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CounterPOPd Web Interactive: Software to investigate the population scale impact of lead in bald eagles in the Northeast United States from 1990-2018

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Overview of the software application

We integrated veterinary data on lead toxicosis in breeding adult bald eagles from seven Northeastern United States (CT, ME, MA, NJ, NY, NH, and VT) with current population dynamics (“EaglePOPd; software application; <https://doi.org/10.7298/q4m1-se95>) to create a comparative software application that is used to explore the differences in population dynamics that arise in the presence and absence of Pb.

This CounterPOPd interactive application allows the user to view and compare the algorithm-predicted asymptotic and transient population properties for male and female bald eagles in the Northeast, USA between 1990-2018. Comparisons include three scenarios: (1) current (Pb) scenario (“Northeast, US”), (2) hypothetical scenario with the removal Pb poisoning cases (“Exper.I”), and (3) hypothetical scenario with the removal of all Pb exposure cases (“Exper.II”).

Comparative demographic properties include:

- 1) Life table
- 2) Predicted annual abundances
- 3) Predicted bi-annual abundances

- 4) Predicted bi-annual hatchling abundances
- 5) Predicted bi-annual immature and non-breeding adult abundances
- 6) Predicted bi-annual breeding adult abundances
- 7) Predicted abundances during the breeding period
- 8) Predicted abundances during the non-breeding period
- 9) Migration and dispersal
- 10) Asymptotic growth rates
- 11) Survival rates
- 12) Stable stage distribution
- 13) Reproductive value
- 14) Sensitivities
- 15) Elasticities
- 16) Damping ratio and convergence time
- 17) Cumulative growth
- 18) Stochastic growth rate
- 19) Transient growth rate
- 20) Harmonic vs. arithmetic mean abundances
- 21) Loss of genetic diversity
- 22) Population inertia
- 23) Reactivity
- 24) Maximum amplification
- 25) Maximum attenuation

Interactive Software User Tutorial

Preparing and running the software for female and male bald eagles:

Running the app for female bald eagles:

Step 1: Download the “CounterPOPd for Females” folder.

Step 2: Inside the folder, you will find several pre-saved .txt files:

“BestAlgorithmPredictedModelsNORTHEAST.txt”,
 “BestAlgorithmPredictedModelsCOUNTERFACTUAL_PAIN_A.txt”,
 “BestAlgorithmPredictedModelsCOUNTERFACTUAL_PAIN_C.txt”,
 “NEW_AA_NORTHEAST”,
 “NEW_AA_COUNTERFACTUAL_PAIN_A.txt”,
 “NEW_AA_COUNTERFACTUAL_PAIN_C.txt”,
 “NEW_PA_NORTHEAST”,
 “NEW_PA_COUNTERFACTUAL_PAIN_A.txt”,
 “NEW_PA_COUNTERFACTUAL_PAIN_C.txt”,
 “NEW_SA_NORTHEAST”,
 “NEW_SA_COUNTERFACTUAL_PAIN_A.txt”,
 “NEW_SA_COUNTERFACTUAL_PAIN_C.txt”,
 “NEW_PS_NORTHEAST”,
 “NEW_PS_COUNTERFACTUAL_PAIN_A.txt”,
 “NEW_PS_COUNTERFACTUAL_PAIN_C.txt”,
 “NEW_Adults_January_NORTHEAST”,

“NEW_Adults_January_COUNTERFACTUAL_PAIN_A.txt”,
 “NEW_Adults_January_COUNTERFACTUAL_PAIN_C.txt”,
 “NEW_Adults_June_NORTHEAST”,
 “NEW_Adults_June_COUNTERFACTUAL_PAIN_A.txt”,
 “NEW_Adults_June_COUNTERFACTUAL_PAIN_C.txt”,
 “NEW_Subadults_January_NORTHEAST”,
 “NEW_Subadults_January_COUNTERFACTUAL_PAIN_A.txt”,
 “NEW_Subadults_January_COUNTERFACTUAL_PAIN_C.txt”,
 “NEW_Subadults_June_NORTHEAST”,
 “NEW_Subadults_June_COUNTERFACTUAL_PAIN_A.txt”,
 “NEW_Subadults_June_COUNTERFACTUAL_PAIN_C.txt”,
 “NEW_Juveniles_June_NORTHEAST”,
 “NEW_Juveniles_June_COUNTERFACTUAL_PAIN_A.txt”,
 “NEW_Juveniles_June_COUNTERFACTUAL_PAIN_C.txt”,
 “NEW_AdultsAbsorbPercent_NORTHEAST”,
 “NEW_AdultsAbsorbPercent_COUNTERFACTUAL_PAIN_A.txt”,
 “NEW_AdultsAbsorbPercent_COUNTERFACTUAL_PAIN_C.txt”,
 “NEW_AdultsPurgePercent_NORTHEAST”,
 “NEW_AdultsPurgePercent_COUNTERFACTUAL_PAIN_A.txt”,
 “NEW_AdultsPurgePercent_COUNTERFACTUAL_PAIN_C.txt”,
 “NEW_SubadultsAbsorbPercent_NORTHEAST”,
 “NEW_SubadultsAbsorbPercent_COUNTERFACTUAL_PAIN_A.txt”,
 “NEW_SubadultsAbsorbPercent_COUNTERFACTUAL_PAIN_C.txt”,
 “NEW_SubadultsPurgePercent_NORTHEAST”,
 “NEW_SubadultsPurgePercent_COUNTERFACTUAL_PAIN_A.txt”,
 “NEW_SubadultsPurgePercent_COUNTERFACTUAL_PAIN_C.txt”,
 “NEW_TIMESERIES_NORTHEAST”,
 “NEW_TIMESERIES_COUNTERFACTUAL_PAIN_A.txt”,
 “NEW_TIMESERIES_COUNTERFACTUAL_PAIN_C.txt”,
 “TIMESERIES_NORTHEAST.txt”,
 “TIMESERIES_TIMESERIES_COUNTERFACTUAL_PAIN_A.txt”,
 “TIMESERIES_TIMESERIES_COUNTERFACTUAL_PAIN_C.txt”

