Terms of Reference

Optimized Bird Fatality Monitoring Program for Lekela Power 250MW West Bakr Wind Farm in the Gulf of Suez, Egypt during Spring Autumn 2022

December 2021

RCREEE

Regional Center for Renewable Energy and Energy Efficiency

المركز الإقليمي للطاقة المتجددة وكفاءة الطاقة

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Contents

1 Purpose of this document

Building on an intensive FMP study at KfW and RGWE WPPs and associated powerlines, it suggests a program that focusses resources on monitoring fatality rates of Migratory Soaring Birds (MSBs) using a design tailored to landscape characteristics of the area, and offers a straightforward, consistent monitoring approach that can be implemented at multiple projects, offering the potential of efficient, robust project specific and cumulative fatality assessments for GoS WPPs and GoS powerlines.

This Terms of Reference provides practical advice for designing, planning and conducting an operational phase bird and bat fatality monitoring program (FMP) for Lekela Power 250 MW West Bakr wind energy farm project (WBWF) and associated powerlines (part of 220 kV transmission lines shown in red color in Figure 1) during two bird migration seasons spring and autumn 2022 in the Gulf of Suez (GoS), Egypt.

The WBWF area is serviced by the Ras Ghareb – Zafarana Highway at about 2 km to the East from which it can be accessed as well as the Ras Ghareb – El Shaikh Fadel road to the South. The WBWF is constructing 96X2.6MW WTG Figure 1. The boundary coordinates for the WBWF Area is given in Table below.

WBWF Site Coordinates	
Easting	Northing
487595.230	3156804.978
485131.585	3154469.140
482106.157	3154498.398
481958.396	3156299.596
480496.963	3156294.516
480479.661	3162693.354
482464.288	3164443.391
484629.886	3158960.495

Figure 1: The WBWF's layout and OHTL (96X2.6 MW WTG)

2 Context

Bird and Bat fatality monitoring programs at wind energy projects should be iterative and be enhanced as understanding of collision risk develops through the operational phase of projects. Intensive fatality monitoring programs aligned with GIIP and implemented at RGWE and KfW WPPs (e.g. Al-Hasani 2017; Al-Hasani 2018; Al-Hasani & El Gebaly 2018; Shohdi 2019) have provided robust and valuable information on the likely suite of species at risk from turbine and powerline collision at wind power projects in the Gulf of Suez, Egypt. These studies have demonstrated that MSBs are the principal fatality risk and smaller species, specifically bats only occur as fatalities extremely rarely. Building on these findings and the conservation imperative to understand fatality rates of MSBs associated with WPPs and powerlines along the GoS, to inform RCREEEs comprehensive Active Turbine Management Program (ATMP), the approach suggested here optimizes monitoring effort to obtain accurate unbiased fatality estimates for MSBs. The approach should also provide unbiased fatality estimates for non-MSBs at a level of accuracy capable of highlighting emerging risks to these species. Fatality estimates for all species are calculated using state-of-the-art good international wind industry standard GenEst fatality[1] analysis software.

3 Objectives of the fatality monitoring guidance

The proposed approach aims to provide:

- an uncomplicated search survey design appropriate for assessing fatality rates at all WPPs along GoS as well as along transmission powerlines
- project specific, accuracy optimized, unbiased fatality rate estimates for MSBs
- project specific unbiased fatality rate estimates for non- MSBs
- consistent and comparable fatality rate data across all WPPs and overhead transmission powerlines along the GoS, to facilitate robust assessment of cumulative effects and with the potential to inform GoS adaptive management strategies for wind energy

4 Fatality monitoring program design

Obtaining unbiased fatality rates requires the following field activities to be conducted at Lekela Power turbines and along part of 220 kV transmission powerlines during spring and autumn 2022 bird migration seasons (from 20th February to 25 May 2022 and from 10th August to 10th November 2022) :

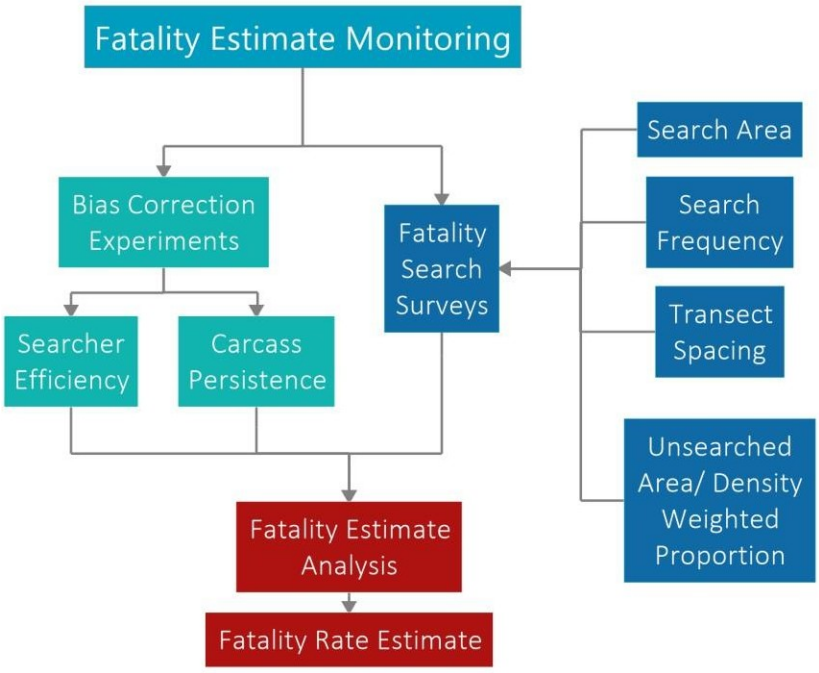
1. A schedule of systematic **fatality search surveys** conducted;
   - at a specified number of turbines and powerline sections,

[1] https://www.usgs.gov/software/genest-a-generalized-estimator-mortality

- within defined **search area** limits (the search plot) (e.g. within a 90m radius around each turbine),
- using defined **transect spacing** within the search area (e.g. 20m apart),
- within the area defined as 'searchable' within the search plot.

2. Identify **potential carcasses** for the use in scavenger removal experiments
3. **Searchable efficiency** bias correction experiments to estimate the % of fatalities missed by searchers;
4. **Carcass persistence** bias correction experiments to estimate fatalities removed by scavengers between searches.

Fatality rate estimate monitoring requirement shows in the following flowchart.



