Understanding the Acoustic Environment

Jesse R. Barber

Boise State University

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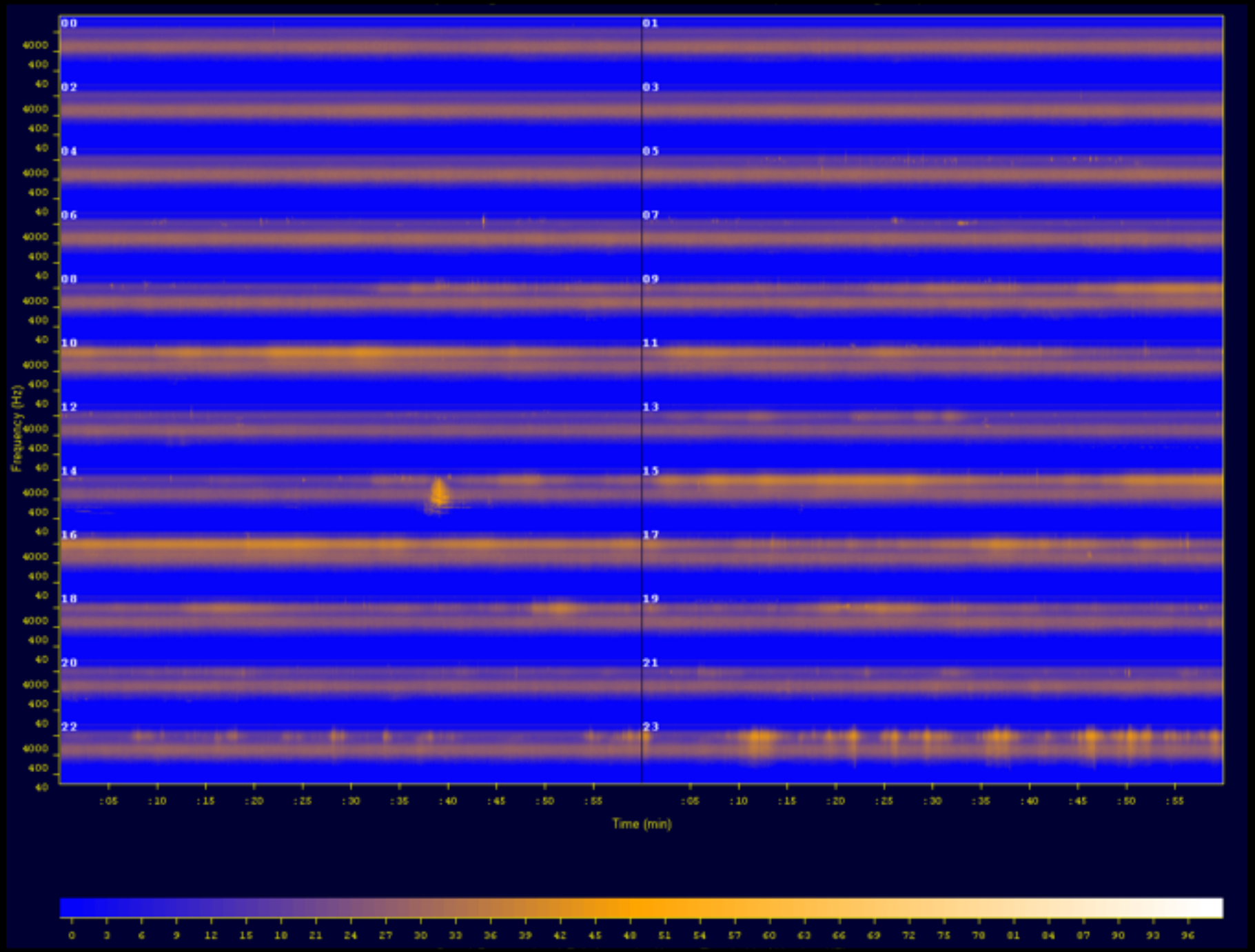
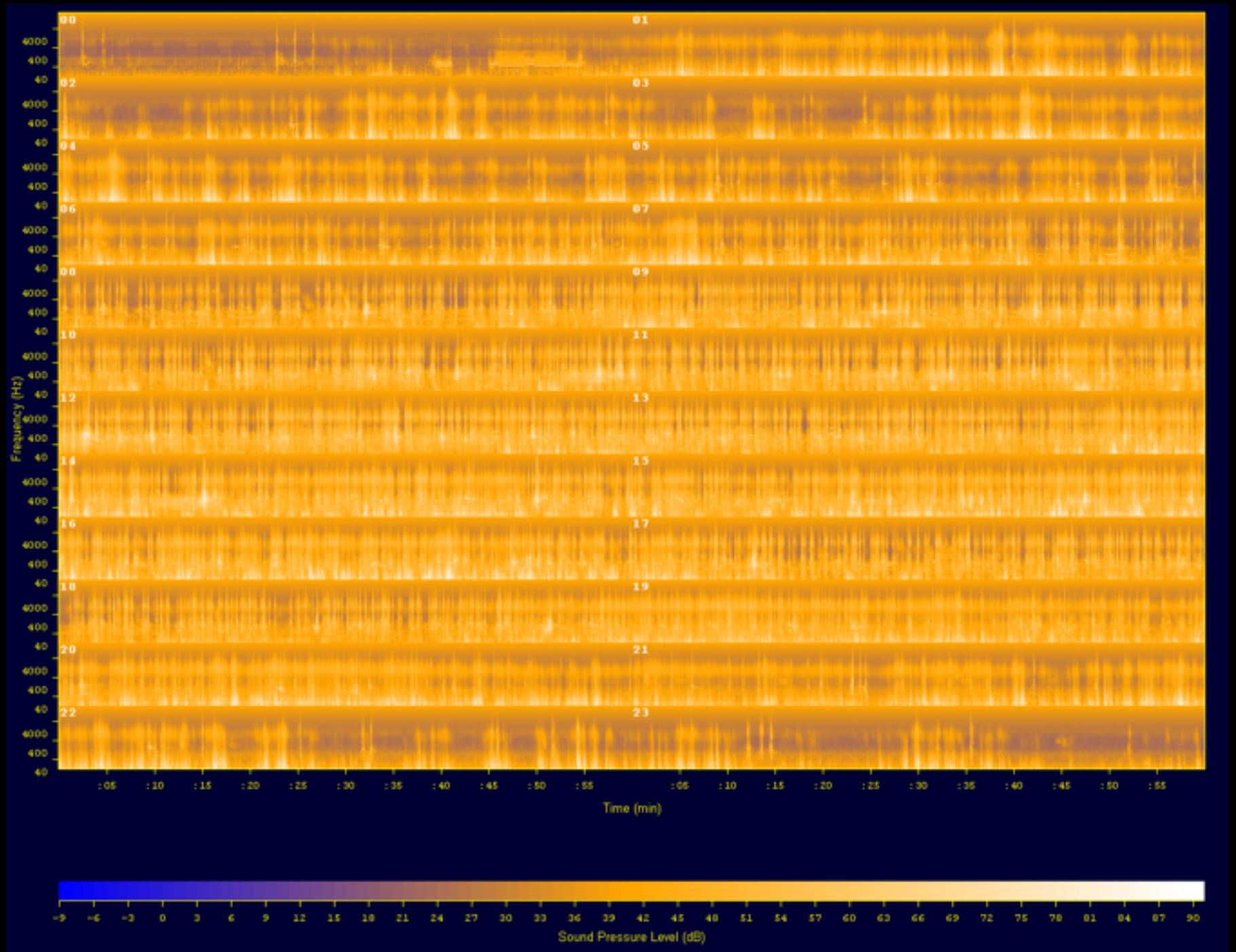

Frequency (Hz)
Time (min)


BBC TWO


00
01
02
03
04
05
06
07
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09
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15
16
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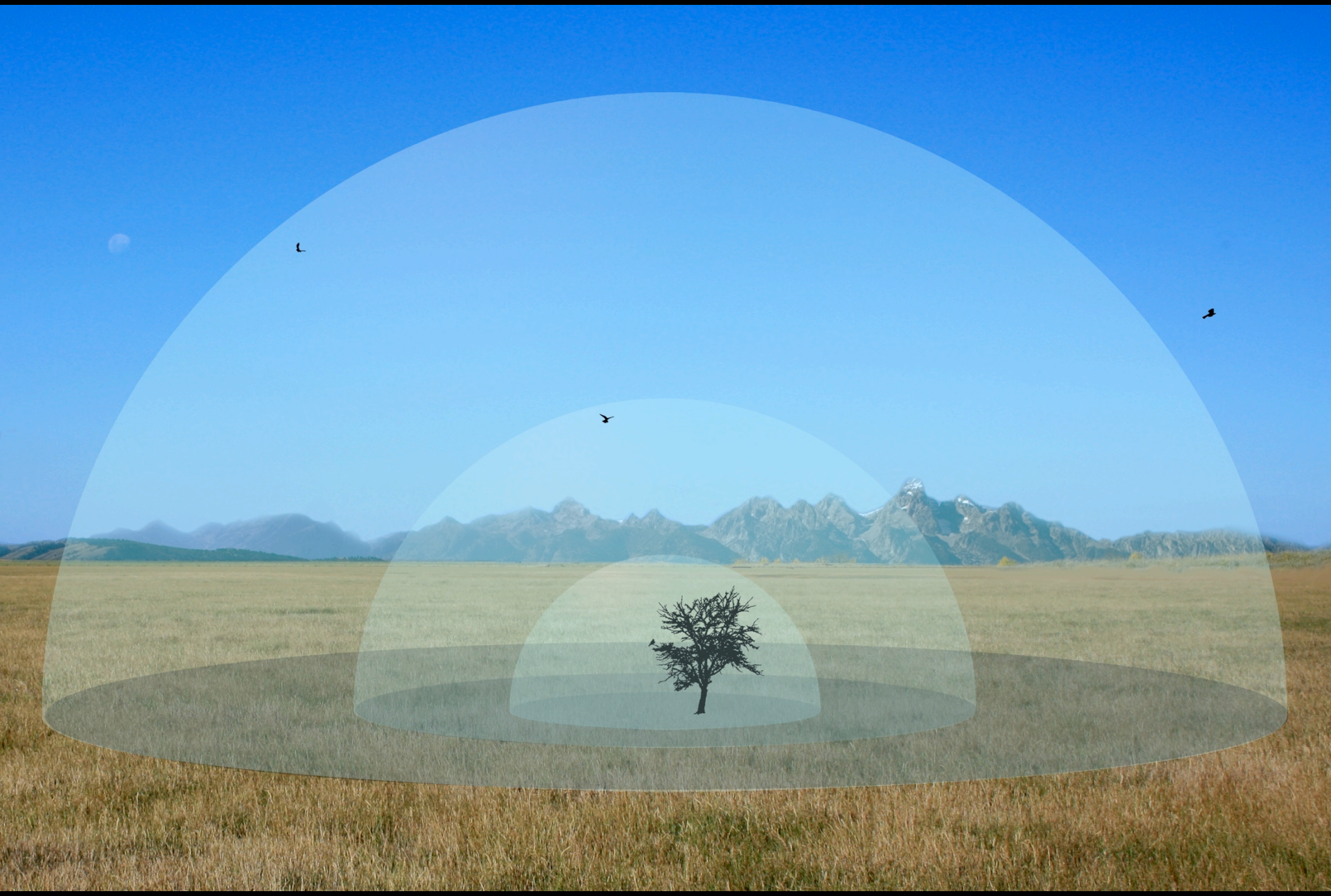
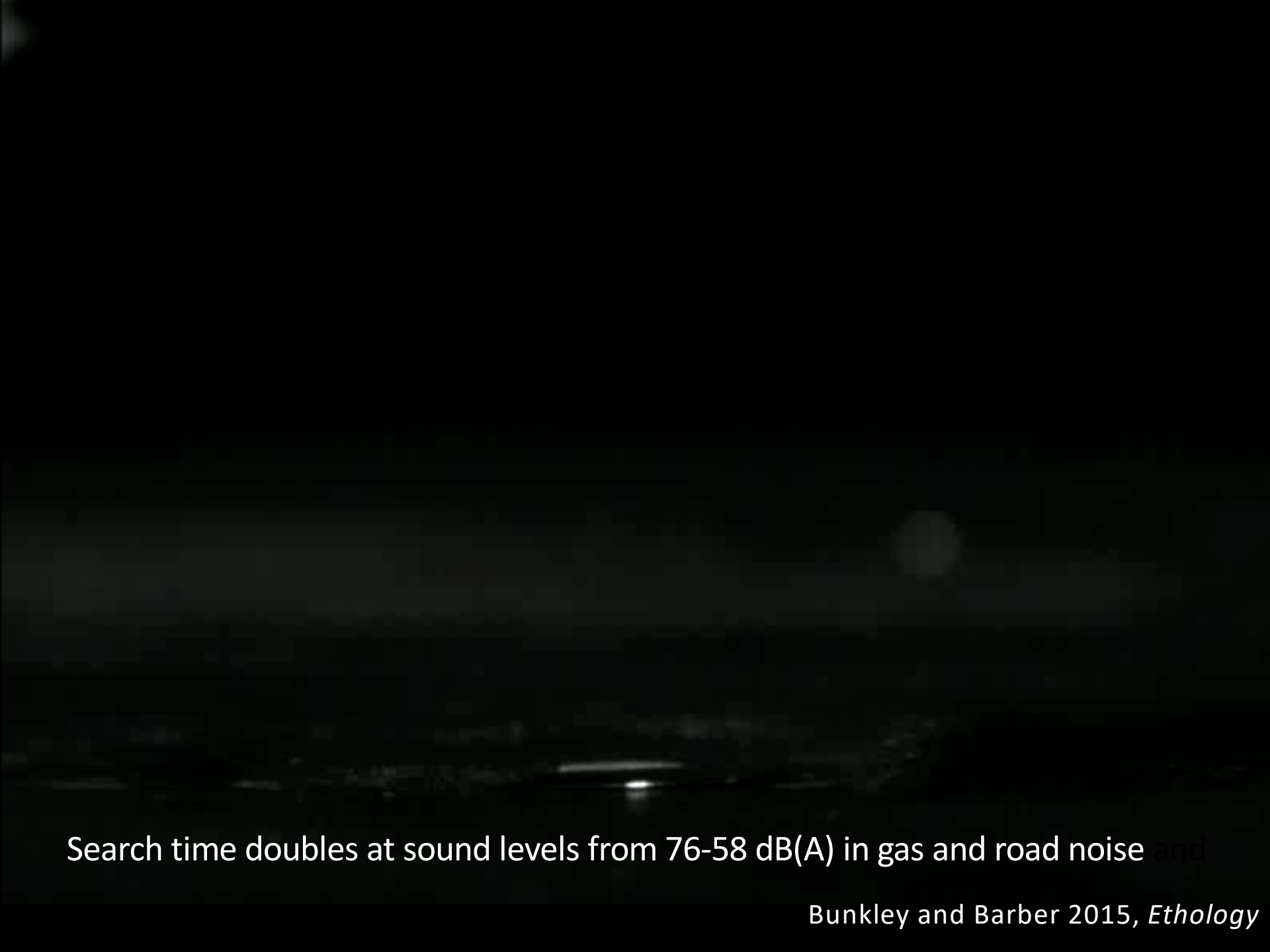
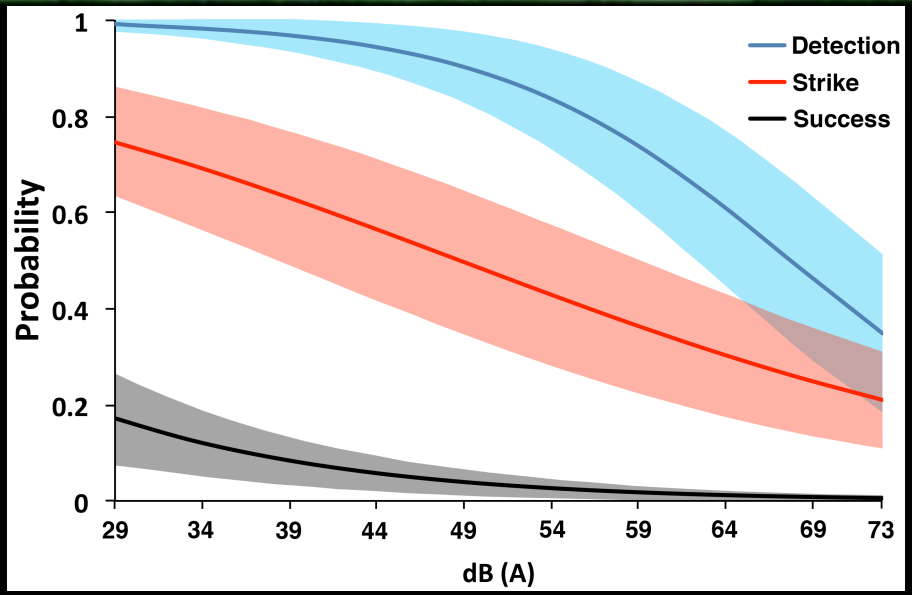
18
19
20
21
22
23
Frequency (Hz)
40
400
4000
:05
:10
:15
:20
:25
:30
:35
:40
:45
:50
:55
Time (min)
-9
-6
-3
0
3
6
9
12
15
18
21
24
27
30
33
36
39
42
45
48
51
54
57
60
63
66
69
72
75
78
81
84
87
90
Sound Pressure Level (dB)