Step 3: Save these text files in a specific location on your computer.

Step 4: Open R.

Step 5: In R Studio, install the appropriate versions of the six packages: “shinyBS”, “shiny”, “popdemo”, “rgl”, “FSA”, and “rmarkdown”. The appropriate versions are listed below.

Step 6: Open the FemaleCounterPOPd.R file in R studio and set the working directory to the location where you saved the .txt files.

Step 7: Click “Run All”.

Step 8: Begin interacting with the FemaleCounterPOPd software application.

NOTE: The above 8-step process requires the use of all the pre-saved files that are listed in Step 2. However, you may generate the files yourself using the algorithms. For example, the “...NORTHEAST.txt” files are attained from the EaglePOPd software (“Algorithm Northeast.R”; included here for convenience), while the “...COUNTERFACTUAL_PAIN_A.txt” and

“...COUNTERFACTUAL_PAIN_C.txt” files are attained from the “Algorithm – Exper.I.R” and “Algorithm – Exper.II.R” software files. If you wish to modify and run the altered algorithms on your own machine (to overwrite the .txt files with new versions):

Step i. Conduct Step 2-3 (above),

Step ii. Open the appropriate “Algorithm...R” file in R,

Step iii. Set the working directory to the folder in Step i.

Step iv. Select “Run all”. ***Beware, the runtime of the unmodified algorithms is a minimum of 6 hours, so ensure your computer is plugged in, will not go to sleep, and turn off your screen to save the backlight from burnout.*** The algorithm will run and automatically save the new .txt files into the folder that you specified in Step iii.

Running the app for male bald eagles:

Step 1: Download the “CounterPOPd for Males” folder.

Step 2: Inside the folder, you will find several pre-saved .txt files:

“BestAlgorithmPredictedModelsNORTHEAST.txt”,
“BestAlgorithmPredictedModelsCOUNTERFACTUAL_PAIN_A.txt”,
“BestAlgorithmPredictedModelsCOUNTERFACTUAL_PAIN_C.txt”,
“NEW_AA_NORTHEAST”,
“NEW_AA_COUNTERFACTUAL_PAIN_A.txt”,
“NEW_AA_COUNTERFACTUAL_PAIN_C.txt”,
“NEW_PA_NORTHEAST”,
“NEW_PA_COUNTERFACTUAL_PAIN_A.txt”,
“NEW_PA_COUNTERFACTUAL_PAIN_C.txt”,
“NEW_SA_NORTHEAST”,
“NEW_SA_COUNTERFACTUAL_PAIN_A.txt”,
“NEW_SA_COUNTERFACTUAL_PAIN_C.txt”,
“NEW_PS_NORTHEAST”,
“NEW_PS_COUNTERFACTUAL_PAIN_A.txt”,
“NEW_PS_COUNTERFACTUAL_PAIN_C.txt”,
“NEW_Adults_January_NORTHEAST”,
“NEW_Adults_January_COUNTERFACTUAL_PAIN_A.txt”,
“NEW_Adults_January_COUNTERFACTUAL_PAIN_C.txt”,
“NEW_Adults_June_NORTHEAST”,
“NEW_Adults_June_COUNTERFACTUAL_PAIN_A.txt”,
“NEW_Adults_June_COUNTERFACTUAL_PAIN_C.txt”,
“NEW_Subadults_January_NORTHEAST”,
“NEW_Subadults_January_COUNTERFACTUAL_PAIN_A.txt”,
“NEW_Subadults_January_COUNTERFACTUAL_PAIN_C.txt”,
“NEW_Subadults_June_NORTHEAST”,
“NEW_Subadults_June_COUNTERFACTUAL_PAIN_A.txt”,
“NEW_Subadults_June_COUNTERFACTUAL_PAIN_C.txt”,
“NEW_Juveniles_June_NORTHEAST”,
“NEW_Juveniles_June_COUNTERFACTUAL_PAIN_A.txt”,
“NEW_Juveniles_June_COUNTERFACTUAL_PAIN_C.txt”,

