Effects of Noise and Other Human Disturbance on Wildlife

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AWA

Sound rarely occurs in a vacuum

It's usually associated with something visual …and sometimes something physical

Is it the boat or the noise from the boat?
Or is it both?

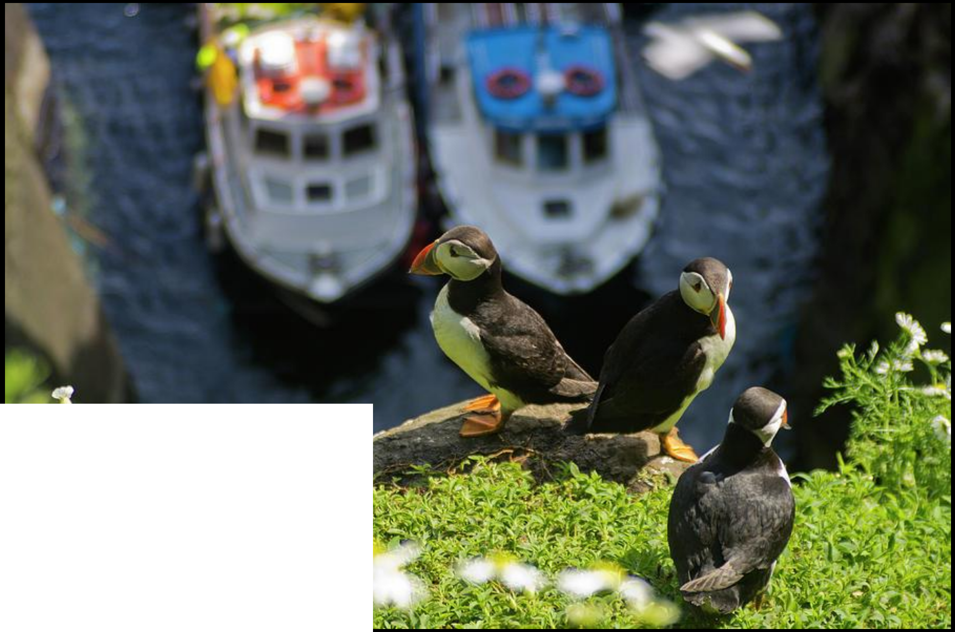
Walrus haulout at Cape Seniavin in Bristol Bay

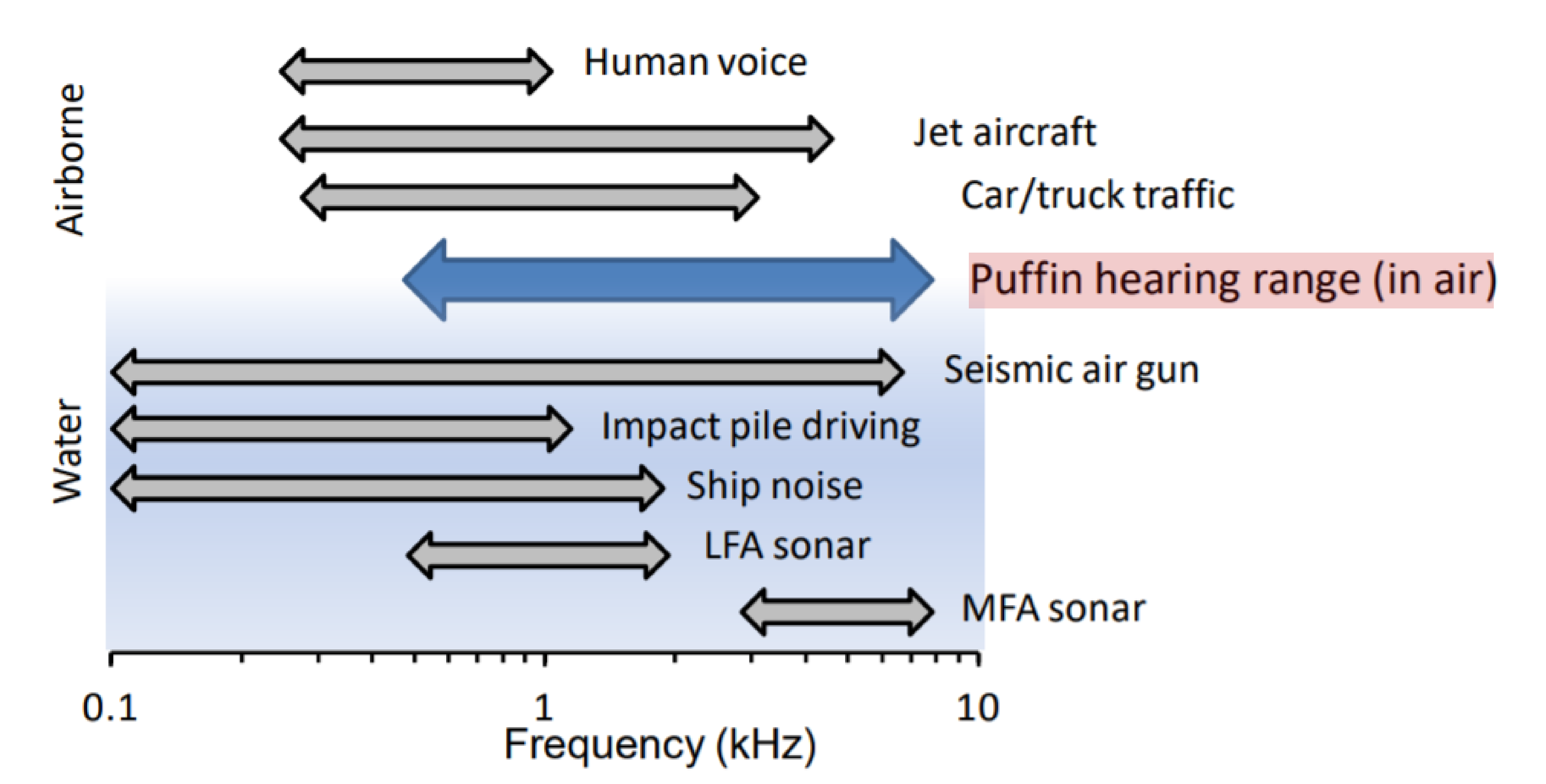
https://news.uaf.edu/spooked-easy/

Is it the jet skis or the noise from the jet skis?
Is the whale happy or upset?

Blackstone Bay, Prince William Sound

Are noises the same above and under water?

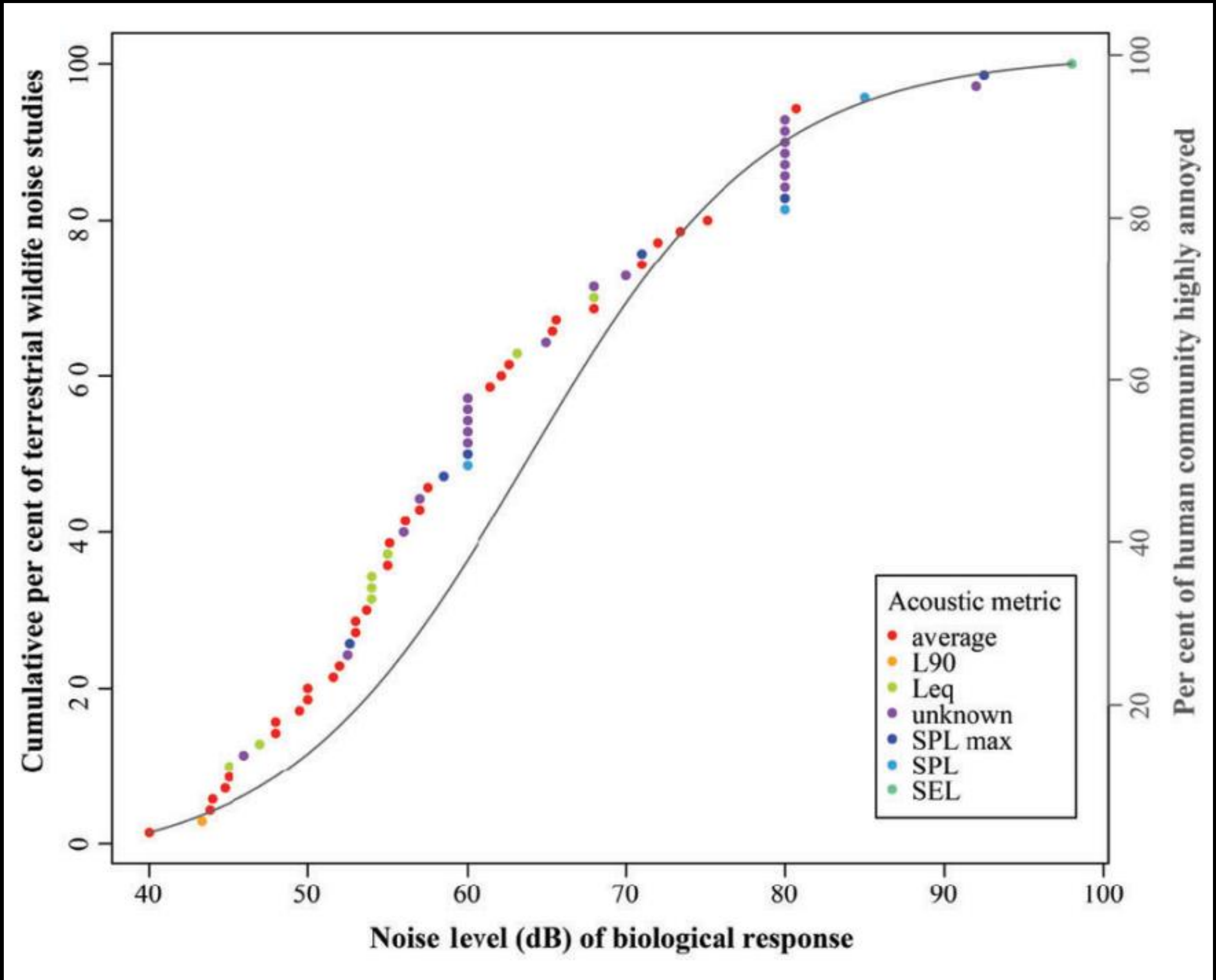




Mooney et al. 2019

Are sound measurements equally meaningful for humans and other animals?

