



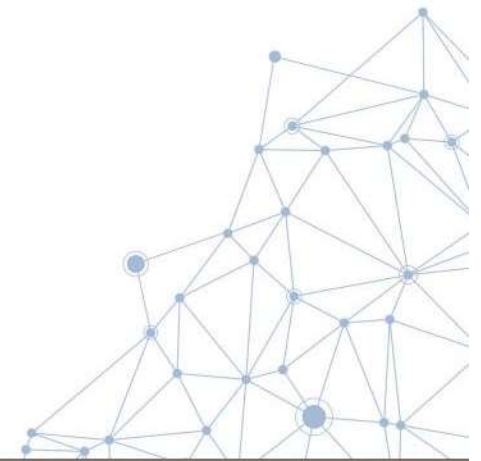
Bat Acoustic Monitoring at Wind Farms in Hawai'i 2006-2020

Matt Stelmach – March 6, 2020

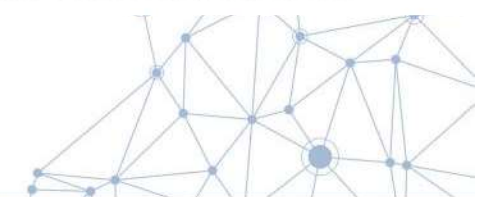
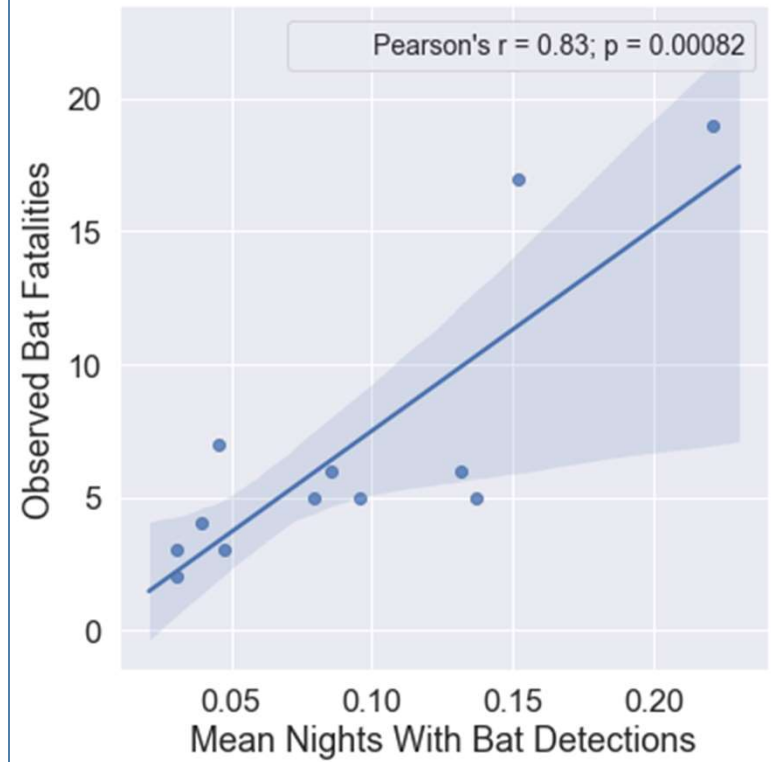
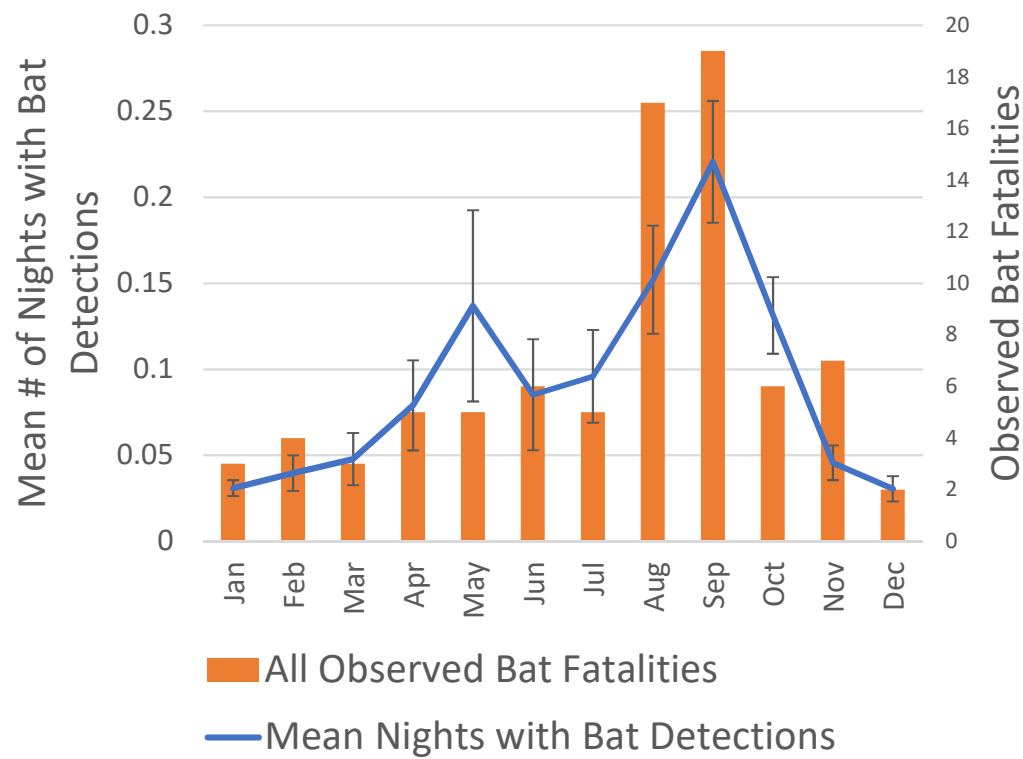


