IMLS Sparks! Ignition Grant for Museums and Libraries White Paper

1. **Administrative Information**
   - Grant Award: MG-45-15-0029-15
   - Institution: National Audubon Society
   - Project Name: Integrating Mapping Technology into Environmental Education Programs
   - Amount Awarded: $25,000
   - Project Dates: October 1, 2015 – Sept. 30, 2017 (1 yr. extension granted)
   - Project Director: Doreen Whitley-Rogers, Geospatial Information Officer, NAS (no longer employed by NAS)

2. **Project Summary (Need or challenge, activities developed to meet need)**

Figure 1 Using the Collector app on tablet to gather nest box data

Our project, entitled "Integrating Mapping into Environmental Education Programs," recognizes the lack of use of technology in non-formal education programs offered by nature centers, as well as museums and other interpretive sites, as a universal problem for these providers. There are currently 41 nature centers within the Audubon network, so the organization has an interest in implementing best environmental education (EE) practices and sharing successes with other conservation-oriented institutions in order to help create a more environmentally literate population. As experts in both environmental education and Geographic Information System (GIS) applications, our aim is to break down this technology barrier by creating a simple, replicable process for incorporating GIS-based activities into nature center programming. This pilot project was executed at the Wildcat Glades Conservation & Audubon

Figure 2 Students identify macroinvertebrates they collect from Shoal Creek in order to create a water quality rating score based on their sensitivity to pollution.

Center (WGCAC) in Joplin, Missouri. The GIS technology used is ArcGISonline (AGOL), a web based part of the Environmental Systems Research Institute (Esri) GIS platform, now available for free to all schools in the United States.

Because nature center "collections" often consist of natural areas that in most instances cover many acres of ground, they are uniquely suited to the use of GIS mapping as a technological tool. Those centers that can use this tool, and can facilitate its use among the schools that visit, will both build their clientele and help those visitors carry their nature center experience back into the classroom. The people at Esri recognize the power of centers to make their technology come alive with rich spatial content for students and teachers, and for this reason agreed to partner with the National Audubon Society, and is assisting in the advertisement of an E-book we have created for those in the non-formal education field. It is hoped that this E-book may provide a framework for other interpretive sites to implement similar projects utilizing the mapping technology and accessibility found within AGOL with their clientele, primarily school children visiting their sites. There is also the potential to digitally connect with new audiences that are unable to visit in person, but can still learn about various ecosystems and the "collections" of organisms found there and the relationships we humans have with them.
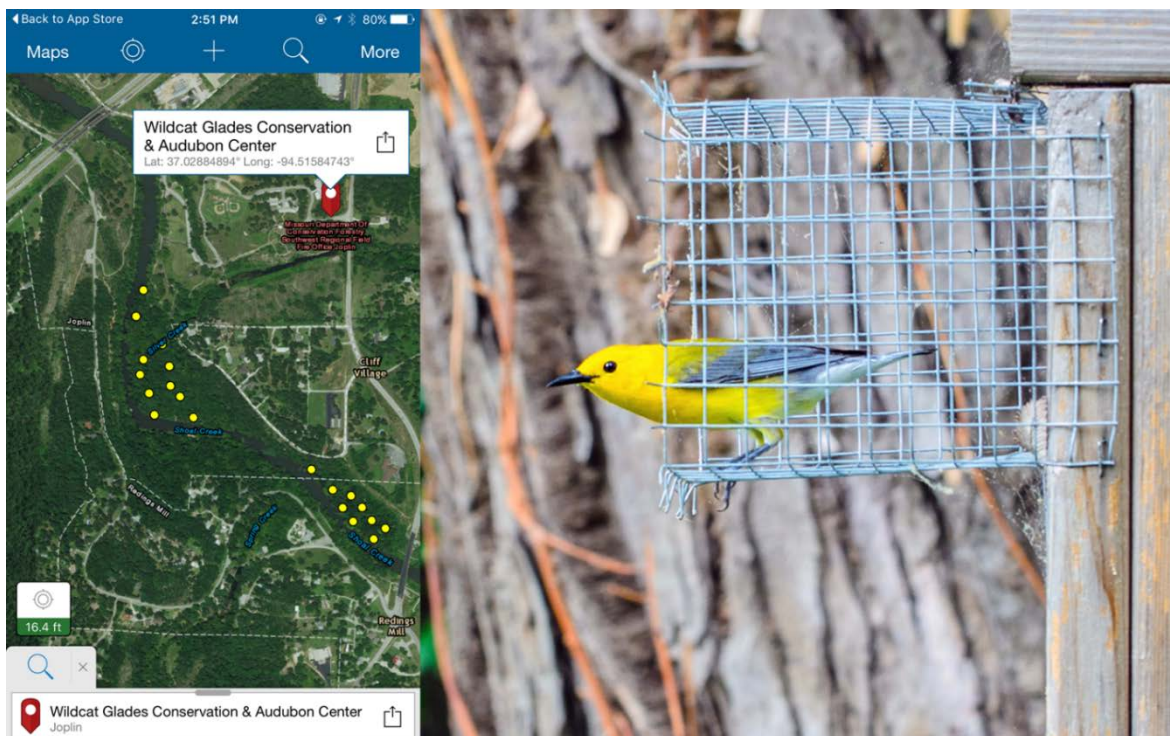

