Appendix A. User's Guidance for TIM v.3.0 (beta)

Introduction

Appendix A provides detailed guidance to the user on how to select input parameters for running the Terrestrial Investigation Model (TIM; version 3.0 beta) as well as recommendations for default values that can be used when no chemical-specific or species-specific information are available. This user's guidance is an appendix to a manual (referred to here at "technical manual") that includes a complete technical description of TIM, including its conceptual model, equations, assumptions and uncertainties. Appendix A focuses only on the parameters used by TIM, which must be determined by the model user.

The contents of this guidance are as follows (page):

Getting Started

The Terrestrial Investigation Model (version 3.0, beta) executable can be run with two different approaches: 1) a Graphical User Interface (GUI) and 2) a text file. It is highly recommended that the model user run TIM with the GUI. This user's guide will focus on how to run TIM with the GUI, with some discussions about running the model with the text file option.

TIM (v3.0 beta) is available on EFED's models website (http://www.epa.gov/pesticides/science/models_pg.htm#terrestrial). The model is packaged as a zip file, which contains several files, including the following:
- The GUI (TIMv3.0beta.exe), which is programmed and compiled in Matlab;
- The model tool (TIMv3.0beta_3-18-15b.exe), which is programmed in C and compiled using Visual Studio C++;
- And two batch files (CallTIMMar15.bat and StopTIMMar15.bat) that allow the GUI and model tool to communicate.

The model user should copy the files onto his or her computer. It is highly recommended that the user create a folder specifically devoted to TIM since the model will generate output files that will be saved to the same location as the executable.

Prior to using the TIM GUI for the first time, the model user must install the MATLAB compiler runtime library (MCR). It can be downloaded from Mathworks at: http://www.mathworks.com/products/compiler/mcr/ by selecting the Windows 32-bit R2012a version. Installation of the MCR requires administrator privileges. To install, double-click "MCR_R2012a_win32_installer.exe" or select "Run…" and browse to the MCR file. Installation may take several minutes due to the very large file size. The model user should only need to download the MCR file once. This is the same MCR that is used for MCnest; therefore, if the model user already has MCnest on his/her computer, it is not necessary to download the MCR.

TIM is called by double-clicking the GUI file or selecting "Run…" from the Windows Start menu and then navigating to the GUI. Doing so brings up the main TIM screen (**Figure A1**). Two other screens used to input parameter values can be located by selecting "file" in the upper left corner of the main screen. Those screens include one titled "Pesticide Parameters" and the other titled "Species." The Chemical Parameters screen (**Figure A2**) includes toxicity and physical/chemical/fate properties used to represent the simulated pesticide. The species screen (**Figure A3**) is used to represent the species of interest. The following sections provide guidance on how to select appropriate values to represent these parameters.
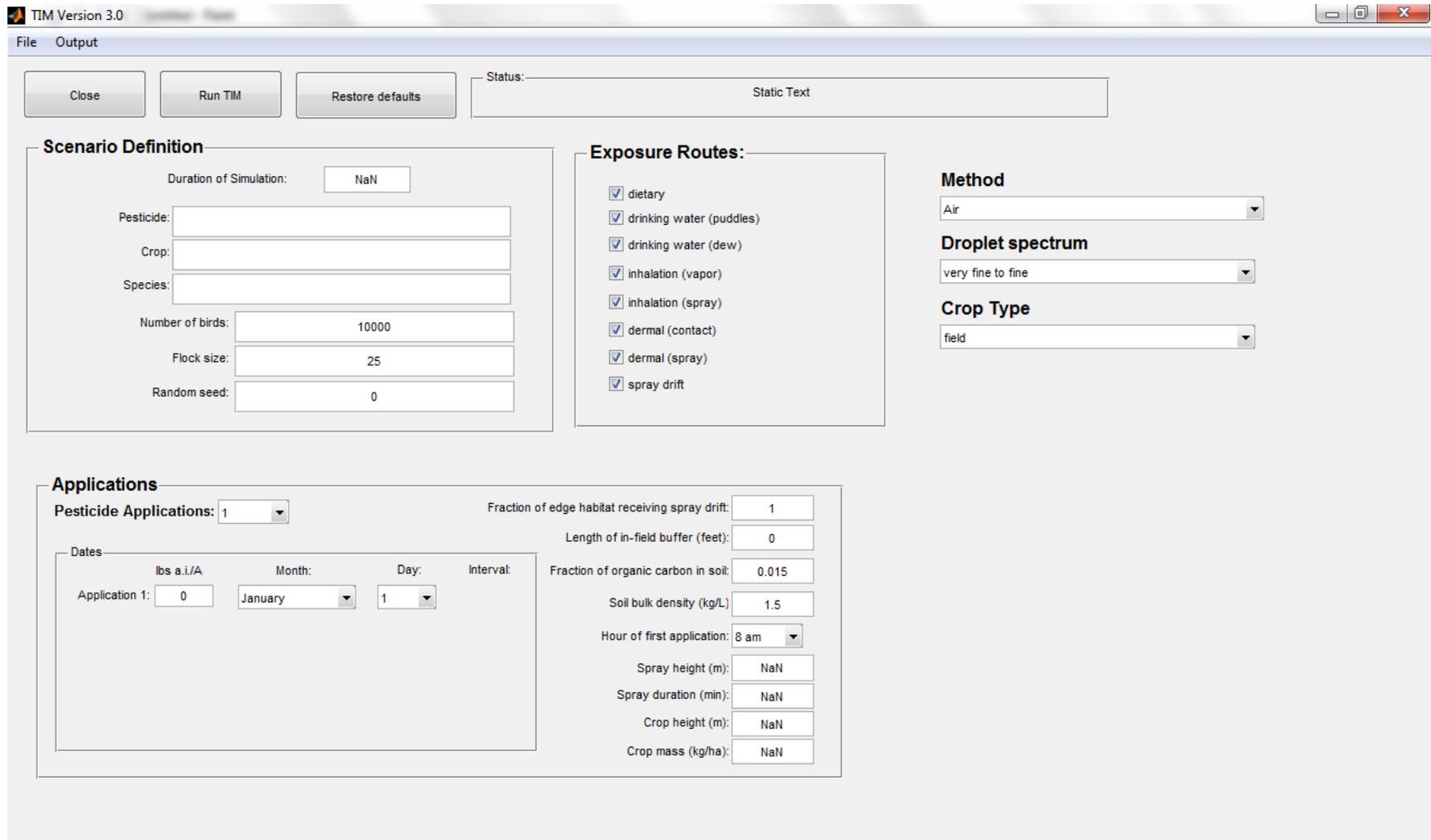
Figure A1. TIMv3.0 (beta) opening screen.

Figure A2. Parameters defining toxicity and physical/chemical properties of simulated pesticide.

Figure A3. Input parameters representing the simulated species.

If the model user chooses to run TIM without the GUI, the executable must be run using a text input file named "TIM_inputs.txt." This input file must be saved to the same directory location as the executable. The order of the parameters in this input file is critical to the proper functioning of the model. An example input file is available in **Appendix B**. The example input file includes descriptions of each parameter, contained within /* */. In order to use this file, the descriptive text, including the /**/ must be removed.

When running TIM through the GUI, an input file titled "TIM_inputs.txt" will be generated automatically. If the model user wishes to save his or her input file for future use or reference, the model user can save the TIM_inputs.txt file to another name. The model user can then reload the input parameters using the GUI by navigating to the file's new name, which has a .mat extension.

Selecting Input Parameter Values

TIM requires up to 93 input parameters. The full list of parameters used by TIM is listed in **Table A1**. In cases where no chemical-specific data are available, default parameters may be used. When first using TIM, it is populated with default parameters. **Table A1** also includes the default input parameters that the modeler may consider using. Guidance for selecting individual parameters is provided below. Note that not all input parameters have a default value. (See parameters where "none" is indicated in **Table A1**).

Table A1. Input Parameters for TIM (v.3.0).

Screen	Parameter	Default Value
Main: scenario definition	Duration of simulation (in days)	none
	Pesticide (name)	none
	Crop (name)	none
	Species (name)	none
	Number of birds simulated	10,000
	Flock size	25
	Random seed (Enter 0 if user does not select a seed)	0
Main: exposure routes	Food switch	On
	Drinking water puddle switch	On
	Drinking water dew switch	On
	Inhalation vapor switch	On
	Inhalation spray switch	On
	Dermal contact switch	On
	Dermal spray switch	On
	Spray drift switch	On
Main	Method	none
	Droplet spectrum	none

Screen	Parameter	Default Value
	Crop type	none
Main: Applications	Number of applications	none
	Rate of application #1 (lb a.i./A)	none
	Date of application #1	none
	Rate of application #2 (lb a.i./A)	none
	Date of application #2	none
	Rate of application #3 (lb a.i./A)	none
	Date of application #3	none
	Rate of application #4 (lb a.i./A)	none
	Date of application #4	none
	Rate of application #5 (lb a.i./A)	none
	Date of application #5	none
	Fraction of edge habitat receiving drift	1
	Length of in-field spray drift buffer (ft)	0
	Fraction of organic carbon in soil	0.015
	Bulk density of soil (kg/L)	1.5
	Time of first application (hour)	8 am
	Spray height (m)	none
	Spray duration (min)	none
	Crop height (m)	none
	Crop mass (kg/ha)	none
Chemical parameters: toxicity	Avian acute oral LD50 (mg a.i./kg-bw)	none
	Body weight of animals from LD50 (g)	none
	Mineau scaling factor	1.15
	Slope of avian oral LD50	4.5
	Avian acute inhalation LD50 (mg a.i./kg-bw) (enter 0 if no value is available)	0
	Rat inhalation LD50 (mg a.i./kg-bw)	none
	Rat acute oral LD50 (mg a.i./kg-bw)	none
	Respiratory physiology adjustment factor	none
	Chemical specific avian dermal LD50 (enter 0 if no value is available)	0
	Food matrix adjustment factor	1
	Fraction of pesticide retained from one hour to the next	none
	Ratio of juvenile to adult toxicity	1
Chemical parameters: fate	Pesticide half-life in puddles (days)	none
	Koc (L/kg-oc)	none
	Kow	none
	Henry's law constant (atm/m3-mol)	none
	Solubility in water (mg/L)	none
	Dislodgeable foliar residue adjustment factor	0.62

