Ministry for Sustainable Development, the Environment and Climate Change

Report on a survey of the influx of migratory Common Quail and Turtle Dove over the Maltese Islands, made in April 2016

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1. Introduction

On 12th January 2016, the Ministry for Sustainable Development, the Environment and Climate Change (hereafter 'MSDEC') published a call for tenders titled 'Service tender for an independent scientific study on the influx or passage of migratory Common Quail and Turtle Dove in Malta during the 2016 spring season' bearing reference 2/2016. The Terms of Reference (ToR) of the call are as follows:

8.1 Contract Objectives and Expected Results

8.1.1 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 2016 Spring season.*

8.2.2 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;*

The findings of the study will assist the Contracting authority in providing additional verification mechanism for assessing the numbers of turtle doves and quail reported hunted via the game reporting system.

8.2.3 Results to be achieved by the Consultant

The tender results are the following:

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

2. *A monitoring report for Spring 2016 season which must include:*
   a) *List of monitoring stations which recorded high/low counts;*
   b) *Dates which showed 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 and 2015. Reports available on: http://environment.gov.mt/en/Pages/WBRU/Reports-and-Statistics.aspx*

8.3. Assumptions and Risks

8.3.1 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 Clause 8.4.1.1.

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.

8.3.2 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 in Part 9 Section 9.2.

The award of this tender and hence the undertaking of this bird migration study is dependent on a decision by the Government of Malta to apply a derogation for the hunting of Turtle Dove and Quail in Spring 2016. The award of the tender may be cancelled if no such derogation is applied. Provided that this tender shall in no way be construed or perceived as obliging the Government or any other relevant authority to take a decision applying a derogation for the Spring Hunting 2016 season.

8.4 Scope of the Work

8.4.1 General

8.4.1.1 Project Description

The monitoring of the influx or passage of the Turtle Dove and Common Quail shall take place during Spring 2016, on the dates to be specified by the Contracting Authority, which monitoring period shall not exceed an aggregate period of 3 weeks. The consultant shall mobilise all staff and equipment by the end of March, in preparation for the execution of the Spring 2016 bird migration study. The bird monitoring phase shall commence on the 10th of April 2016 and is to be concluded on the 30th of April 2016 (monitoring on both dates is included).

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 consultant 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 2016 report has been certified for quality assurance by the Contracting Authority, the final Spring 2016 monitoring report is to be submitted within 5 working days from such a review.

8.4.1.2 Geographical Area to be covered

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

8.4.1.3 Target Groups

Not applicable

8.4.2 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. Thus 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 relevant experience in bird identification and shall 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 collection of scientific data to elucidate population trends for both species is beyond the scope of this bird migration study. The consultant must submit the daily datasheets with raw counts to the Contracting Authority at the end of each week of each of the bird monitoring periods. The draft monitoring report and analysis for Spring 2016 is to be submitted within 5 working days from the termination of the Spring 2016 bird monitoring phase. Once such draft report has been certified for quality assurance by the Contracting Authority, the final Spring 2016 monitoring report is to be submitted within 5 working days from such a review. All Spring 2016 project activities must be completed to the Contracting Authority's satisfaction by two weeks from the termination of the Spring 2016 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.*

8.4.3 Project Management

8.4.3.1 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.

8.4.3.2 Management Structure

The Head of the Wild Birds Regulation Unit within the Ministry for Sustainable Development, the Environment and Climate Change is the official responsible for this contract. The Head

may delegate various tasks to other officials within the Wild Birds Regulation Unit and may appoint an official to act as a project manager and to monitor the progress of this project.

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

None

8.5. Logistics and Timing

8.5.1 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.

8.5.2 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 2 months from this date.

8.6. Requirements

8.6.1 Personnel

8.6.1.1 Other Experts

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

The Consultant 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 Consultant 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 Consultant 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.

Note that civil servants and other staff of the Public Service of the beneficiary country cannot be recruited as experts. See sub-article 9.5 of the General Conditions.

8.6.1.2 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.*

8.6.2 Accommodation

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

8.6.3 Facilities to be provided by the Consultant

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

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

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

8.6.4 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*

8.7. Reports

8.7.1 Reporting Requirements

(Please refer/peg to Article 26 of the Special/General Conditions)

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*

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 consultant.

The consultant must submit the daily datasheets with raw counts to the Contracting Authority at the end of each week during the Spring 2016 bird monitoring phase. The draft Spring 2016 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 2016 monitoring report is to be submitted within five working days from such a review. All Spring 2016 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.

8.7.2 Submission & approval of progress reports

The daily data sheets with raw counts and 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.

8.8 Monitoring and Evaluation

8.8.1 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 2016 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 2016 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 2016 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 by the MSDEC 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 10 to 30 April 2016, which includes period during which the 2016 spring season was open for hunting (17 – 30 April 2016) for which a derogation was applied by the government of Malta, and is based on the ToR stated above.

In order to put the present study in perspective, an overview of the findings from previous similar studies (Ecoserv, 2011; 2012; 2013; 2014; 2015) follows, however, the reader is also referred to the review on migratory behaviour of the two 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 within 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 have been carried out between 2011 and 2015 by Ecoserv (Ecoserv, 2011; 2012; 2013; 2014; 2015).

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:

Turtle Dove

- 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:

<u>Turtle Dove</u>

- 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.

2. Methodology

The methodology used by Ecoserv during the present 2016 survey is identical to that used in surveys made by the same company in previous spring seasons (see Ecoserv, 2011; 2012; 2013; 2014; 2015); 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 10 and 30 April, 2016. 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, 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 (Armier or Qala) instead. The sampling sites used in the present study include ones used in the previous surveys undertaken during spring 2011-2015 (see Ecoserv, 2011; 2012; 2013; 2014; 2015), and are represented by the grid cell reference numbers listed in Table 1, while their locations are shown in Figure 1.

Since the survey was mainly aimed at quantifying the influx of migrating individuals, field sites were sited at strategic locations 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 birds 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 always made between 06:00 and 13:00, while monitoring of Common Quail was made during a 2 hour period sometime between 06:30 and 13:00. 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 MSDEC.

One-way Analysis of Variance (ANOVA) was carried to test for differences in counts of Turtle Dove and Quail between 2012 (Ecoserv, 2012), 2013 (Ecoserv, 2013), 2014 (Ecoserv, 2014), 2015 (Ecoserv, 2015) and 2016 (present survey), using the mean daily values recorded between 10 and 30 April from the five years as replicate data. Data collected by Thomaidis (nd) in 2008 and 2009 was not included in this analysis since the survey methodology used by Thomaidis (nd) in 2008 and 2009 was not identical to that used in the later surveys made by Ecoserv. Nor was data from the 2011 survey (Ecoserv, 2011) included in the analysis given that the data had been collected during a different period; i.e. in May.

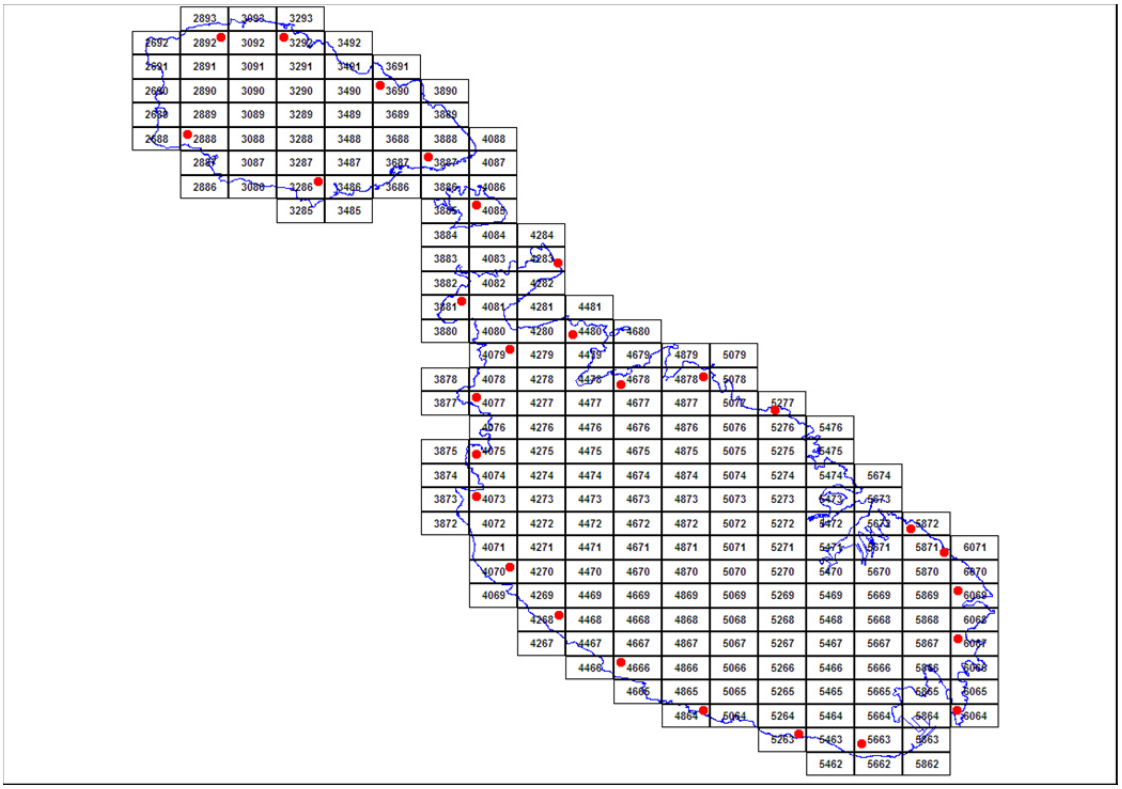

Figure 1. Map of the Maltese Islands showing the localities (grid cells indicated by the red filled circle) where the bird counts were made; see also Table 1.

