Comparing Angler Effort and Catch Rate Estimates Across Creel Survey Methods at Three Alabama Reservoirs

by

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Abstract

I compared different creel survey methods at three Alabama reservoirs (Harris, Jordan, and Mitchell) to identify approaches that could improve precision and reduce costs. I was particularly interested in whether boat trailer counts from time-lapse photos taken at boat ramp parking lots could be used as an index of fishing effort to improve the temporal coverage of sampling at relatively low cost. Angler effort was estimated independently through the use of roving creels, access point creels, aerial census counts, and compared with fixed-location digital camera images of trailers at boat ramps. Digital camera counts of trailers correlated with angler effort from aerial census (R^2=0.8), access point creel surveys (R^2=0.76), and roving creel surveys (R^2=0.64). This finding suggests that time-lapse digital cameras as a sampling method to obtain angler effort may provide a feasible method once calibrated to a system. Best-fitting models for relationships between time-lapse trailer counts and the other methods included covariates for seasonal and day type (weekend vs. weekday) effects, but not reservoir and time-of-day effects. I also compared the influence of creel survey methods on estimates of fishery metrics such as proportion of anglers targeting bass and crappie, black bass and crappie catch rate, proportion of bass and crappie harvested, proportion of anglers tournament fishing, and proportion of anglers being residents of Alabama at these reservoirs. Differences in fishery metrics were observed among roving weekday, roving weekend, and access point creel surveys. These differences included black bass and crappie catch rate, proportion of bass and crappie harvested, and proportion of anglers tournament associated. Differences in black bass catch rate were greater in roving weekday creel surveys (0.94 fish/hr) than both roving weekend (0.71 fish/hr) and weekend access (0.68 fish/hr). Additionally, the proportion of bass harvested on roving weekday

creels (0.28) was higher than roving weekend (0.14) and weekend access creels (0.06). This suggest that sampling only on weekends with the use of an access point creel surveys are not fully representative of weekday rates and proportions of angling fishery metrics.

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I. Introduction:

Monitoring of fisheries for catch and effort is essential for management of inland recreational fisheries (Pollock et al. 1994). Creel surveys are a technique used to obtain information about angler catch, harvest, fishing effort, target species, socio-demographics, and economic impacts (Pollock et al. 1994; Ditton and Hunt 2001). These survey methods give biologists insights about the fishing quality, recreational fishing pressure, and the economic importance of the fishery.

Creel surveys are designed to monitor fishing effort and can be used to evaluate management implications, such as regulation changes (Alexiades et al. 2015), or determine the 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). Anglers that place a higher value in a fishery are willing to spend more money on the experience (Long and Melstrom 2016; Loomis and Ng 2012). With state agency revenues being financed primarily through license sales and federal funds, angler satisfaction is important to ensure retention of revenue from these license sales (Long and Melstrom 2016).

In 2016, it was estimated that 35.8 million U.S. residents over the age of 16 recreationally fished which resulted in roughly 459 million days of effort and 46.1 billion dollars in expenditures (U.S. Fish and Wildlife Service 2016). This revenue source can be an important contribution to local economies (Martin 1987). The economic data associated with recreational fishing can lead to a more effective allocation of directed resources to best meet public demands (Dalton et al. 1998). Understanding angler motivation is imperative to providing best management decisions to benefit both the resource and the public (Fedler and Ditton 1994). These concepts are important as the willingness of anglers to pay for improved fishing quality can lead to increased funding for natural resource agencies (Hutt et al 2013). The effectiveness of a system can be seen through a concept of angler's "voting with their feet" (Morey and Waldman 2000). Anglers are more likely to frequent where they receive the best value for their time and if unsatisfied will move to another resource. The monitoring of fishing effort via creel surveys is important to better understand these angler effort responses.

Creel surveys are typically conducted through the use of a variety of sampling methods (Newman et al. 1997). Most commonly employed are the use of intercept surveys: access point and roving creel surveys (Robson and Jones 1989). However, the use of aerial census counts, mail surveys, and other remote sensing methods are also used. These additional creel survey methods can provide a less labor-intensive approach to obtaining angling data. However, these surveys may be less efficient at obtaining both effort and catch data. Which survey to utilize is often dependent on study location, staff resources, management objectives, and the information desired (Smallwood et al. 2012).