Search time doubles at sound levels from 76-58 dB(A) in gas and road noise

Bunkley and Barber 2015, *Ethology*

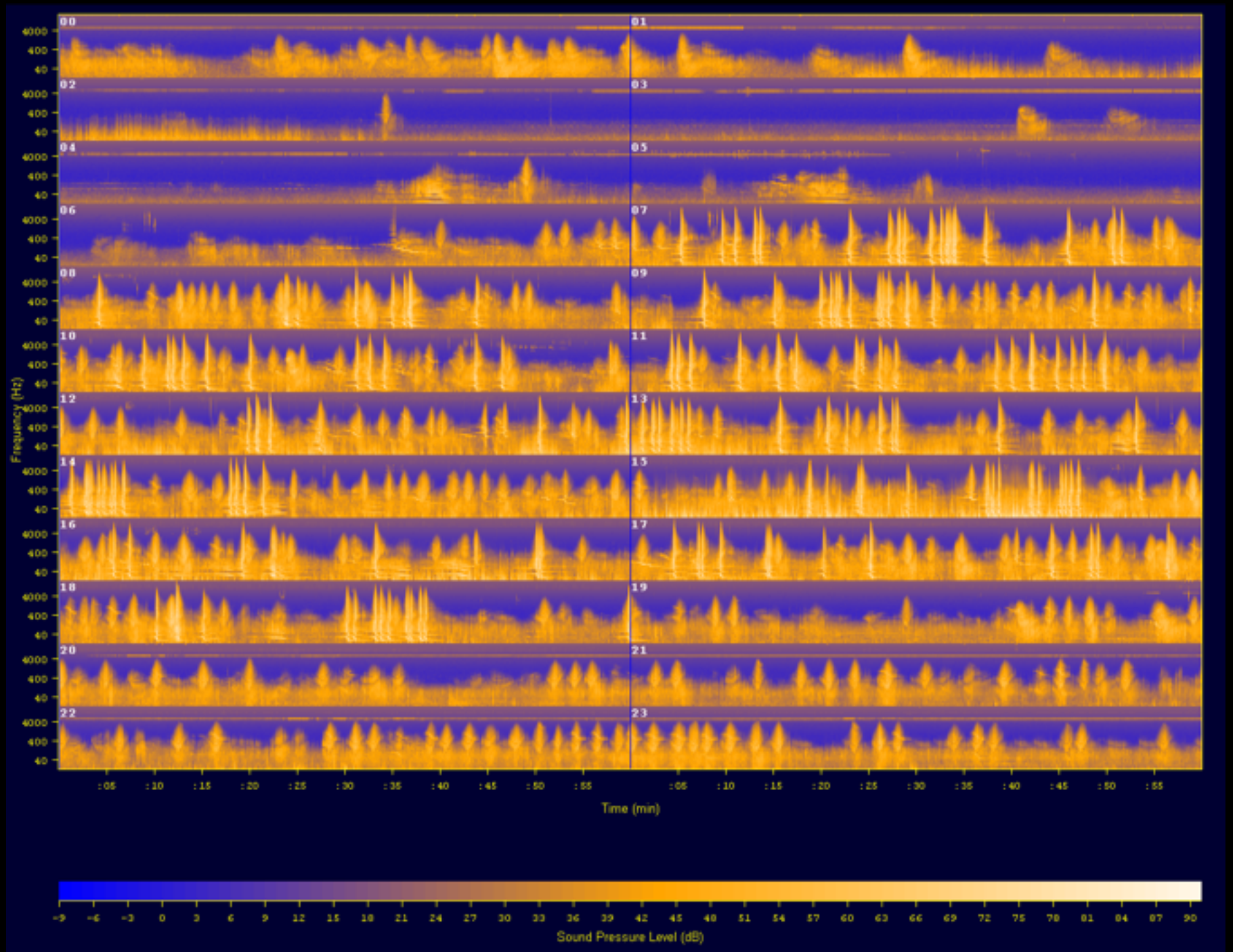


Mason *et al*. 2016, *Biol Conserv*

Bernal et al. 2007

Magrath et al. 2007

Roche et al. 1999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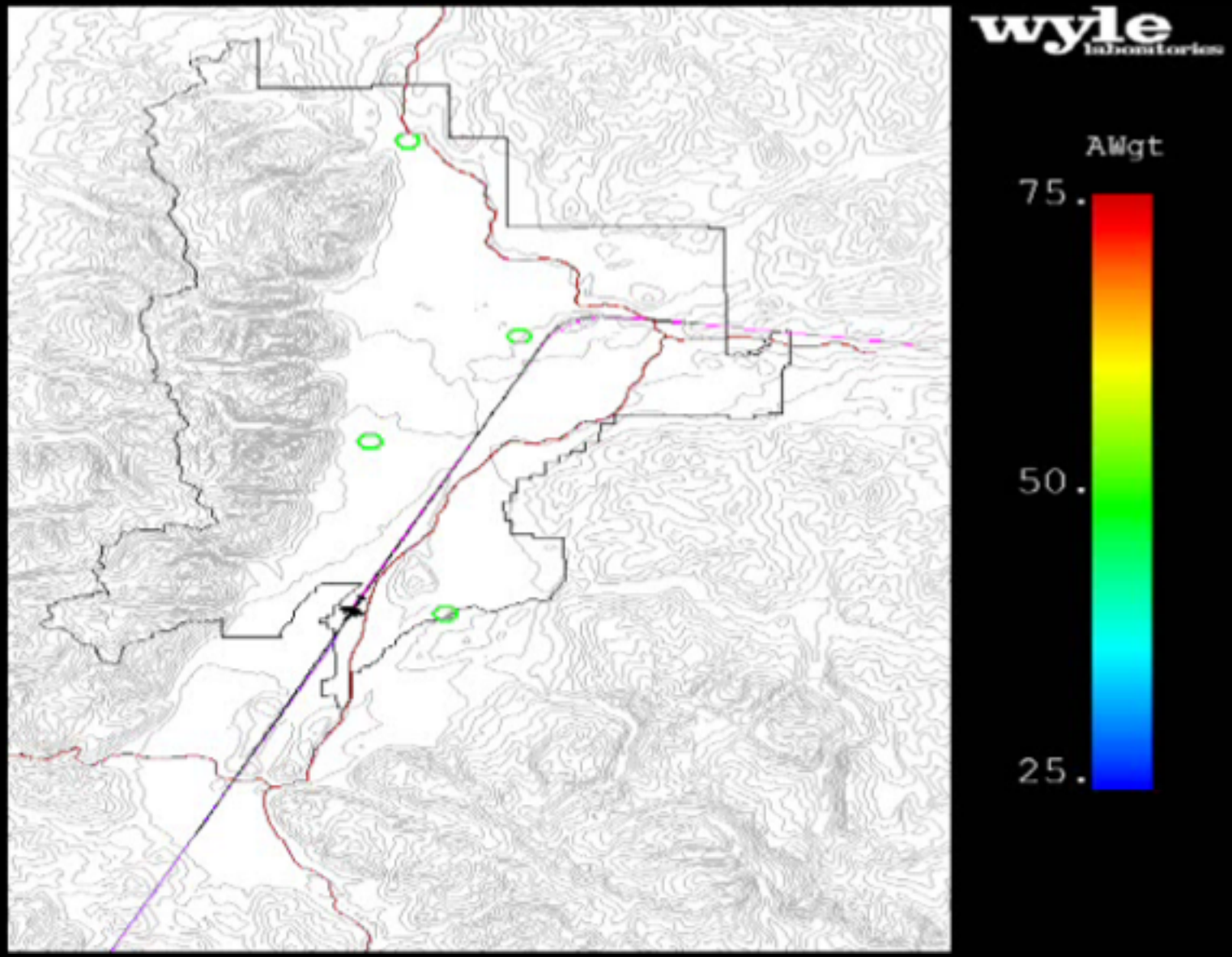
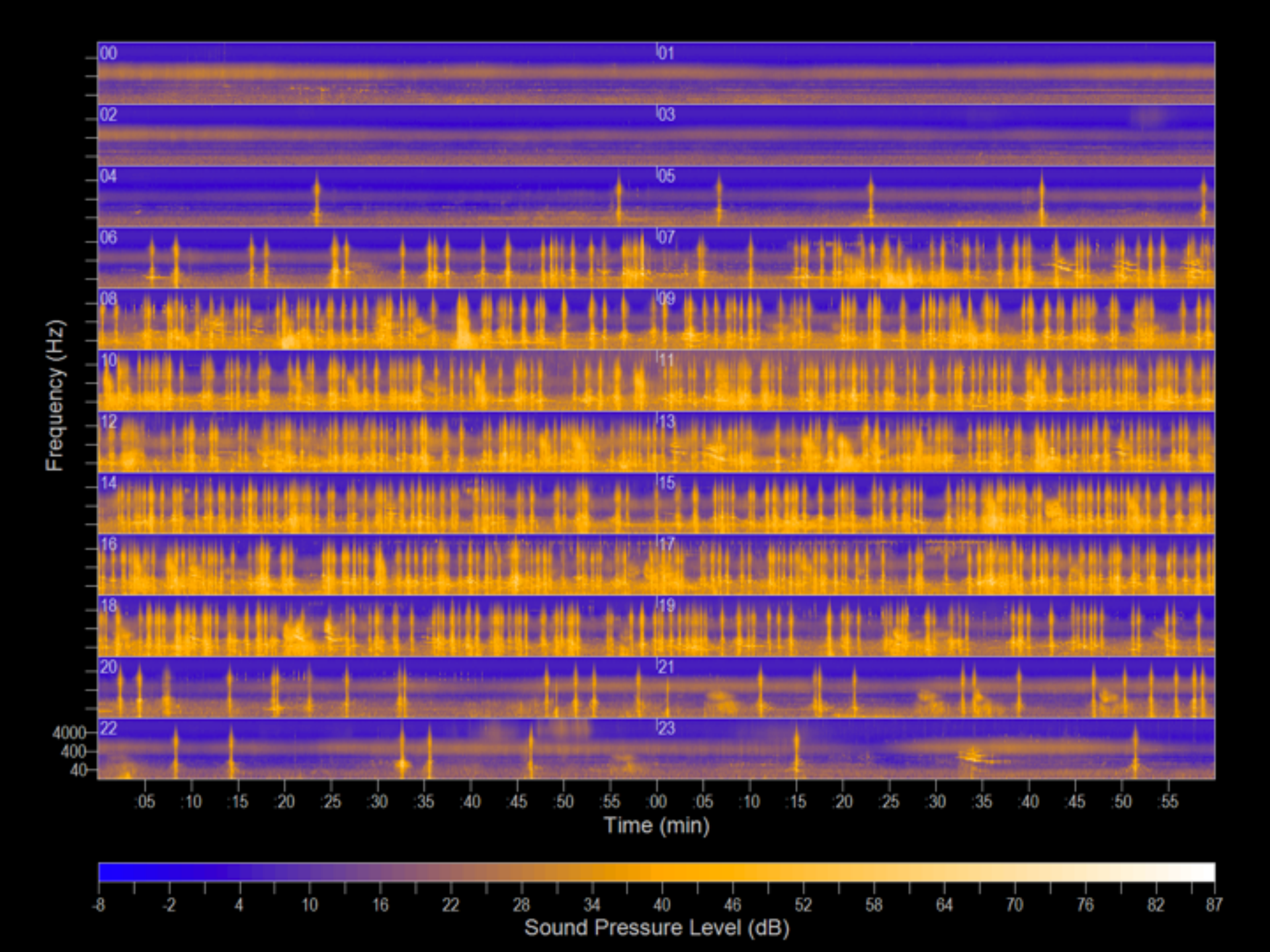
23
4000
400
40
Frequency (Hz)
:05
:10
:15
:20
:25
:30
:35
:40
:45
:50
:55
Time (min)
-9
-6
-3
0
3
6
9
12
15
18
21
24
27
30
33
36
39
42
45
48
51
54
57
60
63
66
69
72
75
78
81
84
87
90
Sound Pressure Level (dB)



Barber et al. 2011, *Landscape Ecol*


00
01
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04
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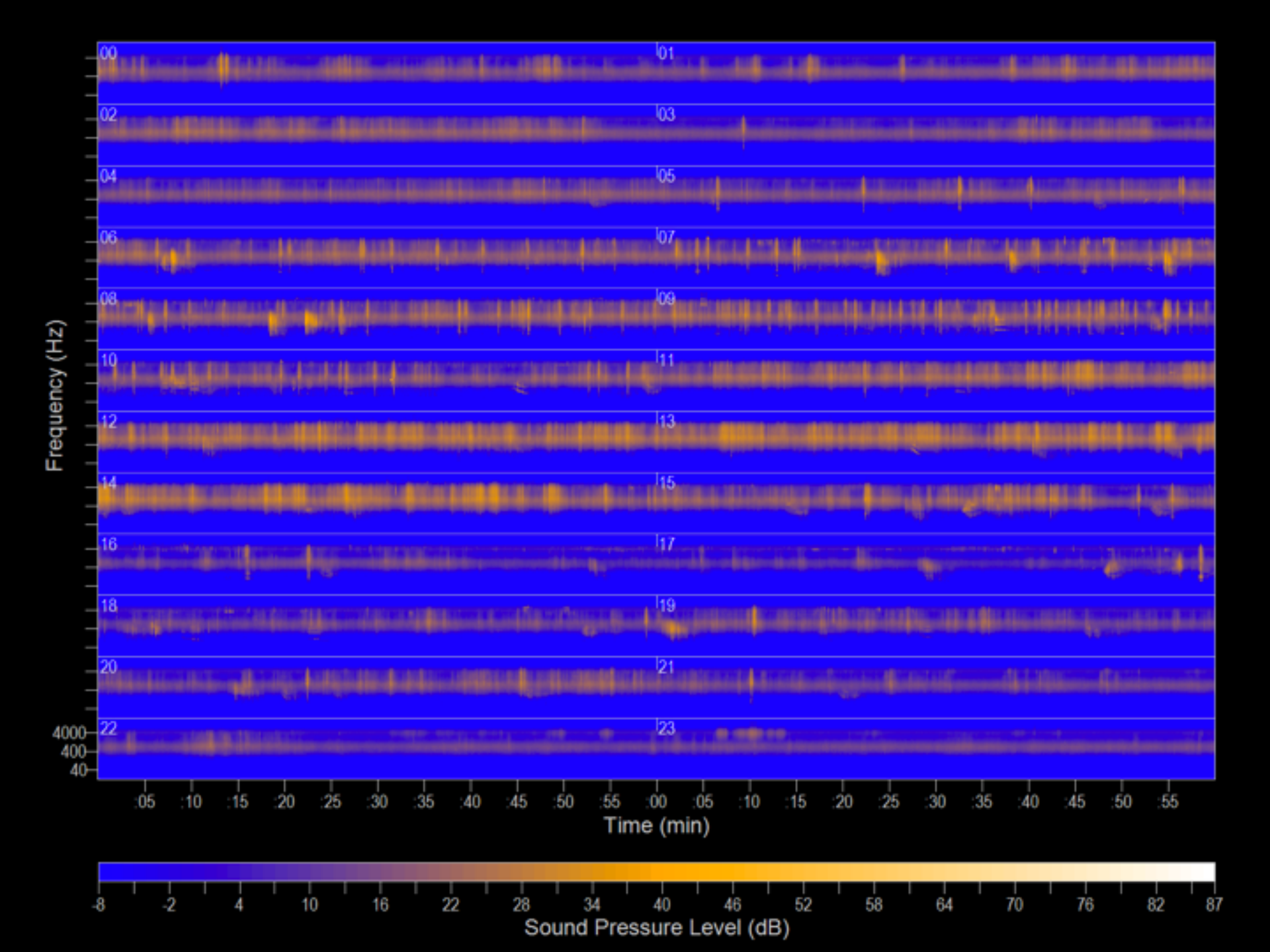
06
07
08
09
10
11
12
13
14
15
16
17
18
19
20
21
22
23
Frequency (Hz)
4000
400
40
:05 :10 :15 :20 :25 :30 :35 :40 :45 :50 :55 :00 :05 :10 :15 :20 :25 :30 :35 :40 :45 :50 :55
Time (min)
-8 -2 4 10 16 22 28 34 40 46 52 58 64 70 76 82 87
Sound Pressure Level (dB)


00
01
02
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20
21
22
23
Frequency (Hz)
4000
400
40
:05 :10 :15 :20 :25 :30 :35 :40 :45 :50 :55 :00 :05 :10 :15 :20 :25 :30 :35 :40 :45 :50 :55
Time (min)
-8 -2 4 10 16 22 28 34 40 46 52 58 64 70 76 82 87
Sound Pressure Level (dB)

83% of the land in the continental U.S. is within 1061 m of a road (Ritters and Wickham 2003)

Barber et al. 2011, *Landscape Ecol*

Effects of Traffic Noise on Occupancy Patterns of Forest Birds

SARAH E. GOODWIN* AND W. GREGORY SHRIVER

The Journal of Applied Ecology, Vol. 31, No. 1. (Feb., 1994), pp. 95-101

The Effects of Car Traffic on Breeding Bird Populations in Woodland. I. Evidence of Reduced Habitat Quality for Willow Warblers (Phylloscopus trochilus) Breeding Close to a Highway

Rien Reijnen; Ruud Foppen

for nestling white-crowned sparrows

O.L. Crino [a,*], B. Klaassen Van Oorschot [a]

Pescador[b]

C.W. Breuner [a]