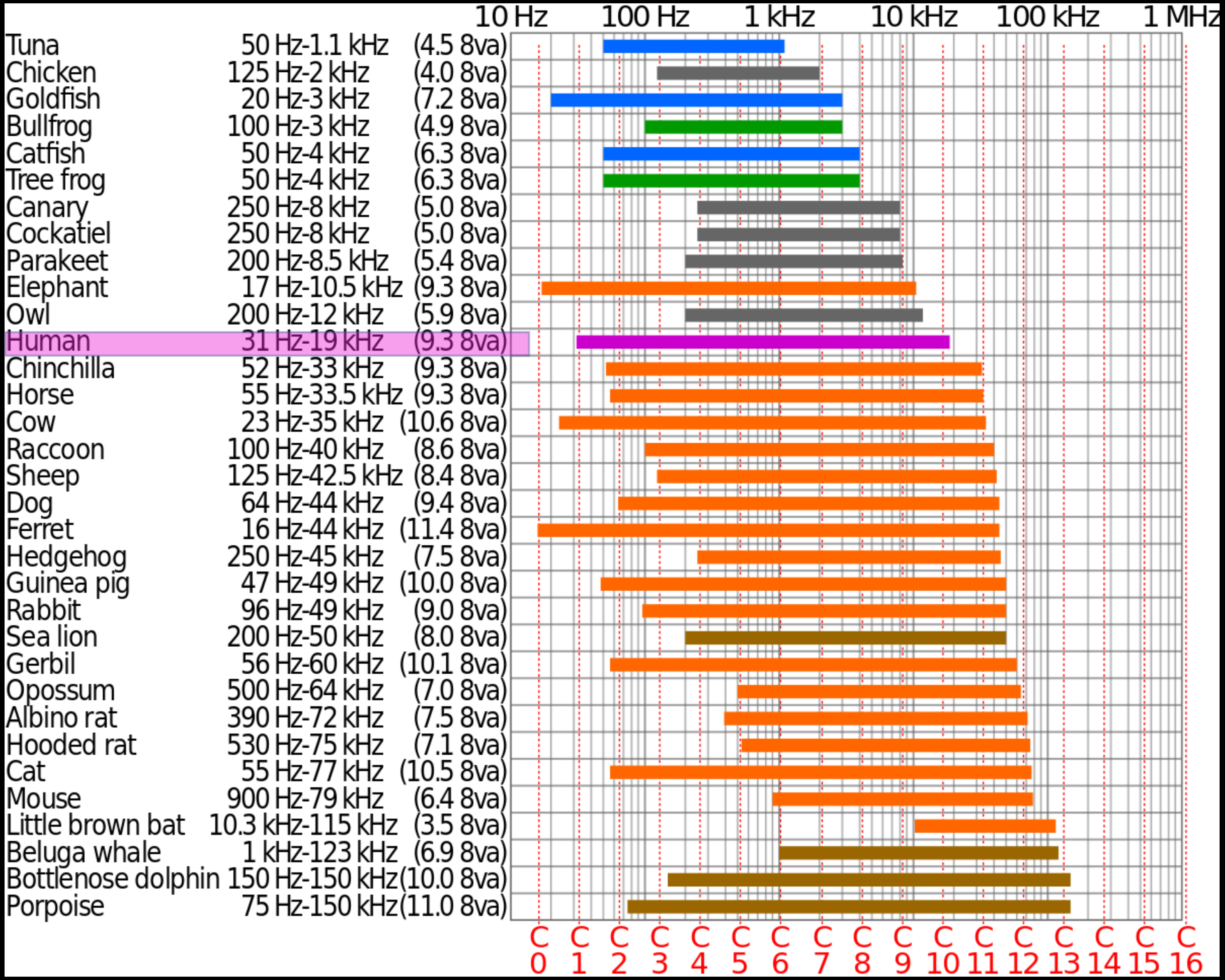
Black line = response of quiet rural community residents exposed to new or unfamiliar noise



Shannon et al. 2016

Do animals hear the same sounds we hear?

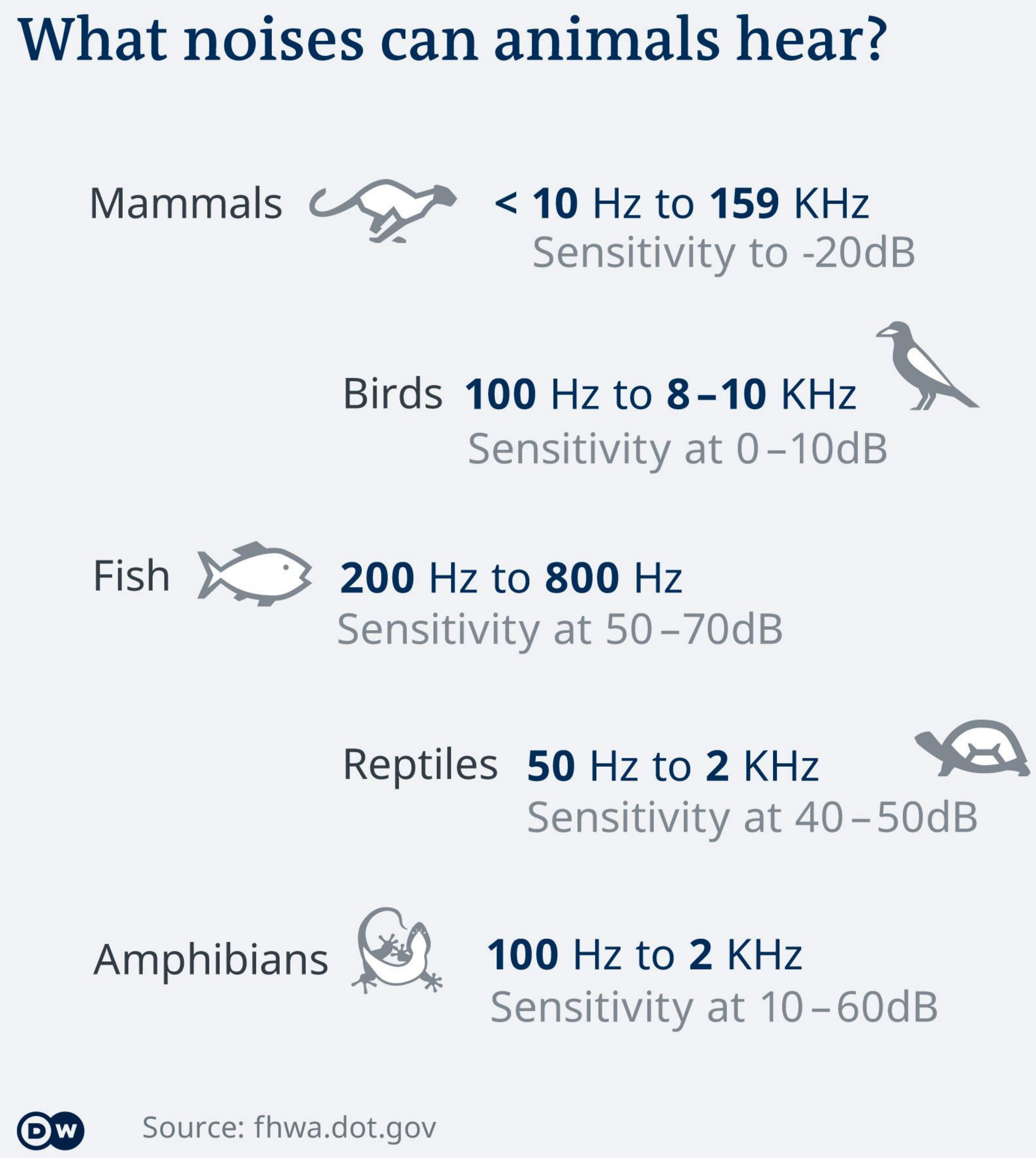
Human hearing overlaps with other vertebrates, but many species hear lower (infrasound) and higher (ultrasound) frequencies than we do



https://commons.wikimedia.org/

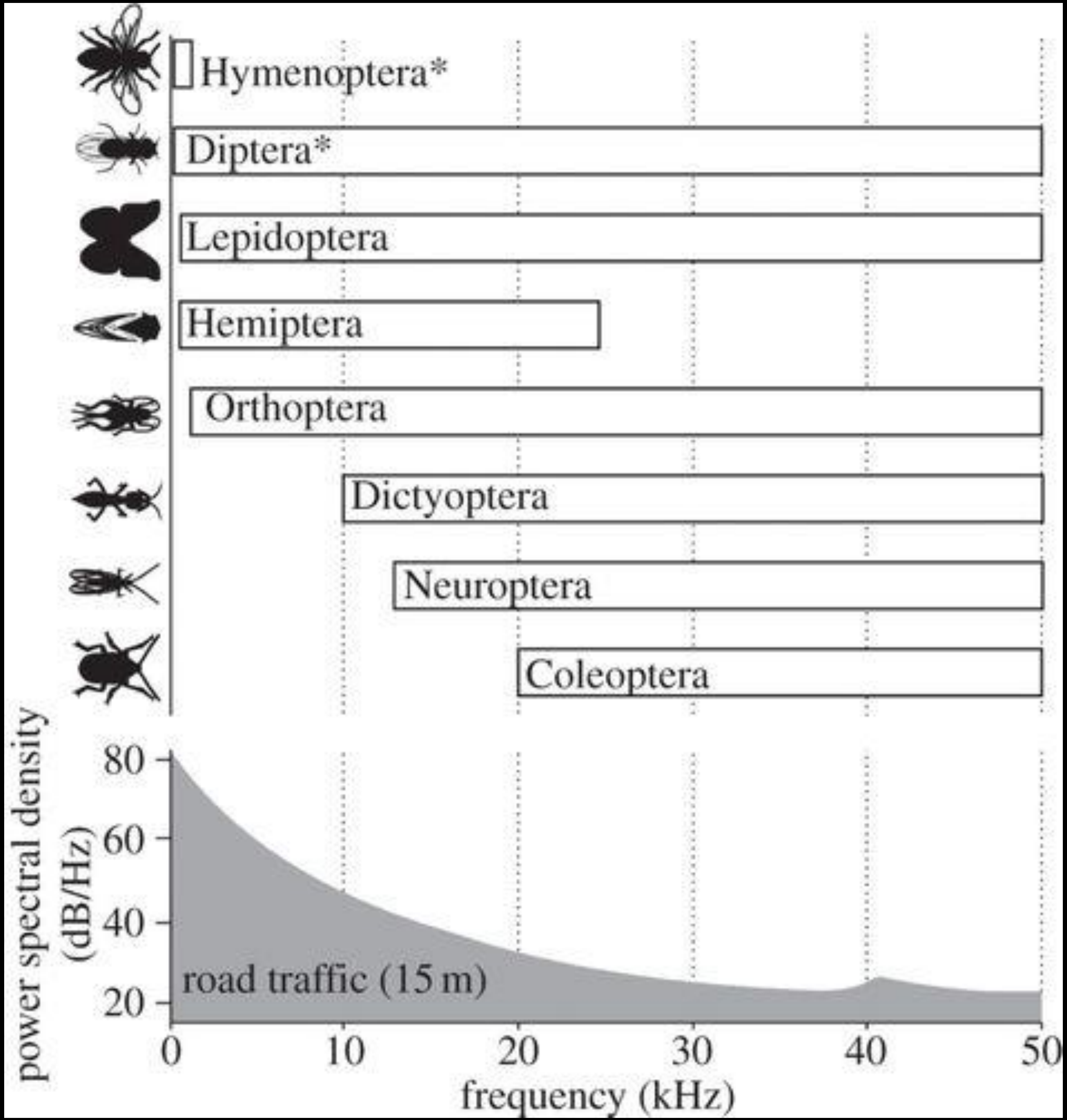
Does hearing differ among taxonomic groups?

What about invertebrates?



