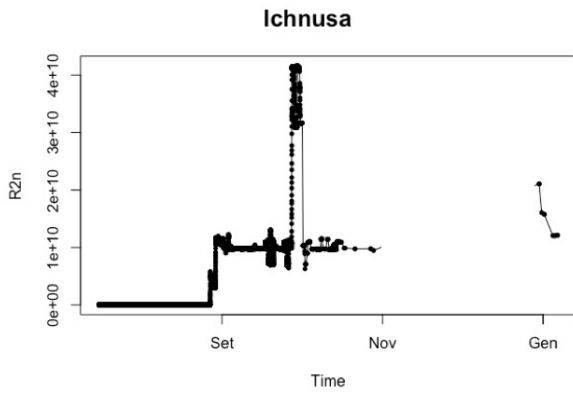
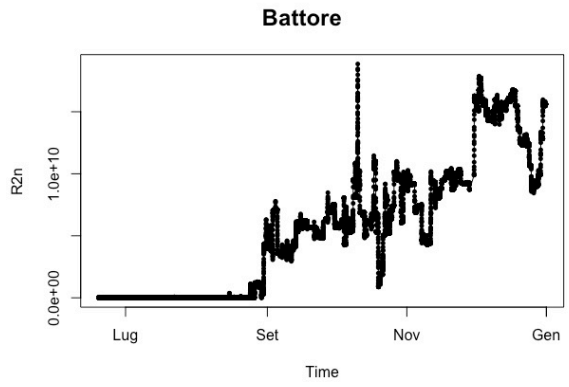
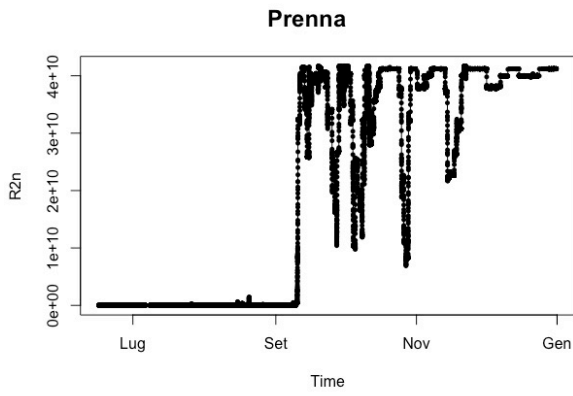
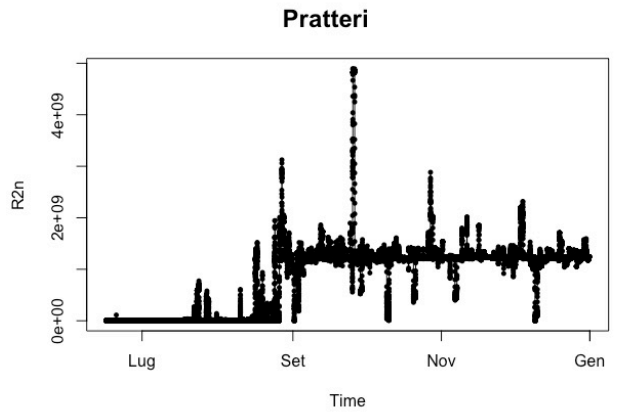
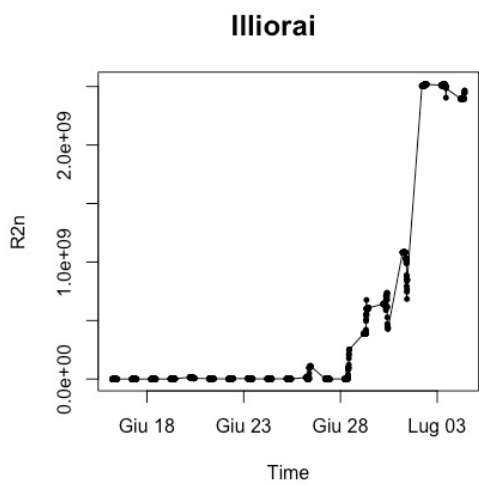


Fig. 2 Movement of the released eagles from release (see tab.1) to 31 December 2019 (Artaneddu omitted due to short post-release monitoring)

3. SIGNIFICANT DISPERSAL AREAS

Based upon all the Bonelli's eagles movements up to 31 December 2019, highly frequented areas already identified in 2018 can be confirmed. Although the eagles roamed across almost all the island, these areas have been visited repeatedly by different animals in both years.

Data confirmed the area of Sulcis (south Sardinia) as visited by almost all the released eagles (except Pratteri and Battore in 2019): Tepilora and Nurasè probably settled there. Oristano province, mainly the western part, is also highly visited by almost all the animals. This area is particularly attractive because it's rich of wetlands and cultivated plains (including rice fields) which offer a high variety/availability of prey species. Monte Arci and the northern slope of Monte Linas represent the only mountains present in the area; however, there's high availability of cliffs along the coast.

