

Ministry for the Environment, Sustainable Development and Climate Change

Report on a survey of the influx of Golden Plover and Song Thrush over the Maltese Islands, made between October and December 2018

Prepared by



12, Sir Arthur Borton Street
Mosta, MST1881
MALTA

Telephone: (+356) 2143 1900

Fax: (+356) 21424 137

e-mail: info@ecoserv.com.mt

www.ecoserv.com.mt

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The present report has been compiled by:

JOSEPH A. BORG

BSc MSc PhD (Plymouth) CBiol MRSB MMBA FIBMS

and

JULIAN EVANS

BSc (Hons) MSc PhD (Plymouth) CBiol MRSB MMBA

Coordinator of study logistics:

SARAH DEBONO

BSc (Hons) MSc MRSB



Report checked by:

Julian Evans BSc (Hons) MSc PhD CBiol
MRSB MMBA



Report approved by:

Joseph A Borg BSc MSc PhD CBiol MRSB
MMBA FIBMS

1. Introduction

1.1 Preamble

The Ministry for the Environment, Sustainable Development and Climate Change (hereafter 'MESDC') issued a call for tenders (reference: MESDC 218/2018) on the 17th August 2018 titled "*Tender for an independent scientific study on the influx or passage of migratory finches, Golden Plover and Song Thrush in Malta during the 2018 Autumn/Winter season*". The Terms of Reference (ToR) specified in the tender document are as follows:

2 Contract Objectives and Expected Results

2.1 Overall Objectives

The overall objective of this contract is to provide an independent study on the influx or passage during the Autumn/Winter 2018 migration period of the following species:

*Common Linnet (Linaria cannabina),
Common Chaffinch (Fringilla coelebs),
European Serin (Serinus serinus),
European Goldfinch (Carduelis carduelis),
European Greenfinch (Chloris chloris),
Hawfinch (Coccothraustes coccothraustes),
Eurasian Siskin (Spinus spinus),
Golden Plover (Pluvialis apricaria), and
Song Thrush (Turdus philomelos).*

2.2 Specific Objectives

The objectives of this contract which are not necessarily those of the project are as follows:

- To survey and scientifically monitor the daily influx of seven species of finches, Golden Plover and Song Thrush; and*
- To estimate the overall presence (influx) of these nine species per day and for the whole study period, subject to scientifically justified assumptions;*
- To correlate migration data gathered through the present survey with bag data for the relevant species, should any live-capturing derogations be applied during the 2018 autumn season.*

2.3 Results to be achieved by the Consultant

- 1. Daily datasheets with raw counts for 7 finch species: (Common Linnet Linaria cannabina, Common Chaffinch Fringilla coelebs, European Serin Serinus serinus, European Goldfinch Carduelis carduelis, European Greenfinch Chloris chloris, Hawfinch Coccothraustes coccothraustes, Eurasian Siskin Spinus spinus, and*
- 2. Daily datasheets with raw counts for Golden Plover (Pluvialis apricaria) and Song Thrush (Turdus philomelos); and*

3. Two (2) monitoring reports for Autumn/Winter 2018: one report comprising the monitoring of the influx of seven species of finches, and a separate report comprising the monitoring of the influx of golden plover and song thrush. Each of these two reports must include:
 - a) List of monitoring stations which recorded high/low counts;
 - b) Dates which showed high/low peaks in the migration of each of the bird species;
 - c) A daily estimate of the influx of each of the bird species for the whole of the Maltese Islands;
 - d) The estimated total influx for these species for the whole of the study period, subject to scientifically justified assumptions;
 - e) Comparison of the influxes recorded in 2018 with the influxes recorded as a result of 2014, 2015, 2016 and 2017 studies (reports of such past studies are available online from: <http://environment.gov.mt/en/Pages/WBRU/livecapturingder.aspx>); and
 - f) A comparative analysis of the results obtained with the bag data extracted from live-capturers' telephonic reports for 2018, (this would only apply in case relevant derogations permitting live-capturing are applied in 2018).

3. Assumptions and Risks

3.1 Assumptions Underlying the Project Intervention

*For the purposes of this bird migration study, it will be assumed that the consultant shall use the daily counts obtained from the monitoring stations to extrapolate the approximate estimate of the total influx of each of the nine bird species: (Common Linnet *Linaria cannabina*, Common Chaffinch *Fringilla coelebs*, European Serin *Serinus serinus*, European Goldfinch *Carduelis carduelis*, European Greenfinch *Chloris chloris*, Hawfinch *Coccothraustes coccothraustes*, Eurasian Siskin *Spinus spinus*, Golden Plover *Pluvialis apricaria* and Song Thrush *Turdus philomelos*) over the Maltese Islands.*

Moreover, it shall also be assumed that the passage of birds at different localities is extremely variable and may be subject to local topographic, anthropogenic, climatic and other conditions which are to be taken into account in the appropriate extrapolation methods that shall be used to estimate the total influx of the species concerned.

3.2 Risks

Execution of the bird migration study is dependent on an adequate enrolment of the ornithologists/ field assistants who shall be manning the monitoring stations (at least 21 in number). It shall be the responsibility of the consultant to ensure that the active monitoring stations are manned by a sufficient number of ornithologists and/or field assistants. The number of active stations on any given day shall be six (6) sites manned by at least two ornithologists and/or field assistants each site has to be surveyed every 4 days. The numbers and location of the monitoring stations, as well as the level of personnel deployed in each station should be consistent with the corresponding parameters deployed in past studies of this nature in Malta which can be accessed on <http://environment.gov.mt/en/Pages/WBRU/Reports-and-Statistics.aspx>.

The consultants shall propose strategies to address the identified risks. These proposals shall be included in the tenderer's technical offer.

The publication of this tender shall in no way be construed or perceived as obliging the Government or any other relevant authority to take any decision in connection with any derogation under the European Union Birds Directive or any other law or regulation.

4 Scope of the Work

4.1 General

4.1.1 Project Description

*The monitoring of the influx or passage of nine bird species (Common Linnet *Linaria cannabina*, Common Chaffinch *Fringilla coelebs*, European Serin *Serinus serinus*, European Goldfinch *Carduelis carduelis*, European Greenfinch *Chloris chloris*, Hawfinch *Coccothraustes coccothraustes*, Eurasian Siskin *Spinus spinus*, Golden Plover *Pluvialis apricaria* and Song Thrush *Turdus philomelos*) shall take place during the period between the 20th October 2018 and the 31st December 2018 both dates included. The consultant shall mobilise all staff and equipment by the end of September 2018, in preparation for the execution of Autumn/Winter 2018 migration study.*

The bird migration study should comprise the on-field surveying and scientific monitoring of the daily influx of migration of all 7 finch species and golden plover and song thrush concerned. This would provide an independent verification of the level of presence of the nine species in Autumn/Winter and the timing of their migration. This shall be achieved by generating a "Migration Count," that is a count of migrant birds of each species in question in the stipulated time span when monitoring is undertaken.

The collection of scientific data to elucidate general population trends for these species is beyond the scope of this bird migration study. The consultant must submit the daily datasheets with raw counts to the Contracting Authority at the end of each week. The draft monitoring reports and analysis are to be submitted by the 15th of January 2019.

The issuance of the quality assurance certification shall not be later than 31st January 2019. In this regard, the Contractor is bound to submit his final version for quality assurance certification to the Contracting Authority, three (3) working days prior to termination of Contract.

4.1.2 Geographical Area to be covered

The three inhabited islands of the Maltese archipelago, namely Malta, Gozo and Comino.

4.1.3 Target Groups

As appropriate.

4.2 Specific Activities

*The bird migration study shall monitor the influx of migratory specimens of Common Linnet *Linaria cannabina*, Common Chaffinch *Fringilla coelebs*, European Serin *Serinus serinus*, European Goldfinch *Carduelis carduelis*, European Greenfinch *Chloris chloris*, Hawfinch *Coccothraustes coccothraustes*, Eurasian Siskin *Spinus spinus*, Golden Plover *Pluvialis apricaria**

and Song Thrush Turdus philomelos, bearing in mind any methodological and physical limitations in the monitoring of these species, such as ability to identify or differentiate species of finches on the basis of their call rather than appearance.

A field protocol of standard operating procedures, which will be used in the same manner from day to day should be designed by the commissioned experts on the basis of best practice procedures. There might be a need to take into consideration however, the flexibility of the techniques used to meet the constraints imposed by local geographical conditions.

A network of monitoring stations will need to be set up throughout the three inhabited islands of the Maltese archipelago for the study period. Such a network would need to comprise at least 21 monitoring stations. The number of active stations on any given day shall be six (6) sites manned by at least two ornithologists and/or field assistants each site has to be surveyed every 4 days. Monitoring in Malta, Gozo and Comino shall be carried out on a daily basis; however this requirement shall be waived with respect to Comino on those days when access to the Island would not be possible due to adverse weather conditions. The ornithologists and/or field assistants shall be persons with relevant knowledge in bird identification and shall have the capacity to identify all of the nine (9) bird species visually but most importantly being able to recognise their call in flight. Daily monitoring at each station shall be conducted from 09:00hrs to 14:00hrs during the first eleven days of the study (20th October–30th October) and from 08:00hrs to 13:00hrs during the 31st October–31st December study period to factor in the Daylight Saving Time, which ends on 30th October.

For each day during the bird monitoring phase, at least 6 monitoring stations must be fully manned. The exact number, location and area of the monitoring stations will be determined in consultation with scientific experts listed by contractor who are commissioned to undertake this bird migration study. Such details should be included in the methodology submitted in Section 4 Technical Offer (Organization and Methodology) by the contractor. Given that the survey is aimed at quantifying the influx or passage of migrating specimens, all monitoring stations shall be placed in strategic locations depending on the species being surveyed and the expected geographical occurrence of the species depending on the timing of the migration and prevailing weather conditions. The location of the monitoring stations shall be selected with care and shall not include areas where the settlement or sighting of the birds under study cannot in practice occur.

The Project coordinator should be able to co-ordinate a team of scientists and scientific experts and conduct environmental monitoring, nature-related and/or ornithological studies. The role of the scientists accompanying the Project coordinator should also include the ability to conduct environmental monitoring, nature-related and/or ornithological studies.

Each, monitoring station should include or encompass a defined 'count area' that has features that are compatible with the chosen count procedures. Moreover, no matter the type of method, the experts should also define the total daily 'count period', as well as the standard daily time periods during which the various component activities of bird counting procedures occur.

Surveys should focus on observations made, and should be coordinated by the Project co-ordinator or/and scientist/s, so as to enable an appropriate scientific determination with ecological statistics and/or models leading to population estimates (possibly through the extrapolation of results, with standard errors being indicated) and should cover, at least, the three main inhabited islands of the Maltese archipelago. The migration count can include birds

counted at a site, observed flying past a fixed point in diurnal migration or alighting onto the ground or trees. For monitoring small landbirds, particular attention should be drawn to birds observed at short-term stopover sites immediately following a migratory flight. There are several options for producing a useful migration count of small landbirds; these options include: visible migration count; area search or route census counts; incidental observations; and daily estimated totals. The commissioned experts should define in the final monitoring report what they will consider as a migration count and what standardised methods will be used.