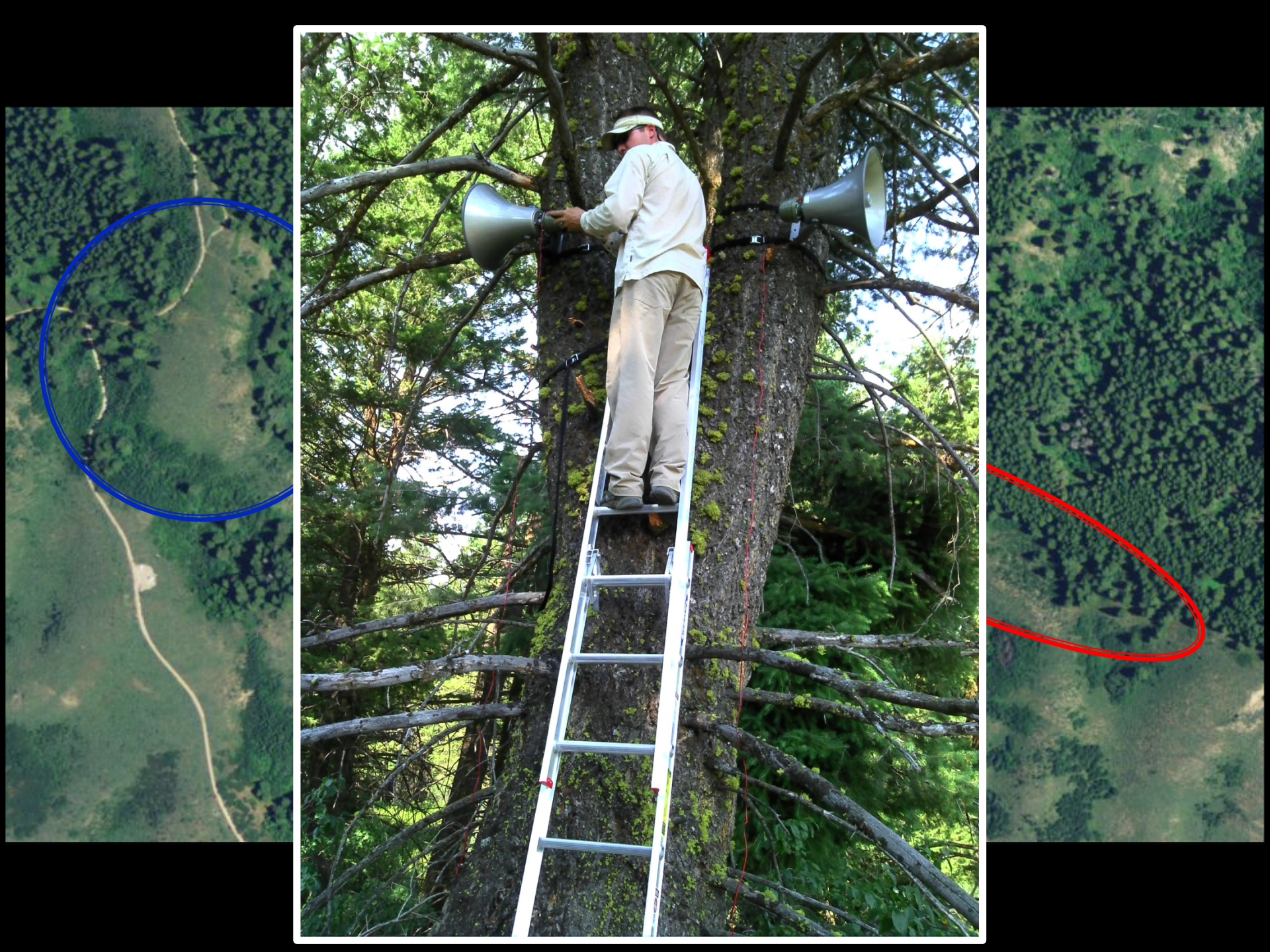
M. Lessells[2] and Hans

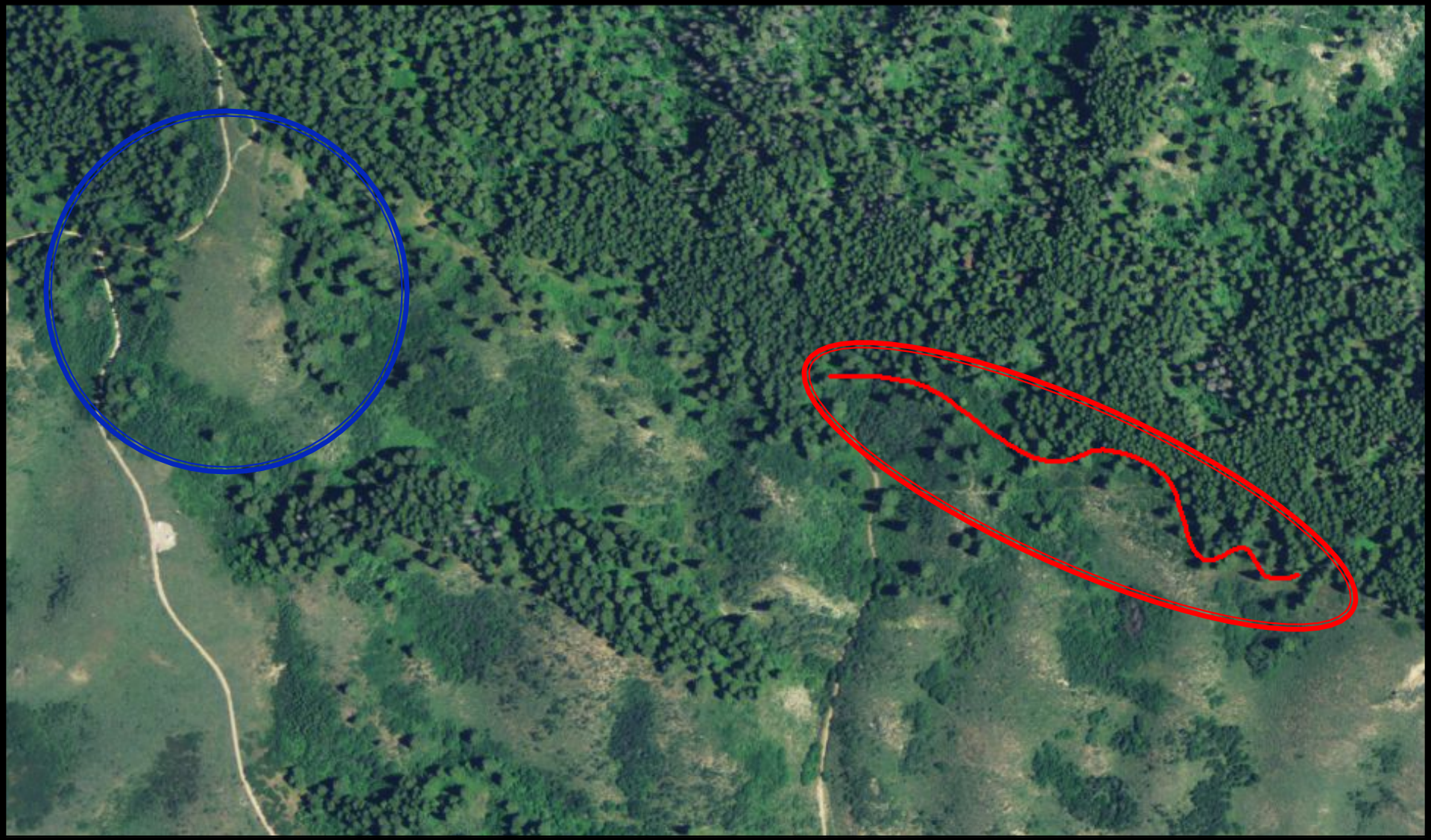
Bird Populations in Woodland. II. Breeding (Phylloscopus trochilus) in Relation to the

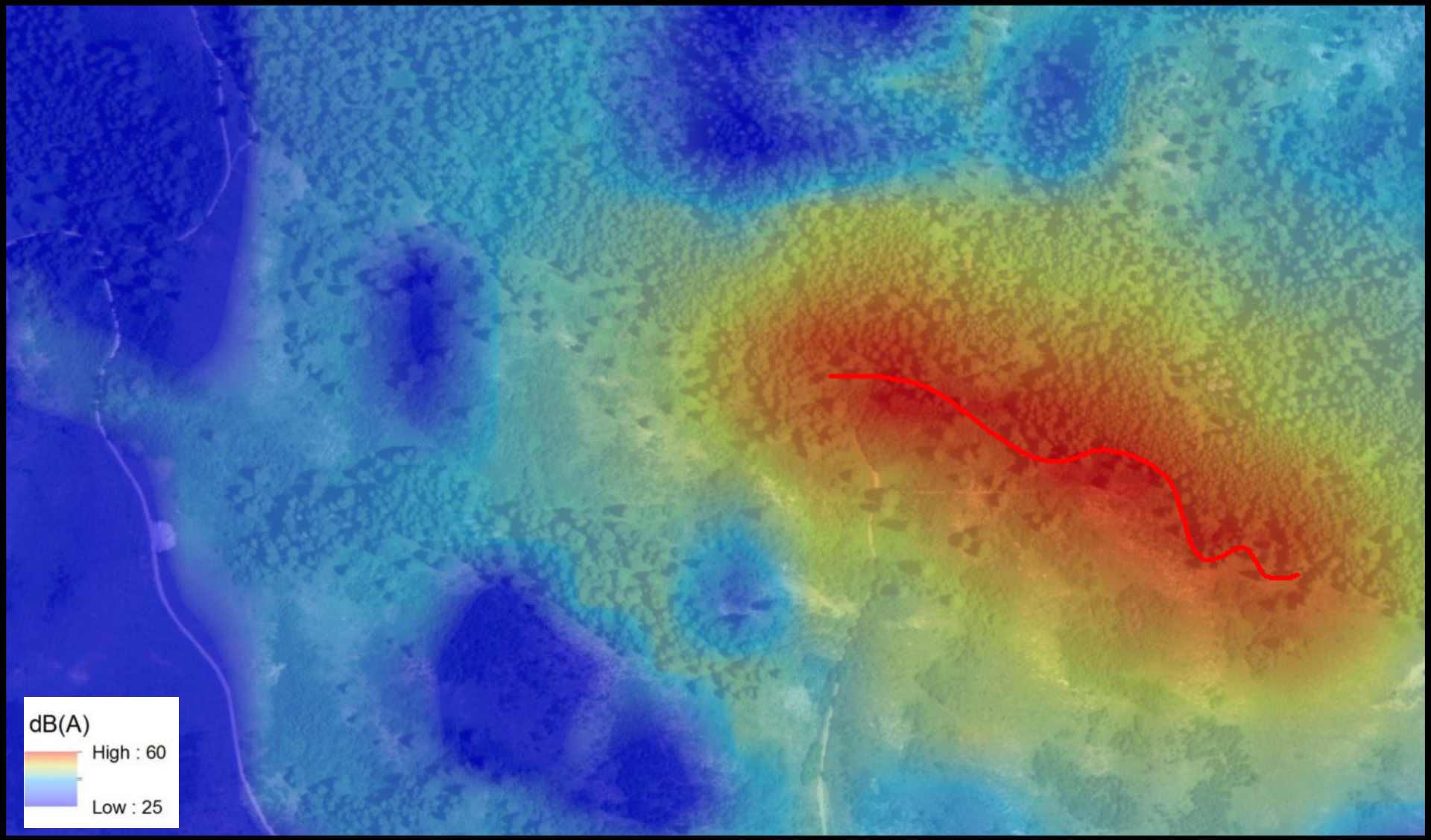
Ruud Foppen; Rien Reijnen

10.1007/s00267-001-0065-4


The Phantom Road
Douglas fir
Mountain shrubland
Shrub-steppe






dB(A)
High : 60
Low : 25

LEQ [dB(A)]

48

37

4-day blocks

Julian date

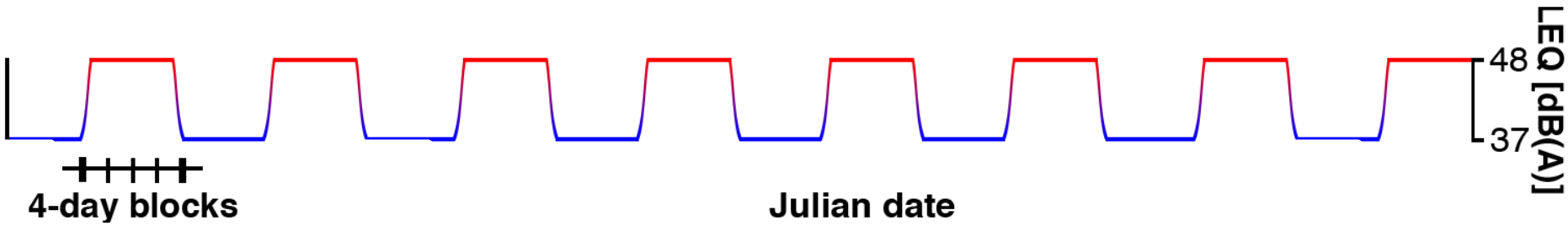
LEQ [dB(A)]

