LIFE AEGYPIUS RETURN

REPORT

Deliverable 3.2. Annual report on soft releases and movements of tagged Cinereous Vultures. 2024.

December 2024

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Almost four decades after becoming extinct in Portugal as a breeding species, the Cinereous Vulture (*Aegypius monachus*) returned to colonize the country in 2010, as some birds coming from Spain nested in the Tejo International Natural Park. Thanks to the conservation efforts carried out in both countries by NGOs and government entities, the number of breeding pairs has been steadily increasing. However, the Portuguese population is still too fragile, and its future remains uncertain. The LIFE Aegypius Return project will ensure the definitive return of the species.

https://4vultures.org/life-aegypius-return/

Coordinating beneficiary

VCF VULTURE CONSERVATION FOUNDATION

Associated beneficiaries

Palombar Associação de Conservação da Natureza e do Património Rural

Herdade da Contenda

spea Sociedade Portuguesa para o Estudo das Aves

LPN liga para a protecção da natureza

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Contributing organizations *(to tagging and monitoring tasks, by alphabetical order)*

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Hawk Mountain Sanctuary

Herdade da Contenda

LPN - Liga para a Protecção da Natureza

Palombar - Conservação da Natureza e do Património Rural

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List of acronyms

CAD - Centro de Análisis y Diagnóstico de la Fauna Silvestre de Andalucía
GNR – Guarda Nacional Republicana
ICNF - Instituto da Conservação da Natureza e das Florestas, I.P.
U.Évora – Universidade de Évora

Wildlife Rehabilitation Centres *(in Portugal and Spain, by alphabetical order)*

AMUS – Acción por el Mundo Salvaje (Villafranca de los Barros, Badajoz)
CARAS - Centro de Acolhimento e Recuperação de Animais Selvagens (Évora)
CERAS - Centro de Estudos e Recuperação de Animais Selvagens (Castelo Branco)
CERVAS - Centro de Ecologia, Recuperação e Vigilância de Animais Selvagens (Gouveia)
CIARA – Centro de Interpretação Ambiental e Recuperação Animal (Felgar)
CRAS-HVUTAD - Centro de Recuperação de Animais Selvagens do Hospital Veterinário da Universidade de Trás-os-Montes e Alto Douro (Vila Real)
CRASM – Centro de Recuperação de Animais Selvagens de Montejunto (Cadaval)
GREFA – Grupo de Rehabilitación de la Fauna Autóctona y su Hábitat (Majadahonda, Madrid)
LxCRAS - Centro de Recuperação de Animais Silvestres de Lisboa (Lisboa)
RIAS - Centro de Recuperação e Investigação de Animais Selvagens (Olhão)

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Abstract

This report is prepared in the scope of the project LIFE Aegypius Return, under Actions T.3.2 - *Soft release of Cinereous Vultures from wildlife recovery centres in Portugal to reinforce the Douro Internacional (SPA DIVA) breeding colony* and T.6.2 - *Monitoring of the Cinereous Vulture and assessing the project impact on its population.* It summarizes the progress made regarding the objectives of soft-release and the movements recorded by the Cinereous Vultures tagged in Portugal.

So far, 41 Cinereous Vultures (*Aegypius monachus*) were tagged with a GPS/GSM transmitter: 34 chicks, one adult, two rehabilitated and released juveniles, and four soft released juveniles. Of these, 31 birds are still alive, seven died and three have an unknown status. Mortality causes varied and include both natural and human induced factors.

The soft release programme started in 2024 with the acclimatization and release of four juvenile Cinereous Vultures. Of these, three remain near the acclimatization site. The fourth bird flew eastward, showing a more exploratory behaviour.

Movement data revealed a dual behaviour in juvenile Cinereous Vultures during their first year, with some remaining near their colonies while others embark on dispersive movements covering vast areas of the Iberian Peninsula and beyond. These dispersive movements increase through the year, peaking in spring and summer when birds explore further from their birthplace. Roosting site analysis highlights key areas which can guide future prospections of new colonies.

The remote monitoring system in place is effective in obtaining the birds' locations and behaviours, feeding sites and roosts, as well as in detecting threats and mortalities. Notwithstanding, at times, the lack of GSM network coverage hinders or prevents data collection, limiting the capacity for analysis and action and exceeding the technical capabilities of the project teams. Solutions to these limitations are being discussed among the scientific and conservation communities.

Foreword

The Cinereous Vulture (*Aegypius monachus*) is an endangered species with conservation status of Endangered (EN) in Portugal (Almeida et al., 2022) and Vulnerable (VU) in Spain (Real Decreto 139/2011). Globally, it is classified as Near Threatened (NT) by the International Union for Conservation of Nature. It is protected by the Habitats Directive (Annex I), as a priority conservation species in Europe, by the Bern Convention (Annex II), by the Bonn Convention (Annex II) and by the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES - Annex II-A).

As a scavenger bird, it plays a fundamental ecological role by feeding on carcasses and minimising the spread of disease.

Formerly widespread in the Iberian Peninsula, the Cinereous Vulture became increasingly scarce in the region over the 20th century mostly due to habitat loss, wildlife poisoning and direct persecution. In the 1970s the breeding population went extinct in Portugal, and only around 200 pairs remained in Spain. Following the implementation of legal protection and targeted conservation measures, the species started recovering in Spain and naturally recolonised Portugal with the first breeding pair detected in 2010 in the Tejo Internacional Natural Park. Since then, more pairs began settling across different regions of Portugal and five colonies are currently known (the fifth just recently discovered, in June 2024).

The recovery process has been steady, although slow and limited, and the need of urgent action to ensure the definitive return of the species to Portugal and Western Spain led to the approval of the LIFE Aegypius Return project.

Until 2027, the project aims to increase the breeding population in Portugal to at least 80 pairs in five colonies, improve the breeding success, encourage the connectivity between colonies and downgrade the national conservation status from Critically Endangered to Endangered (which already occurred in 2023 with the update of the Portuguese Red List of Breeding Birds – Almeida et al. 2022).

Concrete conservation actions will focus on reducing disturbances around nests, preventing fires, installing and repairing nesting platforms, improving food availability, combating poisoning, and reinforcing populations through soft release strategies – the central topic of this report. Furthermore, a thorough collaboration and capacitation plan will be put in place, promoting joint work with all relevant stakeholders – e.g. hunters, farmers, national authorities, conservationists – to improve ecological conditions for the species and to detect and fight wildlife crime and illegal poisoning, which is vultures' biggest threat worldwide.

The success of LIFE Aegypius Return relies on the extensive collaboration of nine partners and the active involvement of such stakeholders.

1. SOFT RELEASE: CONSTRUCTION OF THE ACCLIMATIZATION AVIARY AND OPERATIONAL MANAGEMENT

Following the approval of the LIFE Aegypius Return project, the partner organization Palombar began implementing Action T.3.2, for which they serve as the lead partner. This action includes the construction of an acclimatization aviary (Fig. 1) as part of the soft release strategy for Cinereous Vultures, defined to reinforce the breeding colony in Douro Internacional.

The licensing details and construction plans for the acclimatization cage were presented in Deliverable 3.1 (Matos et al., 2023a, available on the project's website). A final report on the construction of the facilities was issued in April 2024 (Gutiérrez et al., 2024a, available on the project's website), providing detailed information on the location, fencing, structure, architecture, video surveillance, and cage opening plans.

Each year, an average of five injured or weakened Cinereous Vultures are admitted to Wildlife Rehabilitation Centers throughout Portugal. A protocol (Matos et al., 2023b, available on the project's website) for their rehabilitation and release has been established and agreed upon, ensuring consistent procedures and decision-making. This protocol includes a decision tree to determine the fate of each rehabilitated bird, as well as the eligibility criteria for participation in the soft release program.

Over the course of the project, it is expected that about 20 rehabilitated Cinereous Vultures will participate in the soft release programme. To ensure animal well-being and standardized procedures in maintaining and safeguarding the individuals that participate in the soft release programme, and hence stay a few months in the acclimatization aviary, a management protocol was issued in February 2024 (Gutiérrez et al., 2024b, available on the project's website). This document also ensures standardized procedures for monitoring the birds, conducting the releases, and implementing contingency plans in case of emergencies.

Fig. 1. General view of the finalized acclimatization aviary. ©Leonor Carvalho/Palombar

2. SOFT RELEASE OF CINEREOUS VULTURES

The acclimatization facilities were completed by March 2024 (Fig. 1), and inaugurated on May 21st, with the admission of four Cinereous Vultures. As foreseen in the rehabilitation and release protocol (Matos et al., 2023b), the four birds hatched in the wild (two in 2022 and two in 2023), and had been found weakened in various parts of the country. They were rescued and rehabilitated at various rehabilitation centres: CARAS (Évora), two of them; another at CERAS (Castelo Branco) and another at CRASM (Tojeira, Cadaval). Afterwards, they were all transferred to CERAS, where they finished their rehabilitation. Then, instead of being returned directly to the wild, they entered the soft release programme, to acclimatize to the Douro region and later reinforce the local breeding colony (Table 1).

The introduction of the vultures into the acclimatization aviary was accompanied by biologists from Palombar, and teams of veterinarians from CERAS and CRAS-HVUTAD (Fig. 2, Fig. 3), who also helped with the collection of biological samples for genetical and biochemical analysis.

During the acclimatization period, the birds were regularly fed and monitored as foreseen in the management protocol (Gutiérrez et al., 2024b) developed within the project, and no incidents occurred. All the four birds remained healthy and interacting with wild individuals that regularly fed on the supplementary feeding station in front of the acclimatization cage and often approached the cage (Fig. 4).

On the 2nd October 2024 the birds were subjected to a veterinary check-up and equipped with a GPS/GSM transmitter, again with the help of biologists from Palombar and veterinarians from CRAS-HVUTAD. The tagging operations were carried out also with the support of a team from the Biodiversity Research Institute (University of Oviedo - CSIC - Principality of Asturias).

The aviary was finally opened on the 3rd November 2024. The return of the four Cinereous Vultures to freedom was celebrated with an event open to the public, organised by Palombar. The event included a guided walk and various environmental awareness activities and was attended by around 30 people. The opening of the cage was observed from a great distance, from the Carrascalinho viewpoint, respecting the necessary tranquillity of the birds.

Following the procedures established for soft release, the birds were released with minimal contact with human beings, so as not to disturb them. Once the cage is open, the vultures decide when they want to leave, without the intervention of the project technicians. The four vultures eventually left the cage the following day, timidly and after an interaction with a wild Cinereous Vulture (the juvenile named *Arribes*, hatched and tagged in 2024) (Fig. 5) and a wild Griffon Vulture, that approached and entered the aviary.

The four soft released vultures' movements and behaviours are being closely monitored. The results on their movements will be presented in Chapter 4 of this report, and individual maps are presented in Annex II.

Table 1. Data on the four Cinereous Vultures that inaugurated the LIFE Aegypius Return soft release programme. Dates are presented in the day/month/year DD/MM/YYY format.

Hatching year	Region of collection	Bird name	#Metal ring	#PVC Ring	#Tag	Sex	Status on 19/12/2024	Deployment start	Deployment end	Cause of admission in rehab centre	Date of admission in rehab centre
2022	Belmonte	Almeirão	1359	4S	243614	M	Alive	04/11/2024	-	Malnutrition	20/04/2022
2022	Évora	Azedinha	1358	4R	234028	F	Alive	04/11/2024	-	Possible illegal captivity	29/10/2022
2023	Serra Aire e Candeeiros	Alfavaca	1337	5N	243613	F	Alive	04/11/2024	-	Collision with windmill	27/10/2023
2023	Évora	Arçã	1323	58	243612	F	Alive	04/11/2024	-	Malnutrition	17/11/2023

Fig. 2. Veterinary check-up before admitting the Cinereous Vultures to the acclimatization aviary (21/05/2024). ©Leonor Carvalho/Palombar

Fig. 3. Cinereous Vultures in the acclimatization aviary, where habitat enrichment items are visible. Image captured using the remote surveillance system.

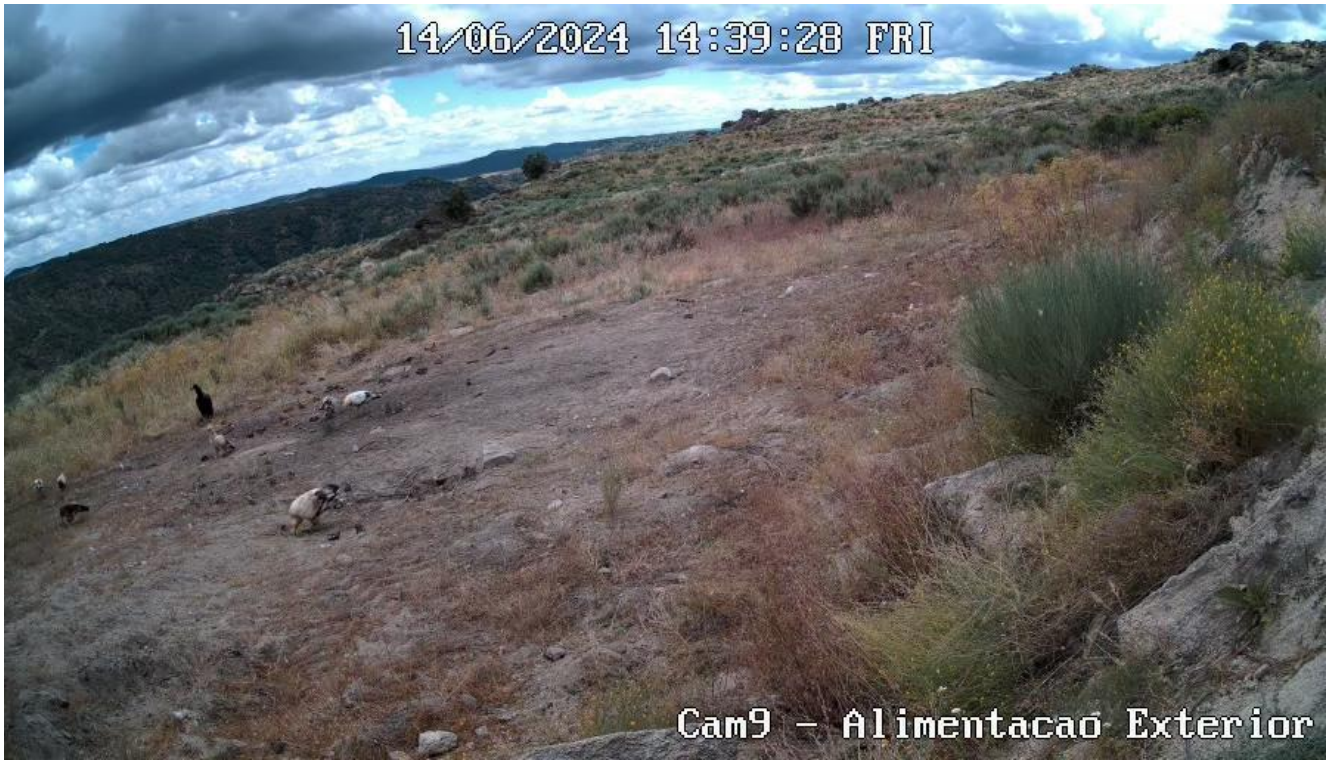


Fig. 4. Cinereous Vultures and Egyptian Vultures feeding on the supplementary feeding station in front of the LIFE Aegypius Return acclimatization cage. Image captured using the remote surveillance system.

