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 2019 and January 2020

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1. Introduction

1.1 Preamble

The Ministry for the Environment, Sustainable Development and Climate Change (hereafter 'MESDC') issued a call for tenders (reference: MESDC 48/2019) on the 21st February2019 titled "*Tender for an independent scientific study on the influx or passage of migratory finches, Golden Plover and Song Thrush in Malta during the 2019 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 2019 migration period of the following species:

*Common Linnet(*Linariacannabina*),*
*Common Chaffinch(*Fringilla coelebs*),*
*European Serin(*Serinusserinus*),*
*European Goldfinch (*Carduelis carduelis*),*
*European Greenfinch (*Chloris chloris*),*
*Hawfinch (*Coccothraustes coccothraustes*),*
*Eurasian Siskin (*Spinus spinus*),*
*Golden Plover (*Pluvialisapricaria*), and*
*Song Thrush (*Turdusphilomelos*)*

2.2 Specific Objectives

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

- *Tosurveyandscientificallymonitorthedailyinfluxofsevenspeciesoffinches, Golden Plover and Song Thrush; and*
- *Toestimatetheoverallpresence(influx)oftheseninespeciesperdayandforthe 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 2019 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*Serinusserinus*, 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 (*Pluvialisapricaria*) and Song Thrush (*Turdusphilomelos*); and*

3. *Two (2) monitoring reports for Autumn/Winter 2019: 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 thebird species;*
   c) *A daily estimate of the influx of each of thebird species for the whole of the MalteseIslands;*
   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 2019 with the influxes recorded as a result of 2014, 2015, 2016, 2017 and2018 studies(reportsofsuchpaststudiesareavailableonlinefrom: 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'telephonicreportsfor2019, (this would only apply in case relevant derogations permitting live-capturing are applied in 2019).*

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 dailycountsobtainedfromthemonitoringstationstoextrapolatetheapproximateestimateof the total influx of each of the nine bird species: (Common Linnet Linaria cannabina*, Common Chaffinch* Fringilla coelebs*, European Serin*Serinusserinus*, European Goldfinch* Cardueliscarduelis*, European Greenfinch* Chloris chloris*, Hawfinch* Coccothraustes coccothraustes*, Eurasian Siskin* Spinus spinus*, Golden Plover* Pluvialisapricaria *and Song Thrush* Turdusphilomelos*) over the Maltese Islands.*

Moreover, it shall also beassumed that the passage of birds at different localities is extremely variable and maybe subject to local topographic,anthropogenic, climatic and otherconditions 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

Executionofthebirdmigrationstudyisdependentonanadequateenrolmentofthe ornithologists/fieldassistantswhoshallbemanningthemonitoringstations(atleast21 in number).Itshallbetheresponsibilityoftheconsultanttoensurethattheactivemonitoring 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 Maltawhichcanbeaccessedon 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.

Thepublicationofthistendershallinnowaybeconstruedorperceivedasobligingthe Governmentoranyotherrelevantauthoritytotakeanydecisioninconnectionwithany 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

Themonitoringoftheinfluxorpassageofninebirdspecies(Common Linnet Linaria cannabina*, Common Chaffinch* Fringilla coelebs*, European Serin*Serinusserinus*, European Goldfinch* Carduelliscarduelis*, European Greenfinch* Chloris chloris*, Hawfinch* Coccothraustes coccothraustes*, Eurasian Siskin* Spinus spinus*, Golden Plover* Pluvialisapricaria *and Song Thrush* Turdusphilomelos*) shall take place during the period between the 15thOctober2019 andthe 10th January 2020 bothdatesincluded.Theconsultantshall mobilise all staff and equipment by the 24thSeptember 2019, in preparation for the execution of Autumn/Winter2019 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 wouldprovideanindependentverificationofthelevelofpresenceoftheninespeciesin Autumn/Winterandthetimingoftheirmigration.Thisshallbeachievedbygeneratinga "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 27thof January 2020.

The issuance of the quality assurance certification shall not be later than 11th February 2020. 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

Thebirdmigrationstudyshallmonitortheinfluxofmigratoryspecimensof Common Linnet Linaria cannabina*, Common Chaffinch* Fringilla coelebs*, European Serin*Serinusserinus*, European Goldfinch* Cardueliscarduelis*, European Greenfinch* Chloris chloris*, Hawfinch* Coccothraustes coccothraustes*, Eurasian Siskin* Spinus spinus, *GoldenPlover*Pluvialisapricaria*andSongThrush*Turdusphilomelos*,bearinginmindany methodologicalandphysicallimitationsinthemonitoringofthesespecies,suchasabilityto identify or differentiate species of finches on the basis of their call rather than appearance.*

A fieldprotocol 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 monitoringstations.Thenumberofactivestationsonanygivendayshallbesix(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 monitoringateachstationshallbeconductedfrom09:00hrsto14:00hrsduringthefirst thirteen days of the study (15th October– 27th October 2019) and from 08:00hrs to 13:00hrs during the 28th October 2019 – 10th January 2020 study period to factor in the Daylight Saving Time, which ends on 30th October.

Foreachdayduringthebirdmonitoringphase,atleast6monitoringstationsmustbefully manned.Theexactnumber,locationandareaofthemonitoringstationswillbedeterminedin consultation with scientific expertslisted by contractor who are commissioned to undertake this bird migration study. Such details should be included in the methodology submitted inSection 4 TechnicalOffer(OrganizationandMethodology)bythecontractor.Giventhatthesurveyis aimed at quantifying the influx or passage of migrating specimens, all monitoring stations shall be placedinstrategiclocationsdependingonthespeciesbeingsurveyedandtheexpected geographicaloccurrenceofthespeciesdependingonthetimingofthemigrationandprevailing weather conditions. The location of the monitoring stations shall be selected with care and shall notincludeareaswherethesettlementorsightingofthebirdsunderstudycannotin 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/andscientist/s,soastoenableanappropriatescientificdeterminationwithecological statisticsand/ormodelsleadingtopopulationestimates(possiblythroughtheextrapolationof results, with standard errors being indicated) and should cover, at least, the three main inhabited islandsoftheMaltesearchipelago.Themigrationcountcanincludebirdscountedatasite, 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 usefulmigrationcountofsmalllandbirds;theseoptionsinclude:visiblemigrationcount;area searchorroutecensuscounts;incidentalobservations;anddailyestimatedtotals.The commissionedexpertsshoulddefineinthefinalmonitoringreportwhattheywillconsiderasa migration count and what standardised methods will be used.

Nonetheless,inviewthatthebirdspeciesunderstudyhaveapreferenceformigratingduring particulartimesofday,observationsshouldfocusonsuchpeaktimes.Inthisrespectthe monitoring is to be carried out from 09:00hrs to 14:00hrs during the first thirteen days of the study (15thOctober– 27thOctober 2019) and from 08:00hrs to 13:00hrs during the 28thOctober 2019 – 10th January 2020 study period to factor in the Daylight Saving Time, which ends on 30thOctober.

Itisimperativethattheobservers,orpersonsdeployedbytheconsultanttomanthestations and/orconductcountsorobservationsforthepurposeofthisstudyshallnotbedirectlyor indirectly involved with the practice of live-capturing or hunting.

Standardisationofcountingmethodscanmakeamajorcontributiontoremovingextraneous variation derived from variable observer effort and sampling procedures. Nevertheless, migration countswillstillbesubjecttouncontrollablevariationfromweather,observerdifferences,andunavoi dablechangesinthelevelofeffort.Suchproblemsshouldbeaddressedbytheuseof appropriate analytical procedures.

Daily datasheets with raw counts need to be drawn for each of the monitoring stations in use, such thattheprevalentmeteorologicalconditions,namely:winddirectionandspeed,thedegreeof cloudcover,thehabitattype,birdcounts,thetimesandlocations,andthenamesofthefield 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 countsalso need to include the standarddeviation errors.Suchmeancountsshallthenbeextrapolatedsoastocoverthetotalareawherethe speciesmaysettle/whichservesasshort-termstopoversites,inordertoestimatethetotal 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 88 days during the Autumn/Winter migration period, between the 15th October 2019 and the 10th January 2020, inclusive of both dates. 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 2019 Finches, Golden Plover and Song Thrush Migration monitoring reports and analysis is to be submitted by the 27th January 2020. Once suchdraftreportshavebeencertifiedforqualityassurancebytheContractingAuthority,the FinchesMigration2019 monitoringreportandGoldenPloverandSongThrushMigration 2019 monitoringreportaretobesubmittedwithin10workingdaysfromsuchareview.All Autumn/Winter2019 projectactivitiesmustbecompletedtotheContractingAuthority'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

TheoverallresponsibilityoftheimplementationofthiscontractlieswiththeContracting 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 EnvironmentandClimateChangeistheofficialresponsibleforthiscontract.TheHeadmay 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 thesetupoftheadministrativeframeworkfromhisownpremises.Thecontractorshouldbe available during office hours via e-mail and telephone.