5 General Estimator of Mortality (GenEst)

The suggested approach uses the GenEst program to calculate fatality rates. This free to use, state-of- the-art estimator software combines the expertise from teams that developed earlier fatality estimators and is demonstrated to provide unbiased fatality rate estimates, improving on, and replacing all previous estimators. The software has been designed to be used by ecological managers and features a user-friendly interface and comprehensive and practical user manual[2] IFC are currently developing wind energy fatality guidance based on the use of GenEst.

In the suggested approach these activities generate data which is transferred from field data sheets to five (5) input files for analysis in GenEst (See Annex 1). These files are:

1. **Carcass observations (CO)** – containing details of all found fatalities during search surveys,
2. **Search schedule (SS)** – containing dates when each turbine/powerline was searched,
3. **Searcher efficiency (SE)** – containing results of searcher attempts to find carcasses placed to test searcher efficiency,
4. **Carcass persistence (CP)** – containing results of the times when carcasses placed to test carcass persistence were last recorded present and first recorded absent,
5. **Density weighted proportion (DWP)** – containing turbine/powerline specific figures giving the % of the total carcasses available to be found accounting for those that were not 'available' because they landed in unsearched areas either within or beyond the search plot.

These files are uploaded to the GenEst program and allow the analysis of fatality rate estimates to be calculated.

6 Detailed information on the design and implementing of the suggested approach for ecological managers

The detailed guidance in section 6 provides"

- Suggested design components for the fatality search survey (6.1.1) at turbines along powerlines in the GoS with the reasoning for selecting each.
- Key points to consider when preparing the fatality search survey (6.1.2).
- Key points to consider when conducting fatality search surveys (6.1.3).
- Key points to relating to data entry for fatality surveys (6.1.4).
- Key points relating to the design of searcher efficiency experiments (6.2).
- Key points relating to the design of carcass persistence experiments (6.3).
- 'GenEst' analysis summary (7).
- 'GenEst' reporting summary (8).

6.1 Fatality search surveys

6.1.1 Design

6.1.1.1 Sample size

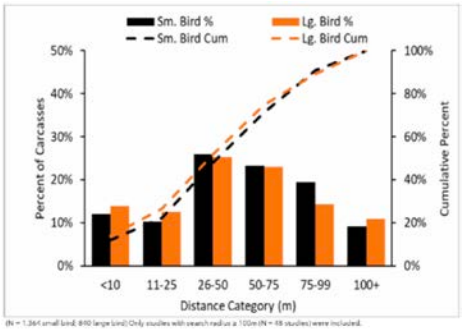
Suggested sample size	For turbines	All turbines
	For powerlines beside the WBWF boundary	Total length of the powerline over which the project has influence

Reasoning. Searching all turbines and all powerlines over which the project has influence recognizes the potential for high conservation status and/or multiple fatalities to occur at any turbine and along any section of powerline. It

acknowledges the value of using a design which allows all fatality search data to be formally analyzed within fatality rate estimate software. Compared to the studies at RGWE and KfW where 30- 40% of turbines were systematically searched, the increased time require to systematic search all turbines is compensated for by the increased transect spacing (6.1.1.3 below) and reducing search frequency (6.1.1.4) suggested in this design.

6.1.1.2 Search area limits (search plot)

Suggested search plot size	For turbines	A square plot with each boundary 90m from the turbine base + access roads to a distance of 120m from the turbine base
	For powerlines	Corridor extending 20m either side of center-line of powerline cables



Reasoning. *The search plot around turbines and along powerlines needs to balance the objective of finding priority species fatalities (i.e.MSBs)with there sources available and the fact that search area increases with distance from a turbine. Studies examining the fall distances' of birds hit by turbines (e.g. (Hallingstad et al. 2018) indicates that approximately 80% of birds land within approximately 70- 80m from the turbine base beyond which search area per fatality increases. The recommended plot size for turbines in this design uses this information to define a plot size that optimizes search effort.*

For powerlines, there are few studies that have measured fall distances of birds. Of those that have; Murphy et al. (2009) found that approx. 70% of 28 Sandhill Crane fatalities Occurred within 20m of the powerline, Shaw et al. (2010) found 100% of approximately 65 Blue Crane fatalities occurred within 15m of the powerline, and Frost (2008) found 37% of Mute Swans were found within 20m -

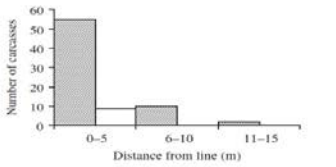
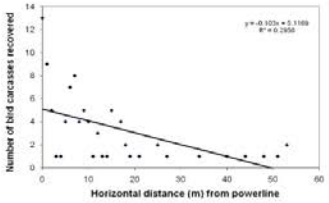


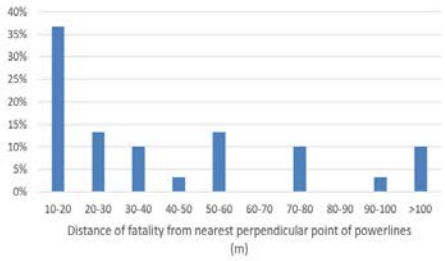
Figure 3. Distance of Blue Crane carcasses from the power line in open habitats, i.e. pasture and stubble (shaded), and closed habitats, i.e. mature cereal and veld (white).

Shaw *et. al.* 2010



Appendix A. Distribution of distances at which bird carcasses were discovered from powerlines at Rowe, spring 2007 (R. Murphy and T. Smith, University of Nebraska-Kearney, unpublished data).

Murphy *et. al.* 2029



Frost et. al. 2008

but highlighted the likelihood that some injured birds moved further away from the location where they first landed. Overall these studies suggest that a search area extending 20m either side of the powerline will likely be sufficient to detect an adequate proportion of the fatalities occurring along powerlines.

Searching along access roads

The suggested design requires a single transect to be searched beyond the main search plot along access roads out to a typical maximum distance that birds may land when they collide with turbines and associated powerlines. The purpose of this is to obtain some information (with minimum effort) about this outer area which is otherwise unsearched. Provided the search is conducted in the same way as the within the main plot (i.e. one transect walk

scanning 10m either side of the walk route) this information can easily be incorporated in the analysis alongside the information from the main plot.

