Post-construction Monitoring
Bat Fatality Study
for the High Prairie Renewable Energy Center
Schuyler and Adair Counties, Missouri

Year 4 Report
April 2024 – October 2024

Prepared for:

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ACRONYM LIST

AICc	corrected Akaike Information Criterion
Ameren	Ameren Missouri
carcass searches	standardized carcass searches
CI	confidence interval
Covered Species	Indiana, northern long-eared, and little brown bat
CP	carcass persistence
CPT	carcass persistence trial
CrI	credible interval
DWP	density-weighted proportion
EoA	Evidence of Absence
full plots	circular full plots
GenEst	Generalized Estimator of Mortality
GUI	Graphical User Interface
HCP	Habitat Conservation Plan
HPREC	High Prairie Renewable Energy Center
ITP	Incidental Take Permit
m	meter
maternity buffers	2.5-mile buffer around documented female Indiana bat fatalities
MDC	Missouri Department of Conservation
min	minute
MW	megawatt
PCM	Post-construction bata fatality monitoring
QA/QC	Quality assurance and quality control
road and pad	Gravel turbine pads and access roads
rpm	rotations per minute
SEEF	searcher efficiency
SOCC	Species of Conservation Concern
Stantec	Stantec Consulting Services, Inc.
USFWS	US Fish and Wildlife Service
WEST	Western EcoSystems Technology, Inc.

1 INTRODUCTION

Ameren Missouri (Ameren) owns and operates the High Prairie Renewable Energy Center (HPREC) in Schuyler and Adair counties, Missouri (Figure 1). Ameren obtained an Incidental Take Permit (ITP; ESPER0011567) for the federally listed as endangered Indiana bat,[1] federally listed as endangered northern long-eared bat, and little brown bat (currently under review for federal listing; hereafter, collectively referred to as the Covered Species) from the US Fish and Wildlife Service (USFWS) on May 14, 2021. Compliance monitoring is required by terms of the ITP to determine if take of the HPREC Habitat Conservation Plan (HCP; Stantec Consulting Services, Inc. [Stantec] 2021a) Covered Species is within the limits authorized by the ITP, and to evaluate the need for adaptive management measures. HPREC completed compliance monitoring in 2021, 2022, and 2023 under the ITP (Stantec 2021b, 2022, 2023) and this report includes the monitoring results for 2024.

To meet this requirement, Ameren contracted Western EcoSystems Technology, Inc. (WEST), to develop and implement a fourth year of post-construction bat fatality monitoring (PCM) at the HPREC. The PCM study was designed to fulfill the monitoring commitments described in Section 7.0 of the HPREC's HCP. The objectives of this study were to 1) estimate the number of Indiana bat, northern long-eared bat, and little brown bat fatalities using the Evidence of Absence (EoA) framework (Huso et al. 2015, Dalthorp et al. 2017) as described in the HCP, 2) to determine if adaptive management was triggered, and 3) estimate the overall bat fatality rate using the Generalized Estimator of Mortality (GenEst) estimator. This report presents the results of the 2024 (Year 4) study conducted within the HPREC from April 1 to October 31, 2024.

1.1 Project Description

The HPREC is a 400-megawatt (MW) wind facility owned by Ameren that became operational in December 2020 and consists of 163 Vestas V120 turbines and 12 Vestas V112 turbines. The 2.2-MW V120 turbines have a hub height of 92 meters (m) and rotor diameter of 120 m. The V112 turbines have a hub height of 94 m and rotor diameter of 112 m.

The 46,083-hectare project area defined in the HCP is in Schuyler and Adair counties, Missouri, situated between the cities of Lancaster to the north, Queen City on the west, and Kirksville to the south (Figure 1). Land use within the permit area is primarily agricultural. Land cover consists mostly of pasture, hayfields, and row crops; forested areas are scattered throughout, mostly along rivers and streams.

[1] See Appendix A for scientific names of all bat species.

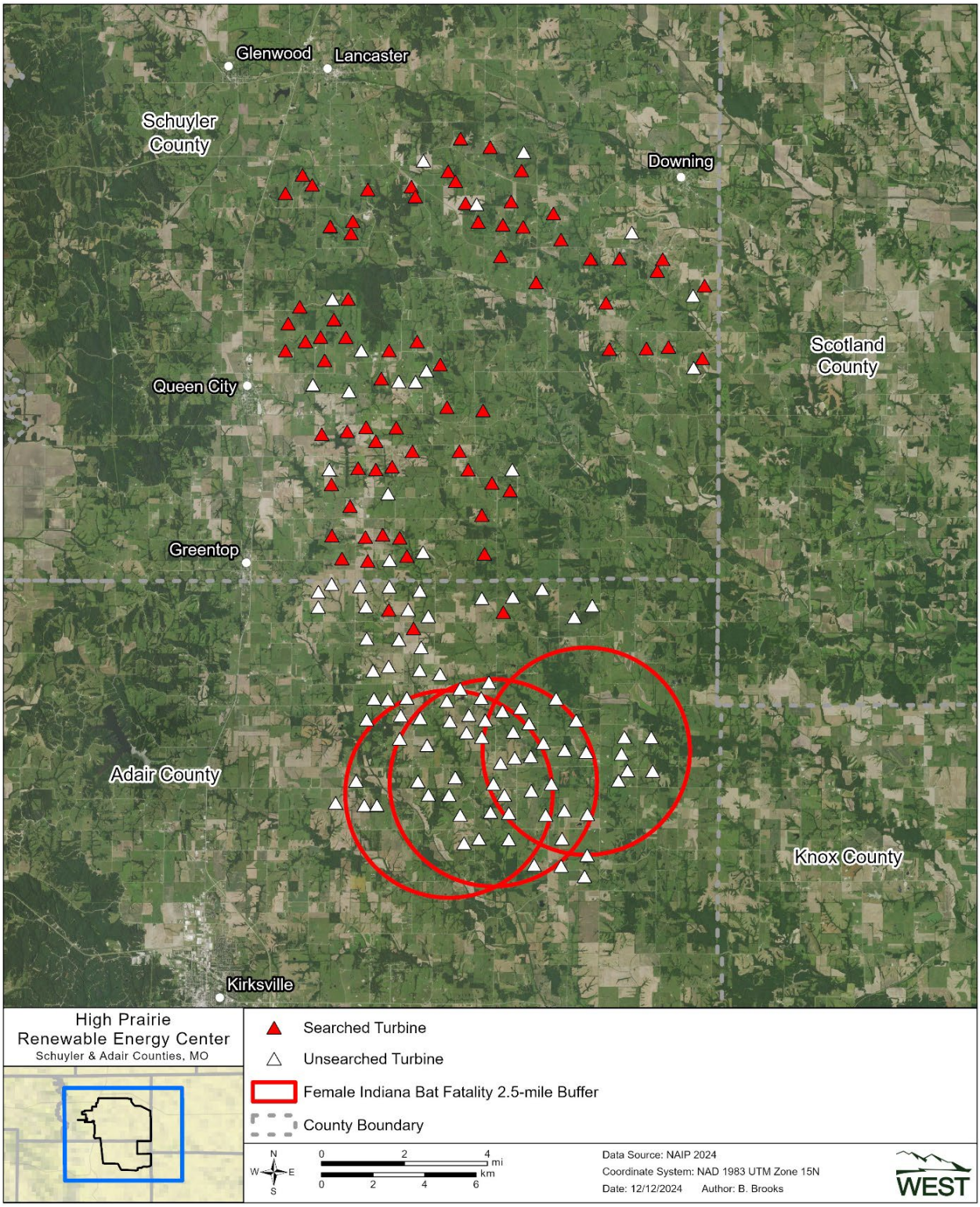


Figure 1. Location of turbines at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri.

Note: Red triangles represent turbines that were searched for bat carcasses and operated at night during a portion of the 2024 monitoring season. Female maternity buffers, shown in red, represent 2.5-mile buffers of locations where female Indiana bat fatalities were documented during previous years of monitoring in Adair County. Turbines did not operate at night within the Adair County maternity buffers during the entire 2024 active bat season.

The HCP/ITP requires the HPREC to maintain take of Covered Species within authorized levels (Section 6.2.6 of the HCP), and adhere to adaptive management commitments (Section 7.5 of the HCP). During the 2024 monitoring period (April 1 to October 31), Ameren voluntarily ceased nighttime operations at approximately half of the turbines to avoid potential impacts to Indiana bats in the southern portion of the HPREC within Adair County (Figure 2). Turbines that operated at night were limited to those located outside of 2.5-mile buffers of documented female Indiana bat fatalities, hereafter referred to as maternity buffers (Figure 1). From 50–78 turbines operated at a cut-in speed of 8.0 m per second when no bats of any species, regardless of their coverage under the ITP, were detected by the EchoSense[2] system each night, from 45 minutes (min) before sunset to 45 min after sunrise (Table 1).

Due to unforeseen events described below, the number of nighttime-operating turbines varied within and across seasons (Table 1). Throughout the monitoring period, PCM was conducted at all turbines that operated at night.

On April 28, 2024, Turbine G-08 collapsed and, due to safety concerns, all turbine operations (daytime and nighttime) were halted from April 28 through the afternoon of May 15 (Table 1). After determining that turbine operations no longer posed a safety risk, all turbines were released for daytime operations, and 50 turbines resumed nighttime operations. An additional 28 turbines were released for nighttime operations between May 29 and June 3, 2024 (Table 1).

On the morning of June 10, 2024, a carcass of an unidentified *Myotis* bat was found at an operating turbine[3] and Ameren voluntarily halted all nighttime turbine operations within 2.5 mi (maternity buffers) of three turbines in Schuyler County where female Indiana bat fatalities had been found (one in 2024, two in previous years of monitoring) for the remainder of the bat active season. On the following day (June 11, 2024), Ameren released all turbines for daytime operations. In addition, 48 of the 78 previously nighttime-operating turbines located outside the maternity buffers were released for nighttime operations (Figure 2) on the evening of June 11, 2024.

These 48 turbines continued to operate at night through the morning of August 25, 2024, when Turbine B-11 collapsed. Due to safety concerns, all turbines ceased daytime and nighttime operations from August 25 to 30, 2024. Ameren's investigation determined that operating the 12 V112 turbines posed no safety risk; consequently, these 12 turbines resumed daytime-only operations on the afternoon of August 30. The 163 V120 turbines resumed daytime-only operations on September 10, 2024. No turbines operated at night from August 25 to October 31, 2024 (Table 1). Carcass searches continued at the 48 non-operational turbines from August 25 to October 15, 2024.

[2] EchoSense is a form of acoustic-triggered smart curtailment designed to minimize bat fatalities at wind facilities.

[3] This bat was later confirmed through DNA (deoxyribonucleic acid) analysis to be a female Indiana bat.

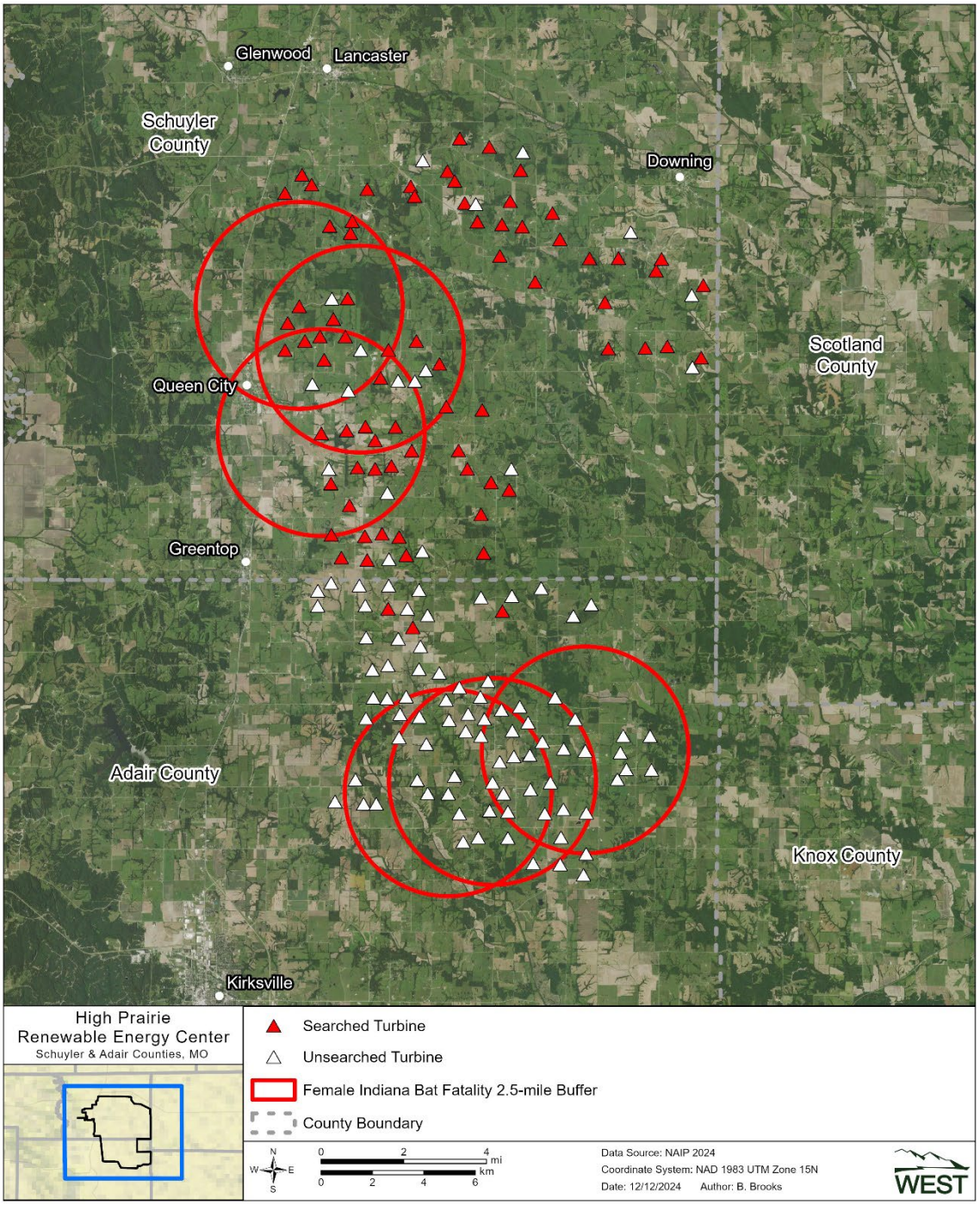


Figure 2. Location of turbines (red triangles) that were operational at night at some point between April 1 and October 31, and were searched for bat carcasses at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri. nighttime

Note: Maternity buffers, shown in red, represent 2.5-mile buffers of locations where female Indiana bat fatalities were documented (one in 2024, two during previous years of monitoring). On June 10, 2024, a female Indiana bat was found at Turbine A-10, after which Ameren voluntarily ceased operation at all turbines within the three overlapping maternity buffers in Schuyler County. Turbines did not operate at night within the Adair County maternity buffers during the entire 2024 active bat season.

Table 1. Summary of nighttime operations and curtailment regime at the High Prairie Renewable Energy Center, Adair and Schuyler counties, Missouri, during the 2024 monitoring period (April 1 – October 31, 2024).

Season	Date Range	Number of Turbines Operating at Night	Number of Turbines Not Operating at Night	Curtailment
Spring	April 1 – April 27	50	125	8.0 m/s + EchoSense
	April 28 – May 14	0	174	N/A
Summer	May 15	0	174	N/A
	May 16 – May 28	50	124	8.0 m/s + EchoSense
	May 29 – June 2	75	99	8.0 m/s + EchoSense
	June 3 – June 9	78	96	8.0 m/s + EchoSense
	June 10	0	174	N/A
	June 11 – August 15	48	126	8.0 m/s + EchoSense
Fall	August 16 – August 24	48	126	8.0 m/s + EchoSense
	August 25 – October 31	0	173	N/A

2 METHODS

Throughout the monitoring period, PCM was conducted at all turbines operating at night and continued at those same turbines during the subsequent temporary shutdowns from April 1 to October 15, 2024. The PCM study consisted of three primary monitoring components: 1) standardized carcass searches (carcass searches) around turbines, 2) searcher efficiency (SEEF) trials to estimate the probability a carcass was found by a technician, and 3) carcass persistence (CP) trials (CPT) to estimate the average length of time a carcass remained in the search area for possible detection. In addition, a search area adjustment was estimated to account for carcasses that fell outside of search areas. The methodologies of each of these components and associated analysis are described below.

2.1 Study Design

A description of the study design for the HPREC is presented in Table 2, including the number of turbines searched, type of search area (plot type), type of search (technician only or detection-dog team), and search frequency. Although the number of operating turbines varied across the monitoring period, all turbines that operated at night (at any point during the study period) were always searched, Approximately 70% of monitored turbines were searched as full plots by technicians or dog teams, and approximately 30% of monitored turbines were searched as roads and pads by technicians. Searches continued during portions of each season at turbines that were not operating during the night. Seasons were defined as follows: spring (April 1 to May 14), summer (May 15 to August 15) and fall (August 16 to October 31).

Table 2. Summary of nighttime operations and plot type at the High Prairie Renewable Energy Center, Adair and Schuyler counties, Missouri, between April 1 and October 31, 2024.

Season	Date Range	Number of Operational Nights	Number of Turbines Operating at Night	Number of Plots by Search Area (Search Type)			Frequency (Searches per Week)
				Full Plot (Technician)	Full Plot (Detection-dog Team)	Road and Pad (Technician)	
Spring	April 1 – April 27	27	50	35	0	15	2
	April 28 – May 14	0	0	35	0	15	2
Summer	May 15	0	0	35	0	15	2
	May 16 – May 28	13	50	16	20	14	2
	May 29 – June 2	5	75	25	28	22	2
	June 3 – June 9	7	78	25	28	22	2
	June 10	0	0	25	28	22	2
	June 11	1	48	17	15	15	2
	June 12 – June 15	4	48	17	15	16	2
	June 16 – June 19	4	48	17	15	16	4
	June 20 – August 15	57	48	18	15	15	4
Fall	August 16 – August 24	9	48	18	15	15	4
	August 25 – September 15	0	0	18	15	15	4
	September 16 – October 31	0	0	18	15	15	2

2.1.1 Turbines used for Searches

Seventy-seven turbines were searched at least once during the monitoring period (Figure 2).

2.1.2 Search Frequency

Searches were conducted two times per week between April 1 and June 15, four times per week between June 16 and September 15, and two times per week between September 16 and October 15 (Table 2).

2.1.3 Search Areas

Searches were conducted within two types of search areas (plot types): gravel turbine pads and access roads (road and pad plots) and circular full plots (full plots). Turbines were assigned a plot type (road and pad versus full plot) by Ameren, based on landowner participation. Road and pad plots included the gravel pad around the base of the turbine, all gravel roads, and a 1-m buffer within a 95-m radius centered on the turbine base. Full plots included a 60-m radius circle centered on the turbine. Vegetation within all full plots was regularly mowed to maintain a vegetation height of approximately 15 centimeters.

2.1.4 Search Methods

Carcass searches for bats were conducted using two search methods: searching by human technicians (i.e., technician-only visual search) and searching using detection-dog teams (olfactory search), where a team consisted of one handler and one dog. All personnel were trained to follow the HPREC's study plan including proper handling and reporting of carcasses. Carcass searches were conducted from April 1 to October 15, 2024, during the day, beginning as early as one half hour after sunrise.

2.1.4.1 Technician-only Visual Searches

Road and pad searches were conducted by technicians walking along the edge of all gravel access roads and pads while scanning towards the center and one m off to the side. Full plots were searched by technicians walking transects spaced six[4] m apart while scanning out to three m on either side (Figure 3). Direction of travel at full plots alternated between north-south oriented transects one day followed by east-west oriented searches the next. During all technician-only visual searches, technicians looked for carcasses while walking at a pace of approximately 45–60 m per min within the search areas. From April 1 to September 1, all full plot searches were conducted by technicians working independently. From September 2 to October 15, all full plot searches were conducted by pairs of technicians, with each member of the pair starting at opposite ends of the search area. Throughout the monitoring period, road and pad searches were conducted by technicians working independently.

[4] Transect width was reduced to 5.0 m (scanning out to 2.5 m on either side) beginning September 9, 2024, to increase SEEF rates.

Figure 3. Representative photograph of technician-only visual search plot conditions on road and pad plots (A) and full plots (B) at the High Prairie Renewable Energy Center.

2.1.4.2 Detection-dog Team Searches

Detection-dog teams searched full plots for bat carcasses starting on May 16, 2024. Detection-dog teams searched 45–56% of all full plots during the summer and fall seasons (Table 2). Turbines assigned to be searched by detection-dog teams were chosen in consideration of dog and handler safety to avoid potential hazards (e.g., frequent cattle grazing, thorny vegetation, or frequently water-logged areas), to the extent practicable. Detection-dog plots, once selected, were only searched by detection-dog teams throughout the study period.

Prior to each search, dog handlers determined the survey start points and the number of transects needed to cover the plot after considering wind speed and direction, humidity, and vegetation density. Handlers oriented the detection dog to start searches perpendicular to the wind to maximize the probability of scent detection. Windspeed and vegetation density can affect dispersal of the target odor (i.e., bat carcasses) across the search area. To maximize detection rates during a detection-dog search, transect width varied with windspeed and vegetation density, ranging from five to 10 m apart in densely vegetated areas to 10–15 m in shorter vegetation. Detection dogs were rewarded with either a food reward or a short play session when they correctly alerted to a bat carcass.

2.1.4.3 Detection-dog Team Evaluation

Detection dogs were considered candidates for carcass searches if they met basic temperament and obedience criteria and demonstrated the trainability to detect bat carcasses. Temperament characteristics sought after were high-energy and a high-food or toy drive. Prior to conducting carcass searches at the HPREC, handlers trained their detection dogs on the scent of bat carcasses following methods derived from search and rescue programs and drug detection (Kay

2012, Helfers 2017). Dogs were initially trained with dehydrated bat carcasses, placed at increasing distances over a period of four weeks. Once the dog achieved 80% or higher in a scent recognition test, consisting of 10 blind trial lineups using dehydrated bats, the dog and handler were evaluated in the field to measure their performance. A dog coordinator designee conducted field evaluation of each detection-dog team. After teams achieved a SEEF of 75% or greater for a minimum of 12 bats placed during evaluation trials, the teams were approved to conduct carcass searches. Three Labrador retrievers composed the detection dog teams (Figure 4).

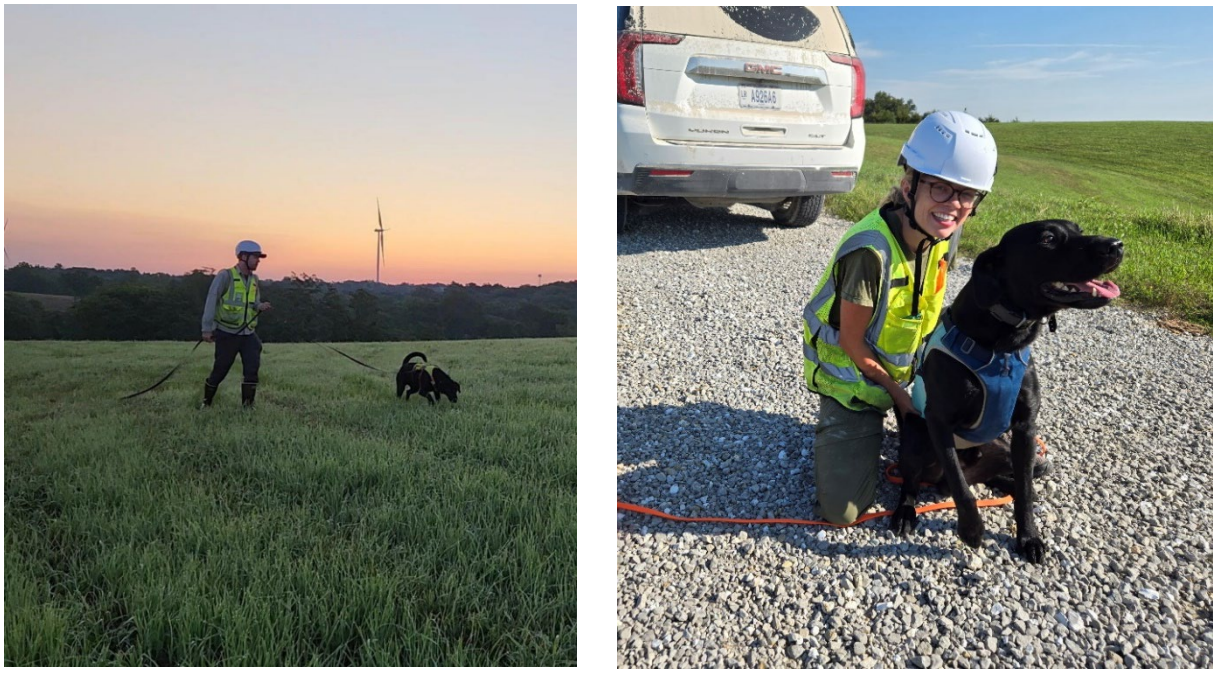


Figure 4. Photographs of detection-dog teams at the High Prairie Renewable Energy Center.

2.2 Field Methods

Technicians and detection-dog teams, trained in proper search techniques, conducted the carcass searches from April 1 to October 15, 2024. Bat carcasses found by technicians were recorded by the methods described below, whether they were found during standardized searches or incidentally.

2.2.1 Data Collection

Technicians and dog-handlers recorded the date, search start and end times, technician name or dog-handler name, turbine number, type of search, and if any carcasses were found during each carcass search. All bat carcasses found were recorded. Data recorded for carcasses included the following:

- an identification code
- species, sex, age, and reproductive condition (when identifiable)
- date and time
- Universal Transverse Mercator location

- measured distance and direction from turbine
- estimated time of death
- any comments that indicated possible cause of death
- photograph(s) of carcass as found, including any visible injuries and surrounding habitat
- location of bat carcass plotted on a map
- condition (e.g., intact, scavenged, dismembered, feather spot, injured)
    - Intact – a carcass that was completely intact, was not badly decomposed, and showed no sign of being fed upon by a predator or scavenger.
    - Scavenged – an entire carcass that showed signs of scavenging or was heavily infested by insects, or portion(s) of a carcass in one location (e.g., wings).
    - Dismembered – a carcass that was found in multiple pieces distributed more than one m apart from one another due to scavenging or other reasons.
    - Injured – a bat that was found alive.

All bat carcasses found were collected and handled in accordance with permit conditions. All injured bats were handled in accordance with permit conditions and were recorded and considered fatalities for analysis. Bat carcasses were collected under the HPREC's ITP (ESPER0011567), WEST's Federal Native Endangered and Threatened Species Recovery Permit (ES234141), and Missouri Collection/Salvage Permits. Technicians placed bat carcasses in a resealable plastic bag, labeled with a unique carcass identification number, turbine number, and date, and stored them in a freezer on site. Technicians wore rubber and leather gloves to handle all bat carcasses to eliminate possible transmission of rabies or other diseases. The USFWS was notified when a carcass of a federally listed as threatened or endangered species was found, and the Missouri Department of Conservation (MDC) was notified when a state-listed as endangered or threatened species or Species of Conservation Concern (SOCC; MDC 2024) was found.

Federally permitted bat biologists verified all bat carcass identifications. Tissue samples were collected from heavily scavenged or decomposed bat carcasses that could not be positively identified and were suspected to be a Covered Species based upon available identifiable physical characteristics. Tissue samples were submitted to a USFWS-approved laboratory, the Bat Ecology and Genetics Lab at Northern Arizona University (Species from Feces | Bat Ecology and Genetics Lab) on June 12, 2024. Bat carcasses that were heavily scavenged but did not have potential to be a Covered Species (i.e., fur was present on the wing and/or forearms measured greater than 41 millimeters and lacked notches in claws) were identified to the closest genus or group possible and were not sent off for further identification.

2.2.2 Searcher Efficiency Trials

The objective of SEEF trials was to collect data to estimate the probability that technicians and detection-dog teams detected bat carcasses. SEEF trials were placed on multiple days within each season to account for variability in detection associated with changes in conditions such as vegetation, topography, weather (e.g., rain and/or cloud cover, muddy plots), and to account for individual technician and detection-dog team detection variability. A minimum of 20 carcasses

were placed per search method (technician-only, detection-dog team) per plot type (road and pad, full plot) per season (spring, summer, fall). Due to a limited number of available bat carcasses, house mouse (*Mus musculus*) carcasses were used for all spring SEEF trials. Bat carcasses were used for all summer and fall SEEF trials and consisted of carcasses previously found on site or obtained from other PCM projects in Missouri. Carcasses of Covered Species or of federally or state-listed as threatened or endangered species were not used for bias trials.

The bias trial administrator placed SEEF carcasses in plots before scheduled searches so that technicians and detection-dog teams conducting the searches did not know when or where SEEF carcasses were placed. To the extent practicable, SEEF carcasses for technicians were placed in the morning, prior to the start of that day's scheduled searches, to minimize the risk of carcass removal. When morning placement was not possible, SEEF carcasses were placed the night before scheduled searches. For detection-dog teams, the bias trial administrator walked in a meandering path and dropped carcasses the day prior to the next search to allow time for the scent to pool and disperse prior to scheduled searches and to eliminate a direct scent trail. Trial carcasses were placed within the plot using randomly selected distances and bearings from the turbine.

Prior to placement, each SEEF carcass was marked discreetly with a black zip-tie and/or a piece of electrical tape around the upper forelimb for identification as a trial carcass after it was found. The bias trial administrator dropped SEEF carcasses from waist height or higher and allowed them to land in a random posture. Technicians had one chance to locate trial carcasses during the first search after carcass placement. The number and location of trial carcasses found during the subsequent search were recorded, and the number of trial carcasses available during each search was determined immediately after each trial by the trial administrator.

2.2.3 Carcass Persistence Trials

The objective of CPT was to collect data to estimate the length of time (in days) a carcass would persist, or be available for detection, in the field. The data collected were used to adjust for the potential bias of carcasses removed prior to carcass searches. CPTs were conducted throughout the study period to incorporate the effects of varying weather, climatic conditions, and scavenger densities. Means of carcass removal included scavenging or agricultural practices, such as being plowed into a field. Estimates of CP were incorporated into the estimates of g to account for carcasses removed from the plot. Bat and mouse carcasses were used for CPTs in spring; only bat carcasses were used for CPTs in summer and fall.

Seventy-five SEEF carcasses were left in place for CPT, including 16 mouse carcasses in spring, 49 bat carcasses in summer, and 10 bat carcasses in fall. An additional 59 carcasses were placed as CPT-only trials for a minimum of 14 trials per search method (technician-only, detection-dog team) per plot type (road and pad, full plot) per season (spring, summer, fall). Bat carcasses used for CPTs included previously frozen hoary bats, eastern red bats, silver-haired bats, and big brown bats. Carcasses were marked discreetly with a black zip-tie and/or a piece of electrical tape around the upper forelimb for recognition by technicians and other personnel and dropped from waist height or higher and allowed to land in a random posture within the plot.

No more than three trial carcasses were placed on a plot to avoid potential over-seeding and attracting scavengers. CPT carcasses were monitored over a 30-day period according to the following schedule: every day for the first seven days, then on days 10, 14, 21, and 30. The condition of carcasses was recorded each time the CPT carcasses were checked. The schedule varied slightly depending on weather and coordination with other monitoring work. Detection-dog teams checked CPT carcasses on the full plots they searched to determine when carcasses were removed, while technicians determined the status of CPT carcasses placed on technician-searched full plots and road and pads plots. Carcasses were monitored until they were completely removed (were not found on two consecutive checks), or until the trial period ended. Following the 30-day period, any remaining evidence of carcasses was removed.

2.2.4 Search Area Mapping

Technicians recorded the boundaries of the roads and pad plots and the 60-m full plots using a Juniper Geode sub-meter Global Positioning System unit. A 62-m radius projection was applied to full plots where plot boundaries were ill defined due to cattle grazing. The additional two m were added to the radius to account for the width of the turbine tower. Unsearchable areas within plot boundaries were also mapped. Plot boundaries were used to verify if carcasses were found inside the plots and to inform the distribution of carcasses around turbines to estimate the number of carcasses that fell inside or outside of search plots.

2.3 Data Management

2.3.1 Data Compilation and Storage

A Microsoft® SQL Server database was specifically developed to store, organize, and retrieve monitoring data. Data were keyed into the electronic database using a pre-defined format to facilitate subsequent quality assurance and quality control (QA/QC) and data analysis. All data forms and electronic files were retained according to WEST's data retention policy.

2.3.2 Quality Assurance and Quality Control

WEST implemented QA/QC measures at all stages of the study, including in the field, during data entry and analysis, and report writing. Multiple reviews were conducted as QA/QC measures throughout the study-life cycle. Following searches, technicians were responsible for inspecting data forms for completeness, accuracy, and legibility. If errors or anomalies were found within the data, follow-up measures were implemented including discussions and review of field data with field technicians and/or Project Managers. If any errors, omissions, or problems were identified in later stages of analysis or report writing, they were traced back to the raw data forms where appropriate changes and measures were implemented and documented.

3 STATISTICAL ANALYISIS

The GenEst (Dalthorp et al. 2018) was used to calculate bias correction factors (SEEF and CP), which, along with an area correction estimate and carcass data, were used to estimate the Project-wide fatality rate (fatalities/turbine and fatalities/MW) for all bat species. The EoA

framework (Dalthorp et al. 2017 and Huso et al. 2015) was used to estimate the probability of detection (*g*), the take rate of Covered Species, and the number of Covered Species fatalities that occurred, to determine if take thresholds were exceeded, and to determine whether adaptive management was warranted.