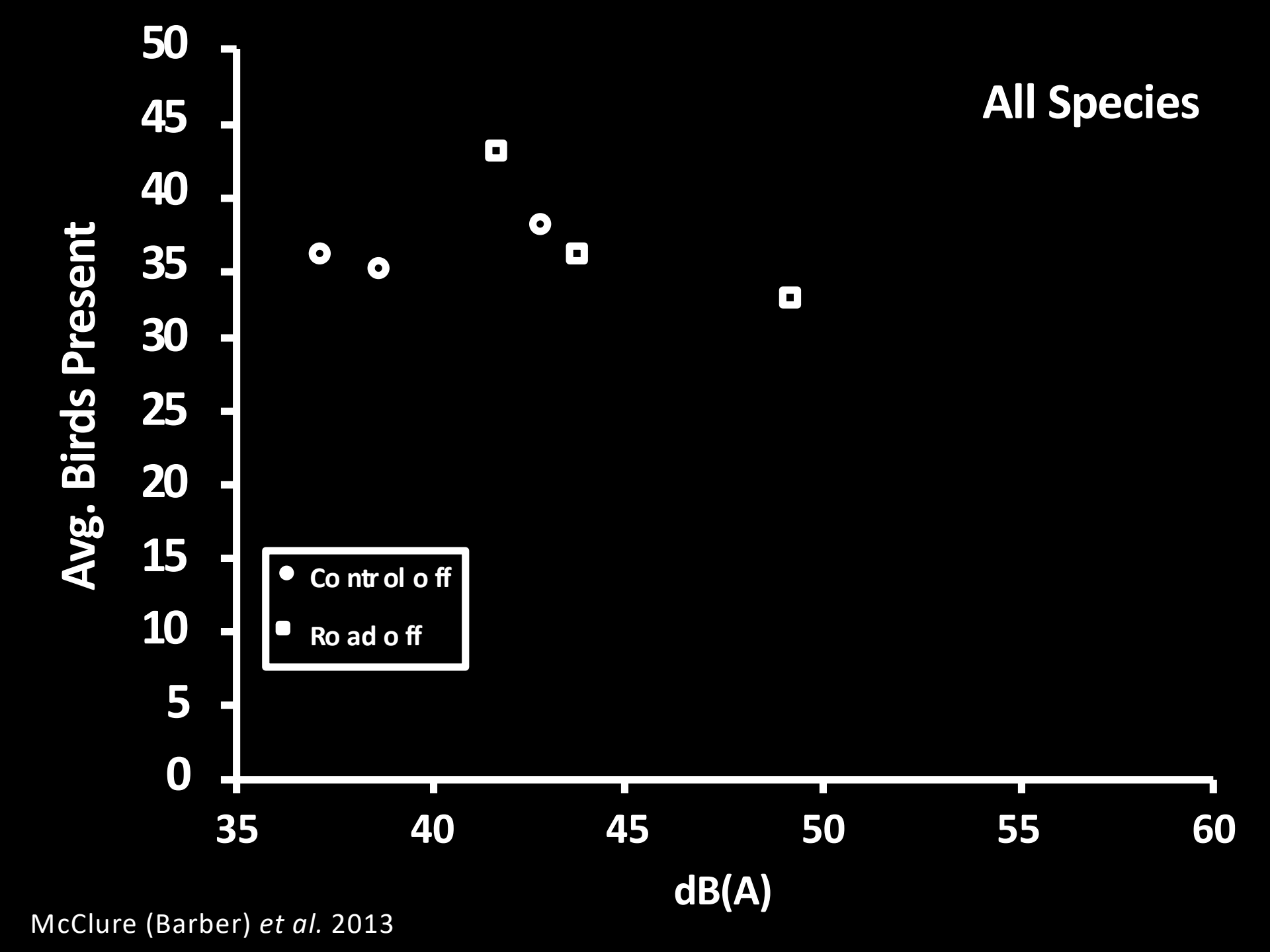
48

37

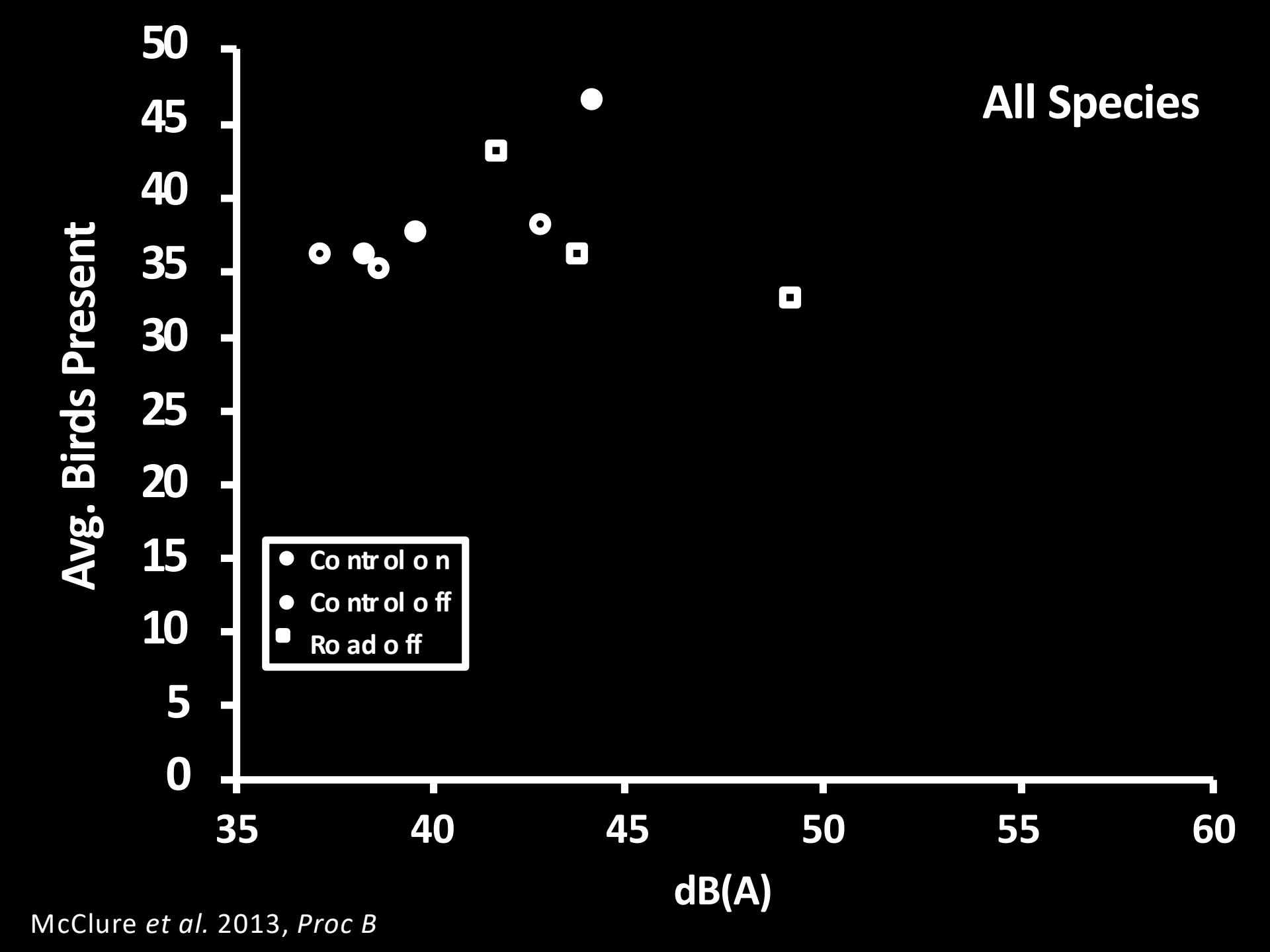
4-day blocks

Julian date

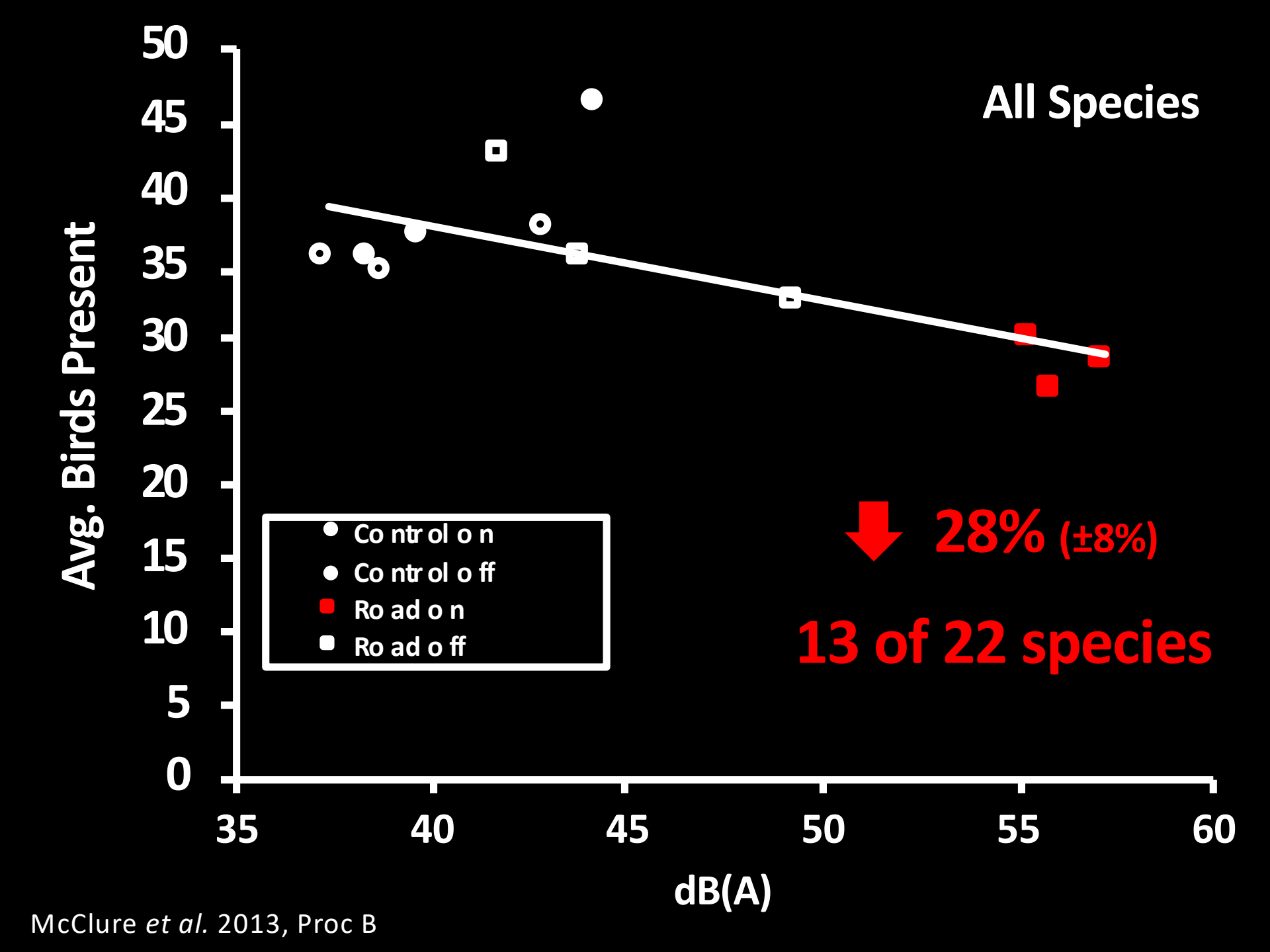

LEQ [dB(A)]
48
37
4-day blocks
Julian date



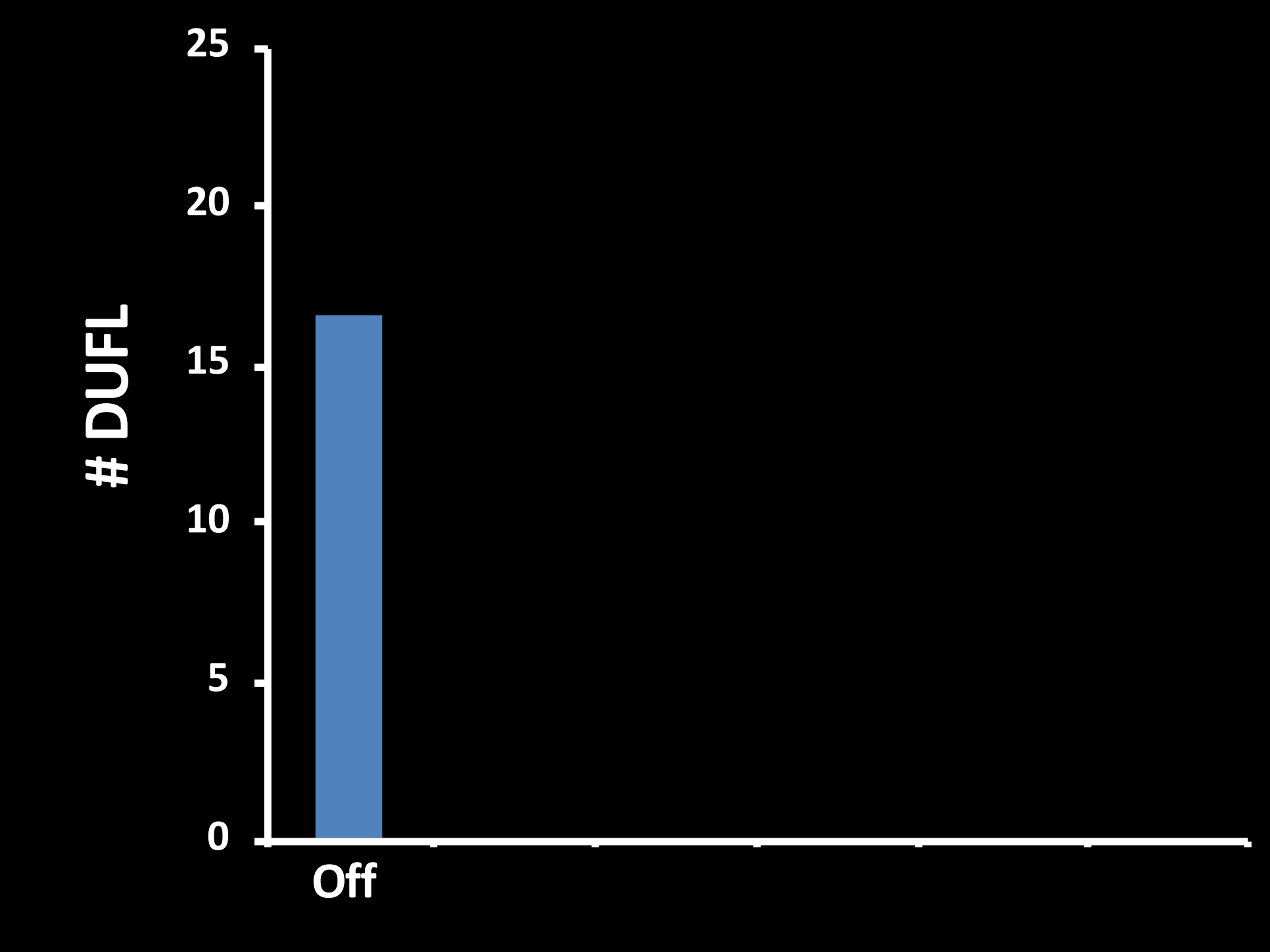
McClure (Barber) *et al.* 2013

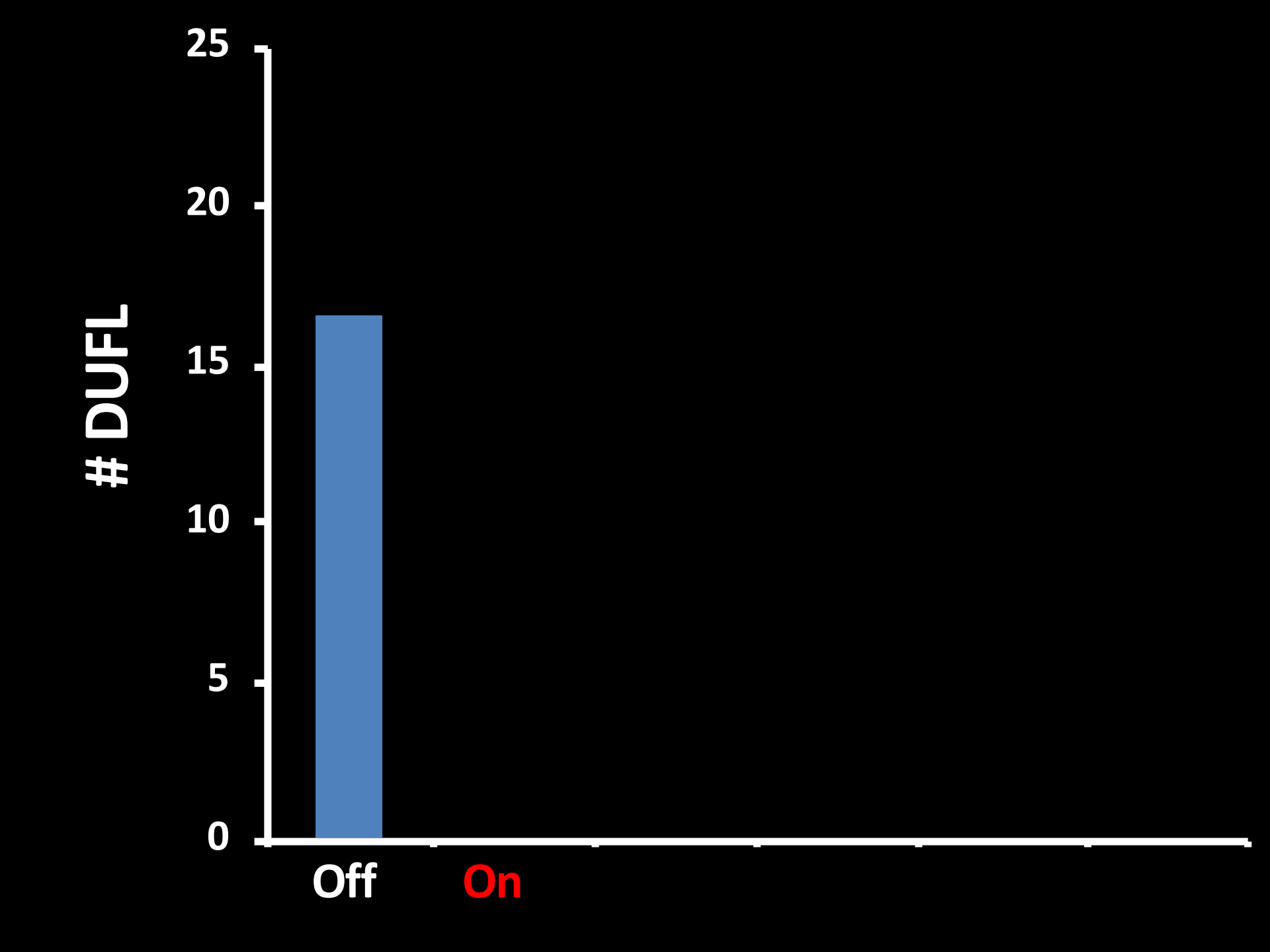


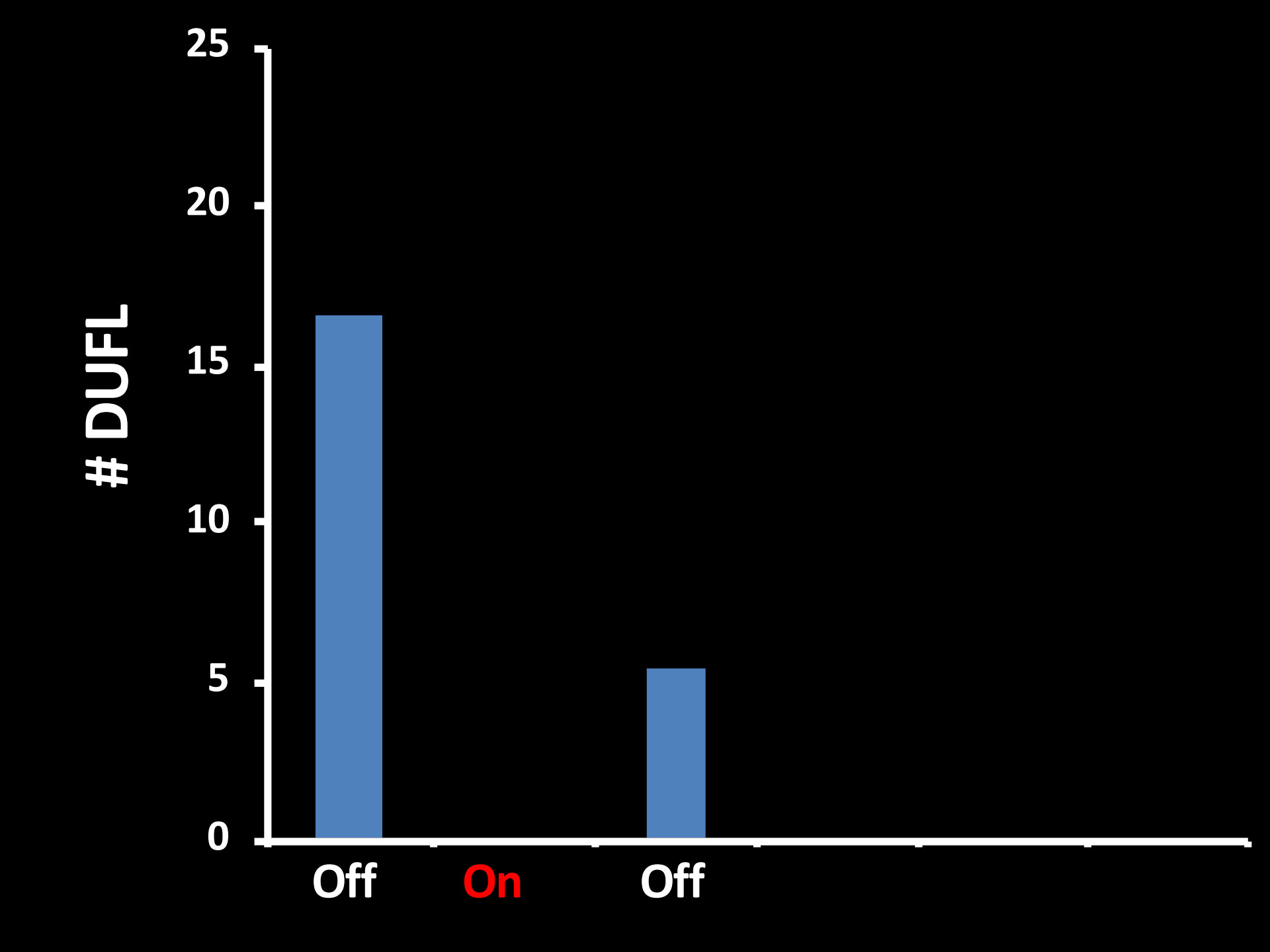
McClure *et al.* 2013, *Proc B*

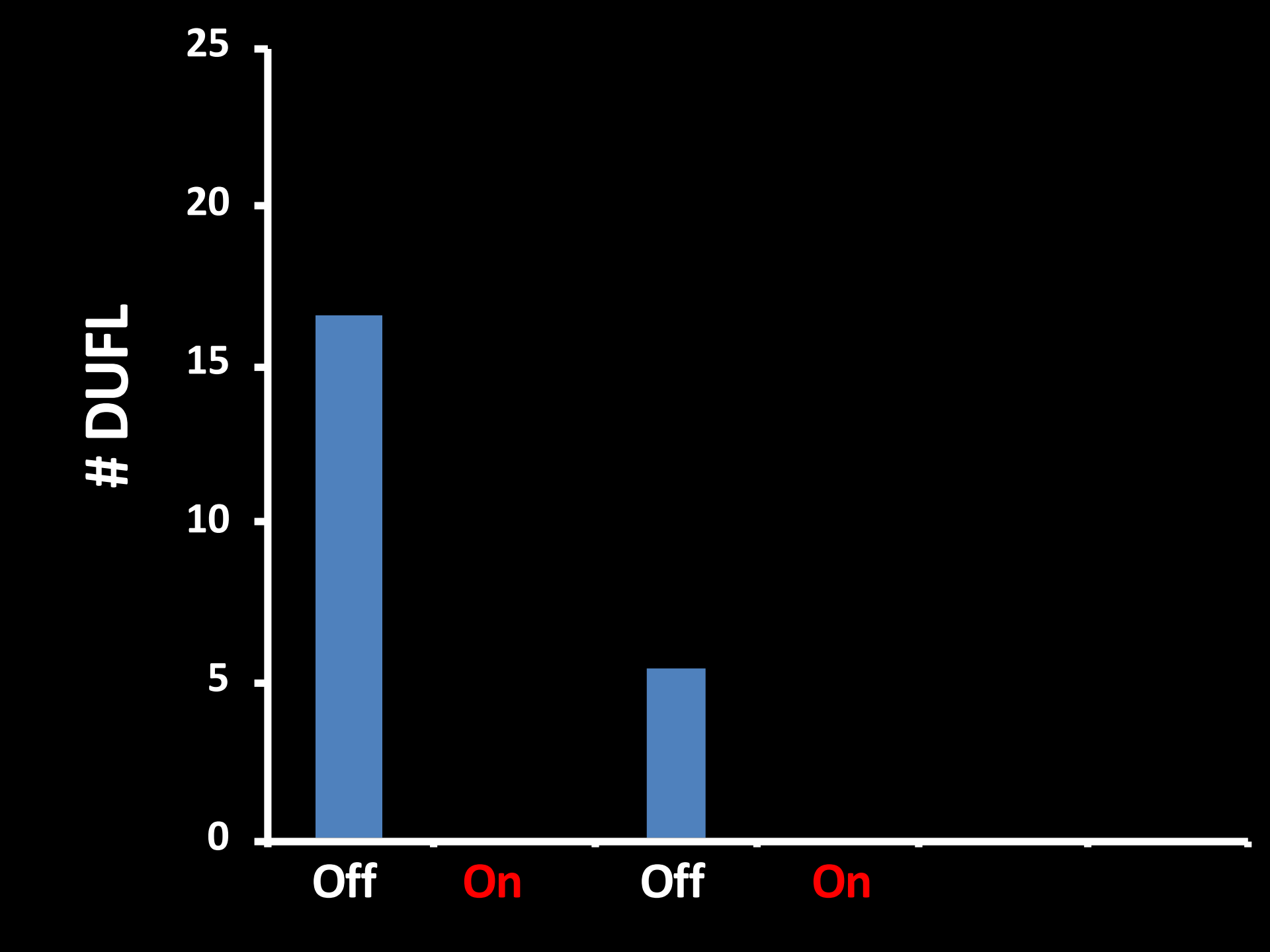


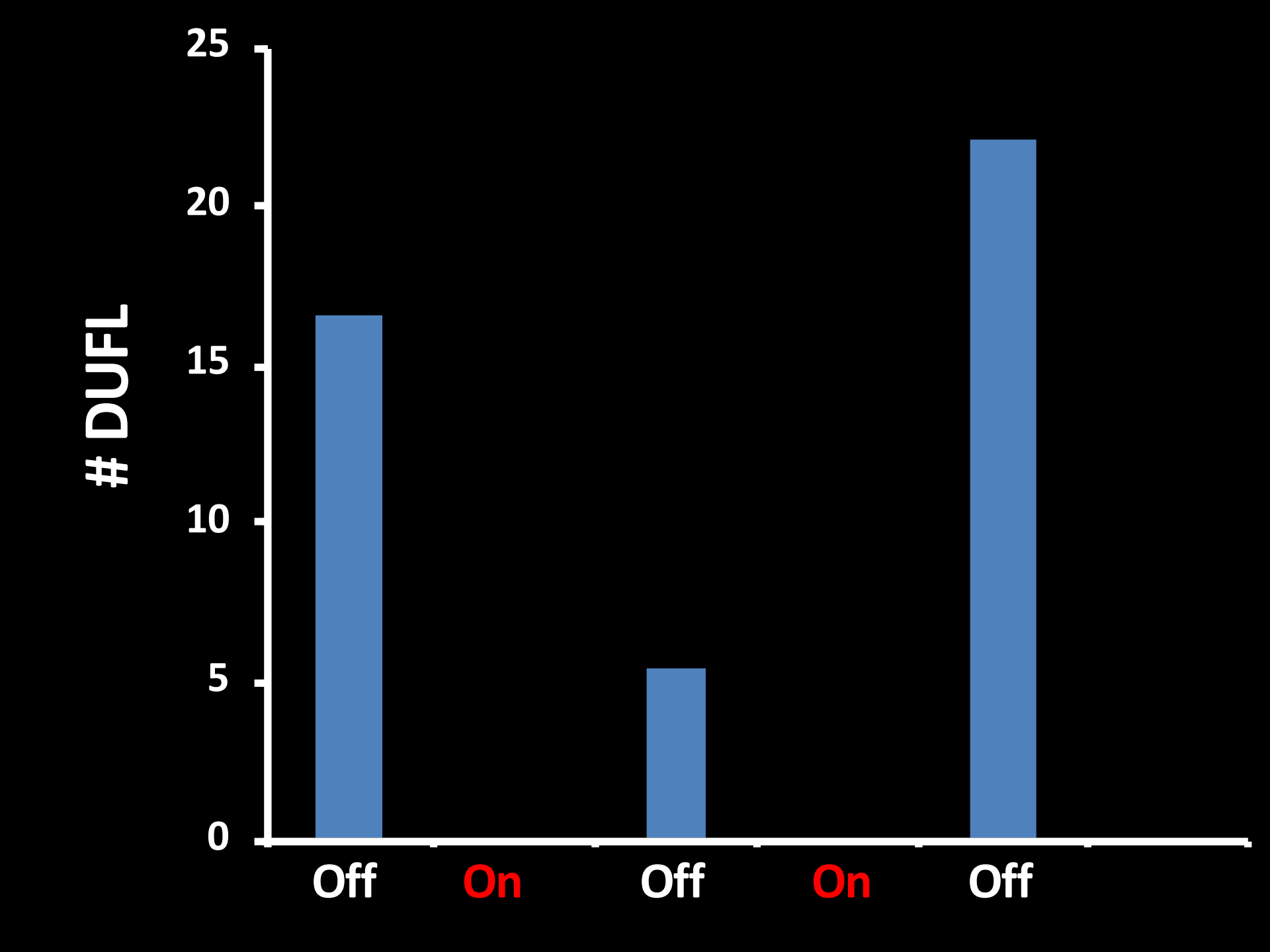
