

Satellite Tagging of Song Thrushes (*Turdus philomelos*) and Eurasian Golden Plovers (*Pluvialis apricaria altifrons*): Results from the 2022 – 2025 Research Period

Final Report



Figure A. Satellite-tagged Song Thrush prior to release.



Figure B. Two first-year Golden Plovers (male above, satellite-tagged) flying away after release.

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Executive Summary

This report presents the consolidated findings of a satellite-tracking study on the Song Thrush (*Turdus philomelos*) and Eurasian Golden Plover (*Pluvialis apricaria altifrons*), conducted at the request of the European Commission to determine the breeding grounds of Malta's reference population of these two species. Wintering areas, migratory routes, and stopover sites during pre-nuptial (spring) migration were also mapped.

The project utilised 60 satellite tags—30 allocated per species—deployed across multiple operational phases between February 2022 and December 2025. Song Thrushes were captured by licensed bird ringers using mist-nets and fitted with non-solar tags, while Golden Plovers were captured by licensed live-capturers using clap-nets and fitted with solar-powered transmitters. Live-capturing site coordinates and licensee credentials were submitted to law enforcement for compliance monitoring.

To optimise data collection across the crucial breeding grounds, a strategic decision was implemented in later phases to adopt less intensive GPS schedules. Nine Song Thrush tags and one Golden Plover tag were decommissioned due to battery failure, while three recovered Golden Plover tags were redeployed.

The Song Thrush component concluded with 21 of the 30 procured tags deployed between 2022 and 2024. All Song Thrushes tagged during post-nuptial migration overwintered in Malta, within their tagging area. Telemetry data from seven specimens provided conclusive evidence of breeding locations in Romania ($n = 2$), Bulgaria ($n = 2$), Slovakia ($n = 1$), Hungary ($n = 1$), and Ukraine ($n = 1$), confirming that 85.7% of the tracked Song Thrushes spent the breeding season within the territory of the European Union. This component also established that the species follows a distinct south-west to north-east pre-nuptial migration route, initiating migration between the last week of March and the first week of April.

Seventeen satellite tags yielded comprehensive tracking data for the Golden Plover component. Individuals were recorded wintering exclusively in Tunisia prior to initiating northward migration. Breeding grounds were mapped across Sweden ($n = 3$), Finland ($n = 3$), Norway ($n = 4$), and Russia ($n = 7$), demonstrating that 35.3% of the tracked Golden Plovers spent the breeding season within the territory of the European Union.

Although the final Golden Plover tag was deployed on 31 December 2025, it failed to transmit telemetry data, bringing active data collection to a close at the end of 2025. This document presents the consolidated results for both species components and will be submitted to the Malta Ornis Committee prior to publication on the website of the Wild Birds Regulation Unit and formal transmission to the European Commission.

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1. Introduction

This report details the findings of a satellite-tracking study on the Song Thrush (*Turdus philomelos*) and the Eurasian Golden Plover (*Pluvialis apricaria altifrons*). The project, conducted under an Article 9(1)(b) research derogation and overseen by the Wild Birds Regulation Unit, was initiated at the request of the European Commission during a bilateral meeting on 26 November 2019. The primary objective was to improve the knowledge base on Malta's reference populations of these two species, specifically by determining the geographical locations of their breeding grounds using satellite tracking.

The study utilized 60 satellite tags, with 30 allocated to each species. The tags for Golden Plovers were solar-powered for long-term data collection, while the non-solar Song Thrush tags had a lifespan of approximately one year. Both sets of tags were programmed with specific schedules to optimize data collection. The project tracked the movements of specimens that were tagged over five phases from February 2022 to December 2025, providing valuable insights into migration patterns, wintering locations, and breeding grounds.

This report summarizes the findings from the project's inception in 2022 to its final tag deployment in December 2025, detailing the deployment efforts, data collection methodology, and key results from tracking both species.

2. Objective of the Research

This study's objective is to enhance scientific understanding of Malta's reference populations of the Golden Plover (*Pluvialis apricaria s.l.*) and the Song Thrush (*Turdus Philomelos*) through the use of satellite tracking technology. This project, conducted under an Article 9(1)(b) research derogation from the general prohibitions of the Birds Directive, was initiated in response to a request from the European Commission during a bilateral meeting in November 2019. The key aim was to determine the geographical locations of the breeding grounds of the tagged individuals. As an added value, this project also analysed temporal migration patterns during pre-nuptial and post-nuptial periods, throughout the lifespan of the tags.

3. Procurement of Satellite Tags

On 27 August 2020, the Wild Birds Regulation Unit (WBRU) obtained the necessary approvals from the Ministry for Finance to procure sixty satellite tags. Thirty tags were allocated for Golden Plovers (*Pluvialis apricaria*) and thirty for Song Thrushes (*Turdus philomelos*). The procurement included the associated PinPoint Reader/Programme/Charger (Lotek UK Ltd) and monthly data charges from CLS - Collecte Localisation Satellites, Argos. All related costs, totaling €90,409 (excluding VAT) for the tags and reader, plus monthly data charges (€15/active tag + €4/day, capped at €63/month/active tag, excluding VAT), were borne by the Wild Birds Regulation Unit. Teflon harness material, as recommended by Lotek UK Ltd, was also procured for the tags.

The satellite tags for each species had distinct specifications. Tags for the Golden Plover (Figures 1 and 2) weighed 6.04 g (7.21 g with harness and breast-loop crimp) and were powered by a solar-charged battery. The tags for the Song Thrush (Figures 3 and 4) were not solar-powered and weighed 2.46 g (3.3 g with harness and breast-loop crimp). The lifespan of the Song Thrush tags was approximately one year from deployment/activation, depending on the programmed schedule.

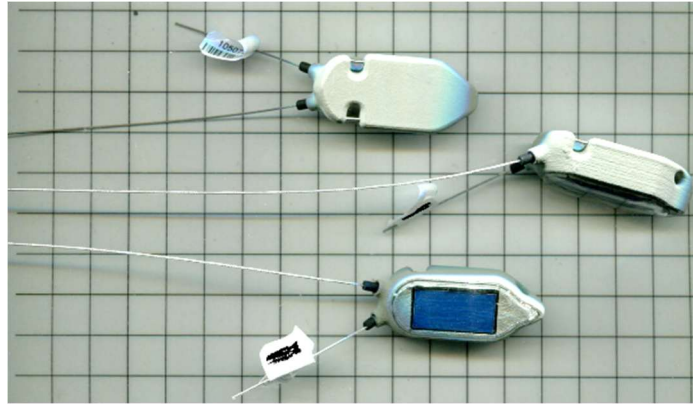


Figure 1. Satellite tags for Golden Plovers. PP-ARG-SOL-40 (not to scale). Source: Lotek UK Ltd.



Figure 2. Weight (7.21 g) of a Golden Plover satellite tag (PP-ARG-SOL-40) including harness and breast-loop crimp. Source: WBRU (2022).

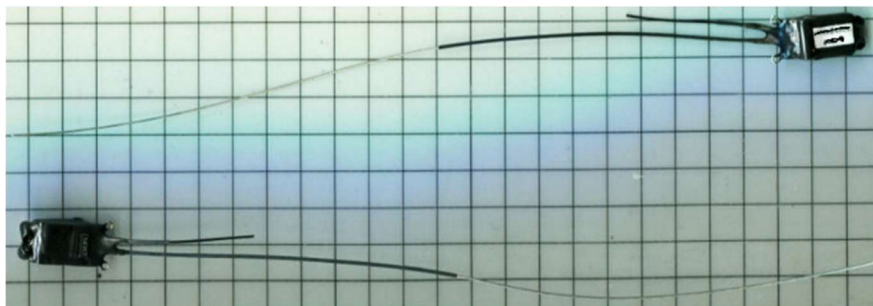


Figure 3. Satellite tags for Song Thrushes. PP-ARG-40 light (not to scale). Source: Lotek UK Ltd.



Figure 4. Weight (3.33 g) of a Song Thrush satellite tag (PP-ARG-40 light) including harness and breast-loop crimp. Source: WBRU (2022).

4. Methodology

Song Thrushes were captured using mist-nets by BirdLife Malta's licensed bird-ringers (Figure A). Golden Plovers were captured using clap-nets with a mesh size of 60mm × 60mm by individuals holding a valid general live-capturing licence and a special satellite-tagging licence. The Golden Plover satellite-tagging licence was issued pursuant to an Article 9(1)(b) research derogation for each phase of the project, a notice of which was published in the Government Gazette (refer to Section 5 for details).

In all data tables, dates are presented in the Day-Month-Year (DMY) format, indicated by dd/mm/yyyy in column headers.

Prior to deployment, a specific schedule was programmed and saved onto each satellite tag using the DLC Interface and the PinPoint Host Application. The DLC Interface was also utilized to charge the tags. The software provides three distinct scheduling rules, which can be applied individually or in combination to meet the needs of the study (PinPoint Host Application User Manual, Lotek, August 2019).

Daily Cycle Rule: This rule configures a daily schedule between two specified dates (Rule Period). For each day, GPS fixes are taken at a defined Fix Interval over a specified time period (Start Time to End Time). The total number of fixes is determined by the duration of the period and the set interval.

Discrete Rule: This rule sets a daily schedule of individual fixes between two dates. Fixes are scheduled to occur at one or more specific times (Daily Fix Times).

Rollover Rule: This rule establishes a continuous schedule between two dates. Unlike the Daily Cycle Rule, the schedule does not reset daily but rolls over according to the Repetition Fix Interval. A fix is taken at the Start Date/Time, and subsequent fixes occur at the specified Fix Interval until the End Date/Time. The interval can be set from one minute to 1,000 days.

The ability to combine multiple rules (Discrete, Daily Cycle, or Rollover) allowed for a flexible approach to data collection. For instance, the Song Thrush tags, with their approximate one-year battery lifespan, were programmed to take fixes on a specific day each month using a Rollover rule while simultaneously taking several fixes during the critical breeding season using a Daily Cycle rule.

Tag Activation and Deployment

Once programmed, tags were stored in an inactive state or activated immediately prior to deployment. Deployment is defined as fitting an activated tag onto a specimen for release, after which the schedule could no longer be modified remotely. To maximize efficiency, the Golden Plover and Song Thrush tags were programmed with different schedules to reflect their respective battery lifespans. Following deployment, GPS locations were transmitted with every third successful fix.

To avoid unnecessary data charges, which begin immediately upon activation, tags were activated just before being fitted to a bird. However, this posed a logistical challenge, as activation required specific software and access to the DLC interface. This was further complicated by the fact that multiple activated PinPoint Argos tags, which all operate on the same frequency, could not be placed within close proximity (~1m) of each other. According to Lotek UK Ltd, the strong Argos signal could damage the electronics of other activated tags nearby.

5. Regulatory Approvals and Project Phases

On 29 July 2020, the Malta Ornis Committee unanimously approved an Article 9(1)(b) derogation to study Golden Plover and Song Thrush migration routes via satellite tracking¹, subject to methodology approval. This decision was published in Government Notice No. 1415/2020 on 01 December 2020². On 29 March 2021, the Committee approved the methodology, limiting the study to the pre-nuptial period (01 February – 31 March 2022)³ (**Phase 1**). While the Federation for Hunting and Conservation (FKNK) and Kaċċaturi San Ubertu (KSU) offered assistance, the Committee agreed that site selection and participant lists should be left to the discretion of WBRU. Live-capturing site coordinates and licensee credentials were submitted to law enforcement for compliance monitoring.

Project Phases

- **Phase 2:** The renewal application for the period 20 October 2022 to 31 March 2023 was deferred from the 5 October 2022 meeting to 16 November 2022⁴. Following approval, the project was renewed with a validity period commencing from the publication of Government Notice No. 1618/2022 on 29 November 2022⁵ until 31 March 2023.
- **Phase 3:** Recommended by the Ornis Committee on 2 August 2023⁶, this phase covered the period from 20 October 2023 to 31 March 2024. This was formally published as Government Notice No. 1110/2023 on 11 August 2023⁷.
- **Phase 4:** The project's fourth phase was recommended by the Ornis Committee on 5 September 2024⁸ for the period 20 October 2024 to 31 March 2025. This was subsequently published as Government Notice No. 1277/2024 on 1 October 2024⁹.
- **Phase 5:** The project's final phase was recommended by the Ornis Committee on 6 October 2025¹⁰ for the period 01 November 2025 to 10 January 2026. This was subsequently published as Government Notice No. 1900/2025 on 02 December 2025¹¹.

¹ Minutes of the Ornis Committee meeting held on 29 July 2020. Available at: <https://wbru.gov.mt/wp-content/uploads/2024/03/oMinTweNinJul20.pdf>

² Government Notice No. 1415/2020, published in the Government Gazette No. 20,530 on 01 December 2020. Available at: <https://www.gov.mt/en/Government/DOI/Government%20Gazette/Documents/2020/12/Government%20Gazette%20-%201st%20December.pdf>

³ Minutes of the Ornis Committee meeting held on 29 March 2021. Available at: <https://wbru.gov.mt/wp-content/uploads/2024/03/oMinTweNinMar21.pdf>

⁴ Minutes of the Ornis Committee meetings held on 5 October 2022 and 16 November 2022. Available at: <https://wbru.gov.mt/wp-content/uploads/2024/03/oMinutesOctNov22.pdf>

⁵ Government Notice No. 1618/2022, published in the Government Gazette No. 20,967 on 29 November 2022. Available at: <https://www.gov.mt/en/Government/DOI/Government%20Gazette/Documents/2022/11/Gaz%20Government%20Gazette%20-%2029th%20November.pdf>

⁶ Minutes of the Ornis Committee meeting held on 02 August 2023. Available at: <https://wbru.gov.mt/wp-content/uploads/2024/03/oMinSecAug23.pdf>

⁷ Government Notice No. 1110/2023, published in the Government Gazette No. 21,099 on 11 August 2023. Available at: <https://www.gov.mt/en/Government/DOI/Government%20Gazette/Documents/2023/08/Government%20Gazette%20-%2011th%20August.pdf>

⁸ Minutes of the Ornis Committee meeting held on 05 September 2024. Available at: <https://wbru.gov.mt/wp-content/uploads/2025/04/Ornis-Meeting-Minutes-05.09.24.pdf>

⁹ Government Notice No. 1277/2024, published in the Government Gazette No. 21,321 on 01 October 2024. Available at: <https://www.gov.mt/en/Government/DOI/Government%20Gazette/Documents/2024/10/Government%20Gazette%20-%201st%20October.pdf>

¹⁰ Minutes of the Ornis Committee meeting held on 06 October 2025. Available at: <https://wbru.gov.mt/en/the-department/ornis-committee/>

¹¹ Government Notice No. 1900/2025, published in the Government Gazette No. 21,546 on 02 December 2025. Available at: <https://www.gov.mt/en/Government/DOI/Government%20Gazette/Documents/2025/12/Government%20Gazette%20-%202nd%20December.pdf>

6. Outcome of Research Period (February 2022 – December 2025)

Song Thrush

Initial Tag Deployment and Decommissioning

A total of three tags were deployed during the initial research period (Phase 1, February – March 2022). Seven tags were decommissioned in 2022 due to battery failure (Figure 5).

Phase 2 Deployment and Tag Failures

During Phase 2 of the project (November 2022 – March 2023), 11 additional tags were deployed. Tags **208603** and **208608** were decommissioned on 11 September and 17 October 2023, respectively, due to battery failure, as shown in Figure 6.



Figure 5. Seven Song Thrush tags were decommissioned in 2022 (note damage to black potting due to battery expansion). Not to scale.



Figure 6. Tags 208603 and 208608 were decommissioned in 2023 due to battery failure/expansion. Not to scale.

Phase 3 Deployment Strategy

For the final phase of the Song Thrush component (Phase 3), deployment was strategically limited to late February and March 2024 to maximize the number of GPS fixes during the breeding season. This decision was based on three key factors:

- The tags had a limited shelf life of one year, regardless of their deployment date.
- The tags, which were procured in 2020, required a prolonged charging period to maintain their function, which reduced the probability of them being in good working condition.
- Data from Phase 2 showed a need for a larger sample size on the breeding grounds. The majority of fixes from that phase were recorded during the wintering period, which led to inconclusive data on breeding locations due to tag battery failure after the birds migrated to mainland Europe.

The Song Thrush tags deployed during Phase 3 were programmed with a schedule designed to capture the start of post-nuptial migration, their migration route and breeding grounds. This schedule included daily GPS fixes from 29–31 March 2024, and 15–17 May 2024, along with a fix every 12 days from 02 April 2024, until battery depletion (Figure 7).

File Rules	
Type	Rule
Rolling Interval	Rule Period [yyyy-mm-dd hh:mm]: 2024-04-02 00:00 to 2032-11-23 23:59 Interval [dd hh:mm]: 12 days 00:00
Discrete	Rule Period [yyyy-mm-dd]: 2024-03-29 to 2024-03-31 Daily Fix Time [hh:mm]: 21:00;
Discrete	Rule Period [yyyy-mm-dd]: 2024-05-15 to 2024-05-17 Daily Fix Time [hh:mm]: 10:00;
Show Calendar >>	
Schedule Only – Battery life not considered.	

Figure 7. Song Thrush GPS schedule during phase 3 (2024).

Based on this schedule, the estimated battery life ranged from 190 to 281 GPS days, with a mean of 242 days (Figure 8). The timing was set with the assumption that birds would depart from their wintering grounds in Malta during the pre-nuptial period (late March to early April), consistent with previous tagging phases.

Operating Life Estimation

GPS Schedule Beacon Schedule RF Communication Schedule Iridium/Cellular Schedule Proximity Schedule Activity Schedule

Product Family: PinPoint Family Product Activation Date: 2024-03-29 Fix Type: Standard Fix Fix Strategy: Standard Economy

Product Type: PinPoint ArgosP-40 Beacon Type: Beeper Globalstar Mode: 6 - 6 Fixes per Message Globalstar Position Transmission: Every Fix

Argos Transmit Rate [s]: 60 Proximity Direction: Tx Proximity Type: 0dBm Proximity Burst Rate [BPM]: 20

VHF Family Setting: Separation Proximity Type: 0dBm Activity Mode: Average Data GNSS: GPS

Start Estimation

Stop Estimation

Estimation Progress...

Product Operating Life

	Calculated	GPS Days	VHF End Date
Best Case (40s/3s)	40s	281	
Average Case (55s/15s)	55s	242	
Worst Case (70s/70s)	70s	190	

☒ GPS Enabled ☐ Iridium/Cellular Schedule Enabled

☐ Beacon Enabled ☐ Proximity Enabled

☐ VHF Download Enabled

☐ Mortality Enabled

☐ Activity Enabled

GPS Schedule Beacon Schedule RF Communication Schedule Iridium/Cellular Schedule Proximity Schedule Activity Schedule

Type	Rule
Rolling Interval	Rule Period [yyyy-mm-dd hh:mm]: 2024-04-02 00:00 to 2032-11-23 23:59 Interval [dd hh:mm]: 12 days 00:00
Discrete	Rule Period [yyyy-mm-dd]: 2024-03-29 to 2024-03-31 Daily Fix Time [hh:mm]: 21:00;
Discrete	Rule Period [yyyy-mm-dd]: 2024-05-15 to 2024-05-17 Daily Fix Time [hh:mm]: 10:00;

Figure 8. Estimated operating life of Song Thrush tags.