Overview

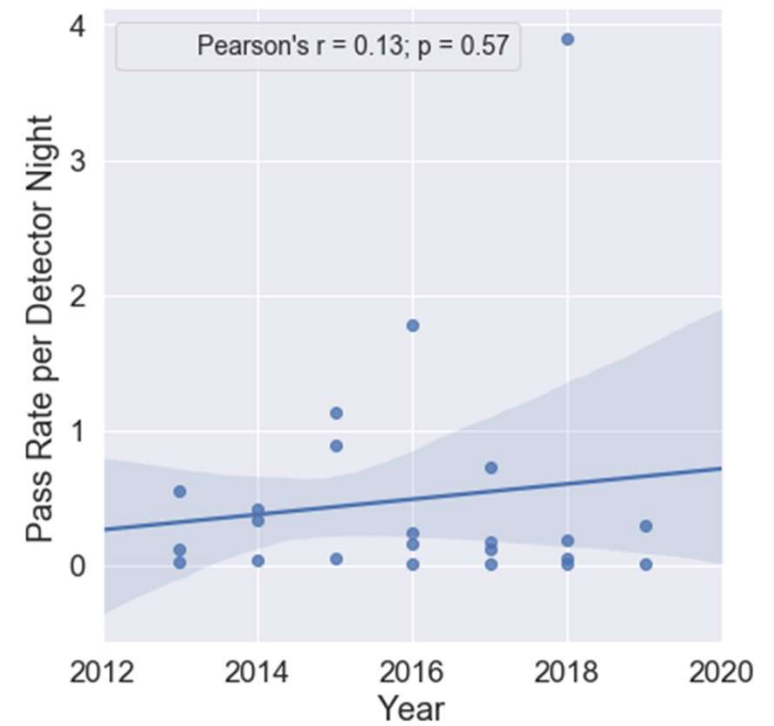
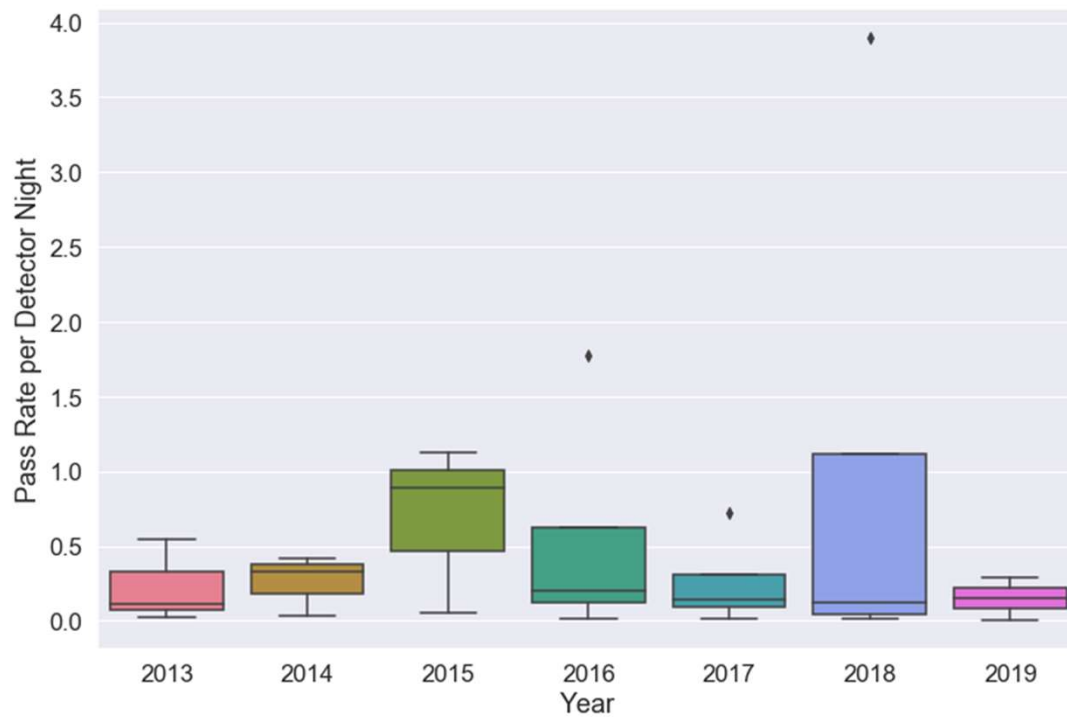
- **Goal of Acoustic Monitoring at Wind Farms**
- **Observations from Hawai'i Wind Farms**
 - Seasonality
 - Annual Variation
 - Time of Night
 - Wind Speed
- **Application and Challenges**
- **Discussion of ESRC Goals**
- **Future Research**