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

3. Results

Ecoserv's laboratory report reference for the present survey is **036-16**. The sample reference codes for the bird count data are **B-004-16** to **B-059-16**.

Turtle dove

Raw counts for Turtle Dove recorded from the 28 sites during the present study varied between 0 and a maximum of 25 (see Appendix I), while the mean daily counts ranged between 0.2 and 5.4 (Table 2). It is to be noted that counts from different sites incorporate peaks (such as a count of 25 recorded on 22 April). During the present (2016) migration, peak numbers of Turtle Dove occurred on 22 April. The recorded counts also varied appreciably between the different sites. At the lower end, at grid location 4864 (see Figure 1), no Turtle Doves were recorded throughout the survey period, while at the higher end, 34 Turtle Doves were recorded from the site at grid location 4268.

Values of mean and total daily counts of Turtle Dove recorded during the period 10 to 30 April from the present survey are summarised in Table 2. These same values are also shown, along with values of mean counts for the same period in 2008, 2009 (Thomaidis, nd), 2012 (Ecoserv, 2012), 2013 (Ecoserv, 2013), 2014 (Ecoserv, 2014), and 2015 (Ecoserv, 2015), in Figure 2.

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
10-Apr-16	0.20	± 0.42	2	108
11-Apr-16	0.60	± 1.58	6	325
12-Apr-16	1.10	± 0.99	11	597
13-Apr-16	1.10	± 1.20	11	597
14-Apr-16	1.10	± 1.66	11	597
15-Apr-16	2.90	± 4.20	29	1573
16-Apr-16	2.20	± 1.81	22	1193
17-Apr-16	2.50	± 1.72	25	1356
18-Apr-16	3.10	± 2.77	31	1682
19-Apr-16	3.10	± 4.38	31	1682
20-Apr-16	3.10	± 2.81	31	1682
21-Apr-16	1.60	± 1.78	16	868
22-Apr-16	5.40	± 7.23	54	2929
23-Apr-16	2.20	± 1.48	22	1193
24-Apr-16	2.20	± 2.49	22	1193
25-Apr-16	0.70	± 1.57	7	380
26-Apr-16	0.40	± 0.70	4	217
27-Apr-16	0.40	± 0.70	4	217
28-Apr-16	3.50	± 2.51	35	1899
29-Apr-16	2.20	± 2.82	22	1193
30-Apr-16	1.60	± 1.26	16	868
			Estimated Total Influx	**22349**

Overall, counts recorded during the present survey show a similar trend to those recorded by Thomaidis (nd) in spring 2008 and 2009, and by Ecoserv (2012; 2013; 2014; 2015) in spring 2012–2015, for the same survey period, although no very high mean counts as recorded in 2008 (98 on 15-4-08 and 26 on 20-4-08; see Figure 2) and in 2009 (33 on 23-4-12; see Figure 2) were recorded during the present survey. The general pattern from all years compared is a main migratory influx during the last two weeks of April.

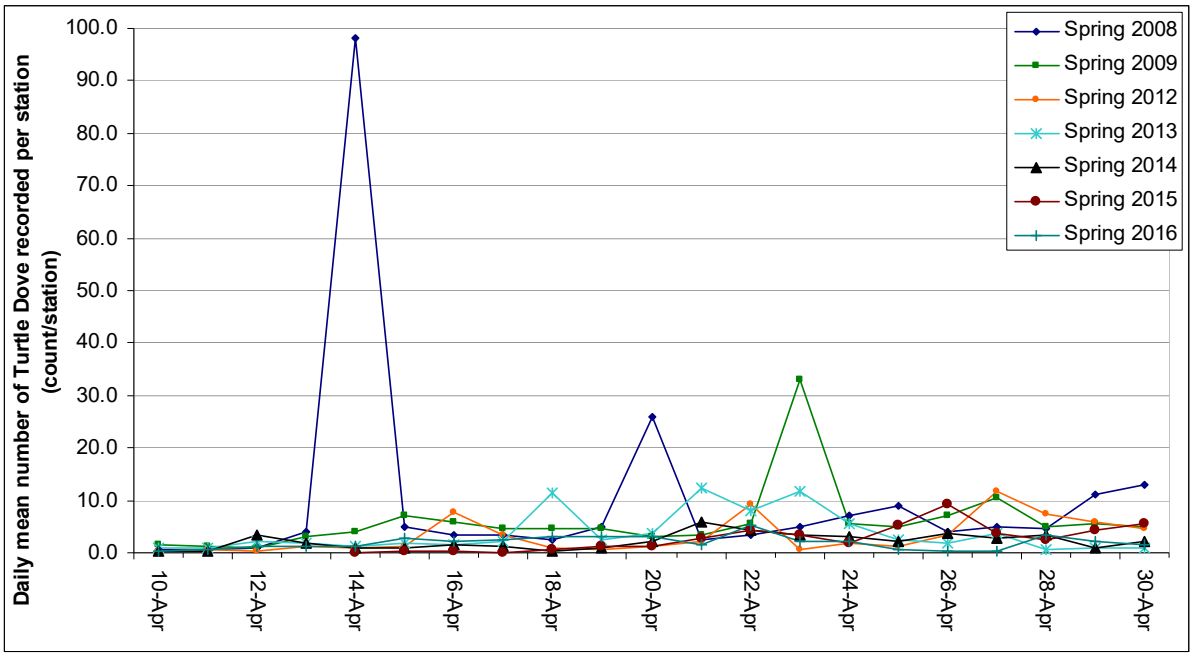

Figure 2. Daily mean counts of Turtle Dove per station (= site) recorded during the present survey during the period 10 – 30 April, together with values of the same statistic for spring 2008 and 2009 as reported in Thomaidis (nd), for spring 2012 as reported in Ecoserv (2012), for spring 2013 as reported in Ecoserv (2013), for spring 2014 as reported in Ecoserv (2014), and for spring 2015 as reported in Ecoserv (2015).

Values of the grand mean of Turtle Dove counts recorded during the period 10 to 30 April from the present survey, together with values of the grand mean for the same period in 2008, 2009 (Thomaidis, nd), 2012, 2013, 2014 and 2015 (Ecoserv, 2012; 2013; 2014; 2015), are shown in Figure 3. Overall, the grand mean recorded during the present (spring 2016) survey is lower than that recorded during the previous surveys. However, ANOVA indicated that the difference between counts recorded during the present survey and those recorded in 2012, 2013, 2014 and 2015 was not statistically significant.

Mean count values recorded from each of the 28 sites are indicated on the map shown in Figure 4. The highest mean count was recorded from Dingli (Grid 4268), while overall high counts were recorded from study sites located along the southwestern parts of Malta and northern parts of Gozo. The lowest mean counts were recorded from the northeastern parts of Malta, particularly from study sites located in the stretch between Salina Bay and Marsascala; comparatively low counts were also recorded from the site at Qala in Gozo and from the site in Comino.

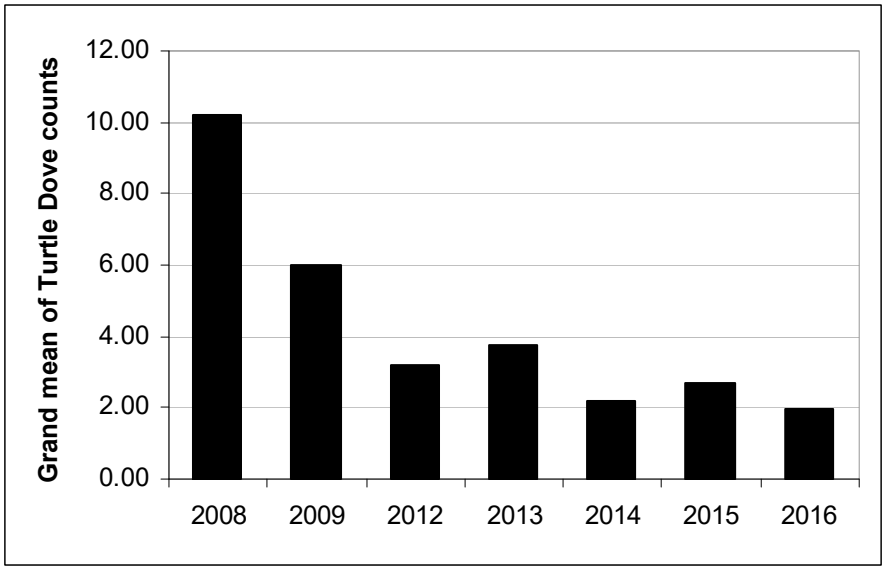

Figure 3. Grand mean of Turtle Dove counts made using data from the period 14 – 30 April for spring 2016 (present survey), spring 2015 (Ecoserv, 2015), spring 2014 (Ecoserv, 2014), spring 2013 (Ecoserv, 2013), spring 2012 (Ecoserv, 2012), spring 2009 (Thomaidis, nd) and spring 2008 (Thomaidis, nd).

