Appendix 1.3: Surveys of Migratory Waterfowl (2016-2017)

These surveys were funded under a different GLRI grant than the rest of this report

Purpose

Migratory waterfowl comprise one of the most historically, culturally, and economically important elements of the Green Bay ecosystem. Yet, no long-term systematic or standardized monitoring has taken place in the LGB&FR AOC, though some attempts have been made to study waterfowl usage in lower Green Bay (e.g., UW-Green Bay master's thesis by Vicky Harris, 1998). Unfortunately, most standardized waterfowl surveys are conducted from airplanes with bird biologists counting birds from the air. Airplane surveys can be expensive and logistically difficult to coordinate.

Therefore, we developed and implemented a systematic, repeatable method for surveying migratory waterfowl in the LGB&FR AOC from permanent ground survey points. Specific objectives for this aspect of the project are as follows:

1. Identify and map locations where waterfowl stage within the LGB&FR AOC during fall 2016, winter 2016-17, and spring 2017 migratory periods.
2. Describe waterfowl species composition and estimate seasonal numbers of individuals in the LGB&FR AOC.
3. Describe how waterfowl distributions change throughout each migratory period and across seasons.
4. Compare data collected at ground survey points with aerial sampling and describe how these field methodologies differ.

Ground-based Waterfowl Surveys

With the assistance of Howe, Wolf, and Giese, Waterfowl Expert, Tom Prestby, established eight permanent, land-based sampling points within the LGB&FR AOC based on their local expert knowledge on where waterfowl are known to stage and where there are easily accessible locations (Figure 1, Appendix 1.3):

- Three points on the west shore of the bay of Green Bay;
- Three points on the east shore of the bay of Green Bay;
- One point at the mouth of the Fox River; and
- One point at the De Pere dam by Voyageur Park.

They also established two reference locations (Sensiba State Wildlife Area; Bay Shore County Park) in order to compare waterfowl usage in the LGB&FR AOC (Figure 1, Appendix 1.3). Prestby scouted and refined these 10 locations and filled out a Site Description form (one per location), which documents the location's name and geospatial coordinates, safe parking areas, property information, and any other helpful notes (Figure 2, Appendix 1.3).