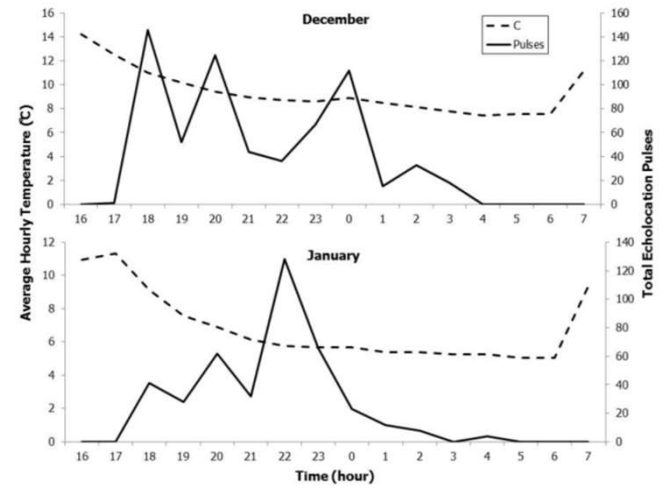
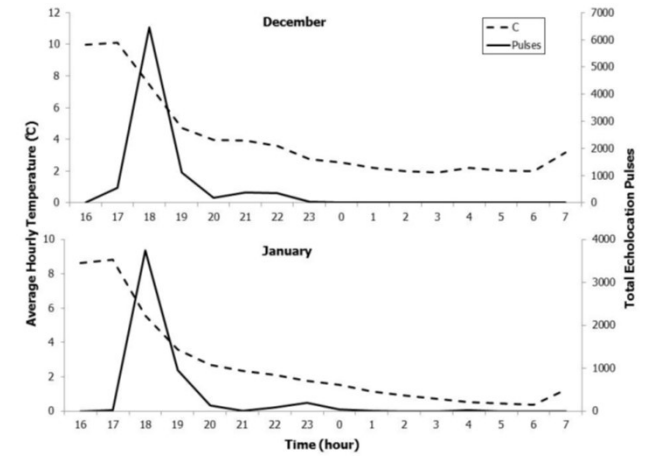
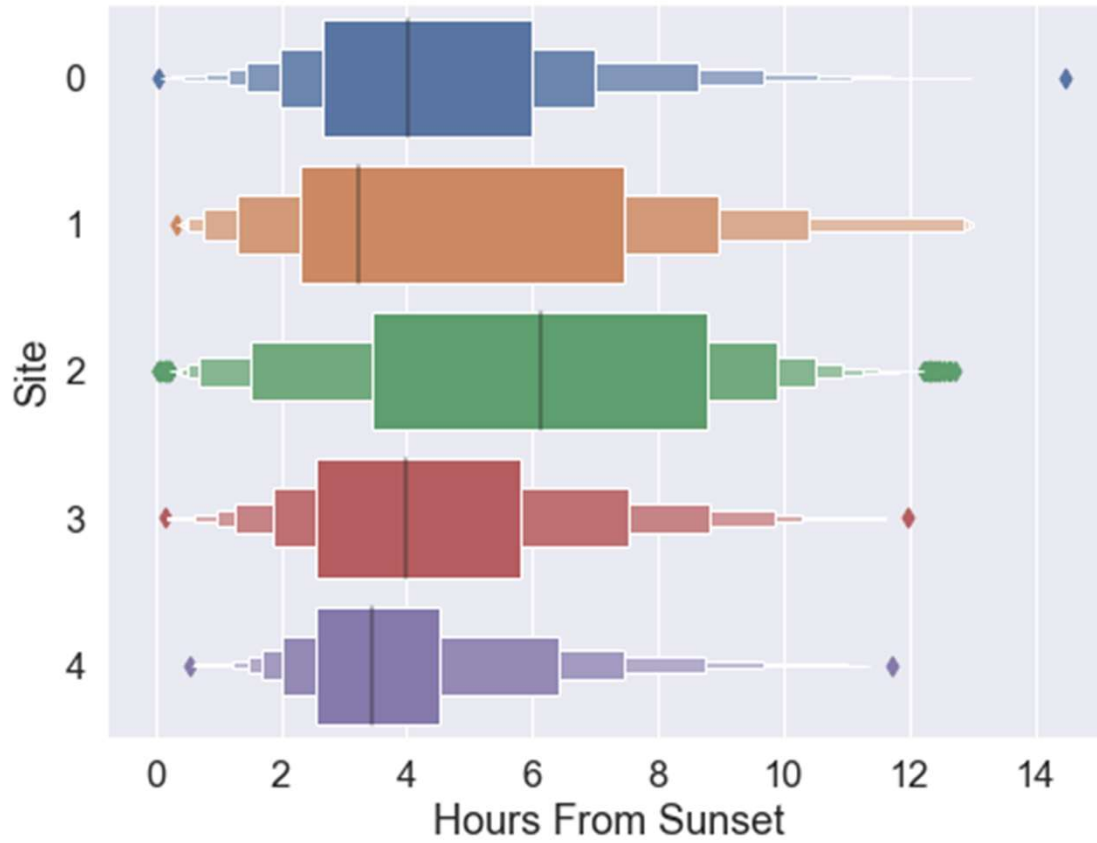
Seasonality



