Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

# USING ECHOLOCATION CALL RECORDING TECHNIQUES AND GPS TO MONITOR BAT POPULATIONS IN CONNECTICUT IN THE WAKE OF WHITE-NOSE SYNDROME

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New England Chapter of the Wildlife Society
Annual Fall Workshop
October 24, 2013
Amherst, Massachusetts

# Bats of Connecticut

Big Brown Bat, Newgate 2011

## Tree Roosting (migratory)

Silver-haired Bat *(Lasionycteris noctivagans)*
Eastern Red Bat *(Lasiurus borealis)*
Hoary Bat *(Lasiurus cinereus)*

Paul Fusco

## Cave Hibernating

Big Brown Bat *(Eptesicus fuscus)*
Little Brown Bat *(Myotis lucifigus)*
Northern Long-eared Bat *(Myotis septentrionalis)*
Tri-colored Bat *(Perimyotis subflavus)*

Eastern small-footed Bat *(Myotis leibii)*
Indiana Bat *(Myotis sodalis)*

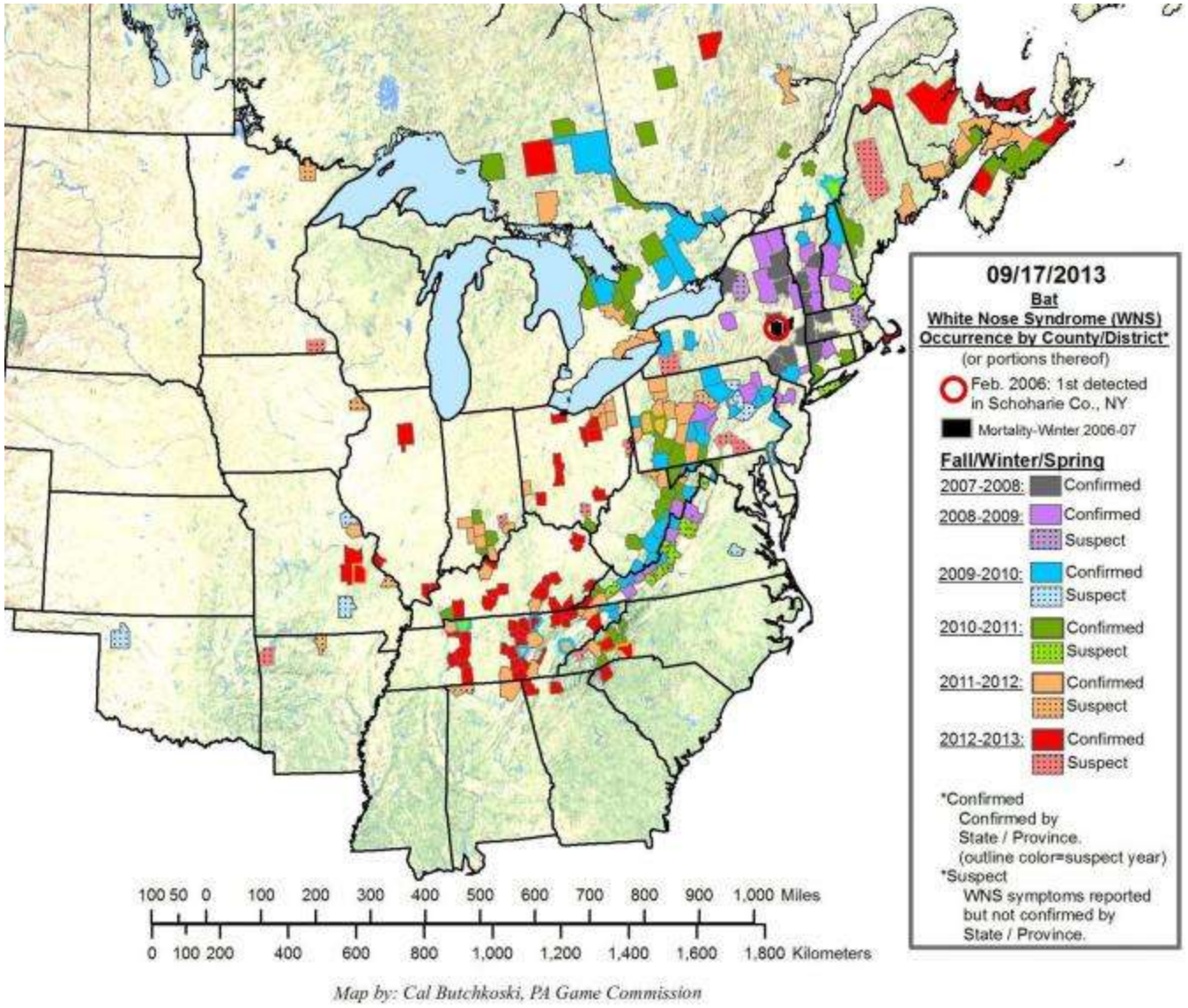
# White-nose Syndrome

Photo: Al Hicks, NY DEC

- Cold-loving fungus: *Pseudogymnoascus destructans*
- Epidermal infection of the muzzle and wings
- Affects cave hibernating bats
- 90-100 % mortality depending on spp and region
- Nearly 6 million bats have diedas a result of WNS (USFWS, Jan 2012)

Photo: Nancy Heaslip, Hailes Cave 3/14/2007

# Distribution of WNS in North America



# Benefits of Acoustic Monitoring

- Non-invasive, hands-off monitoring
- Casts a bigger “net”
- No threat of spreading WNS
- Enables driving transects for broader geographic coverage

Image from Joe Szewczak

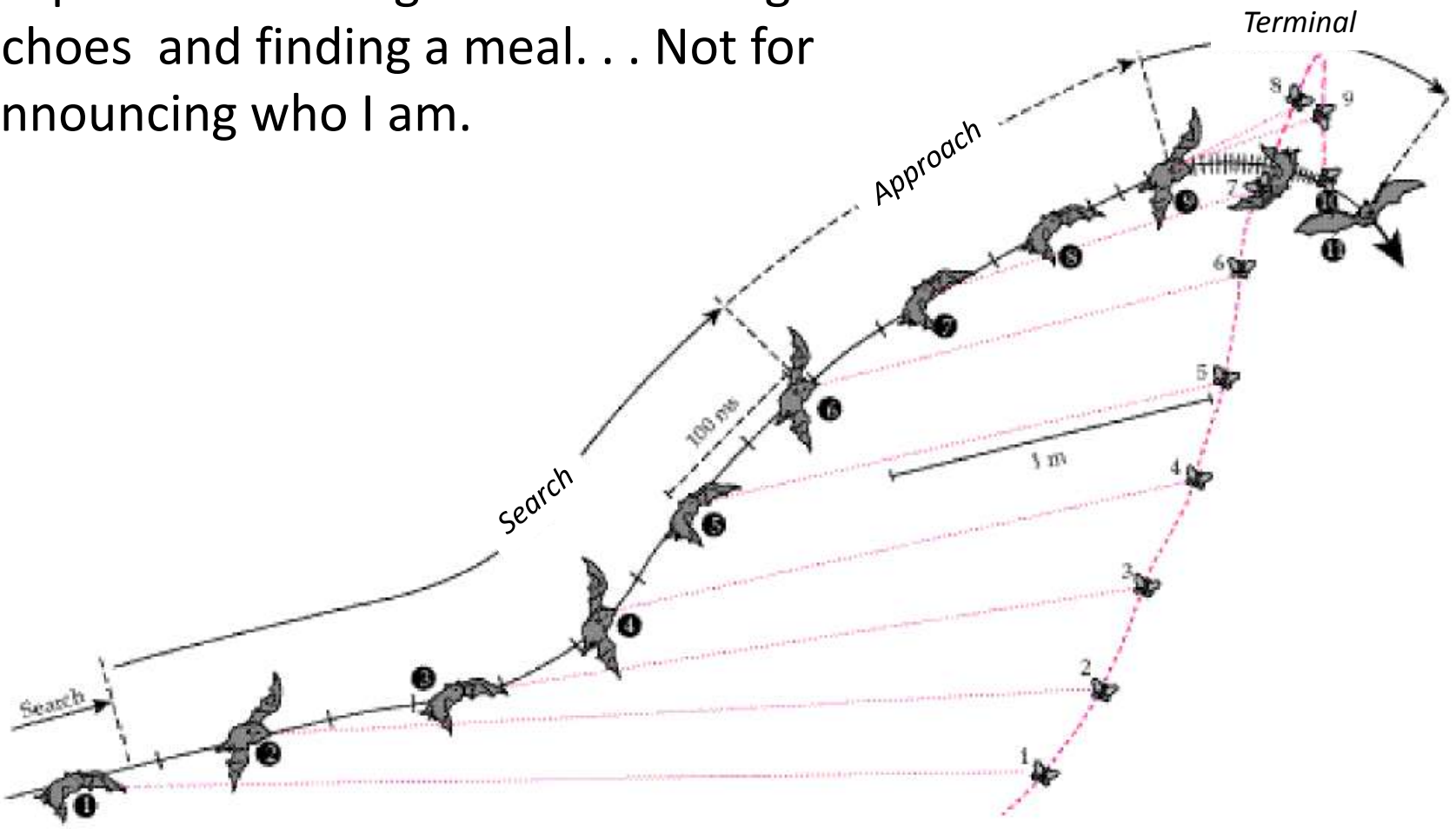
# Echolocation

- Ultrasonic vocalizations used to forage for insects.
- Sophisticated sensory system analyzes the returning echoes.