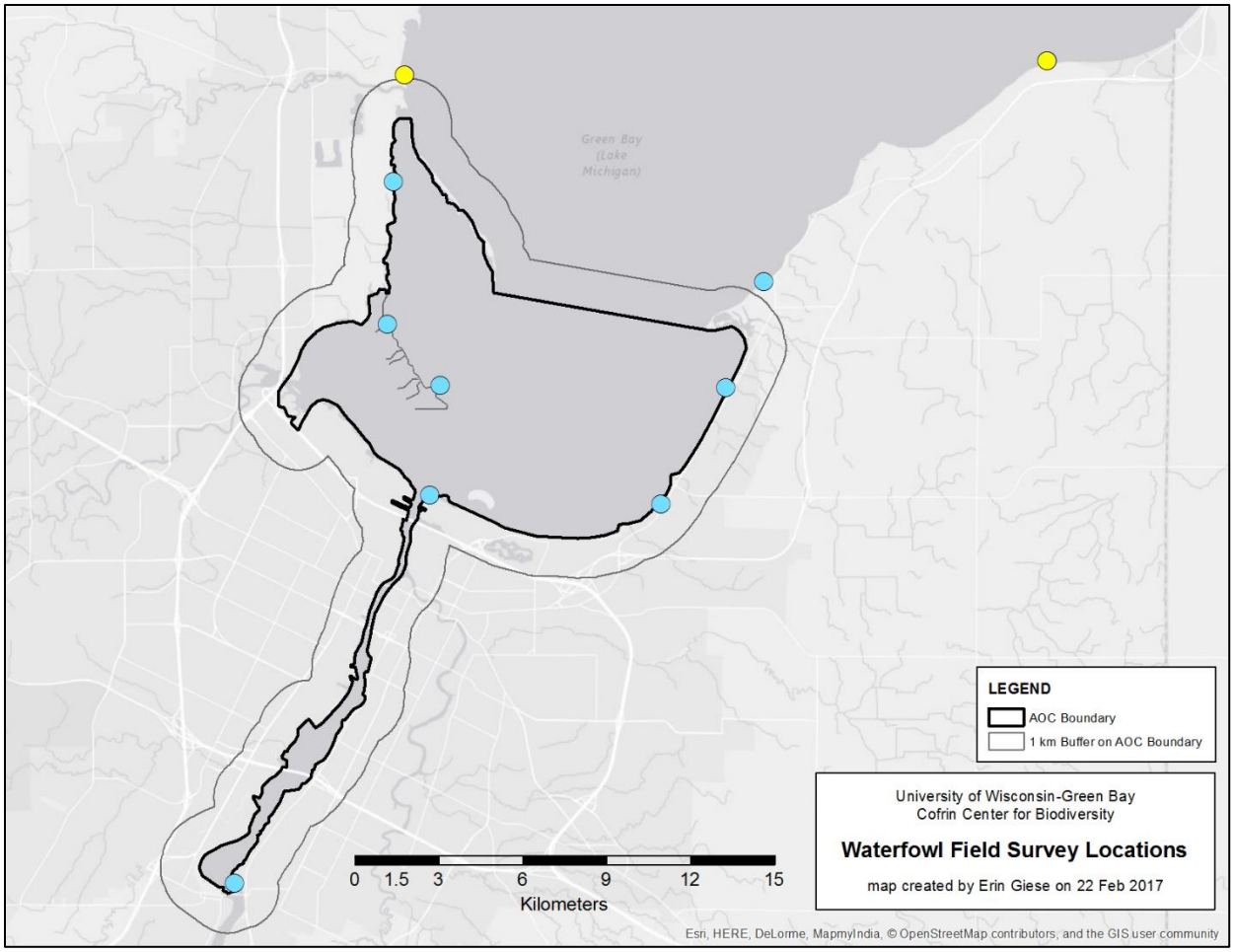


Figure 1. Point count locations (n = 10) that were surveyed for waterfowl in fall 2016, winter 2016-17, and spring 2017 in the Lower Green Bay and Fox River Area of Concern (LGB&FR AOC). Eight points (blue circles) were established to document waterfowl usage within the LGB&FR AOC: three points along the west shore, two points on the Fox River, and three points on the east shore. Two reference points (yellow circles) were established in order to make comparisons with the LGB&FR AOC. Note that although the northernmost point along the east shore next to Point au Sable (not the reference point) is technically outside the project study area (1 km buffer from LGB&FR AOC boundary), waterfowl rafts were documented both inside and outside the project study area. Basemap sources: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community. Map created in ArcGIS 10.3.1 (Environmental Systems Research Institute 2015).

Lower Green Bay & Fox River Area of Concern Waterfowl Survey
SITE DESCRIPTION

University of Wisconsin-Green Bay

Site Name	Point Number

Date	Start Visit (depart car)	Arrive at Point	Start Census	Leave Point	End Visit (depart in car)	Observer(s)
201_						

Location	Latitude (dd.ddddd)	Longitude (dd.ddddd)	Waypoint #	3D (✓)	Directions / Notes
Car Park					
Survey Point					

Site Description (dominant plant species, flowers in bloom, etc.)

Other Notes:

Figure 2. Sample Site Description form filled out for each waterfowl point count location that documents the location's name and geospatial coordinates, safe parking locations, description of the overall view of the bay of Green Bay, and any other important notes.

Howe, Wolf, Prestby, and Giese developed the following systematic, repeatable field protocol for surveying migratory waterfowl from land in the LGB&FR AOC during the fall, winter, or spring (sample data form in Figures 3a,b, Appendix 1.3):

1. Sample each of the 10 permanent, ground-based sampling locations approximately twice a week throughout each season, so long as there is open water.
    a. Do not survey when visible area of water from survey location is >90% ice-covered.
    b. Check ice coverage at all points, especially in beginning and end of winter, because ice shifts unpredictably.
    c. Randomize order of surveys to eliminate biases due to time of day.
        i. West shore and east shore points can be surveyed together for logistical reasons, but randomize order of points therein. Avoid conditions likely to decrease detectability associated with time of day, especially surveying toward a low sun angle in clear or partly cloudy conditions.

2. Surveys may be conducted during the following dates by season:
    a. Fall: August 15 - November 30
    b. Winter: December 1 - February 28
    c. Spring: March 1 - May 31

    Seasonal dates are defined by the Wisconsin Society for Ornithology (https://wsobirds.org/report-sightings). Surveys began on 12 October 2016 immediately after funding was obtained and ended in May 2017 when migratory waterfowl concentrations had ceased.

3. Surveys should be conducted during relatively good weather conditions with good visibility (not during thick fog or if waves affect line of sight), but not during heavy rain or very high wind.

4. Surveys may be conducted at any time during daylight hours.

5. Record the following basic information about the count:
    a. Site name
    b. Date
    c. Start time (using the 24-hr clock; 13:00 h = 1:00 pm)
    d. Length of survey (in minutes)
    e. Observer
    f. # of boats
    g. Boat disturbance: use one of the following codes:
        i. 0 = no effect
        ii. 1 = little effect
        iii. 2 = some effect
        iv. 3 = strong effect
    h. Notes (e.g., noise, access)
    i. Temperature (in °C)
    j. Wind: record wind direction (e.g., NW) and one of the following wind speed codes:
        i. 0 = none
        ii. 1 = 1-3 mph (1.6-4.8 kph)
        iii. 2 = 4-7 mph (6.4-11.3 kph)
        iv. 3 = 8-12 mph (12.9-19.3 kph)
        v. 4 = 12-18 mph (19.3-29.0 kph)

vi. 5 = 18-25 mph (29.0-40.2 kph)
vii. 6 = >25 mph (>40.2 kph)
viii. Note that wind speed was not collected with an instrument but rather estimated by observer.

k. Cloud cover (estimate to the nearest 10%)
l. Precipitation: use one of the following codes:
    i. LR = light rain or drizzle
    ii. R = rain
    iii. H = hail
    iv. FR = freezing rain
    v. F = flurries
    vi. S = snow
m. Wave height (estimate in feet)
n. Visibility
    i. 1 = clear (>3 km)
    ii. 2 = light fog/haze/rain (<2 km)
    iii. 3 = heavy fog/rain (<1 km)
    iv. 4 = heat waves/distortion

