Sea Duck Joint Venture – Project # 147

Annual Project Summary
FY 2015 – (October 1, 2014 to Sept 30, 2015)

Project Title: Using crowdsourcing to interpret digital imagery from aerial sea duck surveys.

Principal Investigator(s):
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Project Description:

This project developed an experimental crowdsourcing site to review aerial sea duck survey photographs. The project team worked with DiscoverLife to load photos from the Sea Duck Aerial Survey Detectability Project to DiscoverLife, create a review-and-tag process, and determine the feasibility of tagging a large number of survey images.

Objectives:

- Develop a crowdsourcing website to review photographs from recently funded SDJV detection studies and to facilitate additional, cost-effective digital imaging survey work.
- Create a validated library of images that will serve as a rich dataset for research into observation biases in sea duck surveys.
- Estimate detection and misidentification rates for both aerial and photo observers for ongoing winter sea duck surveys.
- Educate the public about sea ducks and the science used to manage these species.

Results: See attached project report.

Project Status: Completed

A CROWDSOURCING APPROACH

TO AERIAL PHOTO SURVEY ANALYSIS OF NORTH AMERICA'S WATERBIRDS

DIRECTORATE FELLOWS PROGRAM FINAL REPORT

SUMMER 2015

Shanie Gal-Edd, U.S. Fish & Wildlife Service Directorate Fellows Program

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INTRODUCTION

The U.S. Fish & Wildlife Service's Division of Migratory Bird Management, in partnership with the Atlantic Marine Assessment Program for Protected Species (AMAPPS), Washington Department of Fish & Wildlife, and the Sea Duck Joint Venture, is pioneering the use of high resolution digital imagery in conjunction with standard observer data for aerial waterbird surveys. The goals of this effort are to:

1. Collect high quality imagery along with data from aerial observers,
2. Create a working crowdsourcing infrastructure for photo survey analysis,
3. Deploy crowdsourcing for photo review and assess the value of the approach, and
4. Employ the results to adjust and correct aerial observer data,

with the ultimate goal of providing unbiased information about species distribution and abundance to aid in the conservation and management of migratory waterbirds.

To this end, the 2011-2014 Sea Duck Aerial Survey Detectability Project collected data using two observer biologists who identified and counted birds in real time, simultaneous with cameras that took continuous photos from two positions: front-facing (FF) and point-of-view (POV). POV images, which should have the same field of view as the observer biologists, will be used to evaluate the detection and misidentification rates of the observer biologists; while FF images, which record the presence of birds within the transect strip ahead of the plane, will be compared to the corresponding POV images to determine whether plane disturbance is biasing observer data (availability bias).
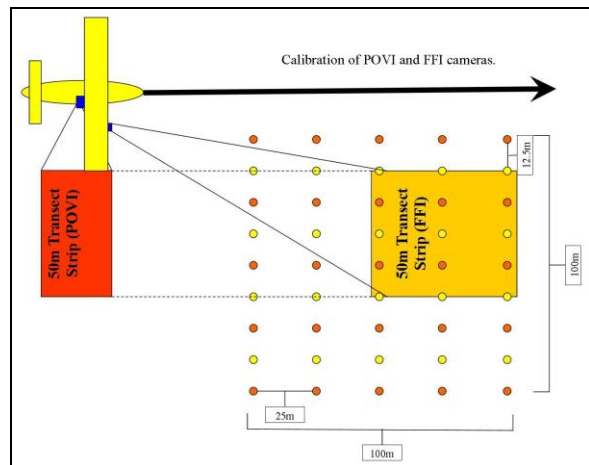

Figure 1- Observer and Camera Positions

Figure 2- FF camera captures the transect area ahead of the plane; birds will pass into the POV field of view as the plane moves forward along the transect.

With the digital imaging technology in place, the next challenge has been to create a platform with the capability to process the resulting photos quickly, inexpensively, and accurately. As

these aerial surveys have two cameras that each take multiple photos per second, hundreds of thousands of photos are generated and thousands of man-hours are required to process them (e.g., over 14 months at 40 hr/week for one survey effort).

There are a number of components to the processing of survey images. First, sort out photos containing no birds (bird negative photos). Then, for those that do contain birds: count and crop out each bird, account for redundant photos (photos containing the same birds) and match the POV and FF photos with observer data. Finally, identify each bird to species.

SECTION I: A CROWDSOURCING APPROACH TO PHOTO DETECTION

Crowdsourcing is an ideal format to analyze massive amounts of photo data that require the ability to make subtle visual distinctions beyond the current capability of computer algorithms. Via crowdsourcing, we can solicit small contributions from each of a large group of people in order to achieve a large goal, within a short timeframe, and inexpensively. Crowdsourcing has the additional benefit of doubling as outreach and community education, which is fundamental to the U.S. Fish and Wildlife Service's mission.

The challenges to any crowdsourcing project begin with making science simple enough to be conducted by a novice audience, and accessible to this audience via the internet and/or mobile applications. The project should be designed from the outset with both the user and the desired data output in mind. Methods to ensure high quality data must be built into the system and employed to evaluate incoming data at pace with data collection. Building the technology requires expertise in computer programming, web design, and data collection. Once the design and web platform is in place, the next challenge is to recruit, train, and retain volunteer users. Finally, when employing volunteer resources, it is important to consider at the outset any ethical, legal, and privacy issues that may arise.

The potential benefits of crowdsourcing are only realized if the effort is well-thought out and designed. Fortunately, crowdsourcing efforts are extensive enough that a number of best practices have been identified. Table 1 lists these for the various components of a successful crowdsourcing effort.

Table 1: Components of a successful crowdsourcing effort. These components are drawn from the Forum on Citizen Science and Earth Observations, a workshop conducted by the US Group on Earth Observations (USGEO) and the Federal Community of Practice for Crowdsourcing and Citizen Science (FCPCCS) on July 10, 2015.