  - Distance
  - Size
  - Velocity
  - Direction
  - Flutter
  - Texture

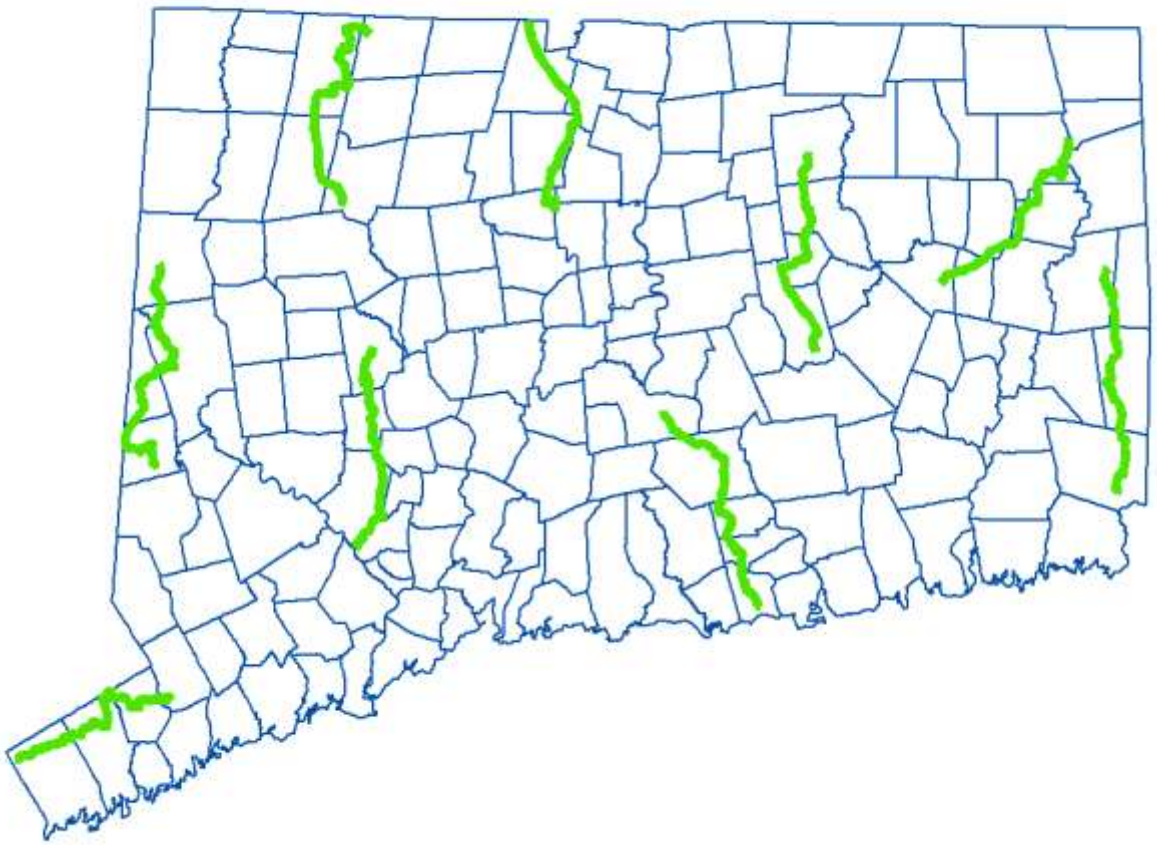
*Virginia Big-eared Bat*

Foraging vocalizations are for the purpose of listening to the returning echoes  and finding a meal. . . Not for announcing who I am.




Source: Bat Sensory World

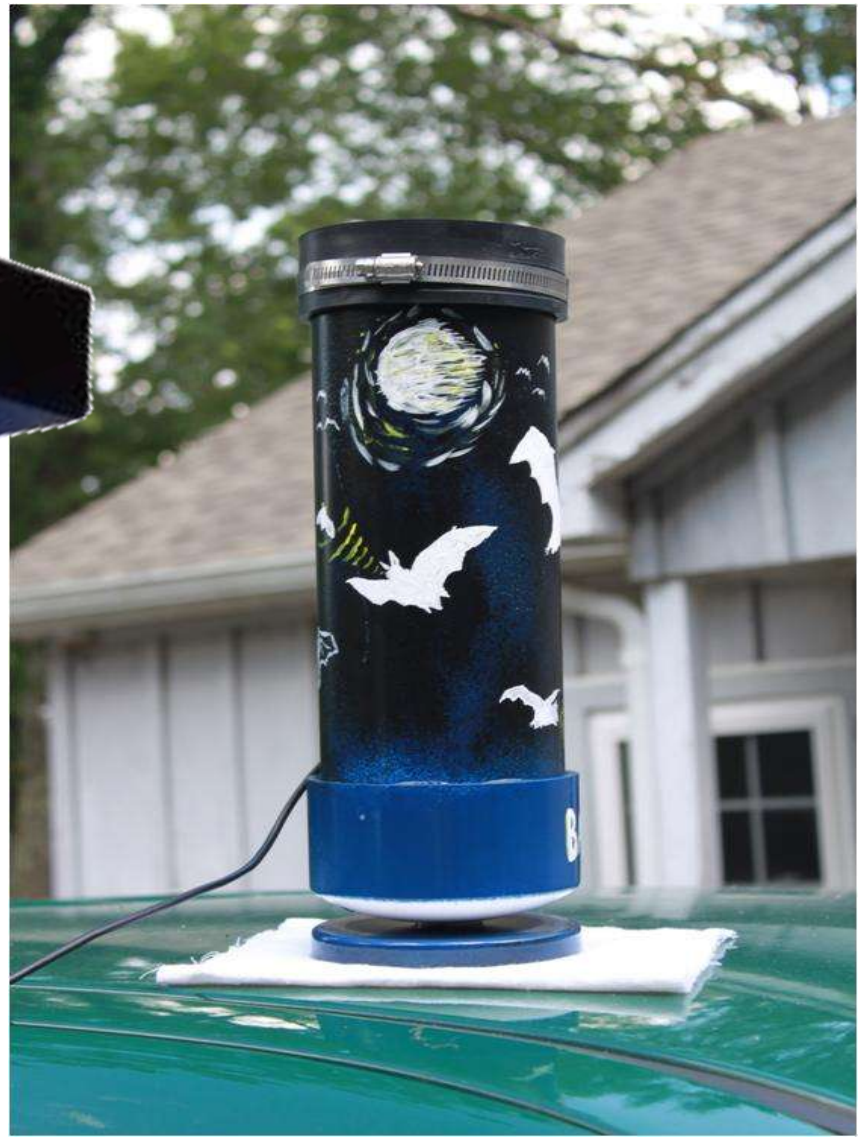
# Acoustic Monitoring Routes in Connecticut



Nine ~20-mile routes surveyed twice per month from May – October
108 surveys per year with thousands of recordings made.