Access point creel surveys utilize a stationary creel clerk to intercept anglers who have completed their fishing trip (Miranda 2005; Pollock et al. 1994). Typically, in this survey method a creel clerk waits at a boat ramp or other access point to obtain information from anglers or angling parties leaving the system. This allows them to obtain total effort, catch, harvest, and any socio-demographic information included in the survey. These surveys are advantageous in systems that have few angler access points (Pollock et al 1994). On systems that have more than one access point, sampling stratification can be utilized to survey a larger demographic of anglers using the system. This can be done by having a random access location selected based on proportion of angler's use or with the use of a "bus route" approach. The bus route design samples multiple access sites during a single sample day. The creel clerk moves along a route stopping at each access point proportional to expected angling pressure. Calculations are performed based on the fraction of a boat trailer's total duration being equal to the fraction of time the creel clerk spent at the access point (Robson and Jones 1989; Jones et al. 1990; Soupir et al. 2006). With access point survey methods, any angling conducted on the fishery that does not come in contact with the creel clerk will be missed. For most cases this consists of shoreline anglers or lakefront landowners with private boat access.

The other intercept sampling survey, a roving creel survey, requires intercepting anglers on the water during their fishing trip. This method is advantageous in systems that are larger, have several access points, or have large amounts of waterfront property (Malvestuto et al. 1978; Pollock et al. 1994). With a roving creel survey, angler effort is conducted as an instantaneous count or a progressive count. An instantaneous count is completed within a short time period, typically 15-20 minutes, to get the most accurate count of anglers and boats within 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 due to there being a large area that must be covered (Pollock et al. 1994). Progressive counts of anglers are recorded throughout the entire survey period. Incorporating stratified random sampling into roving creel surveys can be used to increase precision and reduce potential bias by accounting for patterns in angling effort (Malvestuto et al. 1978; Pollock et al. 1994; Lockwood 2000). Since both intercept creel surveys depend on interactions with anglers, these survey methods can become costly, both in time and money (Isermann and Paukert 2010). Therefore, it is important that biologists use the most efficient and cost-effective approach in obtaining angler data.

Aerial surveys are conducted by obtaining a census count via aircraft of either the number of boats on the system or trailers in the parking lots. Aerial counts are able to obtain information regarding angler effort but are unable to gather any information related to catch due to having no contact with the anglers themselves. An advantage of aerial surveys is the capability to count the number of anglers over large areas and being able to sample multiple systems within a day (Pollock et al. 1994). These surveys have unique biases to consider. It is difficult to completely randomize flight times due to weather, pilot availability, and plane availability. Thus, flights can only be conducted during good weather and during daylight hours, which prohibits sampling at dawn and dusk when angling effort may be high (Soupir et al. 2006). These realities associated with aerial surveys may lead to biases in effort estimates.

Mail surveys offer a simple and cost-effective method of sampling anglers in an off-site survey (Pollock et al. 1994). They typically are distributed from a license database query or following an on-site sample. Mail surveys are typically comprised of a personalized cover letter, questionnaire, postage-paid return envelope, and, if available, an incentive for returning the survey (Dillman 1978; Pollock et al. 1994). Though this method can be cheaper compared to intercept surveys, it can suffer from multiple biases including nonresponse bias, avidity bias, and length-of-stay bias (Pollock et al. 1994; Siemiatycki and Campbell 1984).

Digital cameras are becoming increasingly common in fisheries to obtain estimates of fishing effort (Smallwood et al. 2002; Greenburg and Godin 2015; Kristine 2012; Hining and Rash 2016; Fitzsimmons et al. 2013). They provide an alternative to high-intensity on-site creel surveys (Greenburg and Godin 2015). Digital cameras can be programmed in a time-lapse or motion detection fashion. If designed for time-lapse operation, effort can be estimated based on angler, boat, or trailer counts within the field of view. If the field of view does not provide a census count of anglers, then indices of effort could be developed by relating camera counts and concurrent intercept surveys. With motion detection, a time stamp is available to estimate total effort spent by anyone perceived by the camera. A downside to this survey method is the extensive time required to analyze the data gathered from these remote cameras, but this effort may be less than typically required to conduct an intercept creel survey (Kristine 2012; Smallwood et al. 2012). Another problem encountered with the use of digital cameras is accounting for missing data. This can come from obtaining no pictures of effort even though angling was conducted or from malfunctioning/stolen equipment (van Poorten et al. 2015).

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). For example, Stahr and Knudson (2018) incorporated the utilization of a time-lapse digital camera at intervals of 5 seconds to correlate fishing trip length from cameras to access point creel. They determined that the cameras were capable of being used as a supplement to measure angler effort when access creels were not conducted. These multi-survey designs allow for estimates of fishing effort, catch, and harvest to be estimated by correlating effort from the non-intercept survey (Pollock et al. 1994). The incorporation of multiple survey techniques allows for a more complete and cost-effective strategy in estimating catch and harvest data (Smallwood et al. 2012).