Project Design	Recruiting Volunteers	Retaining Volunteers	Training Volunteers	Data Quality
User-friendly, fast. Attractive and enjoyable. Accessible by computer/phone. Rewarding. Low barrier to entry with increasing investment and reward. Saves metadata. Makes use of other projects' experience: don't reinvent the wheel!	Estimate ahead how many volunteers will be needed. Harness social media. Target your recruitment to the right audience, leverage passion and expertise, tap into the "nerdy" element. Connect the project to the core work of the agency.	Provide multiple trajectories and opportunities to volunteers: Hierarchical volunteer model. Provide incentives in the form of : • raffles & prizes • increasing status levels & badges • certifications in key skills • recognition via press, agency website, social media, etc. Keep in contact and thank the participants!	Clear instructions via video or animated tutorial. Make training quick and fun. Integrate into the user experience. Require training and/or quizzes to proceed. Evaluate volunteer performance and give feedback along the way. Provide "help desk," support, and/or a forum to discuss project with other users. Translate into multiple languages. Easily accessed via YouTube or similar.	Crowdsourcing augments but does not replace science/experts. Create pre-analyzed subset of data to be used as a training/ evaluation set. Require user registration. Weight data by user performance. Flag and block low quality users & saboteurs. Certain volunteers ascend to become leaders/reviewers/ "power users." Iterative data collection.

SECTION II: CROWDSOURCING PROJECT DESIGN

Our design for the crowdsourcing platform recognizes three phases. In Phase I, participants identify photos as bird "positive" or "negative." The goal of Phase I is to sort out the bird negative photos. False negatives must be carefully avoided, as those marked bird negative will not be reviewed in later phases. In Phase II, participants count the birds. This entails clicking on each bird, whereupon a cropped photo at maximum resolution is saved for Phase III. Phase II may need to happen in two steps: first, groups of birds will be cropped out, and later each bird within a cropped image will be counted and further cropped. In Phase III, the birds are identified to species. This requires the development of an identification guide and extensive volunteer

training. In this project, species identification will be the greatest challenge and require the most user-training materials, including, ideally, an aerial photo guide for all species that might appear in our surveys.

Phase I Challenges

Each design phase has a unique set of challenges. For Phase I, bird detection, the size of the birds and the photos are an issue: In most images, the birds are small. This makes them difficult to detect, especially on choppy water. Part of the training for this phase may need to include a quiz for visual acuity before users can proceed, and standardizing user effort per photo will be a challenge best addressed through some combination of training, data quality feedback, or iterative photo review. Still, there is the likelihood of a higher detection bias against smaller species and diving birds. A second issue is that the high volume of large, high-resolution images creates storage, display and loading difficulties. There is a tradeoff to consider between speed of photo loading and image size/quality to see and identify birds. Finally, transect lines run diagonally across the photos, and only the area within them comprises our survey region; but this presents a potentially confusing situation for the users, particularly where birds are passing into and out of the transect area.

Figure 3- Survey transect area lies in the region between the yellow lines.

Phase II Challenges

The task of phase II, bird counting, is surprisingly complex. The biggest challenge in producing useful data from this phase is managing the information from multiple photos of the same birds. How do we track birds through the photos? For example, in Figure 4, the blue stationary buoys

are each present in thirteen consecutive FF photos as they move along the transect, passing into the frame from the upper right corner and exiting out the lower left corner..
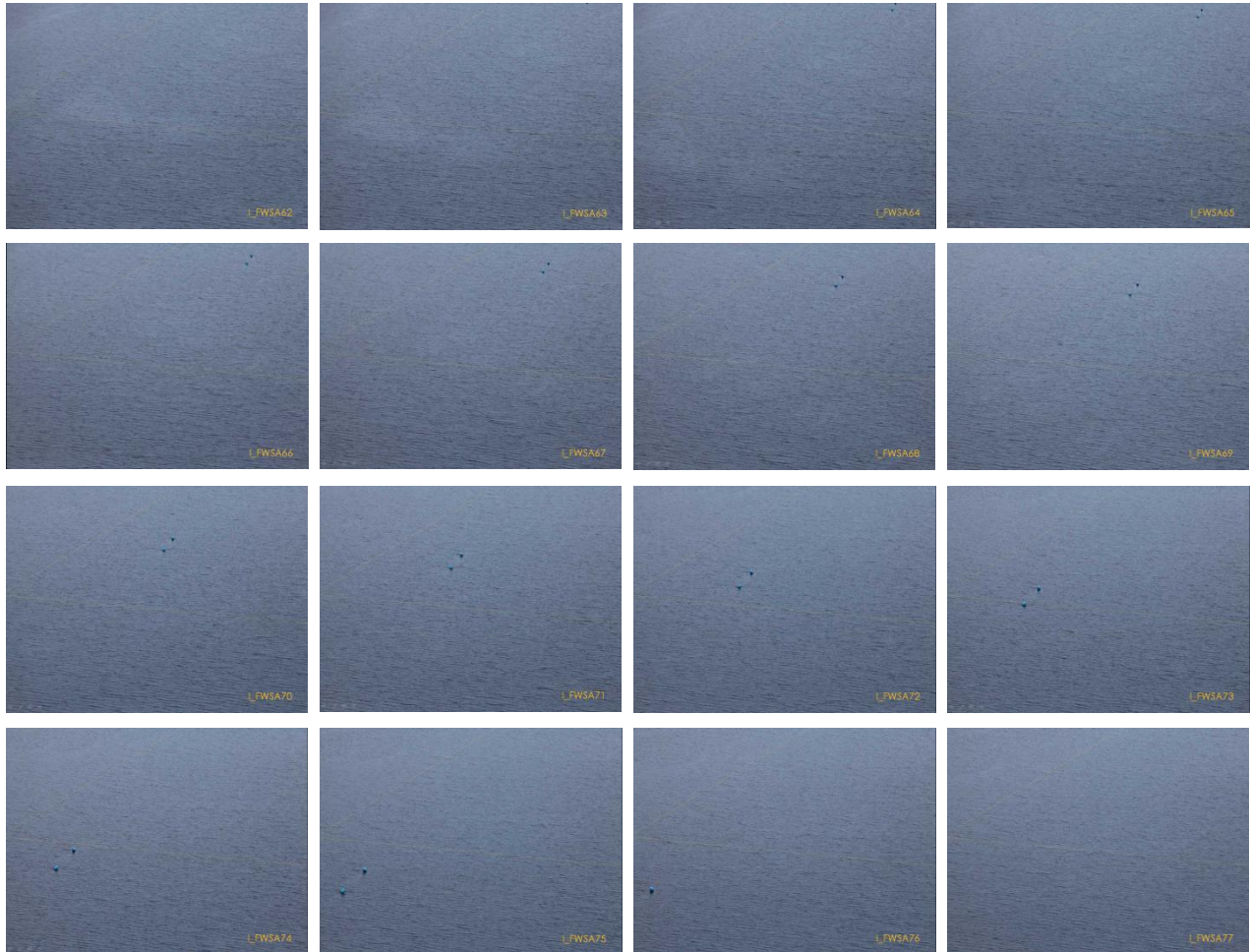