5.2 Commencement Date & Period of Execution

Theintendedcommencementdateforthemonitoringphaseisthe 15th October2019 andthe period of execution of the contract shall be not later than 11th February, 2020.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

CVsforexpertsotherthanthekeyexpertsarenotexaminedpriortothesignatureofthe 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

- *Thebirdmigrationstudyistobesupportedbyornithologistsorfieldassistantswith relevantknowledgein 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.

Thecontractorshallprovidetheequipment,softwareandhardwareneededforcarryingout 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 consortiumpartner 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.

Thecontractorshallberesponsibleforestablishinghisownsourcesforgoods,equipment, materials and software to perform the necessary activities and tasks, which may include:

- *FieldMonitoringequipment,asappropriatee.g.binoculars,compass(tomeasurewind 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 ofcloudcover,thehabitattype,birdcounts,thetimesandlocations,thenamesofthefield assistants all need to be recorded.

Followingthesurvey/studyperiodadetailedanalysisshallbecarriedoutonthedatacollated whicharetobepresentedinTWOseparatereports(oneconcerningsevenfinchspeciesanda separatereportconcerninggoldenploverandsongthrushmigration).Suchreportsareto 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 outand 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*
- *anextrapolationindicatingthetotalinfluxofeachoftherelevantspecies 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 forthecurrentperiod(thiswouldonlyapplyincaserelevantderogations permitting live-capturing would be applied in 2019)*

Thesereportsshouldonlyconcerninformation/dataontheinfluxofthemigratorybirdsand 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 2019 Migration monitoring report Finch report and the Golden Plover and Song Thrush Migration monitoring report analysis are to be submitted by the 27th January 2020.

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 thereports in line for issuance of quality assurance certification. The issuance of the quality assurance certification shall not be later than 11th February 2020. 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

Allreports and other forms of written communication must bepresented inan editable format usingcommonlyavailablesoftware.AllreportsmustbeapprovedbytheContractingAuthority

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

Thedailydatasheetswithrawcountsandtwo(2)hardcopiesandasoftcopyofeachofthe 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*
Dailydatasheetswithrawcounts ofCommon Linnet Linaria cannabina*, Common Chaffinch* Fringilla coelebs*, European Serin*Serinusserinus*, European Goldfinch* Cardueliscarduelis*, European Greenfinch* Chloris chloris*, Hawfinch* Coccothraustes coccothraustes*, Eurasian Siskin* Spinus spinus*, Golden Plover* Pluvialisapricaria *and Song Thrush* Turdusphilomelos	*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.*	*The original datasheets submitted to the Contracting Authority.*
Autumn/Winter2019 Finches migration monitoringreportwhichpresents clearanalysesofthemonitoring carried out.	*The draft monitoring report shall be completed within the 27th January 2020.* *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.*	*The actual monitoring report presented by the contractor.*
Autumn/Winter 2019 Golden Plover and Song Thrush migration monitoringreportwhichpresents clearanalysesofthemonitoring carried out.	*The draft monitoring report shall be completed within the 27th January 2020.* *The monitoring report will be finalised by the consultant and approved by the Contracting Authority within four weeks from the termination of the*	*The actual monitoring report presented by the contractor.*

	bird monitoring phase.	

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 (*Pluvialisapricaria*) and Song Thrush (*Turdusphilomelos*) in Malta, undertaken by the company during the period 15 October2019 to 10January 2020, which overlaps with the 2019 autumn/winter live-capturing season (01 November 2019 to 10 January 2020 for Golden Plover; 20 October to 31 December 2019 for Song Thrush), and is based on the ToR stated above.

An overview of the migratory behaviour and records for Golden Plover (*Pluvialisapricaria*) and Song Thrush (*Turdusphilomelos*)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, 2017and 2018 (see Ecoserv, 2016a; 2017a; 2018a; 2019a), 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 2018 are available in the *Carnet de Chasse*/Game Reporting Data reports for the respective years (reports for 2010–2018accessible 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 2012–2018 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 designused by Ecoserv during the present autumn/winter 2019 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; 2019a) and other migratory bird species (Ecoserv, 2011; 2012; 2013; 2014a; 2014b; 2015b; 2015c; 2016b; 2016c; 2017b; 2017c; 2017d; 2018b; 2018c; 2018d; 2019b; 2019c; 2019d). 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 a period of 88 days, between 15 October2019 and 10 January 2020. During the survey, counts of individuals of the two species(Golden Plover *Pluvialisapricaria* and Song Thrush *Turdusphilomelos*) 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 arerepresented 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 locationsin coastal areas. 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.

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

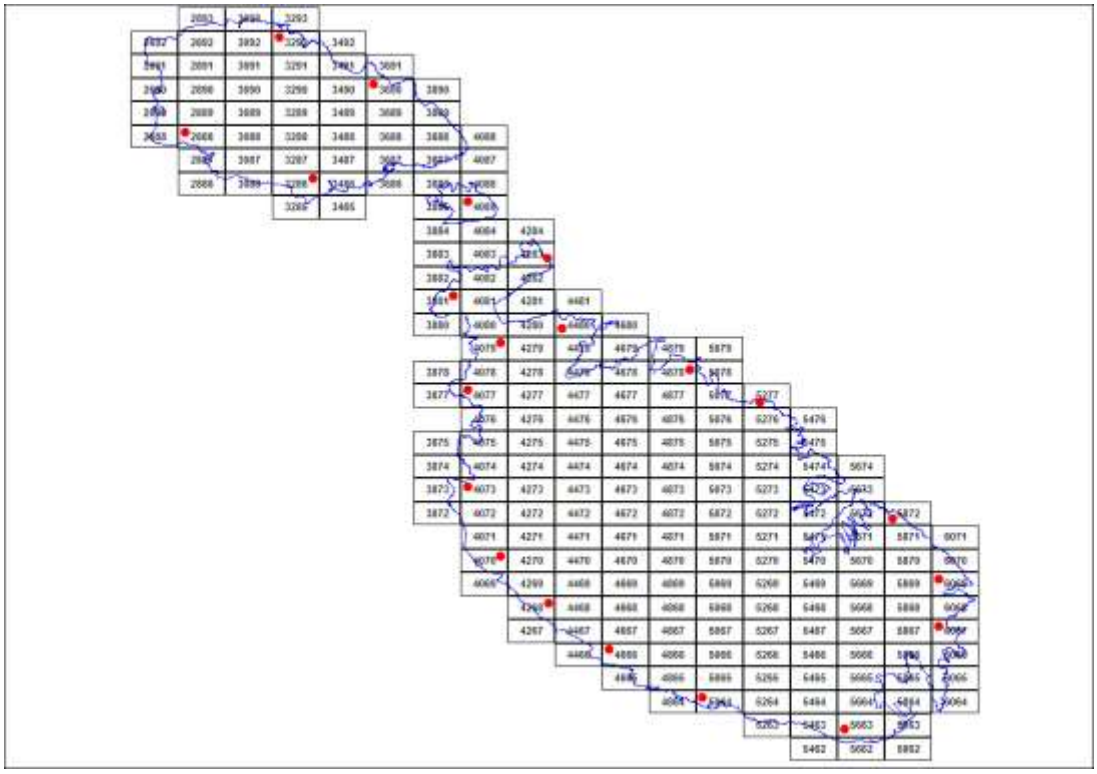

Figure 1. Map of the Maltese Islands showing the localities (grid cells indicated by the red filled circle) where the bird counts were made; see also Table 1.

Monitoring of Golden Plover and Song Thrush was made between 09:00 and 14:00 during the first thirteen 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.

Data analysis

Using the recorded raw data for each of the two bird species, estimates were made of the mean daily count and total countfor the study period (15October 2019 to 10 January 2020). 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 late 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/winter 2019) 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 **006-20**. The sample reference codes for the bird count data are **B-353-19** to **B-394-19**.

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

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

and 3.50 (Table 2). Most of the counts for this species were recorded between mid-November and early January. The total counts, i.e. the total number of Golden Plover individuals recorded from a given grid location (= study site) during the whole study period (88 days),variedappreciably between the different sites: at the lower end, only two individuals were recorded throughout the survey period from the sites at grid locations6069, 3268 and 5872, while at the higher end, 70Golden Plover individuals were recorded from the site at grid location 4085 (which was surveyed daily).

Values of mean daily counts and total counts of Golden Plover recorded during the period 15 October 2019 to 10 January 2020 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, 2017 and 2018 surveys, are shown graphically in Figure 2. Overall, count values for Golden Plover from the present (autumn/winter 2019) survey show a similar trend to those recorded in the previous autumn surveys, with higher count values recorded during the period mid-November to early January.

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 1,899 individuals, with a total influx over the survey period (15 October 2019 – 10 January 2020; i.e. 88 days) of 21,245individuals, i.e. some 241 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 Fawwara (Grid 4666) located in western Malta, while relatively high counts were also recorded from other sites located on the western coast of Malta and from the site in Comino. Very low counts for this species were recorded from study sites located in southern Malta and from Ta Ċenċ(Grid 3292) in Gozo.