Screen	Parameter	Default Value
	Dermal adsorption fraction	1
	Contaminated fractions of food items	1
	Half-life on food items (days)	35
Species	Choose species (custom or one of 30 generic species)	none
Species: feeding times	Morning start time: min	4
	Morning start time: max	5
	Morning end time: min	6
	Morning end time: max	10
	Afternoon start time: min	16
	Afternoon start time: max	19
	Afternoon end time: min	20
	Afternoon end time: max	21
	Prop min (Minimum proportion of daily feeding occurring in the morning)	0.4
	Prop max (Maximum proportion of daily feeding occurring in the morning)	0.6
	Gorging factor	1
Species: body weight (custom species only)	Mean (g)	none
	Standard deviation (g)	none
	Minimum (g)	none
	Maximum (g)	none
Species: field fidelity (custom species only)	Field resident	none
	Fidelity factor (edge residents = 0.6, field residents = 0.8)	none
	Frequency on field: mean	none
	Frequency on field: min	none
	Frequency on field: max	none
Species: species type (custom species only)	Passerine	On
	Precocial	Off
	Feeding category: (1 = insectivore, 2 = herbivore, 3 = granivore, 4 = omnivore)	none
Species: daily proportions (in diet; custom species only)	Adults: insects	none
	Adults: seeds	none
	Adults: fruit	none
	Adults: grass	none
	Adults: broadleaf	none
	Juveniles: insects	1.0
	Juveniles: seeds	0
	Juveniles: fruit	0
	Juveniles: grass	0
	Juveniles: broadleaf	0

Main TIM Input Screen (Figure A1)

Scenario Definition

Names of pesticide, crop, and species: Several input parameters are intended to aid the user in differentiating the modeling scenario from other scenarios. These input parameters include the names of the pesticide, crop and species. These input parameters do not impact the model results in any way. Each of these parameters has a character limit of 50 (including spaces).

Number of birds: The default value for the number of birds is 10,000. This number was selected because it is sufficiently large to capture the variability in model outputs. The model user should note that running a simulation with significantly fewer trials will not return stable results upon repeat. An alternative parameter value could be the population estimate of the simulated bird species, if that size is >10,000.

Flock size: This value is used to determine the probabilities associated with mortality to different numbers of birds within a small group of birds or a flock. For generic birds, this value should be set to 25. For specific species that have low population estimates (*e.g.,* Atwater's prairie chicken estimated population is 90), the user may choose to enter the population number, which would generate probability estimates of mortality to different proportions of the population. This approach assumes that all individuals of the population are exposed to the pesticide.

Random Seed: This value sets the seed that is used by the random number generator. The user may choose to set the seed to a specific value when attempting to repeat previous results. The seed can have as many as ten digits. If the user wishes to use a random seed, a value of 0 should be entered.

Exposure Routes

TIM includes eight switches that control the exposure pathways considered by the model. These pathways include dietary, drinking from puddles, drinking dew, inhalation of volatilized pesticide, inhalation of spray (at the time of application), dermal contact with contaminated foliage, dermal exposure through direct spray (at the time of application), and spray drift transport to edge habitats. As a default, all pathway switches should be turned on. (In the text file, a value of 1 should be entered). The user may choose to turn off a switch if the exposure pathway is not relevant to the application scenario, to explore risk mitigation options (*e.g.,* spray drift reduction) or to explore the model's sensitivity to a specific pathway. As discussed in the technical manual, for some application methods (*i.e.,* ground banded and in-furrow), some switches may be automatically turned off by TIM (regardless of the user input) because the exposure routes are not considered significant. A useful source of information relevant to drinking water sources for specific species is the Birds of North America species profiles (http://bna.birds.cornell.edu/bna/).

Method

Application methods include the following: aerial, ground broadcast, ground banded, ground infurrow and airblast. These application methods may impact the types of exposure routes that are relevant to birds, as well as the spray drift exposure.

In the input text file, the following values are used to define the application method: 1 = Air, 2 = Ground broadcast, 3 = Ground banded, 4 = Ground infurrow, 5 = Airblast.

Droplet Spectrum

For aerial applications, four choices are available for droplet spectra. From most to least conservative, those options are: very fine to fine, fine to medium, medium to coarse and coarse to very coarse.

For ground spray applications, two options are available: very fine to fine and fine to medium/coarse. This may be used for ground broadcast applications as well as ground banded and ground in furrow.

For airblast, there is no need to select a droplet spectrum.

In the text file, the following values are used to define the droplet spectrum: 1= very fine to fine, 2 = fine to medium, 3 = medium to coarse, 4 = coarse to very coarse.

Crop Type

Crop types include field, orchard or vineyard. The type of field may impact the frequency on field of generic birds.

When considering the input text file, the following values apply to the different crops: 1 = field, 2 = orchard, and 3 = vineyard.

Applications

These parameters describe the timing and magnitude of the pesticide applications, as well as the field conditions.

Number of applications: The user should enter the number of applications that may be applied in a season. A maximum of 5 can be entered.

Application rates and dates: The rates (in lb a.i./A) should be entered for each individual application. To the right of each application rate, the date should be entered. The model will automatically calculate the interval (in days) between sequential applications.

Fraction of edge habitat receiving spray drift: Enter the fraction of the edge habitat that receives spray drift. The default assumption is 1, meaning that all sides of the field receive spray drift. This value may be particularly representative of fields with limited non-cropped areas. The

model user may alter this parameter value to represent a particular scenario. For example, for an area with prevailing winds where only one side of the field is expected to receive spray drift, the parameter would be 0.25. This value cannot be >1.

Length of in-field buffer: Enter the length of the in-field spray drift buffer in feet. The default assumption for this parameter is 0 (*i.e.,* there is no in-field buffer).

Fraction of organic carbon in soil: Enter the fraction of organic carbon present in the soil. The default is 0.015. The user may select an alternative value that is representative of a PRZM scenario and the use of interest (**Table A2**).

Soil bulk density: The default is 1.5 kg/L. The user may select an alternative value that is representative of a PRZM scenario and the use of interest (**Table A2**).

Table A2. Parameter Values for Fraction of Organic Carbon and Bulk Density of Soils for Standard EFED PRZM Scenarios (Field Crops, Orchards and Vineyards)

PRZM Scenario	Fraction of organic carbon	Bulk density (kg/L)
CAalfalfa_WirrigOP	0.0177	1.4
CAalmond_WirrigSTD	0.0081	1.6
CAAvocadoRLF_V2	0.0044	1.6
CAcitrus_WirrigSTD	0.0046	1.6
CAColeCropRLF_V2	0.0174	1.5
CAcornOP	0.0058	1.6
CAcotton_WirrigSTD	0.0029	1.5
CAForestryRLF	0.0116	1.4
CAfruit_WirrigSTD	0.0058	1.7
CAGarlicRLF_V3	0.0046	1.5
CAgrapes_WirrigSTD	0.0072	1.8
CAlettuceSTD	0.00725	1.6
CAMelonsRLF_V2	0.0046	1.5
CAOliveRLF_V2	0.0116	1.4
CAonion_WirrigSTD	0.0091	1.4
CAPotatoRLF_V2	0.0014	1.6
CArangelandhayRLF_V2	0.0116	1.3
CARowCropRLF_V2	0.0174	1.4
CAStrawberry-noplasticRLF_V2	0.0058	1.7
CAsugarbeet_WirrigOP	0.0348	1.4
CAtomato_WirrigSTD	0.0095	1.3
CAWheatRLF_V2	0.0044	1.6
CAWineGrapesRLF_V2	0.0116	1.4
FLcabbageSTD	0.0116	1.7
FLcarrotSTD	0.0116	1.7
FLcitrusSTD	0.0232	1.5

PRZM Scenario	Fraction of organic carbon	Bulk density (kg/L)
FLcucumberSTD	0.0116	1.7
FLpeppersSTD	0.0116	1.7
FLpotatoNMC	0.03	1.3
FLstrawberry_WirrigSTD	0.0116	1.3
FLsugarcaneSTD	0.0232	1.5
FLsweetcornOP	0.0116	1.7
FLtomatoSTD_V2	0.0116	1.7
GAOnion_WirrigSTD	0.0174	1.6
GAPeachesSTD	0.0029	1.3
GAPecansSTD	0.0116	1.5
IAcornstd	0.0093	1.4
IDNpotato_WirrigSTD	0.0087	1.6
ILalfalfaNMC	0.015	1.5
ILbeansNMC	0.015	1.5
ILCornSTD	0.0232	1.5
INCornStd	0.0116	1.5
KSCornStd	0.0174	1.3
KSsorghumSTD	0.0174	1.6
LAsugarcaneSTD	0.0232	1.7
MeadowBSS	0.0116	1.4
MEpotatoSTD	0.0464	1.3
MIAsparagusSTDv2	0.00655	1.7
MIbeansSTD	0.0348	1.1
MICherriesSTD	0.0174	1.6
MImelonStd	0.0116	1.3
MNalfalfaOP	0.0406	1.4
MNCornStd	0.029	1.3
MNsugarbeetSTD	0.0406	1.4
MOmelonStd	0.00725	1.4
MScornSTD	0.0116	1.7
MScottonSTD	0.0128	1.4
MSsoybeanSTD	0.0128	1.4
NCalfalfaOP	0.0116	1.6
NCappleSTD	0.0058	1.3
NCcornESTD	0.0116	1.5
NCcornWOP	0.0232	1.6
NCcottonSTD	0.0232	1.8
NCpeanutSTD	0.0116	1.5
NCSweetPotatoSTD	0.0116	1.5
NCtobaccoSTD	0.0029	1.6