Fig. 5. The four Cinereous Vultures in the opened acclimatization aviary, interacting with a wild Cinereous Vulture (*Arribes*), Image captured using the remote surveillance system.

3. TAGGED CINEREOUS VULTURES

So far, in LIFE Aegypius Return, a total of 41 Cinereous Vultures were tagged: 34 chicks, one adult, two rehabilitated and released juveniles, and the abovementioned four soft released juveniles. Of these, 31 birds are still alive, seven died and three have an unknown status (the tags are not sending data).

During the tagging operations, each individual is fitted with an OrniTrack-E50 4G GPS/GSM solar-powered transmitter from Ornitela using natural tubular Teflon. The applied tagging method is either leg loop harness or backpack, depending on the tagger's assessment and/or specific characteristics of each bird (e.g. weight and size).

As the tagging operations occur mostly in Portugal, each year tagging permits are requested to the Institute of Nature Conservation and Forests (ICNF), the statutory Portuguese national authority for fauna monitoring, for identified tagging experts who are cooperating with the project. In 2024, an additional tagging permit was requested to the Junta de Castilla y Leon for tagging a Cinereous Vulture chick (*Arribes*) from the Douro Internacional colony whose nest was in the Spanish side of the river.

All field technicians and taggers involved in the tagging operations attended a workshop on tagging techniques that the Project organized in the AMUS Wildlife Rehabilitation Centre in Villafranca de los Barros, Spain, in June 2023, to exchange experiences and define best practice.

The tagging operations also always include marking the birds in one leg with a small metal ring with a unique identifier code (that works as the bird's "Identity Card" and is issued by the Portuguese ringing centre CEMPA), and in the other leg with a very light PVC coloured ring. The PVC rings are slightly larger than the metal ones and allow information to be obtained by observing the birds from a distance.

Direct contact with endangered and sensitive species like the Cinereous Vulture is a rare and invaluable opportunity. Within the LIFE Aegypius Return project, this opportunity is maximized to gather scientific data essential for informed conservation decision-making.

Every tagged Cinereous Vulture undergoes a thorough veterinary examination to evaluate its body condition, overall health, and the potential presence of injuries, diseases, or parasites. Detailed biometric measurements, such as beak length and wing size, are recorded, and biological samples are collected, following a specific protocol developed by the project teams (Delgado et al., 2024, available at the project's website). These samples are then analysed by collaborating laboratories to determine the bird's sex and to conduct biochemical, haematological, genetic, and toxicological studies. These analyses provide two key benefits: first, they establish critical baseline data for the species; second, they help identify diseases, contaminants, or other risks. Genetic analyses enable the verification of individual lineages and offer insights into population dynamics and reproductive patterns between colonies and regions.

This comprehensive information, integrated with the ecological information provided by the remote monitoring, is essential for understanding the species and its threats, thereby supporting the development and implementation of more effective and evidence-based conservation strategies.

3.1. Chicks

Cinereous Vulture chicks are tagged when they reach an appropriate size, typically at 80 to 90 days of age. Field monitoring teams estimate the chicks' age based on their physical development and the behaviour of their parents. Within each colony, the selection of chicks for tagging is carefully made, taking into account not only their age but also the accessibility and safety conditions required to reach their nests, which are constructed at the tops of trees.

In 2023, four Cinereous Vultures breeding colonies were known and closely monitored in Portugal. A total of 78-81 breeding pairs were recorded, which produced 35-37 fledglings. Of these, 15 were tagged and sampled.

In 2024, the monitoring teams recorded 108 to 116 nesting pairs in Portugal, which produced at least 48 fledglings. Of these, 19 were tagged.

A fifth breeding colony was discovered by the ICNF in southern Portugal, near Vidigueira, in June 2024. The late discovery, midway through the breeding season, made it impossible to conduct detailed monitoring of all breeding parameters while ensuring the birds' tranquillity. However, the ICNF confirmed the presence of five nests and successful reproduction in one of them. The resulting chick, a young male *(Pousio*), was tagged, and will provide valuable information for better understanding and following this new colony.

So far, a total of 34 Cinereous Vulture chicks were tagged and sampled within LIFE Aegypius Return, as summarized in Table 2. To this date, six of those chicks have died (three from 2023 and three from 2024). The causes of mortality varied (Table 2) and have not yet been fully determined, as the results from some necropsies and laboratory analyses are still pending. Preliminary results suggest that three birds (*1U*, *5E*, and *Aravilinho*) may have died of natural causes.

3.2. Adults

The Project foresees some attempts to capture adult Cinereous Vultures, aiming to capture at least one wild adult from each colony.

To date, and in coordination with other ongoing projects (e.g., led by Quercus), a total of eight capture attempts have been carried out: one in Douro Internacional, two in Malcata, three in Tejo Internacional, and two at Herdade da Contenda. Each attempt lasts between two and four days and employs various methodologies, such as walk-in traps and clap-nets, placed at supplementary feeding stations stocked with ample bait carcasses.

Despite these efforts, only one adult individual, *Aravil*, has been successfully captured and tagged to date. This capture occurred in Tejo Internacional on 09/12/2023 (Table 3).

Aravil is now a male 14-year-old Cinereous Vulture that was ringed as a chick, in the nest, in 2010. It is one of the first two chicks that hatched for the first time in Portugal, after the species' return to the country, in the Tejo International Nature Park. As a chick, it had fallen from the nest and went missing for about one week. After thorough searches in the woods, it was found, and was put back on an artificial nest by some biologists that are now part of the LIFE Aegypius Return project. The parents immediately arrived and took care of the chick, who was recaptured in 2023 in the same area, over 13 years later. As an adult and since its tagging, the bird remains in its hatching area (Annex II, page 35).

Tagging additional adult vultures would be highly valuable for the project, as it would enable the monitoring of their movements and territory occupancy, the identification of threats to mature individuals, and the collection of samples from individuals that have lived in the wild for extended periods.

3.3. Rehabilitated Cinereous Vultures

Since the beginning of the project, two birds (*Zimbro* and *Gerês*) coming from Wildlife Rehabilitation Centres in Portugal were tagged and released (Table 3). By that time, the acclimatisation aviary was not yet built.

Zimbro, a male Cinereous Vulture, hatched in the wild in 2021 in an unknown location. Later that year, he was found weak in central Portugal and entered the Wildlife Rescue Centre in Lisbon (LXCras). It took almost one year of treatment and physiotherapy under the attentive care of the veterinary team for *Zimbro* to recover fully. Rehabilitated in December 2022, he was transferred to CIARA, in northern Portugal, to regain his flight practice and needed musculature. Finally, on 21 March 2023, Zimbro was tagged and released in Northeastern Portugal and shortly after flew to Spain. He has been wandering in the province of Zamora, Spain, since then (Annex II, page 33).

Gerês, also a male, hatched in 2022 and was unfortunately shot in October that year, in the Gerês National Park, Portugal. He was admitted in CRAS-HVUTAD with a broken wing. After orthopaedic surgery and veterinary treatment, he was also transferred to CIARA to restore his flying skills. *Gerês* was tagged and released on August 10, 2023, in the same place as *Zimbro* (Miradouro do Carrascalinho). He was intensively exploring the Douro International Nature Park and died a week after the release. The dead body was retrieved by partners Palombar and the ICNF, on a Douro cliff, and sent to necropsy at CRAS-HVUTAD. It was not possible to determine the cause of death.

Fig. 6. Tagging of a Cinereous Vulture chick and processing of the biological samples collected, at Herdade da Contenda. ©VCF

Fig. 7. Release of Aravil, an adult Cinereous Vulture, after tagging (09/12/2023) in Tejo Internacional. ©Samuel Infante/Quercus

Table 2. Data on the 34 Cinereous Vulture chicks tagged within LIFE Aegypius Return in 2023 and 2024, organized by date of tagging.
Red lines refer to individuals dead by December 2024. Breeding colonies – Douro: Douro Internacional (PTZPE0038); Malcata: Serra da Malcata (PTZPE0007); Tejo Int: Tejo Internacional (PTZPE0042); Contenda: Herdade da Contenda (PTZPE0045); Vidigueira: Municipality of Vidigueira. Dates are presented in the day/month/year format.

	Date of tagging	Hatching year	Colony	Nest code	Bird name	#Metal ring	#PVC Ring	#Tag	Sex	Status on 19/12/2024	Deployment start (or fledging date)	Deployment end (date of death)	Cause of death	Place of death	Obs.
1	01/07/2023	2023	Douro	AM-SA-30	Freixo	1652	20	215607	M	Dead	21/08/2023	28/01/2024	Collision with powerline	Douro Internacional, PT	Necropsy done in CRAS-HV-UTAD.
2	01/07/2023	2023	Douro	AM-SA-20	Juniperus	1653	21	215609	M	Alive	27/07/2023	-			
3	02/07/2023	2023	Malcata	AM08		1612	1X	234021	F	Unknown	13/08/2023	-			No signal since 22/01/2024.
4	02/07/2023	2023	Malcata	AM12		1613	1T	201437	M	Alive	06/08/2023	-			
5	03/07/2023	2023	Malcata	AM04		1614	1U	234020	M	Dead	19/08/2023	04/10/2023	Septicaemia of bacterial origin followed by drowning	Ramales de la Victoria, ES	Lab analysis done in CAD.
6	03/07/2023	2023	Malcata	AM16		1615	1V	234032	M	Unknown	03/07/2023	-			Never connected to GSM network.
7	04/07/2023	2023	Tejo Int	Pôpa 15	Roselha-grande	1332	4V	203507	F	Alive	12/08/2023	-			
8	04/07/2023	2023	Tejo Int	Pôpa 21	Sérgio	1334	51	234023	M	Alive	13/08/2023	-			
9	04/07/2023	2023	Tejo Int	Cubeira 9	Rosmaninho	1335	52	234024	M	Alive	14/08/2023	-			
10	05/07/2023	2023	Tejo Int	Cubeira 13	Rosa-albardeira	1329	54	234034	F	Alive	29/08/2023	-			
11	05/07/2023	2023	Tejo Int	Cubeira 16	Aroeira	1330	55	234036	F	Alive	13/08/2023	-			
12	06/07/2023	2023	Tejo Int	Águas de Verão 1	Aquis	1322	57	234037	M	Alive	19/09/2023	-			
13	13/07/2023	2023	Contenda	C206	Mirante	1616	1W	234022	M	Dead	15/08/2023	26/08/2024	Gunshot	Cumbres de San Bartolomé, ES	Toxicology results pending (Spanish teams).

	Date of tagging	Hatching year	Colony	Nest code	Bird name	#Metal ring	#PVC Ring	#Tag	Sex	Status on 19/12/2024	Deployment start (or fledging date)	Deployment end (date of death)	Cause of death	Place of death	Obs.
14	13/07/2023	2023	Contenda	N40	Bolota	1617	1Y	234025	F	Alive	16/08/2023	-			
15	14/07/2023	2023	Contenda	N31	Raia	1618	2J	234033	F	Alive	16/08/2023	-			
16	01/07/2024	2024	Malcata	AM18		1620	2C	243639	M	Alive	01/07/2024	-			
17	01/07/2024	2024	Malcata	AM24		1541	2E	234030	F	Alive	01/07/2024	-			
18	01/07/2024	2024	Malcata	AM04	Brutus	1542	2F	243641	M	Unknown	01/07/2024	-			No signal since 16/08/2024.
19	08/07/2024	2024	Contenda	N30	Touril	1543	2K	243615	M	Alive	31/07/2024	-			
20	08/07/2024	2024	Contenda	C212	Medronho	1544	2L	243616	M	Alive	22/08/2024	-			
21	08/07/2024	2024	Contenda	N37	Arroio	1545	2R	243617	M	Alive	18/08/2024	-			
22	14/07/2024	2024	Douro	AM-SA-35	Zelha	1711	23	234017	M	Alive	16/08/2024	-			
23	21/07/2024	2024	Douro	AM-SA-40	Celtis	1712	24	234035	F	Alive	25/08/2024	-			
24	21/07/2024	2024	Douro (ES)	AM-SA-Espanha-3	Arribes	J06765	XV3	234027	M	Alive	21/08/2024	-			
25	16/07/2024	2024	Tejo Int	Pôpa 4.1		1338	5E	243618	M	Dead	Did not fledge	11/09/2024	Fell from the nest (2nd time).	Under the nest (Tejo Int)	Toxicology results pending (CAD).
26	16/07/2024	2024	Tejo Int	Pôpa 4		1691	5F	243619	F	Alive	04/09/2024	-			
27	16/07/2024	2024	Tejo Int	Pôpa 12		1696	5H	243620	F	Alive	17/08/2024	-			

	Date of tagging	Hatching year	Colony	Nest code	Bird name	#Metal ring	#PVC Ring	#Tag	Sex	Status on 19/12/2024	Deployment start (or fledging date)	Deployment end (date of death)	Cause of death	Place of death	Obs.
28	17/07/2024	2024	Tejo Int	Cubeira 11.1		1692	5J	243621	M	Dead	18/08/2024	19/09/2024	Inconclusive. Possibly gunshot	Penha de Águia, PT	Toxicology results pending (CAD).
29	17/07/2024	2024	Tejo Int	Cubeira 16		1693	5X	243622	F	Alive	02/09/2024	-			
30	17/07/2024	2024	Tejo Int	Cubeira 19	Natator	1694	5S	243623	M	Alive, in rehab	15/08/2024	-			Rescued from Tagus margin 14/09/2024. Rehab in CERAS ongoing.
31	18/07/2024	2024	Tejo Int	Soalheiras 3	Aravilinho	1695	5W	237168	F	Dead	29/08/2024	23/09/2024	Drowned	Barragem de Alcântara, ES	Necropsy done in CRFS Los Hornos, Cáceres.
32	19/07/2024	2024	Vidigueira	Vid01	Pousio	1546	2H	238668	M	Alive	03/09/2024	-			
33	06/08/2024	2024	Malcata	AM13		1547	2M	243640	F	Alive	06/08/2024	-			
34	06/08/2024	2024	Malcata	AM03		1548	2S	234019	M	Alive	06/08/2024	-			

Table 3. Data on the 2 rehabilitated (Zimbro and Gerês) and one adult (Aravil) Cinereous Vultures tagged within LIFE Aegypius Return in 2023 and 2024.
Red lines refer to individuals dead by December 2024. Places of release – Douro: Douro Internacional (PTZPE0038); Tejo Int: Tejo Internacional (PTZPE0042). Dates are presented in the day/month/year format.