Figure 4- FF Images 62 through 77 show two buoys present in multiple photos as the plane flies along its transect.

This provides a baseline estimate of how many consecutive photos in which each bird is expected to be present, but because birds may be moving towards or away from the plane, the estimate may over or undershoot reality. Therefore, filtering photos to include only non-overlapping images, for instance by only reviewing every thirteen photos, would drastically reduce processing time but potentially lead to missed or double-counted birds. Furthermore, multiple images of the same birds offer more information for accurate counts (since birds might be obscured or diving in some photos) and identification. The challenge will thus be in determining how to present repeated images of a bird or birds in order, without necessitating time consuming, full review of simultaneous images. Another challenge in Phase II results because birds may move in and out of the images, overlap one another, or sit along the edge of the photo or transect line. Our ultimate goal is to reconcile the observer counts to the POV and

FF photos, which requires matching photos (or sections of photos) between cameras and to observer counts, and resolving count discrepancies among images. We might consider harnessing the crowd to help us track each bird across 10-15 consecutive FF photos and match them up to POV photos, as this is the type of task better suited to people than computer algorithms; but the task is made increasingly difficult as the number of birds per photo increases. More exploration must be done to design a solution to best address the challenges of Phase II.

Phase III Challenges

Phase III, species identification, poses the greatest challenges and will require the most design, training, and user effort and expertise. Bird identification in even the best circumstances requires an extensive knowledge of all possible species that might appear in the survey region, and some species can be differentiated only by noticing subtle characteristics. This is made more complicated by the fact that juveniles and females of most species are difficult to distinguish, and males undergo plumage changes by season and maturity. In mixed flocks, identification is especially difficult for females and juveniles. Identification from aerial survey photos further presents its own unique set of challenges. First, the distance from the plane to the birds results in poor resolution, small birds, and loss of important color detail in the photos. Secondly, the ocean backdrop does not provide context for size determination, making it difficult at times to even distinguish large birds from small. Finally, photographs don't capture characteristic movement and flight patterns that aid identification. This phase will require recruitment of experienced birders rather than the more general crowds utilized in earlier phases, and comprehensive training materials will need to be designed to transition this crowd to the aerial perspective. One component will be an interactive species guide, hosted through Discover Life, that will allow users to filter species by various characteristics, such as taxonomic classification, species guild, size, color patterns, neck length, and survey season and location. The guide will need to include images of male, female, juvenile, and various plumages, in both the resting and flying position, for each species. Collecting these images will be a significant undertaking, as high quality aerial photos are difficult and expensive to obtain.

SECTION III: CROWDSOURCING APPROACHES FOR MULTI-PHASE PHOTO ANALYSIS

The design of the photo analysis crowdsourcing website depends upon the project objective and the potential crowd. In our case, the question is: do we wish to focus on a large crowd or a smaller expert team of participants (e.g., experienced and motivated bird enthusiasts)? A third option is to develop a dual approach, where a large crowd performs tasks that do not require expertise, while participants experienced with birds focus on the difficult task of identification. Table 2 summarizes the pros and cons of these approaches.

Table 2. Pros and cons of three options designed to utilize a large novice crowd, a small expert crowd, or a mixed approach.

Option 1: Large Crowd- Many people making small contributions	Option 2: Harnessing Bird Experts- Few people making large contributions	Option 3: Mixed method- Large crowd does counting, Experts do ID
Pros:		
Large supply of volunteers, no expertise required. Can use free citizen science recruiter groups. Informs, educates, and engages the public in our mission.	Harnesses passion and expertise of those already interested in our mission. Bird-minded, science-minded crowd should produce good data. Generates reliable data, quickly. No need to spend time on slick design. We benefit from their expertise rather than educate them. Create a network that could be used over many years. They could offer: photographs, observations, field experience, connections, expertise.	Novice crowd does simple task of detecting and counting birds, while experts' knowledge is utilized in species identification.
Cons:		
Potentially low quality data. High volunteer turnover. Low personal investment by volunteers. Too many people to build personal relationships. Competing for volunteers with other crowdsourcing projects. Requires web/app design expertise beyond what we have now.	Potentially wastes time of experts, having them do simple tasks like counting birds. Volunteers must be found and cultivated. Some experts may not be able to put in the time required.	Requires multiple recruiting strategies and all the work of both Options 1 & 2.