PRZM Scenario	Fraction of organic carbon	Bulk density (kg/L)
NDcanolaSTD	0.0236	1.5
NDcornOP	0.0406	1.4
NDwheatSTD	0.0406	1.4
NECornStd	0.0174	1.3
NJmelonStd	0.0096	1.6
NYGrapesSTD	0.0348	1.4
OHCornSTD	0.0116	1.6
ORappleSTD	0.023	1.3
ORberriesOP	0.0186	1.4
OrchardBSS	0.0116	1.4
ORfilbertsSTD	0.023	1.3
ORgrassseedSTD	0.0232	1.4
ORhopsSTD	0.0186	1.4
ORmintSTD	0.0116	1.2
ORsnbeansSTD	0.0232	1.4
ORswcornOP	0.0186	1.4
ORwheatOP	0.0464	1.3
ORXmasTreeSTD	0.0116	1.6
PAalfalfaOP	0.0174	1.3
PAappleSTD_V2	0.0116	1.7
PAcornSTD	0.029	1.6
PAtomatoSTD	0.0174	1.3
PAvegetableNMC	0.018	1.3
PRcoffeeSTD	0.023	1.0
RangeBSS	0.0116	1.4
STXcornNMC	0.012	1.5
STXcottonNMC	0.012	1.5
STXgrapefruitNMC	0.012	1.5
STXmelonNMC	0.012	1.5
STXvegetableNMC	0.012	1.5
TXalfalfaOP	0.0116	1.6
TXcornOP	0.0058	1.6
TXcottonOP	0.0073	1.6
TXsorghumOP	0.0058	1.6
TXwheatOP	0.0073	1.6
WAbeansNMC	0.0015	1.5
WAonionsNMC	0.0015	1.5
WAorchardsNMC	0.0045	1.3
WApotatoNMC	0.0045	1.3

Hour of first application: Enter the hour of pesticide application. Aerial applications should be customized at user's discretion; however, agricultural applications of pesticides typically occur between sunrise and sunset. Ground applications may occur at any time of the day. Note that in the input text file, this input parameter is on a 24-hour clock. If no data are available, the user may want to select a morning application that is shortly after sunrise. That will maximize exposure to birds, by allowing exposure to occur during both feeding times of the day of the application.

Spray height: enter the height of the spray boom in meters (m). For ground applications, the default values are 0.5 and 1.3 for low and high booms, respectively. For aerial, the default is 3.

Spray duration: Enter the duration of the application (in min). For ground applications, the default is 0.5 min, and for aerial, the default is 1.5 min.

Crop height: Enter the height of the crop (in m) at the time of application. Consult extension documentation if needed. Note that the crop height does not vary over the simulation.

Crop mass: Enter the mass of the crop (kg wet weight) per hectare at the time of application. This value should be derived by considering the mass per plant at the appropriate growth stage and the number of plants per hectare. This parameter is used for the volatilization route of exposure. If that route is turned off, a value of 1 can be entered.

The following is an illustration of how to calculate the crop mass parameter value. In this example, the crop of interest is corn, and the application is made on July 15. A study in the literature reported an average dry weight of 224 g for corn grown in Kansas[1]. This value is converted to a wet weight basis, assuming that plants are 80%. (T-REX User's Guide[2]). Therefore, the wet-weight of a corn plant on July 15 is 1.12 kg. According to recommendations of the Kansas extension[3], between 13,000 and 36,000 plants should be grown per acre. This translates to 32,000-89,000 plants per hectare. The estimated range of plant mass is 40,000-100,000 kg/ha. The midpoint of this range, which is 70,000 kg/ha, would be an appropriate parameter. If inhalation of vapors is a major pathway of concern for avian mortality, the model user should consider modeling the low and high ends of the range of values for this parameter to determine uncertainty in the model results.

Pesticide Parameters Input Screen (Figure A2)

Toxicity

Avian acute oral LD50: Enter the avian oral LD_{50} from acceptable or supplemental registrant-submitted (OPPTS Guideline 850.2100) or open literature studies. For all toxicity data, non-definitive LD_{50} values should not be used. The model user may choose to create an LD_{50} from a range of available LD_{50} values, such as a percentile from a species sensitivity distribution. (See

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[1] http://www.ksre.ksu.edu/historicpublications/pubs/stb054.pdf
[2] USEPA. 2012a. User's Guide: T-REX Version 1.5 (Terrestrial Residue Exposure Model). Office of Pesticide Programs, Environmental Fate and Effects Division. Available online at: http://www.epa.gov/oppefed1/models/terrestrial/trex/t_rex_user_guide.htm
[3] http://www.ksre.ksu.edu/bookstore/pubs/l818.pdf

Appendix J for a detailed description of how to derive an SSD). The user should consider scaling LD50 values to account for different sensitivities that may be attributed to body weight (*e.g.,* ECOFRAM, 1999). See the section below for instructions on how to scale LD50 values. For custom species, the GUI automatically scales the LD50, accounting for the BWs of the test species and custom species. The GUI does not automatically scale the BW for generic species.

> *How to scale the LD50: If manually scaling the LD50, the body weights (in g) of the assessed species (AW) and test species (TW) should be entered into Equation 8.3. Generally, acute oral tests involve adult animals. If body weight data are not available in the study report, the literature can be cited for species specific body weights. Default body weights for the the bobwhite quail and mallard duck are 178 and 1580 g, respectively. Body weights for additional bird species can be found in Dunning (1984). The Mineau scaling factor (s) is used to adjust bird body weights. If deriving an SSD, all LD50 values should first be scaled to the same AW value.*

Equation 8.3. $Normalized\ LD_{50} = LD_{50} \left(\frac{AW}{TW}\right)^{(s-1)}$

Mean body weight of tested animals: Enter the mean body weight of the birds used to derive the LD50 (above parameter). For custom species, this will be used to scale the body weight of the test species to that of the assessed species.

Mineau scaling factor: This value is used to adjust bird body weights. When chemical specific values are available in Mineau (1996), they should be used. If these values are not available, the default value of 1.15 should be used.

Slope of avian oral LD50: Enter a slope that is representative of the avian oral LD_{50} value. In the case where there is no slope, a default of 4.5 should be used. The user should consider bounding uncertainty associated with the slope, using confidence bounds of the chemical-specific slope or the default confidence interval of 2 and 9. The user should note that slope and LD_{50} are not necessarily independent variables.

Avian acute inhalation LD50: Enter the avian inhalation LD_{50}. If no value is available but a mammalian inhalation LD_{50} is available, enter 0. If no avian or mammalian LD_{50} values are available, enter the avian acute oral LD_{50} (scaled if applicable). The latter approach assumes that the oral and inhalation LD50 values are equivalent.

Generally, avian inhalation toxicity endpoints are expressed as concentration and specific duration based on the exposure period of the test (*e.g.,* 4-hour LC_{50} in mg a.i./L). The user must convert the LC_{50} to a dose-based endpoint (*i.e.,* LD_{50} in mg a.i./kg-bw), using equation 5.10. It should be noted that the body weight and respiration rate used in this equation should be derived based on the test species (BW_{test} and $R_{rate(test)}$). The variable h represents the duration of the exposure period (in hours) and is used to derive the total volume of contaminated air inhaled by the bird during the study. This approach assumes that the birds that died during the study did so after the 4-hour exposure period.

Equation 5.10. $LD_{50} = \frac{LC_{50}*R_{rate(test)}*h}{BW_{test}}$

Rat inhalation LD50: If an avian inhalation value is available and was entered above, enter 0 for this parameter. If an avian inhalation value is not available, enter rat inhalation LD_{50} (mg a.i./kg-bw). As noted above, LC_{50} values from toxicity tests must be converted to an LD_{50}, using Equation 5.10. Either an avian or rat inhalation value MUST be entered. (The program will not run if both of these entries are zero).

Rat acute oral LD50: Enter the rat oral LD_{50} (in mg a.i./kg-bw) from acceptable or supplemental registrant-submitted (OPPTS Guideline 870.1100) or open literature studies. Data from another test species may be entered; however, this test species must be the same as the one tested for the rat inhalation study.

Respiratory physiology adjustment factor: enter 0 for generic species. For custom species, enter the appropriate value based on the BW range relevant to the species (**Table A3**).

Table A3. Respiratory physiology adjustment factors based on BW of custom species.

Approximate BW (g)	Factor
10	2.6
20	2.7
30-50	2.8
60-110	2.9
120-220	3.0
250-500	3.1
550-900	3.2
1000	3.3
2000	3.4

Avian dermal LD50: Enter the chemical specific avian dermal LD_{50} (mg a.i./kg-bw). Enter 0 if no value is available.

Food matrix adjustment factor: The default assumption for this parameter value is 1, meaning that the food matrix does not alter the dose-based toxicity of the chemical. This default should only be altered by the user when chemical-specific data are available to quantify the effects of the food matrix on the dose-based toxicity of the chemical. A FMA value >1 indicates that the dietary matrix decreases the dose-based toxicity of the chemical, while a FMA value <1 indicates that the dietary matrix increases the dose-based toxicity of the chemical.