Figure 3 AGOL map of Prothonotary Warbler nest box locations in Wildcat Park and male warbler on box

3. **Process (How did you accomplish your work?)**

We began in the proposal stage with an analysis of WCGAC's existing environmental education programs, current science curriculum within the local schools, and the intersections between them, along with new opportunities to integrate spatial problem-solving and geography for students. We believe this initial action was critical for our

success, and should be thoroughly researched by other centers who wish to conduct a similar project. This project was conducted through a partnership with 7th grade science teachers from Joplin Middle Schools, staff and volunteers from WGCAC including a paid GIS intern, and staff from Audubon's centralized GIS team. The education staff at Esri also assisted with editing and publishing the E-book, our main deliverable for the grant. The Geospatial Information Officer for NAS was the author of the book. Other deliverables including the program outline and support materials were created by the education staff at WGCAC, the GIS intern, and NAS GIS staff.

After identifying our existing program about water and aquatic ecosystems as the target, we adapted the program outline to include the ArcGIS technology and activities and created some new mapping activities including pre and post-trip classroom modules for the 7th grade science teachers. We also created stand-alone modules for 6th and 8th grade science teachers to use in their curriculum hoping that these teachers would also begin utilizing AGOL as a teaching tool. We conducted a half-day teacher training with 15 Joplin middle school and high school teachers from various subject areas including history, math, and social studies about AGOL, and later did a one-day training with five 7th grade science teachers from the 3 middle schools participating in the aquatic ecosystem field trip. We scheduled field trips with the teachers and visited each of their classes about the trip and introduced them to the technology used. We then conducted 7 field trips for 313 students and attempted to evaluate the student's performance in their small work groups. Student's data was shared on Google Drive so that it was available after the trip for review or further lessons in the classroom. We also conducted a teacher evaluation of the entire experience in order to improve the program.

Following this implementation stage, we began the process of writing the E-book. This resource is available to anyone, but would be especially useful to nature centers and other non-formal education institutions. We presented the results of this project to other environmental educators, interpreters, and Nature Center administrators on three different occasions including the North American Association of Environmental Educators annual conference (October, 2016), the National Association for Interpretation annual workshop (November, 2016), and a webinar for Audubon Nature Center Directors (July, 2017). It is hoped that these presentations will help start a group that is interested in integrating mapping technology such as ArcGIS into their environmental education programs.

Resources Needed (financial, mgmt., human):

- A GIS intern, made possible with funding from the grant, was critical to the success of the project.
- Technical and logistic support and expertise from NAS allowing their Geospatial Information Officer and staff to assist with the project with no direct compensation to their department was also necessary for our success.
- Within the Audubon network, the WINGS internship program helped us advertise the GIS intern position and secure interviews with candidates.

- The ability to contract with PEER Associates for help with student evaluations was very valuable. This expertise was not readily available within the Audubon organization, but they have a long relationship with PEER in assisting with evaluations for grants and other projects.
- The support from Esri (creator of the ArcGIS software) with free software use by the schools and advertising the E-book was also essential to the project's success.
- Within our Audubon Center, other staff assisted in management of the grant including the Center Director who managed the finances and the Development Associate who assisted with writing and filing reports for IMLS.

Organizational or Policy Changes Necessary:

No organizational or policy changes were required to complete this project. However, this was the first time a paid intern was available to assist the WGCAC staff in implementing our environmental education goals, and due to the success with this intern we hope to seek out future paid internships whenever possible through grants or other means.

