Effects of Noise and Other Human Disturbance on Wildlife
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?
Are sound measurements equally meaningful for humans and other animals?

Black line = response of quiet rural community residents exposed to new or unfamiliar noise
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.
Does hearing differ among taxonomic groups?

What about invertebrates?

**What noises can animals hear?**

- **Mammals**: < 10 Hz to 159 KHz
  Sensitivity to -20dB
- **Birds**: 100 Hz to 8–10 KHz
  Sensitivity at 0–10dB
- **Fish**: 200 Hz to 800 Hz
  Sensitivity at 50–70dB
- **Reptiles**: 50 Hz to 2 KHz
  Sensitivity at 40–50dB
- **Amphibians**: 100 Hz to 2 KHz
  Sensitivity at 10–60dB

Source: fhwa.dot.gov
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
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)

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<th>Biological response</th>
<th>Environmental</th>
<th>Transportation</th>
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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.
How wildlife perceive sounds as “disturbing” is complex.
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
How wildlife perceive sounds as “disturbing” is complex
Chronic traffic noise (80 dB) interferes with Greater Mouse-eared Bat’s prey capture rate by 22%
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
Vegetation cover affects how traffic noise decreases with distance.
How wildlife perceive sounds as “disturbing” is complex

Heart rate/MR
Flight – fight response
Reproductive fitness
Fight-flight response to acute noise events

- Sympathetic nervous system 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

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

**Undisturbed**
- 36% Feed
- 37% Rest
- 11% Alert
- 0% Swim
- 15% Fly

**Human Disturbance**
- 40% Feed
- 19% Rest
- 9% Alert
- 9% Swim
- 10% Fly
- 13% Other

Morton 2002
Morton et al. 1989
American Black Duck response to acute human disturbances in daytime (automobiles, people, aircraft, boats)

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

**Graphs:**
- **Undisturbed:** 36% Feed, 37% Rest, 15% Other, 0% Swim, 11% Fly
- **Human Disturbance:** 40% Feed, 9% Rest, 19% Alert, 13% Swim, 10% Fly, 9% Other

_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).
How wildlife perceive sounds as “disturbing” is complex.
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

Derived means adjusted for variability due to Julian date, air temperature, and wind speed.
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)
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
How wildlife perceive sounds as “disturbing” is complex
Mariana Fruit Bat colony “tolerant” to B1 bomber departure (110 dBA)

66 of 144 flushed but quickly resettled

Morton 1996
Mariana Swiftlets are intolerant of human disturbance in their cave

Morton and Amidon 1996
How wildlife perceive sounds as “disturbing” is complex.
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
How wildlife perceive sounds as “disturbing” is complex
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

NOTICE
Jet-skis, Water-skis, & Towing Water Toys are NOT authorized for use on the Kenai National Wildlife Refuge in accordance with 50 CFR, Part 27.33.