6. Conducting the survey:
    a. Conduct an unlimited-distance point count by counting the number of individuals of each waterfowl (e.g., ducks, geese, mergansers) and waterbird species (e.g., gulls, terns, shorebirds, etc.) that are actively using open water and shoreline, regardless of how far away an individual is. Or, estimate to nearest 100, 1,000, 5,000, or 10,000. Record these counts or estimates in the six columns left of the solid black vertical line on the data form (Figure 3a, Appendix 1.3) next to the appropriate species or species group (e.g., grebe sp.).
    b. When an individual or group of waterfowl cannot be identified, which is common due to distance, lighting, or waves, record as the species or family group that the individual or group can most safely be identified to. Options range from “scaup sp.” to “waterfowl sp.”
    c. Draw waterfowl rafts on the back of the data form for the appropriate point count location (e.g., Figure 3b, Appendix 1.3) by drawing a polygon shape that represents the raft and recording the species and estimated number of individuals.
        i. Also draw ice coverage on map and other notable occurrences affecting waterfowl identification or congregation including severe glare or hunters.
    d. Record the species (or species group) and count the number of individuals of waterfowl that fly by the area being surveyed but that do not stay and actively use the water. These observations are called “Fly-ins” or “Fly-bys” and are recorded in the two columns to the right of the solid black vertical line on the data form (Figure 3a, Appendix 1.3).
        i. “Fly-ins/Flybys” are generally not recorded on the map on the back of the data form. However, notable groups can be recorded with an arrow starting on one side of the bird code label and ending on the other, indicating the direction of flight.
    e. Each point count is 15 minutes in length at a minimum. If all waterfowl can be accurately recorded and counted in 15 minutes, then the count ends at 15 minutes. If there is a large number of waterfowl to record and the observer needs more than 15 minutes, then the observer stays to accurately count all waterfowl for however long it takes to count them.

f. An observer should use a handheld tally counter (e.g., Sparco Hand Tally Counter) to quickly count or estimate large waterfowl rafts.
g. High-quality optics are required for these unlimited-distance point counts. In 2017, Prestby used a Swarovski 80 HD spotting scope and Swarovski 8 x 42 EL binoculars. A rangefinder is recommended for estimating distances.

UW-Green Bay's Lower Green Bay & Fox River Area of Concern Migratory Waterfowl Survey

Site Name	Date	Start Time	Length (min)
	_____ / _____ / 2016	_____:_____ h	

Observer	# of Boats	Boat Disturbance	Notes (e.g., noise, access)

Temp (°C)	Wind	Cloud Cover (nearest 10%)	Precipitation	Wave Height (ft)	Visibility
	Code: _____ Direction: _____				

Species	#	Species	#	Species	#	Fly-in/Flyby	#
SNGO		RUDU		Gull sp.			
CANG		BUFF		Tern sp.			
CACG		COGO		*Sterna* sp.			
TUSW		HOGR		Shorebird sp.			
AWPE		PBGR		Scaup sp.			
DCCO		RNGR		*Aythya* sp.			
WODU		COLO		Merganser sp.			
GADW		RTLO		Diving sp.			
NOPI		AMCO		Dabbler sp.			
AMWI		HOME		Duck sp.			
ABDU		COME		Swan sp.			
MALL		RBME		Loon sp.			
BWTE		LTDU		Grebe sp.			
GWTE		RBGU		Scoter sp.			
NSHO		HERG		GBHE			
REDH		GBBG		GREG			
RNDU		BOGU					
CANV		CATE					
GRSC		COTE					
LESC		FOTE					
SUSC		KILL					
WWSC		SPSA					
BLSC		SAND					

Boat Disturbance to Waterfowl:
0 = no effect
1 = little effect
2 = some effect
3 = strong effect

Wind:
0 = none
1 = 1-3 mph
2 = 4-7 mph
3 = 8-12 mph
4 = 12-18 mph
5 = 18-25 mph
6 = >25 mph

Precipitation:
LR = light rain or drizzle
R = rain
H = hail
FR = freezing rain
F = flurries
S = snow

Visibility:
1 = clear (> 3 km)
2 = light fog/haze/rain (< 2 km)
3 = heavy fog/rain (< 1km)
4 = heat waves/distortion

version 19 October 2016

Figure 3a. Sample waterfowl point count data sheet used during fall 2016, winter 2016-17, and spring 2017 surveys. Waterfowl rafts were mapped on paper maps (Figure 3b, Appendix 1.3) on the back of this data form.

Figure 3b. Sample map for waterfowl point count location, Long Tail01, where waterfowl rafts are drawn and recorded. Bird species and total number of individuals were recorded in a table on the front side of this data form (Figure 3a, Appendix 1.3). Map created by UW-Green Bay undergraduate student Cody Becker using ArcGIS 10.5 (Environmental Systems Research Institute 2016).

Aerial Waterfowl Surveys

In order to compare ground-based waterfowl surveys with aerial sampling (the project's fourth objective), Prestby and Giese explored waterfowl documentation from a small Cessna 172 airplane on 2 December 2016 (Figure 4, Appendix 1.3). They hired a pilot from the Green Bay CAVU Flight Academy to fly them over the LGB&FR AOC near the ten waterfowl point count locations and practice documenting waterfowl. They flew out of the Austin Straubel International Airport in Green Bay, Wisconsin.