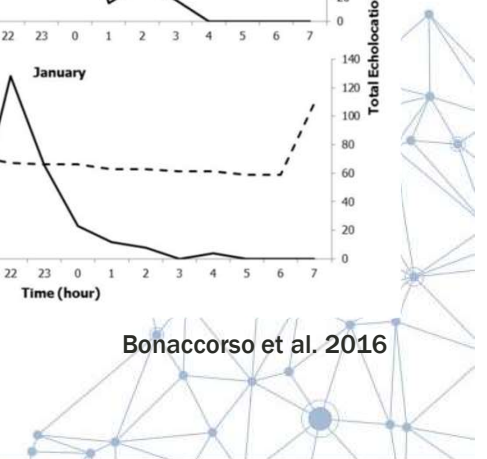
Annual Bat Activity for Hawai'i Wind Farms (August)



Time of Night

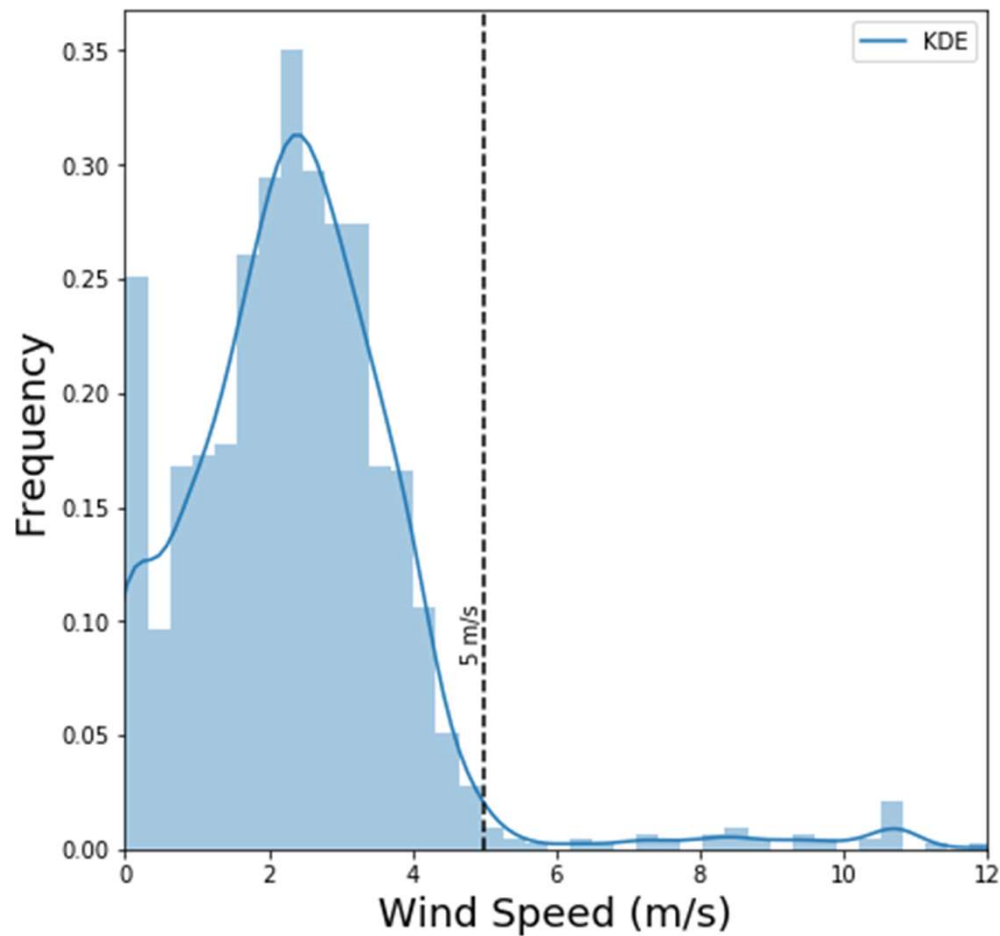


Bonaccorso et al. 2016

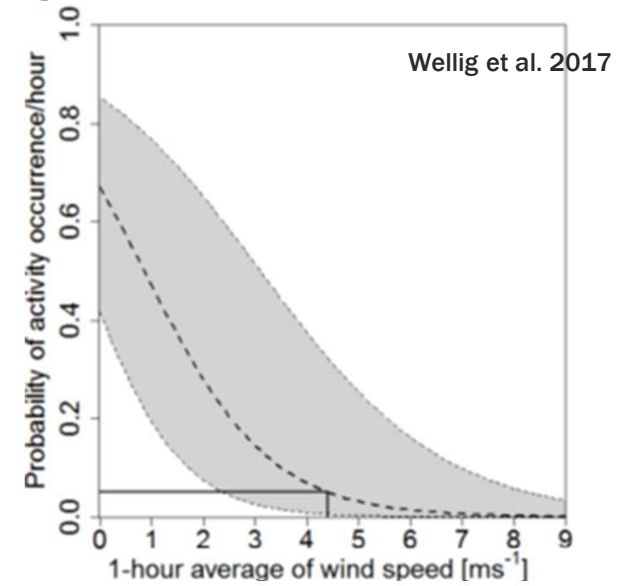