3.1 Bias Estimation

3.1.1 Searcher Efficiency Estimation

Data collected during SEEF trials were used to estimate the probability that bat carcasses were detected by technicians. Estimates of SEEF were used to adjust carcass counts for detection bias. SEEF is the probability of a carcass being detected by a technician given the carcass was available to be found. Estimates were obtained using a logit regression model (Dalthorp et al. 2018). SEEF was estimated separately for technicians and detection-dog teams to account for different modes of detection (i.e., technicians use sight, whereas dogs use scent). Covariates (explanatory variables of interest) for these logit regression models included plot type and season, and the interactions between these variables for the technician models, and season for the detection-dog team models. Models were selected using an information theoretic approach known as AICc, or corrected Akaike Information Criterion (Burnham and Anderson 2002). The best-supported model was selected as the most parsimonious model (i.e., model with the fewest parameters) within two AICc units of the model with the lowest AICc value.

The change in SEEF between successive searches was defined by a parameter called the detection reduction factor (*k*) that ranged from zero to one. When *k* is zero, it is implied a carcass missed on the first search will never be found. A *k* of one implies SEEF remains constant no matter how many times a carcass is missed. The detection reduction factor is a required parameter for GenEst; however, data were not collected to estimate *k*. Huso et al. (2017) estimated *k* to be 0.67 for bats, and this value was assumed for this analysis. The Single Class Module of EoA uses the raw SEEF data (i.e., number of found and available trial carcasses) to inform the overall *g*. SEEF data were input into the EoA software stratified according to the model selection results.

3.1.2 Carcass Persistence Estimation

Data collected during CPT were used to model the amount of time, in days, carcasses remained available within search plots. Models of CP were used to adjust carcass counts for removal bias by estimating the average probability a carcass persisted through the search interval (i.e., the time between scheduled searches). The persistence of a carcass was modeled using an interval-censored survival regression for each size class using exponential, log-logistic, lognormal, and Weibull distributions (Kalbfleisch and Prentice 2002, Dalthorp et al. 2018). Persistence was estimated separately for plots searched by technicians and by detection-dog teams to account for different modes of detection (i.e., dogs are often able to detect smaller fragments of carcasses than technicians). Covariates were fit to each of the parameters of the distributions and included season and plot type for the technician models and season for the detection-dog team models. The best-supported model was selected as the most parsimonious model (i.e., model with the fewest parameters) within two AICc units of the model with the lowest AICc value.

The parameter estimates of the selected model (shape (α) and scale (β), including the 95% confidence interval [CI] of β) were used as inputs in the EoA Single Class module. The EoA software requires the 95% CI for β regardless of the CI selected for the take estimates.

3.1.3 Search Area Adjustment Estimate

The search area adjustment (often referred to as the density-weighted proportion, or DWP; Simonis et al. 2018) accounted for unsearched areas beneath turbines and was calculated as a probability that ranged from zero to one. For example, a search area adjustment of 0.75 meant that an estimated 75% of carcasses fell within the search plots. The search area adjustment was estimated by multiplying the predicted proportion of carcasses occurring within each 10-m annulus around the base of the turbine (according to the carcass density distribution; see below) and the average proportion of area searched within that 10-m annulus. The product of these two components for each annulus was summed over all 10-m annuli from the turbine base to the maximum predicted fall distance (100 m) for each plot type.

Unsearched areas were due to survey obstacles such as ground cover (e.g., tall crops) or terrain, or areas where carcasses fell outside the search plots (e.g., a carcass landed 70 m away from the turbine on a plot searched out to 60 m from the turbine base). The proportion of area searched was calculated in a geographic information system as the amount of area searched divided by the total area searched at each 10-m annulus around the turbine. The carcass-density distribution predicts the likelihood a carcass fell a given distance from the turbine base.

The predicted proportion of carcasses occurring within each 10-m annulus (the carcass density distribution) was calculated by dividing the count of carcasses found within each 10-m annulus by the average proportion of area searched within the annulus to get an adjusted number of carcasses for the annulus. The adjusted number of carcasses from the present 2024 study year was added to Stantec's (2021a) predicted counts of carcasses per 10-m annulus to increase the sample size and create a better understanding of the overall fatality distribution. The resulting counts per annulus were divided through by the total adjusted count of carcasses to yield a proportion of carcasses in each annulus (which collectively summed to 1.0). The average proportion of area searched within each 10-m annulus was weighted by the number of searches at each turbine. Therefore, the proportion of area searched for all turbines at each 10-m annulus was multiplied by the fraction of total searches that occurred at that turbine and then summed to get an average proportion of area searched for each annulus.

The median area adjustment values across all turbines for each plot type were used as inputs in the EoA Single Class Module.

3.2 GenEst Fatality Rate Estimation

Carcasses included in the fatality rate estimation were found within the search plots at operational turbines and had an estimated time of death when monitoring was conducted from April 1 to October 15. Fatality rates were estimated for all bat species for the entire study period using GenEst (Dalthorp et al. 2018, Simonis et al. 2018). To obtain an overall estimate of fatality, each

carcass included in the analysis was adjusted to account for SEEF, CP, a detection reduction factor (also referred to as "*k*;" see below), and search area adjustment. Estimates and 90% CIs were calculated using a parametric bootstrap (Dalthorp et al. 2018).

3.3 Evidence of Absence

The EoA modeling framework (Dalthorp et al. 2017 and Huso et al. 2015) was used with data collected in the field to estimate *g*, the take rate of the Covered Species, the number of Covered Species fatalities that occurred, and to determine if take thresholds were exceeded. Data used in the EoA model included number of carcasses (Covered Species only), along with the search area adjustment, the results of SEEF and CP analyses, the seasonal arrival distribution (see below), and the detection reduction factor (*k*). SEEF were estimated as described above for GenEst and using in the EoA calculations.

Estimates of take of Covered Species were calculated separately for operational versus non-operational turbines. All operational turbines were searched for carcasses, and this study was designed to calculate the take of the HPREC to Covered Species at operational turbines. Non-operational turbines were monitored during periods when daytime and nighttime operations were curtailed due to turbine failures. This resulted in a potentially biased sample of non-operational turbines; therefore, we limited our fatality estimation at non-operational turbines to only the periods of time when we searched non-operational turbines, and only to turbines that were searched.

3.3.1 Carcasses Included in the Evidence of Absence Analysis

Covered Species carcasses were included in the EoA analysis data if the carcass was in the search area and the estimated time of death occurred within the study period. A Covered Species carcass was excluded from analysis data when the carcass was discovered outside of the spatial or temporal scope of the monitoring design. Carcasses outside the spatial scope of the monitoring design cannot be included as data but because they are known to have occurred, they were incorporated in the estimates of M* by truncating the prior to reflect the knowledge that those fatalities occurred even though they weren't detected as part of the data. A Covered Species carcass that had an estimated time of death that placed the fatality outside of the study period (e.g., a carcass found in the spring that was estimated to have died prior to April 1) would also be excluded because the carcass occurred outside of the study period.

3.3.2 Detection Probability, Density-weighted Proportion, and Weights

The monitoring and bias trial data were separated into search strata, where each search stratum was defined by several turbines that were searched, a plot type, search method, a search frequency, the proportion of days in the study period, and a weight that represented the relative risk within the stratum to estimate $g_{stratum}$. Strata were defined to ensure all the factors that defined them were identical within strata. The EoA Single Class module was used to estimate $g_{stratum}$ in each search stratum. This resulted in Ba and Bb parameters that defined the beta distribution of $g_{stratum}$ in each stratum. Unsearched areas were treated as distinct strata and assigned a detection probability of 10^{-5} by setting the beta distribution parameters to Ba = 0.01 and Bb = 1,000.

The Multiple Class module of the EoA Graphical User Interface (GUI) was then used three times: once to develop the distribution of *g* for each subseason ($g_{subseason}$) by combining $g_{stratum}$ (e.g., road and pads, full plots, or unsearched areas), using the appropriate weights; once to develop the distribution of *g* for each season (g_{season}) by combining $g_{subseason}$, using the appropriate weights; and again to develop the distribution of *g* for the study period by combining g_{season}, using the appropriate weights. Weights ("DWP" in the software) represent the relative fatality risk within each search stratum or season and are used for combining detection probabilities. For each stratum, the DWP was calculated as the product of several different weights, which are described in the sections below. DWP within seasons and subseasons were re-scaled to sum to one before calculating seasonal and subseasonal detection probabilities, respectively, as required by the EoA GUI.

DWP for combining across strata within subseasons were calculated using the sampling fraction. DWP for combining across subseasons within seasons were calculated as the product of the arrival proportions and relative turbine risk (see below), re-scaled so that all subseason weights sum to one within a season. DWP for combining across seasons within the study period were calculated using the seasonal arrival proportions.

3.3.2.1 Arrival Proportions

The proportion of annual fatalities expected within a season is called the arrival proportion and was used to weight the contributions of detection probability from different subseasons and seasons in the overall *g* estimate. Arrival proportions were calculated using fatality data at the HPREC during 2024 monitoring. Seasonal weights were estimated by dividing the number of fatalities included in the analysis by the *g* for that season, which provides an index of fatality risk that is adjusted for search effort. These weights were then re-scaled to sum to one across all three seasons. Subseason weights were calculated by partitioning the seasonal arrival weight into each subseason based on the proportion of days within each subseason relative to the entire season.

3.3.2.2 Relative Turbine Risk

The relative turbine risk weight was used to adjust for changes in the number of operational turbines throughout the study period. This weight was calculated by dividing the number of operational turbines within each stratum by the total number of turbines at the facility.

3.3.2.3 Take Estimates

The Multiple Years module of EoA was used to estimate:

- median cumulative take to date ($M^*_{2021\text{-}2024}$, based on monitoring from 2021–2024)
- median annual take (M^*_{2024})
- mean annual take rate (λ)
- projected take estimate ($M^*_{projected}$) for operational turbines
- median take estimate for non-operational turbines ($M^*_{2024\ non\text{-}operational}$)

The cumulative take to date ($M^*_{2021\text{-}2024}$) was calculated using monitoring data from 2021–2024. The median annual take (M^*_{2024}), mean annual take rate (λ), and median take estimate for non-operational turbines ($M^*_{2024\ non\text{-}operational}$) were all calculated using monitoring data from 2024, alone. The median projected take estimate ($M^*_{projected}$) for operational turbines was calculated using monitoring data from 2021–2024, and assumed two more years of ITP monitoring with a detection probability of 0.2 and the same relative risk as seen in 2024.

The EoA Multiple Years Module requires the input ρ, which weights the years appropriately for combining beta distribution parameters. This value was calculated using the same approach as in previous years. Turbine rotor speed (rotations per min [rpm]) data was recorded in 10-min intervals for all turbines between April 1 and October 31, where each interval was categorized as operational if the rpm value was greater than one. The calculations for ρ were limited to turbine rpm data between sunset and sunrise and when wind speeds were less than 15 m per second. The number of operational 10-min nighttime periods were summed monthly. These sums of 10-min operational intervals were then weighted by the monthly relative number of acoustic bat passes recorded at 35 turbines by the EchoSense system in 2024. These weighted sums were then converted to turbine-hours of operation that likely posed risk to bats.

The resulting number of weighted hours with rotor speed over one rpm was 1,151 for 2024, representing a 37% decrease in relative mortality risk compared to the 1,829 weighted hours in 2021. Therefore, a ρ of 0.63 was used for 2024 (Table 3).

Table 3. Calculated number of hours at night when turbine rotor speed exceeded one rotation per minute in 2021–2024, weighted by monthly rate of acoustic bat passes detected by EchoSense in 2022–2024 at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri.

Year	Total Hours with Rotor Speed >1 rpm	Hours with Rotor Speed >1 rpm (weighted by bat activity)	ρ
2021	51,326	1,829	1.00
2022	2,759	128	0.07
2023	4,983	370	0.20
2024	8,714	1,151	0.63

rpm = rotations per minute.

3.3.3 Adaptive Management Triggers

The estimates from the EoA analysis were used to test two adaptive management triggers: a short-term test of whether the estimated take rate exceeded the expected take rate, and a long-term test of whether permitted take had been met (Dalthorp and Huso 2015). Both the short- and long-term triggers were tested individually for each of the Covered Species.

3.3.3.1 Evidence of Absence Short-term Trigger

The EoA short-term trigger is designed as an early warning signal that the HPREC may be on a trajectory to exceed the permitted take (T) by the end of the permit term. The short-term trigger is designed to determine if an adaptive management response is needed to prevent the cumulative

take estimate from exceeding the permitted take. The short-term trigger tests if the estimated annual take rate (λ) exceeded the expected take rate (τ = T ÷ years in permit) at a credible level of α = 0.5, per the HCP. The HPREC's short-term trigger is designed to evaluate cumulative take within one year of PCM. If, within any study year, the estimated take rate exceeds the expected take rate with 50% probability, the short-term trigger would be met, indicating the minimization plan in the HCP may need to be adjusted to ensure the median cumulative take estimate remains within the permitted limit over the ITP term. Only data from the 2024 monitoring period were used to evaluate this trigger.

3.3.3.2 Evidence of Absence Long-term Trigger

The EoA long-term trigger was designed to test if the cumulative take to date was equal to or greater than the permitted take (T). Per the HCP, cumulative take to date ($M^*_{2021\text{-}2024}$) was estimated at a credible level of α = 0.5 (using the median, or 50th credible bound, of the posterior distribution of estimated fatality). If the cumulative take to date ($M^*_{2021\text{-}2024}$) at α = 0.5 was less than the total permitted take ($M^*_{2021\text{-}2024}$ < T), then the HPREC was in compliance with the ITP. If the cumulative take- ($M^*_{2021\text{-}2024}$) to-date at α = 0.5 was greater than the total permitted take ($M^*_{2021\text{-}2024}$ ≥ T), then the take limit has been exceeded and the HPREC must enact avoidance measures or amend their ITP.

Even though the triggers have not been met, Ameren has submitted an application to increase the Indiana bat take numbers as recommended by USFWS. The draft amendment is currently being reviewed and will also include take for non-operational turbines, which was not a covered activity in the original ITP. Please see Section 5 for additional details.

4 RESULTS

4.1 All Bats

4.1.1 Carcass Searches

There were 3,963 road and pad and full plot searches completed between April 1 and October 15, 2024. Overall, 2,761 searches (69.7%) were conducted at turbines with nighttime operations and 1,202 (30.3%) were conducted when turbines were non-operational during the night (Table 4). There were 1,666 searches (42.0%) conducted on technician-searched full plots compared to 1,251 (31.6%) on road and pad plots and 1,046 (26.4%) on detection-dog-searched plots (Table 4). One hundred fifty-seven searches were missed due to turbine maintenance, cattle present on the plot, aerial spraying, electric fences, or weather.

Table 4. Number of searches conducted during operational and non-operational periods by plot type at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri.

		Number of Searches					
Plot Type	**Aided Search**	**Operational**	**%**	**Non-operational**	**%**	**Total**	**%**
Full plot	yes*	761	27.6	285	23.7	1,046	26.4
Full plot	no	1,134	41.1	532	44.3	1,666	42.0
Road and pad plot	no	866	31.4	385	32.0	1,251	31.6
Total	**N/A**	**2,761**	**100**	**1,202**	**100**	**3,963**	**100**

* Indicates plots searched by detection-dog teams

Twenty-six bat carcasses were found during or incidental to standardized searches (Table 5, Appendix B). Twelve carcasses were found during searches conducted at operational turbines, 10 were found at non-operational turbines, and four were found incidentally (Table 5). Of the 22 carcasses found during scheduled searches, 18 were found on detection-dog full plots, three on technician full plots, and one on road and pad plots (Table 5).

Table 5. Number of bat carcasses found during or incidental to standardized carcass searches conducted during operational and non-operational periods by plot type at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri.

		Number of Carcasses Found							
Plot Type	**Aided Search**	**Operational**	**%**	**Non-operational**	**%**	**Incidental**	**%**	**Total**	**%**
Full plot	yes*	10	62.5	8	80.0	0	0	18	69.3
Full plot	no	2	12.5	1	10.0	0	0	3	11.5
Road and pad	no	0	0	1	10.0	0	0	1	6.3
Other	N/A	0	0	0	0	4	100	4	15.4
Total	**N/A**	**12**	**100**	**10**	**100**	**4**	**100**	**26**	**100**

* Indicates plots searched by detection-dog teams

Nine carcasses were found during fall compared to two in spring and between zero and five during each of the summer sub-seasons (Table 6). The average search interval ranged between 1.83 days during Fall to 3.83 days during Summer 2 (Table 6).

4.1.2 Species Composition

Twenty-six carcasses representing at least five bat species were found during or incidental to the standardized searches (Table 7) Eleven bat carcasses were found within search area boundaries during scheduled searches and were included in the GenEst analysis (Table 7). The remaining 15 were excluded because they were found during non-operation periods (incidental to standardized searches, the estimated time of death was outside the study period, or they were found while turbines were not operating at night; Table 7).

Table 6. Summary of post-construction bat fatality monitoring conducted at the High Prairie Renewable Energy Center in Schuyler and Adair counties, Missouri, from April 1 to October 15, 2024.

Season	Dates	Number of Turbines Searched	Number of Searches	Average Search Interval (days)	Bats Found at Operational Turbines	Bats Found at Non-operational Turbines	Number of Bats Found Incidentally[1]	Total
Spring	April 1 – May 14	50	639	3.35	1	1	0	2
Summer 1	May 15 – May 28	50	192	3.59	2	0	2	4
Summer 2	May 29 – June 12	75	287	3.83	5	0	0	5
Summer 3	June 13 – June 19	48[2]	140	2.62	0	0	0	0
Summer 4	June 20 – August 15	48	1,515	1.84	3	0	2	5
Fall	August 16 – October 15	48	1,190	1.83	1	9	0	10
Total	**April 1 – October 15**	**n/a**	**3,963**	**n/a**	**12**	**10**	**4**	**26**

1. Incidental finds include carcasses found during on-site activities other than scheduled carcass searches

2. 48 turbines were searched during this season. No carcasses were found. One turbine was excluded from the take estimates during this season because the turbine was designated as a full plot, but access was limited to road and pad.

Table 7. Species composition of bat carcasses found at the High Prairie Renewable Energy Center in Schuyler and Adair counties, Missouri, between April 1 and October 31, 2024.

	Included in fatality estimates		Outside search areas		Outside Study period		Incidental		Found at non-operational turbines		Total	
Species	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**	**Count**	**%**
eastern red bat	2	18.2	0	0	1	100	1	25.0	4	40.0	8	30.8
hoary bat	3	27.3	0	0	0	0	0	0	1	10.0	4	15.4
big brown bat	2	18.2	0	0	0	0	1	25.0	2	20.0	4	15.4
Indiana bat	1	9.1	0	0	0	0	0	0	2	20.0	3	11.5
evening bat	0	0	0	0	0	0	2	50.0	0	0	3	11.5
silver-haired bat	1	9.1	0	0	0	0	0	0	1	10.0	2	7.7
unidentified non-myotis	1	9.1	0	0	0	0	0	0	0	0	1	3.8
unidentified bat	1	9.1	0	0	0	0	0	0	0	0	1	3.8
Overall Bats	**11**	**100**	**0**	**0**	**1**	**100**	**4**	**100**	**10**	**100**	**26**	**100**

Fourteen of the 26 bat carcasses were found during summer compared to 10 in fall and two in summer (Table 8). Eastern red bat (eight carcasses), big brown bat (four), and hoary bat (four) together accounted for 61.5% of all bats found incidentally and during scheduled searches (Table 8). Ten of the 11 bat carcasses included in the fatality estimates were found during summer, compared to one in fall and zero in spring (Table 8). Hoary bat (three carcasses), big brown bat (two), and eastern red bat (two) together accounted for 63.6% of all bat carcasses included in the fatality estimates (Table 8). Carcasses of one Covered Species (Indiana bat) and two SOCC (MDC 2024; hoary bat, silver-haired bat) were found (Table 8).

Table 8. Seasonal distribution of all bat carcasses found incidentally and during scheduled searches and of bat carcasses included in fatality rate estimates calculated for the High Prairie Renewable Energy Center in Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

	Number Found (Number Included in Fatality Estimates)			
Species	**Spring**	**Summer**	**Fall**	**Total**
big brown bat	0	3 (2)	1 (0)	4 (2)
eastern red bat	1 (0)	3 (2)	4 (0)	8 (2)
evening bat	1 (0)	2 (0)	0	3 (0)
hoary bat[1]	0	2 (2)	2 (1)	4 (3)
Indiana bat[2, 3]	0	1 (1)	2 (0)	3 (1)
silver-haired bat[1]	0	1 (1)	1 (0)	2 (1)
unidentified bat	0	1 (1)	0	1 (1)
unidentified Myotis	0	1 (1)	0	1 (1)
Overall Bats	**2 (0)**	**14 (10)**	**10 (1)**	**26 (11)**

1. State-listed as a Species of Conservation Concern (Missouri Department of Conservation 2024)
2. Federally and state-listed as endangered
3. Covered species

4.1.3 Searcher Efficiency Estimation

Two hundred SEEF trials were conducted using either bat carcasses or bat carcass surrogates (house mice, spring only). Of those placed, 64 trials were available for the technician to find on road and pad plots, 62 were available for the technician to find in full plots, and 41 were available for the detection-dog teams to find on full plots (Table 9). Across all seasons, technicians found 96.88% of available trials on road and pad plots, 33.87% on technician-searched full plots, and 80.49% on detection-dog full plots (Table 9).

Table 9. Searcher efficiency results by search area, search type, and season at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Search Area (Searcher Type)	Season	Number Placed	Number Available	Number Found	% Found
Road and pad (Technician)	Spring[1]	23	21	21	100
	Summer	25	21	19	90.48
	Fall	22	22	22	100
	Overall	**70**	**64**	**62**	**96.88**
Full plot (Technician)	Spring[1]	27	20	6	30.0
	Summer	25	20	5	25.00
	Fall	23	22	10	45.45
	Overall	**75**	**62**	**21**	**33.87**
Full plot (Detection-dog Team)	Spring	n/a	n/a	n/a	n/a
	Summer	29	20	17	85.00
	Fall	26	21	16	76.19
	Overall	**55**	**41**	**33**	**80.49**

[1.] House mouse carcasses were used as bat surrogates during spring trials; bat carcasses were used for all other trials.

SEEF was estimated separately for technicians and detection-dog teams. The best supported model for SEEF estimates for technicians included search area as a covariate (Appendix C1) while the best supported model for detection-dog teams included no covariates (Appendix C2). Modeled SEEF rates were 0.97 (90% CI = 0.90–0.99) for technicians on road and pad plots, 0.34 (90% CI = 0.25–0.44) for technicians on full plots, and 0.81 (90% CI = 0.68–0.89) for detection-dog teams on full plots (Table 10).

Table 10. Modeled searcher efficiency rates for technicians (n = 126 carcasses) and detection-dog teams (n = 41 carcasses) at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Plot type	Search Type	Number of Trials	Searcher efficiency rate	90% CI
Road and pad plot	Technician	64	0.97	0.90–0.99
Full plot	Technician	62	0.34	0.25–0.44
Full plot	Detection-dog Team	41	0.81	0.68–0.89

4.1.4 Carcass Persistence Estimation

CP rates were modeled separately for plots searched by technicians and plots searched by detection-dog teams. One hundred thirty-four bat or bat surrogate carcasses were used to estimate CP including 54 on road and pads, 50 on full plots, and 30 on dog-assisted plots. The

best-supported model for CP on technician-searched plots included no covariates (Appendix C3) and the best supported model for detection-dog team-searched plots included season as a covariate (Appendix C4). The median CP for plots searched by technicians was 3.65 days across all seasons (Table 11; Appendix C5). The median CP for plots searched by detection-dog teams was 14.39 days in summer and 2.87 days in fall (Table 9, Appendix C5).

Table 11. Median carcass persistence (days) for plots searched by technicians (n = 104) and plots searched by detection-dog teams (n = 30) at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Search Type	Season	Number of Trials	Median Carcass Persistence (Days)
Technician	–	104	3.65
Detection-dog Team	Summer	15	14.39
	Fall	15	2.87

4.1.5 Search Area Adjustment

Eleven bat carcasses found during the study period at operational turbines were included in the modeling for the search area adjustment (Table 7). Approximately 1% of the area within full plots was unsearchable and accounted for within the search area adjustment. These data were combined with the 157 bat carcasses found during monitoring in 2021 to calculate the search area adjustment for the 2024 analysis. All full plots have a search area adjustment of 0.74; road and pad plots have a search area adjustment of 0.11.

4.1.6 Estimated Fatality Rates – Generalized Estimator of Mortality

Estimated fatality rates and 90% CIs for all bat species combined were calculated per MW and per turbine for each plot type, search type, and season. Estimated fatality rates were calculated based on the estimated SEEF, CP, the "*k*" detection reduction factor, and search area adjustment.

4.1.6.1 Seasonal Fatality Rates

11 bat carcasses, 10 which were found during summer, one during fall, and zero during spring were included in the fatality rate estimates. Fatality rate estimates were calculated using the adjustment factors in Appendix D. The highest fatality rate estimates were for full plots in summer (0.38 fatalities/turbine, 90% CI = 0.20–0.60; 0.17 fatalities/MW, 90% CI = 0.09–0.27; Table 12).

Table 12. Estimated fatality rates and adjustment factors, with 90% confidence intervals, from studies conducted at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, during periods of operation between April 1 to October 31, 2024.

	Spring		Summer		Fall	
Fatality Rate	**50 turbines searched**		**48–75 turbines searched**		**48 turbines searched**	
Plot type	**Estimate**	**90% CI**	**Estimate**	**90% CI**	**Estimate**	**90% CI**
Fatalities/Turbine						
Road and Pad Plots	0	n/a*	0	n/a*	0	n/a*
Full Plots	0	n/a*	0.38	0.20–0.60	0.07	n/a*
All Plot Types	0	n/a*	0.27	0.14–0.42	0.05	n/a*

Table 12. Estimated fatality rates and adjustment factors, with 90% confidence intervals, from studies conducted at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, during periods of operation between April 1 to October 31, 2024.

Fatality Rate	Spring 50 turbines searched		Summer 48–75 turbines searched		Fall 48 turbines searched	
Plot type	**Estimate**	**90% CI**	**Estimate**	**90% CI**	**Estimate**	**90% CI**
Fatalities/Megawatt						
Road and Pad Plots	0	n/a*	0	n/a*	0	n/a*
Full Plots	0	n/a*	0.17	0.09–0.27	0.03	n/a*
All Plot Types	0	n/a*	0.12	0.06–0.19	0.02	n/a*

* Confidence interval (CI) for plot type/season not calculated because the observed carcass count is less than five.

4.1.6.2 Overall Fatality Rates

Overall fatality rate estimates by plot type are presented in Table 13. Estimated fatality rates for all bats combined at full plots were 0.21 fatalities/MW (90% CI = 0.11–0.31) and 0.45 fatalities/turbine (90% CI = 0.24–0.69; Table 13). No carcasses were found during searches at road and pad plots; thus, although a fatality rate can be calculated (zero fatalities/MW, 0 fatalities/turbine), CI cannot be calculated (Table 13). Estimated fatality rates for all search areas combined were 0.14 fatalities/MW (90% CI = 0.08–0.22) and 0.32 fatalities/turbine (90% CI = 0.17–0.48; Table 13).

Table 13. Overall fatality rates per megawatt and per turbine, by plot type, at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, during periods of operation between April 1 to October 31, 2024.

	Per Megawatt Estimates		Per Turbine Estimates	
	Estimate	**90% CI**	**Estimate**	**90% CI**
Road and Pad Plots	0	n/a*	0	n/a*
Full Plots	0.21	0.11–0.31	0.45	0.24–0.69
All Search Areas	0.14	0.08–0.22	0.32	0.17–0.48

* Confidence interval (CI) not calculated because the observed carcass count is less than five.

4.1.6.3 Species-specific Fatality Rates

The number of bats found at operational turbines, and associated fatality estimates, were less than five for any individual species. The highest estimate was the hoary bat, followed by the eastern red bat, unknown bat, big brown bat, Indiana bat, and silver-haired bat (Table 14).

Table 14. Bat fatality estimates, by species, calculated using GenEst from the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, during periods of operation between April 1 to October 31, 2024.

Species	Total Found	Total Estimated Fatality (90% CI)	Fatalities per Turbine (90% CI)	Fatalities per Megawatt (90% CI)
big brown bat	2	3.22 (0.05–6.83)	0.07 (0–0.14)	0.03 (0–0.06)
eastern red bat	2	3.45 (0.03–7.52)	0.06 (0–0.13)	0.03 (0–0.06)
hoary bat	3	4.07 (0.28–9.35)	0.07 (0–0.17)	0.03 (0–0.08)
Indiana bat	1	1.92 (0–4.96)	0.03 (0–0.07)	0.01 (0–0.03)
silver-haired bat	1	1.54 (0–4.51)	0.03 (0–0.09)	0.01 (0–0.04)
unknown bat	2	3.38 (0.04–7.13)	0.06 (0–0.12)	0.03 (0–0.05)

CI = confidence interval.

4.2 Covered Species

Three Indiana bat carcasses and zero northern long-eared bat or little brown bat carcasses were found during surveys (Table 7; Appendix B). One Indiana bat carcass, found at Turbine H-01 (Figure 5) on June 10, 2024, at an operational turbine and within the plot boundary, was determined to be a female through DNA analysis. The location of the female Indiana bat and a 2.5-mi buffer are shown in Figure 5, relative to the locations of previous female Indiana bat fatalities.

An Indiana bat of unknown sex was found at Turbine C-10 on September 11, 2024, nine m outside of the plot boundary. A male Indiana bat was found at Turbine B-08 on September 12, 2024, within the plot boundary (Figure 5). Both Indiana bats were found during a period in which no turbines were operating at night (Appendix B).

Nine Indiana bats, one little brown bat, and zero northern-long-eared bat carcasses have been found, to date, under the ITP at operational turbines (Figure 5).

One female Indiana bat was found in 2024. Six total female Indiana bat fatalities have been confirmed since monitoring began, including three in Schuyler County and three in Adair County. The corresponding 2.5-mi adaptive management maternity colony buffers overlap in both the northern and southern portions of the Project, with three overlapping buffers in each county (Figure 5). Therefore, per Appendix B of the HCP, no maternity colony adaptive management triggers have been met.

4.2.1 Evidence of Absence

Inputs required to run the EoA Single Class, Multiple Class, and Multiple Years modules are described in Appendix E. Screenshots from the EoA software are shown in Appendix F.

4.2.1.1 Detection probability

The *g* achieved for the 2024 study period had a mean of 0.30 (95% CrI: 0.28–0.32; Table 15). Data from four monitoring study periods were used in the EoA analysis (2021–2024) along with the values of ρ: 1.00, 0.07, 0.20, and 0.63, respectively.

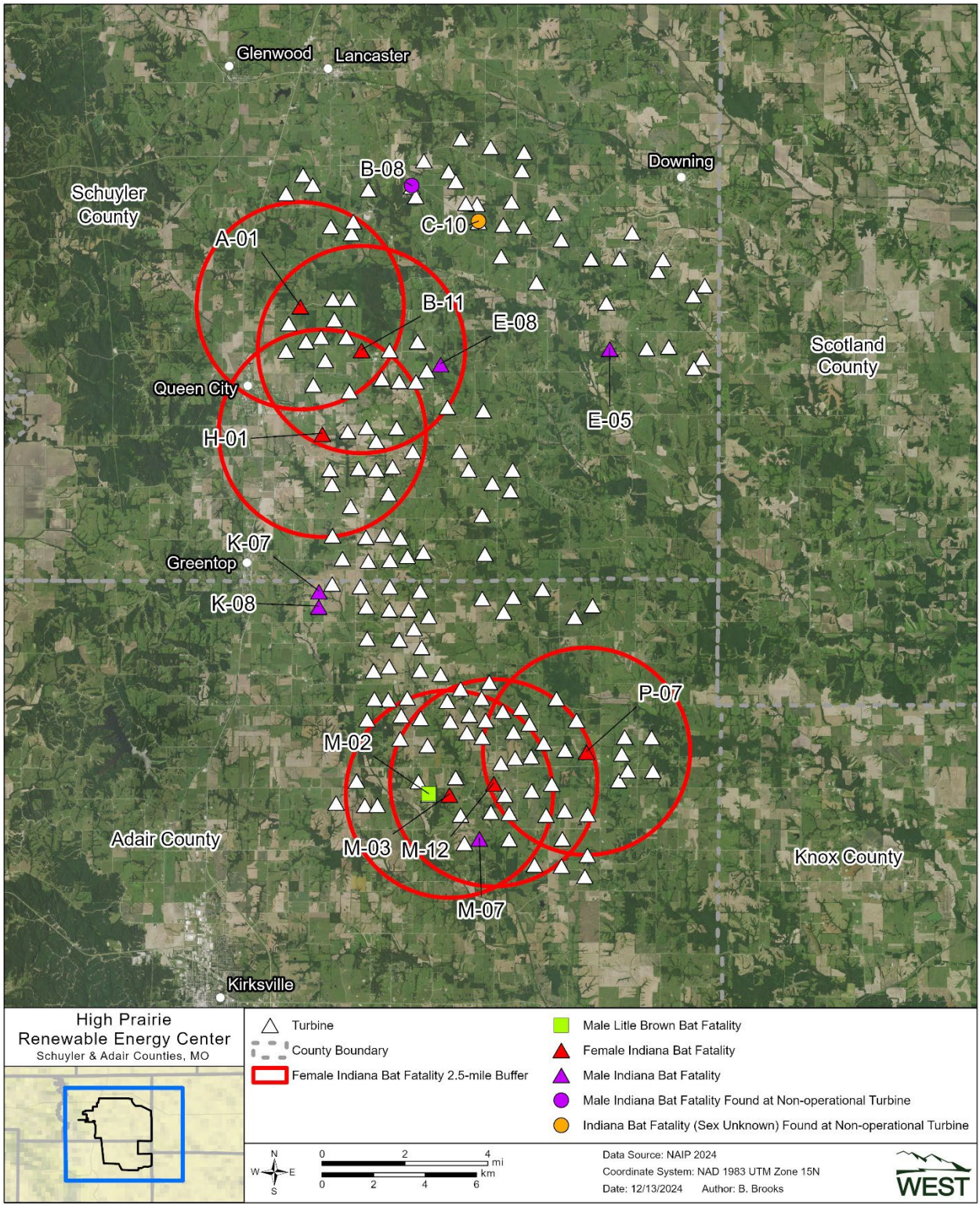


Figure 5. Location of fatalities of Covered Species during the Incidental Take Permit period (2021–2024) at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri.

