U.S. Department of Homeland Security
Centers of Excellence Summit
University research and workforce development for a safe and secure Homeland

Construction and Testing of an Electronic Avian Deterrent Device (E.A.D.D.) for Catfish Farms Impacted by Flooding

Student Name(s): Kaldrian Moore Jr, Desiree Mills, Romans Grant, Zachary Dixon
Research Mentor(s) Dr. Scoty Hearst, Dr. Meherun Laiju, Dr. Santanu Banerjee

COASTAL RESILIENCE CENTER
A U.S. Department of Homeland Security Center of Excellence

Homeland Security Challenge

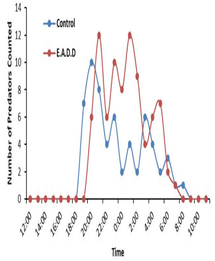
Natural disasters such as wildfires, earthquakes, flooding, and extreme weather are on the rise worldwide. Flooding has become a major problem for Mississippians in the past few years, especially for the Mississippi catfish farmer. Mississippi is the nation's largest catfish producer, producing 60% of the catfish on the market today. The Mississippi Delta was hit hard with around 200,000 acres impacted by flooding in June of 2019. Farmland and catfish farms were underwater destroying vital crop production of corn, soybean, and cotton as well as catfish operations. Although the flood waters have receded, new problems have emerged making recovery from the flooding disaster more difficult for catfish farmers. A new aquatic habitat produced by flooding attracted more avian pests to the Mississippi Delta region, that now have made Mississippi catfish farms a regular food stop along their yearly migration. This increase in avian pest activity has left catfish farmers and their crops vulnerable causing a huge financial burden to farmers and the catfish industry as a whole. As a result catfish farmers have had to increase the use of butane cannons, bangers, poppers, and other deterrents to maintain fish production. To help reduce this burden, we have built an electronic avian deterrent device (E.A.D.D.), that would be a more long-term and sustainable solution to the avian pest problems harming catfish farmers recovering from the recent flooding disaster. Here, we detail the construction and field testing of our E.A.D.D. prototype at a catfish farm in the Mississippi Delta. We created over 21 unique bird deterrent sounds and tested their efficiency in deterring wading birds such as Egrets and Herons away from catfish ponds. We used the most efficient deterrents in our E.AD.D. and examined changes in bird activity at the catfish farm site over a 26 day survey period. Overall, we found that the use of our E.A.D.D. significantly reduced the number of avian pests inhabiting the catfish farm, and was more effective than the current deterrent methods. The E.A.D.D. significantly reduced the number of avian pests from over 900 birds down to less than 200 birds. This data validates further study into the unique spectral properties of the sounds that deterred birds most efficiently. With further research and development, we suggest that our prototype E.A.D.D. could ideally be use to create a non-lethal bird deterrent useful for reducing catfish predication from wading birds on catfish farms and ultimately improve crop yields for catfish farmers impacted by flood related avian pests.

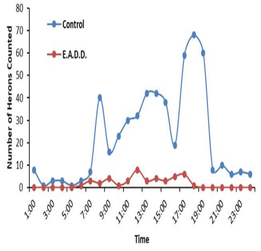
Approach / Methodology

Electronic Avian Deterrent Device Prototype Construction: We assembled a waterproof control box containing an mp3 soundboard equipped with outdoor speakers and a 100 watt amplifier to operate on a 12volt dc battery system powered by an automobile. Audio recordings of high pitch frequencies and avian predatory sounds were recorded on an SD memory card to play through the soundboard on a random and continuous loop pattern. We compare this to a commercial piezo speaker product used to deter birds and other animals using a sound level meter.

