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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 lead toxins.

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 (leaded) scenarios ("N"), (2) hypothetical scenarios with the removal of acute lead toxicosis cases ("A"), and (3) hypothetical scenarios with the removal of acute and chronic lead toxicosis cases ("C").

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:

<u>Running the app for female bald eagles:</u>

Step 1: Download the "CounterPOPd for Females" folder.
Step 2: Inside the folder, you will find several presaved .txt files:
"BestAlgorithmPredictedModelsNORTHEAST.txt",
"BestAlgorithmPredictedModelsCOUNTERFACTUAL.PAIN.ACUTE.txt",
"BestAlgorithmPredictedModelsCOUNTERFACTUAL.PAIN.CHRONIC.txt",
"NEW_AA_NORTHEAST",
"NEW_AA_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_AA_COUNTERFACTUAL.PAIN.CHRONIC",
"NEW_PA_NORTHEAST",
"NEW_PA_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_PA_COUNTERFACTUAL.PAIN.CHRONIC",
"NEW_SA_NORTHEAST",
"NEW_SA_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_SA_COUNTERFACTUAL.PAIN.CHRONIC",
"NEW_PS_NORTHEAST",
"NEW_PS_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_PS_COUNTERFACTUAL.PAIN.CHRONIC",
"NEW_Adults_January_NORTHEAST",

“NEW_Adults_January_COUNTERFACTUAL.PAIN.ACUTE”,
“NEW_Adults_January_COUNTERFACTUAL.PAIN.CHRONIC”,
“NEW_Adults_June_NORTHEAST”,
“NEW_Adults_June_COUNTERFACTUAL.PAIN.ACUTE”,
“NEW_Adults_June_COUNTERFACTUAL.PAIN.CHRONIC”,
“NEW_Subadults_January_NORTHEAST”,
“NEW_Subadults_January_COUNTERFACTUAL.PAIN.ACUTE”,
“NEW_Subadults_January_COUNTERFACTUAL.PAIN.CHRONIC”,
“NEW_Subadults_June_NORTHEAST”,
“NEW_Subadults_June_COUNTERFACTUAL.PAIN.ACUTE”,
“NEW_Subadults_June_COUNTERFACTUAL.PAIN.CHRONIC”,
“NEW_Juveniles_June_NORTHEAST”,
“NEW_Juveniles_June_COUNTERFACTUAL.PAIN.ACUTE”,
“NEW_Juveniles_June_COUNTERFACTUAL.PAIN.CHRONIC”,
“NEW_AdultsAbsorbPercent_NORTHEAST”,
“NEW_AdultsAbsorbPercent_COUNTERFACTUAL.PAIN.ACUTE”,
“NEW_AdultsAbsorbPercent_COUNTERFACTUAL.PAIN.CHRONIC”,
“NEW_AdultsPurgePercent_NORTHEAST”,
“NEW_AdultsPurgePercent_COUNTERFACTUAL.PAIN.ACUTE”,
“NEW_AdultsPurgePercent_COUNTERFACTUAL.PAIN.CHRONIC”,
“NEW_SubdultsAbsorbPercent_NORTHEAST”,
“NEW_SubdultsAbsorbPercent_COUNTERFACTUAL.PAIN.ACUTE”,
“NEW_SubdultsAbsorbPercent_COUNTERFACTUAL.PAIN.CHRONIC”,
“NEW_SubadultsPurgePercent_NORTHEAST”
“NEW_SubadultsPurgePercent_COUNTERFACTUAL.PAIN.ACUTE”
“NEW_SubadultsPurgePercent_COUNTERFACTUAL.PAIN.CHRONIC”
“NEW_TIMESERIES_NORTHEAST”
“NEW_TIMESERIES_COUNTERFACTUAL.PAIN.ACUTE”
“NEW_TIMESERIES_COUNTERFACTUAL.PAIN.CHRONIC”
“TIMESERIES_NORTHEAST.txt”
“TIMESERIES_TIMESERIES_COUNTERFACTUAL.PAIN.ACUTE.txt”
“TIMESERIES_TIMESERIES_COUNTERFACTUAL.PAIN.CHRONIC.txt”

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

Step 4: Open R.

Step 5: In R, install five packages: “shinyBS”, “shiny”, “rgl”, “MASS”, “popdemo”, and “rmarkdown”. To install a package, type install.packages(“shinyBS”) into your R console and run the line. Repeat this command with the other packages.