Table 15. Annual and overall probabilities of detection (*g*), Ba, Bb, and ρ for the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, during periods of operation between April 1 to October 31[3], 2021 – 2024.

Year	Ba[1]	Bb[1]	*g* (95% CrI)[2]	ρ	Carcass Count		
					INBA	NLBA	LBBA
2021	44.98	345.68	0.12 (0.09–0.15)	1.00	7	0	1
2022	72.85	81.53	0.47 (0.39–0.55)	0.07	0	0	0
2023	109.6	157.12	0.41 (0.35–0.47)	0.20	1	0	0
2024	591.01	1,388.48	0.30 (0.28–0.32)	0.63	1	0	0
Short-term Trigger (2024 only)	591.01	1,388.48	0.30 (0.28–0.32)	–	1	0	1
Long-term Trigger (Cumulative)	394.26	1,395.88	0.22 (0.20–0.24)	–	9	0	1

1. Ba and Bb are the parameters for the beta distribution used to characterize the distribution of the probability of detection. The *g*-value is the mean of that distribution.

2. CrI = Confidence Interval

3. Monitoring was completed through October 31 in 2021–2023. During 2024, the US Fish and Wildlife Service notified Ameren Missouri that monitoring could cease on October 15.

INBA = Indiana bat; LBBA = little brown bat; NLBA = northern long-eared bat

Based on monitoring conducted at non-operational turbines between April 29 and May 19, and between August 25 and October 15, the *g* achieved for the non-operational monitoring period was 0.26 (95% CrI: 0.23–0.29; Table 16).

Table 16. Overall probability of detection (*g*), Ba, Bb, and ρ for the non-operational monitoring period at High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 29 to May 14, and August 16 to October 15,[3] 2024.

Year	Ba[1]	Bb[1]	*g* (95% CrI)[2]	INBA Carcass Count (included)	INBA Carcass Count (excluded, used to adjust M* prior)
2024 – non-operational	224.82	649.06	0.26 (0.23–0.29)	1	1

1. Ba and Bb are the parameters for the beta distribution used to characterize the distribution of the probability of detection. The *g*-value is the mean of that distribution.

2. CrI = Credible Interval

3. Monitoring was completed through October 31 in 2021–2023. During 2024, the US Fish and Wildlife Service notified Ameren Missouri that monitoring could cease on October 15.

INBA = Indiana Bat.

4.2.1.2 Fatality estimates and Adaptive Management Triggers

Fatality rates, annual, and cumulative take estimates were below the short-term (Table 17) and long-term (Table 18) triggers, and no adaptive management is required as described in the HCP.

4.2.1.3 Evidence of Absence Short-term Trigger

Mean annual take rates (λ) based on monitoring from operational turbines in 2024 were estimated to be 5.03 (95% CrI: 0.361–15.700) Indiana bat fatalities per year, 1.68 (95% CrI: 0.002–8.432) northern long-eared bat fatalities per year, and 1.68 (95% CrI: 0.002–8.432) little brown bat fatalities per year (Table 17). The expected average annual take rates reported in the HCP were 12 Indiana bat fatalities per year, three northern long-eared bat fatalities per year, and 16 little brown bat fatalities per year.

The short-term trigger assesses if the estimated annual take (λ) rate exceeds the expected take rate with sufficient probability, $Pr(\lambda \geq \tau) \geq (1 - \alpha)$. At a 50% credible level ($\alpha = 0.5$), $Pr(\lambda \geq \tau)$ must be greater than or equal to 0.5 for the short-term trigger to fire. For Indiana bat fatalities, $Pr(\lambda \geq \tau) = 0.21$, northern long-eared bat fatalities $Pr(\lambda \geq \tau) = 0.28$, and little brown bat fatalities $Pr(\lambda \geq \tau) = 0.01$ (Table 17). None of these probabilities meet or exceed 0.50, indicating the short-term trigger was not met and no adaptive management actions are necessary (Table 17).

Projected take estimates from operational turbines ($M^*_{projected}$) were estimated to be 70.0 Indiana bats, 1.5 northern long-eared bats, and 9.5 little brown bats (Table 18).

Table 17. Summary of Evidence of Absence outputs at operational turbines for Covered Species at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1, 2021 to October 31, 2024.

Species	Number of Carcasses	Mean λ (95% CrI)	Expected Take Rate (τ)	Pr(λ ≥ τ)[1]	Short-Term Trigger Fires at α = 0.5?
Indiana bat	1	5.03 (0.361–15.700)	12	0.07	no
northern long-eared bat	0	1.68 (0.002–8.432)	3	0.18	no
little brown bat	0	1.68 (0.002–8.432)	16	0.01	no

Table 18. Summary of the annual and cumulative take estimates from operational turbines for Covered Species at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1, 2021 to October 31, 2024.

Species	Annual take estimate (M^*_{2024})	Cumulative Take ($M^*_{2021\text{-}2024}$)	Permitted Take (T)	Projected Take Estimate ($M^*_{projected}$)	Long-Term Trigger Fires at α = 0.5?
Indiana bat (50th credible bound)	4.00	41.00	72.00	70.0	no
Northern long-eared bat (50th credible bound)	0	0	18.00	1.5	no
Little brown bat (50th credible bound)	0	5.00	96.00	9.5	no

4.2.1.4 Evidence of Absence Long-term Trigger

Cumulative take under the ITP to date, $M^*_{2021\text{-}2024}$, at α = 0.5 (50th credible bound), from operational turbines is estimated to be 41 Indiana bat fatalities, zero northern long-eared bat fatalities, and five little brown bat fatalities. The total take permitted by the ITP is 72 Indiana bat fatalities, 18 northern long-eared bat fatalities, and 96 little brown bat fatalities over the 6-year permit term. Annual take estimates for 2024 monitoring, M^*_{2024}, at α = 0.5 (50th credible bound), is estimated to be four Indiana bat fatalities, zero northern long-eared bat fatalities, and zero little brown bat fatalities (Table 18).

The estimated cumulative take to date, $M^*_{2021\text{-}2024}$ at α = 0.5 (50th credible bound), was below the total permitted take for all three Covered Species (Table 18). The long-term trigger was not met, and the HPREC is in compliance because $M^*_{2021\text{-}2024} < T$ for each species. Therefore, an avoidance response is not necessary.

4.2.1.5 Estimates of Take at Non-operational Turbines

Two Indiana bat carcasses were found at non-operational turbines, of which only one was found within a search plot. Based on only turbines that were monitored, the non-operational take estimate $M^*_{2024\ non\text{-}operational}$, at α = 0.5 (50th credible bound), was four Indiana bats.

4.3 Design Protocols – Future Monitoring

The HCP specifies a target detection probability (*g*) of 0.2 over the 6-year permit term. During the 2024 monitoring period the *g* was 0.3. The cumulative *g* from 2021–2024 is 0.22 (90% CrI: 0.20–0.24)

PCM efforts for 2025 will again target an overall *g* of 0.2 or greater, as required by the HCP. The following estimates from monitoring in 2024 were used to generate potential monitoring scenarios for 2025:

- SEEF of 0.4 on full plots by technicians, and 0.75 by dog teams
- SEEF of 0.9 on roads and pads by technicians
- CP of 3.6 days, using the CP distribution calculated from the summer technician model
- Area adjustment of 0.74 on full plots and 0.1 on roads and pads

Monitoring will occur in 2025 from April 1 – October 31 (unless amended) at all operational turbines. Below we describe potential monitoring approaches that are expected to achieve a *g* of 0.20 or higher, assuming the bias correction factors measured in 2024 remain consistent through 2025 (Table 19). The plans provided below are considered conservative because we used a conservative estimate of persistence times recorded during 2024 to generate the monitoring scenarios. SEEF and CPT will be completed in each season, and the preliminary results will be provided to the USFWS within seasonal reports.

Table 19. Projected probabilities of detection (*g*) for differing potential monitoring plans that may be implemented in 2025 at the High Prairie Renewable Energy Center. Potential plans that are projects to meet or exceed a *g* of 0.20 are highlighted in green.

Proportion of Plot Types			Search Frequency* (Number of Searches per week)		
Technician Full Plots	Dog Team Full Plots	Technician Road and Pads	2	3	5
0.17	0.47	0.36	0.20	0.33	0.37
0.20	0.40	0.40	0.27	0.30	0.35
0.20	0.30	0.50	0.23	0.26	0.30
0.20	0.20	0.60	0.19	0.22	0.25
0.20	0.10	0.70	0.15	0.17	0.20
0.30	0.10	0.60	0.18	0.20	0.23
0.40	0.10	0.50	0.20	0.22	0.26
0.64	0	0.36	0.21	0.24	0.28

5 SUMMARY AND DISCUSSION OF 2024 POST-CONSTRUCTION BAT FATALITY MONITORING AND NEXT STEPS

Monitoring during the 2024 season achieved a *g* of 0.3. No little brown bat or northern long-eared bat carcasses were found in 2024. Three Indiana bats were found in 2024, one of which was found at an operational turbine. Two Indiana bat carcasses were found during September at turbines that were not operating and had blade speeds slowed to one rpm or less. Take of Covered Species at the HPREC at non-operational turbines was not anticipated in the HCP, and monitoring in 2024 was not designed to estimate take at non-operational turbines.

The cumulative take estimates of Indiana bats from 2021–2024 ($M^*_{2021\text{-}2024}$) of 41 from operational turbines remain below the overall permitted take number, and were lower than the cumulative take estimate from 2021–2023 of 45. As the *g*-to-date continues to increase and become more precise with additional years of monitoring, carcass counts continue to remain low and, therefore, the take estimates have decreased after every year of monitoring. The estimated Indiana bat fatality rate was also lower than the short-term adaptive management trigger threshold.

Ameren intends to adjust the maternity colony adaptive management protocols based on the results of the 2024 (Schuyler County) and 2025 (Adair County) maternity colony monitoring (i.e., mist-net surveys, radio-telemetry, and emergence counts). The updated maternity colony adaptive management protocol will be designed in coordination with the USFWS and will be submitted to the USFWS in early 2025. Per USFWS request, Ameren will also summarize patterns in bat activity recorded at acoustic detectors in 2024 and will provide a supplemental report in early 2025.

6 REFERENCES

Burnham, K. P. and D. R. Anderson. 2002. Model Selection and Multimodel Inference: A Practical Information-Theoretic Approach. Second Edition. Springer, New York, New York.

Dalthorp, D. and M. Huso. 2015. A Framework for Decision Points to Trigger Adaptive Management Actions in Long-Term Incidental Take Permits. US Geological Survey Open-File Report 2015-1227. 88 pp. doi: 10.3133/ofr20151227. Available online: https://pubs.usgs.gov/of/2015/1227/ofr20151227.pdf

Dalthorp, D., M. M. P. Huso, and D. Dail. 2017. Evidence of Absence (V2.0) Software User Guide. US Geological Survey (USGS) Data Series 1055. USGS, Reston, Virginia. 109 pp. doi: 10.3133/ds1055. Available online: https://pubs.usgs.gov/ds/1055/ds1055.pdf

Dalthorp, D. H., L. Madsen, M. M. Huso, P. Rabie, R. Wolpert, J. Studyvin, J. Simonis, and J. M. Mintz. 2018. GenEst Statistical Models—a Generalized Estimator of Mortality. US Geological Survey (USGS) Techniques and Methods 7-A2. Chap. A2, 13 p. Available online: https://pubs.usgs.gov/tm/7a2/tm7a2.pdf

Helfers, F. 2017. The Nose Work Handler - Foundation to Finesse. Dogwise Publishing, Wenatchee, Washington. 144 pp.

Huso, M., N. Som, and L. Ladd. 2015. Fatality Estimator User's Guide. US Geological Survey (USGS) Data Series 729. Version 1.1. December 2015. Available online: http://pubs.usgs.gov/ds/729/pdf/ds729.pdf

Huso, M., D. Dalthorp, and F. Korner-Nievergelt. 2017. Statistical Principles of Post-Construction Fatality Monitoring Design. Pp. In: M. Perrow, ed. Wildlife and Wind Farms, Conflicts and Solutions. Pelagic Publishing, Exeter, United Kingdom. Vol. Volume 2, Onshore: Monitoring and Mitigation.

Kalbfleisch, J. D. and R. L. Prentice. 2002. The Statistical Analysis of Failure Time Data. John Wiley & Sons, Hoboken, New Jersey.

Kay, D. 2012. Super Sniffer Drill Book - a Workbook for Training Detector Dogs. Coveran Publishing House, 86 pp.

Missouri Department of Conservation (MDC). 2024. Missouri Species and Communities of Conservation Concern Checklist. Missouri Department of Conservation, Jefferson City, Missouri. January 2024.

Simonis, J., D. H. Dalthorp, M. M. Huso, J. M. Mintz, L. Madsen, P. Rabie, and J. Studyvin. 2018. Genest User Guide—Software for a Generalized Estimator of Mortality. U.S. Geological Survey Techniques and Methods. Chap. C19, 72 p. Available online: https://pubs.usgs.gov/tm/7c19/tm7c19.pdf

Stantec Consulting Services, Inc. (Stantec). 2021a. Final Habitat Conservation Plan for the High Prairie Renewable Energy Center. Prepared for Ameren Missouri, St. Louis, Missouri. Prepared by Stantec Consulting Services, Inc., Independence, Iowa. May 21, 2021.

Stantec Consulting Services, Inc. (Stantec). 2021b. 2021 Annual Post-construction Bat Mortality Monitoring Report, High Prairie Renewable Energy Center, Schuyler and Adair Counties, Missouri. Prepared for Ameren Missouri, St. Louis, Missouri. Prepared by Stantec Consulting Services, Inc., Independence, Iowa. December 15, 2021.

Stantec Consulting Services, Inc. (Stantec). 2022. 2022 Annual Post-construction Bat Mortality Monitoring Report, High Prairie Renewable Energy Center, Schuyler and Adair Counties, Missouri. Prepared for Ameren Missouri, St. Louis, Missouri. Prepared by Stantec Consulting Services, Inc., Independence, Iowa. December 15, 2022.

Stantec Consulting Services, Inc. (Stantec). 2023. 2023 Annual Post-construction Bat Mortality Monitoring Report, High Prairie Renewable Energy Center, Schuyler and Adair Counties, Missouri. Prepared for Ameren Missouri, St. Louis, Missouri. Prepared by Stantec Consulting Services, Inc., Independence, Iowa. December 13, 223.

US Department of Agriculture (USDA) Farm Production and Conservation Business Center (FPAC-BC). 2024. NAIP Public Image Services. USDA FPAC-BC, Washington, D.C. Created December 19, 2013. Updated May 30, 2024. Accessed December 2024. Available online: https://www.arcgis.com/home/item.html?id=0ecb05ec9e0540d3a201c4ef9d2aee88

Appendix A. Scientific Names of Covered Species and Bat Species Found during Post-construction Bat Fatality Monitoring at the High Prairie Renewable Energy Center, Schuyler and Adair Counties, Missouri, from April 1 to October 31, 2024.

Appendix A. Scientific names of Covered Species and bat species found during post-construction bat fatality monitoring at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Species	Scientific name
big brown bat	*Eptesicus fuscus*
eastern red bat	*Lasiurus borealis*
evening bat	*Nycticeius humeralis*
hoary bat	*Lasiurus cinereus*
Indiana bat[1]	*Myotis sodalis*
little brown bat[1]	*Myotis lucifugus*
northern long-eared bat[1]	*Myotis septentrionalis*
silver-haired bat	*Lasionycteris noctivagans*

[1] Indicates a Covered Species as defined in the Incidental Take Permit and Habitat Conservation Plan.

Appendix B. Details of All Bat Fatalities Found during Post-construction Bat Fatality Monitoring at the High Prairie Renewable Energy Center in Adair and Schuyler Counties, Missouri, from April 1 to October 31, 2024.

Appendix B. All bat fatalities found during post-construction bat fatality monitoring at the High Prairie Renewable Energy Center in Adair and Schuyler counties, Missouri, from April 1 to October 31, 2024.

Found Date	Species	Distance from Turbine (m)	Turbine	Search Type	Plot Type	Physical Condition	Aided Search[1]
04/01/2024	eastern red bat[2*]	50	A-09	carcass search	technician full plot	scavenged	no
04/29/2024	evening bat*	48	E-07	carcass search	n/a	scavenged	no
05/22/2024	evening bat*	0	F-04	incidental	n/a	injured	no
05/23/2024	big brown bat*	1	F-04	incidental	n/a	injured	no
05/27/2024	big brown bat	50	B-01	carcass search	detection-dog team full plot	scavenged	yes
05/28/2024	eastern red bat	36	B-08	carcass search	detection-dog team full plot	dismembered	yes
05/30/2024	hoary bat	56	B-10	carcass search	detection-dog team full plot	scavenged	yes
06/03/2024	unidentified bat	47	E-07	carcass search	detection-dog team full plot	dismembered	yes
06/10/2024	Indiana bat	11	H-01	carcass search	detection-dog team full plot	scavenged	yes
06/11/2024	eastern red bat	55	D-03	carcass search	detection-dog team full plot	scavenged	yes
06/11/2024	hoary bat	48	C-12	carcass search	detection-dog team full plot	scavenged	yes
07/02/2024	silver-haired bat	39	F-06	carcass search	detection-dog team full plot	scavenged	yes
07/03/2024	evening bat*	0	M-02	incidental	n/a	intact	no
07/16/2024	big brown bat	9	F-06	carcass search	detection-dog team full plot	scavenged	yes
07/23/2024	eastern red bat*	60	N-06	incidental	n/a	dismembered	no
08/06/2024	unidentified non-Myotis	44	B-07	carcass search	detection-dog team full plot	scavenged	yes
08/22/2024	hoary bat	39	D-12	carcass search	technician full plot	intact	no
08/28/2024	silver-haired bat*	51	E-01	carcass search	n/a	scavenged	yes
09/02/2024	eastern red bat*	31	C-10	carcass search	n/a	scavenged	yes
09/02/2024	eastern red bat*	27	D-03	carcass search	n/a	scavenged	yes
09/03/2024	eastern red bat*	53	B-08	carcass search	n/a	scavenged	yes
09/09/2024	big brown bat*	70[3]	C-10	carcass search	n/a	scavenged	yes
09/11/2024	Indiana bat*	69[3]	C-10	carcass search	n/a	scavenged	yes
09/12/2024	Indiana bat*	28	B-08	carcass search	n/a	scavenged	yes
09/20/2024	eastern red bat*	48	K-04	carcass search	n/a	intact	yes
10/03/2024	hoary bat*	44	E-04	carcass search	n/a	intact	no

1. Yes indicates a dog-aided search, no indicates a technician-only search.

2. Carcass found outside survey period.

3. Carcass found outside search area boundaries.

* Carcass excluded from the GenEst fatality estimates.

Appendix C. Searcher Efficiency, Carcass Persistence, and Area Adjustment Model Fitting Results at the High Prairie Renewable Energy Center in Adair and Schuyler Counties, Missouri, from April 1 to October 31, 2024.

Appendix C1. Searcher efficiency models for technicians (n = 126 carcasses) at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Covariates	*k* Value	AICc	Delta AICc
Plot Search Type	*k* fixed at 0.67	101.28	0*
Season + Plot Search Type	*k* fixed at 0.67	101.66	0.38
Season * Plot Search Type	*k* fixed at 0.67	105.18	3.90
No Covariates	*k* fixed at 0.67	163.78	62.50
Season	*k* fixed at 0.67	166.04	64.76

* Selected model

AICc = corrected Akaike Information Criterion

Delta AICc is the change from the minimum AICc

Appendix C2. Searcher efficiency models detection-dog teams (n = 41 carcasses) at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Covariates	*k* Value	AICc	Delta AICc
No Covariates	*k* fixed at 0.67	42.57	0*
Season	*k* fixed at 0.67	44.28	1.71

* Selected model

AICc = corrected Akaike Information Criterion

Delta AICc is the change from the minimum AICc

Appendix C3. Carcass persistence models with covariates and distributions for bats at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024 (n = 104).

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
Plot Search Type	Season	loglogistic	479.32	0
No Covariates	Season	loglogistic	480.00	0.68*
Plot Search Type	Season	lognormal	480.67	1.35
Plot Search Type	Season + Plot Search Type	loglogistic	480.82	1.50
No Covariates	Season	lognormal	480.92	1.60
No Covariates	Season + Plot Search Type	loglogistic	481.39	2.07
Plot Search Type	Season + Plot Search Type	lognormal	481.97	2.65
No Covariates	Season + Plot Search Type	lognormal	482.07	2.75
Season * Plot Search Type	Season * Plot Search Type	Weibull	482.38	3.06
Season * Plot Search Type	Season	loglogistic	482.57	3.25
Season * Plot Search Type	Season	lognormal	482.69	3.37
Season + Plot Search Type	Season	loglogistic	482.90	3.58
Plot Search Type	Season * Plot Search Type	loglogistic	483.10	3.78
Season * Plot Search Type	Season	Weibull	483.45	4.13
No Covariates	Season * Plot Search Type	loglogistic	483.48	4.16
Season	Season	loglogistic	483.50	4.18
Season + Plot Search Type	Season	lognormal	484.10	4.78
Season	Season	lognormal	484.11	4.79
No Covariates	Season * Plot Search Type	lognormal	484.15	4.83
Plot Search Type	Season * Plot Search Type	lognormal	484.46	5.14
Season * Plot Search Type	Season + Plot Search Type	loglogistic	484.48	5.16
Season * Plot Search Type	Season + Plot Search Type	lognormal	484.52	5.20

Appendix C3. Carcass persistence models with covariates and distributions for bats at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024 (n = 104).

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
Season + Plot Search Type	Season + Plot Search Type	loglogistic	484.63	5.31
Season	Season + Plot Search Type	loglogistic	485.16	5.84
Season	Season + Plot Search Type	lognormal	485.43	6.11
Season * Plot Search Type	Season + Plot Search Type	Weibull	485.51	6.19
Season + Plot Search Type	Season + Plot Search Type	lognormal	485.59	6.27
Season	Season * Plot Search Type	Weibull	485.90	6.58
Season + Plot Search Type	Season * Plot Search Type	Weibull	486.09	6.77
Season * Plot Search Type	Season * Plot Search Type	lognormal	486.57	7.25
Season + Plot Search Type	Season * Plot Search Type	loglogistic	486.71	7.39
No Covariates	No Covariates	loglogistic	486.82	7.50
No Covariates	Season * Plot Search Type	Weibull	486.88	7.56
Season * Plot Search Type	Season * Plot Search Type	loglogistic	486.96	7.64
Season + Plot Search Type	Season * Plot Search Type	lognormal	487.37	8.05
No Covariates	No Covariates	lognormal	487.45	8.13
Season	Season * Plot Search Type	loglogistic	487.47	8.15
Season	Season * Plot Search Type	lognormal	487.50	8.18
No Covariates	Plot Search Type	loglogistic	487.80	8.48
No Covariates	Season	Weibull	487.84	8.52
Plot Search Type	Season * Plot Search Type	Weibull	487.98	8.66
No Covariates	Plot Search Type	lognormal	488.23	8.91
No Covariates	Season + Plot Search Type	Weibull	488.64	9.32
Plot Search Type	No Covariates	loglogistic	488.74	9.42
Season	Season	Weibull	488.87	9.55
Plot Search Type	Season	Weibull	489.04	9.72
Plot Search Type	No Covariates	lognormal	489.52	10.20
Season	No Covariates	lognormal	489.72	10.40
Season + Plot Search Type	Season	Weibull	489.73	10.41
Plot Search Type	Plot Search Type	loglogistic	489.75	10.43
Plot Search Type	Season + Plot Search Type	Weibull	489.81	10.49
Season	No Covariates	loglogistic	489.86	10.54
Season	Season + Plot Search Type	Weibull	490.17	10.85
Plot Search Type	Plot Search Type	lognormal	490.31	10.99
Season	Plot Search Type	lognormal	490.94	11.62
Season	Plot Search Type	loglogistic	491.27	11.95
Season + Plot Search Type	Season + Plot Search Type	Weibull	491.48	12.16
Season * Plot Search Type	No Covariates	loglogistic	491.71	12.39
Season + Plot Search Type	No Covariates	loglogistic	491.85	12.53
Season + Plot Search Type	No Covariates	lognormal	491.89	12.57
Season * Plot Search Type	No Covariates	lognormal	491.95	12.63
Season	No Covariates	Weibull	492.41	13.09
Season * Plot Search Type	No Covariates	Weibull	492.49	13.17
Season * Plot Search Type	-	exponential	492.92	13.60
Season + Plot Search Type	Plot Search Type	lognormal	493.14	13.82
Season * Plot Search Type	Plot Search Type	loglogistic	493.18	13.86
Season + Plot Search Type	Plot Search Type	loglogistic	493.29	13.97
Season	Plot Search Type	Weibull	493.30	13.98
Season * Plot Search Type	Plot Search Type	lognormal	493.37	14.05
Season * Plot Search Type	Plot Search Type	Weibull	493.99	14.67
Season + Plot Search Type	No Covariates	Weibull	494.58	15.26
Season + Plot Search Type	Plot Search Type	Weibull	495.56	16.24
No Covariates	No Covariates	Weibull	495.81	16.49

Appendix C3. Carcass persistence models with covariates and distributions for bats at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024 (n = 104).

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
Season	-	exponential	496.05	16.73
No Covariates	Plot Search Type	Weibull	496.35	17.03
Plot Search Type	No Covariates	Weibull	497.72	18.40
Season + Plot Search Type	-	exponential	498.12	18.80
Plot Search Type	Plot Search Type	Weibull	498.50	19.18
No Covariates	-	exponential	504.67	25.35
Plot Search Type	-	exponential	506.28	26.96

* Selected model

AICc = corrected Akaike Information Criterion

Delta AICc is the change from the minimum AICc

Appendix C4. Carcass persistence models with covariates and distributions for bats, dog-aided, at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024 (n = 30).

Location Covariates	Scale Covariates	Distribution	AICc	Delta AICc
Season	No Covariates	Weibull	133.95	0*
Season	No Covariates	lognormal	135.47	1.52
Season	No Covariates	loglogistic	135.96	2.01
Season	Season	Weibull	136.56	2.61
Season	-	exponential	137.08	3.13
Season	Season	lognormal	138.10	4.15
No Covariates	No Covariates	Weibull	138.13	4.18
Season	Season	loglogistic	138.62	4.67
No Covariates	No Covariates	loglogistic	139.08	5.13
No Covariates	No Covariates	lognormal	139.22	5.27
No Covariates	Season	Weibull	140.61	6.66
No Covariates	Season	loglogistic	141.46	7.51
No Covariates	Season	lognormal	141.52	7.57
No Covariates	-	exponential	144.31	10.36

* Selected model

AICc = corrected Akaike Information Criterion

Delta AICc is the change from the minimum AICc

Appendix C5. Carcass persistence top models with covariates, distributions, and model parameters for the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Size Class	Season	Distribution	Predicted Median Removal Times (days)	Parameter 1	Parameter 2	Aided Search Type
bats	Fall	Weibull*	2.87	shape = 0.659	scale = 5.003	yes***
bats	Summer	Weibull*	14.39	shape = 0.659	scale = 25.103	yes***
bats	Fall	loglogistic**	3.65	shape = 0.489	scale = 1.296	none
bats	Spring	loglogistic**	3.65	shape = 1.043	scale = 1.296	none
bats	Summer	loglogistic**	3.65	shape = 0.721	scale = 1.296	none

* Parameterization follows the base R parameterization for this distribution.

** Parameterization follows the FAdist parameterization for this distribution.

*** dog-aided search.

Appendix D. Estimated Adjustment Factors, with 90% Confidence Intervals at Plot Types for Studies Conducted at the High Prairie Renewable Energy Center, Schuyler and Adair Counties, Missouri, from April 1 to October 31, 2024.

Appendix D1. Estimated adjustment factors, with 90% confidence intervals (CI) at technician road and pad plots for studies conducted at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024, at operational turbines.

Spring 50 turbines searched		Summer1 50 turbines searched		Summer2 75 turbines searched		Summer3 47 turbines searched		Summer4 48 turbines searched		Fall 48 turbines searched	
Estimate	**90% CI**	**Estimate**	**90% CI**	**Estimate**	**90% CI**	**Estimate**	**90% CI**	**Estimate**	**90% CI**	**Estimate**	**90% CI**
Search Area Adjustment											
0.11	–	0.11	–	0.11	–	0.11	–	0.11	–	0.11	–
Searcher Efficiency											
0.97	0.90–0.99	0.97	0.90–0.99	0.97	0.90–0.99	0.97	0.90–0.99	0.97	0.90–0.99	0.97	0.90–0.99
Average Probability of a Carcass Persisting Through the Search Interval*											
0.70	0.65–0.76	0.74	0.68–0.80	0.73	0.67–0.78	0.81	0.75–0.87	0.87	0.81–0.92	0.93	0.88–0.97
Probability of Available and Detected											
0.61	0.57–0.66	0.64	0.59–0.69	0.64	0.59–0.69	0.64	0.59–0.69	0.64	0.59–0.69	0.66	6.1–0.74

* The search interval was twice per week for Spring, Summer1, Summer2, and four times per week for Summer3, Summer4, and Fall.

Appendix D2. Estimated adjustment factors, with 90% confidence intervals (CI) at technician full plot plots for studies conducted at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024, at operational turbines.

Spring 50 turbines searched		Summer1 50 turbines searched		Summer2 75 turbines searched		Summer3 47 turbines searched		Summer4 48 turbines searched		Fall 48 turbines searched	
Estimate	**90% CI**	**Estimate**	**90% CI**	**Estimate**	**90% CI**	**Estimate**	**90% CI**	**Estimate**	**90% CI**	**Estimate**	**90% CI**
Search Area Adjustment											
0.74	–	0.74	–	0.74	–	0.74	–	0.74	–	0.74	–
Searcher Efficiency											
0.34	0.25–0.44	0.34	0.25–0.44	0.34	0.25–0.44	0.34	0.25–0.44	0.34	0.25–0.44	0.34	0.25–0.44
Average Probability of a Carcass Persisting Through the Search Interval*											
0.70	0.65–0.76	0.74	0.68–0.80	0.73	0.67–0.78	0.81	0.75–0.87	0.87	0.81–0.92	0.93	0.88–0.97
Probability of Available and Detected											
0.30	0.22–0.37	0.28	0.21–0.36	0.28	0.21–0.36	0.28	0.21–0.36	0.28	0.21–0.36	0.27	0.20–0.36

* The search interval was twice per week for Spring, Summer1, Summer2, and four times per week for Summer3, Summer4, and Fall.

Appendix D3. Estimated adjustment factors, with 90% confidence intervals (CI) at detection-dog team full plots for studies conducted at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from May 15 to October 31, 2024, at operational turbines.

Summer1 50 turbines searched		Summer2 75 turbines searched		Summer3 47 turbines searched		Summer4 48 turbines searched	
Estimate	**90% CI**	**Estimate**	**90% CI**	**Estimate**	**90% CI**	**Estimate**	**90% CI**
Search Area Adjustment							
0.74	–	0.74	–	0.74	–	0.74	–
Searcher Efficiency							
0.80	0.68–0.89	0.80	0.68–0.89	0.80	0.68–0.89	0.80	0.68–0.89
Average Probability of a Carcass Persisting Through the Search Interval*							
0.84	0.73–0.93	0.87	0.77–0.95	0.90	0.81–0.96	0.74	0.59–0.87
Probability of Available and Detected							
0.80	0.68–0.89	0.80	0.68–0.89	0.80	0.68–0.89	0.58	0.44–0.74

* The search interval was twice per week for Spring, Summer1, Summer2, and four times per week for Summer3, and Summer4.

Appendix E. Inputs for Single Class and Multiple Class Modules in Evidence of Absence at the High Prairie Renewable Energy Center in Adair and Schuyler Counties, Missouri, from April 1 to October 31, 2024.

Appendix E1. Inputs needed to run Evidence of Absence: Single Class Module for the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.[1]

Season	Plot Type[4]	Aided Search Type	Search Interval	Number of Searches (days)	Spatial Coverage (a)	Searcher Efficiency		Carcass Persistence[2,3]	
						Carcasses Available	Carcasses Found	Shape (α)	Scale (β)
Spring1	full plot	none	3.5	8	0.74	62	21	0.96	3.66
Spring1	road and pad	none	3.5	8	0.11	64	62	0.96	3.66
Summer1	full plot	dog	3.5	4	0.74	41	33	0.66	25.10
Summer1	full plot	none	3.5	4	0.74	62	21	1.39	3.66
Summer1	road and pad	none	3.5	4	0.11	64	62	1.39	3.66
Summer2	full plot	dog	3.5	4	0.74	41	33	0.66	25.10
Summer2	full plot	none	3.5	4	0.74	62	21	1.39	3.66
Summer2	road and pad	none	3.5	4	0.10	64	62	1.39	3.66
Summer2	unsearched	–	–	–	–	–	–	–	–
Summer3	full plot	dog	2.0	3	0.74	41	33	0.66	25.10
Summer3	full plot	none	2.0	3	0.74	62	21	1.39	3.66
Summer3	road and pad	none	2.0	3	0.10	64	62	1.39	3.66
Summer3	unsearched	–	–	–	–	–	–	–	–
Summer4	full plot	dog	2.0	30	0.74	41	33	0.66	25.10
Summer4	full plot	none	2.0	32	0.74	62	21	1.39	3.66
Summer4	road and pad	none	2.0	32	0.10	64	62	1.39	3.66
Fall1	full plot	dog	2.0	5	0.74	41	33	0.66	5.00
Fall1	full plot	none	2.0	5	0.74	62	21	2.05	3.66
Fall1	road and pad	none	2.0	5	0.10	64	62	2.05	3.66

1. The detection reduction factor *k* was assumed to equal 0.67 for all strata.

2. A loglogistic distribution was used for carcass persistence on technician searches. The 95% lower and upper confidence intervals (CIs) for technician searches are 2.907 and 4.591, respectively.

