Ministry for the Environment, Sustainable Development, and Climate Change

Report on a survey of the influx of migratory Common Quail and Turtle Dove over the Maltese Islands, made in April 2018

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1. Introduction

On 16th January 2018, the Ministry for the Environment, Sustainable Development and Climate Change (hereafter 'MESDC') published a call for tenders bearing reference 160/2017 and titled 'Service tender for an independent scientific study on the influx or passage of migratory Common Quail and Turtle Dove in Malta during the 2018 spring season'. The Terms of Reference (ToR) of the call are as follows:

2 Contract Objectives and Expected Results

2.1 Overall Objectives

The overall objective of the contract is to provide an independent study on the influx or passage of the migratory turtle dove and common quail in Malta during the 2018 Spring season.

2.2 Specific Objectives

The specific objectives of this contract are as follows:

- *To survey and scientifically monitor the daily influx of the Turtle Dove and Common Quail;*
- *To estimate the overall presence (influx) of these two species per day and for the whole study period, subject to scientifically justified assumptions;*
- *To analyse observed and estimated migration trends in conjunction with the trends recorded in past studies, and in conjunction with any hunting data on the species surveyed, if applicable*

2.3 Results to be achieved by the Consultant

The following results are expected to be delivered:

1. *Daily datasheets with raw counts for Turtle Dove and Common Quail;*

2. *A monitoring report for Spring 2018 season which must include:*
   a) *List of monitoring stations which recorded high/low counts;*
   b) *Dates which indicate high/low peaks in the migration of the Turtle Dove and Common Quail;*
   c) *A daily estimate of the influx of these two 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) *A comparative analysis with the results of previous studies commissioned during Spring 2008 & 2009; 2012; 2013, 2014, 2015, 2016 and 2017. Reports available on: http://environment.gov.mt/en/Pages/WBRU/Reports-and-Statistics.aspx*
   f) *A comparison between the results of the present study and any hunting data on the species surveyed, if applicable.*

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 the Turtle Dove and Common Quail over the Maltese islands during the period stipulated in Section 3 Article 18. 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 24 in number, of which at least 10 stations are to be active on any given day during the monitoring period). It shall be the responsibility of the consultant to ensure that the monitoring stations (at least 10 in number on any given day), are manned by a sufficient number of ornithologists and/or field assistants. 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. The consultants shall propose strategies to address the identified risks. These proposals shall be included in the tenderer's technical offer. This tender shall in no way be construed or perceived as obliging the Government or any other relevant authority to take any decision concerning application of any derogation in spring 2018.

4 Scope of the Work

4.1 General

4.1.1 Project Description

The monitoring of the influx or passage of the Turtle Dove and Common Quail shall take place during Spring 2018, on the dates to be specified by the contractor, which monitoring period shall not exceed an aggregate period of 3 weeks. The consultant shall mobilise all staff and equipment by early March, in preparation for the execution of the Spring 2018 bird migration study. The bird monitoring phase shall commence on the date that shall be indicated by the Contracting Authority following award of this tender. Such monitoring commencement date may occur either in the second half of March 2018 or at the beginning of April 2018. The duration of the monitoring phase shall be 3 calendar weeks (21 days) from this monitoring commencement date to be advised by the Contracting Authority.

The bird migration study should comprise the on-field surveying and scientific monitoring of the daily influx of migration of both species concerned. This would provide an independent verification of the level of presence of the two species in Spring and the timing of their migration. This shall be achieved by generating a "Migration Count," that is a count of migrant birds of both species in question in the stipulated time span when monitoring is undertaken. The collection of scientific data to elucidate general population trends for both

species is beyond the scope of this bird migration study. The contractor must submit the daily datasheets with raw counts to the Contracting Authority at the end of each week.

The draft monitoring report and analysis is to be submitted within five working days from the termination of the bird monitoring phase. Once the draft Spring 2018 report has been certified for quality assurance by the Contracting Authority, the final Spring 2018 monitoring report is to be submitted within 5 working days from such a review.

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

Not applicable

4.2 Specific Activities

The bird migration study shall monitor the influx of migratory specimens of the Turtle Dove and the Common Quail, bearing in mind any methodological limitations in the monitoring of these species (as identified in the European Union Management Plan for the Common Quail).

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 24 monitoring stations. Each of these monitoring stations shall be operated on at least two days per week and manned by at least two ornithologists and/or field assistants. The number of active stations on any given day shall be at least 10. 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 appropriate abilities to carry out bird identification in flight and shall specifically have the capacity to identify both Turtle Dove and Quail in the field with ease.

For each day during the bird monitoring phase, at least 10 monitoring stations must be fully manned. The exact number, location and area of the monitoring stations will be determined in consultation with scientific experts who are commissioned to undertake this bird migration study. 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. The location of the monitoring stations shall be selected with care and shall not include areas where the settlement or sighting of the Turtle Dove and the Common Quail cannot in practice occur.

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, particularly nocturnal migrants, 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 Common Quail has a preference for cover and may be more difficult to observe or be detected, the surveys for this species should focus on area searches. These may include, the use of dogs to flush the birds out and/or through the use of line transects (a method where observers traverse the monitoring area in close parallel lines to search the area). Surveys for the Common Quail should be carried out for at least two hours in the morning (prior to 12:00hrs) at each of the monitoring stations in operation.

The surveys of the Turtle Dove, on the other hand, should focus mainly on observations (which should include both specimens observed in flight as well as those alighting within the study site). The monitoring of this species needs to be carried out during the times of maximum activity/ major influx of the Turtle Dove and for a minimum of seven hours at each of the monitoring stations in operation. The consultant may also propose a variation to such methodology, but this shall not take effect unless previously agreed with and confirmed in writing by the Contracting Authority and shall in any case not involve any trapping or any taking of any bird, whether alive or dead, nor any part of any bird.

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 both the Common Quail and Turtle Dove. 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 a maximum of 3 weeks during the Spring migration period, as specified by the Contracting Authority. 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 draft monitoring report and analysis for Spring 2018 is to be submitted within 5 working days from the termination of the Spring 2018 bird monitoring phase. Once such draft report has been certified for quality assurance by the Contracting Authority, the final Spring 2018 monitoring report is to be submitted within 5 working days from such a review. All Spring 2018 project activities must be completed to the Contracting Authority's satisfaction by two weeks from the termination of the Spring 2018 bird monitoring phase.

These activities will result in:
1. *Daily datasheets with raw counts for the Turtle Dove and Common Quail*
2. *A monitoring report for the season.*

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 the Environment, Sustainable Development 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 is the date of signature of the contract and the period of execution of the contract will be 3 months from this date.

6. Requirements

6.1 Personnel

6.1.1 Key Experts

Key Expert 1:

A Project co-ordinator:

i. In possession of a Ph.D. or other academic qualification at MQRIC level 8 related to natural sciences
ii. Able to co-ordinate a team of scientists and scientific experts
iii. Able to conduct environmental monitoring, nature-related and/or ornithological studies

Key Expert 2:

A Scientist:

i. In possession of a Masters degree or other academic qualification at MQRIC level 7 in natural sciences
ii. Able to conduct environmental monitoring, nature-related and/or ornithological studies

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).

6.1.2 Other Experts

CVs for experts other than the key experts are not examined prior to the signature of the contract.

The Contractor shall select and hire other experts as required according to the profiles identified in the Organisation & Methodology and these Terms of Reference. For the purposes of this contract, international experts are considered to be those whose permanent residence is outside the beneficiary country while local experts are considered to be those whose permanent residence is in the beneficiary country.

The Contractor should pay attention to the need to ensure the active participation of local professional skills where available, and a suitable mix of international and local staff in the project teams. 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.

6.1.3 Support Staff and Backstopping

- *The bird migration study is to be supported by ornithologists or field assistants with relevant experience 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 Contractor.

6.3 Facilities to be provided by the Contractor

The Contractor 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 as part of this service contract or transferred to the Contracting Authority 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.*
- *Gun dogs to flush out Common Quails*
- *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 a Report. Such a report is to indicate:

- *the raw counts*
- *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 the Turtle Dove and the Common Quail migrating over the Maltese Islands for each day*
- *an estimated total influx of the Turtle Dove and the Common Quail for the whole study period*
- *assumptions taken for such estimates*
- *an analysis of the observed and estimated migration trends in conjunction with the trends recorded in past studies, and in conjunction with any hunting data on the species surveyed, if applicable*

This report should only concern information/data on the influx of the migratory Turtle Dove and Common Quail 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 Spring 2018 bird monitoring phase. The draft Spring 2018 report and analysis is to be submitted within five working days from the termination of the bird monitoring phase. Once such draft report has been certified for quality assurance by the Contracting Authority, the final Spring 2018 monitoring report is to be submitted within five working days from such a review. All Spring 2018 project activities must be completed to the Contracting Authority's satisfaction within two weeks from the termination of the bird monitoring phase. 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 raw datasheets and the report must be written in English. The Project Manager is responsible for approving the draft monitoring report.

8 Monitoring and Evaluation

8.1 Definition of Indicators

Results	*Objectively verifiable indicators*	*Sources of verifications*
Daily datasheets with raw counts of the Turtle Dove and Common Quail	*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.*
Spring 2018 Monitoring report which presents a clear analyses of the monitoring carried out	*The draft monitoring report shall be completed within five working days from the termination of the Spring 2018 bird monitoring phase. The monitoring report will be finalised by the consultant and approved by the Contracting Authority within two weeks from the termination of the Spring 2018 bird monitoring phase.*	*The actual monitoring report presented by the contractor.*

Ecoserv Ltd (hereafter 'Ecoserv') submitted a response to the tender and was subsequently notified that the company's bid was successful.

The present submission constitutes Ecoserv's report of the independent scientific study on the influx of migratory Common Quail *Coturnix coturnix* and Turtle Dove *Streptopelia turtur* in Malta, undertaken by the company during the period 1 to 21 April 2018, which includes the period during which the 2018 spring season was open for hunting Quail (1 to 21 April 2018).

In order to put the present study in perspective, an overview of the findings from previous similar studies (Ecoserv, 2011; 2012; 2013; 2014; 2015; 2016; 2017) follows, however, the reader is also referred to the review on migratory behaviour of the two bird species, as well as the overview of local bird hunting and trapping activities and of EU legislation concerning these activities, that have been presented in Ecoserv (2011).

Although there is a dearth of published information on migration of the Common Quail and Turtle Dove across the Maltese Islands, a considerable amount of data has been collected over the past nine years, with such collection of data being initiated by Thomaidis (nd), who studied the occurrence and patterns of movement of these two species over the Islands between spring 2008 and autumn 2009. The data used to compile the report by Thomaidis (nd) were recorded by assigned hunters who contributed to the surveys under his supervision and coordination. Subsequently, regular local surveys of migration of these two species were been carried out between 2011 and 2017 by Ecoserv (Ecoserv, 2011; 2012; 2013; 2014; 2015; 2016; 2017).

The findings from the spring 2011 survey, which was undertaken by Ecoserv during the period 8th – 28th May 2011, and based on ToR that were similar to the ones for the present study, are as follows (see Ecoserv, 2011):

- Counts for Turtle Dove recorded from the 24 field sites (= stations) varied between 0 and a maximum of 14, with mean daily counts ranging between 0.38 and 4.25. With extrapolation, the daily mean figures translated to an estimated daily influx ranging between 203 and 2,305 individuals, with a total influx over the survey period (21 days) of 18,057 individuals. It was noted that the recorded counts varied appreciably between the different field sites, which is to be expected, given that the 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 meters. Another limitation of the estimated counts is that some birds may pass overhead, maintaining high altitude and avoiding landfall, while others migrate during the night. Nonetheless, the counts for Turtle Dove recorded by Ecoserv (2011) did not appear to differ markedly from those reported by Thomaidis (nd) for the years 2008 and 2009.
- Counts for Common Quail recorded from the 24 field sites varied between 0 and a maximum of 11, while the mean daily counts ranged between 0 and 1.38. Through extrapolation, this translated to a total influx of 22,699 individuals over the survey period (21 days). No Common Quail were recorded at 13 of the 24 sites, on any of the survey dates. As in the case of Turtle Dove, migration of Common Quail is dependent on weather conditions and high numbers may be recorded at one site and a potentially much lower number at a different site, even if the two sites are separated by a very small distance of as little as a few hundred meters. Given that Common Quail tend to stay in the same general area for a few days if left undisturbed, even though this is highly unlikely because of the intense hunting pressure, as several hunters usually roam the same area with dogs after each other, it was not possible to ascertain whether high numbers of individuals recorded successively at the same field site included new migratory individuals, or whether they comprised individuals already included in counts from previous days.
- Overall, when comparing the results of Ecoserv's spring 2011 survey with those from Thomaidis' (nd) surveys held in 2008 and 2009 for the same period, similar counts are noted for Turtle Dove. In the case of Common Quail, there was a tendency for overall higher counts recorded during the spring 2011 survey. Therefore, no decreased influx of migratory Turtle Dove and Common Quail was evident when comparing the results of the spring 2011 survey with those from Thomaidis' (nd) 2008 and 2009 surveys.
- A number of constraints were pointed out in Ecoserv (2011)'s report:
    - The length of coastline surveyed per day (4 km) amounts to less than 1.5% of the total coastline; the accuracy of the estimated total migratory influx would be higher if a larger proportion of coastline is surveyed. Furthermore, the migration count was based on count data recorded over part of the day only (06:00 - 13:00), hence any individuals migrating at other times of the day (including night time) were not taken into consideration, leading to a potential underestimate of the total influx of birds if significant migration occurred between 13:00 and 06:00. Furthermore, the total coastline length used in the extrapolation includes stretches of coast that are highly developed and densely inhabited, for example, the Sliema – Valletta and Cottonera areas, where one would expect some disturbance to birds migrating at low altitude, hence their numbers there would be expected to be lower, resulting in an overestimate.

- The survey commenced late during the migratory season; it effectively incorporated only the tail end of the Turtle Dove migratory season and essentially missed the peak period of Quail migration. The data set from the spring 2011 study is therefore limited and limits the value of comparisons with data collected from previous years.
- Given resource limitations and time constraints, it was not feasible to collect a larger data set; the relatively small sampling effort used in the spring 2011 study is reflected in the observed high standard deviation values. Inasmuch, the extrapolations made were estimated using limited count data and the stated estimates of total influx should therefore be treated as indicative, and used with caution.
- The data can only be used for purposes of trend analysis, and even in this respect, due caution should be exercised given the limited data collected; the sampling effort used, while based on that reported and utilized by Thomaidis (nd) for the years 2008 and 2009, is not identical, hence comparison of data over a three-year period may not be sufficient to determine migratory influx with accuracy. Comparisons made in Ecoserv's (2011) report are therefore purely indicative.

- Ecoserv (2011) recommended that robust and rigorous assessment of migratory influx would require 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 be collected over the whole migratory season and, ideally, the study would entail a larger sampling effort, for example by making counts daily at all of a minimum 24 sites.

The findings from the spring 2012 survey, which was undertaken by Ecoserv during the period 9 April to 26 May, 2012, and based on ToR that were similar to the ones for the 2011 (Ecoserv, 2011) and present studies, are as follows:

Turtle Dove

- When comparing the results of the 2012 survey with those from Thomaidis' (nd) surveys held in 2008 and 2009 for the same period and with those from the May 2011 survey by Ecoserv (2011), a similar trend of Turtle Dove counts is noted overall; the pattern of counts for the four years compared indicates a steady migratory influx during April, while the last 2-3 weeks of May represent the tail end of the Turtle Dove' migration period. However, in contrast to the occasional high mean counts recorded in 2008 and in 2009, no such peaks were recorded in spring 2012. When comparing the grand mean count recorded during the 2012 survey to that recorded during the previous 2011 survey, a higher value is evident for the former, however, this was attributed to collection of data late in the migratory period; namely between 8 and 28 May 2011, while the data from the 2012 survey were collected over a much longer period of 48 days that spanned April and May, and therefore included the peak migratory period for the species. On the other hand, the grand mean count recorded during the 2012 survey was lower than that recorded in 2008 and in 2009. While this would seem to indicate a lower influx of Turtle Dove for spring 2012, the data collected by Thomaidis (nd) during 2008 and 2009 utilised a greater number of field sites per day, which would increase accuracy. Hence, the lower grand mean count recorded during the 2012 survey may have resulted from the lower sampling effort compared to that made in Thomaidis (nd)' surveys. It was also noted that the occasional very high peak counts of Turtle Dove recorded in 2008 and 2009 during Thomaidis (nd)' surveys contributed to a high grand mean count. No such very high peak counts were recorded during the 2012 survey.

