

**Comparing angler effort and catch rate estimates on Alabama reservoirs across a variety
of creel survey methods**

Master's Thesis Proposal

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I. Introduction:

Monitoring of fisheries based on catch and effort are essential for management of inland recreational fisheries (Pollock et al. 1994). Creel surveys are used to obtain estimates of angler effort and catch rates (Pollock et al. 1994). These surveys can be used to evaluate management implications (Alexiades et al. 2015) or determine economic value of a fishery (Pollock et al. 1994). Fishing effort has been positively related with the economic value of a fishery (Palm and Malvestuto 1983). Creel surveys are typically done through the use of one of two sampling strategies, access point creels and roving creels (Pollock et al. 1997).

Access point creel surveys use a stationary creel clerk to intercept anglers who have completed their fishing trip (Miranda 2005). These surveys are advantages in systems that are limited in ways anglers could potentially access the water (Pollock et al. 1994). The other sampling technique, a roving creel survey, requires intercepting anglers on the water who have not completed their fishing trip. This method becomes advantages in systems that are larger, have several access points, or large amounts of waterfront property (Malvestuto et al. 1978; Pollock et al. 1994). With a roving creel angler effort is done as an instantaneous count or a progressive count. An instantaneous count is completed within a short time period, 15-20 minutes, to get the most accurate count of anglers and boats within in an area before anglers have the opportunity to leave (Pollock et al. 1994; Bernard et al. 1998). A progressive count method (i.e., count as you go approach) is favorable in systems where doing an instantaneous count is unfeasible (Pollock et al. 1994). Progressive counts are recorded throughout the entire survey period. Since both creel surveys depend on interactions with anglers, these survey methods become costly, both in time and money (Isermann and Paukert 2010). Therefore, it is important that biologist use the most efficient and cost effect approach in obtaining angler data.

Incorporating a stratified random design in survey methods will reduce potential biasness (Malvestuto et al. 1978; Pollock et al. 1994; Lockwood 2000). This is done by incorporating various hours and areas sampled that will account for patterns in angling efforts. By combining multiple survey techniques, accuracy and precision can be increased (Pollock et al. 1994). These combined strategies have included aerial surveys and access point creel surveys (Volstad et al. 2006), roving creel surveys and mail surveys (Ditton and Hunt 2001), and access point creel survey and digital camera time lapse photos (Stahr and Knudson 2018). This allows for a more complete and cost-effective strategy in estimating catch and harvest data (Smallwood et al. 2012).

Inclusion of auxiliary data (e.g., digital cameras) provide an alternative to high-intensity man powered creel surveys (Greenburg and Godin 2015). Using digital cameras to obtain estimates of effort is becoming increasingly more common in fisheries (Smallwood et al 2002, Greenburg and Godin 2015; Kristine 2012; Hining and Rash 2016). Though analyzing data gathered from these remote cameras images requires extensive time, it is less than what is typically required to conduct a creel survey (Kristine 2012; Smallwood et al. 2002).

Research Objectives

This study is designed to provide further information on the performance of current sample design on angler surveys conducted on reservoirs in Alabama. Economic benefits from fishing related expenditures are proportional to fishing effort. We anticipate that estimates of fishing effort that incorporate the use of digital cameras will be cheaper than traditional creel surveys. The use of this auxiliary data source will also provide more precise estimates of effort than current established designs. This project has the potential to create new design standards for creel surveys if they are more precise or less expensive. Cost is the limiting factor in the amount

of recreational fishing data that is collected. Therefore, a need for more efficient estimates of fishing effort and catch per effort (CPE) is a driving factor to create new methods for these types of surveys. This will increase our understanding of recreational fishery dynamics in reservoirs and beyond. But regardless of whether the estimates are more efficient, we will better understand the advantages and potential limitations of these auxiliary data streams in recreational effort and creel surveys.

Objective 1: Estimate relationships between aerial (fixed wing aircraft) estimates of lake-wide fishing effort and indices of fishing effort from fixed-location digital camera images of boat ramp parking lots.

Objective 2: Estimate relationships between access point boat effort estimates and estimates of trailer effort from fixed-location digital camera images of boat ramp parking lots. If these relationships are strong and can be reliably estimated, then indices of fishing effort from these technologies could improve the precision of lake-wide estimates. With the improved precision of estimates fewer on-site surveys would be necessary.