3. A Weibull distribution was used for carcass persistence on dog-aided searches. The 95% lower and upper CIs for dog-aided searches in summer are 9.718 and 64.78, respectively. The 95% lower and upper CIs for dog-aided searches in fall are 2.20 and 11.36, respectively.

4. Temporal coverage (v) was set to 1 across all strata. Seasonality of risk is accounted for in the Multiple Class Module.

Appendix E2. Inputs needed to run Evidence of Absence model to combine detection probability distributions across strata within subseasons: Multiple Class Module for the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Season	Plot Type	Aided Search Type	Number of Turbines	Weight (DWP)[1]	Ba[2]	Bb[2]	*g* (95% CrI)[3]
Spring1	full plot	none	35	0.70	34.85	117.39	0.23 (0.17–0.30)
Spring1	road and pad	none	15	0.30	5,018.64	60,468.73	0.08 (0.07–0.08)
Summer1	full plot	dog	20	0.40	76.14	63.73	0.54 (0.46–0.63)
Summer1	full plot	none	16	0.32	30.23	117.23	0.21 (0.14–0.27)
Summer1	road and pad	none	14	0.28	3,178.59	34,164.13	0.09 (0.08–0.09)
Summer2	full plot	dog	28	0.36	76.02	63.45	0.55 (0.46–0.63)
Summer2	full plot	none	25	0.32	30.22	117.00	0.21 (0.14–0.27)
Summer2	road and pad	none	22	0.28	3,205.76	38,265.03	0.08 (0.07–0.08)
Summer2	unsearched	–	3	0.04	0.01	1,000.00	0 (0–0)
Summer3	full plot	dog	15	0.31	99.57	77.03	0.56 (0.49–0.64)
Summer3	full plot	none	17	0.35	28.30	83.21	0.25 (0.18–0.34)
Summer3	road and pad	none	15	0.31	3,076.30	34,034.19	0.08 (0.08–0.09)
Summer3	unsearched	–	1	0.02	0.01	1,000.00	0 (0–0)
Summer4	full plot	dog	15	0.31	137.16	87.54	0.61 (0.55–0.67)
Summer4	full plot	none	18	0.38	34.50	77.78	0.31 (0.23–0.40)
Summer4	road and pad	none	15	0.31	5,419.70	59,451.26	0.08 (0.08–0.09)
Fall1	full plot	dog	15	0.31	44.04	51.18	0.46 (0.36–0.56)
Fall1	full plot	none	18	0.38	29.65	74.96	0.28 (0.20–0.37)
Fall1	road and pad	none	15	0.31	4,683.35	47,425.21	0.09 (0.09–0.09)

1. The density-weighted proportion (DWP) is the fraction of carcasses expected within the stratum
2. Ba and Bb are the α and β parameters of a beta distribution describing the detection probability distribution
3. CrI = Credible Interval

Appendix E3. Weights used to combine detection probability distributions across strata within subseasons: Multiple Class Module for the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Season	Plot Type	Aided Search Type	Sampling Weight	Weight (DWP)[1]
Spring1	full plot	none	0.70	0.70
Spring1	road and pad	none	0.30	0.30
Summer1	full plot	dog	0.40	0.40
Summer1	full plot	none	0.32	0.32
Summer1	road and pad	none	0.28	0.28
Summer2	full plot	dog	0.36	0.36
Summer2	full plot	none	0.32	0.32
Summer2	road and pad	none	0.28	0.28
Summer2	unsearched	–	0.04	0.04
Summer3	full plot	dog	0.31	0.31
Summer3	full plot	none	0.35	0.35
Summer3	road and pad	none	0.31	0.31
Summer3	unsearched	–	0.02	0.02
Summer4	full plot	dog	0.31	0.31
Summer4	full plot	none	0.38	0.38
Summer4	road and pad	none	0.31	0.31
Fall1	full plot	dog	0.31	0.31
Fall1	full plot	none	0.38	0.38
Fall1	road and pad	none	0.31	0.31

1. The density-weighted proportion (DWP) is the fraction of carcasses expected within the stratum.

Appendix E4. Weights used to combine detection probability distributions across subseasons within seasons: Multiple Class Module for the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Season	Arrival Weight	Turbine Risk Weight	Weight (DWP)[1]
Summer1	0.11	0.29	0.14
Summer2	0.12	0.45	0.24
Summer3	0.05	0.28	0.07
Summer4	0.44	0.28	0.55

1. The density-weighted proportion (DWP) is the fraction of carcasses expected within the stratum.

Appendix E5. Inputs needed to run Evidence of Absence model to combine detection probability distributions across subseasons within seasons: Multiple Class Module for the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Season	Weight (DWP)[1]	Ba[2]	Bb[2]	*g* (95% CrI)[3]
Summer1	0.14	162.43	362.63	0.31 (0.27–0.35)
Summer2	0.24	165.17	413.30	0.29 (0.25–0.32)
Summer3	0.07	163.46	395.02	0.29 (0.26–0.33)
Summer4	0.55	192.26	385.16	0.33 (0.30–0.37)

1. The density-weighted proportion (DWP) is the fraction of carcasses expected within the stratum

2. Ba and Bb are the α and β parameters of a beta distribution describing the detection probability distribution

3. CrI = Credible Interval

Appendix E6. Weights used to combine detection probability distributions across seasons within the study period: Multiple Class Module for the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Season	Arrival Weight	Weight (DWP)[1]
Spring	0.10	0.10
Summer	0.84	0.84
Fall	0.06	0.06

1. The density-weighted proportion (DWP) is the fraction of carcasses expected within the stratum.

Appendix E7. Inputs needed to run Evidence of Absence model to combine detection probability distributions across seasons within the study period: Multiple Class Module for the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Season	Weight (DWP)[1]	Ba[2]	Bb[2]	*g* (95% CrI)[3]
Spring	0.10	48.19	196.03	0.20 (0.15–0.25)
Summer	0.83	462.65	1003.07	0.32 (0.29–0.34)
Fall	0.07	106.52	257.45	0.29 (0.25–0.34)

1. The density-weighted proportion (DWP) is the fraction of carcasses expected within the stratum

2. Ba and Bb are the α and β parameters of a beta distribution describing the detection probability distribution

3. CrI = Credible Interval

Appendix E8. Inputs needed to run Evidence of Absence: Single Class Module for the non-operational take estimates at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.[1]

						Searcher Efficiency		Carcass Persistence[2,3]	
Season	Plot Type[4]	Aided Search Type	Search Interval	Number of Searches	Spatial Coverage (a)	Carcasses Available	Carcasses Found	Shape (α)	Scale (β)
Spring 2	full plot	none	3.5	5	0.74	62	21	0.96	3.66
Spring 2	road and pad	none	3.5	5	0.11	64	62	0.96	3.66
Fall 2	full plot	dog	1.5	11	0.74	41	33	0.66	5.00
Fall 2	full plot	none	1.5	11	0.74	62	21	2.05	3.66
Fall 2	road and pad	none	1.5	12	0.10	64	62	2.05	3.66
Fall 3	full plot	dog	3.5	8	0.74	41	33	0.66	5.00
Fall 3	full plot	none	3.5	9	0.74	62	21	2.05	3.66
Fall 3	road and pad	none	3.5	9	0.10	64	62	2.05	3.66

1. The detection reduction factor *k* was assumed to equal 0.67 for all strata.

2. A loglogistic distribution was used for carcass persistence on technician searches. The 95% lower and upper confidence intervals (CIs) for technician searches are 2.907 and 4.591, respectively.

3. A Weibull distribution was used for carcass persistence on dog-aided searches. 95% lower and upper CIs for dog-aided searches in fall are 2.20 and 11.36, respectively.

4. Temporal coverage (v) was set to 1 across all strata. Seasonality of risk is accounted for in the Multiple Class Module.

Appendix E9. Inputs needed to run Evidence of Absence model to combine detection probability distributions across strata within subseasons: Multiple Class Module for the non-operational take estimates at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Season	Plot Type	Aided Search Type	Number of Turbines	Weight (DWP)[1]	Ba[2]	Bb[2]	*g* (95% CrI)[3]
Spring 2	full plot	none	35	0.70	31.43	107.95	0.23 (0.16 - 0.30)
Spring 2	road and pad	none	15	0.30	839.74	10142.39	0.08 (0.07 - 0.08)
Fall 2	full plot	dog	15	0.31	55.36	55.26	0.50 (0.41 - 0.59)
Fall 2	full plot	none	18	0.38	30.93	58.15	0.35 (0.25 - 0.45)
Fall 2	road and pad	none	15	0.31	3128.30	29757.97	0.10 (0.09 - 0.10)
Fall 3	full plot	dog	15	0.31	28.53	42.22	0.40 (0.29 - 0.52)
Fall 3	full plot	none	18	0.38	27.16	84.14	0.24 (0.17 - 0.33)
Fall 3	road and pad	none	15	0.31	411.11	4799.90	0.08 (0.07 - 0.09)

1. The density-weighted proportion (DWP) is the fraction of carcasses expected within the stratum

2. Ba and Bb are the α and β parameters of a beta distribution describing the detection probability distribution

3. CrI = Credible Interval

Appendix E10. Weights used to combine detection probability distributions across strata within subseasons: Multiple Class Module for the non-operational take estimates at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Season	Plot Type	Aided Search Type	Sampling Weight	Weight (DWP)[1]
Spring 2	full plot	none	0.70	0.70
Spring 2	road and pad	none	0.30	0.30
Fall 2	full plot	dog	0.31	0.31
Fall 2	full plot	none	0.38	0.38
Fall 2	road and pad	none	0.31	0.31
Fall 3	full plot	dog	0.31	0.31
Fall 3	full plot	none	0.38	0.38
Fall 3	road and pad	none	0.31	0.31

1. The density-weighted proportion (DWP) is the fraction of carcasses expected within the stratum.

Appendix E11. Weights used to combine detection probability distributions across subseasons within seasons: Multiple Class Module for the non-operational take estimates at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Season	Arrival Weight	Turbine Risk Weight	Weight (DWP)[1]
Fall 2	0.32	0.28	0.42
Fall 3	0.44	0.28	0.58

1. The density-weighted proportion (DWP) is the fraction of carcasses expected within the stratum.

Appendix E12. Inputs needed to run Evidence of Absence model to combine detection probability distributions across subseasons within seasons: Multiple Class Module for the non-operational take estimates at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

Season	Weight (DWP)[1]	Ba[2]	Bb[2]	*g* (95% CrI)[3]
Fall 2	0.42	119.11	257.43	0.32 (0.27 - 0.36)
Fall 3	0.58	79.14	247.66	0.24 (0.20 - 0.29)

1. The density-weighted proportion (DWP) is the fraction of carcasses expected within the stratum

2. Ba and Bb are the α and β parameters of a beta distribution describing the detection probability distribution

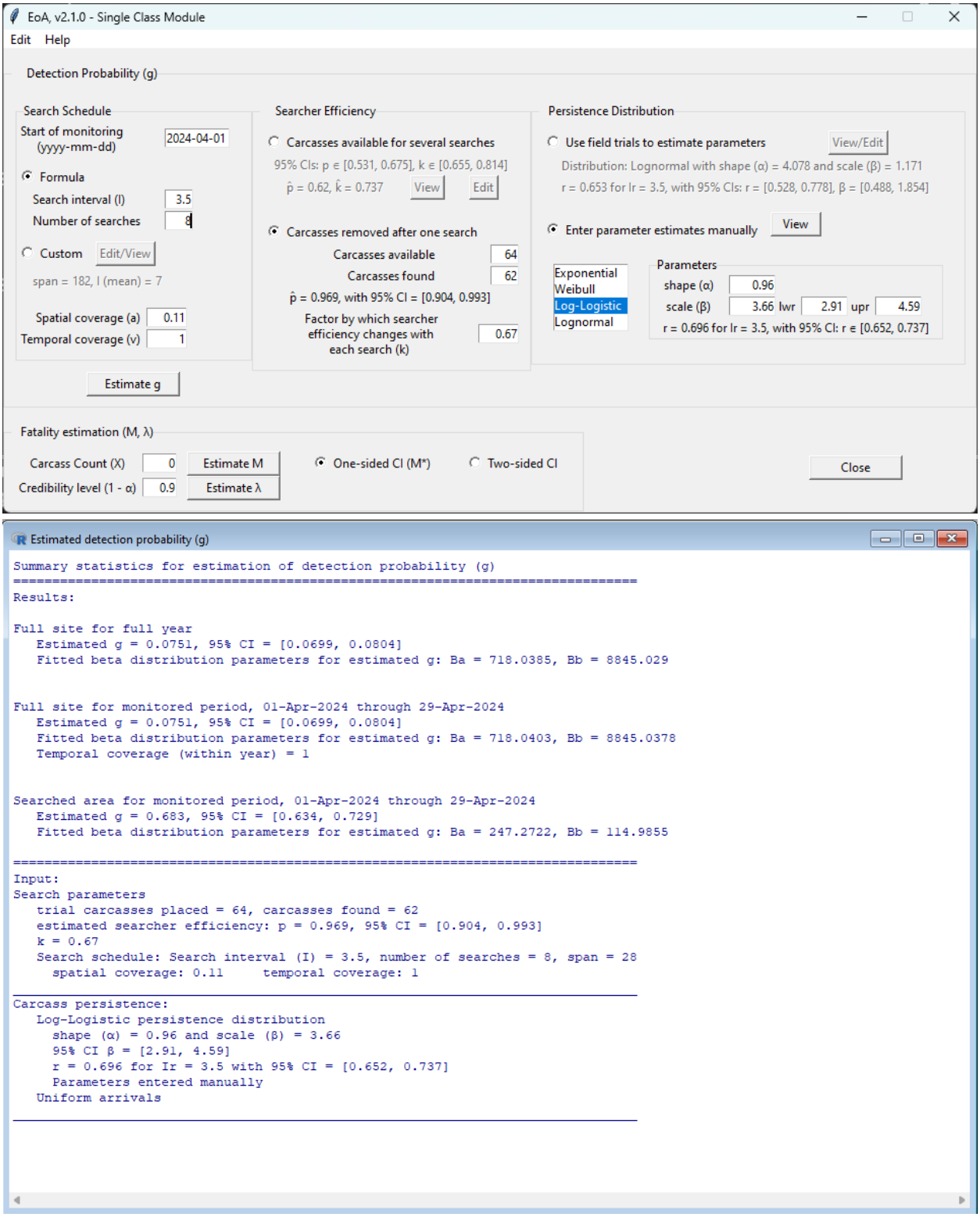
3. CrI = Credible Interval

Appendix E13. Weights used to combine detection probability distributions across seasons within the study period: Multiple Class Module for the non-operational take estimates at the High Prairie Renewable Energy Center, Schuyler and Adair counties, Missouri, from April 1 to October 31, 2024.

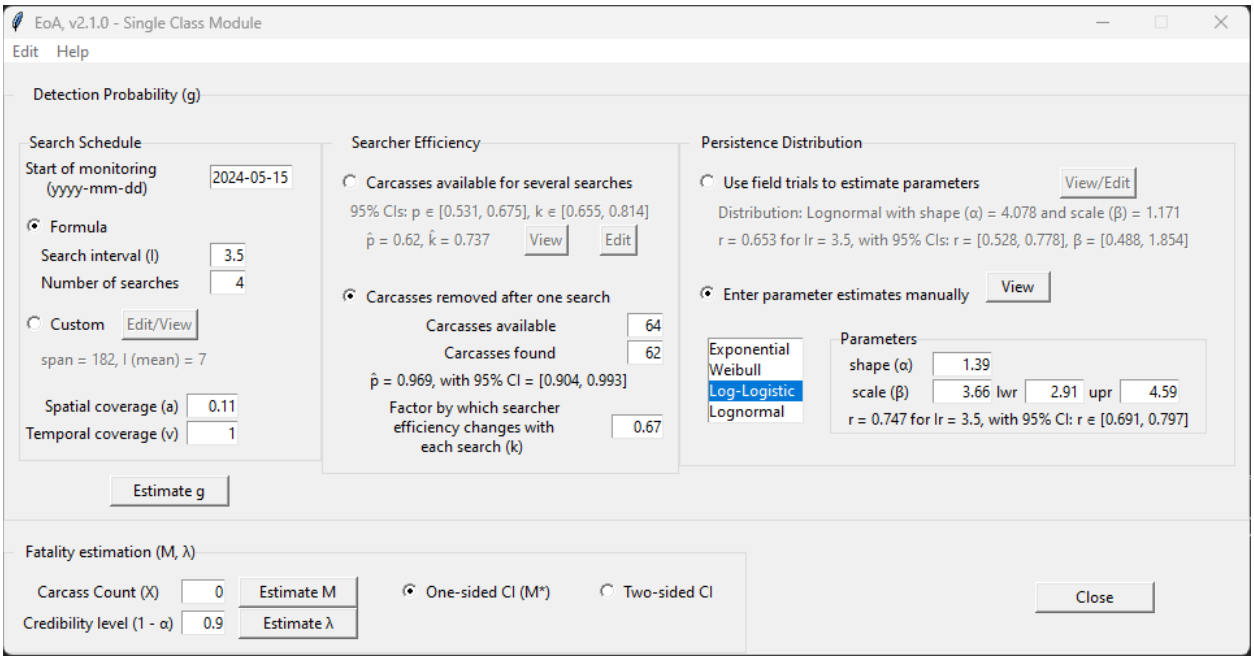
Season	Arrival Weight	Weight (DWP)[1]
Spring	0.14	0.14
Fall	0.86	0.86

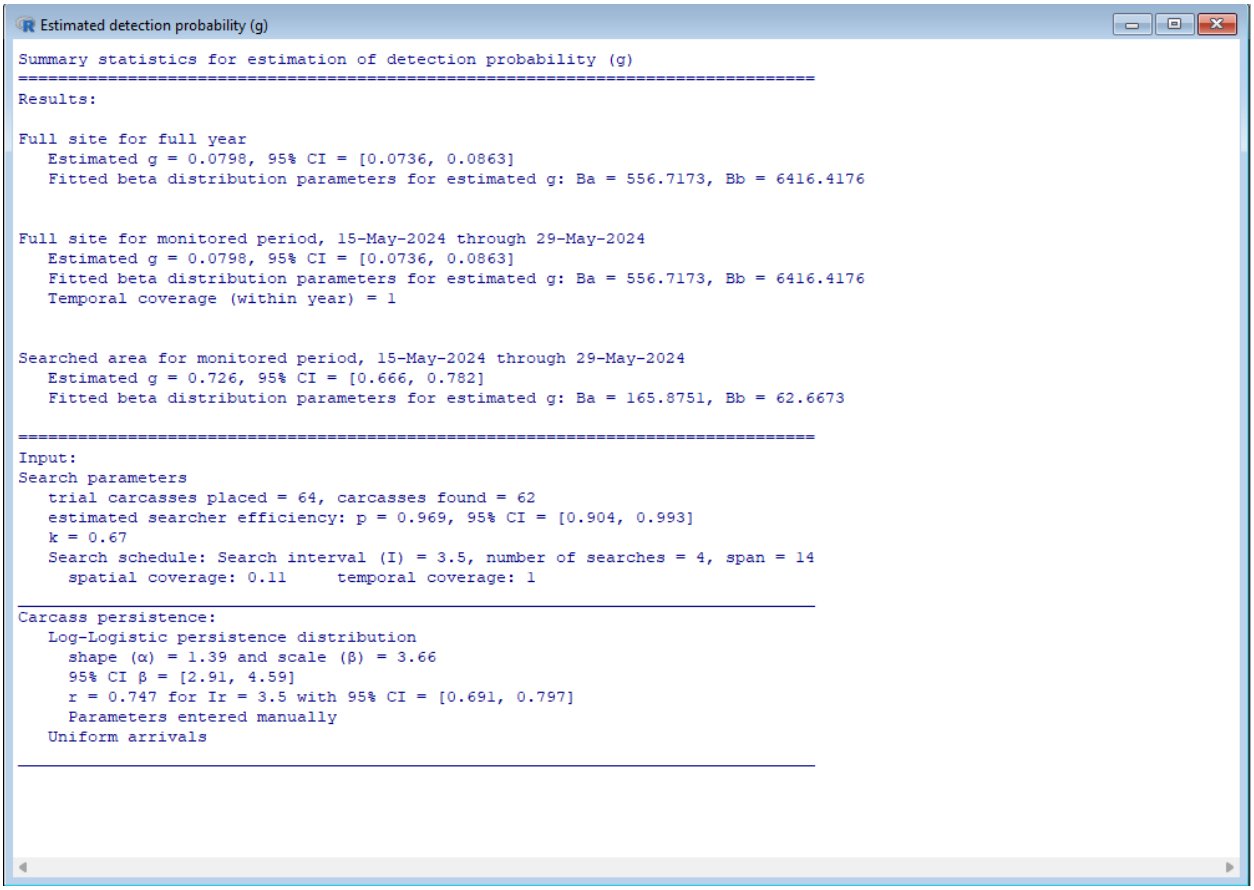
1. The density-weighted proportion (DWP) is the fraction of carcasses expected within the stratum.

Appendix F. Evidence of Absence Screenshots

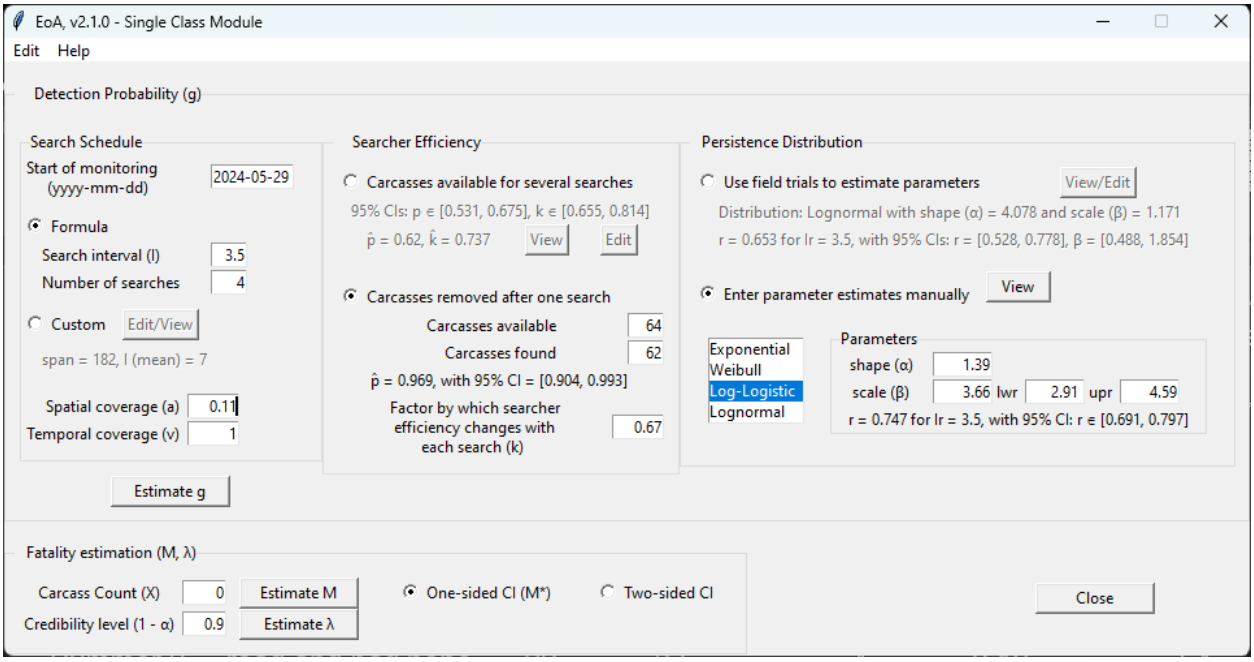


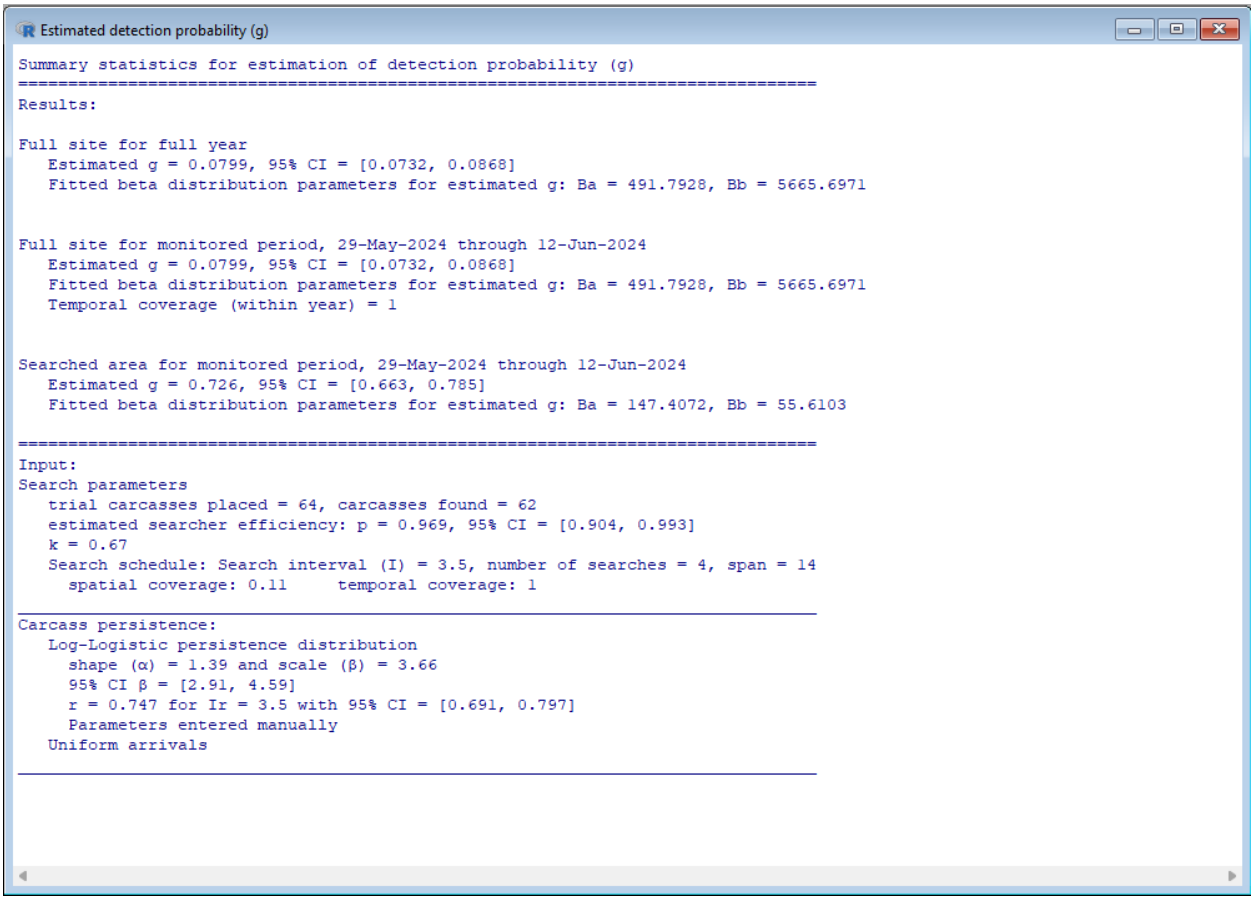
Appendix F1. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for operational Spring 2024 95-meter road and pad searches at 15 turbines, searched at a 3.5-day interval.



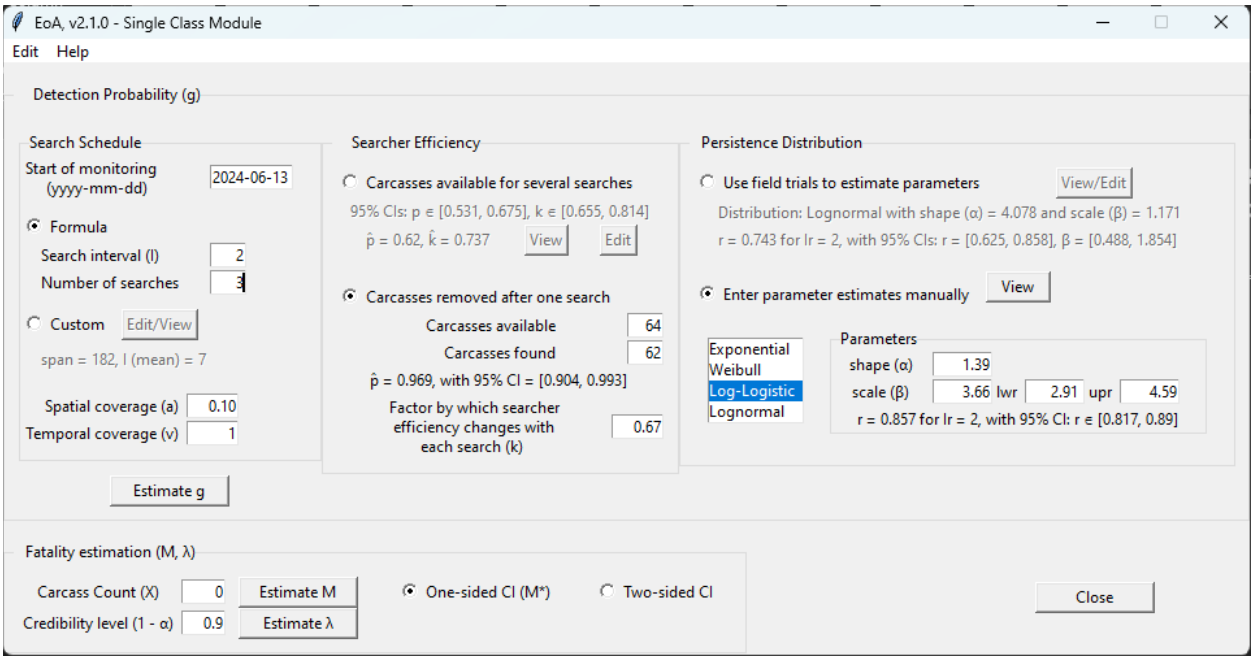


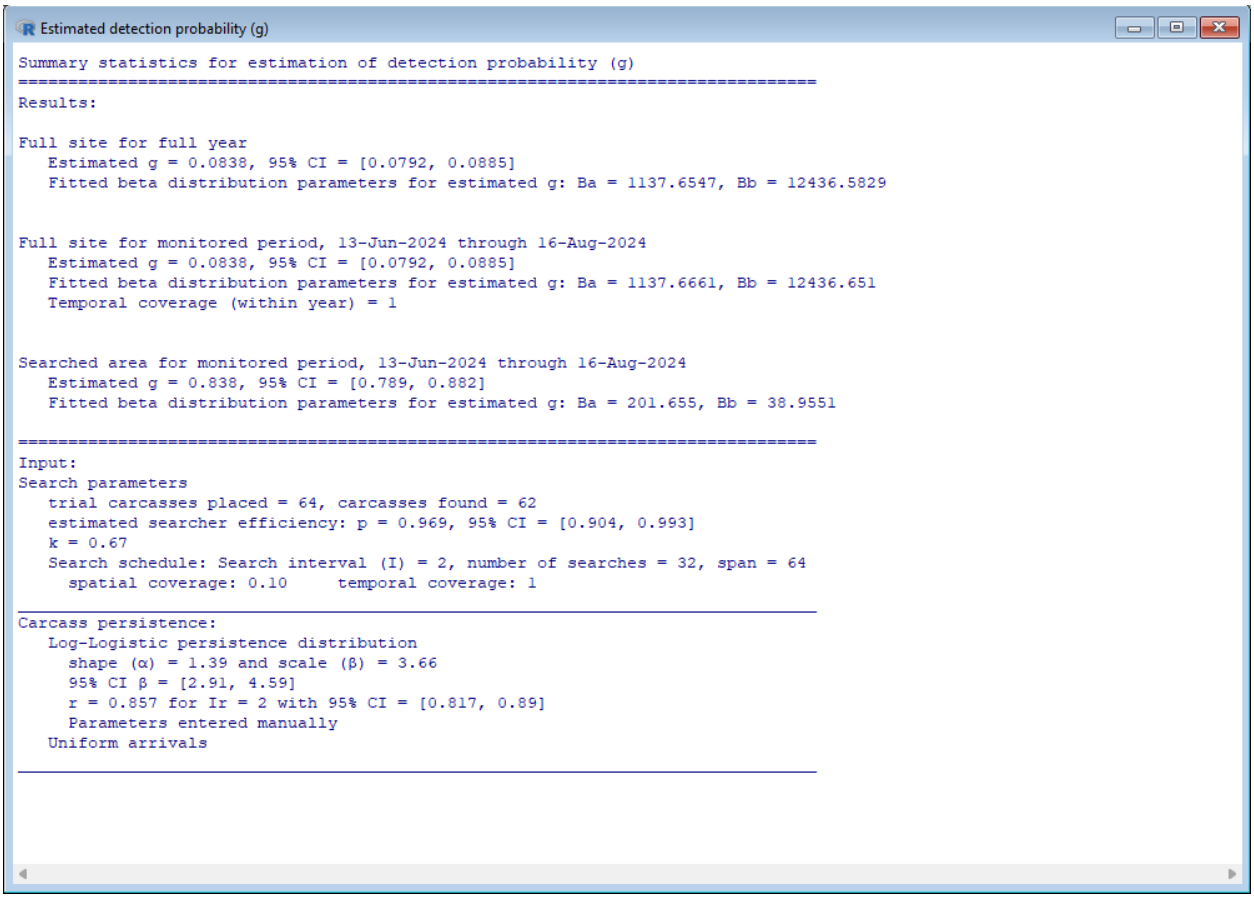
Appendix F2. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for Summer1 2024 95-meter road and pad searches at 14 turbines, searched at a 3.5-day interval.