Hatching year	Region of collection	Bird name	#Metal ring	#PVC Ring	#Tag	Sex	Status on 19/12/2024	Deployment start	Deployment end (date of death)	Cause of admission in rehab centre	Date of 1st admission in rehab centre	Date of release	Place of release	Obs
2021	Porto de Mos (Leiria)	Zimbro	1236	1K	215888	M	Alive	21/03/2023	-	Weakness	10/2021	21/03/2023	Douro	
2022	Parque Nacional da Peneda-Gerês	Gerês	1654	22	234017	M	Dead	10/08/2023	16/08/2023	Gunshot	21/10/2022	10/08/2023	Douro	Found dead 24/08/2023 on a cliff (Douro Int). Necropsy was inconclusive.
2010	Tejo Int	Aravil	MT368	5C	234031	M	Alive	09/12/2024	-	-	-	09/12/2023	Tejo Int	ADULT trapped and tagged in Tejo 09/12/2023; bird originally ringed as chick in 2010.

4. MOVEMENTS OF THE TAGGED BIRDS

4.1. Chicks/ Juvenile Cinereous vultures

Once juvenile Cinereous Vultures start flying and leave the nest, they remain dependent on their parents for some weeks to months (Hiraldo, 1983). After emancipating, while some birds remain in their colony and surroundings, other birds disperse, engaging in large wandering movements of tens or even hundreds of kilometres away from their colonies (e.g. García-Macía et al., 2024). This pattern could be observed in the chicks tagged in 2024 (Fig. 8) as well as in 2023 (Fig. 9; Matos et al., 2023a).

Throughout their first year, juvenile Cinereous Vultures explored large areas in most of the central Iberian Peninsula. The annual Kernel Utilization Distributions (KUD; see Annex I for detailed methods) of the birds tagged in 2023 (Fig. 9), show their combined whereabouts, highlighting the importance of the colonies and surroundings which were more frequently used (i.e., their '*core range*'; 50% KUD), as well as the areas they explored throughout the year covering large parts of most central Iberian Peninsula (i.e., their '*home range*'; 95% KUD).

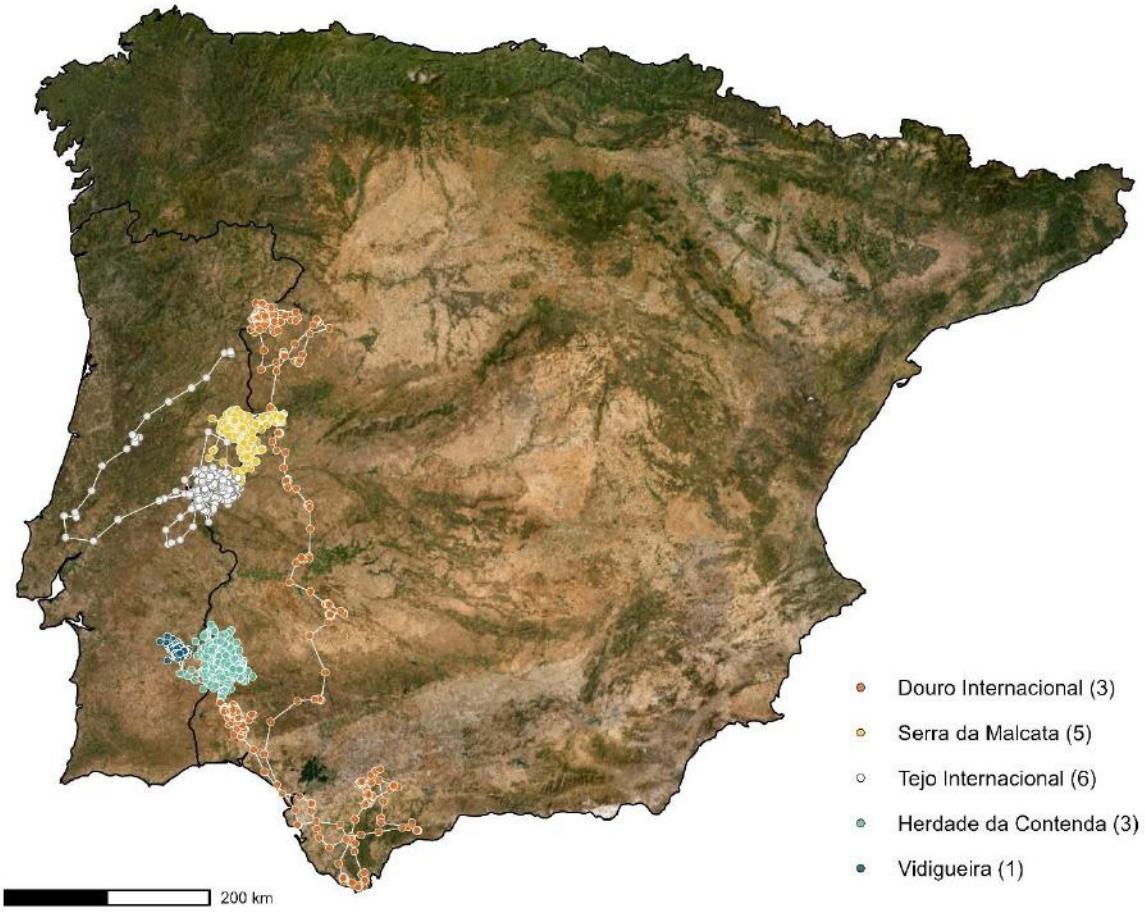


Fig. 8. Movements of juvenile Cinereous Vultures tagged in the nest in 2024, with tracks coloured by colony of origin and number of chicks tagged in each colony show in parenthesis (1 chick from Tejo Internacional that died before fledging was removed). Movements shown from the day of tagging to 15 December 2024.

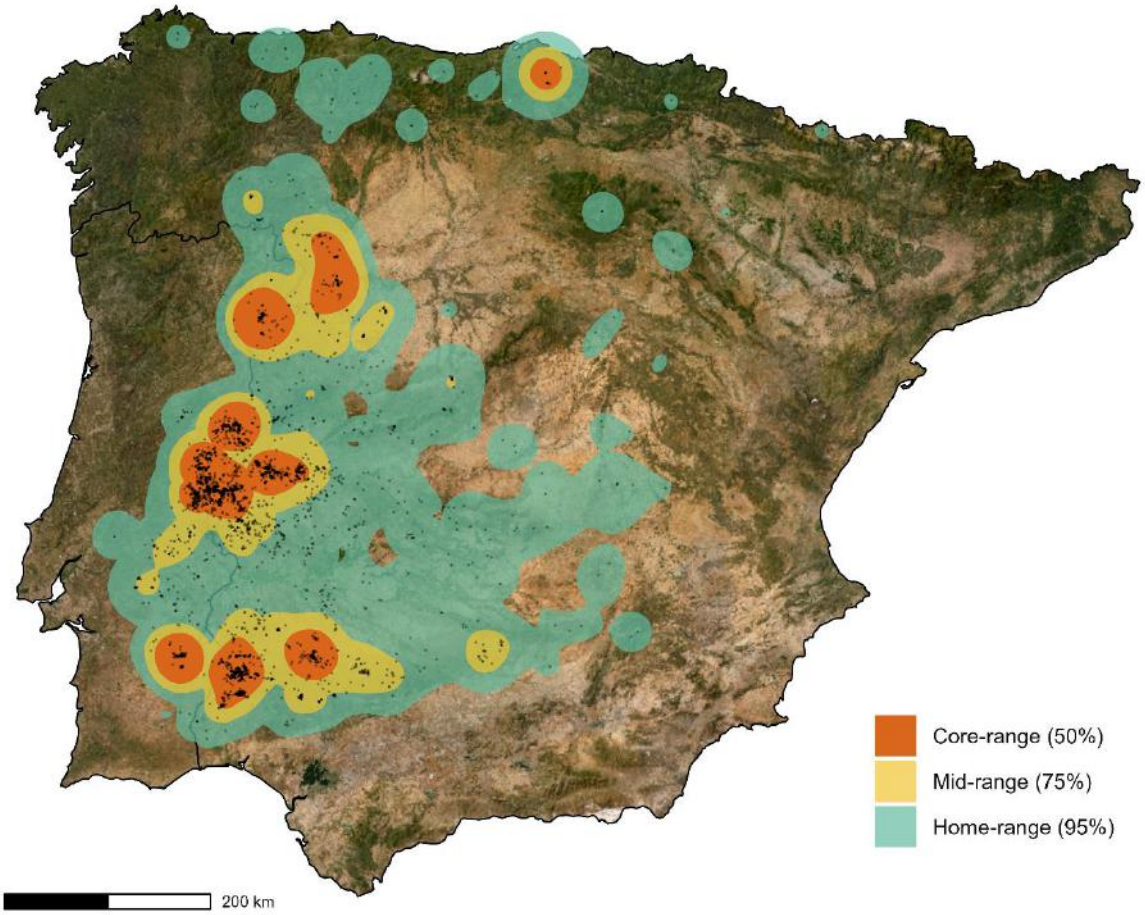


Fig. 9. Annual Utilization Distribution of Cinereous Vultures tagged in 2023, showing the core range (50% Kernel Utilization Distribution - KUD), mid-range (75% KUD), and home range (95%) within an annual-cycle in the Iberian Peninsula (locations in France not shown). Black dots show daily locations (n = 6 692) of all juvenile vultures included (n = 14). The core and mid-ranges in the North of the Iberian Peninsula (near Bilbao) refer to the area where the bird 1U spent some time weakened before dying of bacterial septicemia and drowning (see Table 2), so they should not be taken as true representations of the Cinereous Vulture range.

The dispersive movements of juvenile Cinereous Vultures seem to increase as the year progresses (Fig. 10). While in Autumn, when juvenile birds still depend on their parents, and in Winter, when the weather conditions are poor to roam wide, travelled distances were relatively short (Fig. 10). However, in Spring and Summer juveniles start dispersing through long flights covering large stretches of territory far away from their birthplace (Fig. 10). For example, Rosmaninho (tagged in 2023 in the Tejo Internacional colony) has performed large dispersive flights away from his colony during its first year of life (Fig. 11). These patterns are in line with those reported for other colonies in the Iberian Peninsula (García-Macía et al., 2024).

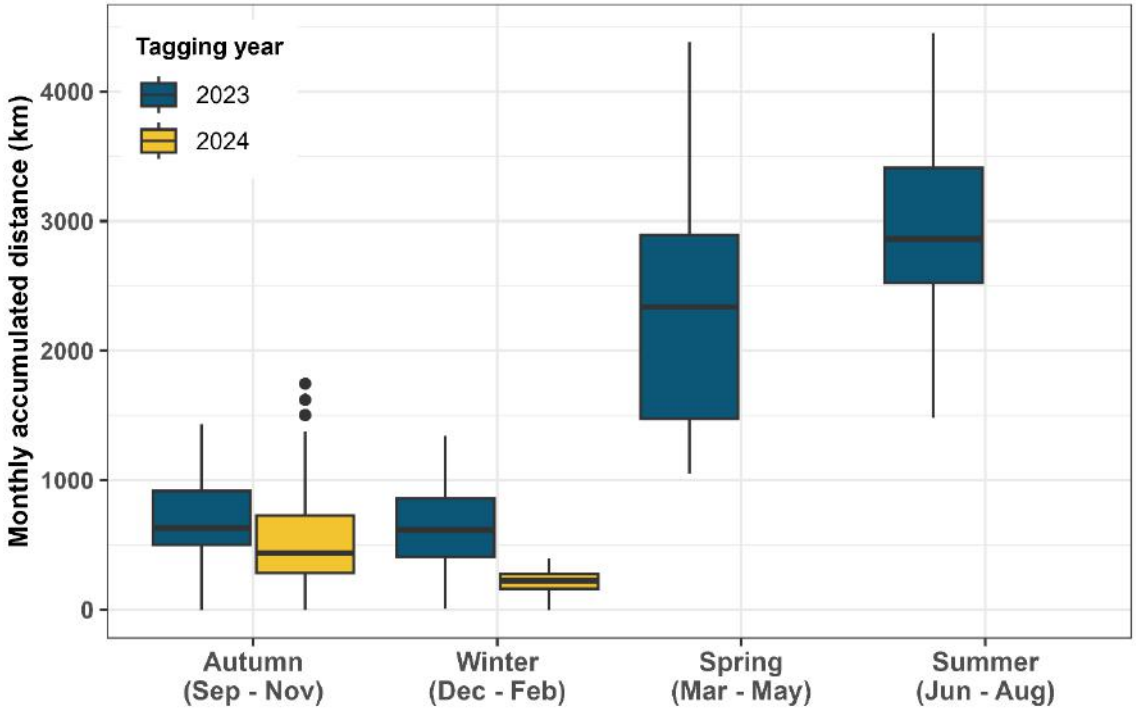


Fig. 10. Distance travelled by Cinereous Vultures tagged on the nest in 2023 and 2024, showing boxplots of monthly accumulated distances by season of the year. Note that for birds tagged in 2024, the winter only contains data up to 15 December 2024.

