BROAD SPECTRUM SOUND SATURATION & BIRD HABITAT DENIAL:

Preliminary Results of an Acoustic Deterrent System at MCAS Iwakuni (Japan)

Taylor Houston Todd Bayless

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Background

Noise pollution negatively affects birds

- Physical damage to ears
- Stress responses
- Flight-fight responses
- Avoidance responses
- Impacts on reproduction
- Behavioral changes
- Masking important environmental sounds

Ortega, C. P. (2012). Chapter 2: Effects of noise pollution on birds: A brief review of our knowledge. *Ornithological monographs*, *74*(1), 6-22

Acoustic Deterrents on Airfields

Acoustic Deterrent Type	Noise Stress Effect Types							
	Physical Damage	Stress Response	Fright-Flight	Avoidance Responses	Behavioral Responses	Reproductive Success Effects	Changes in Vocal Comm	Masking
Percussive Noise Generators[1]		P	P	S	P			
Simulated Wildlife Sounds[2]		P	P	P	P	S		
Masking Sound Systems[3]		P	S	P	P	S*	P	P

Note 1: Devices that periodically generate a sound pressure wave either automatically (e.g., propane cannon) or manually (e.g., "banger" type pyrotechnics)
Note 2: Devices that broadcast animal distress sounds or predator noises
Note 3: Broad spectrum sound files that mask inter- and intra-species communications, predator sounds, and other environmental cues.

Ortega, C. P. (2012). Chapter 2: Effects of noise pollution on birds: A brief review of our knowledge. *Ornithological monographs*, *74*(1), 6-22
Callaghan, K., & Mengak, M. T. (2020). Managing Wildlife Damage: Canada Goose (*Branta canadensis*).
Merrell, R. J. (2012). Some successful methods to mitigate conflicts caused by common ravens in an industrial environment. *Human-Wildlife Interactions*, *6*(2), 339-343.
Drake, D., & Villano, A. (2005). Effectiveness of flagging and propane cannons to disperse Canada geese in winter wheat fields. *Journal of Extension*, *43*(2).
Linz, G. M., Homan, H. J., Werner, S. J., Carlson, J. C., & Bleier, W. J. (2012). Sunflower growers use nonlethal methods to manage blackbird damage.

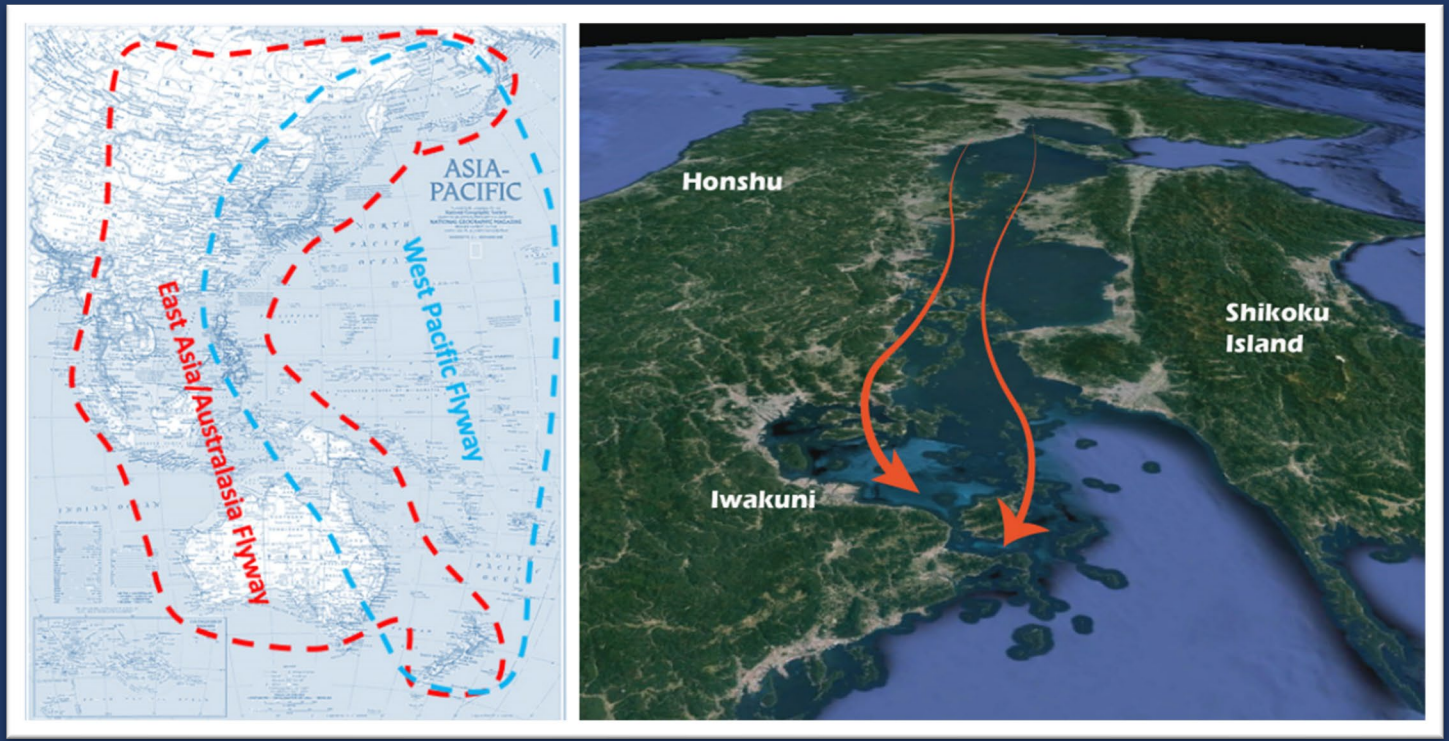
Premise of Deploying a Masking Acoustic Deterrent

- Recent studies from natural gas extraction (noise generated compressor stations), wind farms (turbine noise) allow for natural experiments
- Larger bodied birds using lower *f* use noisy areas less than smaller bodied birds with higher *f* = strong selective force in an area
- Noise increases of 3 dB–10 dB correspond to 30% to 90% reductions in alerting distances for wildlife

Teff-Seker, Y., Berger-Tal, O., Lehnardt, Y., & Teschner, N. (2022). Noise pollution from wind turbines and its effects on wildlife: A cross-national analysis of current policies and planning regulations. *Renewable and Sustainable Energy Reviews*, *168*, 112801.

North Retention Pond, MCAS Iwakuni Japan

- MCASI has regional factors conducive to migrations
- Large retention pond ~55 acres near Runway 2/20 takeoff area
- Surveys conducted in 2016-2019, monthly counts: ~75% of birds are cormorants/ducks/grebes
- Thousands of large amounts of waterbirds in November-February (cormorants, ducks, etc…).
- Forms a “complex” with other waterbodies on base and off (tidal flats, other retention ponds)