Table 2

Values of mean (± 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
15-Oct-19	1.00	± 2.45	6	542
16-Oct-19	0.00	± 0.00	0	0
17-Oct-19	0.00	± 0.00	0	0
18-Oct-19	0.00	± 0.00	0	0
19-Oct-19	0.00	± 0.00	0	0
20-Oct-19	0.00	± 0.00	0	0
21-Oct-19	0.00	± 0.00	0	0
22-Oct-19	0.00	± 0.00	0	0
23-Oct-19	0.00	± 0.00	0	0
24-Oct-19	0.00	± 0.00	0	0
25-Oct-19	0.00	± 0.00	0	0
26-Oct-19	0.00	± 0.00	0	0
27-Oct-19	0.00	± 0.00	0	0
28-Oct-19	0.00	± 0.00	0	0
29-Oct-19	0.00	± 0.00	0	0
30-Oct-19	0.00	± 0.00	0	0
31-Oct-19	0.00	± 0.00	0	0

Date	Mean daily count	Standard deviation	Total daily count	Estimated daily influx
01-Nov-19	0.00	± 0.00	0	0
02-Nov-19	0.00	± 0.00	0	0
03-Nov-19	0.00	± 0.00	0	0
04-Nov-19	0.00	± 0.00	0	0
05-Nov-19	0.00	± 0.00	0	0
06-Nov-19	0.00	± 0.00	0	0
07-Nov-19	0.00	± 0.00	0	0
08-Nov-19	0.00	± 0.00	0	0
09-Nov-19	0.17	± 0.41	1	90
10-Nov-19	0.00	± 0.00	0	0
11-Nov-19	0.00	± 0.00	0	0
12-Nov-19	0.67	± 1.21	4	362
13-Nov-19	0.00	± 0.00	0	0
14-Nov-19	0.17	± 0.41	1	90
15-Nov-19	0.33	± 0.52	2	181
16-Nov-19	0.33	± 0.82	2	181
17-Nov-19	0.00	± 0.00	0	0
18-Nov-19	0.33	± 0.82	2	181
19-Nov-19	0.17	± 0.41	1	90
20-Nov-19	0.33	± 0.82	2	181
21-Nov-19	0.00	± 0.00	0	0
22-Nov-19	0.00	± 0.00	0	0
23-Nov-19	0.67	± 1.63	4	362
24-Nov-19	0.33	± 0.52	2	181
25-Nov-19	1.33	± 2.80	8	723
26-Nov-19	2.33	± 4.27	14	1266
27-Nov-19	1.00	± 0.89	6	542
28-Nov-19	0.00	± 0.00	0	0
29-Nov-19	0.50	± 0.84	3	271
30-Nov-19	3.50	± 6.69	21	1899
01-Dec-19	2.67	± 2.66	16	1447
02-Dec-19	1.00	± 1.26	6	542
03-Dec-19	1.00	± 2.45	6	542
04-Dec-19	0.50	± 1.22	3	271
05-Dec-19	0.50	± 1.22	3	271
06-Dec-19	0.67	± 1.63	4	362
07-Dec-19	0.83	± 0.98	5	452
08-Dec-19	1.17	± 1.33	7	633
09-Dec-19	0.17	± 0.41	1	90
10-Dec-19	1.17	± 1.94	7	633
11-Dec-19	0.83	± 2.04	5	452
12-Dec-19	1.17	± 1.60	7	633
13-Dec-19	0.83	± 1.33	5	452
14-Dec-19	0.17	± 0.41	1	90
15-Dec-19	1.33	± 1.97	8	723
16-Dec-19	0.00	± 0.00	0	0
17-Dec-19	0.50	± 1.22	3	271
18-Dec-19	0.67	± 1.03	4	362
19-Dec-19	0.33	± 0.82	2	181
20-Dec-19	0.17	± 0.41	1	90
21-Dec-19	0.67	± 1.63	4	362
22-Dec-19	0.67	± 1.03	4	362

Date	Mean daily count	Standard deviation	Total daily count	Estimated daily influx
23-Dec-19	0.00	± 0.00	0	0
24-Dec-19	0.67	± 1.03	4	362
25-Dec-19	0.00	± 0.00	0	0
26-Dec-19	0.33	± 0.52	2	181
27-Dec-19	0.50	± 0.84	3	271
28-Dec-19	0.33	± 0.82	2	181
29-Dec-19	0.67	± 1.21	4	362
30-Dec-19	0.50	± 0.84	3	271
31-Dec-19	0.67	± 0.82	4	362
01-Jan-20	0.33	± 0.82	2	181
02-Jan-20	0.50	± 0.84	3	271
03-Jan-20	0.00	± 0.00	0	0
04-Jan-20	0.83	± 1.60	5	452
05-Jan-20	0.17	± 0.41	1	90
06-Jan-20	0.17	± 0.41	1	90
07-Jan-20	0.67	± 1.63	4	362
08-Jan-20	1.83	± 2.56	11	994
09-Jan-20	0.67	± 1.03	4	362
10-Jan-20	0.17	± 0.41	1	90
Total Count / Estimated Influx			**235**	**21,245**

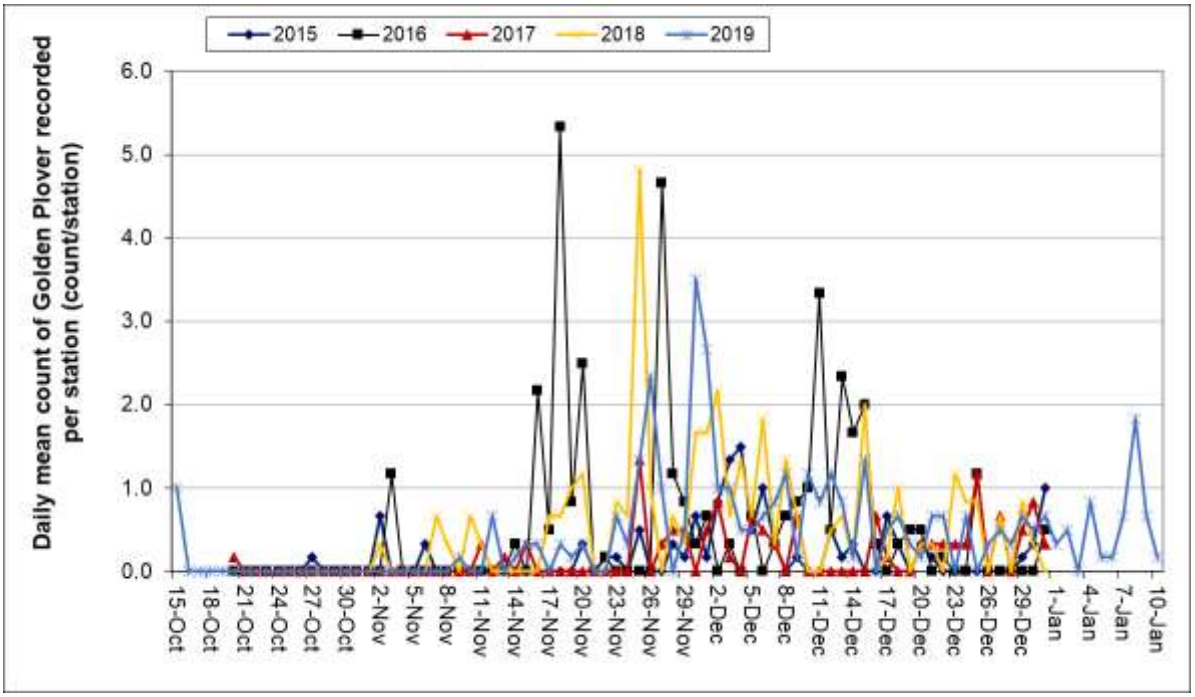

Figure 2. Daily mean counts of Golden Ploverper station (= site) recorded between 15 October 2019 and10 January 2020 during the present (2019) and between 20 October and 31 December during previous (2015, 2016, 2017, 2018) surveys.

