Bank Swallow Survey Methods for the Sacramento and Feather Rivers, California

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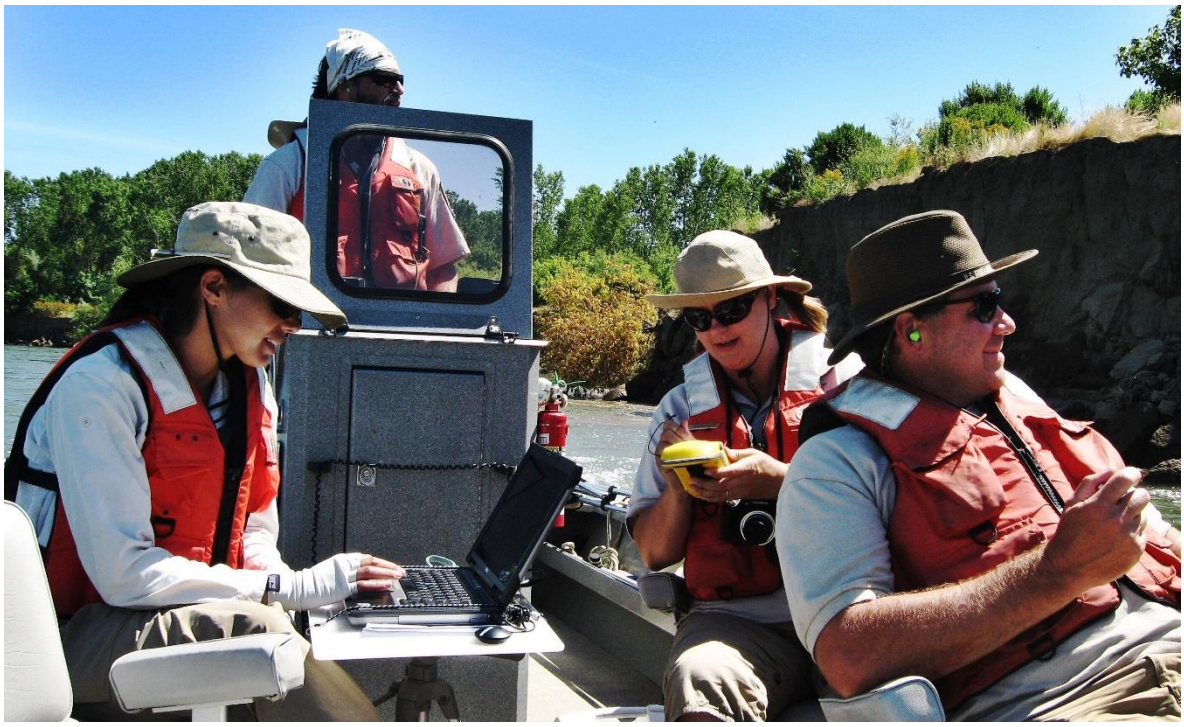

Prepared by the Bank Swallow Technical Advisory Committee (BANS TAC) Research and Monitoring Subcommittee

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History and Purpose

This document describes Standard Survey Methodology for annual burrow counts of Bank Swallow (*Riparia riparia riparia*, or BANS) nesting colonies along the Sacramento River and Feather River, California. The California Department of Fish and Wildlife (CDFW) initiated the Sacramento River Bank Swallow Project in 1986 when the first surveys were conducted. Annual surveys continue to present day with the U.S. Fish and Wildlife Service (USFWS), Sacramento National Wildlife Refuge Complex forming a cooperative effort in 1998, and the California Department of Water Resources (DWR) Northern Region Office (NRO), Oroville Field Division (OFD), and staff from CDFW Region 2 joining in 2008.

Survey methods have evolved. For example, during the first two years, colonies occurring on opposite banks were identified as a single colony by River Mile (from the confluence of the Sacramento and San Joaquin rivers). Colonies are located by River Mile (RM) and bank, left (L) or right (R), oriented by the downstream direction of travel. Various U.S. Army Corp of Engineers (ACE) and DWR maps have been used to keep pace with channel migration of the Sacramento River. Yet every river atlas used for the survey required various degrees of interpretation regarding RM location of the actual colony on a bank of the channel because it no longer occurred as photographed on the atlas map. GPS technologies have been used since 1999 to increase survey accuracy. On-board GIS was first used on the survey in 2008 to increase both accuracy and efficiency in data recording. These developments are compatible with previous efforts. This document is the product of the Bank Swallow Technical Advisory Committee (BANS-TAC), 2013.