Fraction of pesticide retained from one hour to the next: Enter the fraction of pesticide retained from one hour to another. Value should be obtained from a magnitude of residue study with poultry (Guideline 860.1480).

The user may also use a value based on the recovery of an organism after exposure to the assessed chemical. For example, if the study is quantifying acetylcholinesterase (AChE) levels in

exposed birds, this input value could represent the increase of AChE after the exposure has ended. In this example, the value would be a surrogate for elimination of the chemical.

Ratio of juvenile to adult toxicity: Enter a value of 1.0, unless chemical specific data are available to derive an alternative ratio. This value represents the ratio of juvenile to adult LD_{50} values; therefore, a value > 1 indicates that juveniles are less sensitive compared to adults.

Chemical Properties

Pesticide half-life in puddles: enter the aerobic soil metabolism half-life in days from standard studies (OCSPP 835.4100). If multiple aerobic soil metabolism half-life values are available, enter the rate constant corresponding to the 90th percentile confidence bound on the mean half-life value. If a single aerobic soil metabolism half-life value is available, enter the rate constant corresponding to 3x the half-life value.

Koc: Enter the mean of available organic carbon – water partition coefficients (Koc; L/kg-oc). Ideally, the same value should also be used when running the Surface Water Concentration Calculator (SWCC).

Kow: Estimates of octanol-water partitioning coefficients (K_{OW}) can be obtained for a pesticide from acceptable or supplemental registrant-submitted studies (OPPTS Guidelines 830.7550, 830.7560, 830.7570) and from scientific literature. One useful source for locating Log K_{OW} data in the scientific literature is Sangster (2007). Before using data from this database, the scientist should review the original citation and determine whether the data are acceptable or supplemental. If no measured values of K_{OW} are available, this value can be estimated using EPI Suite software that includes KOWIN (USEPA, 2009), which considers contributions of the molecule's individual fragments to the overall K_{OW}.

Henry's law constant: Use the measured Henry's Law Constant from submitted product chemistry data (units: atm/m^3-mol). If a measured value is not available, calculate the value from this equation: HENRY = (VP/760)/(SOL/MW), where VP is vapor pressure in torr, MW is the molecular weight in g/mol, and SOL is the solubility in water in mg/L (USEPA, 2002).

Solubility in water: Enter the solubility of the pesticide in water in units of mg a.i./L.

Dislodgeable Foliar Residue Adjustment Factor (F_{dfr}): This is the ratio of the dislodgeable foliar residues (DFR; mg a.i./m^2) to the total pesticide residue (TPR; mg a.i./kg wet weight) at time 0. This value can be calculated using Equation 6.5. DPR is from measured data immediately following pesticide application to the target crop and reported in submissions to the Agency (Guideline 875.2100). The TPR value is based on residues measured immediately following pesticide application to the target crop. If no data are available, a default value of 0.62 should be used.

Equation 6.5. $F_{dfr} = \dfrac{DPR}{TPR}$

Dermal absorption fraction: The default dermal absorption constant is 1. This assumes that 100% of the applied dermal dose is absorbed. The user may define a new fraction given availability of empirical data relevant to this parameter.

Diet: This section defines the contaminated fraction (FC_k) and half-life for each food item. The contaminated fraction should be 1.0 for all food items for aerial, ground broadcast, and airblast applications. For in-furrow or banded spray applications, the pesticide application is assumed to be limited to the portion of the treated field constituting the furrows or bands. For plant food items (*i.e.,* seeds, fruit, grass, broadleaf), FC_k should be set at a fixed value representing the area proportion of the treated field to which pesticide is directly applied. For example, for an in-furrow treatment with 40-inch row spacing and 2-inch wide furrows, FC_k is 0.05 for seeds. For insects, FC_k should be set to 1 for all applications.

In regards to dissipation half-lives, food item-specific half-lives can be entered. In general, only foliar dissipation half-life data are available for a chemical. If specific values are not available for each food item, a foliar dissipation half-life can be used for all values. In either case, the user should consult foliar dissipation half-life guidance on establishing these values. (See User's Guide for T-REX). If no value is available, use the default half-life of 35 d.

Species Input Screen (Figure A3)

The model user has the choice between using a generic species or a specific/custom species, which can be parameterized by the user to represent an avian species of interest. The species can be selected from a drop down menu (titled "Choose species") on the species input screen. The generic species can be used to identify groups of species that may be at risk. In addition, generic species that predominate agricultural areas, such as small to medium sized insectivores and omnivores, may be simulated to consider potential indirect effects to predatory birds or mammals. Specific species and species of interest, including federally-listed endangered and threatened species, may be simulated as a refinement in the assessment.

If a generic species is chosen, the model input page only displays input parameters for feeding times. In this case, input parameter values are not necessary for body weight, field fidelity, species type or diet. Guidance on feeding time inputs are provided below, following Tables A3-A5.

Generic Species

The generic species include small, medium and large sized birds that are insectivores, granivores, herbivores, omnivores and frugivores that are either edge or field residents. With the full combination of diet type, size and residency status, a total of 30 generic species are available to the user for modeling purposes (**Table 2.2 of technical manual**). The generic birds are assumed to be passerines because most birds that visit agricultural areas are Passeriformes and because their exposures are greater than those of non-passeriformes.

Given the observations included in these census studies, not all of the generic birds included in **Table 2.2** are representative of avian species that visit agricultural areas. The most prevalent

species are represented by small to medium sized insectivores, granivores and omnivores. (For details, see Appendix D). If the user is interested in understanding impacts of the pesticide on the general avian community, the edge and field resident, small and medium insectivore, granivore and omnivore birds are the most representative of that community.

Of the available generic species, the highest estimated exposures are for small, field-resident birds eating grass since field residents have the highest FOF and grasses have the highest estimated initial pesticide residues. Small birds are assumed to be more sensitive to pesticide exposure and are assumed to receive higher body burdens relative to larger birds. Although this generic species may be useful as a screen, its representativeness may be limited to small birds with small plants and grass in their diets for some period of time. It is likely that feeding on short grass is not sustainable for a long period of time if grass energy content value used in the model is assumed; however, young shoots are much higher in protein and lipid than mature grasses.

Custom Species

Tables A4-A6 contain input parameters that may be used to represent 56 different species that are also part of the MCnest species library. With the exception of American kestrel, bobolink and mallard, all of these species were observed in avian census studies discussed in **Appendix D**. The user can also simulate other species that are not included on this list. Guidance on deriving values for species specific parameters is provided below.

Body weight: Enter the mean, standard deviation, minimum and maximum parameter values in grams.

Field fidelity parameters: These include residency status, the field fidelity factor and frequency on field.

The residency status may be established according to the nesting habitat and preferences of the species and the likelihood that the treated area does or does not represent the preferred nesting habitat of the species. Click the box if the bird is expected to be a resident of the simulated crop. Note that field residency may vary for a species depending upon whether the pesticide application is made to a field crop or an orchard.

The frequency on field of the simulated birds is drawn from a distribution of values defined by the average, minimum and maximum values for a species. The range of mean frequency on field (FOF) values from these avian census studies and the relevant crops from those studies are included in **Table A4.** The recommended mean FOF value is the highest of the field observations. The highest mean value was selected due to the limited number of field studies available to determine a representative species-specific FOF value. The model user should consider the influence of this parameter on the model results by modeling the available range as the input value for mean FOF. In general, the minimum and maximum values may be assumed to be 0.0 and 1.0, respectively. In cases where the user is simulating a species not included in **Table A4** and no data are available for the species of interest, data from a species similar to the species of interest may be used.

For the field fidelity factor, default values are used for edge and field residents. For edge residents, enter 0.6. For field residents, enter 0.8.

Dietary proportions: The proportion of the adult and juvenile diets attributed to each dietary item should be defined. The total diet should sum to 1.

Species type: Species type is defined by whether a species is a passerine or not and whether the offspring are precocial or altricial. Most passerines are altricial. Also relevant is the dietary category. Dietary categories should be consistent with the dietary fractions. The user must define whether a modeled species is an insectivore, herbivore, granivore or omnivore. As a general rule, a species may be defined as insectivore, herbivore or granivore if >70% of its diet is represented by the appropriate food item. If no food item represents >70% of the diet, the species is identified as an omnivore.

Table A4. Custom Species Parameters for Specific Species: Basic Species Information, Residency Status and Frequency on Field. Based on information provided in Appendix D