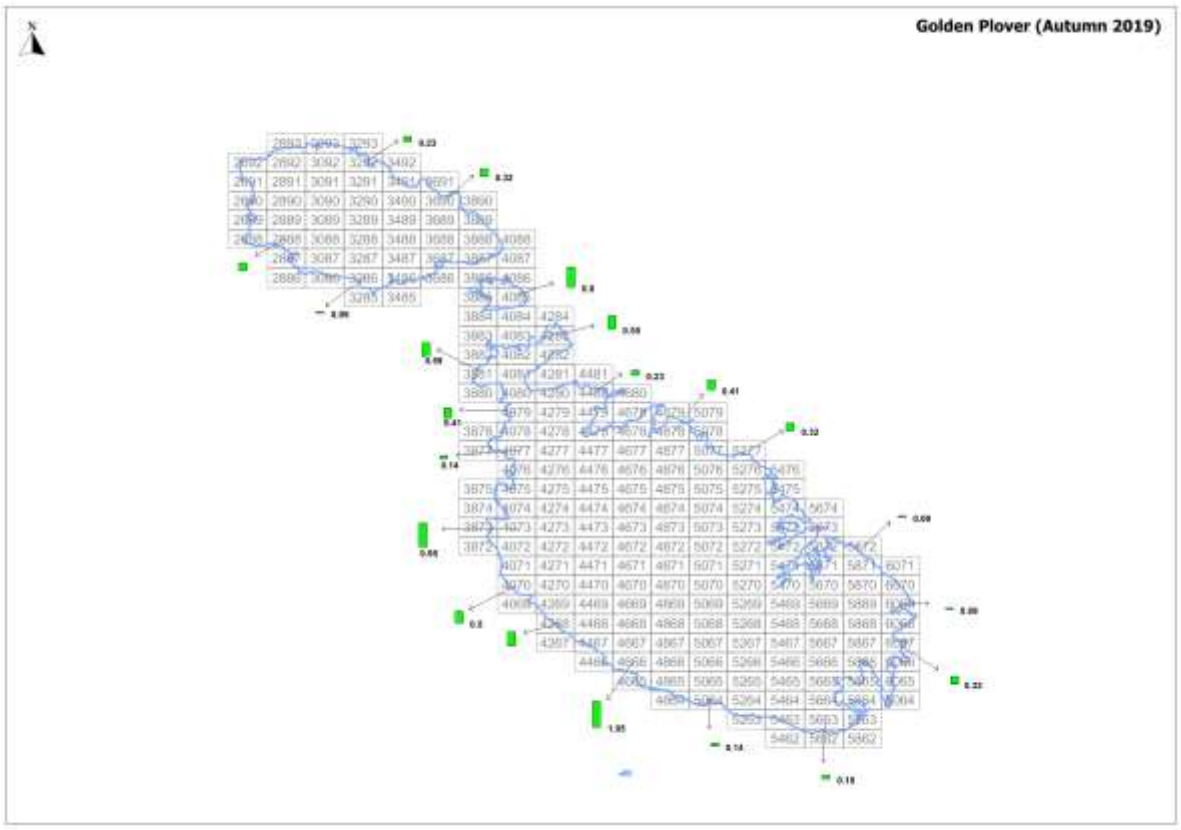

Figure 3. Map of the Maltese Islands showing the standard grid and respective codes, including ones used in the present study. The green bars indicate mean counts of Golden Plover recorded from study sites in the respective cells.

Song Thrush

Raw daily counts for Song Thrush recorded from the 21 sites during the present study varied between 0 and a maximum of 45 (see Appendix I), while the mean daily counts ranged between 0 and 9.17 (Table 3). Comparatively higher counts were recorded between late October and mid-November. The total count, i.e. the total number of Song Thrush individuals recorded from a given grid location (= study site) during the whole study period (88 days), varied appreciably between the different sites: at the lower enda total of five individuals wasrecorded throughout the survey period from the siteat grid location 6069, while at the higher end95Song Thrush individuals were recorded from the site at grid location 4085, which was surveyed daily, and 59 Song Thrush individuals were recorded from the site at grid location 4073.

Values of mean daily counts and total counts of Song Thrush recorded during the period 15 October 2019 to 10 January 2020 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, 2017 and 2018 surveys, are shown graphically in Figure 4. Overall, count values for Song Thrush from the present (autumn/winter 2019) 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 4,972 individuals, with a total influx over the survey period (15 October 2019 – 10January 2020; i.e. 88 days) of 48,272 individuals, i.e. some 549 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 counts were recorded fromFommir-Riħ (Grid 4073) in northwestern Malta and Marsalforn (Grid 3292) in Gozo, while comparatively high mean counts were also recorded from other sites located on the northern coast of Malta, from Comino and from Ta Ċenċ (Grid 3268) inGozo. The lowest counts for this species were recorded from study sites in the southern coasts of Malta.

Table 3

Values of mean (± 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
15-Oct-19	1.00	± 1.26	6	542
16-Oct-19	3.00	± 2.97	18	1627
17-Oct-19	1.33	± 1.63	8	723
18-Oct-19	1.00	± 0.63	6	542
19-Oct-19	1.50	± 1.97	9	814
20-Oct-19	1.17	± 1.60	7	633
21-Oct-19	3.33	± 3.14	20	1808
22-Oct-19	9.17	± 17.75	55	4972
23-Oct-19	5.83	± 4.17	35	3164
24-Oct-19	4.17	± 4.79	25	2260
25-Oct-19	2.33	± 1.97	14	1266
26-Oct-19	5.33	± 6.74	32	2893
27-Oct-19	3.67	± 3.44	22	1989
28-Oct-19	3.67	± 1.97	22	1989
29-Oct-19	3.33	± 4.80	20	1808
30-Oct-19	2.00	± 3.03	12	1085
31-Oct-19	1.67	± 1.86	10	904
01-Nov-19	1.83	± 2.32	11	994
02-Nov-19	3.83	± 2.99	23	2079
03-Nov-19	2.00	± 1.55	12	1085
04-Nov-19	1.17	± 1.17	7	633
05-Nov-19	2.83	± 4.07	17	1537
06-Nov-19	2.83	± 6.01	17	1537
07-Nov-19	0.33	± 0.82	2	181
08-Nov-19	1.67	± 3.61	10	904
09-Nov-19	0.67	± 1.63	4	362
10-Nov-19	0.50	± 0.84	3	271
11-Nov-19	1.00	± 2.00	6	542
12-Nov-19	0.00	± 0.00	0	0
13-Nov-19	0.67	± 1.21	4	362
14-Nov-19	0.67	± 1.63	4	362
15-Nov-19	0.17	± 0.41	1	90
16-Nov-19	0.50	± 1.22	3	271
17-Nov-19	2.17	± 2.71	13	1175
18-Nov-19	0.67	± 1.21	4	362
19-Nov-19	1.00	± 1.26	6	542
20-Nov-19	0.17	± 0.41	1	90

Date	Mean daily count	Standard deviation	Total daily count	Estimated daily influx
21-Nov-19	1.17	± 2.40	7	633
22-Nov-19	0.33	± 0.82	2	181
23-Nov-19	0.33	± 0.82	2	181
24-Nov-19	1.00	± 2.45	6	542
25-Nov-19	0.17	± 0.41	1	90
26-Nov-19	0.67	± 0.82	4	362
27-Nov-19	0.67	± 1.03	4	362
28-Nov-19	0.17	± 0.41	1	90
29-Nov-19	0.50	± 1.22	3	271
30-Nov-19	0.00	± 0.00	0	0
01-Dec-19	0.67	± 1.63	4	362
02-Dec-19	0.50	± 1.22	3	271
03-Dec-19	0.50	± 1.22	3	271
04-Dec-19	0.00	± 0.00	0	0
05-Dec-19	0.00	± 0.00	0	0
06-Dec-19	0.67	± 1.63	4	362
07-Dec-19	0.17	± 0.41	1	90
08-Dec-19	0.00	± 0.00	0	0
09-Dec-19	0.00	± 0.00	0	0
10-Dec-19	0.00	± 0.00	0	0
11-Dec-19	0.00	± 0.00	0	0
12-Dec-19	0.00	± 0.00	0	0
13-Dec-19	0.00	± 0.00	0	0
14-Dec-19	0.33	± 0.82	2	181
15-Dec-19	1.17	± 2.40	7	633
16-Dec-19	0.17	± 0.41	1	90
17-Dec-19	0.00	± 0.00	0	0
18-Dec-19	0.00	± 0.00	0	0
19-Dec-19	0.00	± 0.00	0	0
20-Dec-19	0.00	± 0.00	0	0
21-Dec-19	0.17	± 0.41	1	90
22-Dec-19	0.00	± 0.00	0	0
23-Dec-19	0.00	± 0.00	0	0
24-Dec-19	0.00	± 0.00	0	0
25-Dec-19	0.00	± 0.00	0	0
26-Dec-19	0.00	± 0.00	0	0
27-Dec-19	0.33	± 0.82	2	181
28-Dec-19	0.00	± 0.00	0	0
29-Dec-19	0.00	± 0.00	0	0
30-Dec-19	0.17	± 0.41	1	90
31-Dec-19	0.17	± 0.41	1	90
01-Jan-20	0.00	± 0.00	0	0
02-Jan-20	0.00	± 0.00	0	0
03-Jan-20	0.33	± 0.82	2	181
04-Jan-20	0.00	± 0.00	0	0
05-Jan-20	0.00	± 0.00	0	0
06-Jan-20	0.17	± 0.41	1	90
07-Jan-20	0.17	± 0.41	1	90
08-Jan-20	0.17	± 0.41	1	90
09-Jan-20	0.00	± 0.00	0	0
10-Jan-20	0.00	± 0.00	0	0

Date	Mean daily count	Standard deviation	Total daily count	Estimated daily influx
Total Count / Estimated Influx			534	48,272