Bioacoustic masking of insect communication

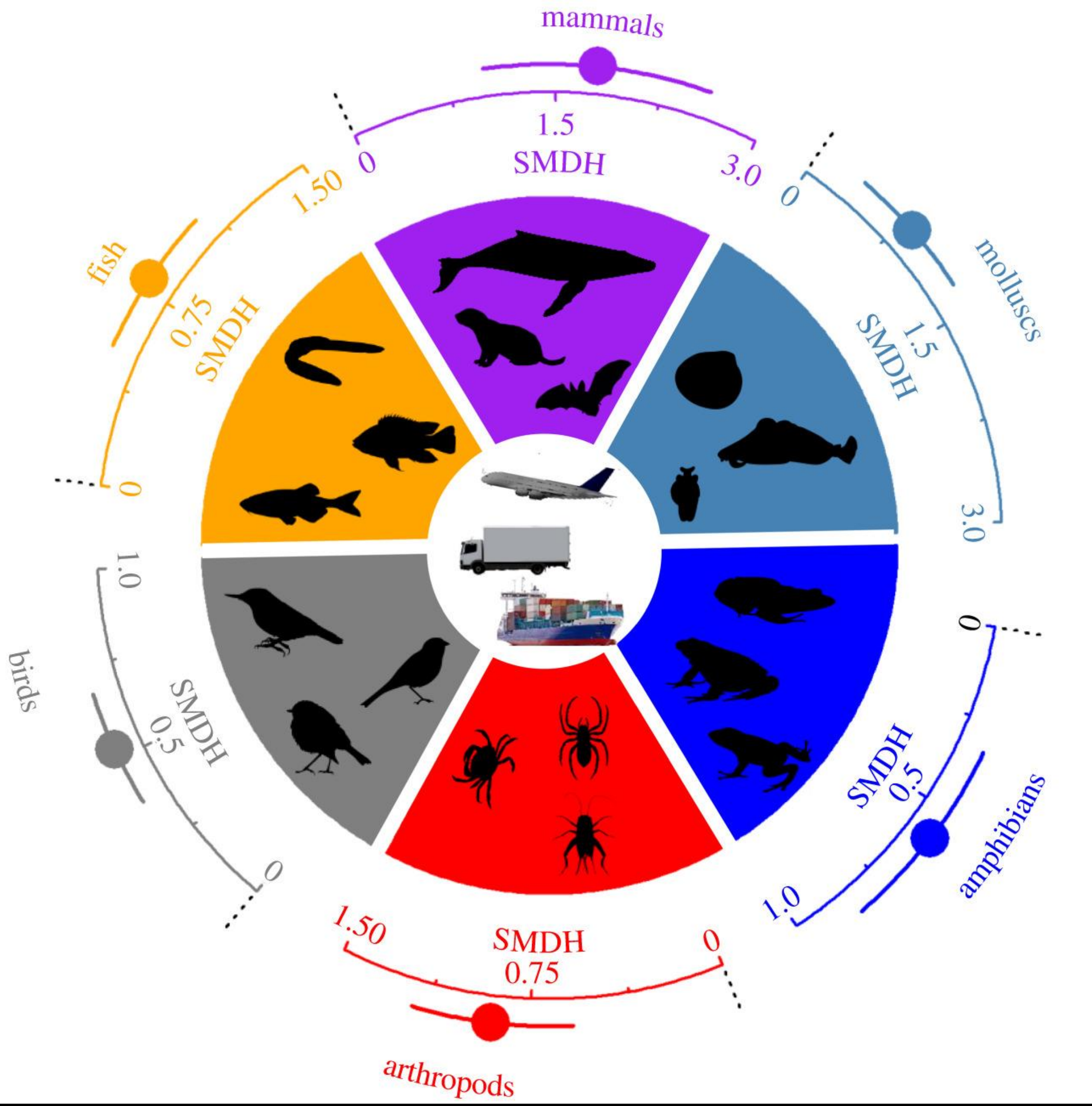
- Sounds for aggression, mating, predator avoidance, detection of parasite host species
- Many invertebrates communicate < 10 kHz and hear within the frequency spectrum of anthropogenic noise
- In addition to sound wave pressure, some invertebrates communicate via particle velocity (flies*) and vibrations through plants & ground



Morely et al. 2013

Meta-analysis: experimental studies of 109 species shows all taxonomic groups are impacted by anthropogenic sounds

Standardized mean difference (95% CI) from random effects models



Kunc and Schmidt 2019

When is sound disturbing?

Animals assess risk

"A jet aircraft taking off may not ruffle the composure of the most timid rabbits grazing near the runway"

—Worden 1973

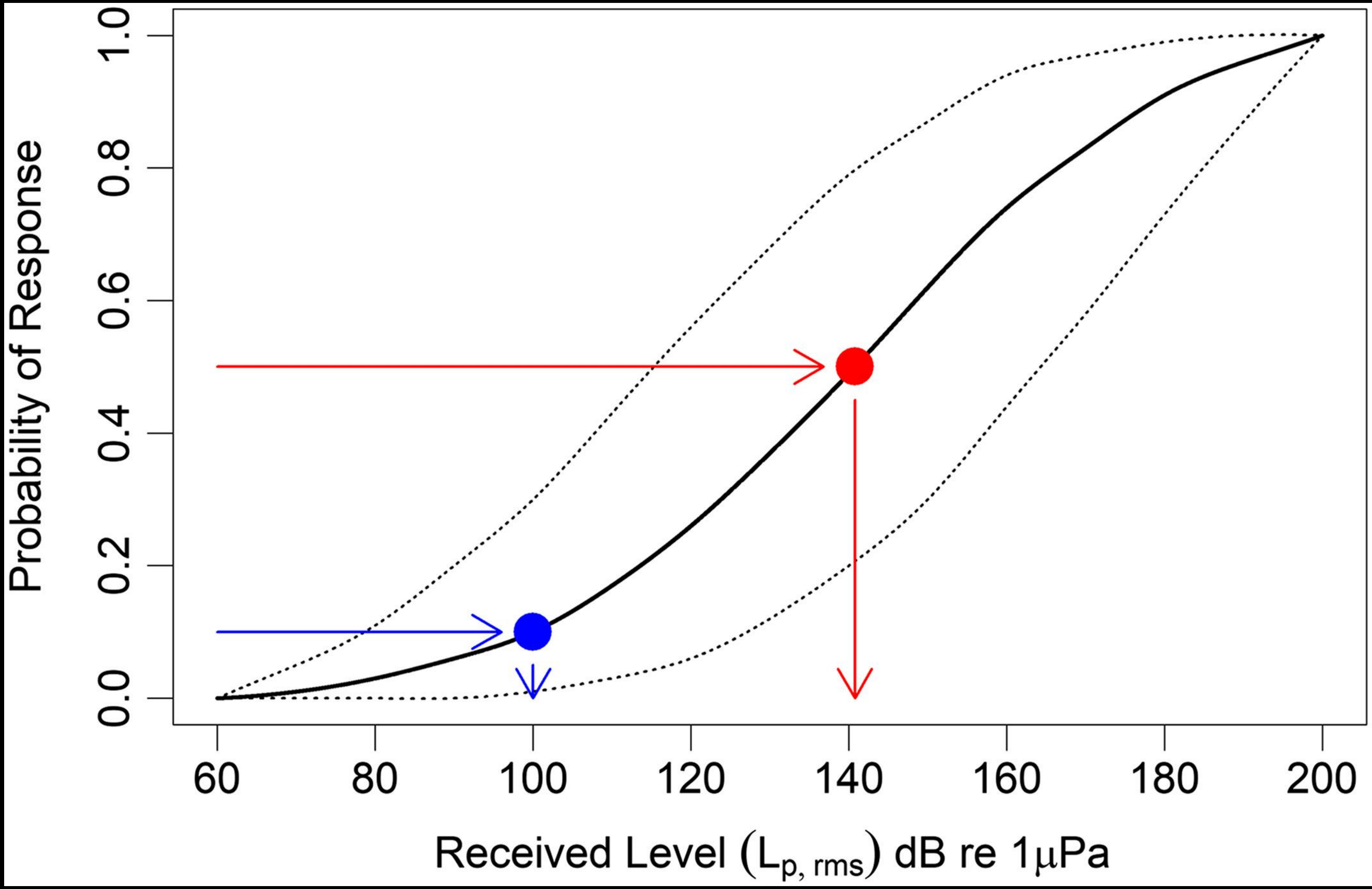
Literature review of effects of anthropogenic noise on wildlife (1990-2013)

		Noise source				
	Biological response	Environmental	Transportation	Industrial	Military	Other
All Studies (*N=212*)	*vocal behaviour*	20.3%	9.9%	1.4%	1.9%	2.8%
	movement	1.9%	4.2%	5.7%	6.1%	4.2%
	physiology	–	4.2%	5.2%	2.4%	7.5%
	population metrics	1.4%	4.2%	4.7%	0.5%	–
	vigilance	–	0.9%	0.5%	0.9%	0.5%
	mating behaviour	–	1.4%	0.9%	–	0.5%
	foraging behaviour	–	2.4%	–	0.5%	–
	direct fitness metrics	0.5%	0.5%	0.9%	–	–
	community-levelmetrics	0.5%	–	0.5%	–	–

2/3 of studies focused on marine mammals and songbirds

Shannon et al. 2016

In a perfect world, the effects of anthropogenic sounds on wildlife are modeled as dose-response curves



Tyack and Thomas 2019

How wildlife perceive sounds as "disturbing" is complex

Species tolerance
Group size
Food abundance

Initial behavior
Experience
Habituation
Reproductive status

Duration
Magnitude
Frequency

Source
Behavior
Travel vector

Distance
Wind direction
Environment

Heart rate/MR
Flight – fight response
Reproductive fitness

How wildlife perceive sounds as “disturbing” is complex

Average ~ 90 dBA. But@ 60 mph > 115 dBA, during radical maneuvers < 95 dBA, and 15 dBA louder when leave the water

Underwater noise 100 Hz - 10 kHz generated by jet stream, with frequency-modulated tonals corresponding to impeller blade rates and harmonics