During Phase 3, all seven remaining tags were deployed. The Song Thrushes were captured over several days using mist-nets set up within the Buskett Bird Sanctuary. Table 1 lists the corresponding tag details and deployment dates for all Song Thrushes fitted with a satellite tag since the project's inception in February 2022.

Table 1. Deployment of Song Thrush tags during 2022 – 2024 (PP-ARG-40 light, weight 3.33g with 35cm harness and breast-loop crimp).

Date (dd/mm/yyyy)	Location	Ring No.	Specimen's Weight (g) (without satellite tag)	Tag-to-weight ratio (%)	Tag No.
04/02/2022	Buskett	CC4804	73.0	4.56	208582
04/02/2022	Buskett	CC4756	63.0	5.29	208583
01/03/2022	Girgenti	CC4805	67.8	4.91	208586
06/12/2022	Buskett	CC4772	62.3	5.35	208590
08/12/2022	Manikata	CC5303	64.4	5.17	208589
09/12/2022	Girgenti	CC4808	65.6	5.08	208594

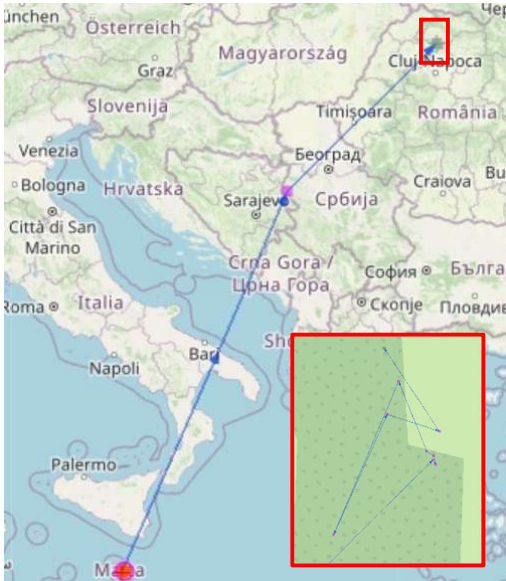
Date (dd/mm/yyyy)	Location	Ring No.	Specimen's Weight (g) (without satellite tag)	Tag-to-weight ratio (%)	Tag No.
09/12/2022	Żebbiegh	CC5605	66.4 (re-trapped on 18 March 2023 weighing 81.2 g, including tag)	5.02	208593
12/12/2022	Buskett	CC4773	67.0	4.97	208595
12/12/2022	Buskett	CC4774	68.2	4.88	208592
04/01/2023	Buskett	CC4776	72.9	4.57	208597
16/01/2023	Buskett	CC4777	72.2	4.61	208596
23/01/2023	Buskett	CC4358	68.5	4.86	208578
28/02/2023	Simar	CC3563	76.3	4.36	208585
10/03/2023	Wied Harq Hamiem	CC5355	75.4	4.42	208584
28/02/2024	Buskett	CC4815	78.2	4.26	208598
29/02/2024	Buskett	CC4816	68.4	4.89	208602
29/02/2024	Buskett	CC4817	68.0	4.90	208605
29/02/2024	Buskett	CC4818	70.7	4.71	208609
03/03/2024	Buskett	CC4819	66.1	5.04	208604
03/03/2024	Buskett	CC4820	67.3	4.95	208600
03/03/2024	Buskett	CC4821	79.0	4.22	208599

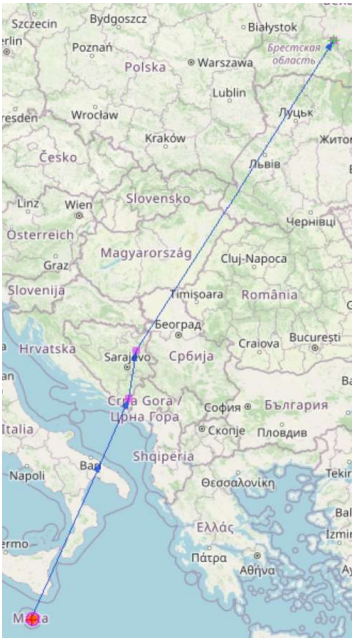
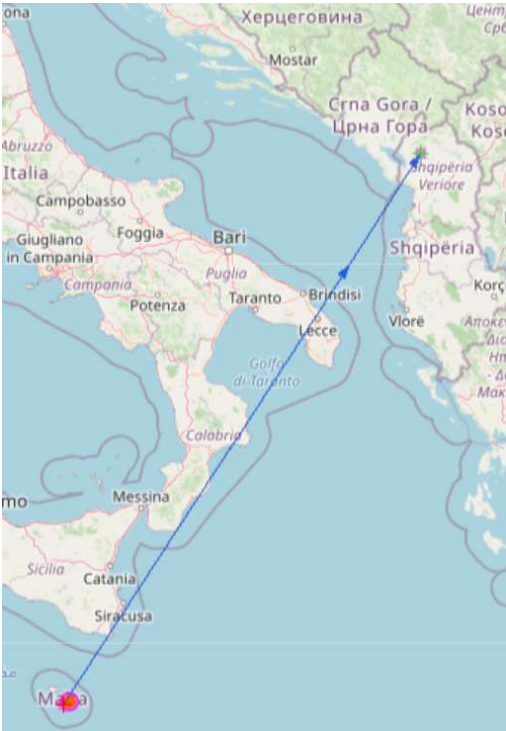
Song Thrush Geolocations

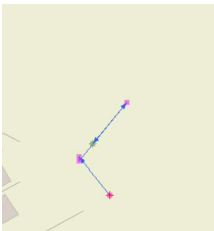
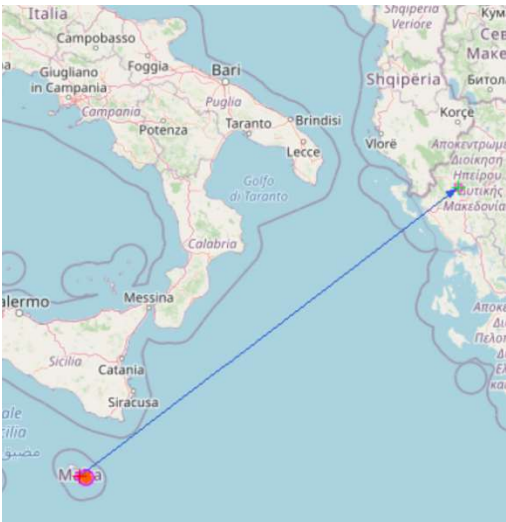
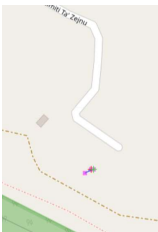
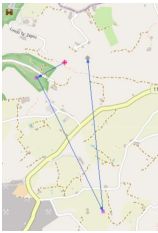
The GPS fixes for the satellite-tagged Song Thrushes are detailed in Table 2. A composite map illustrating the complete migration routes of all tagged individuals is presented in Figure 9.

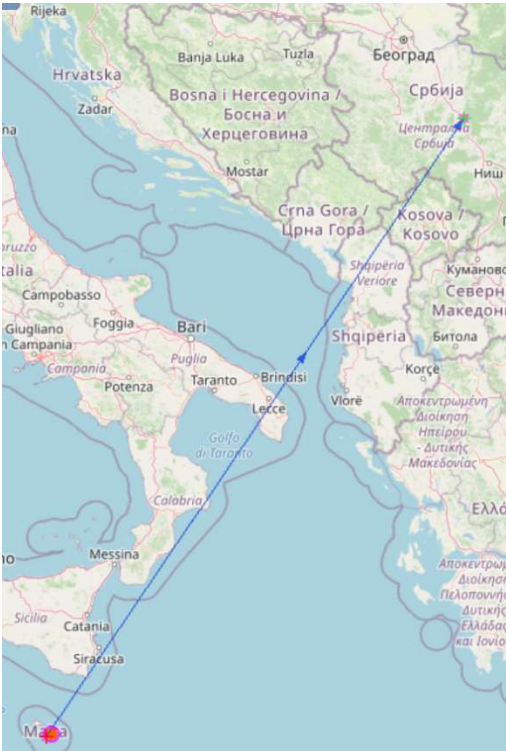
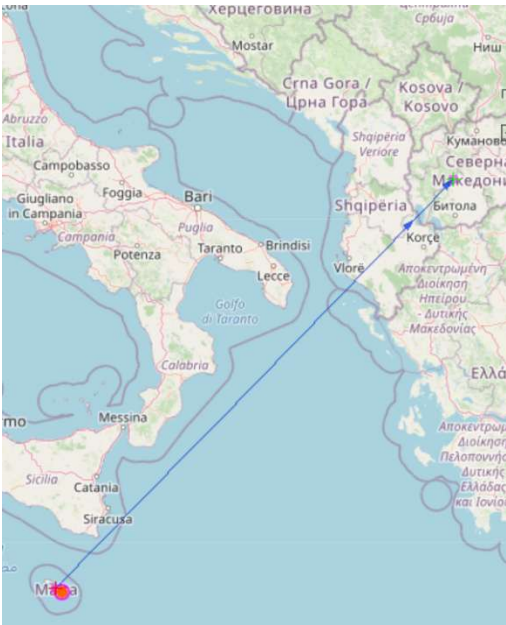
Table 2. GPS tracking data for Song Thrushes, detailing migratory routes, wintering and breeding locations.

A note about the formatting: Deployment locations and dates are in italics; the last recorded location and date of transmission are in bold. Inset maps show the location of the satellite-tagged individuals during the breeding season.

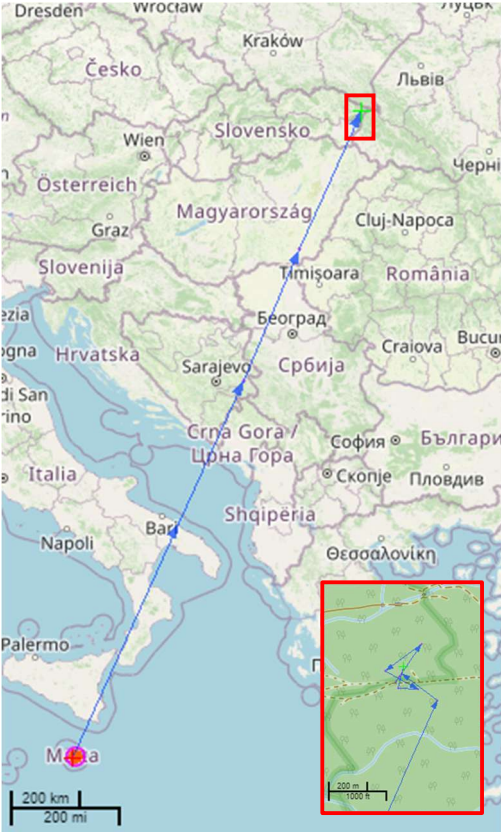
Species	Ring No.	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Turdus philomelos</i>	CC4804	208582	<i>Buskett, Malta</i> <i>Buskett, Malta</i> <i>Buskett, Malta</i> <i>Buskett, Malta</i> <i>Planina, Serbia</i> <i>Ileanda, Romania</i> <i>Ileanda, Romania</i> <i>Ileanda, Romania</i> <i>Ileanda, Romania</i> <i>Ileanda, Romania</i> <i>Ileanda, Romania</i> Ileanda, Romania	<i>04/02/2022</i> <i>08/02/2022</i> <i>15/02/2022</i> <i>22/02/2022</i> <i>29/03/2022</i> <i>05/04/2022</i> <i>12/04/2022</i> <i>26/04/2022</i> <i>03/05/2022</i> <i>10/05/2022</i> <i>17/05/2022</i> 14/06/2022	

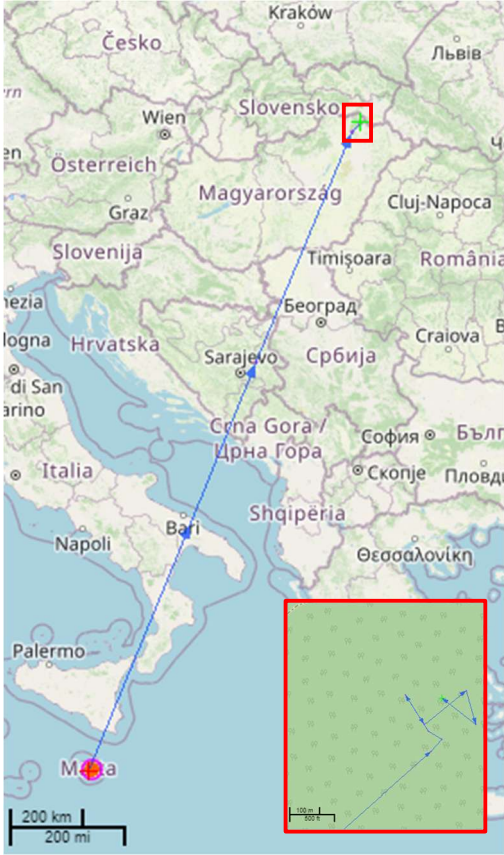
Species	Ring No.	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Turdus philomelos</i>	CC4756	208583	Buskett, Malta Gġirgenti, Malta Gġirgenti, Malta Gġirgenti, Malta Buskett, Malta Baljci, Bosnia and Herzegovina Brgule, Bosnia and Herzegovina Kletsk District, Belarus	04/02/2022 08/02/2022 15/02/2022 22/02/2022 22/03/2022 12/04/2022 19/04/2022 26/04/2022	
<i>Turdus philomelos</i>	CC4805	208586	Gġirgenti, Malta Gġirgenti, Malta Gġirgenti, Malta Gġirgenti, Malta	01/03/2022 08/03/2022 15/03/2022 22/03/2022	
<i>Turdus philomelos</i>	CC4772	208590	Buskett, Malta Buskett, Malta Buskett, Malta Buskett, Malta Buskett, Malta Likaj, Albania	06/12/2022 26/12/2022 05/01/2023 16/01/2023 18/03/2023 06/04/2023	
<i>Turdus philomelos</i>	CC5303	208589	Manikata, Malta	08/12/2022	No GPS data

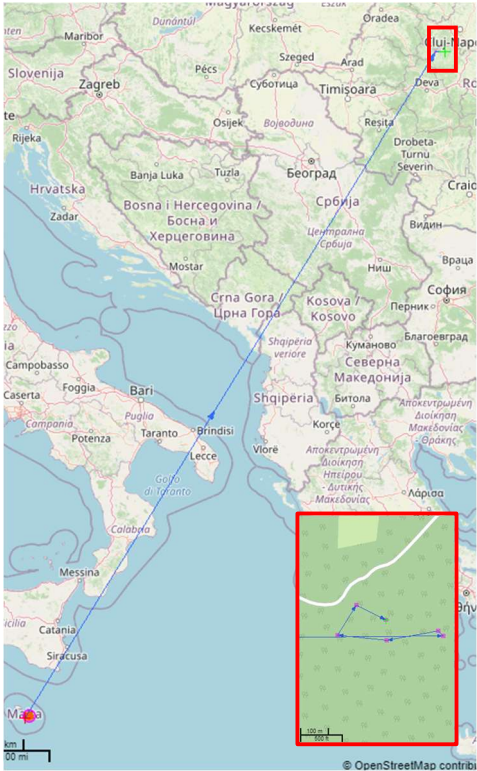
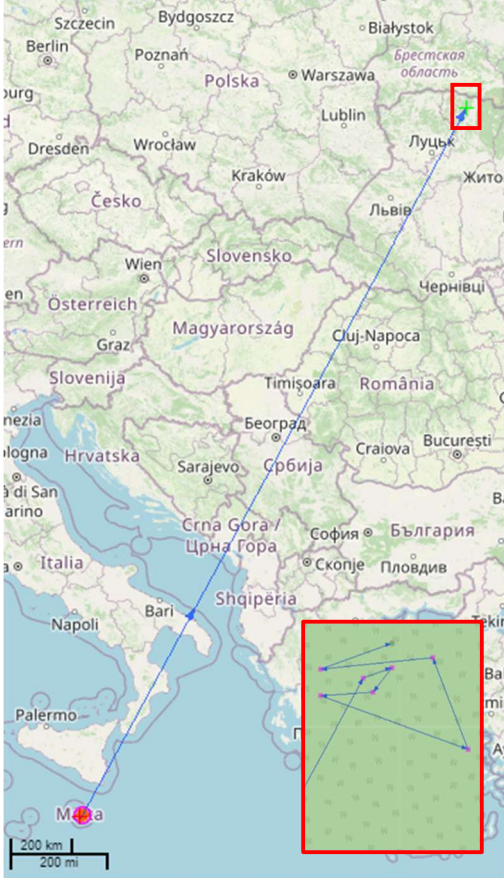
Species	Ring No.	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Turdus philomelos</i>	CC4808	208594	Girgenti, Malta Girgenti, Malta Girgenti, Malta Girgenti, Malta Girgenti, Malta Girgenti, Malta	09/12/2022 26/12/2022 05/01/2023 16/01/2023 05/02/2023 25/02/2023	
<i>Turdus philomelos</i>	CC5605	208593	Żebbiegħ, Malta Mġarr, Malta Mġarr, Malta Mġarr, Malta Mġarr, Malta Perama, Greece	09/12/2022 26/12/2022 05/01/2023 16/01/2023 18/03/2023 07/04/2023	
<i>Turdus philomelos</i>	CC4773	208595	Buskett, Malta	12/12/2022	No GPS data
<i>Turdus philomelos</i>	CC4774	208592	Buskett, Malta Buskett, Malta Buskett, Malta Buskett, Malta	12/12/2022 26/12/2022 05/01/2023 16/01/2023	
<i>Turdus philomelos</i>	CC4776	208597	Buskett, Malta Buskett, Malta Buskett, Malta Buskett, Malta	04/01/2023 05/01/2023 16/01/2023 04/02/2023	
<i>Turdus philomelos</i>	CC4777	208596	Buskett, Malta Buskett, Malta Buskett, Malta Buskett, Malta Buskett, Malta Buskett, Malta Buskett, Malta	16/01/2023 04/02/2023 05/02/2023 25/02/2023 06/03/2023 18/03/2023 06/04/2023	

Species	Ring No.	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Turdus philomelos</i>	CC4358	208578	Buskett, Malta Buskett, Malta Buskett, Malta Bosnjane, Serbia	23/01/2023 04/02/2023 05/02/2023 07/04/2023	
<i>Turdus philomelos</i>	CC3563	208585	Simar, Malta Simar, Malta Mizieb, Malta Debreshte, North Macedonia	28/02/2023 06/03/2023 18/03/2023 06/04/2023	
<i>Turdus philomelos</i>	CC5355	208584	Wied Harq Hamiem, Malta	10/03/2023	No GPS data

Species	Ring No.	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Turdus philomelos</i>	CC4815	208598	Buskett, Malta	28/02/2024	
			Buskett, Malta	29/03/2024	
			Buskett, Malta	30/03/2024	
			Buskett, Malta	31/03/2024	
			Kratovo, North Macedonia	14/04/2024	
			Chiprovtsi, Bulgaria	26/04/2024	
			Chiprovtsi, Bulgaria	08/05/2024	
			Chiprovtsi, Bulgaria	15/05/2024	
			Chiprovtsi, Bulgaria	16/05/2024	
			Chiprovtsi, Bulgaria	17/05/2024	
			Chiprovtsi, Bulgaria	20/05/2024	
			Chiprovtsi, Bulgaria	01/06/2024	
<i>Turdus philomelos</i>	CC4816	208602	Buskett, Malta	29/02/2024	
			Buskett, Malta	03/03/2024	
			Buskett, Malta	26/03/2024	
			Buskett, Malta	02/04/2024	
			Debarca, North Macedonia	14/04/2024	
			Svoqe, Bulgaria	26/04/2024	
			Svoqe, Bulgaria	08/05/2024	
			Svoqe, Bulgaria	15/05/2024	
			Svoqe, Bulgaria	16/05/2024	
			Svoqe, Bulgaria	17/05/2024	
			Svoqe, Bulgaria	20/05/2024	
			Svoqe, Bulgaria	01/06/2024	