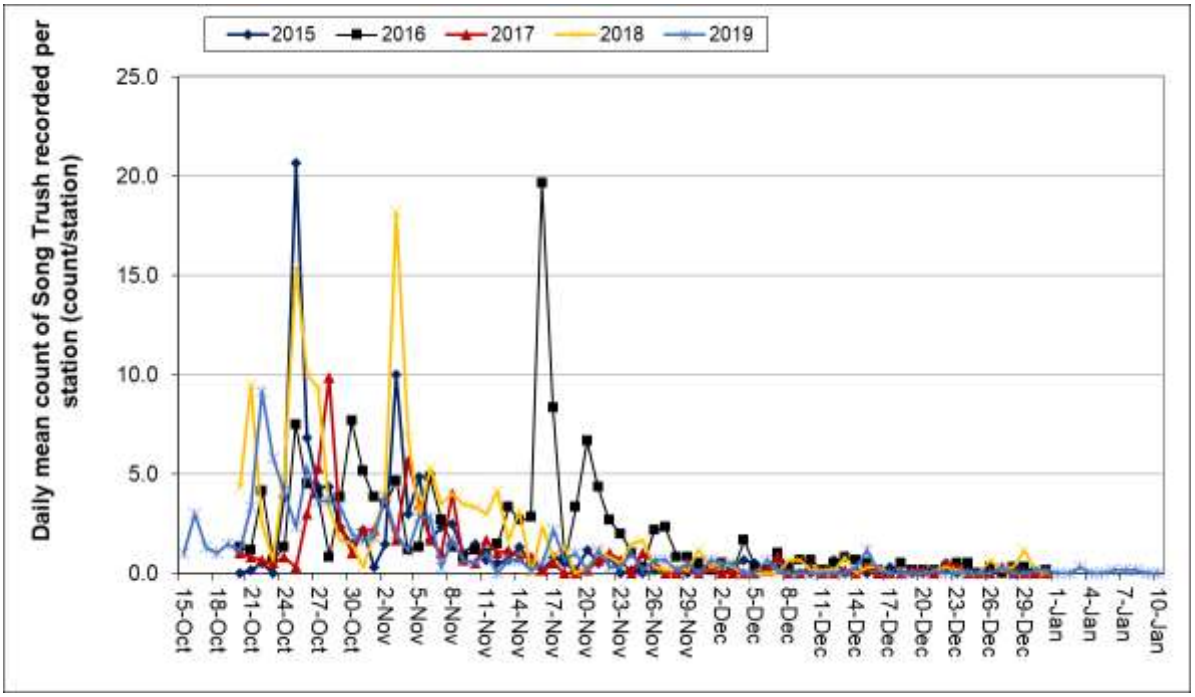

Figure 4. Daily mean counts of Song Thrushper station (= site) recorded between 15 October 2019 and10 January 2020 during the present (2019) and between 20 October and 31 December during previous (2015, 2016, 2017, 2018) surveys.

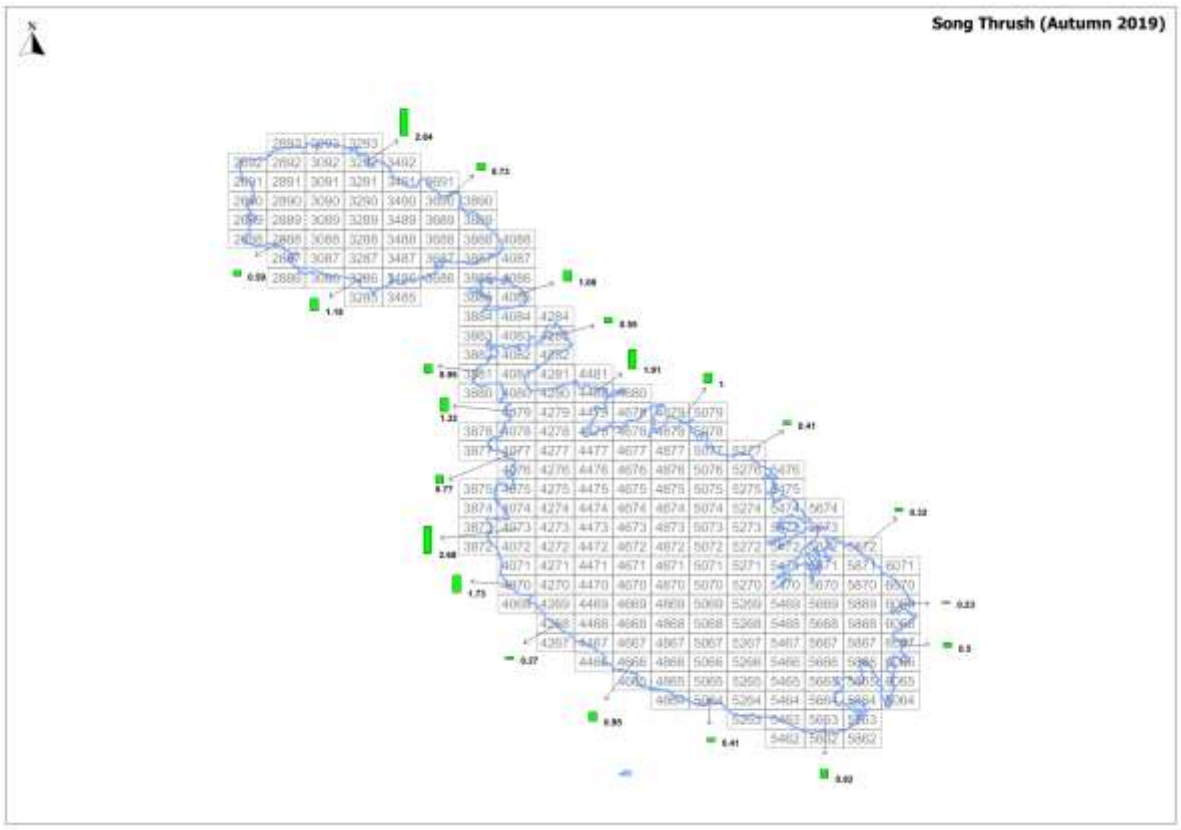

Figure 5. Map of the Maltese Islands showing the standard grid and respective codes, including ones used in the present study. The green bars indicate mean counts of Song Thrush recorded from study sites in the respective cells.

4. Comparison withbagdata

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 period01 November2019 to 10 January 2020 in the case of Golden Plover and for the period 20 October 2019 to 31 December 2019 in the case of Song Thrush.

Graphical representations of the mean daily counts made during the present (2019) survey and the daily bag counts for the same time period (15 October – 10 January) in 2019 (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 smoothening out theday 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 2019 live-capturing season and the mean daily counts of the same species made during the present (2019) 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 2019 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 2019 survey are plotted on the right-side y-axis.

Overall, the highest daily counts made during the 2019 survey occurred between mid-November and early January, with a peak on30November. Bag counts in 2019 were nil throughout October when the season was not open, low inearly November and increased between mid-November and early January, with a peak on30 November. Thus, the general trend observed in the bag counts for 2019 and the daily counts recorded during the 2019 survey is of higher counts starting in mid-Novemberand continuing until early January, with a peak at the end of November.

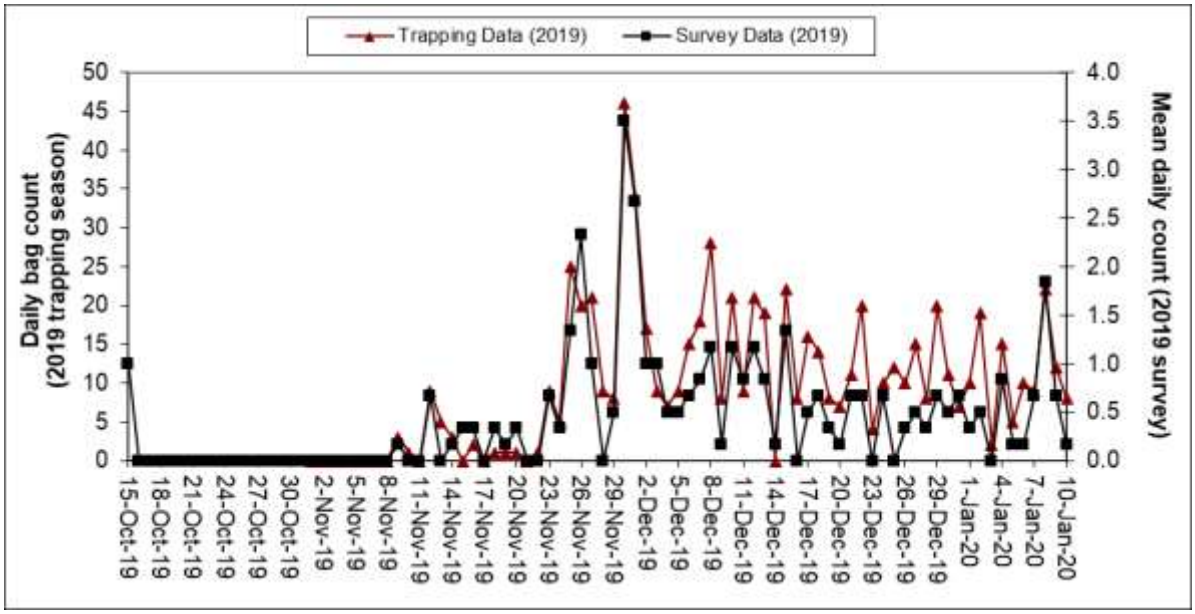

Figure 6. Daily bag count of Golden Plover for the period 01 November 2019 to 10 January 2020 (red line; values on left-side y-axis), together with the mean daily counts recorded during the 2019migration survey (black line; values on right-side y-axis) for the period 15 October 2019 to 10 January 2020.