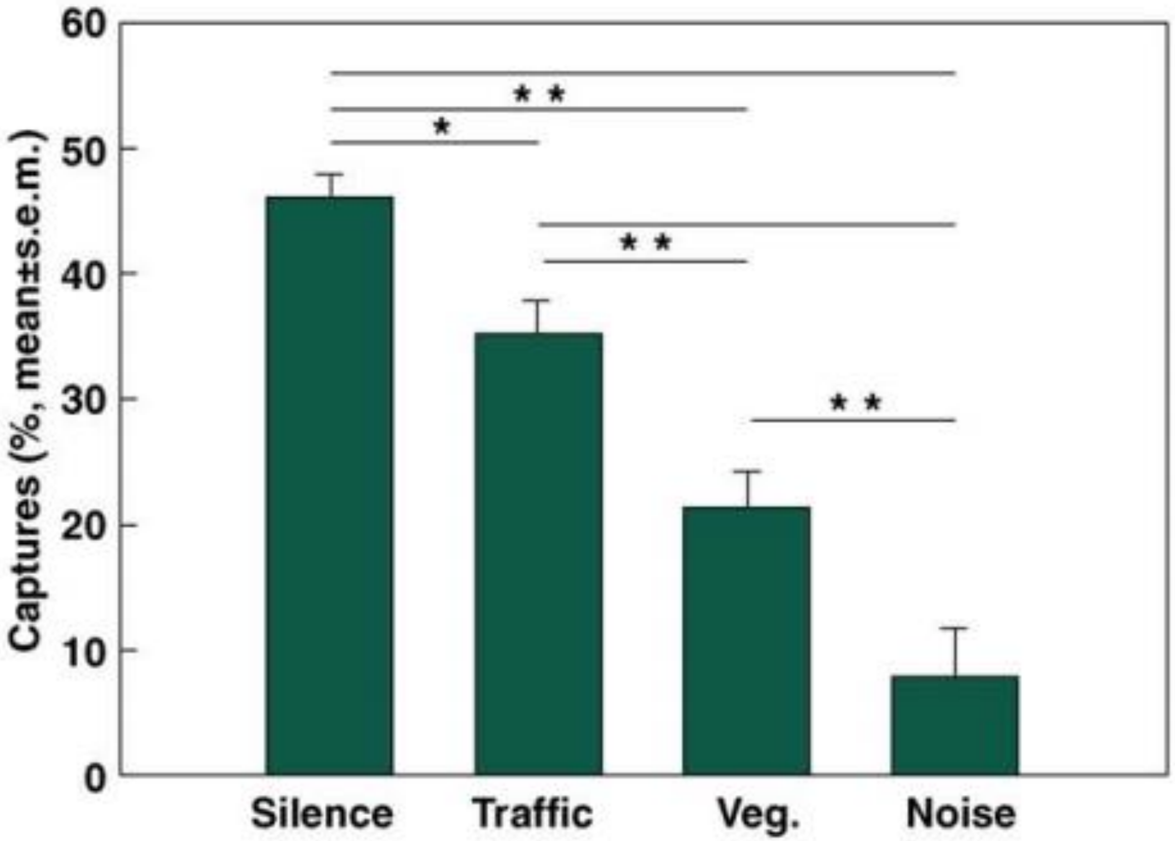
Source
Behavior
Travel vector

How wildlife perceive sounds as "disturbing" is complex

Duration
Magnitude
Frequency


Acute Noise
Chronic Noise
ONLY
LEFT LANE
MUST
TURN LEFT

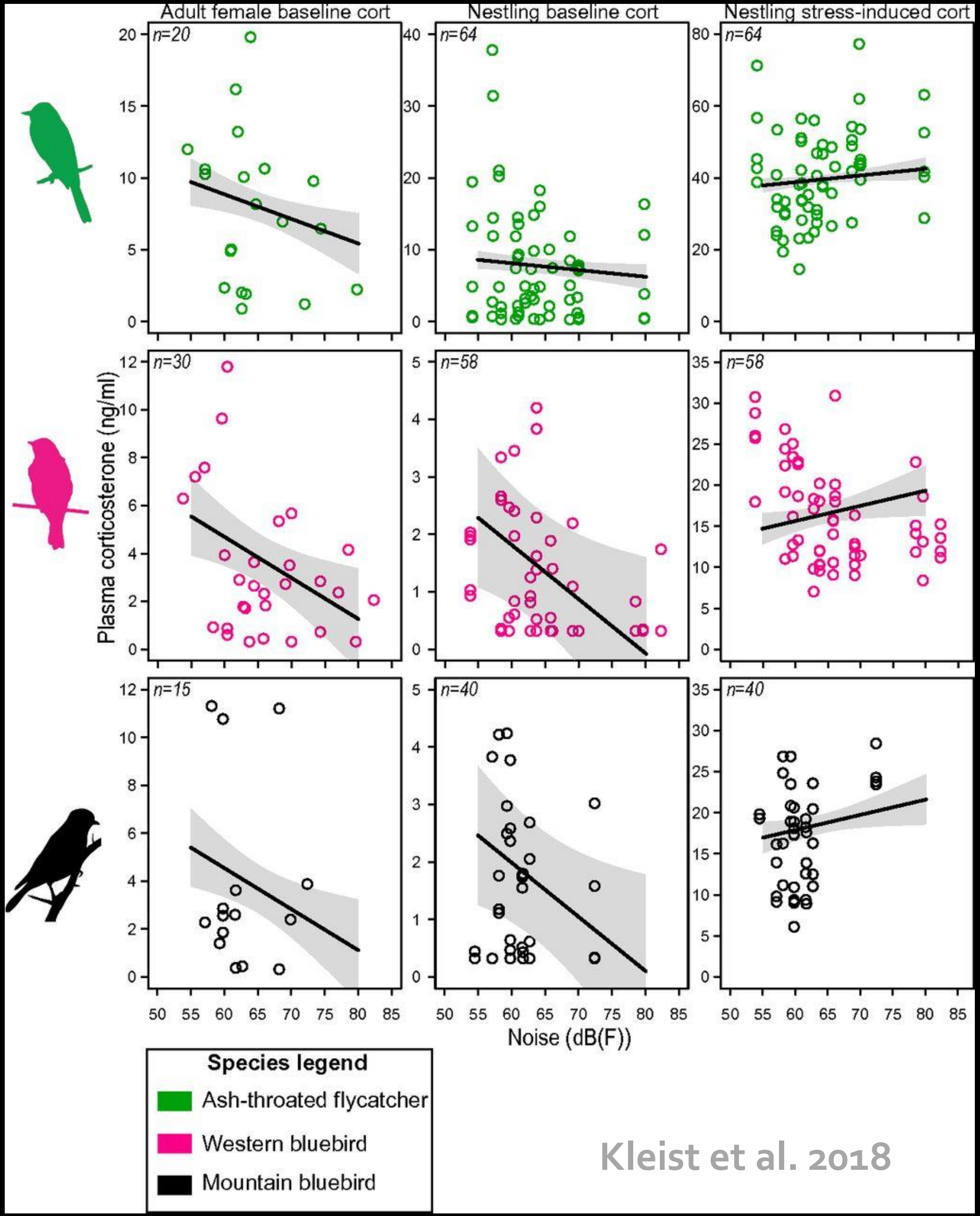
Chronic traffic noise (80 dB) interferes with Greater Mouse-eared Bat's prey capture rate by 22%



Barber et al. 2009

Chronic noise

- Chronic noise from natural gas compressors cause hypocorticism in adult females and nestlings
- But increased corticosteroids in nestlings exposed to acute stress



Kleist et al. 2018

How wildlife perceive sounds as "disturbing" is complex

Distance
Wind direction
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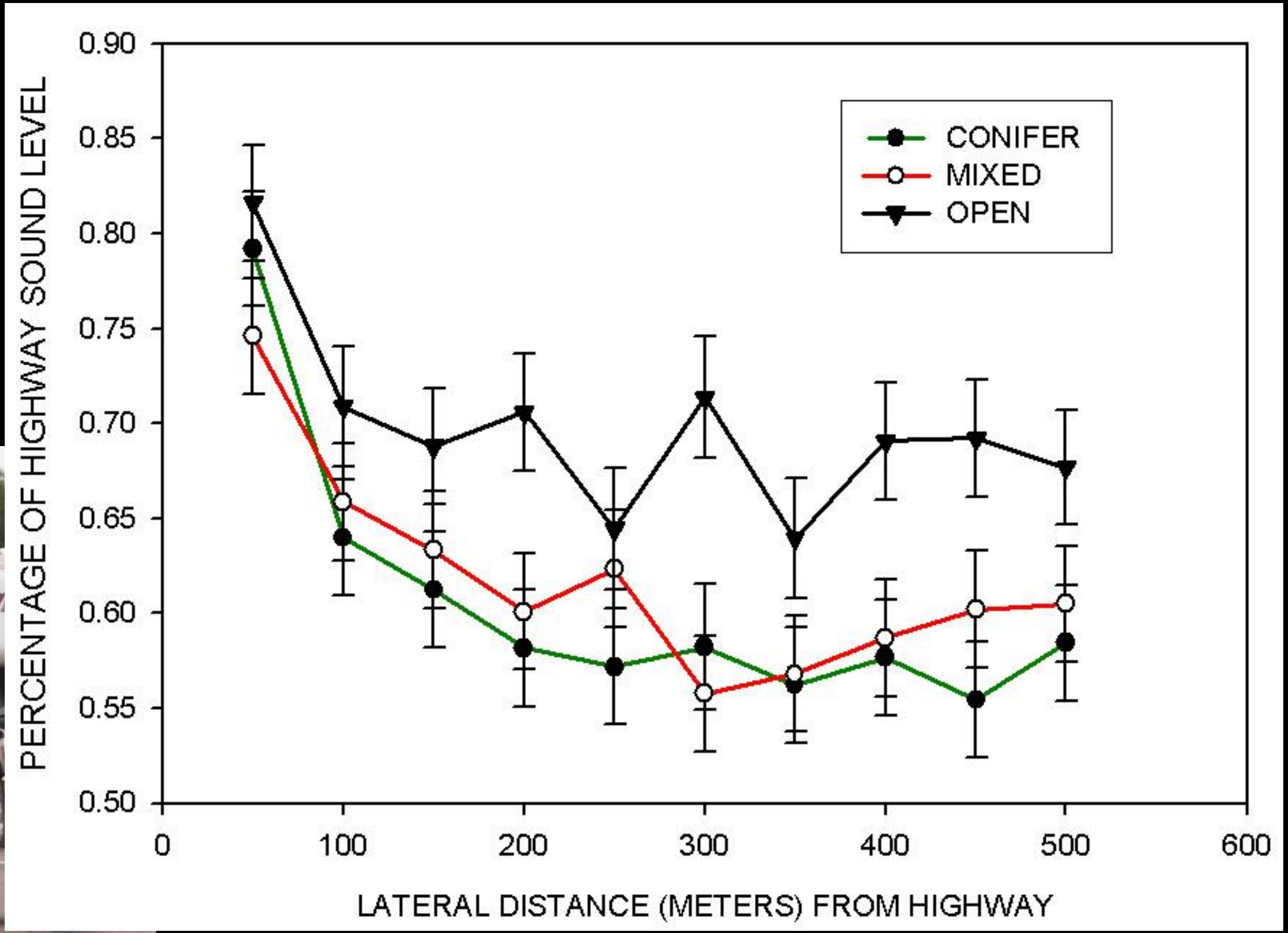
Vegetation cover affects how traffic noise decreases with distance