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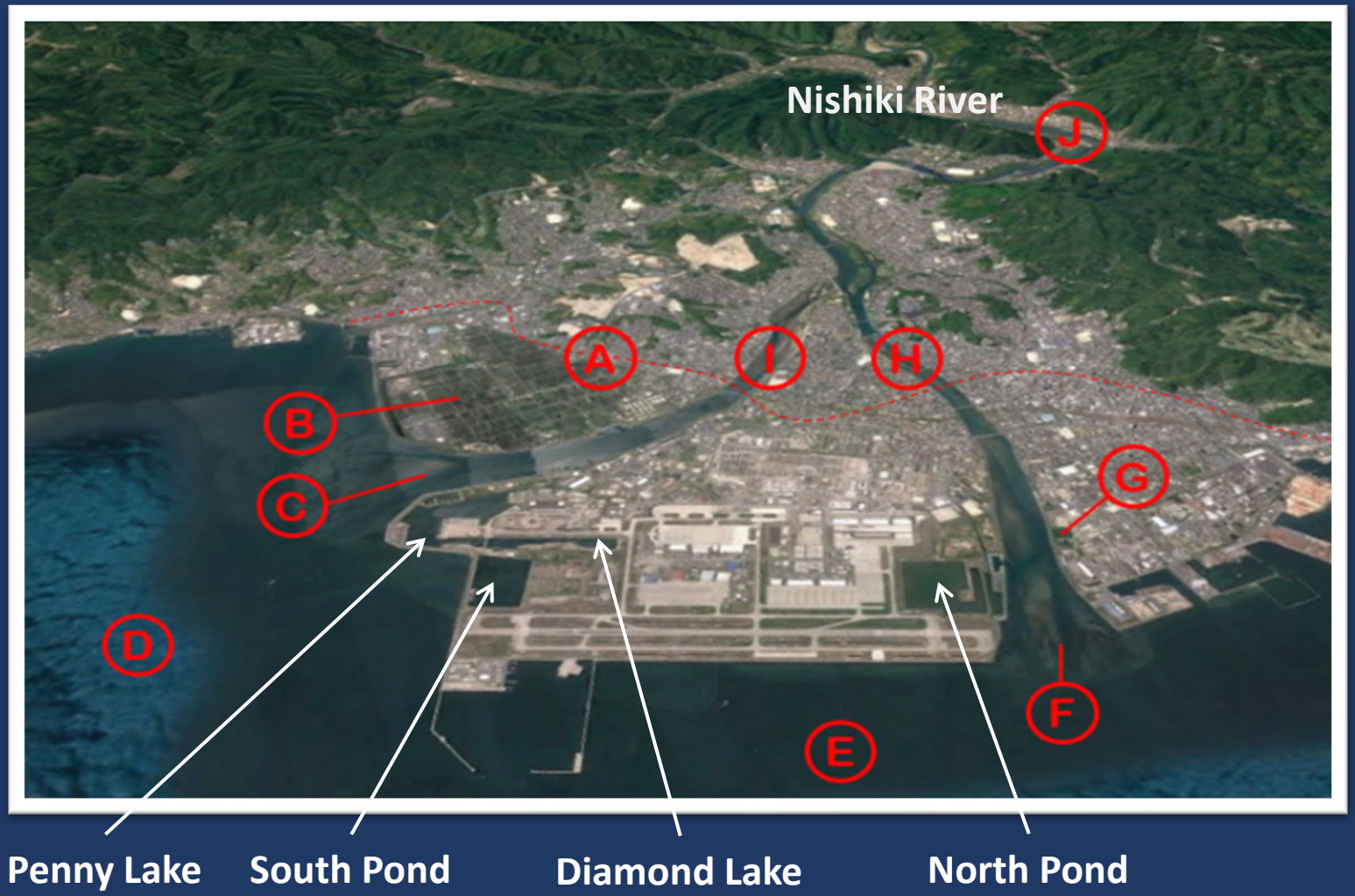

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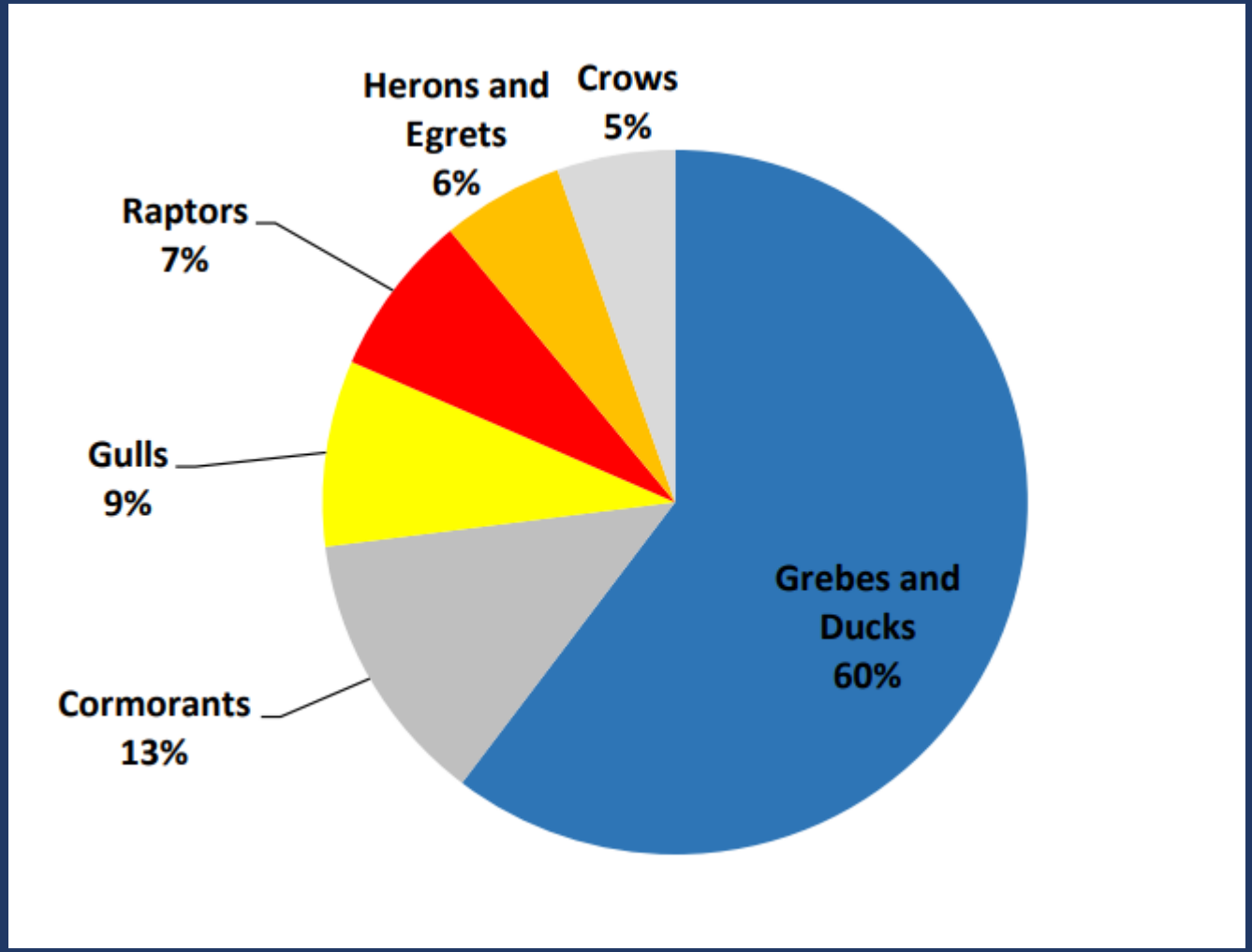