- A total influx of 57,160 individuals of Turtle Dove was estimated for 2012, compared to a total influx of 18,057 individuals estimated for 2011. However, Ecoserv (2011) emphasised that such estimates must be treated with utmost caution, given the relatively small number of field sites used in the surveys and that counts were not made daily at each station. Increasing the number of field sites per day is desirable since influx of birds at different localities is extremely variable, with potential large differences in Turtle Dove passing at two different localities, even if these are separated by a very small distance. Furthermore, the length of coastline surveyed per day (4 km) amounts to less than 1.5% of the total coastline; the accuracy of the estimated total migratory influx would be higher if a larger proportion of coastline is surveyed. Furthermore, the total coastline length used in the extrapolation includes stretches of coast that are highly developed and densely inhabited, for example, the Sliema – Valletta and Cottonera areas, where one would expect some disturbance to birds migrating at low altitude, hence their numbers there would be expected to be lower, resulting in an overestimate. Another limitation was that the Turtle Dove migration counts were recorded over a seven hour survey period (06:00-13:00), hence any individuals migrating at other times of the day were not taken into consideration, leading to a potential underestimate of the total influx if significant Turtle Dove migration occurred between 13:00 and 06:00. On the other hand, the 06:00-13:00 time period represents the time during which the activity of Turtle Dove is at a maximum. 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 Turtle Dove is increasing or decreasing with time.

Common Quail

- When comparing the results of the 2012 survey with those from Thomaidis' (nd) surveys held in 2008 and 2009 for the same period, and with those from the 2011 survey by Ecoserv (2011), a similar trend of Common Quail counts was noted overall; the pattern of counts for the four years compared indicates a steady migratory influx during April, while the last 2-3 weeks of May represent the tail end of the migration period for this species. As recorded in 2008 and in 2009, some peaks of Common Quail counts were recorded during the 2012. When comparing the total mean count recorded during the 2012 survey with that recorded during the previous 2011 survey, a slightly lower value is evident for the former. This was somewhat unexpected, given that the data from the previous 2011 survey were collected late in the migratory period; namely over a short period of 21 days between 8 and 28 May 2011, while the data on Common Quail from the 2012 were collected over a much longer period of 48 days that spanned April and May, and therefore included the peak migratory period for the species. Evidently, this resulted from the unusual high counts for Common Quail recorded during May 2011. However, although the grand mean count of Common Quail recorded during the 2012 survey turned out to be lower than that recorded in 2009, it was similar to that recorded in 2008.

- The total influx of Common Quail estimated for 2012 was 35,018 individuals, compared to 22,699 individuals estimated for the previous year 2011. However, as emphasised above for Turtle Dove, such estimates must be treated with utmost caution, given the relatively small number of field sites used in the surveys and that counts were not made daily at each site. The considerations highlighted above for Turtle Dove also apply to the Common Quail; birds may migrate along specific pathways, with the result that high numbers may be recorded at one site and a potentially much lower number at a different site, even if the two sites are separated by a relatively small distance of a few hundred meters. Hence, increasing the number of survey sites per day to account for such variation in counts between different sites is desirable. Furthermore, the daily area surveyed for Common Quail amounts to less

than 1% of the total area; the accuracy of the estimated total migratory influx would be higher if a larger area is surveyed.

- It was noted that the design of the 2012 survey was largely improved compared to that of the previous survey made in 2011, since counts from spring 2012 were made over a period of 48 days, which included a great part of the peak migratory period of both Turtle Dove and Common Quail.
- For both Turtle Dove and Common Quail, a number of limitations, which had already been highlighted in Ecoserv's (2011) report, were reiterated, namely:
  - The data presented in the 2012 report can only be used for purposes of trend analysis, and even in this respect, due caution should be exercised; the sampling effort used in the study, while partly based on that reported and utilized by Thomaidis (nd) for the years 2008 and 2009, is not identical, hence comparison of data with that collected in 2008 and 2009 may not be sufficient to determine migratory influx and trends over time with accuracy. Comparison of data from 2012 with data from 2011 is limited since the bird counts from the latter year were restricted to a 21 day period during May, unlike bird counts from the 2012 survey which spanned nearly both April and May. Comparisons made in Ecoserv's 2012 report should therefore be interpreted with caution.
  - 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 be collected over the whole migratory season and, ideally, the study would entail a larger sampling effort, for example by making counts daily at all of a minimum 24 sites. Nevertheless, the data from the 2012 survey provided a useful indication of influx of Turtle Dove and Common Quail, provided that results are interpreted within the context of the stated limitations.

The findings from the spring 2013 survey, which was undertaken by Ecoserv during the period 10 April to 30 April, 2013, and based on ToR that were similar to the ones for the 2011 (Ecoserv, 2011), 2012 (Ecoserv, 2012), and present studies, are as follows:

<u>Turtle Dove</u>

- When comparing the results of the 2013 survey with those from Thomaidis' (nd) surveys held in 2008 and 2009, and those from the 2012 survey by Ecoserv (2012), a similar trend of counts recorded during the period 10 – 30 April was noted overall; the pattern of counts for the four years compared indicated a steady migratory influx during the last two weeks of April. However, in contrast to the occasional high mean counts recorded in 2008 and in 2009, no such peaks were recorded during the 2013 survey. When comparing the grand mean value recorded during the spring 2013 survey to that recorded during the previous (spring 2012) survey, a higher value was evident for the former, but this difference was not statistically significant. However, the grand mean value recorded during the 2013 survey was lower than that recorded in 2008 and 2009. While this would seem to indicate a lower influx of Turtle Dove for spring 2013 compared to 2008 and 2009, the data collected by Thomaidis (nd) during the latter two years utilised a greater number of field sites per day, which would increase accuracy. Hence, the lower grand mean value recorded during the 2013 survey may have resulted from the lower sampling effort compared to that used in Thomaidis (nd)' surveys. On the other hand, the occasional very high peak counts of Turtle Dove recorded in 2008 and 2009 (see Figure 2) from Thomaidis (nd)' (2008 and 2009) surveys contribute to a high grand mean. No such very high peak counts were recorded during the 2013 survey.

- The total influx of Turtle Dove for the 2013 survey period (10 – 30 April 2013) was estimated at 42,521 individuals. For the period 9 April – 26 May 2012, Ecoserv (2012) estimated a total influx of 57,160 individuals, while a total influx of 18,057 individuals was estimated for the period 8 – 28 May 2011 (Ecoserv, 2011). However, Ecoserv (2013) emphasised that such values must be treated with utmost caution, given the relatively small number of field sites used in the surveys, that counts were not made daily at each site, and since the extrapolation procedure used is likely to result in a rough estimate. Increasing the number of field sites per day is desirable since influx of birds at different localities is extremely variable, with potential large differences in Turtle Dove passing at two different localities, even if these are separated by a very small distance, as indicated above. Furthermore, the length of coastline surveyed per day (4 km) amounts to less than 1.5% of the total coastline; the accuracy of the estimated total migratory influx would be higher if a larger proportion of coastline is surveyed. It should also be noted that the total coastline length used in the 2013 includes stretches of coast that are highly developed and densely inhabited, for example, the Sliema – Valletta and Cottonera areas, where one would expect some disturbance to birds migrating at low altitude, hence their numbers there would be expected to be lower, resulting in an overestimate. Another limitation is that the Turtle Dove migration counts were recorded over a seven hour survey period (06:00 - 13:00), hence any individuals migrating at other times of the day were not included, leading to a potential underestimate of the total influx if significant Turtle Dove migration occurred between 13:00 and 06:00. On the other hand, the 06:00-13:00 time period represents the time during which the activity of Turtle Dove is expected to be highest. 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 Turtle Dove is increasing or decreasing with time.

Common Quail

- When comparing the results of the 2013 survey with those from Thomaidis' (nd) surveys held in 2008 and 2009, and those from the 2012 survey by Ecoserv (2012), a similar trend of Common Quail counts recorded during the period 10 – 30 April was noted overall between the 2008, 2012 and 2013 surveys, while slightly higher counts were recorded in 2009. However, no migratory peaks for Common Quail were recorded during the 2013 survey, whereas such peaks had been recorded in 2008, 2009 and 2012. When comparing the grand mean value recorded during the 2013 survey with that recorded during the previous (2012) survey, a lower value was evident for the former, although this difference was not statistically significant. The grand mean value of Common Quail recorded during the 2013 survey was also lower than those recorded in 2008 and 2009.

- The total influx of Common Quail for the 2013 survey period (10 – 30 April 2013) was estimated at 67,460 individuals. For the period 9 April – 26 May 2012, Ecoserv (2012) estimated a total influx of 35,018 individuals, while a total influx of 22,699 individuals was estimated for the period 8 – 28 May 2011 (Ecoserv, 2011). The estimate made for the 2013 survey was therefore much higher than for previous years and may be an overestimate resulting from an artefact of the extrapolation procedure. Ecoserv (2013) reiterated that such estimates must be treated with utmost caution, given the relatively small number of field sites used in the present survey, that counts were not made daily at each site, and since the extrapolation procedure used is likely to result in a rough estimate. The considerations emphasised above for Turtle Dove also apply to the Common Quail – birds may migrate along specific pathways, with the result that high numbers may be recorded at one site and a potentially much lower number at a different site, even if the two sites are separated by a very small distance of even a few hundred meters. Hence increasing the number of field sites per day to account for such variation in counts between different sites is desirable. Furthermore, the daily area surveyed for Common Quail amounts to less than 1% of the total

area; the accuracy of the estimated total migratory influx would be higher if a larger area is surveyed.

- It was noted that the design of the 2013 survey included counts made over a 21 day period between 10 and 30 April 2013, which covers the period when peak migration of Turtle Dove and Quail normally occurs and was therefore an improvement over the 2011 survey (which, having been held in May, only covered the tail end of the migratory periods). However, no information on potential migratory peaks, particularly for Turtle Dove, which may have occurred in May 2013, was available, given that no count data were collected during this month.
- For both Turtle Dove and Common Quail, a number of limitations, which had already been highlighted in Ecoserv's reports from the two previous spring seasons (Ecoserv, 2011; 2012), were reiterated, namely:
    - The data presented in the 2013 report can only be used for purposes of trend analysis, and even in this respect, due caution should be exercised given that the sampling effort used in the 2013 study, while partly based on that reported and utilized by Thomaidis (nd) for the years 2008 and 2009, is not identical. Comparison with data collected by Ecoserv (2011) during spring 2011 was not possible since the bird counts from that year were collected in May, while the 2013 survey was made in April, which is deemed to be more representative of the period during which migratory influx of Turtle Dove, and to a lesser extent Common Quail, is highest.
    - 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 24 sites. Nevertheless, the data from the 2013 study provides a useful indication of the influx of Turtle Dove and Common Quail, provided that results are interpreted in the context of these limitations.

The findings from the spring 2014 survey, which was undertaken by Ecoserv during the period 10 April to 30 April, 2014, and based on ToR that were similar to the ones for the 2011 (Ecoserv, 2011), 2012 (Ecoserv, 2012), and 2013 (Ecoserv, 2013) studies, are as follows:

Turtle Dove

- When comparing the results of the 2014 survey with those from Thomaidis' (nd) surveys held in 2008 and 2009, and those from the 2012 and 2013 surveys by Ecoserv (2012; 2013), a similar trend of counts recorded during the period 10 – 30 April was noted overall; the pattern of counts for the five years compared indicated a migratory influx throughout the periods when the survey was held. However, in contrast to the occasional high mean counts recorded in 2008 and in 2009, no such peaks were recorded during the 2014 survey. When comparing the grand mean value recorded during the spring 2014 survey to that recorded during the previous two surveys (spring 2012 and 2013), a lower value was evident for the former, but this difference was not statistically significant. Nevertheless, a general trend of decrease in migratory influx was evident; this was corroborated by reports from hunters and ornithologists who observed an overall low migratory influx in 2014. Furthermore, the grand mean value recorded during the 2014 survey was lower than that recorded by Thomaidis in 2008 and 2009, which indicates a lower influx of Turtle Dove for spring 2014. No such very high peak counts were recorded during the spring 2014 survey.

- The total influx of Turtle Dove for the 2014 survey period (10 – 30 April 2014) was estimated at 24,922 individuals. For the period 10 April – 30 May 2013, a total influx of 42,521 individuals was estimated (Ecoserv, 2013); for the period 9 April – 26 May 2012, a total influx of 57,160 individuals was estimated (Ecoserv 2012), and for the period 8 – 28 May 2011, a total influx of 18,057 individuals was estimated (Ecoserv, 2011). However, Ecoserv (2014) emphasised that such estimates 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. Increasing the number of field sites per day is desirable since influx of birds at different localities is extremely variable, with potential large differences in Turtle Dove passing at two different localities, even if these are separated by a very small distance, as indicated above. Furthermore, the length of coastline surveyed per day (4 km) amounts to less than 1.5% of the total coastline; the accuracy of the estimated total migratory influx would be higher if a larger proportion of coastline is surveyed. It should also be noted that the total coastline length used in the 2014 survey included stretches of coast that are highly developed and densely inhabited, for example, the Sliema – Valletta and Cottonera areas, where one would expect some disturbance to birds migrating at low altitude, hence their numbers there would be expected to be lower, resulting in an overestimate. Another limitation is that the Turtle Dove migration counts were recorded over a seven hour survey period (06:00 - 13:00), hence any individuals migrating at other times of the day were not included, leading to a potential underestimate of the total influx if significant Turtle Dove migration occurred between 13:00 and 06:00. On the other hand, the 06:00-13:00 time period represents the time during which the activity of Turtle Dove is deemed maximum. 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 Turtle Dove is increasing or decreasing with time.

Common Quail

- When comparing the results of the 2014 survey with those from Thomaidis' (nd) surveys held in 2008 and 2009, and those from the 2012 and 2013 surveys by Ecoserv (2012; 2013), a similar trend of Common Quail counts recorded during the period 10 – 30 April was noted overall between the 2008, 2012, 2013 and present surveys, while slightly higher counts were recorded in 2009. However, no migratory peaks for Common Quail were recorded during the 2014 survey, whereas such peaks had been recorded in 2008, 2009 and 2012. When comparing the grand mean value recorded during the spring 2014 survey with that recorded during the previous two surveys (spring 2012 and 2013), a lower value is evident for the former. In the case of the 2014 and 2013 surveys, the difference was marginal and not statistically significant. On the other hand, the grand mean value recorded in 2014 was significantly lower than that recorded in 2012. The grand mean value of Common Quail recorded during the 2014 survey was also lower than those recorded in 2008 and 2009.

- The total influx of Common Quail for the 2014 survey period (10 – 30 April 2014) was estimated at 37,773 individuals. For the period 10 April – 30 May 2013, a total influx of 67,460 individuals was estimated (Ecoserv, 2013); for the period 9 April – 26 May 2012, a total influx of 35,018 individuals was estimated (Ecoserv, 2012), and for the period 8 – 28 May 2011, a total influx of 22,699 individuals was estimated (Ecoserv, 2011). The estimate made for the 2014 survey was therefore lower than that for 2013 but similar to that recorded in 2012. Ecoserv (2014) reiterated that such estimates 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. The considerations emphasised above for Turtle Dove also apply to the Common Quail – birds may migrate along specific pathways, with the result that high

numbers may be recorded at one site and a potentially much lower number at a different site, even if the two sites are separated by a very small distance of even a few hundred meters. Hence increasing the number of field sites per day to account for such variation in counts between different sites is desirable. Furthermore, the daily area surveyed for Common Quail amounts to less than 1% of the total area; the accuracy of the estimated total migratory influx would be higher if a larger area is surveyed.