Figure 4. Out of the Austin Straubel International Airport in Green Bay, Wisconsin, waterfowl expert, Tom Prestby (pictured above), and Erin Giese flew with a CAVU Flight Academy pilot in a Cessna 172 airplane over the Lower Green Bay and Fox River Area of Concern on 2 December 2016. In flight, Prestby tried counting and documenting waterfowl usage while Giese took photographs of waterfowl and waterbirds. Photograph taken by Giese.

Counting Waterfowl

Throughout the duration of the flight, the pilot flew at an altitude of around 1,000 ft (300 m), which is two to three times as high as other local aerial waterfowl sampling (H. J. "Bud" Harris, *pers. comm.*, from surveys in the 1990s). Flying at such a high altitude made it difficult for Prestby to estimate numbers of waterfowl and for Giese to take photographs of the waterfowl. It was also dark and overcast during the flight, which created low light conditions and limited visibility.

Without using binoculars, Prestby simultaneously described the waterfowl he saw (recording species and estimated numbers of individuals) by speaking into an audio recorder (Sony PCM-D50) and marked waypoints using a GPS unit to geospatially record their locations in the air (Figures 5 and 6, Appendix 1.3). Because they were flying at such a high altitude and it was a dark, overcast day, Prestby was only able to identify waterfowl using the following species groups (not individual species): gulls, mergansers, scaup, goldeneye, and cormorants. In other cases, he could only record waterfowl rafts as unidentified ducks. Prestby later transcribed the waterfowl data from the audio recorder and GPS unit into a MS Excel table. Taking photographs of waterfowl groups also proved to be very difficult because of the altitude and poor weather conditions (Figure 7a,b, Appendix 1.3). Instead, Giese took many aerial photographs of the

LGB&FR AOC landscape and “priority areas” (e.g., Point au Sable, Peters Marsh, Cat Island Chain Restoration Site), which are included in this report (Appendix 7).

Figure 5. Tom Prestby documenting waterfowl species by speaking into an audio recorder (Sony PCM-D50) and marking geospatial locations with a GPS unit in a Cessna 172 airplane on 2 December 2016. Photograph taken by Erin Giese.

On the afternoon of December 2, 2016, only 2-3 hours after aerial surveys, Prestby conducted point counts at some of the established survey locations (Bay Shore County Park, Point au Sable, Communiversity Park) to compare on-the-ground survey results directly to aerial survey results.