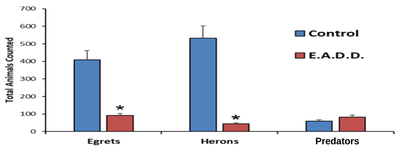
Field Testing the Electronic Avian Deterrent Device Prototype: The portable Electronic Avian Deterrent Device was placed on a farm vehicle and tested at a catfish pond in Humphreys County, MS, where high predatory bird activity is common. In the first phase of testing, we compared over 20 different sound files played in the E.A.D.D. over 3 trial periods to determine which sounds most effectively deterred birds. Birds that heard the sound and flew away were counted as deterred. Birds that did not fly away were counted as undeterred. The total birds was the sum of both deterred and undeterred birds counted when the sounds was played through the E.A.D.D. The percentage of deterred birds was calculated from the total and averaged over 3 separate trials over 3 days. The most effective sounds were then used in the final stage of testing. In the final stage of testing, the effects on bird and other predator activity were recorded using 3 wildlife cameras stations around the catfish pond for 26 days. In the first 13 days, the device was not used and the farming assistances patrolled the ponds from 9 am to 5 pm and deterred birds using normal deterrent methods such as butane cannons, bangers, and poppers. This data was used to record the normal or Control bird activity without the device. During the last 13 days, the E.A.D.D was activated by the farming assistants in their mobile vehicle as they patrolled the farm and used the machine to deter birds from 9 am to 5 pm. The number of birds feeding in the catfish pond was recorded by the wildlife cameras and the birds and other predators were assessed by number, by time of day, and as Control or with E.A.D.D. The catfish farming assistants did not change any other behavior during the 26 day survey and were completely unbiased. They were only encouraged to use the E.A.D.D. during the last 13 days as opposed to normal deterrent methods such as butane cannons, bangers, and poppers. The total number of birds and predators were assessed during the two trial periods by examining the photos collected by the wildlife cameras. These numbers were obtained by multiple observers analyzing the image data and were used to calculated statistical significance. Statistics were taken using the students t-test where $p<0.05$ is significant.

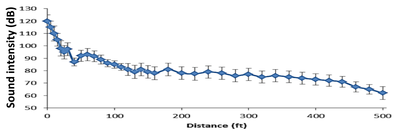
Outcomes / Results





Shown on the left are the avian pests consuming catfish. Egrets (white birds) and Herons (grey birds) were often seen consuming fish in large numbers under Control conditions. Shown are the nocturnal predators consuming catfish. We captured many images of coyotes, raccoons, otters, and skunks inhabiting the catfish farms after sundown. Shown on the right are two graphs that display nocturnal predators activity over time as compared to the Control conditions, as well as heron activity over time during the day. Nocturnal predators were not significantly reduced since the E.A.D.D was only employed during daytime, resulting in this graph being considered as somewhat inconsequential. On the other hand, heron activity was significantly reduced with usage of the E.A.D.D. Shown on the bottom left is a graph that displays graphical data of the Mean ± Stdev total number of animals counted during the survey period under Control conditions or when the E.A.D.D was used as a deterrent. Overall, the E.A.D.D. significantly reduced the number of avian pests as compared to the Control. Shown on the lower right is the graph displaying the 30 watt horn speakers which was shown to have a maximum of 120 dB and lost 50% Sound Intensity at around 500 ft. After observing that the 30 watt horn speakers were far more powerful that its counterpart, we used it to construct our E.A.D.D





References

1. Glahn, James E., David S. Reinhold, and Patrick Smith. "Wading bird depredations on channel catfish Ictalurus punctatus in northwest Mississippi." ***Journal of the World Aquaculture Society* 30, no. 1 (1999): 107-114.**

2. Glahn, James F., and D. Tommy King. "16 Bird depredation." In ***Developments in aquaculture and fisheries science*, vol. 34, pp. 503-529. Elsevier, 2004.**

3. Avery, J. "Mississippi catfish are going to the birds". ***MSU Extension Outdoors. May 2018.***

4. Burr, P., J. Avery, G. Street, B. Strickland, and B. Dorr. "Fish-eating Birds on Catfish Ponds in the Mississippi Delta." ***Mississippi State University Extension Service Publication (2020) 3482.***

5. Zhu, Alissa. "Everything is underwater. Floods claim homes, farms, livelihoods. Recovery years away." ***Mississippi Clarion Ledger. May 2019.***

Conclusions

In this study, we detail the construction and field testing of an E.A.D.D. prototype to assist catfish farmers in the Mississippi Delta recovering from flood related avian pests. We created over 21 unique bird deterrent sounds and tested their efficiency in deterring wading birds such as Egrets and Herons away from catfish ponds. We used the most efficient deterrents in our E.AD.D. and examined changes in bird activity at the catfish farm site over a 26 day survey period. Overall, we found that the use of our E.A.D.D. significantly reduced the number of avian pests inhabiting the catfish farm, and was more effective than the current deterrent methods. The E.A.D.D. significantly reduced the number of avian pests from over 900 birds down to less than 200 birds. This data validates further study into the unique spectral properties of the sounds that deterred birds most efficiently. With further research and development, we suggest that our prototype E.A.D.D. could ideally be used to create a non-lethal bird deterrent useful for reducing catfish predication from wading birds on catfish farms and ultimately improve crop yields for catfish farmers impacted by flood related avian pests.

Acknowledgements

This material is based upon work supported by the U.S. Department of Homeland Security under Grant Award Number 2015-ST-061-ND0001-01. The views and conclusions contained herein are those of the authors and should not be interpreted as necessarily representing the official policies, either expressed or implied, of the U.S Department of Homeland Security.