# Hardware

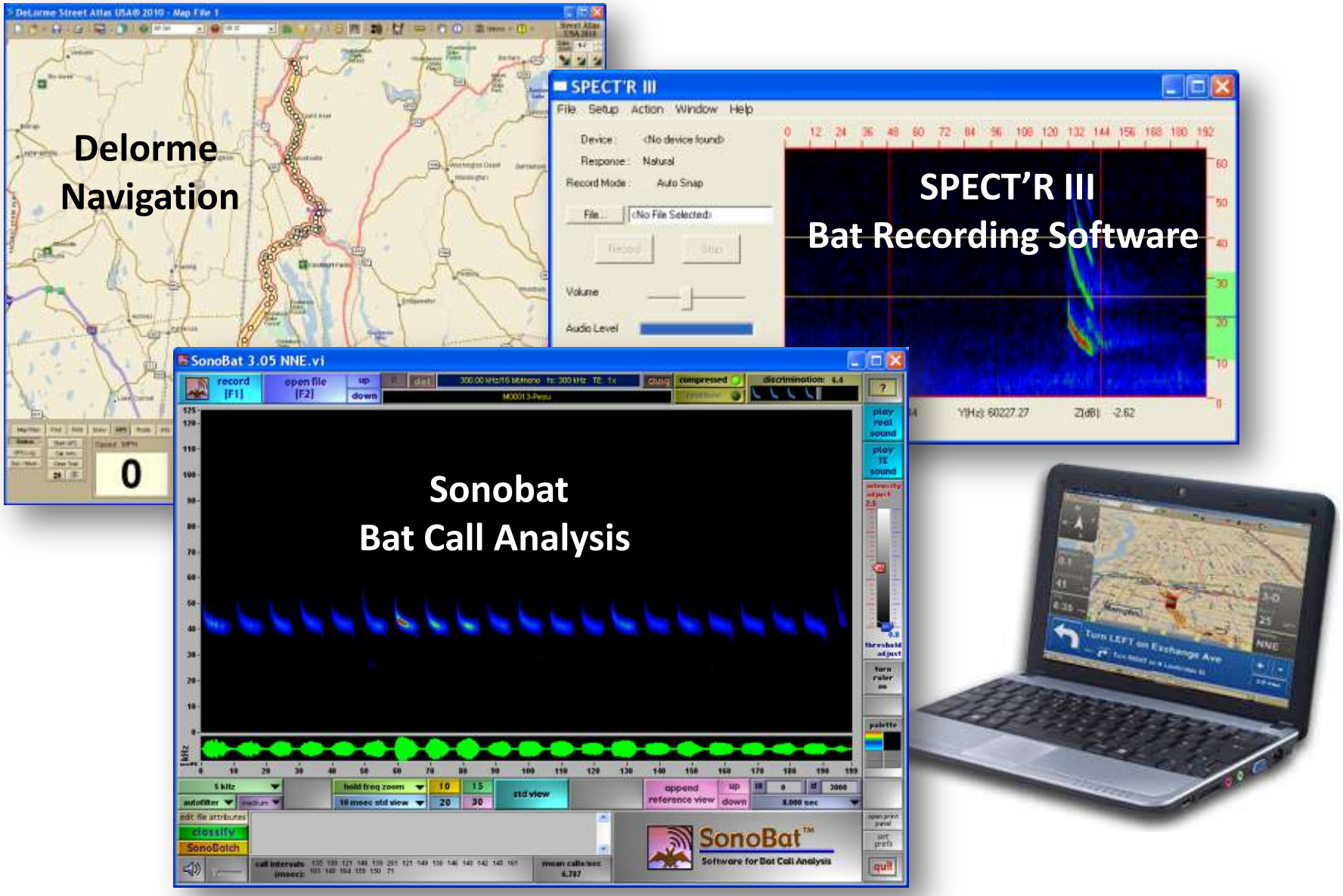
- Binary Acoustics AR 125 bat detector in PVC housing
- Inexpensive GPS unit



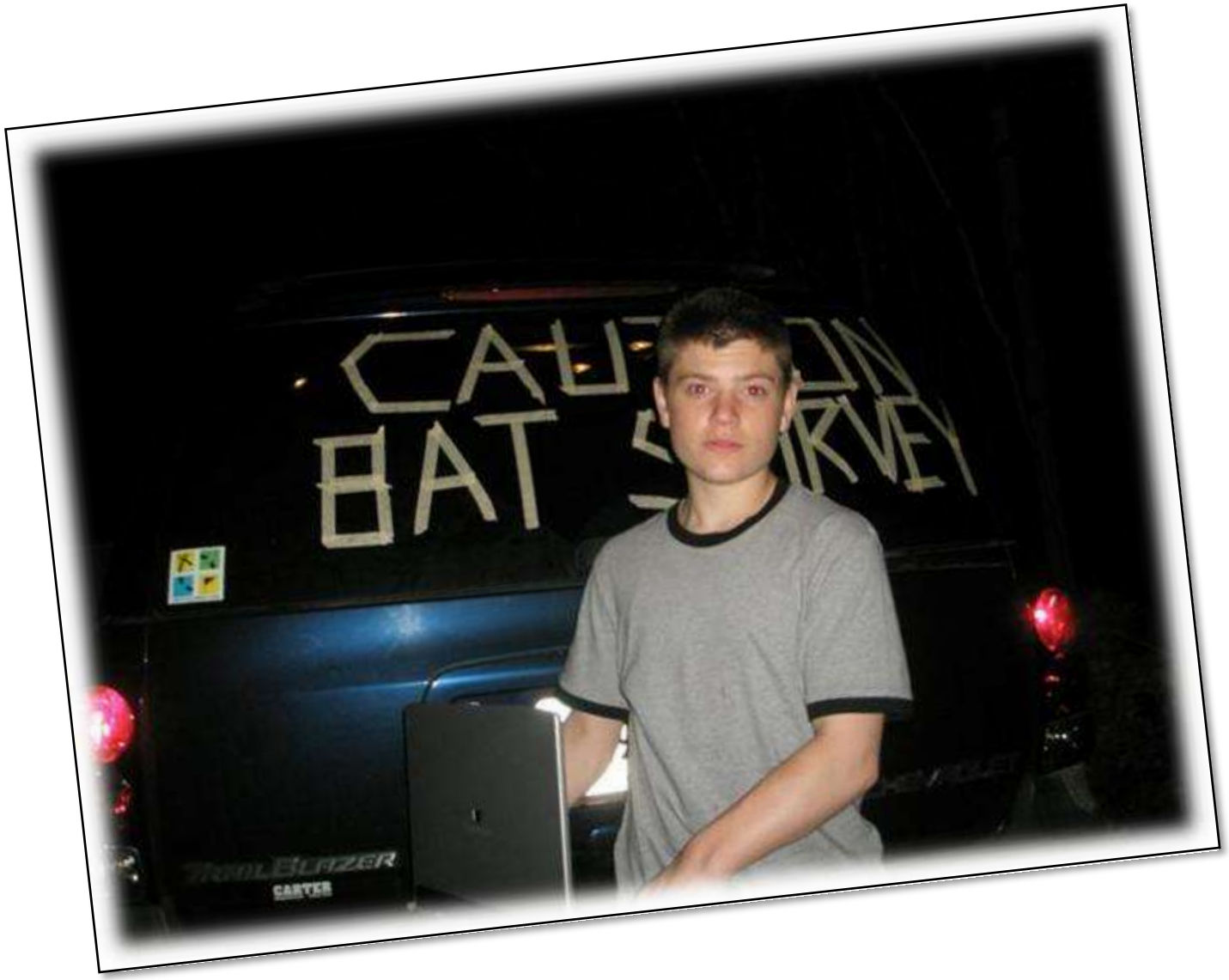
Protocol adapted from Carl Herzog & Al Hicks, NY DEC.