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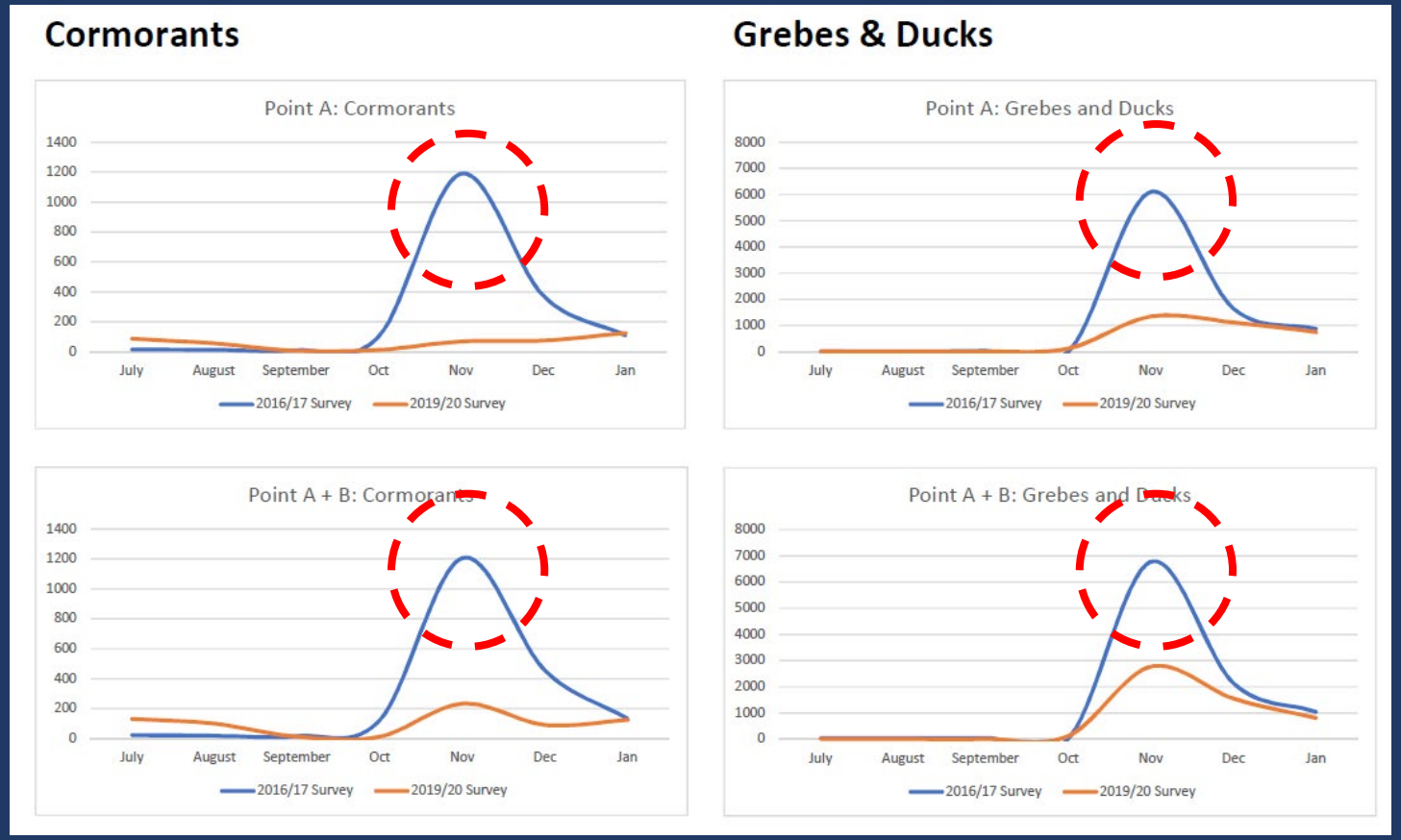

Monthly Bird Counts showing Point Stations Near North Retention Pond

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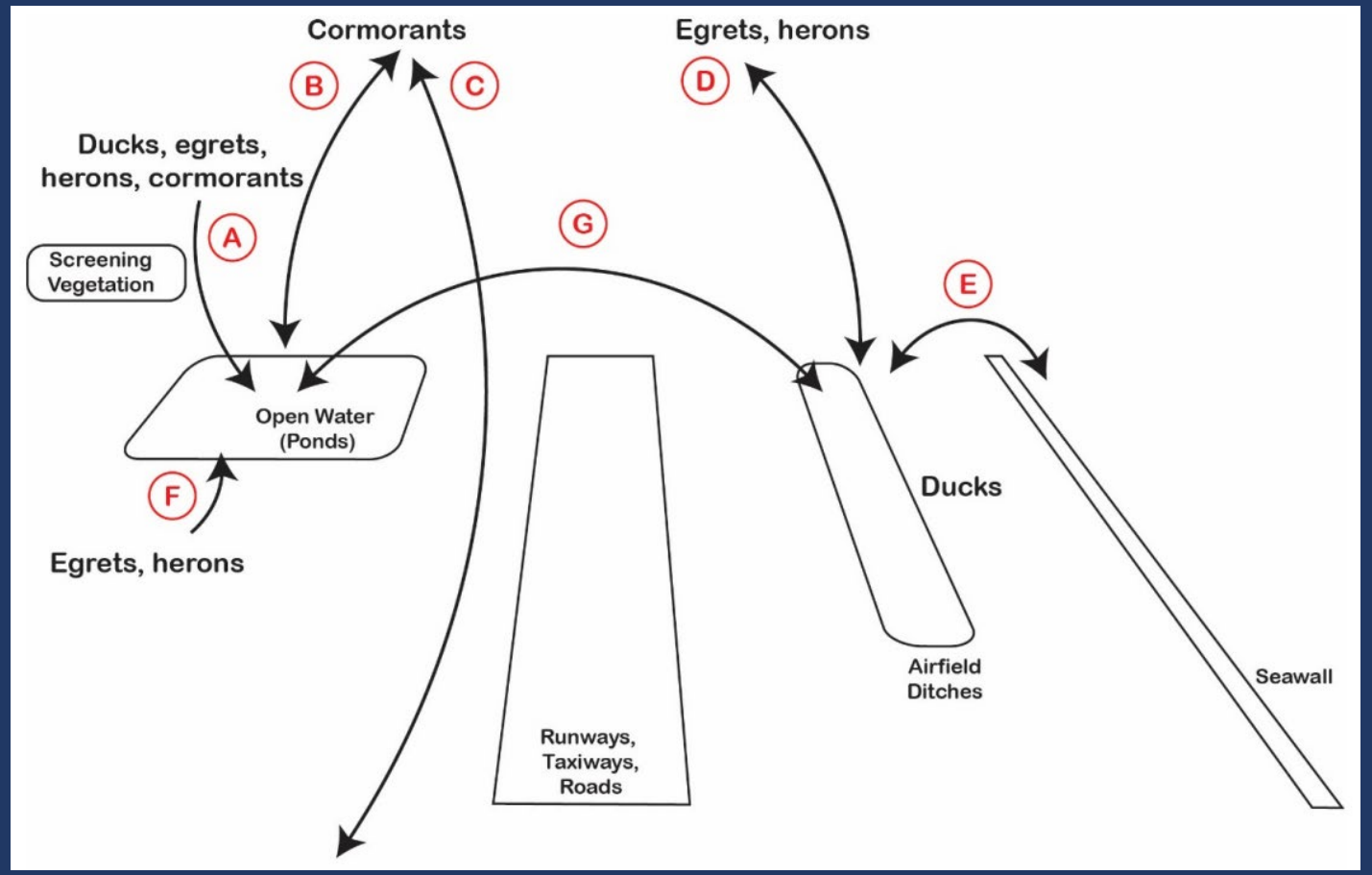
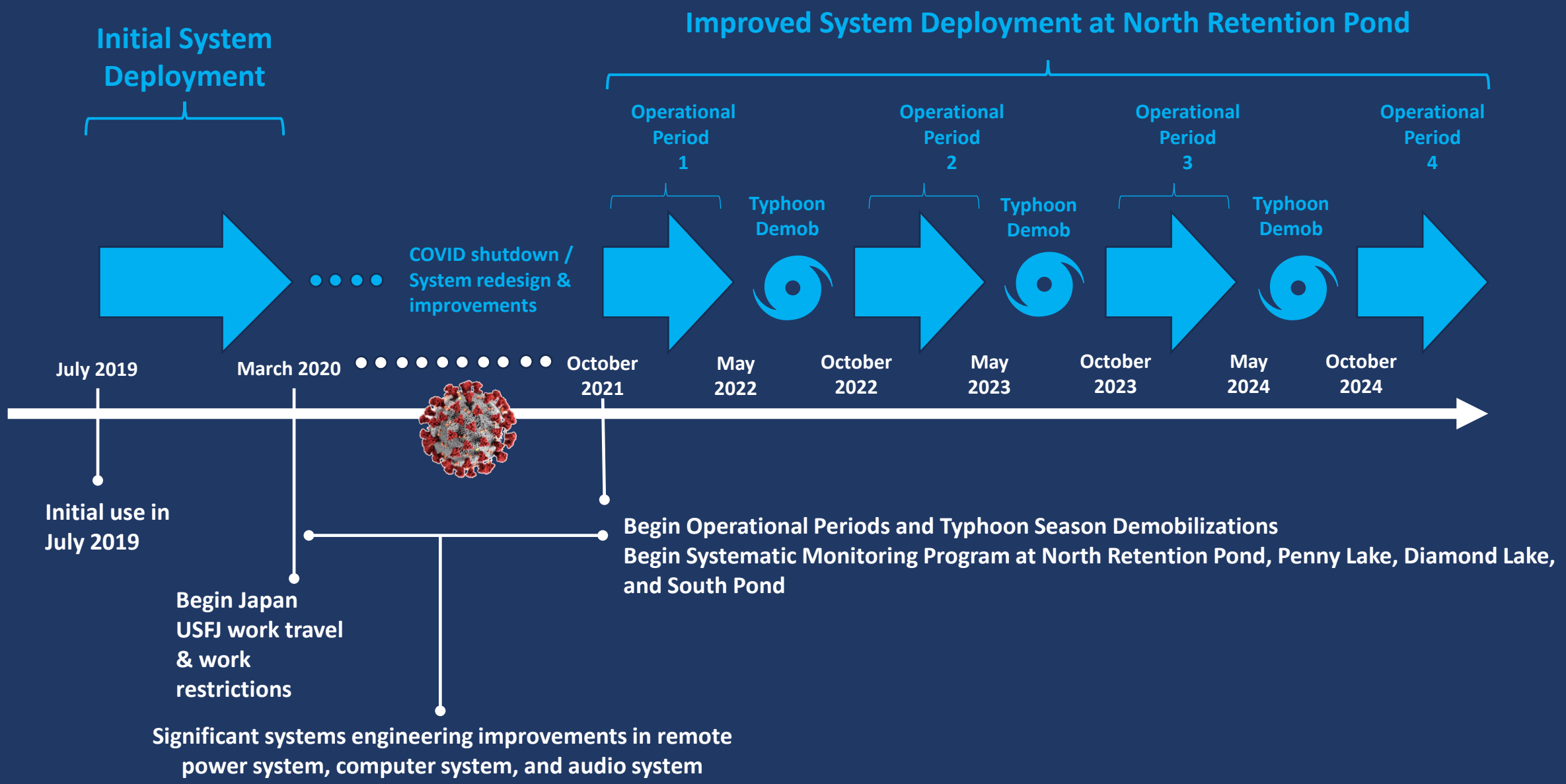