Nonetheless, in view that the bird species under study have a preference for migrating during particular times of day, observations should focus on such peak times. In this respect the monitoring is to be carried out from 09:00hrs to 14:00hrs during the first eleven days of the study (20th October–30th October) and from 08:00hrs to 13:00hrs during the 31st October–31st December study period to factor in the Daylight Saving Time, which ends on 30th October.

It is imperative that the observers, or persons deployed by the consultant to man the stations and/or conduct counts or observations for the purpose of this study shall not be directly or indirectly involved with the practice of live-capturing or hunting.

Standardisation of counting methods can make a major contribution to removing extraneous variation derived from variable observer effort and sampling procedures. Nevertheless, migration counts will still be subject to uncontrollable variation from weather, observer differences, and unavoidable changes in the level of effort. Such problems should be addressed by the use of appropriate analytical procedures.

Daily datasheets with raw counts need to be drawn for each of the monitoring stations in use, such that the prevalent meteorological conditions, namely: wind direction and speed, the degree of cloud cover, the habitat type, bird counts, the times and locations, and the names of the field assistants, are all recorded.

The count data collected for a pre-defined area and the count period at each study site shall be used to establish the average counts (per day) recorded in a typical monitoring station for each of the nine (9) bird species. The calculations for such counts also need to include the standard deviation errors. Such mean counts shall then be extrapolated so as to cover the total area where the species may settle / which serves as short-term stopover sites, in order to estimate the total number of birds migrating daily over the Maltese Islands.

The appropriate methodology for extrapolation shall be determined by the scientific experts taking into account the possibility of repeat counting of observed birds; the patchiness of each species' distribution and frequency depending on available appropriate habitat; the seasonal geographical variation in the frequency of sightings dependent on the expected migration flow direction and any assumptions taken for such calculations need to be clearly stated in the monitoring report.

Relevant seasonal, local topographic (e.g. configuration of the coast), climatic and anthropogenic factors (such as degree of local urbanization) shall be duly taken into account in the extrapolation methodology, subject to scientifically justified assumptions.

The methodology shall not involve trapping or any taking of any bird, whether alive or dead, nor any part of any bird.

The field study shall cover 73 days during the Autumn/Winter migration period, between the 20th October 2018 and the 31st December 2018. The collection of scientific data to elucidate population trends for each bird species is beyond the scope of this bird migration study. The consultant must submit the daily datasheets with raw counts to the Contracting Authority at the end of each week of each of the bird monitoring periods. The Autumn/Winter 2018 Finches, Golden Plover and Song Thrush Migration monitoring reports and analysis is to be submitted by the 15th January 2019. Once such draft reports have been certified for quality assurance by the Contracting Authority, the Finches Migration 2018 monitoring report and Golden Plover and Song Thrush Migration 2018 monitoring report are to be submitted within 10 working days from such a review. All Autumn/Winter 2018 project activities must be completed to the Contracting Authority's satisfaction within four weeks from the termination of the Autumn/Winter bird monitoring phase.

These activities will result in:

- 1. Daily datasheets with raw counts for each of the above mentioned bird species.*
- 2. Two monitoring reports for the season, including comparative analysis.*

4.3 Project Management

4.3.1 Responsible Body

The overall responsibility of the implementation of this contract lies with the Contracting Authority. An official will be appointed to oversee the implementation of the contract.

4.3.2 Management Structure

The Head of the Wild Birds Regulation Unit within the Ministry for Sustainable Development, the Environment and Climate Change is the official responsible for this contract. The Head may delegate various tasks to other officials within the Wild Birds Regulation Unit and may appoint an official to act as a project manager and to monitor the progress of this project.

4.3.3 Facilities to be provided by the Contracting Authority and/or other parties

None

5. Logistics and Timing

5.1 Location

The Republic of Malta.

The monitoring stations shall be set up at appropriate locations within the three inhabited Maltese Islands, namely in Malta, Gozo and Comino.

The contractor, moreover, is expected to compile reports, prepare scientific analysis, and prepare the setup of the administrative framework from his own premises. The contractor should be available during office hours via e-mail and telephone.

5.2 Commencement Date & Period of Execution

The intended commencement date for the monitoring phase is the 20th October 2018 and the period of execution of the contract shall be not later than 31st January, 2019. Article 19.1 of the Special Conditions will determine the actual commencement date and period of execution.

6. Requirements

6.1 Personnel

The Service Provider/s must be a natural person, or a legal entity providing the below Key Experts :

A list of the key experts and other staff proposed for the execution of the contract as per Form marked Key Experts to be submitted online through the prescribed tender response format (tender structure).

Key Expert 1

A Project coordinator who must be:

In possession of a Ph.D. or other academic qualification at MQRIC Level 8 related to natural sciences

Key Expert 2

A Scientist who must be:

In possession of a Masters degree or other academic qualification at MQRIC level 7 in natural sciences

The above key expertise can be provided by a single person, provided that he/she has the required qualifications as stipulated above.

6.1.1 Other Experts

CVs for experts other than the key experts are not examined prior to the signature of the contract. They should not have been included in tenders.

The Consultant shall select and hire other experts as required according to the profiles identified in the Organisation & Methodology and these Terms of Reference.

All experts must be independent and free from conflicts of interest in the responsibilities accorded to them.

The selection procedures used by the Contractor to select these other experts shall be transparent, and shall be based on pre-defined criteria, including professional qualifications, language skills and work experience. The findings of the selection panel shall be recorded. The selection of experts shall be subject to approval by the Contracting Authority..

6.1.2 Support Staff and Backstopping

- *The bird migration study is to be supported by ornithologists or field assistants with relevant knowledge in bird identification.*
- *Other support staff should be capable in carrying out statistical analysis, report writing and/or other relevant administration work.*

6.2 Accommodation

Office accommodation of a reasonable standard and of approximately 10 square metres for each expert working on the contract is to be provided by the Consultant.

6.3 Facilities to be provided by the Consultant

The Consultant shall ensure that experts are adequately supported and equipped. In particular it shall ensure that there is sufficient administrative, secretarial and interpreting provision to enable experts to concentrate on their primary responsibilities. It must also transfer funds as necessary to support its activities under the contract and to ensure that its employees are paid regularly and in a timely fashion.

The contractor shall provide the equipment, software and hardware needed for carrying out surveys, data gathering, storage, analysis and evaluation.

If the Consultant is a consortium, the arrangements should allow for the maximum flexibility in project implementation. Arrangements offering each consortium partner a fixed percentage of the work to be undertaken under the contract should be avoided.

6.4 Equipment

No equipment is to be purchased on behalf of the Contracting Authority / beneficiary country as part of this service contract or transferred to the Contracting Authority / beneficiary country at the end of this contract. Any equipment related to this contract which is to be acquired by the beneficiary country must be purchased by means of a separate supply tender procedure.

The contractor shall be responsible for establishing his own sources for goods, equipment, materials and software to perform the necessary activities and tasks, which may include:

- *Field Monitoring equipment, as appropriate e.g. binoculars, compass (to measure wind direction), radar equipment etc.*
- *Research equipment*

7. Reports

7.1 Reporting Requirements

Daily data sheets with raw counts need to be drawn for each of the monitoring stations in use, such that the prevalent meteorological conditions, namely wind direction and speed, the degree of cloud cover, the habitat type, bird counts, the times and locations, the names of the field assistants all need to be recorded.

Following the survey/study period a detailed analysis shall be carried out on the data collated which are to be presented in TWO separate reports (one concerning seven finch species and a

separate report concerning golden plover and song thrush migration). Such reports are to indicate:

- the raw counts for the species covered by the corresponding migration report
- sampling methodology used
- the time schedule for the monitoring taken place
- the locations where monitoring was carried out and the estimated area of each site of observation
- the peak and low counts for each of the species under study
- the locations/ monitoring stations which had peak/low counts
- an extrapolation indicating the total influx of each of the relevant species migrating over the Maltese Islands for each day
- an estimated total influx of each of the relevant bird species for the whole study period
- assumptions taken for such estimates
- comparison of the results with live-capturing bag data for the species concerned for the current period (this would only apply in case relevant derogations permitting live-capturing would be applied in 2018)

These reports should only concern information/data on the influx of the migratory birds and should not include personal opinions of the Contractor.

The Contractor must submit the daily datasheets with raw counts to the Contracting Authority at the end of each week during the bird monitoring phase. The draft Autumn/Winter 2018 Migration monitoring report Finch report and the Golden Plover and Song Thrush Migration monitoring report analysis are to be submitted by the 15th January 2019.

Draft reports are to be submitted to the Contracting Authority for quality assurance certification. The Contracting Authority reserves the right to request the necessary modifications to bring the reports in line for issuance of quality assurance certification. The issuance of the quality assurance certification shall not be later than 31st January 2019. In this regard, the Contractor is bound to submit his final version for quality assurance certification to the Contracting Authority, three (3) working days prior to termination of Contract

All reports and other forms of written communication must be presented in an editable format using commonly available software. All reports must be approved by the Contracting Authority before these can be considered finalised. All reports will be property of the Contracting Authority and it will have sole copyright.

7.2 Submission & approval of progress reports

The daily data sheets with raw counts and two (2) hard copies and a soft copy of each of the monitoring reports referred to above must be submitted to the Project Manager identified in the contract. The progress reports must be written in English. The Project Manager is responsible for approving the progress reports.

8 Monitoring and Evaluation

8.1 Definition of Indicators

Results	Objectively verifiable indicators	Sources of verifications
<i>Daily datasheets with raw counts of Common Linnet <i>Linaria cannabina</i>, Common Chaffinch <i>Fringilla coelebs</i>, European Serin <i>Serinus serinus</i>, European Goldfinch <i>Carduelis carduelis</i>, European Greenfinch <i>Chloris chloris</i>, Hawfinch <i>Coccothraustes coccothraustes</i>, Eurasian Siskin <i>Spinus spinus</i>, Golden Plover <i>Pluvialis apricaria</i> and Song Thrush <i>Turdus philomelos</i></i>	<i>The original raw datasheets which are to be completed on site during the monitoring process to be submitted by the end of each week of the monitoring phase.</i>	<i>The original datasheets submitted to the Contracting Authority.</i>
<i>Autumn/Winter 2018 Finches migration monitoring report which presents clear analyses of the monitoring carried out.</i>	<i>The draft monitoring report shall be completed within the 15th January 2019.</i> <i>The monitoring report will be finalised by the consultant and approved by the Contracting Authority within four weeks from the termination of the bird monitoring phase.</i>	<i>The actual monitoring report presented by the contractor.</i>
<i>Autumn/Winter 2018 Golden Plover and Song Thrush migration monitoring report which presents clear analyses of the monitoring carried out.</i>	<i>The draft monitoring report shall be completed within the 15th January 2019.</i> <i>The monitoring report will be finalised by the consultant and approved by the Contracting Authority within four weeks from the termination of the bird monitoring phase.</i>	<i>The actual monitoring report presented by the contractor.</i>

Ecoserv Ltd (hereafter 'Ecoserv') made a submission and was subsequently informed by the MESDC that its bid was successful and, as a result, was awarded the tender.