6.1.1.3 Transect spacing

Suggested transect spacing	For turbines	20m
	For powerlines	20m

Reasoning. *Birdlife International (2015) guidance suggests a transect width of 20m (i.e. searching 10m either side of a transect line) for medium (buzzard size) raptors. Although reducing the spacing will increase the possibility of detecting smaller MSB species, it is expected that this transect spacing will be suitable for detecting and adequate proportion of MSB fatalities across all sizes in typically featureless desert landscapes where projects. Using a 20m transect spacing represents a considerable saving in survey time which is using in this design to allow a larger sample of turbines to be search systematically and a larger plot area to be searched around each turbine. Specific sites with more mountainous terrain, specifically the KfW WPP, will likely require narrower transect spacing to adequately detect an adequate proportion of fatalities, however even here this should be balanced with the increased number of turbines that can be searched systematically and included in formal fatality rate estimate analysis.*

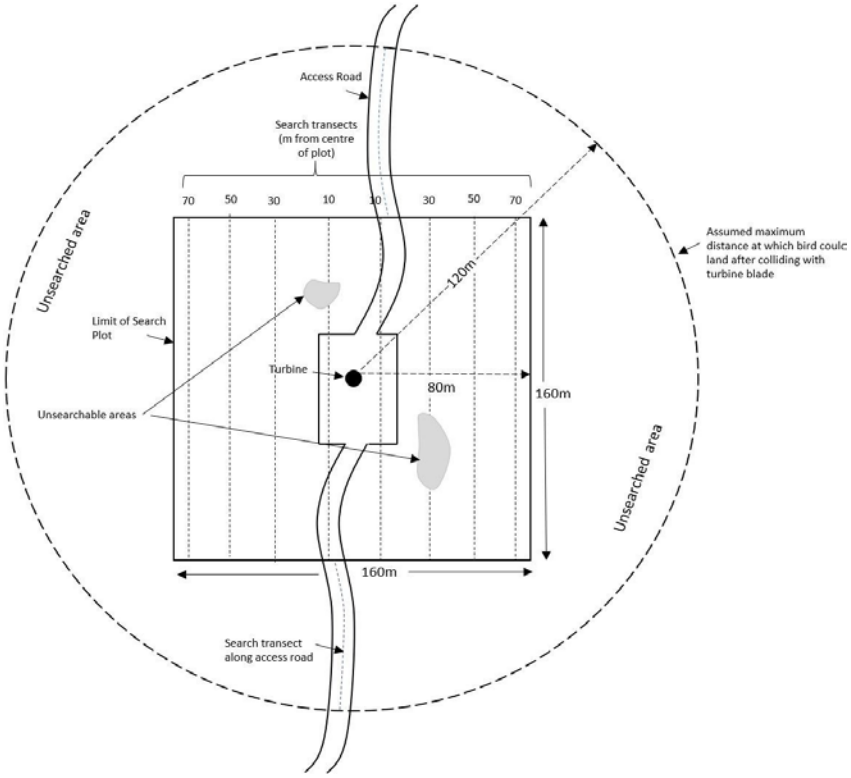
For powerlines the 20m spacing would require in 2 transects 10m either side of the centre line of the powerline. Importantly, searcher efficiency experiment results should be used to confirm the adequacy of transect spacing at all powerlines during the early implementing of this plan.

6.1.1.4 Search frequency

Suggested search frequency	For turbines	Weekly
	For powerlines	Weekly

Reasoning. *The principal role of fatality monitoring in this area is to assess risk and impacts to MSBs. The validity of focusing on these species is further validated by the negligible presence of bats and high priority small birds determined from the intensive fatality monitoring carried out in the early operational phase. Carcass persistence rates for raptors and other MSB species in recent literature (e.g.Urquhart, Hulka & Duffy 2015; Hallingstad et al. 2018) and from unpublished WPP carcass persistence studies, including those at KFW and RGWE WPPs, indicate that a weekly search interval would not substantially reduce the number of carcasses detected for these types of species. A weekly search interval for MSBs is also supported by relevant international guidance (see advice in Birdlife International 2015, P31).*

6.1.1.5 Suggested turbine search design



6.1.2 Preparing for fatality search surveys

Before fatality search surveys begin the ecological manager will require time to visit each turbine and each length of the powerline to:

1. Define the **limits (boundary) of each search plot/corridor**
2. Identify and **map the area to be searched within the search plot**, clearly marking any areas that are to be regarded as 'unsearchable' areas for the purpose of the survey
3. Identify and **map areas of differing ground visibility** ('visibility classes')

Additionally, field sheets may need to be developed, or if already in use, checked to ensure that they will collect the required data for use in the GenEst program (Annex 13 provides annotated screenshots of the five (5) data files required by GenEst and should be used to check the suitability of field sheets.

6.1.2.1 Map the search plot and search transects and maximum fall radius

For each turbine; the turbine location, hard standing, access roads, 180 x 180 search plots, maximum fall radius, should be determined from GIS/maps/satellite images, marked on field maps, with relevant locations entered into searchers' GPS devices before the start of

the fieldwork program. Additionally 'unsearchable areas' within each search plot determined during initial field visits by the ecological manager should also be marked (see also 6.1.2.2)

In the field, the use of markers to determine the plot boundaries and transect start/end points is essential if it is not feasible for each searcher to have a GPS, and may be useful even if they do.