System Deployment History at MCAS Iwakuni



2021 Deployment

- Vendors from West Virginia, Minnesota, California, Washington
- Pre-Assembled in Texas and shipped to Japan August 2021
- Final assembly on the pond shoreline in late Sep 2021
- 15 operational rafts on the water by October 2021








Assessing Efficacy of Acoustic Deterrent
Camera Trap Monitoring

- A total of **10** camera traps established at ponds/lakes across the airfield to capture bird activity
  - **Treatment site** (location where acoustic deterrent system rafts were deployed):
    - North Pond: freshwater – 3 cameras
  - **Control Sites:**
    - Penny Lake: freshwater – 3 cameras
    - Diamond Lake: freshwater – 1 camera
    - South Pond: saltwater – 3 cameras

Assessing Efficacy of Acoustic Deterrent

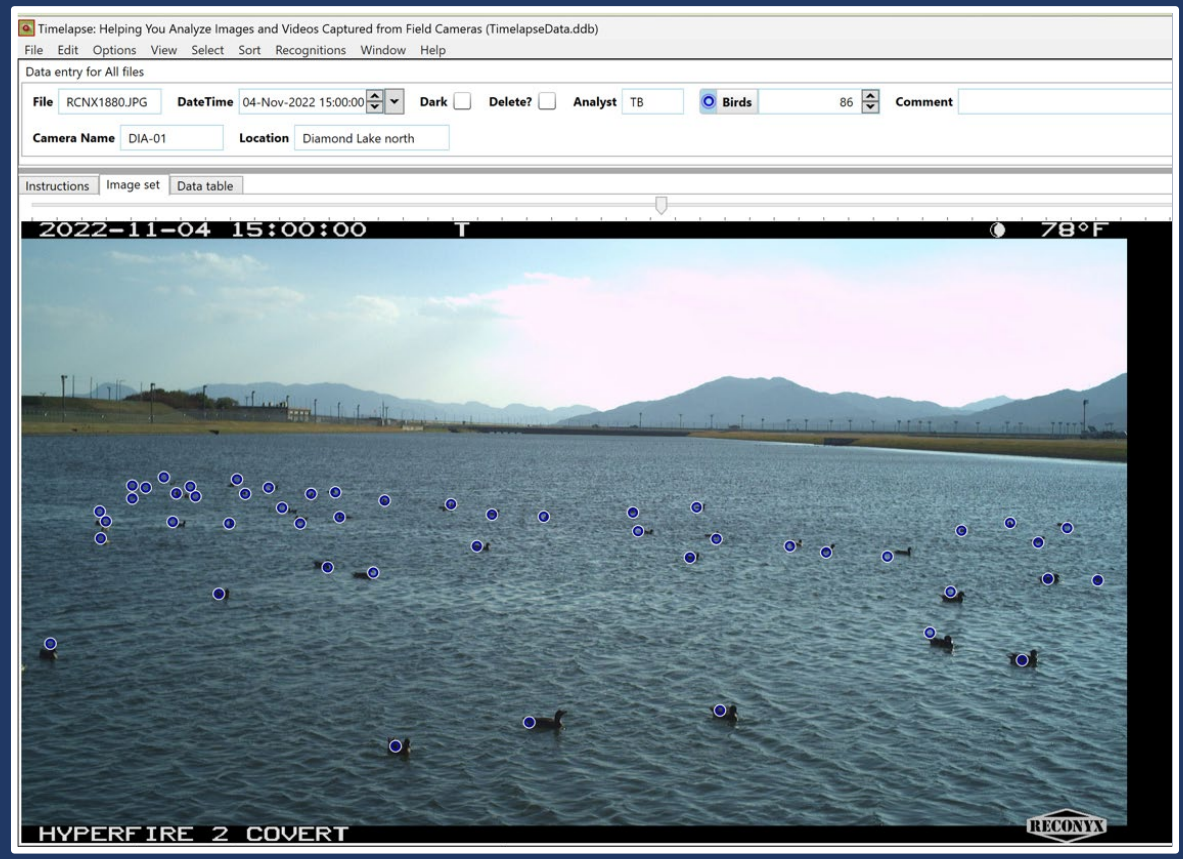
Camera Trap Monitoring

- Reconyx HyperFire 2 Trail Cameras
- Camera trap viewshed areas captured both water surface and shore areas
- Camera trap viewshed areas did not extend into other cameras' photo capture range to eliminate the possibility of double counting