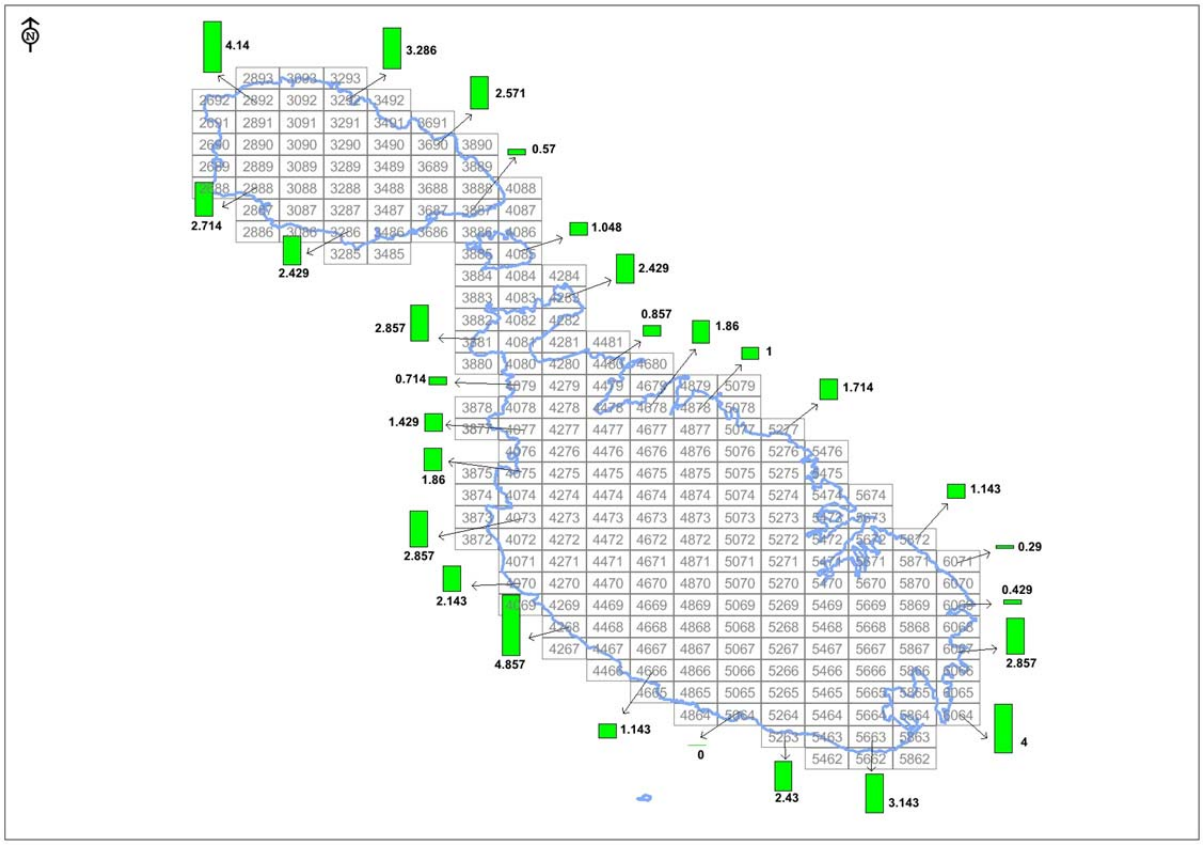

Figure 4. Map of the Maltese Islands showing the standard grid and respective codes, including ones used in the present study. The green bars indicate mean counts of Turtle Dove recorded from study sites in the respective cells.

As has been done in previous surveys (Ecoserv, 2011; 2012; 2013; 2014; 2015), an estimate of the total influx of Turtle Dove over the Maltese Islands was made using the daily counts from the present (2016) 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 (Ecoserv, 2011; 2012; 2013; 2014; 2015), such an estimate must be treated with utmost caution, given the relatively small number of sites used 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 very small distance. As already stated, the other limiting factor is that the field survey stops at 13.00 and does not start again before 06.00, hence potentially missing birds arriving late in the afternoon and early evening, as well as those arriving during the night and which are usually seen at the very first light of day, many of which end up shot within a very short time, and which may have not been recorded by the field observers during the survey. On the other hand, the estimate given in this 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)[1]. Based on the mean daily counts (Table 2), extrapolation translates to an estimated daily influx ranging between 108 and 2,929 individuals, with a total influx over the survey period (10 – 30 April 2016; i.e. 21 days) of 22,349 individuals, i.e. some 1,064 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 1.0. The recorded counts did not vary appreciably between the different sites: at the higher end, a total of 7 individuals were recorded from grid location 4070, while the lower end, no Quails were recorded throughout the survey period from grid locations 4864, 6067, 3286, 5663, 6071, 6064 and 6069.

Values of mean and total daily counts of Common Quail recorded during the period 10 to 30 April from the present survey, as well as the respective area surveyed each day, are given in Table 3. These same values are also shown, along with values of mean counts for the same period in 2008, 2009 (Thomaidis, nd), 2012, 2013, 2014 and 2015 (Ecoserv, 2012; 2013; 2014; 2015), in Figure 5. The daily mean counts recorded during the period 10 – 30 April 2016 (present survey) are overall lower than those obtained in 2009 (Thomaidis, nd) but comparable to those obtained in 2008 (Thomaidis, nd), 2012, 2013, 2014 and 2015 (Ecoserv, 2012; 2013; 2014; 2015) for the same dates, except that no migration peaks (with a mean count >2) as recorded in 2008, 2009 and 2012 (see Figure 4) were recorded during the present survey.

Values of the grand mean Common Quail counts for spring 2016 (present survey), spring 2015 (Ecoserv, 2015), spring 2014 (Ecoserv, 2014), spring 2013 (Ecoserv, 2013), spring 2012 (Ecoserv, 2012), and spring 2008 and spring 2009 (Thomaidis, nd), are shown graphically in Figure 6. The comparison in Figure 6 is based on data collected during the same period (10 to 30 April) in each of the six surveys. The grand mean recorded during the present (spring 2016) survey is lower than that

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

recorded during most of the previous surveys, but slightly higher than that recorded during spring 2015. The results of ANOVA indicated that the counts of Common Quail from the present survey were not significantly different from those recorded during 2013, 2014 or 2015, although they were significantly lower ($p < 0.05$) compared to those from 2012.

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 Daily Count	Total Area Surveyed (km^2)	Estimated Daily Influx
10-Apr-16	0.40	± 0.70	4	0.268	3303
11-Apr-16	0.80	± 1.23	8	0.606	2923
12-Apr-16	1.00	± 1.15	10	0.343	6463
13-Apr-16	0.80	± 0.92	8	0.283	6255
14-Apr-16	0.00	± 0.00	0	0.606	0
15-Apr-16	0.40	± 0.70	4	0.343	2585
16-Apr-16	0.00	± 0.00	0	0.320	0
17-Apr-16	0.10	± 0.32	1	0.591	375
18-Apr-16	0.50	± 0.71	5	0.328	3380
19-Apr-16	0.10	± 0.32	1	0.283	782
20-Apr-16	0.00	± 0.00	0	0.606	0
21-Apr-16	0.00	± 0.00	0	0.380	0
22-Apr-16	0.30	± 0.48	3	0.283	2346
23-Apr-16	0.00	± 0.00	0	0.643	0
24-Apr-16	0.00	± 0.00	0	0.380	0
25-Apr-16	0.10	± 0.32	1	0.268	826
26-Apr-16	0.00	± 0.00	0	0.606	0
27-Apr-16	0.30	± 0.95	3	0.328	2028
28-Apr-16	0.00	± 0.00	0	0.283	0
29-Apr-16	0.00	± 0.00	0	0.606	0
30-Apr-16	0.00	± 0.00	0	0.380	0
				Estimated Total Influx	**31264**

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 Mtaħleb (Grid 4070), while overall elevated counts were recorded from study sites located in the northwestern coast of Malta and from several sites located in Gozo. The lowest mean counts were recorded from the southern parts of Malta, and from Ta' Ċenċ in Gozo. The mean count recorded from the study site on Comino is 0.19, which is close to the median value for the whole range of recorded mean counts.