The methods described in this document are not intended to replace hands on training or experience. The BANS-TAC highly recommends that new surveyors be trained by experienced surveyors and participate in a minimum of one bank swallow nesting colony survey with an experienced team.

Planning and Logistics

Annual survey coordination starts at the beginning of each year in February (Appendix A). Survey leads and crews are identified and planning efforts commence. Survey leads are responsible for securing a boat, pilot, boat shuttle, survey crew, data collector, and survey equipment for their given survey area, as well as for overseeing equipment condition and safety (Appendix B). Survey leads must execute the annual coordination schedule (Appendix A).

Surveys are conducted and data collected using CDFW methods as described in this document. Survey crews consist of one boat operator, two burrow counters, and one mapping specialist/data collector. The boat operator should be familiar with the river and be skilled at operating slow maneuvers in swift currents. Burrow counters should be trained in the methods described in this document and have the ability to identify colonies, bank swallows, burrows, colony activity, and count burrows. The mapping specialist/data collector should have a working knowledge of the equipment and technologies described in this document and be able to troubleshoot problems in the field. Redundant methods for data collection are highly encouraged.

Required survey equipment includes three tally counters (one for a spare), binoculars, digital camera, notebooks, maps (recent aerial photography with previous surveys mapped on them would be best), two GPS units, and batteries. Recent surveys strive to use one of two preferable mapping methods: either a laptop running ArcGIS software, or a mapping-grade GPS unit that is configured with a data dictionary that will accept the necessary data fields (i.e. Trimble GeoExplorer). Survey crews should have a redundant system of paper maps, notebooks and recreation-grade GPS ready in case the GIS or GPS system goes down. See Appendix B.

The second week in June is the target survey window. This time period is in the middle of the breeding season and is consistent with surveys done since 1999.

Typically, the Sacramento River survey is completed in four sections: Reach 1 = Keswick to Red Bluff, Reach 2 = Red Bluff to Ord Ferry, Reach 3 = Ord Ferry to Colusa, and Reach 4 = Colusa to Verona. Each section takes a full day to survey. Sections may be surveyed on concurrent days if multiple surveys crews are available. Alternate survey days should be arranged to allow for any unforeseen problems.
The Feather River survey is typically completed in three days due to two navigational barriers, Sunset Pumps located at RM 38.5, and Shanghai Falls at RM 24.5. Using these barriers as landmarks the river is divided into three survey sections with the upper reach from RM 59 to RM 38.5 surveyed on day 1, the middle reach from RM 38.5 to RM 24.5 on day two, and the lower reach from RM 24.5 to the mouth near Verona (RM 0) on day three.

In order to complete these surveys in a timely manner, it is important to have a shuttle set up so the boat trailer is transported down to the take out spot while the boat is on the water.

Survey Methodology

Colony Location

Whenever possible, river surveys should be conducted starting from the upstream end of the survey area, moving downstream. Moving downstream makes surveys more efficient. Both banks of the river should be surveyed during the same trip, with at least one surveyor constantly looking for burrows on each bank while traveling downstream. While looking for burrows and colonies, the boat speed should not be excessive, but fast enough to stay on plane. Once burrows are located, the upriver extent should be noted and the boat operator should float down river at low speed while the survey team determines activity (see Determination of Activity, below). After the team has determined that all burrows have been seen within the colony reach, the downriver extent is determined and the reach of bank is considered a colony. Survey teams should document the location of both active and inactive colonies Note: surveys conducted between 1999 and 2014 counted burrows for only active colonies, but. beginning in 2015 burrows are counted on both active and inactive colonies. The boat operator will need to make adjustments to speed and distance to the bank based on the request of the counters.

Colony Identification

Colonies are typically clusters of burrows in bare or nearly bare, near-vertical banks; usually with more than 30 holes (but can have as few as 2 and more than 3,000), often somewhat horizontally arrayed along favorable strata. Burrows may be evenly dispersed throughout the length of the colony or may be more sporadic with different densities of burrow numbers within the colony length. Burrows within 0.10 miles of each other are considered part of the same colony.