Species	Ring No.	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Turdus philomelos</i>	CC4817	208605	Buskett, Malta	29/02/2024	
			Buskett, Malta	29/03/2024	
			Buskett, Malta	30/03/2024	
			Buskett, Malta	31/03/2024	
			Buskett, Malta	02/04/2024	
			Rogatica Municipality, Bosnia and Herzegovina	14/04/2024	
			Békéssámson, Hungary	26/04/2024	
			Topoľa, Slovakia	08/05/2024	
			Topoľa, Slovakia	15/05/2024	
			Topoľa, Slovakia	16/05/2024	
			Topoľa, Slovakia	17/05/2024	
			Topoľa, Slovakia	20/05/2024	
			Topoľa, Slovakia	01/06/2024	
			Topoľa, Slovakia	13/06/2024	
			Topoľa, Slovakia	25/06/2024	
			Topoľa, Slovakia	07/07/2024	
<i>Turdus philomelos</i>	CC4818	208609	Buskett, Malta	29/02/2024	No GPS data

Species	Ring No.	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Turdus philomelos</i>	CC4819	208604	Buskett, Malta	03/03/2024	
			Buskett, Malta	29/03/2024	
			Buskett, Malta	30/03/2024	
			Buskett, Malta	31/03/2024	
			Buskett, Malta	02/04/2024	
			Han Pijesak, Bosnia and Herzegovina	14/04/2024	
			Tállya, Hungary	26/04/2024	
			Nagyhuta, Hungary	08/05/2024	
			Kovácsvágás, Hungary	15/05/2024	
			Kovácsvágás, Hungary	16/05/2024	
			Kovácsvágás, Hungary	17/05/2024	
			Kovácsvágás, Hungary	20/05/2024	
			Kovácsvágás, Hungary	01/06/2024	
			Kovácsvágás, Hungary	13/06/2024	
			Kovácsvágás, Hungary	25/06/2024	
			Kovácsvágás, Hungary	07/07/2024	

Species	Ring No.	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Turdus philomelos</i>	CC4820	208600	Buskett, Malta	03/03/2024	
			Bistra, Romania	26/03/2024	
			Posaga, Romania	14/04/2024	
			Posaga, Romania	17/05/2024	
			Posaga, Romania	20/05/2024	
			Posaga, Romania	01/06/2024	
			Posaga, Romania	13/06/2024	
			Posaga, Romania	25/06/2024	
			Posaga, Romania	07/07/2024	
<i>Turdus philomelos</i>	CC4821	208599	Buskett, Malta	03/03/2024	
			Buskett, Malta	29/03/2024	
			Buskett, Malta	30/03/2024	
			Girgenti, Malta	02/04/2024	
			Litvytsya, Rivne Oblast, Ukraine	15/05/2024	
			Litvytsya, Rivne Oblast, Ukraine	16/05/2024	
			Litvytsya, Rivne Oblast, Ukraine	17/05/2024	
			Litvytsya, Rivne Oblast, Ukraine	20/05/2024	
			Litvytsya, Rivne Oblast, Ukraine	01/06/2024	
			Litvytsya, Rivne Oblast, Ukraine	13/06/2024	
			Litvytsya, Rivne Oblast, Ukraine	25/06/2024	
			Litvytsya, Rivne Oblast, Ukraine	07/07/2024	

As illustrated in Figure 9, the flightpath of satellite-tagged Song Thrushes during pre-nuptial migration is consistent with the general framework of northeasterly spring migration across Europe as observed by Spina and Volponi (2008)¹². No additional GPS fixes were registered by the tags deployed during Phases 1 and 3 after the respective progress reports were compiled and presented to the Ornis Committee.

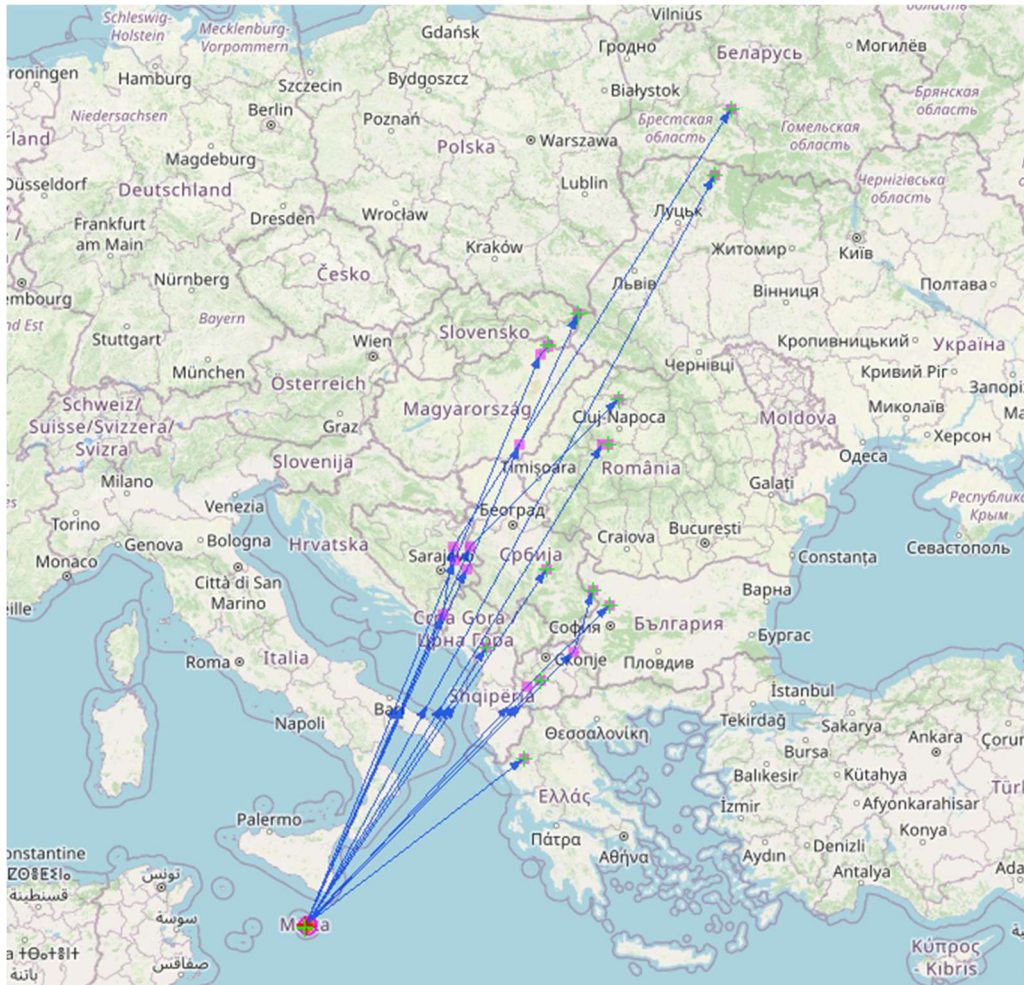


Figure 9. Composite map of Song Thrushes pre-nuptial migration, illustrating a distinct south-west to north-east movement (data from 04 Feb 2022 to 07 Jul 2024). Source: movebank.org, study name "Migration of Golden Plovers and Song Thrushes", study ID 1995912295.

Wintering Grounds (2022 – 2023 Data)

Six of the 14 Song Thrush tags deployed between 4 February 2022 and 10 March 2023, transmitted GPS fixes from continental Europe during pre-nuptial migration, following the birds' wintering period in Malta (Table 3). The wintering location of the satellite-tagged Song Thrushes was very restricted—all specimens remained in the same area where they were captured and tagged throughout the wintering period. The remaining tags did not transmit any data.

Data from Phase 3 (2024) were excluded from this analysis because the seven specimens were tagged at the end of the wintering period and the start of post-nuptial migration.

¹² See p.12 of the Golden Plover and Song Thrush Conservation Status Report (2021 update), available at: <https://mgof.gov.mt/en/Documents/WBRU/Reports%20and%20Statistics/consStaRepMay21GpSt.pdf>

Table 3. GPS data for Song Thrushes during their wintering period in Malta.

Tag no.	Date tagged (dd/mm/yyyy)	Last GPS fix in Malta (dd/mm/yyyy)	First GPS fix overseas (dd/mm/yyyy)	Wintering period in Malta (days)		
				Minimum	Maximum	Mean
208582	04/02/2022	22/02/2022	29/03/2022	18	53	36
208583	04/02/2022	22/03/2022	12/04/2022	46	67	57
208590	06/12/2022	18/03/2023	06/04/2023	102	121	112
208593	09/12/2022	18/03/2023	07/04/2023	99	119	109
208578	23/01/2023	05/02/2023	07/04/2023	13	74	44
208585	28/02/2023	18/03/2023	06/04/2023	18	37	28
Mean				49	79	64

Breeding Grounds (2022 – 2024 Data)

The Song Thrush fitted with Tag **208582** remained in Romania throughout the breeding season (05 April – 14 June 2022). The specimen with Tag **208583** appeared to remain in Belarus; however, because the last confirmed data was transmitted on 26 April 2022, it could not be confirmed whether the specimen stayed in Belarus for the entire breeding season or migrated further north in May.

Deployments during Phase 2 in 2023 did not yield conclusive data on breeding grounds, as the tags' batteries failed shortly after the specimens reached continental Europe. Conversely, the Phase 3 deployments in 2024 provided comprehensive breeding ground data for six of the seven tagged specimens (Table 4). This success highlights the strategic decision to deploy the tags later in the wintering period and to program a less intensive schedule for the Phase 3 tags. This approach prioritized data collection on breeding grounds, as sufficient information on wintering locations had already been gathered in previous phases.

Table 4. GPS data for Song Thrushes during the breeding season.

Tag No.	Last set of GPS fixes from overseas countries during pre-nuptial and breeding period		Number of GPS fixes	Location of GPS fixes during breeding period
	Location	Date (dd/mm/yyyy)		
208582	Romania	05/04/2022 – 14/06/2022	7	Romania
208583	Belarus	26/04/2022	1	Inconclusive
208590	Albania	06/04/2023	1	Inconclusive
208593	Greece	07/04/2023	1	Inconclusive
208578	Serbia	07/04/2023	1	Inconclusive
208585	North Macedonia	06/04/2023	1	Inconclusive
208598	Bulgaria	26/04/2024 – 01/06/2024	7	Bulgaria
208602	Bulgaria	26/04/2024 – 01/06/2024	7	Bulgaria
208605	Slovakia	08/05/2024 – 07/07/2024	9	Slovakia
208604	Hungary	26/04/2024 – 07/07/2024	10	Hungary
208600	Romania	26/03/2024 – 07/07/2024	8	Romania
208599	Ukraine	15/05/2024 – 07/07/2024	8	Ukraine

Table 5 lists the stopover sites used by satellite-tagged Song Thrushes during their northbound (pre-nuptial) migration.

Table 5. Northbound migration of satellite-tagged Song Thrushes: stopover sites.

Greece
Albania
North Macedonia
Bosnia and Herzegovina
Serbia
Hungary

Based on the project's GPS data from 05 Apr 2022 to 07 Jul 2024, seven satellite-tagged Song Thrushes spent the breeding season in five countries: Romania ($n = 2$), Bulgaria ($n = 2$), Slovakia ($n = 1$), Hungary ($n = 1$), and Ukraine ($n = 1$), as shown in Table 4 and illustrated in Figure 10.

According to the study's data, 85.7% of the satellite-tagged Song Thrushes bred within the territory of the European Union.

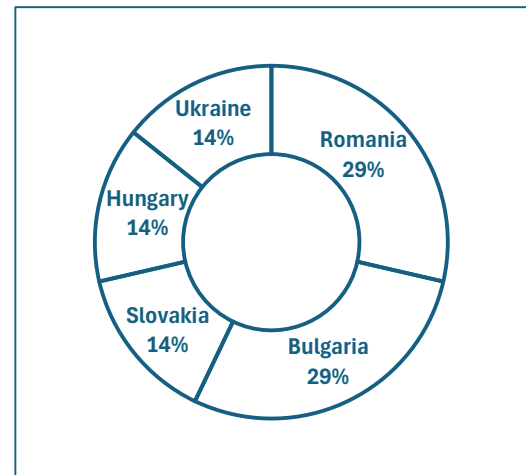


Figure 10. Proportional distribution of satellite-tagged Song Thrushes across their breeding grounds, based on the project's satellite tagging data from 05 Apr 2022 to 07 Jul 2024 (refer to Table 4).

Eurasian Golden Plover

Tagging Methodology

Golden Plovers were fitted with solar-powered PP-ARG-SOL-40 tags, which, unlike the non-solar tags used for Song Thrushes, were designed for long-term deployment and a more frequent GPS schedule. During testing, the tags maintained a schedule of one GPS fix every two hours for 12 consecutive days, even in cloudy weather. After a brief standby period to recharge, the fixes resumed. A 'worst-case' battery life estimate was calculated using the non-solar tag's parameters, as Lotek's program for estimating battery life does not apply to solar models.

Tagging schedule adjustments

Following the unexpected failure of tags with an intensive GPS schedule during the latter part of the 2023 breeding season, the programming for subsequent phases was modified. It was determined that the intensive schedule likely led to battery failure because the time between transmissions was insufficient for solar recharging. The revised schedule for Phase 3 (2023 – 2024) was designed to extend the tags' battery life during the post-nuptial migration period and included the following:

Discrete Fixes:

- Three fixes every two hours during the first six hours.
- Two fixes on the second day.
- One daily fix for the following week.

Rolling Interval:

- A single fix every 25 days thereafter.

Tag **208629** was the only exception, with a schedule of one fix per week followed by fixes every 25 days. Despite this revised approach, all tags ceased transmission before the post-nuptial migration period.

The tags' schedule for Phases 4 and 5 (2024 – 2025) was also programmed with both discrete and rolling interval fixes. This schedule was designed to specifically target the migratory and breeding seasons, as detailed below and as shown in Figure 11.

Discrete Fixes:

- First fix on 14 March.
- Second fix on 2 April.
- Daily fixes from 29–31 May.
- Daily fixes from 28–30 June.
- A fix on 18 August.

Rolling Interval:

- A single fix on April 26, and every 25 days thereafter.

The screenshot shows a software window titled "GPS Schedule Management" with a menu bar (File, Rules) and a toolbar. Below is a table with two columns: "Type" and "Rule".

Type	Rule
Discrete	Rule Period [yyyy-mm-dd]: 2025-04-02 to 2025-04-02 Daily Fix Time [hh:mm]: 10:00;
Discrete	Rule Period [yyyy-mm-dd]: 2025-05-29 to 2025-05-31 Daily Fix Time [hh:mm]: 10:00;
Discrete	Rule Period [yyyy-mm-dd]: 2025-06-28 to 2025-06-30 Daily Fix Time [hh:mm]: 10:00;
Rolling Interval	Rule Period [yyyy-mm-dd hh:mm]: 2025-04-26 10:00 to 2032-11-23 18:00 Interval [dd hh:mm]: 25 days 00:00
Discrete	Rule Period [yyyy-mm-dd]: 2025-08-16 to 2025-08-16 Daily Fix Time [hh:mm]: 10:00;
Discrete	Rule Period [yyyy-mm-dd]: 2025-03-14 to 2025-03-14 Daily Fix Time [hh:mm]: 10:00;

At the bottom, there is a "Show Calendar >>" button and a status bar that reads "Schedule Only – Battery life not considered."

Figure 11. Golden Plover GPS schedule for phase 4 (2024 – 2025).

Although solar capability was intended to capture a complete annual cycle, tag performance degraded towards the end of the breeding season. Consequently, tracking successfully spanned the final leg of the post-nuptial migratory route from Malta to Tunisia, pre-nuptial migration, and breeding ground occupancy. However, telemetry data could not be acquired for the subsequent return post-nuptial flight or second wintering period.

Golden Plover Observations and Tagging Effort

Golden Plovers follow a narrower flightpath during pre-nuptial migration (spring) compared to a broad-front post-nuptial migration (autumn and winter), which explains their scarcer presence in Malta during February and March relative to November – January.

Table 6 provides the observations and tagging summary across all phases of the project, while Appendix A contains a detailed daily log of the satellite tagging effort.

Table 6. Golden Plovers observed and satellite-tagged.

Phase	Date (dd/mm/yyyy)	Hours	Golden Plover Sightings	Golden Plovers Caught/Weighed	Tagged
1	05/02/2022 – 31/03/2022	191.5	2	0	0
2	29/11/2022 – 31/03/2023	823.5	21	6	5
3	20/10/2023 – 30/03/2024	1,231.5	132	12	10
4	20/10/2024 – 28/02/2025	903.5	47	17	17
5	03/12/2025 – 31/12/2025	187	29	1	1
Total		3,337	231 ¹³	36	33

Table 7 provides satellite tag details and deployment dates.

¹³ Excludes 33 pre-permit observations: 29 Golden Plovers recorded during 04/11/2022–28/11/2022 and 4 during 16/11/2025–29/11/2025.

Table 7. Deployment of Golden Plover tags during 2022 – 2025 (PP-ARG-SOL-40, weight 7.21g with 45cm harness and breast-loop crimp).