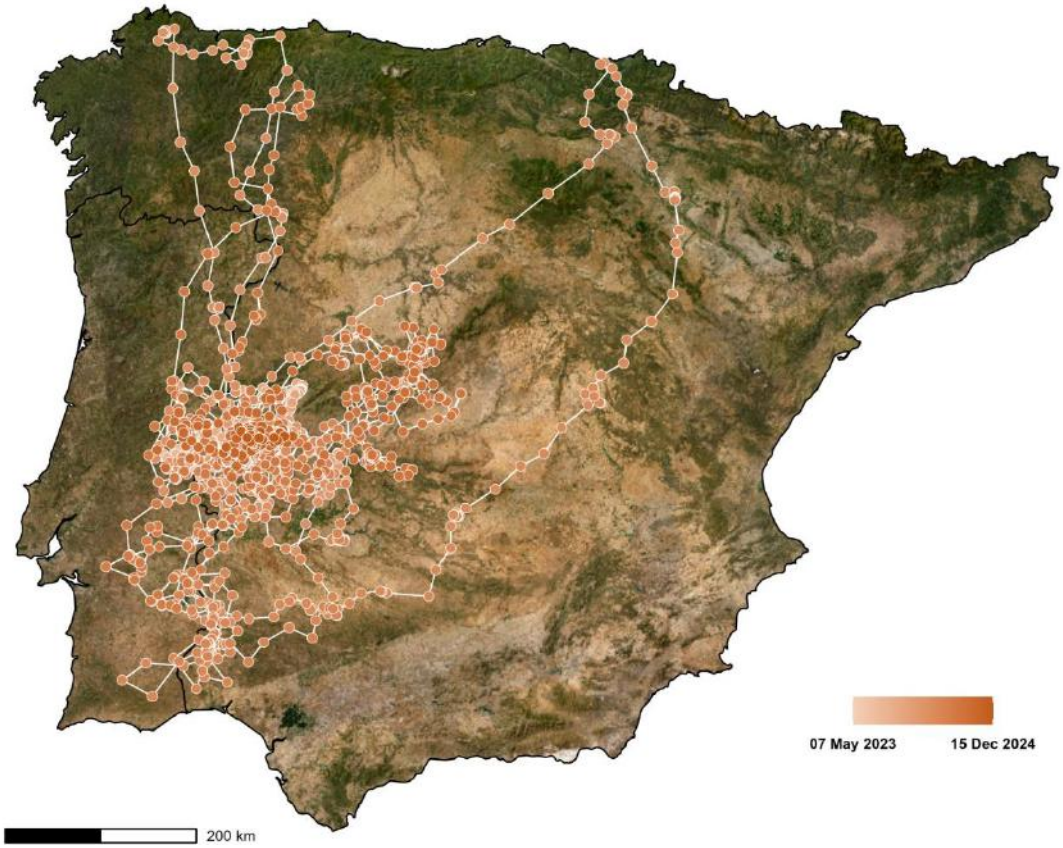


Fig. 11. Movements of Rosmaninho, showing his large dispersive movements across the Iberian Peninsula.

As juveniles disperse and cover larger areas and explore unknown territories, they may become more exposed to threats or have difficulty in finding food. Indeed, some of the mortalities were recorded while birds were away from their main colonies (Fig. 12). For example, bird 5J (tagged in Tejo Internacional colony in 2024), started a large dispersive flight just one month after leaving the nest (Fig. 12). The bird flew toward the southwest approaching Lisbon and changed its route to the northeast, reaching Penha de Águia two days and about 210 km later, where it died in the next morning of unknown cause.

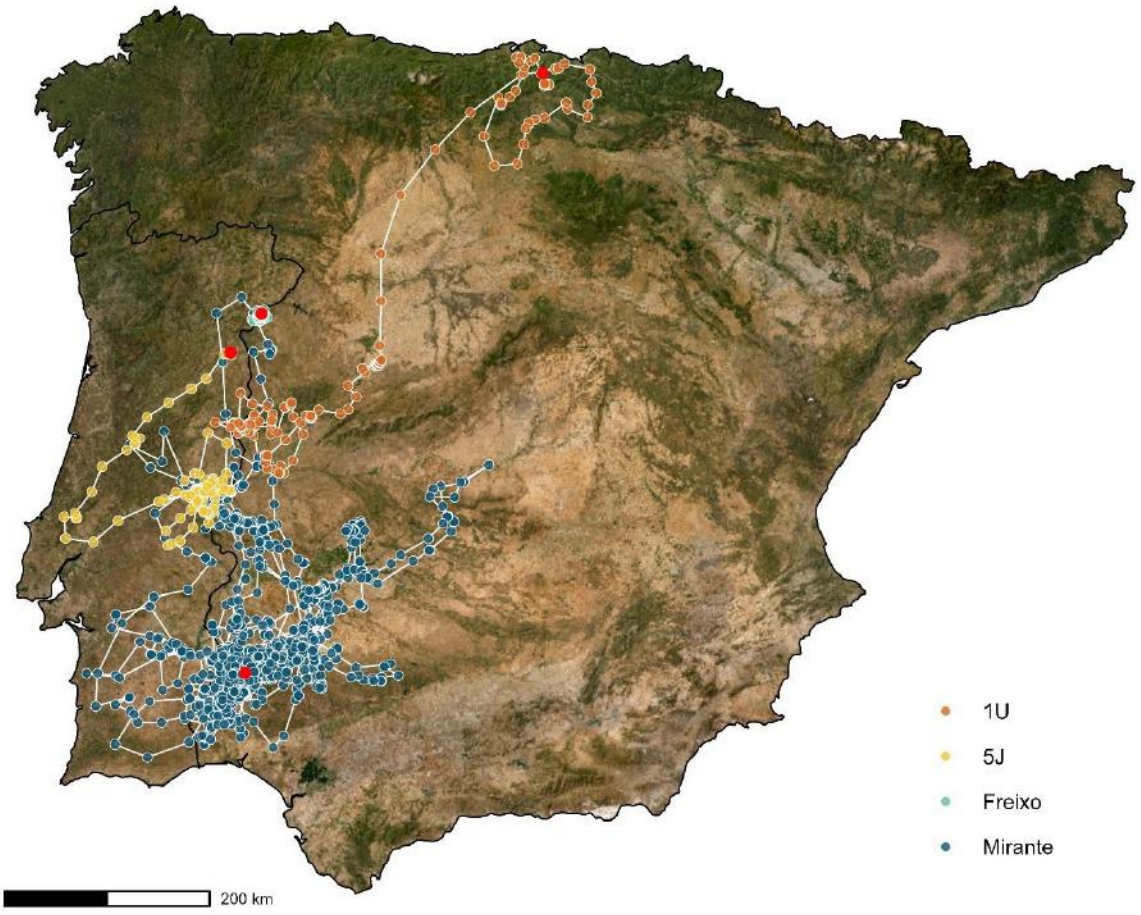


Fig. 12. Map of juvenile tagged Cinereous Vultures who died, showing the complete movements of each bird and the locations where they were found dead (red dots).

4.2. Soft-released birds

Staying in the acclimatisation aviary allows rehabilitated Cinereous Vultures to socialise with other individuals, observe conspecifics in the feeding site facing the cage, and adjust to local conditions, which will help them better survive and settle once they are freed back into the wild (Ivanov et al., 2023). Of the four birds released in early November in Douro Internacional, three stayed mostly around the releasing site, with *Arçã* and *Almeirão* having visited together three sites in Spain up to 25 km away (Fig. 13). The fourth bird, *Alfavaca*, performed a long flight eastward ending up in the centre of the Spanish town Aranda del Duero. A team from GREFA was sent to monitor the bird, fed it, and attempted to catch it for a veterinary examination but failed. The team continued surveying the bird in the next days until it flew southward. It remains apparently healthy since then.

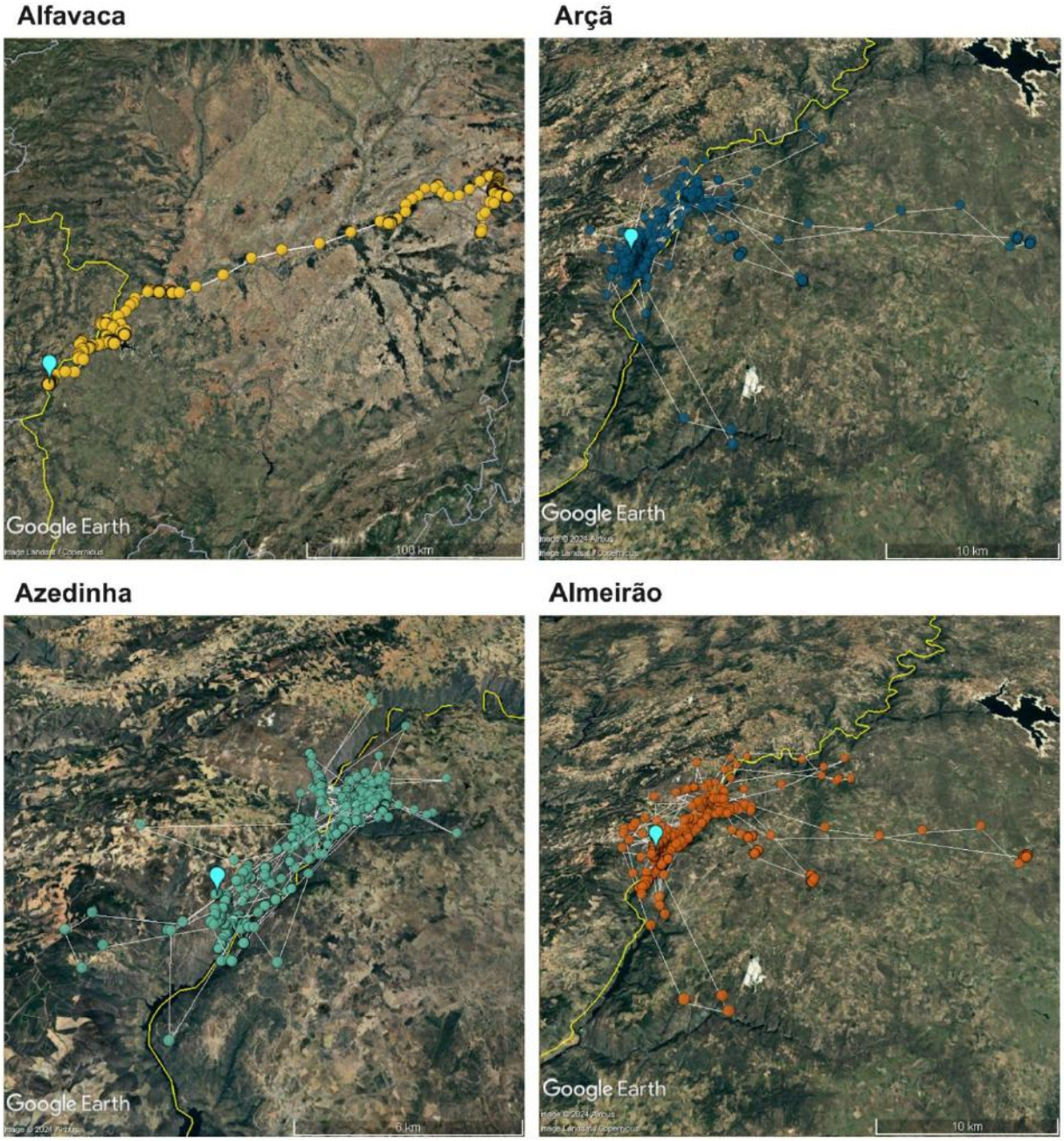
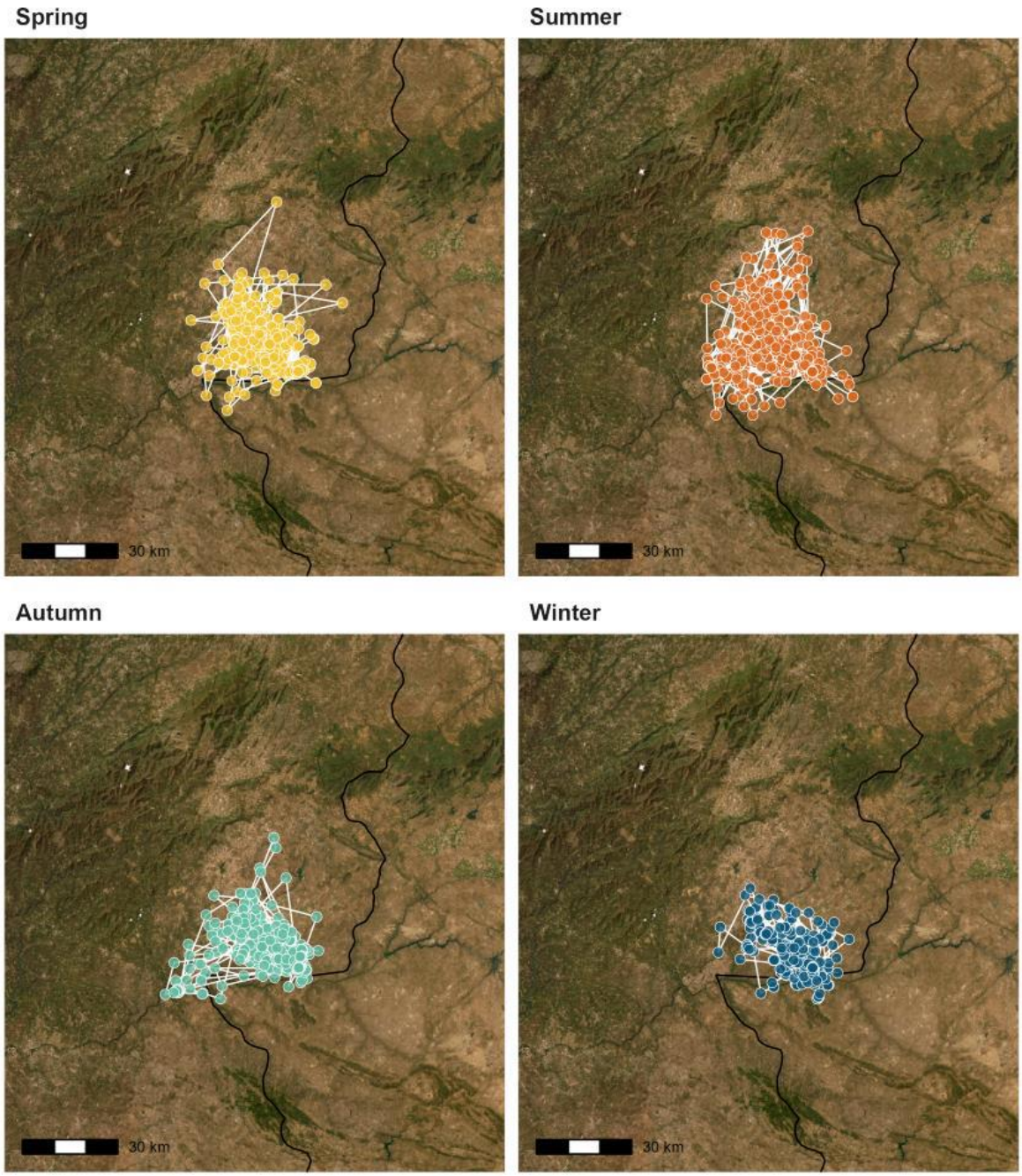


Fig. 13. Movements of the four soft released Cinereous Vultures, showing the complete movements of each bird between 04/11/2024 and 15/12/2024, and the location of the acclimatization aviary (light-blue pin).