Table 3, continued. Strategies for the three options designed to utilize a large novice crowd, a small expert crowd, or a mixed approach.

Option 1: Large Crowd- Many people making small contributions	Option 2: Harnessing Bird Experts- Few people making large contributions	Option 3: Mixed method- Large crowd does counting, Experts do ID
Strategy:		
No barrier to entry. Make it pretty and user-friendly! Start with Phase I: Birds Present or Absent/Count and Click on Birds. Mix in diagnostic pictures to test their accuracy, provide them with this feedback (make it a game) Mobile app option. Optional progress posts to Facebook/Twitter, achievements reached. Host competitions, online events, and raffles for prizes to keep it fun and interesting. Earn ability to work on species ID. Train on one species at a time: ask, is this species present in the photo, provide warning of look-alikes.	Recruit birding experts and photographers, particularly retired birders who have time to contribute. Train recruits extensively in person or via online training. Offer site benefits (i.e. photo album memberships) to prolific photographers to encourage lifelong participation with the site. Create a community of volunteers and show personalized appreciation to retain them.	Employ two different volunteer recruiting and retention strategies. Offer multiple trajectories to volunteers. Hierarchical volunteer design with increasing responsibility and rewards. Require quizzes to participate in Phase III.

SECTION IV: THE CROWDSOURCING PLATFORM

We are collaborating with John Pickering, Professor at University of Georgia and creator of Discover Life, to host our project through Discover Life's crowdsourcing platform. Founded in 1998, Discover Life is a website with the technology to enable scientists, students and volunteers to work together, study biodiversity, and share information on a grand scale. It was initially created to be a platform for citizen science and crowdsourcing for the purpose of moth monitoring and identification, and was designed to enable batch image viewing and categorization for the purpose of species identification. Currently it and its partner databases provide information on 1.29 million species. Its online tools include identification guides and a global mapper that enables users to compare the distribution of 648,000 species across geographic scales. Since inception Discover Life has served 3.4 billion pages and images to 32 million IP address. It now serves information, including nearly 500 million records and 2 million images, to over 800,000 IP address monthly.

Collaborating with Discover Life has a number of benefits. First, its servers will store our photos indefinitely at maximum resolution for all present and future surveys. Second, it already has some key design features that our project requires, such as user login, a species guide infrastructure that can be adapted for Phase III, and security measures in place to monitor and maintain data quality. John Pickering is working closely with us to custom-adapt the site for our project's unique needs. Finally, due to Discover Life's strong internet presence and reputation, it already has an audience of avid biologists that are a potential crowd for our project. One drawback is that Discover Life has certain limitations due to its structure that restrict the ability to review images iteratively.

Zooniverse is a well-known crowdsourcing site for image analysis that might serve as an alternative platform; it offers free project hosting and provides instant access to the Zooniverse audience. The Zooniverse Project Builder makes it easy to create an attractive, user-friendly project in which you can design your own workflow for the user. For instance, an aerial survey image could be presented with the question, "Are there any birds in this photo?," with multiple choice options of "Yes," "No," and "I'm not sure." If the answer is "Yes," a next task could follow, for instance in the form of an instruction: "Please draw a rectangle around each group of birds. A single bird by itself counts as a group." Help text can be added: "The birds might look like tiny specks on the ocean and are easily confused with waves. Zoom in to make sure you haven't missed any birds!" Zooniverse also has an X-marks-the-spot point function that could be used in later steps to mark each individual bird within a group. Zooniverse allows for multiple workflows to be created, from which users can choose. Unfortunately, in building a prototype for our project Birds from Above, I was unable to upload any of our images, because Zooniverse's size limit per image is 650 kB.

In the case that the project builder is not adequate, Zooniverse offers the opportunity to collaborate on a custom-built project, and it seems that the possibilities for this are vast. However, their customer service can only be contacted by email, and they warn that their ability to respond to emails is limited due to their small team size. I don't know whether designing a custom-built project would allow us to upload images above 650 kB, nor what the cost would be for a custom project.

Alternatively, one could custom build a platform. Pybossa provides free crowdsourced code to build your own project site, and the Office of Science and Technology Policy, in partnership with the Office of Personnel Management and the Federal Community of Practice on Crowdsourcing and Citizen Science, is developing a Federal Government Citizen Science and Crowdsourcing Toolkit, which should be launched soon.

SECTION V: DISCOVER LIFE PLATFORM DEVELOPMENT

We have developed working prototypes of Phases I & II, and are in the early stages of designing a species guide for Phase III. For the beta version of Phase I and II, Discover Life will be presenting survey images to volunteers at 50% compression from the max resolution in order to speed loading time. Users can toggle between smaller (900) and bigger (1200) image easily. In Phase I, click on any bird to mark the photo "bird +". This will generate a cropped zoom of the bird at max resolution. If the zoomed crop reveals that it is not, in fact, a bird, clicking on the crop again will remove the "bird +" classification and return the user to the original image for further review. If no bird is present, the link at the top of the web page "NO BIRD" will mark the photo "bird −". The website tracks progress of each volunteer by requiring a login and keeping score of how many photos each person has completed. Top performers are displayed in the leaderboard.

Figure 5. Phase I interface allows the user to click on any bird to move the photo to the next phase, or classify it as bird negative.

In Phase II, "bird +" photos are randomly presented and volunteers are asked to place a yellow square outline around one or more birds. As in Phase I, a zoomed crop is generated and mistakes can be corrected by clicking on the crop. If no more birds remain unenclosed, the "NO MORE BIRDS" link at the top of the web page will retire that photo from Phase II.

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Figure 6. In Phase II, users enclose each bird or group of birds with a yellow square, which will save a cropped image to be reviewed in Phase III.