Mid-course Corrections:

- At the request of the school administration, we added an additional teacher workshop to train teachers from other disciplines besides science to try and integrate the technology use across several curricula, including math, social science, and language or communication arts.
- We added a visit to the classroom before the field trip so the GIS intern could familiarize students with the tablets and software.
- At the request of teachers, we added a pre and post-trip lesson plan to better prepare the students and extend the learning into the classroom.
- We realized after beginning the project that we would not have adequate funding for much contract work with PEER towards our evaluation process or for implementing Redmine or similar software to help us evaluate student performance in the field with the devices. We were able to get some assistance with PEER thanks to their generosity with their time and some existing evaluation tools they had helped create for another project.

4. **Project Results (What did you learn?)**

Due to limited staffing and expertise, we need more staff/volunteer help at our site with experience using GIS technology and managing tablets. This may be possible with future student volunteers or interns from local colleges or other sites.

Non-formal educators and interpreters should carefully choose schools to pilot the program with and have a good working relationship and commitment from them to ensure longevity of similar projects. If the interpretive site normally charges a program

fee, it would be helpful to have school funding already secured or waive the fee, depending on the audience and the demographics of the region.

Don't try to teach too much about AGOL to the teachers and manage their expectations. It's not practical in a short timeframe. Focus on preparing for the field trip, but suggest other opportunities where they can learn more on-line with Esri or at local colleges.

Some teachers felt that the classroom modules created by Esri and available online had poorly written instructions and would be difficult for their students to follow. Perhaps Esri could rewrite those instructions to be more understandable for seventh graders.

Students were excited to use the technology in the field and were successful at using the app and software on the tablets. It made the subject more interesting for them since the majority like using technology. Only a couple of students were hesitant about using the tablets.

Teachers liked how the students were engaged in the field trip with the technology while also learning about water in their science curriculum. However when we tried to do the same thing the following year without the grant funding to cover the field trip costs (bus transportation and program fee of $4 per child), they instead went on a different field trip which was free. Several had expressed concerns that they had students who couldn't afford the $4 fee, and the school does not budget to provide the student fee. If it had been free again, they most likely would have continued. Prior to this grant, we had another grant to cover the cost of a non-point source water pollution-themed program for 3 years and worked with the same schools and the 6th grade teachers to bring students on a field trip. At that time water was in the 6th grade science curriculum instead of the 7th grade curriculum. This previous project was very successful and well received by students and teachers.

What were the results?

Date:_____   Group:_____   Evaluator:_____

Checklist for Assessing Group GIS Activity & Field Skills

GIS/Field Skill	Yes (1)	No (0)
1. Using the My location tool (blue dot that moves) to navigate to data points for nest boxes that are already on the map	❏	❏
2. Choose correct layer (Nest Box, PROW, or Other Species) to collect data point	❏	❏
3. Add a data point to the map and fill in the attributes	❏	❏
4. Add an attachment (photo) to a data point	❏	❏
5. Use densiometer correctly to measure canopy cover	❏	❏
TOTAL SCORE (Out of 5 possible): _____		

Group Results and Conclusion Evaluation Rubric

	Excellent (4 pts)	Proficient (3 pts)	Developing (2 pts)	Needs Attention (1 pt)	Points Earned	Comments
RESULTS	Results are clearly explained in a comprehensive level of detail.	Results are explained, but not as clearly, level of detail not as sufficient.	Results are not very clearly explained, level of detail insufficient.	Results are not clearly explained, level of detail is severely insufficient.		
CONCLUSION	Interpretation of results is thoughtful and insightful, and informed by results.	Interpretation of results is sufficient, and less informed by results.	Interpretation of results is lacking in insight and not clearly informed by results.	Interpretation of results is incorrect, or not at all informed by results.		
				TOTAL SCORE: (Out of 8 possible)		