The present submission constitutes Ecoserv's report of the independent scientific study on the influx of Golden Plover (*Pluvialis apricaria*) and Song Thrush (*Turdus philomelos*) in Malta, undertaken by the company during the period 20 October to 31 December 2018, which coincides with the 2018 autumn/winter live-capturing season, and is based on the ToR stated above.

An overview of the migratory behaviour and records for Golden Plover (*Pluvialis apricaria*) and Song Thrush (*Turdus philomelos*) around the Maltese Islands has already been presented in Ecoserv (2016a) and will not be repeated here. Except for the bird migration monitoring studies conducted in the autumn of 2015, 2016 and 2017 (see Ecoserv, 2016a; 2017a; 2018a), no similar studies on Golden Plover and Song Thrush have been previously undertaken locally. However, records of the number of individuals of these two species caught by live-capturers between 2002 and 2016 are available in the *Carnet de Chasse/Game Reporting Data* reports for the respective years (reports for 2010–2016

accessible from the Wild Birds Regulation Unit website: <http://msdec.gov.mt/en/Pages/WBRU/Reports-and-Statistics.aspx>, while the records of Golden Plover and Song Thrush catches made during the 2012–2017 Autumn live-capturing derogations are available from the website of the Wild Birds Regulation Unit (<http://msdec.gov.mt/en/Pages/WBRU/livecapturingder.aspx>).

2. Methodology

Field procedure

The survey design used by Ecoserv during the present autumn/winter 2018 survey was aimed at assessing the migratory influx of Golden Plover and Song Thrush, which entails trend analysis based on data from monitoring carried out regularly over a sufficiently long period comprising subsequent years, and using a similar methodology to that used previously by Ecoserv to monitor the migratory influx of Golden Plover and Song Thrush (Ecoserv, 2016a; 2017a; 2018a) and other species (Ecoserv, 2011; 2012; 2013; 2014a; 2014b; 2015b; 2015c; 2016b; 2016c; 2017b; 2017c; 2017d; 2018b; 2018c; 2018d). During the survey, two individuals - a field assistant capable of identifying Golden Plover and Song Thrush and an observer who was responsible for recording of data in the field - were stationed at a total of 21 sites (= count stations) distributed over Malta, Comino and Gozo. Prior to enrolment for the survey, the field assistants would have been assessed by Ecoserv's environmental scientists and ecologists to ensure that they are capable of identifying the bird species concerned. The observers were given briefings by Ecoserv's consultants on identification of Golden Plover and Song Thrush, and received further training in the field on same by the field assistants. Throughout the survey, Ecoserv's environmental scientists and ecologists ensured close monitoring of the activities of the field personnel to ensure that collection of data proceeded as per designated protocol by carrying out field visits (most of which were 'surprise visits') on a regular basis.

The survey was undertaken over an 11-week period between 20 October and 31 December, 2018. During the survey, counts of individuals of the two species (Golden Plover *Pluvialis apricaria* and Song Thrush *Turdus philomelos*) were made at each of 6 different sites on each day during the monitoring period. Each group of 6 sites was surveyed once every 4 days, such that a total of 21 sites were surveyed over each period of 4 days, as agreed with the Contracting Authority. The study site at Comino was included in the 6 sites surveyed on any one day, such that every attempt was made to survey this site on a daily basis. However, when weather conditions precluded count surveys at this site due to unavailability of sea transport services, counts were recorded at an alternative site (in Qala) located at the southeastern most tip of Gozo (close to Comino). The sampling sites are represented by the grid cell reference numbers listed in Table 1, while their locations are shown in Figure 1.

Since the survey was mainly aimed at quantifying the influx of migrating individuals, field sites were sited at strategic locations behind the coast. For each species, the number of individuals observed flying within each study site was recorded, while the count area was estimated as the area within the observer's field of view when observing horizontally (c. 250m on each side of the observer) and vertically upwards (as far as the birds were detected by sight). Golden Plover and Song Thrush are small birds that are difficult to identify when they are flying at a distance, even if binoculars are used. Nonetheless, every effort was made to identify the species as accurately as possible; to aid the observers detect the birds, field personnel used a pair of binoculars (magnification: 8 x 21). The different species were identified on the basis of their flight pattern and call. When the field personnel

had doubt as to the specific identity of a species, a '?' was placed next to the record on the field data sheet to indicate the uncertainty. Afterwards, during data analysis (see below), comparison was made of records marked with a '?' from a particular site with records from other sites for the same day as corroboration procedure. Uncertain records were allotted to the species which the field personnel determined as most probable with respect to species identity and which showed agreement with appreciable records from other sites on the same day for that species.

Monitoring of Golden Plover and Song Thrush was made between 09:00 and 14:00 during the first eleven days of the study (i.e. up to the date when the daylight saving hour was removed) and between 08:00 and 13:00 during the rest of the study period. The count data collected for the pre-defined area and count period at each study site was used to establish the mean number of birds recorded for each day of the survey.

At each study site, the observers also recorded the prevalent weather conditions, namely wind direction and strength, and degree of cloud cover. This information is available on the raw data sheets, copies of which have been submitted to the Wild Birds Regulation Unit of the MESDC. Although it would be interesting to explore potential relationships between weather conditions and migratory influx of the bird species surveyed, this would entail in-depth statistical analyses, while assessment of the influence of local climatic factors on the migratory influx of birds was beyond the scope of the present study. Nevertheless, the weather data collected during the present survey is useful as it will be available for such potential study.

Table 1

List of grid locations where monitoring of influx of migratory birds was carried out.

Location	Day 1	Day 2	Day 3	Day 4
Gozo	3690	3292	2888	3286
Comino	4085	4085	4085	4085
Malta	3881	4079	4077	4073
Malta	4070	4268	4666	5064
Malta	5663	6067	6069	5872
Malta	5277	4878	4480	4283

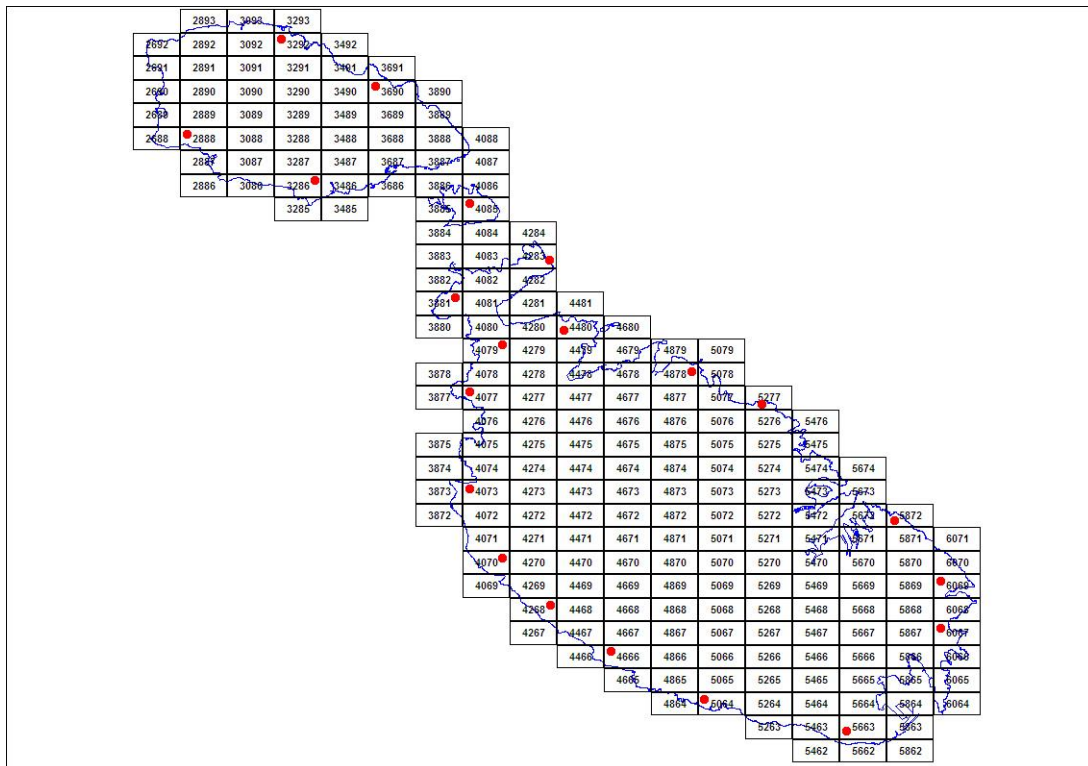


Figure 1. Map of the Maltese Islands showing the localities (grid cells indicated by the red filled circle) where the bird counts were made; see also Table 1.

Data analysis

Using the recorded raw data for each of the two bird species, estimates were made of the mean daily count and total count for the study period (20 October to 31 December 2018). Values of standard deviation for the respective mean daily counts were also estimated; standard deviation is a measure of variability among counts recorded from the different sites; that is, a low standard deviation implies that very similar counts were recorded at all six sites surveyed during a particular day, whereas dissimilar values would lead to a high standard deviation. Standard deviation is influenced by sample size (i.e. number of study sites); it tends to increase with a decreased sample size.

An estimate of total influx of the respective bird species was made using the daily counts. Extrapolations were then made to obtain the total number of individuals of each species that migrated over the Maltese Islands on a particular date. However, such an estimate must be treated with utmost caution, given that: (a) migration of Golden Plover and Song Thrush is not necessarily restricted to that time of the year covered by the present study; (b) a relatively small number of sites used; (c) the counts were not made daily at each site; and (d) bird counts were made while the live-capturing season for Golden Plover and Song Thrush was open, hence individuals may have been caught before the field personnel could record them. Being small birds, Golden Plover and Song Thrush are easy to miss and present difficulty to identify if they pass beyond a certain distance from the observer, and especially if they do not call while in flight. Furthermore, passage of birds at different localities is extremely variable, with potential large differences in birds passing at two different localities, even if these are separated by a very small distance.

As already stated, another notable limiting factor was that on any day of the field survey, recording of data was stopped in the early afternoon and was resumed the following morning, hence potentially missing birds that arrive during that time of the day not covered by the present survey, as these would

not have been recorded by the field observers. Golden Plover and Song Thrush are known to also migrate between dusk and dawn; hence individuals migrating during this time would not be detected during the survey. One should also mention that Song Thrush migration starts before the survey period, given that they start migrating from mid-September onwards, whereas the autumn/winter migration of Golden Plover extends into January; hence such birds would not have been included in the present survey. On the other hand, the estimates given in the present report will be useful when making comparisons of data collected from the present study period (autumn 2018) and that collected from future studies held in autumn in subsequent years, assuming that a similar survey design is adopted, to assess whether the trend in influx is increasing or decreasing with time. Since the coastal length surveyed at each site during the present survey is approximately 0.5 km, the mean daily count represents the mean influx of the respective species per 0.5 km coastline. The estimated daily influx was obtained by extrapolating the mean daily values obtained (per 0.5 km) to the total coastline length for the Maltese Islands, which have a perimeter of 271.22 km (Mallia *et al*, 2002)¹; that is the estimated daily influx equals the mean daily count multiplied by an extrapolation factor of 271.22/0.5. Values of estimated daily influx were then summed to obtain an estimate of the total influx of the two bird species (Golden Plover and Song Thrush).