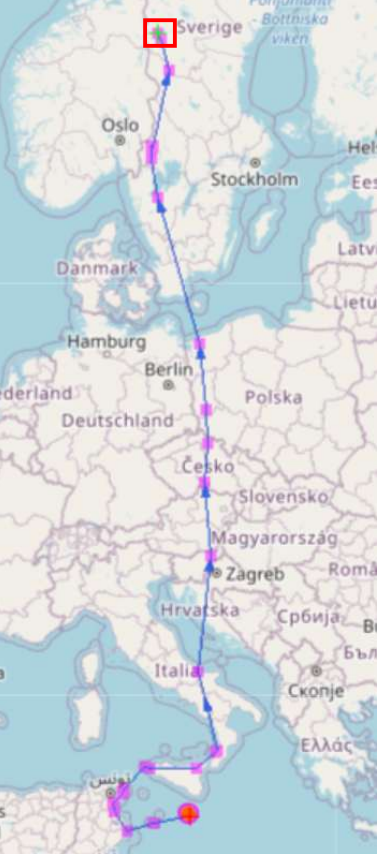
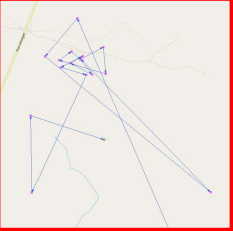
Date (dd/mm/yyyy)	Location	Age	Sex	Specimen's weight (g) (without satellite tag)	Wing length (mm)	Tag-to- weight ratio (%)	Tag No.
16/12/2022	Biržebbuža	Adult	♂	166	182	4.34	208612
30/12/2022	Biržebbuža	First Year	♂	158	189	4.56	Not tagged. Released with tagged specimen 208581 (refer to next row).
30/12/2022	Biržebbuža	First Year	♀	169	183	4.27	208581
07/02/2023	Biržebbuža	First Year	♂	150	190	4.81	208591
26/02/2023	Biržebbuža	Adult	♂	168	186	4.29	208617
12/03/2023	Biržebbuža	First Year	♂	202	190	3.57	208612 (re-used)
20/11/2023	Biržebbuža	First Year	♂	158	191	4.56	208614
20/11/2023	Biržebbuža	First Year	♀	160	189	4.51	Not tagged. Released with tagged specimen 208614 (refer to previous row and Figure B).
21/11/2023	Biržebbuža	Adult	♂	154	184	4.68	208615
21/11/2023	Biržebbuža	First Year	♀	158	186	4.56	208616
26/11/2023	Biržebbuža	First Year	♂	164	182	4.40	208618
04/12/2023	Biržebbuža	First Year	♂	132	184	5.46	Released untagged. Tag-to-weight ratio >5%
08/12/2023	Biržebbuža	First Year	♂	171	196	4.22	208619
11/01/2024	Biržebbuža	Adult	♂	189	194	3.81	208620
12/01/2024	Biržebbuža	First Year	♀	153	187	4.71	208626
12/01/2024	Biržebbuža	Adult	♀	165	180	4.37	208629
13/01/2024	Biržebbuža	Adult	♂	175	182	4.12	208621
14/03/2024	Biržebbuža	First Year	♂	217	194	3.32	208624
06/11/2024	Biržebbuža	First Year	♂	150	178	4.81	208620 (re-used)
14/11/2024	Biržebbuža	First Year	♀	158	181	4.56	208627
24/11/2024	Žurrieq	First Year	♀	150	186	4.81	208634
26/11/2024	Biržebbuža	Adult	♀	181	185	3.98	208622
26/11/2024	Biržebbuža	First Year	♂	163	184	4.42	208623
26/11/2024	Biržebbuža	Adult	♂	159	191	4.53	208635
26/11/2024	Biržebbuža	First Year	♂	166	190	4.34	208636
01/12/2024	Žurrieq	First Year	♀	153	188	4.71	208637
06/12/2024	Žurrieq	First Year	♂	153	187	4.71	209224
10/12/2024	Žurrieq	First Year	♀	152	188	4.74	209227
12/12/2024	Žurrieq	First Year	♀	147	185	4.90	209225
13/12/2024	Žurrieq	Adult	♂	159	189	4.53	209226
14/12/2024	Biržebbuža	First Year	♂	161	194	4.48	208625
18/12/2024	Biržebbuža	First Year	♀	167	186	4.32	208630
18/12/2024	Biržebbuža	First Year	♂	169	184	4.27	208631
16/01/2025	Biržebbuža	Adult	♀	173	189	4.17	208633
10/02/2025	Biržebbuža	Adult	♀	157	187	4.59	208628
31/12/2025	Biržebbuža	Adult	♀	163	186	4.42	208633 (re-used)

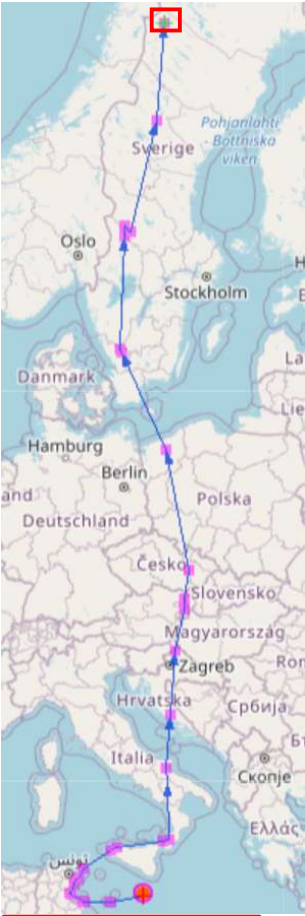
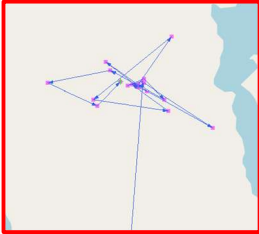
Golden Plover Tracking Data

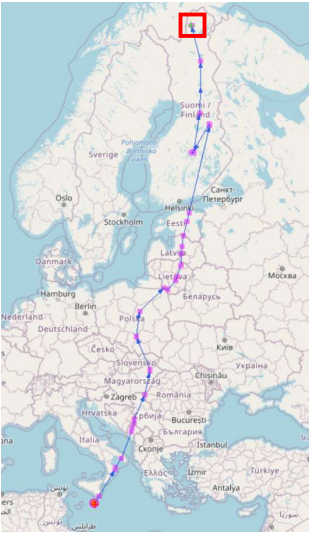
The GPS fixes for the satellite-tagged Golden Plovers are detailed in Table 8. A composite map illustrating the complete migration routes of all tagged individuals is presented in Figure 12.

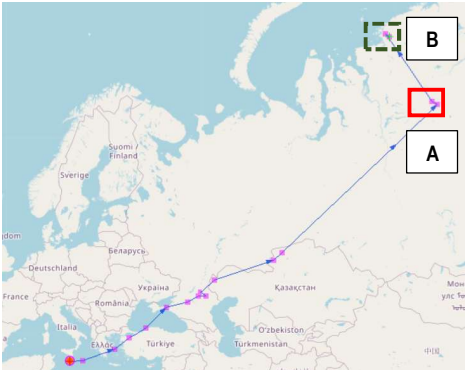
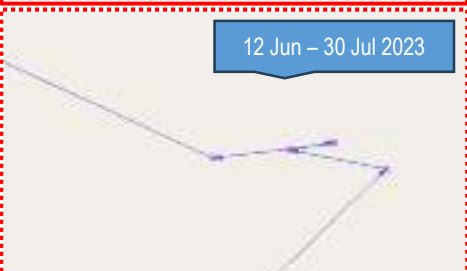
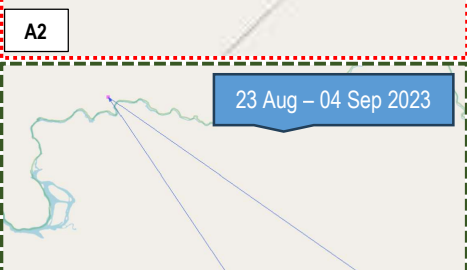
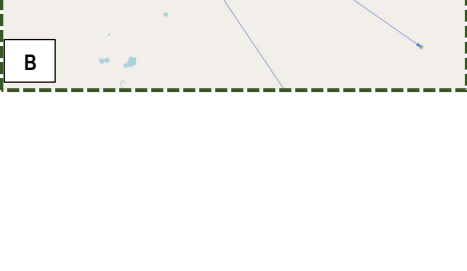
Table 8. GPS tracking data for Golden Plovers, detailing migratory routes, wintering and breeding locations.

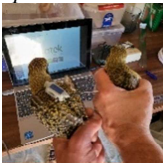
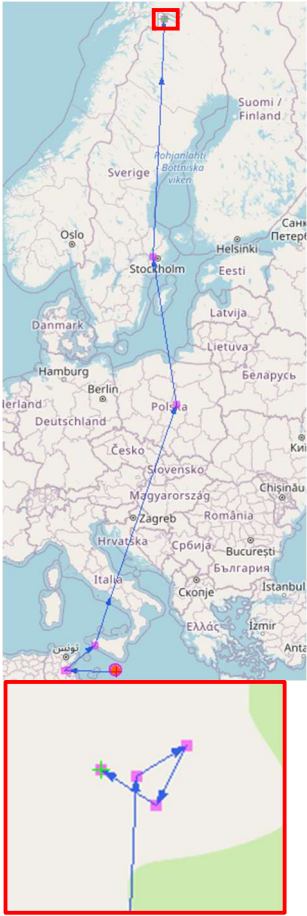
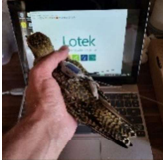
A note about the formatting: Deployment locations and dates are in italics; the last recorded location and date of transmission are in bold. Inset maps show the location of the satellite-tagged individuals during the breeding season.

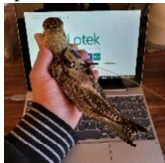
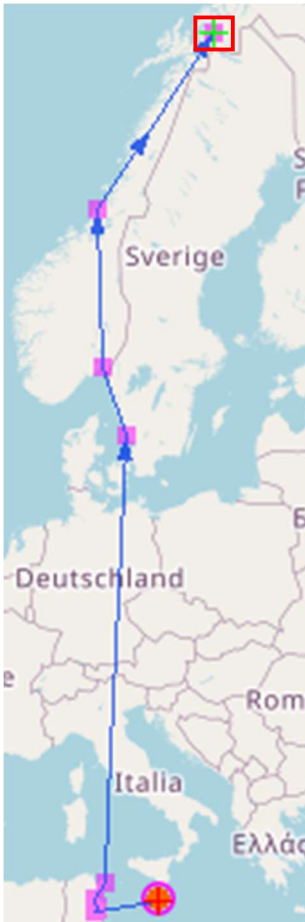
Species	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Pluvialis apricaria</i>	208612	<i>Birżebbuġa, Malta</i> Birżebbuġa, Malta	<i>16/12/2022</i> 17/12/2022 (shot; tag returned to WBRU the following working day)	
<i>Pluvialis apricaria</i>	208581	<i>Birżebbuġa, Malta</i> <i>Birżebbuġa, Malta</i> <i>Filfla, Malta</i> Lampedusa Chebba, Tunisia Sidi Bou Ali, Tunisia Enfidha, Tunisia Bouficha, Tunisia Errmal, Tunisia Errmal, Tunisia Hammamet, Tunisia Menzel Temime, Tunisia Menzel Temime, Tunisia Haouaria, Tunisia Nabeul, Tunisia Marettimo, Sicily Favignana, Sicily Randazzo, Sicily Rombiolo, Italy San Gregorio d'Ippona, Italy Campobasso, Italy Rače, Slovenia Studená, Czechia Horka u Staré Paky, Czechia Gmina Brzeźnica, Poland Gmina Gryfice, Poland Grästorp Municipality, Sweden Årjäng Municipality, Sweden Arvika Municipality, Sweden Arvika Municipality, Sweden Härjedalen, Sweden Falkvålen, Sweden Falkvålen, Sweden	<i>30/12/2022</i> <i>01/01/2023</i> <i>02/01/2023</i> <i>03/01/2023</i> <i>04/01/2023</i> <i>09/01/2023</i> <i>12/01/2023</i> <i>19/01/2023</i> <i>20/01/2023</i> <i>18/02/2023</i> <i>22/02/2023</i> <i>26/02/2023</i> <i>09/03/2023</i> <i>11/03/2023</i> <i>13/03/2023</i> <i>15/03/2023</i> <i>15/03/2023</i> <i>17/03/2023</i> <i>18/03/2023</i> <i>18/03/2023</i> <i>20/03/2023</i> <i>22/03/2023</i> <i>24/03/2023</i> <i>26/03/2023</i> <i>28/03/2023</i> <i>31/03/2023</i> <i>01/04/2023</i> <i>03/04/2023</i> <i>08/04/2023</i> <i>08/05/2023</i> <i>10/05/2023</i> <i>14/05/2023</i> 27/07/2023	 

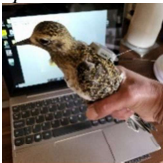
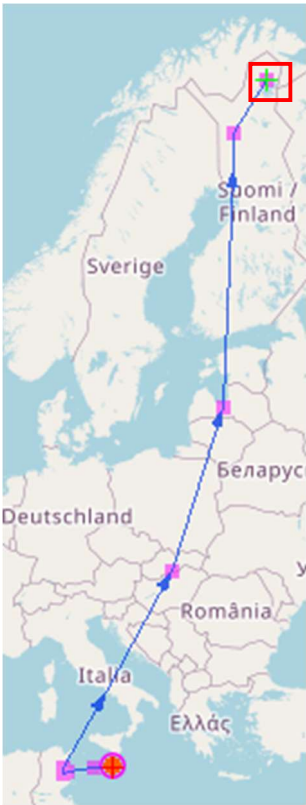
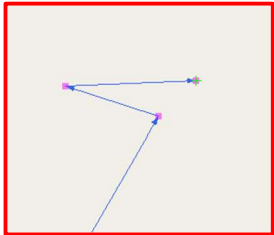
Species	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Pluvialis apricaria</i> 	208591	Birzebbuga, Malta	07/02/2023	
		Birzebbuga, Malta	07/02/2023	
		Lampedusa	09/02/2023	
		Mahdia, Tunisia	10/02/2023	
		Mahdia, Tunisia	18/02/2023	
		Moknine, Tunisia	20/02/2023	
		Kalaa Kebira, Tunisia	22/02/2023	
		Sebhika Kelbia, Tunisia	24/02/2023	
		Kondar, Tunisia	26/02/2023	
		Hammamet, Tunisia	28/02/2023	
		Bou Argoub, Tunisia	02/03/2023	
		Dar Chaabane El Fehri, Tunisia	06/03/2023	
		Korba, Tunisia	08/03/2023	
		Haouaria, Tunisia	10/03/2023	
		Trapani, Sicily	12/03/2023	
		Messina, Sicily	14/03/2023	
		Reggio Calabria, Italy	14/03/2023	
		Foggia, Italy	16/03/2023	
		Radonić, Croatia	16/03/2023	
		Središče ob Dravi, Slovenia	18/03/2023	
		Parndorf, Austria	20/03/2023	
		Ebenthal, Austria	22/03/2023	
		Čelechovice na Hané, Czechia	24/03/2023	
		Gmina Świdwin, Poland	26/03/2023	
		Hylte Municipality, Sweden	28/03/2023	
		Gislaved Municipality, Sweden	30/03/2023	
		Torsby Municipality, Sweden	01/04/2023	
		Malung, Sweden	10/04/2023	
		Malung, Sweden	08/05/2023	
		Strömsund Municipality, Sweden	10/05/2023	
		Sorsele Municipality, Sweden	12/05/2023	
		Sorsele Municipality, Sweden	26/07/2023	
				

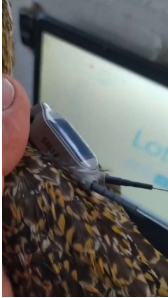
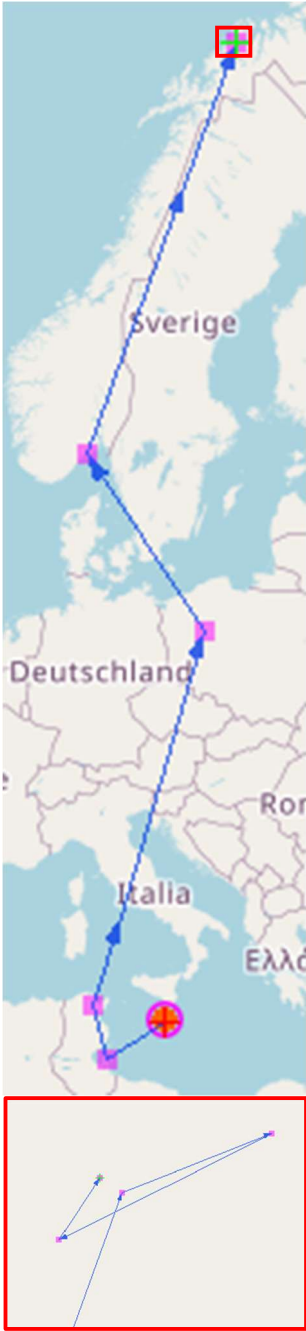
Species	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Phuvarialis apricaria</i> 	208617	Birżebbuġa, Malta	26/02/2023	
		Marsaskala, Malta	26/02/2023	
		Syracuse, Italy	26/02/2023	
		Crotone, Italy	26/02/2023	
		Lecce, Italy	26/02/2023	
		Ozrinići, Montenegro	28/02/2023	
		Novakovići, Montenegro	28/02/2023	
		Kaluđerovići, Serbia	02/03/2023	
		Hercegovačka Goleša, Serbia	02/03/2023	
		Zaovine, Serbia	04/03/2023	
		Tomnatic, Romania	06/03/2023	
		Tiszavasvári, Hungary	08/03/2023	
		Mezőzombor, Hungary	08/03/2023	
		Drochlin, Poland	10/03/2023	
		Konieczpol, Poland	10/03/2023	
		Dłużniewo Duże, Poland	12/03/2023	
		Makauskai, Lithuania	12/03/2023	
		Lebedžiūnai, Lithuania	20/03/2023	
		Krape, Latvia	22/03/2023	
		Kārļi, Latvia	24/03/2023	
		Naukšēni Parish, Latvia	26/03/2023	
		Sõrandu, Estonia	28/03/2023	
		Aukūla, Estonia	30/03/2023	
		Ristijärvi, Finland	01/04/2023	
		Ristijärvi, Finland	14/04/2023	
		Hyrnsalmi, Finland	16/04/2023	
		Pielavesi, Finland	18/04/2023	
		Pielavesi, Finland	22/04/2023	
		Tervo, Finland	24/04/2023	
		Keitele, Finland	26/04/2023	
		Tervo, Finland	08/05/2023	
		Pudasjärvi, Finland	10/05/2023	
		Pudasjärvi, Finland	12/05/2023	
		Sodankylä, Finland	14/05/2023	
		Northern Lapland, Finland	16/05/2023	
		Northern Lapland, Finland	29/07/2023	

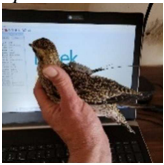
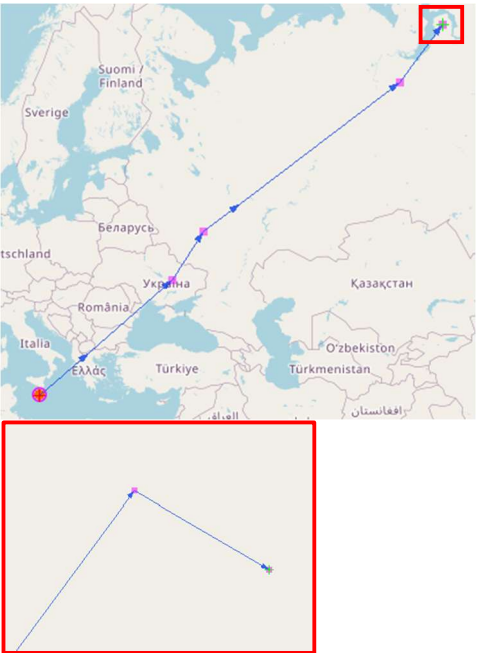
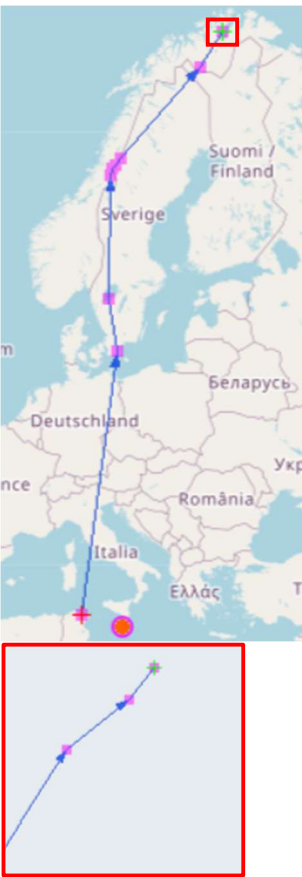
Species	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Phuvarialis apricaria</i> 	208612 (re-used)	Birżebbuġa, Malta	12/03/2023	
		Birżebbuġa, Malta	21/03/2023	
		Mediterranean Sea (268km from eastern coast of Malta)	23/03/2023	
		Idrousa, Greece (10km NE from Andros Island)	25/03/2023	
		Beylik, Turkey	02/04/2023	
		Black Sea (33km from northern coast of Hatipler, Turkey)	05/04/2023	
		Temryuksky District, Russia	14/04/2023	
		Gorodovikovskiy District, Russia	17/04/2023	
		Gorodovikovskiy District, Russia	20/04/2023	
		Zavetinsky District, Russia	23/04/2023	
		Beloozerskii, Republic of Kalmykia, Russia	23/04/2023	
		Sarpinsky District, Republic of Kalmykia, Russia	05/05/2023	
		Dizhiembet, Zhanybek District, Kazakhstan	08/05/2023	
		Dizhiembet, Zhanybek District, Kazakhstan	17/05/2023	
		Zhiyenbat, Zhanybek District, Kazakhstan	20/05/2023	
		Zhiyenbat, Zhanybek District, Kazakhstan	23/05/2023	
		Grishenka, Denisov District, Kazakhstan	26/05/2023	
		Grishenka, Denisov District, Kazakhstan	29/05/2023	
		Kostanay District, Kazakhstan	01/06/2023	
		Evenkiysky District, Krasnoyarsk Krai (Siberia), Russia	12/06/2023	
		Evenkiysky District, Krasnoyarsk Krai (Siberia), Russia	11/08/2023	
		Krasnoyarsk Krai (Siberia), Russia	23/08/2023	
		Krasnoyarsk Krai (Siberia), Russia	04/09/2023	