- It was noted that the design of the 2014 survey included counts made over a 21 day period between 10 and 30 April 2014, which covers the period when peak migration of Turtle Dove and Quail normally occurs and was therefore and improvement over the 2011 survey (which, having been held in May, only covered the tail end of the migratory periods). However, no information on potential migratory peaks, particularly for Turtle Dove, which may have occurred in May 2014, was available, given that no count data were collected during this month.
- For both Turtle Dove and Common Quail, a number of limitations, which had already been highlighted in Ecoserv's reports from previous spring seasons (Ecoserv, 2011; 2012; 2013), were reiterated, namely:
    - The data presented in the 2014 report can only be used for purposes of trend analysis, and even in this respect, due caution should be exercised given that the sampling effort used in the 2014 study, while partly based on that reported and utilized by Thomaidis (nd) for the years 2008 and 2009, is not identical. Comparison with data collected by Ecoserv (2011) during spring 2011 was not possible since the bird counts from that year were collected in May, while the 2014 survey was made in April, which is deemed to be more representative of the period during which migratory influx of Turtle Dove, and to a lesser extent Common Quail, is highest.
    - 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 28 sites. Nevertheless, the data from the 2014 study provides a useful indication of the influx of Turtle Dove and Common Quail, provided that results are interpreted in the context of these limitations.

The findings from the spring 2015 survey, which was undertaken by Ecoserv during the period 14 April to 30 April, 2015, and based on ToR that were similar to the ones for the 2011 (Ecoserv, 2011), 2012 (Ecoserv, 2012), 2013 (Ecoserv, 2013) and 2014 (Ecoserv, 2014) surveys, are as follows:

Turtle Dove

- When comparing the results of the present survey with those from Thomaidis' (nd) surveys held in 2008 and 2009, and those from the 2012, 2013 and 2014 surveys by Ecoserv (2012; 2013; 2014), a similar trend of counts was recorded during the period 14 – 30 April; the pattern of counts for the five years indicated a migratory influx throughout the period when the surveys was held. However, in contrast to the occasional high mean counts recorded in 2008 and in 2009, no elevated counts were recorded during the 2015 survey. When comparing the grand mean value recorded during the spring 2015 survey to that recorded during the previous three surveys (spring 2012, 2013 and 2014), a slight increase in counts was evident in spring 2015 compared to the previous spring 2014, while the spring 2015 values was still lower than values recorded in 2012 and 2013; however, the differences in grand mean values were not statistically significant. Nevertheless, a general trend of decrease in migratory influx was evident for 2014 and 2015; this was corroborated by reports

from hunters and ornithologists who observed an overall low migratory influx during the month of April in 2014 and 2015. Furthermore, the grand mean value recorded during the 2015 survey was much lower than that recorded by Thomaidis in 2008 and 2009, which indicates a lower influx of Turtle Dove for spring 2015.

- The total influx of Turtle Dove for the 2015 survey period (14 – 30 April 2015) was estimated at 25,006 individuals. For the period 10 April – 30 May 2014, a total influx of 24,922 individuals was estimated (Ecoserv, 2014); for the period 10 April – 30 May 2013, a total influx of 42,521 individuals was estimated (Ecoserv, 2013); for the period 9 April – 26 May 2012, a total influx of 57,160 individuals was estimated (Ecoserv 2012); and for the period 8 – 28 May 2011, a total influx of 18,057 individuals was estimated (Ecoserv, 2011). In their report of the 2015 survey, the authors reiterated that such estimates 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. Increasing the number of field sites per day is desirable since influx of birds at different localities is extremely variable, with potential large differences in Turtle Dove passing at two different localities, even if these are separated by a very small distance, as indicated above (Ecoserv, 2015). The authors also emphasised that the length of coastline surveyed per day (4 km) amounted to less than 1.5% of the total coastline; the accuracy of the estimated total migratory influx would be higher if a larger proportion of coastline is surveyed. It should also be noted that the total coastline length used in the extrapolation includes stretches of coast that are highly developed and densely inhabited, for example, the Sliema – Valletta and Cottonera areas, where one would expect some disturbance to birds migrating at low altitude, hence their numbers there would be expected to be lower, resulting in an overestimate. Another limitation is that the Turtle Dove migration counts were recorded over a seven hour survey period (06:00 - 13:00), hence any individuals migrating at other times of the day were not included, leading to a potential underestimate of the total influx if significant Turtle Dove migration occurred between 13:00 and 06:00. On the other hand, the 06:00-13:00 time period represents the time during which the activity of Turtle Dove is deemed maximum. 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 Turtle Dove is increasing or decreasing with time.

Common Quail

- When comparing the results of the 2015 survey with those from Thomaidis' (nd) surveys held in 2008 and 2009, and those from the 2012, 2013 and 2014 surveys by Ecoserv (2012; 2013; 2014), a similar trend of Common Quail counts recorded during the period 14 – 30 April was noted overall between the 2008, 2012, 2013, 2014 and 2015 surveys, while slightly higher counts were recorded in 2009. However, no migratory peaks for Common Quail were recorded during the 2015 survey, whereas such peaks had been recorded in 2008, 2009 and 2012. When comparing the grand mean value recorded during the spring 2015 survey with that recorded during the previous three surveys (spring 2012, 2013 and 2014), a lower value was evident for the former. In the case of the 2015 survey and those held in 2014 and 2013, the differences were marginal and not statistically significant. On the other hand, the grand mean value recorded in 2015 was significantly lower than that recorded in 2012. The grand mean value of Common Quail recorded during the 2015 survey was also lower than values recorded in 2008 and 2009.

- The total influx of Common Quail for the 2015 survey period (14 – 30 April 2015) was estimated at 20,211 individuals. For the period 10 April – 30 May 2014, a total influx of 37,773 individuals was estimated (Ecoserv, 2014); for the period 10 April – 30 May 2013, a total influx of 67,460 individuals was estimated (Ecoserv, 2013); for the period 9 April – 26

May 2012, a total influx of 35,018 individuals was estimated (Ecoserv, 2012), and for the period 8 – 28 May 2011, a total influx of 22,699 individuals was estimated (Ecoserv, 2011). The estimate made for the 2015 survey was is therefore lower than that for previous years, but similar to that recorded in 2011. The authors reiterated that such estimates must be treated with utmost caution, given the relatively small number of field sites used in the present survey, that counts were not made daily at each site, and since the extrapolation procedure used is likely to result in a rough estimate (Ecoserv, 2015). The considerations emphasised above for Turtle Dove were also applicable to the Common Quail – birds may migrate along specific pathways, with the result that high numbers might be recorded at one site and a potentially much lower number at a different site, even if the two sites are separated by a very small distance of even a few hundred meters. Hence increasing the number of field sites per day to account for such variation in counts between different sites is desirable. Furthermore, the daily area surveyed for Common Quail amounts to less than 1% of the total area; the accuracy of the estimated total migratory influx would be higher if a larger area is surveyed.

- It was noted that the design of the 2015 survey included counts made over a 17 day period between 14 and 30 April 2015, which covers the period when peak migration of Turtle Dove and Quail normally occurs and was therefore an improvement over the 2011 survey, which having been held in May, only covered the tail end of the migratory periods. However, no information on potential migratory peaks, particularly for Turtle Dove, which may have occurred in May 2015, is available, given that no count data were collected during the latter month.
- For both Turtle Dove and Common Quail, a number of limitations, which had already been highlighted in Ecoserv's reports from previous spring seasons (Ecoserv, 2011; 2012; 2013; 2014), were reiterated, namely:
    - The data presented in the 2015 report can only be used for purposes of trend analysis, and even in this respect, due caution should be exercised given that the sampling effort used in the 2015 study, while partly based on that reported and utilized by Thomaidis (nd) for the years 2008 and 2009, is not identical. Comparison with data collected by Ecoserv (2011) during spring 2011 was not possible since the bird counts from that year were collected in May, while the 2015 survey was made in April, which is deemed to be more representative of the period during which migratory influx of Turtle Dove, and to a lesser extent Common Quail, is highest.
    - 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 28 sites. However, the necessary costs for such an extensive survey may be prohibitive, whist it will be also very difficult to recruit the large number of personnel required in the field. Nevertheless, the data from the 2015 study provides a useful indication of the influx of Turtle Dove and Common Quail, provided that results are interpreted in the context of these limitations.

The findings from the spring 2016 survey, which was undertaken by Ecoserv during the period 10 April to 30 April 2016, and based on ToR that were similar to the ones for the 2011 (Ecoserv, 2011), 2012 (Ecoserv, 2012), 2013 (Ecoserv, 2013), 2014 (Ecoserv, 2014), and 2015 (Ecoserv, 2015) surveys, are as follows:

Turtle Dove

- When comparing the results of the 2016 survey with those from Thomaidis' (nd) surveys held in 2008 and 2009, and those from the 2012, 2013, 2014 and 2015 surveys by Ecoserv (2012; 2013; 2014; 2015), a similar trend of counts was recorded during the period 10 – 30 April; the count values indicate a migratory influx throughout the period when the surveys were held. However, in contrast to the occasional elevated mean counts recorded in 2008 and in 2009, no such peaks were recorded during the 2016 survey. When comparing the grand mean value recorded during the spring 2016 survey to that recorded during the previous spring surveys (held in 2012, 2013, 2014 and 2015), a lower value was evident for the former; however, the differences in grand mean values were not statistically significant. Nevertheless, a general trend of decrease in migratory influx over recent years was evident; this was corroborated by reports from hunters and ornithologists who observed an overall low migratory influx during the month of April in 2014, 2015 and 2016. Furthermore, the grand mean value recorded during the 2016 survey was much lower than that recorded by Thomaidis in 2008 and 2009, which indicates a comparatively lower influx of Turtle Dove during spring 2016.

- The total influx of Turtle Dove for the 2016 survey period (10 – 30 April 2016) was estimated at 22,349 individuals; for the period 14 – 30 April 2015, a total influx of 25,006 individuals was estimated (Ecoserv, 2015); for the period 10 – 30 April 2014, a total influx of 24,922 individuals was estimated (Ecoserv, 2014); for the period 10 – 30 April 2013, a total influx of 42,521 individuals was estimated (Ecoserv, 2013); for the period 9 April – 26 May 2012, a total influx of 57,160 individuals was estimated (Ecoserv 2012); and for the period 8 – 28 May 2011, a total influx of 18,057 individuals was estimated (Ecoserv, 2011). In their report of the 2016 survey, the authors reiterated that such estimates 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. Increasing the number of field sites per day is desirable since influx of birds at different localities is extremely variable, with potential large differences in the number of Turtle Dove passing at two different localities, even if these are separated by a very small distance, as already emphasised above. The authors also stressed that the length of coastline surveyed per day (4 km) amounted to less than 1.5% of the total coastline; the accuracy of the estimated total migratory influx would be higher if a larger proportion of coastline is surveyed. It should also be noted that the total coastline length used in the extrapolation includes stretches of coast that are highly developed and densely inhabited, for example, the Sliema – Valletta and Cottonera areas, where one would expect some disturbance to birds migrating at low altitude, hence numbers recorded there would be expected to be lower, resulting in an overestimate. Another limitation is that the Turtle Dove migration counts were recorded over a seven hour survey period (06:00 - 13:00), hence any individuals migrating at other times of the day were not included, leading to a potential underestimate of the total influx if significant Turtle Dove migration occurred between 13:00 and 06:00. On the other hand, the 06:00-13:00 time period represents the time during which the activity of Turtle Dove is deemed maximum. Nevertheless, the estimate provided is useful when making comparison between different years, assuming data from surveys based on a similar design are available, to assess whether influx of Turtle Dove is increasing or decreasing with time.

Common Quail

- When comparing the results of the 2016 survey with those from Thomaidis' (nd) surveys held in 2008 and 2009, and those from the 2012, 2013, 2014 and 2015 surveys by Ecoserv (2012; 2013; 2014; 2015), a similar trend of Common Quail counts recorded during the period 10 – 30 April was noted over the survey years 2008, 2012, 2013, 2014, 2015 and 2016, while slightly higher counts were recorded in 2009. However, no migratory peaks for Common

Quail were recorded during the 2016 survey, whereas such peaks had been recorded in 2008, 2009 and 2012. When comparing the grand mean value recorded during the spring 2016 survey with that recorded during the previous surveys (spring 2012, 2013, 2014 and 2015), a slight increase in spring 2016 compared to the previous spring 2015 was evident, while the spring 2016 values were still lower than those recorded in 2012, 2013 and 2014. In the case of the 2016 survey and those held in 2015, 2014 and 2013, the differences were marginal and not statistically significant. On the other hand, the grand mean value recorded in 2016 was significantly lower than that recorded in 2012. The grand mean value of Common Quail recorded during the 2016 survey was also lower than values recorded in 2008 and 2009.

- The total influx of Common Quail for the 2016 survey period (10 – 30 April 2016) was estimated at 31,264 individuals. For the period 14 – 30 April 2015, a total influx of 20,211 individuals was estimated (Ecoserv, 2015); for the period 10 – 30 April 2014, a total influx of 37,773 individuals was estimated (Ecoserv, 2014); for the period 10– 30 April 2013, a total influx of 67,460 individuals was estimated (Ecoserv, 2013); for the period 9 April – 26 May 2012, a total influx of 35,018 individuals was estimated (Ecoserv, 2012), and for the period 8 – 28 May 2011, a total influx of 22,699 individuals was estimated (Ecoserv, 2011). The estimate made for the 2016 survey was therefore higher than that for 2015, but similar to that recorded in 2014. The authors reiterated that such estimates 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. The considerations emphasised above for Turtle Dove were also applicable to the Common Quail – birds may migrate along specific pathways, with the result that high numbers might be recorded at one site but potentially much lower numbers are recorded at a different site, even if the two sites are separated by a very small distance of just a few hundred meters. Hence, increasing the number of field sites per day to account for such variation in counts between different sites is desirable. Furthermore, the daily area surveyed for Common Quail amounts to less than 1% of the total area; the accuracy of the estimated total migratory influx would be higher if a larger area is surveyed.
- It was noted that the design of the 2016 survey included counts made over a 21 day period between 10 and 30 April 2015, which covers the period when peak migration of Turtle Dove and Quail normally occurs. However, no information on potential migratory peaks, particularly for Turtle Dove, which may have occurred in May 2016, is available, given that no count data were collected during the latter month.
- For both Turtle Dove and Common Quail, a number of limitations, which had already been highlighted in Ecoserv's reports from previous spring seasons (Ecoserv, 2011; 2012; 2013; 2014; 2015), were reiterated, namely:
    - The data presented in the 2016 report can only be used for purposes of trend analysis, and even in this respect, due caution should be exercised given that the sampling effort used in the 2016 study, while partly based on that reported and utilized by Thomaidis (nd) for the years 2008 and 2009, is not identical. Comparison with data collected by Ecoserv (2011) during spring 2011 was not possible since the bird counts from that year were collected in May, while the 2016 survey was made in April, which is deemed to be more representative of the period during which migratory influx of Turtle Dove, and to a lesser extent Common Quail, is highest.
    - 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 28 sites. However, the necessary costs for such an extensive survey may be prohibitive, whist it will be also very difficult to recruit the large number of personnel required in the field. Nevertheless, the data from the 2016 study provides a useful indication of the influx of Turtle Dove and Common Quail, provided that results are interpreted in the context of these limitations.