McClure *et al.* 2013, Proc B

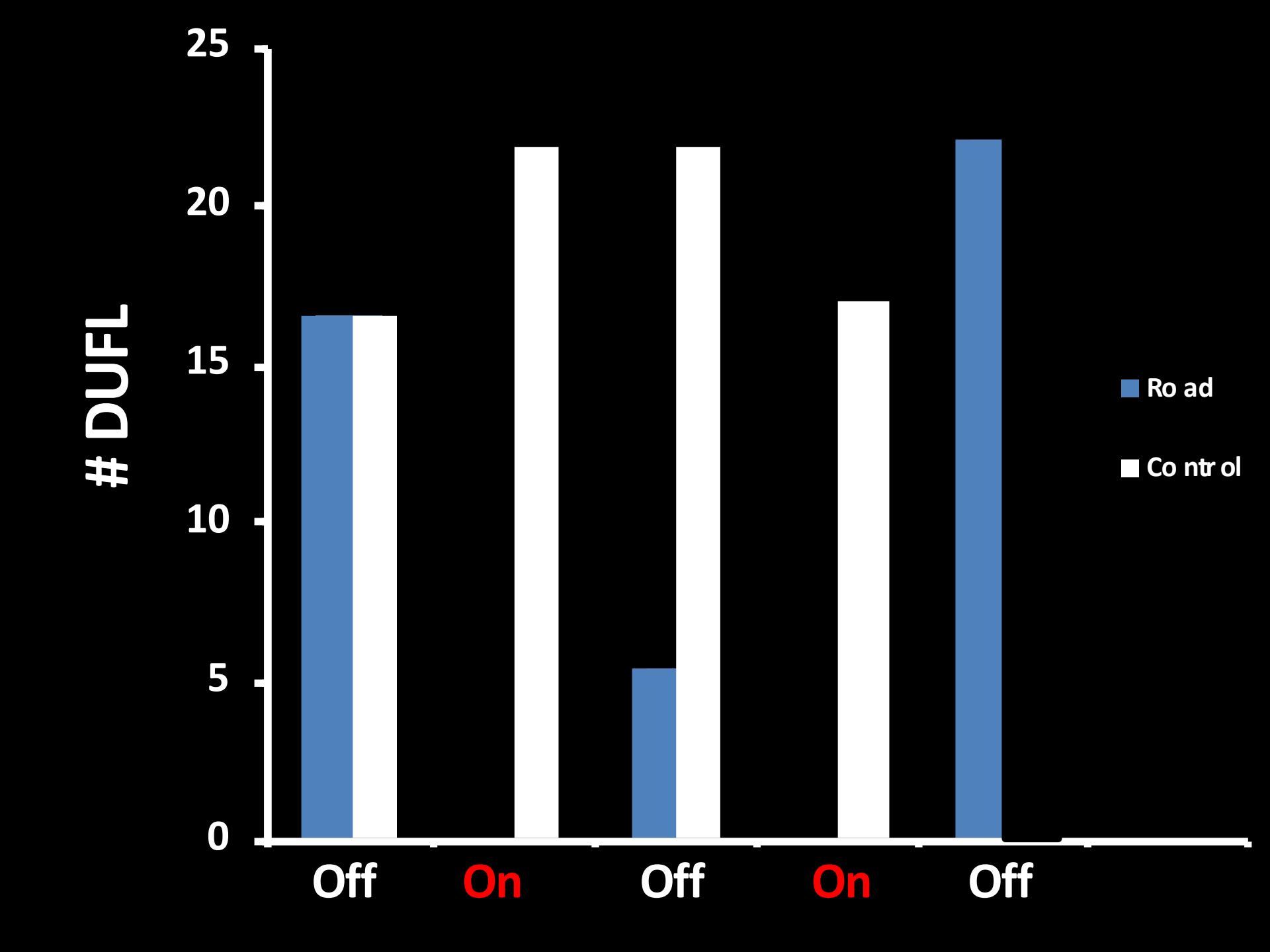

25
20
15
10
5
0
DUFL
Off


25
20
15
10
5
0
DUFL
Off
On


25
20
15
10
5
0
DUFL
Off
On
Off


25
20
15
10
5
0
DUFL
Off
On
Off
On


25
20
15
10
5
0
DUFL
Off
On
Off
On
Off

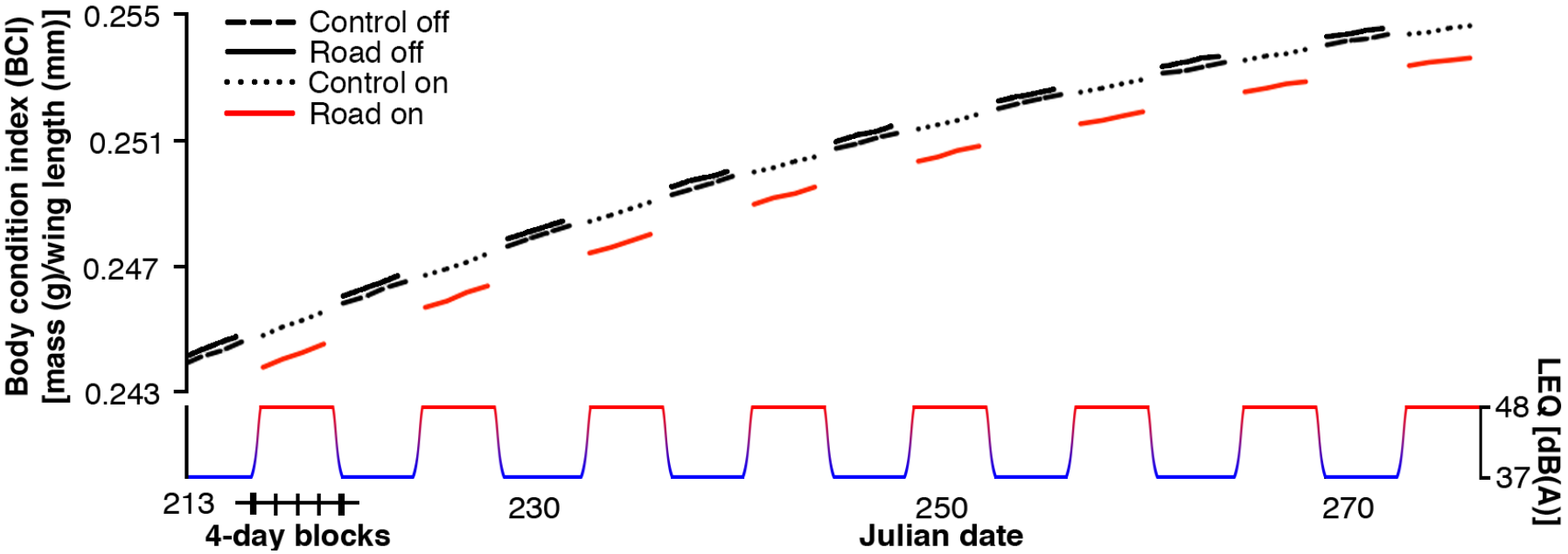

25
20
15
10
5
0
DUFL
Off
On
Off
On
Off
Ro ad
Co ntr ol

dB(A)	Sound
0	Breathing
20	Rustling leaves
50	Quiet suburb
~55	Phantom Road
60	Average office
70	Freeway (15m)
90	Busy urban street