Sterling Highway

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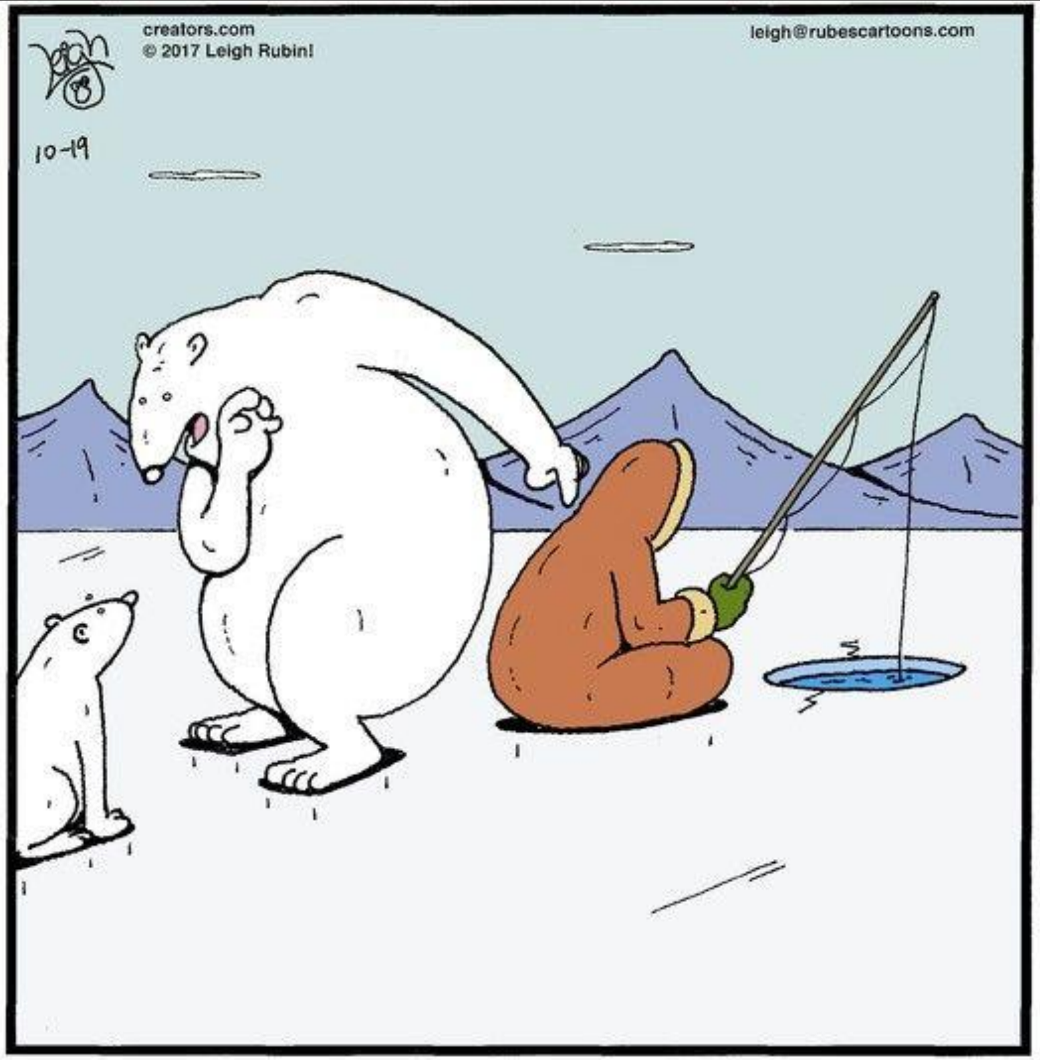
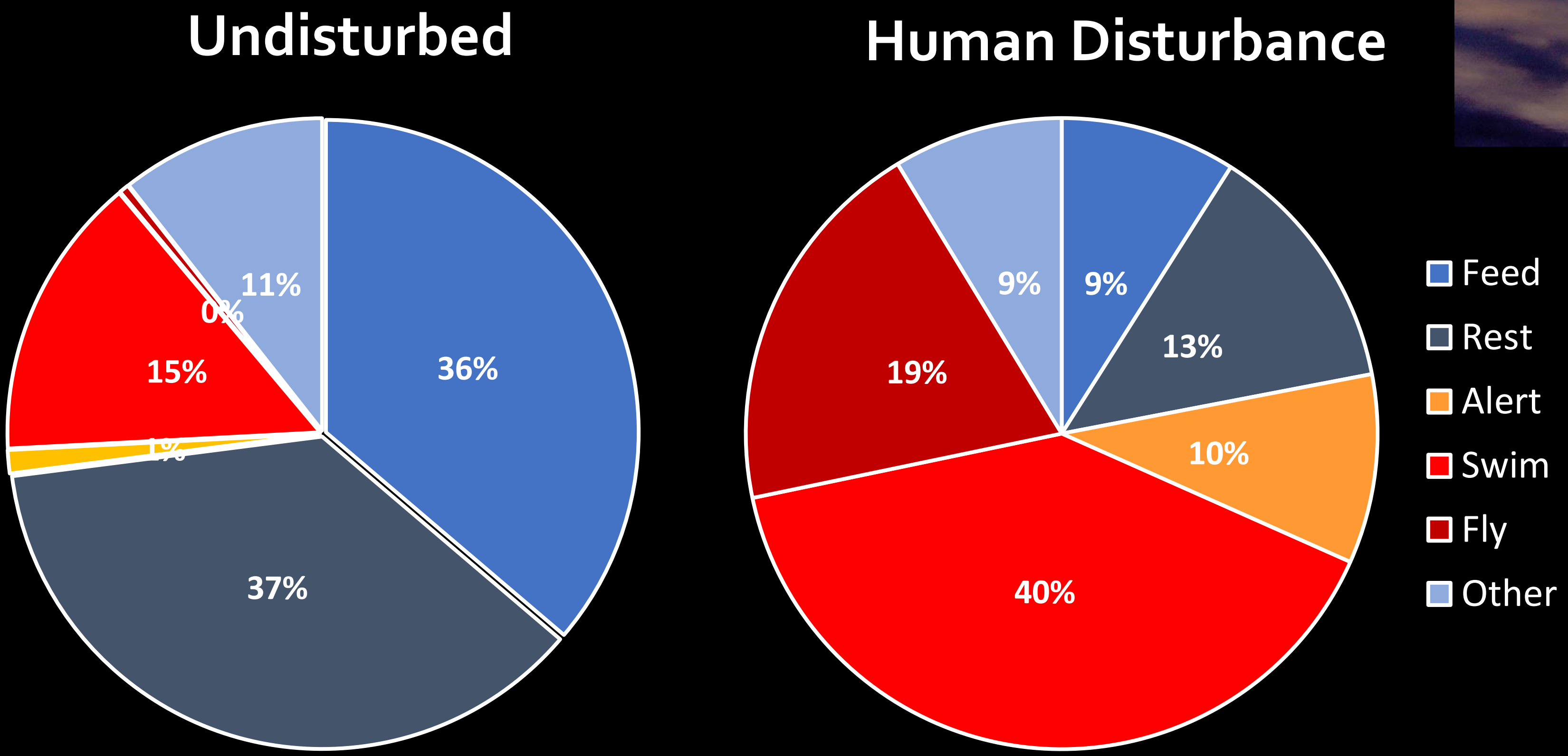


"While we have no fear of them, son, the feeling is not mutual. Watch as I demonstrate just how a slight tap on the shoulder instantly initiates a fight-or-flight response, resulting in an amusing phenomenon known as an 'adrenaline rush.'"

Fight-flight response to acute noise events

- Sympathetic nervous systems stimulates adrenal glands to release adrenaline (epinephrine) and other catecholamines
- Glucocorticoids both stimulate and suppress sugar release
- Increased heart rate, blood pressure, breathing rate
- Dry mouth, tunnel vision
- After threat is gone, takes 20-60 minutes to return to pre-arousal levels
- Flying is energetically expensive! 5-6 times more calories/unit time than swimming or running away

American Black Duck response to acute human disturbances in daytime (automobiles, people, aircraft, boats)

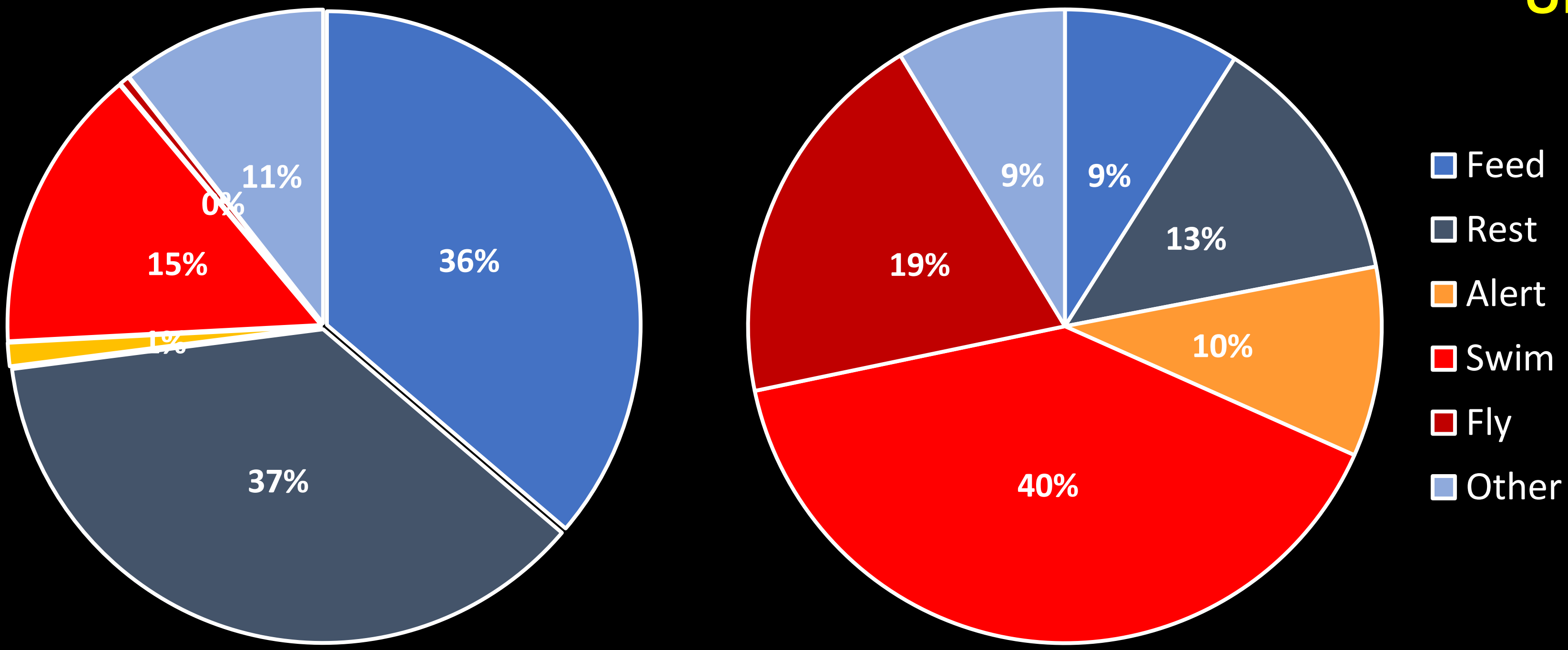


Morton 2002
Morton et al. 1989

American Black Duck response to acute human disturbances in daytime (automobiles, people, aircraft, boats)

Undisturbed

Human Disturbance



Disturbed flock = 14.21 kcal/hr
Undisturbed flock = 6.80 kcal/hr

Morton 2002
Morton et al. 1989

Caribou moved 70% faster and crossed twice as many habitats in response to simulated oil exploration noise (90-100 dBA)

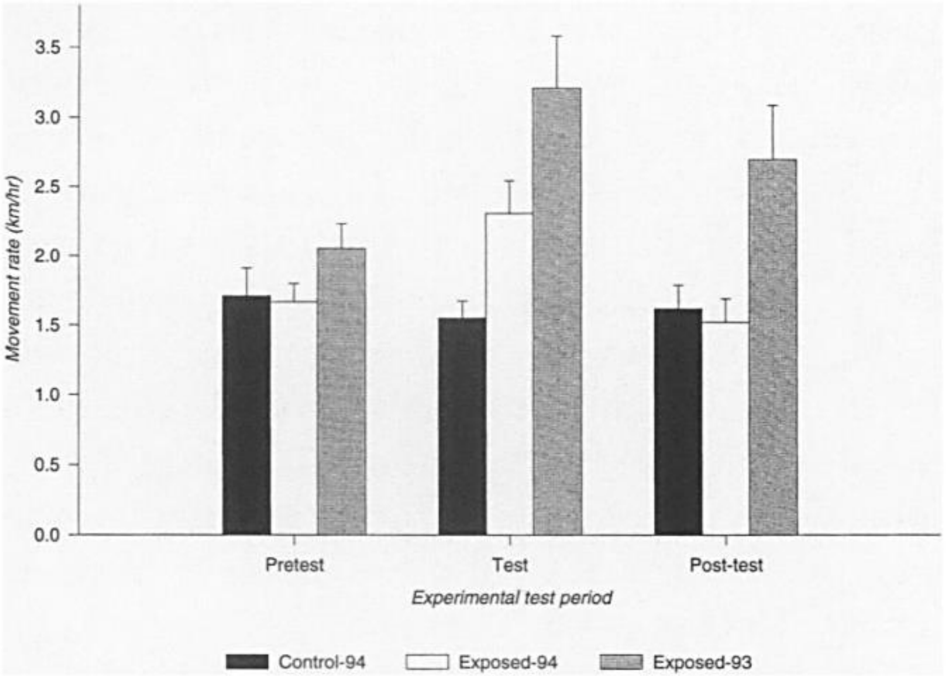


Fig. 1. Mean movement rates per experimental test period (+SE) for exposed (1993–94) and control caribou (1993).