Phase I Beta Test

We conducted a beta test of the Phase I site from August 12-18, 2015. Test participants included FWS Migratory Birds employees, collaborating scientists, and pilot biologists. Participants were asked to watch a 10-minute training video, work on the Phase I website for exactly 30 minutes, and complete a feedback form.

Our beta testers accessed the Discover Life platform from a range of locations and internet providers, including multiple FWS offices, Comcast, DSL, FiOS home wifi, and hotel wifi. They averaged 76.71 Phase I photos completed in 30 min. Testers were split regarding their preference for using the smaller or bigger image option for photo review and reported no significant difference between loading time of the two. For some users, their photo analysis speed increased with practice; for others, speed decreased with practice as they became more thorough. At the moment, we don't know how user speed correlates to accuracy; we plan to explore this question by retroactively evaluating the accuracy of our beta-testers after closely examining each beta-test image at max resolution for a set period of time per photo. Then, going forward, we can use these images as the training set for Phase I, in addition to drawing conclusions about the time-accuracy relationship.

In general, the response was positive and beta-testers were impressed with the functionality of the platform and training materials. On average, users rated the ease of photo analysis a 4.0 and

their confidence in correctly classifying photos a 4.25 on scale of 1-5. As expected, it was more difficult for our beta testers to confirm the absence of birds in photos (bird −) than presence (bird +), although this was easier in smooth waters, from which the birds stand out clearly. The main impediment to classifying photos with confidence was when photos contained choppy waters, in which shadows and crests of waves create a number of false positives and obscure the presence actual birds. In order to improve the confidence and accuracy of our photo reviewers in Phase I, we will need to design an additional or separate method for reviewing photos of choppy waters, perhaps by splitting the photos into fourths so that they can be presented at higher resolution without taking up more room on the screen, or by incorporating a magnifying tool that shows the max resolution when scrolling over the smaller image. This might be a necessary solution applied to choppy-water photos, despite the increased loading time.

In regards to the design and user-friendliness of the Phase I platform, we received consistent feedback that the workflow was confusing in cases when the next photo was presented before the previous one had been confirmed bird positive. In addition, we were advised that there should be an undo button and an option for black background. There was also some concern that the scoring system, which assigns a point per photo completed, encourages speed rather than accuracy and should be adjusted to reflect either time spent per photo, or accuracy as evaluated by randomly-presented training set photos. Our beta testers expressed an overall desire for feedback regarding their accuracy, and a greater explanation of and connection to the Fish & Wildlife Service's mission in regard to how this project will help migratory bird species. Finally, the testers felt that the website's appearance should be made sleeker, starting with removing extraneous information like the image identification number.

A more detailed summary of beta-test responses can be found in Appendix B.

Phase II Release: Our First Crowd

At 5 pm Thursday August 13th, an email was sent to the Maryland Birding Listserv (~1347 people), U.S. Geological Survey Patuxent, and associated researchers (~200 people). Within 45 hours, 100 visitors to our site processed about 13,000 FF photos, exhausting our first batch. These volunteers averaged approximately 65 photos per person per day in Phase I. To keep users engaged, we launched Phase II (click on each bird) and uploaded a batch of POV photos for Phase I.

By observing the response by, and data generated from, that first crowd, we can get a sense of the crowdsourcing aerial photo platform's potential. Most importantly, we found that there is an eager audience excited about this project. The users who visited our site showed great enthusiasm via their comments, and voraciously worked through our first batch of photos faster than expected. It took approximately 100 users 18 days to complete both Phase I and II of 16,847 photos, which averages to ~8.2 photos per person day. Given this, we can estimate that

to process 160,000 photos through Phases I & II would require approximately one month of work by 650 volunteers. Furthermore, the 100 site visitors generated from an email sent to approximately 1500 people represents ~6% response rate.

Next Steps

With the prototypes of Phase I & II developed and tested, the next step will be to improve the platform based on lessons learned from our beta tests. This will start with making the recommended changes to the web design such as implementing an undo button, improved workflow, optional black background, and an additional phase for reviewing photos of choppy waters. We will also need to conduct the data quality evaluation of beta test images and use these to create a training set, which can then be used to monitor user performance and be integrated into the user score calculation. Next we must develop an approach to repeated images of birds for Phase II and implement the necessary changes within the Phase II platform. For Phase III, we will need to collect photos from each necessary category (i.e. male, female, flying, floating, etc.) and design the species guide. From there, Phase III training and platform must be created, beta-tested, and improved. Finally, before we are able to launch the finished platform, we must have a comprehensive volunteer recruitment, appreciation, and retention program in place.

APPENDIX A: TECHNICAL RECOMMENDATIONS

Developing and testing the crowdsourcing infrastructure entailed employing a number of technical tools for file sharing, tutorial development, beta testing feedback, data storage, and privacy issues. The following section includes my recommendations and lessons learned for each.

File Sharing: Federal restrictions on Google Drive and Form sharing complicate a collaborative project like this. We had difficulty finding a sanctioned program that allowed us to provide non-FWS collaborators important materials.

Video Tutorials: I explored three programs that could be used to create a video tutorial. Reviews are summarized below.

1. ALL Capture 3.0 I downloaded a 1-month free trial version of ALL Capture 3.0 to create the screen-capture training video. This program allows for one-step tutorial creation by offering the option to record your voice audio (I used my laptop's built-in mic) simultaneous with your screen capture demonstration. You can then edit the video within the program (although not user-friendly). Tutorials can be saved as a project and then exported as .MOV files or .EXE files.