The findings from the spring 2017 survey, which was undertaken by Ecoserv during the period 25 March to 14 April 2017, and based on ToR that were similar to the ones for the 2011 (Ecoserv, 2011), 2012 (Ecoserv, 2012), 2013 (Ecoserv, 2013), 2014 (Ecoserv, 2014), 2015 (Ecoserv, 2015) and 2016 (Ecoserv, 2016) surveys, are as follows:

Turtle Dove

- When comparing the results of the 2017 survey with those from Thomaidis' (nd) survey held in 2009, a similar trend of counts recorded during the period 25 March to 14 April was noted overall; the count values indicated a low migratory influx throughout the period when the two surveys were held, with slightly higher counts recorded after 9 April. Comparison of the results from the 2017 study with those from Thomaidis' (nd) survey held in 2008 and the 2012, 2013, 2014, 2015, 2016 surveys by Ecoserv (2012; 2013; 2014; 2015; 2016) were limited to the period 9 – 14 April, since the previous surveys were initiated on 9 April or later. Overall, similar count values were recorded during the six days 9 – 14 April in the 2008, 2012, 2013, 2014, 2015, 2016 and 2017 surveys. However, in contrast to the occasional elevated mean counts recorded in 2008, no such peaks were recorded during the 2017 survey. The grand mean value recorded during the spring 2017 survey was similar to that recorded during most of the previous surveys (spring 2009, 2012, 2013, 2014, 2015 and 2016), but much lower than that recorded in 2008.
- The total influx of Turtle Dove for the 2017 survey period (25 March to 14 April 2017) was estimated at 7,539 individuals; for the period 10 – 30 April 2016, a total influx of 22,349 individuals was estimated (Ecoserv, 2016); for the period 14 – 30 April 2015, a total influx of 25,006 individuals was estimated (Ecoserv, 2015); for the period 10 – 30 April 2014, a total influx of 24,922 individuals was estimated (Ecoserv, 2014); for the period 10 – 30 April 2013, a total influx of 42,521 individuals was estimated (Ecoserv, 2013); for the period 9 April – 26 May 2012, a total influx of 57,160 individuals was estimated (Ecoserv 2012); and for the period 8 – 28 May 2011, a total influx of 18,057 individuals was estimated (Ecoserv, 2011). The estimate made for the 2017 survey was therefore lower than that made in all previous surveys, which however is to be expected since the survey period used in the spring 2017 study only partly overlapped with the main migratory period of Turtle Dove. In their report of the 2017 survey, the authors reiterated that such estimates 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. Increasing the number of field sites per day is desirable since influx of birds at different localities is extremely variable, with potential large differences in the number of Turtle Dove passing at two different localities, even if these are separated by a very small distance, as already emphasised above. The authors also emphasised that the length of coastline surveyed per day (4 km) amounted to less than 1.5% of the total coastline; the accuracy of the estimated total migratory influx would be higher if a larger proportion of coastline is surveyed. It should also be noted that the total coastline length used in the present extrapolation includes stretches of coast that are highly developed and densely inhabited, for example, the Sliema – Valletta and Cottonera areas, where one would expect some disturbance to birds migrating at low altitude, hence their numbers there would be expected to be lower, resulting in an overestimate. Another limitation is that the Turtle Dove

migration counts were recorded over a seven hour survey period (06:30 - 13:30), hence any individuals migrating at other times of the day were not included, leading to a potential underestimate of the total influx if significant Turtle Dove migration occurred between 13:30 and 06:30. On the other hand, the 06:30-13:30 time period represents the time during which the activity of Turtle Dove is deemed maximum. Nevertheless, the estimate provided is useful when making comparison between different years, assuming data from surveys based on a similar design are available, to assess whether influx of Turtle Dove is increasing or decreasing with time.

Common Quail

- When comparing the results of the 2017 survey with those from Thomaidis' (nd) survey held in 2009, slightly lower counts were recorded during the period 25 March to 14 April in the 2017 survey. Comparisons of the results from the spring 2017 survey with those from Thomaidis' (nd) survey held in 2008, and with those from the 2012, 2013, 2014, 2015, 2016 surveys by Ecoserv (2012; 2013; 2014; 2015; 2016), were limited to the period 9 – 14 April, since the latter surveys had started on 9 April or later. Overall, similar count values were recorded during the period 9 – 14 April from the 2008, 2012, 2013, 2014, 2015, 2016 and 2017 surveys. The grand mean value recorded during the spring 2017 survey was lower than values recorded from the previous surveys.

- The total influx of Common Quail for the 2017 survey period (25 March to 14 April 2017) was estimated at 27,615 individuals. For the period 10 – 30 April 2016, a total influx of 31,264 individuals was estimated (Ecoserv, 2016); for the period 14 – 30 April 2015, a total influx of 20,211 individuals was estimated (Ecoserv, 2015); for the period 10 – 30 April 2014, a total influx of 37,773 individuals was estimated (Ecoserv, 2014); for the period 10– 30 April 2013, a total influx of 67,460 individuals was estimated (Ecoserv, 2013); for the period 9 April – 26 May 2012, a total influx of 35,018 individuals was estimated (Ecoserv, 2012), and for the period 8 – 28 May 2011, a total influx of 22,699 individuals was estimated (Ecoserv, 2011). The estimate made for the 2017 survey was therefore lower than that for 2012, 2013, 2014 and 2016, but higher than that recorded in 2011 and 2014. The authors reiterated that such estimates must be treated with utmost caution, given the relatively small number of field sites used in the present survey, that counts were not made daily at each site, and since the extrapolation procedure used is likely to result in a rough estimate. The considerations emphasised above for Turtle Dove were also applicable to the Common Quail – birds may migrate along specific pathways, with the result that high numbers may be recorded at one site and a potentially much lower number at a different site, even if the two sites are separated by a very small distance of even a few hundred meters. Hence increasing the number of field sites per day to account for such variation in counts between different sites is desirable. Furthermore, the daily area surveyed for Common Quail amounts to less than 1% of the total area; the accuracy of the estimated total migratory influx would be higher if a larger area is surveyed.

- It was noted that the design of the 2017 survey included counts made over a 21 day period between 25 March and 14 April 2017. Although migratory peaks for Common Quail can occur in late March and early April, the peak migration of Turtle Dove and Common Quail usually occurs in the last three weeks of April, while Turtle Dove migration can also extend to May. No information on migration of Turtle Dove and Quail occurring after 14 April 2017 was available since the survey period ended on this date.

- For both Turtle Dove and Common Quail, a number of limitations, which had already been highlighted in Ecoserv's reports from previous spring seasons (Ecoserv, 2011; 2012; 2013; 2014; 2015; 2016), were reiterated, namely:

- The data presented in the 2017 report can only be used for purposes of trend analysis, and even in this respect, due caution should be exercised given that the sampling effort used in the 2017 study, while partly based on that reported and utilized by Thomaidis (nd) for the years 2008 and 2009, is not identical. Comparison with data collected by Ecoserv (2011) during spring 2011 was not possible since the bird counts from that year were collected in May. Comparison with data collected by Ecoserv (2012, 2013, 2014, 2015, 2016) was also limited because the 2012–2016 surveys did not start before 9 April, while the 2017 survey was made between 25 March and 14 April. The 10–30 April survey period used in previous surveys was deemed to be more representative of the period during which migratory influx of Turtle Dove, and to a lesser extent Common Quail[1], is highest.
- 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 28 sites. Nevertheless, the data from the 2017 study provides a useful indication of the influx of Turtle Dove and Common Quail, provided that results are interpreted in the context of these limitations.

2. Methodology

The methodology used by Ecoserv during the present (spring 2018) survey is identical to that used in surveys made by the same company in previous spring seasons (see Ecoserv, 2011; 2012; 2013; 2014; 2015; 2016; 2017); the survey design is aimed at assessing changes in migratory influx, which entails trend analysis based on data from monitoring carried out regularly over a sufficiently long period comprising subsequent years, and using the same methodology. During the survey, two individuals – a field assistant capable of identifying Turtle Dove and Common Quail and an observer who was responsible for recording data in the field – were stationed at a total of 28 sites (= count stations) distributed around Malta, Comino and Gozo. The survey was undertaken over a 3-week period between 1 and 21 April 2018. During the survey, counts of individuals of the two species *Coturnix coturnix* and *Streptopelia turtur* were made at 10 different sites each day. Each group of sites was surveyed once every 3 days, such that a total of 28 sites were surveyed over each period of 3 days. Furthermore, wherever possible, the study site at Comino was included in the 10 sites surveyed on any one day, such that this site was surveyed on a daily basis. When weather conditions precluded surveys at the Comino site due to unavailability of sea transport services, these were undertaken at alternative sites (San Blas or Qala) instead. The sampling sites used in the present study include ones used in the previous surveys undertaken during spring 2011-2017 (see Ecoserv, 2011; 2012; 2013; 2014; 2015; 2016; 2018), and are represented by the grid cell reference numbers listed in Table 1, while their locations are shown in Figure 1.

[1] Given that migratory peaks for Common Quail also occur in late March – early April.

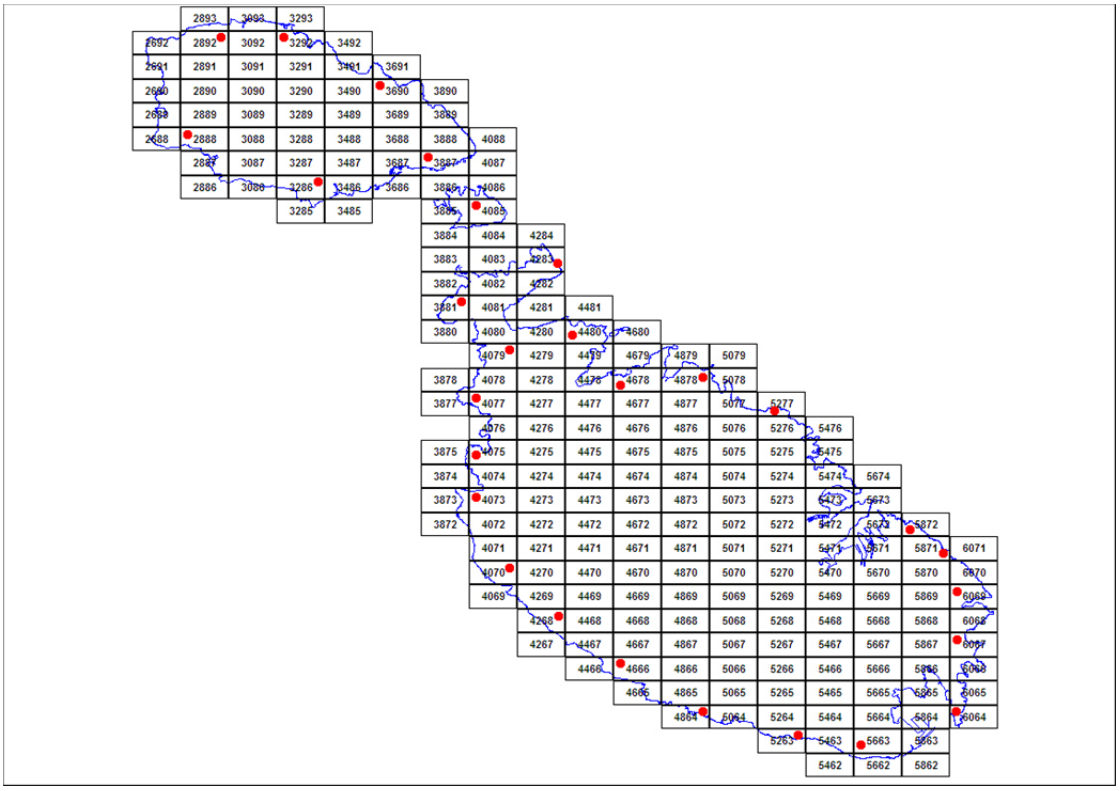


Figure 1. Map of the Maltese Islands showing the localities (grid cells indicated by the red filled circle) where the bird counts were made; see also Table 1.

Table 1

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

Location	Day 1	Day 2	Day 3
Gozo	2892	3690	3292
Gozo	3887	3286	2888
Comino	4085	4085	4085
Malta	3881	4077	4079
Malta	4073	4075	4070
Malta	4268	5263	4666
Malta	4864	5663	6064
Malta	6067	6071	6069
Malta	5872	5277	4878
Malta	4678	4480	4283

Since the survey was mainly aimed at quantifying the influx of migrating individuals, field sites were sited at strategic locations within coastal areas. Birds also fly in at different altitudes; sometimes they are observed flying high over coastal areas and they may either keep that course as they overfly or alight in inland areas. In the case of Turtle Dove, 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. 500m) and vertically upwards (as far as the birds were detected by sight). Since the Common Quail is mainly a nocturnal migrant, monitoring of this species was based on counts of individuals that would have settled in during the previous night. Surveys of

Quail entailed the use of trained dogs to locate and flush the birds out from vegetation, in order to count them when they take flight. The count area was taken as the total area surveyed in this manner at a particular site. Monitoring of Turtle Dove was made between 07:00 and 14:00, while monitoring of Common Quail was made during a two hour period sometime between 07:00 and 12:00. 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 survey raw data sheets, copies of which have been submitted to the Wild Birds Regulation Unit (WBRU) of the MESDC.

3. Results

Ecoserv's laboratory report reference for the present survey is **044-18**. The sample reference codes for the bird count data are **B-024-18** to **B-079-18**.

Turtle dove

Raw counts for Turtle Dove recorded from the 28 sites during the present study varied between 0 and a maximum of 139 (see Appendix I), while the mean daily counts ranged between 0.1 and 25.1 (Table 2). It is to be noted that counts recorded from different sites incorporate two appreciable peaks (counts of 139 and 54 individuals recorded on 19 April) and other smaller peaks (such as a count of 26 recorded on 21 April). During the present (2018) migration, peak numbers of Turtle Dove occurred on 19 - 21 April. The recorded counts varied appreciably between the different sites. At the lower end, at grid locations 6071 and 4079 (see Figure 1), only one Turtle Dove individual was recorded throughout the survey period, while at the higher end, 149 Turtle Doves were recorded from the site at grid location 2892.

Values of mean and total daily counts of Turtle Dove recorded during the period 1 to 21 April from the present survey are summarised in Table 2. These same values are also shown in Figure 2 along with values of mean counts for the same period in 2009 (Thomaidis, nd). Figure 2 also shows the mean daily counts recorded in 2008 (Thomaidis, nd), 2012 (Ecoserv, 2012), 2013 (Ecoserv, 2013), 2014 (Ecoserv, 2014), 2015 (Ecoserv, 2015), 2016 (Ecoserv, 2016) and 2017 (Ecoserv, 2017). However, it should be noted that most of these previous surveys were initiated on 9 April or later and extended beyond 21 April, while the 2017 survey started on 25 March but ended in 14 April; hence there is only partial overlap between the survey period used in most previous studies and that used in the present study.

Overall, counts recorded during the present survey show a similar trend to those recorded in previous surveys. The general pattern is of very low counts recorded in March and early April, with marginally higher counts recorded in mid-April, including peaks in some years. Counts made between 1 April and 8 April during the present survey are similar to those made in spring 2009 (Thomaidis, nd) and 2017 (Ecoserv, 2017); surveys made in other years did not cover this period. Counts recorded after 9 April are also similar to those recorded by Thomaidis (nd) in spring 2008 and 2009, and by Ecoserv (2012; 2013; 2014; 2015; 2016; 2017) in spring 2012–2017, but high peak counts were not recorded in all years. In 2008, a very high mean count (98, on 15-4-08) and a secondary peak (26, on 20-04-08) were recorded. During the present (spring 2018) survey a single main peak (25, on 19-04-18) was recorded, while no mean counts greater than 20 were recorded in any of the other years.

Table 2

Mean (± SD) and total daily counts of Turtle Dove recorded during the present study, together with estimates of daily and total influx of migratory individuals.

Date	Mean Daily Count ± SD		Total Daily Count	Estimated Total Daily Influx
01-Apr-18	0.20	± 0.63	2	108
02-Apr-18	0.20	± 0.42	2	108
03-Apr-18	0.10	± 0.32	1	54
04-Apr-18	0.40	± 0.52	4	217
05-Apr-18	0.20	± 0.42	2	108
06-Apr-18	0.10	± 0.32	1	54
07-Apr-18	0.30	± 0.48	3	163
08-Apr-18	0.20	± 0.42	2	108
09-Apr-18	1.50	± 1.51	15	814
10-Apr-18	1.20	± 0.92	12	651
11-Apr-18	1.20	± 1.40	12	651
12-Apr-18	2.50	± 3.78	25	1,356
13-Apr-18	1.40	± 1.35	14	759
14-Apr-18	2.00	± 2.79	20	1,085
15-Apr-18	7.10	± 8.32	71	3,851
16-Apr-18	4.60	± 5.80	46	2,495
17-Apr-18	1.30	± 1.34	13	705
18-Apr-18	0.90	± 0.99	9	488
19-Apr-18	25.10	± 42.86	251	13,615
20-Apr-18	6.30	± 4.62	63	3,417
21-Apr-18	6.50	± 7.99	65	3,526
		Sum Total	**633**	**34,333**

Values of the grand mean of Turtle Dove counts recorded during the period 1 to 21 April from the present survey (spring 2018), together with values of the grand mean for the same period in 2009 (Thomaidis, nd), for the period 9 to 21 April in 2012 (Ecoserv, 2012), for the period 10 to 21 April in 2008 (Thomaidis, nd), 2013, 2014 and 2016 (Ecoserv, 2012; 2013; 2014; 2016), for the period 14 to 21 April 2015 (Ecoserv, 2015), and for the period 1 to 14 April 2017 (Ecoserv, 2017) are shown in Figure 3. Overall, the grand mean recorded during the present (spring 2018) survey is similar to that recorded during most of the previous surveys, but much lower than that recorded in 2008.