Average Scores of Each Middle School
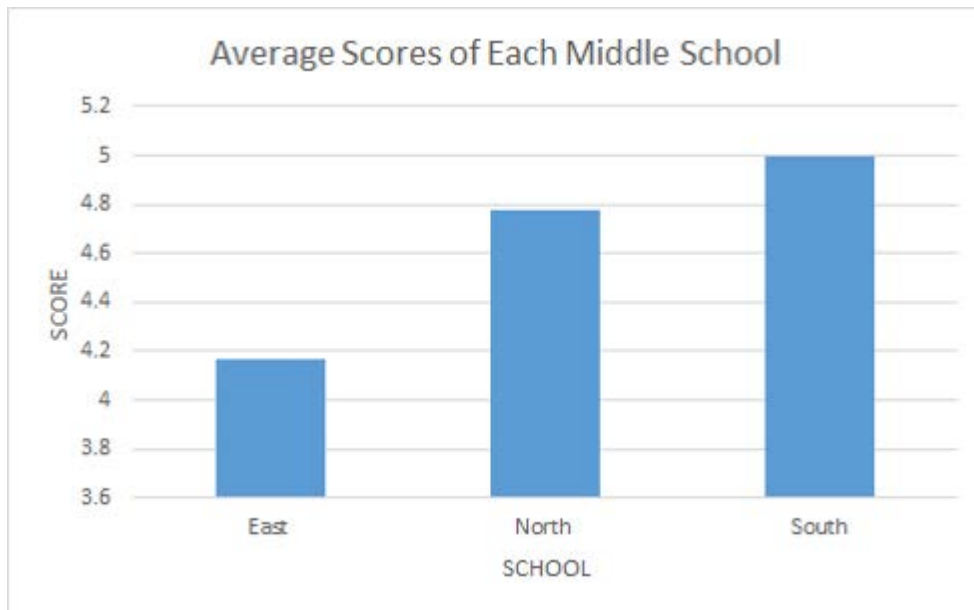
Following are some evaluations of the program itself from teachers, students, Center staff and volunteers, as well as attendees at a professional conference where we presented a session about the project:

Teachers:

Teachers were sent written evaluation forms for the two training presentations conducted prior to the field trips, as well as after the students visited the site. Verbal feedback was very positive overall, as well as the written evaluations. However, upon trying to get them to repeat the program for a second year, none of the teachers responded to e-mails sent to them on two different occasions. One school teacher finally responded and said they scheduled a different field trip with another site instead, which supposedly involved fewer logistics. The teacher indicated that they were interested, but due to staff and administrative turnover at that school, she felt that it would be too difficult logistically to do it again this year.

The other factor that may have prevented return visits is that the field trip was no longer free due to the grant expiring. The grant also covered the cost of substitute teachers and transportation. Prior to starting the grant several teachers had expressed concern whether they could participate if it was not free. In the e-mail sent the second year, it was stated that if cost was an issue they should let us know so that we could try to work out a solution by seeking a donor to underwrite the cost. Still, none of the teachers replied. We hope to work with new school administrators and teachers in the future, possibly from different schools, to bring them back out and continue this program.

We, as well as the teachers themselves, believe they need additional training and support in order to fully utilize the software. With limited time and resources we were unable to provide this to the teachers. All the 7th grade science teachers saw the potential for using the technology to help teach their curriculum, but some wanted more specific examples of how to use this in the classroom given to them. With their limited time, we believe new information must be delivered in the simplest and most efficient way possible. Some seemed unwilling to dedicate additional time on their own to make the connections between the technology and their curriculum.

Written teacher evaluations:

Feb. 19, 2016 general training workshop on AGOL for any middle school or high school teacher: We received 4 responses out of 15 that attended. All were positive except one that felt that the workshop was not what they were expecting. They were expecting the workshop to focus more on science content, rather than using

AGOL. Other comments involved some difficulty in navigating through the existing on-line Esri modules for students in various subject areas.

Mar. 28, 2016 training workshop for 7th grade science teachers attending the field trip: We received 2 responses out of 6 that attended. Both were very positive overall. They felt that it prepared them well for the field trip experience with students later in May.

May, 2016 field trip programs: We received 1 response out of 6 from a teacher that was moving to a different school district, but overall very positive. They suggested entering some practice data with the Collector app during the pre-trip classroom visit for additional exposure to the tablets and software.

Students:

Most students were overheard making positive comments about the experience, although nothing was written. We would recommend seeking more student input in the future, even if it is a verbal survey, which should probably be done individually so as to not inhibit truthful responses due to peer pressure. Time constraints already kept us very busy just trying to complete the program, let alone attempt more evaluation. Due to the programs being conducted one to two weeks before the end of the school year, there was no time for teachers to use the post-trip materials we created, which would have also helped us evaluate what the students learned.

Center Staff/GIS Intern/Volunteers:

Anecdotal observations were made that students seemed engaged and enjoyed the activities and the tablets overall. The evaluation tool created for leaders to use in the field indicated that most students were able to successfully use the technology to collect data to add to the map using the Collector app. The logistics of conducting the activities with students and trying to complete the tool in the field was somewhat challenging, therefore, not very many forms were completed by the Center staff and intern. Some were filled out after the activities were completed and the students had left the site. We would have been able to measure student achievement more accurately had we been able to utilize Redmine or other software that automatically evaluates student success in using AGOL in the field. This was in our original proposal, but we found that we did not have adequate funding or time to incorporate this in the project.