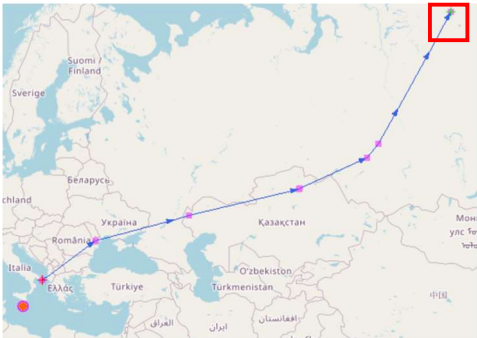
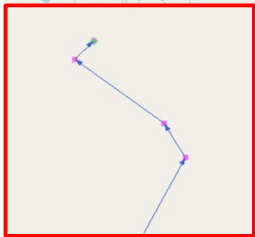
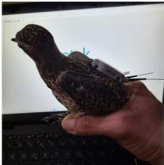
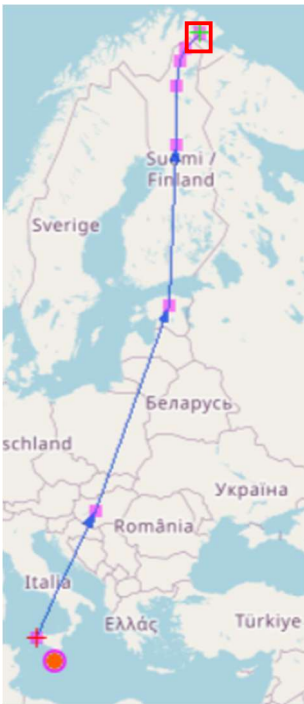
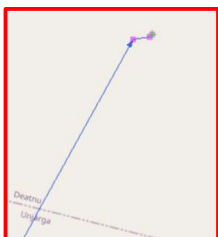
Species	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Pluvialis apricaria</i> 	208614	Birżebbuġa, Malta	20/11/2023	
		Birżebbuġa, Malta	22/11/2023	
		Balaoum, Tunisia	23/11/2023	
		Dar el Oussef, Tunisia	24/11/2023	
		Kondar, Tunisia	19/12/2023	
		Kondar, Tunisia	13/01/2024	
		El Alam, Tunisia	07/02/2024	
		Mazara del Vallo, Trapani, Italy	03/03/2024	
		Gmina Żychlin, Poland	28/03/2024	
		Färingsö, Sweden	22/04/2024	
<i>Pluvialis apricaria</i> 	208615	Birżebbuġa, Malta	21/11/2023 (10:40am)	No GPS data
<i>Pluvialis apricaria</i> 	208616	Birżebbuġa, Malta	21/11/2023 (02:50pm)	No GPS data

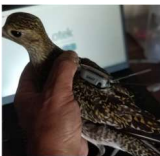
Species	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Pluvialis apricaria</i> 	208618	<i>Birżebbuġa, Malta</i> Birżebbuġa, Malta	26/11/2023 27/11/2023	 
		Ech-Chahda Est, Tunisia Ouled Moulahem Ouest, Tunisia	30/11/2023 03/12/2023	
		Sebkhet de Sidi El Hani, Tunisia	28/12/2023	
		Kroussia Ouest, Tunisia Kondar, Tunisia	22/01/2024 16/02/2024	
		Damousse, Tunisia	12/03/2024	
		Falkenberg, Sweden	06/04/2024	
		Råde Municipality, Norway Steinsdalen, Norway	01/05/2024 26/05/2024	
		Sjøvegan, Norway Sjøvegan, Norway	20/06/2024 15/07/2024	
		Sjøvegan, Norway	09/08/2024	

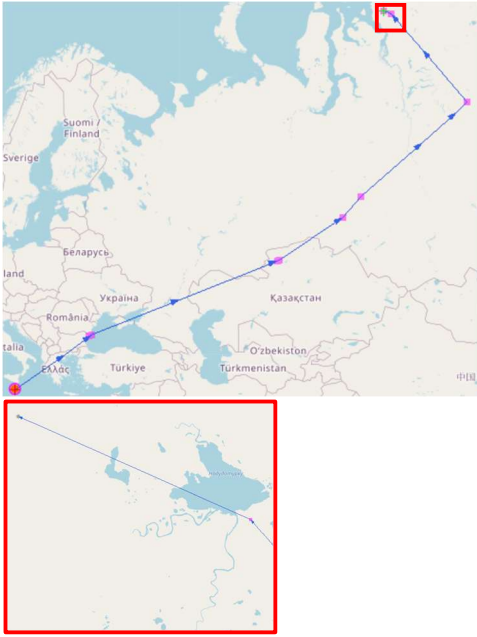
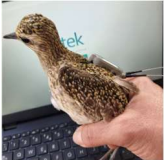
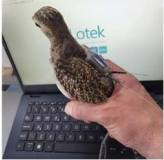
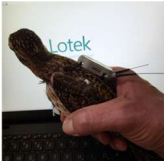
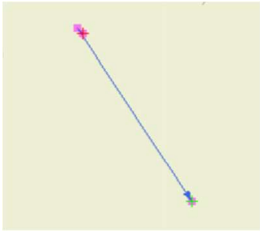
Species	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Pluvialis apricaria</i> 	208619	Birżebbuġa, Malta Birżebbuġa, Malta Linosa, Italy Bouhlale El Ali Nord, Tunisia Ech-Chahda Est, Tunisia Sidi El Heni Sud, Tunisia Bechachma, Tunisia Lučenec, Slovakia Olaine Municipality, Latvia Kittilä, Finland Inari, Finland Inari, Finland Inari, Finland	08/12/2023 14/12/2023 18/12/2023 21/12/2023 14/01/2024 08/02/2024 04/03/2024 29/03/2024 22/04/2024 16/05/2024 11/06/2024 06/07/2024 31/07/2024	 
<i>Pluvialis apricaria</i> 	208620	Birżebbuġa, Malta Birżebbuġa, Malta	11/01/2024 11/01/2024 (shot; tag returned to WBRU)	No GPS data
<i>Pluvialis apricaria</i> 	208626	Żurrieq, Malta Żurrieq, Malta	12/01/2024 12/01/2024 (possibly shot; tag not returned to WBRU)	No GPS data

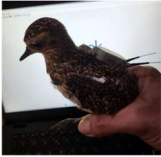
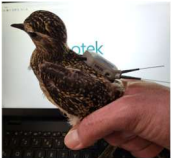
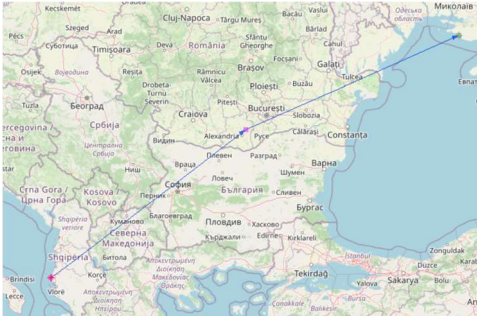
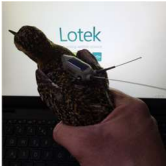
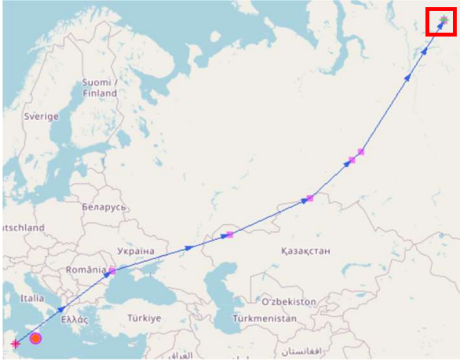
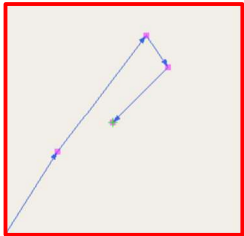
Species	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Phuvialis apricaria</i> 	208629	Birżebbuġa, Malta	12/01/2024	
		Birżebbuġa, Malta	19/01/2024	
		Mezraia, Tunisia	13/02/2024	
		Sabkhet Sijoumi Sud, Tunisia	09/03/2024	
		Budzyń, Poland	03/04/2024	
		Larvik Municipality, Norway	28/04/2024	
		Kvaløya, Tromsø Municipality, Norway	23/05/2024	
		Kvaløya, Tromsø Municipality, Norway	17/06/2024	
<i>Phuvialis apricaria</i> 	208621	Birżebbuġa, Malta	13/01/2024	No GPS data. Tag 208621 was decommissioned in September 2024 due to battery failure.
		Birżebbuġa, Malta	17/01/2024 (shot; tag returned to WBRU)	

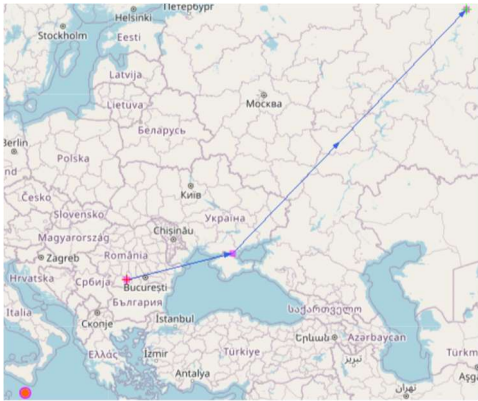
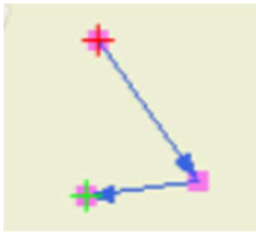
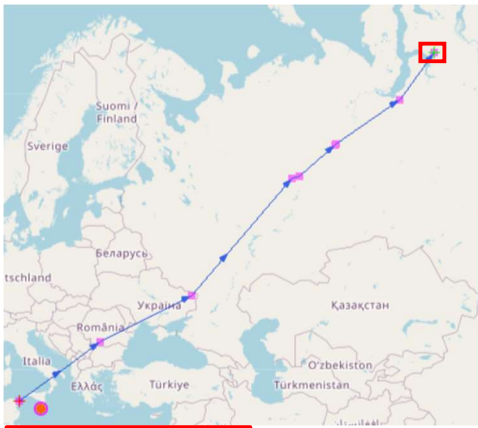
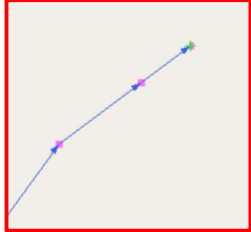
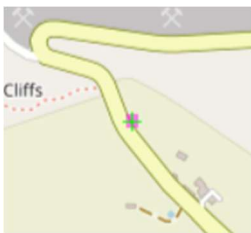
Species	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Pluvialis apricaria</i> 	208624	Birżebbuġa, Malta	14/03/2024	
		Birżebbuġa, Malta	22/03/2024	
		Kulisheve, Dnipropetrovsk Oblast, Ukraine	15/04/2024	
		Domachi, Lipetsk Oblast, Russia	11/05/2024	
		Priuralsky District, Yamalo-Nenets Autonomous Okrug, Russia (Western Siberia)	04/06/2024	
		Tazovsky District, Yamalo-Nenets Autonomous Okrug, Russia (Western Siberia)	24/07/2024	
		Tazovsky District, Yamalo-Nenets Autonomous Okrug, Russia (Western Siberia)	19/08/2024	
<i>Pluvialis apricaria</i> 	208620 (re-used)	Birżebbuġa, Malta	06/11/2024	
		La Marsa, Tunisia	14/03/2025	
		Månslanda, Sweden	02/04/2025	
		Tolsjö, Sweden	26/04/2025	
		Staldvik, Norway	21/05/2025	
		Røyrvik Municipality, Norway	29/05/2025	
		Hattfjelldal Municipality, Norway	30/05/2025	
		Kroken, Norway	31/05/2025	
		Kautokeino Municipality, Norway	15/06/2025	
		Porsanger Municipality, Norway	28/06/2025	
		Porsanger Municipality, Norway	29/06/2025	
		Porsanger Municipality, Norway	30/06/2025	

Species	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Phluvialis apricaria</i> 	208627	Birzebbuga, Malta	14/11/2024	 
		Hlavani, Odesa Oblast, Ukraine	02/04/2025	
		Kuygenkol, Kazakhstan	26/04/2025	
		Kulstan, Kazakhstan	21/05/2025	
		Zhanazhol, Kazakhstan	29/05/2025	
		Novopokrovka, Tomsk Oblast, Russia	30/05/2025	
		Argat-Yul, Tomsk Oblast, Russia	31/05/2025	
		Evenkiysky District Krasnoyarsk Krai, Russia	15/06/2025	
		Evenkiysky District Krasnoyarsk Krai, Russia	28/06/2025	
		Evenkiysky District Krasnoyarsk Krai, Russia	29/06/2025	
		Evenkiysky District Krasnoyarsk Krai, Russia	30/06/2025	
<i>Phluvialis apricaria</i> 	208634	Żurrieq, Malta	24/11/2024	 
		Salemi, Trapani, Italy	14/03/2025	
		Sárkeresztúr, Hungary	02/04/2025	
		Ageri, Järva County, Estonia	26/04/2025	
		Rovaniemi, Finland	21/05/2025	
		Pohjois-Lappi, Finland	29/05/2025	
		Pohjois-Lappi, Finland	30/05/2025	
		Pohjois-Lappi, Finland	31/05/2025	
		Nesseby Municipality, Varangerbotn, Norway	15/06/2025	
		Tana Municipality, Norway	28/06/2025	
		Tana Municipality, Norway	29/06/2025	
		Tana Municipality, Norway	30/06/2025	

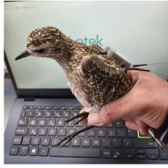
Species	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Pluvialis apricaria</i>	208622	Birżebbuga, Malta	24/11/2024	
		Campomarino, Campobasso, Italy	14/03/2025	
		Slampe, Tukums Municipality, Latvia	02/04/2025	
		Hälvati, Pärnu County, Estonia	26/04/2025	
		Pohjois-Lappi, Finland	21/05/2025	
		Pohjois-Lappi, Finland	29/05/2025	
		Pohjois-Lappi, Finland	30/05/2025	
		Pohjois-Lappi, Finland	31/05/2025	
		Inari, Finland	15/06/2025	
		Inari, Finland	28/06/2025	
		Inari, Finland	29/06/2025	
		Inari, Finland	30/06/2025	

Species	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Pluvialis apricaria</i> 	208623	Birżebbuġa, Malta	26/11/2024	
		Trigortsi, Bulgaria	02/04/2025	
		Lugovoye, Kazakhstan	21/05/2025	
		Polovnikovka, Kazakhstan	29/05/2025	
		Tarsky District Omsk Oblast, Russia	30/05/2025	
		Kargasoksky District Tomsk Oblast, Russia	31/05/2025	
		Evenkiysky District Krasnoyarsk Krai, Russia	15/06/2025	
		Evenkiysky District Krasnoyarsk Krai, Russia	28/06/2025	
		Evenkiysky District Krasnoyarsk Krai, Russia	29/06/2025	
		Evenkiysky District Krasnoyarsk Krai, Russia	30/06/2025	
		Evenkiysky District Krasnoyarsk Krai, Russia	10/07/2025	
		Taymyrsky Dolgano- Nenetsky District Krasnoyarsk Krai, Russia	04/08/2025	
		Taymyrsky Dolgano- Nenetsky District Krasnoyarsk Krai, Russia	16/08/2025	
<i>Pluvialis apricaria</i> 	208635	Birżebbuġa, Malta	26/11/2024	No GPS data
<i>Pluvialis apricaria</i> 	208636	Birżebbuġa, Malta	26/11/2024	No GPS data
<i>Pluvialis apricaria</i> 	208637	Żurrieq, Malta Żurrieq, Malta	01/12/2024 26/04/2025 (possibly shot; tag not returned to WBRU)	

Species	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Pluvialis apricaria</i> 	209224	Żurrieq, Malta Żurrieq, Malta	06/12/2024 26/04/2025 (possibly shot; tag not returned to WBRU)	
<i>Pluvialis apricaria</i> 	209227	Żurrieq, Malta	10/12/2024	No GPS data
<i>Pluvialis apricaria</i> 	209225	Żurrieq, Malta Darëzezë e Re, Albania Merişani, Romania Tendrivske, Kherson Oblast, Ukraine	12/12/2024 14/03/2025 02/04/2025 26/04/2025	
<i>Pluvialis apricaria</i> 	209226	Żurrieq, Malta Hanshir al Raqubah, Tunisia Kam'yans'ke, Odesa Oblast, Ukraine Kimer-Sayek-Kul', Kazakhstan Zhambyl District, Kazakhstan Zhambyl District, Kazakhstan Kargasoksky District Tomsk Oblast, Russia Alexandrovsky District Tomsk Oblast, Russia Taymyrsky Dolgano-Nenetsky District, Krasnoyarsk Krai, Russia Taymyrsky Dolgano-Nenetsky District, Krasnoyarsk Krai, Russia Taymyrsky Dolgano-Nenetsky District, Krasnoyarsk Krai, Russia Taymyrsky Dolgano-Nenetsky District, Krasnoyarsk Krai, Russia Taymyrsky Dolgano-Nenetsky District, Krasnoyarsk Krai, Russia	13/12/2024 14/03/2025 02/04/2025 26/04/2025 21/05/2025 29/05/2025 30/05/2025 31/05/2025 15/06/2025 28/06/2025 29/06/2025 30/06/2025	 