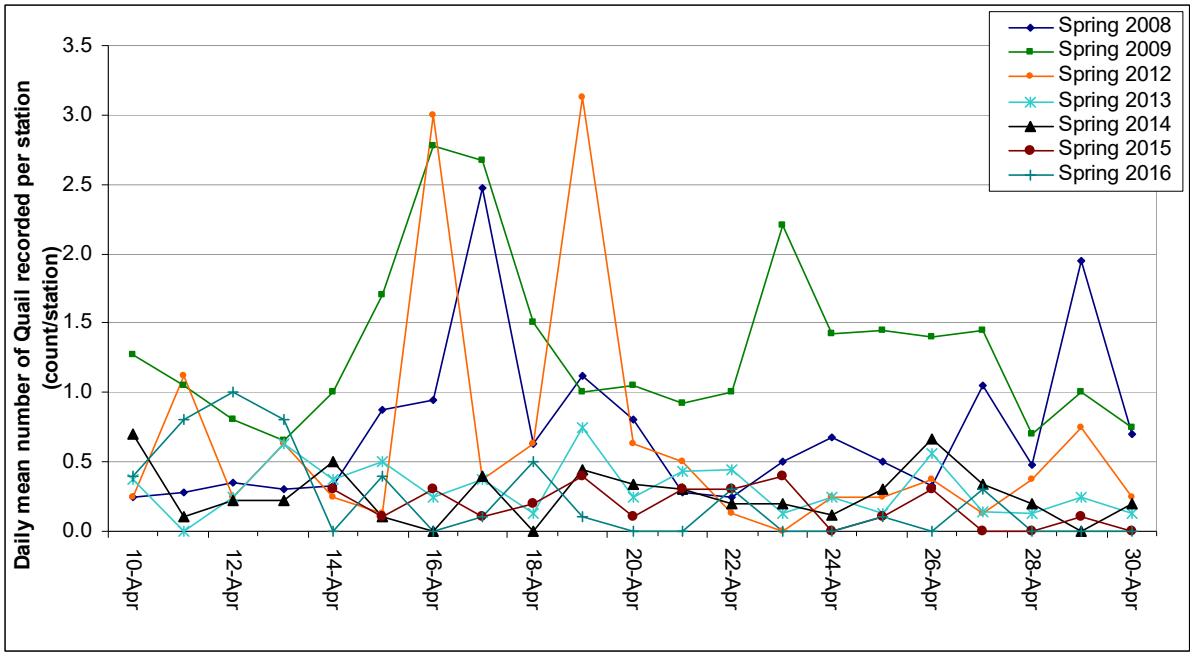

Figure 5. **Daily mean counts of Common Quail per station (= site) recorded during the present survey during the period 14 – 30 April, together with values of the same statistic for spring 2008 and 2009 as reported in Thomaidis (nd), for spring 2012 as reported in Ecoserv (2012), for spring 2013 as reported in Ecoserv (2013), for spring 2014 as reported in Ecoserv (2014), and for spring 2015 as reported in Ecoserv (2015).**

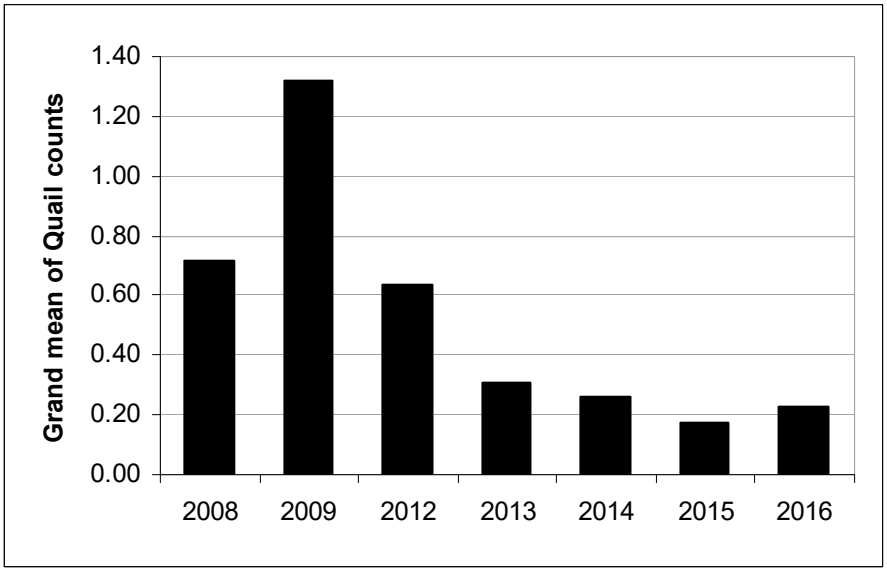

Figure 6. **Grand mean of Common Quail counts made using data from the period 14 – 30 April for spring 2016 (present survey), spring 2015 (Ecoserv, 2015), spring 2014 (Ecoserv, 2014), spring 2013 (Ecoserv, 2013), spring 2012 (Ecoserv, 2012), spring 2009 (Thomaidis, nd) and spring 2008 (Thomaidis, nd).**

As has been done in previous surveys (Ecoserv, 2011; 2012; 2013; 2014; 2015), 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 10 – 30 April 2016 of 31,264 individuals, or some 1,489 Quails per day (see Table 3). However, as emphasised in the reports of previous surveys (Ecoserv, 2011; 2012; 2013; 2014; 2-15), such an estimate must be treated with utmost caution, given the relatively small number of field sites used in the present survey 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.

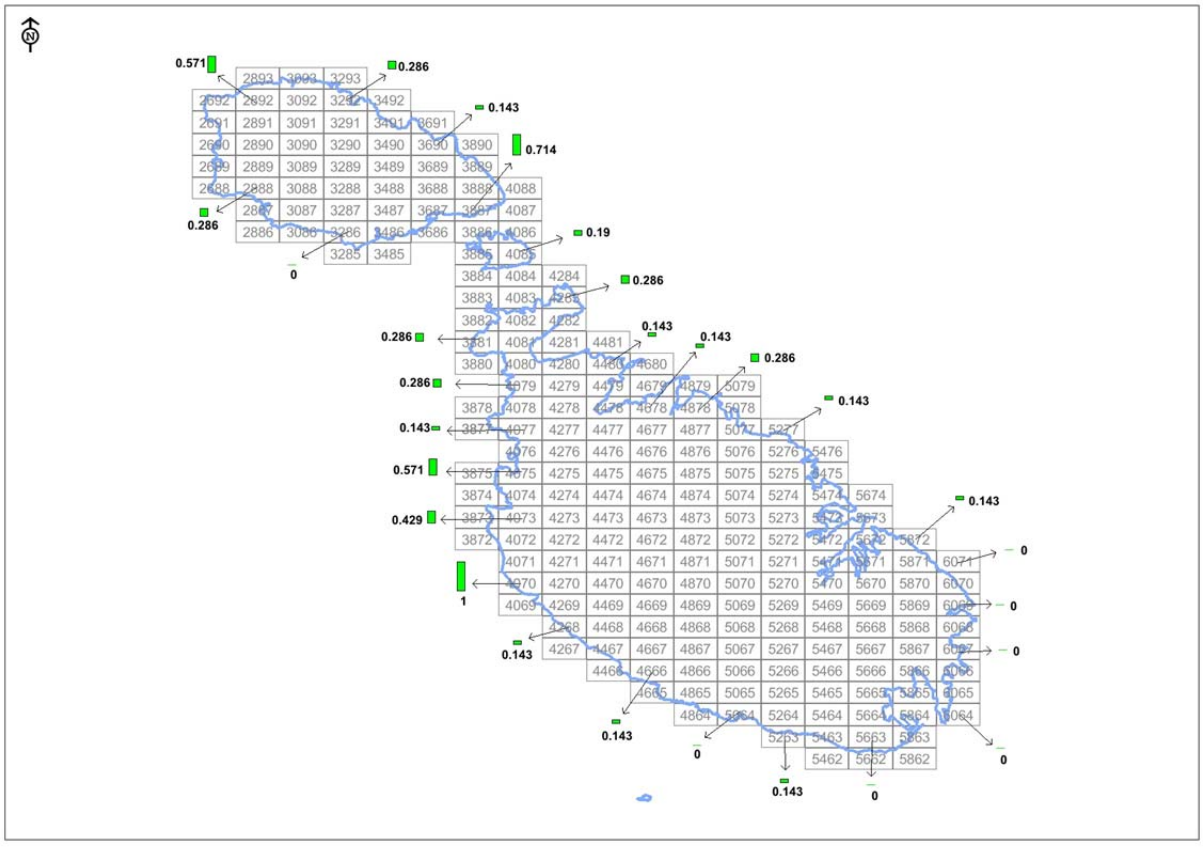

Figure 7. Map of the Maltese Islands showing the standard grid and respective codes, including ones used in the present study. The green bars indicate mean counts of Common Quail recorded from study sites in the respective cells.