Mean count values recorded from each of the 28 sites during the present survey are indicated on the map shown in Figure 4. The highest mean count was recorded from Wied il-Mielaħ (Grid 2892), while overall high counts were recorded from other study sites located in Gozo and along the northern parts of Malta. The lowest mean counts were recorded from the south eastern parts of Malta, particularly from study sites located in the stretch between Rinella and St. Thomas Bay; comparatively low counts were also recorded from the sites at Anchor Bay and Mistra in Malta and from the site at Qala in Gozo. The mean count recorded from the study site on Comino is 3.62, which is higher than the median value for the whole range of recorded mean counts.

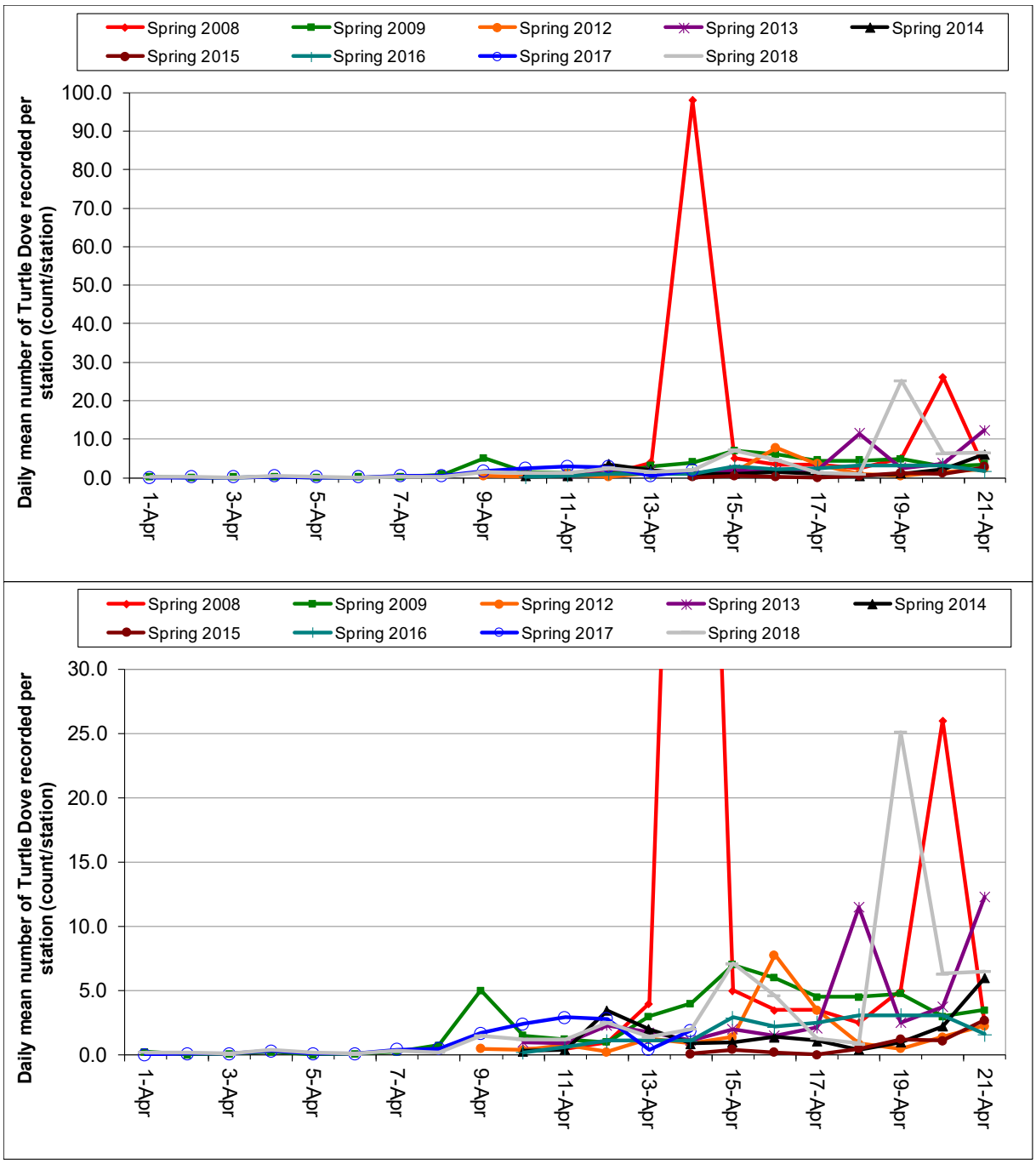


Figure 2. Daily mean counts of Turtle Dove per station (= site) recorded during the present (spring 2018) survey held between 1 and 21 April, together with values of the same statistic for: spring 2008 and 2009 as reported in Thomaidis (nd), spring 2012 as reported in Ecoserv (2012), spring 2013 as reported in Ecoserv (2013), spring 2014 as reported in Ecoserv (2014), spring 2015 as reported in Ecoserv (2015), spring 2016 as reported in Ecoserv (2016), and spring 2017 as reported in Ecoserv (2017). *Top*: graph showing all values including the peak count of 98 individuals recorded on 14-April-2008 (Thomaidis, nd); *Bottom*: graph showing all values except the peak count of 98 individuals recorded on 14-April-2008 (Thomaidis, nd).

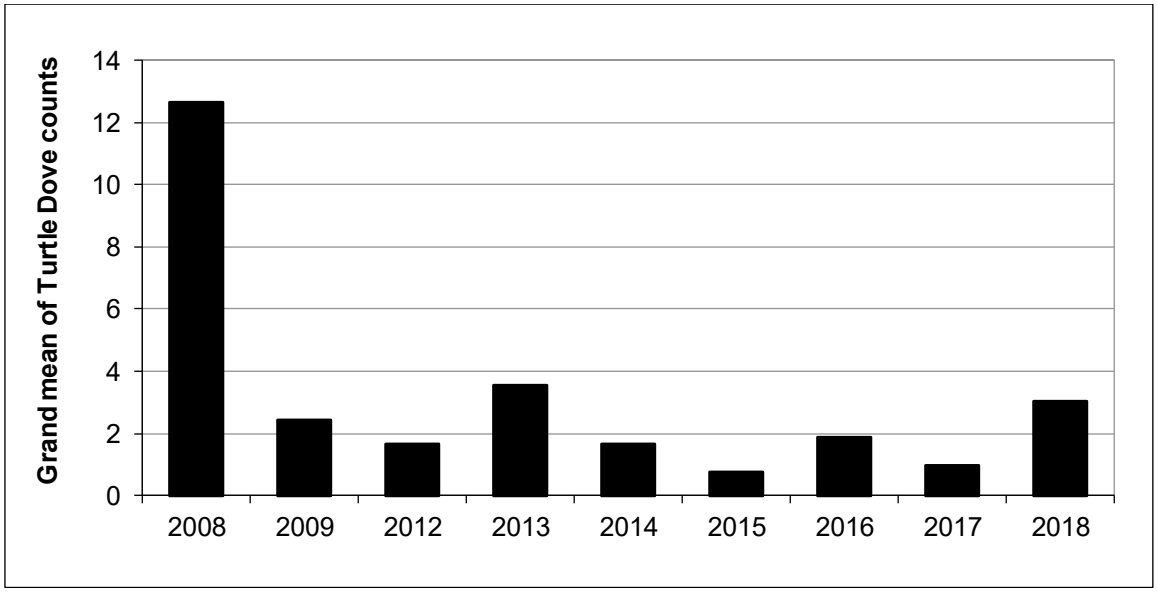


Figure 3. Grand mean of Turtle Dove counts for data from the period 1 to 21 April recorded in spring 2018 (present survey) and spring 2009 (Thomaidis, nd), together with the grand mean for data from the period 9 to 14 April recorded in spring 2012 (Ecoserv, 2012), from the period 10 to 14 April for spring 2008 (Thomaidis, nd), 2013, 2014 and 2016 (Ecoserv, 2012; 2013; 2014; 2016), from the period 14 to 21 April recorded in spring 2015 (Ecoserv, 2015), and from the period 1 to 14 April recorded in spring 2017 (Ecoserv, 2017).

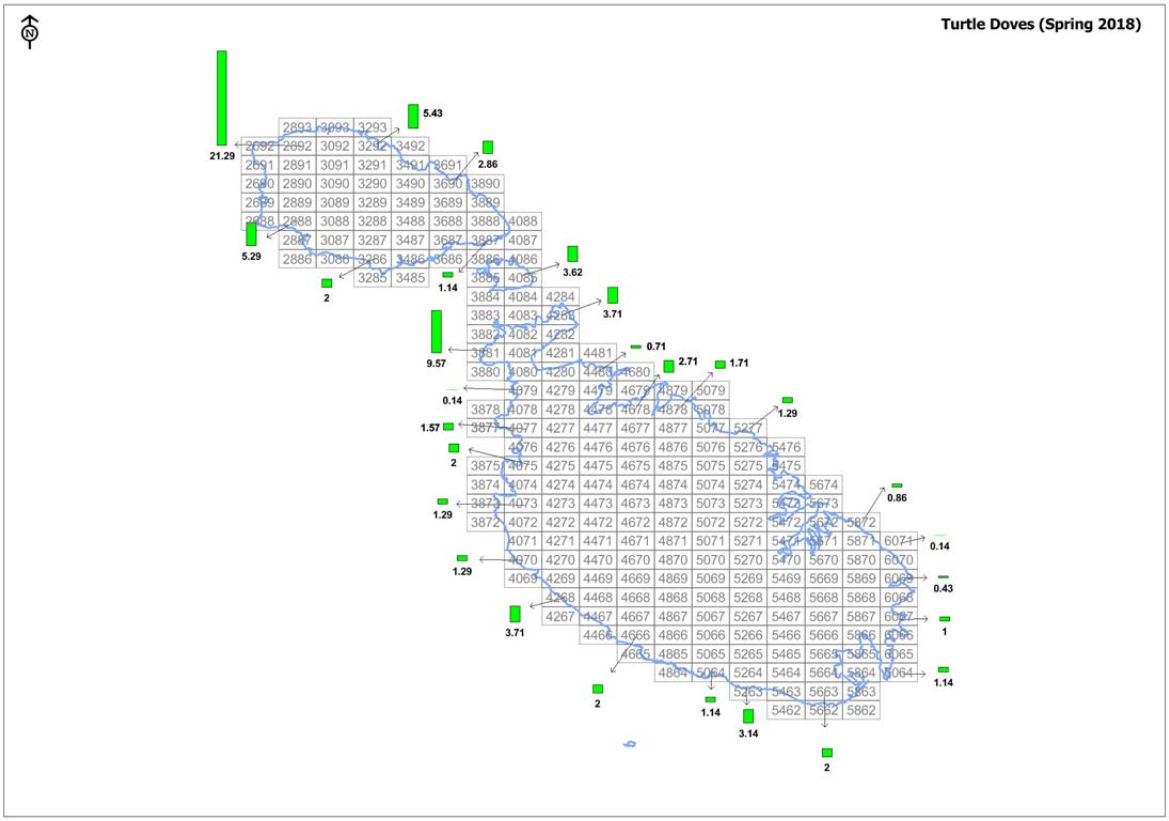


Figure 4. Map of the Maltese Islands showing the standard grid and respective codes, including ones used in the present study. The green bars indicate mean counts of Turtle Dove recorded from study sites in the respective cells.

As has been done in previous surveys (Ecoserv, 2011; 2012; 2013; 2014; 2015; 2016; 2017), an estimate of the total influx of Turtle Dove over the Maltese Islands was made using the daily counts recorded from the present survey. Extrapolations were then made to obtain the approximate total number of individuals of this species that are envisaged to have migrated over the Maltese Islands on a particular date. However, as emphasised in reports of surveys from previous years made in spring (Ecoserv, 2011; 2012; 2013; 2014; 2015; 2016; 2017), such an estimate must be treated with utmost caution, given the relatively small number of sites used on any one day and that the counts were not made daily at each site. Furthermore, passage of birds at different localities is extremely variable, with potential large differences in birds passing at two different sites, even if these are separated by a small distance. As already stated, the other limiting factor is that the field survey stops at 14:00 and does not start again before 07:00 of the following morning, hence potentially missing birds arriving late in the afternoon and early evening, as well as those arriving during the night, which may have not been recorded by the field observers during the survey. On the other hand, the estimate given in the present report is useful when making comparison between different years, assuming data from surveys based on a similar design are available 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 total influx of migrating Turtle Dove for the three-week study period was estimated by extrapolating the values obtained to the total coastline length for the Maltese Islands, which have a perimeter of 271.22 km (Mallia *et al*, 2002)[2]. Based on the mean daily counts (Table 2), extrapolation translates to an estimated daily influx ranging between 54 and 13,615 individuals, with a total influx over the survey period (1 to 21 April 2018; i.e. 21 days) of 34,333 individuals, i.e. some 1,635 birds per day; see Table 2.

Common Quail

The daily observation times by the field observers spent at each quail monitoring station are given in Appendix II. Raw counts for Common Quail recorded from the 28 sites during the present study varied between 0 and a maximum of 4 (see Appendix I), while the mean daily counts ranged between 0 and 0.90. The recorded counts did not vary appreciably between the different sites: at the higher end, a total of 9 individuals were recorded from grid location 4268, while at the lower end no Quail individuals were recorded from grid locations 6067, 4678, 6071, 4480, 4666, 6069 and 4283.

Values of mean and total daily counts of Common Quail recorded during the period 1 to 21 April from the present survey, as well as the respective area surveyed on each day are given in Table 3. These same values are also shown in Figure 5, along with values of mean counts for the same period in 2009 (Thomaidis, nd). Figure 5 also shows the mean daily counts recorded in 2008 (Thomaidis, nd), 2012 (Ecoserv, 2012), 2013 (Ecoserv, 2013), 2014 (Ecoserv, 2014), 2015 (Ecoserv, 2015), 2016 (Ecoserv, 2016), and 2017 (Ecoserv, 2017) but it should be noted that most of these surveys had started on 9 April or later, while the 2017 survey started on 25 March but ended in 14 April; hence there is only partial overlap with the present survey period.

The daily mean counts recorded during the period 1 to 21 April 2018 (present survey) are overall lower than those obtained in 2009 (Thomaidis, nd) during the same period, and also lower when compared to values recorded on 10 April and subsequent dates by Thomaidis (nd) in spring 2008, and by Ecoserv (2012) in spring 2012. On the other hand, values recorded in 2018 are overall similar to those recorded in spring 2017 by Ecoserv (2017) for the period 1 to 14 April, and to those recorded in spring 2013-2016 by Ecoserv (2013; 2014; 2015; 2016) during 10 to 21 April.

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

Table 3

Mean (± SD) daily counts of Common Quail recorded and area surveyed, together with estimates of daily and total influx of migratory individuals.

Date	Mean Daily Count ± SD		Total Area Surveyed (km^2)	Total Daily Count	Estimated Daily Influx
01-Apr-18	0.20	± 0.42	0.258	2	1,713
02-Apr-18	0.20	± 0.63	0.572	2	774
03-Apr-18	0.10	± 0.32	0.268	1	826
04-Apr-18	0.20	± 0.42	0.279	2	1,585
05-Apr-18	0.30	± 0.48	0.550	3	1,208
06-Apr-18	0.20	± 0.42	0.270	2	1,642
07-Apr-18	0.10	± 0.32	0.279	1	792
08-Apr-18	0.30	± 0.67	0.550	3	1,208
09-Apr-18	0.20	± 0.42	0.268	2	1,651
10-Apr-18	0.90	± 1.37	0.255	9	7,799
11-Apr-18	0.10	± 0.32	0.550	1	403
12-Apr-18	0.30	± 0.48	0.246	3	2,702
13-Apr-18	0.70	± 0.67	0.279	7	5,546
14-Apr-18	0.00	± 0.00	0.550	0	0
15-Apr-18	0.80	± 1.03	0.246	8	7,204
16-Apr-18	0.50	± 0.97	0.279	5	3,962
17-Apr-18	0.20	± 0.63	0.550	2	805
18-Apr-18	0.20	± 0.42	0.270	2	1,642
19-Apr-18	0.10	± 0.32	0.279	1	792
20-Apr-18	0.40	± 0.70	0.572	4	1,547
21-Apr-18	0.30	± 0.67	0.246	3	2,702
			Sum Total	**63**	**46,503**

Values of the grand mean of Common Quail counts recorded during the period 1 to 21 April from the present survey (spring 2018), together with values of the grand mean for the same period in 2009 (Thomaidis, nd), for the period 9 to 14 April in 2012 (Ecoserv, 2012), for the period 10 to 14 April in 2008 (Thomaidis, nd), 2013, 2014 and 2016 (Ecoserv, 2012; 2013; 2014; 2016), for the period 14 to 21 April 2015 (Ecoserv, 2015), and for the period 1 to 14 April 2017 (Ecoserv, 2017) are shown in Figure 6. The grand mean recorded during the present (spring 2018) survey is similar to that recorded during the 2013 - 2017 surveys but lower than that recorded in 2008, 2009 and 2012.