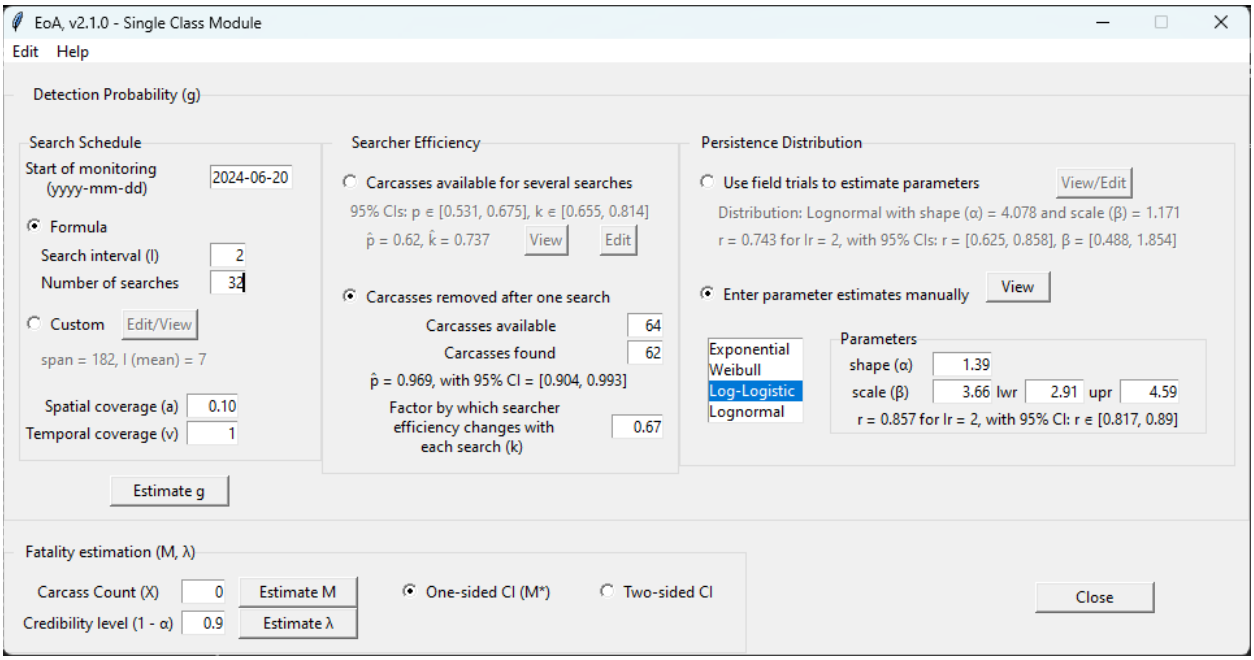


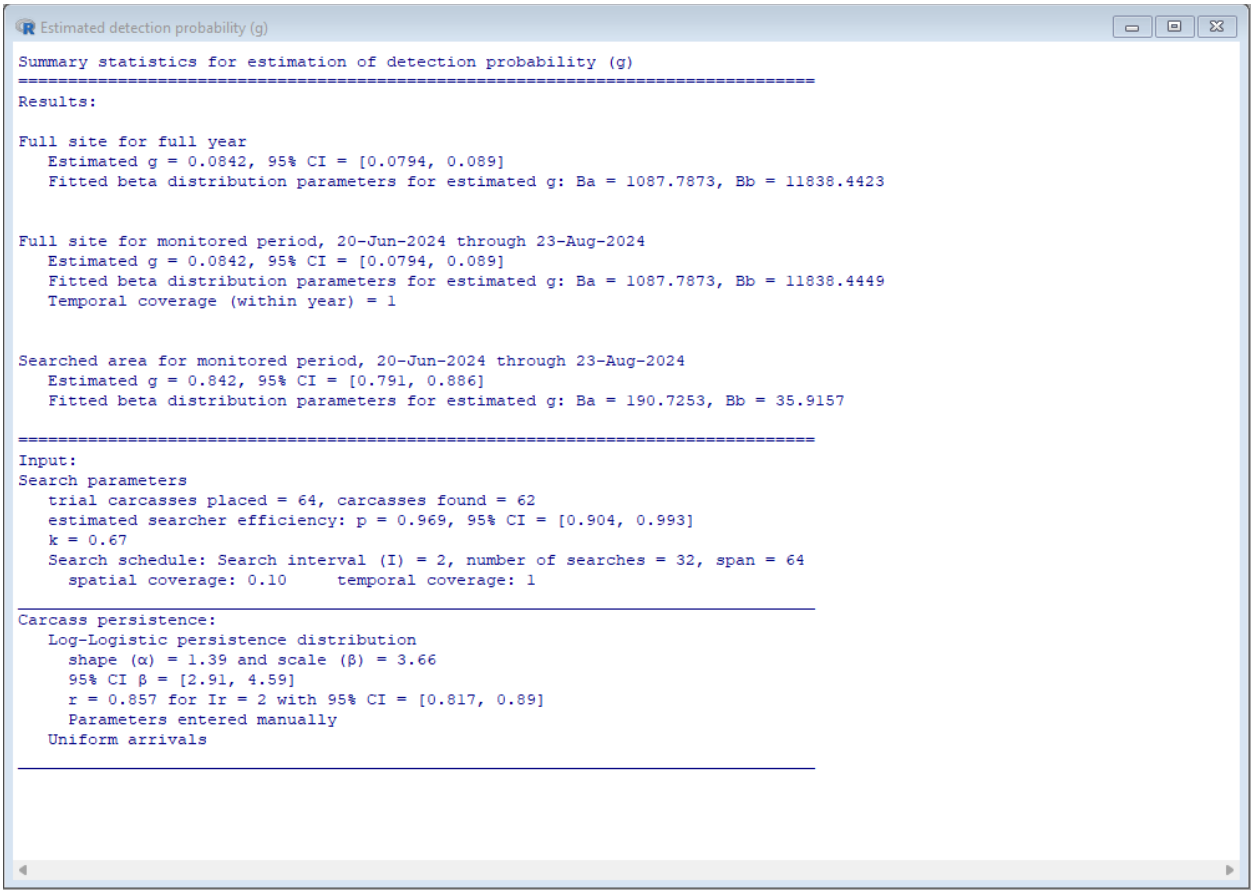
Appendix F3. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for Summer2 2024 95-meter road and pad searches at 22 turbines, searched at a 3.5-day interval.



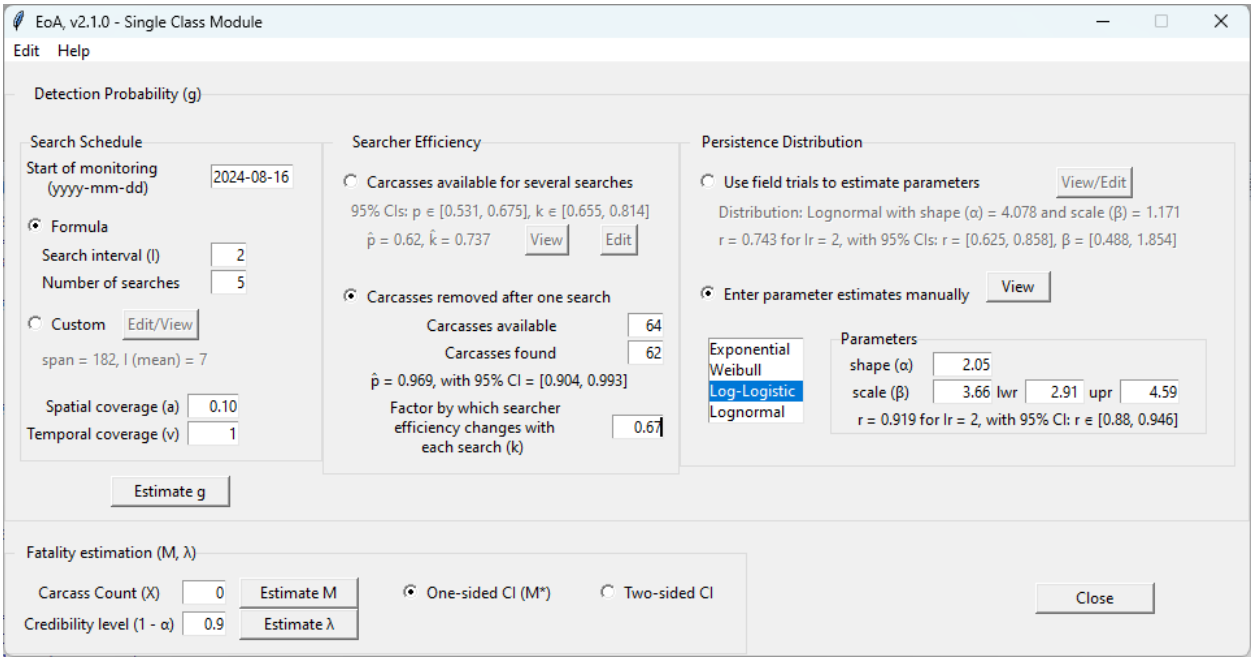


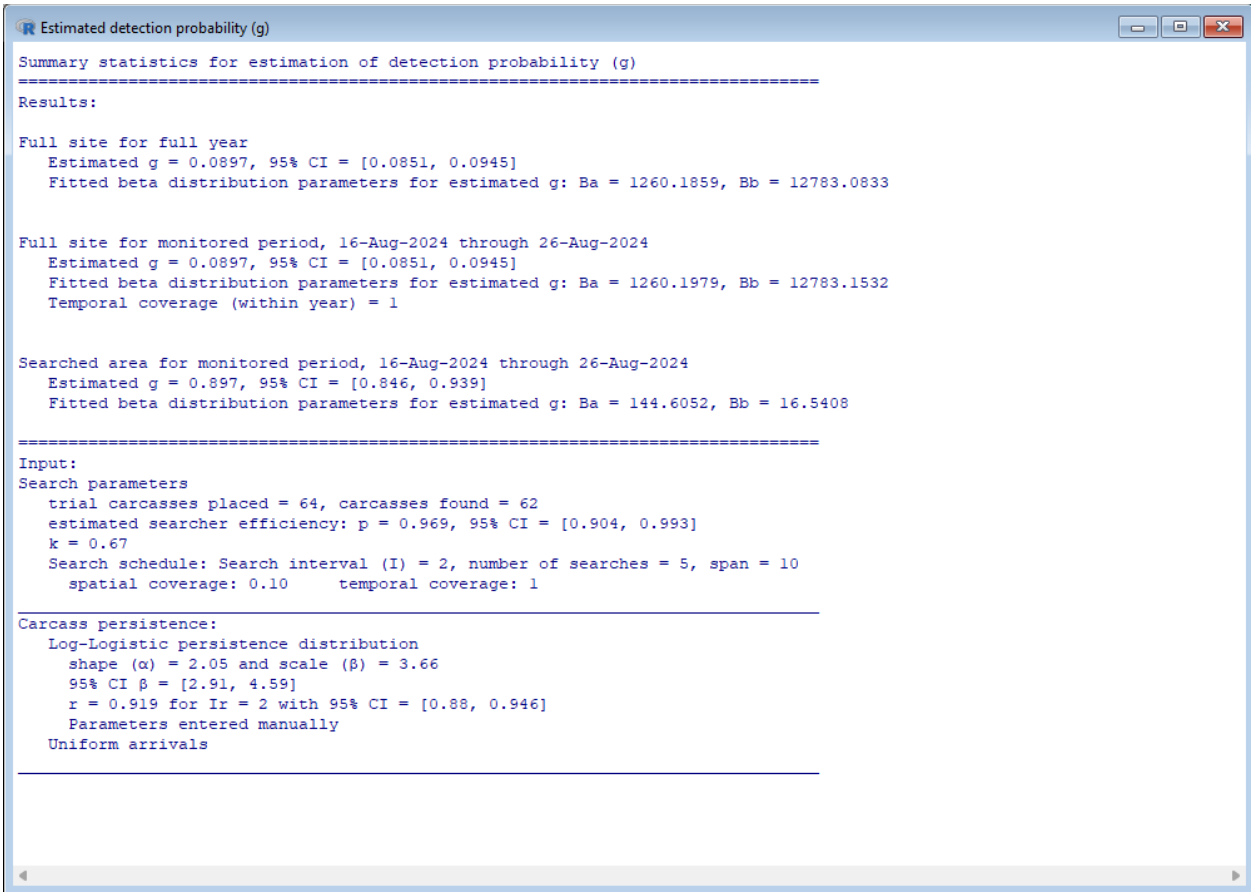
Appendix F4. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for Summer3 2024 95-meter road and pad searches at 15 turbines, searched at a 2-day interval.



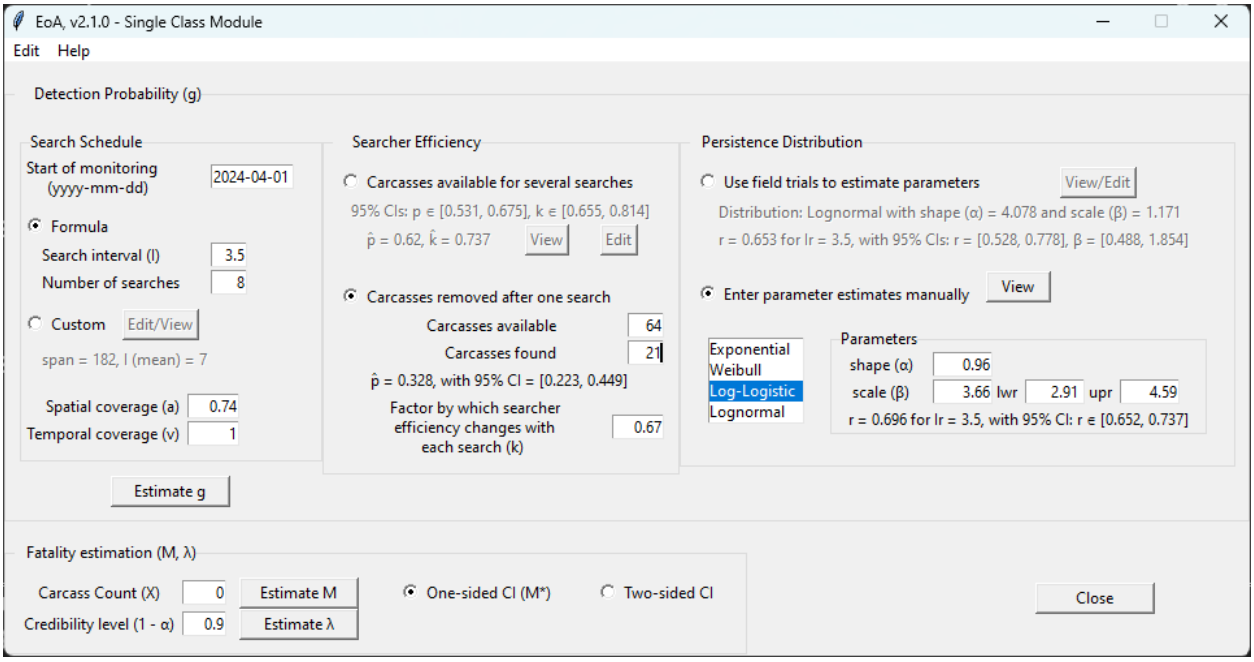


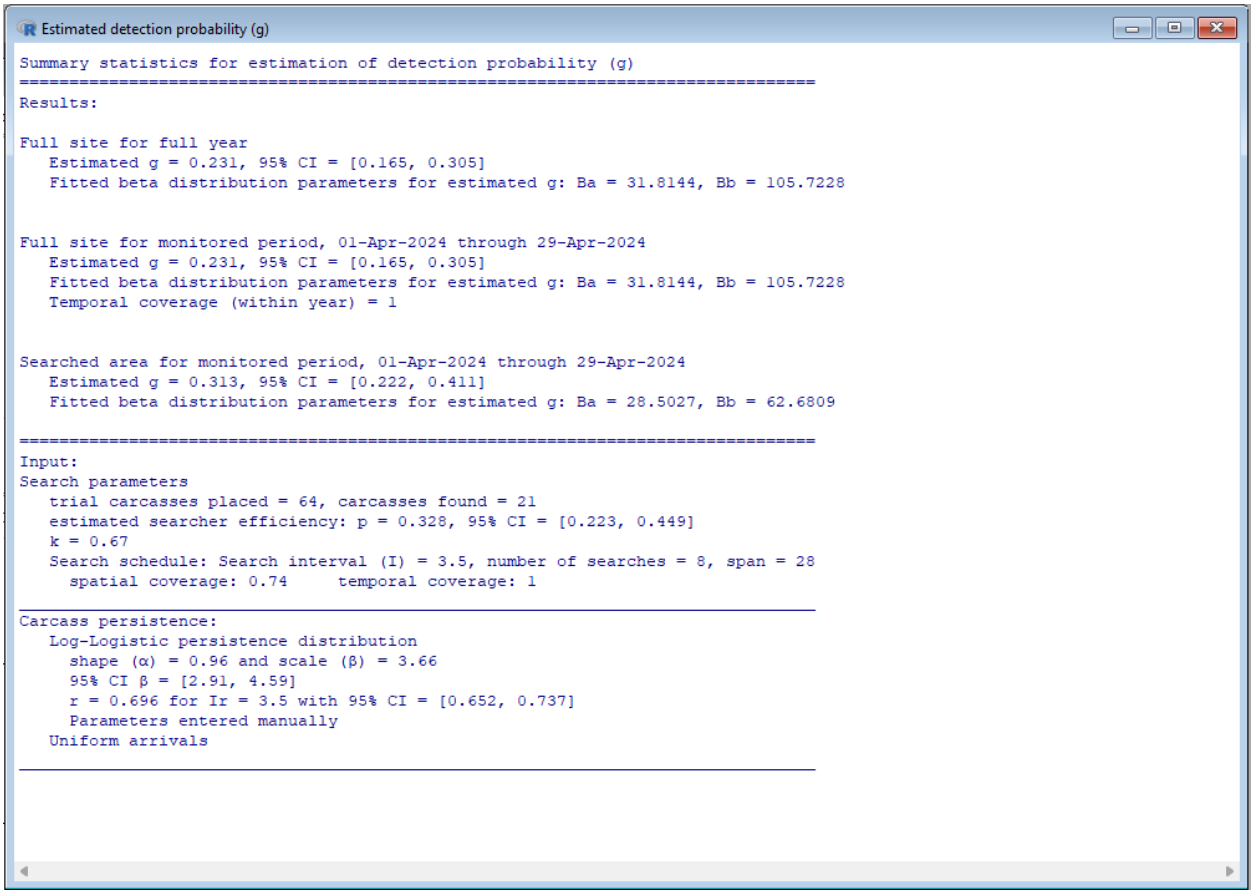
Appendix F5. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for Summer4 2024 95-meter road and pad searches at 15 turbines, searched at a 2-day interval.



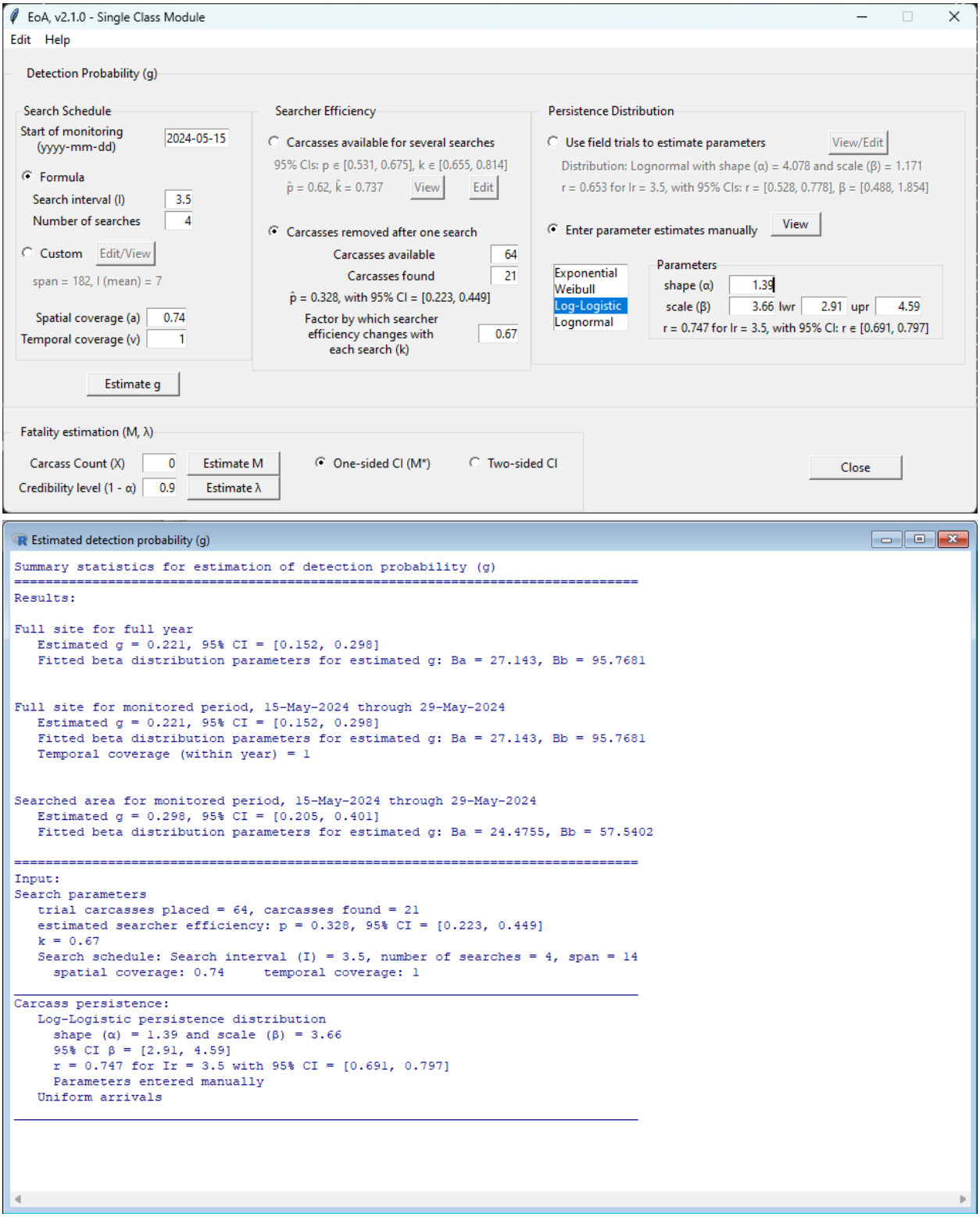


Appendix F6. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for Fall1 2024 95-meter road and pad searches at 15 turbines, searched at a 2-day interval.

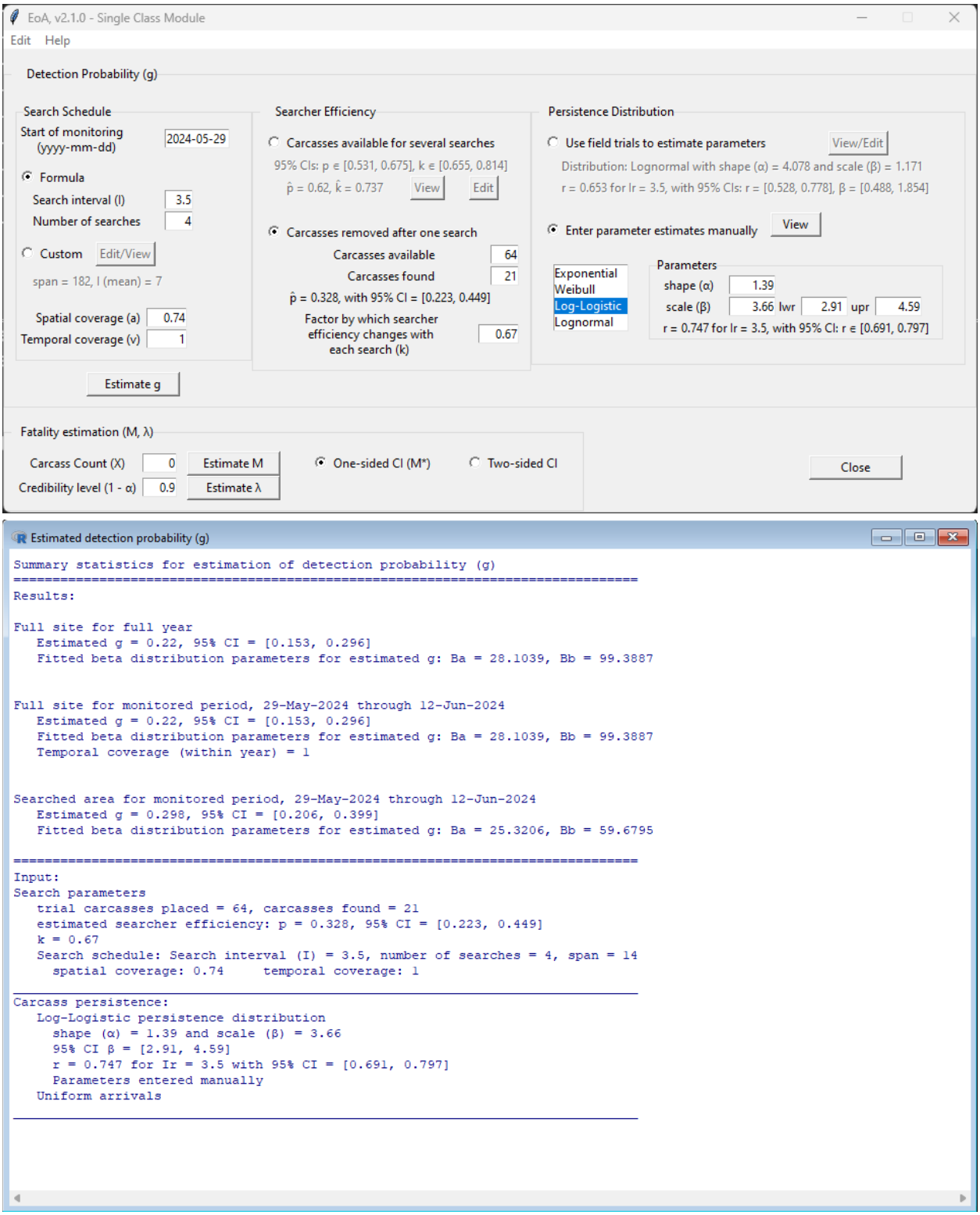




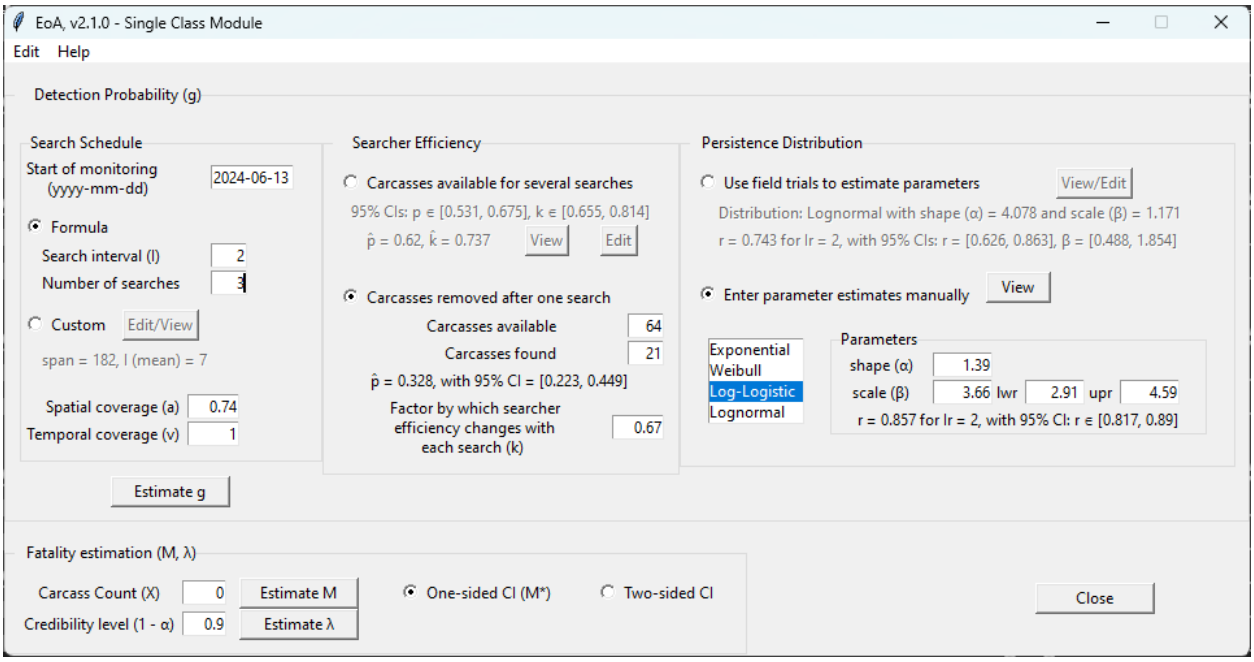
Appendix F7. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for Spring1 2024 60-meter full plot technician searches at 35 turbines, searched at a 3.5-day interval.

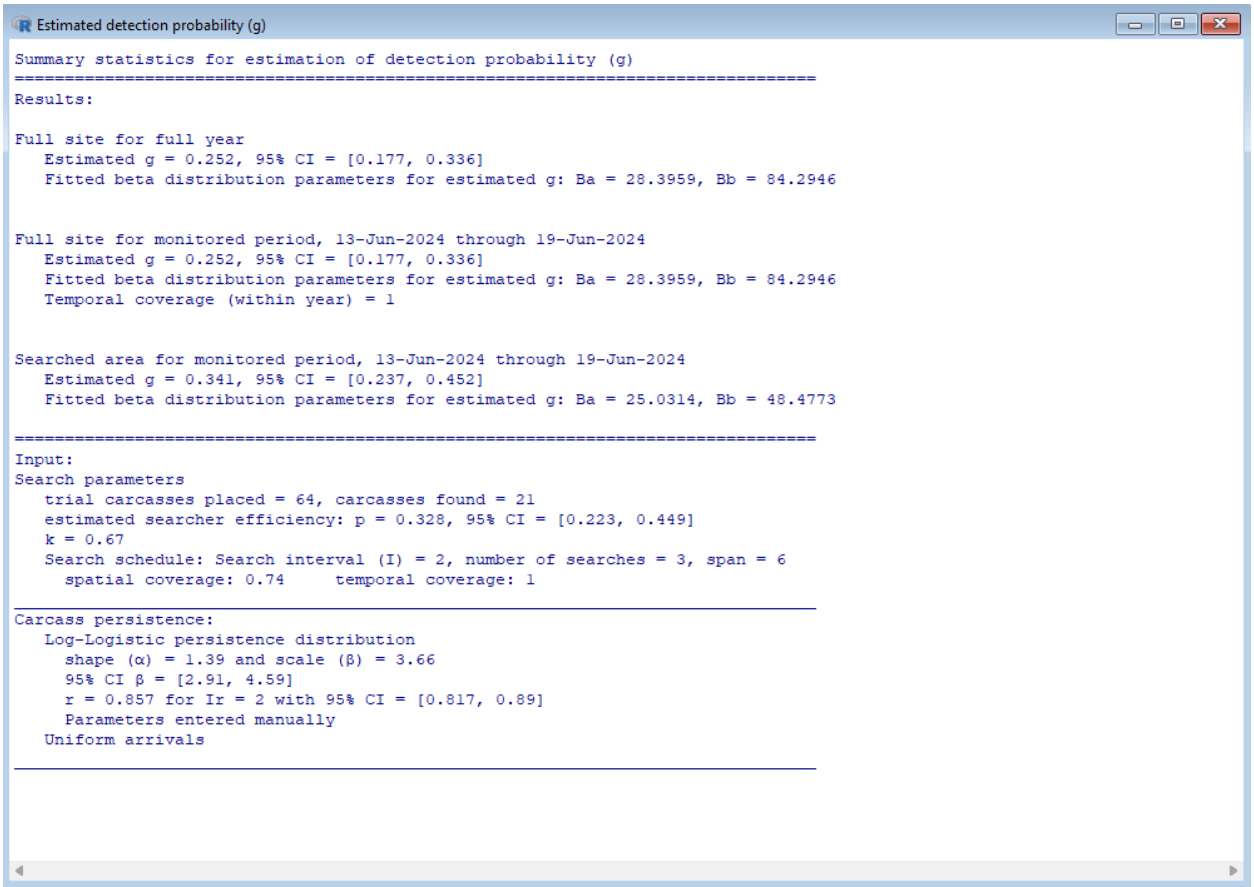


Appendix F8. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for Summer1 2024 60-meter full plot technician searches at 16 turbines, searched at a 3.5-day interval.