- Photos taken once every 30 minutes during all weather conditions
- Photo data collected in Fall and Winter seasons concurrent with acoustic deterrent system deployment period
  - Year One = October 2022 – March 2023
  - Year Two = October 2023 – March 2024

Assessing Efficacy of Acoustic Deterrent
Camera Trap Monitoring

- Photos downloaded and imported into the program **Timelapse**[1] to tally birds
- "Dark" (night-time) photos removed from each data set
- Distorted photos (ex. rain drops, light distortion, etc.) also eliminated from data sets
- Bird counts for each site were divided by the total number of images analyzed
    - Reported as **Average Bird Observations per Image**
    - Provides a direct comparison between treatment site and control sites



[1]Greenberg, S. and Godin, T. (2012). Timelapse Image Analysis Manual. Technical Report 2012-1028-11, Department of Computer Science, University of Calgary, Calgary, AB, Canada. Software and additional documentation available at http://grouplab.cpsc.ucalgary.ca/cookbook/index.php/Demos/TimelapseCoder

Assessing Efficacy of Acoustic Deterrent

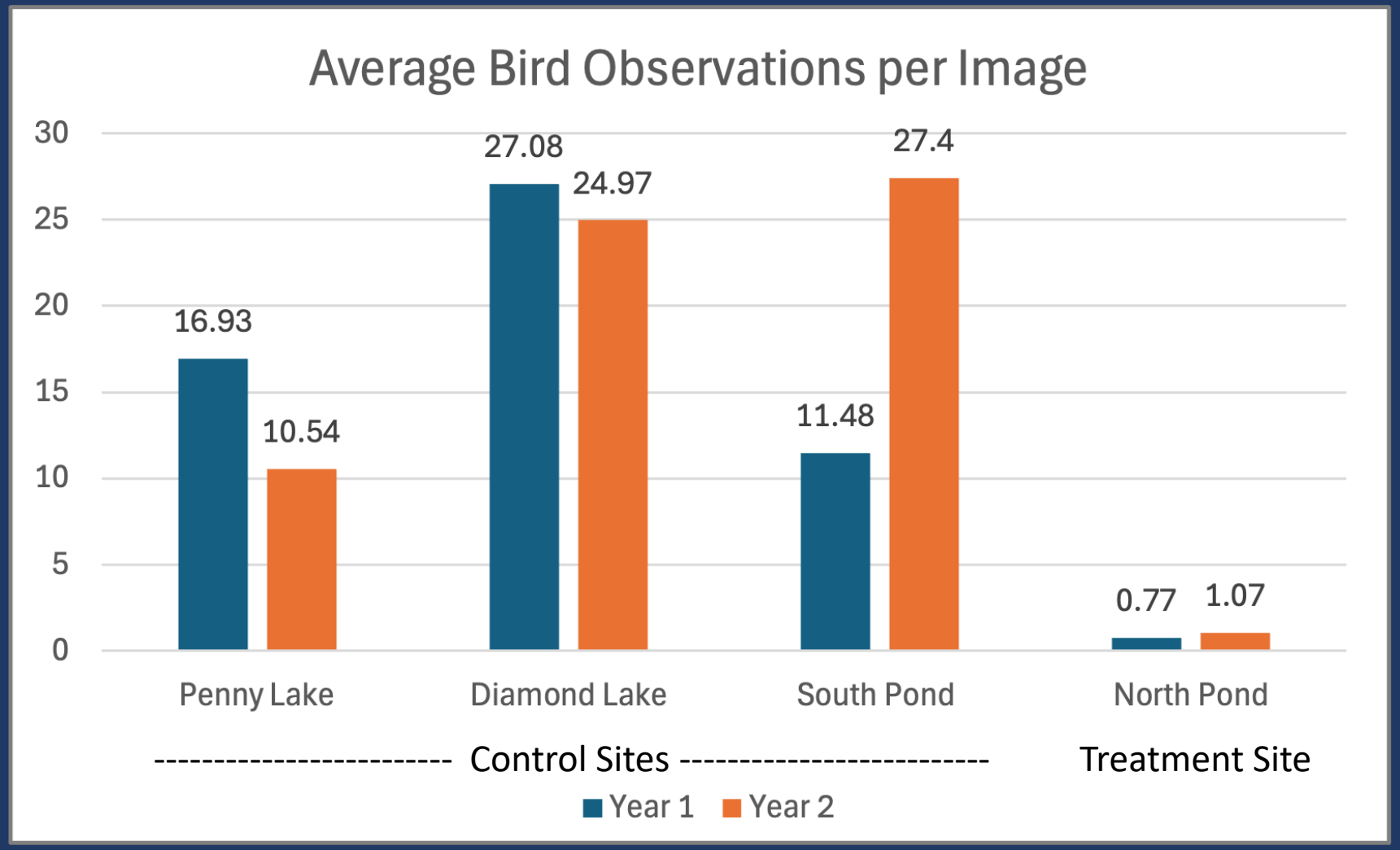
Camera Trap Monitoring Results

- **YEAR ONE**
  - October 21, 2022 - March 16, 2023
  - 33,698 daytime images analyzed from 10 cameras
  - 384,208 bird observations recorded

- **YEAR TWO**
  - October 21, 2023 - March 16, 2024
  - 33,622 daytime images analyzed from 10 cameras
  - 476,415 bird observations recorded

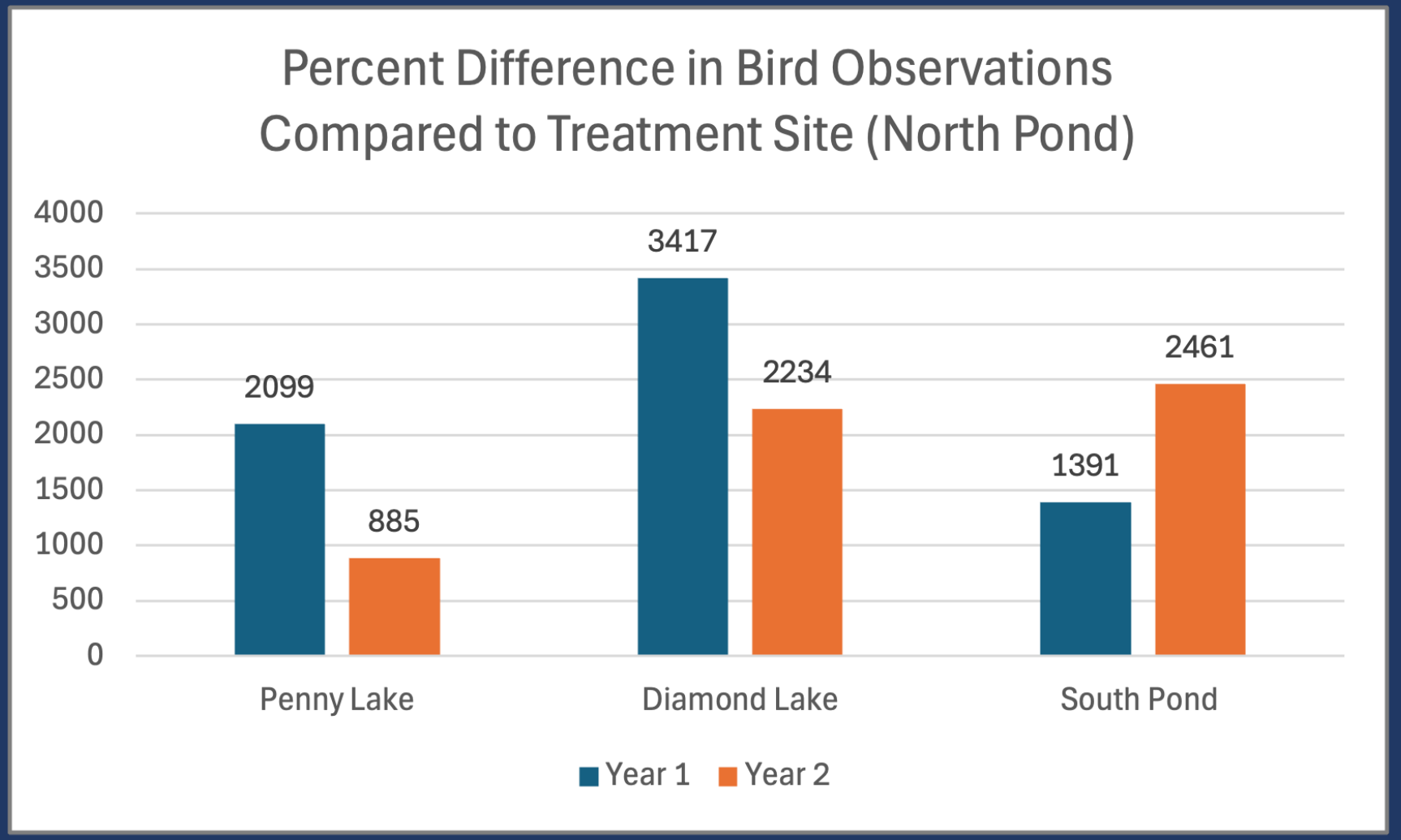
Assessing Efficacy of Acoustic Deterrent