Mean count values recorded from each of the 28 sites are indicated on the map shown in Figure 7. The highest mean count was recorded from Dingli (Grid 4268), while relatively high counts were recorded from study sites located along the western coast of Malta and from Marsalforn (Grid 3292) in Gozo. Zero counts were recorded from seven study sites in Malta. The mean count recorded from the study site on Comino is 0.33, which is slightly higher than the median value for the whole range of recorded mean counts.

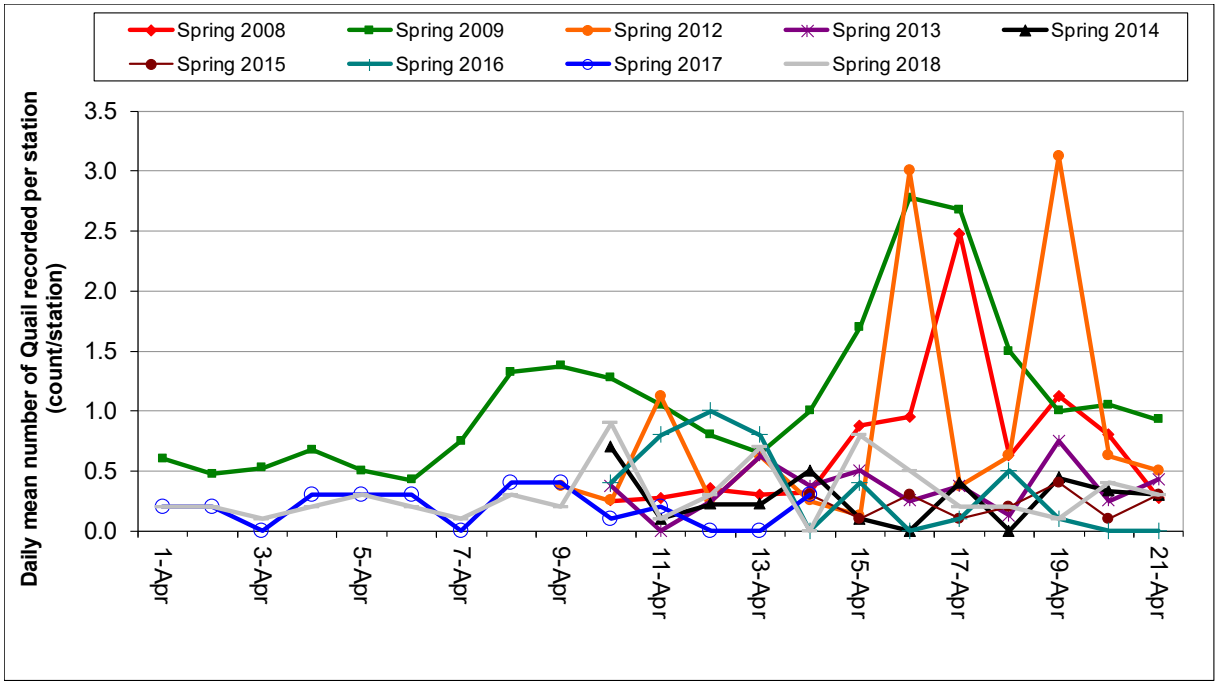


Figure 5. **Daily mean counts of Common Quail per station (= site) recorded during the present survey during the period 1 to 21 April, together with values of the same statistic for: spring 2008 and 2009 as reported in Thomaidis (nd), spring 2012 as reported in Ecoserv (2012), spring 2013 as reported in Ecoserv (2013), spring 2014 as reported in Ecoserv (2014), spring 2015 as reported in Ecoserv (2015), spring 2016 as reported in Ecoserv (2016), and spring 2017 as reported in Ecoserv (2017).**

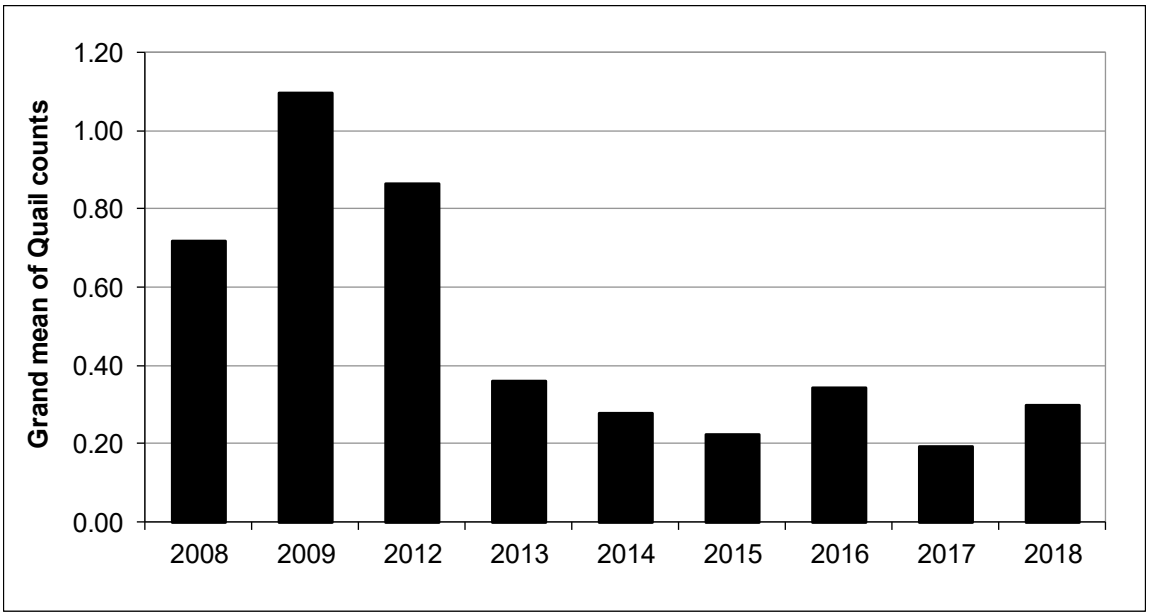


Figure 6. **Grand mean of Common Quail counts for data from the period 1 to 21 April recorded in spring 2018 (present survey) and spring 2009 (Thomaidis, nd), together with the grand mean for data from the period 9 to 14 April recorded in spring 2012 (Ecoserv, 2012), from the period 10 to 14 April for spring 2008 (Thomaidis, nd), 2013, 2014 and 2016 (Ecoserv, 2012; 2013; 2014; 2016), from the period 14 to 21 April recorded in spring 2015 (Ecoserv, 2015), and from the period 1 to 14 April recorded in spring 2017 (Ecoserv, 2017).**

As has been done in previous surveys (Ecoserv, 2011; 2012; 2013; 2014; 2015; 2016; 2017), the total influx of Common Quail was estimated for the whole area of the Maltese Islands using the recorded area surveyed for Quail at each site. However, such an estimate requires the following assumptions: (i) the rate of Quail settling at coastal sites (where the survey was carried out) is equal to that at inland locations, and (ii) the total area used to estimate the migration count does not include areas where settlement of Quail cannot occur in practice. Since Quail tend to migrate to inland sites, settling of Quail in coastal areas will likely be less than or equal to that in inland regions, but not greater, meaning that the estimated total may be an underestimate. The use of only coastal sites is still justified since these are more likely to serve as short-term stopover sites immediately following a migratory flight than inland locations; thus, including inland locations may result in an overestimate of the total influx due to repeated counting of resident Quails. To ensure that the total area used to estimate the migration count does not include regions within which Quail do not normally settle, even though some birds may fly over urbanized areas, the total area was calculated as the sum of agricultural areas (161.5 km^2), forested areas (2.1 km^2) and areas of natural vegetation (57.8 km^2); this amounts to 221.4 km^2, representing 72% of the 315 km^2 total area of the Maltese Islands (land cover data source: MEPA, 2010). The mean (± SD) daily counts and estimated total influx of birds per day are shown in Table 3. Based on these data, extrapolation translates to a total influx of Common Quail during 1 to 21 April 2018 of 46,503 individuals, or some 2,214 Quail per day (see Table 3). However, as emphasised in the reports of previous surveys (Ecoserv, 2011; 2012; 2013; 2014; 2015; 2016; 2017), such an estimate must be treated with utmost caution, given the relatively small number of field sites used on any one day and that counts were not made daily at each site, such that only a very small portion of the total area of potential habitat in the Maltese Islands was sampled.

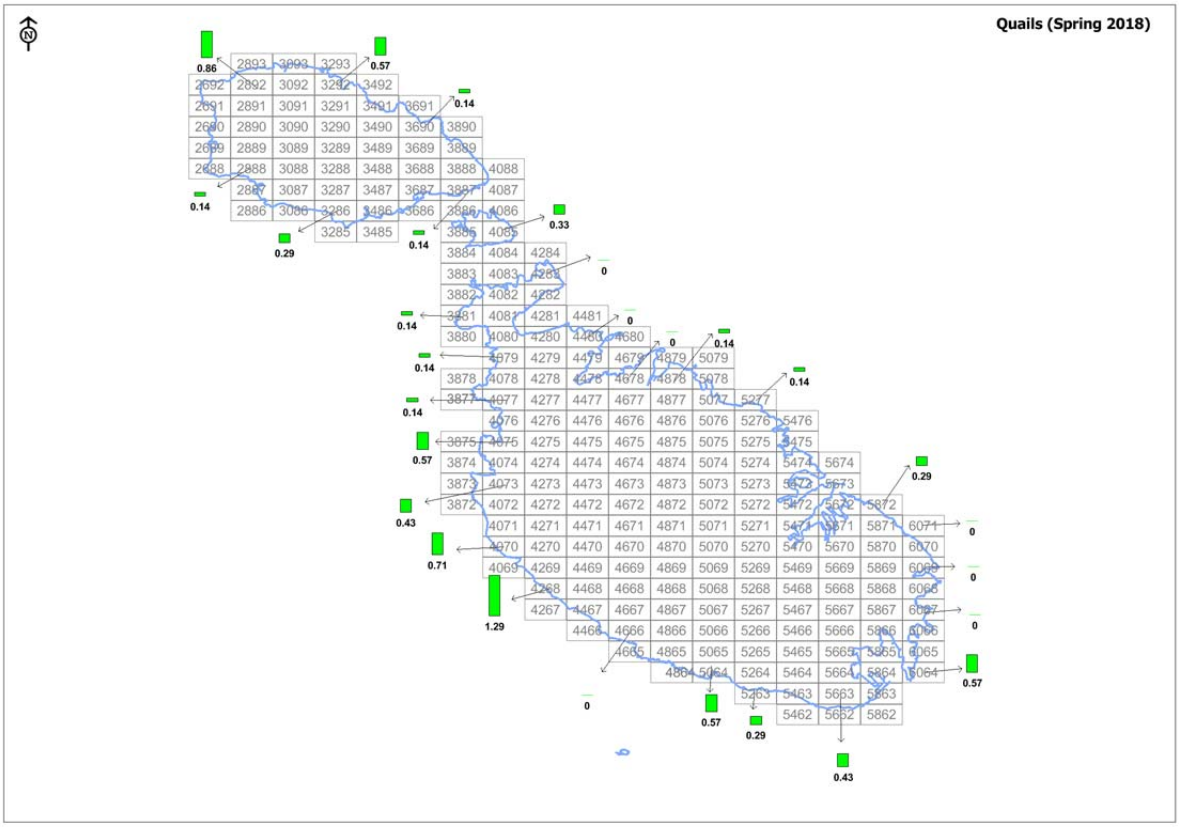


Figure 7. Map of the Maltese Islands showing the standard grid and respective codes, including ones used in the present study. The green bars indicate mean counts of Common Quail recorded from study sites in the respective cells.

4. Comparison with Quail bag data

A comparative analysis of data from the present study with bag data provided by the Wild Birds Regulation Unit (WBRU) of the MESDC was undertaken. The dataset provided by the WBRU comprised the daily bag count of Common Quail (as reported by hunters through a telephone reporting system) for the period 1 to 21 April 2018. It should be noted that the two sets of data were collected for different purposes and using very different methodologies; therefore, the magnitudes of values are not directly comparable. However, the temporal trends can be expected to follow similar patterns; that is, within the same season the periods when higher mean daily counts were recorded during the present survey should broadly follow the days when higher numbers of Common Quail were caught (and reported in the bag data). Graphical representations of the mean or total daily counts made during the present (2018) survey and the daily bag counts for the same period (1 to 21 April 2018; MESDC unpublished data) for Common Quail were prepared to compare temporal trends among the two different data sets.

The daily bag counts indicating the number of Common Quail caught during the 2018 spring hunting season and the mean daily counts of Common Quail recorded during the present (2018) survey are shown in Figure 8, while Figure 9 shows the same data, but with the results from the present (2018) survey given as total daily counts. As already noted, the magnitudes of the bag counts and those of the mean/total counts made in the 2018 survey are not directly comparable; hence the two sets of values are on different scales. Therefore, in Figures 8 and 9, two separate y-axes are used: the bag count data is plotted on the left-side y-axis, whereas the counts from the 2018 survey are plotted on the right-side y-axis.

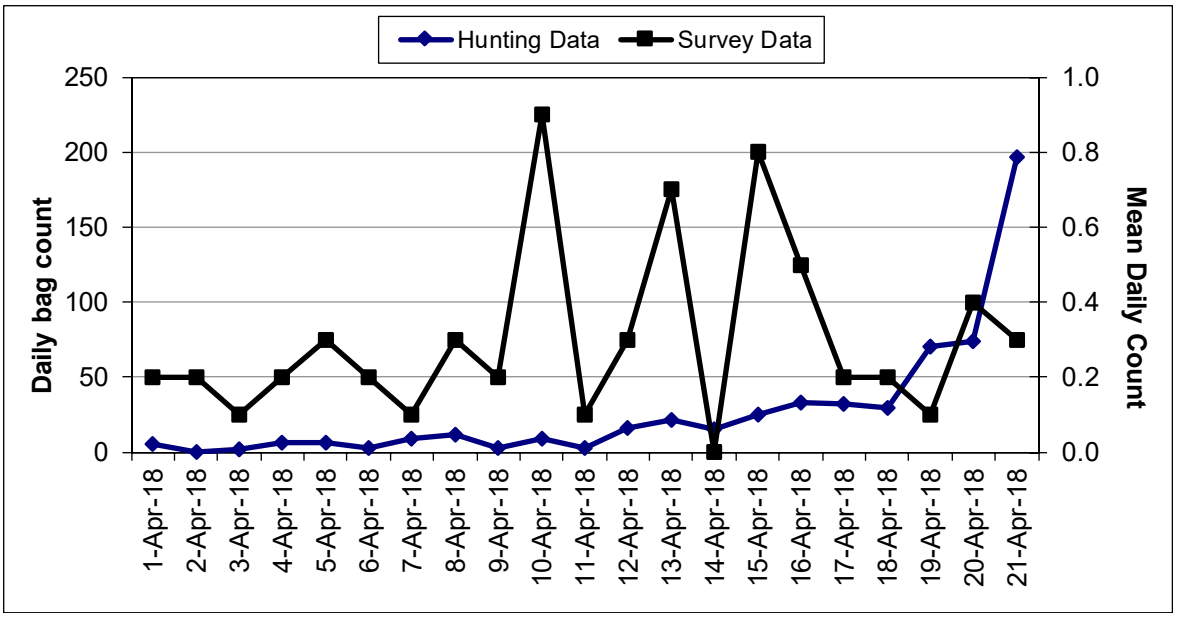


Figure 8. Daily bag count of Common Quail during 2018 (blue line; values on left-side y-axis), together with the mean daily counts recorded during the 2018 survey (black line; values on right-side y-axis), for the period 1 – 21 April 2018.