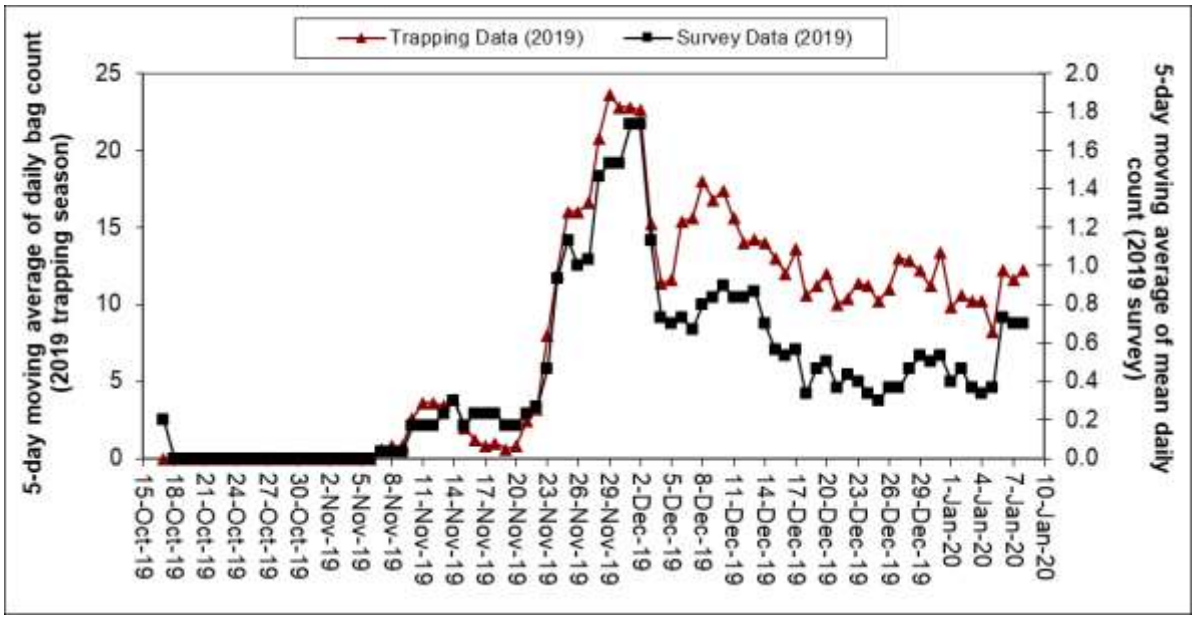

Figure 7. Moving average based on a 5-day rolling time period of the daily bag counts of Golden Plover for the period 01 November 2019 to 10 January 2020 (red line; values on left-side y-axis), and of the mean daily counts recorded during the 2019 migration survey (black line; values on right-side y-axis) for the period 15 October 2019 to 10 January 2020.

Song Thrush

The daily bag counts indicating the number of Song Thrush caught during the 2019 live-capturing season and the mean daily counts of the same species made during the present (2019) 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 2019 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 2019 survey are plotted on the right-side y-axis.

Overall, the highest daily counts made during the 2019 survey occurred between mid-October and mid-November, with counts declining thereafter; most days in December and January were characterised by low or zero counts. The highest bag counts in 2019 also occurred between mid-October and mid-November, and decreased thereafter. Thus, the general trend observed in the bag counts for 2019 and the daily counts recorded during the 2019 survey is of higher counts in the earlier part of the live-capturing season, up to around mid-November.

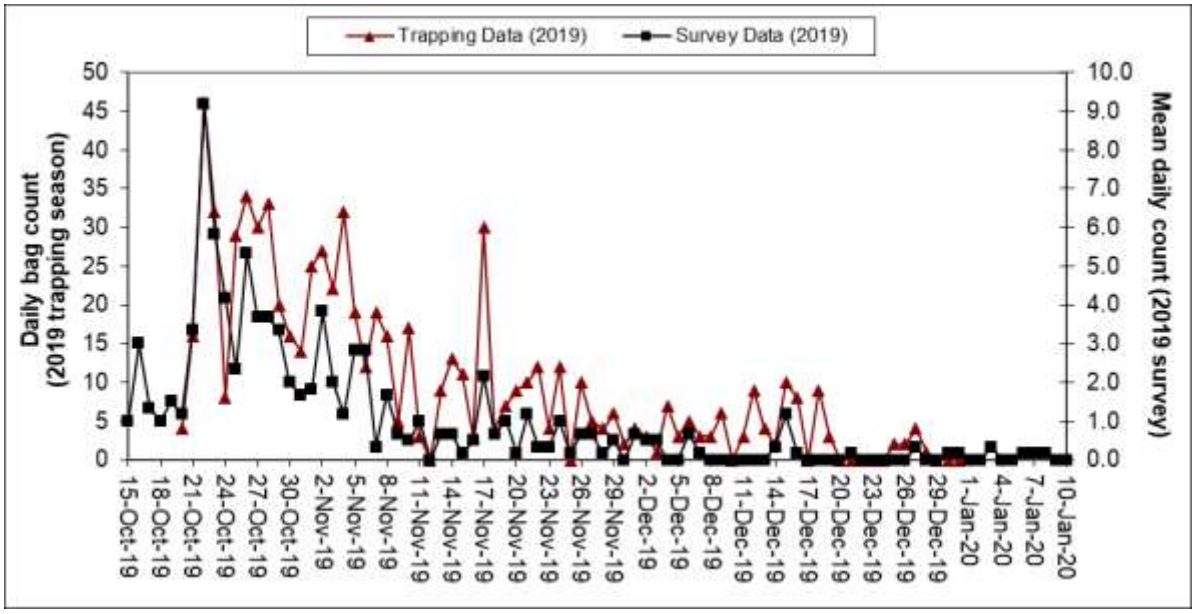

Figure 8. Daily bag count of Song Thrush for the period 01 November 2019 to 10 January 2020 (red line; values on left-side y-axis), together with the mean daily counts recorded during the 2019 migration survey (black line; values on right-side y-axis) for the period 15 October 2019 to 10 January 2020.

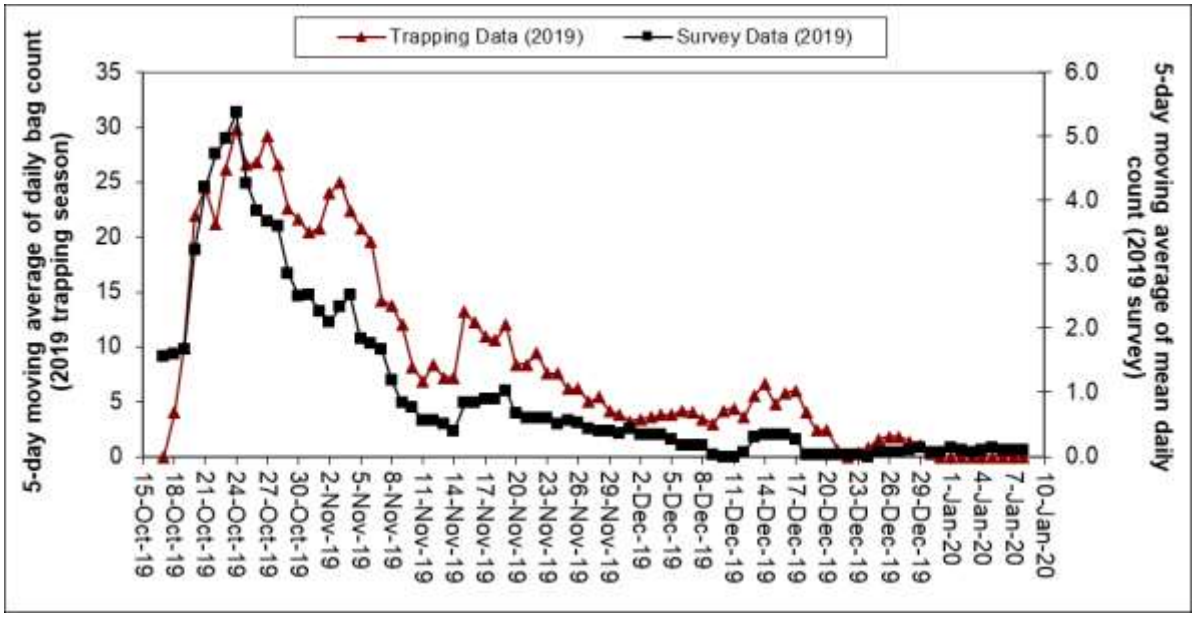

Figure 9. Moving average based on a 5-day rolling time period of the daily bag counts of Song Thrush for the period 01 November 2019 to 10 January 2020 (red line; values on left-side y-axis), and of the mean daily counts recorded during the 2019 migration survey (black line; values on right-side y-axis) for the period 15 October 2019 to 10 January 2020.

5. Appraisal

The present survey provides data on mean daily counts of Golden Plover (*Pluvialisapricaria*) and Song Thrush (*Turdusphilomelos*) recorded during the study period held between15 October 2019 and 10January 2020, together with estimates of the migratory influx of the two species. Government had established the autumn/winter live-capturing season for these species(01 November 2019 to 10 January 2020 for Golden Plover; 20 October to 31 December 2019 for Song Thrush), which overlapped with the period of the present study.