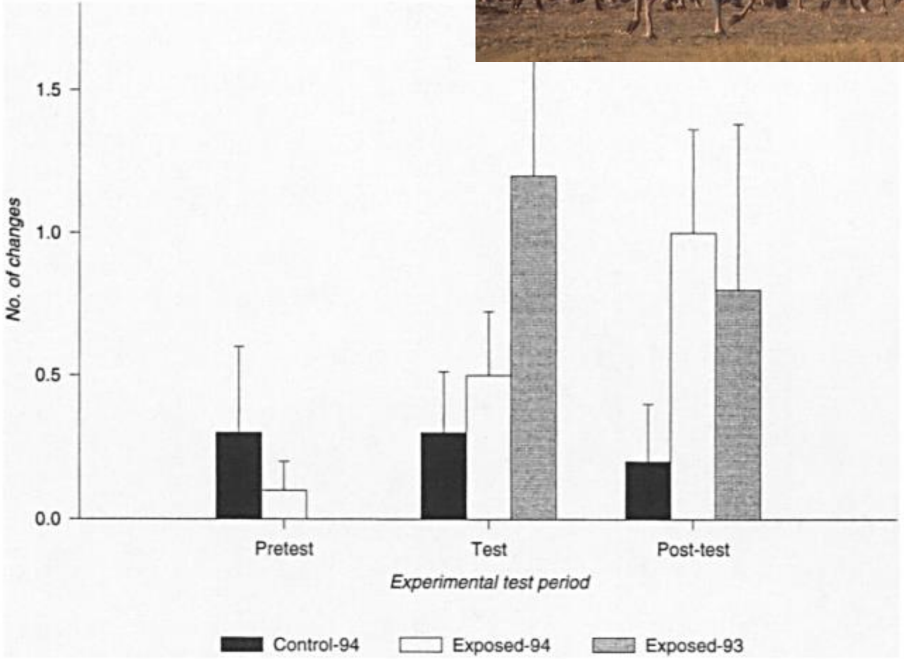


Fig. 2. Mean number of habitat patch changes per experimental test period (+SE).

Bradshaw et al. 1997

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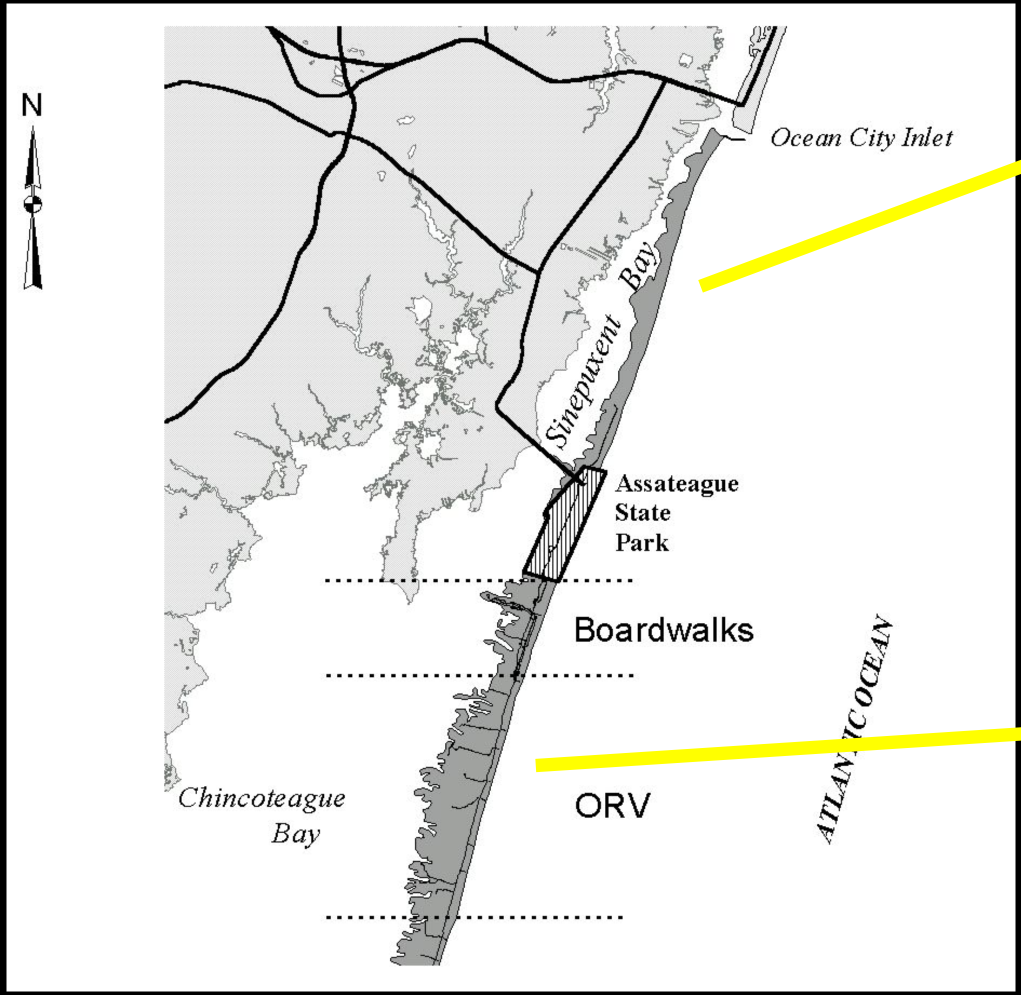
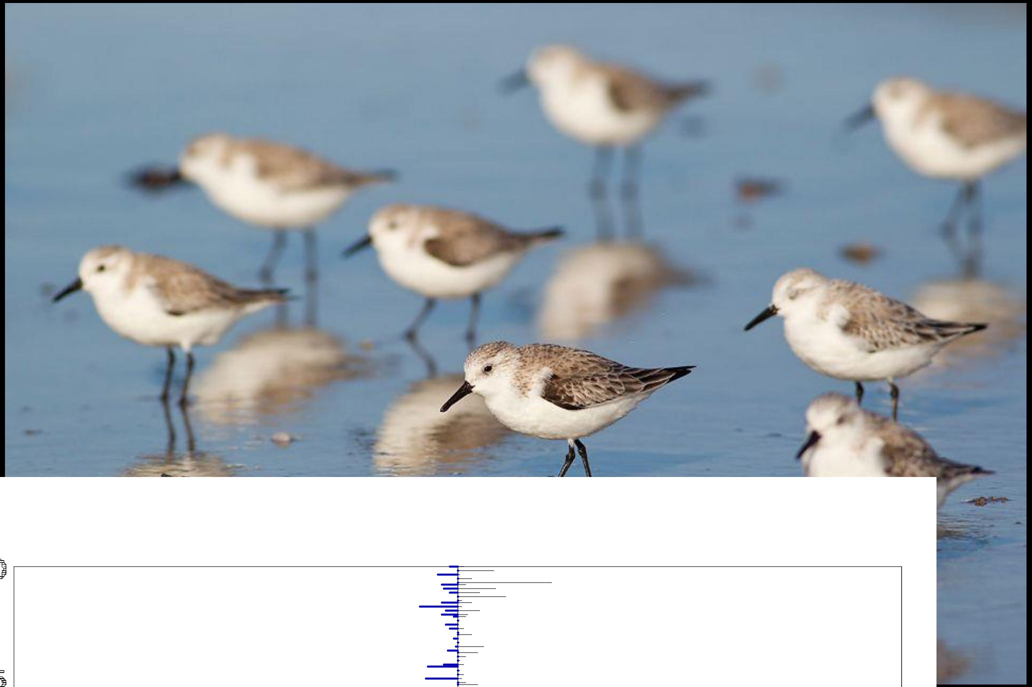
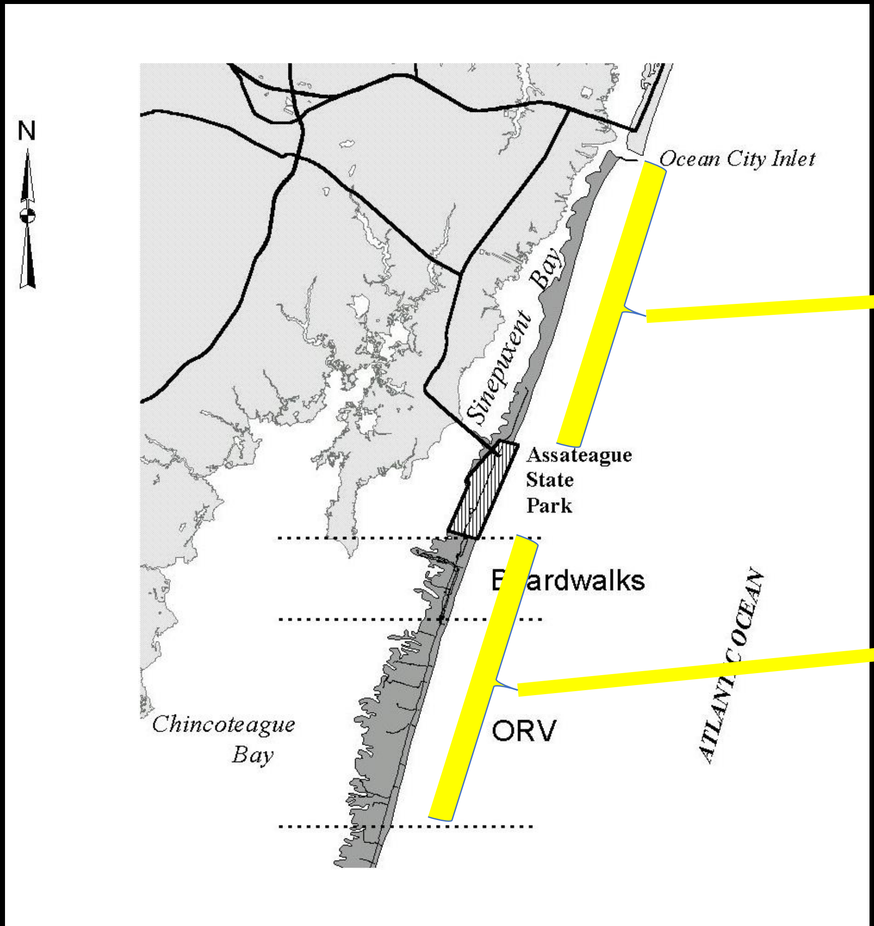
Sanderlings wintering on Assateague Island National Seashore