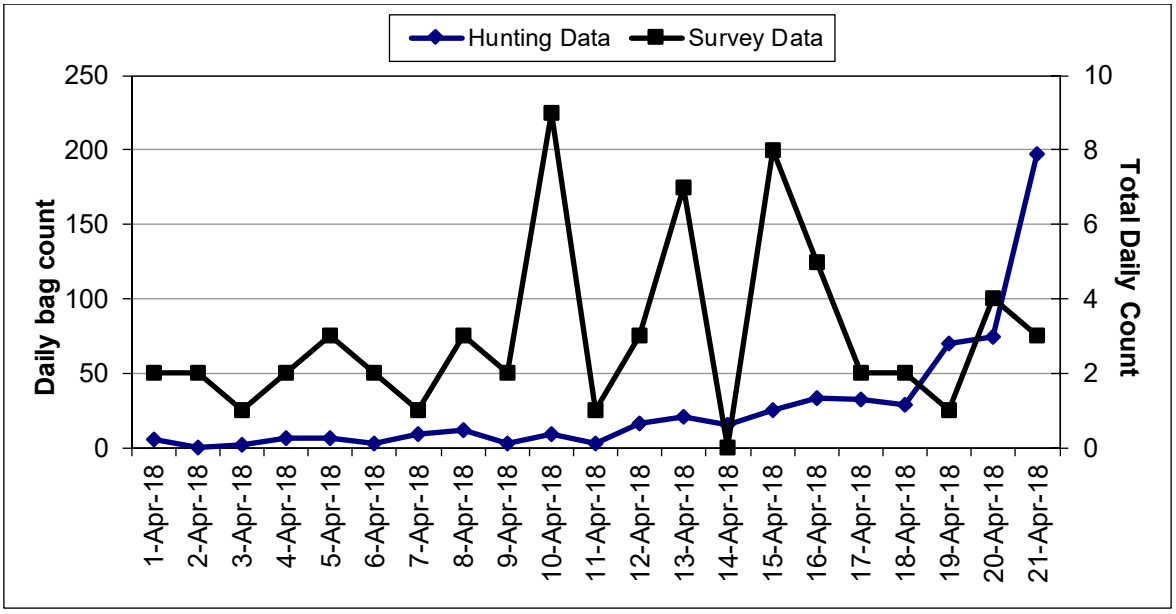


Figure 9. Daily bag count of Common Quail during 2018 (blue line; values on left-side y-axis), together with the total daily counts recorded during the 2018 survey (black line; values on right-side y-axis), for the period 1 – 21 April 2018.

The daily counts made during the 2018 survey include day-to-day fluctuations, with the highest counts being made on 10 April, 13 April and 15 April 2018, which seem to indicate overall elvated counts during the period 10 – 15 April; but apart from this, no overall trend of increase or decrease in daily survey counts is discernible over the survey period. On the other hand, the bag count data indicate an overall trend of increase, especially towards the end of the survey period. Bag counts reported between 1 and 11 April range between 0 and 12 birds; those reported between 12 and 18 April range between 16 and 33 birds, and the highest bag counts of 70, 74 and 197 birds were reported on 19, 20 and 21 April 2018 respectively. The increase in bag counts reported in the last three days of the survey period is not reflected in the daily counts made during the 2018 survey. It should be noted, however, that the total daily counts made during the 2018 survey were low, which introduces an additional difficulty in making interpretations of these comparisons.

5. Appraisal

The present survey provides data on counts of Turtle Dove and Common Quail recorded during April 2018, as well as estimates of the migratory influx of the two species. In 2018, the Government had established the open season for hunting of Common Quail between 1 and 21 April, which was covered by the period during which the present study was held.

For Turtle Dove, when comparing the results of the present survey with those from previous surveys, a similar trend of counts is noted overall. The general pattern is of very low counts recorded in March and early April, with marginally higher counts recorded in mid-April, including peaks in some years. Counts made between 1 April and 8 April during the present survey are similar to those made in spring 2009 (Thomaidis, nd) and 2017 (Ecoserv, 2017); surveys made in other years did not cover this period. Counts recorded after 9 April are also similar to those recorded by Thomaidis (nd) in spring 2008 and 2009, and by Ecoserv (2012; 2013; 2014; 2015; 2016; 2017) in spring 2012–2017, but high

peak counts were not recorded in all years. In 2008, a very high mean count (98, on 15-4-08) and a secondary peak (26, on 20-04-08) were recorded. During the present (spring 2018) survey a single main peak (25, on 19-04-18) was recorded, while no mean counts greater than 20 were recorded in any of the other years. The grand mean recorded during the present (spring 2018) survey is similar than that recorded during most of the previous surveys, but much lower than that recorded in 2008.

The total influx of Turtle Dove for the present survey period (1 to 21 April 2018) is estimated at 34,333 individuals; for the period 25 March to 14 April 2017, a total influx of 7,539 individuals was estimated (Ecoserv, 2017); for the period 10 – 30 April 2016, a total influx of 22,349 individuals was estimated (Ecoserv, 2016); for the period 14 – 30 April 2015, a total influx of 25,006 individuals was estimated (Ecoserv, 2015); for the period 10 – 30 April 2014, a total influx of 24,922 individuals was estimated (Ecoserv, 2014); for the period 10 – 30 April 2013, a total influx of 42,521 individuals was estimated (Ecoserv, 2013); for the period 9 April – 26 May 2012, a total influx of 57,160 individuals was estimated (Ecoserv 2012); and for the period 8 – 28 May 2011, a total influx of 18,057 individuals was estimated (Ecoserv, 2011). Therefore, the estimate from the present survey (2018) is the third highest made over the 8 years for spring with each survey (except the 2015 survey) lasting around 21 days; the highest two being those made in 2013 and 2014. It is reiterated that such estimates must be treated with utmost caution, given the relatively small number of field sites used on any one day, that counts were not made daily at each site, and since the extrapolation procedure used is likely to result in a rough estimate. Increasing the number of field sites per day is desirable since influx of birds at different localities is extremely variable, with potential large differences in Turtle Dove passing at two different localities, even if these are separated by a very small distance. Furthermore, the length of coastline surveyed per day (4 km) amounts to less than 1.5% of the total coastline; the accuracy of the estimated total migratory influx would be higher if a larger proportion of coastline is surveyed. It should also be noted that the total coastline length used in the present extrapolation includes stretches of coast that are highly developed and densely inhabited, for example, the Sliema – Valletta and Cottonera areas, where one would expect some disturbance to birds migrating at low altitude, hence their numbers there would be expected to be lower, resulting in an overestimate. Another limitation is that the Turtle Dove migration counts were recorded over a seven hour survey period (07:00 - 14:00), hence any individuals migrating at other times of the day were not included, leading to a potential underestimate of the total influx if significant Turtle Dove migration occurred between 14:00 and 07:00. On the other hand, the 07:00-14:00 time period represents the time during which the activity of Turtle Dove is deemed maximum. 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 Turtle Dove is increasing or decreasing with time. Furthermore, actual implementation of a survey such as the present poses huge logistical (including to recruit a sufficient number of suitable personnel for a relatively short duration) and cost contraints.

For Common Quail, when comparing the results of the present survey with those from Thomaidis' (nd) survey held in 2009, slightly lower counts were recorded during the same period (1 to 21 April) in the present survey. Comparison of the results from the present (spring 2018) with those from Thomaidis' (nd) survey held in 2008, and with those from the 2012, 2013, 2014, 2015, 2016 surveys by Ecoserv (2012; 2013; 2014; 2015; 2016), are limited to the period 9 – 21 April, since these surveys had started on 9 April or later, while comparisons with the 2017 survey by Ecoserv (2017) are limited to 1 – 14 April. Daily mean counts recorded during the present survey were lower compared to values recorded on 10 April and subsequent dates by Thomaidis (nd) in spring 2008 and by Ecoserv (2012) in spring 2012. On the other hand, values recorded in 2018 are overall similar to those recorded in spring 2017 by Ecoserv (2017) for the period 1 to 14 April, and to those recorded in spring 2013-2016 by Ecoserv (2013; 2014; 2015; 2016) during 10 to 21 April. The grand mean

recorded during the present (spring 2018) survey is similar than that recorded during the 2013-2017 surveys, but lower than that recorded in 2008, 2009 and 2012.

The total influx of Common Quail for the present survey period (1 to 21 April 2018) is estimated at 46,503 individuals. For the period 25 March to 14 April 2017, a total influx of 27,615 individuals was estimated (Ecoserv, 2017). For the period 10 – 30 April 2016, a total influx of 31,264 individuals was estimated (Ecoserv, 2016); for the period 14 – 30 April 2015, a total influx of 20,211 individuals was estimated (Ecoserv, 2015); for the period 10 – 30 April 2014, a total influx of 37,773 individuals was estimated (Ecoserv, 2014); for the period 10– 30 April 2013, a total influx of 67,460 individuals was estimated (Ecoserv, 2013); for the period 9 April – 26 May 2012, a total influx of 35,018 individuals was estimated (Ecoserv, 2012), and for the period 8 – 28 May 2011, a total influx of 22,699 individuals was estimated (Ecoserv, 2011). The estimate made for the present survey (2018) is therefore lower than that for 2013, but higher than that recorded in other years. It is reiterated that such estimates must be treated with utmost caution, given the relatively small number of field sites used in the present survey, that counts were not made daily at each site, and since the extrapolation procedure used is likely to result in a rough estimate. The considerations emphasised above for Turtle Dove also apply to the Common Quail – birds may migrate along specific pathways, with the result that high numbers may be recorded at one site and a potentially much lower number at a different site, even if the two sites are separated by a very small distance of even a few hundred meters. Hence increasing the number of field sites per day to account for such variation in counts between different sites is desirable. Furthermore, the daily area surveyed for Common Quail amounts to less than 1% of the total area; the accuracy of the estimated total migratory influx would be higher if a larger area is surveyed.

The design of the present survey included counts made over a 21 day period between 1 and 21 April 2018. Although migratory peaks for Common Quail can occur in late March and early April, the peak migration of Turtle Dove and Common Quail usually occurs in the last three weeks of April, while Turtle Dove migration can also extend to May. No information on migration of Turtle Dove and Quail occurring after 21 April 2018 is available since the survey period ended on this date.

For both Turtle Dove and Common Quail, a number of limitations, which have already been highlighted in Ecoserv (2011; 2012; 2013; 2014; 2015; 2016; 2017), are reiterated, namely:

- The data reported on in the present document can only be used for purposes of trend analysis, and even in this respect, due caution should be exercised given that the sampling effort used in the present 2018 study, while partly similar that reported and utilized by Thomaidis (nd) for the years 2008 and 2009, is not identical. Comparison with data collected by Ecoserv (2011) during spring 2011 was not possible since the bird counts from that year were collected in May. Comparison with data collected by Ecoserv (2012, 2013, 2014, 2015, 2016, 2017) was also limited because the 2012–2016 surveys never started before 9 April and the 2017 survey ended on 14 April, while the present survey was made between 1 and 21 April. The 10– 30 April survey period used in previous surveys is deemed to be more representative of the period during which migratory influx of Turtle Dove, and to a lesser extent Common Quail[3], is highest.
- 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 28 sites.

[3] Given that migratory peaks for Common Quail also occur in late March – early April.

Nevertheless, the data from the present study provides a useful indication of the influx of Turtle Dove and Common Quail, provided that results are interpreted in the context of the limitations detailed above.

6. References

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Thomaidis (nd). Study of the migration patterns of Turtle Dove *Streptopelia turtur* and quail *Coturnix coturnix* over the Maltese Islands. Technological Education Institute of Lamia, Department of Forestry and Management of Narutal Environment, Kapenisi, Greece; 56 pp.

APPENDIX I - Raw counts

Table A. Daily counts of Turtle Dove recorded per site.

Ecoserv Sample Reference Code	B-024-18	B-025-18	B-026-18	B-027-18	B-028-18	B-029-18	B-030-18	B-031-18	B-032-18	B-033-18	B-034-18	B-035-18	B-036-18	B-037-18
Grid Location	**4085**	**3887**	**2892**	**3881**	**4073**	**4268**	**4864**	**6067**	**5872**	**4678**	**3690**	**3286**	**4077**	**4075**
01-Apr-18	0	0	0	0	0	0	2	0	0	0				
02-Apr-18	0										1	0	0	0
03-Apr-18	0													
04-Apr-18	0	0	0	0	0	0	1	1	1	1				
05-Apr-18	0										0	0	0	1
06-Apr-18	0													
07-Apr-18	0	1	1	0	1	0	0	0	0	0				
08-Apr-18	0										0	0	1	1
09-Apr-18	2													
10-Apr-18	0	1	1	1	1	3	2	0	1	2				
11-Apr-18	0										0	0	3	1
12-Apr-18	2													
13-Apr-18	4	2	3	1	1	2	0	0	0	1				
14-Apr-18	1										2	1	2	6
15-Apr-18	9													
16-Apr-18	18	1	5	11	0	4	0	1	1	5				
17-Apr-18	0										3	1	1	2
18-Apr-18	0													
19-Apr-18	11	3	139	54	6	17	3	5	3	10				
20-Apr-18	3										14	12	4	3
21-Apr-18	26													

Table A continued. Daily counts of Turtle Dove recorded per site.

Ecoserv Sample Reference Code	B-038-18	B-039-18	B-040-18	B-041-18	B-042-18	B-043-18	B-044-18	B-045-18	B-046-18	B-047-18	B-048-18	B-049-18	B-050-18	B-051-18
Grid Location	**5263**	**5663**	**5871**	**5277**	**4480**	**3292**	**2888**	**4079**	**4070**	**4666**	**6064**	**6069**	**4878**	**4283**
01-Apr-18														
02-Apr-18	0	0	0	1	0									
03-Apr-18						0	0	0	1	0	0	0	0	0
04-Apr-18														
05-Apr-18	1	0	0	0	0									
06-Apr-18						1	0	0	0	0	0	0	0	0
07-Apr-18														
08-Apr-18	0	0	0	0	0									
09-Apr-18						0	3	0	2	3	4	0	1	0
10-Apr-18														
11-Apr-18	2	3	0	0	3									
12-Apr-18						12	1	0	0	0	1	2	6	1
13-Apr-18														
14-Apr-18	8	0	0	0	0									
15-Apr-18						11	25	0	0	10	2	0	0	14
16-Apr-18														
17-Apr-18	3	0	0	3	0									
18-Apr-18						3	2	1	1	1	0	0	1	0
19-Apr-18														
20-Apr-18	8	11	1	5	2									
21-Apr-18						11	6	0	5	0	1	1	4	11

Table B. Daily counts of Common Quail recorded per site, together with the area surveyed at each site.

Ecoserv Sample Reference Code	B-052-18	B-053-18	B-054-18	B-055-18	B-056-18	B-057-18	B-058-18	B-059-18	B-060-18	B-061-18	B-062-18	B-063-18	B-064-18	B-065-18
Grid Location	**4085**	**3887**	**2892**	**3881**	**4073**	**4268**	**4864**	**6067**	**5872**	**4678**	**3690**	**3286**	**4077**	**4075**
Surveyed Area (km^2)	0.037	0.015	0.018	0.035	0.016	0.036	0.022	0.019	0.036	0.021	0.061	0.168	0.040	0.004
01-Apr-18	0	0	0	0	0	1	1	0	0	0				
02-Apr-18	0										0	0	0	2
03-Apr-18	0													
04-Apr-18	0	1	0	0	0	0	1	0	0	0				
05-Apr-18	1										1	0	0	0
06-Apr-18	1													
07-Apr-18	0	0	1	0	0	0	0	0	0	0				
08-Apr-18	0										0	2	0	1
09-Apr-18	1													
10-Apr-18	0	0	2	0	1	4	2	0	0	0				
11-Apr-18	0										0	0	0	0
12-Apr-18	0													
13-Apr-18	1	0	2	1	1	1	0	0	1	0				
14-Apr-18	0										0	0	0	0
15-Apr-18	2													
16-Apr-18	0	0	1	0	0	3	0	0	1	0				
17-Apr-18	0										0	0	0	0
18-Apr-18	0													
19-Apr-18	0	0	0	0	1	0	0	0	0	0				
20-Apr-18	0										0	0	1	1
21-Apr-18	1													

Table B continued. Daily counts of Common Quail recorded per site, together with the area surveyed at each site.