Camera Trap Monitoring Results



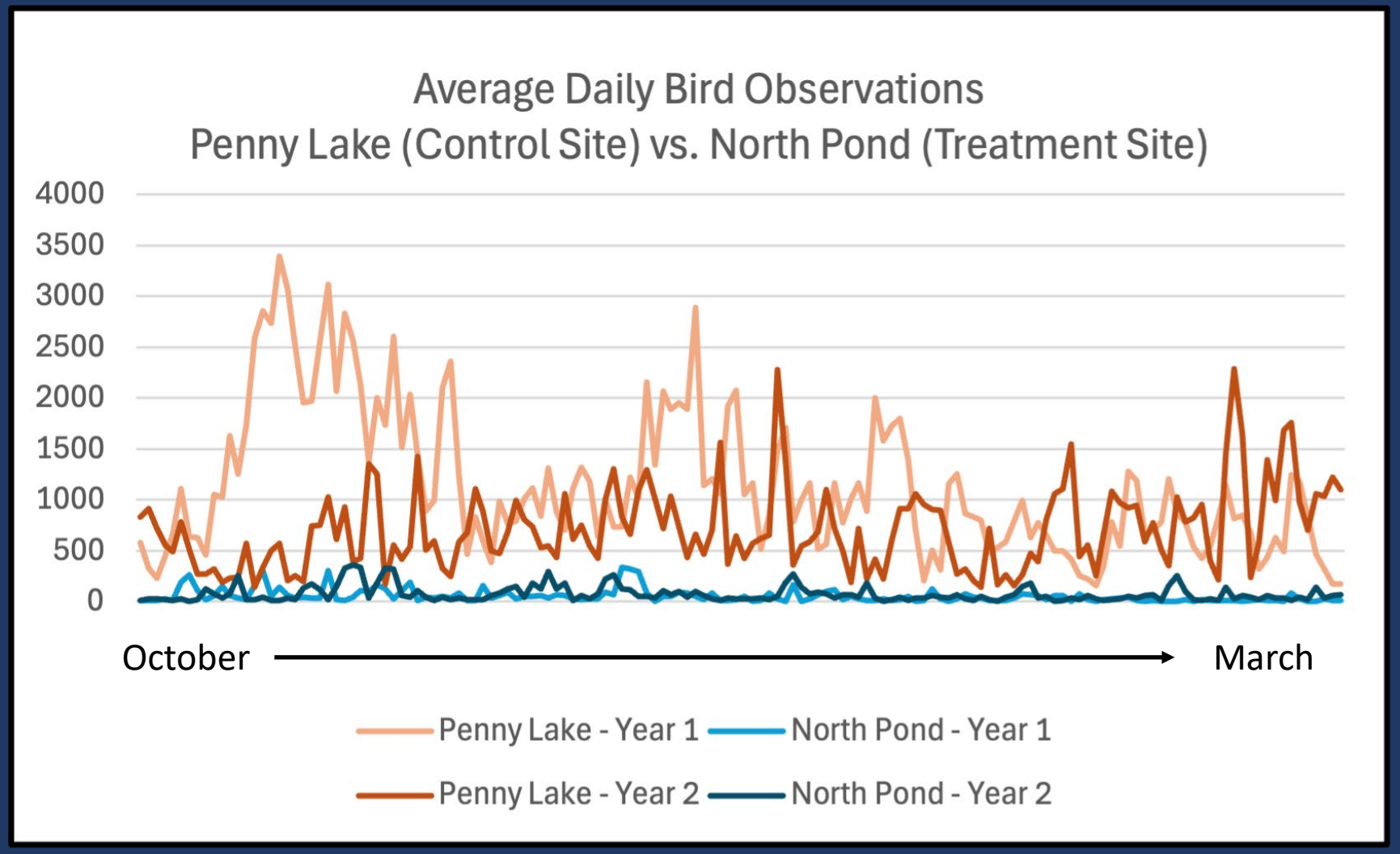
Assessing Efficacy of Acoustic Deterrent