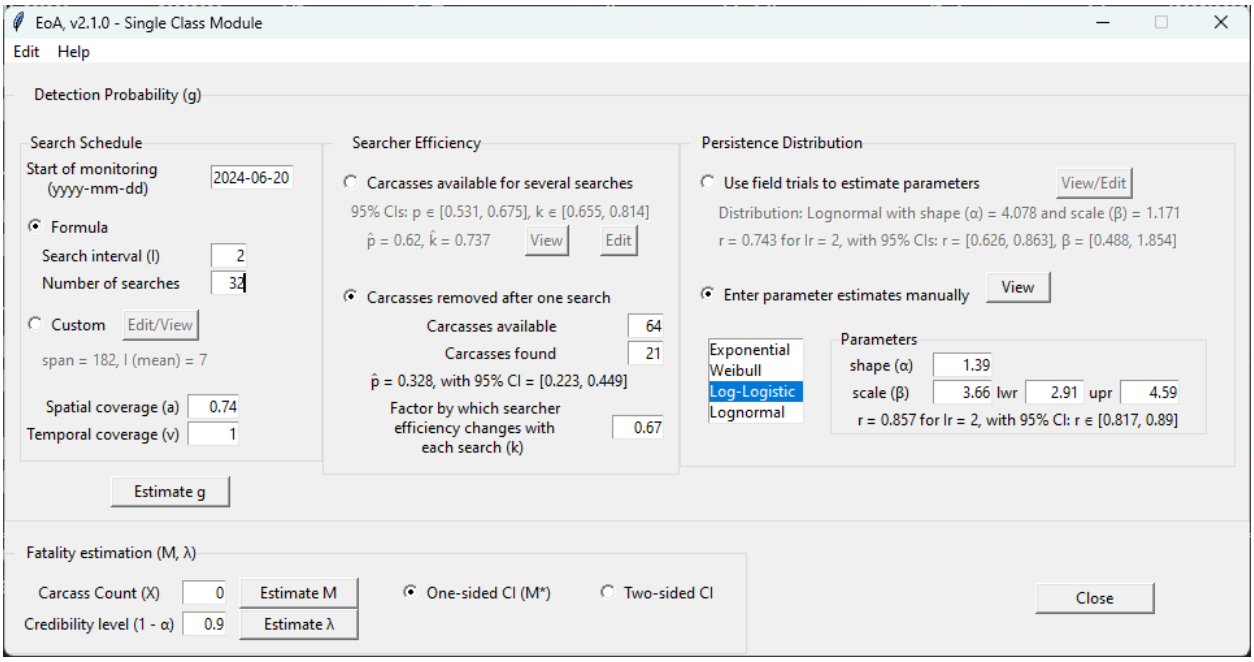


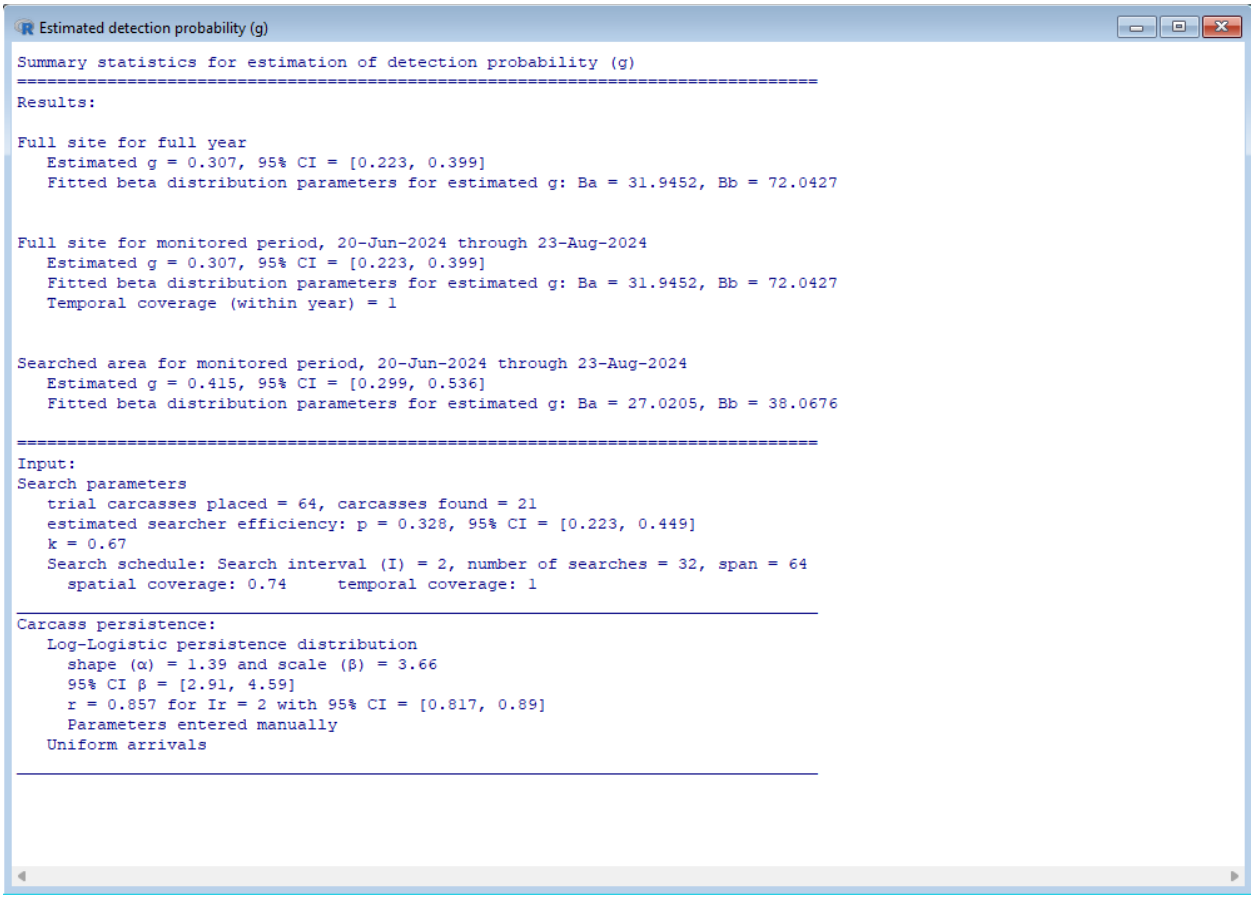
Appendix F9. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for Summer2 2024 60-meter full plot technician searches at 25 turbines, searched at a 3.5-day interval.



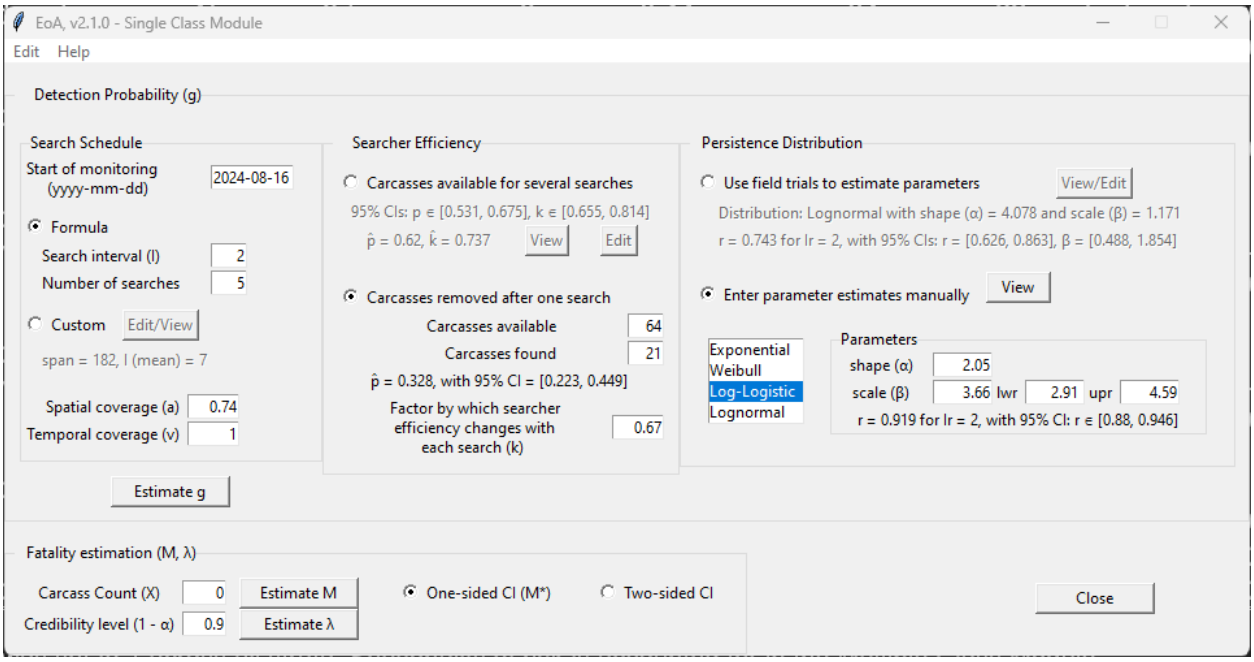


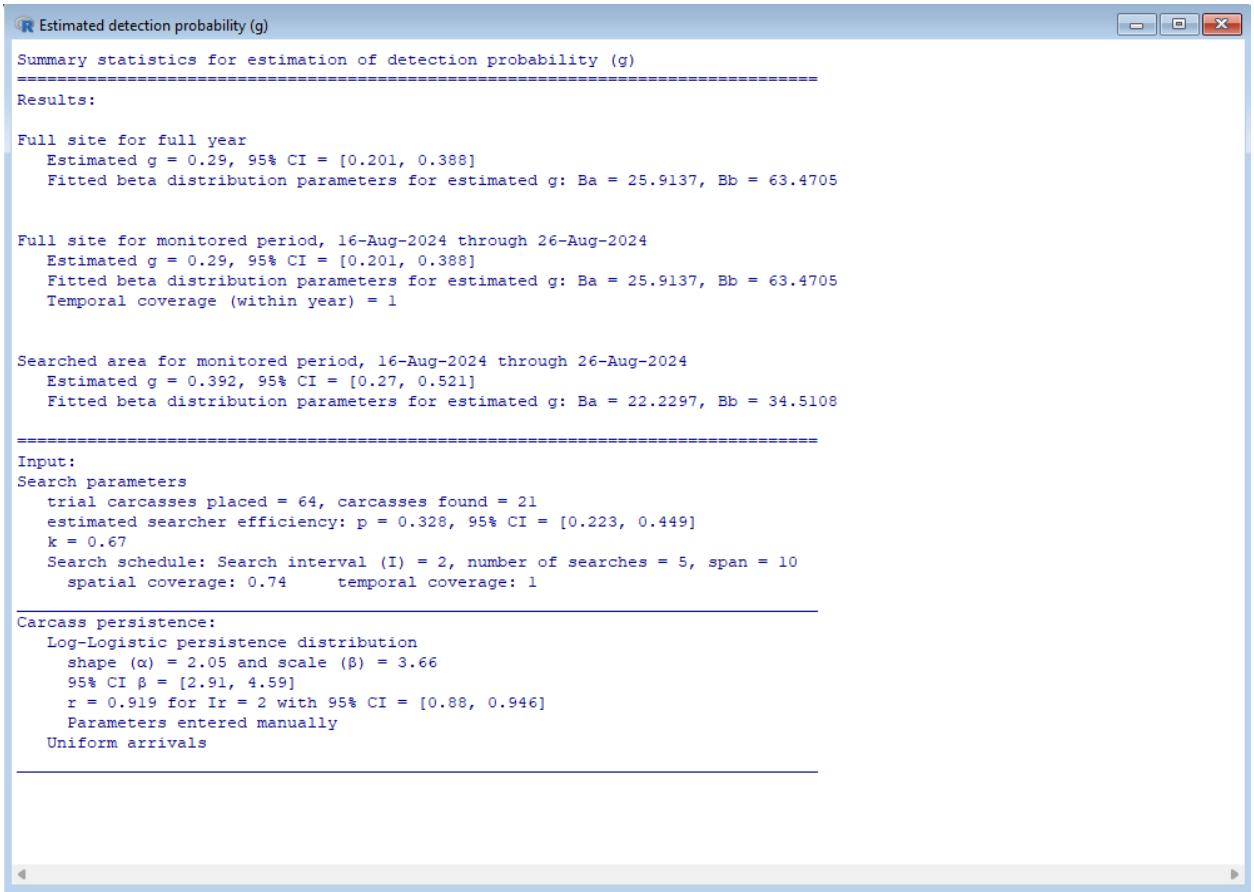
Appendix F10. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for Summer3 2024 60-meter full plot technician searches at 17 turbines, searched at a 2-day interval.



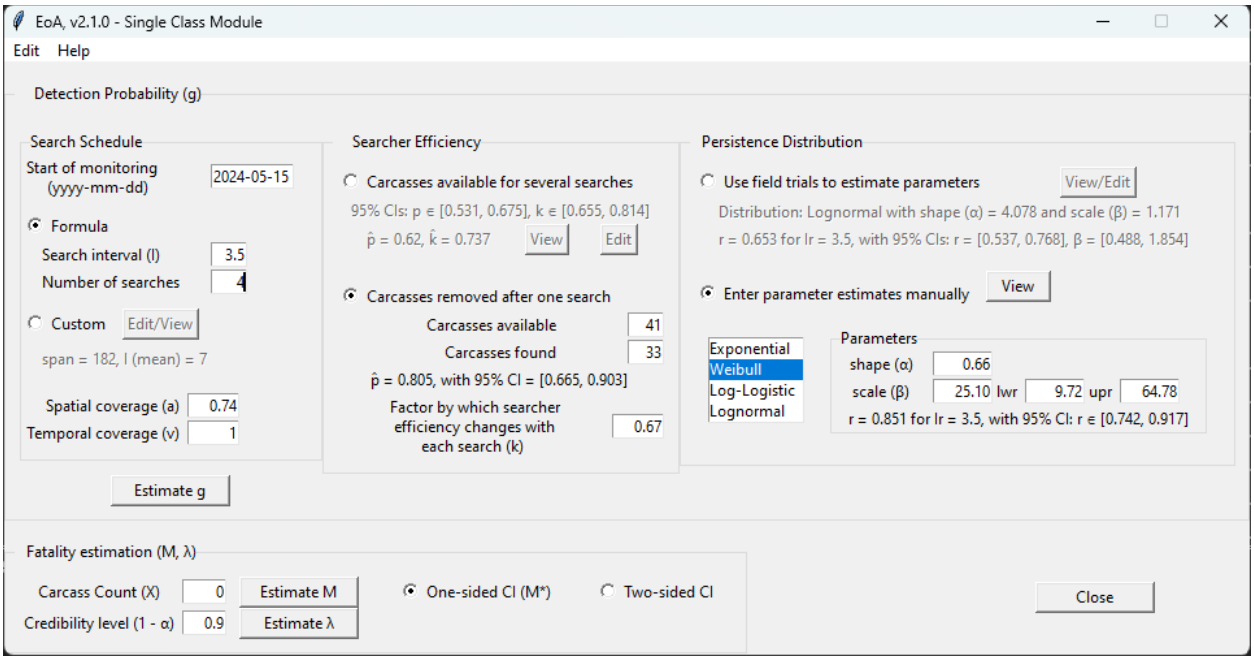


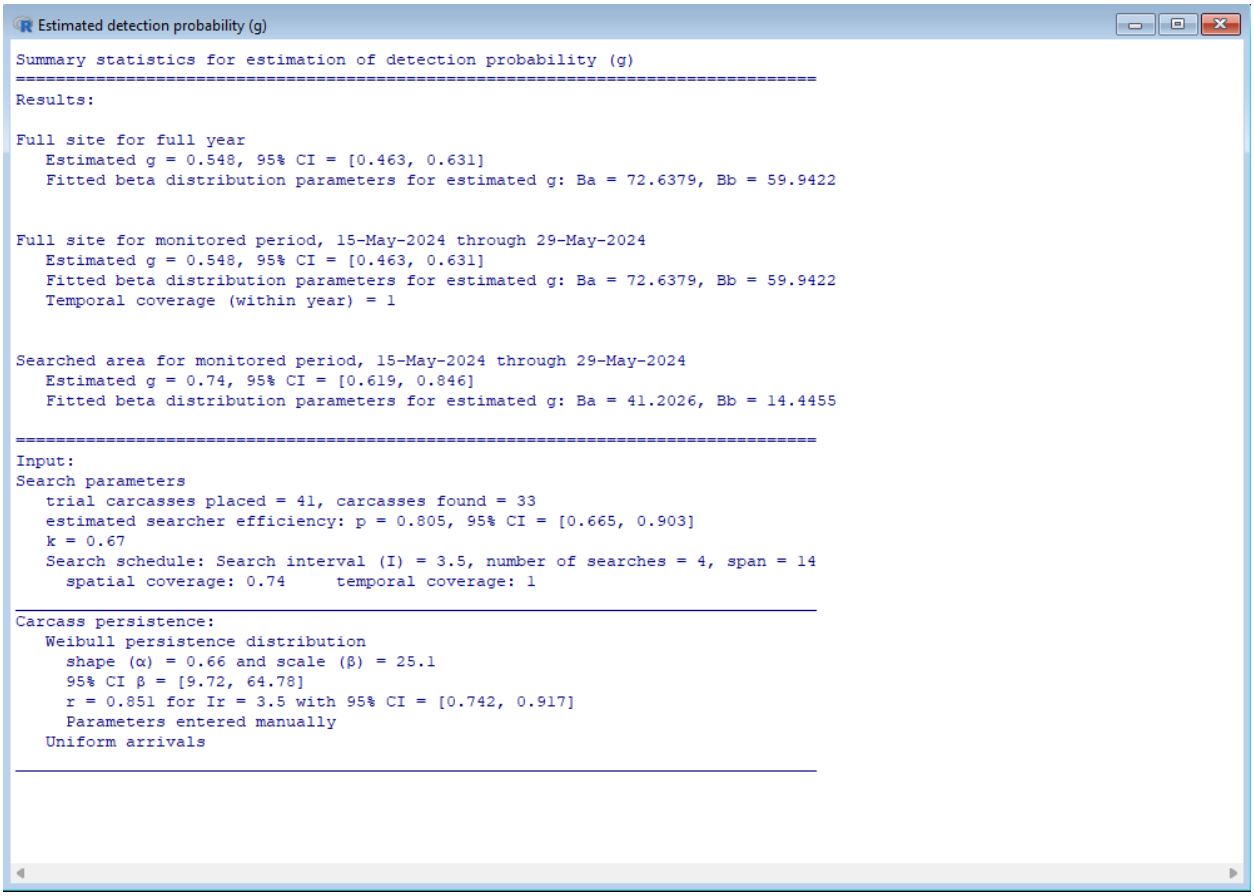
Appendix F11. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for Summer4 2024 60-meter full plot technician searches at 18 turbines, searched at a 2-day interval.



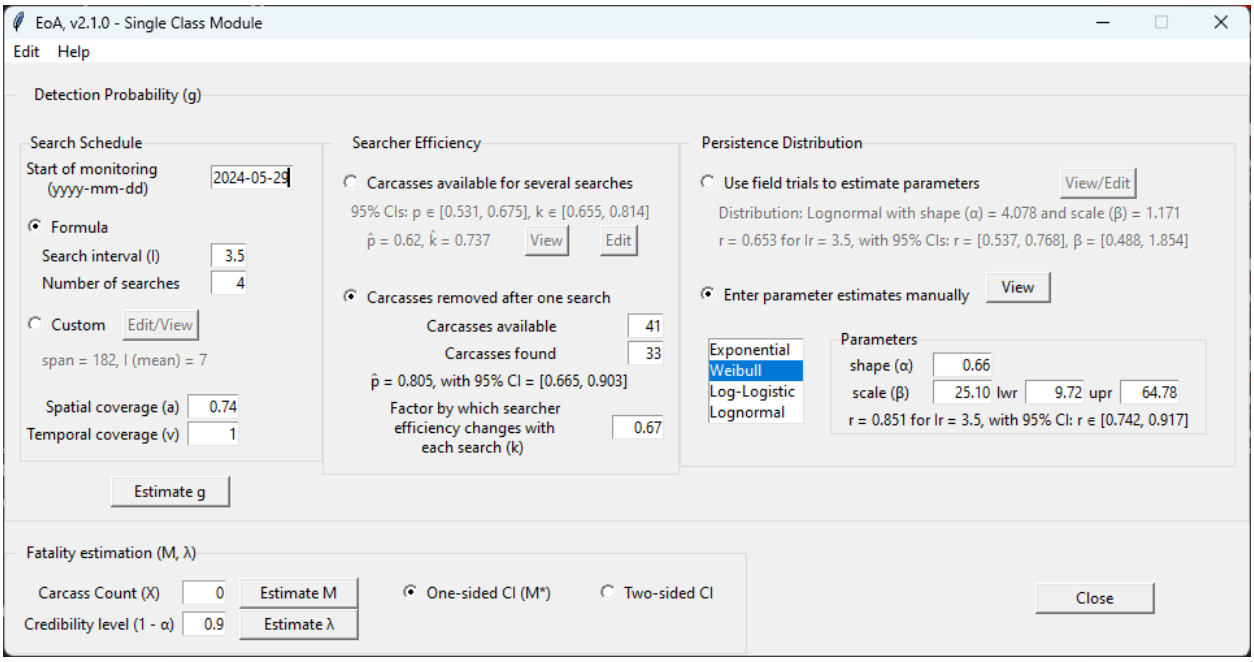


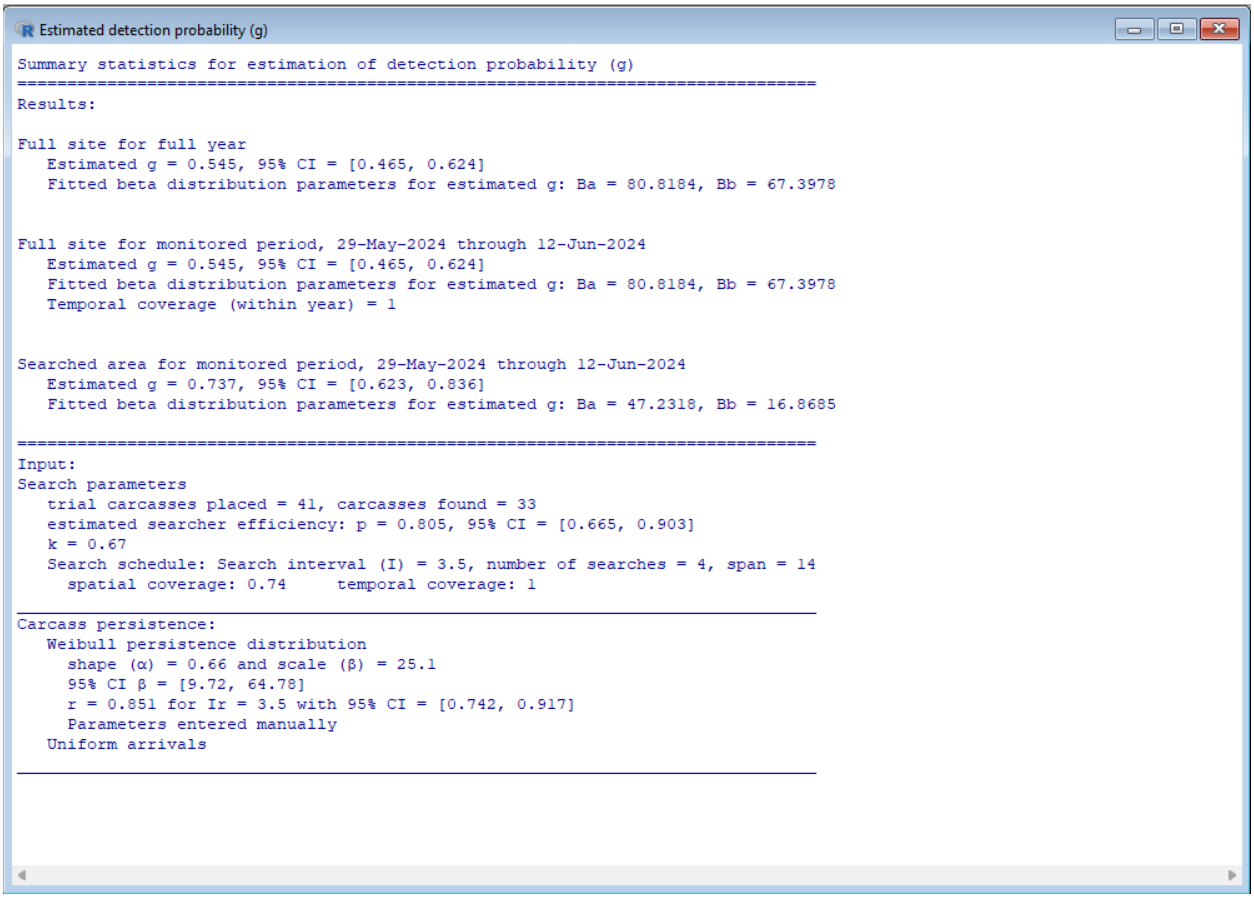
Appendix F12. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for Fall1 2024 60-meter full plot technician searches at 18 turbines, searched at a 2-day interval.



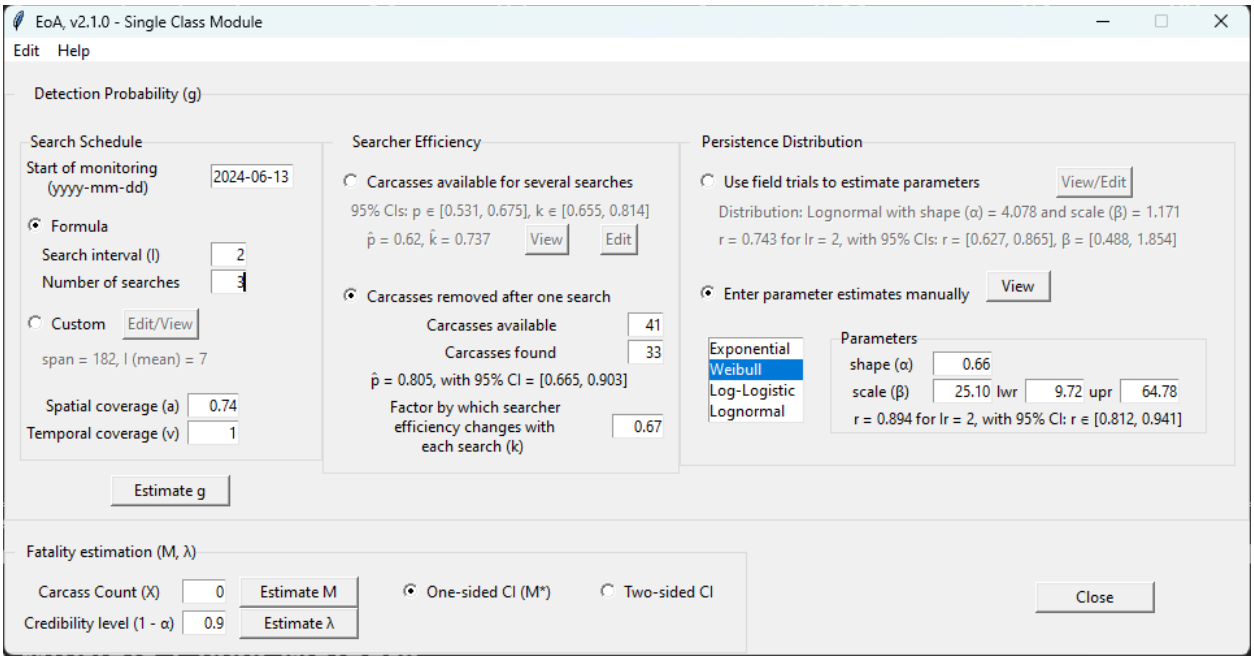


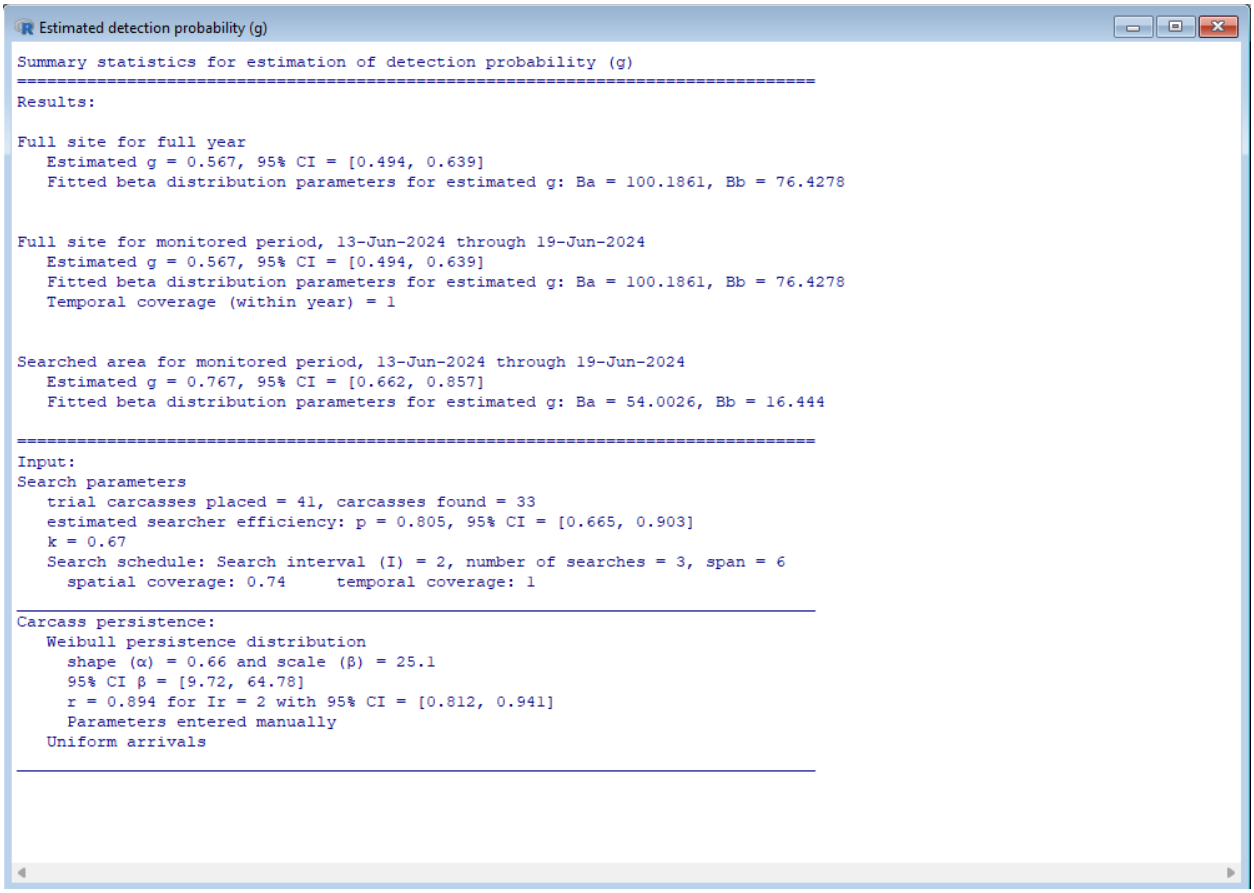
Appendix F13. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for Summer1 2024 60-meter full plot detection-dog team searches at 20 turbines, searched at a 3.5-day interval.