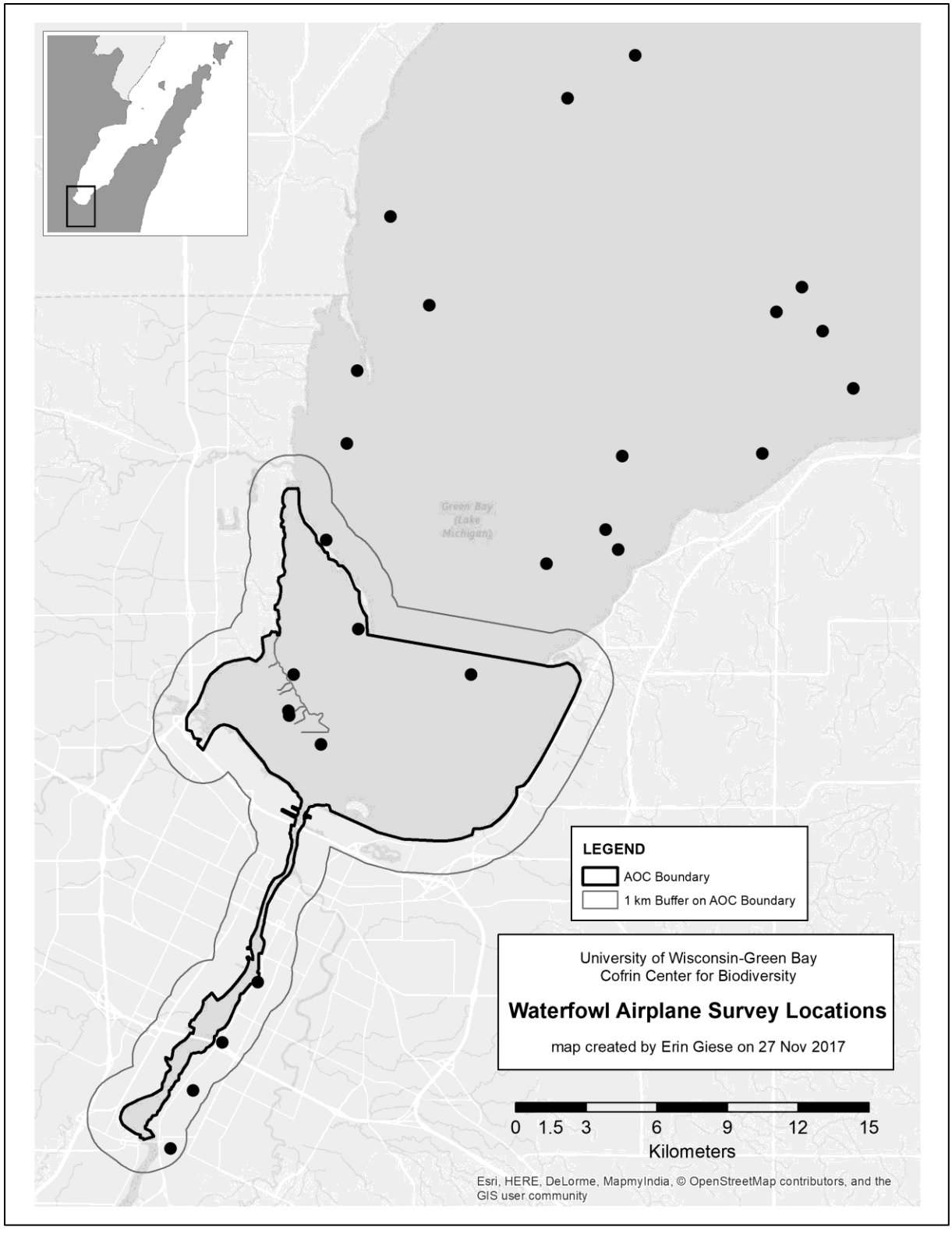


Figure 6. Locations (n = 26) of general areas that contained waterfowl that Tom Prestby noted while being flown in a Cessna 172 airplane on 6 December 2016. Basemap sources: Esri, HERE, DeLorme, MapmyIndia, © OpenStreetMap contributors, and the GIS user community. Map created by Erin Giese in ArcGIS 10.5 (Environmental Systems Research Institute 2016).

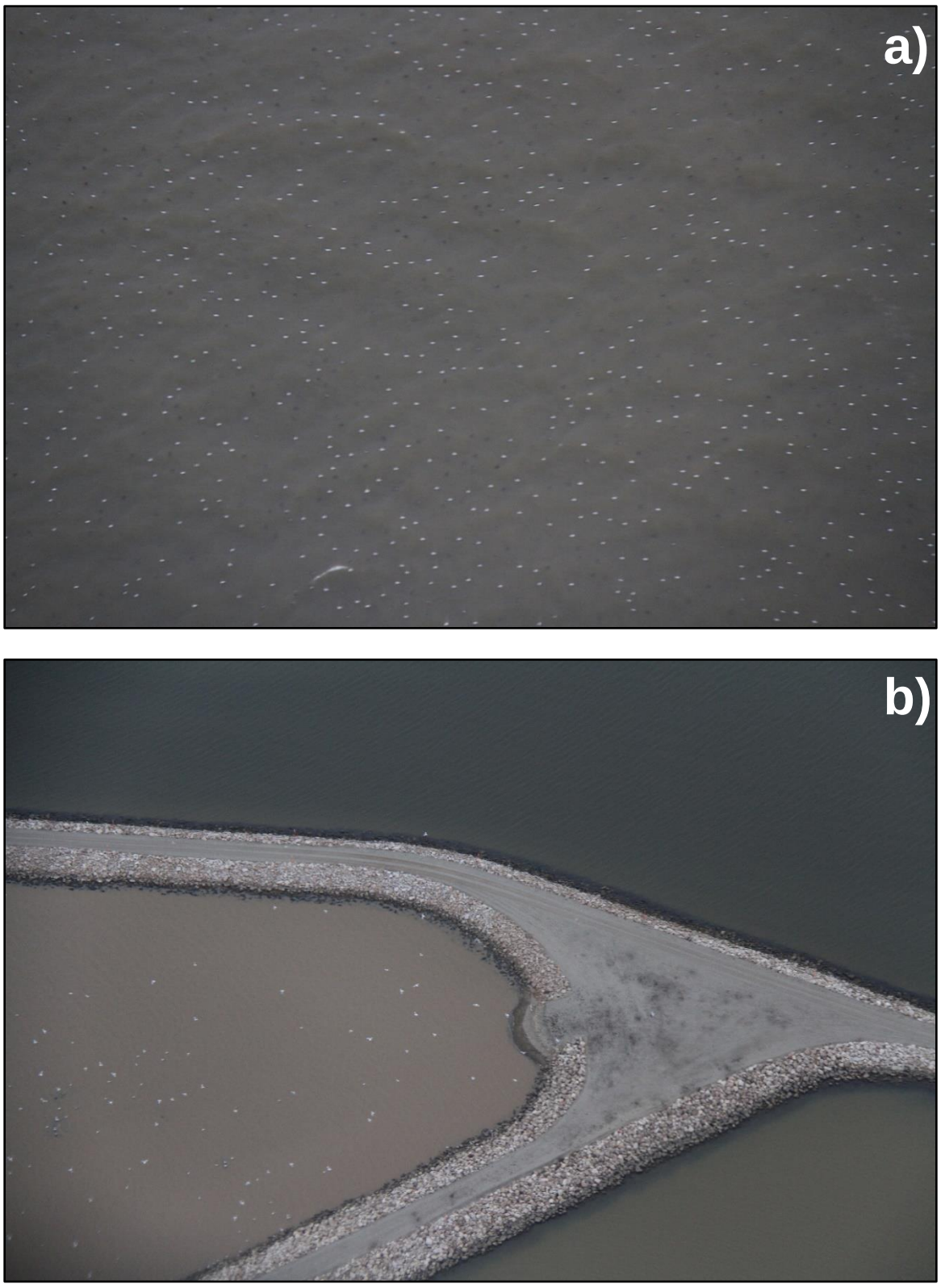


Figure 7. Sample waterfowl photographs of waterfowl (e.g., ducks, gulls) taken by Erin Giese while flying in a Cessna 172 on 2 December 2016. The top photograph (a) was taken over open water in the LGB&FR AOC. The bottom photograph was taken above the Cat Island Chain Restoration Site. Because the airplane maintained an altitude of around 300 m (1,000 ft) and the weather was overcast, it was extremely difficult to take photographs of waterfowl and to identify them. The small white and black dots are gulls and other waterfowl.