4. CONCLUSION AND FUTURE PERSPECTIVE

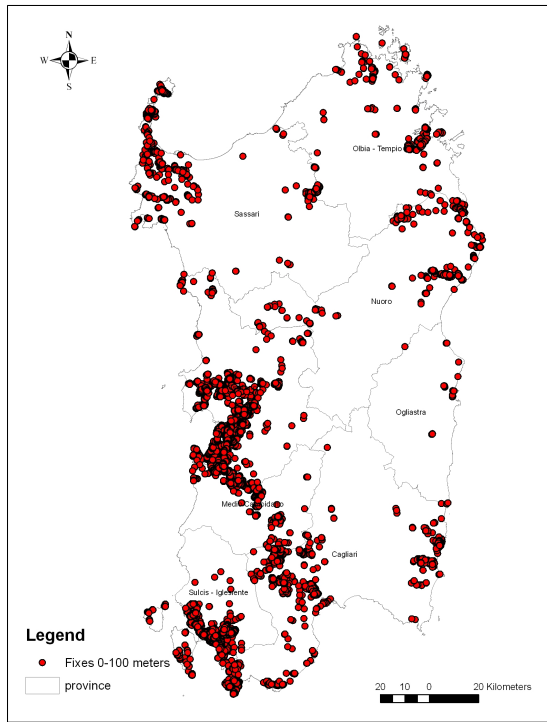
The first two years monitoring provides an interesting view of the spatial use and movements during dispersal and before settlement. The post-release stage is confirmed to be critical; notably the possibility for the animals to feed from the platforms seems to be crucial to attain good physical condition to face the cost of dispersal. Leaving too early the release site might be risky and compromise the fate of the animals. To help post release feeding, food was offered in sites the eagles showed interest to, e.g. mainly the cage itself (roof and door, once opened). Some of the eagles came back into the cage, sometimes spending a whole night inside.

Based upon data available up to now, animals tend to start dispersal in late August-September regardless the release date. Therefore in 2019, eagles stayed longer at the release site than in 2018 and fed longer than the eagles released in 2018.

Dispersal data and frequently used area helped identify crucial area for electrocution risk.

Fixes of dispersing eagles were analyzed on Google Earth and any pylon/line used/crossed was marked in the map. However, although the animals crossed several power lines, no pylons were found to be clearly used as a perch by them. Therefore, to highlight more dangerous lines, positions under 100 m of height above ellipsoid were selected among all the positions pooled across animals; at this height it is more probable for an eagle to collide or be electrocuted in presence of electric line. In this way, we obtained a clear picture of the most frequented areas (Fig. 3 a). A grid 5x5 km was superimposed to the positions and each square was classified according to the internal density of positions (Fig. 3b). Thereafter, power lines inside the most used squared have been marked using Google Earth, enlarging the bulk of data already available about the positions of power lines. New sites were added to the already known heavily used areas (Sulcis, Oristano province, Campidano-Marmilla), including Bolotana plain, where Saccaia was electrocuted. These data will be discussed with e-distribution, to get a clear picture of costs to be sustained for their retrofitting.

a)



b)

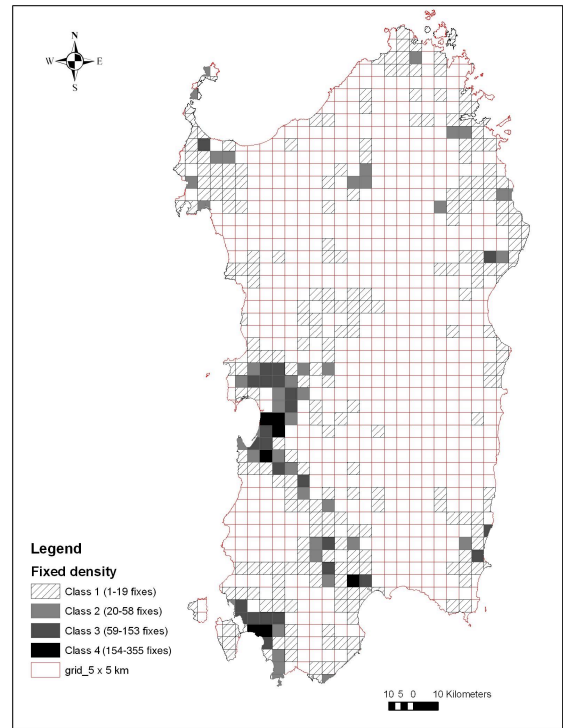


Fig.3 a and b. Map of the most used areas (see text for explanation)