Species (scientific name)	Passerine ?	Altricial/ Precocial	Residency (ag. field)	Residency (orchard)	Mean FOF	Range of FOF	Crops where species was observed (in field studies used for FOF)
American crow (*Corvus brachyrhynchos*)	Yes	Altricial	edge	field	0.74	0.03-0.74	apples, cabbage, corn, potatoes, soybeans
American goldfinch (*Carduelis tristis*)	Yes	Altricial	edge	field	0.84	0.02-0.84	apples, cabbage, corn, grapes, potatoes
American kestrel (*Falco sparverius*)	No	Altricial	edge	edge	0.69/0.89*	none	none
American robin (*Turdus migratorius*)	Yes	Altricial	edge	field	0.87	0.02-0.87	alfalfa, apples, cabbage, citrus, corn, grapes, potatoes, soybeans
Ash-throated flycatcher (*Myiarchus cinerascens*)	Yes	Altricial	NA	edge	0.23	0.23	citrus
Barn swallow (*Hirundo rustica*)	Yes	Altricial	edge	field	0.99	0.01-0.99	alfalfa, apples, cabbage, corn, cotton, potatoes, soybeans
Black-capped chickadee (*Poecile atricapillus*)	Yes	Altricial	edge	NA	0.48	0-0.48	alfalfa, cabbage, corn
Blue jay (*Cyanocitta cristata*)	Yes	Altricial	edge	field	0.67	0.01-0.67	alfalfa, apples, cabbage, corn, cotton, potatoes
Blue-gray gnatcatcher (*Polioptila caerulea*)	Yes	Altricial	edge	NA	0.01	0.01	cotton
Blue-winged Teal (*Anas discors*)	No	Precocial	edge	NA	0.65	0.65	corn
Boat-tailed Grackle (*Quiscalus major*)	Yes	Altricial	edge	NA	0.68	0.68	corn
Bobolink (*Dolichonyx oryzivorus*)	Yes	Altricial	field	field	0.97/0.89*	none	none
Brewer's blackbird (*Euphagus cyanocephalus*)	Yes	Altricial	edge	field	0.4	0-0.4	citrus, corn
Canada goose (*Branta canadensis*)	No	Precocial	edge	NA	1	100	corn
Carolina chickadee (*Poecile carolinensis*)	Yes	Altricial	edge	NA	0.08	0-0.08	alfalfa, cotton, potatoes
Carolina wren (*Thryothorus ludovicianus*)	Yes	Altricial	edge	NA	0.01	0-0.01	cotton, potatoes
Cassin's sparrow (*Aimophila cassinii*)	Yes	Altricial	field	NA	0.07	0.07	cotton
Cedar waxwing (*Bombycilla cedrorum*)	Yes	Altricial	edge	field	0.8	0-0.80	apples, cabbage, corn
Chipping sparrow (*Spizella passerina*)	Yes	Altricial	edge	field	0.15-0.88	0.15-0.88	alfalfa, apples, grapes, corn, soybeans
Common grackle (*Quiscalus quiscula*)	Yes	Altricial	edge	NA	0.97	0.02-0.97	alfalfa, cabbage, corn, cotton, potatoes, soybeans

Common yellowthroat (*Geothlypis trichas*)	Yes	Altricial	edge	NA	0.46	0-0.46	cabbage, corn, cotton, potatoes
Dark-eyed junco (*Junco hyemalis*)	Yes	Altricial	edge	NA	0.11	0.11	alfalfa
Dickcissel (*Spiza americana*)	Yes	Altricial	field	NA	1	0.16-1	alfalfa, corn, cotton
Eastern bluebird (*Sialia sialis*)	Yes	Altricial	edge	field	0.79	0.76-0.79	apples, corn
Eastern kingbird (*Tyrannus tyrannus*)	Yes	Altricial	edge	field	0.45	0.01-0.45	alfalfa, corn, grapes
Eastern meadowlark (*Sturnella magna*)	Yes	Altricial	field	NA	0.89	0.88-0.89	alfalfa, corn
Eastern phoebe (*Sayornis phoebe*)	Yes	Altricial	edge	NA	0	0	corn
Field sparrow (*Spizella pusilla*)	Yes	Altricial	edge	NA	1	0.03-1	corn
Grasshopper sparrow (*Ammodramus savannarum*)	Yes	Altricial	field	NA	0.56	0.15-0.56	alfalfa, corn
Great-tailed Grackle (*Quiscalus mexicanus*)	Yes	Altricial	edge	NA	0.35	0.35	corn
Horned lark (*Eremophila alpestris*)	Yes	Altricial	field	NA	0.88	0.36-0.88	corn, cotton, soybeans
House finch (*Carpodacus mexicanus*)	Yes	Altricial	edge	field	0.32	0.02-0.32	citrus, cotton
House sparrow (*Passer domesticus*)	Yes	Altricial	edge	NA	0.63	0.13-0.63	alfalfa, corn, soybeans
House wren (*Troglodytes aedon*)	Yes	Altricial	edge	NA	0.24	0-0.24	alfalfa, corn, potatoes
Killdeer (*Charadrius vociferus*)	No	Precocial	field	field	1	0.65-1	alfalfa, cabbage, corn, grapes, soybeans
Lark bunting (*Calamospiza melanocorys*)	Yes	Altricial	edge	NA	0.07	0.07	corn
Lark sparrow (*Chondestes grammacus*)	Yes	Altricial	edge	NA	0.79	0.33-0.79	corn, cotton
Mallard (*Anas platyrhynchos*)	No	Precocial	edge	edge	0.69/0.89*	none	none
Mourning dove (*Zenaida macroura*)	No	Altricial	edge	field	0.73	0-0.73	alfalfa, apples, citrus, corn, cotton, potatoes, soybeans
Northern bobwhite (*Colinus virginianus*)	No	Precocial	edge	NA	0.53	0.01-0.53	alfalfa, corn, cotton, potatoes
Northern cardinal (*Cardinalis cardinalis*)	Yes	Altricial	edge	NA	0.68	0.01-0.68	alfalfa, corn, cotton, potatoes, soybeans
Northern flicker (*Colaptes auratus*)	No	Altricial	edge	NA	0.29	0-0.29	cabbage, corn, potatoes
Northern mockingbird (*Mimus polyglottos*)	Yes	Altricial	edge	edge	0.35	0.04-0.35	citrus, cotton, potatoes
Ovenbird (*Seiurus aurocapillus*)	Yes	Altricial	edge	NA	0	0	potatoes
Red-winged blackbird (*Agelaius phoeniceus*)	Yes	Altricial	edge	edge	0.89	0.01-0.89	alfalfa, cabbage, citrus, corn, cotton, grapes, potatoes, soybeans
Savannah sparrow (*Passerculus sandwichensis*)	Yes	Altricial	field	field	0.87	0.14-0.87	alfalfa, apples, cabbage, corn, grapes
Tree swallow (*Tachycineta bicolor*)	Yes	Altricial	edge	NA	0.69	0-0.69	cabbage, cotton
Verdin (*Auriparus flaviceps*)	Yes	Altricial	edge	NA	0.57	0.57	cotton
Vesper sparrow (*Pooecetes gramineus*)	Yes	Altricial	field	NA	0.5	0.13-0.50	alfalfa, corn, soybeans

Western meadowlark *(Sturnella neglecta)*	Yes	Altricial	field	NA	0.33	0-0.33	alfalfa, corn
White-crowned sparrow *(Zonotrichia leucophrys)*	Yes	Altricial	edge	NA	0.48	0.48	corn
White-winged dove *(Zenaida asiatica)*	No	Altricial	edge	NA	0.06	0.06	cotton
Willow flycatcher *(Empidonax trailii)*	Yes	Altricial	edge	NA	0	0	corn
Wood thrush *(Hylocichla mustelina)*	Yes	Altricial	edge	NA	0.01	0.01	potatoes
Yellow warbler *(Dendroica petechia)*	Yes	Altricial	edge	NA	0.29	0-0.29	corn, potatoes
Yellow-rumped warbler *(Dendroica magnolia)*	Yes	Altricial	edge	NA	0.09	0.09	corn
*No data are available from avian census studies. Default values are used for field/orchard.							

Table A5. Custom Species Parameter Values for Body Weight[4]

Species (scientific name)	Female BW (g)				Male BW (g)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
American crow *(Corvus brachyrhynchos)*	438	32.0	289	666	458	33.4	302	696
American goldfinch *(Carduelis tristis)*	12.6	0.81	10	17.1	13.2	1.13	8.6	20.7
American kestrel *(Falco sparverius)*	120	9.2	79	182	111	9.3	73	169
American robin *(Turdus migratorius)*	77.3	0.38	63.5	103	77.3	0.38	63.5	103
Ash-throated flycatcher *(Myiarchus cinerascens)*	27.2	2.0	24	31	27.2	2.0	24	31
Barn swallow *(Hirundo rustica)*	18.6	1.49	13.4	23.4	18.6	1.49	13.4	23.4
Black-capped chickadee *(Poecile atricapillus)*	10.8	1.38	8.2	13.6	10.8	1.38	8.2	13.6
Blue jay *(Cyanocitta cristata)*	86.8	8.08	64.1	109	86.8	8.08	64.1	109
Blue-gray gnatcatcher *(Polioptila caerulea)*	6	0.13	4.8	8.9	6	0.13	4.8	8.9
Blue-winged Teal *(Anas discors)*	363	26	240	545	409	29.9	270	590
Boat-tailed Grackle *(Quiscalus major)*	119	8.7	102	132	214	15	175	253
Bobolink *(Dolichonyx oryzivorus)*	37.1	2.71	26.5	44.3	47	3.4	28.5	56.3
Brewer's blackbird *(Euphagus cyanocephalus)*	58.1	4.9	50.6	67	67.2	3.2	60	73
Canada goose *(Branta canadensis)*	3514	257	3062	3912	4181	305	3799	4727
Carolina chickadee *(Poecile carolinensis)*	9.8	0.59	6.5	14.9	10.5	0.72	6.9	16.0
Carolina wren *(Thryothorus ludovicianus)*	21	1.15	14	32	21	1.15	14	32
Cassin's sparrow *(Aimophila cassinii)*	18.9	1.51	14	23.5	18.9	1.51	14	23.5
Cedar waxwing *(Bombycilla cedrorum)*	33.1	1.07	28	40.2	30.6	1.72	25.5	39.6
Chipping sparrow *(Spizella passerina)[5]*	12.5	1.47	10.2	16.5	12.5	1.47	10.2	16.5

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[4] Body weights from Dunning (1984). For standard deviations, minimum and maximum values that were not available, these values were calculated by multiplying the mean by 0.073, 0.66 and 1.52, respectively.

[5] Data not available in Dunning (1984) for chipping sparrow. Body weight information for field sparrow (same genus) used.