Photo Documentation and Processing

Erin Giese took seven videos and 208 photographs, primarily documenting LGB&FR AOC "priority areas" since the airplane was too high to take photographs of waterfowl, though she also took a few photographs of groups of waterfowl. They were digitally organized into folders based on the site or general area they were taken at.

Data Management and Archiving

Giese designed a data management system for organizing and backing up incoming field data. Within a few days of conducting a waterfowl survey, Prestby would provide Giese with his completed data forms. Giese audited each data form and then scanned and organized the forms digitally. Implementing these strict data back-up procedures ensured no data were lost.

Data Entry

After the field season, Prestby carefully entered the raw tabular waterfowl data from his ground-based surveys into a MS Excel spreadsheet created by Giese that employed data validation techniques to minimize data entry error. Prestby and Giese wrote accompanying metadata and produced a final, high quality data set. UW-Green Bay undergraduate student, Cody Becker, used ArcGIS 10.5 (Environmental Systems Research Institute 2016) to digitize every waterfowl raft for each point count conducted (see section GIS Digitizing of Waterfowl Rafts). Prestby proofed all data entry by comparing the data forms to the MS Excel data entry document.

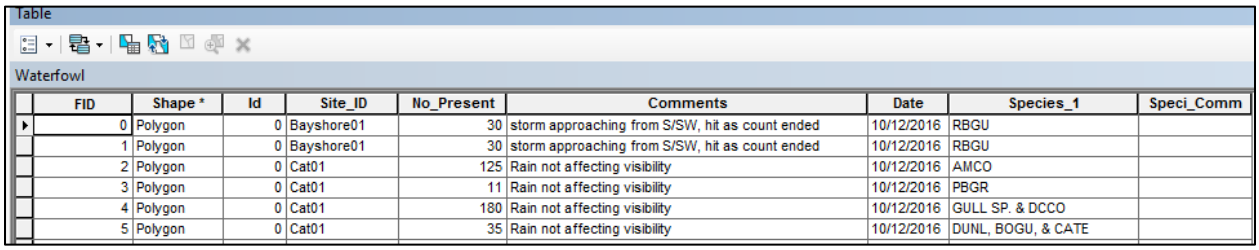
Prestby also transcribed the waterfowl observations he collected during the 2 December 2016 flight using an audio recorder and GPS unit into a MS Excel table.

Workflow Summary of Digitizing of Waterfowl Rafts in GIS (written by Cody Becker)

Overview

Prestby's field data were collected on double-sided paper forms. One side of the form has a map with hand drawn polygons of waterfowl rafts. Each polygon had a 4-8 digit species code assigned to them. On the other side, there was a table with species codes and the number of each species present, date, time, weather conditions, and comments. The polygons were digitized in ArcMap and the attribute table was generated using the date, site ID, comments, and species present found on the front page.

Each polygon is represented as a record in the attribute table (see below). The added fields include *No_Present* (number of species present), *Comments*, *Date* (mm/dd/yyyy), *Species_1* (Species ID), and *Speci_Comm* (Species common name). The data for each field can be found on the front page of the field data forms.



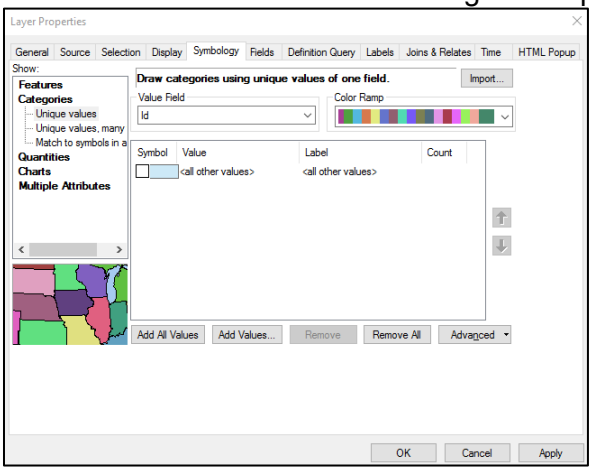
Table

Waterfowl

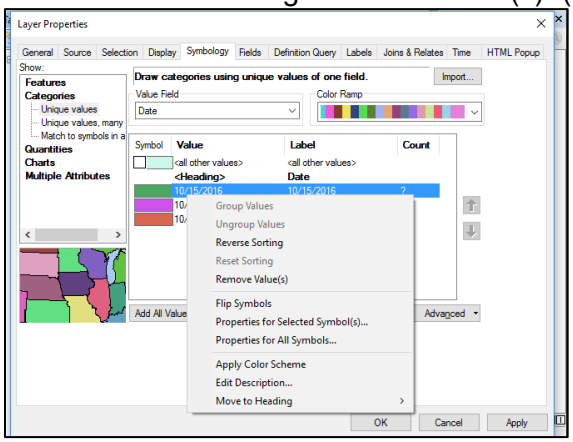
FID	Shape *	Id	Site_ID	No_Present	Comments	Date	Species_1	Speci_Comm
0	Polygon	0	Bayshore01	30	storm approaching from S/SW, hit as count ended	10/12/2016	RBGU	
1	Polygon	0	Bayshore01	30	storm approaching from S/SW, hit as count ended	10/12/2016	RBGU	
2	Polygon	0	Cat01	125	Rain not affecting visibility	10/12/2016	AMCO	
3	Polygon	0	Cat01	11	Rain not affecting visibility	10/12/2016	PBGR	
4	Polygon	0	Cat01	180	Rain not affecting visibility	10/12/2016	GULL SP. & DCCO	
5	Polygon	0	Cat01	35	Rain not affecting visibility	10/12/2016	DUNL, BOGU, & CATE	