Reservoir angler surveys have frequently been conducted to analyze fisheries data and economic impacts (Hutt et al. 2013; Schorr et al. 1995; Loomis and Ng 2012; Soupir et al. 2006). Current creel techniques have difficulties in sampling effort and catch on large systems, such as reservoirs, with multiple access points. The addition of digital cameras has been used to estimate effort for systems with few access points (Stahr and Knudson 2018) or areas where the cameras effectively sample the entire system (Fitzsimmons et al. 2013; Smallwood et al 2012). However, these camera survey methods could potentially be used on systems with multiple access points to provide the same benefits in estimating recreational angler effort. This would aid in the reduction of cost compared to traditional access point or roving creel surveys and potentially provide a new design standard for creel surveys on reservoirs.

Creel surveys have been employed and accepted as a means to measure fishing effort and harvest. The precision of estimates from creel surveys have been frequently studied (Malvestuto et al. 1978; Dent and Wagner 1991; Knight and Malvestuto 1991; Malvestuto and Knight 1991; Sztramko 1991; Rasmussen et al. 1998; Lockwood 1997) but testing estimates among/between creel survey methods have been studied less frequently. Newman et al. (1997) reported no statistical difference for harvest rate and effort from a stratified, instantaneous count, access point creel survey to a mandatory creel census. However, Phippen and Bergersen (1991) reported observing a difference in creel rates when comparing completed trips to that of incomplete trips.

Due to the expense cost associated with gathering information from anglers, constraints are made on number of samples and sampling method performed (De Jesus et al. 2009). The Alabama Department of Conservation and Natural Resources (ADCNR) utilizes a weekend only access creel survey with intentions of obtaining the largest “bang for their buck”. A primary assumption with their sampling method is that the majority of recreational angling occurs on weekends and angling fishery characteristics do not differ between weekday and weekend, or that weekday effort is minimal enough that it is considered marginal. Roving creels are impacted by a length of stay bias where anglers who stay longer are more likely to be intercepted by a roving creel clerk (Pollock et al. 1994). However, roving creels include estimates of catch and effort from shoreline anglers not fishing from access points and landowners with private boat access that are undetectable by access point creel surveys. Though both of these survey methods are often utilized, little research has been done to compare differences in recreational angling fishery characteristics between roving and access creel survey methods. If access point creels are representative of the entire reservoir then they can be used in place of roving creel surveys because they are less expensive to conduct.

The objectives of this study are to identify relationships of effort between creel surveys and time-lapse digital cameras at public boat ramps. Effort was compared from aerial census counts, weekend access creels, and roving creel surveys. Next, precision of effort were compared between seasonal effort estimation from roving creel surveys and the use of a hybrid roving/photo creel. I also evaluated the influence of frequency of roving creels on the precision of the hybrid creel design. Last, I compared estimates of fishery metrics such as catch rates, percent harvested, and proportion of anglers resident of Alabama, and proportion of anglers tournament associated between roving and access point creel surveys to assess whether lower-cost access point creels provide representative estimates of fishery characteristics.

II. Methods:

Study Areas

Three study reservoirs were chosen in Alabama to assess the usage of creel survey methods: Harris, Mitchell, and Jordan. These reservoirs were chosen to include a variety in reservoir size, shoreline development index, and the number of paved public boat access points to the reservoir.

Reservoir size was a major constraint in determining sample systems. Each reservoir needed to be small enough to employ a half day roving creel for feasibility and labor considerations while still ensuring the entire lake is sampled. Harris reservoir is located on the Tallapoosa river and is 10,660 acres in size (Table 1). Mitchell and Jordan reservoirs are located on the Coosa river with Mitchell being 5,850 acres and Jordan being 6,800 acres. Each reservoir had the lake portion of reservoir sampled.

The shoreline development index (SDI), which relates the shoreline length of a lake to the shoreline length of a perfectly circular lake of equal area, ranges from 14-19 (Aranow 1982). Shoreline development index increases as lakes become sinuous and elongated. An SDI of 1 indicates a perfectly circular lake. Systems that are more complex in shoreline, having large amounts of coves and pockets, potentially increase the risk of anglers not being detected during creel surveys. Out of the reservoirs that I sampled, Harris Reservoir is the most complex based on an SDI of 19. Harris Reservoir is comprised of a sinuous river-like system with several coves and two bays located in the southern portion of the impoundment. Mitchell Reservoir with an SDI of 14 contains multiple finger-like projections with several coves and backwater areas. Jordan Reservoir has two larger bays located on the western portion of the reservoir with two smaller channels found on the east side. Jordan reservoir has an SDI of 16.