A "typical" BANS burrow entrance is wider than tall, roughly 3 inches wide by 2 inches tall, but there is great variation in this. Figure 1 is a representative photo of a BANS colony.

Figure 1. BANS colony illustrating the variation in burrow shape.

The birds can get into considerably smaller holes, and sometimes the opening of the burrow is eroded or collapsed so that it becomes larger, rounded, or even taller than wide. BANS burrows are oftentimes dug into by raccoons such that they have a greatly enlarged opening. Claw marks are typically evident when this has happened. Occasionally Northern Rough-winged swallows (*Stelgidopteryx serripennis*, or NRWS) may nest within BANS colonies. Typically, Northern rough-winged swallow nest in burrows excavated by other bank nesting species including the Bank Swallow and Belted Kingfisher (*Ceryle alcyon).* Therefore, their nesting burrows may vary in size, but they typically nest singly or in small groups (Djong 1996). Also, the NRWS is similar in appearance to the BANS, but is slightly larger and lacks the distinctive brown breast band of the BANS.

Determination of Activity

A colony may only be classified as active if bank swallows are deemed to be present. Presence of bank swallows may include a swarm of birds around the burrows, birds popping in and out of holes, or young peering out. Even if only one bird is observed entering or exiting a burrow then the colony may be classified as active. If bank swallows are not immediately apparent, then the condition of the burrows should be assessed; if burrows appear to be fresh then extra time should be spent trying to confirm bank swallow presence. Clapping hands loudly near the colony may elicit bank swallows to exit their burrows, confirming presence and activity.

Active colonies will have active burrows that are clean and well-maintained, and may have white wash or guano at the entrance. Burrows appear inky black, because they are deeply dug, and in general they have a smooth, uniform appearance. They may have claw marks associated with them, either faint tiny swallow marks at the burrow entrance, or deeper marks of predators that attempted to dig out the burrows to prey on young and/or eggs.

Inactive burrows often appear rough or craggy and lack scrape marks and white wash. They may appear grayish because they are shallow, incompletely dug or collapsed. Spider webs may crisscross inactive burrows and should not to be confused with root fringes which may occur at the edges of active burrows.

In 1989, Garrison et al. noted "Burrows counted had dark entrances (> 2 cm deep) when viewed from a distance of 5-25 meters. We counted all burrows in active sections of banks and did not count old burrows from inactive sections. Bank Swallows flying into burrows were used to determine activity, and we observed colonies for 15-60 minutes to assess whether or not a colony or section of colony was active." ... "inactive burrows from previous years were often filled with spider webs, vegetation, or collapsed soil."

Both active and inactive colony locations should be mapped, with all burrows that appear to be from the current year counted (beginning in 2015, see Counting section, below) and habitat physical characteristics documented.

Counting

Binoculars are not to be used except in special circumstances when the boat cannot be piloted close enough to the colony for counts to be made with the naked eye.

<u>For active colonies:</u> Two people (the counters) use a standard handheld tally counter to count each active burrow within the active colony (see above for classification of active burrows and active colonies). Large colonies may require the counter to tally groups of 5 or 10 burrows per tally click and multiply the resulting tally accordingly. Pointing to burrows with an extended hand or finger may aid counter in keeping their place. During the count, the crew should remain quiet because any distraction may cause the counters to lose their place and require them to begin the count again. The boat should move slowly upstream, as per counter instruction, to be sure all active burrows are included in the count. Once

the count is completed, the counters determine if they are within 10% of each other. Tallies that are significantly off (over 10%) are not documented, and the tally counters are zeroed and colony is recounted. Once a satisfactory tally is made, both tallies are entered into the database or field notes by the mapping specialist.

For inactive colonies: Burrow counts are done in the same manner as with active colonies. That is, only "active" burrows are counted. The only exception is that there is not a requirement for counts of the two observers to be within 10%. This requirement was removed to save time during the surveys.

Beginning in 2013 an estimate of the number of bank swallows observed at each colony is recorded. This includes all visible BANS either foraging or perched near the colony site. This estimate is recorded in the "number of birds" field and can be used as a general "activity index" for each colony.

Mapping

Each colony should be mapped from the downstream to upstream end by the mapping specialist. The lead counter determines the beginning and end of each colony, instructing the mapping specialist where to start and end each colony. Mapping should be performed using either the mobile GIS or mapping-grade GPS method. If it is not possible to use these methods then a recreational-grade GPS unit may be used with paper datasheets, although this method yields less accurate locational data and has other disadvantages. Each method is described below. Data collection (see Data Collection Section, below) is performed concurrently as the counters are tallying burrows and colony boundaries are being mapped.