51 songbird species

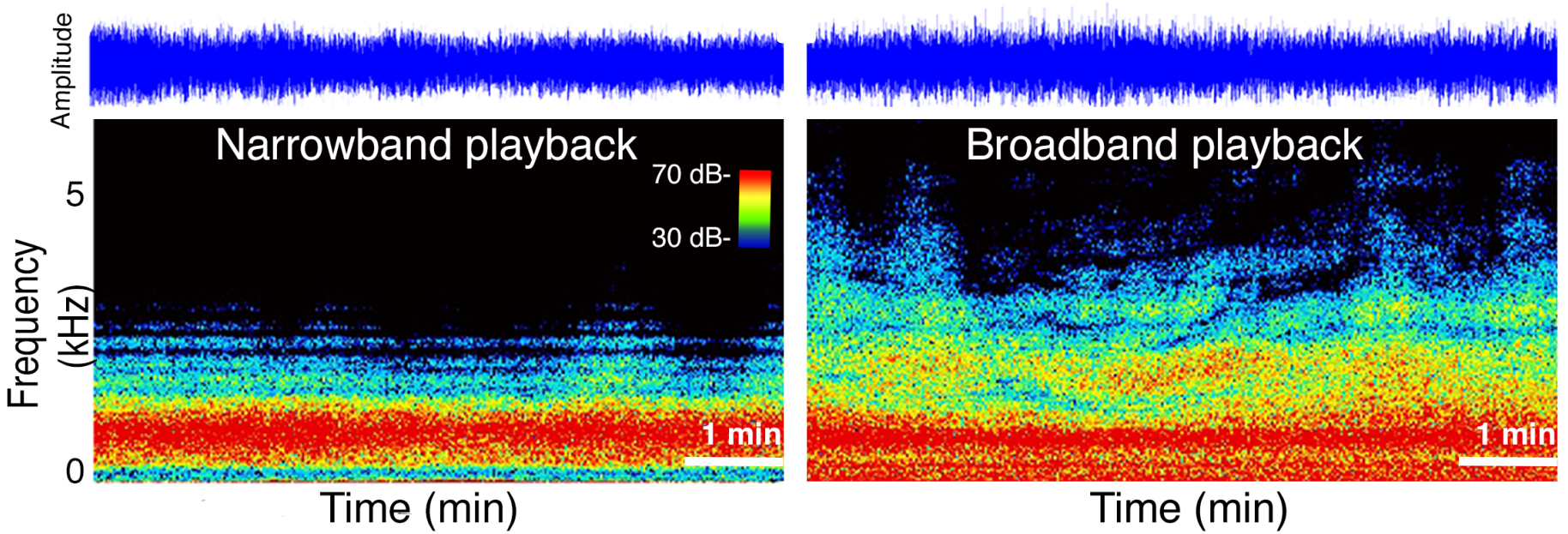
9,924 individuals

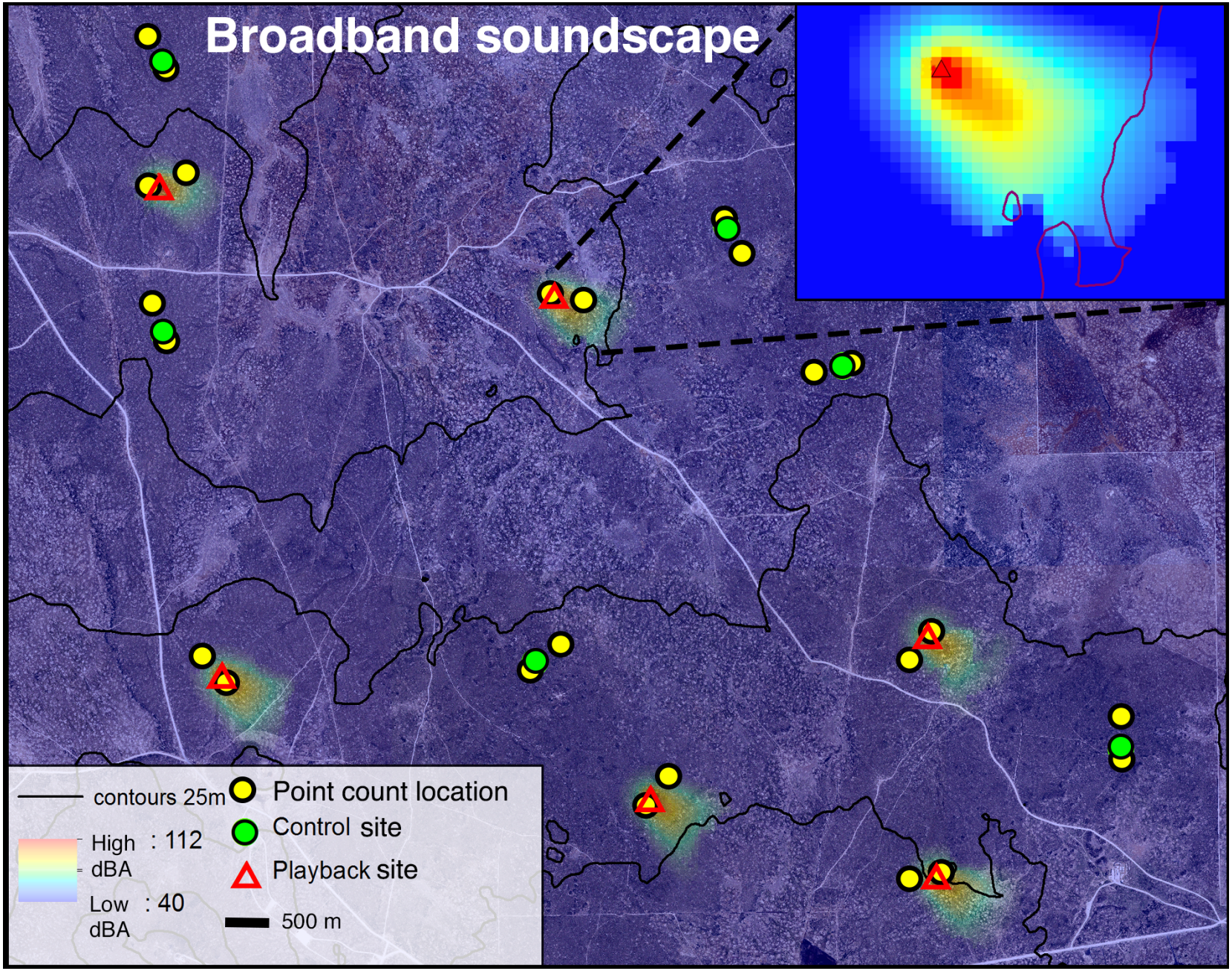
Body Condition Index



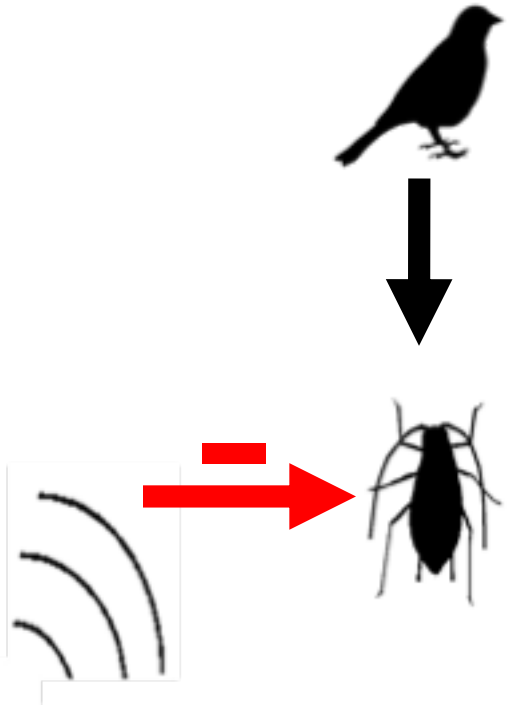
Ware *et al.* 2015, *PNAS*

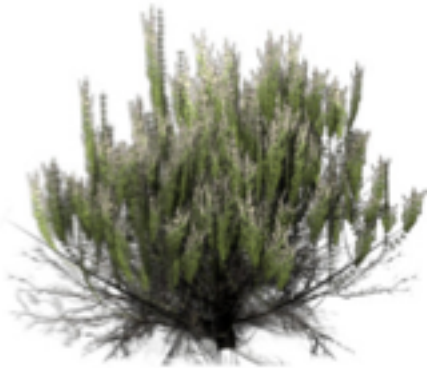
Phantom Natural Gas Field


Amplitude
Narrowband playback
70 dB-
30 dB-
5
Frequency (kHz)
0
1 min
Time (min)
Broadband playback
1 min
Time (min)

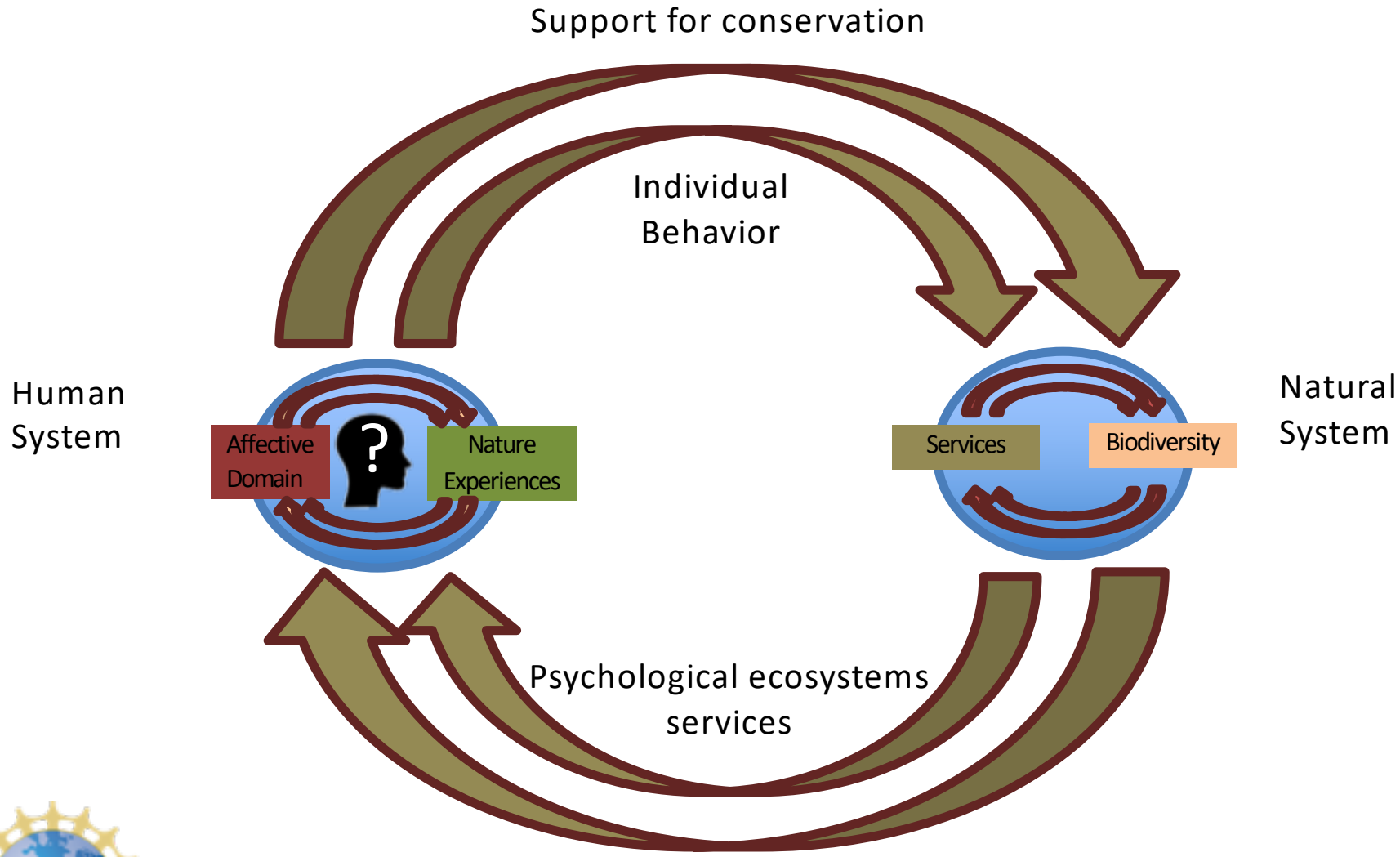

Broadband soundscape
contours 25m
High : 112 dBA
Low : 40 dBA
Point count location
Control site
Playback site
500 m

Narrowband

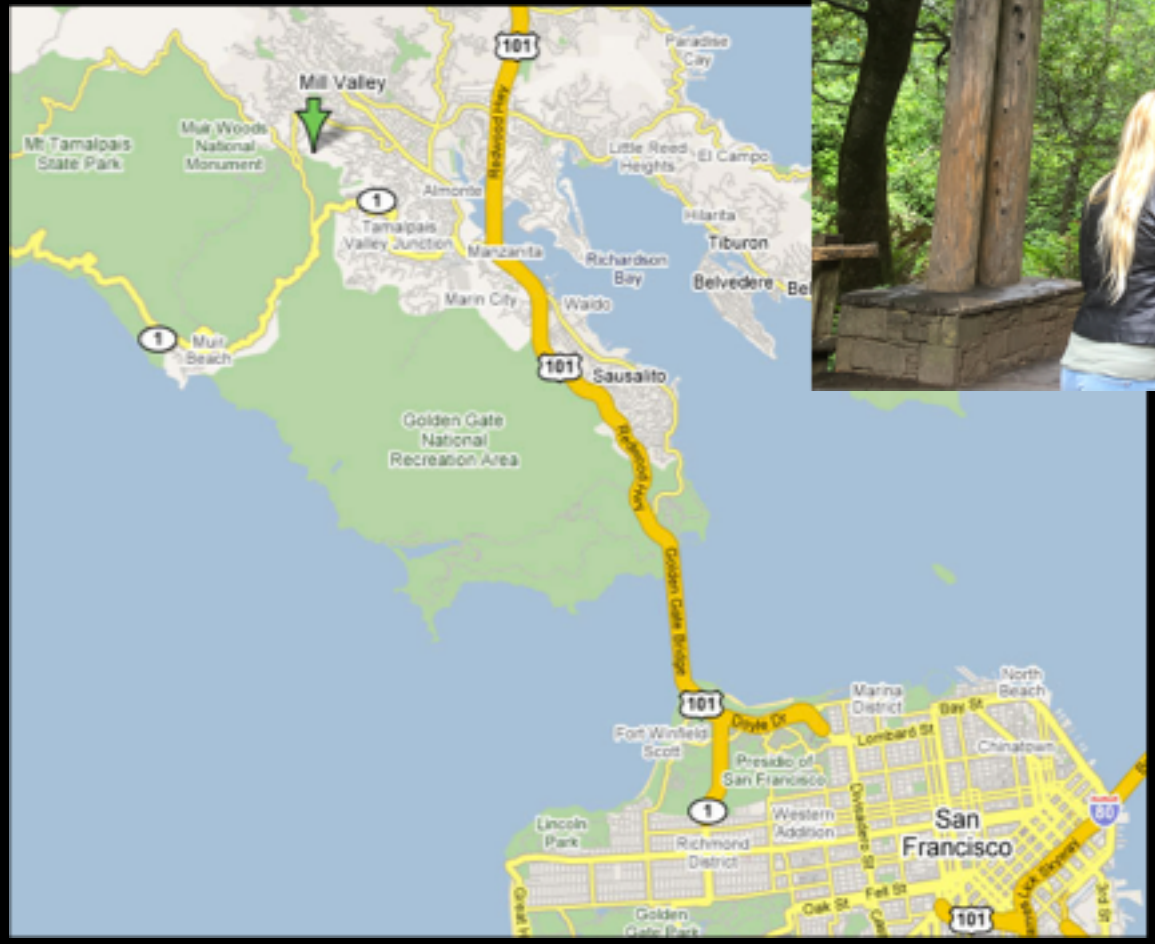




Anthropogenic noise as an element in coupled natural and human systems

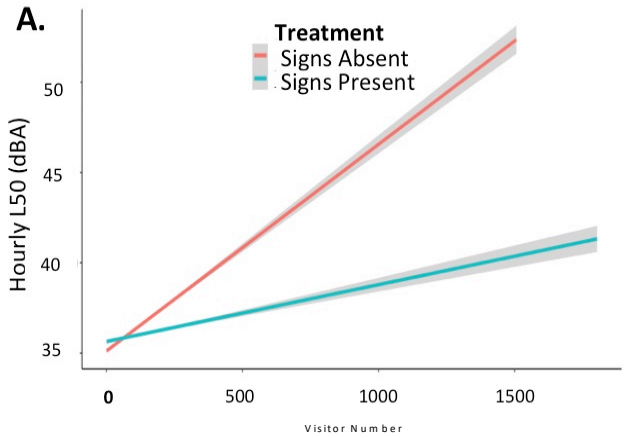


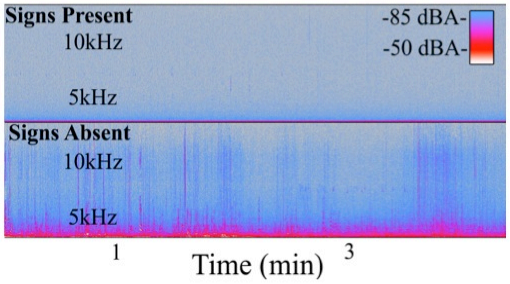

MUIR WOODS
NATIONAL MONUMENT
NATIONAL PARK SERVICE DEPARTMENT OF INTERIOR

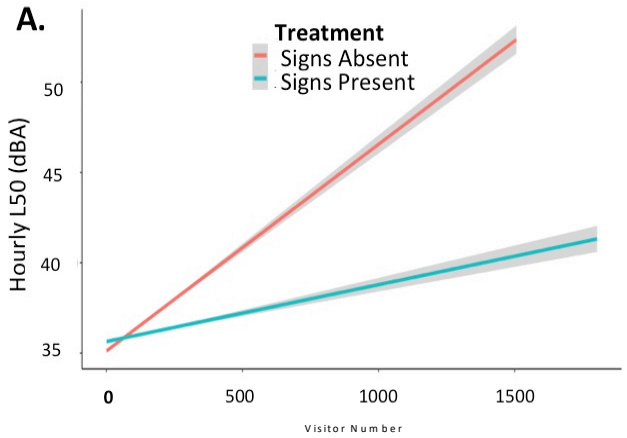

Mill Valley
Mt Tamalpais State Park
Muir Woods National Monument
Tamalpais Valley Junction
Almonte
Manzanita
Richardson Bay
Belvedere
Tiburon
Marin City
Waldo
Muir Beach
Sausalito
Golden Gate National Recreation Area
Golden Gate Bridge
Fort Winfield Scott
Presidio of San Francisco
Lincoln Park
Richmond District
Western Addition
San Francisco
Marina District
North Beach
Chinatown
Lombard St
Bay St
Oak St
Fell St
Golden Gate Park
101
1
80

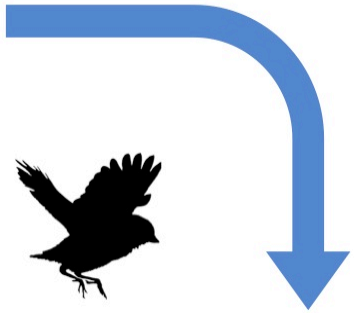

maintain natural quiet
Muir Woods
National Monument
National Park Service
U.S. Department of the Interior
Golden Gate
National Recreation Area
What you can do to help
natural soundscapes:
1. Speak softly
2. Mute phones and electronics
3. Encourage children to walk quietly
4. Be aware that noise can affect wildlife

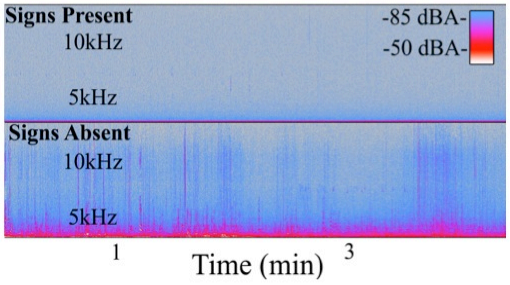

maintain natural quiet

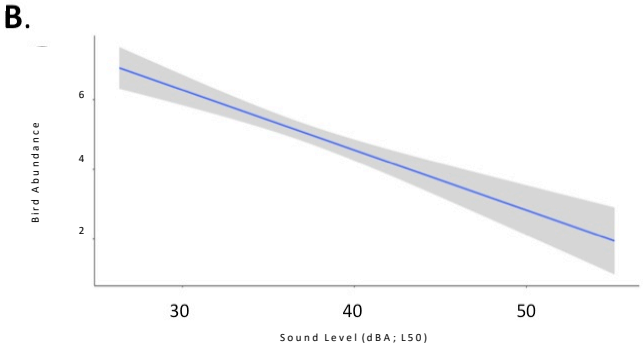

A.
Treatment
Signs Absent
Signs Present
Hourly L50 (dBA)
50
45
40
35
0
500
1000
1500
Visitor Number

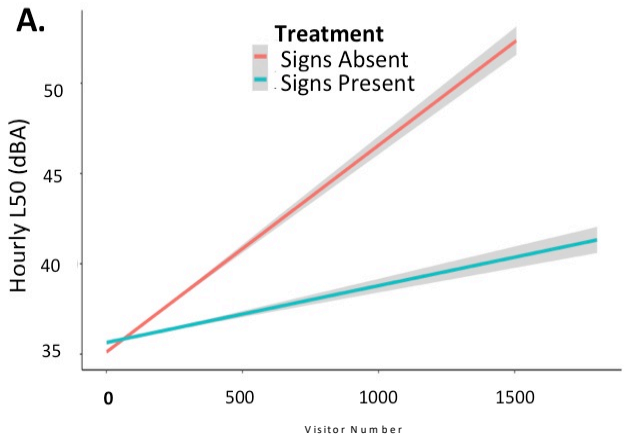

Signs Present
10kHz
5kHz
-85 dBA-
-50 dBA-
Signs Absent
10kHz
5kHz
1
3
Time (min)