All three reservoirs selected have multiple paved public boat ramps. Harris has six paved boat ramps on the lake portion of the reservoir, Mitchell has two, and Jordan has two. The number of boat ramps impacted how access creels were conducted on each reservoir.

Sportfish species vary across reservoirs and include largemouth bass (*Micropterus salmoides)*, spotted bass (*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*).

Relationships between time-lapse boat trailer counts and concurrent creel surveys

I estimated the relationships between effort indices from time-lapse digital cameras and aerial census counts, access, and roving creel interviews.

The first analysis focused on a snapshot in time between aerial census counts of angling boats on the reservoir and the number of trailers observed in digital photos of boat ramp parking lots. To estimate the relationship between aerial census counts of angling boats and the number of trailers observed in digital photos, the digital photographs were analyzed to determine the number of trailers at the closest time to which the flight occurred. All ramps had the number of trailers summed across reservoir to compare with the number of angling boats observed by aerial census. This model included potential covariates of reservoir, season, day type (weekday vs weekend), and time of day (AM vs PM). Using stepwise regression, the best fit model composed of aerial angling boat counts being a function of trailer counts with an interaction of season and day type.

Aerial surveys took place from March 4, 2018 to March 2, 2019. Flights were performed in partnership with Auburn University Aviation Center four times per 28 days. Two of the flight occurred on weekdays and two on weekends. Weekdays were randomly selected between the entirety of the 20 possible weekdays within the 28-day period dependent on weather and pilot availability. Weekend samples were conducted on the two weekend days per 28-day period that intercept creels were not being performed. Time was randomized as best as possible within the constraints of the flight school's availability and schedule. All three reservoirs were flown over and sampled during each flight. A single pass over each reservoir occurred at an altitude between 1,000-2,000ft with census counts of boat type (e.g. angler, pontoon, non-fishing) and whether or not the boat was moving. Flights were only conducted when visual flight rules were met, a ceiling greater than 3,000ft and visibility greater than 5 miles.

Digital cameras were deployed at boat ramps for remote monitoring of fishing effort. Cameras were set up to overlook the parking lots of paved public boat ramps on the reservoirs. These cameras were positioned 12-15ft high and attached to trees adjacent to boat ramp parking lots. Digital cameras were programmed to take a time-lapse photo at one photo per hour. The cameras were angled to maximize field of view over the boat ramp parking lot. The entire lot was not always fully captured, and any additional overflow parking was likely missed due to the unpredictability of parking locations and number of trailers; however, the majority of each parking lot was captured. Cameras, batteries, and memory cards were checked and replaced twice a month to minimize risk of corrupted data, dead batteries, or technical issues. Harris had nine cameras split between six paved public ramps, Mitchell had seven cameras among two ramps, and Jordan had three cameras covering two ramps. Photos were transferred from 32gb SD cards to two 1tb external hard drives. Photos were processed by reviewing pictures taken between 0700 – 1900 and quantifying the number of trailers observed in each picture for each hour. Trailers observed in parking lots with several cameras were accounted for once.

The second analysis compared camera counts with effort estimates from concurrent access point creel surveys. I used a linear model to estimate the relationship between daily effort (angler hours) gathered from access point creels and the sum of trailer hours on the camera(s) located at that particular ramp on the day that the access point creel was conducted. Potential covariates included reservoir, season, and boat ramp. The best fit model based on stepwise regression related access boat effort (hours) to an interaction of trailer effort from time lapse digital cameras by season. Trailer effort (hours) was summed across all cameras located at the ramp for the hours the access creel was conducted. Access creel effort was estimated as the sum of interviewed angler hours multiplied by an expansion factor for anglers not interviewed. The expansion factor is the number of anglers interviewed plus the number of anglers counted but not interviewed divided by the number of anglers interviewed.

The access point creel survey was conducted over a one-year period concurrent with the cameras, aerials surveys, and roving creels. Two access creel surveys were performed for each reservoir per period of 28 days. These access point creel surveys had their sampling methods designed identical to that of Alabama Department of Conservation and Natural Resources current sampling protocol. These surveys occurred on weekends with a start time of 7.5 hours before sunset and extending 30 minutes past sunset. Ramp location was randomly selected with equal probability across all ramps that had digital cameras located at them. Angler interviews were completed trip interviews obtained as the angler exited the reservoir. Anglers were surveyed with standard questions regarding target species, time spent fishing, catch, harvest, and fishing vessel type, (Figure A-1). Boats that were not fishing were tallied to obtain information regarding proportion of trailers that were fishing.