The mean daily counts from the present survey indicate thathigher countsfor Golden Plover were recorded betweenmid-November to early January, while for Song Thrush higher counts were recorded between mid-October and mid-November. The higher values recorded on certain dates indicate a general trend of migratory influx during mid-November to early January for Golden Plover, and during mid-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 thevalues 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 (15October 2019 – 10 January 2020) was estimated at21,245 for Golden Plover and 48,272 for Song Thrush. When comparing the present results with those from the autumn 2015, 2016, 2017and 2018surveys (Ecoserv, 2016a, 2017a, 2018a, 2019a), the following overall observations are noted:

- The migratory influx of Golden Plover recorded from the present autumn/winter 2019 survey is similar to those recorded during the autumn 2016 and 2018 surveys, and higher than those recorded during the autumn 2015 and 2017 surveys. The total influx of this species recorded in autumn 2016,2018 and 2019is nearly three times higher than that recorded during the autumn 2015 and 2017 surveys; this can be attributed to migratory peaks recorded during the 2016,2018 and 2019surveys, since no such peaks for Golden Plover were recorded in the 2015and 2017 surveys.
- In the case of Song Thrush, the migratory influx recorded from the present autumn/winter 2019 survey is similar to those recorded during the autumn 2015 and 2017 surveys, and lower than those recorded during the autumn 2016 and 2018 surveys. The influxrecorded during the autumn 2016 and 2018 surveysis about twice as high as that recorded during the autumn 2015, 2017 and 2019 surveys. This can also be attributed to the presence of more migratory peaks during autumn 2016 and 2018.
- When comparing data from 2019 with those from 2015, 2016, 2017 and 2018 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 sameperiod 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 15 October 2019) 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 a88-day period between 15 October2019 and 10 January 2020, 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 (2017d). Report on a survey of the influx of migratory Common Quail and Turtle Dove over the Maltese Islands, made in during September and October 2017. Malta, unpublished report; 51pp.

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Ecoserv (2018b). Report on a survey of the influx of migratory finches (Linnet, Chaffinch, Serin, Goldfinch, Greenfinch, Hawfinch, and Siskin) over the Maltese Islands, made between October and December 2017. Malta, unpublished report; 87pp.

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APPENDIX I - Raw counts

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

Ecoserv Sample Reference Code	B-353-19	B-354-19	B-355-19	B-356-19	B-357-19	B-358-19	B-359-19	B-360-19	B-361-19	B-362-19	B-363-19
Grid Location	**4085**	**3292**	**4079**	**4268**	**6067**	**4878**	**2888**	**4077**	**4666**	**6069**	**4480**
15-Oct-19	0										
16-Oct-19	0	0	0	0	0	0					
17-Oct-19	0						0	0	0	0	0
18-Oct-19	0										
19-Oct-19	0										
20-Oct-19	0	0	0	0	0	0					
21-Oct-19	0						0	0	0	0	0
22-Oct-19	0										
23-Oct-19	0										
24-Oct-19	0	0	0	0	0	0					
25-Oct-19	0						0	0	0	0	0
26-Oct-19	0										
27-Oct-19	0										
28-Oct-19	0	0	0	0	0	0					
29-Oct-19	0						0	0	0	0	0
30-Oct-19	0										
31-Oct-19	0										
01-Nov-19	0	0	0	0	0	0					
02-Nov-19	0						0	0	0	0	0
03-Nov-19	0										
04-Nov-19	0										
05-Nov-19	0	0	0	0	0	0					
06-Nov-19	0						0	0	0	0	0
07-Nov-19	0										
08-Nov-19	0										
09-Nov-19	0	0	1	0	0	0					
10-Nov-19	0						0	0	0	0	0

Ecoserv Sample Reference Code	B-353-19	B-354-19	B-355-19	B-356-19	B-357-19	B-358-19	B-359-19	B-360-19	B-361-19	B-362-19	B-363-19
11-Nov-19	0										
12-Nov-19	0										
13-Nov-19	0	0	0	0	0	0					
14-Nov-19	1						0	0	0	0	0
15-Nov-19	1										
16-Nov-19	0										
17-Nov-19	0	0	0	0	0	0					
18-Nov-19	0						0	0	0	0	2
19-Nov-19	0										
20-Nov-19	0										
21-Nov-19	0	0	0	0	0	0					
22-Nov-19	0						0	0	0	0	0
23-Nov-19	0										
24-Nov-19	0										
25-Nov-19	1	0	0	0	0	7					
26-Nov-19	11						1	1	1	0	0
27-Nov-19	2										
28-Nov-19	0										
29-Nov-19	0	1	0	2	0	0					
30-Nov-19	2						0	0	17	0	2
01-Dec-19	4										
02-Dec-19	3										
03-Dec-19	6	0	0	0	0	0					
04-Dec-19	3						0	0	0	0	0
05-Dec-19	0										
06-Dec-19	0										
07-Dec-19	1	2	2	0	0	0					
08-Dec-19	3						2	0	0	2	0
09-Dec-19	0										
10-Dec-19	1										
11-Dec-19	5	0	0	0	0	0					
12-Dec-19	4						2	0	0	0	1

Ecoserv Sample Reference Code	B-353-19	B-354-19	B-355-19	B-356-19	B-357-19	B-358-19	B-359-19	B-360-19	B-361-19	B-362-19	B-363-19
13-Dec-19	2										
14-Dec-19	1										
15-Dec-19	1	0	2	5	0	0					
16-Dec-19	0						0	0	0	0	0
17-Dec-19	0										
18-Dec-19	2										
19-Dec-19	0	0	2	0	0	0					
20-Dec-19	1						0	0	0	0	0
21-Dec-19	0										
22-Dec-19	2										
23-Dec-19	0	0	0	0	0	0					
24-Dec-19	2						0	2	0	0	0
25-Dec-19	0										
26-Dec-19	0										
27-Dec-19	0	0	1	0	0	2					
28-Dec-19	0						0	0	2	0	0
29-Dec-19	3										
30-Dec-19	0										
31-Dec-19	0	2	0	1	1	0					
01-Jan-20	0						0	0	2	0	0
02-Jan-20	2										
03-Jan-20	0										
04-Jan-20	0	0	1	4	0	0					
05-Jan-20	0						0	0	1	0	0
06-Jan-20	0										
07-Jan-20	0										
08-Jan-20	4	0	0	1	6	0					
09-Jan-20	2						2	0	0	0	0
10-Jan-20	0										

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

Ecoserv Sample Reference Code	B-364-19	B-365-19	B-366-19	B-367-19	B-368-19	B-369-19	B-370-19	B-371-19	B-372-19	B-373-19
Grid Location	**3268**	**4073**	**5064**	**5872**	**4283**	**3690**	**3881**	**4070**	**5663**	**5277**
15-Oct-19						6	0	0	0	0
16-Oct-19										
17-Oct-19										
18-Oct-19	0	0	0	0	0					
19-Oct-19						0	0	0	0	0
20-Oct-19										
21-Oct-19										
22-Oct-19	0	0	0	0	0					
23-Oct-19						0	0	0	0	0
24-Oct-19										
25-Oct-19										
26-Oct-19	0	0	0	0	0					
27-Oct-19						0	0	0	0	0
28-Oct-19										
29-Oct-19										
30-Oct-19	0	0	0	0	0					
31-Oct-19						0	0	0	0	0
01-Nov-19										
02-Nov-19										
03-Nov-19	0	0	0	0	0					
04-Nov-19						0	0	0	0	0
05-Nov-19										
06-Nov-19										
07-Nov-19	0	0	0	0	0					
08-Nov-19						0	0	0	0	0
09-Nov-19										
10-Nov-19										
11-Nov-19	0	0	0	0	0					
12-Nov-19						0	3	1	0	0

Ecoserv Sample Reference Code	B-364-19	B-365-19	B-366-19	B-367-19	B-368-19	B-369-19	B-370-19	B-371-19	B-372-19	B-373-19
13-Nov-19										
14-Nov-19										
15-Nov-19	0	0	0	1	0					
16-Nov-19						0	0	2	0	0
17-Nov-19										
18-Nov-19										
19-Nov-19	0	1	0	0	0					
20-Nov-19						0	0	2	0	0
21-Nov-19										
22-Nov-19										
23-Nov-19	0	4	0	0	0					
24-Nov-19						0	1	0	0	1
25-Nov-19										
26-Nov-19										
27-Nov-19	1	2	0	1	0					
28-Nov-19						0	0	0	0	0
29-Nov-19										
30-Nov-19										
01-Dec-19	1	6	0	0	5					
02-Dec-19						0	2	0	1	0
03-Dec-19										
04-Dec-19										
05-Dec-19	0	0	3	0	0					
06-Dec-19						0	0	0	0	4
07-Dec-19										
08-Dec-19										
09-Dec-19	0	1	0	0	0					
10-Dec-19						0	1	5	0	0
11-Dec-19										
12-Dec-19										
13-Dec-19	0	3	0	0	0					
14-Dec-19						0	0	0	0	0