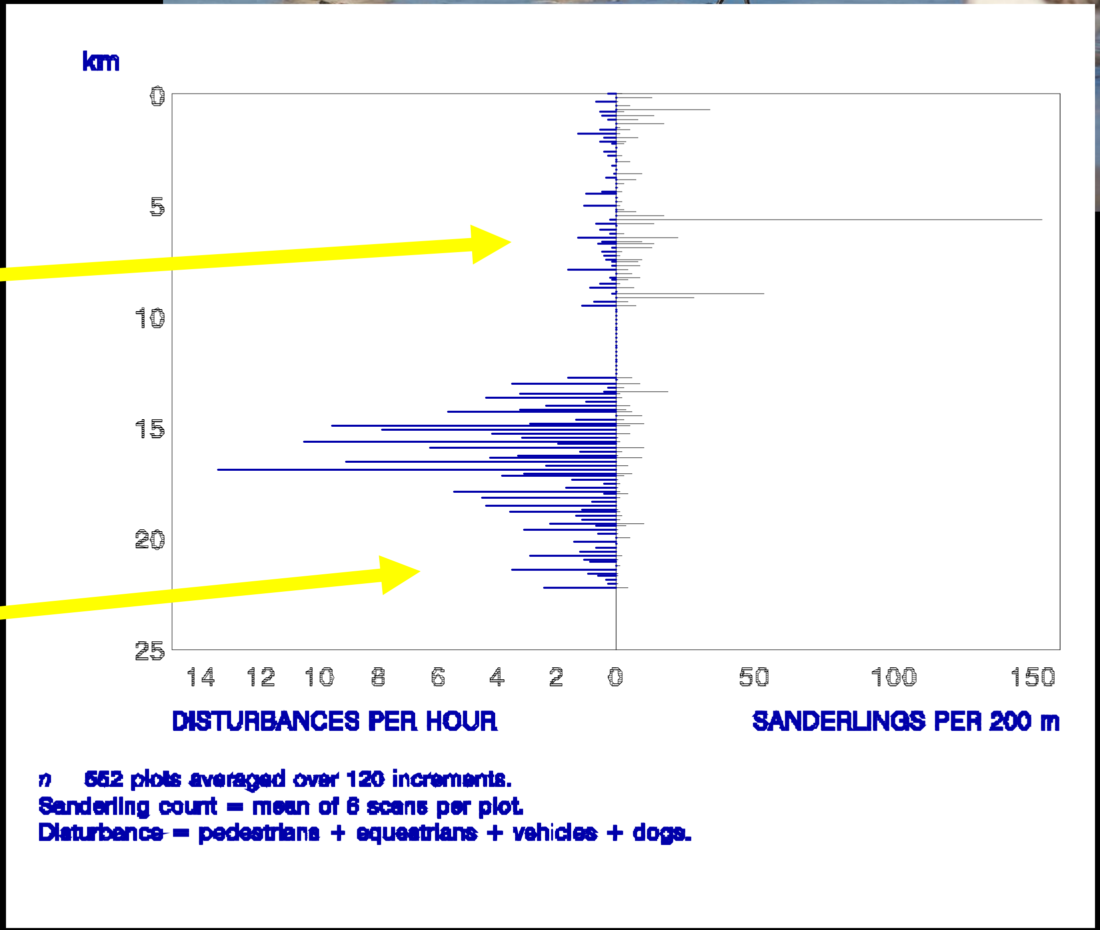


Human disturbance reduced Sanderling densities by 60%

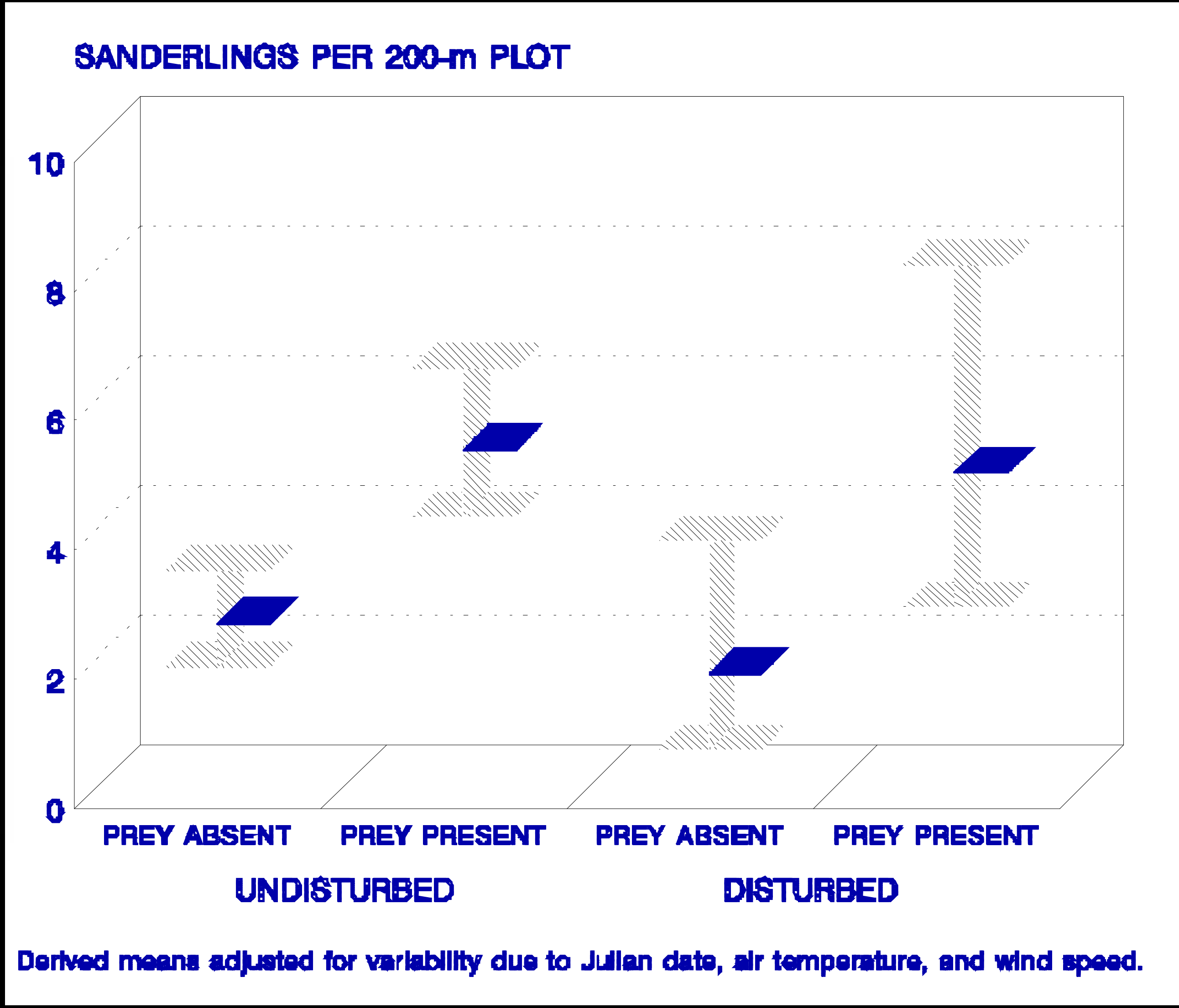
6.31 kJ/hr (undisturbed) vs 9.64 kJ/hr (disturbed)







But Sanderlings tolerated disturbance when food was available (mole crabs)

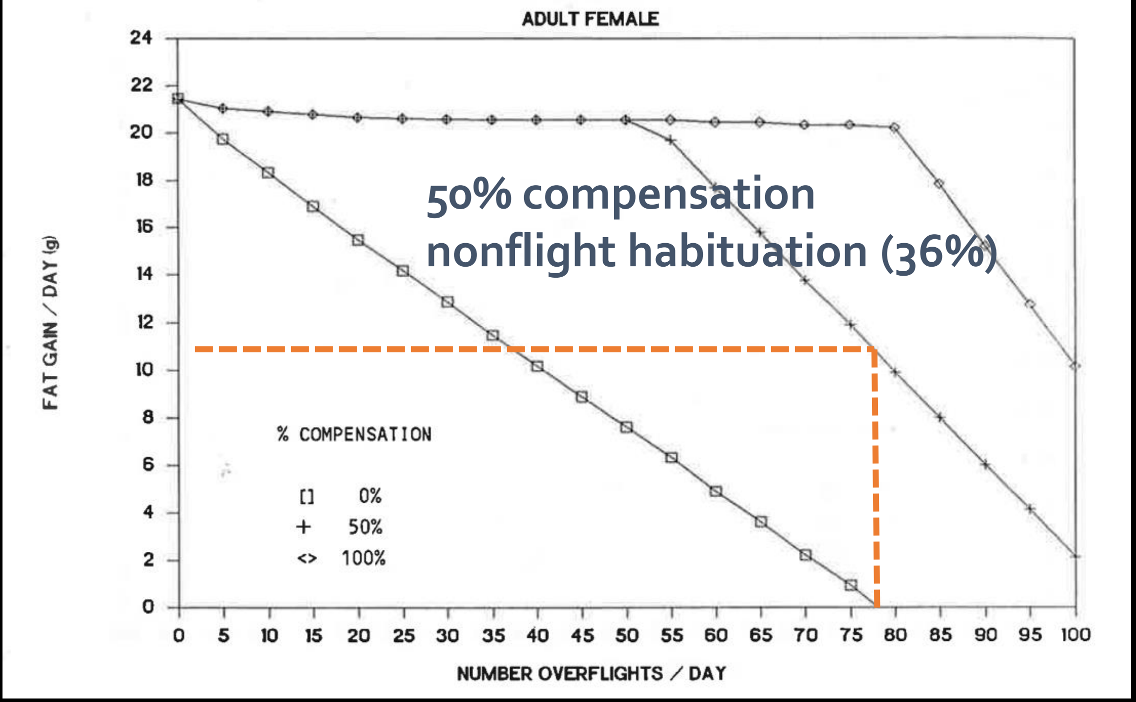


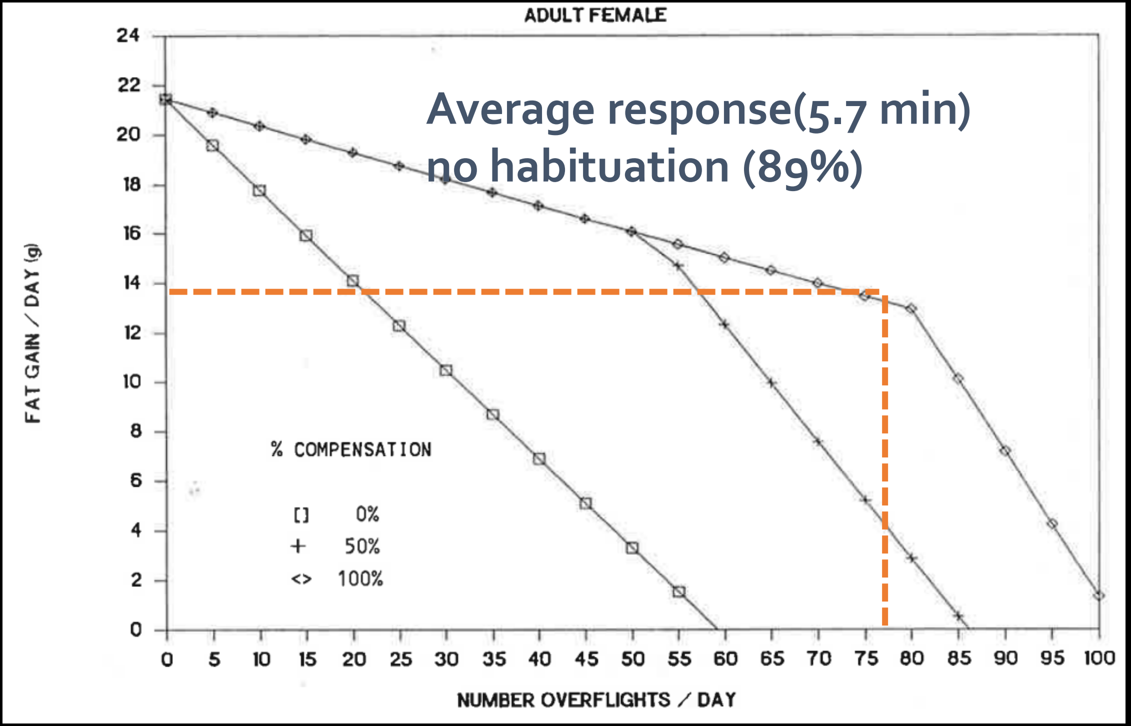
Morton 1996

Pre-migratory fat gain in Lesser Snow Geese staging on the Arctic Coastal Plain

- < 300,000 geese
- feed < 16 hours a day (hyperphagia)
- eat < third of body weight daily
- increase body fat < 400% in 2-3 weeks (22 g / day)

Brackney 1987





Simulated tradeoff between habituation and compensatory feeding effects on fat gain

75-80 overflights/day reduce fat gain by 50% assuming nonflight habituation and 50% compensatory feeding

75-80 overflights/day reduce fat gain by 38% assuming no habituation and 100% compensatory feeding