Ecoserv Sample Reference Code	B-066-18	B-067-18	B-068-18	B-069-18	B-070-18	B-071-18	B-072-18	B-073-18	B-074-18	B-075-18	B-076-18	B-077-18	B-078-18	B-079-18
Grid Location	**5263**	**5663**	**5871**	**5277**	**4480**	**3292**	**2888**	**4079**	**4070**	**4666**	**6064**	**6069**	**4878**	**4283**
Surveyed Area (km^2)	0.092	0.031	0.052	0.054	0.031	0.048	0.015	0.052	0.012	0.019	0.023	0.032	0.011	0.018
01-Apr-18														
02-Apr-18	0	0	0	0	0									
03-Apr-18						1	0	0	0	0	0	0	0	0
04-Apr-18														
05-Apr-18	0	0	0	1	0									
06-Apr-18						1	0	0	0	0	0	0	0	0
07-Apr-18														
08-Apr-18	0	0	0	0	0									
09-Apr-18						1	0	0	0	0	0	0	0	0
10-Apr-18														
11-Apr-18	0	1	0	0	0									
12-Apr-18						1	0	1	1	0	0	0	0	0
13-Apr-18														
14-Apr-18	0	0	0	0	0									
15-Apr-18						0	1	0	1	0	3	0	1	0
16-Apr-18														
17-Apr-18	2	0	0	0	0									
18-Apr-18						0	0	0	1	0	1	0	0	0
19-Apr-18														
20-Apr-18	0	2	0	0	0									
21-Apr-18						0	0	0	2	0	0	0	0	0

APPENDIX II - The daily observation times by the field observers spent at each Common Quail monitoring station

Date	Location	Observation time	Date	Location	Observation time
1 April 2018	Comino	08:00 –10:00	5 April 2018	Comino	07:00 – 09:00
1 April 2018	Gozo: Qala / Halfa	07:00 – 09:00	5 April 2018	Gozo: San Blas	10:00 – 12:00
1 April 2018	Gozo: Wied il-Mielah	07:00 – 09:00	5 April 2018	Gozo: Ta' Cenc	08:00 – 10:00
1 April 2018	Cirkewwa / Torri l-Ahmar	08:00 – 10:00	5 April 2018	Ghajn Tuffieha	07:30 – 09:30
1 April 2018	Fomm ir-Rih	08:00 – 10:00	5 April 2018	Gnejna	08:00 – 10:00
1 April 2018	Rdum ta' Had-Dingli	10:00 – 12:00	5 April 2018	Zurrieq	07:15 – 09:15
1 April 2018	Lapsi	09:00 – 11:00	5 April 2018	Ghar Hasan	07:00 – 09:00
1 April 2018	San Tumas	07:15 – 09:15	5 April 2018	Xghajra Ta' Barkat	07:00 – 09:00
1 April 2018	Rinella	07:00 – 09:00	5 April 2018	White Rocks	07:30 – 09:30
1 April 2018	Wardija	07:30 – 09:30	5 April 2018	Mistra / Mgiebah	07:00 – 09:00
2 April 2018	Comino	07:00 – 09:00	6 April 2018	Comino	07:30 – 09:30
2 April 2018	Gozo: San Blas	07:00 – 09:00	6 April 2018	Gozo: Marsalforn	07:00 – 09:00
2 April 2018	Gozo: Ta' Cenc	08:00 – 10:00	6 April 2018	Gozo: Ghadira ta' Sarraflu	08:30 – 10:30
2 April 2018	Ghajn Tuffieha	08:30 – 10:30	6 April 2018	Anchor Bay / Rdum taht il-Mellieha	07:00 – 09:00
2 April 2018	Gnejna	9:30 – 11:45	6 April 2018	Rdum ta' Had-Dingli	09:00 – 11:00
2 April 2018	Zurrieq	07:30 – 09:30	6 April 2018	Fawwara	07:00 – 09:00
2 April 2018	Ghar Hasan	07:12 – 09:12	6 April 2018	Delimara Point	08:20 – 10:20
2 April 2018	Xghajra Ta' Barkat	08:00 – 10:00	6 April 2018	Zonqor Point	08:30 – 10:30
2 April 2018	White Rocks	10:00 – 12:00	6 April 2018	Ghallis	07:30 – 09:30
2 April 2018	Mistra / Mgiebah	07:00 – 09:00	6 April 2018	L-Ahrax tal-Mellieha	08:00 – 10:00
3 April 2018	Comino	07:00 – 09:00	7 April 2018	Comino	07:00 – 09:00
3 April 2018	Gozo: Marsalforn	07:30 – 09:30	7 April 2018	Gozo: Qala / Halfa	08:00 – 10:00
3 April 2018	Gozo: Ghadira ta' Sarraflu	07:30 – 09:30	7 April 2018	Gozo: Wied il-Mielah	07:00 – 09:00
3 April 2018	Anchor Bay / Rdum taht il-Mellieha	07:00 – 09:00	7 April 2018	Cirkewwa / Torri l-Ahmar	08:00 – 10:00
3 April 2018	Mtahleb to Migra l-Ferha	07:00 – 09:00	7 April 2018	Fomm ir-Rih	08:00 – 10:00
3 April 2018	Fawwara	07:30 – 09:30	7 April 2018	Rdum ta' Had-Dingli	10:00 – 12:00
3 April 2018	Delimara Point	07:20 – 09:20	7 April 2018	Lapsi	07:00 – 09:00
3 April 2018	Zonqor Point	09:00 – 11:00	7 April 2018	San Tumas	08:00 – 10:00
3 April 2018	Ghallis	07:00 – 09:00	7 April 2018	Rinella	07:00 – 09:00
3 April 2018	L-Ahrax tal-Mellieha	08:00 – 10:00	7 April 2018	Wardija	07:30 – 09:30
4 April 2018	Comino	08:00 – 10:00	8 April 2018	Comino	07:30 – 09:30
4 April 2018	Gozo: Qala / Halfa	08:00 – 10:00	8 April 2018	Gozo: San Blas	07:00 – 09:00
4 April 2018	Gozo: Wied il-Mielah	07:00 – 09:00	8 April 2018	Gozo: Ta' Cenc	07:30 – 09:30
4 April 2018	Cirkewwa / Torri l-Ahmar	07:30 – 09:30	8 April 2018	Ghajn Tuffieha	08:00 – 10:00
4 April 2018	Fomm ir-Rih	07:30 – 09:30	8 April 2018	Gnejna	07:30 – 09:30
4 April 2018	Rdum ta' Had-Dingli	09:00 – 11:00	8 April 2018	Zurrieq	07:00 – 09:00
4 April 2018	Lapsi	07:00 – 09:00	8 April 2018	Ghar Hasan	07:00 – 09:00
4 April 2018	San Tumas	07:30 – 09:30	8 April 2018	Xghajra Ta' Barkat	08:00 – 10:00
4 April 2018	Rinella	07:00 – 09:00	8 April 2018	White Rocks	07:30 – 09:30
4 April 2018	Wardija	08:00 – 10:00	8 April 2018	Mistra / Mgiebah	07:30 – 09:30

APPENDIX II continued.

Date	Location	Observation time	Date	Location	Observation time
9 April 2018	Comino	07:00 – 09:00	13 April 2018	Comino	07:30 – 09:30
9 April 2018	Gozo: Marsalforn	08:00 – 10:00	13 April 2018	Gozo: Qala / Halfa	10:00 – 12:00
9 April 2018	Gozo: Ghadira ta' Sarraflu	07:00 – 09:00	13 April 2018	Gozo: Wied il-Mielah	07:00 – 09:00
9 April 2018	Anchor Bay / Rdum taht il-Mellieha	07:00 – 09:00	13 April 2018	Cirkewwa / Torri l-Ahmar	07:00 – 09:00
9 April 2018	Mtahleb to Migra l-Ferha	08:00 – 10:00	13 April 2018	Fomm ir-Rih	07:00 – 09:00
9 April 2018	Fawwara	07:00 – 09:00	13 April 2018	Rdum ta' Had-Dingli	07:00 – 09:00
9 April 2018	Delimara Point	10:00 – 12:00	13 April 2018	Lapsi	07:30 – 09:30
9 April 2018	Zonqor Point	08:00 – 10:00	13 April 2018	San Tumas	07:00 – 09:00
9 April 2018	Ghallis	07:00 – 09:00	13 April 2018	Rinella	08:00 – 10:00
9 April 2018	L-Ahrax tal-Mellieha	07:00 – 09:00	13 April 2018	Wardija	07:30 – 09:30
10 April 2018	Comino	07:00 – 09:00	14 April 2018	Comino	07:00 – 09:00
10 April 2018	Gozo: Qala / Halfa	07:30 – 09:30	14 April 2018	Gozo: San Blas	07:00 – 09:00
10 April 2018	Gozo: Wied il-Mielah	07:00 – 09:00	14 April 2018	Gozo: Ta' Cenc	08:00 – 10:00
10 April 2018	Cirkewwa / Torri l-Ahmar	07:30 – 09:30	14 April 2018	Ghajn Tuffieha	08:00 – 10:00
10 April 2018	Fomm ir-Rih	09:00 – 11:00	14 April 2018	Gnejna	07:00 – 09:00
10 April 2018	Rdum ta' Had-Dingli	10:00 – 12:00	14 April 2018	Zurrieq	07:00 – 09:00
10 April 2018	Lapsi	07:30 – 10:00	14 April 2018	Ghar Hasan	07:00 – 09:00
10 April 2018	San Tumas	08:30 – 10:30	14 April 2018	Xghajra Ta' Barkat	07:00 – 09:00
10 April 2018	Rinella	07:30 – 09:30	14 April 2018	White Rocks	07:30 – 09:30
10 April 2018	Wardija	08:30 – 10:30	14 April 2018	Mistra / Mgiebah	07:30 – 09:30
11 April 2018	Comino	07:00 – 09:00	15 April 2018	Comino	07:00 – 09:00
11 April 2018	Gozo: San Blas	08:00 – 10:00	15 April 2018	Gozo: Marsalforn	07:00 – 09:00
11 April 2018	Gozo: Ta' Cenc	07:00 – 09:00	15 April 2018	Gozo: Ghadira ta' Sarraflu	07:00 – 09:00
11 April 2018	Ghajn Tuffieha	07:30 – 09:30	15 April 2018	Anchor Bay / Rdum taht il-Mellieha	07:00 – 09:00
11 April 2018	Gnejna	07:00 – 09:00	15 April 2018	Mtahleb to Migra l-Ferha	08:00 – 10:00
11 April 2018	Zurrieq	08:00 – 10:00	15 April 2018	Fawwara	08:00 – 10:00
11 April 2018	Ghar Hasan	08:00 – 10:00	15 April 2018	Delimara Point	08:07 – 10:32
11 April 2018	Xghajra Ta' Barkat	08:50 – 10:50	15 April 2018	Zonqor Point	07:00 – 09:00
11 April 2018	White Rocks	08:00 – 10:00	15 April 2018	Ghallis	08:00 – 10:00
11 April 2018	Mistra / Mgiebah	07:30 – 09:30	15 April 2018	L-Ahrax tal-Mellieha	07:30 – 09:30
12 April 2018	Comino	07:30 – 09:30	16 April 2018	Comino	07:30 – 09:30
12 April 2018	Gozo: Marsalforn	07:30 – 09:30	16 April 2018	Gozo: Wied il-Mielah	08:30 – 10:30
12 April 2018	Gozo: Ghadira ta' Sarraflu	07:00 – 09:00	16 April 2018	Gozo: Qala / Halfa	08:00 – 10:00
12 April 2018	Anchor Bay / Rdum taht il-Mellieha	08:00 – 10:00	16 April 2018	Cirkewwa / Torri l-Ahmar	08:00 – 10:00
12 April 2018	Mtahleb to Migra l-Ferha	07:00 – 09:00	16 April 2018	Fomm ir-Rih	07:30 – 09:30
12 April 2018	Fawwara	08:00 – 10:00	16 April 2018	Rdum ta' Had-Dingli	10:00 – 12:00
12 April 2018	Delimara Point	09:30 – 11:30	16 April 2018	Lapsi	07:00 – 09:00
12 April 2018	Zonqor Point	07:00 – 09:00	16 April 2018	San Tumas	07:30 – 09:30
12 April 2018	Ghallis	07:00 – 09:00	16 April 2018	Rinella	07:00 – 09:00
12 April 2018	L-Ahrax tal-Mellieha	08:00 – 10:00	16 April 2018	Wardija	08:00 – 10:00

APPENDIX II continued.

Date	Location	Observation time	Date	Location	Observation time
17 April 2018	Comino	07:30 – 09:30	20 April 2018	Comino	07:30 – 09:30
17 April 2018	Gozo: San Blas	07:00 – 09:00	20 April 2018	Gozo: San Blas	07:00 – 09:00
17 April 2018	Gozo: Ta' Cenc	08:00 – 10:00	20 April 2018	Gozo: Ta' Cenc	07:00 – 09:00
17 April 2018	Ghajn Tuffieha	08:00 – 10:00	20 April 2018	Ghajn Tuffieha	09:00 – 11:00
17 April 2018	Gnejna	07:00 – 09:00	20 April 2018	Gnejna	08:00 – 10:00
17 April 2018	Zurrieq	08:30 – 10:45	20 April 2018	Zurrieq	08:30 – 10:30
17 April 2018	Ghar Hasan	07:00 – 09:00	20 April 2018	Ghar Hasan	08:00 – 10:00
17 April 2018	Xghajra Ta' Barkat	07:30 – 09:30	20 April 2018	Xghajra Ta' Barkat	07:00 – 09:00
17 April 2018	White Rocks	07:30 – 09:30	20 April 2018	White Rocks	07:30 – 09:30
17 April 2018	Mistra / Mgiebah	07:15 – 09:15	20 April 2018	Mistra / Mgiebah	08:30 – 10:30
18 April 2018	Comino	07:30 – 09:30	21 April 2018	Comino	07:00 – 09:00
18 April 2018	Gozo: Marsalforn	07:30 – 09:30	21 April 2018	Gozo: Marsalforn	07:30 – 09:30
18 April 2018	Gozo: Ghadira ta' Sarraflu	07:30 – 09:30	21 April 2018	Gozo: Ghadira ta' Sarraflu	07:00 – 09:00
18 April 2018	Anchor Bay / Rdum taht il-Mellieha	08:30 – 10:30	21 April 2018	Anchor Bay / Rdum taht il-Mellieha	08:00 – 10:00
18 April 2018	Rdum ta' Had-Dingli	10:00 – 12:00	21 April 2018	Mtahleb to Migra l-Ferha	08:30 – 10:35
18 April 2018	Fawwara	07:30 – 09:30	21 April 2018	Fawwara	07:00 – 09:00
18 April 2018	Delimara Point	07:20 – 09:20	21 April 2018	Delimara Point	07:10 – 09:10
18 April 2018	Zonqor Point	07:30 – 09:30	21 April 2018	Zonqor Point	07:00 – 09:00
18 April 2018	Ghallis	07:30 – 09:30	21 April 2018	Ghallis	08:00 – 10:00
18 April 2018	L-Ahrax tal-Mellieha	07:30 – 09:30	21 April 2018	L-Ahrax tal-Mellieha	07:00 – 09:00
19 April 2018	Comino	07:30 – 09:30			
19 April 2018	Gozo: Qala / Halfa	08:00 – 10:00			
19 April 2018	Gozo: Wied il-Mielah	08:00 – 10:00			
19 April 2018	Cirkewwa / Torri l-Ahmar	07:00 – 09:00			
19 April 2018	Fomm ir-Rih	07:00 – 09:00			
19 April 2018	Rdum ta' Had-Dingli	07:30 – 09:30			
19 April 2018	Lapsi	07:30 – 09:30			
19 April 2018	San Tumas	08:45 – 10:45			
19 April 2018	Rinella	07:45 – 09:45			
19 April 2018	Wardija	08:00 – 10:00			