Camera Trap Monitoring Results



Assessing Efficacy of Acoustic Deterrent

Camera Trap Monitoring Results



Assessing Efficacy of Acoustic Deterrent

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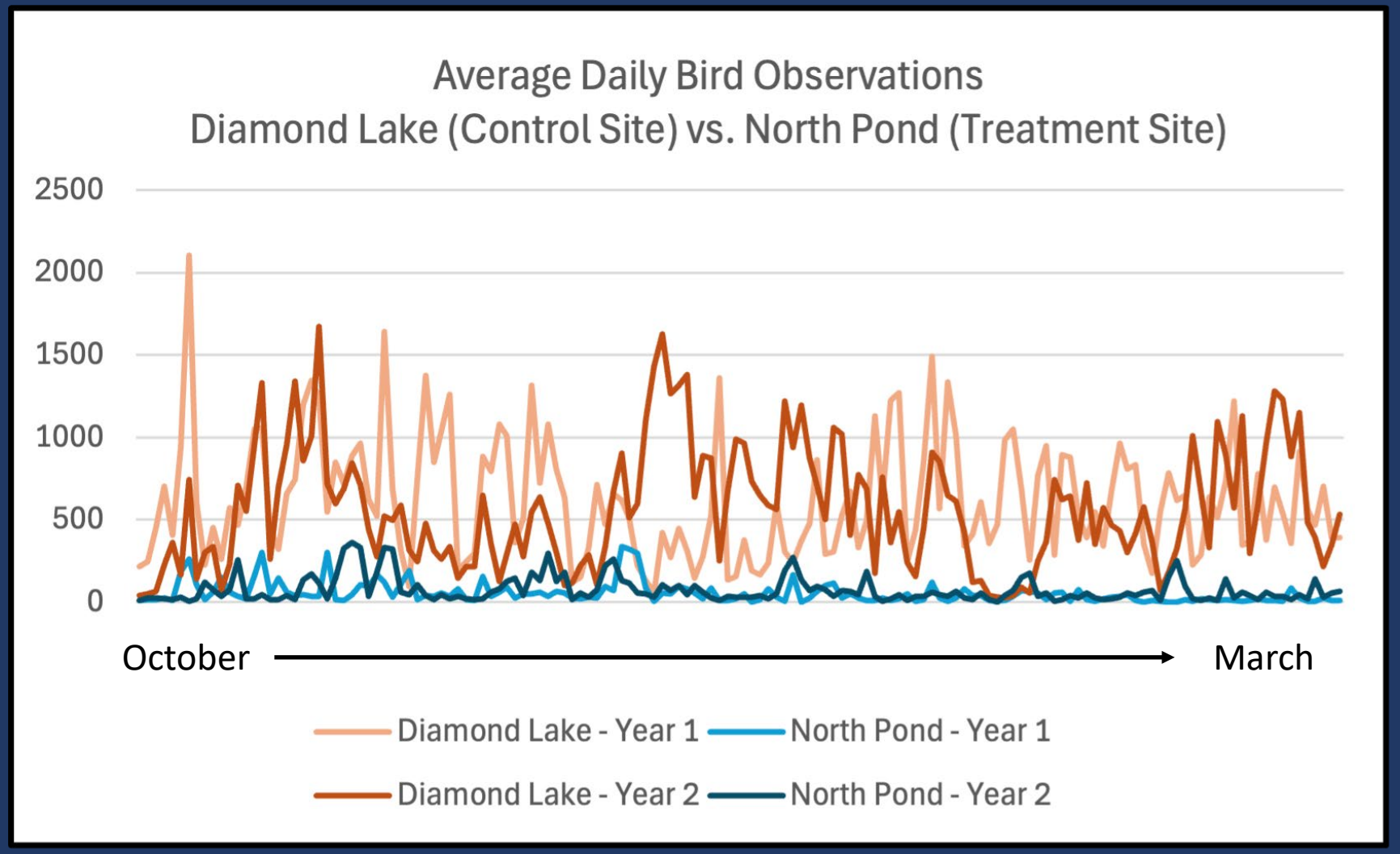

Assessing Efficacy of Acoustic Deterrent

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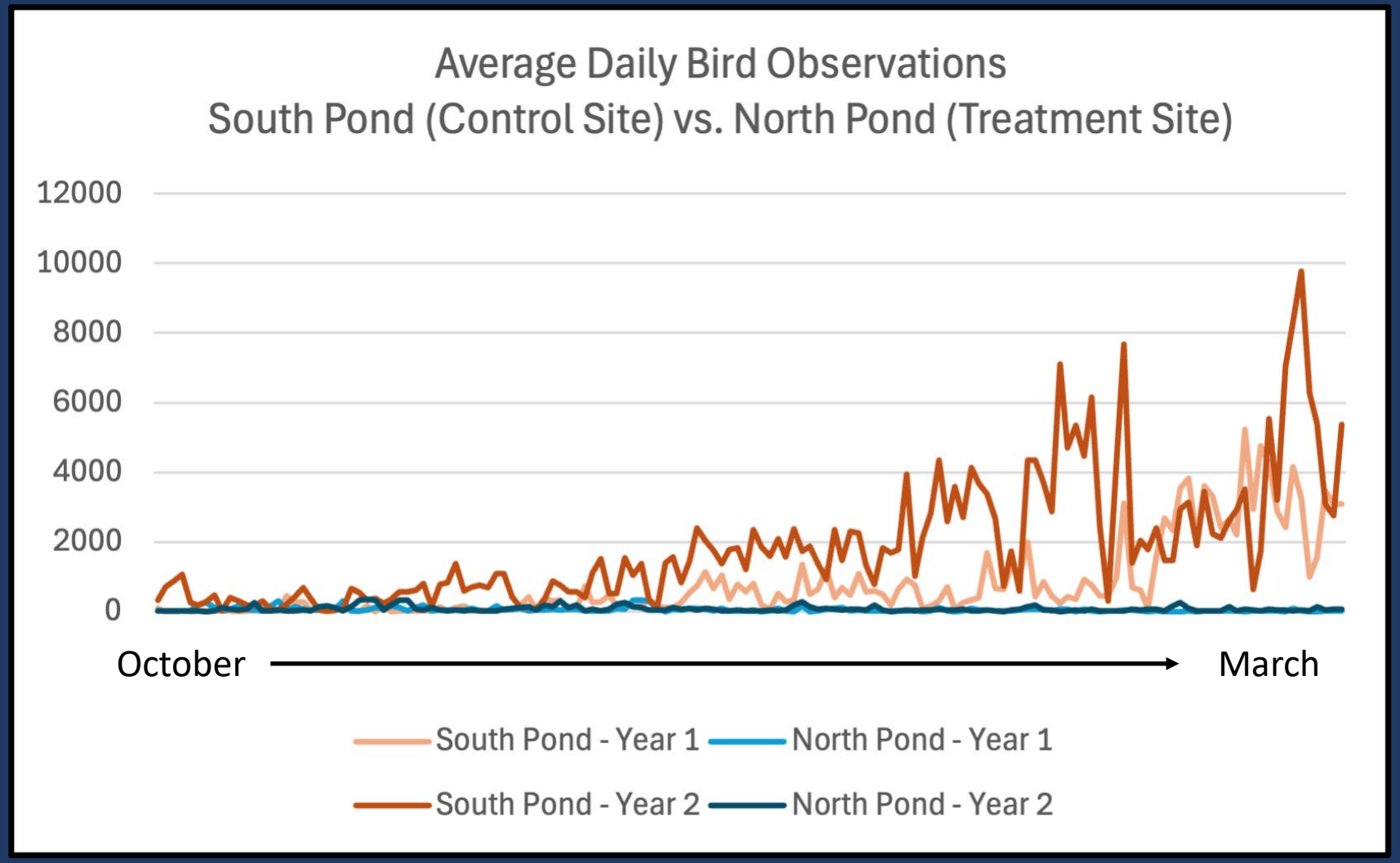

Assessing Efficacy of Acoustic Deterrent

Camera Trap Monitoring Results

Year One
(2022 -2023)

Site Comparisons	Control Site Daily Bird Observations mean ± *SD*	Acoustic Deterrent Site Daily Bird Observations mean ± *SD*	P[a]
Penny Lake vs. North Pond	1149.9 ± 711.6	53.6 ± 66.3	< .00001
South Pond vs. North Pond	788.8 ± 1119.2	53.6 ± 66.3	< .00001
Diamond Lake vs. North Pond	621.4 ± 362.7	53.6 ± 66.3	< .00001

[a] Results of Mann-Whitney tests.

Year Two
(2023 -2024)

Site Comparisons	Control Site Daily Bird Observations mean ± *SD*	Acoustic Deterrent Site Daily Bird Observations mean ± *SD*	P[a]
Penny Lake vs. North Pond	712.2 ± 407.6	73.7 ± 78.2	< .00001
South Pond vs. North Pond	1867 ± 1838	73.7 ± 78.2	< .00001
Diamond Lake vs. North Pond	566.1 ± 370.2	73.7 ± 78.2	< .00001

[a] Results of Mann-Whitney tests.