4. Comparison with bag data

A comparative analysis of data from the present study with bag data provided by the Wild Birds Regulation Unit (WBRU) of the MSDEC was undertaken. The dataset provided by the WBRU comprised the daily bag count of Turtle Dove and Common Quail (as reported by hunters through a telephone reporting scheme) for the period 17 to 30 April 2016. It should be noted that the two sets of data were collected for different purposes, using very different methodologies, and 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 turtle dove or common quail were caught (and reported in the bag data). Graphical representations of the mean or total daily counts made during the present (2016) survey and the daily bag counts for the same time period (17 – 30 April 2015; MSDEC unpublished data) of Turtle Dove and Common Quail were prepared to compare temporal trends among the two different data sets.

Turtle Dove

The daily bag counts indicating the number of Turtle Dove caught during the 2016 spring hunting season and the mean daily counts of Turtle Dove made during the present (2016) survey are shown in Figure 8, while Figures 9 shows the same data but with the results from the present (2016) 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 2016 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 2016 survey are plotted on the right-side y-axis.

Overall, the general trend of daily counts made during the 2016 survey is of relatively similar counts throughout the survey period, with a small peak on 22 April 2016 and slightly lower counts recorded between 25 and 27 April 2016. The bag count data includes a similar trend of lower counts between 25 and 27 April 2016, but an appreciable increase in bag counts occurred in the last three days of the survey period, with the highest peak on 30 April 2016. Therefore, overall, there was a similar temporal trend of slightly higher counts up to 24 April 2016, followed by a decline until 27 April 2016 in both the daily counts made during the present survey and the bag count data, but the bag count data showed a peak in counts during the last two days of the season whereas no such increase in daily counts made on 29 and 30 April 2016 was recorded during the 2016 survey.

Common Quail

The daily bag counts indicating the number of Common Quail caught during the 2016 spring hunting season and the mean daily counts of Common Quail recorded during the present (2016) survey are shown in Figure 10, while Figures 11 shows the same data, but with the results from the present (2016) 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 2016 survey are not directly comparable; hence the two sets of values are on different scales. Therefore, in Figures 10 and 11, two separate y-axes are used: the bag count data is plotted on the left-side y-axis, whereas the counts from the 2016 survey are plotted on the right-side y-axis.

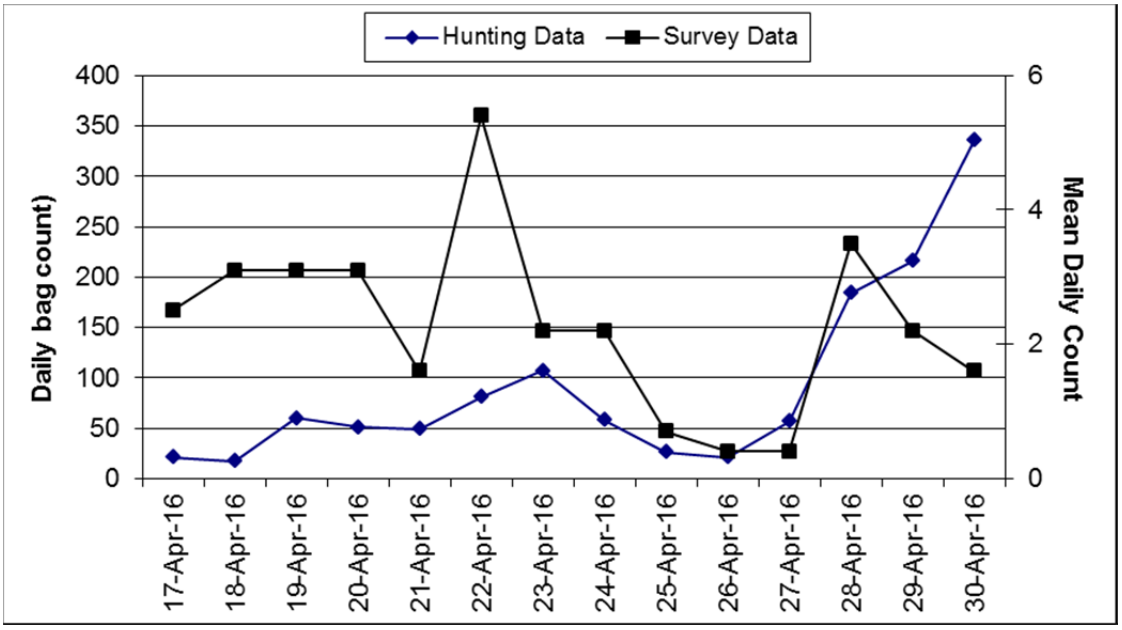

Figure 8. **Daily bag count of Turtle Dove during 2016 (blue line; values on left-side y-axis), together with the mean daily counts recorded during the 2016 survey (black line; values on right-side y-axis), for the period 17 – 30 April 2016.**

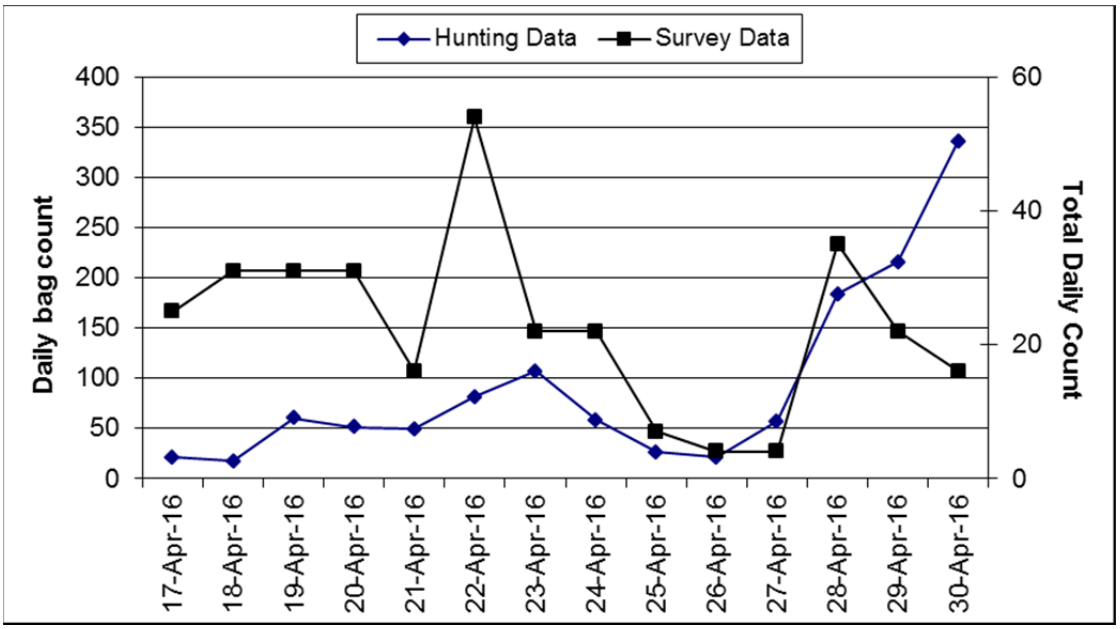

Figure 9. **Daily bag count of Turtle Dove during 2016 (blue line; values on left-side y-axis), together with the total daily counts recorded during the 2016 survey (black line; values on right-side y-axis), for the period 17 – 30 April 2016.**

The daily counts made during the 2016 survey include day to day fluctuations, with the highest counts being made on 18, 22 and 27 April 2016, while no overall increasing or decreasing trend in daily survey counts over the survey period is discernable. The bag count data included similar day to day fluctuations, but there was an overall increasing trend during the survey period. Overall, the general trend in both datasets is of a day to day fluctuation in counts, with peak counts coinciding on some, but not all, dates. It should be noted, however, that both the total daily counts made during the 2016 survey and the daily bag counts for Common Quail were low, which introduces difficulty in

making interpretations of these comparisons, and hence any attempt at conclusions should be made with utmost caution.