   However, there are multiple drawbacks to this program: first, it does not seem to work on a full-screen capture, although there is an option for it; second, it produces inconsistent video resolution. The quality of our survey photos was extremely degraded upon exporting to .MOV files, for some reason, so I ended up saving it to a .EXE (which only degraded quality of smooth-water survey photos) and sharing it over Google Docs. This .EXE file gave our beta team trouble, as USFWS security measures quarantined the download. YouTube did not allow for upload of a .EXE, and Discover Life did not have the functionality to upload it either. For those few beta-testers who could not access the .EXE video by retrieving it from quarantine, I shared an earlier version of the tutorial via Google drive, which was (for some reason) not degraded in .MOV format. I personally had no problem retrieving the .EXE file from quarantine; I simply opened the Symantec program, clicked on the quarantined file and selected "Restore" from the below options. Overall, ALL Capture is inconsistent and therefore unreliable. I would not recommend purchasing or using it for future projects.

2. Snagit 12 Editor. The 2-week free trial version of Snagit 12 Editor was much more impressive. This program has the same audio recording capability, saves automatically as an MP4 file, is consistent, and maintains better image quality than ALL Capture 3.0. It also has features that allow you to draw on your videos/images and create custom profiles

to auto-save videos to YouTube, etc. I would recommend purchase of this program for creation of future video tutorials.

3. <u>Windows Live Movie Maker.</u> This came standard on my PC laptop, and is free, user-friendly video editor. Easily add audio to a video, crop, combine, and rearrange video clips. I used this program to add my presentation audio recording to my screen capture of the PowerPoint presentation.

<u>Google Forms:</u> The Phase I Feedback Form was shared only with the Phase I beta team. Lessons learned from this exercise follow:

1. Include a question that asks the respondent for their email address. This is necessary in order to have an automated receipt of submission emailed to them, and to use the Form Notifications and Form Publisher functions (see below).
2. Download add-ons through the top of your GoogleForm edit page by going to the "Add-ons" tab -> Get Add-ons. Then choose Form Notifications, Form Publisher, and App Sheet.
   Form Notifications: Allows you to create an automatic confirmation email that goes to the participant (you must indicate which question asks for their email address) and to the owner when a form is submitted, and if you enable "Edit after Submitting," participants can use the email to navigate back to their form, edit and resubmit it.
   Form Publisher: Creates an automated spreadsheet or document that is sent to the participant with their responses upon submission.

   App Sheet: Allows you to create a custom mobile app from your form's response spreadsheet.

3. As the owner, to edit submitted forms from any and all users: type in the URL (goo.gl/hJGVOY for this project), then select your file and manage the response data from there. This will automatically update the spreadsheet responses and the response summaries.

<u>Privacy & Information collection:</u> Vany Kaiser, Departmental Privacy Specialist, 202-208-3387, referred me to Melissa Allen, FWS FOIA (Privacy) Officer, 703-358-2470, fwhq_foia@fws.gov (FOIA=Freedom of Information Act). She said we need to provide a privacy notice and complete a privacy impact assessment form DI4001 on https://eforms.doi.gov. Even though our site is hosted by Discover Life, we need to adhere to FWS policy if our name is on the site.

As crowdsourcing involves data public input, the project also requires an Information Collection Request to obtain a Paperwork Reduction Act clearance (fws.gov/pdm/infocol.html). This is coordinated by Hope Grey in the Divison of Policy and Directives Management.

Data Storage Options

1. Discover Life
2. Federal contracts with Google? (Google Nearline?)
3. Federal contracts with Amazon? (AWS Amazon Web Service?)
4. FedRAMP (GSA contract for cloud computing)
5. FederalSoup.com?
6. Contact IRTM – division in our service responsible for our computers
7. 18F digital services
8. Citrex
9. GitHub

APPENDIX B: PHASE I BETA TEST MATERIALS

Test participants

Name	Email	Invited	RSVPed	Participated
Emily Silverman	emily_silverman@fws.gov	x	x	x
Shanie Gal-Edd	shanie_gal-edd@fws.gov	x	x	x
Jeffery Leirness	jeffery.leirness@gmail.com	x	x	x
Tim Bowman	tim_bowman@fws.gov	x	x	x
Becky Rau	rebecca_rau@fws.gov	x	x	x
Joe Evenson	joseph.evenson@dfw.wa.gov	x	x	x
Mark Koneff	mark_koneff@fws.gov	x	x	x
Kathy Fleming	kathy_fleming@fws.gov	x	x	x
Khristi Wilkins	khristi_wilkins@fws.gov	x	x	
Pam Garrettson	pam_garrettson@fws.gov	x	x	
Walt Rhodes	walt_rhodes@fws.gov	x	x	
Tim Jones	tim_jones@fws.gov	x		
Ken Richkus	ken_richkus@fws.gov	x		
Nate Zimpfer	nathan_zimpfer@fws.gov	x		
Jim Wortham	jim_wortham@fws.gov	x		
Kyle Dettloff	kyle.dettloff@gmail.com			
Terry Liddick	terry_liddick@fws.gov			
Sarah Yates	sarah_yates@fws.gov			
Total:		15	11	8

E-mails Sent to Beta-Testers

- Recruiting

    August 4, 2015

    Dear Nate, Tim, Walt, Mark, Kathy, Khristi, Pam, Ken, Jim and Joe,

    The FWS Migratory Bird Program in collaboration with John Pickering of Discover Life have developed a beta version of our Phase I platform to review aerial waterbird survey photos, and we would like your input on its performance and usability. Phase I involves identifying photos as either containing birds, or not. Later phases will involve counting birds and identifying them to species.

    Testing of Phase I would occur at your convenience anytime next week (**August 10-14**) and would take no more than **1 hour** of your time. Please let us know as soon as possible whether you are able to participate!