Species (scientific name)	Female BW (g)				Male BW (g)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Common grackle (*Quiscalus quiscula*)	100	7.3	66	152	127	9.3	84	193
Common yellowthroat (*Geothlypis trichas*)	9.9	0.78	7.6	15.3	10.3	0.66	7.6	15.5
Dark-eyed junco (*Junco hyemalis*)	18.8	0.78	14.3	25.1	20.4	1.21	14.3	26.7
Dickcissel (*Spiza americana*)	24.6	1.8	16	37	29.3	2.1	19	45
Eastern bluebird (*Sialia sialis*)	31.6	0.92	21	48	31.6	0.92	21	48
Eastern kingbird (*Tyrannus tyrannus*)	39.5	1.85	35.8	40.8	39.5	1.85	35.8	40.8
Eastern meadowlark (*Sturnella magna*)	76	5.5	50	116	102	11.2	67	155
Eastern phoebe (*Sayornis phoebe*)	19.8	7.47	11.4	24.4	19.8	7.47	11.4	24.4
Field sparrow (*Spizella pusilla*)	12.5	1.47	10.2	16.5	12.5	1.47	10.2	16.5
Grasshopper sparrow (*Ammodramus savannarum*)	17	1.34	15	20.3	17	1.34	15	20.3
Great-tailed Grackle (*Quiscalus mexicanus*)	107	11.4	96	140	191	22.8	157	234
Horned lark (*Eremophila alpestris*)	30.8	2.2	20	47	31.9	2.3	21	48
House finch (*Carpodacus mexicanus*)	21.4	1.29	10	25.5	21.4	1.29	10	25.5
House sparrow (*Passer domesticus*)	27.4	2.24	20.1	34.5	28	1.55	20	34
House wren (*Troglodytes aedon*)	10.9	0.8	8.9	14.2	10.9	0.8	8.9	14.2
Killdeer (*Charadrius vociferus*)	101	7.37	87.7	121	92.1	10.4	83.9	109
Lark bunting (*Calamospiza melanocorys*)	37.6	3.66	29.5	51.5	37.6	3.66	29.5	51.5
Lark sparrow (*Chondestes grammacus*)	29	1.94	24.7	33.3	29	1.94	24.7	33.3
Mallard (*Anas platyrhynchos*)	1082	129	720	1580	1082	129	720	1580
Mourning dove (*Zenaida macroura*)	115	1.76	76	175	123	1.85	81	187
Northern bobwhite (*Colinus virginianus*)	178	13.0	117	271	178	13.0	117	271
Northern cardinal (*Cardinalis cardinalis*)	43.9	4.53	33.6	64	45.4	4.29	33.7	63.2
Northern flicker (*Colaptes auratus*)	129	7.67	106	164	135	6.37	114	160
Northern mockingbird (*Mimus polyglottos*)	48.5	3.5	36.2	55.7	48.5	3.5	36.2	55.7
Ovenbird (*Seiurus aurocapillus*)	19.4	1.22	14	28.8	19.4	1.22	14	28.8
Red-winged blackbird (*Agelaius phoeniceus*)	41.5	2.74	29	55	63.6	4.43	52.9	81.8
Savannah sparrow (*Passerculus sandwichensis*)	19.5	2.29	13	30	20.6	1.35	14	31
Tree swallow (*Tachycineta bicolor*)	20.1	1.58	15.6	25.4	20.1	1.58	15.6	25.4
Verdin (*Auriparus flaviceps*)	6.8	0.69	5.5	8.5	6.8	0.69	5.5	8.5
Vesper sparrow (*Pooecetes gramineus*)	24.9	1.8	16	38	26.5	1.9	17	40
Western meadowlark (*Sturnella neglecta*)	89.4	6.5	59	136	106	7.7	70	161
White-crowned sparrow (*Zonotrichia leucophrys*)	32	2.18	27	35.5	32	2.18	27	35.5
White-winged dove (*Zenaida asiatica*)	153	13.2	125	187	153	13.2	125	187
Willow flycatcher (*Empidonax trailii*)	13.7	1.46	11.3	16.4	13.1	1.37	12	15.7
Wood thrush (*Hylocichla mustelina*)	47.4	4.17	39.2	57.7	47.4	4.17	39.2	57.7
Yellow warbler (*Dendroica petechia*)	9.2	0.59	7.4	16	9.8	0.68	7.9	12.8

Species (scientific name)	Female BW (g)				Male BW (g)			
	Mean	SD	Min	Max	Mean	SD	Min	Max
Yellow-rumped warbler *(Dendroica magnolia)*	8.5	0.35	6.6	12.6	8.9	0.58	7	12.9

Table A6. Custom Species Parameters for Diet. Based on MCnest species library

Species (scientific name)	Feeding category[6]	Adult diet					Juvenile diet				
		insects	seeds	fruit	grass	broadleaf	insects	seeds	fruit	grass	broadleaf
American crow *(Corvus brachyrhynchos)*	Omnivore	0.28	0.54	0.18	0	0	0.165	0.835	0	0	0
American goldfinch *(Carduelis tristis)*	Granivore	0	1	0	0	0	0	1	0	0	0
American kestrel *(Falco sparverius)*	Insectivore	1	0	0	0	0	1	0	0	0	0
American robin *(Turdus migratorius)*	Insectivore	0.72	0	0.28	0	0	0.7	0	0.3	0	0
Ash-throated flycatcher *(Myiarchus cinerascens)*	Insectivore	1	0	0	0	0	1	0	0	0	0
Barn swallow *(Hirundo rustica)*	Insectivore	1	0	0	0	0	1	0	0	0	0
Black-capped chickadee *(Poecile atricapillus)*	Insectivore	0.9	0.05	0.05	0	0	1	0	0	0	0
Blue jay *(Cyanocitta cristata)*	Omnivore	0.4	0.6	0	0	0	0.4	0.6	0	0	0
Blue-gray gnatcatcher *(Polioptila caerulea)*	Insectivore	1	0	0	0	0	1	0	0	0	0
Blue-winged Teal *(Anas discors)*	Insectivore	0.91	0.09	0	0	0	1	0	0	0	0
Boat-tailed Grackle *(Quiscalus major)*	Insectivore	0.92	0	0.08	0	0	1	0	0	0	0
Bobolink *(Dolichonyx oryzivorus)*	Omnivore	0.57	0.43	0	0	0	1	0	0	0	0
Brewer's blackbird *(Euphagus cyanocephalus)*	Insectivore	0.82	0.18	0	0	0	1	0	0	0	0
Canada goose *(Branta canadensis)*	Herbivore	0	0	0	1	0	0	0	0	1	0
Carolina chickadee *(Poecile carolinensis)*	Insectivore	0.9	0.05	0.05	0	0	1	0	0	0	0
Carolina wren *(Thryothorus ludovicianus)*	Insectivore	0.98	0.02	0	0	0	1	0	0	0	0

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[6] If species diets are ≥ 70% insects, they are identified as insectivores. This same cutoff applies to herbivores and granivores. If no dietary item represents ≥ 70% of the overall diet, the species is considered an omnivore.

Species (scientific name)	Feeding category[6]	Adult diet					Juvenile diet				
		insects	seeds	fruit	grass	broadleaf	insects	seeds	fruit	grass	broadleaf
Cassin's sparrow (*Aimophila cassinii*)	Insectivore	1	0	0	0	0	1	0	0	0	0
Cedar waxwing (*Bombycilla cedrorum*)	Frugivore	0.2	0	0.8	0	0	0.2	0	0.8	0	0
Chipping sparrow (*Spizella passerina*)	Omnivore	0.38	0.62	0	0	0	0.2	0.8	0	0	0
Common grackle (*Quiscalus quiscula*)	Granivore	0.3	0.7	0	0	0	1	0	0	0	0
Common yellowthroat (*Geothlypis trichas*)	Insectivore	1	0	0	0	0	1	0	0	0	0
Dark-eyed junco (*Junco hyemalis*)	Omnivore	0.6	0.4	0	0	0	1	0	0	0	0
Dickcissel (*Spiza americana*)	Insectivore	0.7	0.3	0	0	0	1	0	0	0	0
Eastern bluebird (*Sialia sialis*)	Insectivore	0.93	0	0.07	0	0	1	0	0	0	0
Eastern kingbird (*Tyrannus tyrannus*)	Insectivore	0.855	0	0.145	0	0	1	0	0	0	0
Eastern meadowlark (*Sturnella magna*)	Insectivore	0.9	0.1	0	0	0	1	0	0	0	0
Eastern phoebe (*Sayornis phoebe*)	Insectivore	1	0	0	0	0	1	0	0	0	0
Field sparrow (*Spizella pusilla*)	Omnivore	0.5	0.5	0	0	0	1	0	0	0	0
Grasshopper sparrow (*Ammodramus savannarum*)	Omnivore	0.61	0.39	0	0	0	1	0	0	0	0
Great-tailed Grackle (*Quiscalus mexicanus*)	Insectivore	1	0	0	0	0	1	0	0	0	0
Horned lark (*Eremophila alpestris*)	Granivore	0.27	0.73	0	0	0	1	0	0	0	0
House finch (*Carpodacus mexicanus*)	Granivore	0.05	0.88	0.07	0	0	0.02	0.98	0	0	0
House sparrow (*Passer domesticus*)	Granivore	0.04	0.96	0	0	0	0.68	0.32	0	0	0
House wren (*Troglodytes aedon*)	Insectivore	1	0	0	0	0	1	0	0	0	0
Killdeer (*Charadrius vociferus*)	Insectivore	1	0	0	0	0	1	0	0	0	0
Lark bunting (*Calamospiza melanocorys*)	Omnivore	0.64	0.36	0	0	0	1	0	0	0	0
Lark sparrow (*Chondestes grammacus*)	Omnivore	0.5	0.5	0	0	0	1	0	0	0	0
Mallard (*Anas platyrhynchos*)	Insectivore	0.72	0.28	0	0	0	0.9	0.1	0	0	0
Mourning dove (*Zenaida macroura*)	Granivore	0	1	0	0	0	0	1	0	0	0