3. Results

Ecoserv's laboratory report reference for the present survey is **002-19**. The sample reference codes for the bird count data are **B-269-18** to **B-310-18**.

Where indicated in the following results, a mean count value of '0' recorded for a bird species on a particular day during the survey period, which would also have been extrapolated to a total influx value of zero for that specific date, is highly unlikely to correspond to actual total absence of migration of the particular species over the Maltese Islands, and should be attributed to an artefact of sampling, resulting from the small sample size.

Golden Plover

Raw daily counts for Golden Plover recorded from the 21 sites during the present study varied between 0 and a maximum of 17 (see Appendix I), while the mean daily counts ranged between 0 and 4.83 (Table 2). Most of the counts for this species were recorded between mid-November and late December 2018. The total counts, i.e. the total number of Golden Plover, recorded from a given grid location (= study site) during the whole study period (73 days), varied appreciably between the different sites: at the lower end, no individuals were recorded throughout the survey period from the site at grid location 5064, while at the higher end, 30 Golden Plover individuals were recorded from the site at grid location 4070.

Values of mean daily counts and total counts of Golden Plover recorded during the period 20 October to 31 December 2018 from the present survey are summarised in Table 2. Values of standard deviation associated with the mean daily counts are also provided in Table 2. Counts of Golden Plover recorded from the present survey, along with those made during the autumn 2015, 2016 and 2017 surveys, are shown graphically in Figure 2. Overall, count values for Golden Plover from the present (autumn 2018) survey show a similar trend to those recorded in the previous autumn surveys, with higher count values recorded during the period mid-November to late December.

¹ Note, however, that this estimate includes the perimeter of minor islets and rocks.

An estimate of total influx of Golden Plover over the Maltese Islands is given in Table 2. Based on the mean daily counts (Table 2), extrapolation translates to an estimated daily influx ranging between 0 and 2,622 individuals, with a total influx over the survey period (20 October – 31 December; i.e. 73 days) of 19,711 individuals, i.e. some 270 birds per day; see Table 2.

Mean count values for Golden Plover recorded from each of the 21 sites are indicated on the map shown in Figure 3. The highest mean count was recorded from Mtaħleb (Grid 4070) located in the western Malta, while relatively high counts were also recorded from other sites located on the western coast of Malta. A zero count was recorded from Lapsi (Grid 5064), while very low counts for this species were recorded from study sites located in southern Malta and from Marsalforn (Grid 3292) in Gozo.

Table 2

Values of mean (\pm SD) daily count and daily total count recorded from the six study sites, together with total influx of migratory Golden Plover.

Date	Mean daily count	Standard deviation	Total daily count	Estimated daily influx
20-Oct-18	0.00	± 0	0	0
21-Oct-18	0.00	± 0	0	0
22-Oct-18	0.00	± 0	0	0
23-Oct-18	0.00	± 0	0	0
24-Oct-18	0.00	± 0	0	0
25-Oct-18	0.00	± 0	0	0
26-Oct-18	0.00	± 0	0	0
27-Oct-18	0.00	± 0	0	0
28-Oct-18	0.00	± 0	0	0
29-Oct-18	0.00	± 0	0	0
30-Oct-18	0.00	± 0	0	0
31-Oct-18	0.00	± 0	0	0
1-Nov-18	0.00	± 0	0	0
2-Nov-18	0.33	± 0.52	2	181
3-Nov-18	0.00	± 0	0	0
4-Nov-18	0.00	± 0	0	0
5-Nov-18	0.00	± 0	0	0
6-Nov-18	0.00	± 0	0	0
7-Nov-18	0.67	± 1.03	4	362
8-Nov-18	0.33	± 0.82	2	181
9-Nov-18	0.00	± 0	0	0
10-Nov-18	0.67	± 1.63	4	362
11-Nov-18	0.33	± 0.82	2	181
12-Nov-18	0.00	± 0	0	0
13-Nov-18	0.00	± 0	0	0
14-Nov-18	0.00	± 0	0	0
15-Nov-18	0.00	± 0	0	0
16-Nov-18	0.00	± 0	0	0
17-Nov-18	0.67	± 0.82	4	362
18-Nov-18	0.67	± 1.21	4	362
19-Nov-18	1.00	± 2	6	542
20-Nov-18	1.17	± 1.17	7	633
21-Nov-18	0.00	± 0	0	0
22-Nov-18	0.00	± 0	0	0
23-Nov-18	0.83	± 0.98	5	452

Date	Mean daily count	Standard deviation	Total daily count	Estimated daily influx
24-Nov-18	0.67	± 1.03	4	362
25-Nov-18	4.83	± 6.85	29	2622
26-Nov-18	1.00	± 1.67	6	542
27-Nov-18	0.00	± 0	0	0
28-Nov-18	0.67	± 1.21	4	362
29-Nov-18	0.33	± 0.82	2	181
30-Nov-18	1.67	± 2.07	10	904
1-Dec-18	1.67	± 2.42	10	904
2-Dec-18	2.17	± 4.36	13	1175
3-Dec-18	0.67	± 1.63	4	362
4-Dec-18	1.33	± 2.16	8	723
5-Dec-18	0.67	± 1.63	4	362
6-Dec-18	1.83	± 3.60	11	994
7-Dec-18	0.33	± 0.82	2	181
8-Dec-18	1.33	± 2.16	8	723
9-Dec-18	0.67	± 1.03	4	362
10-Dec-18	0.00	± 0	0	0
11-Dec-18	0.00	± 0	0	0
12-Dec-18	0.50	± 1.22	3	271
13-Dec-18	0.67	± 1.21	4	362
14-Dec-18	0.17	± 0.41	1	90
15-Dec-18	2.00	± 3.03	12	1085
16-Dec-18	0.00	± 0	0	0
17-Dec-18	0.17	± 0.41	1	90
18-Dec-18	1.00	± 2	6	542
19-Dec-18	0.00	± 0	0	0
20-Dec-18	0.33	± 0.82	2	181
21-Dec-18	0.33	± 0.82	2	181
22-Dec-18	0.00	± 0	0	0
23-Dec-18	1.17	± 2.04	7	633
24-Dec-18	0.83	± 1.33	5	452
25-Dec-18	0.83	± 2.04	5	452
26-Dec-18	0.00	± 0	0	0
27-Dec-18	0.67	± 1.21	4	362
28-Dec-18	0.00	± 0	0	0
29-Dec-18	0.83	± 2.04	5	452
30-Dec-18	0.33	± 0.82	2	181
31-Dec-18	0.00	± 0	0	0
Total Count / Estimated Influx			218	19,711

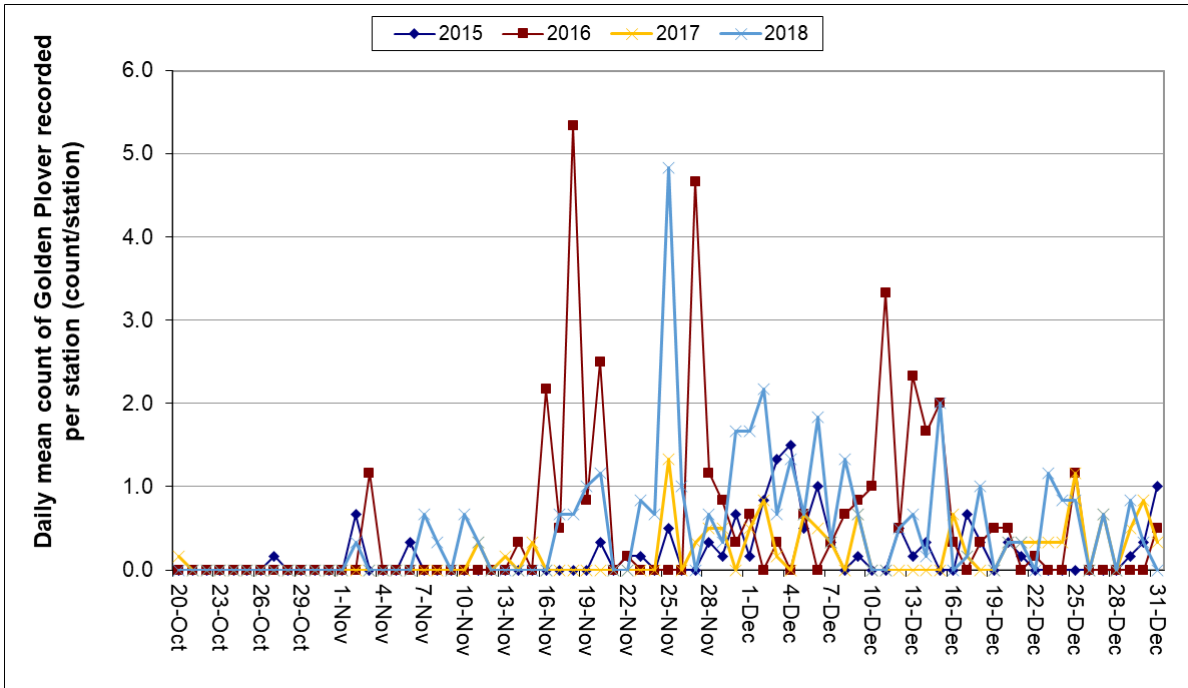


Figure 2. Daily mean counts of Golden Plover per station (= site) recorded between 20 October and 31 December during the present (2018) and previous (2015, 2016, 2017) surveys.