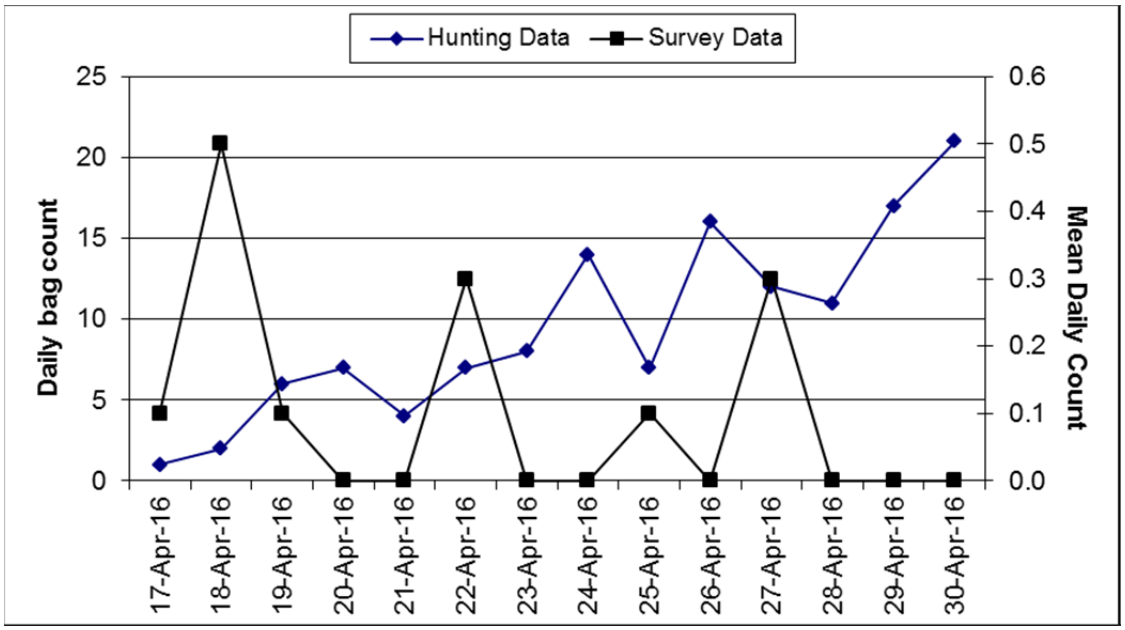

Figure 10. Daily bag count of Common Quail during 2016 (blue line; values on left-side y-axis), together with the mean daily counts recorded during the 2016 survey (black line; values on right-side y-axis), for the period 17 – 30 April 2016.

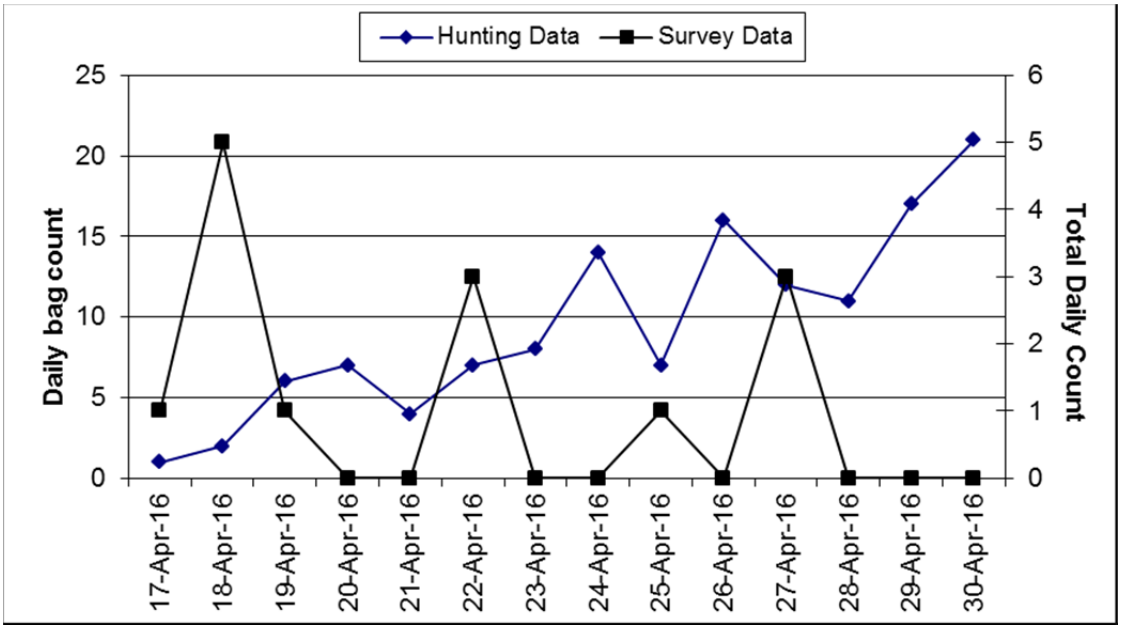

Figure 11. Daily bag count of Common Quail during 2016 (blue line; values on left-side y-axis), together with the total daily counts recorded during the 2016 survey (black line; values on right-side y-axis), for the period 17 – 30 April 2016.

5. Appraisal

The present survey provides data on counts of Turtle Dove and Common Quail recorded during April 2016, as well as estimates of the migratory influx of the two species. In 2016, the Government had established the open season for hunting between 17 and 30 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 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 recorded during the period 10 – 30 April is noted overall; the count values indicate a migratory influx throughout the periods 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 present survey. When comparing the grand mean value recorded during the present survey (spring 2016) to that recorded during the previous four surveys (spring 2012, 2013, 2014 and 2015), a lower value is evident for the former; the differences in grand mean values were not statistically significant. Nevertheless, a general trend of decrease in migratory influx is evident for the last few years; this is 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 present survey is much lower than that recorded by Thomaidis in 2008 and 2009, which indicates a comparatively lower influx of Turtle Dove during spring 2016 (see Figure 2).

The total influx of Turtle Dove for the present survey period (10 – 30 April 2016) is 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). However, it is 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. 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 (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.

For Common Quail, 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, 2014 and 2015 surveys by Ecoserv (2012; 2013; 2014; 2015), a similar trend of Common Quail counts recorded during the period 10 – 30 April is noted overall between the 2008, 2012, 2013, 2014, 2015 and present surveys, while slightly higher counts were recorded in 2009. However, no migratory peaks for Common Quail were recorded during the present survey, whereas such peaks had been recorded in 2008, 2009 and 2012. When comparing the grand mean value recorded during the present (spring 2016) survey with that recorded during the previous four surveys (spring 2012, 2013, 2014 and 2015), a slight increase in spring 2016 compared to the previous spring 2015 is evident, while the spring 2016 values are still lower than those recorded in 2012, 2013 and 2014. In the case of the present (2016) survey and those held in 2015, 2014 and 2013, the differences are marginal and not statistically significant. On the other hand, the grand mean value recorded in 2016 is significantly lower than that recorded in 2012. The grand mean value of Common Quail recorded during the present survey is also lower than values recorded in 2008 and 2009.

The total influx of Common Quail for the present survey period (10 – 30 April 2016) is 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 present survey (2016) is therefore higher than that for 2015, but similar to that recorded in 2014. 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 10 and 30 April 2016, which covers the period when peak migration of Turtle Dove and Quail usually 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 this month.

For both Turtle Dove and Common Quail, a number of limitations, which have already been highlighted in Ecoserv (2011; 2012; 2013; 2014; 2015), 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 2016 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, while the present 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[2], is highest.

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

- 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 present 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.

6. References

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APPENDIX I - Raw counts

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

Ecoserv Sample Reference Code	B-004-16	B-005-16	B-006-16	B-007-16	B-008-16	B-009-16	B-010-16	B-011-16	B-012-16	B-013-16	B-014-16	B-015-16	B-016-16	B-017-16
Grid Location	**4085**	**3887**	**2892**	**3881**	**4073**	**4268**	**4864**	**6067**	**5872**	**4678**	**3690**	**3286**	**4077**	**4075**
10-April-16	1	0	0	0	0	0	0	0	1	0				
11-April-16	0										1	0	0	0
12-April-16	1													
13-April-16	1	0	0	1	3	2	0	3	0	1				
14-April-16	0										5	2	0	0
15-April-16	0													
16-April-16	1	2	3	5	2	0	0	5	1	3				
17-April-16	1										2	5	2	2
18-April-16	2													
19-April-16	2	1	15	2	3	3	0	4	0	1				
20-April-16	1										7	2	4	4
21-April-16	1													
22-April-16	4	0	5	5	6	25	0	1	5	3				
23-April-16	2										3	5	1	3
24-April-16	0													
25-April-16	0	1	0	1	0	0	0	5	0	0				
26-April-16	0										0	1	0	0
27-April-16	0													
28-April-16	5	0	6	6	6	4	0	2	1	5				
29-April-16	0										0	2	3	4
30-April-16	0													

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

Ecoserv Sample Reference Code	B-018-16	B-019-16	B-020-16	B-021-16	B-022-16	B-023-16	B-024-16	B-025-16	B-026-16	B-027-16	B-028-16	B-029-16	B-030-16	B-031-16
Grid Location	**5263**	**5663**	**5871**	**5277**	**4480**	**3292**	**2888**	**4079**	**4070**	**4666**	**6064**	**6069**	**4878**	**4283**
10-April-16														
11-April-16	0	0	0	5	0									
12-April-16						1	0	1	2	1	3	0	0	2
13-April-16														
14-April-16	0	2	0	2	0									
15-April-16						2	3	0	3	3	14	0	0	4
16-April-16														
17-April-16	6	2	1	3	1									
18-April-16						5	7	2	8	1	1	0	1	4
19-April-16														
20-April-16	4	8	0	0	1									
21-April-16						5	4	0	0	2	0	0	2	2
22-April-16														
23-April-16	4	1	1	1	1									
24-April-16						4	3	0	1	0	8	3	1	2
25-April-16														
26-April-16	0	0	0	1	2									
27-April-16						2	0	1	0	0	0	0	1	0
28-April-16														
29-April-16	3	9	0	0	1									
30-April-16						4	2	1	1	1	2	0	2	3