Objective 3: Compare roving creel survey estimates of angler catch rates and effort with low-intensity access point surveys (similar to current ADCNR surveys). This objective will provide information on whether low-intensity access-point surveys provide reliable estimates of catch rates and variation in fishing effort over time.

Objective 4: Assess the utility of fixed-location digital cameras, with the inclusion of expansion factors, to determine effectiveness in obtaining reservoir wide estimates of angler catch rates and angler effort.

II. Methods:

Study Areas

Three study reservoirs will be chosen in Alabama to assess the usage of creel survey methods. The reservoirs chosen are Harris, Mitchell, and Jordan. These reservoirs were chosen to include variety in reservoir size, assemblage, and how anglers may potentially access the water body. Harris reservoir is located on the Tallapoosa river and is 10,660 acres in size. Mitchell and Jordan reservoirs are located on the Coosa river with Mitchell being 5,850 acres and Jordan being 6,800 acres. Primary species vary across reservoirs and include largemouth bass (*Micropterus salmoides*), spotted (*Micropterus punctulatus*), Alabama bass (*Micropterus henshalli*), bluegill (*Lepomis macrochirus*), channel catfish (*Ictalurus punctatus*), black crappie (*Pomoxis nigromaculatus*), white crappie (*Pomoxis annularis*), and striped bass (*Morone saxatilis*). Each reservoir will have the lake portion of reservoir sampled.

Roving Creel Surveys:

We will conduct a one-year roving creel survey on Harris, Mitchell, and Jordan reservoirs. The creel survey will be conducted from March 1, 2018 to March 4, 2019. We will use a stratified random design with equal sampling probabilities. We will stratify by day type (weekday vs weekend) and time period (morning vs afternoon). Four samples will be conducted per reservoir per 28 days, two weekends and two weekdays. Angler interviews will consist of gathering data on incomplete fishing trips when intercepting the angler on the reservoir by motor boat. Direction of travel and initial site location will be randomly selected. Anglers will be

surveyed with standard questions regarding target species, time spent fishing, catch, harvest, vessel fishing type, and how they accessed the reservoir (i.e., private ramp, public ramp, private boat dock). The number of boats fishing will be enumerated with a count-as-you-go approach.

Access Creel Surveys:

We will conduct a one-year access point creel survey with methods identical to Alabama Department of Conservation and Natural Resources (ADCNR) creel surveys. Four access creel surveys will be performed per reservoir per period of 28 days. These surveys will only occur on weekends, identical to ADCNR methods, with a start time of 7.5 hours before sunset and extending till 30 minutes past sunset. Ramp location will be randomly selected with equal probability from all large public boat ramps located on the reservoir. Angler interviews will be completed trip interviews obtained as the angler is exiting the reservoir. Anglers will be surveyed with the same questions as the roving creel survey.

Aerial Census:

We will conduct aerial flights over all three reservoirs four times per 28 days, with two occurring on weekdays and the other two on weekends. Flights will be conducted by Auburn Aviation in partnership with this project. All three reservoirs will be flown over and sampled for each flight. A single pass over of reservoir will occur at an elevation between 1,000 – 2,000ft with census counts of boat type (e.g., angler, recreational, pontoon, bass boat) and whether or not the boat is moving.

Remote Digital Cameras:

Digital cameras will be deployed at boat ramps for remote monitoring of fishing effort. Cameras will be set up to overlook the parking lots of major, high use, public boat ramps on reservoirs. These cameras will be positioned 12-15ft high attached to trees adjacent to parking lots. Digital cameras will be programmed to take a time lapse photo at one photo per hour.

Cameras, batteries, and memory cards will be checked and replaced twice a month to minimize risk of corrupted data, dead batteries, or technical issues.

Angler Effort and Catch Rates

Objective 1: Relationship between digital cameras and aerial boat counts

Comparison between angler boats observed on the water from fly over creel surveys will be correlated with the number of trailers observed on digital cameras at the closest time at which the fly over occurred. An analysis of covariance (ANCOVA) will be conducted to determine relationship between the two creel methods with aerial count being the dependent variable. Independent variables include time of day, season, reservoir, and day type. If correlation is strong or relationship between the creel methods is predictable the cameras are effectively determining the number of angling boats at any given hour.