# Software

Full spectrum call recording and analysis



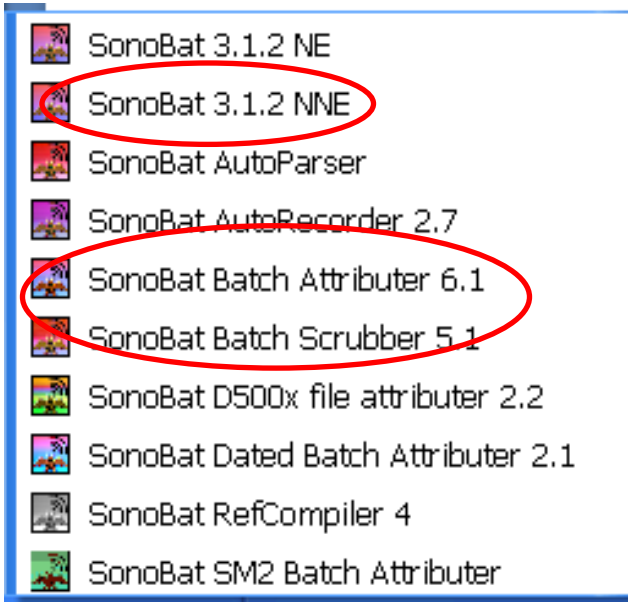
# Nocturnal Volunteers

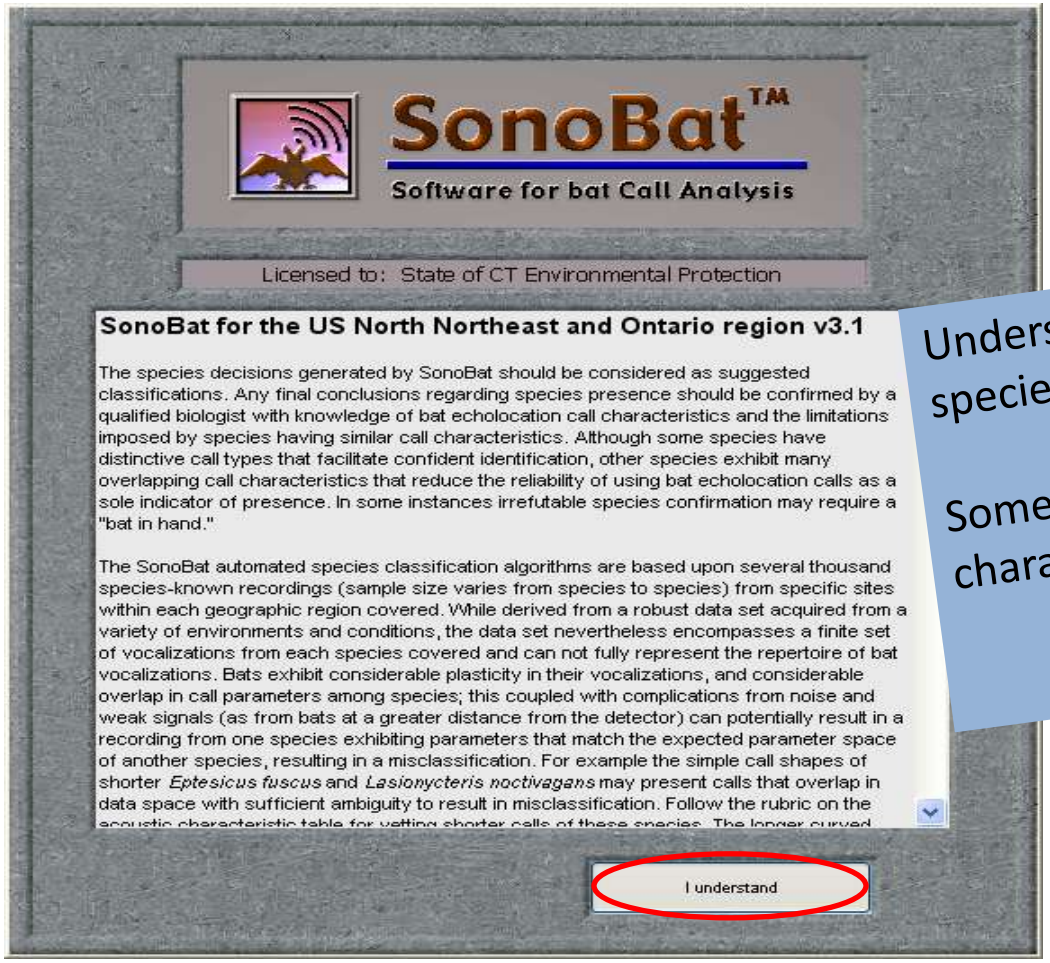


SonoBat™ Software for Bat Call Analysis

Suite of utilities supporting multiple detectors.

- Regional versions
- Accepts full spectrum data
- File attributer
- Data scrubbing
- Species classification
- Batch processing
- Reference call library






Understand the limitations of species classifications.

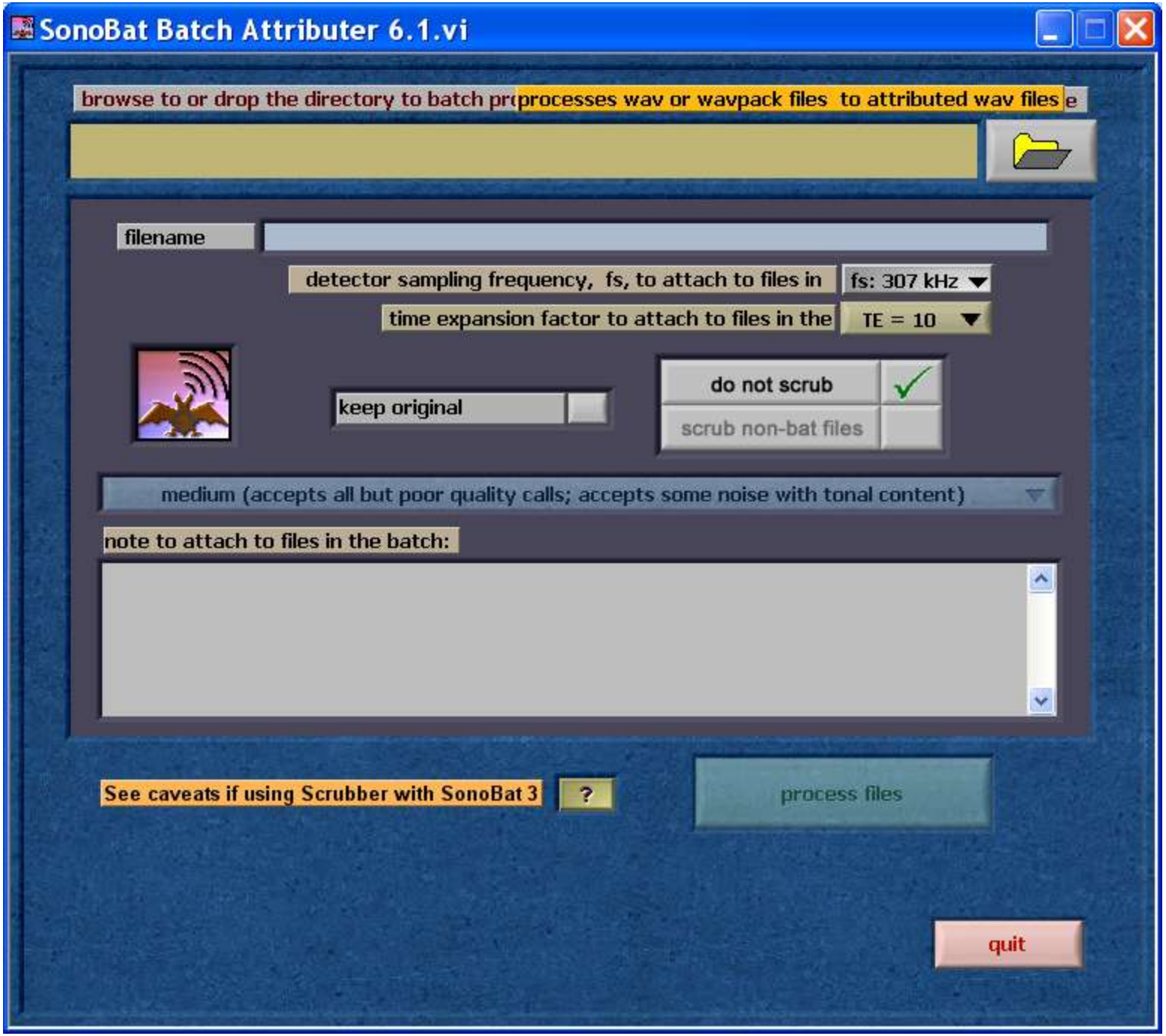
Some species have overlapping call characteristics that can be misleading.