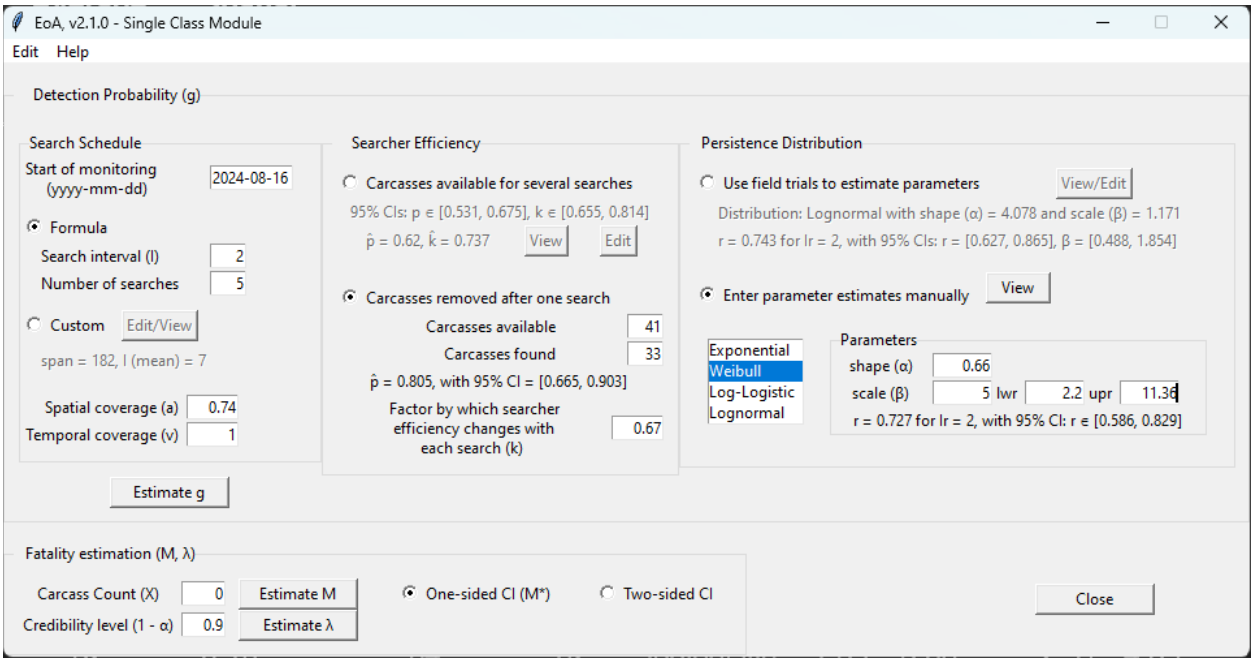


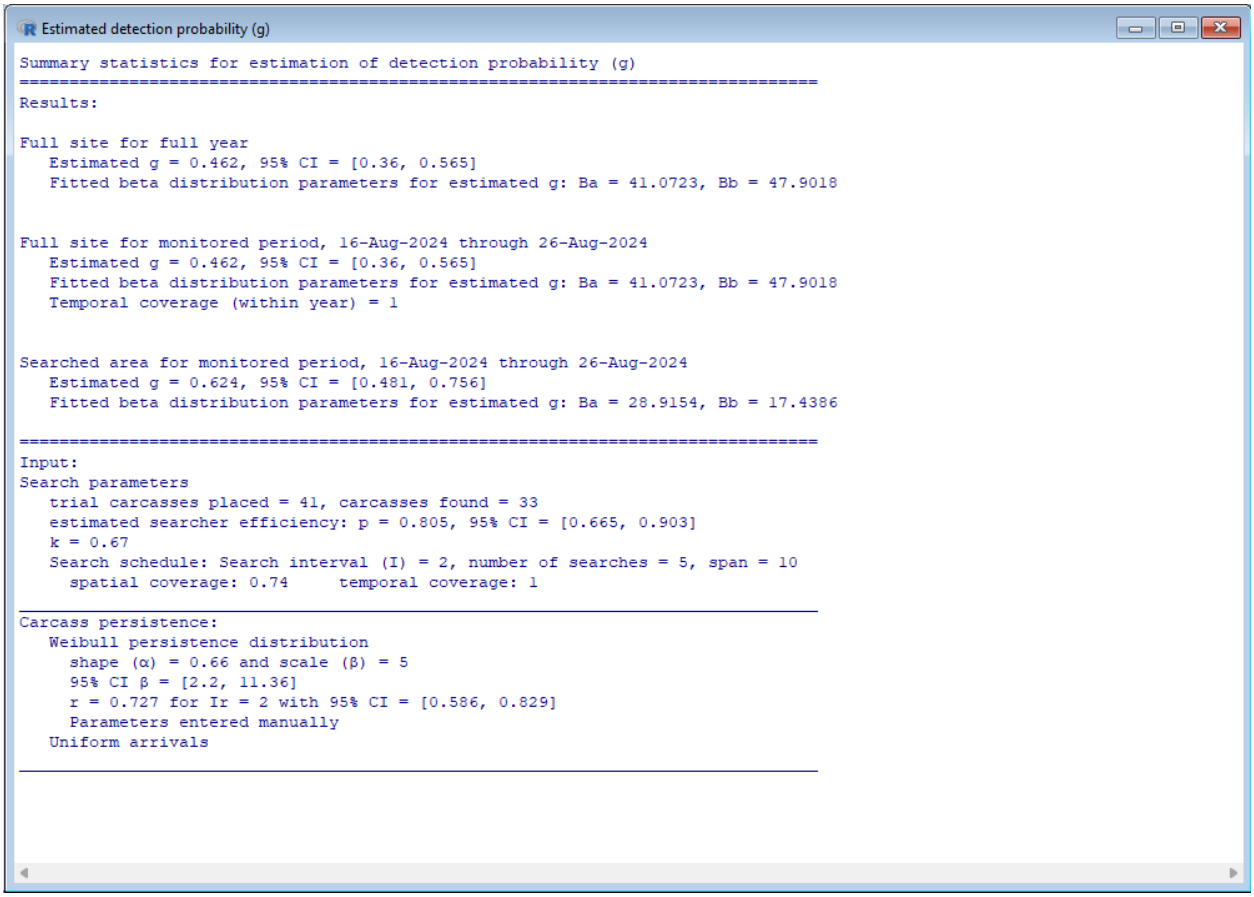
Appendix F14. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for Summer2 2024 60-meter full plot detection-dog team searches at 28 turbines, searched at a 3.5-day interval.



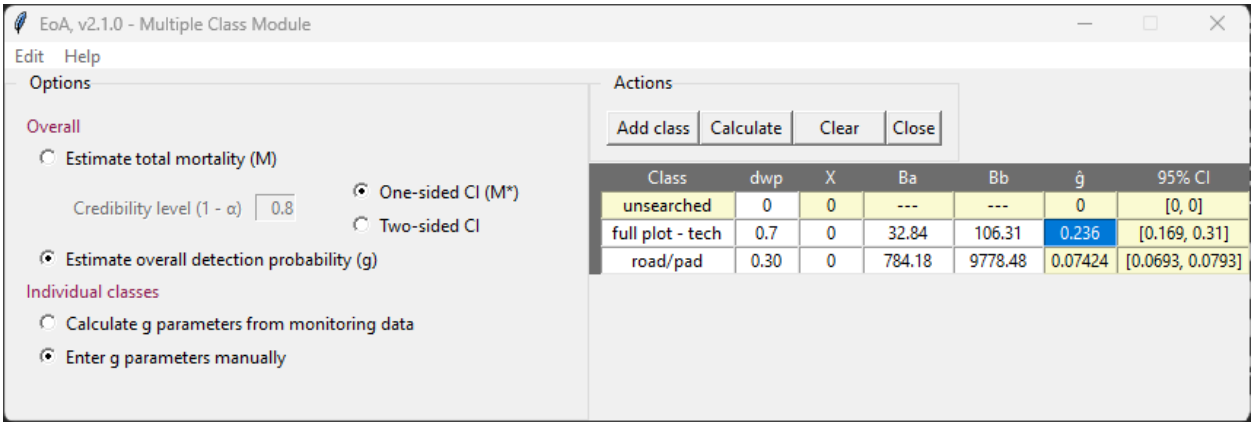


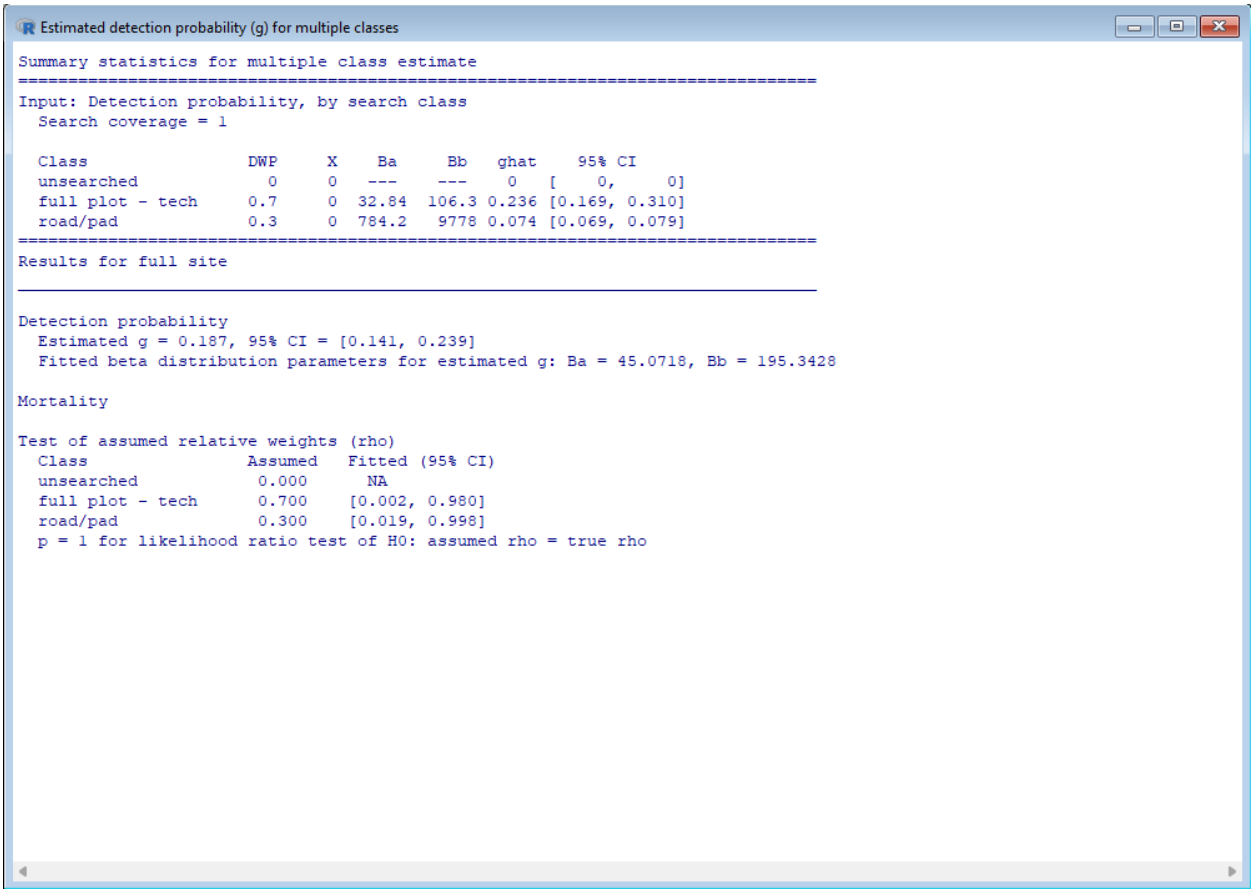
Appendix F15. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for Summer3 2024 60-meter full plot detection-dog team searches at 15 turbines, searched at a 2-day interval.



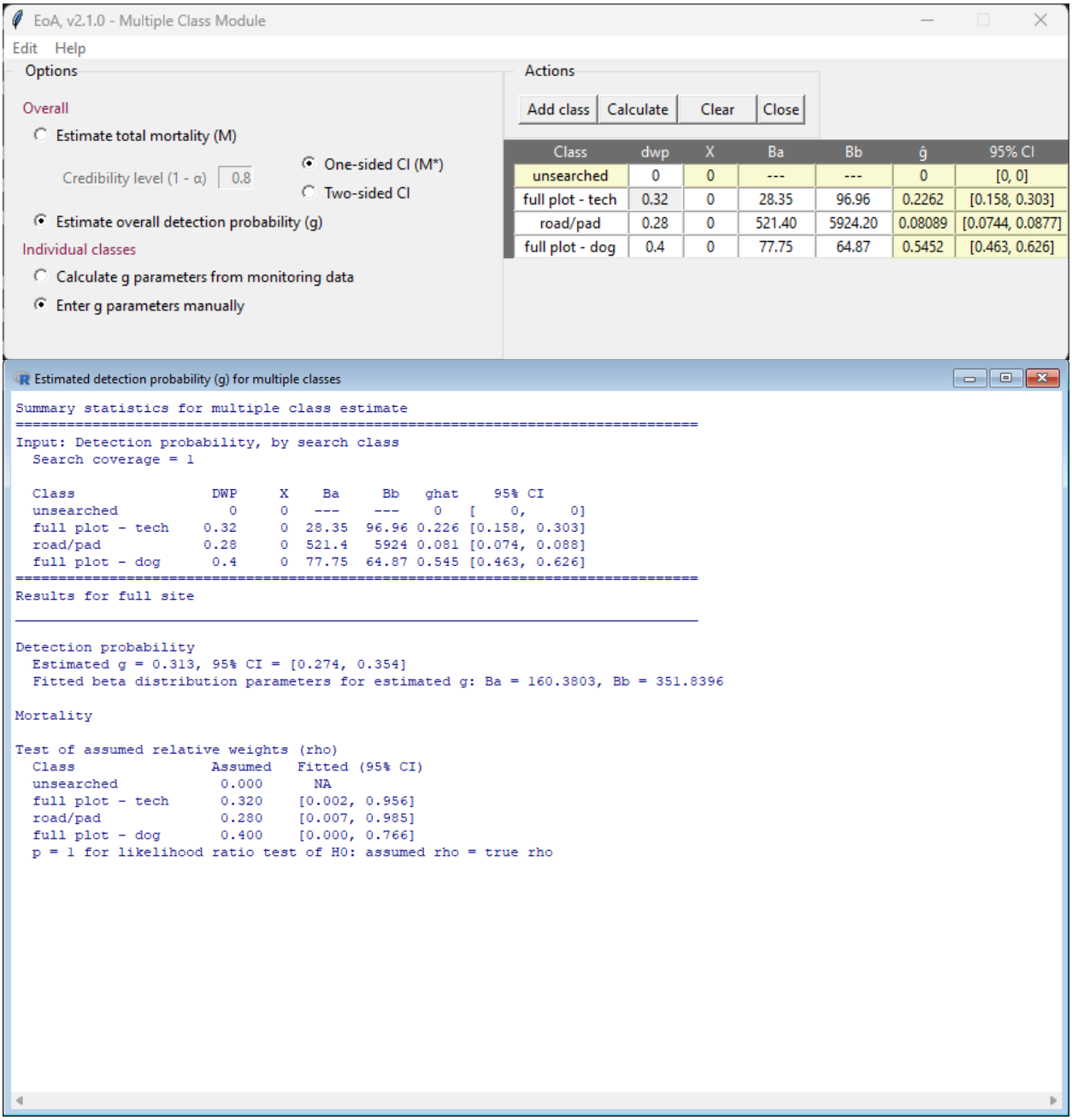


Appendix F16. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Single Class Module inputs for Fall1 2024 60-meter full plot detection-dog team searches at 18 turbines, searched at a 2-day interval.

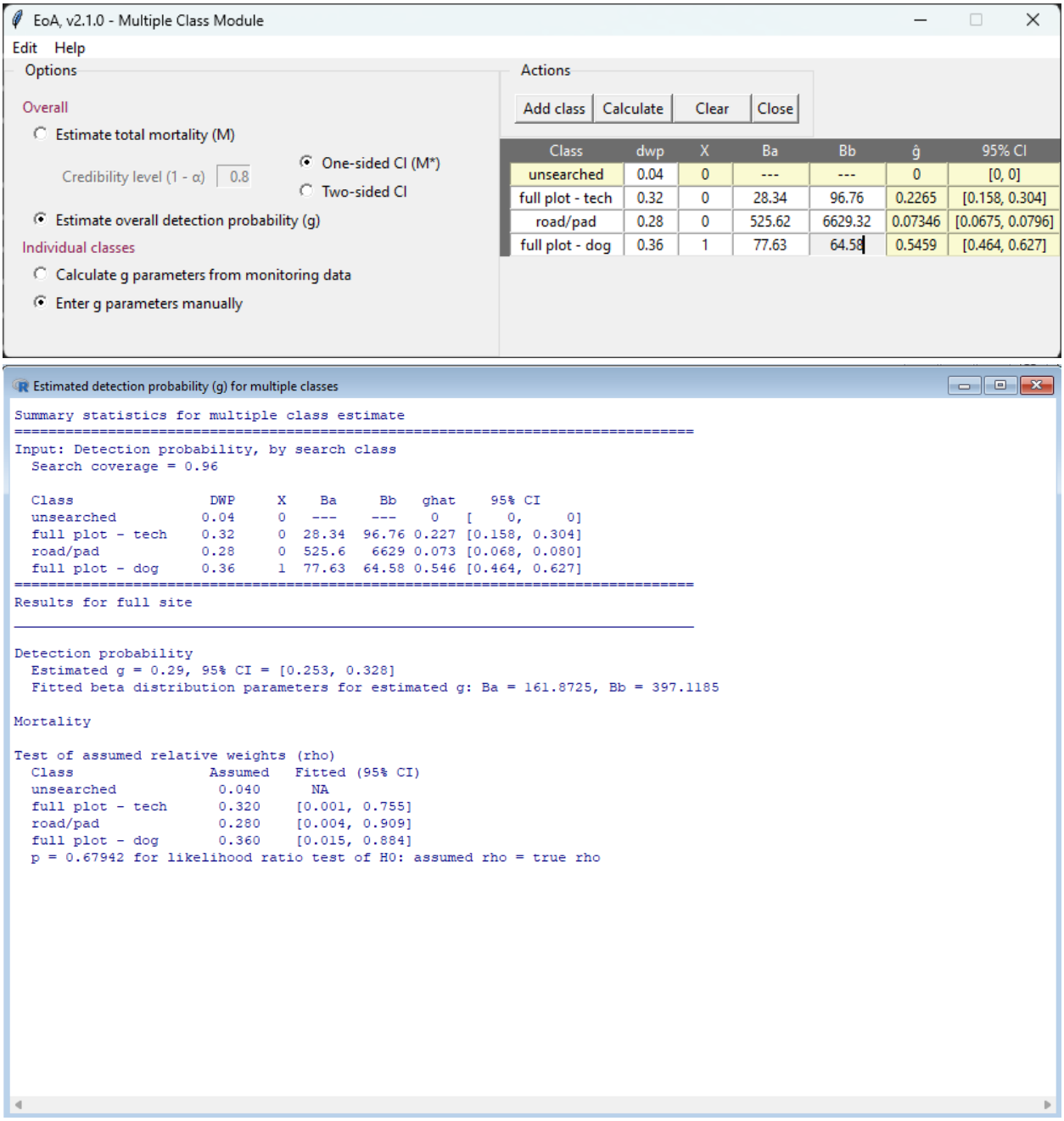




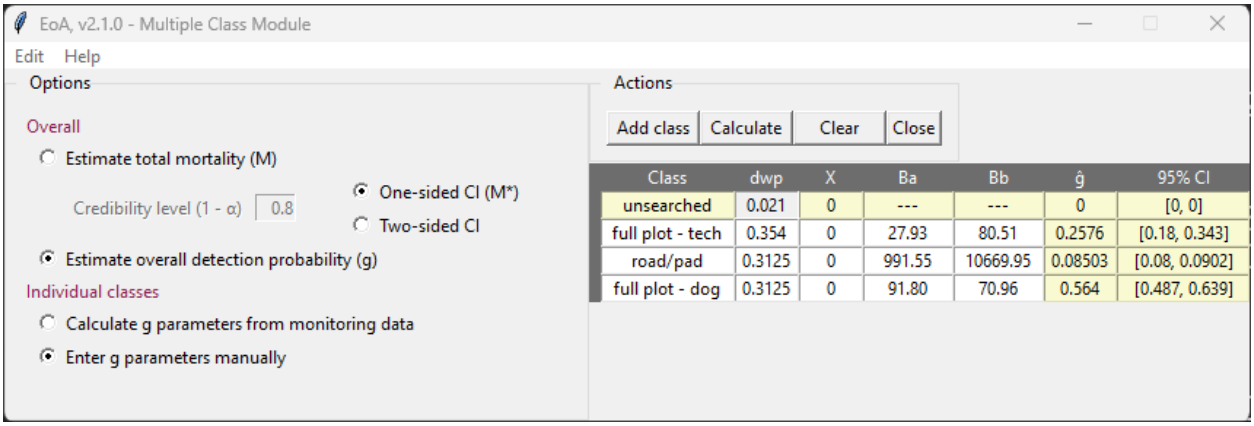
Appendix F17. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Class Module inputs for Spring1 2024 stratified by plot type, searches at 50 turbines, searched at a 3.5-day interval.

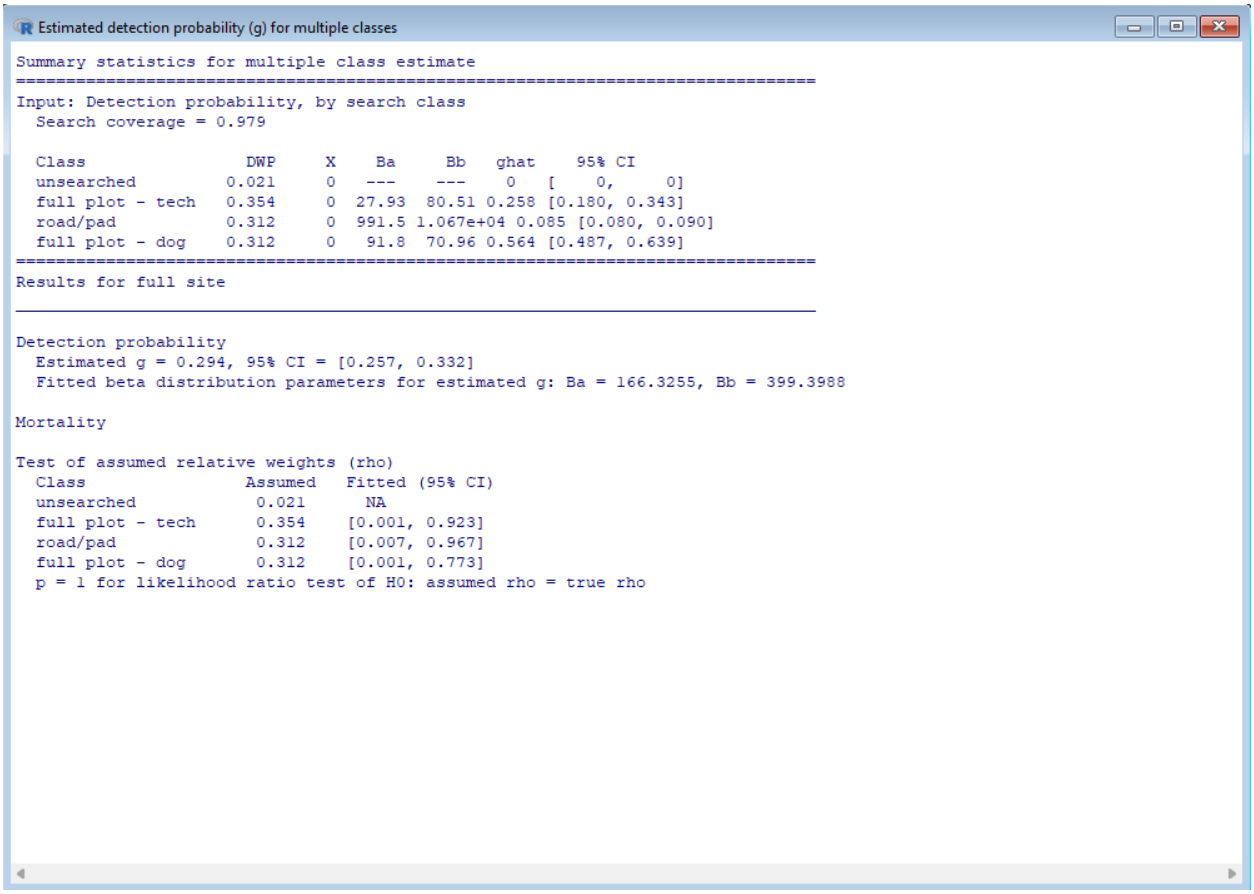


Appendix F18. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Class Module inputs for Summer1 2024 searches at 50 turbines, searched at a 3.5-day interval.

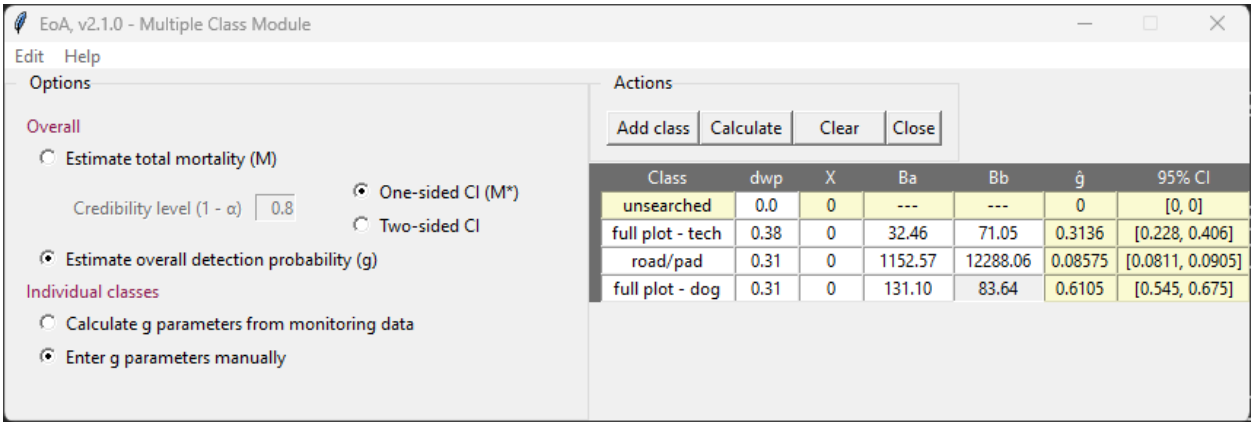


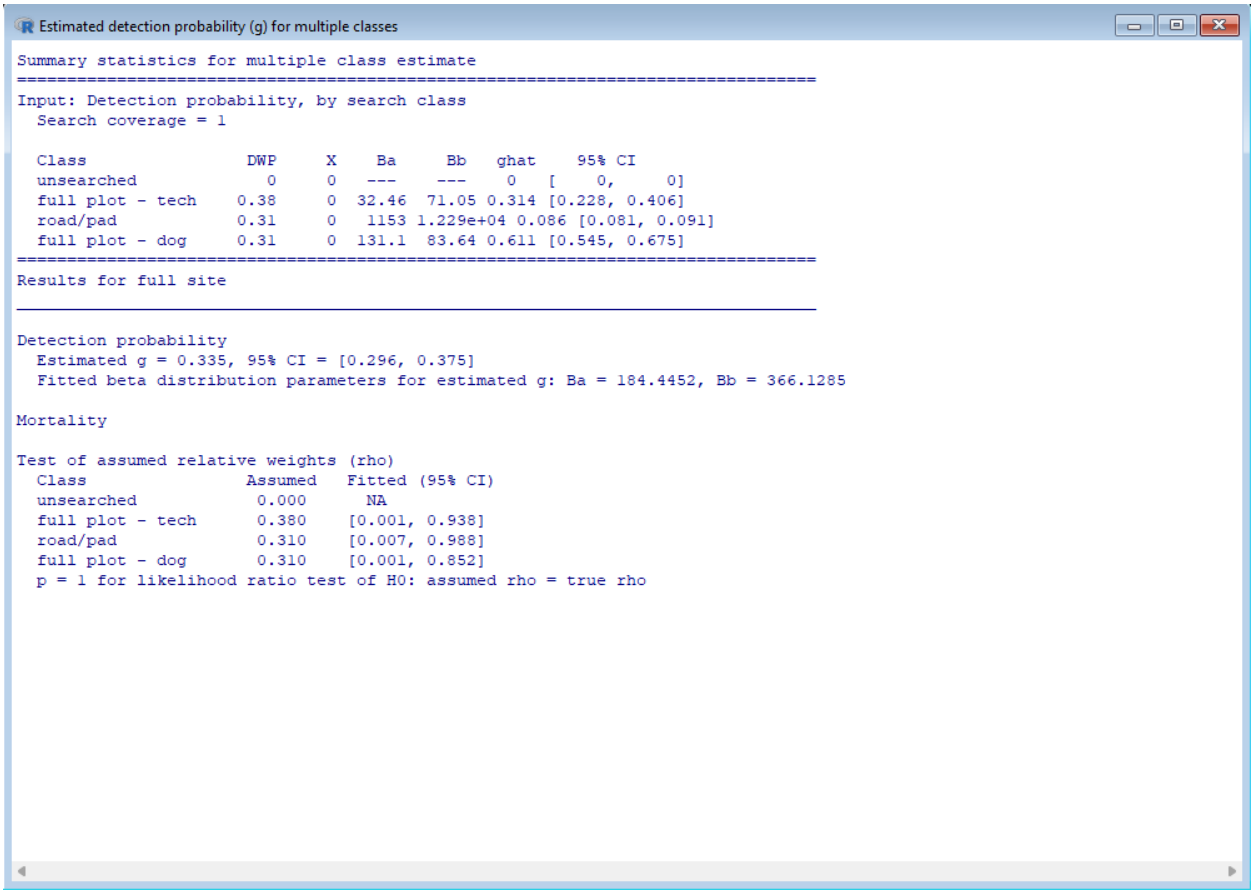
Appendix F19. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Class Module inputs for Summer2 2024 stratified by plot type, searches at 75 turbines, searched at a 3.5-day interval.



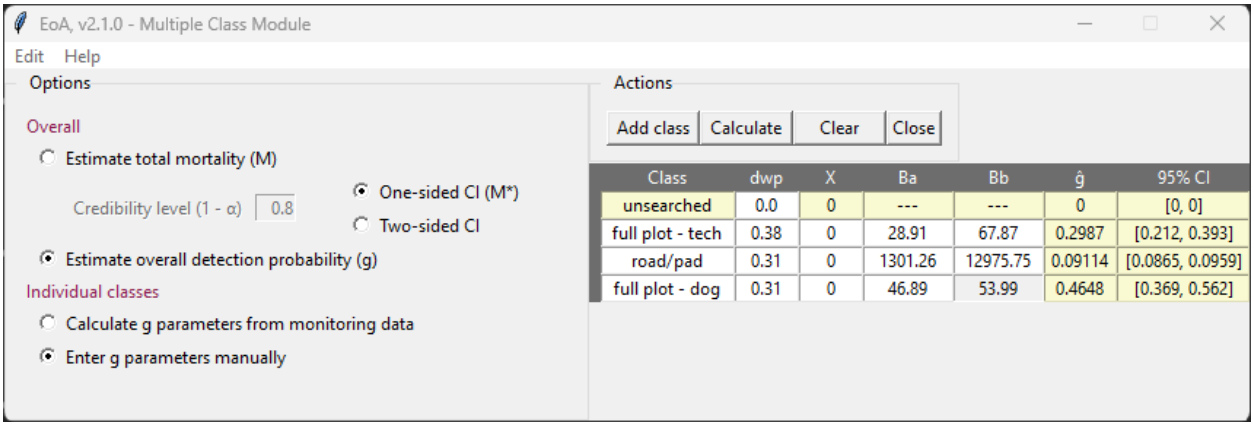


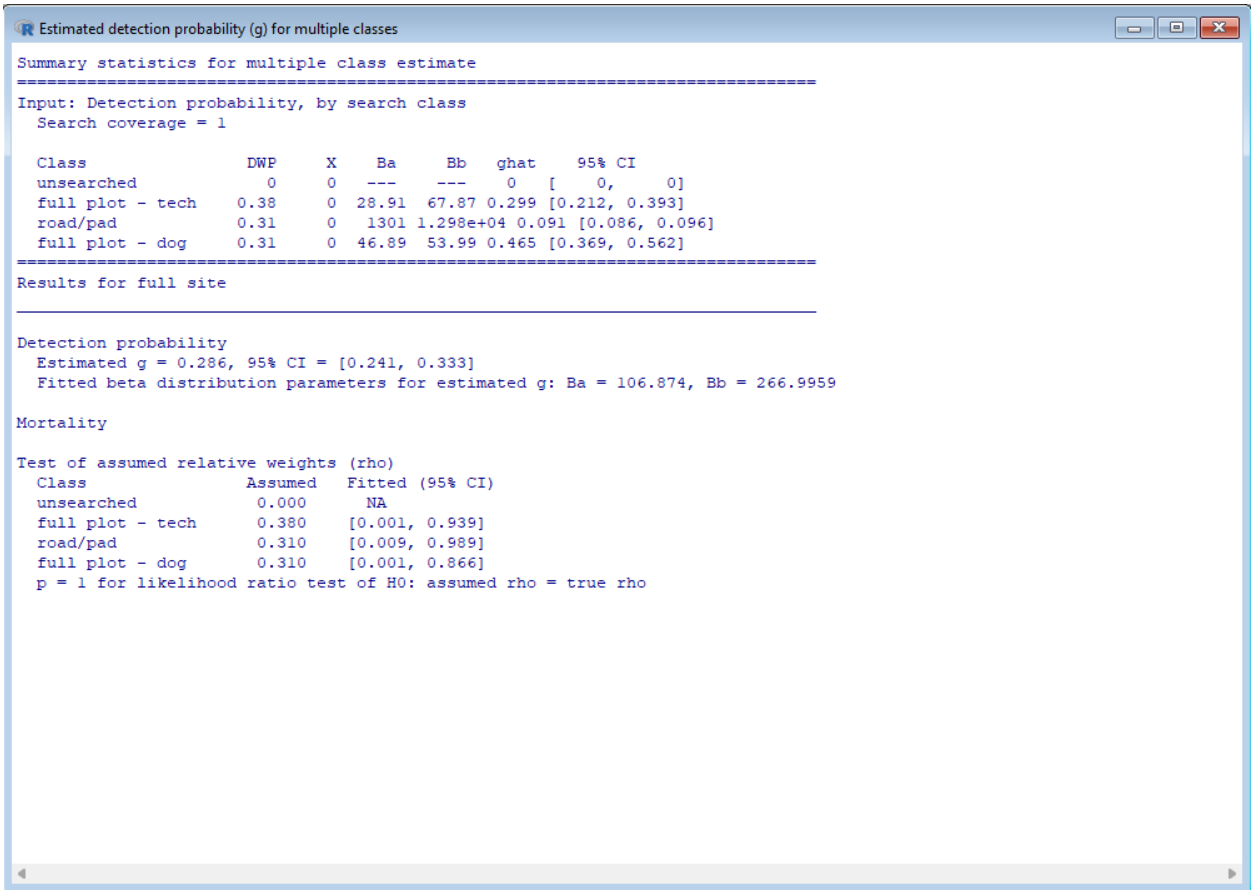
Appendix F20. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Class Module inputs for Summer3 2024 stratified by plot type, searches at 47 turbines, searched at a 2-day interval.