Objective 2: Relationship between digital camera trailer hours and access point boat hours

Comparison between trailer count summed up over entire daylight hours across an entire day to that of boat effort obtained from access point creel survey. Comparison will be done only for days in which an access point creel survey was conducted with the cameras stationed at that boat ramp. An analysis of covariance will be conducted to determine relationship between effort hours by the creel surveys with a dependent variable of access point boat effort hours. Independent variables include boat trailer effort hours, reservoir, and season. If correlation is strong or relationship is reliably predictable, stationary digital cameras will be able to determine boat effort from each access point to reservoir.

Objective 3: Compare roving creel survey estimates of angler catch rates and effort with low-intensity access point survey

Comparison between expanded angler effort and catch rates by reservoir through the use of access point and roving creel surveys. Comparison will only include weekend data since no weekday access point surveys were conducted. Expansion factors for access point survey will include equal probabilities for all ramps and expanded out for all weekend days not sampled per season. Roving creel will be expanded to include equal probability between morning and afternoon rates and effort and expanded for weekend days not sampled per season. We will use an analysis of variance (ANOVA) to test for differences in mean catch rates and angler effort between access point surveys of boat anglers and the roving creel surveys.

Objective 4: Assess the utility of fixed-location digital cameras

Anglers per Boat:

The number of anglers per boat will be recorded from the roving creel. The number of anglers per boat is required for expansion factors to obtain angler effort for the digital cameras. Anglers per boat will be compared through the use of ANCOVA with factors that include reservoir, season, day type, and time.

Angler access to Reservoirs:

Angler access to reservoir will be sampled through the use of the roving creel. Angler access reservoir is required for expansion factors for total effort with the use of digital cameras. Digital cameras are only able to acquire data from trailers observed at ramps they are located. Therefore, missing any data on shore anglers, people launching from other ramps, private ramps, or people who own a boat dock on the reservoirs. Data will be compared using a multinomial logistic model with covariates of reservoir, season, day of week, and time of day.

Species Targeting:

Species specific effort and catch rates will be sampled through the use of the roving creel survey. Species targeting is required for expansion factor to get at species specific effort and catch with the use of digital cameras.

Utility of Digital Cameras:

Angler effort and catch rates will be enumerated expansion factors to get at reservoir wide estimates of effort and CPE. Reservoir wide estimates from digital cameras will be compared to roving and access creel surveys from objective 3. Utility will be assessed based on variance carried forward with all included expansion factors.

III. Expected Results:

Objective 1: Relationship Between Digital Cameras and Aerial Boat Counts

The relationship between digital cameras and aerial boat counts are expected to have a strong correlation. The number of trailers observed from digital cameras should be an indicator of number of boats on the reservoir. This relationship is not expected to be 1:1 due to anglers who may use private ramps or live on the water that have their boat docked on the reservoir. Using an ANCOVA, it is expected that the model that incorporates seasonality will have the lowest AIC. This prediction is based on the shift in recreational activities from angling to general watercraft activities during the summer and early fall months.

Objective 2: Relationship Between Digital Camera Trailer Hours and Access Point Boat Hours

The relationship between digital camera trailer hours and access point boat hours are expected to have a strong correlation. Digital cameras should be able to be used as an indicator

of boat effort. This relationship is not expected to be 1:1 due to being unable to identify trailers that are not fishing as a recreation. Using an ANCOVA, it is expected the model that incorporates seasonality will have the best fit.

Objective 3: Compare roving creel survey estimates of angler catch rates and effort with low-intensity access point survey

It is predicted that roving creel surveys will have lower effort and higher catch rates in comparison to access point creel surveys. This will be due to the nature of how the surveys are conducted. The progressive count method of roving creels will encounter a broader range of anglers but at the cost of not being able to intercept every angler. This broader range of anglers will allow for more variation in catch rates and harvest rates compared to that of the access creel. It is expected that non-tournament anglers do not range far from the point in which they access the reservoir. This will limit catch rates to species most commonly found near the access point.

Objective 4: Assess the utility of fixed-location digital cameras

The fixed-location digital cameras are expected to be fully capable of enumerating angler effort and catch rates that are not significantly different from roving or access creels once extrapolated. If the effort and catch data are similar to other creel surveys, we will evaluate the extent to which incorporating multiple creel survey designs can reduce cost and increase precision and accuracy of effort and catch estimates. If the digital camera estimates of catch and effort have undesirable variance, a better understanding of limitations of digital cameras will be identified for use in creel surveys.

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