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 presaved 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.ACUTE.txt” and

"…COUNTERFACTUAL.PAIN.CHRONIC.txt" files are attained from the "Algorithm Acute Pain Observed Only.R" and "Algorithm Chronic Pain Observed Only.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 presaved .txt files:
"BestAlgorithmPredictedModelsNORTHEAST.txt",
"BestAlgorithmPredictedModelsCOUNTERFACTUAL.PAIN.ACUTE.txt",
"BestAlgorithmPredictedModelsCOUNTERFACTUAL.PAIN.CHRONIC.txt",
"NEW_AA_NORTHEAST",
"NEW_AA_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_AA_COUNTERFACTUAL.PAIN.CHRONIC",
"NEW_PA_NORTHEAST",
"NEW_PA_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_PA_COUNTERFACTUAL.PAIN.CHRONIC",
"NEW_SA_NORTHEAST",
"NEW_SA_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_SA_COUNTERFACTUAL.PAIN.CHRONIC",
"NEW_PS_NORTHEAST",
"NEW_PS_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_PS_COUNTERFACTUAL.PAIN.CHRONIC",
"NEW_Adults_January_NORTHEAST",
"NEW_Adults_January_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_Adults_January_COUNTERFACTUAL.PAIN.CHRONIC",
"NEW_Adults_June_NORTHEAST",
"NEW_Adults_June_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_Adults_June_COUNTERFACTUAL.PAIN.CHRONIC",
"NEW_Subadults_January_NORTHEAST",
"NEW_Subadults_January_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_Subadults_January_COUNTERFACTUAL.PAIN.CHRONIC",
"NEW_Subadults_June_NORTHEAST",
"NEW_Subadults_June_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_Subadults_June_COUNTERFACTUAL.PAIN.CHRONIC",
"NEW_Juveniles_June_NORTHEAST",
"NEW_Juveniles_June_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_Juveniles_June_COUNTERFACTUAL.PAIN.CHRONIC",

"NEW_AdultsAbsorbPercent_NORTHEAST",
"NEW_AdultsAbsorbPercent_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_AdultsAbsorbPercent_COUNTERFACTUAL.PAIN.CHRONIC",
"NEW_AdultsPurgePercent_NORTHEAST",
"NEW_AdultsPurgePercent_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_AdultsPurgePercent_COUNTERFACTUAL.PAIN.CHRONIC",
"NEW_SubdultsAbsorbPercent_NORTHEAST",
"NEW_SubdultsAbsorbPercent_COUNTERFACTUAL.PAIN.ACUTE",
"NEW_SubdultsAbsorbPercent_COUNTERFACTUAL.PAIN.CHRONIC",
"NEW_SubadultsPurgePercent_NORTHEAST"
"NEW_SubadultsPurgePercent_COUNTERFACTUAL.PAIN.ACUTE"
"NEW_SubadultsPurgePercent_COUNTERFACTUAL.PAIN.CHRONIC"
"NEW_TIMESERIES_NORTHEAST"
"NEW_TIMESERIES_COUNTERFACTUAL.PAIN.ACUTE"
"NEW_TIMESERIES_COUNTERFACTUAL.PAIN.CHRONIC"
"TIMESERIES_NORTHEAST.txt"
"TIMESERIES_TIMESERIES_COUNTERFACTUAL.PAIN.ACUTE.txt"
"TIMESERIES_TIMESERIES_COUNTERFACTUAL.PAIN.CHRONIC.txt"

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

Step 4: Open R.

Step 5: In R, install five packages: "shinyBS", "shiny", "rgl", "popdemo", and "rmarkdown". To install a package, type install.packages("shinyBS") into your R console and run the line. Repeat this command with the other packages.

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 presaved 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.ACUTE.txt" and "…COUNTERFACTUAL.PAIN.CHRONIC.txt" files are attained from the "Algorithm Acute Pain Observed Only.R" and "Algorithm Chronic Pain Observed Only.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". ***<u>Beware</u>, 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 Studio Version 1.1.463 – © 2009-2018 RStudio, Inc., and requires six R Shiny packages: “shinyBS”, “shiny”, “rgl”, “popdemo”, and “rmarkdown”.

Financial Support

This study was funded in part by the Morris Animal Foundation under Grant # D18ZO-103. This software has not been reviewed nor endorsed by the Foundation, and the views expressed in this software do not necessarily reflect the views of the Foundation, its officers, directors, affiliates or agents.

Acknowledgements

We’d like to thank Mathew Plourde and the online R troubleshooting community for the code segment used to create the tabs in the user interface.

License

Suggested Citation for this Software:

Hanley, B., Dhondt, A., Bunting, E., Pokras, M., Hynes, K., Forzán, M., & Schuler, K. 2019. CounterPOPd Web Interactive: Software to investigate the population scale impact of lead in bald eagles in the Northeast United States from 1990-2018 [Software]. Cornell University Library eCommons Repository. https://doi.org/10.7298/0v1k-wq39