Next Steps

- Re-Deployment in 2024 (October)
- Continue Monitoring with camera traps 2024-2025
- New monitoring to determine sound levels at edge of treatment areas
- System Improvements
  - Computer system in firmware and hardware
  - Power system (e.g., remotely operated safety breakers)
  - Audio system
    - Fewer rafts with same ensonified area or greater
    - Iterative sound file improvement through updated literature review
  - Raft system
    - Paced replacement of older rafts with aluminum-framed rafts
    - Improved moorings

Other Applications

Large body communi-cative birds + Attracting habitats + No adjacent residential commercial recreational = Good application scenario

Issues to address

- ESA consultations
- Seasonal deployment scenarios
- Scheduling maintenance visits
- Allowing for adaptive management
- Does deployment allow for personnel to focus interdiction in other areas?

Possible treatment areas

Summary

- Broad spectrum sound simulates noise pollution that degrades habitat
- Acoustic deterrent significantly reduced seasonal bird presence
- Allows for more focused effort for BASH crews on the flightline
- This deterrent does not affect all high-strike risk birds evenly
  - Migratory waterfowl-focused
  - Other interventions effective for kites and ospreys

Our Team

Danny Heilprin
John LaBonte, PhD
Todd Bayless
Taylor Houston

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- Mr. Paul Block, CNIC BASH Program Ecologist / COR NAVFAC Atlantic
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  - Mr. Peter Magolske, Environmental Division Director
  - Ms. Yasue Fuki, Environmental, NR/CR Manager
  - Mr. Vincent Engle, Airfield Manager
  - Mr. Jerron Johnson, Deputy Airfield Manager
  - Mr. Ed Hosack, BASH Supervisor
- Past MCAS Iwakuni Airfield Personnel
  - Mr. Chad Schuch, Airfield Manager
  - Mr. DeMarco Harris, Environmental Division Director
  - Mr. Paul Edlund, BASH Supervisor
- ***ALL MCAS IWAKUNI BASH TEAM MEMBERS!***

QUESTIONS?

Taylor Houston* Todd Bayless

*contact: Taylor.Houston@mantech.com / 512-299-0609

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BACKUP SLIDES

Assessing Efficacy of Acoustic Deterrent

Camera Trap Monitoring

SYSTEM DEPLOYMENT

MONITORING

Improved System Deployment at North Retention Pond

Initial System Deployment

Operational Period 1

Operational Period 2

Operational Period 3

Operational Period 4

COVID shutdown / System redesign & improvements

Typhoon Demob

Typhoon Demob

Typhoon Demob

July 2016

July 2019

March 2020

October 2021

May 2022

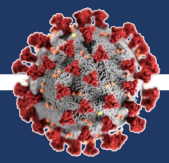
October 2022

May 2023

October 2023

May 2024

October 2024



Surveys supporting MCASI WHA Development

COVID shutdown / Design of systematic monitoring regime

Typhoon Demob

Typhoon Demob

Typhoon Demob

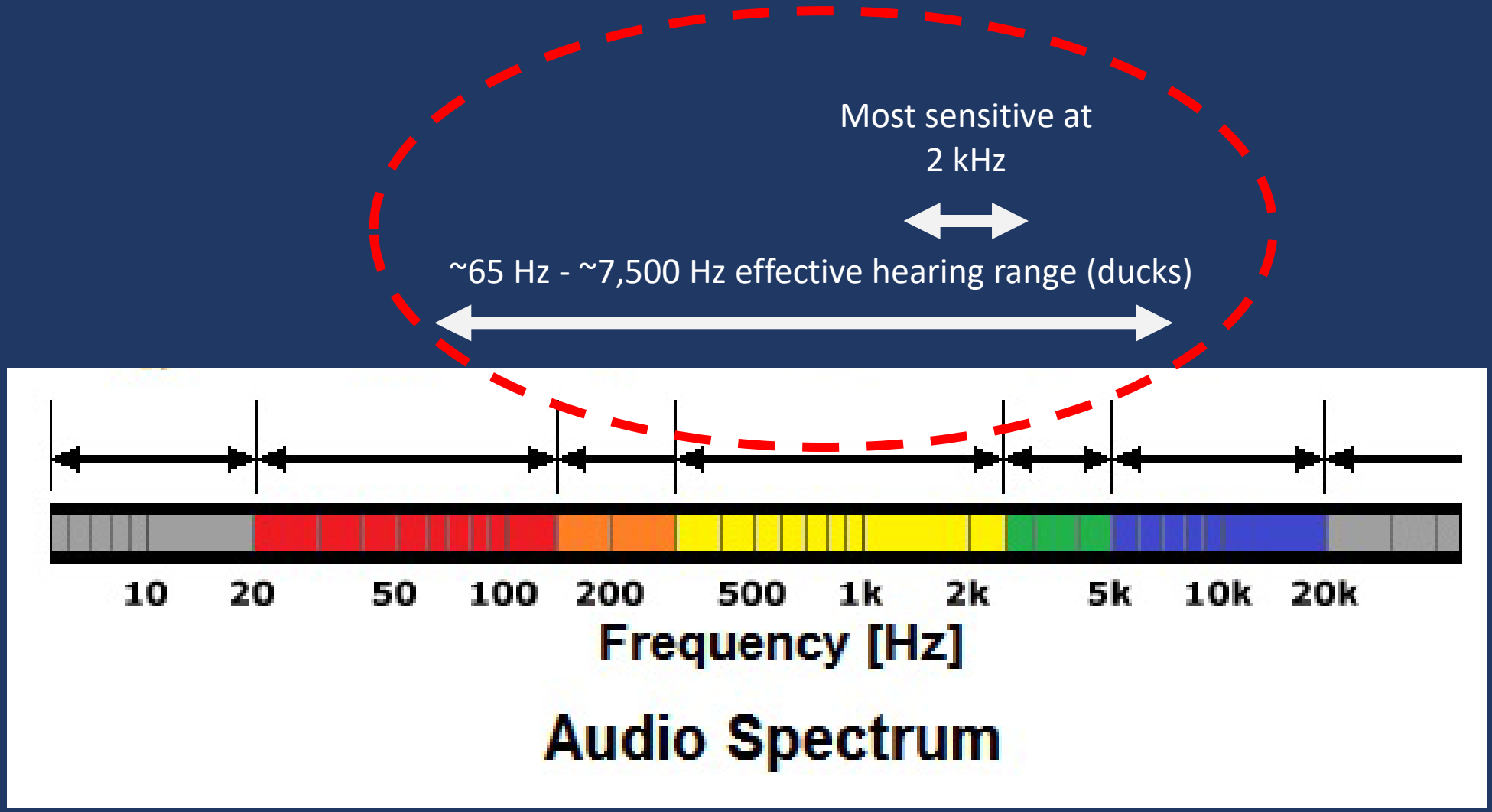
Monthly Bird Counts + Limited Camera Trapping

Systematic Camera Trap Protocols: Fixed Point Camera Traps at North Retention Pond, Penny Lake, Diamond Lake, & South Pond

Design Criteria for a Masking Acoustic Deterrent at North Retention Pond, MCAS Iwakuni Japan

Requirement	Solution
Ensonify an area at least 100 dB at source and 60 dB at edge of treatment area	Two 4x100W amplifiers to drive 8 speakers/system (OTS)
Sound file to cover effective hearing ranges for target bird guilds	Literature review to design sound files for target bird guilds (IP)
Power system designed to sustain system for 18 hours/day over 5 months	>420W PV panel, 24 V 100 Ah battery bank, MPPT charge controller
Push sound at shorelines, not away from shorelines	Raft-based system to mount computer, audio, and power systems

Sound File Design



Hill, E.M. Audiogram of the mallard duck (*Anas platyrhynchos*) from 16 Hz to 9 kHz. *J Comp Physiol A* **203**, 929–934 (2017). https://doi.org/10.1007/s00359-017-1204-6