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

Ecoserv Sample Reference Code	B-032-16	B-033-16	B-034-16	B-035-16	B-036-16	B-037-16	B-038-16	B-039-16	B-040-16	B-041-16	B-042-16	B-043-16	B-044-16	B-045-16
Grid Location	**4085**	**3887**	**2892**	**3881**	**4073**	**4268**	**4864**	**6067**	**5872**	**4678**	**3690**	**3286**	**4077**	**4075**
Surveyed Area (km^2)	0.037	0.022	0.028	0.037	0.025	0.032	0.051	0.010	0.018	0.021	0.061	0.355	0.067	0.003
10-April-16	0	1	2	0	1	0	0	0	0	0				
11-April-16	0										1	0	0	4
12-April-16	0													
13-April-16	0	2	2	2	1	1	0	0	0	0				
14-April-16	0										0	0	0	0
15-April-16	0													
16-April-16	0	0	0	0	0	0	0	0	0	0				
17-April-16	0										0	0	1	0
18-April-16	1													
19-April-16	0	0	0	0	0	0	0	0	1	0				
20-April-16	0										0	0	0	0
21-April-16	0													
22-April-16	0	1	0	0	1	0	0	0	0	1				
23-April-16	0										0	0	0	0
24-April-16	0													
25-April-16	0	1	0	0	0	0	0	0	0	0				
26-April-16	0										0	0	0	0
27-April-16	3													
28-April-16	0	0	0	0	0	0	0	0	0	0				
29-April-16	0										0	0	0	0
30-April-16	0													

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

Ecoserv Sample Reference Code	B-046-16	B-047-16	B-048-16	B-049-16	B-050-16	B-051-16	B-052-16	B-053-16	B-054-16	B-055-16	B-056-16	B-057-16	B-058-16	B-059-16
Grid Location	**5263**	**5663**	**5871**	**5277**	**4480**	**3292**	**2888**	**4079**	**4070**	**4666**	**6064**	**6069**	**4878**	**4283**
Surveyed Area (km^2)	0.011	0.044	0.010	0.004	0.013	0.030	0.053	0.108	0.016	0.015	0.010	0.020	0.034	0.019
10-April-16														
11-April-16	1	0	0	1	1									
12-April-16						2	0	0	3	1	0	0	2	2
13-April-16														
14-April-16	0	0	0	0	0									
15-April-16						0	1	1	2	0	0	0	0	0
16-April-16														
17-April-16	0	0	0	0	0									
18-April-16						0	1	1	2	0	0	0	0	0
19-April-16														
20-April-16	0	0	0	0	0									
21-April-16						0	0	0	0	0	0	0	0	0
22-April-16														
23-April-16	0	0	0	0	0									
24-April-16						0	0	0	0	0	0	0	0	0
25-April-16														
26-April-16	0	0	0	0	0									
27-April-16						0	0	0	0	0	0	0	0	0
28-April-16														
29-April-16	0	0	0	0	0									
30-April-16						0	0	0	0	0	0	0	0	0

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

Date	Location	Observation time	Date	Location	Observation time
10 April 2016	Comino	08:00 - 10:00	14 April 2016	Comino	09:00 - 11:00
10 April 2016	Gozo: Wied il-Mielah	09:00 - 11:00	14 April 2016	Gozo: San Blas	08:00 - 10:00
10 April 2016	Gozo: Qala / Halfa	07:00 - 09:00	14 April 2016	Gozo: Ta' Cenc	07:00 - 09:00
10 April 2016	Cirkewwa / Torri l-Ahmar	07:00 - 09:00	14 April 2016	Ghajn Tuffieha	07:00 - 09:00
10 April 2016	Fomm ir-Rih	07:00 - 09:00	14 April 2016	Gnejna	07:00 - 09:00
10 April 2016	Rdum ta' Had-Dingli	09:00 - 11:00	14 April 2016	Zurrieq	07:00 - 09:00
10 April 2016	Lapsi	06:00 - 08:00	14 April 2016	Ghar Hasan	07:00 - 09:00
10 April 2016	San Tumas	08:00 - 10:00	14 April 2016	Xghajra Ta' Barkat	06:00 - 08:00
10 April 2016	Rinella	06:00 - 08:00	14 April 2016	White Rocks	10:00 - 12:00
10 April 2016	Wardija	08:00 - 10:00	14 April 2016	Mistra / Mgiebah	07:00 - 09:00
11 April 2016	Comino	07:00 - 09:00	15 April 2016	Comino	07:00 - 09:00
11 April 2016	Gozo: San Blas	08:00 - 10:00	15 April 2016	Gozo: Marsalforn	08:00 - 10:00
11 April 2016	Gozo: Ta' Cenc	08:00 - 10:00	15 April 2016	Gozo: Ghadira ta' Sarraflu	09:00 - 11:00
11 April 2016	Ghajn Tuffieha	07:00 - 09:00	15 April 2016	Anchor Bay / Rdum taht il-Mellieha	07:30 - 09:30
11 April 2016	Gnejna	06:00 - 08:00	15 April 2016	Mtahleb to Migra l-Ferha	08:30 - 10:30
11 April 2016	Zurrieq	06:30 - 08:30	15 April 2016	Fawwara (to Lapsi)	09:00 - 11:00
11 April 2016	Ghar Hasan	06:00 - 08:00	15 April 2016	Delimara Point	08:00 - 10:00
11 April 2016	Xghajra Ta' Barkat	06:30 - 08:30	15 April 2016	Zonqor Point	06:30 - 08:30
11 April 2016	White Rocks	06:45 - 08:45	15 April 2016	Ghallis	08:00 - 10:00
11 April 2016	Mistra / Mgiebah	07:00 - 09:00	15 April 2016	L-Ahrax tal-Mellieha	06:30 - 08:30
12 April 2016	Comino	08:00 - 10:00	16 April 2016	Comino	07:30 - 09:30
12 April 2016	Gozo: Marsalforn	09:00 - 11:00	16 April 2016	Gozo: Wied il-Mielah	07:00 - 09:00
12 April 2016	Gozo: Ghadira ta' Sarraflu	07:00 - 09:00	16 April 2016	Gozo: Qala / Halfa	08:00 - 10:00
12 April 2016	Anchor Bay / Rdum taht il-Mellieha	06:30 - 08:30	16 April 2016	Cirkewwa / Torri l-Ahmar	07:00 - 09:00
12 April 2016	Mtahleb to Migra l-Ferha	09:00 - 11:00	16 April 2016	Fomm ir-Rih	06:00 - 08:00
12 April 2016	Fawwara (to Lapsi)	07:00 - 09:00	16 April 2016	Rdum ta' Had-Dingli	07:30 - 09:30
12 April 2016	Delimara Point	06:00 - 08:00	16 April 2016	Lapsi	07:00 - 09:00
12 April 2016	Zonqor Point	06:00 - 08:00	16 April 2016	San Tumas	06:15 - 08:15
12 April 2016	Ghallis	07:00 - 09:00	16 April 2016	Rinella	06:30 - 08:30
12 April 2016	L-Ahrax tal-Mellieha	06:00 - 07:00 09:00 - 10:00	16 April 2016	Wardija	08:00 - 10:00
13 April 2016	Comino	08:00 - 10:00	17 April 2016	Comino	09:00 - 11:00
13 April 2016	Gozo: Wied il-Mielah	06:30 - 08:30	17 April 2016	Gozo: San Blas	08:00 - 10:00
13 April 2016	Gozo: Qala / Halfa	09:00 - 11:00	17 April 2016	Gozo: Ta' Cenc	07:00 - 09:00
13 April 2016	Cirkewwa / Torri l-Ahmar	06:00 - 08:00	17 April 2016	Ghajn Tuffieha	07:00 - 09:00
13 April 2016	Fomm ir-Rih	07:00 - 09:00	17 April 2016	Gnejna	07:00 - 09:00
13 April 2016	Rdum ta' Had-Dingli	08:00 - 10:00	17 April 2016	Zurrieq	10:00 - 12:00
13 April 2016	Lapsi	07:00 - 09:00	17 April 2016	Ghar Hasan	06:30 - 08:30
13 April 2016	San Tumas	07:00 - 09:00	17 April 2016	Xghajra Ta' Barkat	07:00 - 09:00
13 April 2016	Rinella	06:30 - 08:30	17 April 2016	White Rocks	07:00 - 09:00
13 April 2016	Wardija	08:00 - 10:00	17 April 2016	Mistra / Mgiebah	08:15 - 10:15

APPENDIX II continued.