Initial Preparation

- Open existing “WaterfowlRaft_10.4.mxd” or create a new .mxd in ArcMap
    - For new .mxd, add “Waterfowl” and “WaterfowlSurveyPts” shapefiles
    - Add a basemap or satellite photos of Brown County
        - In the original basemap, Becker downloaded photos from the National Map Viewer (https://viewer.nationalmap.gov/basic/?howTo=true) and used the “Mosaic to New Raster” tool in ArcToolbox merge all photos together
- Change the symbology of the Waterfowl layer (see reference photo below)
    - Right click on the Waterfowl layer in the Table of Contents Pane
    - Select “Properties”
    - Navigate to the “Symbology” tab and select “Categories” from the list
    - Change the “Value Field” to the “Date” attribute using the dropdown list



    - Uncheck the “<all other values>” box and select “Add Values” from the bottom toolset
        - Choose the dates you wish to view from the box using the CTRL+Click method, if not, all dates show up select the “Complete List” button
            - **NOTE:** This will add the dates from the attribute table, but **WILL NOT** add new dates, see below for more information
        - Unwanted values can be removed (see below) by right clicking the unwanted date and selecting “Remove Value(s)” (see below)

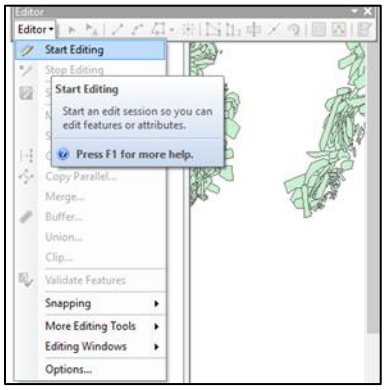


    - Click “Apply” and “OK” to apply settings

- Repeat the above steps to customize what is visible on the map by using the “Add Values” button

Adding New Polygons and New Dates

- To add new polygons, select “Start Editing” from the Editor Toolbar (see below) and edit the “Waterfowl” shapefile
  - Demo polygons need to be added for new dates to be included in attribute table and to show up on the Create Feature Pane

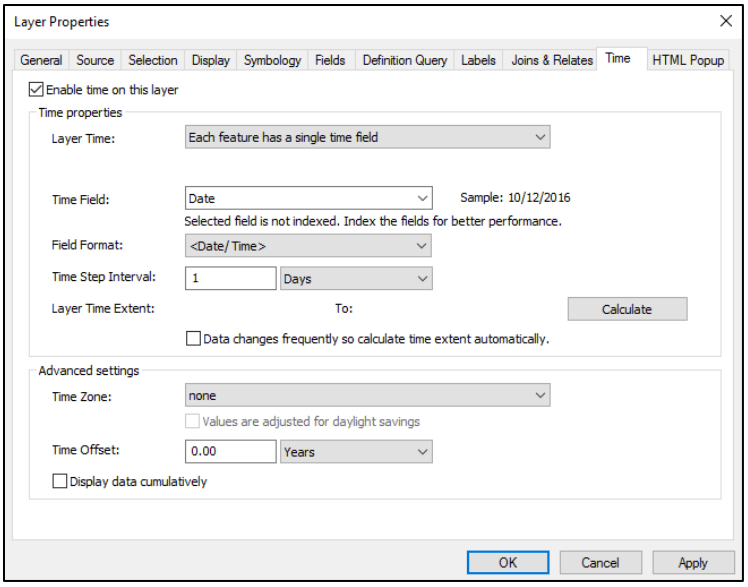


- Create a new polygon using the Create Feature Pane
  - Select the date you wish to draw from the Create Feature Pane to create a polygon from an existing date
  - To create a new date, you must select a date from the Create Feature Pane and draw a DEMO polygon somewhere outside of the survey areas
    - Once the polygon is drawn, enter new date in attribute table and out “DEMO” in the comments section
    - Once all data has been entered, delete the “DEMO” polygons. The DEMO polygons act as placeholders for the editing process
      - **NOTE:** Adding polygons with new dates does not show up in the Create Feature Pane, so the “Waterfowl” shapefile edits must be saved, removed from the .mxd, and re-added before the changes are visible (possible ArcMap bug)
  - Periodically save edits using the Editor toolbar by selecting the “Save Edits” button from the dropdown list
- Once all data are entered, backup the “Waterfowl” and “WaterfowlSurveyPts” shapefile