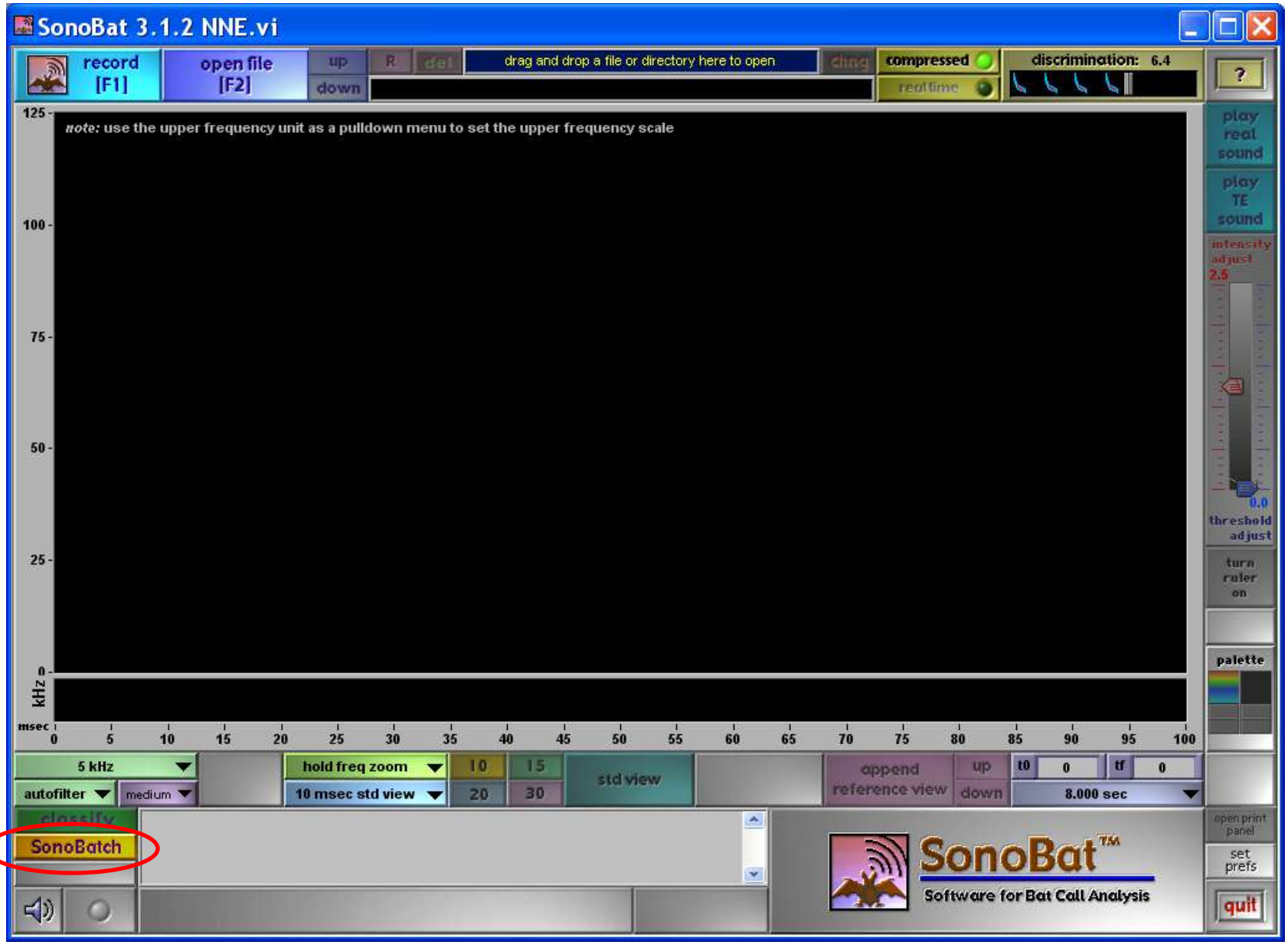
Epfu/Lano

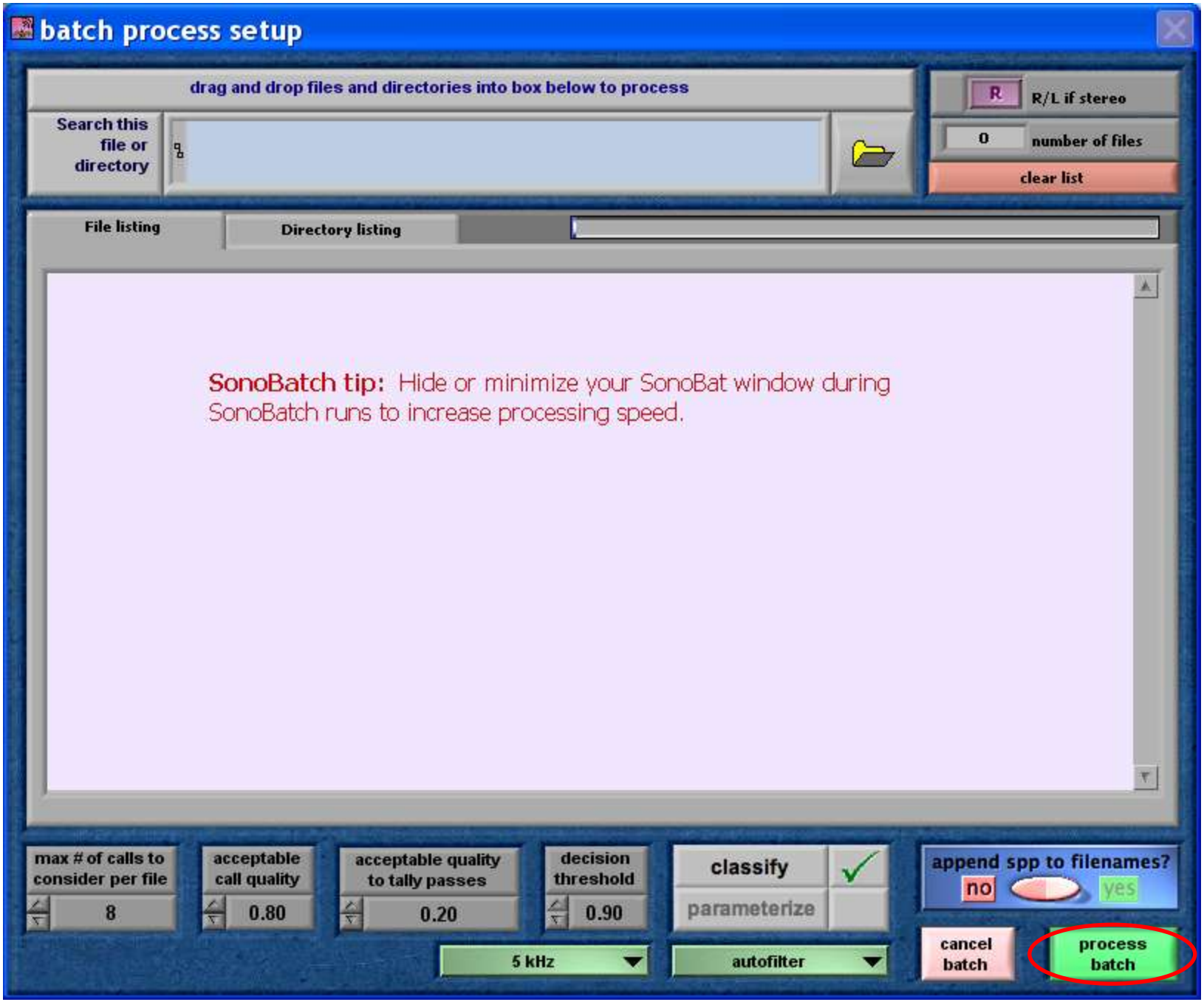
Mylu/Myso

# SonoBat Species Classification

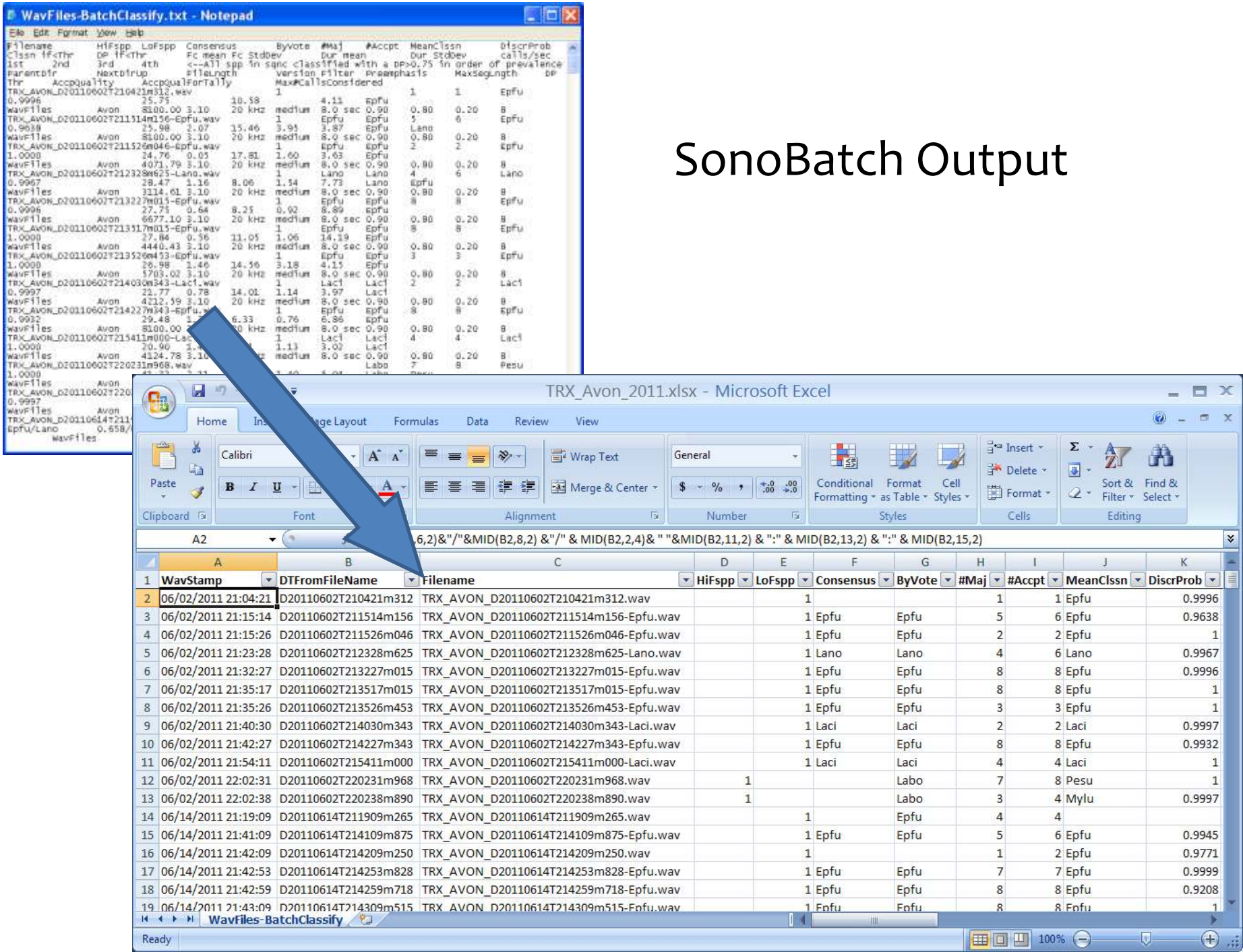
- Over 60 call parameters analyzed and compared to reference calls
- By mean parameter for the series
- By vote on the most powerful high-quality pulses
- Consensus between 2 approaches >>> Species classification


SonoBat Batch Attributer 6.1.vi
browse to or drop the directory to batch pr
processes wav or wavpack files to attributed wav files
e
filename
detector sampling frequency, fs, to attach to files in
fs: 307 kHz
time expansion factor to attach to files in the
TE = 10
keep original
do not scrub
scrub non-bat files
medium (accepts all but poor quality calls; accepts some noise with tonal content)
note to attach to files in the batch:
See caveats if using Scrubber with SonoBat 3
?
process files
quit


SonoBat 3.1.2 NNE.vi
record [F1]
open file [F2]
up
down
R
del
drag and drop a file or directory here to open
clear
compressed
realtime
discrimination: 6.4
?