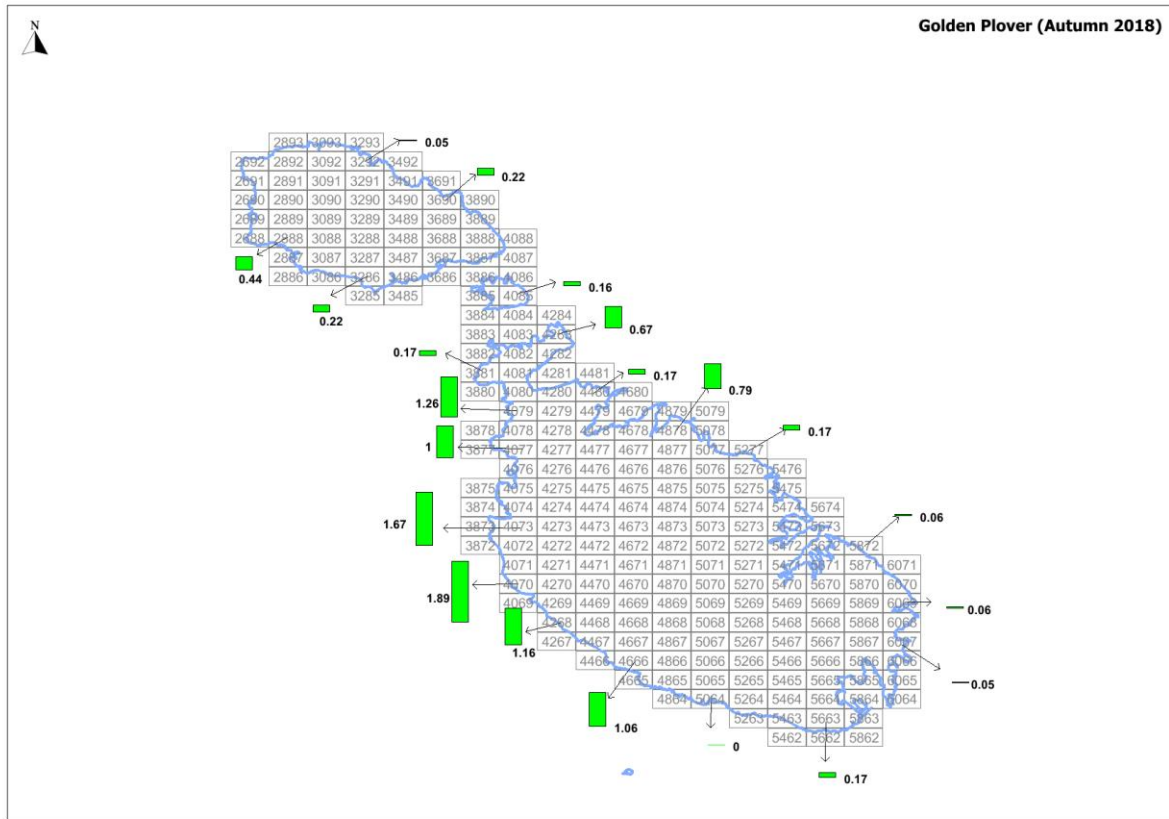


Figure 3. Map of the Maltese Islands showing the standard grid and respective codes, including ones used in the present study. The green bars indicate mean counts of Golden Plover recorded from study sites in the respective cells.

Song Thrush

Raw daily counts for Song Thrush recorded from the 21 sites during the present study varied between 0 and a maximum of 71 (see Appendix I), while the mean daily counts ranged between 0 and 18.17 (Table 3). Comparatively higher counts were recorded between late October and mid-November. The total count, i.e. the total number of Song Thrush, recorded from a given grid location (= study site) during the whole study period (73 days), varied appreciably between the different sites: at the lower end a total of eight individuals was recorded throughout the survey period from the site at grid location 6067, while at the higher end 108 Song Thrush individuals were recorded from the site at grid location 4077.

Values of mean daily counts and total counts of Song Thrush recorded during the period 20 October to 31 December 2018 from the present survey are summarised in Table 3. Values of standard deviation associated with the mean daily counts are also provided in Table 3. Counts of Song Thrush recorded from the present survey, along with those made during the autumn 2015, 2016 and 2017 surveys, are shown graphically in Figure 4. Overall, count values for Song Thrush from the present (autumn 2018) survey show a similar trend to those recorded in the previous autumn surveys, with higher count values recorded during the period late October to mid-November (Figure 4).

An estimate of total influx of Song Thrush over the Maltese Islands is given in Table 3. Based on the mean daily counts (Table 3), extrapolation translates to an estimated daily influx ranging between 0 and 9,854 individuals, with a total influx over the survey period (20 October – 31 December; i.e. 73 days) of 80,824 individuals, i.e. some 1,107 birds per day; see Table 3.

Mean count values for Song Thrush recorded from each of the 21 sites are indicated on the map shown in Figure 5. The highest mean count was recorded from Għajn Tuffieħa (Grid 4077) in northwestern Malta, while comparatively high mean counts were also recorded from other sites located on the northwestern coast of Malta and from several study sites in Gozo. The lowest counts for this species were recorded from study sites in the northeastern and southern coasts of Malta.

Table 3

Values of mean (\pm SD) daily count and daily total count recorded from the six study sites, together with total influx of migratory Song Thrush.

Date	Mean daily count	Standard deviation	Total daily count	Estimated daily influx
20-Oct-18	4.33	\pm 5.43	26	2351
21-Oct-18	9.50	\pm 10.6	57	5153
22-Oct-18	2.50	\pm 2.95	15	1356
23-Oct-18	0.67	\pm 1.21	4	362
24-Oct-18	4.83	\pm 4.88	29	2622
25-Oct-18	15.33	\pm 27.57	92	8317
26-Oct-18	10.00	\pm 6.99	60	5424
27-Oct-18	9.33	\pm 5.57	56	5063
28-Oct-18	3.33	\pm 1.97	20	1808
29-Oct-18	1.67	\pm 1.63	10	904
30-Oct-18	1.50	\pm 1.97	9	814
31-Oct-18	0.33	\pm 0.82	2	181
1-Nov-18	2.00	\pm 1.9	12	1085
2-Nov-18	4.00	\pm 4.29	24	2170
3-Nov-18	18.17	\pm 20.61	109	9854

Date	Mean daily count	Standard deviation	Total daily count	Estimated daily influx
4-Nov-18	6.83	± 2.79	41	3707
5-Nov-18	2.83	± 3.43	17	1537
6-Nov-18	5.33	± 7.2	32	2893
7-Nov-18	3.50	± 4.85	21	1899
8-Nov-18	4.00	± 5.8	24	2170
9-Nov-18	3.50	± 4.14	21	1899
10-Nov-18	3.33	± 3.39	20	1808
11-Nov-18	3.00	± 2.28	18	1627
12-Nov-18	4.17	± 5	25	2260
13-Nov-18	1.67	± 1.63	10	904
14-Nov-18	3.17	± 1.6	19	1718
15-Nov-18	0.00	± 0	0	0
16-Nov-18	2.33	± 1.63	14	1266
17-Nov-18	0.83	± 1.6	5	452
18-Nov-18	1.33	± 2.16	8	723
19-Nov-18	0.00	± 0	0	0
20-Nov-18	0.33	± 0.52	2	181
21-Nov-18	1.00	± 1.26	6	542
22-Nov-18	0.83	± 1.6	5	452
23-Nov-18	0.50	± 0.55	3	271
24-Nov-18	1.50	± 1.64	9	814
25-Nov-18	1.67	± 2.07	10	904
26-Nov-18	0.33	± 0.82	2	181
27-Nov-18	0.17	± 0.41	1	90
28-Nov-18	0.33	± 0.52	2	181
29-Nov-18	0.17	± 0.41	1	90
30-Nov-18	1.17	± 1.33	7	633
1-Dec-18	0.33	± 0.82	2	181
2-Dec-18	0.50	± 0.84	3	271
3-Dec-18	0.33	± 0.52	2	181
4-Dec-18	0.00	± 0	0	0
5-Dec-18	0.00	± 0	0	0
6-Dec-18	0.00	± 0	0	0
7-Dec-18	0.00	± 0	0	0
8-Dec-18	0.67	± 1.03	4	362
9-Dec-18	0.67	± 1.63	4	362
10-Dec-18	0.17	± 0.41	1	90
11-Dec-18	0.17	± 0.41	1	90
12-Dec-18	0.17	± 0.41	1	90
13-Dec-18	0.83	± 2.04	5	452
14-Dec-18	0.00	± 0	0	0
15-Dec-18	0.33	± 0.82	2	181
16-Dec-18	0.33	± 0.82	2	181
17-Dec-18	0.00	± 0	0	0
18-Dec-18	0.00	± 0	0	0
19-Dec-18	0.00	± 0	0	0
20-Dec-18	0.00	± 0	0	0
21-Dec-18	0.17	± 0.41	1	90
22-Dec-18	0.33	± 0.82	2	181
23-Dec-18	0.17	± 0.41	1	90
24-Dec-18	0.00	± 0	0	0
25-Dec-18	0.00	± 0	0	0

Date	Mean daily count	Standard deviation	Total daily count	Estimated daily influx
26-Dec-18	0.67	± 1.21	4	362
27-Dec-18	0.17	± 0.41	1	90
28-Dec-18	0.33	± 0.52	2	181
29-Dec-18	1.17	± 2.86	7	633
30-Dec-18	0.17	± 0.41	1	90
31-Dec-18	0.00	± 0	0	0
Total Count / Estimated Influx			894	80,824

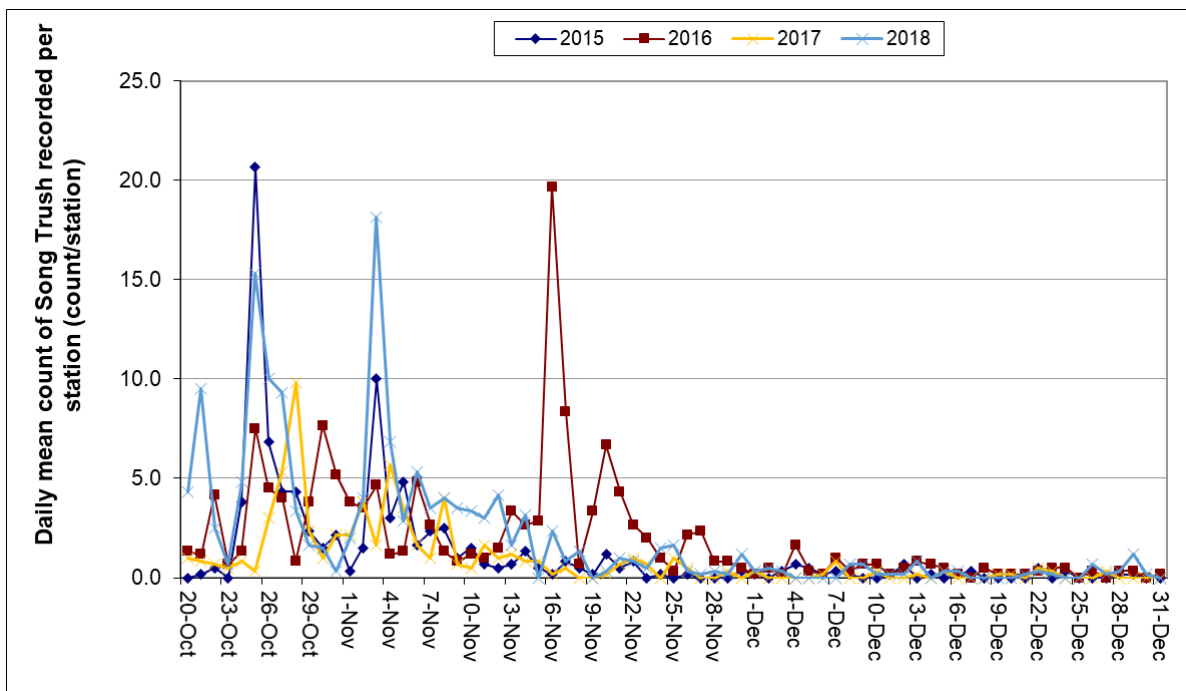


Figure 4. Daily mean counts of Song Thrush per station (= site) recorded between 20 October and 31 December during the present (2018) and previous (2015, 2016, 2017) surveys.