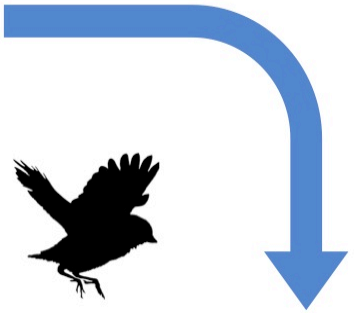

A.
Treatment
Signs Absent
Signs Present
Hourly L50 (dBA)
50
45
40
35
0
500
1000
1500
Visitor Number

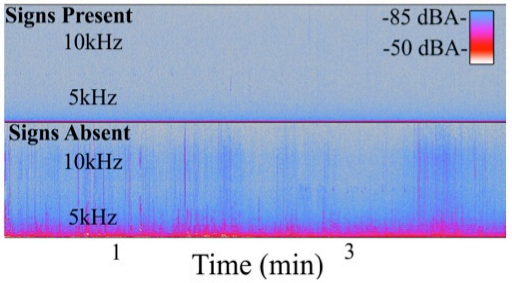


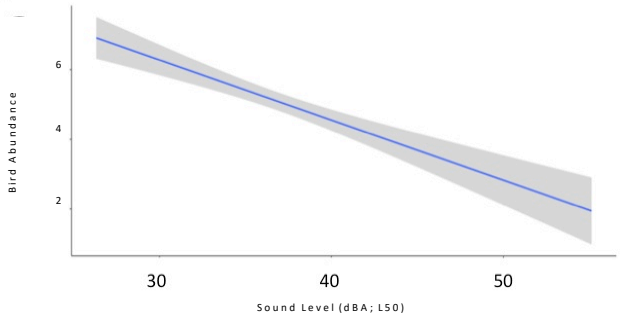

Signs Present
10kHz
5kHz
-85 dBA-
-50 dBA-
Signs Absent
10kHz
5kHz
1
3
Time (min)

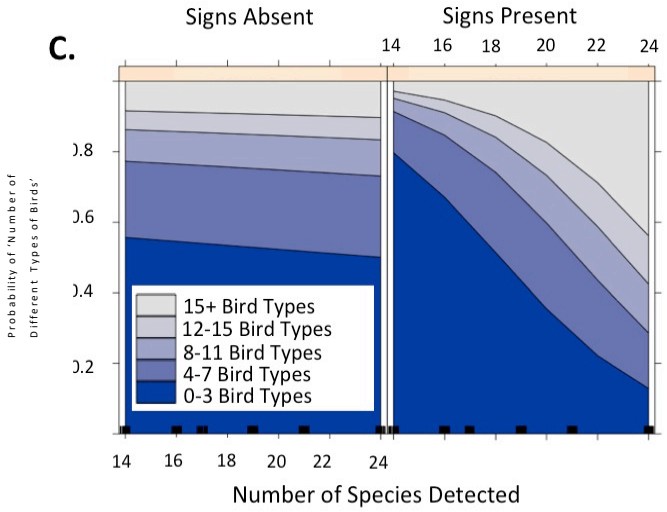

B.
Bird Abundance
6
4
2
30
40
50
Sound Level (dBA; L50)

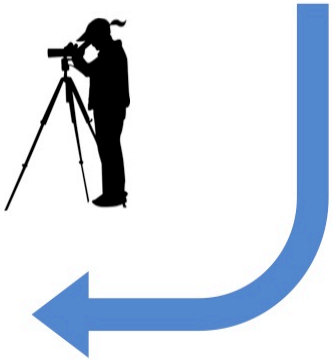

A.
Treatment
Signs Absent
Signs Present
Hourly L50 (dBA)
50
45
40
35
0
500
1000
1500
Visitor Number

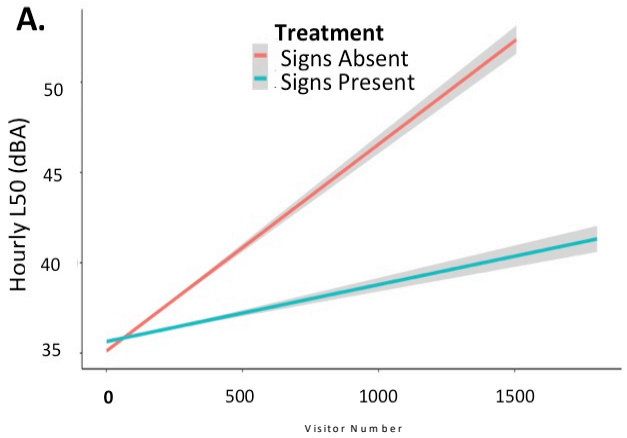


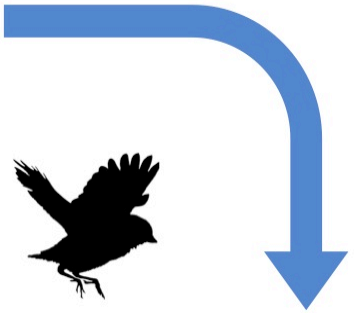

Signs Present
10kHz
5kHz
-85 dBA-
-50 dBA-
Signs Absent
10kHz
5kHz
1
3
Time (min)

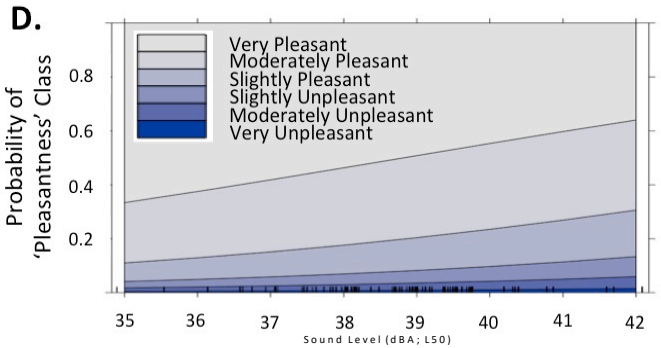

B.
Bird Abundance
6
4
2
30
40
50
Sound Level (dBA; L50)

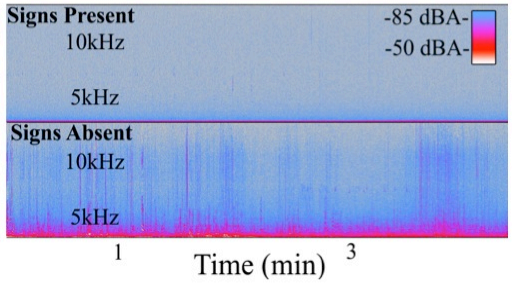

C.
Signs Absent
Signs Present
14
16
18
20
22
24
Probability of 'Number of Different Types of Birds'
15+ Bird Types
12-15 Bird Types
8-11 Bird Types
4-7 Bird Types
0-3 Bird Types
Number of Species Detected

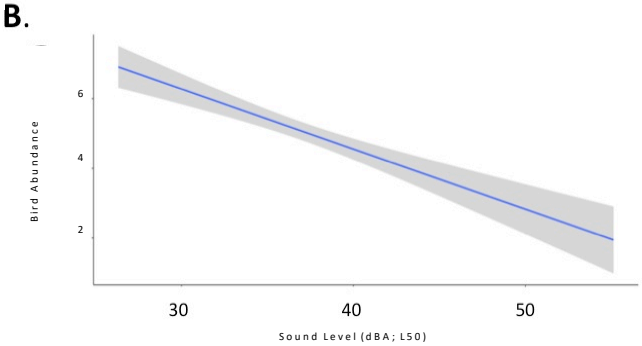


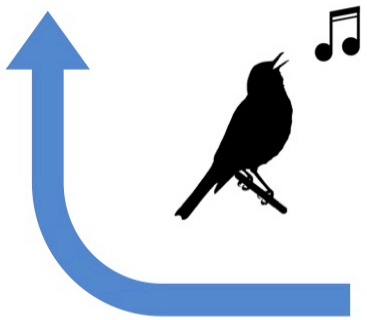

A.
Treatment
Signs Absent
Signs Present
Hourly L50 (dBA)
50
45
40
35
0
500
1000
1500
Visitor Number

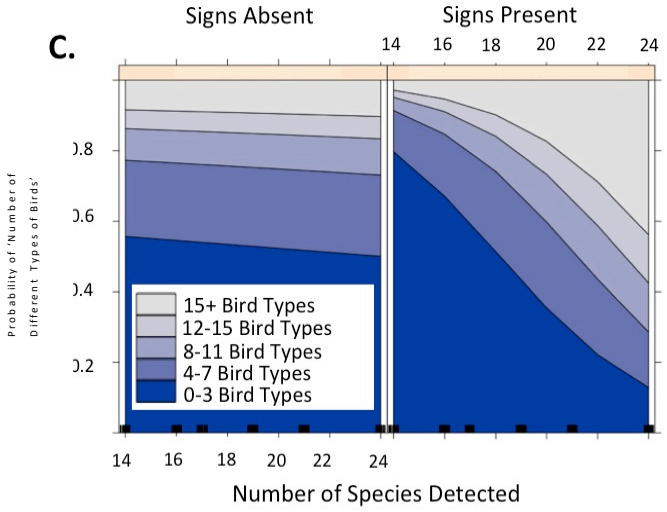


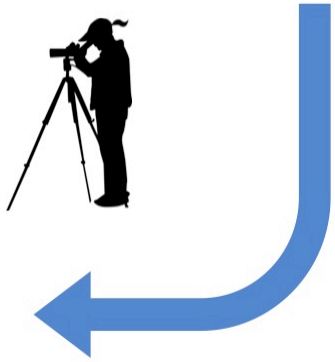

D.
Probability of 'Pleasantness' Class
0.8
0.6
0.4
0.2
Very Pleasant
Moderately Pleasant
Slightly Pleasant
Slightly Unpleasant
Moderately Unpleasant
Very Unpleasant
35
36
37
38
39
40
41
42
Sound Level (dBA; L50)

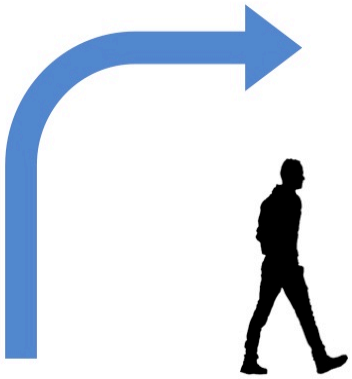

Signs Present
10kHz
5kHz
-85 dBA-
-50 dBA-
Signs Absent
10kHz
5kHz
1
3
Time (min)

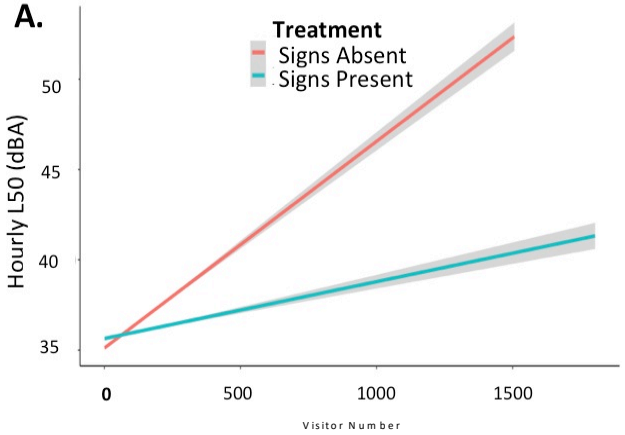

B.
Bird Abundance
6
4
2
30
40
50
Sound Level (dBA; L50)

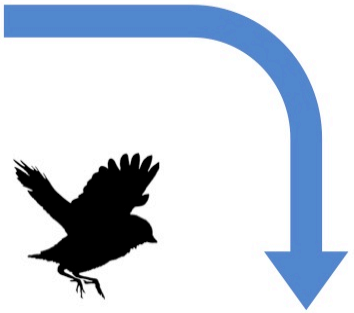


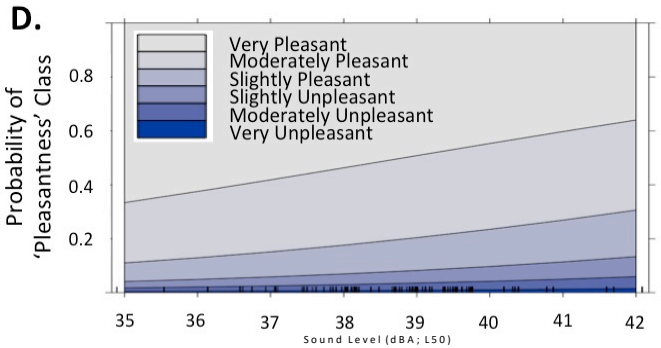

C.
Signs Absent
Signs Present
14
16
18
20
22
24
Probability of 'Number of Different Types of Birds'
15+ Bird Types
12-15 Bird Types
8-11 Bird Types
4-7 Bird Types
0-3 Bird Types
Number of Species Detected






A.
Treatment
Signs Absent
Signs Present
Hourly L50 (dBA)
50
45
40
35
0
500
1000
1500
Visitor Number

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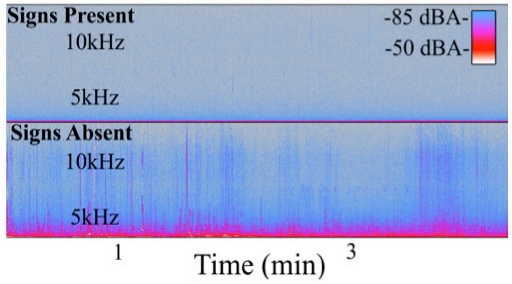
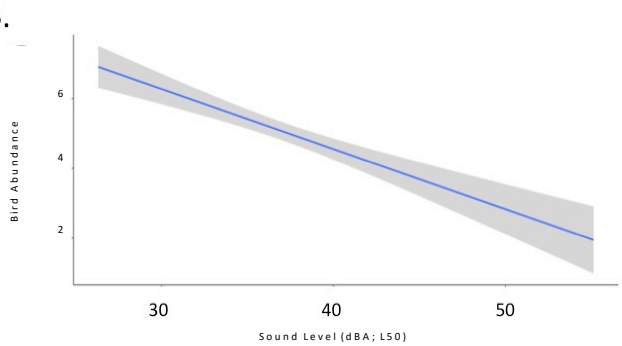
Sound Level (dBA; L50)


Signs Present
10kHz
-85 dBA-
-50 dBA-
5kHz
Signs Absent
10kHz
5kHz
1
3
Time (min)


B.
Bird Abundance
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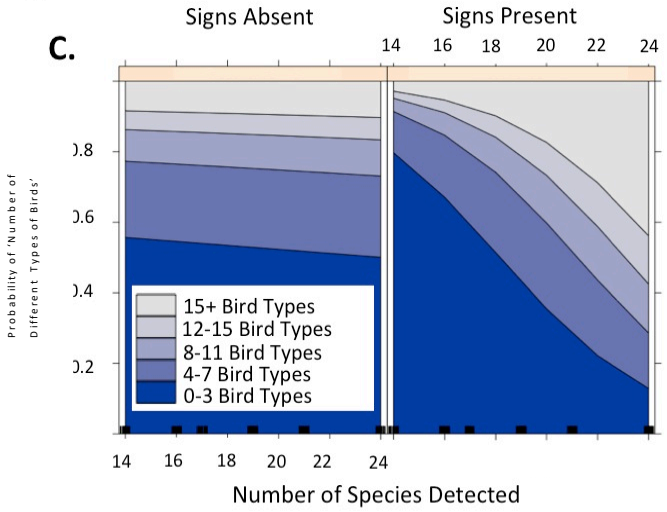
40
50
Sound Level (dBA; L50)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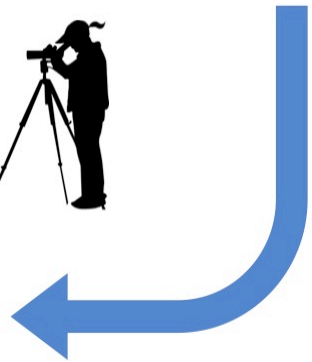
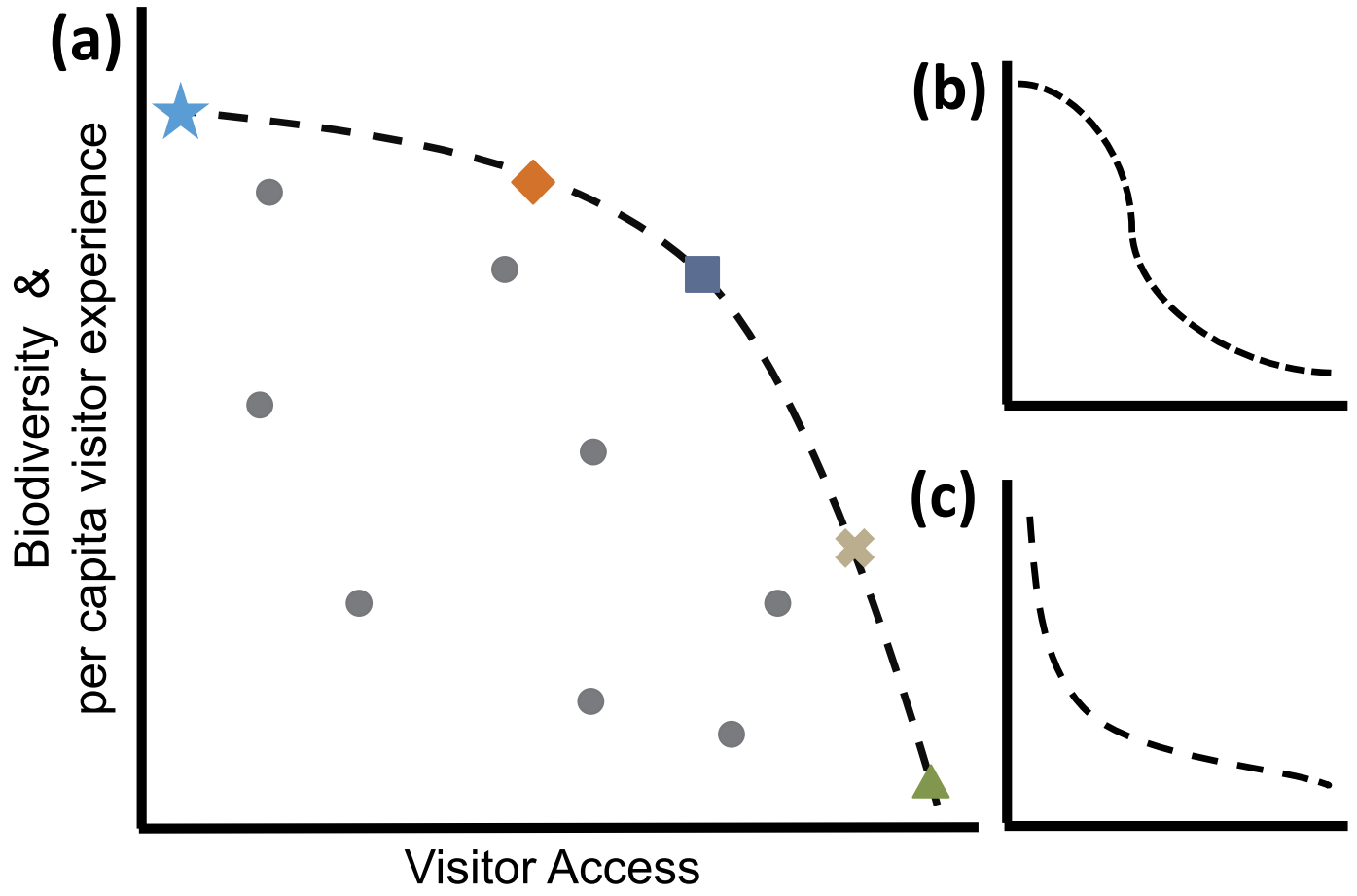
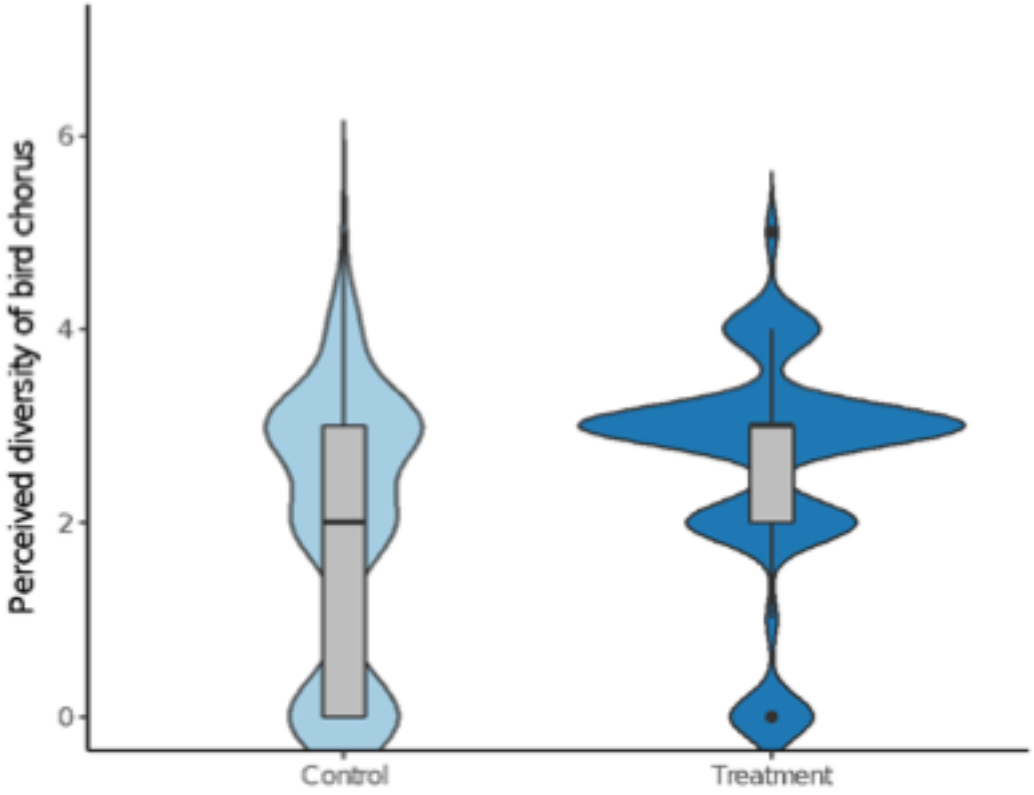