play real sound
play TE sound
intensity adjust
2.5
0.0
threshold adjust
turn ruler on
palette
note: use the upper frequency unit as a pulldown menu to set the upper frequency scale
125
100
75
50
25
0
kHz
msec
0 5 10 15 20 25 30 35 40 45 50 55 60 65 70 75 80 85 90 95 100
5 kHz
autofilter
medium
hold freq zoom
10 msec std view
10
15
20
30
std view
append reference view
up
down
t0
0
tf
0
8.000 sec
classify
SonoBatch
open print panel
set prefs
quit
SonoBat™
Software for Bat Call Analysis

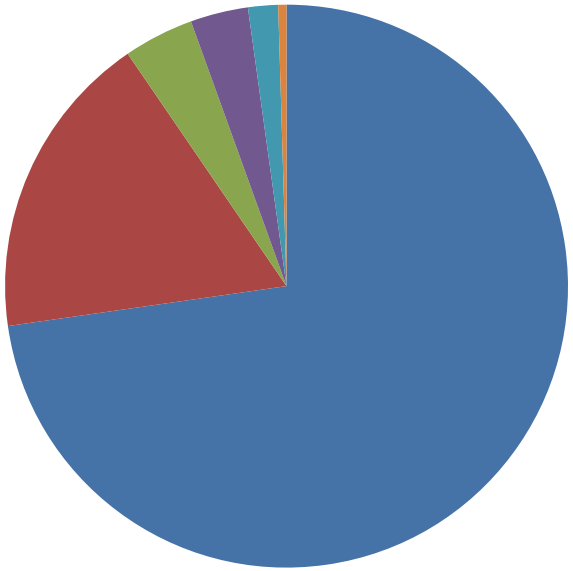

batch process setup
drag and drop files and directories into box below to process
Search this file or directory
R
R/L if stereo
0
number of files
clear list
File listing
Directory listing
SonoBatch tip: Hide or minimize your SonoBat window during SonoBatch runs to increase processing speed.
max # of calls to consider per file
8
acceptable call quality
0.80
acceptable quality to tally passes
0.20
decision threshold
0.90
classify
parameterize
append spp to filenames?
no
yes
5 kHz
autofilter
cancel batch
process batch