Wind Speed and Acoustic Activity

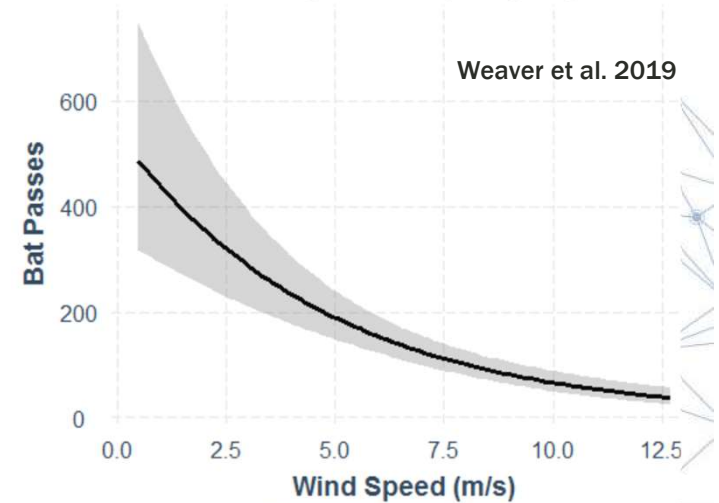
Hawai'i



Europe



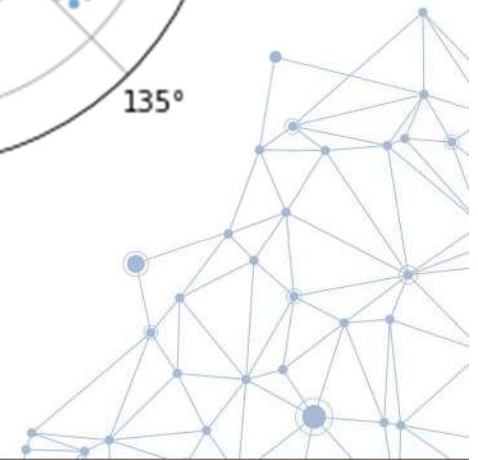
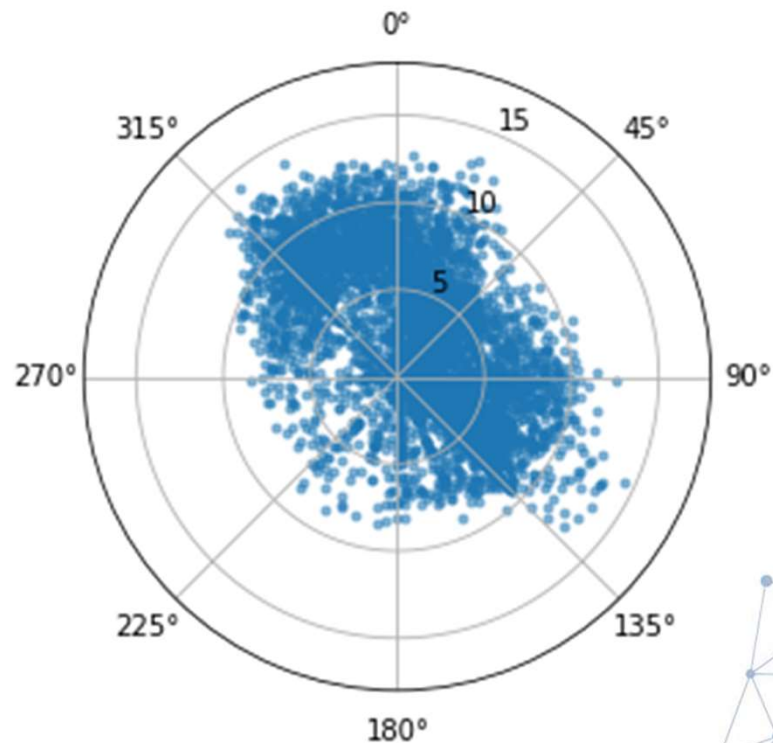
Mainland US