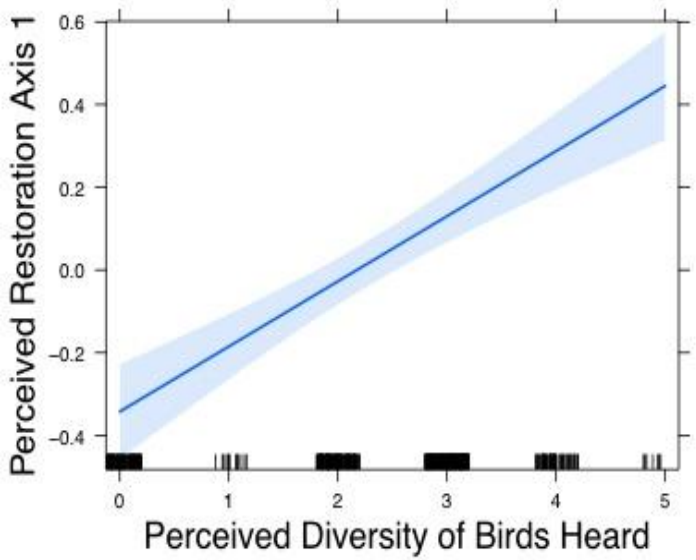
Francis *et al.* 2017, *J Environmental Management*

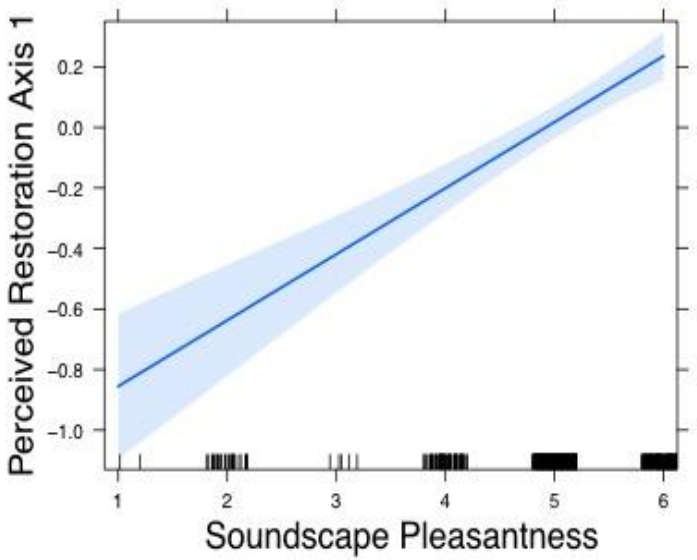
Phantom Bird Chorus

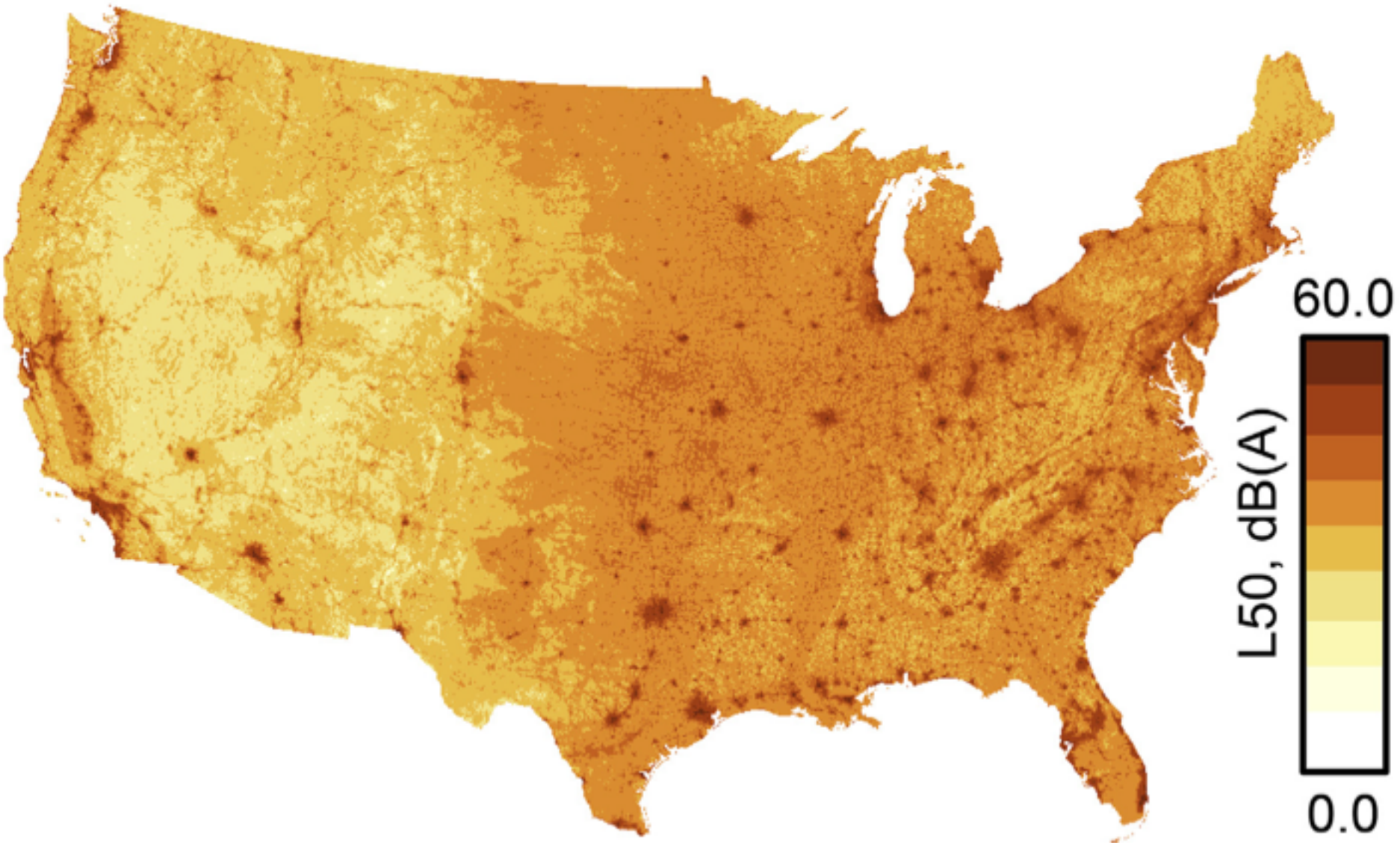
Boulder County
Parks & Open Space



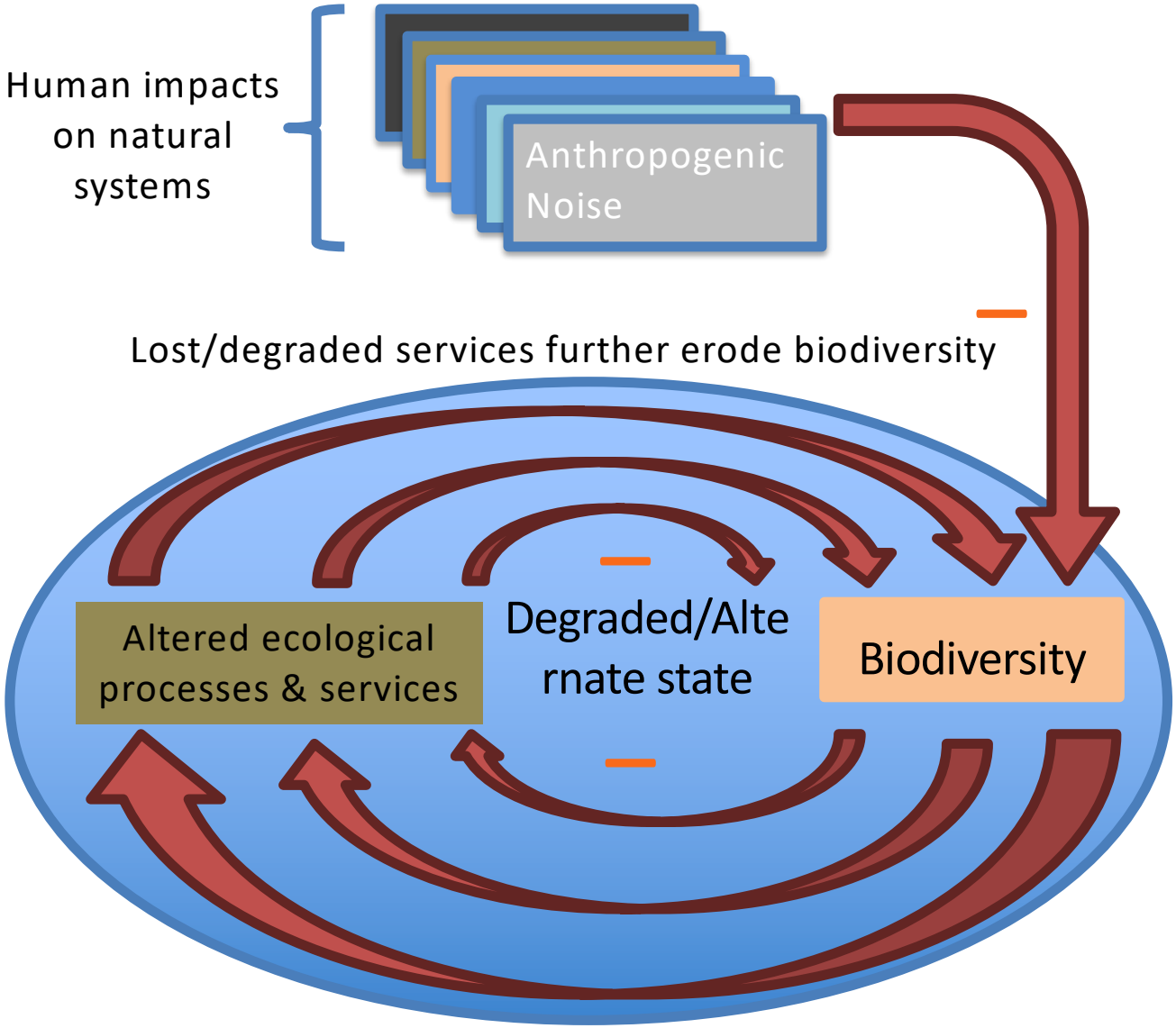
Phantom Bird Chorus

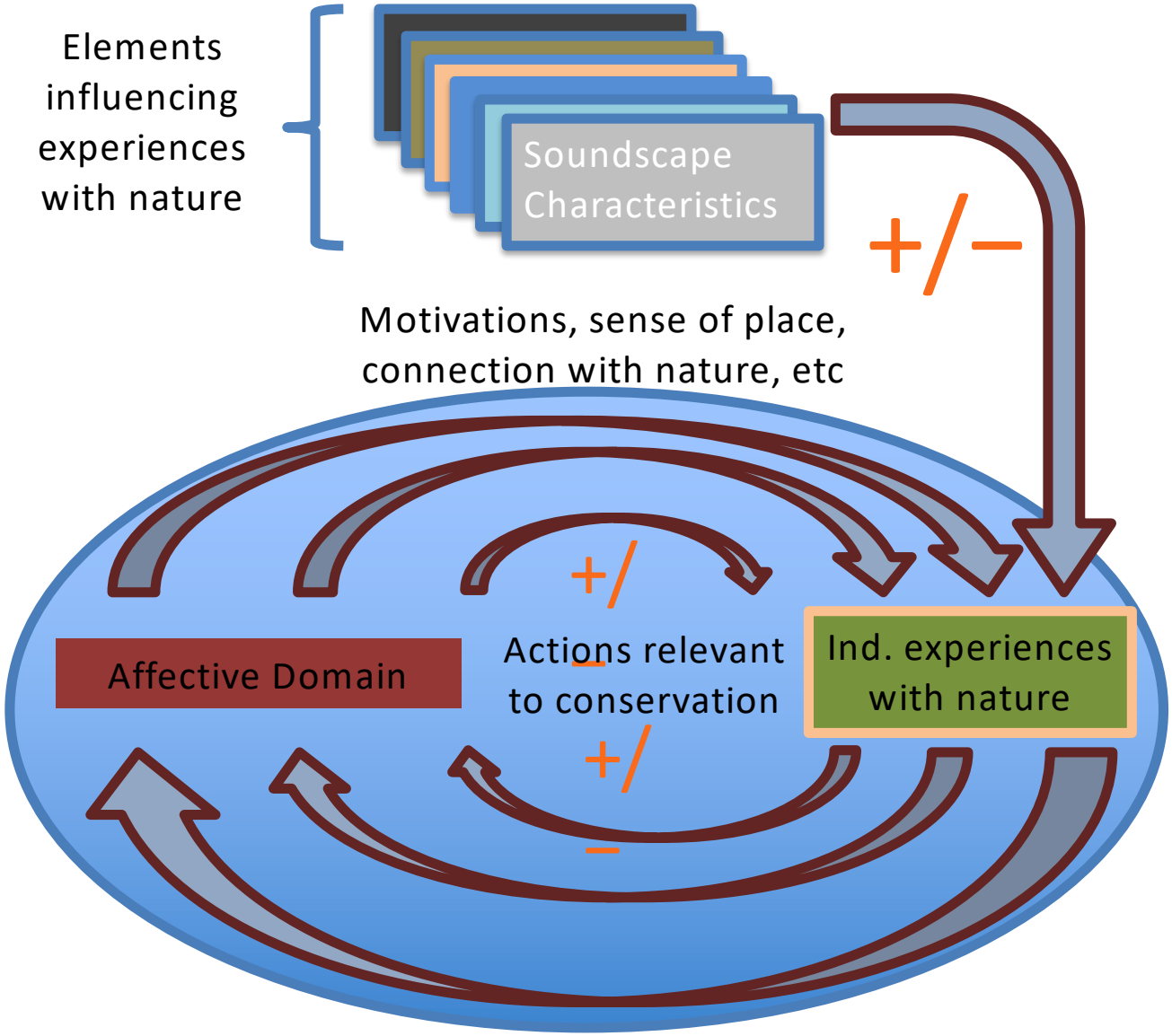






Map generated by NPS; figure in Francis *et al.* 2017, *J Environmental Management*


Human impacts on natural systems
Anthropogenic Noise
Lost/degraded services further erode biodiversity
Altered ecological processes & services
Degraded/Alternate state
Biodiversity
Declines in biodiversity erode ecological processes and services


Elements influencing experiences with nature
Soundscape Characteristics
+/−
Motivations, sense of place, connection with nature, etc
+/
Affective Domain
Actions relevant to conservation
Ind. experiences with nature
+/
−
Reinforcement/change feelings towards nature


(C) Dr Klaus Schmitt, Weinheim, Germany

BOISE STATE UNIVERSITY

Francis Lab at Cal Poly, Newman Lab at Penn State, Kawahara Lab at U. Florida, Reinhardt Lab at Idaho State, Monz Lab at Utah State, Natural Sounds and Night Skies Division of NPS