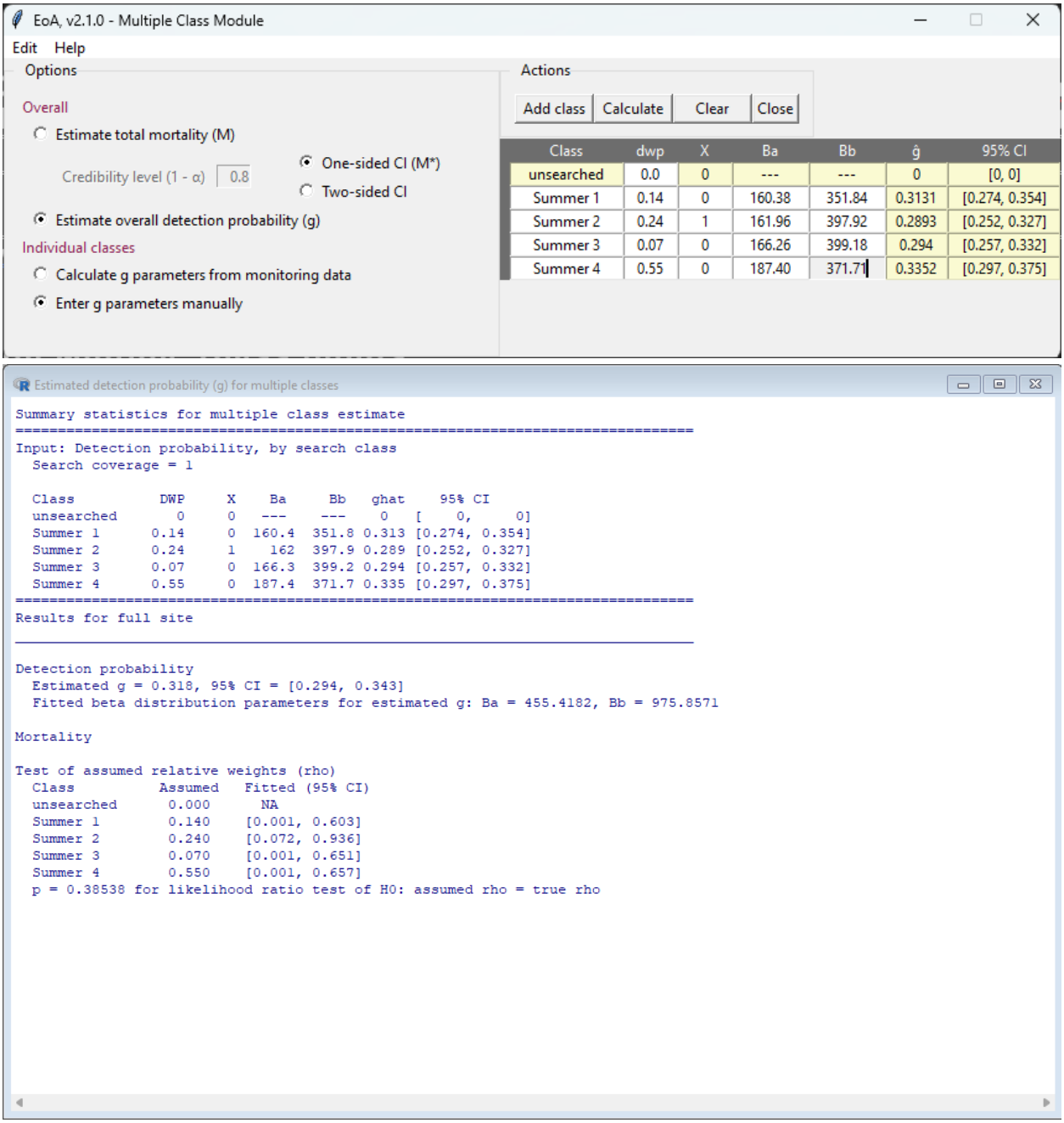


Appendix F21. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Class Module inputs for Summer4 2024 stratified by plot type, searches at 48 turbines, searched at a 2-day interval.

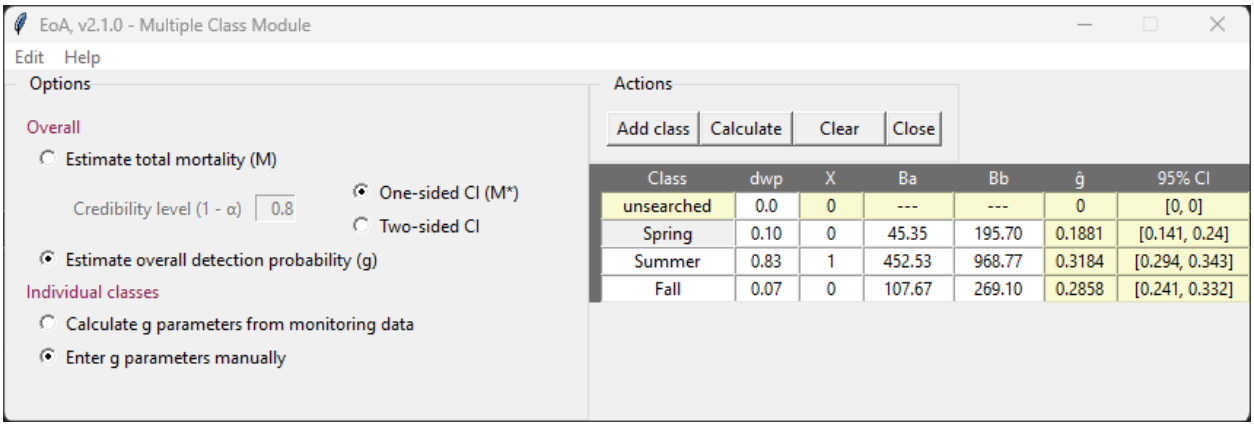


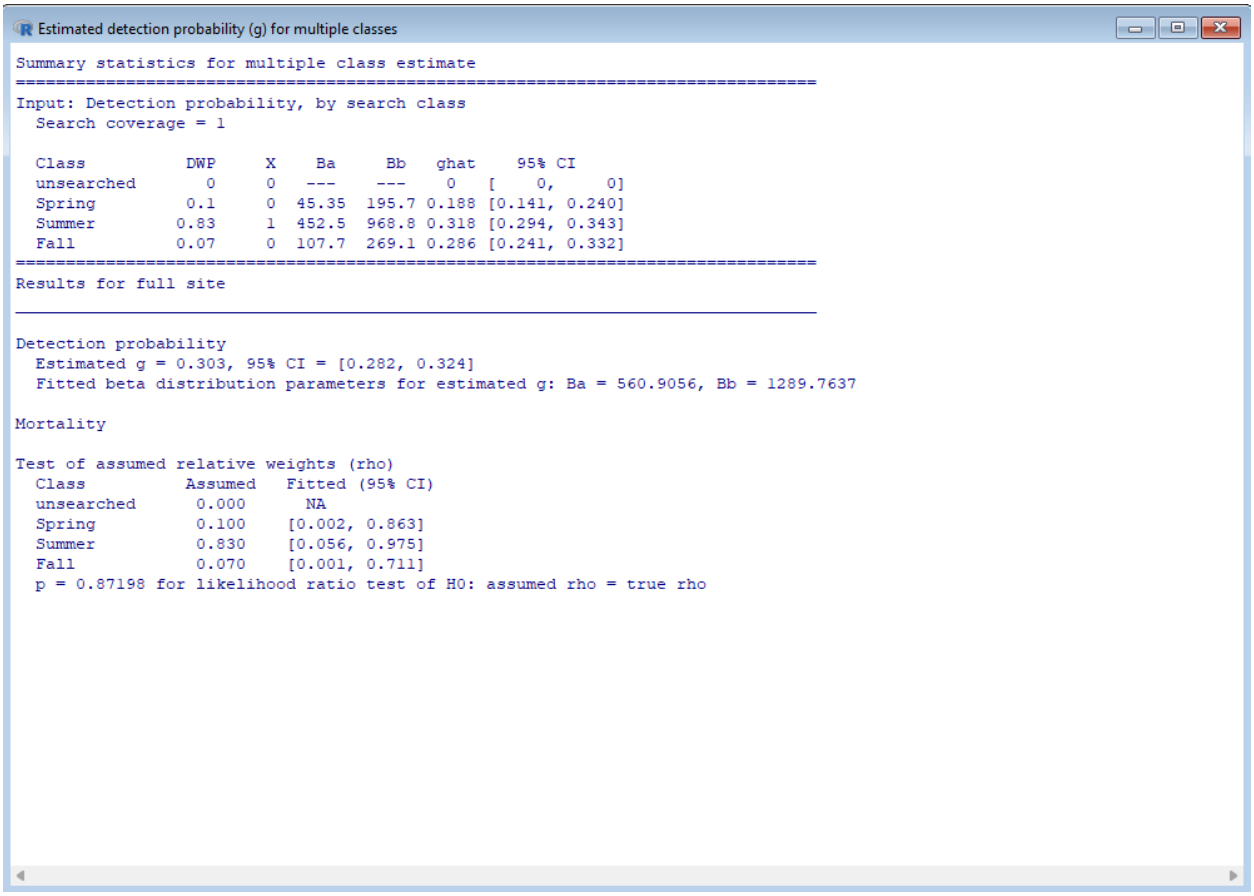


Appendix F22. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Class Module inputs for Fall1 2024 stratified by plot type, searches at 48 turbines, searched at a 2-day interval.

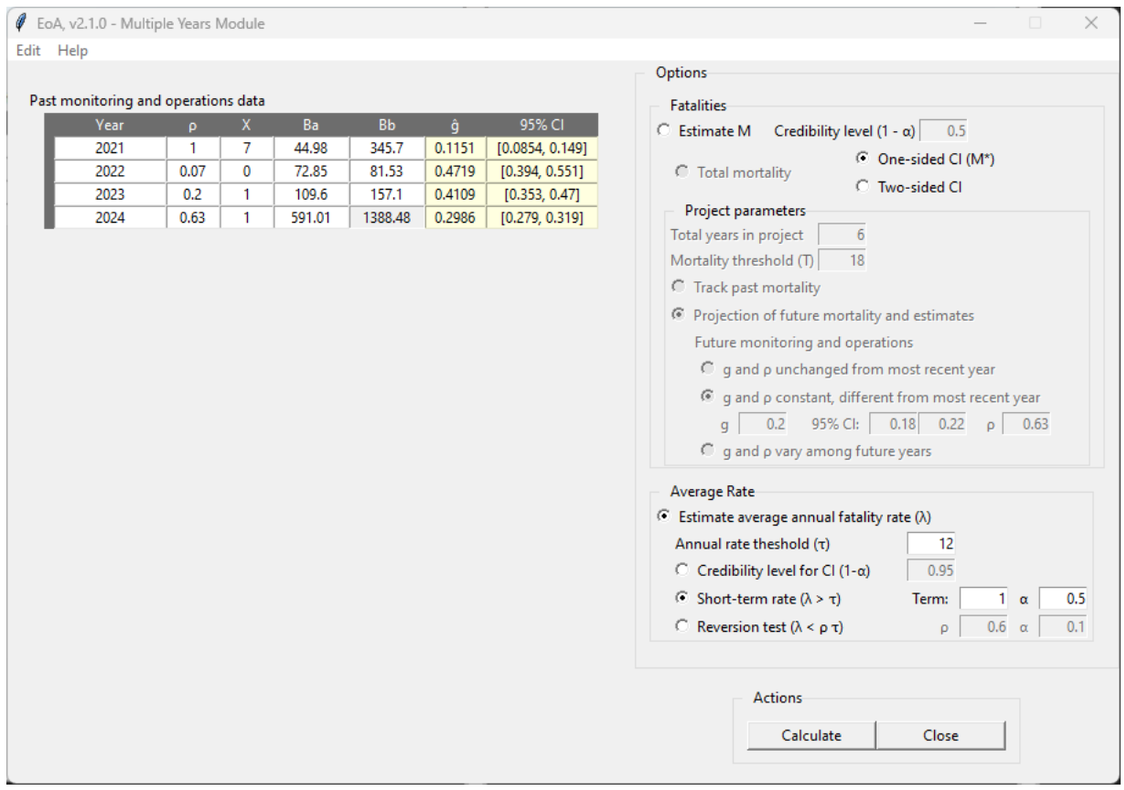


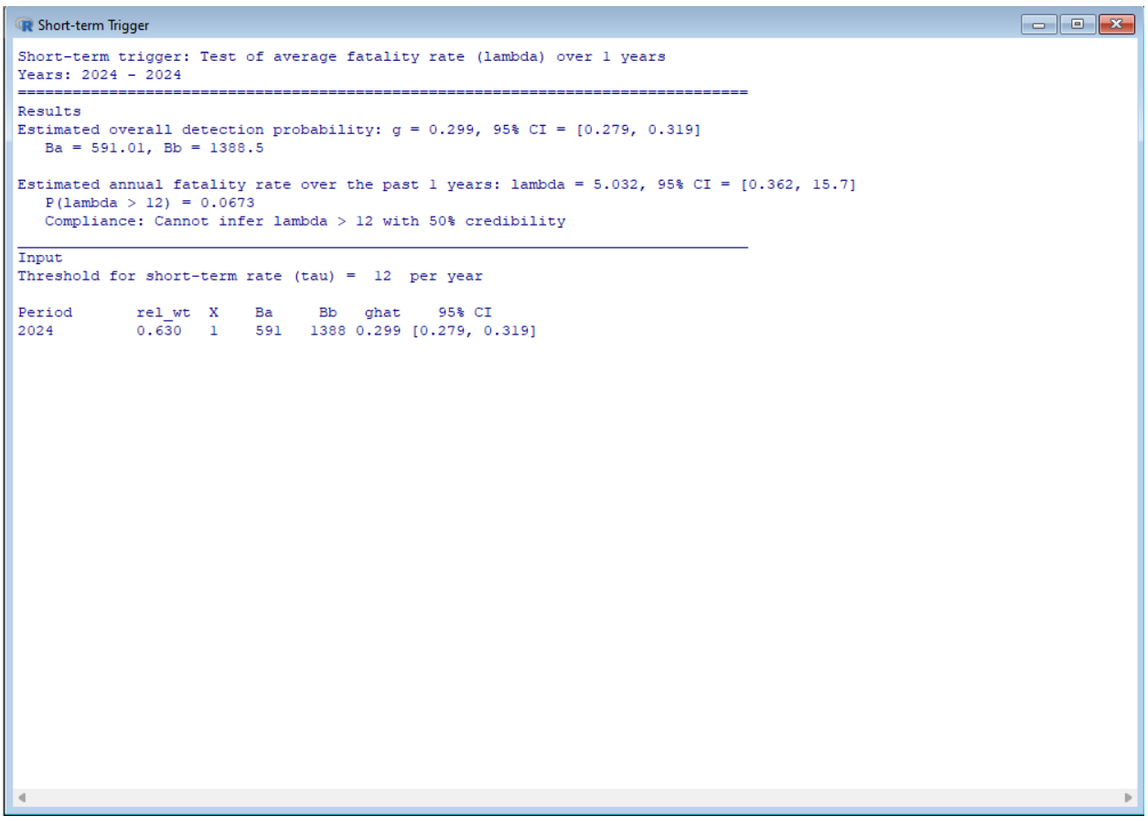
Appendix F23. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Class Module inputs for Summer 2024 stratified by subseason.



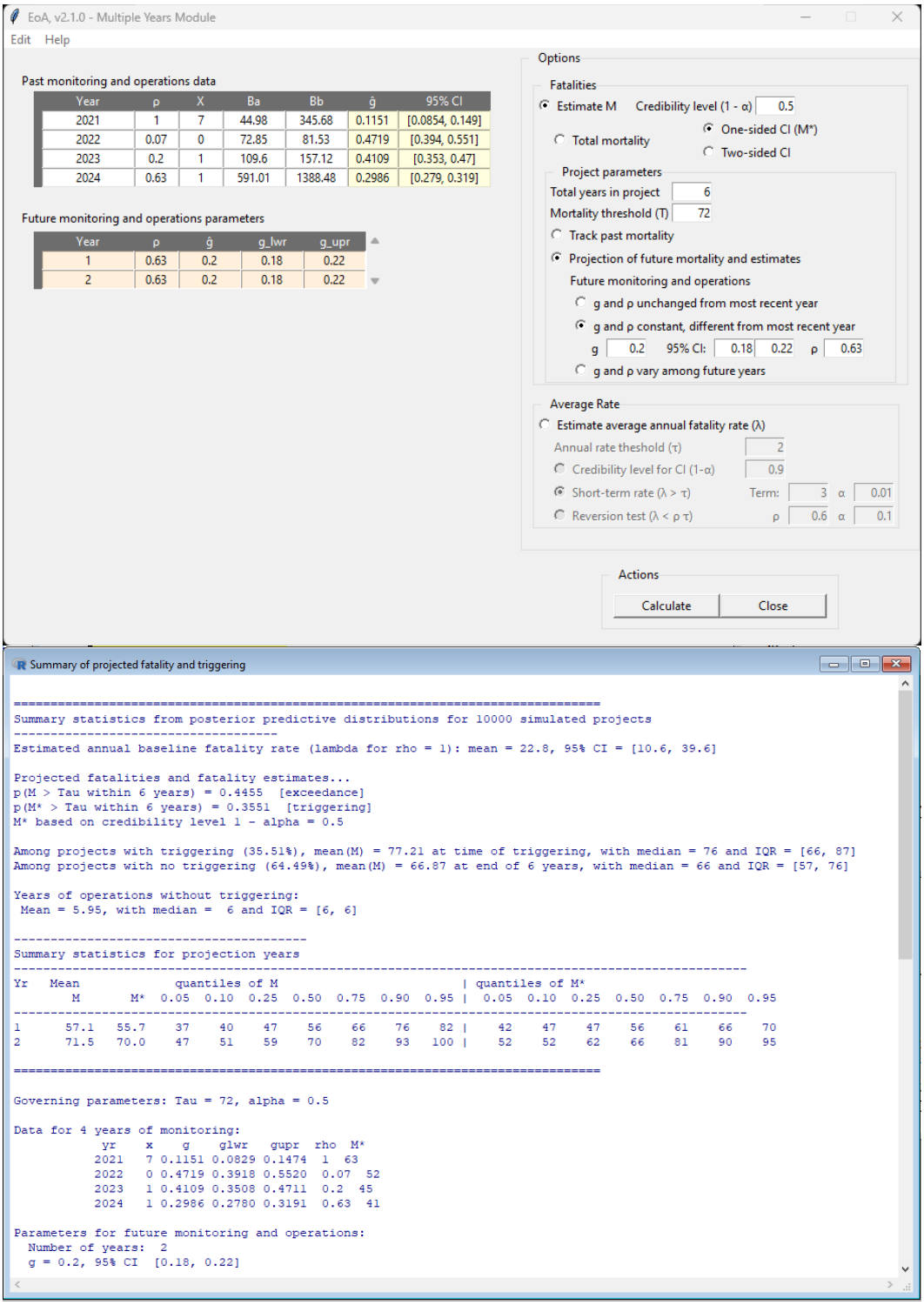


Appendix F24. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Class Module inputs for 2024 stratified by season.

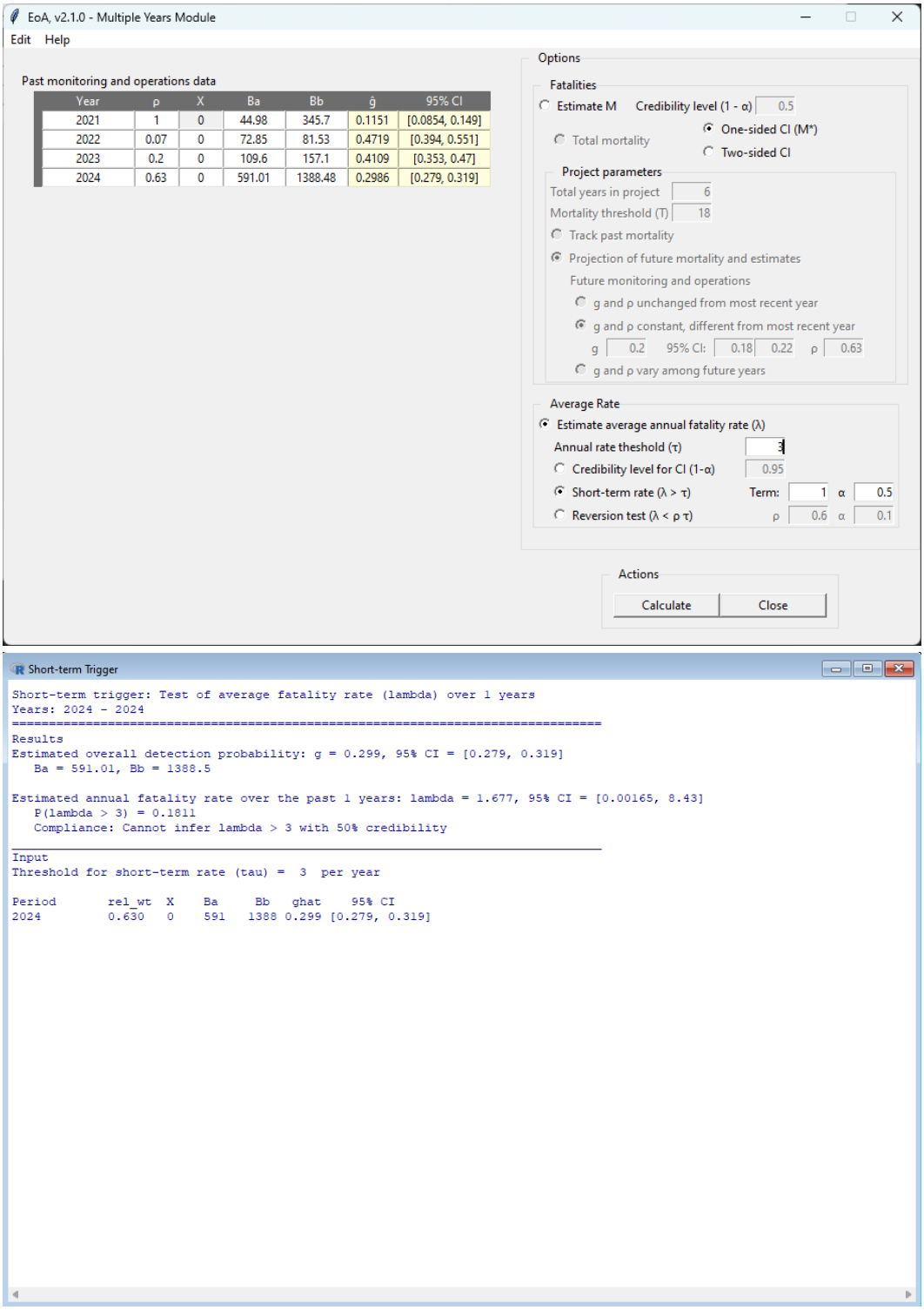




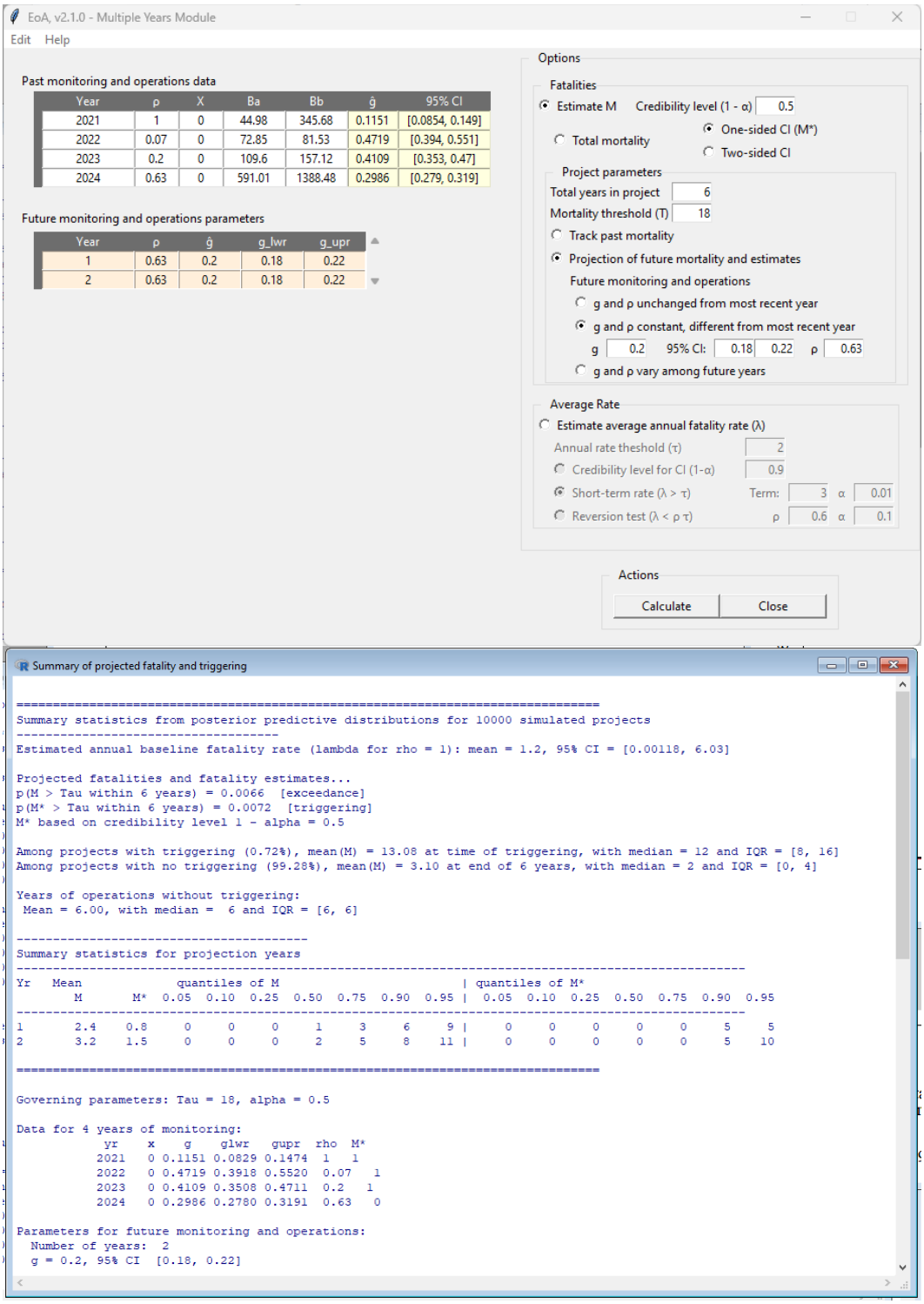
Appendix F25. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Years Module for estimation of Indiana bat rolling average detection probability and short-term adaptive management trigger test. Inputs are based on values reported in the main text.



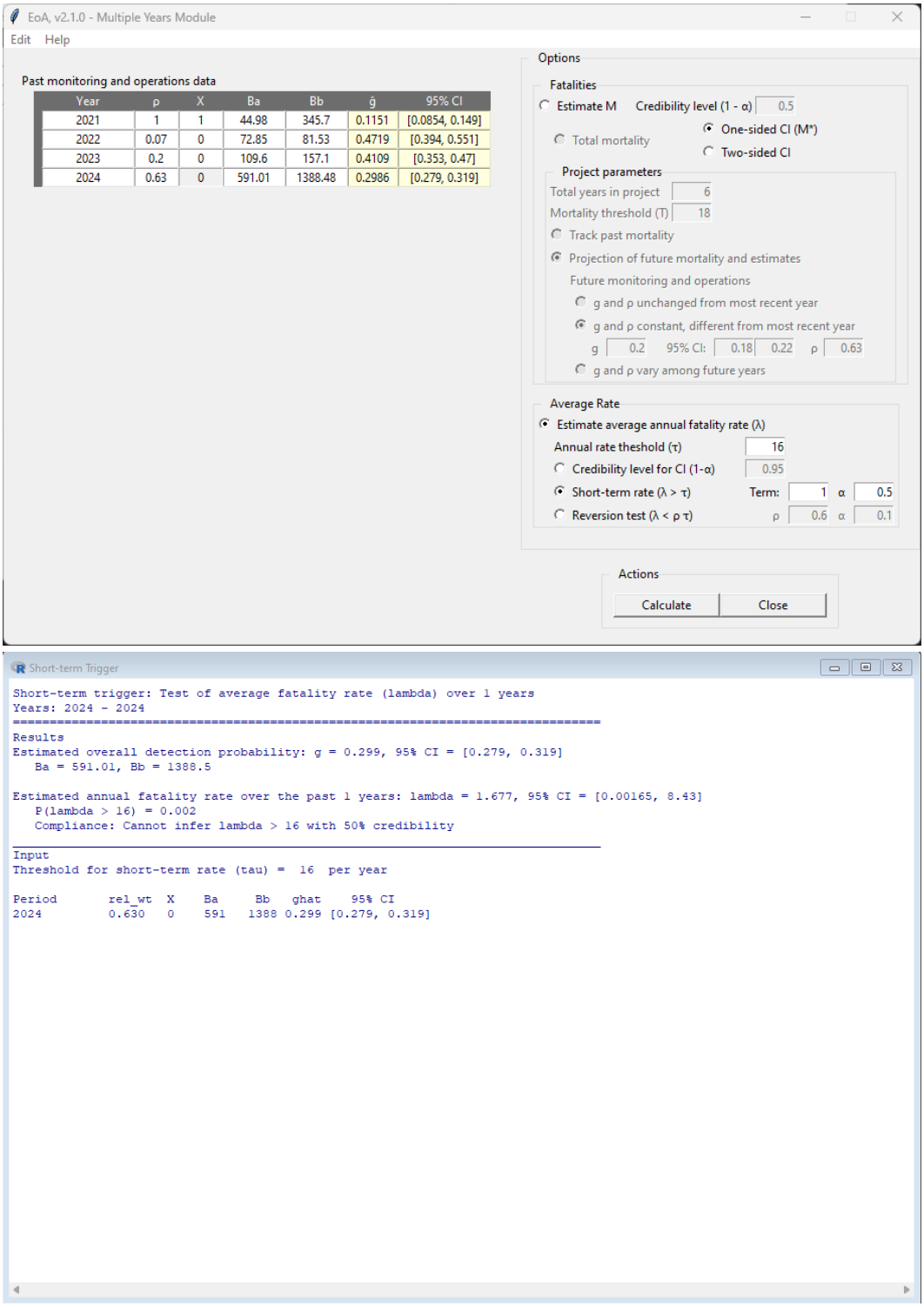
Appendix F26. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Years Module for Indiana bat projected take estimate (M*). Inputs are based on values reported in the main text.



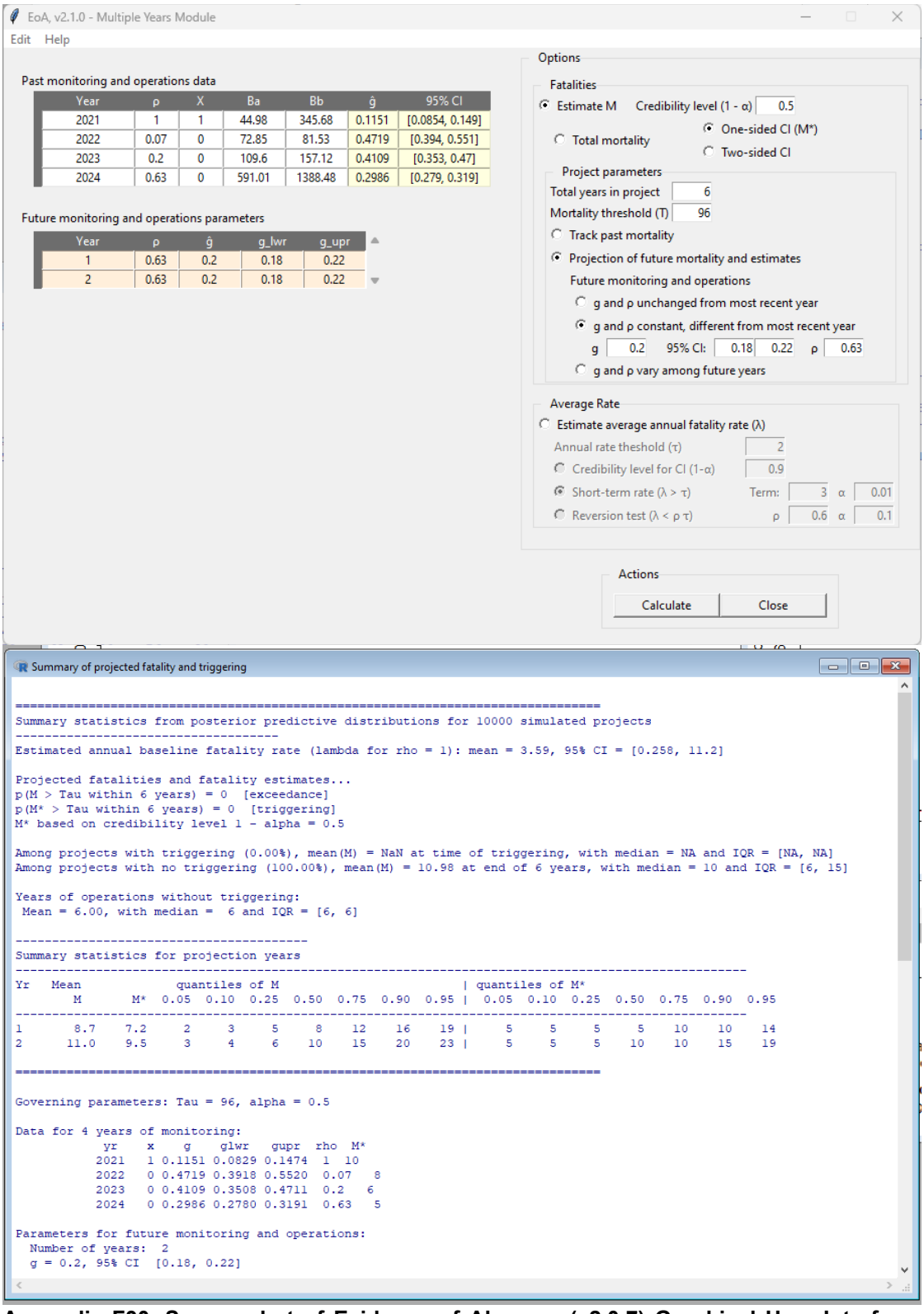
Appendix F27. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Years Module for estimation of northern long-eared bat rolling average detection probability and short-term adaptive management trigger test. Inputs are based on values reported in the main text.



Appendix F28. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Years Module for northern long-eared bat projected take estimate (M*). Inputs are based on values reported in the main text.



Appendix F29. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Years Module for estimation of little brown bat rolling average detection probability and short-term adaptive management trigger test. Inputs are based on values reported in the main text.



Appendix F30. Screen shot of Evidence of Absence (v2.0.7) Graphical User Interface, Multiple Years Module for little brown bat projected take estimate (M*). Inputs are based on values reported in the main text.