Species	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Pluvialis apricaria</i> 	208625	Birżebbuġa, Malta	14/12/2024	
		Piatra – Olt, Romania	14/03/2025	
		Heniches'kyi District Kherson Oblast, Ukraine	02/04/2025	
		Bychina, Perm Krai, Russia	21/05/2025	
<i>Pluvialis apricaria</i> 	208630	Birżebbuġa, Malta	18/12/2024	
		Birżebbuġa, Malta	26/04/2025 (possibly shot; tag not returned to WBRU)	
<i>Pluvialis apricaria</i> 	208631	Birżebbuġa, Malta	18/12/2024	 
		El Haouaria Sud, Tunisia	14/03/2025	
		Preajba de Jos, Romania	02/04/2025	
		Pysarivka, Luhansk Oblast, Ukraine	26/04/2025	
		Cherdynskiy Rayon, Perm Krai, Russia	21/05/2025	
		Kamgort, Perm Krai, Russia	29/05/2025	
		Beryozovsky District, Russia	30/05/2025	
		Nadym'sky District, Russia	31/05/2025	
		Nadym'sky District, Russia	15/06/2025	
		Tazovsky District, Russia	28/06/2025	
		Tazovsky District, Russia	29/06/2025	
		Tazovsky District, Russia	30/06/2025	
<i>Pluvialis apricaria</i> 	208633	Birżebbuġa, Malta	16/01/2025	
		Lapsi, l/o Siġġiewi, Malta	30/05/2025 (shot; tag retrieved on 04/06/2025 by WBRU, assisted by EPU)	

Species	Tag No.	Location of GPS fixes	Date (dd/mm/yyyy)	Map
<i>Pluvialis apricaria</i>	208628	Birzebbuga, Malta	10/02/2025	No GPS data



<i>Pluvialis apricaria</i>	208633 (re-used)	Birzebbuga, Malta	31/12/2025	No GPS data
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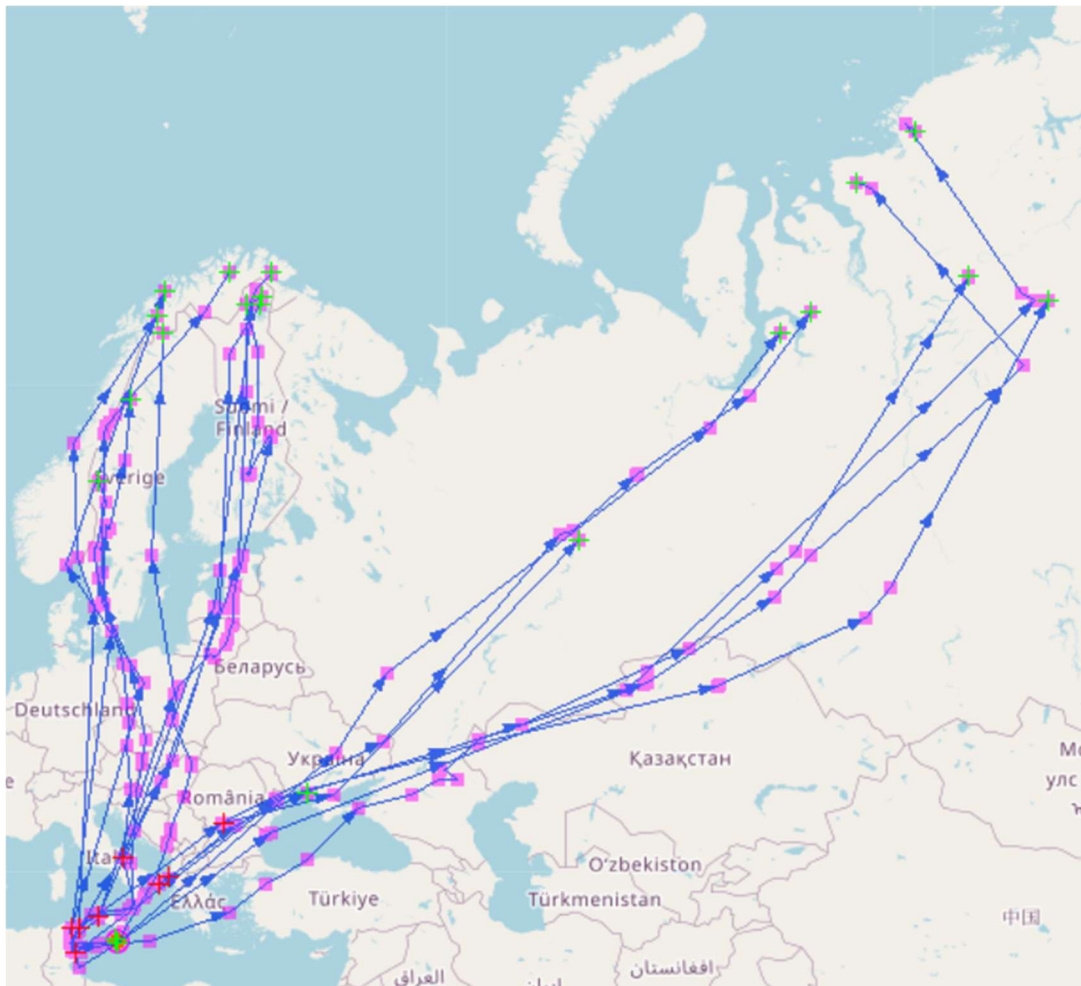
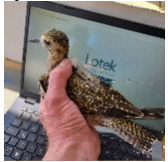


Figure 12. Composite map illustrating the wintering grounds, breeding grounds, and migration routes of satellite-tagged Golden Plovers (data from 30 Dec 2022 to 16 Aug 2025). Source: movebank.org, study name "Migration of Golden Plovers and Song Thrushes", study ID 1995912295.

Spatiotemporal Telemetry Analysis by Project Phase

Phase 1 and Phase 2

Although deployed 39 days apart, the Golden Plovers with Tags **208581** and **208591** followed nearly identical migration routes during both post-nuptial and pre-nuptial periods toward their breeding grounds in Sweden. They wintered in separate locations in Tunisia for 68 and 26 days, respectively, departing for Europe from two distinct sites in Cap Bon (Nabeul on 13 March 2023 and Haouaria on 08 March 2023). While their movements overlapped in some regions, temporal partitioning of their GPS fixes indicates it is unlikely the birds occupied the same area concurrently. Both tags ceased transmission after July 2023.

The Golden Plover fitted with Tag **208617** followed a completely different path, heading north-northeast through nine countries before arriving in Ristijärvi, Finland, on 01 April 2023. It spent two weeks there, moved south, and then gradually headed north to its breeding grounds in Northern Lapland, Finland, arriving on 16 May 2023. This tag also ceased transmission after July 2023.

The fourth individual, fitted with Tag **208612**, flew east toward Greece and Turkey following an 11-day stopover in Biržebbuga. From mid-April to mid-May 2023, this bird was recorded in Southern Russia and Western Kazakhstan. It departed Northern Kazakhstan and arrived in Central Siberia (Krasnoyarsk) between 01 June and 12 June 2023. The bird spent 60 days in the Evenkiysky District, Siberia, from 12 June to 11 August 2023. On 23 August 2023, it was recorded further north in the Taymursky Dolgano-Nenetsky District before initiating post-nuptial migration on 04 September 2023. No further GPS fixes were recorded after this date.

Phase 3 (20 October 2023 – 31 March 2024)

Between 20 October 2023 and 31 March 2024, 12 Golden Plovers were captured (11 during post-nuptial migration and one during pre-nuptial migration). Ten specimens were fitted with satellite tags; however, only five tags transmitted data through to the breeding season.

On 20 November 2023, two first-year Golden Plovers (one male, one female) were captured simultaneously. Due to the intensive duty cycle programmed at deployment, only the male was tagged, adhering to the requirement that active tags remain separated by at least one metre. Both individuals were subsequently released together (Figure B). A first-year male captured on 04 December 2023 was not tagged because its body mass was below the 147 g minimum threshold; it was released immediately following biometric logging.

On 21 November 2023, satellite tags were deployed on two Golden Plovers captured and released separately. Both tags subsequently failed to yield the minimum baseline of three GPS fixes. This points to two potential operational scenarios:

- The individuals were harvested before sufficient transmission cycles occurred (tags unrecovered).
- The birds joined the same flock post-release, and proximity closer than one metre induced mutual signal interference or failure.

Golden Plovers with Tags **208614**, **208618**, **208619**, and **208629** wintered in Tunisia. Tag **208629** transmitted its last local fix from Malta on 19 January 2024 and its first fix from Tunisia on 13 February 2024, consistent with its 25-day duty cycle following the initial deployment week. During pre-nuptial migration, these four birds traversed a shared north-northeast corridor through Northwest Europe and Southern Scandinavia to reach breeding grounds in Sweden ($n = 1$), Norway ($n = 2$), and Finland ($n = 1$).

The fifth individual, Tag **208624**, routed northeast through Greece, Romania, and Ukraine after staging for at least seven days in Biržebbuga. It continued to breeding grounds in Russia, logging fixes south of Moscow in mid-May 2024 and in Western Siberia from June onwards.

Phase 4 (20 October 2024 – 31 December 2025)

To conserve power and maximize data transmission density during the breeding season—a primary research objective—the GPS duty cycle for Phase 4 was modified to initiate logging on 14 March rather than upon release. Between 20 October 2024 and 31 December 2025, 18 Golden Plovers were satellite-tagged (17 caught during post-nuptial migration, one during pre-nuptial migration).

At the scheduled startup on 14 March 2025, seven tags successfully transmitted geodata. Three birds were on their wintering grounds in Tunisia (Tags **208620**, **209226**, and **208631**), while four had commenced pre-nuptial migration: two in Italy (Tags **208634** and **208622**), one in Romania (Tag **208625**), and one in Albania (Tag **209225**). Two tags (**208623** and **208627**) did not log data on 14 March 2025, but subsequently recorded locations on 2 April 2025 in Bulgaria and Ukraine, respectively. Tag **209225** ceased transmission on 26 April 2025 while in Ukraine.

Tagged individuals breeding in Russia exhibited an east-northeast migratory corridor that bifurcated into two flyways upon reaching the Black Sea, with select birds staging in Kazakhstan prior to reaching Siberian breeding grounds. Birds breeding in Norway, Finland, and Sweden followed the Central European flyway. The final GPS transmission for this phase occurred on 16 August 2025 (Tag **208623**), marking the end of Phase 4 data collection.

Phase 5 (December 2025)

Following the retrieval of Tag **208633** from Lapsi on 04 June 2025, field operations resumed on 03 December 2025 upon publication of the derogation notice in the Government Gazette. Tagging was restricted to a single site, and field activities concluded immediately following final deployment.

Wintering and Breeding Grounds Summary (2022 – 2025)

Between 2022 and 2025, satellite tags were deployed on 33 Golden Plovers. Data were successfully transmitted through to the breeding season for 17 individuals (52%).

Table 9 details all logged wintering and breeding ground GPS coordinates across all study phases.

Table 9. A summary of wintering and breeding grounds for satellite-tagged Golden Plovers.

Tag number	Wintering grounds	Wintering period (first –last fixes) (dd/mm/yyyy)	Breeding grounds	Breeding period (first –last fixes) (dd/mm/yyyy)	Number of GPS fixes	Breeding period fix frequency (days) *
208581	Tunisia	04/01/2023 – 13/03/2023	Falkvålen, Sweden	14/05/2023 – 27/07/2023	18	2
208591	Tunisia	10/02/2023 – 10/03/2023	Sorsele Municipality, Sweden	12/05/2023 – 26/07/2023	19	2
208617	N/A	N/A	Northern Lapland, Finland	16/05/2023 – 29/07/2023	19	2
208612	N/A	N/A	Evenkiysky District, (Central Siberia), Russia	12/06/2023 – 11/08/2023	5	12
208614	Tunisia	23/11/2023 – 07/02/2024	Abisko Östra, Sweden	16/05/2024 – 30/07/2024	4	25
208618	Tunisia	30/11/2023 – 12/03/2024	Sjøvegan, Norway	20/06/2024 – 09/08/2024	3	25
208619	Tunisia	21/12/2023 – 04/03/2024	Inari, Finland	11/06/2024 – 31/07/2024	3	25
208629	Tunisia	13/02/2024 (19/01/2024?) – 09/03/2024	Kvaløya, Norway	23/05/2024 – 06/08/2024	4	25
208624	N/A	N/A	Tazovsky District (Western Siberia), Russia	24/07/2024 – 19/08/2024	2	25

208620	Tunisia	– 14/03/2025	Porsanger Municipality, Norway	28/06/2025 – 30/06/2025	3	1
208627	N/A	N/A	Evenkiysky District (Central Siberia), Russia	15/06/2025 – 30/06/2025	4	15, 1
208634	N/A	N/A	Tana Municipality, Norway	28/06/2025 – 30/06/2025	3	1
208622	N/A	N/A	Inari, Finland	15/06/2025 – 30/06/2025	4	15, 1
208623	N/A	N/A	Evenkiysky–Taymyrsky Dolgano-Nenetsky Districts (Central Siberia), Russia	31/05/2025 – 16/08/2025	7	15, 1
209225	N/A	N/A	<i>Inconclusive [Russia]</i>	N/A	N/A	N/A
209226	Tunisia	– 14/03/2025	Taymyrsky Dolgano-Nenetsky District (Central Siberia), Russia	15/06/2025 – 30/06/2025	4	15, 1
208625	N/A	N/A	Bychina, Perm Krai, Russia	21/05/2025 –	1	15, 1
208631	Tunisia	– 14/03/2025	Tazovsky District (Western Siberia), Russia	28/06/2025 – 30/06/2025	3	1

* Note: The number in the "Breeding period fix frequency (days)" column represents the frequency of GPS fixes in days (e.g., "2" means a fix was recorded every two days, whereas "15, 1" means a fix every fifteen days followed by a daily fix).

Table 10 lists the key stopover sites used by satellite-tagged golden plovers during their northbound (pre-nuptial) migration.

Table 10. Northbound migration of satellite-tagged Golden Plovers: stopover sites.

Northeast European (West Continental) population	Siberian population
Sicily	Greece
Italy	Turkey
Croatia	Albania
Montenegro	Bulgaria
Serbia	Romania
Slovenia	Ukraine
Hungary	Kazakhstan
Romania	
Czechia	
Poland	
Lithuania	
Latvia	
Estonia	

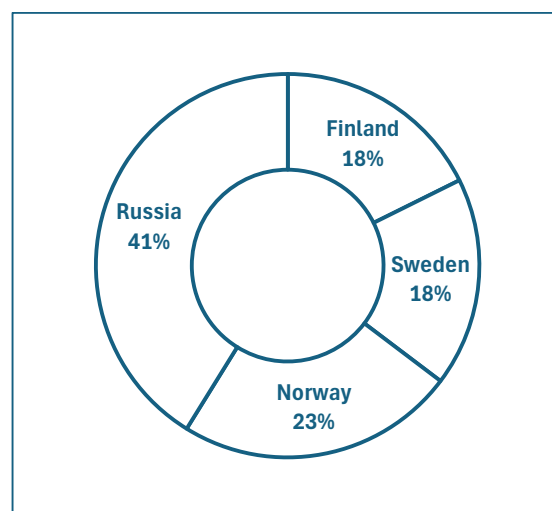


Figure 13. Proportional distribution of satellite-tagged Golden Plovers across their breeding grounds, based on the project's satellite tagging data from 14 May 2023 to 16 Aug 2025 (refer to Table 9).

Based on the project's GPS data from 14 May 2023 to 16 August 2025, 17 satellite-tagged Golden Plovers spent the breeding season in four countries: Finland ($n = 3$), Sweden ($n = 3$), Norway ($n = 4$), and Russia ($n = 7$), as shown in Table 9 and illustrated in Figure 13.

According to the study's data, 35.3% of the satellite-tagged Golden Plovers bred within the territory of the European Union.

7. Timing of Tagging and Associated Hunting Risks

The tagging period coincided with the autumn hunting and live-capturing seasons for both target species. However, limiting tagging operations exclusively to prohibited hours offered no clear practical benefit. Data from the initial study phases demonstrated that all tagged Golden Plovers delayed their onward migration by an average of 4 days (range: 1 to 11 days), remaining within the tagging area during permitted hunting hours. Conversely, Song Thrushes presented minimal exposure risk, as all tagged individuals overwintered within bird sanctuaries (where hunting and live-capturing are prohibited) and initiated pre-nuptial migration during the closed season (end-March to early April).

Under the conditions of the special live-capturing licence, licensees are legally required to immediately release any bird fitted with a scientific ring or satellite transmitter. In flight, a satellite-tagged Golden Plover is visually indistinguishable from an untagged individual, giving tagged birds an equal exposure risk to harvesting pressure regardless of release timing. Identification of a satellite tag is only feasible when a bird is resting or foraging, subject to observation distance and angle (Figures 14–17).



Figure 14. Golden Plover with Tag 208581. The satellite tag is barely visible from this distance (60 metres) and angle. The photo was taken in Biržebbuğa on 01 January 2023, two days post-tagging, just before the specimen migrated to Tunisia.



Figure 15. A magnified view of Figure 14, confirming the presence of the tag (circled).



Figure 16. Dorsal view of Golden Plover with Tag 208624. The satellite tag is clearly visible from this distance (20 metres) and angle. The photo was taken in Biržebbuğa on 14 March 2024, approximately three hours post-tagging and eight days before the specimen migrated to Russia.



Figure 17. Ventral view of Golden Plover with Tag 208624. From this angle, it is difficult to confirm the presence of the satellite tag.

8. Data Monitoring and Reporting

The location of each satellite-tagged specimen was monitored throughout the lifespan of the tags via the Movebank online data repository¹⁴. The main findings of this study were included in the report on the conservation status of the Golden Plover and Song Thrush and presented to the Malta Ornis Committee.

9. Conclusion

The primary goal of this research was to address the European Commission's 2019 request to enhance the knowledge base on Malta's Golden Plover and Song Thrush reference populations through satellite tracking. Out of 30 Song Thrush tags procured for this species, 21 were deployed and nine were decommissioned due to battery failure. The project yielded comprehensive data on the wintering grounds, confirming that all tagged Song Thrushes overwintered in the same area where they were captured before departing Malta between late March and early April.

Conclusive breeding ground data were obtained from seven Song Thrushes, each providing multiple GPS fixes from their breeding territory. They spent the breeding season (April – June) in Romania ($n = 2$), Bulgaria ($n = 2$), Slovakia ($n = 1$), Hungary ($n = 1$), and Ukraine ($n = 1$). Data from five other specimens were inconclusive, as only one GPS fix was received from continental Europe after they left Malta. The data confirm that Song Thrushes follow a distinct south-west to north-east pre-nuptial migration route, aligning with previous observations by Spina and Volponi (2008). The study demonstrated that 85.7% of the satellite-tagged Song Thrushes spent the breeding season within the territory of the European Union.

The Golden Plover tracking data provided valuable insights into both wintering and breeding grounds. All GPS data from the wintering period showed that the specimens wintered in Tunisia. Data from 17 satellite-tagged specimens revealed breeding locations in four countries: Sweden ($n = 3$), Finland ($n = 3$), Norway ($n = 4$), and Russia ($n = 7$). The study confirmed that Golden Plovers satellite-tagged in Malta belong to the Swedish, Finnish, Norwegian, and Russian populations of *Pluvialis apricaria altifrons*. Novel data on the Siberian population in Russia were also recorded. The study demonstrated that 35.3% of the satellite-tagged Golden Plovers spent the breeding season within the territory of the European Union.

The project has also documented the post-deployment movement of Golden Plovers in Malta, confirming that most specimens delay their onward migration by an average of four days (and up to 12 days). During this time, they remain near the research site before continuing their migration.

The last Golden Plover tag (**208633**) was deployed on 31 December 2025. Despite the solar-recharging capability of these tags, frequent GPS fixes and extended recharging periods between phases have been shown to deplete and damage batteries. To optimise battery life and maximize data collection during the breeding season, the schedule programmed during Phase 4 was maintained for the final study period (Phase 5); therefore, the first fix was scheduled to commence on 14 March 2026. Despite the optimised schedule, the last tag failed to transmit any data.