Brackney 1987

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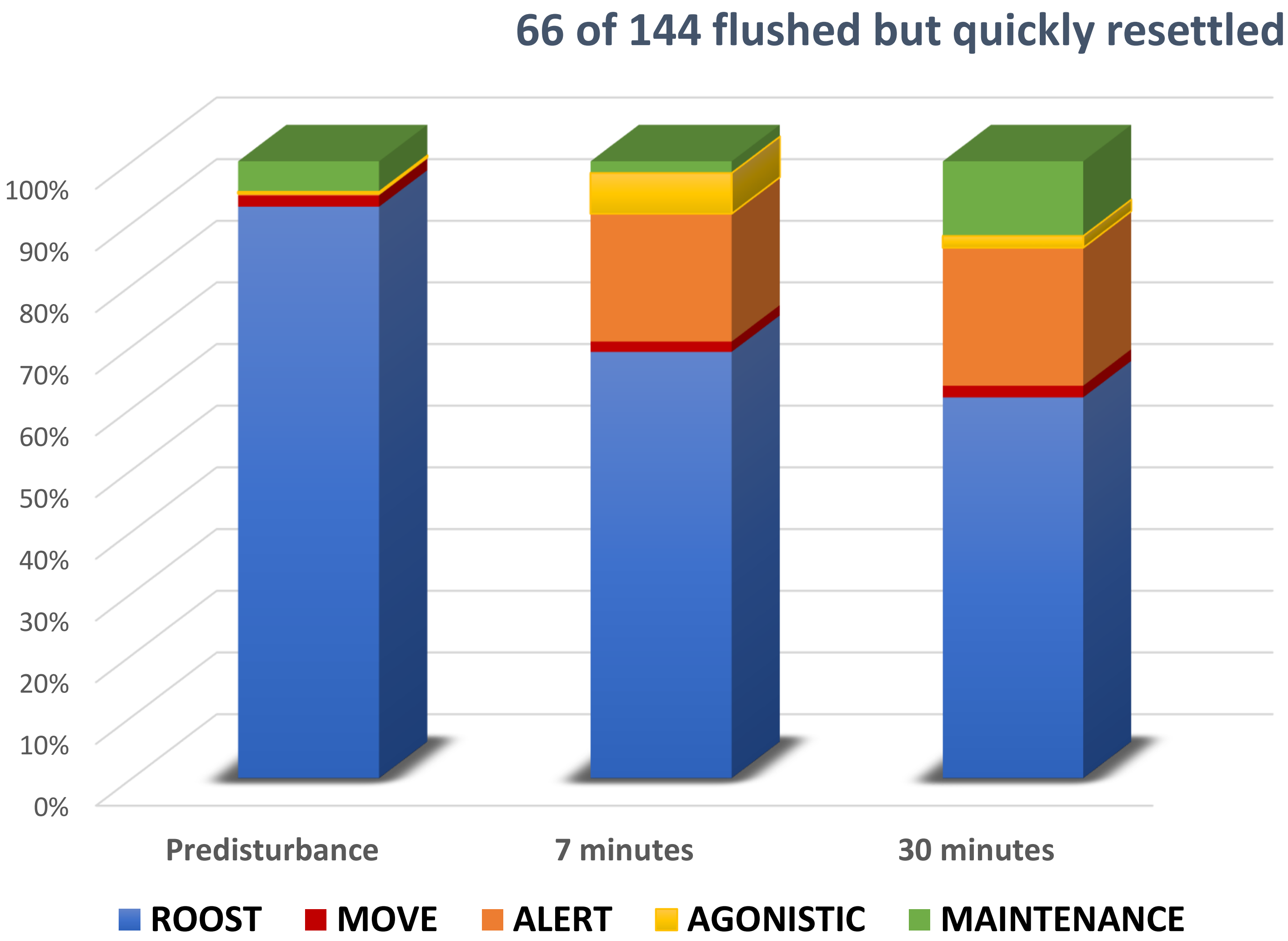
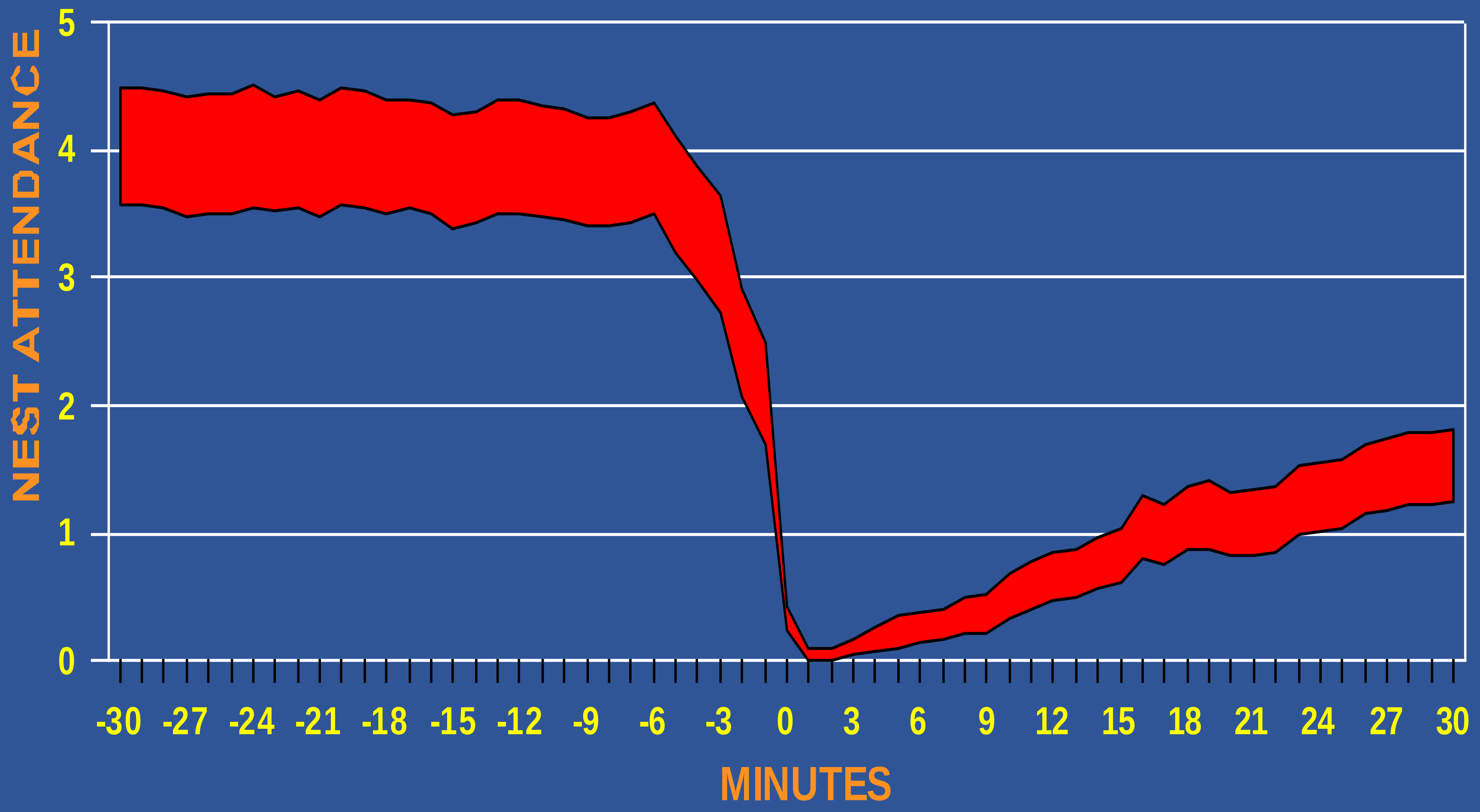
Mariana Fruit Bat colony "tolerant" to B1 bomber departure (110 dBA)



Morton 1996

Mariana Swiftlets are intolerant of human disturbance in their cave



Morton and Amidon 1996

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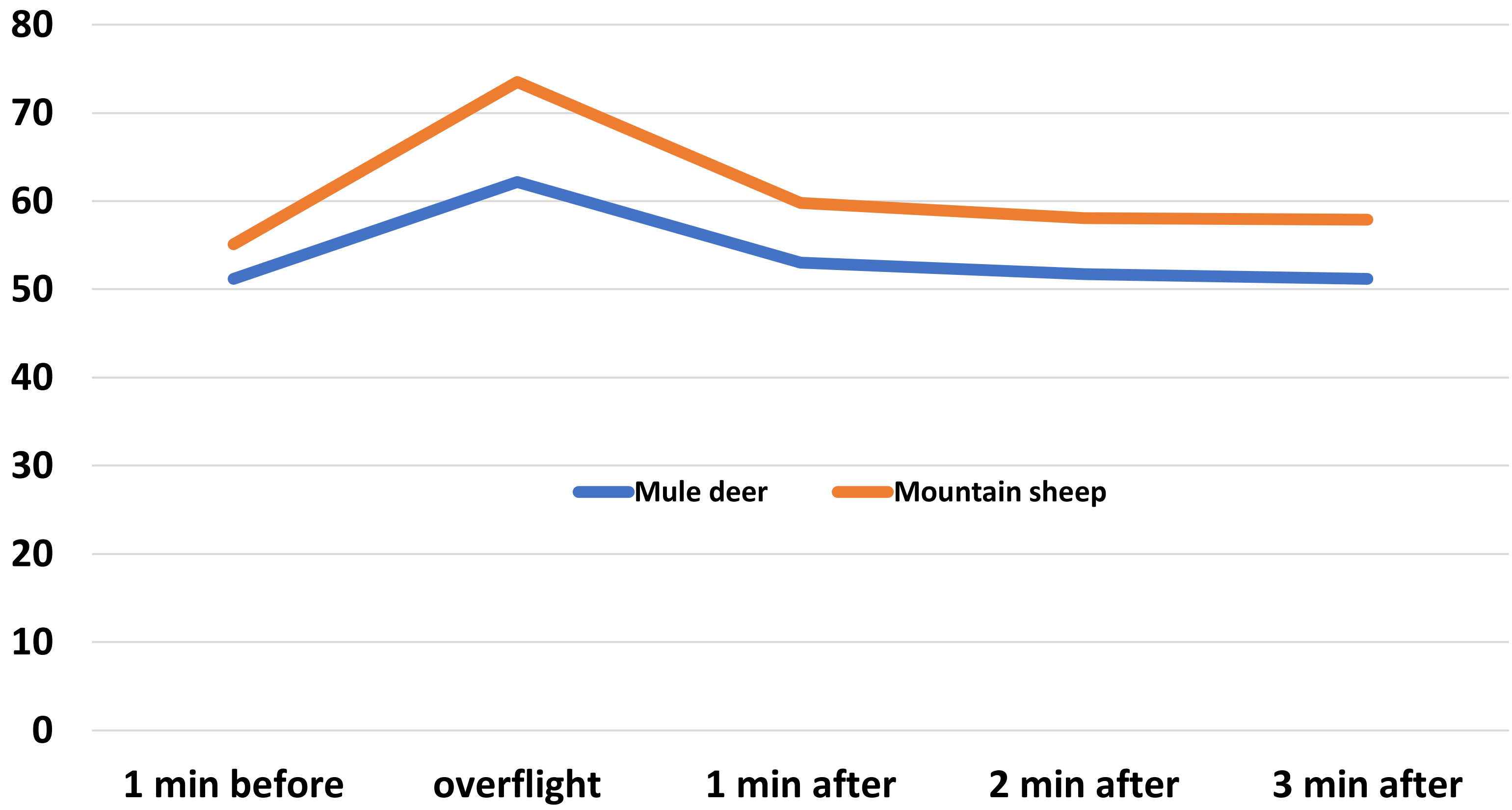
Habituation to noise (100-125 dBA)

- Operate no earlier than 3-4 weeks prior to *veraison* and stop right after harvest
- Operate during daylight hours, 30 min before sunrise and 30 min after sunset
- Move weekly so birds do not get used to their location

Mean heart rate elevated by simulated aircraft noise (83 – 112 dBA)…but diminished with repeated exposure (habituation)



Weisenberger et al. 1996

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Ways you can reduce disturbance of wildlife

- Appreciate natural sounds and sights
- Keep your distance, alter your route
- Use a long lens (binoculars, scopes, telephoto camera lens)
- Stay downwind
- Color choice
- Move slowly
- Be respectful