4.3. Adult birds and rehabilitated birds

During 2024, *Aravil* stayed in the same general area in Tejo Internacional (Fig. 14a). Although it did not embark on long dispersive flights, its tracking data showed periods of intense local activity, during which *Aravil* covered substantial distances within its limited home range (Fig. 14b; see Annex II). *Aravil* successfully bred, with its chick hatching on April 25th. As chick rearing progressed, the bird's monthly accumulated distance increased significantly, peaking in August (Fig. 14b). This period coincided with the chick's increased demand for food and favourable weather conditions, allowing for longer flights to distant foraging areas (García-Macía et al., 2023).

(a)



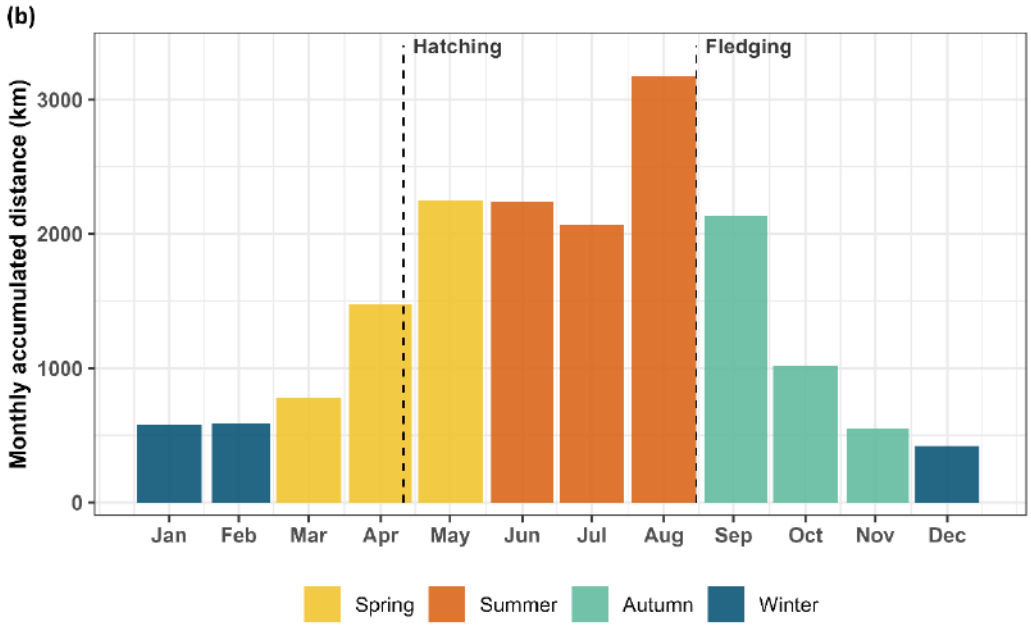


Fig. 14. Monthly (a) movements and (b) accumulated distances of Aravil, showing the dates of hatching and fledging of his chick and the remarkable increase in the distances travelled during the summer months and September, which correspond to the chick rearing period.

Since he was rehabilitated and released, *Zimbro* performed an impressive wandering flight, crossing the Pyrenees to France and reaching the NW coast by the English Channel (Fig. 15). The bird returned to the Iberian Peninsula just after three days and travelled along the Spanish Northern coast before returning to its core range, East of Douro Internacional (see map in Annex II, page 33).

Fig. 15. Movements of Zimbro since its release, showing the impressive travel through France and back in just 3 days.

4.4. Identification of roosts

In their dispersive movements, Cinerous Vultures move and feed in areas far from their colonies, but they also need to find safe places to spend the night. Identifying these roosting sites is important as they may indicate locations where other conspecifics are and, possibly, breeding sites that remain undiscovered. This analysis may also inform and prevent potential threats such as electrocutions, collisions, poisoning events or others.

The main roosting sites for the tagged Cinereous Vultures were mapped following the methodology described in Annex I (page 32).

As expected, the areas where most Cinereous Vultures spent most nights were within the known colonies in Portugal and in Spain (Fig. 16). Notably, the recently discovered colony in Vidigueira has been used for roosting by birds already tagged in 2023. Other heavily used areas include forested areas to the north of the Herdade da Contenda colony, the Monsaraz-Alqueva area, Ponte de Sôr, and Penha Garcia - Vale Feitoso. These data will inform field searches to more efficiently prospect new possible breeding colonies.

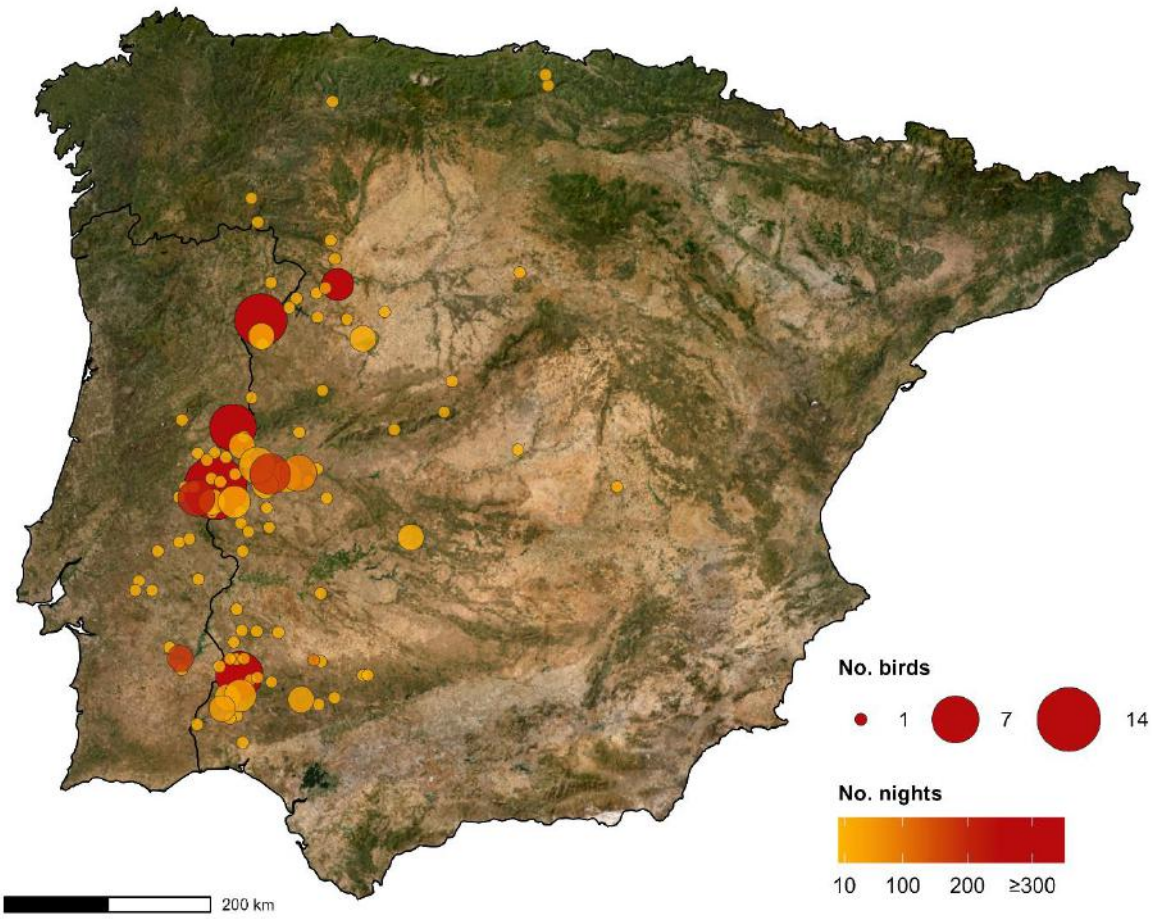


Fig. 16. Roosts of tagged Cinereous Vultures, showing sites where at least one bird spent three or more nights within a single week in locations less than 2 km apart. Larger dots indicate a higher number of individuals roosting at the site, while darker red reflects locations where vultures accumulated more nights spent therein.

5. ASSESSMENT OF THE MONITORING SYSTEM

The system established for remotely monitoring tagged birds has proven highly effective, as critical data is regularly extracted and analysed, including movements and flyways, feeding areas, dispersal zones, and roosting sites, among other key metrics. This information not only enhances our understanding of the species and its current range expansion but also informs conservation strategies and helps mitigate potential threats.

For instance, the LIFE Aegypius Return project consortium regularly issues opinions on initiatives put out for public consultation, such as territorial management instruments, environmental impact studies, construction plans for energy projects, among others, identifying flyways and important hotspots for the species that must remain undisturbed (these opinions are linked with project action *T.7.3. Promotion and technical contribution to national and international Plans and Strategies related to Cinereous Vulture conservation*). Moreover, once the laboratory analysis of all the samples collected from the tagged birds are completed, it will be possible to comprehensively integrate behavioural and ecological data with genetic, physical, and physiological information. This holistic approach will provide invaluable scientific insights to further support the species conservation and management.

Furthermore, while cases of mortality or injury are unfortunate, they offer crucial insights into threats such as poisoning, collisions or electrocution. The LIFE Aegypius Return monitoring system proved efficient in promptly detecting and responding to such incidents. Abnormal movement patterns have been swiftly identified by the project teams, enabling rapid action. Field teams have been deployed to rescue injured vultures or retrieve deceased individuals for proper forensic investigation, ensuring that every case contributes to a deeper understanding of the risks faced by the species.

5.1. Rescuing Cinereous Vultures chicks in distress

During the 2024 breeding season, several tagged chicks showed signs of distress, for example by falling from the nest before reaching the age to fly, or, after leaving the nest, by staying stationary for several days in one place.

Tagged chicks *Medronho* (tag nr. 243616), from Herdade da Contenda, and the one with the PVC ring *5E* (tag nr. 243618), from Tejo Internacional, both recorded movements some meters away from the nest, while they were too young to fly – Cinereous Vultures are able to fly when they are about 110 to 120 days old (e.g. Moreno-Opo, 2007). The small vultures are prompt to jump from their nest due to high temperatures on the top of the trees and seeking for shades if the parents are away. In both cases, field teams were immediately sent to observe the chicks from a safe distance first. In both cases, the teams confirmed the chicks were on the ground, in distress and vulnerable to the attack of predators. Both chicks were then rescued (following the protocol Matos et al., 2023c, developed within the project and available at the project's website) and transported to the reference Wildlife Rehabilitation Centres (LxCRAS and CERAS, respectively) for diagnosis and care. Both chicks revealed no signs of trauma, disease or injury, hence, once stabilised, hydrated and fed, they were transported back to their nests, so that the parents could "readopt them", which luckily happened after a few days of close monitoring. Unfortunately, the chick *5E* jumped from the nest again a few days later, sustaining fatal injuries. The tag was recovered, and the body was sent for toxicological analysis (results pending) to check for lead or other contaminants.

A different case was that of *Natator* (tag nr. 243623), a chick from Tejo Internacional that in its first flights landed on the Spanish margin of the river Tagus where GSM reception is very low. When the tag finally sent new locations, it was possible to confirm the bird stood in the same place for about three days. The tag's accelerometer data showed it was alive, but displaying very short movements. A field check was conducted and confirmed the bird was trapped on a rock between the water and high vegetation, unable to take off. The

bird tried to swim away, but showed signs of exhaustion, and a rescue team was then organized. The bird was retrieved by boat in a transboundary effort with Portuguese project technicians and rangers from ICNF and Junta de Extremadura, in Spain. To this date, the bird is still in recovery in CERAS.

5.2. Assuring proper forensic investigation to dead Cinereous Vultures

In 2024, five tagged juvenile Cinereous Vultures (*Freixo, Mirante, 5E, 5J*, and *Aravilinho*; Table 2) and six additional untagged Cinereous Vultures (Table 4) died under different circumstances. The project teams made sure all individuals were subjected to necropsy and, where applicable, proper forensic / toxicological analysis were performed. When criminal activities were suspected, the teams articulated with the authorities and relevant stakeholders, making sure all applicable protocols were followed. Samples or bodies were sent for toxicological analysis in CAD, in Málaga, who is closely cooperating with the project teams regarding the detection and understanding of threats posed to vultures

Table 4. Untagged Cinereous Vultures that died in 2024, subjected to necropsies and adequate forensic investigation where applicable. Dates are presented in the day/month/year format.