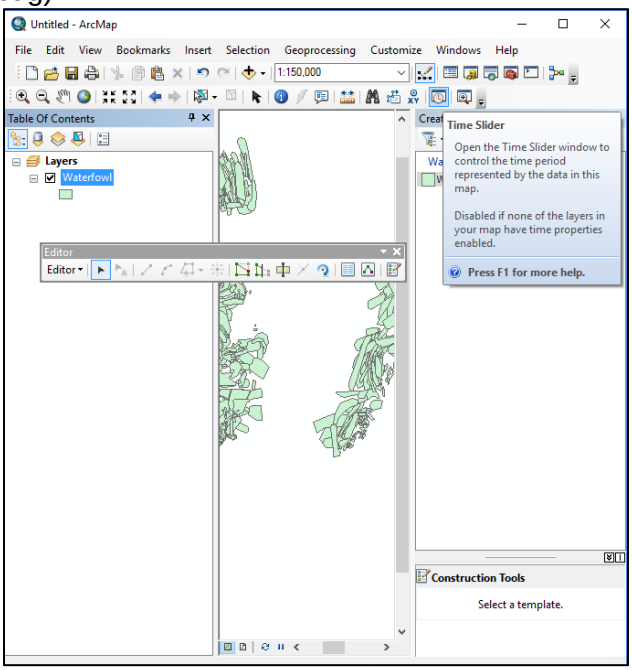
Enabling Time on a Layer

Time-lapse animations can be generated in ArcMap by using the time features built in to each layer. So far, Becker has had mixed results with the time-lapse features due to potential bugs within ArcMap. There is a link to the official Esri documentation here: http://desktop.arcgis. com/en/arcmap/10.3/map/time/enabling-time-on-your-data.htm.

- Open the shapefile containing a basemap or orthoimagery, the “Waterfowl” shapefile, and the “WaterfowlSurveyPts” shapefile
- Right click on the Waterfowl layer and select “Properties” from the dropdown menu
- Navigate to the “Time” tab (see below)

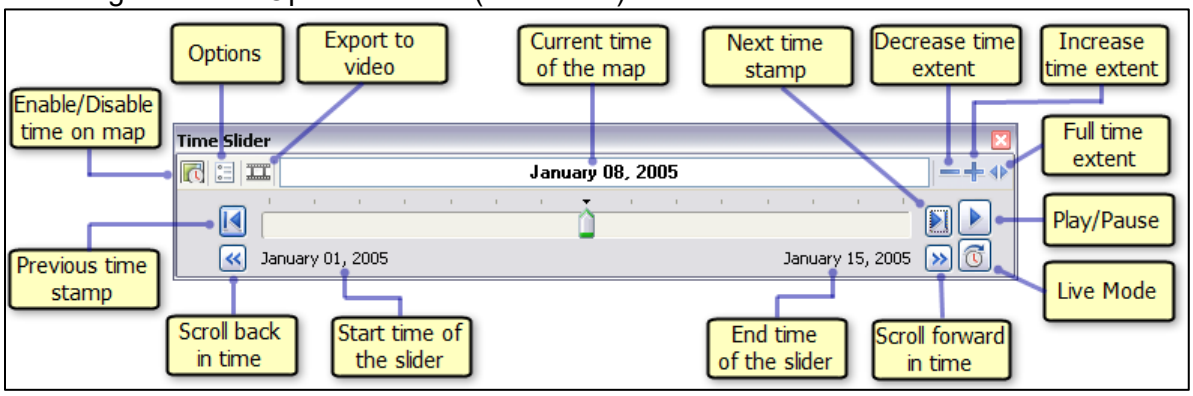


- Check the “Enable Time on this Layer” box
- Make sure the “Time Field” box has “Date” in it
- Change the “Time Step Interval” to 1 Days
- Select “Apply” and “OK” to enable time on the Waterfowl layer
- Navigate to the “Time Slider” button (see image below)
    - **NOTE:** Sometimes the time slider will say “Time is not enabled on this layer” after enabling time. If this is the case, open a new .mxd, add a basemap or orthophotos and the survey points, and go through the enable time process again (possible ArcMap bug)



Creating and Exporting Animations

- On the Time Slider, there is an option to create and export time animations
- Navigate to the “Options” button (see below)



- Change the Time Step Interval on the “Time Display” tab to 1 day
- Navigate to the “Playback” tab and slect the “Play in specified duration (seconds)” button and enter in the length you want the animation to be in seconds
    - This tells ArcMap how long to make your animation, Becker typically uses 4 minutes (240 s), but one will have to experiment to see what works best
- Click the “OK” button to close the Time Slider Options menu
- Click on the “Export to Video” button and navigate to the video save location
    - Give the video a title, and the video will be exported as a .avi file
- Leave all options at their default, click “OK” and let GIS create your animation
    - **NOTE:** Since surveys are not conducted every day within the time period, there will be frames with no visible polygons. It is suggested that one cuts these out using a video editing software such as Windows Movie Maker

Zonal Statistics (Spatial Analyst Toolbox)

- Zonal statistics was used to extract the average depth (from the “**bathygris**” raster) for each waterfowl raft. The data are summarized in the file “**ZonalStatistics_AvgDepthforEachPoly**”
    - **NOTE:** The FID field in “**Waterfowl_NAD_20171009**” = the OID field in “**ZonalStats_20171018.dbf**” and is used to join the two data sets together

Contact Information

- Cody Becker, University of Wisconsin-Green Bay Undergraduate Student, GIS Analyst & UAV Pilot, cbecker301@gmail.com, (920) 207-5932
- Tom Prestby, University of Wisconsin-Green Bay’s Cofrin Center for Biodiversity, Field Waterfowl Expert, jjprestby@msn.com, (414) 614-0798