Mobile GIS

Equipment includes a laptop computer with sufficient battery power to last the entire field day, ArcGIS (or equivalent) software, and a GPS unit that can be connected to and communicate with laptop and software. The GIS project should include the latest high resolution aerial photography of the study area in georeferenced raster format, river mile markers in vector format, current State and Federal ownership in vector format, and previous BANS survey records in vector format. Each colony should be mapped by heads up digitizing the colony from recent aerial photos on a laptop computer running ArcGIS (or equivalent software), using the GPS to locate the position of the boat.

The advantages of using this method include higher accuracy, digital data collection, creation of the GIS file in the field, and easy access to previous BANS data and other GIS features which increases flexibility. The disadvantages of this method are that required hardware and software can be expensive and bulky in the field and requires the mapping specialist have a working knowledge of the hardware and GIS software.

Mapping-Grade GPS

Equipment includes a mapping-grade GPS (such as a Trimble GeoExplorer or equivalent) with sufficient battery power to last the entire field day and a paper map or atlas of aerial photography and river miles. Mapping-grade GPS units provide two major advantages over recreational grade GPS units for BANS surveys: GPS data can be post processed using differential correction to improve accuracy and data dictionaries can be both preloaded in the unit and exported directly into GIS files. The mapping-grade GPS should be preloaded with a data dictionary which includes the data types described in this document and vector files of river miles, recent channel alignment, State and Federal ownership, and previous BANS surveys. Each colony should be mapped by acquiring a GPS position at the upstream and downstream end points of the colony as close to the bank as possible.

In the office, the GPS points are differentially corrected and exported into a GIS point file. Using recent high resolution rectified aerial photography or accurate channel lines as base maps, the colony lines are developed in the GIS between the endpoints using heads up digitizing or spatial joins. The data collected in the GPS form are then attributed to the newly created colony lines.

The advantages of using this method include high accuracy, portable and easy to use hardware, digital data collection, creation of a GPS file that can be exported to GIS in the office, and some access to previous BANS data and other GIS features. The Trimble GPS interface is more intuitive to most users than GIS software. The disadvantages of this method are that required hardware and software can be expensive, data requires more manipulation in post processing, lower ability to leverage other digital data in the field, and requires the mapping specialist have a working knowledge of the GPS unit.

Recreation-Grade GPS

Equipment includes a recreation-grade GPS unit (Garmin, Magellan, Delorme or equivalent) with sufficient battery power to last the entire field day, a paper map or atlas of aerial photography and river miles, and several paper data sheets. If possible, the recreation-grade GPS should be preloaded with vector files of river miles, recent channel alignment, and previous BANS surveys. Each colony should be mapped by acquiring a GPS position at the upstream and downstream end points of the colony as close to the bank as possible.

In the office, the GPS points are downloaded and exported into a GIS point file. Using recent high resolution rectified aerial photography or accurate channel lines as base maps, the colony lines are developed in the GIS between the endpoints using heads up digitizing or spatial joins. The data collected on the paper form are keyed into the database and then attributed to the newly created colony lines.

The advantages of using this method include portable, easy to use, and inexpensive hardware, GPS waypoints that can be imported to GIS in the office, and some limited access to previous BANS data and other GIS

features. The recreation-grade GPS interface is more intuitive to most users than mapping-grade GPS and GIS software. The disadvantages of this method are lower accuracy, data requires more post processing including keying in data from paper form into GIS database, and requires the mapping specialist have a working knowledge of the GPS unit.

Regardless of the method used, data should be processed and QA/QCed as soon as possible after the survey date. A back up method should be available to surveyors in case of hardware or software failure in the field.

Data Collection

In addition to spatial colony location, field data to be recorded in the GIS database (maintained by DWR), GPS form, or paper field data sheets that are used during the survey include the following:

Survey Reach – the "name" of the survey section. The survey is broken down into seven sections: Sac Reach 1 = Sacramento River from Keswick to Red Bluff, Sac Reach 2 = Sacramento River from Red Bluff to Ord Bend, Sac Reach 3 = Sacramento River from Ord Bend to Colusa, Sac Reach 4 = Sacramento River from Colusa to Verona, Feather Reach 1 = Feather River from RM 59 to 38.5, Feather Reach 2 = Feather River from RM 38.5 to 24.5, and Feather Reach 3 = Feather River from RM 24.5 to 0 (the mouth at Verona).