Species (scientific name)	Feeding category[6]	Adult diet					Juvenile diet				
		insects	seeds	fruit	grass	broadleaf	insects	seeds	fruit	grass	broadleaf
Northern bobwhite *(Colinus virginianus)*	Granivore	0.2	0.8	0	0	0	0.9	0.1	0	0	0
Northern cardinal *(Cardinalis cardinalis)*	Omnivore	0.61	0.39	0	0	0	1	0	0	0	0
Northern flicker *(Colaptes auratus)*	Insectivore	0.9	0	0.1	0	0	0.9	0	0.1	0	0
Northern mockingbird *(Mimus polyglottos)*	Insectivore	0.85	0	0.15	0	0	1	0	0	0	0
Ovenbird *(Seiurus aurocapillus)*	Insectivore	1	0	0	0	0	1	0	0	0	0
Red-winged blackbird *(Agelaius phoeniceus)*	Insectivore	0.71	0.29	0	0	0	1	0	0	0	0
Savannah sparrow *(Passerculus sandwichensis)*	Insectivore	1	0	0	0	0	1	0	0	0	0
Tree swallow *(Tachycineta bicolor)*	Insectivore	1	0	0	0	0	1	0	0	0	0
Verdin *(Auriparus flaviceps)*	Insectivore	1	0	0	0	0	1	0	0	0	0
Vesper sparrow *(Pooecetes gramineus)*	Omnivore	0.56	0.44	0	0	0	1	0	0	0	0
Western meadowlark *(Sturnella neglecta)*	Insectivore	0.9	0.1	0	0	0	1	0	0	0	0
White-crowned sparrow *(Zonotrichia leucophrys)*	Omnivore	0.36	0.64	0	0	0	1	0	0	0	0
White-winged dove *(Zenaida asiatica)*	Granivore	0	1	0	0	0	0	1	0	0	0
Willow flycatcher *(Empidonax trailii)*	Insectivore	1	0	0	0	0	1	0	0	0	0
Wood thrush *(Hylocichla mustelina)*	Omnivore	0.65	0	0.35	0	0	1	0	0	0	0
Yellow warbler *(Dendroica petechia)*	Insectivore	1	0	0	0	0	1	0	0	0	0
Yellow-rumped warbler *(Dendroica magnolia)*	Insectivore	0.85	0	0.15	0	0	1	0	0	0	0

Feeding Times

In TIM, birds have two different feeding periods during the day, *i.e.,* morning and afternoon. Times are expressed on a 24-hour clock. These times are based on the sunrise and sunset, as well as the heat of the day. The heat of the day is assumed to occur from 10 to 16 (*i.e.,* 10 am to 4 pm). The model user can parameterize the morning and afternoon feeding times based on the sunset and sunrise times for a geographical region that is being represented. For sunrise and sunset in the expected area of application, consult the following website: http://www.usno.navy.mil/USNO/astronomical-applications/data-services/rs-one-day-us.

For generic species, sunrise and sunset times in the geographic center of the 48 contiguous United States (*i.e.,* Lebanon, KS) are used. During the months when pesticide applications for agricultural purposes are most likely to occur (*i.e.,* May-August), sunrise times are between 5 and 6 (**Table A7**) and sunset times are generally between 19 and 20[7] (**Table A8**). The default times for sunrise and sunset are 5 and 20, which is representative of the summer solstice. For generic birds, the values are set to 4 and 5. If the application is expected to occur at a different time, the user may choose to alter the default assumption for sunrise and sunset using the times provided in **Tables A7 and A8**.

Table A7. Average of Daily Sunrise Times for Lebanon, KS (Geographic Center of Contiguous US).[1]

Statistic	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Average	752	727	652	574	520	507	520	550	616	650	719	748
Min	743	709	620	536	508	505	510	533	602	631	703	736
Max	756	742	707	618	535	509	532	601	630	702	735	755

Table A8. Average of Daily Sunset Times for Lebanon, KS (Geographic Center of Contiguous US).[1]

Statistic	Jan	Feb	Mar	Apr	May	June	July	Aug	Sept	Oct	Nov	Dec
Average	1736	1803	1842	1910	1943	1997	1983	1928	1847	1768	1719	1712
Min	1720	1754	1826	1858	1929	1956	1948	1907	1818	1733	1710	1709
Max	1753	1825	1857	1928	1956	2007	2006	1947	1905	1817	1732	1719

Minimum and maximum feeding start times for morning: These times should be set to 1 hour before sunrise and sunrise, respectively. Therefore, the default values are set to 4 and 5.

Minimum and maximum feeding end times for morning: The minimum is set to 1 hour after sunrise, and the maximum depends upon the heat of the day. These values are set to 6 and 10.

Minimum and maximum feeding start times for afternoon: The minimum is based on the heat of the day, and the maximum is set to 1 hour before sunset. Therefore, the default parameters are 16 and 19.

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[7] http://aa.usno.navy.mil/cgi-bin/aa_rstablew.pl

Minimum and maximum feeding <u>end</u> times for <u>afternoon</u>: These times should be set to sunset and 1 hour after sunset, respectively. Therefore, these values are set to 20 and 21.

Prop min and Prop max: These values account for the ratio of time spent feeding in the morning to time spent feeding in the afternoon. The two input parameters correspond to the minimum and maximum values that may be assigned to this ratio for an individual bird on a given day. The default assumption for the minimum and maximum values are 0.4 and 0.6.

Gorging factor: A value >1 is intended to account for an increase in feeding that may occur when a bird is migrating or when excessive prey may be available. The model user should select a value representative of the species and situation being simulated (given available data). ECOFRAM suggested a value in the range of 2-5 for gorging. A value of 1 should be entered when simulating normal feeding (*e.g.,* during the breeding season). This value should not be <1.

Running the Model

Running TIM with the GUI: After entering all input parameter values, the model user should save the input file. This can be accomplished by selecting "Save TIM parameters" from the "File" menu at the upper left corner of the main input page of the GUI. This will generate a file with the extension ".mat". After the file is saved, the model user should hit the "Run TIM" button on the main page of the GUI. A DOS screen will appear and display some results generated by TIM. In the upper right hand corner of the GUI, in the box titled "Status", the display will indicate when the TIM run is complete. If all input parameters are not completed, the GUI may generate an error message, prompting the user to go back to specific parameters for revision.

Running TIM without the GUI (with the text input file): If running TIM without the GUI, the user should save the input file (named "TIM_inputs.txt") to the same folder location as the executable. The model user should double click on the executable file, and the model will run. A DOS screen will appear and display some results generated by TIM. When the model run is complete, several text files with model outputs will be generated and saved to the same directory where the executable is housed. Two files include results that are intended for the model user: Model_Results.txt and Dead_per_hour.txt. These results are discussed below. The model user may also "turn on" the TIM QC report files or the text files containing input data used by MCnest. See the example input file in **Appendix B** for the location of these switches in the input file. If the user wishes to save the model outputs, these files should be saved to another directory. These steps should be followed because each time the TIM executable is run, it replaces older versions of the output files with the newest run. Before moving on to interpreting the results, the model user should review the input parameters that are reported in the "Model_Results.txt" output file. If any of the input parameter values are incorrect, the user should revisit the input file ("TIM_inputs.txt") and correct the necessary parameter values.

Model Results

TIM generates two output files that contain information on the doses and mortalities to individual birds as well as summary statistics. These model outputs can be accessed using the main page of the GUI by clicking on the "Outputs" menu in the upper left hand corner. Two types of outputs are generated: files and plots. The files are text files and the plots are graphs that depict the model results (**Figures A4, A5 and A6,** below).

Of the text output files generated by TIM, the file titled "Model_results.txt" is of most use because it reports the number of dead birds from the simulation and provides information on the relative importance of the different exposure pathways. This output file also contains a summary of the input parameters selected by the user, as well as default values corresponding to a selected generic species. Additional information provided in this file as well as other output files generated by TIM are discussed below.

Model Results

This output includes the model input values. The model user should review the parameters reported in the Model Results output in order to catch any values incorrectly entered into the input file.

This output file generates summary statistics for the number of dead birds and the percent of total simulated birds that died.

This output also generates two tables of values that can be used to characterize the risks of the simulated pesticide use to birds. **Table A9** provides the minimum, maximum, mean and standard deviations of the fractions of total pesticide dose by exposure route for birds that died during the simulation. **Figure A4** depicts this information in a whisker-box plot. This figure may be accessed by the user by selecting the "Dose Fractions" plot under the output menu. As demonstrated by this figure in the lethal birds simulated in this example, pesticide doses received by diet and drinking dew were the major routes of exposure leading to mortality in the simulated birds.