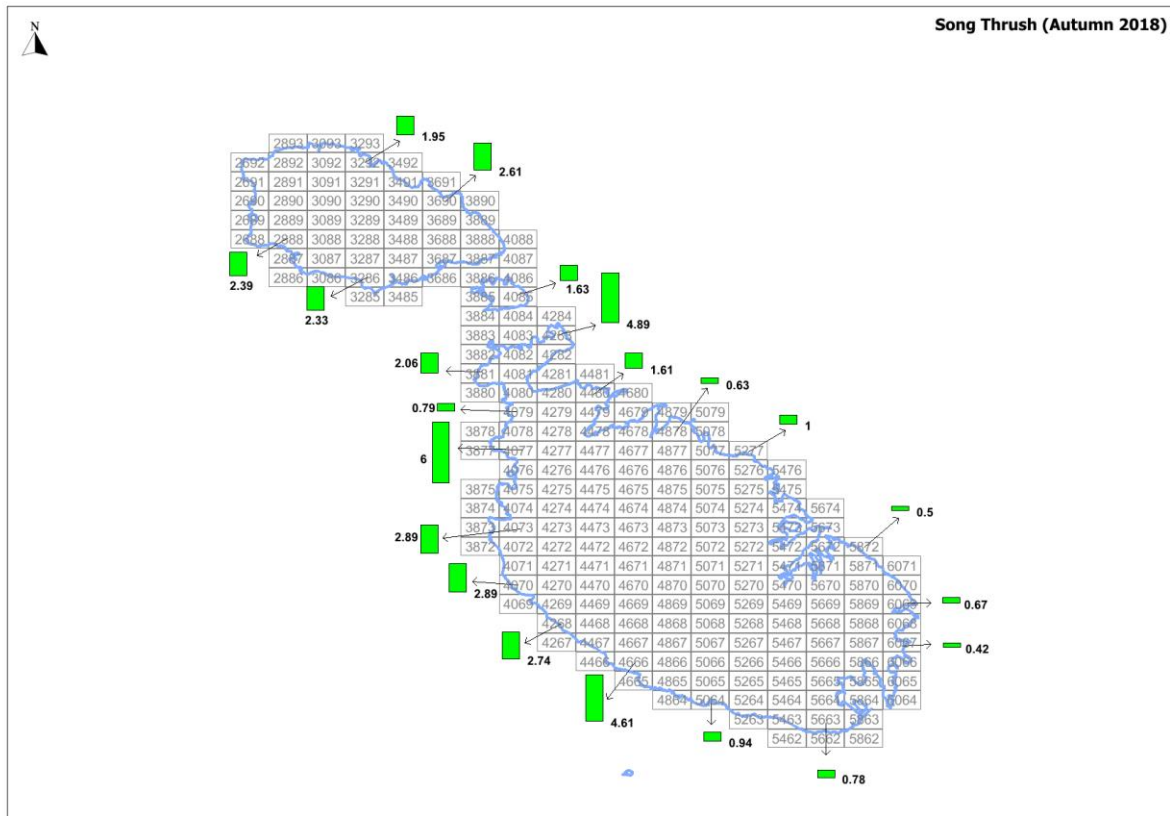


Figure 5. Map of the Maltese Islands showing the standard grid and respective codes, including ones used in the present study. The green bars indicate mean counts of Song Thrush recorded from study sites in the respective cells.

4. Comparison with bag data

A comparative analysis of the results obtained during the present study with bag data provided by the Wild Birds Regulation Unit (WBRU) of the MESDC was undertaken. It should be stated from the outset that the two sets of data were collected for different purposes, using very different methodologies, and therefore the magnitudes of the values are not directly comparable. However, the temporal trends can be expected to follow similar patterns, that is periods when higher mean daily counts were recorded during the present survey should broadly correspond to dates when higher numbers of birds were captured (and reported in the bag data) in the same year. Whether the influx of the bird species follows the same temporal trend from year to year can only be confirmed through a longitudinal study of influx of the different bird species over a period of several years.

The data set provided by the WBRU for this comparison comprises the daily bag count of the two bird species (as reported by live-capturers through a telephonic game reporting system) for the period 20 October to 31 December 2018.

Graphical representations of the mean daily counts made during the present (2018) survey and the daily bag counts for the same time period (20 October – 31 December) in 2018 (MESDC unpublished data) for each of the two bird species were prepared to compare temporal trends among the two

different data sets. In a graphical plot showing daily counts, a high variation in counts from day to day may overshadow temporal trends over the two-month period. To aid visual interpretation, a second set of analyses was undertaken by computing a moving average using a rolling 5-day period for the time series count data. This has the effect of smoothing out the day to day fluctuations and hence making longer-term trends in mean daily counts or daily bag counts more apparent, thus facilitating visual interpretation of temporal trends. Note that the analyses based on a moving average do not replace those based on the raw daily counts. Rather, the graphical representations showing a 5-day moving average should be seen in conjunction with those based on daily counts, which are also presented.

Golden Plover

The daily bag counts indicating the number of Golden Plover caught during the 2018 live-capturing season and the mean daily counts of the same species made during the present (2018) survey are shown in Figure 6, while Figure 7 presents the 5-day moving average computed from these data. As already noted, the magnitude of the bag counts and those of the mean counts made in the 2018 survey are not directly comparable; consequently the two sets of values are on different scales. Therefore, in Figures 6–7, two separate y-axes are used: the bag count data are plotted on the left-side y-axis, whereas the counts from the 2018 survey are plotted on the right-side y-axis.

Overall, the highest daily counts made during the 2018 survey occurred between mid-November and late December, with a peak on 25 November. Bag counts in 2018 were low throughout October and early November and increased between mid-November and late December, with peaks on 17 November, 24 November and 18 December. Thus, the general trend observed in the bag counts for 2018 and the daily counts recorded during the 2018 survey is of higher counts in the later part of the live-capturing season, from mid-November until end December.

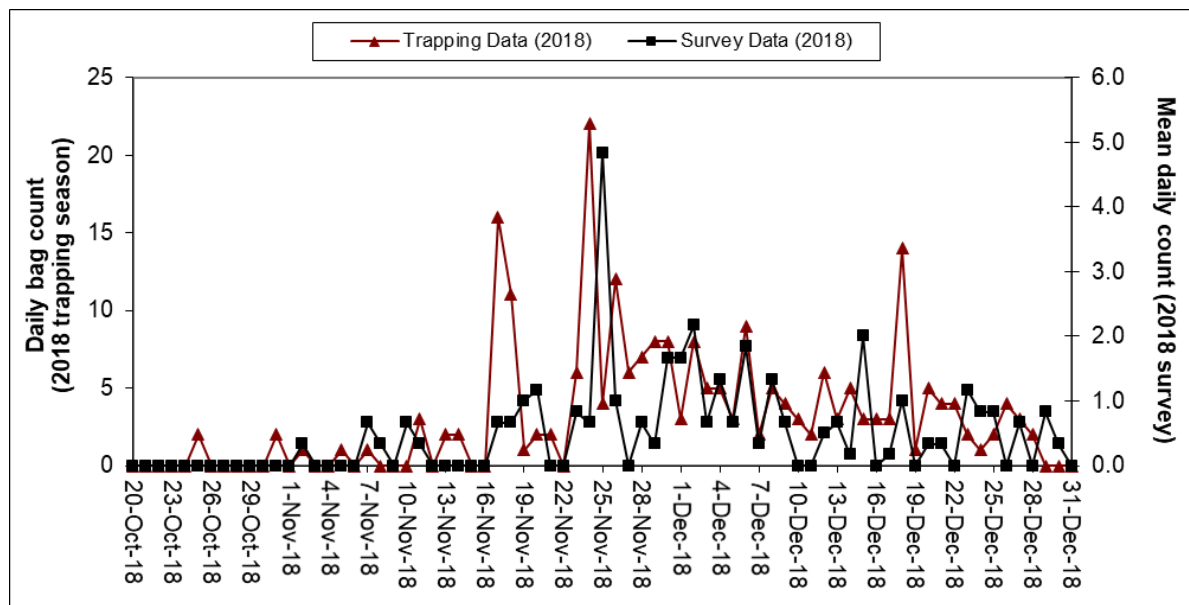


Figure 6. Daily bag count of Golden Plover during 2018 (red line; values on left-side y-axis), together with the mean daily counts recorded during the 2018 survey (black line; values on right-side y-axis), for the period 20 October to 31 December.

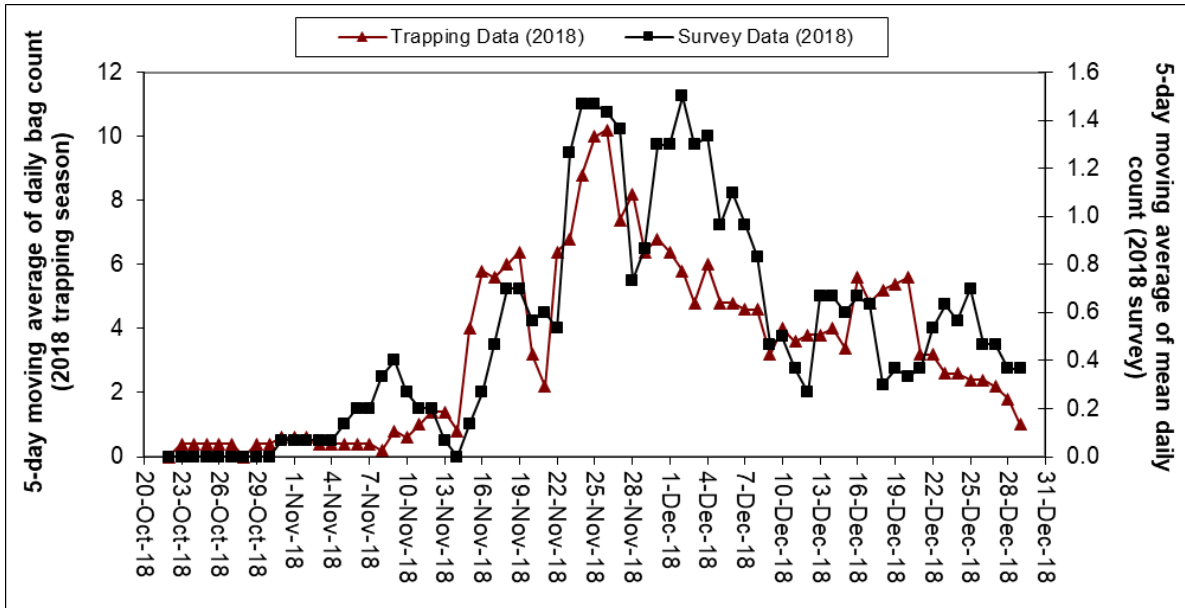


Figure 7. Moving average based on a 5-day rolling time period for the daily bag counts of Golden Plover during 2018 (red line; values on left-side y-axis), and for the mean daily counts recorded during the 2018 survey (black line; values on right-side y-axis), for the period 20 October to 31 December.

Song Thrush

The daily bag counts indicating the number of Song Thrush caught during the 2018 live-capturing season and the mean daily counts of the same species made during the present (2018) survey are shown in Figure 8, while Figure 9 presents the 5-day moving average computed from these data. As already noted, the magnitude of the bag counts and those of the mean counts made in the 2018 survey are not directly comparable, consequently the two sets of values are on different scales. Therefore, in Figures 8–9, two separate y-axes are used: the bag count data are plotted on the left-side y-axis, whereas the counts from the 2018 survey are plotted on the right-side y-axis.