# SonoBatch Output



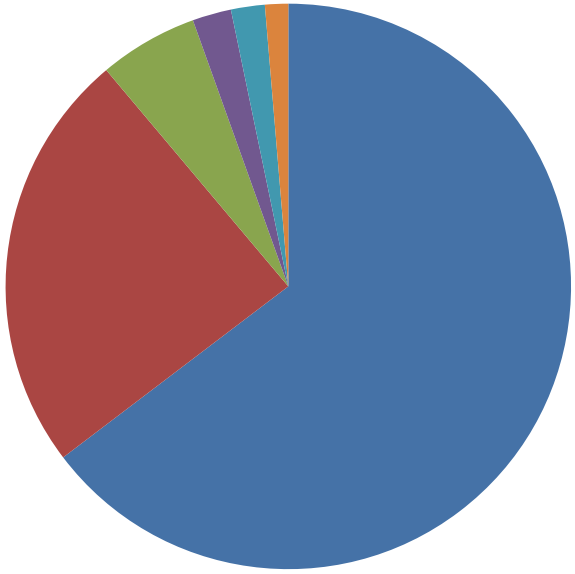

| | A | B | C | D | E | F | G | H | I | J | K |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | WavStamp | DTFromFileName | Filename | HiFspp | LoFspp | Consensus | ByVote | #Maj | #Accpt | MeanClssn | DiscrProb |
| 2 | 06/02/2011 21:04:21 | D20110602T210421m312 | TRX_AVON_D20110602T210421m312.wav | | 1 | | | 1 | 1 | Epfu | 0.9996 |
| 3 | 06/02/2011 21:15:14 | D20110602T211514m156 | TRX_AVON_D20110602T211514m156-Epfu.wav | | 1 | Epfu | Epfu | 5 | 6 | Epfu | 0.9638 |
| 4 | 06/02/2011 21:15:26 | D20110602T211526m046 | TRX_AVON_D20110602T211526m046-Epfu.wav | | 1 | Epfu | Epfu | 2 | 2 | Epfu | 1 |
| 5 | 06/02/2011 21:23:28 | D20110602T212328m625 | TRX_AVON_D20110602T212328m625-Lano.wav | | 1 | Lano | Lano | 4 | 6 | Lano | 0.9967 |
| 6 | 06/02/2011 21:32:27 | D20110602T213227m015 | TRX_AVON_D20110602T213227m015-Epfu.wav | | 1 | Epfu | Epfu | 8 | 8 | Epfu | 0.9996 |
| 7 | 06/02/2011 21:35:17 | D20110602T213517m015 | TRX_AVON_D20110602T213517m015-Epfu.wav | | 1 | Epfu | Epfu | 8 | 8 | Epfu | 1 |
| 8 | 06/02/2011 21:35:26 | D20110602T213526m453 | TRX_AVON_D20110602T213526m453-Epfu.wav | | 1 | Epfu | Epfu | 3 | 3 | Epfu | 1 |
| 9 | 06/02/2011 21:40:30 | D20110602T214030m343 | TRX_AVON_D20110602T214030m343-Laci.wav | | 1 | Laci | Laci | 2 | 2 | Laci | 0.9997 |
| 10 | 06/02/2011 21:42:27 | D20110602T214227m343 | TRX_AVON_D20110602T214227m343-Epfu.wav | | 1 | Epfu | Epfu | 8 | 8 | Epfu | 0.9932 |
| 11 | 06/02/2011 21:54:11 | D20110602T215411m000 | TRX_AVON_D20110602T215411m000-Laci.wav | | 1 | Laci | Laci | 4 | 4 | Laci | 1 |
| 12 | 06/02/2011 22:02:31 | D20110602T220231m968 | TRX_AVON_D20110602T220231m968.wav | 1 | | | Labo | 7 | 8 | Pesu | 1 |
| 13 | 06/02/2011 22:02:38 | D20110602T220238m890 | TRX_AVON_D20110602T220238m890.wav | 1 | | | Labo | 3 | 4 | Mylu | 0.9997 |
| 14 | 06/14/2011 21:19:09 | D20110614T211909m265 | TRX_AVON_D20110614T211909m265.wav | | 1 | | Epfu | 4 | 4 | | |
| 15 | 06/14/2011 21:41:09 | D20110614T214109m875 | TRX_AVON_D20110614T214109m875-Epfu.wav | | 1 | Epfu | Epfu | 5 | 6 | Epfu | 0.9945 |
| 16 | 06/14/2011 21:42:09 | D20110614T214209m250 | TRX_AVON_D20110614T214209m250.wav | | 1 | | | 1 | 2 | Epfu | 0.9771 |
| 17 | 06/14/2011 21:42:53 | D20110614T214253m828 | TRX_AVON_D20110614T214253m828-Epfu.wav | | 1 | Epfu | Epfu | 7 | 7 | Epfu | 0.9999 |
| 18 | 06/14/2011 21:42:59 | D20110614T214259m718 | TRX_AVON_D20110614T214259m718-Epfu.wav | | 1 | Epfu | Epfu | 8 | 8 | Epfu | 0.9208 |
| 19 | 06/14/2011 21:43:09 | D20110614T214309m515 | TRX_AVON_D20110614T214309m515-Epfu.wav | | 1 | Epfu | Epfu | 8 | 8 | Epfu | 1 |

# Species Composition in Connecticut post WNS



- Big Brown Bat 73%
- Eastern Red Bat 18%
- Silver-haired Bat 4.0%
- Hoary Bat 3.3%
- Little Brown Bat 1.7%
- Tri-colored Bat 0.5%

2011

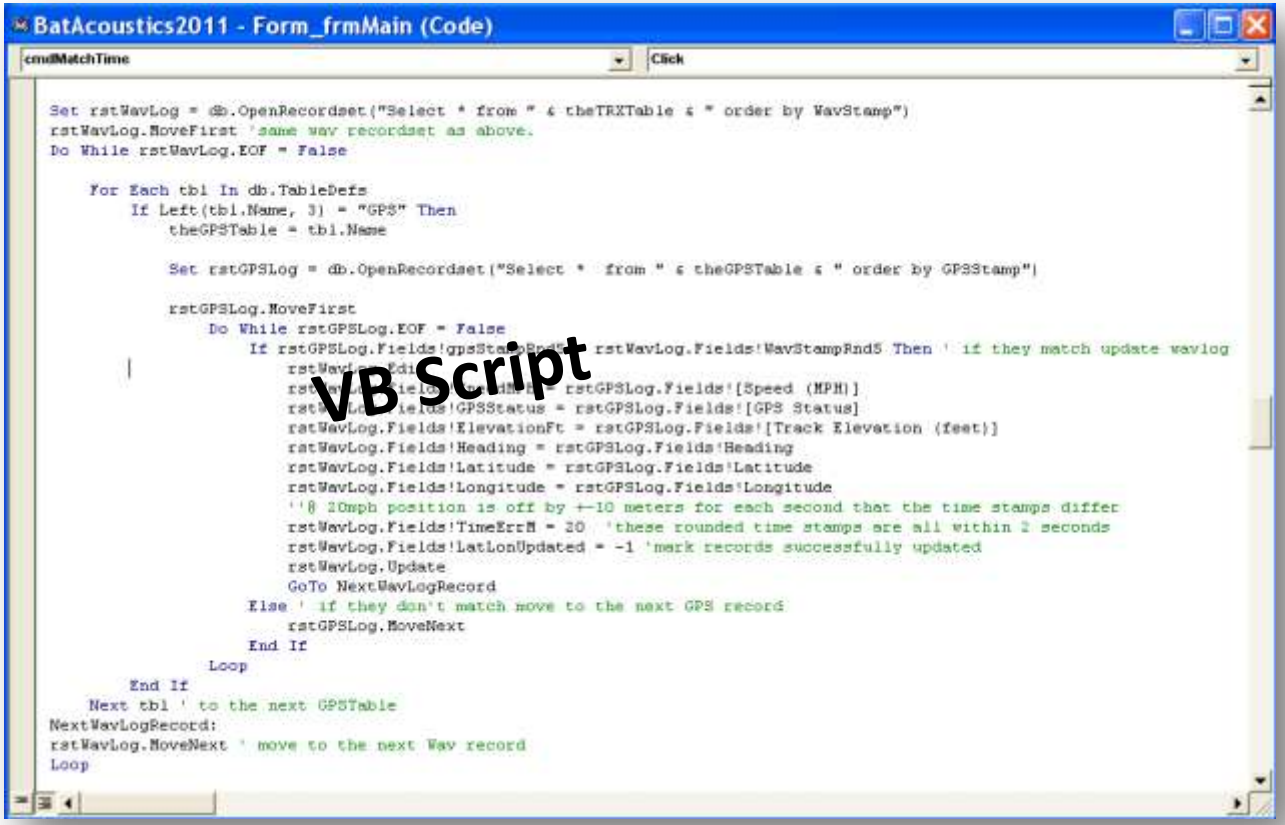


- Big Brown Bat 66%
- Eastern Red Bat 24%
- Silver-haired Bat 5.7 %
- Little Brown Bat 2.2%
- Hoary Bat 1.9%
- Tricolor Bat 0.4 %