Hatching year	Region of collection	Date of death/ collection	Metal ring	PVC Ring	Circumstances of death/ collection	Necropsy centre	Analysis centre	Results /Obs.
2024	Pombal	23/09/2024	-	-	Died in CERVAS with neurological symptoms.	CERVAS	CAD	Toxicology results pending.
2024	Tejo Internacional	17/09/2024	1686	5T	Found drowned in a pond.	CERAS	CAD	Toxicology results pending.
2024	Tejo Internacional	03/08/2024	-	-	Found dead under the nest.	CERAS	CAD	Toxicology results pending.
2024	Herdade da Contenda	28/10/2024	-	-	Found dead on the ground.	U.Évora	CAD	Toxicology results pending.
2024	Lagos	18/11/2024	-	-	Found dead on the beach.	RIAS	-	Death from exhaustion and drowning confirmed. No toxicology analysis done.
2024	Loures	11/11/2024	-	-	Found wounded by gunshot.	LxCRAS	-	Died from gunshot lesions. No toxicology analysis done.

5.3. Limitations

Despite the high quality and efficiency of the technology and procedures in place, no system is entirely flawless. In many remote areas frequented by vultures, poor or non-existent GSM network coverage often prevents the tags from transmitting location and accelerometer data, hindering the project's efforts. When birds eventually enter areas with good reception, it is often possible to retrieve data retroactively. However, this may occur only after critical events, such as fatalities. For instance, in *Natator's* case, the team did not receive data for three days, which could have led to the bird's death.

In other occasions, such as some birds tagged in Malcata, data could never be retrieved (birds *1X*, *1V*, and *Brutus;* Table 2). Although the logger was properly fitted to the chick, the prolonged absence of signal may have caused the tag to fail by the time the bird fledged.

Additional challenges include battery depletion when birds remain in deep valleys or shaded areas for extended periods.

These technical issues are routinely reported to *Ornitela*, the tag manufacturer, and are actively being discussed within the scientific and conservation communities. Efforts are ongoing to develop solutions and mitigate potential risks to the monitored birds.

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ANNEX I – Data analysis methodology

Kernel Utilization Distribution (KUD)

To estimate the spatial distribution of juvenile Cinereous Vultures home ranges, we applied kernel density estimation to GPS movement data of all birds tagged in 2023, to estimate Kernel Utilization Distributions (KUD). KUDs are probability density surfaces (or 'maps') that show the areas where each vulture spends most of their time in terms of the likelihood of finding a given individual across the landscape. For each tracked vulture, we estimated monthly home ranges (95% KUD), mid-ranges (75% KUD), and core ranges (50% KUD; i.e., the most frequently used areas). For months with data available in 2023 and 2024 the maximum values across the two years were used. For each bird, we overlaid all the esimated monthly isopleths to produce individual maps of annual-cycle home ranges (Annex II), and overlaid those of all juveniles tagged in the nest in 2023 to obtain an overall map of the home ranges during vultures' first year (Fig. 9). KUDs and the respective isopleths generated for mapping, were applied to tracking data obtained from tagging date (Table 2) to December 15th, standardised across individuals to one location per hour. KUD were estimated using the reference method to estimate the smoothing parameter, and were implemented with the function *hr_kde* in the amt package (Signer et al., 2019) in R (R Core Team, 2024).

Accumulated distance

We estimated the monthly accumulated distance travelled (in km) by each Cinereous Vulture tagged in the nest in 2023 and 2024 (Fig. 10), and for *Aravil* (Fig. 14b). This metric provides information on the mobility and flight energetic effort (Morant et al., 2023), and was calculated by summing the Euclidian distance between all locations in each month using the function *step_lengths* in the amt package (Signer et al., 2019) in R (R Core Team, 2024). For plotting this metric across individuals, we calculated the monthly average (Fig. 10).

Identifying Roosts

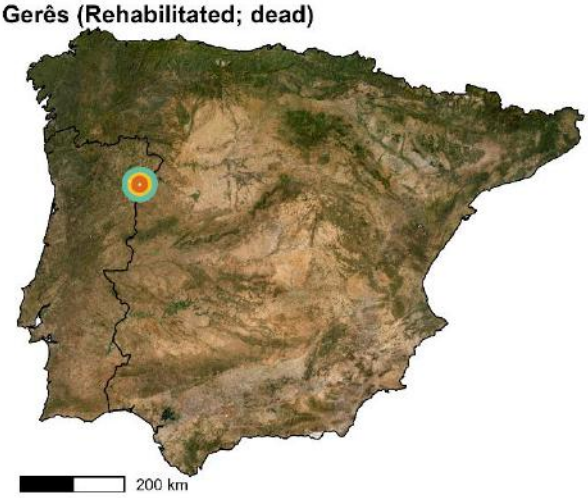
To map the roosts used by Cinereous Vultures, we extracted all nighttime locations across all tagged individuals, using the function *time_of_day* in the amt package (Signer et al., 2019) in R (R Core Team, 2024). Then, we identified 'roosting clusters', which are sites where an individual had spent several consecutive nights, using the GPSeqClus package (Clapp et al., 2021) in R. To form a cluster, the individual had to have spent three or more nights within a week-period in locations less than 2 km apart. Subsequently, all the overlapping clusters, both within individuals and between individuals, were merged. Finally, we mapped the centroid for each (overlapping) cluster (Fig. 16) to represent roosting sites that vary by different number of roosting vultures and different number of nights spent therein.

ANNEX II – Individual movement maps

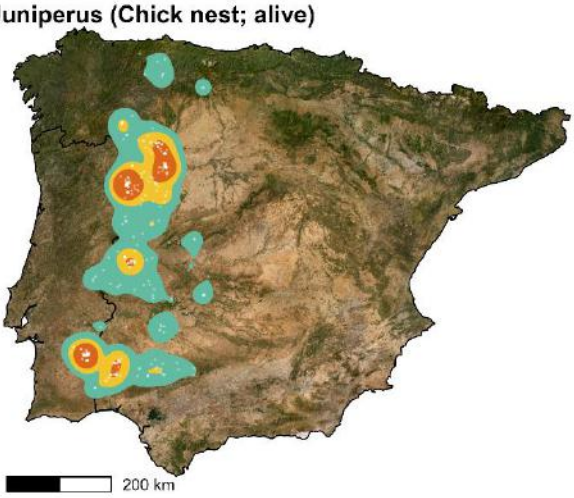
In this section, individual Kernel Utilization Distribution (KUD) of all Cinereous Vultures tagged during the project are presented. For birds tagged in 2023, the core-range (50% KUD), mid-range (50% KUD), and Home-range (95%) in the Iberian Peninsula within a year, and respective daily locations of each individual, were mapped. For birds tagged in 2024, hourly locations were mapped as not enough data were available to estimate home ranges.

Douro Internacional (birds tagged in 2023)

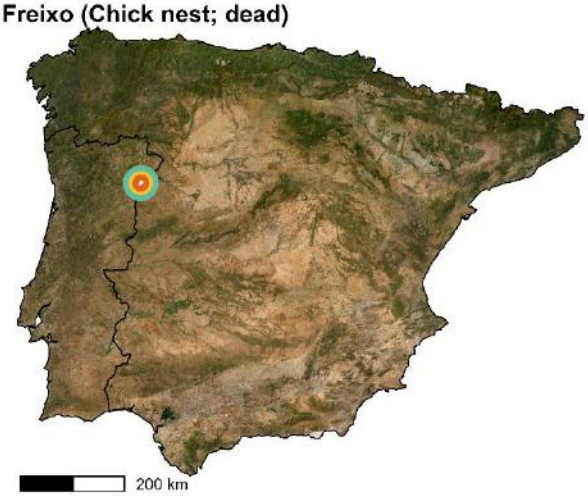
Gerês (Rehabilitated; dead)



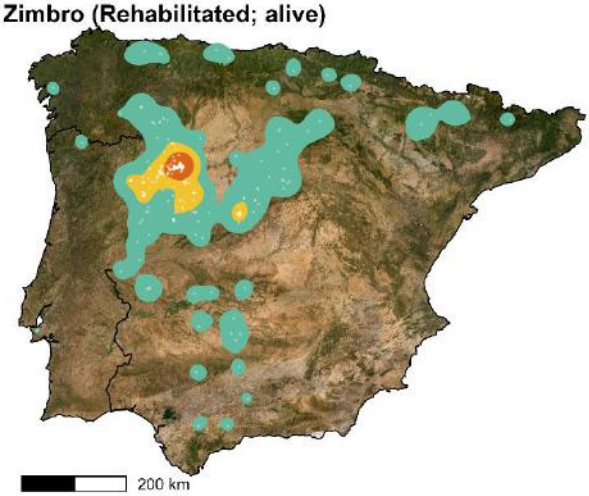
Juniperus (Chick nest; alive)



Freixo (Chick nest; dead)

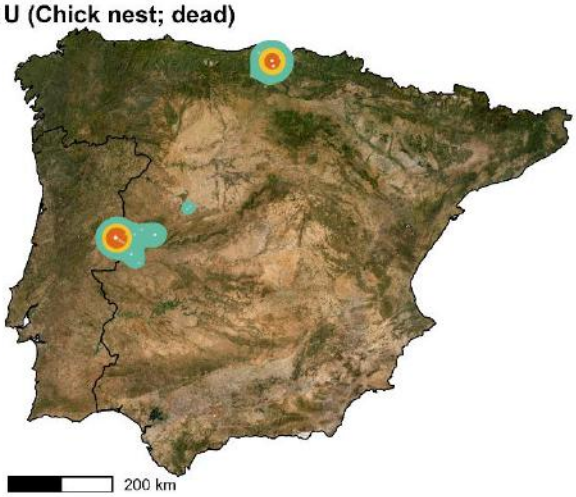


Zimbro (Rehabilitated; alive)

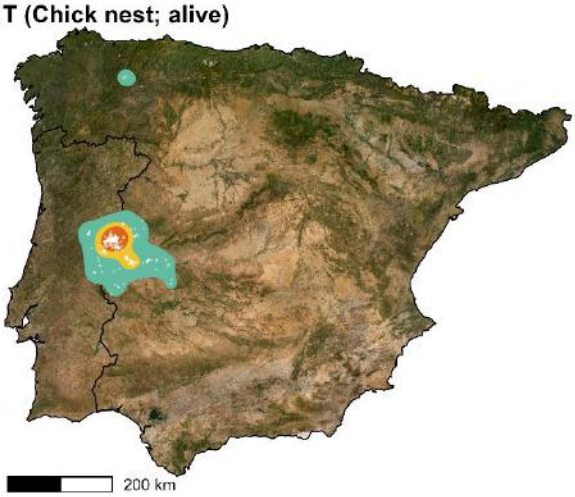


Serra da Malcata (birds tagged in 2023)

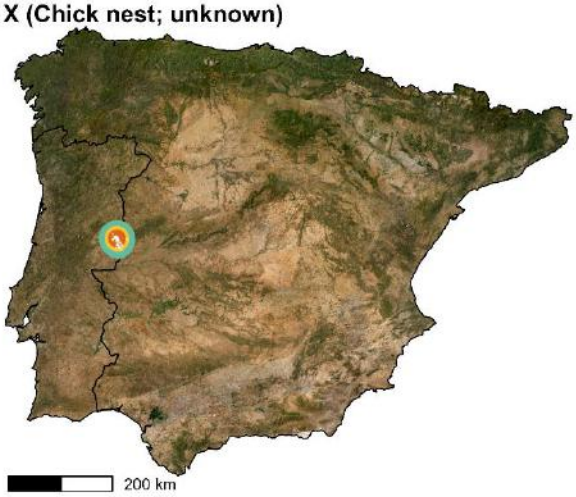
1U (Chick nest; dead)



1T (Chick nest; alive)

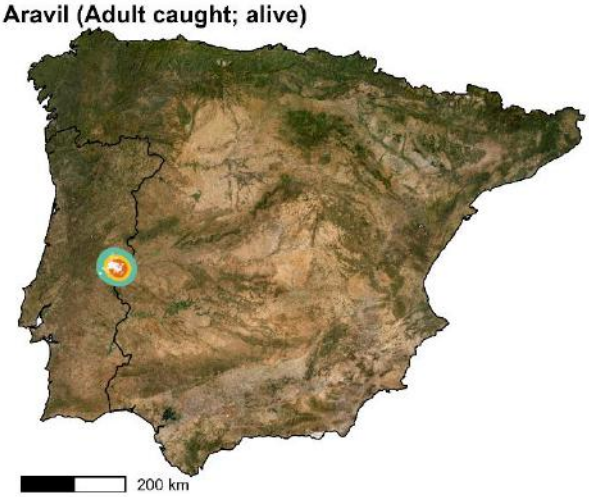


1X (Chick nest; unknown)

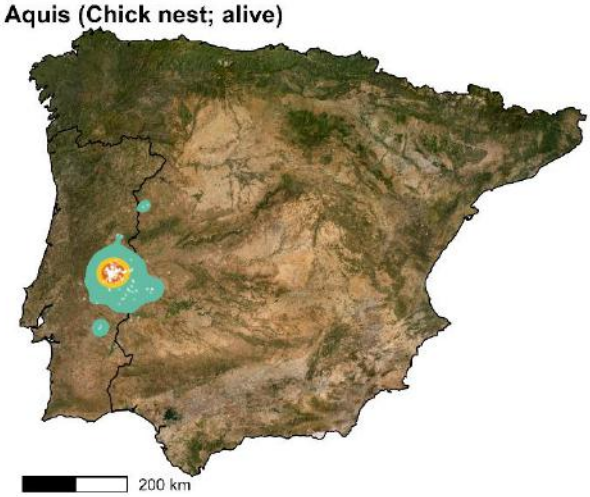


Tejo Internacional (birds tagged in 2023)

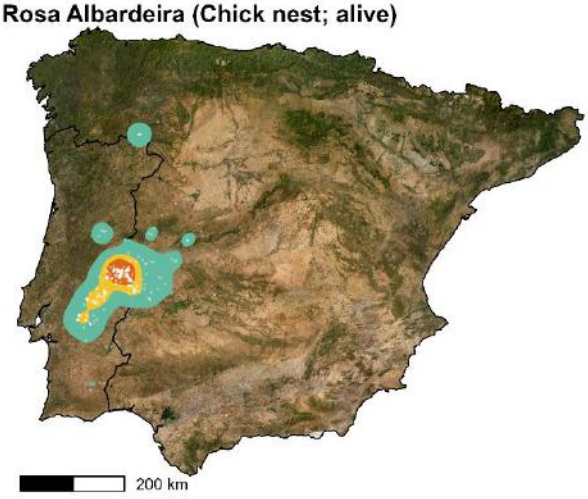
Aravil (Adult caught; alive)