6.1.2.2 Identifying and mapping 'unsearchable' areas

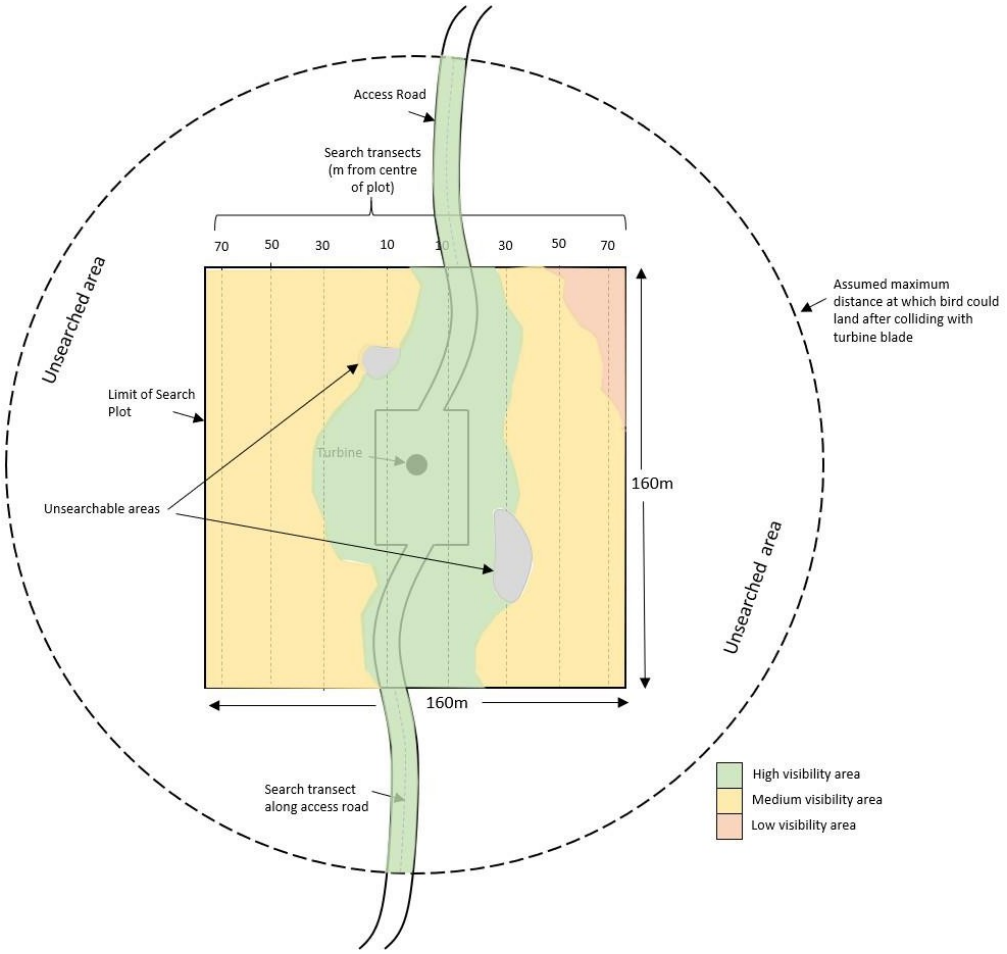
An 'unsearchable' area is an area within the search plot where either; a) the terrain or vegetation result in fatalities being very difficult to find and/or, b) the health/safety of the surveyor is likely to be compromised. In the largely unvegetated areas along the GoS, unsearchable areas will likely relate to patches of ground where a transect walk is difficult because the terrain is steep/rocky. Importantly, this includes mounds of loose rock deposited around turbines and associated powerlines during construction at some sites. These will likely represent a small % of the total search plot, will have little impact on the final fatality rate estimates and should be excluded from the search to improve the overall efficiency of the survey. At many of the turbines and associated powerlines in the Gulf of Suez area there will be no unsearchable areas within search plots.

6.1.2.3 Identifying and mapping visibility classes within each search plot

For each turbine and powerline, the ecological manager will also need to map areas of differing ground surface characteristics to account for differences in fatality visibility. At WPPs in the Gulf of Suez, it is likely that one or two visibility classes will be needed. The described visibility classes below provide a guide

- **high visibility areas** - ≥90% level bare ground, vegetation ≤15cm (includes turbine hard standing and access roads)
- **medium visibility areas** - ≥25% level bare ground, vegetation ≤15cm
- **low visibility areas** - ≤25% level bare ground and/or ≤25% vegetation ≥15cm
- **very low visibility areas** - little or no level bare ground and/or vegetation ≥25% vegetation ≥15cm

Mapping of these areas will be needed to correctly conduct bias correction experiments and estimate fatality rate, but will not be needed by searchers in the field and therefore do not need to appear on the field maps described in 6.1.2.1 above. The following design illustrates turbine search design.



6.1.3 Conducting fatality search survey

Key points

- Focus searches only in the searchable areas within the 180 x 180 search plot, the access road area of 120m from the turbine and, the 40m powerline search corridor.
- All incidental finds of fatalities found either in a) the unsearched area between the edge of the 180 x 180m search plot and the 120m maximum fatality fall radius or b) in 'unsearchable' areas should be recorded in the same way as fatalities found in the search area.
- All found fatalities should be collected and stored frozen in a dedicated on-site freezer for use in future carcass persistence experiments, following good health and safety guidelines.

6.1.4 Data entry for fatality search surveys

Key points

- Each fatality record should provide:
    - a GPS location
    - species
    - turbine number,
    - powerline (voltage level 220 kV or 500 kV, section number)
    - age (where evident)
    - condition
    - date and time of discovery
    - discarded or retained
    - photographs showing head, body underparts, upper parts and wings (closed and outstretched) with scale to show size
    - ID number corresponding to the number on storage bag

6.2 Bias correction experiments – searcher efficiency

The suggested design requires a maximum of two types of searcher efficiency experiments

1. Searcher efficiency experiment for walked transects
2. Searcher efficiency experiment for driven transects along powerlines

If powerlines are to be walked then only the walked transect experiment (1 above) is needed.

Key points relating to the design of searcher efficiency experiments

- Experiments are required for spring and autumn 2022 migration seasons. Ideally experiments are conducted as a small number of clustered events through each migration season
- Aligned with previous searcher efficiency experiments at RGWE and KfW WPPs decoys rather than actual carcasses should be used. Provided decoys reflect the visibility of fatalities that searchers are looking for decoys are a more practical solution compared with real carcasses. Principal advantages are; a sufficient sample size can readily be bought/made and stored, decoys can be reused, and in the field they are less likely to attract scavenging species which can lead to reduced fatality persistence rates and as a result reduced fatality rate accuracy.
- Searcher efficiency experiments should test all size classes potentially found: bats, small, medium and large birds. Although the focus of the fatality monitoring is MSBs which are mainly in the medium/large bird class, understanding the extent to which species in the smaller size class are being missed using the suggested design will allow fatality rate estimate for fatalities in all size classes to be calculated and allow the intensity of the suggested design to be evaluated at each site and if necessary adjusted.
- Good practice is to use a minimum of 10 decoys per covariate (i.e. size class x visibility class x season). For example, at many project sites in the GoS it is likely that there will be just two ground visibility classes, (high and moderate visibility). This situation

would require (4 [size classes] x 2 [visibility classes] x 2 [seasons]) x10 = 160 decoys per year or 80 decoys per migration season.

- The ecological manager should place decoys within the search area to achieve a balanced sample within each covariate class
- Search teams should not be aware that decoys are being placed in the turbine and powerline search areas.
- The ecological manager should check that the decoys are still present after the search is conducted. Any searches where the decoys that are not present after the search should not be included in the analysis as these may have disappeared before the searcher reached the location.
- If feasible, decoys that were not found on the first search should be left in place to test whether searchers find them on the next scheduled search. The GenEst program allows for this information to be entered and incorporated into the fatality rate analysis (See 13.1.4 columns S1,S2…)

6.3 Bias correction experiments – carcass persistence

Carcass persistence methods follow international wind energy good practice standards and the key points below reiterate these practices.