Thanks so much, and looking forward to working with you,
Shanie

- Instructions

August 12, 2015

Hi Team, (Beta Testing Group)

Thank you for agreeing to test our newly developed crowdsourcing platform to review Aerial Waterbird Survey Photos. This beta test should take approximately an hour to complete and can be done anytime between now and August 18. Apologies for launching later than planned- if this change in schedule affects your ability to participate in testing, please let me know.

To complete the testing, there are a number of components, so please read and follow the directions below thoroughly.

Part 1:

Watch the Training Video (~10 minutes). This has been shared with you via Google Drive.
Refer to the workflow instructions attached below.

Part 2:

Set a timer for 30 minutes,
Navigate to http://pick18.pick.uga.edu/fws/
Log in with your name and email,
Review and sort photos for exactly 30 minutes,
Note how many photos you reviewed by looking at the red score in the upper right-hand corner.

Part 3:
Complete the feedback form.

That's it! Thank you so much again.

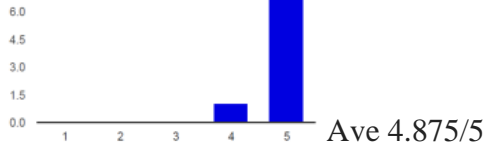If you have any problems during the week, please contact me at this email or on my cell phone: 301-792-1704.
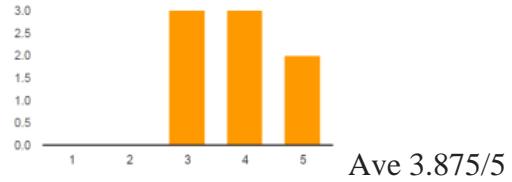
Thanks,
Shanie

APPENDIX C: PHASE I BETA TEST FEEDBACK

Training Video & Instructions

 Ave 4.875/5

- Make available on the homepage via YouTube
- Sound and video quality need improvement (used ALLCapture 3.0)
- Helpful in standardizing volunteer effort and orienting user

Homepage

- Affiliate with FWS by integrating logo and color scheme
- Link project to FWS mission, explain more how data will be used to help birds

Appeal

 Ave 3.5/5

- Is clean and simple
- Could be sleeker and more attractive
- Don't display file names
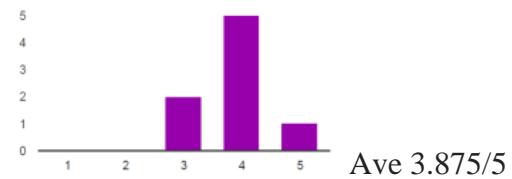- Offer black background option

Workflow

 Ave 3.875/5

- Is easy, fast, fun
- Confusion created by new random image being presented before previous one is done.
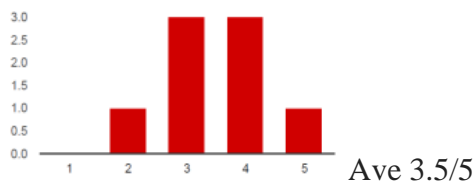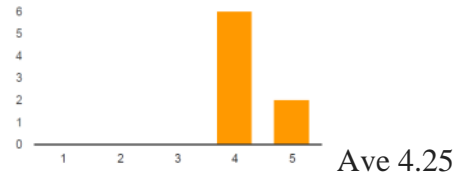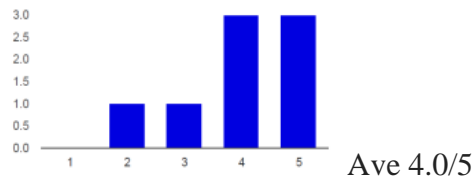- Mark spots that are determined "uhoh, not a bird"
- Undo button needed

Photo Review

Photo loading time:

 Ave 3.875/5

Confidence

 Ave 4.25

Ease of Classifying Photos

 Ave 4.0/5

- Explain or eliminate transect lines
- Choppy waters made bird negative determination difficult
- Divide photos into sectors or separate photos
- Bigger photo required annoying scrolling where as smaller photo sometimes insufficient (magnifier tool?)
- Include a max image option or magnifier
- No sig difference between loading time of smaller and larger photo size

Learning Curve

 Ave 3.0/5
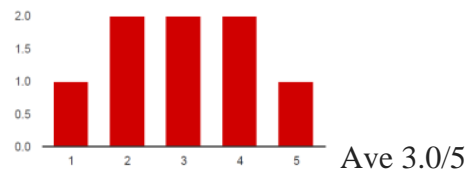
- For some, speed increased with practice, for others, speed decreased with practice as they became more thorough

Scoreboard

- User name instead of full name
- Privacy clause
- Password protect user name
- Earn points for accuracy, not speed (serious science)
- Opt out of leaderboard
- Users want feedback on their accuracy!

APPENDIX D: PRELIMINARY WORK FOR PHASE III

Components of Species Identification Guide for Experts

- Quiz colorblindness/deficit.
- Options filtered by species expected to be present given date and location of survey.
- At-a-glance page with all species compared to scale.
- Sort options: by category, color, size, shape, season and locatiaon, etc.
- Side view, top view, flying, resting, aerial, close-up, male, female, juvenile, seasonal plumage.

Selecting AMAPPS Species of Interest

I compiled the data as advised by Emily Silverman and Tim Jones, based on the AMAPPS Species Summary February 10, 2014 from surveys 2010-2012. I looked at the data a few ways, but in the end, I took the total count of each species over all 4 surveys, and calculated it as a percent of the total count of all species over all surveys. I also tallied how many surveys in which each species occurred, with a max of 4. I ignored the composite species codes and chose the top 20 most abundant species.

The second criterion for our species of interest is conservation status. Species that are classified as anything other than "least concern" are of interest to us.

Because of our partnership with Seaduck Joint Venture, duck species are of paramount importance, particularly the three scoters, longtailed ducks, and common eiders.