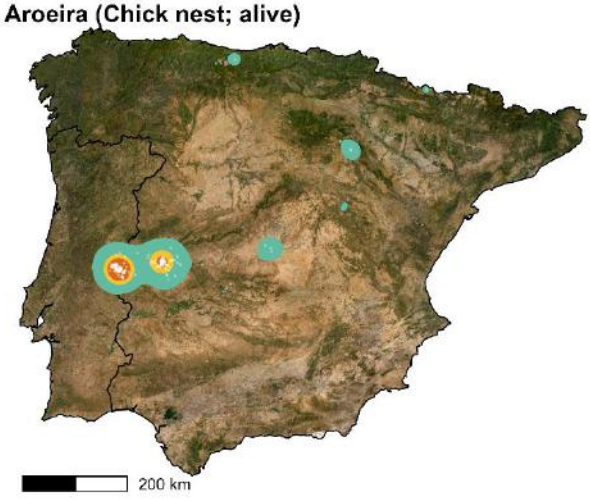
Aquis (Chick nest; alive)



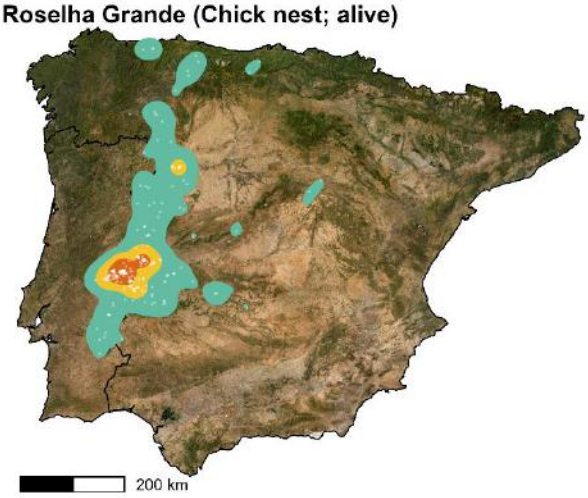
Rosa Albardeira (Chick nest; alive)



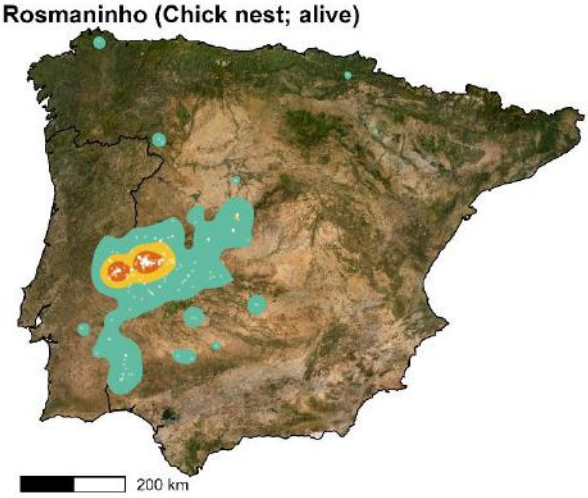
Aroeira (Chick nest; alive)



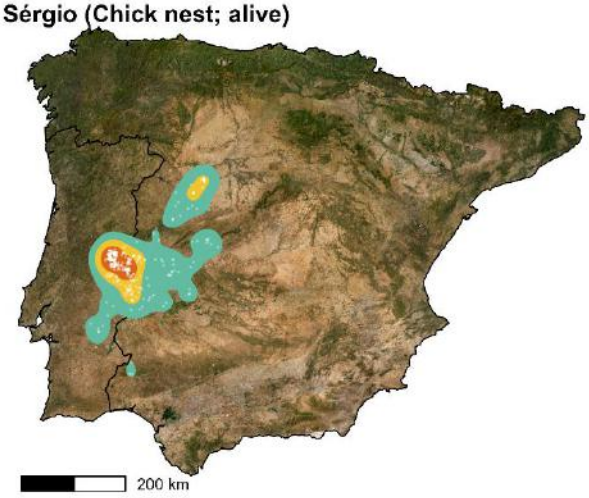
Roselha Grande (Chick nest; alive)



Rosmaninho (Chick nest; alive)

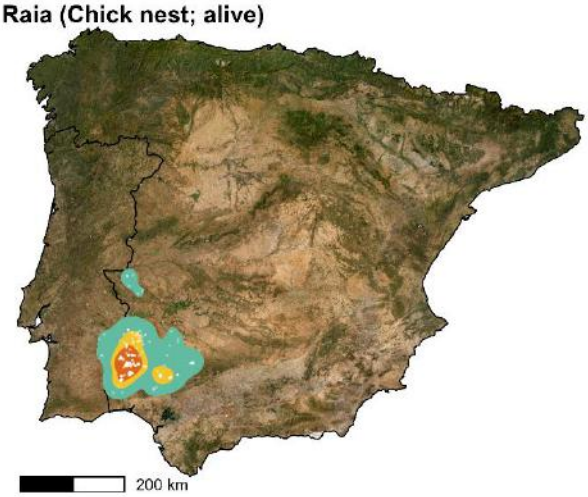


Sérgio (Chick nest; alive)

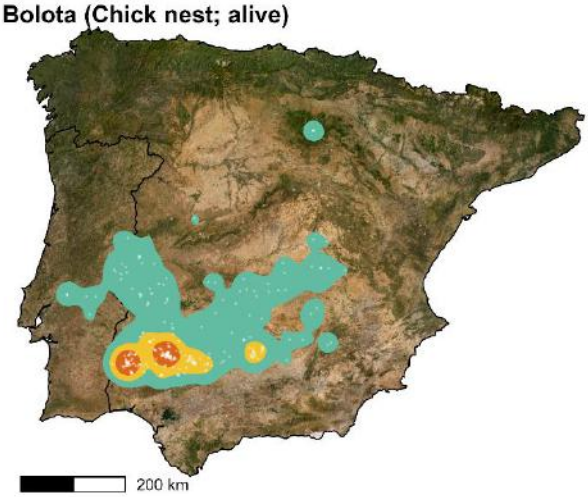


Herdade da Contenda (birds tagged in 2023)

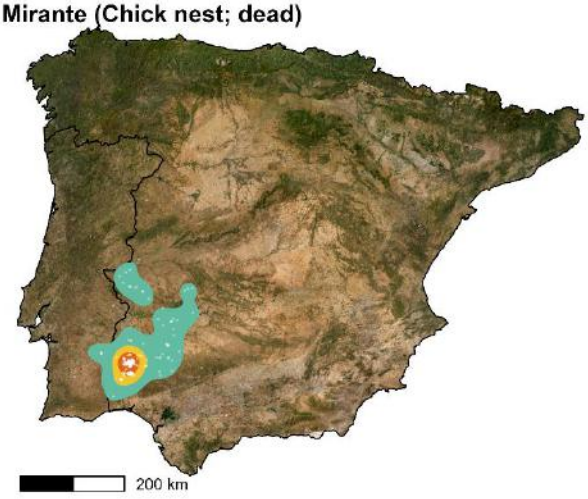
Raia (Chick nest; alive)



Bolota (Chick nest; alive)

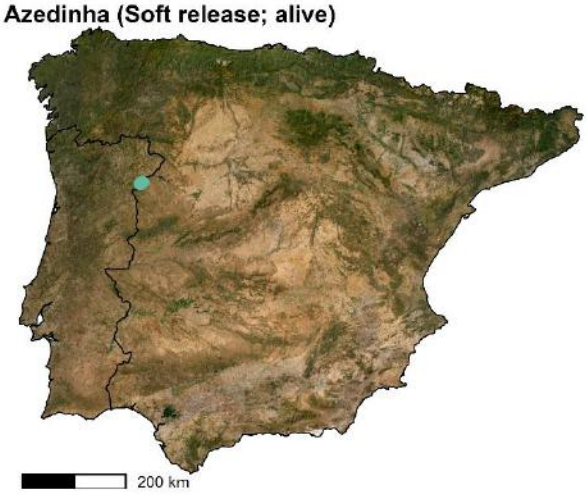


Mirante (Chick nest; dead)

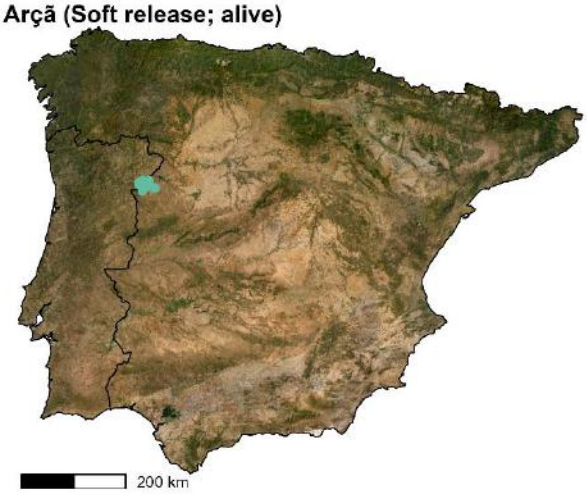


Douro Internacional (birds tagged in 2024)

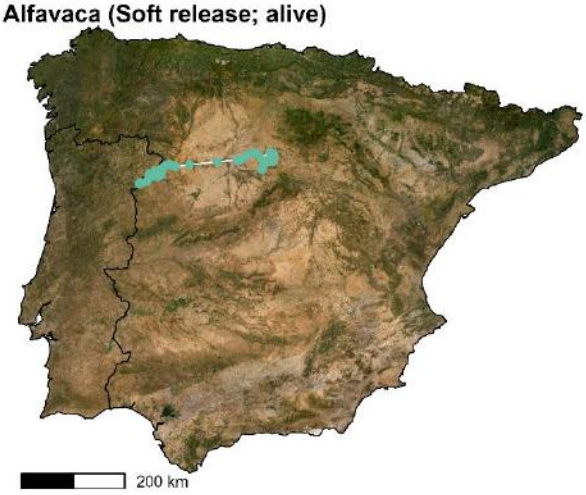
Azedinha (Soft release; alive)



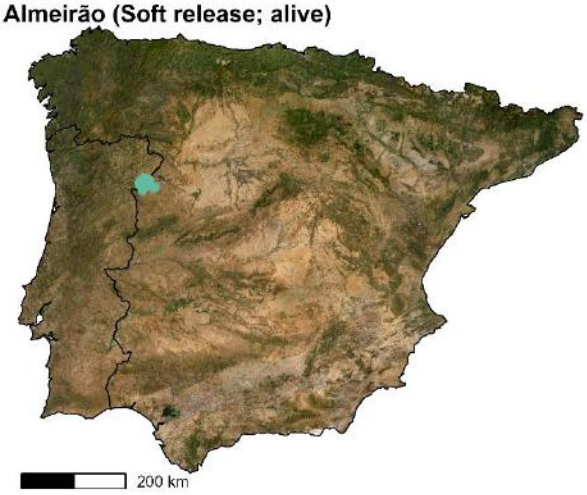
Arçã (Soft release; alive)



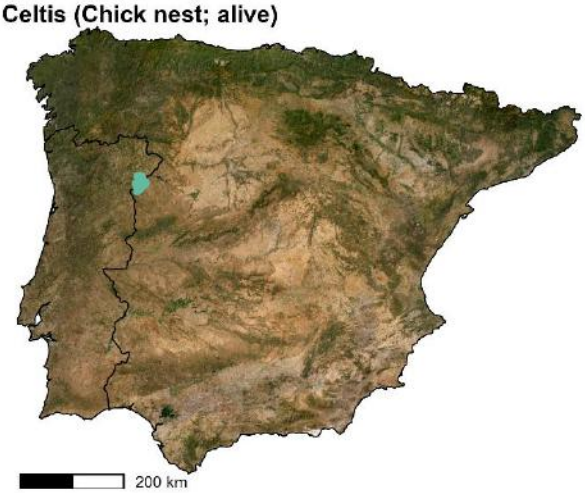
Alfavaca (Soft release; alive)



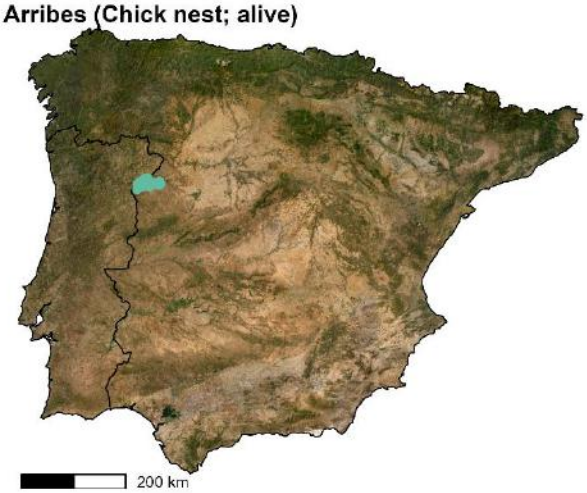
Almeirão (Soft release; alive)



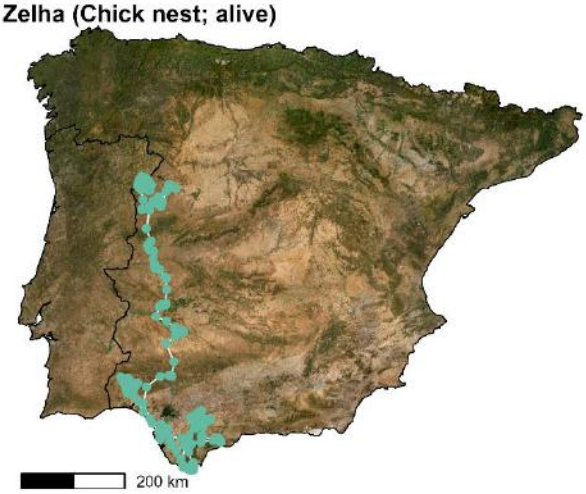
Celtis (Chick nest; alive)



Arribes (Chick nest; alive)