Key points relating to the design of carcass persistence experiments

- Conduct a carcass persistence experiment during each migration season.
- Conduct carcass persistence experiments using actual fatalities for MSBs and other migratory raptors. Raptor fatalities from other sources may be useable as surrogates if they can be sourced. Do not use chickens as surrogates as they are likely to have no value in correcting fatality estimates for raptors and MSBs and may lead to a general increase in the scavenging rate in the area.
- On carcass persistence recording forms give the species name for all experimental carcasses used (rather than just for generic size groupings e.g. medium sized bird or large bird). This will allow carcass persistence to be analyzed for species groups of particular interest, e.g. large raptors, large water birds which will help validate program design search frequency.
- Ensure that carcass persistence is tested at powerline locations as well as turbines. This is especially important if powerlines are not close the turbine array.
- At a minimum check carcass persistence on the following days after placement [1, 2, 3, 4, 5, 7, 10, 14, 20, 27, 34….] until the carcass has disappeared or would no longer be recorded as a fatality if it was found during fatality searches. For example, if 10 feathers or 2 or more primaries is the minimum criteria for evidence of a fatality the same criteria should be used for the carcass persistence experiment. If feasible for all globally threatened/near threatened species and all raptor species consider monitoring the experimental carcass more regularly to provide a more precise estimate of persistence.

- To improve sample size using actual fatalities one approach would be to test for statistical differences between carcass persistence rates in the same season in different years, between different seasons and between years. Where no statistical difference is found it may be valid to pool data to improve sample size and use this pooled data to obtain a more robust carcass persistence rate.

Options for improving carcass persistence sample size

Obtaining valid carcass persistence rates for MSBs and other migratory raptors is a major challenge due to the lack of adequate surrogates. Using actual fatalities is the most accurate measure. For the RCREEE wind development area a unique opportunity exists to implement consistent good practice carcass persistence experiments across all projects and establish a data sharing repository for carcass persistence data. Analysis of shared data will improve understanding of MSB/raptor carcass persistence in this area and could provide reference persistence rates for projects in the early stage of the operational phase where few fatalities have occurred.

7 Fatality rate analysis in GenEst

7.1 Data input

- The five (5) data files required to run GenEst are shown with explanatory notes in Annex 13. Use separate MS Excel.csv or plain text.csv files to enter field derived data and then upload to the program using the buttons on the left side of the panel.
- Carcass Observations (CO), Search Schedule (SS), Searcher Efficiency, and Carcass Persistence (CP) files use data derived directly from the results of the field work.
- The Density Weighted Proportion (DWP) file gives turbine and powerline specific details of the percentage of fatalities arriving in the search area that were detectable, and requires the location of each fatality and a measure of the percentage of area searched within a distance bands out from the turbine and powerline. This needs to be calculated before it can be entered in the DWP data file. The GenEst team are currently developing functionality that will help calculate DWP. Until this is available IFC can provide help with producing DWP files if needed.

7.2 Data analysis

- Based on the input data candidate models are created for searcher efficiency and carcass persistence and the ‘best’ model for each bias correction experiment selected by the user. Once these models are selected the fatality (mortality) rate estimate can be calculated.
- GenEst allows mortality rate to be split according to variables of interest. For example seasonal, species group differences in fatality rate can be directly compared.

8 Reporting fatality rate estimates

Corrected fatality rate estimates should be should be completed for each migration season, IFC has prepared and offered a 6-monthly operational bird and bat monitoring and mitigation reporting template for the wind projects in the Gulf of Suez which would provide a consistent format for summary reporting of fatality rate results both within and across projects. Full details of the fatality rate estimates should provide as an Annex at the end of this reporting template document. This should include:

- Carcass observations input data table + fatality rate estimate output
- Density Weighted Proportion table
- Searcher efficiency results including GenEst input data table, output graphs + tables giving the median searcher efficiency rates with upper and lower confidence levels
- Carcass persistence results including GenEst input data table, candidate model output graphs + output tables giving median carcass persistence rate with lower and upper confidence levels
- Fatality estimates for all size classes of fatality

9 Implementation and delivery schedule

9.1 Overview on execution progression FMP

A team of a Chief FMP Expert and most probably three field researchers are required to implement the FMP; the first step in implementing the FMP is the fieldwork and collection of the fundamental data. The work sequence will follow the activities, tasks and methodology described in the specifications for FMP of Lekela Power's wind farm and associated overhead transmission line.

During the first period, the Chief FMP Expert will lead the team in order to test the feasibility of the proposed methodology implementation on the ground and screening if any additional inputs are required in order to standardize the methodology for the FMP during the upcoming season. Parallel to the implementation of the fieldwork and data collection, a daily follow-up routine for the team, collected data and data storage will be responsibility of the Chief FMP Expert. The three field researchers will be responsible for conducting the field surveys and implementing the methodology on the ground at the Lekela Power West Bakr wind farm, whereas, two field researchers will be responsible for conducting the field surveys and implementing the methodology on the ground along the route of powerlines

The fieldwork team (Field Searchers) will be responsible for daily communication, briefing, and raw data (datasheets) delivery to Chief FMP Expert in order to be organized, processed, analyzed and reported internally to Client, then eventually to the Beneficiaries.

9.2 Reporting and reviewing

During bird migration seasons in spring and autumn 2022, the Chief FMP Expert shall prepare Monthly FMP Reports and regularly inform RCREEE ("the Client") about the progress of the FMP. Any casualty found at the WBWF and along the associated powerlines, in particular fatalities of priority birds, will be reported within a week (but the priorities bird fatalities within two days) to the Client and the Client will report to all involved parties (Beneficiaries, Authorities and the lenders). If the Client s' monitoring reveals that the mitigation measures are inadequate, the Chief FMP Expert shall immediately take necessary actions and adjustments needed to inform RCREEE which in turn informs the competent authorities.

At the end of the bird migration season in spring and autumn seasons 2022, the Chief FMP Expert shall prepare a Draft FMP Report with respect to this ToR. The Chief FMP Expert shall submit the Draft FMP Report to the RCREEE so as to review it and to comment on it.

9.3 Technical workshop

The Draft FMP Report will be the basis for a technical workshop. Within the workshop the Client and the Chief FMP Expert should jointly discuss the technical approach, the obtained results, the main conclusions of the Draft FMP Report and the need for any adjustments with regards to the next seasons. Furthermore, the effectiveness of the applied mitigation measures and any need for adjustments should be assessed. Subsequently, the Chief FMP Expert shall prepare the Final FMP Report which should be disclosed to all involved parties.