We also recommend the field trip be allotted more time than 2 to 2.5 hours and to have smaller groups. Some groups had as many as ten students, mainly because schools wanted to bring the maximum number allowed, 60, at one time. We tried

to make sure all students had the opportunity to use the tablets and collect at least one point on the map. Some students were reluctant to use the tablets, and some expressed a fear of "messing up", so maybe they need more time with the devices prior to the field trip. We did visit each school to introduce the tablets and software before their trip.

Most volunteers were retired individuals where were less tech savvy and were apprehensive about using the technology with the tablets in the field. We did provide training for them, and several felt better afterwards. Others remained apprehensive through the experience, which could have translated to the students depending on the volunteer's comments and non-verbal actions.

Evaluations from Conference Participants on Presentation of the Project:
From our presentation at the National Association for Interpretation workshop we received 4 evaluations from 15 participants. On a scale of 1-5 on all questions rating the presentation, with one being the highest, we received all ones except for one two. The two was on a question regarding whether the participant got new ideas or learned useful tools or techniques. Evaluations were not given to the participants at the NAAEE conference where we presented a session. Apparently they don't evaluate presenters at this conference.

Next steps?

Our next steps include continuing to work with the Audubon Enterprise GIS and Esri staff on developing a network of other nature centers and interpretive sites to implement our process and possibly join a collaborative project working with PROWs and aquatic ecosystems. We currently have 4 sites, 2 from within the Audubon network and 2 from outside the network, which have expressed interest in such a project.

We also hope to help schools secure funding to continue participating in this modified aquatic ecosystem field trip, possibly seeking donations from technology companies and other grants to help cover the cost of the program so that students do not have to pay.

Recommendations for the field?

We have several recommendations for those in the non-formal education field, such as nature centers, museums, or other interpretive sites. If your site lacks staff or volunteers with expertise in GIS, we recommend seeking out a local college student familiar with GIS and other computer technology to assist in starting the program and helping others to learn how to use it.

We also recommend trying to conduct the field trips before the last weeks of the school year. We were constrained mainly by the state testing schedule with our schools which left only the last 2 weeks of the school year for them to visit us. As a result, the teachers did not have time to utilize the post-trip lessons we created and we also had difficulty getting evaluations from the teachers. Another issue for this project was the fact that the

Prothonotary Warblers do not return to our area until mid-April, and some have only begun building nests in the next boxes students monitor around the first part of May. Schools here normally begin their summer break around mid-May, so this leaves little room to conduct the field trips at the optimum time, not to mention the possibility of cancellations due to weather.

It would be extremely beneficial to allow additional time for the field trip to avoid hurrying to finish and running out of time. We did not have time to do a summary with the students at the end of the field trip or conduct many student evaluations in the field. A minimum length of about 3 hours is recommended. We were limited to getting 2 groups of about 60 students each through the entire field trip, once in the morning and again in the afternoon. Schools often were late arriving and we would have to finish the trip within about 2 hours.

Make sure your school is fully committed to the project and will make an attempt to utilize the AGOL software in the classroom after the trip. Perhaps try and integrate more staff time in the classroom with the teachers and students before and after the field trip, like a mentor, so they feel more confident using the software. If your staff don't have the confidence or expertise they need, secure a local professional with GIS skills to assist them.

5. **Resources/Appendices (including web links and references)**

Esri:

ConnectEd Program: http://www.esri.com/connected

ArcGIS Online: http://www.arcgis.com

Story Maps: http://storymaps.arcgis.com

Collector for ArcGIS field app: http://doc.arcgis.com/en/collector/

Survey 123 Field App: http://survey123.arcgis.com/

Audubon materials:

Program outline and other docs: http://wildcatglades.audubon.org/programs/just-teachers

Planning worksheet: http://www.gis.audubon.org/EE/planning.pdf

Wildcat Glades Conservation & Audubon Center Case Study: http://www.gis.audubon.org/EE/casestudy.pdf

Wildcat Glades Geo-Inquiry: http://www.gis.audubon.org/EE/geoinquiry.pdf

Wildcat Glades Program evaluation: http://www.gis.audubon.org/EE/eval.pdf

Wildcat Glades Field Trip Schedule: http://www.gis.auduobn.org/EE/schedule.pdf