Date	Location	Observation time	Date	Location	Observation time
18 April 2016	Comino	06:30 - 08:30	22 April 2016	Comino	08:00 - 10:00
18 April 2016	Gozo: Marsalforn	08:00 - 10:00	22 April 2016	Gozo: Wied il-Mielah	08:00 - 10:00
18 April 2016	Gozo: Ghadira ta' Sarraflu	07:00 - 09:00	22 April 2016	Gozo: Qala / Halfa	09:30 - 11:30
18 April 2016	Anchor Bay / Rdum taht il-Mellieha	09:00 - 11:00	22 April 2016	Cirkewwa / Torri l-Ahmar	06:00 - 08:00
18 April 2016	Mtahleb to Migra l-Ferha	09:00 - 11:00	22 April 2016	Fomm ir-Rih	07:30 - 09:30
18 April 2016	Fawwara (to Lapsi)	06:00 - 08:00	22 April 2016	Rdum ta' Had-Dingli	10:00 - 12:00
18 April 2016	Delimara Point	07:00 - 09:00	22 April 2016	Lapsi	09:00 - 11:00
18 April 2016	Zonqor Point	06:00 - 08:00	22 April 2016	San Tumas	10:00 - 12:00
18 April 2016	Ghallis	08:15 - 10:15	22 April 2016	Rinella	07:00 - 09:00
18 April 2016	L-Ahrax tal-Mellieha	06:30 - 08:30	22 April 2016	Wardija	08:00 - 10:00
19 April 2016	Comino	07:00 - 09:00	23 April 2016	Comino	07:30 - 09:30
19 April 2016	Gozo: Wied il-Mielah	07:00 - 09:00	23 April 2016	Gozo: San Blas	06:00 - 08:00
19 April 2016	Gozo: Qala / Halfa	08:00 - 10:00	23 April 2016	Gozo: Ta' Cenc	08:00 - 10:00
19 April 2016	Cirkewwa / Torri l-Ahmar	07:30 - 09:30	23 April 2016	Ghajn Tuffieha	06:30 - 08:30
19 April 2016	Fomm ir-Rih	10:00 - 12:00	23 April 2016	Gnejna	08:00 - 10:00
19 April 2016	Rdum ta' Had-Dingli	10:00 - 12:00	23 April 2016	Zurrieq	10:00 - 12:00
19 April 2016	Lapsi	06:00 - 08:00	23 April 2016	Ghar Hasan	06:30 - 08:30
19 April 2016	San Tumas	10:00 - 12:00	23 April 2016	Xghajra Ta' Barkat	07:00 - 09:00
19 April 2016	Rinella	07:00 - 09:00	23 April 2016	White Rocks	07:00 - 09:00
19 April 2016	Wardija	07:00 - 09:00	23 April 2016	Mistra / Mgiebah	07:30 - 09:30
20 April 2016	Comino	08:00 - 10:00	24 April 2016	Comino	07:45 - 09:45
20 April 2016	Gozo: San Blas	08:00 - 10:00	24 April 2016	Gozo: Marsalforn	09:00 - 11:00
20 April 2016	Gozo: Ta' Cenc	08:00 - 10:00	24 April 2016	Gozo: Ghadira ta' Sarraflu	06:00 - 08:00
20 April 2016	Ghajn Tuffieha	09:00 - 11:00	24 April 2016	Anchor Bay / Rdum taht il-Mellieha	08:00 - 10:00
20 April 2016	Gnejna	09:00 - 11:00	24 April 2016	Mtahleb to Migra l-Ferha	07:00 - 09:00
20 April 2016	Zurrieq	07:00 - 09:00	24 April 2016	Fawwara (to Lapsi)	06:00 - 08:00
20 April 2016	Ghar Hasan	10:00 - 12:00	24 April 2016	Delimara Point	07:00 - 09:00
20 April 2016	Xghajra Ta' Barkat	07:00 - 09:00	24 April 2016	Zonqor Point	06:30 - 08:30
20 April 2016	White Rocks	06:00 - 08:00	24 April 2016	Ghallis	07:00 - 09:00
20 April 2016	Mistra / Mgiebah	08:00 - 10:00	24 April 2016	L-Ahrax tal-Mellieha	08:00 - 10:00
21 April 2016	Comino	08:00 - 10:00	25 April 2016	Comino	08:00 - 10:00
21 April 2016	Gozo: Marsalforn	09:00 - 11:00	25 April 2016	Gozo: Wied il-Mielah	09:00 - 11:00
21 April 2016	Gozo: Ghadira ta' Sarraflu	07:00 - 09:00	25 April 2016	Gozo: Qala / Halfa	07:00 - 09:00
21 April 2016	Anchor Bay / Rdum taht il-Mellieha	08:00 - 10:00	25 April 2016	Cirkewwa / Torri l-Ahmar	07:00 - 09:00
21 April 2016	Mtahleb to Migra l-Ferha	07:00 - 09:00	25 April 2016	Fomm ir-Rih	08:00 - 10:00
21 April 2016	Fawwara (to Lapsi)	06:00 - 08:00	25 April 2016	Rdum ta' Had-Dingli	08:00 - 10:00
21 April 2016	Delimara Point	07:00 - 09:00	25 April 2016	Lapsi	06:30 - 08:30
21 April 2016	Zonqor Point	06:30 - 08:30	25 April 2016	San Tumas	07:00 - 09:00
21 April 2016	Ghallis	07:30 - 09:30	25 April 2016	Rinella	06:00 - 08:00
21 April 2016	L-Ahrax tal-Mellieha	06:30 - 08:30	25 April 2016	Wardija	08:00 - 10:00

APPENDIX II continued.

Date	Location	Observation time	Date	Location	Observation time
26 April 2016	Comino	07:30 - 09:30	29 April 2016	Comino	07:30 - 09:30
26 April 2016	Gozo: San Blas	09:00 - 11:00	29 April 2016	Gozo: San Blas	09:00 - 11:00
26 April 2016	Gozo: Ta' Cenc	07:00 - 09:00	29 April 2016	Gozo: Ta' Cenc	07:00 - 09:00
26 April 2016	Ghajn Tuffieha	07:00 - 09:00	29 April 2016	Ghajn Tuffieha	07:00 - 09:00
26 April 2016	Gnejna	07:30 - 09:30	29 April 2016	Gnejna	08:00 - 10:00
26 April 2016	Zurrieq	10:00 - 12:00	29 April 2016	Zurrieq	07:00 - 09:00
26 April 2016	Ghar Hasan	06:00 - 08:00	29 April 2016	Ghar Hasan	07:00 - 09:00
26 April 2016	Xghajra Ta' Barkat	06:30 - 08:30	29 April 2016	Xghajra Ta' Barkat	07:00 - 09:00
26 April 2016	White Rocks	07:30 - 09:30	29 April 2016	White Rocks	10:00 - 12:00
26 April 2016	Mistra / Mgiebah	08:00 - 10:00	29 April 2016	Mistra / Mgiebah	06:30 - 08:30
27 April 2016	Comino	07:00 - 09:00	30 April 2016	Comino	08:00 - 10:00
27 April 2016	Gozo: Marsalforn	08:00 - 10:00	30 April 2016	Gozo: Marsalforn	07:00 - 09:00
27 April 2016	Gozo: Ghadira ta' Sarraflu	08:00 - 10:00	30 April 2016	Gozo: Ghadira ta' Sarraflu	06:00 - 08:00
27 April 2016	Anchor Bay / Rdum taht il-Mellieha	08:30 - 10:30	30 April 2016	Anchor Bay / Rdum taht il-Mellieha	07:30 - 09:30
27 April 2016	Mtahleb to Migra l-Ferha	07:30 - 09:30	30 April 2016	Mtahleb to Migra l-Ferha	09:00 - 11:00
27 April 2016	Fawwara (to Lapsi)	08:00 - 10:00	30 April 2016	Fawwara (to Lapsi)	06:00 - 08:00
27 April 2016	Delimara Point	07:00 - 09:00	30 April 2016	Delimara Point	07:00 - 09:00
27 April 2016	Zonqor Point	07:00 - 09:00	30 April 2016	Zonqor Point	07:00 - 09:00
27 April 2016	Ghallis	08:00 - 10:00	30 April 2016	Ghallis	07:00 - 09:00
27 April 2016	L-Ahrax tal-Mellieha	06:30 - 08:30	30 April 2016	L-Ahrax tal-Mellieha	07:00 - 09:00
28 April 2016	Comino	09:00 - 11:00			
28 April 2016	Gozo: Wied il-Mielah	08:00 - 10:00			
28 April 2016	Gozo: Qala / Halfa	08:00 - 10:00			
28 April 2016	Cirkewwa / Torri l-Ahmar	07:00 - 09:00			
28 April 2016	Fomm ir-Rih	07:30 - 09:30			
28 April 2016	Rdum ta' Had-Dingli	10:00 - 12:00			
28 April 2016	Lapsi	06:00 - 08:00			
28 April 2016	San Tumas	08:00 - 10:00			
28 April 2016	Rinella	06:30 - 08:30			
28 April 2016	Wardija	06:30 - 08:30			