Ecoserv Sample Reference Code	B-364-19	B-365-19	B-366-19	B-367-19	B-368-19	B-369-19	B-370-19	B-371-19	B-372-19	B-373-19
15-Dec-19										
16-Dec-19										
17-Dec-19	0	3	0	0	0					
18-Dec-19						0	2	0	0	0
19-Dec-19										
20-Dec-19										
21-Dec-19	0	0	0	0	4					
22-Dec-19						0	0	0	0	2
23-Dec-19										
24-Dec-19										
25-Dec-19	0	0	0	0	0					
26-Dec-19						0	0	1	1	0
27-Dec-19										
28-Dec-19										
29-Dec-19	0	0	0	0	1					
30-Dec-19						1	0	0	2	0
31-Dec-19										
01-Jan-20										
02-Jan-20	0	1	0	0	0					
03-Jan-20						0	0	0	0	0
04-Jan-20										
05-Jan-20										
06-Jan-20	0	0	0	0	1					
07-Jan-20						0	4	0	0	0
08-Jan-20										
09-Jan-20										
10-Jan-20	0	0	0	0	1					

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

Ecoserv Sample Reference Code	B-374-19	B-375-19	B-376-19	B-377-19	B-378-19	B-379-19	B-380-19	B-381-19	B-382-19	B-383-19	B-384-19
Grid Location	**4085**	**3292**	**4079**	**4268**	**6067**	**4878**	**2888**	**4077**	**4666**	**6069**	**4480**
15-Oct-19	3										
16-Oct-19	9	2	2	2	2	1					
17-Oct-19	2						0	2	4	0	0
18-Oct-19	1										
19-Oct-19	0										
20-Oct-19	2	1	0	4	0	0					
21-Oct-19	1						5	5	8	1	0
22-Oct-19	2										
23-Oct-19	5										
24-Oct-19	4	5	13	0	0	3					
25-Oct-19	3						4	0	1	1	5
26-Oct-19	18										
27-Oct-19	8										
28-Oct-19	3	5	5	0	5	4					
29-Oct-19	10						1	0	0	0	9
30-Oct-19	0										
31-Oct-19	3										
01-Nov-19	3	6	0	0	1	1					
02-Nov-19	3						3	5	3	0	9
03-Nov-19	1										
04-Nov-19	1										
05-Nov-19	0	9	0	0	1	7					
06-Nov-19	0						0	0	0	2	15
07-Nov-19	0										
08-Nov-19	1										
09-Nov-19	0	4	0	0	0	0					
10-Nov-19	2						0	0	1	0	0
11-Nov-19	0										
12-Nov-19	0										

Ecoserv Sample Reference Code	B-374-19	B-375-19	B-376-19	B-377-19	B-378-19	B-379-19	B-380-19	B-381-19	B-382-19	B-383-19	B-384-19
13-Nov-19	0	3	1	0	0	0					
14-Nov-19	0						0	4	0	0	0
15-Nov-19	1										
16-Nov-19	0										
17-Nov-19	0	6	2	0	0	5					
18-Nov-19	1						0	0	0	0	3
19-Nov-19	1										
20-Nov-19	0										
21-Nov-19	0	6	0	0	1	0					
22-Nov-19	0						0	0	2	0	0
23-Nov-19	0										
24-Nov-19	0										
25-Nov-19	0	1	0	0	0	0					
26-Nov-19	0						0	0	2	1	1
27-Nov-19	2										
28-Nov-19	0										
29-Nov-19	0	3	0	0	0	0					
30-Nov-19	0						0	0	0	0	0
01-Dec-19	4										
02-Dec-19	0										
03-Dec-19	0	3	0	0	0	0					
04-Dec-19	0						0	0	0	0	0
05-Dec-19	0										
06-Dec-19	0										
07-Dec-19	0	1	0	0	0	0					
08-Dec-19	0						0	0	0	0	0
09-Dec-19	0										
10-Dec-19	0										
11-Dec-19	0	0	0	0	0	0					
12-Dec-19	0						0	0	0	0	0
13-Dec-19	0										
14-Dec-19	0										

Ecoserv Sample Reference Code	B-374-19	B-375-19	B-376-19	B-377-19	B-378-19	B-379-19	B-380-19	B-381-19	B-382-19	B-383-19	B-384-19
15-Dec-19	0	0	6	0	0	1					
16-Dec-19	0						0	1	0	0	0
17-Dec-19	0										
18-Dec-19	0										
19-Dec-19	0	0	0	0	0	0					
20-Dec-19	0						0	0	0	0	0
21-Dec-19	0										
22-Dec-19	0										
23-Dec-19	0	0	0	0	0	0					
24-Dec-19	0						0	0	0	0	0
25-Dec-19	0										
26-Dec-19	0										
27-Dec-19	0	2	0	0	0	0					
28-Dec-19	0						0	0	0	0	0
29-Dec-19	0										
30-Dec-19	0										
31-Dec-19	0	1	0	0	0	0					
01-Jan-20	0						0	0	0	0	0
02-Jan-20	0										
03-Jan-20	0										
04-Jan-20	0	0	0	0	0	0					
05-Jan-20	0						0	0	0	0	0
06-Jan-20	1										
07-Jan-20	0										
08-Jan-20	0	0	0	0	1	0					
09-Jan-20	0						0	0	0	0	0
10-Jan-20	0										

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

Ecoserv Sample Reference Code	B-385-19	B-386-19	B-387-19	B-388-19	B-389-19	B-390-19	B-391-19	B-392-19	B-393-19	B-394-19
Grid Location	**3268**	**4073**	**5064**	**5872**	**4283**	**3690**	**3881**	**4070**	**5663**	**5277**
15-Oct-19						2	1	0	0	0
16-Oct-19										
17-Oct-19										
18-Oct-19	1	0	1	2	1					
19-Oct-19						0	1	4	0	4
20-Oct-19										
21-Oct-19										
22-Oct-19	7	45	0	1	0					
23-Oct-19						2	11	11	4	2
24-Oct-19										
25-Oct-19										
26-Oct-19	1	2	2	1	8					
27-Oct-19						0	6	0	6	2
28-Oct-19										
29-Oct-19										
30-Oct-19	8	2	1	0	1					
31-Oct-19						0	0	3	4	0
01-Nov-19										
02-Nov-19										
03-Nov-19	3	0	4	3	1					
04-Nov-19						0	0	3	2	1
05-Nov-19										
06-Nov-19										
07-Nov-19	0	2	0	0	0					
08-Nov-19						0	0	9	0	0
09-Nov-19										
10-Nov-19										
11-Nov-19	0	5	1	0	0					
12-Nov-19						0	0	0	0	0

Ecoserv Sample Reference Code	B-385-19	B-386-19	B-387-19	B-388-19	B-389-19	B-390-19	B-391-19	B-392-19	B-393-19	B-394-19
13-Nov-19										
14-Nov-19										
15-Nov-19	0	0	0	0	0					
16-Nov-19						3	0	0	0	0
17-Nov-19										
18-Nov-19										
19-Nov-19	2	3	0	0	0					
20-Nov-19						0	0	0	1	0
21-Nov-19										
22-Nov-19										
23-Nov-19	2	0	0	0	0					
24-Nov-19						0	0	6	0	0
25-Nov-19										
26-Nov-19										
27-Nov-19	2	0	0	0	0					
28-Nov-19						0	0	0	1	0
29-Nov-19										
30-Nov-19										
01-Dec-19	0	0	0	0	0					
02-Dec-19						3	0	0	0	0
03-Dec-19										
04-Dec-19										
05-Dec-19	0	0	0	0	0					
06-Dec-19						4	0	0	0	0
07-Dec-19										
08-Dec-19										
09-Dec-19	0	0	0	0	0					
10-Dec-19						0	0	0	0	0
11-Dec-19										
12-Dec-19										
13-Dec-19	0	0	0	0	0					
14-Dec-19						0	0	2	0	0

Ecoserv Sample Reference Code	B-385-19	B-386-19	B-387-19	B-388-19	B-389-19	B-390-19	B-391-19	B-392-19	B-393-19	B-394-19
15-Dec-19										
16-Dec-19										
17-Dec-19	0	0	0	0	0					
18-Dec-19						0	0	0	0	0
19-Dec-19										
20-Dec-19										
21-Dec-19	0	0	0	0	1					
22-Dec-19						0	0	0	0	0
23-Dec-19										
24-Dec-19										
25-Dec-19	0	0	0	0	0					
26-Dec-19						0	0	0	0	0
27-Dec-19										
28-Dec-19										
29-Dec-19	0	0	0	0	0					
30-Dec-19						0	1	0	0	0
31-Dec-19										
01-Jan-20										
02-Jan-20	0	0	0	0	0					
03-Jan-20						2	0	0	0	0
04-Jan-20										
05-Jan-20										
06-Jan-20	0	0	0	0	0					
07-Jan-20						0	1	0	0	0
08-Jan-20										
09-Jan-20										
10-Jan-20	0	0	0	0	0					