9.4 Consultation meeting

The Client will invite all involved stalk holders for a public consultation meeting in which the results, main conclusions should be presented and jointly discussed. The consultations meeting will form a forum for where:

- Discussion/concerns
- Adjustments on the FMP

The future implementation of the FMP will be adjusted by the Chief FMP Expert accordance with outcomes of the consultation meeting.

9.5 Recommendation report

The Chief FMP Expert shall prepare, for Client review and approval, a Recommendation FMP Report that summarizes the lessons learnt and that defines all consequences for next seasons, the report should highlight priorities for future implementation of mitigation measures.

9.6 Work and deliverable schedule

The Chief FMP Expert shall submit to the Client the Deliverable (D) with respect to Bird Fatality Monitoring Program during bird migration seasons in spring and autumn 2022 as showing in the Table below.

N°	Scope of Services /Deliverables	Feb	Mar	Apr	May	Jun	Jul	Aug
B	**Spring 2022**							
	1) Data Collection; organizational works, coordination, communication, on-job training etc. Besides, monthly data evaluation and analysis for drafting monthly FMP reports (**D1_mthly**)							
	2) All field data evaluation and analysis							
	3) Drafting FMP report (**D2**)							
	4) Technical workshop and incorporating comments							
	5) Delivery of final FMP report to RCREEE (**D3**)							
	6) Consultation meeting and drafting FMP recommendation report (**D4**)							
	7) Final FMP recommendation report (**D5**)							

N°	Scope of Services /Deliverables	Aug	Sep	Oct	Nov	Dec	Jan	Feb
A	**Autumn 2022**							
	1) Data collection; organizational works, coordination, communication, on-job training etc. Besides, monthly data evaluation and analysis for drafting monthly FMP reports (**D6_mthly**)							
	2) All field data evaluation and analysis							
	3) Drafting FMP report (**D7**)							
	4) Technical workshop and incorporating comments							
	5) Delivery of final FMP report to RCREEE (**D8**)							
	6) Consultation meeting and drafting FMP recommendation report (**D9**)							
	7) Final FMP recommendation report (**D10**)							

No.	Deliverables (D)	Deadline
The Bird and Bat Fatality Monitoring Program during Spring 2022		
D1_mthly	Monthly FMP Reports	Mid- March/April/May, 2022
D2	Draft FMP Report, Spring 2022	Mid-June, 2022
D3	Final FMP Report incorporating comments raised in the technical workshop, Spring 2022	Mid- July, 2022
D4	Draft FMP Recommendation Report, Spring 2022	First of August, 2022
D5	Final FMP Recommendation Report, August 2022	Mid-August, 2022

No.	Deliverables (D)	Deadline
The Bird and Bat Fatality Monitoring Program during Autumn 2022		
D6_mthly	Monthly FMP Reports	Mid- September/October/November, 2022
D7	Draft FMP Report, Autumn 2022	Mid-December, 2022

D8	Final FMP Report incorporating comments raised in the technical workshop, Autumn 2022	Mid- January, 2023
D9	Draft FMP Recommendation Report, Autumn 2022	First of February, 2023
D10	Final FMP Recommendation Report, Autumn 2022	Mid-February, 2023

The Chief FMP Expert will discuss report structure and presentation of the reports with the Client at an early stage. The Client will have 10 days for commenting, if necessary. The Chief FMP Expert will present adjusted report structure within two weeks. The Chief FMP Expert will have to submit soft copies of the Deliverables in English language.

At the end of the assignment the Chief FMP Expert will provide a CD with the final reports (including all annexes and spreadsheets, tables graphs and pictures used/elaborated during the assignment) in process able formats (word, excel, jpeg, etc).

10 Data management

10.1 Compilation and storage

The Chief FMP Expert will establish a database to store, retrieve, and organize field data. Data from field forms will be keyed into electronic data files, and all field data forms, field notebooks, and electronic data files will be retained.

10.2 Quality assurance / Quality control (QA / QC)

The Chief FMP Expert shall implement QA/QC measures at all stages of monitoring including field data collection, data entry, data analysis, and report preparation. At the end of each survey day, each surveyor will inspect his or her data forms for completeness, accuracy, and legibility. Periodically, the study team leader will review data forms to insure completeness and legibility, and detected problems will be corrected. Any changes made to the data forms will be initialed and dated by the person making the change.

Data will be checked thoroughly for data entry errors. Any errors will be corrected by referencing the raw data forms and/or consulting with the observer(s) who collected the data. Any irregular codes detected, or any data suspected as questionable, will be discussed with the observer and Chief FMP Expert. Any changes made to the raw data will be documented for future reference.

11 Team composition & Qualification requirements for chief FMP expert and field searchers

11.1 Key expert – chief FMP expert

Senior Biodiversity, with overall responsibility for managing the Assignments, managing the relationship with RCREEE, and for the technical outputs of the Assignment as well as day-to-day management of the project including contact with RCREEE. Besides, with overall responsibility for the scientific program and data analysis.

Qualifications and Skills

University degree (or equivalent) in Environmental Science (e.g. Biology, Environmental Management & Planning, Natural Resource Use) or in a related field. Good command of spoken and written English and knowledge of Arabic will be an advantage.

Professional Experience

- At least 10 years' work experience in project management especially environmental projects;
- At least 10 years' experience of working with interaction between birds and renewables, in particular studies of migratory birds (especially so-called soaring migrants);
- At least 5 years' experience of working with bird and bat fatality monitoring programs;
- Experience in preparation of carcass search reports for RE projects;
- Experience in preparation on-job training for fatality monitoring program;
- Experience in development of mitigation measures and public participation;
- At least 5 years' experience working in the Middle East; and
- Familiar with international donor's projects.

11.2 Key field searcher

Surveyor, with overall responsibility for carcass search with specific skills identifying MSB species. Strong scientific approach to the use of data, data analysis and reporting of desk and bird migration studies.

Qualifications and Skills

University degree (or equivalent) in Biology or in a related field. Good command of spoken and written Arabic and knowledge of English will be an advantage.

Professional Experience

- At least 4 years' experience in survey of biological environments, including ornithological survey of migratory birds and habitats;
- At least 2 years' experience in data analysis and interpretation of biological data;
- At least 2 years' working experience in EIA of renewable energy projects;

- At least 3 years' experience Carcass Search and BMP through visual observations;
- Very good working knowledge about local and international guidelines for EIA and Monitoring Protocols for Wind Energy Development Projects;
- At least 3 years' professional experience of work in the Middle East; and
- Familiar with international donor's projects.