“NEW_AdultsAbsorbPercent_NORTHEAST”,
“NEW_AdultsAbsorbPercent_COUNTERFACTUAL_PAIN_A.txt”,
“NEW_AdultsAbsorbPercent_COUNTERFACTUAL_PAIN_C.txt”,
“NEW_AdultsPurgePercent_NORTHEAST”,
“NEW_AdultsPurgePercent_COUNTERFACTUAL_PAIN_A.txt”,
“NEW_AdultsPurgePercent_COUNTERFACTUAL_PAIN_C.txt”,
“NEW_SubadultsAbsorbPercent_NORTHEAST”,
“NEW_SubadultsAbsorbPercent_COUNTERFACTUAL_PAIN_A.txt”,
“NEW_SubadultsAbsorbPercent_COUNTERFACTUAL_PAIN_C.txt”,
“NEW_SubadultsPurgePercent_NORTHEAST”,
“NEW_SubadultsPurgePercent_COUNTERFACTUAL_PAIN_A.txt”,
“NEW_SubadultsPurgePercent_COUNTERFACTUAL_PAIN_C.txt”,
“NEW_TIMESERIES_NORTHEAST”,
“NEW_TIMESERIES_COUNTERFACTUAL_PAIN_A.txt”,
“NEW_TIMESERIES_COUNTERFACTUAL_PAIN_C.txt”,
“TIMESERIES_NORTHEAST.txt”,
“TIMESERIES_TIMESERIES_COUNTERFACTUAL_PAIN_A.txt”,
“TIMESERIES_TIMESERIES_COUNTERFACTUAL_PAIN_C.txt”

Step 3: Save these text files in a specific location on your computer.

Step 4: Open R.

Step 5: In R Studio, install the appropriate versions of the six packages: “shinyBS”, “shiny”, “popdemo”, “rgl”, “FSA”, and “rmarkdown”. The appropriate versions are listed below.

Step 6: Open the MaleCounterPOPd.R file in R studio and set the working directory to the location where you saved the .txt files.

Step 7: Click “Run All”.

Step 8: Begin interacting with the MaleCounterPOPd software application.

NOTE: The above 8-step process requires the use of all the pre-saved files that are listed in Step 2. However, you may generate the files yourself using the algorithms. For example, the “...NORTHEAST.txt” files are attained from the EaglePOPd software (“Algorithm Northeast.R”; included here for convenience), while the “...COUNTERFACTUAL_PAIN_A.txt” and “...COUNTERFACTUAL_PAIN_C.txt” files are attained from the “Algorithm – Exper.I.R” and “Algorithm – Exper.II.R” software files. If you wish to modify and run the altered algorithms on your own machine (to overwrite the .txt files with new versions):

Step i. Conduct Step 2-3 (above),

Step ii. Open the appropriate “Algorithm...R” file in R,

Step iii. Set the working directory to the folder in Step i.

Step iv. Select “Run all”. ***Beware, the runtime of the unmodified algorithms is a minimum of 6 hours, so ensure your computer is plugged in, will not go to sleep, and turn off your screen to save the backlight from burnout.*** The algorithm will run and automatically save the new .txt files into the folder that you specified in Step iii.

Technical Details

This app was written under R version 4.0.2 (2020-06-22) -- "Taking Off Again"
Copyright (C) 2020 The R Foundation for Statistical Computing Platform: x86_64-w64-mingw32/x64 (64-bit) and requires R packages: “devtools (Version 2.3.2)”, “shinyBS (Version 0.61)”, “shiny (Version 1.3.2)”, “rgl (Version 0.100.26)”, “popdemo (Version 1.3-0)”, “FSA (Version 0.8.25)” and “rmarkdown (Version 1.14)”.

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Changes to the Software Since the Original eCommons Submission

Changes made at the request of formal peer reviewers to the CounterPOPd eCommons since the original submission include: (1) the alteration from the terms “acute” to “Exper.I” and “chronic” to “Exper.II” in the code and readme files, (2) the alteration of .txt files names from “...PAIN.ACUTE” and “...PAIN.CHRONIC” to “..._PAIN_A” and “..._PAIN_C” in the code and readme files, (3) the removal of the interpretation boxes in the software, (4) the correction of typos in the narratives, (5) the alteration of the code and readme to include R and package versioning information, (6) the renaming of “Algorithm Acute Pain Observed Only” to “Algorithm – ExperI” and “Algorithm Chronic Pain Observed Only” to “Algorithm-ExperII”, and (7) an update of names in the acknowledgements.

2022-01-04. Changes made include (1) the correction of remaining A and C to “Exper.I” and “Exper.II” in locations that were missed in the previous round of corrections, and (2) the organization of all boxplots to have data displayed (from left to right) as “Northeast”, “Exper.I”, and “Exper.II”.