Approximate River Mile--this is recorded for the center of the colony, rounded to the nearest tenth and can be determined from the GIS or paper maps. River miles are general locations that are taken from the 1991 United States Army Corp of Engineers Aerial Atlas.

Colony Number – this is similar to, and based upon, the Approximate River Mile, but is basically a "name" for the colony that is consistently used from year to year, even if the Approximate River Mile differs slightly based upon the interpretation of the surveyors. This field will allow quick reference with colonies mapped in the past and is considered the unique colony identifier. These data are improved in the office, post-survey.

Active Colony- Yes or no. Whether or not BANS were witnessed by surveyors flying in or out of burrows in the colony while surveying the colony.

River Bank- Left or Right bank. River right is the bank on the right when moving or looking downstream.

Number of BANS – estimate of the number of bank swallows actually observed at the colony (new in 2013). This is an approximation of BANS observed at the colony during survey and may not represent actual number of birds in the colony.

Burrow Estimate 1 – estimate of the number of active burrows observed at the colony, collected by observer #1.

Burrow Estimate 2 – estimate of the number of active burrows observed at the colony, collected by observer #2.

Burrow Average – the average taken from Burrow Estimate 1 and Burrow Estimate 2 at the colony, calculated post-survey

Elevation Above Water- Approximation, to the half meter, of how high above the current waterline the first band of burrows in the colony are on the bank.

Elevation Above Slope Break- Approximation, to the half meter, of how high above

the slope break the first band of burrows in the colony are on the bank. On very steep vertical banks, this maybe the same as the elevation above water.
Total Bank Height- Approximation, within a range of 2 meters, of how high the top of bank is above the waterline. Categorized as 0-2m, 2-4m, 4-6m, 6-8m, 8-10m, and >10m.
Vegetation at Bank- riparian forest (>6 meters), riparian shrub scrub (<6 meters), grassland/herbaceous, orchard (tree or herb), disturbed. This is the dominant vegetation directly above the colony at the bank edge.
Vegetation Over Bank- riparian forest (>6 meters), riparian shrub scrub (<6 meters), grassland/herbaceous, orchard (tree or herb), disturbed. This is the dominant vegetation overbank which is viewable from the boat, and is often different than the vegetation at the bank. This should characterize the dominant vegetation beyond the colony, where the river may erode into in the future or where foraging may occur.
Ownership - If the ownership is known, record whether it is private or public, who the landowner or managing agency is. These data can be improved in the office.
Location Name – If colony is located on property owned by a public agency, record the name of the management unit. These data can be improved in the office.
Observation Date and Time – these are recorded automatically if using ArcGIS or GPS software.
Flow (Q) and Gauge- The average daily flow can be retrieved from the CDEC website. These data can be added in the office. This is important because Elevation Above Water, Elevation Above Slope Break, and Total Bank Height estimates are based on the waterline (stage) and may need to be adjusted if flows are significantly different during survey periods and years.
Photo Number- Digital photos are an important dataset. Multiple photographs should be taken of each colony. The photo numbers should be recorded for each colony in the database and linked in the GIS.
Notes- Any noteworthy data or observations not recorded in the other data fields should be recorded in the *notes* field.

Data Analysis and Storage

Within two weeks of survey completion, the data collectors will meet for a QA/QC session. Datasets for each survey section will be provided in an .xls or GIS format. Excel data will be transformed into a GIS format. The group will go through each record to check for errors and to verify that fields such as Ownership, Location Name, Colony Number, and Approximate River Mile are accurate and consistent with previous years' datasets. Fields that need to be calculated/filled post-survey, such as Burrow Average, Flow, Gauge, and Survey Reach, will be completed. All data will be merged into a single feature class or shapefile. Metadata will be updated. A "distributable version" of the dataset will be created, which will exclude sensitive data (Ownership, Location Name, Notes) and data that may be misinterpreted by external users (Burrow Estimate 1, Burrow Estimate 2, Number of BANS).