12 Reference

- Al-Hasani, I. (2017) Gabel Al-Zayt Windfarm Project (200MW). Post construction fatality monitoring. Spring 2017(4 April - 11 May). Report to Egyptian Environmental Affairs Agency (EEAA) and Birdlife International /UNDP/GEF Migratory Soaring Birds Project.

- Al-Hasani, I. (2018) Post-construction fatality monitoring for KFW Wind Farm Project (240MW) at Gabel al- Zayt. Autumn 2018 (25 August - 1st November). Report to Egyptian Environmental Affairs Agency (EEAA) and Birdlife International /UNDP/GEF Migratory Soaring Birds Project.

- Al-Hasani, I. & El Gebaly, O. (2018) Post-construction fatality monitoring for KFW Wind Farm Project (240MW) at Gabel al-Zayt. Spring 2018. Report to Egyptian Environmental Affairs Agency (EEAA) and Birdlife International /UNDP/GEF Migratory Soaring Birds Project.

- Birdlife International (2015) Guidance on appropriate means of impact assessment of electricity power grids on Migratory Soaring Birds in the Rift Valley / Red Sea Flyway. Regional Flyway Facility. Amman, Jordan.

- Frost, D. (2008) The use of 'flight diverters' reduces mute swan Cygnus olor collision with power lines at Abberton Reservoir, Essex, England. Conservation Evidence, 5, 83-91.

- Hallingstad, E.C., Rabie, P.A., Telander, A.C., Roppe, J.A. & Nagy, L.R. (2018) Developing an efficient protocol for monitoring eagle fatalities at wind energy facilities. PLoS ONE, 13, e0208700.

- Murphy, R.K., McPherron, S.M., Wright, G.D. & Serbousek, K.L. (2009) Effectiveness of avian collision averters in preventing migratory bird mortality from powerline strikes in the Central Platte River, Nebraska. Department of Biology, University of Nebraska-Kearney, Kearney, NE 68849

- Shaw, J.M., Jenkins, A.R., Smallie, J.J. & Ryan, P.G. (2010) Modelling power-line collision risk for the blue crane Anthropoides paradiseus in South Africa. Ibis, 152, 590-599.

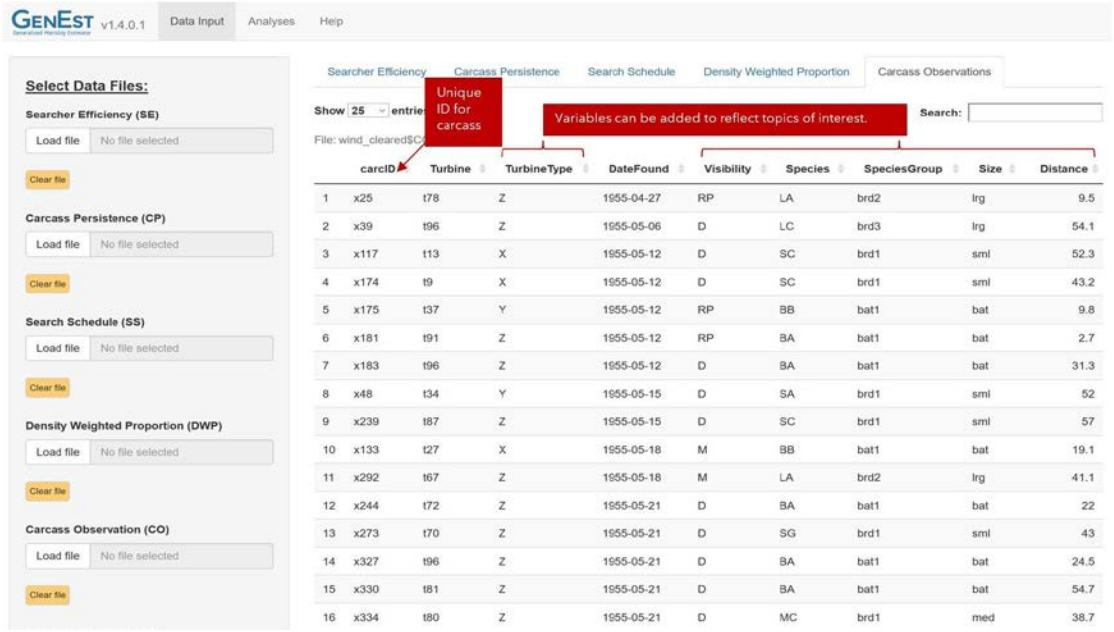
- Shohdi, W.M. (2019) Bird and bat fatality monitoring program in autumn 2019. BOO RGWE wind farm 262.5 MW at Gulf of Suez. Technical report. Regional Centre for Renewable Energy and Energy Efficiency.

- Urquhart, B., Hulka, S. & Duffy, K. (2015) Game birds do not surrogate for raptors in trials to calibrate observed raptor collision fatalities. Bird Study, 62, 1-4.