Application and Challenges with Acoustic Data

7 Days: Wind Speed and Direction

- Requires echolocating
- Detection probability
 - Changes with behavior
 - Changes with habitat
 - Changes with weather
- Interannual variability
- Timing of collision
- Typically a delay between recording and analysis



Goals of Acoustic Monitoring

- **Occupancy analysis**

- **Needs**

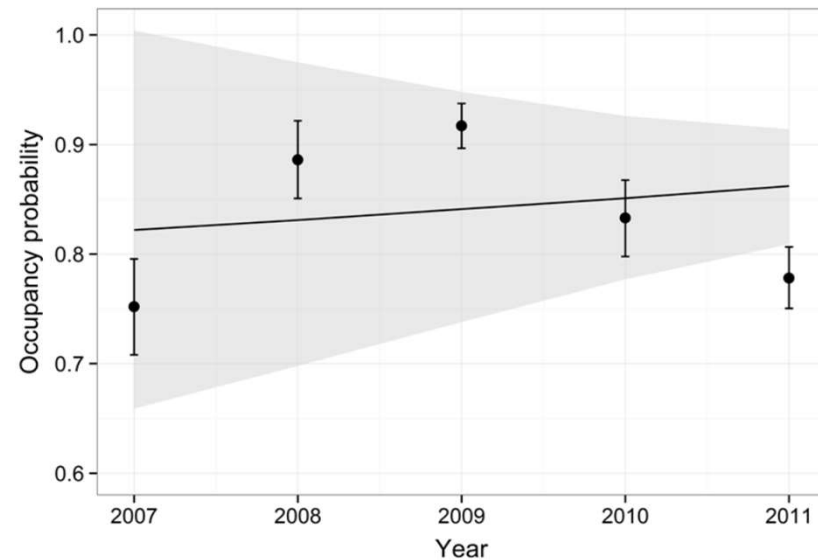
- Site selection
 - Broad geographic coverage
 - Sample size
 - Consistency
 - Definitions
 - Monitoring methods
 - Analysis
 - Centralized long term data storage

- **Control for bias**

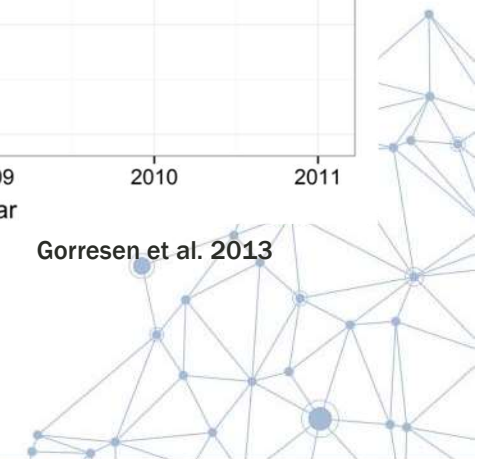
- Changes in microphone sensitivity
 - Changes in detection probability
 - Other