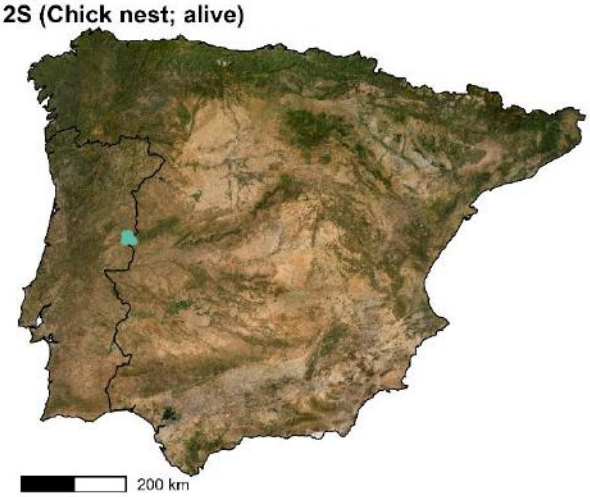


Zelha (Chick nest; alive)

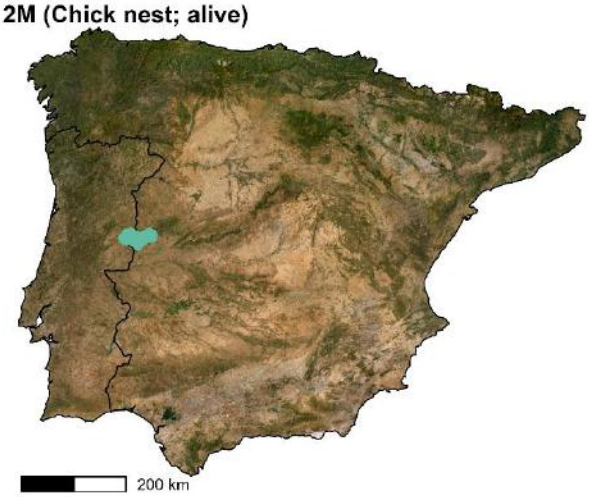


Serra da Malcata (birds tagged in 2024)

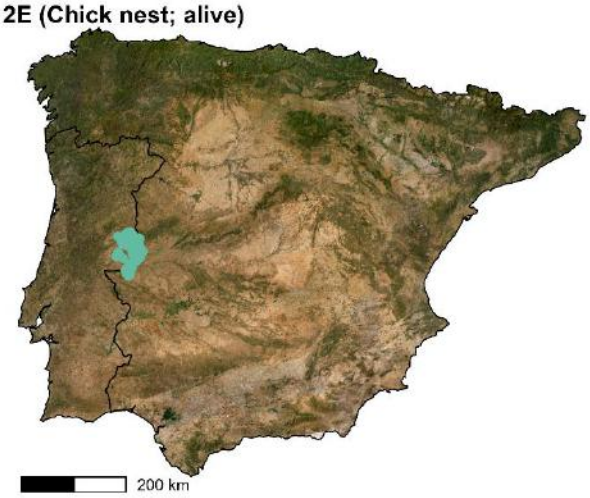
2S (Chick nest; alive)



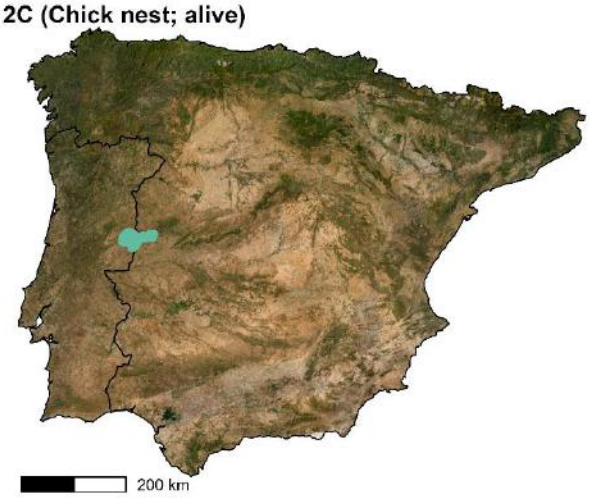
2M (Chick nest; alive)



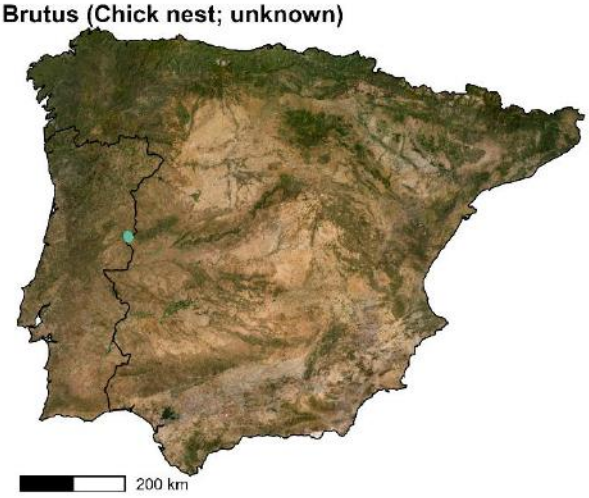
2E (Chick nest; alive)



2C (Chick nest; alive)



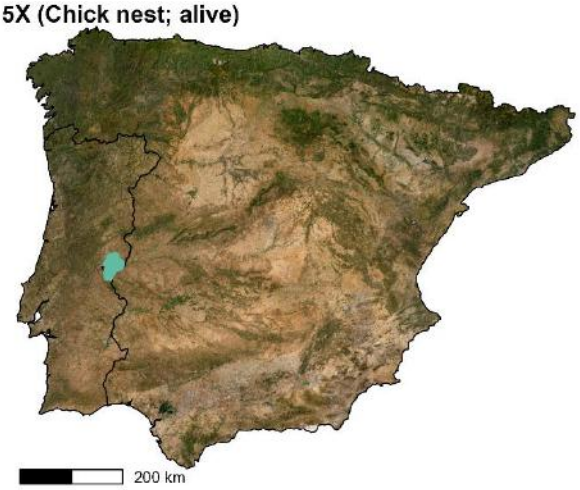
Brutus (Chick nest; unknown)



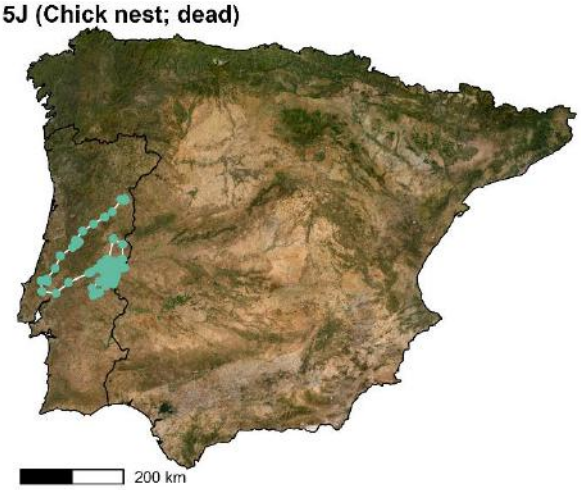
Tejo Internacional (birds tagged in 2024)

Due to technical reasons, it was not possible to retrieve *Aravilinho*'s logger's data and produce maps. This bird fledged on 29/08/2024 and died on 23/09/2024, and never left the Tejo Internacional area.

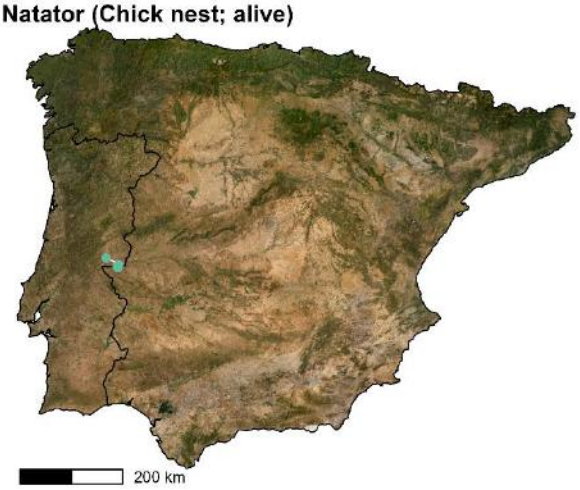
5X (Chick nest; alive)



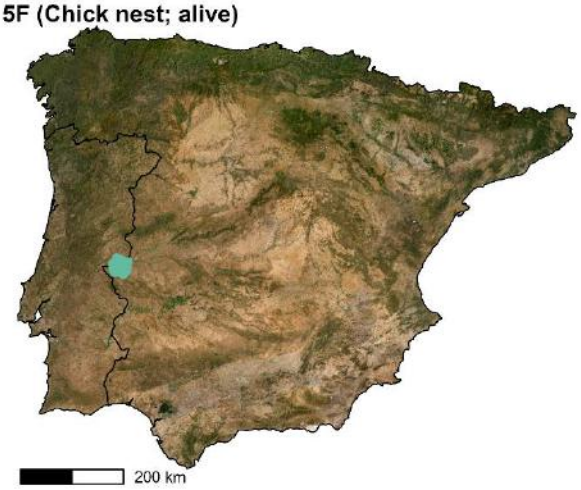
5J (Chick nest; dead)



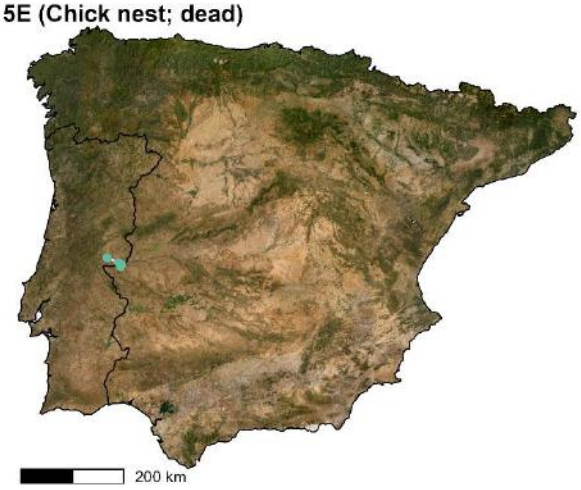
Natator (Chick nest; alive)



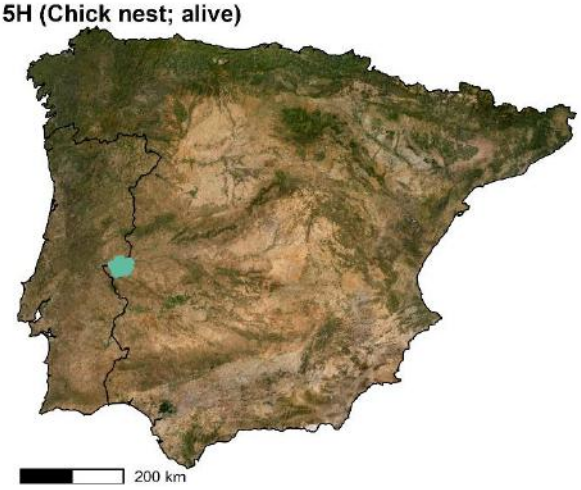
5F (Chick nest; alive)



5E (Chick nest; dead)

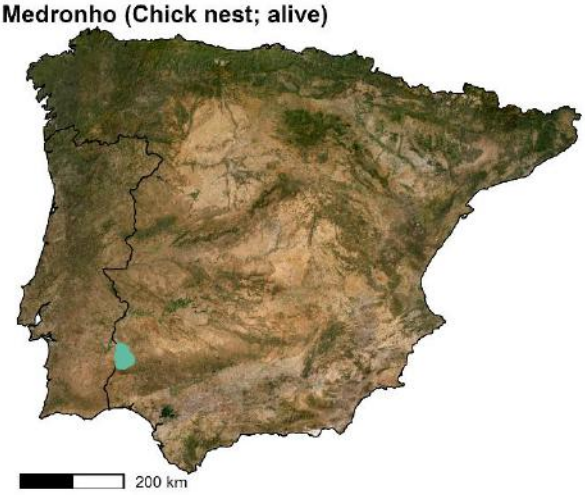


5H (Chick nest; alive)

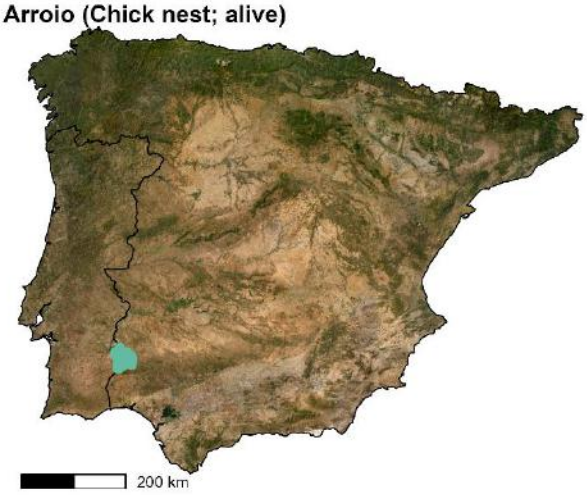


Herdade da Contenda (birds tagged in 2024)

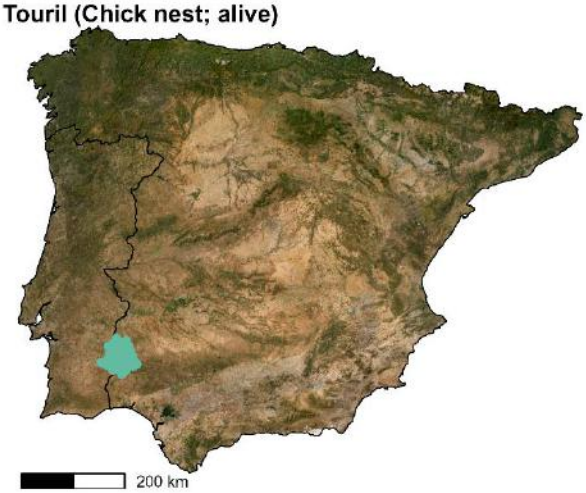
Medronho (Chick nest; alive)



Arroio (Chick nest; alive)



Touril (Chick nest; alive)



Vidigueira (bird tagged in 2024)