Overall, the highest daily counts made during the 2018 survey occurred between late October and mid-November, with counts declining thereafter; most days in December were characterised by low or zero counts. The highest bag counts in 2018 also occurred in late October and early to mid-November, but the 2018 bag data included some minor additional peaks in early December. Thus, the general trend observed in the bag counts for 2018 and the daily counts recorded during the 2018 survey is of higher counts in the earlier part of the live-capturing season, up to around mid-November.

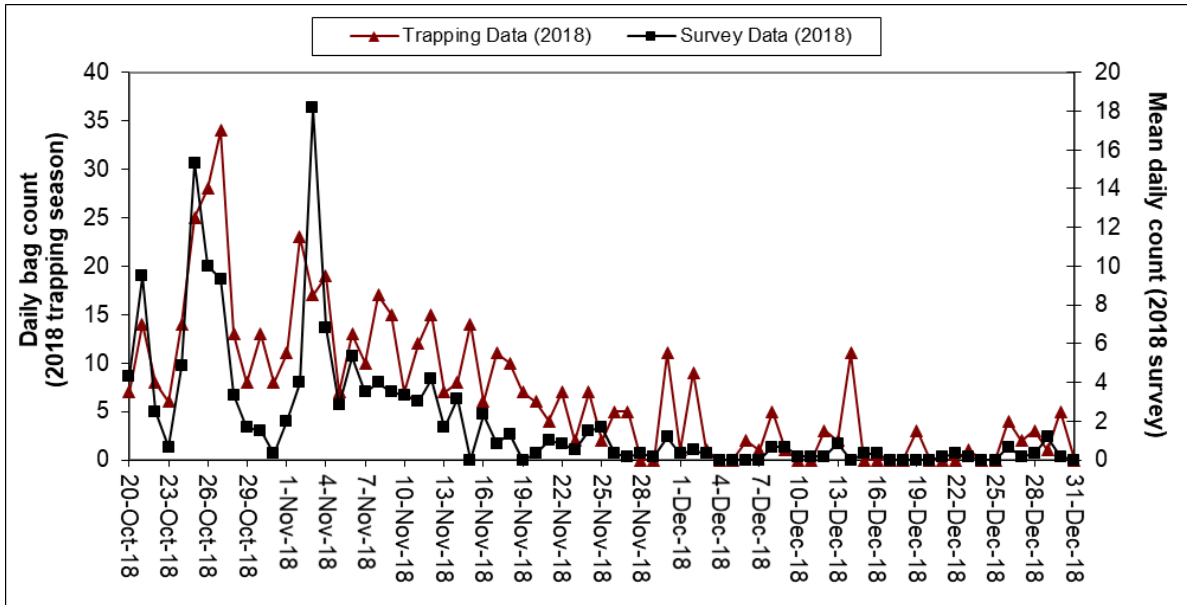


Figure 8. Daily bag count of Song Thrush during 2018 (red line; values on left-side y-axis), together with the mean daily counts recorded during the 2018 survey (black line; values on right-side y-axis), for the period 20 October to 31 December.

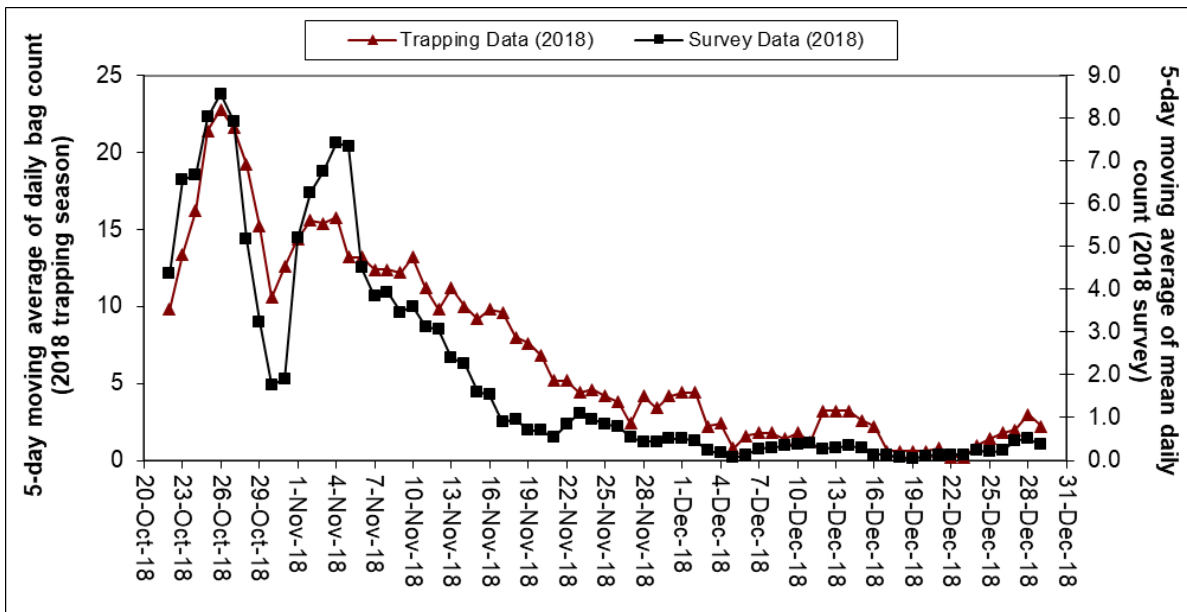


Figure 9. Moving average based on a 5-day rolling time period for the daily bag counts of Song Thrush during 2018 (red line; values on left-side y-axis), and for the mean daily counts recorded during the 2018 survey (black line; values on right-side y-axis), for the period 20 October to 31 December.

5. Appraisal

The present survey provides data on mean daily counts of Golden Plover (*Pluvialis apricaria*) and Song Thrush (*Turdus philomelos*) recorded during the study period held between 20 October and 31 December 2018, together with estimates of the migratory influx of the two species. Government had established the autumn/winter live-capturing season for these species during the same period of the present study.

The mean daily counts from the present survey indicate that higher counts for Golden Plover were recorded between mid-November to late December, while for Song Thrush higher counts were recorded between late October and mid-November. The higher values recorded on certain dates indicate a general trend of migratory influx during mid-November to late December for Golden Plover, and during late October to mid-November for Song Thrush. The raw counts for the two species varied appreciably among the different stations. Such variation is to be expected in studies such as the present, given that birds may have a strong influx at one site and a potentially much lower one at a different site, even if the two sites are separated by a very small distance of even a few hundred metres. Considerations of habitat and land cover apply only to a degree, since migratory birds also fly over urban and other built-up areas. Another noteworthy consideration is that some birds may also pass overhead, maintaining high altitude and avoid alighting on land. The usefulness of the values provided in the present report therefore lies primarily in providing data for future comparison, rather than using the counts *per se*, which in any study of this type should be considered as a rough estimate.

The total influx of individuals for the present survey period (20 October – 31 December 2018) was estimated at 19,711 for Golden Plover and 80,824 for Song Thrush. When comparing the present results with those from the autumn 2015, 2016 and 2017 surveys (Ecoserv, 2016a, 2017a, 2018a), the following overall observations are noted:

- The migratory influx of both Golden Plover and Song Thrush recorded from the present autumn 2018 survey is similar to that recorded during the autumn 2016 survey, and higher than those recorded during the autumn 2015 and 2017 surveys. In the case of Golden Plover, the total influx of this species recorded in autumn 2016 and 2018 is nearly three times higher than that recorded during the autumn 2015 and 2017 surveys; this can be attributed to migratory peaks recorded during the 2016 and 2018 surveys, since no such peaks for Golden Plover were recorded in the 2015 and 2017 surveys. In the case of Song Thrush, the migratory influx recorded during the autumn 2016 and 2018 surveys is about twice as high as that recorded during the autumn 2015 and 2017 surveys. This can also be attributed to the presence of migratory peaks during autumn 2016 and 2018, and also to the fact that the species was recorded more regularly (i.e. on more days) during the 2018 survey period.
- When comparing data from 2018 with those from 2015, 2016 and 2017 within the context of the specific period during which a higher influx of the two species was recorded, no discernible pattern of differences is evident since overall higher counts for the respective species were recorded during the same period in all four years.

It is reiterated that estimates of total influx must be treated with utmost caution, given the relatively small number of field sites used in the survey, that counts were not made daily at each site, and since the extrapolation procedure used is likely to result in a rough estimate. Influx of birds at different localities is extremely variable, with potential large differences in number of birds passing at two different localities, even if these are separated by a very small distance, as indicated above. Furthermore, the total length of coastline surveyed per day (3 km) amounts to less than 1.5% of the total coastline. Other limitations are (i) bird migration starts in September, and therefore birds that would have migrated before the start of the present study (i.e. before 20 October 2018) would not

have been recorded; and (ii) counts were recorded over a five hour survey period, hence any individuals migrating at other times of the day were not included, leading to a potential underestimate of the total influx if significant migratory influx occurred outside the survey time on any day. Nevertheless, the stated estimate is useful when making comparison between different years, assuming data from surveys based on a similar design are available, to assess whether influx of any of the two bird species is increasing or decreasing with time.

The design of the present survey included counts made over a 73 day period between 20 October and 31 December 2018, which covers the period when peak autumn migration of Golden Plover and Song Thrush normally occurs.

Robust and rigorous assessment of migratory influx requires trend analysis based on data from monitoring carried out regularly over a sufficiently long period comprising subsequent years, and using the same methodology. For each year, the data should ideally be collected over the whole migratory season and using a larger sampling effort, for example by making counts daily at all of a minimum 21 sites. However, it should be noted that such higher sampling effort will entail very high costs, which may render the study prohibitively expensive, while it would be very difficult to carry out a survey involving daily counts at a large number of sites, given the large number of field personnel that would be required.

Nevertheless, the data from the present study provides a useful indication of the autumn influx of the two bird species, provided that results are interpreted in the context of the limitations indicated above.