Each survey will have two final products: a GIS spatial data set, and a summary report. A GIS geodatabase or shapefile will be created with complete metadata. The shapefile will

include a series of lines that represent each colony mapped. All the data described above is easily incorporated in the GIS database, which is spatially linked to each colony as part of the GIS shapefile or geodatabase. Photos should be included and distributed with the GIS file and may be hyperlinked to each colony in the database. Using the data generated from the GIS, a summary report will be created that puts the current survey in the context of population trends. The summary report is completed and distributed by appropriate CDFW staff.

A copy of the final full GIS dataset, a set of maps in PDF format, and a summary report will be stored with the California Department of Water Resources Northern Region Office, the U.S. Fish and Wildlife Service at the Sacramento National Wildlife Refuge Complex, and on the Bank Swallow Portal (accessible only to members of the Bank Swallow Technical Advisory Committee) at http://www.sacramentoriver.org/bans. A copy of the "distributable format" GIS dataset will be provided to the California Department of Fish and Wildlife's California Natural Diversity Database (CNDDB) and to their Biogeographic Information & Observation System (BIOS).

References

Dejong, M.J. 1996. Northern Rough-winged Swallow (*Stelgidopteryx serripennis*). *In* The Birds of North America, No. 234 (A. Poole and F. Gill, eds.) The Academy of Natural Sciences, Philadelphia, PA and the America Ornithologists Union, Washington, D. C.

Garrison, B.A., R. W. Schlorff, J. M. Humphrey, S. A. Laymon, and F.J. Michny. 1989. Population trends and management of the bank swallow (*Riparia riparia*) on the Sacramento River, California. USDA Forest Service Gen. Tech. Rep. PSW-110.

Humphrey, J. and B. Garrison. 1986. The Status of Bank Swallow Populations on the Sacramento River, 1986. Calif. Dep. of Fish and Game, Wildlife Management Div., 35 pp. + appends).

Appendix A. Annual Schedule of Bank Swallow Survey Coordination

- ***Task 1. USFWS Lead will select survey date and send out Draft Survey Coordination Spreadsheet – see Attachment A.***
    - Who: USFWS Lead is Joe Silveira (current as of 2016)
    - Due Date: End of February
    - Subtask 1. Leads review and update table with information
        - Due Date: End of March
    - Subtask 2. USFWS Lead will finalize draft
        - Due Date: End of April

- ***Task 2. Pre-survey Coordination***

  Conference Call or in person meeting to formalize survey schedule

  Due Date: End of May
    - Subtask 1. Final Logistics Plan by June 1

- ***Task 3. Complete surveys following BANS-TAC Survey Methods***

- ***Task 4. Post survey QA/QC Meeting***
    - Who: Leads and GIS staff
    - Due Date: within 2 weeks of survey completion
    - Subtasks
        - Adjust River Miles as needed
        - Fill in property ownership in database
        - Correct any data entry/transcription errors
        - DFW Lead for Reach 4 – provide data to QA/QC group to digitize lines and incorporate data into database
        - Update Metadata
        - Create a distributable version of the database
            - Remove Property Ownership
            - Only include burrow average (not both counter totals)

- ***Task 5. Distribute and Archive Annual Survey Data***
    - Who: Survey Leads and/or GIS staff
    - Due Date: Beginning of August
    - Subtasks
        - Produce a standardized summary table and map of data
        - Distribute/share data with the BANS-TAC
        - Upload data to the BANS Portal
        - Send data to CNDDB and BIOS
        - Provide CDFW Lead (currently David Wright) with summary

Appendix B. Pre-survey Checklist

- Verify qualifications of boat pilot and survey crew
- Verify condition of boat and safety equipment meets standards
- Arrange for boat shuttle
- File float plan
- Equipment:
    - Three tally counters (one for each surveyor, and one spare)
    - Binoculars
    - Digital camera
    - Notebooks
    - Maps (recent aerial imagery with previous surveys overlaid is best)
        - Make sure digital versions are loaded onto laptop
        - Bring paper copies as backup in case of software malfunction
    - Two GPS units
    - Batteries
    - Digital data collection device. Acceptable devices include:
        - Laptop running ArcGIS software
        - Mapping-grade GPS unit configured with data dictionary to accept necessary fields (i.e. Trimble GeoExplorer)
    - Approved personal floatation devices for each boat occupant
- Cell phone in waterproof case
- Give pre-float safety talk