Species Master List

This is a spreadsheet compiling all species found in previous Puget Sound and AMAPPS surveys, based on the lists that Joe Evenson (Puget Sound) and Jeff Leirness (AMAPPS) provided to us. Our species of interest for this project (see above) are indicated in bold, including the top 20 most abundant species found in previous AMAPPS surveys and species of International concern. I've been working to divide the species into categories or guilds based on their habitat and taxonomic classification for the purpose of the guide, and have begun cataloguing how many reference photos we have available for each species, from sources such as Tim Bowman, Discover Life, and Puget Sound aerial surveys.

Species Guilds

For the design of the species ID guide, all of the possible species that might appear in our surveys must be organized into convenient groups or guilds that birding experts can easily navigate. Below is the hierarchical classification that we created to be the backbone of the species ID guide. These guilds are meant to reflect scientific taxonomy while using terminology with which birders are more familiar.

Figure 7- The species identification guide allows volunteers to select and view increasingly specific categories of birds in order to narrow their search.

- **Seabirds**
  - Auks, Murres, Puffins & other Alcids
    - Auks (1)
    - Auklets (3)
    - Dovekie (1)
    - Guillemots (2)
    - Murres (2)
    - Murrelets (2)
    - Puffins (3)
    - Razorbill (1)
  - Gulls, Terns & other Larids
    - Gulls (17)
    - Kittiwake (1)
    - Terns (11)
    - Noddy (1)
    - Skimmer (1)
  - Petrels & other Procellariformes
    - Petrels (2)
    - Shearwaters (10)
    - Fulmar (1)
    - Albatrosses (2)
    - Storm-petrels (5)
  - Other Seabirds
    - Cormorants (4)
    - Pelicans (2)
    - Tropicbird (1)
    - Loons (4)
    - Booby (1)
    - Gannet (1)
    - Jaegers (3)
    - Skuas (2)
    - Frigatebird (1)

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- **Waterfowl**
  - Swans (2)
  - Geese (4)
  - Ducks
    - Dabbling Ducks (8)
    - Diving Ducks (6)
    - Sea Ducks (13)

- **Shallow-water Birds**
  - Shorebirds
    - Sandpipers
      - Sandpipers (5)
      - Tattler (1)
      - Turnstones (2)
      - Dowitchers (2)
      - Sanderling (1)
      - Whimbrel (1)
      - Surfbird (1)
      - Dunlin (1)
      - Yellowlegs (2)
      - Godwit (1)
    - Other Shorebirds
      - Oystercatcher (1)
      - Phalaropes (2)
      - Plovers (4)
  - Marsh Birds & Waders
    - Coot (1)
    - Grebes (5)
    - Heron (1)

- **Landbirds**
  - Raptors
    - Eagles (2)
    - Hawks (2)
    - Harrier (1)
    - Vulture (1)
    - Falcon (1)
  - Other Landbirds
    - Dove (1)
    - Pigeon (1)
    - Crow (1)
    - Raven (1)
    - Flicker (1)

(This list has been approved by Emily Silverman, Tim Jones*, Tim Bowman*, and Joe Evenson*.)
*not yet

APPENDIX E: HOW TO NAVIGATE DISCOVER LIFE

Login to Edit Bowman Photos:

1. www.discoverlife.org→original→Albums→B→Bowman,Tim--edit
2. In right corner, log in as Tim Bowman
>   tim_bowman@fws.gov
>   duck1982
>   →submit

Login to Edit Reference Photos:

1. www.discoverlife.org→original→Albums→S→Silverman,Emily--edit
2. In right corner, log in as Emily Silverman
>   emily_silverman@fws.gov
>   duck1982
>   →submit

Login to Edit 2012 Survey Photos:

1. www.discoverlife.org→original→Albums→S→Silverman,Emily_a2012--edit
2. In right corner, log in as Emily Silverman
>   emily_silverman@fws.gov
>   duck1982
>   →submit

Login to Edit 2015 Survey Photos:

1. www.discoverlife.org→original→Albums→S→Silverman,Emily_b2015--edit
2. In right corner, log in as Emily Silverman
>   emily_silverman@fws.gov
>   duck1982
>   →submit

Login to Edit the Guide:

1. www.discoverlife.org→original→ID Nature Guides→Waterbirds of North America
2. To log in: add the following to the web address in the navigator bar:
   &email=shanie.galedd@gmail.com
3. →Menu→Controls→Save→Refresh→Restart
4. Open email to get pin number, copy and paste it onto the end of the web address, starting with **&pin=**

Edit the Guide:

- **Create Thumbnails**:
  1. Select the desired category you want a thumbnail for.
  2. →Compare Images
  3. Find an image you want to use, copy the file name
  4. →Menu→Image Tools→Enter
  5. Change filename (for example, I_LHT6978 becomes I_LHT/0069), then dropdown to select your image (in this case, image 78)
  6. →Crop Photo→Sharpen: NO→crop your photo as desired
  7. →Rename filename or it will overwrite it!!!! Add the Category name at the beginning (i.e. Waterfowl_Duck_...)
  8. Select the category you want it to represent from the bottom menu.
  9. →Save→confirm→save→refresh→restart

- **Create New Categories (Characters/States):**
  1. →Menu→All States & Images→Score→Submit
  2. Add in desired new state(s) →Save→Refresh

- **Edit Category Names (Characters/States):**
  1. →Menu→Don't select anything→rename_if→submit
  2. Fill out form
  3. Save→refresh→restart

- **Sort Species into Categories (Characters/States):**
  1. →Menu→click on desired species names→score_if→submit
  2. Fill out form
  3. Save→refresh→restart
  4. (Then, to search for remaining unclassified species: →has→not)

- **Change Species Category Assignments:**
  1. →Menu→click on desired species names→rename_if→submit
  2. Fill out form
  3. Save→refresh→restart