13 Annexes

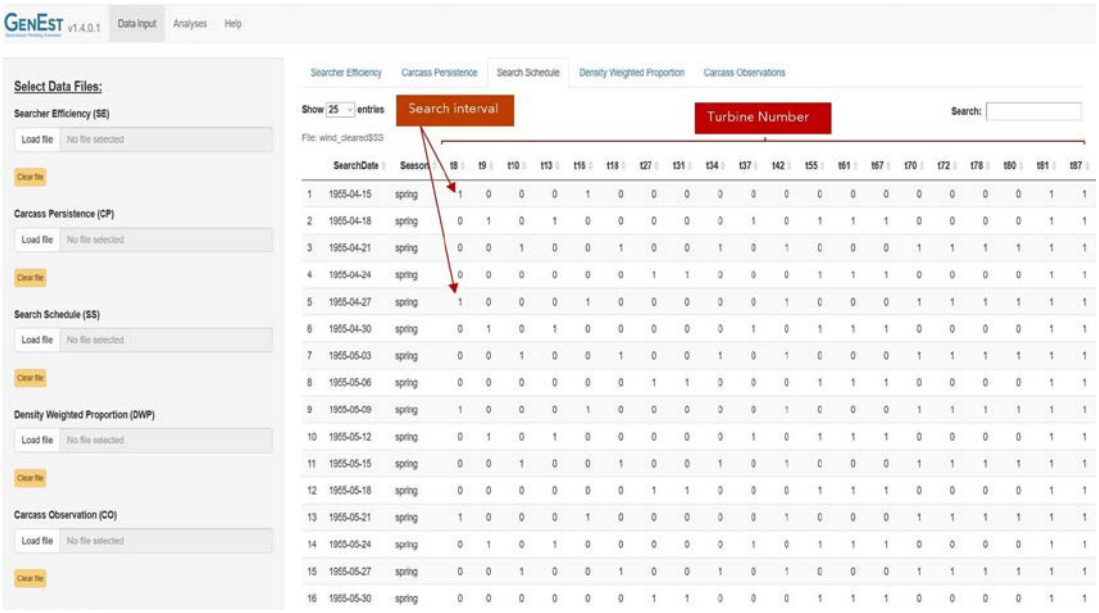
13.1 GenEst input files

13.1.1 Carcass observations



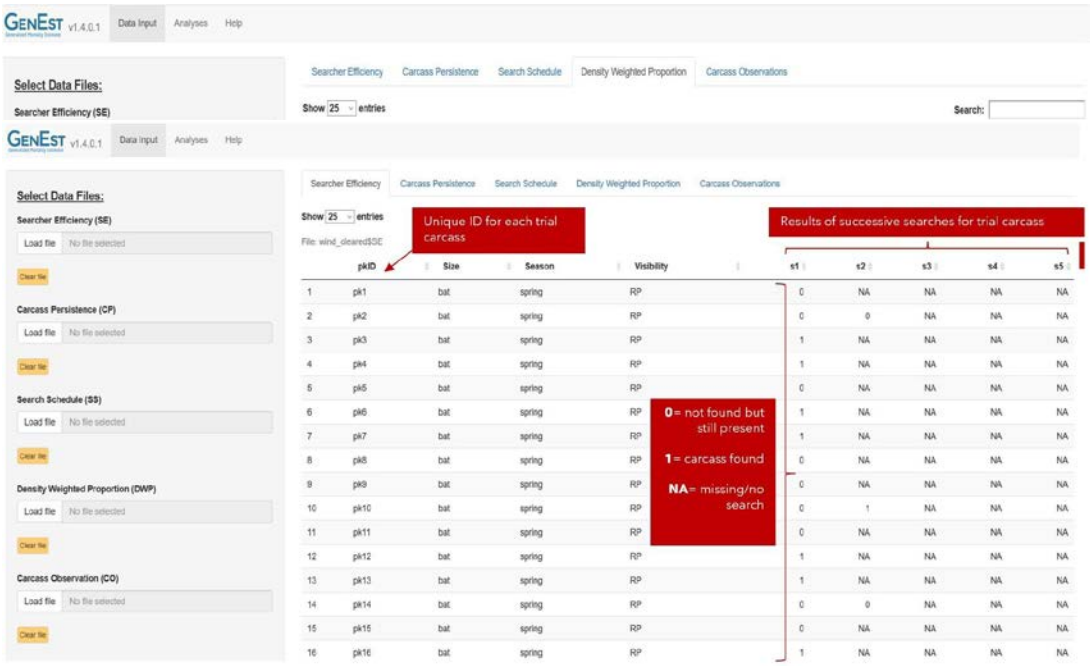
	carcID	Turbine	TurbineType	DateFound	Visibility	Species	SpeciesGroup	Size	Distance
1	x25	t78	Z	1955-04-27	RP	LA	brd2	lrg	9.5
2	x39	t96	Z	1955-05-06	D	LC	brd3	lrg	54.1
3	x117	t13	X	1955-05-12	D	SC	brd1	sml	52.3
4	x174	t9	X	1955-05-12	D	SC	brd1	sml	43.2
5	x175	t37	Y	1955-05-12	RP	BB	bat1	bat	9.8
6	x181	t91	Z	1955-05-12	RP	BA	bat1	bat	2.7
7	x183	t96	Z	1955-05-12	D	BA	bat1	bat	31.3
8	x48	t34	Y	1955-05-15	D	SA	brd1	sml	52
9	x239	t87	Z	1955-05-15	D	SC	brd1	sml	57
10	x133	t27	X	1955-05-18	M	BB	bat1	bat	19.1
11	x292	t67	Z	1955-05-18	M	LA	brd2	lrg	41.1
12	x244	t72	Z	1955-05-21	D	BA	bat1	bat	22
13	x273	t70	Z	1955-05-21	D	SG	brd1	sml	43
14	x327	t96	Z	1955-05-21	D	BA	bat1	bat	24.5
15	x330	t81	Z	1955-05-21	D	BA	bat1	bat	54.7
16	x334	t80	Z	1955-05-21	D	MC	brd1	med	38.7

13.1.2 Search schedule



	SearchDate	Season	t8	t9	t10	t13	t15	t18	t27	t31	t34	t37	t42	t55	t61	t67	t70	t72	t78	t80	t81	t87
1	1955-04-15	spring	1	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	1	1
2	1955-04-18	spring	0	1	0	1	0	0	0	0	0	1	0	1	1	1	0	0	0	0	1	1
3	1955-04-21	spring	0	0	1	0	0	1	0	0	1	0	1	0	0	0	1	1	1	1	1	1
4	1955-04-24	spring	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0	0	0	0	1	1
5	1955-04-27	spring	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1	1	1	1	1	1
6	1955-04-30	spring	0	1	0	1	0	0	0	0	0	1	0	1	1	1	0	0	0	0	1	1
7	1955-05-03	spring	0	0	1	0	0	1	0	0	1	0	1	0	0	0	1	1	1	1	1	1
8	1955-05-06	spring	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0	0	0	0	1	1
9	1955-05-09	spring	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1	1	1	1	1	1
10	1955-05-12	spring	0	1	0	1	0	0	0	0	0	1	0	1	1	1	0	0	0	0	1	1
11	1955-05-15	spring	0	0	1	0	0	1	0	0	1	0	1	0	0	0	1	1	1	1	1	1
12	1955-05-18	spring	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0	0	0	0	1	1
13	1955-05-21	spring	1	0	0	0	1	0	0	0	0	0	1	0	0	0	1	1	1	1	1	1
14	1955-05-24	spring	0	1	0	1	0	0	0	0	0	1	0	1	1	1	0	0	0	0	1	1
15	1955-05-27	spring	0	0	1	0	0	1	0	0	1	0	1	0	0	0	1	1	1	1	1	1
16	1955-05-30	spring	0	0	0	0	0	0	1	1	0	0	0	1	1	1	0	0	0	0	1	1

13.1.3 Density weighted proportion



13.1.4 Searcher Efficiency

13.1.5 Carcass persistence