¹⁴ The data used in this report were accessed from the project's data repository in Movebank (movebank.org, study name "Migration of Golden Plovers and Song Thrushes", study ID 1995912295), available at: https://www.movebank.org/cms/webapp?gwt_fragment=page%3Dstudies%2Cpath%3Dstudy1995912295. Last accessed: 29 August 2025.

Appendix A: Satellite Tagging Effort Activity Logs (Feb 2022 – Dec 2025)

This appendix contains the daily activity log for the Golden Plover satellite-tagging component. All recorded data—comprising Golden Plover sightings from February 2022 to December 2025 and other avian species observed during migration periods between February 2022 and March 2024—were conducted exclusively from a single study site in Birżebbuġa, Malta.

Activity log (satellite tagging effort) during period Feb – Mar 2022 (Phase 1)

Date (dd/mm/yyyy)	Hours	Birds observed <i>Note: Data is limited to birds on passage and wintering.</i>	Golden Plovers Caught/Weighed	Tagged
05/02/2022	3	Song Thrush at 11am White Wagtail Robin	0	0
06/02/2022	4.5	White Wagtail Robin	0	0
08/02/2022	2	White Wagtail Robin	0	0
10/02/2022	8.5	White Wagtail Robin	0	0
12/02/2022	6	White Wagtail Robin	0	0
13/02/2022	4	White Wagtail Robin	0	0
15/02/2022	1	White Wagtail Robin	0	0
17/02/2022	1.5	White Wagtail Robin	0	0
19/02/2022	4	White Wagtail Robin	0	0
26/02/2022	4.5	White Wagtail Robin	0	0
28/02/2022	10.5	White Wagtail Robin	0	0
01/03/2022	6	White Wagtail Robin	0	0
02/03/2022	5.5	White Wagtail Robin	0	0
03/03/2022	6	White Wagtail Robin	0	0
04/03/2022	4	White Wagtail Robin	0	0
05/03/2022	8.5	White Wagtail Robin	0	0
06/03/2022	4.5	White Wagtail Robin	0	0
07/03/2022	10	White Wagtail Robin	0	0
08/03/2022	1	White Wagtail Robin	0	0
10/03/2022	2.5	White Wagtail Robin	0	0
12/03/2022	7	White Wagtail Robin	0	0
13/03/2022	5	Golden Plover at 7:30am (heard) White Wagtail Robin	0	0
14/03/2022	2	White Wagtail Robin	0	0
17/03/2022	2.5	White Wagtail Robin	0	0
18/03/2022	2.5	White Wagtail Robin	0	0
19/03/2022	4	House Martin (x6) White Wagtail Robin	0	0
20/03/2022	9	Hoopoe Ruff (x4) Nightingale Yellow Wagtail (x4) Northern Wheatear (♂ ♀) White Wagtail Robin	0	0
21/03/2022	3.5	Barn Swallow (x2) White Wagtail Robin	0	0
22/03/2022	2.5	White Wagtail Robin	0	0
24/03/2022	2.5	Song Thrush at 17:24 Woodlark White Wagtail Robin	0	0

Activity log (satellite tagging effort) during period Feb – Mar 2022 (Phase 1)

Date (dd/mm/yyyy)	Hours	Birds observed <i>Note: Data is limited to birds on passage and wintering.</i>	Golden Plovers Caught/Weighed	Tagged
25/03/2022	2.5	Wood Sandpiper (heard) White Wagtail Robin	0	0
26/03/2022	9	Quail Subalpine Warbler (♂ ♀) White Wagtail Robin	0	0
27/03/2022	2	Yellow Wagtail (<i>Motacilla flava feldegg</i>) (x5) Tawny Pipit White Wagtail Robin	0	0
28/03/2022	9	Golden Plover at 07:45 Greater Short-toed Lark (x3) Corn Bunting Hoopoe White Wagtail Robin	0	0
29/03/2022	8.5	Tree Pipit (x3) Tawny Pipit Northern Wheatear (3 ♂ 2 ♀), Song Thrush (x4), Tree Pipit Robin	0	0
30/03/2022	11.5	Common Kestrel ♂ Common Swift (x5) Northern Wheatear (♂ ♀) Tree Pipit (x2) Subalpine Warbler (♂ ♀) Greater Short-toed Lark (x3) Robin Zitting Cisticola and Sardinian Warbler observed feeding pulli	0	0
31/03/2022	11	Greater Short-toed Lark (x4) Tree Pipit Song Thrush at 08:39 (x2) Hoopoe Quail (x2) Subalpine Warbler (♂ ♀) Song Thrush at 10:00 Yellow Wagtail (mixed flock <i>M. f. flava</i> and <i>feldegg</i>) (x20) Leucistic Spanish Sparrow ♀ Chiffchaff Red-rumped Swallow	0	0
Total hours (Feb – Mar 2022)		191.5		

Activity log (satellite tagging effort) during period Nov 2022 – Mar 2023 (Phase 2)

Date (dd/mm/yyyy)	Hours	Birds observed <i>Note: Data is limited to birds on passage and wintering.</i>	Golden Plovers Caught/Weighed	Tagged
<i>Shaded rows denote Golden Plover observations recorded prior to publication of Government Notice 1618/2022 and issuance of the satellite-tagging licence.</i>				
04/11/2022	2		0	0
08/11/2022	6		0	0
12/11/2022	1		0	0
14/11/2022	2		0	0
16/11/2022	1		0	0
19/11/2022	1		0	0
21/11/2022	4		0	0
25/11/2022	2 (1, 1)		0	0
26/11/2022	7 (1, 2, 2, 2)		0	0
27/11/2022	2 (1, 1)		0	0
28/11/2022	1		0	0
A total of 29 Golden Plovers were sighted during period 04/11/2022 – 28/11/2022.				
29/11/2022	5.5	White Wagtail Robin Meadow Pipit	0	0
30/11/2022	10	White Wagtail Robin Meadow Pipit	0	0
01/12/2022	9	White Wagtail Robin Meadow Pipit	0	0
02/12/2022	6.5	White Wagtail Robin Meadow Pipit Golden Plover	0	0
03/12/2022	17	White Wagtail Robin Meadow Pipit Golden Plover	0	0

Activity log (satellite tagging effort) during period Nov 2022 – Mar 2023 (Phase 2)

Date (dd/mm/yyyy)	Hours	Birds observed <i>Note: Data is limited to birds on passage and wintering.</i>	Golden Plovers Caught/Weighed	Tagged
04/12/2022	9	White Wagtail Robin Meadow Pipit	0	0
05/12/2022	11	White Wagtail Robin Meadow Pipit	0	0
06/12/2022	3.25	White Wagtail Robin Meadow Pipit	0	0
07/12/2022	13	White Wagtail Robin Meadow Pipit 2 Golden Plovers (1, 1)	0	0
08/12/2022	13	White Wagtail Robin Meadow Pipit	0	0
09/12/2022	11	White Wagtail Robin Meadow Pipit	0	0
10/12/2022	9.5	White Wagtail Robin Meadow Pipit	0	0
11/12/2022	11.5	White Wagtail Robin Meadow Pipit	0	0
12/12/2022	5	White Wagtail Robin Meadow Pipit	0	0
13/12/2022	7.25	White Wagtail Robin Meadow Pipit	0	0
14/12/2022	11	White Wagtail Robin Meadow Pipit	0	0
15/12/2022	6.5	White Wagtail Robin Meadow Pipit	0	0
16/12/2022	10.5	White Wagtail Robin Golden Plover	1	1
17/12/2022	18	White Wagtail Robin Meadow Pipit	0	0
18/12/2022	20	White Wagtail Robin Meadow Pipit	0	0
19/12/2022	14.5	White Wagtail Robin Meadow Pipit	0	0
20/12/2022	10	White Wagtail Robin Meadow Pipit	0	0
21/12/2022	12.25	8 Golden Plovers (7, 1) White Wagtail Robin Meadow Pipit	0	0
22/12/2022	17.25	White Wagtail Robin Meadow Pipit	0	0
23/12/2022	11	White Wagtail Robin Meadow Pipit	0	0
24/12/2022	10.75	White Wagtail Robin Meadow Pipit	0	0
25/12/2022	11.25	White Wagtail Robin Meadow Pipit	0	0
26/12/2022	10	White Wagtail Robin Meadow Pipit	0	0
27/12/2022	14	White Wagtail Robin Meadow Pipit	0	0
28/12/2022	6	White Wagtail Robin Meadow Pipit	0	0
29/12/2022	10.25	White Wagtail Robin Meadow Pipit	0	0
30/12/2022	13	White Wagtail Robin Meadow Pipit 2 Golden Plovers	2	1
31/12/2022	6	White Wagtail Robin Meadow Pipit	0	0
01/01/2023	5	White Wagtail Robin Meadow Pipit	0	0
02/01/2023	14.5	White Wagtail Robin Meadow Pipit	0	0
03/01/2023	11.25	White Wagtail Robin Meadow Pipit	0	0
04/01/2023	10.25	White Wagtail Robin Meadow Pipit Golden Plover	1	1
05/01/2023	7.5	White Wagtail Robin Meadow Pipit	0	0
06/01/2023	11	White Wagtail Robin Meadow Pipit	0	0
07/01/2023	13.5	White Wagtail Robin Meadow Pipit	0	0
08/01/2023	8.75	White Wagtail Robin Meadow Pipit	0	0
09/01/2023	8.5	White Wagtail Robin Meadow Pipit	0	0
10/01/2023	6.5	White Wagtail Robin Meadow Pipit	0	0
11/01/2023	2	White Wagtail Robin Meadow Pipit	0	0
12/01/2023	2.25	White Wagtail Robin Meadow Pipit	0	0
13/01/2023	2.75	White Wagtail Robin Meadow Pipit	0	0
14/01/2023	7.5	White Wagtail Robin Meadow Pipit	0	0

Activity log (satellite tagging effort) during period Nov 2022 – Mar 2023 (Phase 2)

Date (dd/mm/yyyy)	Hours	Birds observed <i>Note: Data is limited to birds on passage and wintering.</i>	Golden Plovers Caught/Weighed	Tagged
15/01/2023	7.5	White Wagtail Robin Meadow Pipit	0	0
18/01/2023	1.25	White Wagtail Robin Meadow Pipit	0	0
19/01/2023	3	White Wagtail Robin Meadow Pipit	0	0
21/01/2023	1	White Wagtail Robin Meadow Pipit	0	0
23/01/2023	1.5	White Wagtail Robin Meadow Pipit	0	0
24/01/2023	3	White Wagtail Robin Meadow Pipit	0	0
25/01/2023	2.5	White Wagtail Robin Meadow Pipit	0	0
26/01/2023	2	White Wagtail Robin Meadow Pipit	0	0
27/01/2023	1.25	White Wagtail Robin Meadow Pipit	0	0
28/01/2023	1	White Wagtail Robin Meadow Pipit	0	0
30/01/2023	1.5	White Wagtail Robin Meadow Pipit	0	0
31/01/2023	4	White Wagtail Robin Meadow Pipit 3 Serins	0	0
01/02/2023	4	White Wagtail Robin Meadow Pipit	0	0
03/02/2023	1.5	White Wagtail Robin Meadow Pipit	0	0
04/02/2023	5.75	White Wagtail Robin Meadow Pipit	0	0
05/02/2023	5.5	White Wagtail Robin Meadow Pipit	0	0
07/02/2023	7	White Wagtail Robin Meadow Pipit Golden Plover	0	0
08/02/2023	5	White Wagtail Robin Meadow Pipit	0	0
11/02/2023	6.5	White Wagtail Robin Meadow Pipit	0	0
12/02/2023	7.5	White Wagtail Robin Meadow Pipit	0	0
14/02/2023	2	White Wagtail Robin Meadow Pipit	0	0
18/02/2023	6.5	White Wagtail Robin Meadow Pipit	0	0
19/02/2023	7.5	White Wagtail Robin Meadow Pipit Barn Swallow Blackcap ♀	0	0
22/02/2023	2.5	White Wagtail Robin Meadow Pipit	0	0
23/02/2023	1.75	White Wagtail Robin Meadow Pipit	0	0
24/02/2023	6.5	Quail (calling ♂) White Wagtail Robin Meadow Pipit Golden Plover	0	0
25/02/2023	9.75	White Wagtail Robin Meadow Pipit Golden Plover	0	0
26/02/2023	16.25	White Wagtail Robin Meadow Pipit Collared Dove Blackcap ♀ Golden Plover Blackcap ♂ House Martin	1	1
27/02/2023	7.5	White Wagtail Robin Quail (calling ♂) Meadow Pipit	0	0
28/02/2023	12	White Wagtail Robin Quail (calling ♂) Meadow Pipit	0	0
01/03/2023	12	White Wagtail Robin Meadow Pipit	0	0
02/03/2023	9.25	White Wagtail Robin Meadow Pipit	0	0
03/03/2023	13.75	Chiffchaff White Wagtail Robin Meadow Pipit Quail (calling ♂) Stonechat ♀	0	0
04/03/2023	11	White Wagtail Robin Black Redstart Meadow Pipit	0	0
05/03/2023	7	White Wagtail Robin 2 Swallows Short-toed Lark Meadow Pipit House Martin	0	0
06/03/2023	10.75	Tree Sparrow Black Redstart White Wagtail Robin Meadow Pipit	0	0
07/03/2023	5.5	White Wagtail Robin Meadow Pipit 6 Squacco Herons Swallow	0	0

Activity log (satellite tagging effort) during period Nov 2022 – Mar 2023 (Phase 2)

Date (dd/mm/yyyy)	Hours	Birds observed <i>Note:</i> Data is limited to birds on passage and wintering.	Golden Plovers Caught/Weighed	Tagged
08/03/2023	4	White Wagtail Robin Meadow Pipit 2 Greenfinches	0	0
09/03/2023	2	White Wagtail Robin Meadow Pipit	0	0
10/03/2023	1.5	White Wagtail Robin Meadow Pipit	0	0
11/03/2023	4	White Wagtail Robin Meadow Pipit Black Redstart	0	0
12/03/2023	5.75	White Wagtail Robin Meadow Pipit Golden Plover	1	1
13/03/2023	4	White Wagtail Robin Meadow Pipit	0	0
14/03/2023	2	White Wagtail Robin Meadow Pipit	0	0
15/03/2023	2.5	White Wagtail Robin Meadow Pipit	0	0
16/03/2023	6	White Wagtail Robin Chiffchaff Black Redstart	0	0
17/03/2023	4	White Wagtail Robin Spotted Flycatcher Meadow Pipit Chiffchaff	0	0
18/03/2023	10.5	Garden Warbler White Wagtail Robin Meadow Pipit Chiffchaff Black Redstart	0	0
19/03/2023	7	White Wagtail Robin Meadow Pipit Chiffchaff	0	0
20/03/2023	1.75	Robin Chiffchaff	0	0
21/03/2023	9.25	Northern Wheatear ♂ Tree Sparrow Common Whitethroat Quail (calling ♂) 14 Yellow Wagtails (<i>Motacilla flava flava</i> , <i>M. f. feldegg</i> , <i>M. f. superciliaris</i> , <i>M. f. cinereocapilla</i>) Chiffchaff 16 Short-toed Larks Subalpine Warbler ♂ Swift Robin Blackcap ♂	0	0
22/03/2023	4	Swallows Short-toed Lark Nightingale Robin 2 Chiffchaffs Hoopoe Black Redstart 2 Meadow Pipits	0	0
23/03/2023	9.5	Robin Chiffchaff 2 Short-toed Larks 9 Glossy Ibises 2 Yellow Wagtails Swallows House Martins Tree Sparrow Swift 2 Grey Herons Blackcap ♂ Quail (calling ♂) Hoopoe Black Redstart ♂	0	0
24/03/2023	3.5	Robin Chiffchaff Yellow Wagtail Northern Wheatears (2 ♂) Meadow Pipit Black Redstart Hoopoe	0	0
25/03/2023	11	Robin Yellow Wagtail Swallows Northern Wheatear ♀ Song Thrush Black Redstart ♂	0	0
26/03/2023	8	Robin Northern Wheatear ♂ ♀ Yellow Wagtail Pallid Harrier ♂ Swift Subalpine Warbler ♂ Swallows Chiffchaff	0	0
27/03/2023	5.5	Robin Hoopoe Spotted Flycatcher 2 Yellow Wagtails Quail (calling ♂) 4 Swifts Chiffchaff	0	0
28/03/2023	11.5	Robin Bee-eaters Blackcap ♂ Swallows Quail (calling ♂) Swifts Chiffchaff Meadow Pipit	0	0
29/03/2023	3.5	Yellow Wagtail Common Whitethroat	0	0
30/03/2023	12	Collared Dove Quail (calling ♂) Sardinian Warblers (♂ ♀ feeding pulli) Blackcap ♀ Northern Wheatear ♂	0	0
31/03/2023	12	Blackcap ♀ Quail (calling ♂) Blackcap ♂ Northern Wheatear ♀ 37 White Storks @ 12:41pm Greater Short-toed Lark Tree Sparrow Chiffchaff Marsh Harrier ♂ Swallows Swifts Robin	0	0
Total hours (Nov 2022 – Mar 2023)		823.5		

Activity log (satellite tagging effort) during period Oct 2023 – Mar 2024 (Phase 3)

Date (dd/mm/yyyy)	Hours	Birds observed <i>Note:</i> Data is limited to birds on passage and wintering.	Golden Plovers Caught/Weighed	Tagged
20/10/2023	9.5	White Wagtail	0	0
21/10/2023	6	White Wagtail	0	0
22/10/2023	8.5	Golden Plover Chiffchaff White Wagtail Robin	0	0
23/10/2023	8.5	Chiffchaff White Wagtail Robin	0	0
24/10/2023	8.5	Chiffchaff White Wagtail Robin	0	0
25/10/2023	10.75	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
26/10/2023	8.5	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
27/10/2023	8.5	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
28/10/2023	8.75	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
29/10/2023	10.5	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
30/10/2023	11.5	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
31/10/2023	11.5	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
01/11/2023	12.5	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
02/11/2023	13	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
03/11/2023	12	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
04/11/2023	12.5	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
05/11/2023	9	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
06/11/2023	12	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
07/11/2023	11	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
08/11/2023	11	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
09/11/2023	13.5	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
10/11/2023	13.25	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
11/11/2023	11.5	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
12/11/2023	13.5	Golden Plover Chiffchaff White Wagtail Robin Meadow Pipit	0	0
13/11/2023	10.5	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
14/11/2023	14	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
15/11/2023	13.5	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
16/11/2023	13.25	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
17/11/2023	11	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
18/11/2023	13.5	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
19/11/2023	13.5	45 Golden Plovers (9, 18, 6, 2, 5, 5) Chiffchaff White Wagtail Robin Meadow Pipit	0	0
20/11/2023	13.5	9 Golden Plovers (1, 2, 3, 2, 1) Chiffchaff White Wagtail Robin Meadow Pipit	2	1

Activity log (satellite tagging effort) during period Oct 2023 – Mar 2024 (Phase 3)