6. References

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Ecoserv Sample Reference Code	B-269-18	B-270-18	B-271-18	B-272-18	B-273-18	B-274-18	B-275-18	B-276-18	B-277-18	B-278-18	B-279-18
16-Nov-18	0										
17-Nov-18	0	1	0	2	0	1					
18-Nov-18	0						1	3	0	0	0
19-Nov-18	1										
20-Nov-18	0										
21-Nov-18	0	0	0	0	0	0					
22-Nov-18	0						0	0	0	0	0
23-Nov-18	2										
24-Nov-18	0										
25-Nov-18	1	0	17	9	0	2					
26-Nov-18	0						2	4	0	0	0
27-Nov-18	0										
28-Nov-18	1										
29-Nov-18	0	0	0	2	0	0					
30-Nov-18	3						2	5	0	0	0
1-Dec-18	0										
2-Dec-18	0										
3-Dec-18	0	0	0	0	0	4					
4-Dec-18	0						0	3	5	0	0
5-Dec-18	0										
6-Dec-18	2										
7-Dec-18	0	0	2	0	0	0					
8-Dec-18	0						0	3	5	0	0
9-Dec-18	0										
10-Dec-18	0										
11-Dec-18	0	0	0	0	0	0					
12-Dec-18	0						0	0	3	0	0
13-Dec-18	0										
14-Dec-18	0										
15-Dec-18	0	0	2	1	1	8					
16-Dec-18	0						0	0	0	0	0
17-Dec-18	0										

Ecoserv Sample Reference Code	B-269-18	B-270-18	B-271-18	B-272-18	B-273-18	B-274-18	B-275-18	B-276-18	B-277-18	B-278-18	B-279-18
18-Dec-18	0										
19-Dec-18	0	0	0	0	0	0					
20-Dec-18	0						0	0	2	0	0
21-Dec-18	2										
22-Dec-18	0										
23-Dec-18	0	0	2	5	0	0					
24-Dec-18	0						2	0	0	0	3
25-Dec-18	0										
26-Dec-18	0										
27-Dec-18	0	0	1	3	0	0					
28-Dec-18	0						0	0	0	0	0
29-Dec-18	0										
30-Dec-18	0										
31-Dec-18	0	0	0	0	0	0					

Table A continued. Daily counts of Golden Plover recorded per site.

Ecoserv Sample Reference Code	B-280-18	B-281-18	B-282-18	B-283-18	B-284-18	B-285-18	B-286-18	B-287-18	B-288-18	B-289-18
Grid Location	3268	4073	5064	5872	4283	3690	3881	4070	5663	5277
20-Oct-18										
21-Oct-18										
22-Oct-18	0	0	0	0	0					
23-Oct-18						0	0	0	0	0
24-Oct-18										
25-Oct-18										
26-Oct-18	0	0	0	0	0					
27-Oct-18						0	0	0	0	0
28-Oct-18										
29-Oct-18										
30-Oct-18	0	0	0	0	0					

Ecoserv Sample Reference Code	B-280-18	B-281-18	B-282-18	B-283-18	B-284-18	B-285-18	B-286-18	B-287-18	B-288-18	B-289-18
31-Oct-18						0	0	0	0	0
1-Nov-18										
2-Nov-18										
3-Nov-18	0	0	0	0	0					
4-Nov-18						0	0	0	0	0
5-Nov-18										
6-Nov-18										
7-Nov-18	2	2	0	0	0					
8-Nov-18						2	0	0	0	0
9-Nov-18										
10-Nov-18										
11-Nov-18	0	2	0	0	0					
12-Nov-18						0	0	0	0	0
13-Nov-18										
14-Nov-18										
15-Nov-18	0	0	0	0	0					
16-Nov-18						0	0	0	0	0
17-Nov-18										
18-Nov-18										
19-Nov-18	0	5	0	0	0					
20-Nov-18						1	0	1	2	3
21-Nov-18										
22-Nov-18										
23-Nov-18	2	1	0	0	0					
24-Nov-18						0	2	2	0	0
25-Nov-18										
26-Nov-18										
27-Nov-18	0	0	0	0	0					
28-Nov-18						0	0	3	0	0
29-Nov-18										
30-Nov-18										
1-Dec-18	0	6	0	1	3					

Ecoserv Sample Reference Code	B-280-18	B-281-18	B-282-18	B-283-18	B-284-18	B-285-18	B-286-18	B-287-18	B-288-18	B-289-18
2-Dec-18						1	1	11	0	0
3-Dec-18										
4-Dec-18										
5-Dec-18	0	4	0	0	0					
6-Dec-18						0	0	9	0	0
7-Dec-18										
8-Dec-18										
9-Dec-18	0	2	0	0	2					
10-Dec-18						0	0	0	0	0
11-Dec-18										
12-Dec-18										
13-Dec-18	0	3	0	0	1					
14-Dec-18						0	0	1	0	0
15-Dec-18										
16-Dec-18										
17-Dec-18	0	0	0	0	1					
18-Dec-18						0	0	5	1	0
19-Dec-18										
20-Dec-18										
21-Dec-18	0	0	0	0	0					
22-Dec-18						0	0	0	0	0
23-Dec-18										
24-Dec-18										
25-Dec-18	0	5	0	0	0					
26-Dec-18						0	0	0	0	0
27-Dec-18										
28-Dec-18										
29-Dec-18	0	0	0	0	5					
30-Dec-18						0	0	2	0	0
31-Dec-18										

Table B. Daily counts of Song Thrush recorded per site.

Ecoserv Sample Reference Code	B-290-18	B-291-18	B-292-18	B-293-18	B-294-18	B-295-18	B-296-18	B-297-18	B-298-18	B-299-18	B-300-18
Grid Location	4085	3292	4079	4268	6067	4878	2888	4077	4666	6069	4480
20-Oct-18	10	4	0	12	0	0					
21-Oct-18	3						10	9	30	2	3
22-Oct-18	8										
23-Oct-18	1										
24-Oct-18	7	4	5	13	0	0					
25-Oct-18	0						8	71	10	2	1
26-Oct-18	19										
27-Oct-18	10										
28-Oct-18	6	2	1	4	2	5					
29-Oct-18	0						2	3	4	0	1
30-Oct-18	2										
31-Oct-18	0										
1-Nov-18	0	5	2	2	3	0					
2-Nov-18	1						12	3	3	0	5
3-Nov-18	13										
4-Nov-18	5										
5-Nov-18	9	4	1	3	0	0					
6-Nov-18	0						2	10	18	1	1
7-Nov-18	3										
8-Nov-18	1										
9-Nov-18	0	7	0	10	1	3					
10-Nov-18	0						1	9	1	4	5
11-Nov-18	2										
12-Nov-18	2										
13-Nov-18	1	4	2	0	0	3					
14-Nov-18	2						2	2	6	3	4
15-Nov-18	0										
16-Nov-18	2										
17-Nov-18	0	4	0	1	0	0					

Ecoserv Sample Reference Code	B-290-18	B-291-18	B-292-18	B-293-18	B-294-18	B-295-18	B-296-18	B-297-18	B-298-18	B-299-18	B-300-18
18-Nov-18	0						3	0	5	0	0
19-Nov-18	0										
20-Nov-18	0										
21-Nov-18	2	0	1	3	0	0					
22-Nov-18	0						1	0	4	0	0
23-Nov-18	0										
24-Nov-18	0										
25-Nov-18	5	2	3	0	0	0					
26-Nov-18	0						0	0	0	0	2
27-Nov-18	0										
28-Nov-18	1										
29-Nov-18	0	0	0	0	1	0					
30-Nov-18	2						0	0	2	0	3
1-Dec-18	0										
2-Dec-18	0										
3-Dec-18	0	1	0	1	0	0					
4-Dec-18	0						0	0	0	0	0
5-Dec-18	0										
6-Dec-18	0										
7-Dec-18	0	0	0	0	0	0					
8-Dec-18	2						0	0	0	0	2
9-Dec-18	0										
10-Dec-18	0										
11-Dec-18	0	0	0	1	0	0					
12-Dec-18	0						0	0	0	0	1
13-Dec-18	0										
14-Dec-18	0										
15-Dec-18	0	0	0	2	0	0					
16-Dec-18	0						2	0	0	0	0
17-Dec-18	0										
18-Dec-18	0										
19-Dec-18	0	0	0	0	0	0					

Ecoserv Sample Reference Code	B-290-18	B-291-18	B-292-18	B-293-18	B-294-18	B-295-18	B-296-18	B-297-18	B-298-18	B-299-18	B-300-18
20-Dec-18	0						0	0	0	0	0
21-Dec-18	0										
22-Dec-18	0										
23-Dec-18	0	0	0	0	0	1					
24-Dec-18	0						0	0	0	0	0
25-Dec-18	0										
26-Dec-18	0										
27-Dec-18	0	0	0	0	1	0					
28-Dec-18	0						0	1	0	0	1
29-Dec-18	0										
30-Dec-18	0										
31-Dec-18	0	0	0	0	0	0					

Table B continued. Daily counts of Song Thrush recorded per site.

Ecoserv Sample Reference Code	B-301-18	B-302-18	B-303-18	B-304-18	B-305-18	B-306-18	B-307-18	B-308-18	B-309-18	B-310-18
Grid Location	3268	4073	5064	5872	4283	3690	3881	4070	5663	5277
20-Oct-18										
21-Oct-18										
22-Oct-18	3	2	0	0	2					
23-Oct-18						0	0	3	0	0
24-Oct-18										
25-Oct-18										
26-Oct-18	17	4	12	3	5					
27-Oct-18						9	18	12	2	5
28-Oct-18										
29-Oct-18										
30-Oct-18	0	0	2	0	5					
31-Oct-18						0	2	0	0	0
1-Nov-18										

Ecoserv Sample Reference Code	B-301-18	B-302-18	B-303-18	B-304-18	B-305-18	B-306-18	B-307-18	B-308-18	B-309-18	B-310-18
2-Nov-18										
3-Nov-18	13	25	0	2	56					
4-Nov-18						9	4	9	4	10
5-Nov-18										
6-Nov-18										
7-Nov-18	3	13	2	0	0					
8-Nov-18						15	1	6	0	1
9-Nov-18										
10-Nov-18										
11-Nov-18	3	3	0	3	7					
12-Nov-18						4	3	14	2	0
13-Nov-18										
14-Nov-18										
15-Nov-18	0	0	0	0	0					
16-Nov-18						3	2	5	2	0
17-Nov-18										
18-Nov-18										
19-Nov-18	0	0	0	0	0					
20-Nov-18						1	0	1	0	0
21-Nov-18										
22-Nov-18										
23-Nov-18	0	0	1	1	1					
24-Nov-18						1	4	0	3	1
25-Nov-18										
26-Nov-18										
27-Nov-18	0	0	0	0	1					
28-Nov-18						0	1	0	0	0
29-Nov-18										
30-Nov-18										
1-Dec-18	2	0	0	0	0					
2-Dec-18						2	1	0	0	0
3-Dec-18										

Ecoserv Sample Reference Code	B-301-18	B-302-18	B-303-18	B-304-18	B-305-18	B-306-18	B-307-18	B-308-18	B-309-18	B-310-18
4-Dec-18										
5-Dec-18	0	0	0	0	0					
6-Dec-18						0	0	0	0	0
7-Dec-18										
8-Dec-18										
9-Dec-18	0	0	0	0	4					
10-Dec-18						0	1	0	0	0
11-Dec-18										
12-Dec-18										
13-Dec-18	0	5	0	0	0					
14-Dec-18						0	0	0	0	0
15-Dec-18										
16-Dec-18										
17-Dec-18	0	0	0	0	0					
18-Dec-18						0	0	0	0	0
19-Dec-18										
20-Dec-18										
21-Dec-18	1	0	0	0	0					
22-Dec-18						0	0	2	0	0
23-Dec-18										
24-Dec-18										
25-Dec-18	0	0	0	0	0					
26-Dec-18						3	0	0	1	0
27-Dec-18										
28-Dec-18										
29-Dec-18	0	0	0	0	7					
30-Dec-18						0	0	0	0	1
31-Dec-18										