Table A9. For Dead Birds: Median, Mean, Standard Deviation, Minimum and Maximum of Fractions of Total Pesticide Dose by Exposure Route

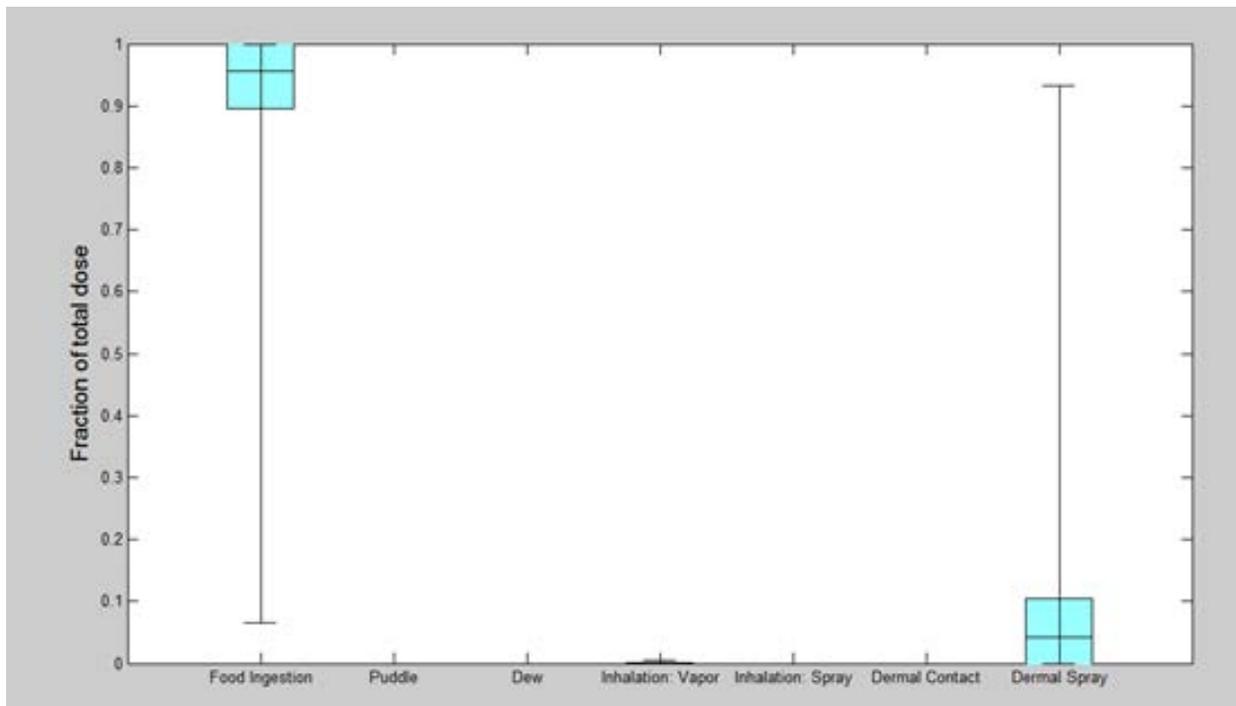| Exposure route	Median	Mean	SD	Minimum	Maximum
Food Ingestion	0.979	0.957	0.062	0.066	1
Drinking: Puddle	0	0	0	0	0
Drinking: Dew	0	0	0	0	0
Inhalation: Vapor	0.001	0.001	0	0	0.004
Inhalation: Spray	0	0	0	0	0
Dermal Contact	0	0	0	0	0
Dermal Spray	0.019	0.042	0.062	0	0.932

Figure A4. Relative Contributions of Different Exposure Pathways to Lethal Doses in Simulated Birds. Box plots represent mean and standard deviations of fractions, with minimum and maximum represented by lines.

Table A10 includes the Probability Density Function (PDF), Cumulative Distribution Function (CDF) and Complementary Cumulative Distribution Function (CCDF) associated with all of the simulated birds (risk) and the exposed birds (adjusted risk). Birds are sorted into flocks of 25, based on user input for flock size. **Figure A5** depicts the PDF, CDF, and CCDFs for the example data provided in **Table A10.** This figure may be accessed by the user by selecting the "Mortality distribution" plot under the output menu. The PDF is used to determine the probability associated with killing exactly x birds. The CDF describes the probability of killing x or fewer birds. The CCDF provides the probability of killing greater than x birds.

Table A10. Probabilities of Mortality to x Birds out of the Flock. Values Generated for PDF, DCF and CCDF. Note that values depicted as 0 or 1 are rounded.

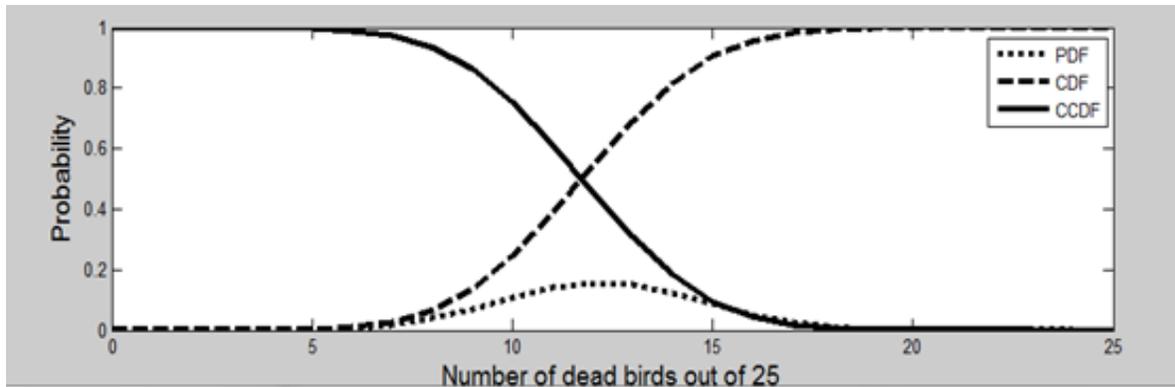| Dead (x)	PDF (probability of killing x birds)	CDF (probability of killing ≤x birds)	CCDF (probability of killing >x birds)
0	1E-07	1E-07	1
1	1.2E-06	1.3E-06	0.999999
2	1.38E-05	1.51E-05	0.999985
3	0.000102	0.000117	0.999883
4	0.000536	0.000652	0.999348
5	0.002158	0.00281	0.99719
6	0.006897	0.009707	0.990293
7	0.017949	0.027656	0.972344
8	0.038725	0.066381	0.933619
9	0.070139	0.13652	0.863481
10	0.107606	0.244126	0.755874
11	0.140701	0.384827	0.615173
12	0.1574	0.542227	0.457773
13	0.150926	0.693153	0.306847
14	0.124045	0.817198	0.182802
15	0.087225	0.904423	0.095577
16	0.052274	0.956697	0.043303
17	0.026536	0.983233	0.016767
18	0.011309	0.994542	0.005459
19	0.003995	0.998537	0.001464
20	0.001149	0.999686	0.000314
21	0.000262	0.999948	5.19E-05
22	4.57E-05	0.999994	6.2E-06
23	5.7E-06	1	5E-07
24	5E-07	1	0
25	0	1	0

Figure A5. PDF, CDF and CCDF Values Generated by TIM for Risk to All Simulated Birds.

The PDF is useful in telling the risk assessor the most likely magnitude of mortality to birds, based on the parameters of the simulation. For example, based on the model results provided in **Table A10,** it is most likely that 13 birds out of the flock of 25 will die (probability = 0.15). Another way to use the PDF data would be to get an understanding of the magnitude of mortality. For example, based on the data in Table A10, there is a 95% chance that 8-17 (out of 25) birds will die. In addition, the results of the PDF may be used to interpret population level effects of avian mortality. For example, the most likely decreases in survival of adult birds could be input to a population model to determine impacts to a species. This information could be useful in interpreting whether a risk that is likely to adversely affect a listed bird species may also result in jeopardy to that population.

The results of the CCDF may be the most relevant when considering risks to listed species of birds. For pesticide effects determinations, EPA determines the potential that a pesticide may affect one individual. The CCDF can be used to describe the likelihood of killing one or more individuals. In the example data provided in **Table A10,** the likelihood of killing one individual of a flock of 25 birds near and on a treated field is >0.999.

Dead Per Hour

This output file contains two columns that are separated by a space. The first column indicates the simulation hour, and the second is the number of birds that died during the simulation. This information can be used to understand the timing of the mortalities relative to the applications. **Figure A6** below depicts an example of the mortalities per hour.
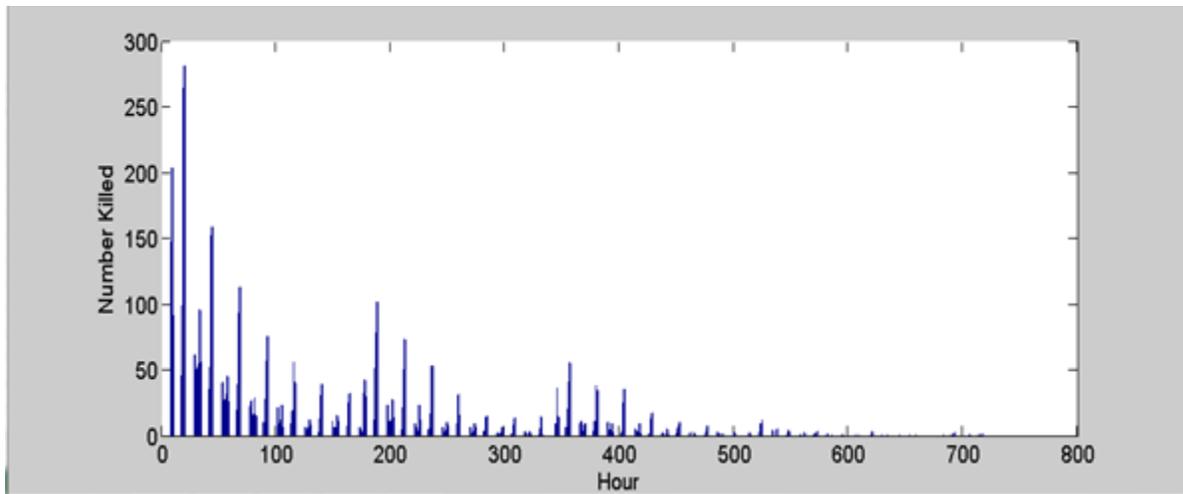
Figure A6. Example Output Depicting Number of Simulated Birds That Died Per Hour.