2012

# More Data Processing . . .

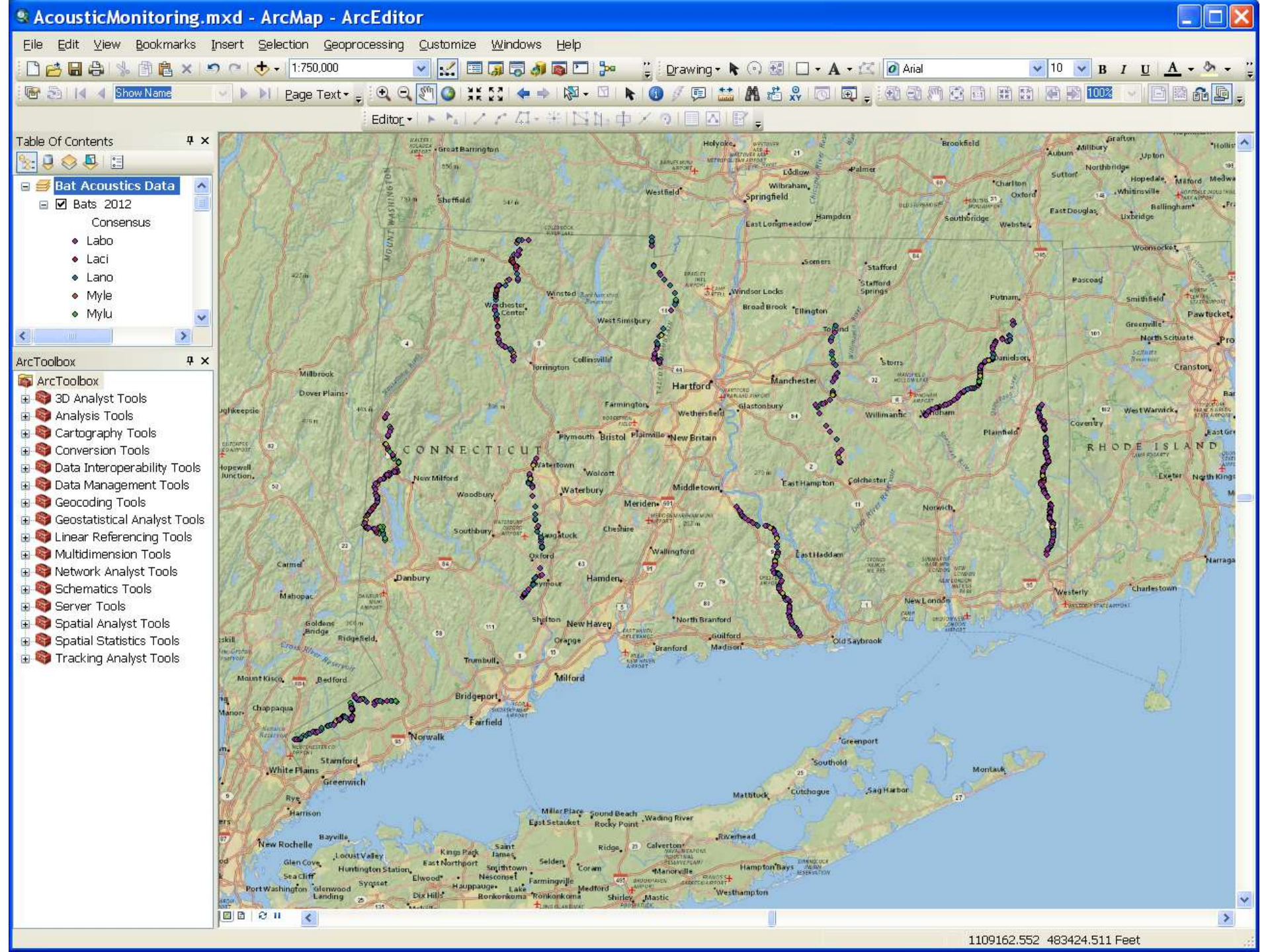
Matching GPS time stamp to WAV file time stamp




```
Set rstWavLog = db.OpenRecordset("Select * from " & theTRXTable & " order by WavStamp")
rstWavLog.MoveFirst 'same wav recordset as above.
Do While rstWavLog.EOF = False

    For Each tbl In db.TableDefs
        If Left(tbl.Name, 3) = "GPS" Then
            theGPSTable = tbl.Name

            Set rstGPSLog = db.OpenRecordset("Select *  from " & theGPSTable & " order by GPSStamp")

            rstGPSLog.MoveFirst
                Do While rstGPSLog.EOF = False
                    If rstGPSLog.Fields!gpsStampRnd5 = rstWavLog.Fields!WavStampRnd5 Then ' if they match update wavlog
                        rstWavLog.Edit
                        rstWavLog.Fields!Speed = rstGPSLog.Fields![Speed (MPH)]
                        rstWavLog.Fields!GPSStatus = rstGPSLog.Fields![GPS Status]
                        rstWavLog.Fields!ElevationFt = rstGPSLog.Fields![Track Elevation (feet)]
                        rstWavLog.Fields!Heading = rstGPSLog.Fields!Heading
                        rstWavLog.Fields!Latitude = rstGPSLog.Fields!Latitude
                        rstWavLog.Fields!Longitude = rstGPSLog.Fields!Longitude
                        ''@ 20mph position is off by +-10 meters for each second that the time stamps differ
                        rstWavLog.Fields!TimeErrM = 20  'these rounded time stamps are all within 2 seconds
                        rstWavLog.Fields!LatLonUpdated = -1 'mark records successfully updated
                        rstWavLog.Update
                        GoTo NextWavLogRecord
                    Else ' if they don't match move to the next GPS record
                        rstGPSLog.MoveNext
                    End If
                Loop
        End If
    Next tbl ' to the next GPSTable
NextWavLogRecord:
rstWavLog.MoveNext ' move to the next Wav record
Loop
```

Geo-referenced recordings

Symbolize by species in ArcGIS


AcousticMonitoring.mxd - ArcMap - ArcEditor
File Edit View Bookmarks Insert Selection Geoprocessing Customize Windows Help
1:750,000
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Stafford
Somers
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Sea Cliff
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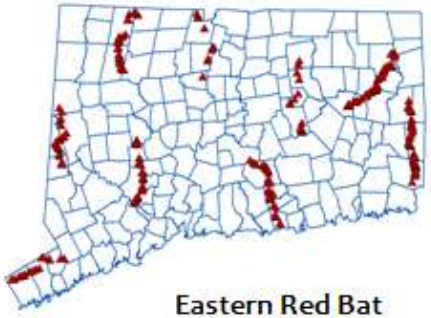
Glenwood Landing
Syosset
Huntington Station
Locust Valley
Kings Park
East Northport
Saint James
Smithtown
Nesconset
Selden
Coram
Farmingville
Medford
Ronkonkoma
Hauppauge
Lake Ronkonkoma
Dix Hills
Shirley
Mastic
Miller Place
East Setauket
Sound Beach
Rocky Point
Wading River
Calverton
Manorville
Riverhead
Hampton Bays
Westhampton
Mattituck
Cutchogue
Southold
Greenport
Sag Harbor
Montauk
1109162.552 483424.511 Feet

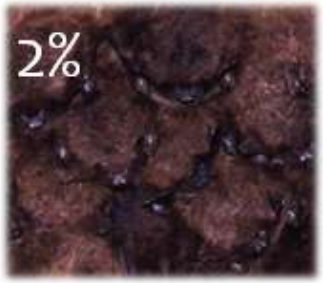
# Results ~1700 bat calls geo-referenced and classified to species.

Big Brown Bat
(*Eptesicus fuscus*)

Hoary Bat
(*Lasiurus cinereus*)

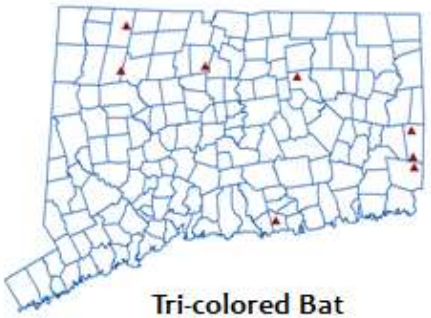


Eastern Red Bat
(*Lasiurus borealis*)



Little Brown Bat
(*Myotis lucifigus*)

Silver-haired Bat
(*Lasionycteris noctivagans*)



Tri-colored Bat
(*Perimyotis subflavus*)

2011

**Status under review**

Little Brown Bat
(*Myotis Lucifugus*)

FEDERAL REGISTER

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Part III

Department of the Interior

Fish and Wildlife Service

50 CFR Part 17

Endangered and Threatened Wildlife and Plants; 12-Month Finding on a Petition To List the Eastern Small-Footed Bat and the Northern Long-Eared Bat as Endangered or Threatened Species; Listing the Northern Long-Eared Bat as an Endangered Species; Proposed Rule

**Proposed Federal Listing: Endangered**

Northern Long-eared Bat
(*Myotis Septentrionalis*)

**Listing not warranted after 12 month review**

Small-footed bat
(*Myotis Leibii*)

Photos by Merlin Tuttle, www.Batcon.org

NABat
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COMING SOON!! The North American Bat Monitoring Program (or NABat)!!!
Despite their importance and the many threats facing their populations [e.g., white-nose syndrome (WNS), climate change, wind energy development, and habitat loss and fragmentation], there are currently no national programs to monitor and track bat populations in North America. A statistically rigorous and nationally coordinated bat monitoring program is critical for determining the impacts of the many stressors on bat populations, as well as for determining the efficacy of management actions taken to conserve bat populations (i.e., adaptive management).
The objectives of NABat are to: 1) provide the architecture for coordinated bat monitoring to support local, regional and range-wide inferences about trends in bat populations and abundances in response to WNS, climate, wind energy, and habitat loss, and 2) provide managers and policy makers with the information they need on bat population trends to effectively manage bat populations, detect early warning signs of population declines, and estimate extinction risk. Workshops are being held to develop the monitoring program in 2013 and 2014. A small group of statisticians (12-15) with expertise in large-scale monitoring designs and bat biologists will participate in these workshops with the goal of developing a national bat monitoring protocol.
The workshops will have scientists and researchers from multiple agencies including USFWS, USGS, U.S. Forest Service, National Park Service, the University of Calgary, the Canadian Wildlife Service, and the University of Tennessee, National Institute of Mathematical and Biological Synthesis. There will also be international representation from Canada, Mexico, and the United Kingdom to present their views on national monitoring programs.
STAY TUNED!!!

Connecticut Department of
ENERGY &
ENVIRONMENTAL
PROTECTION

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Connecticut DEEP
Wildlife Division
kate.moran@ct.gov

U.S. FISH & WILDLIFE SERVICE

State Wildlife Grants