- **Tools**

- Central funding
 - Multi-source input

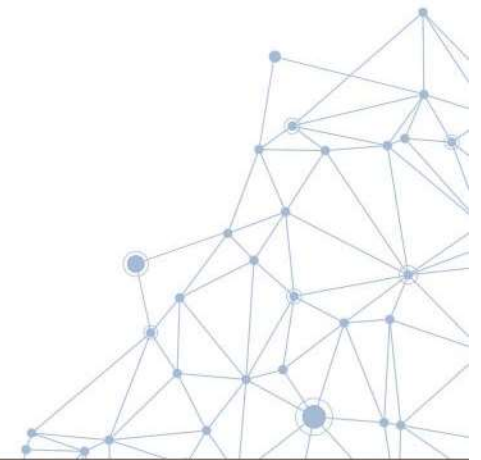


Gorresen et al. 2013



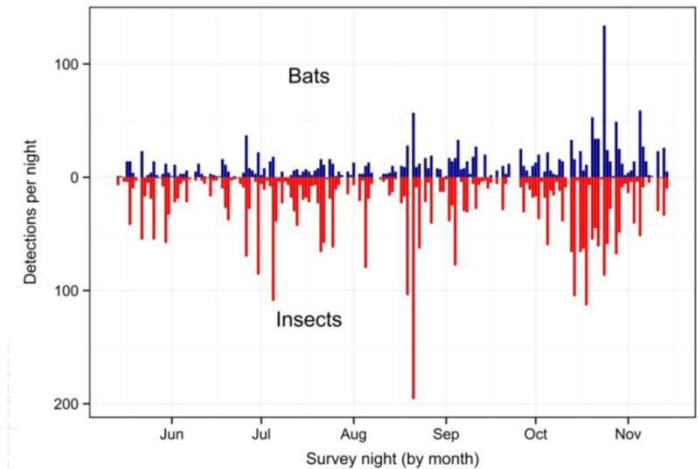
Goals of Acoustic Monitoring

- Predict fatality rates
 - Document downed wildlife incidents
 - Evaluate bat interactions with wind turbines
- “acoustic data gathered prior to construction cannot accurately predict bat fatality “ (Hein et al. 2013)

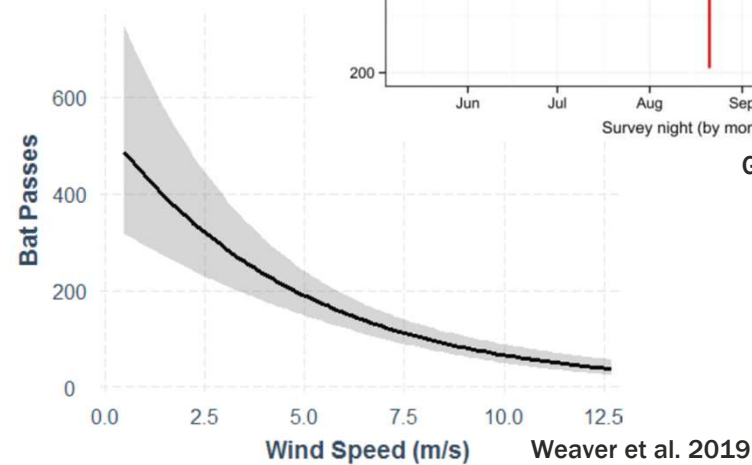


Future Research

- **More of the same - Modest improvements in LWSC**
 - Informed or Smart Curtailment
 - Optimizing cut-in speeds
- **Exploring new methods - Large potential in unexplored and unexplained risk**
 - Insect monitoring
 - Rare but impactful changes to habitat
 - Koa moth outbreak
 - Fire
 - Storm
 - Risk to juvenile vs adult



Gorresen et al. 2015



Weaver et al. 2019



Montoya et al. 2013



Conclusion

- Need to identify study question before experimental design
- Opportunities exist for synergistic gains in long term monitoring if distributed monitoring results can be aggregated
- Additional data on answered questions is not likely to yield valuable new data
- New research efforts may provide valuable insights into currently unexplained variation in bat activity, or impacts to bats