Date (dd/mm/yyyy)	Hours	Birds observed <i>Note:</i> Data is limited to birds on passage and wintering.	Golden Plovers Caught/Weighed	Tagged
21/11/2023	13.5	2 Golden Plovers (1, 1) Chiffchaff White Wagtail Robin Meadow Pipit	2	2
22/11/2023	10.5	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
23/11/2023	15.25	2 Golden Plovers Chiffchaff White Wagtail Robin Meadow Pipit	0	0
24/11/2023	12	10 Golden Plovers Chiffchaff White Wagtail Robin Meadow Pipit	0	0
25/11/2023	5	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
26/11/2023	12.5	9 Golden Plovers (1, 1, 7) Chiffchaff White Wagtail Robin Meadow Pipit	1	1
27/11/2023	10	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
28/11/2023	7.5	2 Golden Plovers (1, 1) Chiffchaff White Wagtail Robin Meadow Pipit	0	0
29/11/2023	8.25	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
30/11/2023	13	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
01/12/2023	13	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
02/12/2023	12.5	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
03/12/2023	13	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
04/12/2023	12.25	Golden Plover Chiffchaff White Wagtail Robin Meadow Pipit	1	0 (132 g)
05/12/2023	12	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
06/12/2023	8.5	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
07/12/2023	8	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
08/12/2023	12	Golden Plover Chiffchaff White Wagtail Robin Meadow Pipit	1	1
09/12/2023	14	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
10/12/2023	12	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
11/12/2023	13.5	Golden Plover Chiffchaff White Wagtail Robin Meadow Pipit	0	0
12/12/2023	11.5	Golden Plover Chiffchaff White Wagtail Robin Meadow Pipit	0	0
13/12/2023	12	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
14/12/2023	11	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
15/12/2023	11.5	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
16/12/2023	12	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
17/12/2023	6	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
18/12/2023	1.5	Chiffchaff Stonechat White Wagtail Robin Meadow Pipit	0	0
19/12/2023	6.25	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
20/12/2023	10	3 Golden Plovers (1, 1, 1) White Wagtail Robin Meadow Pipit	0	0
21/12/2023	6.75	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
22/12/2023	6	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
23/12/2023	9.5	Chiffchaff White Wagtail Robin Meadow Pipit	0	0

Activity log (satellite tagging effort) during period Oct 2023 – Mar 2024 (Phase 3)

Date (dd/mm/yyyy)	Hours	Birds observed <i>Note:</i> Data is limited to birds on passage and wintering.	Golden Plovers Caught/Weighed	Tagged
24/12/2023	4.5	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
26/12/2023	16	2 Golden Plovers (1, 1) Chiffchaff White Wagtail Robin Meadow Pipit	0	0
27/12/2023	11	White Wagtail Robin Meadow Pipit	0	0
28/12/2023	11.75	White Wagtail Robin Meadow Pipit	0	0
29/12/2023	11.5	Golden Plover White Wagtail Robin Meadow Pipit	0	0
30/12/2023	11	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
31/12/2023	9	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
01/01/2024	7.25	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
02/01/2024	8.75	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
03/01/2024	4.25	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
04/01/2024	3.25	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
05/01/2024	7.75	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
06/01/2024	9	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
07/01/2024	10.25	Chiffchaff White Wagtail Robin Meadow Pipit	0	0
09/01/2024	9.75	Golden Plover Chiffchaff White Wagtail Robin Meadow Pipit	0	0
10/01/2024	8	7 Golden Plovers (4, 3) White Wagtail Robin Meadow Pipit	0	0
11/01/2024	13.5	11 Golden Plovers (1, 1, 1, 2, 4, 1, 1) Chiffchaff White Wagtail Robin Meadow Pipit	1	1
12/01/2024	18	11 Golden Plovers (1, 6, 1, 1, 1, 1) Chiffchaff White Wagtail Robin Meadow Pipit Stonechat Common Kestrel	2	2
13/01/2024	18.5	6 Golden Plovers (1, 1, 3, 1) Chiffchaff White Wagtail Robin Meadow Pipit	1	1
14/01/2024	6.75	Chiffchaff Robin Black Redstart Stonechat White Wagtail Meadow Pipit	0	0
27/01/2024	7	Chiffchaff Robin Black Redstart Stonechat White Wagtail Meadow Pipit	0	0
01/02/2024	1.75	Chiffchaff Robin Black Redstart Stonechat White Wagtail Meadow Pipit	0	0
02/02/2024	2.5	Chiffchaff Robin Black Redstart Stonechat White Wagtail Meadow Pipit	0	0
03/02/2024	4	Chiffchaff Robin Black Redstart Stonechat White Wagtail Meadow Pipit	0	0
04/02/2024	7.75	Chiffchaff Robin Black Redstart Stonechat White Wagtail Meadow Pipit	0	0
05/02/2024	1	Chiffchaff Stonechat White Wagtail Meadow Pipit	0	0
06/02/2024	3	Chiffchaff White Wagtail Meadow Pipit	0	0
07/02/2024	2.5	Chiffchaff Stonechat White Wagtail Meadow Pipit	0	0
08/02/2024	2	Chiffchaff Stonechat White Wagtail Meadow Pipit	0	0
09/02/2024	4	White Wagtail Meadow Pipit	0	0
10/02/2024	8.25	Chiffchaff Stonechat White Wagtail Meadow Pipit	0	0
11/02/2024	4.75	Black Redstart Stonechat White Wagtail Meadow Pipit Common Linnet	0	0
13/02/2024	3	Chiffchaff White Wagtail Meadow Pipit	0	0
15/02/2024	2.25	Chiffchaff White Wagtail Robin Meadow Pipit	0	0

Activity log (satellite tagging effort) during period Oct 2023 – Mar 2024 (Phase 3)

Date (dd/mm/yyyy)	Hours	Birds observed <i>Note:</i> Data is limited to birds on passage and wintering.	Golden Plovers Caught/Weighed	Tagged
16/02/2024	3.5	Chiffchaff White Wagtail Meadow Pipit	0	0
17/02/2024	7	Golden Plover Chiffchaff Eurasian Blackcap Common Starling Robin Black Redstart Stonechat Meadow Pipit Garden Warbler	0	0
18/02/2024	8.5	Chiffchaff Robin Stonechat White Wagtail Meadow Pipit	0	0
20/02/2024	3	White Wagtail Robin Meadow Pipit	0	0
21/02/2024	7	Chiffchaff Common Starling Black Redstart Stonechat White Wagtail Meadow Pipit	0	0
22/02/2024	10.25	Chiffchaff Eurasian Blackcap Black Redstart Stonechat White Wagtail Meadow Pipit Common Linnet	0	0
23/02/2024	8.5	Chiffchaff Common Starling Black Redstart Stonechat White Wagtail Meadow Pipit	0	0
24/02/2024	7.75	Chiffchaff Robin Stonechat Tree Sparrow White Wagtail Meadow Pipit	0	0
25/02/2024	9	3 Golden Plovers (2, 1) Common Swift Barn Swallow Chiffchaff Subalpine Warbler Robin Tree Sparrow Meadow Pipit	0	0
26/02/2024	8.5	Robin Stonechat White Wagtail Meadow Pipit	0	0
27/02/2024	6.25	Chiffchaff Stonechat Meadow Pipit	0	0
28/02/2024	11.5	House Martin Chiffchaff Common Starling Robin Black Redstart Stonechat White Wagtail Meadow Pipit Spectacled Warbler	0	0
29/02/2024	8.5	Chiffchaff Black Redstart Stonechat Tree Sparrow Meadow Pipit	0	0
01/03/2024	5	Barn Swallow Common Greenshank	0	0
02/03/2024	7.75	Chiffchaff Robin Black Redstart Stonechat Meadow Pipit	0	0
03/03/2024	8	Great Cormorant Barn Swallow Robin Black Redstart Stonechat White Wagtail Meadow Pipit Song Thrush Common Linnet	0	0
04/03/2024	2.5	White Wagtail Meadow Pipit	0	0
05/03/2024	2.5	White Wagtail Robin Meadow Pipit	0	0
06/03/2024	4.5	White Wagtail Robin	0	0
07/03/2024	2	White Wagtail Robin Meadow Pipit	0	0
09/03/2024	2	White Wagtail Robin Meadow Pipit	0	0
10/03/2024	5.5	Barn Swallow White Wagtail Meadow Pipit	0	0
12/03/2024	2	Robin Meadow Pipit	0	0
13/03/2024	3.5	Robin Meadow Pipit	0	0
14/03/2024	8.5	Golden Plover Western Marsh Harrier Barn Swallow Chiffchaff Eurasian Blackcap Robin Black Redstart White Wagtail Meadow Pipit Subalpine Warbler Spectacled Warbler	1	1
15/03/2024	4	White Wagtail Meadow Pipit Black-crowned Night Heron	0	0
16/03/2024	5.5	Barn Swallow Chiffchaff White Wagtail Meadow Pipit	0	0
17/03/2024	7.5	Barn Swallow Chiffchaff Eurasian Blackcap Black Redstart Northern Wheatear White Wagtail Common Starling Stonechat	0	0

Activity log (satellite tagging effort) during period Oct 2023 – Mar 2024 (Phase 3)

Date (dd/mm/yyyy)	Hours	Birds observed <i>Note:</i> Data is limited to birds on passage and wintering.	Golden Plovers Caught/Weighed	Tagged
18/03/2024	1.75	Meadow Pipit Common Starling	0	0
19/03/2024	11.25	Northern Wheatear Meadow Pipit Black-crowned Night Heron Common Starling	0	0
20/03/2024	3	Barn Swallow Chiffchaff Black Redstart Stonechat	0	0
21/03/2024	10.5	Sedge Warbler Barn Swallow House Martin Northern Wheatear Meadow Pipit	0	0
22/03/2024	12	Collared Dove Hoopoe Barn Swallow Chiffchaff Subalpine Warbler Yellow Wagtail (<i>Motacilla flava superciliaris</i>) Meadow Pipit Black Redstart Stonechat Northern Pintail	0	0
23/03/2024	9	Collared Dove Hoopoe Barn Swallow Chiffchaff Meadow Pipit Tree Pipit Common Quail (calling ♂)	0	0
24/03/2024	10	Barn Swallow Chiffchaff Subalpine Warbler Robin Northern Wheatear Yellow Wagtail (<i>Motacilla flava superciliaris</i>) Meadow Pipit	0	0
25/03/2024	8.5	Common Swift Barn Swallow Chiffchaff Subalpine Warbler Robin Tree Sparrow Meadow Pipit	0	0
26/03/2024	10.5	Common Swift Barn Swallow Robin Yellow Wagtail (<i>Motacilla flava superciliaris</i>) Meadow Pipit Tree Pipit Tawny Pipit Whimbrel	0	0
27/03/2024	10	Collared Dove Common Swift Western Marsh Harrier Common Kestrel Barn Swallow House Martin Willow Warbler Chiffchaff Robin Northern Wheatear Tree Sparrow Yellow Wagtail (<i>Motacilla flava superciliaris</i>) Meadow Pipit Tree Pipit Slender-billed Gull Black Kite Tawny Pipit Linnet	0	0
28/03/2024	7	Common Swift Barn Swallow House Martin Chiffchaff Robin Northern Wheatear Meadow Pipit Tawny Pipit	0	0
29/03/2024	10.5	Yellow Wagtail (<i>Motacilla flava superciliaris</i>) Tree Sparrow	0	0
30/03/2024	3.25	Yellow Wagtail (<i>Motacilla flava superciliaris</i>)	0	0
Total hours (Oct 2023 – Mar 2024)		1,231.5		

Activity log (satellite tagging effort) during period Oct 2024 – Feb 2025 (Phase 4)

Date (dd/mm/yyyy)	Hours	Golden Plovers observed <i>Note:</i> Numbers in parentheses indicate total observations per sighting if daily count exceeds one.	Golden Plovers Caught/Weighed	Tagged
20/10/2024	14	0	0	0
21/10/2024	10.75	0	0	0
22/10/2024	10.5	0	0	0
23/10/2024	11.25	0	0	0
24/10/2024	12.5	0	0	0
25/10/2024	13	0	0	0
26/10/2024	12	0	0	0
27/10/2024	8.5	0	0	0
28/10/2024	10	0	0	0
29/10/2024	13	0	0	0
30/10/2024	9.5	0	0	0

Activity log (satellite tagging effort) during period Oct 2024 – Feb 2025 (Phase 4)

Date (dd/mm/yyyy)	Hours	Golden Plovers observed <i>Note:</i> Numbers in parentheses indicate total observations per sighting if daily count exceeds one.	Golden Plovers Caught/Weighed	Tagged
31/10/2024	12.75	0	0	0
01/11/2024	11.25	0	0	0
02/11/2024	10	0	0	0
03/11/2024	9	0	0	0
04/11/2024	12.25	0	0	0
05/11/2024	11.25	1	0	0
06/11/2024	14.25	1	1	1
07/11/2024	12	0	0	0
08/11/2024	9	0	0	0
09/11/2024	11.25	0	0	0
10/11/2024	10	0	0	0
11/11/2024	11.25	0	0	0
12/11/2024	11.5	0	0	0
13/11/2024	11.5	0	0	0
14/11/2024	12	2 (1, 1)	1	1
15/11/2024	11.25	0	0	0
16/11/2024	12	0	0	0
17/11/2024	11	0	0	0
18/11/2024	12.25	0	0	0
19/11/2024	10.5	0	0	0
20/11/2024	11	1	0	0
21/11/2024	10.5	0	0	0
22/11/2024	5.5	0	0	0
23/11/2024	11	0	0	0
24/11/2024	12.25	2 (1, 1)	1	1
25/11/2024	9	6 (4, 1, 1)	0	0
26/11/2024	11	2 (2)	1	1
27/11/2024	13.5	1	0	0
28/11/2024	12.5	0	0	0
29/11/2024	12.5	0	0	0
30/11/2024	8.75	0	0	0
01/12/2024	11.5	1	1	1
02/12/2024	9	0	0	0
03/12/2024	7	0	0	0
04/12/2024	11	2 (2)	0	0
05/12/2024	10	0	0	0
06/12/2024	10.75	4 (1, 3)	1	1
07/12/2024	6	1	0	0
08/12/2024	4.5	0	0	0
09/12/2024	7.5	0	0	0
10/12/2024	12	1	1	1
11/12/2024	11.5	0	0	0
12/12/2024	9.75	4 (1, 1, 2)	1	1

Activity log (satellite tagging effort) during period Oct 2024 – Feb 2025 (Phase 4)

Date (dd/mm/yyyy)	Hours	Golden Plovers observed <i>Note:</i> Numbers in parentheses indicate total observations per sighting if daily count exceeds one.	Golden Plovers Caught/Weighed	Tagged
13/12/2024	12.25	1	1	1
14/12/2024	11.5	1	1	1
15/12/2024	13	0	0	0
16/12/2024	5.25	0	0	0
17/12/2024	6.5	0	0	0
18/12/2024	10.5	2 (2)	2	2
19/12/2024	5.5	0	0	0
20/12/2024	9.5	1	0	0
21/12/2024	10.25	0	0	0
22/12/2024	7.75	0	0	0
23/12/2024	3.25	0	0	0
24/12/2024	11.75	0	0	0
25/12/2024	3.25	0	0	0
26/12/2024	11.25	5 (1, 1, 2, 1)	3	3
27/12/2024	11.75	0	0	0
28/12/2024	4.5	0	0	0
29/12/2024	6.75	0	0	0
30/12/2024	7.5	0	0	0
31/12/2024	10	0	0	0
01/01/2025	3	0	0	0
02/01/2025	9.5	0	0	0
03/01/2025	9.25	0	0	0
04/01/2025	6.75	0	0	0
05/01/2025	2	0	0	0
07/01/2025	5	0	0	0
09/01/2025	9	0	0	0
10/01/2025	5	0	0	0
11/01/2025	4	0	0	0
12/01/2025	6	0	0	0
13/01/2025	8.75	0	0	0
14/01/2025	9	0	0	0
15/01/2025	6.75	0	0	0
16/01/2025	8.75	1	1	1
17/01/2025	8.5	0	0	0
18/01/2025	7.5	1	0	0
19/01/2025	3	0	0	0
20/01/2025	2	0	0	0
21/01/2025	3.25	0	0	0
22/01/2025	2.25	0	0	0
25/01/2025	3.5	0	0	0
30/01/2025	2.5	0	0	0
06/02/2025	1.25	0	0	0
08/02/2025	11	2 (1, 1)	0	0

Activity log (satellite tagging effort) during period Oct 2024 – Feb 2025 (Phase 4)

Date (dd/mm/yyyy)	Hours	Golden Plovers observed <i>Note:</i> Numbers in parentheses indicate total observations per sighting if daily count exceeds one.	Golden Plovers Caught/Weighed	Tagged
10/02/2025	9	2 (2)	1	1
13/02/2025	4.5	0	0	0
25/02/2025	8.5	2 (2) [observed foraging with a satellite-tagged Golden Plover]	0	0
28/02/2025*	2.75	0		
* Although the project formally ended on 28 February 2025 after the remaining tag (Tag 208632) had failed—decommissioned on 01 March 2025—WBRU retrieved Tag 208633 from Lapsi on 04 June 2025. After testing confirmed that the tag remained fully functional, the project was renewed for a fifth and final phase.				
Total hours		903.5		
(Oct 2024 – Feb 2025)				

Activity log (satellite tagging effort) during period Dec 2025 (Phase 5)

Date (dd/mm/yyyy)	Hours	Golden Plovers observed <i>Note:</i> Data is limited to birds on passage and wintering.	Golden Plovers Caught/Weighed	Tagged
<i>Shaded rows denote Golden Plover observations recorded prior to publication of Government Notice 1900/2025 and issuance of the satellite-tagging licence.</i>				
16/11/2025		1	0	0
29/11/2025		3	0	0
A total of four Golden Plovers were sighted during period 01/11/2025 – 02/12/2025.				
03/12/2025	5	0	0	0
04/12/2025	4	0	0	0
05/12/2025	3.5	0	0	0
06/12/2025	7	0	0	0
07/12/2025	5.5	0	0	0
08/12/2025	5.25	1	0	0
09/12/2025	4.5	0	0	0
10/12/2025	4	0	0	0
11/12/2025	10	4 (3, 1)	0	0
12/12/2025	8.5	0	0	0
13/12/2025	7.5	1	0	0
14/12/2025	6.75	1	0	0
15/12/2025	5	0	0	0
16/12/2025	5.5	0	0	0
17/12/2025	4	0	0	0
18/12/2025	7.5	0	0	0
19/12/2025	9.75	0	0	0
20/12/2025	7	0	0	0
21/12/2025	6	0	0	0

Activity log (satellite tagging effort) during period Dec 2025 (Phase 5)

Date (dd/mm/yyyy)	Hours	Golden Plovers observed <i>Note: Data is limited to birds on passage and wintering.</i>	Golden Plovers Caught/Weighed	Tagged
23/12/2025	8.5	0	0	0
24/12/2025	9	0	0	0
26/12/2025	6.75	4 (2, 2)	0	0
27/12/2025	10	1	0	0
28/12/2025	5.5	0	0	0
29/12/2025	9.5	5 (4, 1)	0	0
30/12/2025	11.5	0	0	0
31/12/2025	10	12 (1, 6, 3, 1, 1)	1	1
Total hours (Dec 2025)		187		

Summary of Fieldwork Operations (Feb 2022 – Dec 2025)

- **Total Golden Plovers Observed: 264** (includes 33 pre-permit observations: 29 Golden Plovers recorded during 04/11/2022–28/11/2022 and 4 during 16/11/2025–29/11/2025)
- **Total Golden Plovers Caught: 36**
- **Total Golden Plovers Tagged: 33** (across 30 unique satellite tags; 3 re-used)
- **Total Hours: 3,337** (191.5 + 823.5 + 1,231.5 + 903.5 + 187)