The last analysis for this objective tested the relationship between roving creel daily effort (angler hours) and trailer hours observed by cameras at a reservoir scale. The model related effort (trailer hours) observed from the digital cameras at all boat ramps to that of the concurrent roving creel survey. The best fit model incorporated a season by camera interaction with an additive effect of day type. Independent variables included in the analysis for testing were reservoir, season, day type, and time of day. Angler effort from the roving creel was calculated as progressive count of anglers multiplied by the number of hours in the sample time slot.

Camera effort (trailer hours) was estimated as the sum of trailer hours across all cameras on the reservoir during the time the roving creel was conducted. Covariates for this relationship include reservoir, time of day (AM vs PM), and season.

A year-round roving creel was conducted on all three reservoirs. I used a stratified random design with stratifications of weekday vs weekend and morning (0700-1300) vs afternoon (1300-1900). Time of sample was randomly chosen with equal probabilities between the two stratifications. Roving creel surveys were conducted 4 times per reservoir per 28 days, two weekends and two weekdays. Every weekday had the same probability of being sampled. Weekend days were sampled on the same reservoir as the concurrent access creel survey. Angler interviews consisted of gathering data on incomplete fishing trips by intercepting the angler on the reservoir by motorboat. The number of boats fishing was enumerated with a count-as-you-go approach. Direction of travel and starting checkpoint location was randomly selected. Each reservoir was broken into 6 sections of roughly similar size divided by the checkpoints. The checkpoints were to ensure creel clerks moved forward at a uniform speed to sample each section of the reservoir evenly. A single survey consisted of making one complete loop around the reservoir interviewing anglers along the way. Anglers were surveyed with standard questions similar to the access creel but also included how they accessed the reservoir (i.e., private ramp, public ramp, private boat dock), (Figure A-2). Repeat anglers and anglers who refuse to be interviewed were tallied for the progressive count.

Incorporating time-lapse trailer counts into roving creel effort estimates

I evaluated the sensitivity of the precision of roving creel-based fishing effort estimates to the inclusion of boat trailer counts from digital time lapse photos. Baseline seasonal estimates of fishing effort (angler hours) were made for each reservoir using the roving creel survey data. These baseline estimates were compared with estimates in which trailer counts from time-lapse cameras were included as a predictor of fishing effort for days on which no roving creel survey was conducted. Using the relationship obtained between roving creel effort and time-lapse digital camera effort from objective 1, effort was predicted from the regression between the sampling methods. Angler effort was estimated as the summation of roving creel effort on days when sampled plus the predicted effort from the regression for days when roving creels were not conducted. The precision of the effort estimates was obtained by summing estimates of the variance of the predicted effort from the regression over all of the regression-based estimates within a season. The effort estimates from roving creels were assumed to have no variance. The sensitivity of the coefficient of variation (CV) of the effort samples was analyzed by adjusting the relationship based on number of roving creel samples performed. Coefficient of variation was averaged over 250 iterations for each unit of roving creel samples. Season wide estimates of the CV were estimated from sampling 12 times per season up to 60 in increments of 6 samples. Current samples were randomly bootstrapped to allow for more samples. This simulation is obtained from a three-reservoir system with a common relationship across all reservoirs that did not include any additional effects of reservoir. The current sampling protocol used 12 samples per reservoir for a total of 36 samples in a season. Additionally, estimates of effort (hours) per season within lake were compared between pure roving creel survey and hybrid roving/camera creel survey. Formulas used to estimate effort and variance are found below.

Roving creel

Total effort for the roving creels was estimated separately for each stratum, which was defined by reservoir, season, and day type (weekday vs weekend). Total angler effort (e_j; hrs) for the i^{th} day within each stratum was estimated via:

$$e_i = \frac{a_i t_i}{P_i}$$

Where a_i is the progressive angler count from the roving creel on day i, t_i is the duration of the interval over which the progressive count was taken, and P_i is the sample selection probability, which in this case was 0.5 because each AM or PM roving creel sample was selected with equal probability.

The roving estimate of total angler effort for each stratum was obtained by multiplying the average daily effort ($\bar{e}_h$; hours) by the number of days (N) in the stratum ($_h$).

$$\hat{e}_h = N_h \bar{e}_h$$

The variance of the mean effort from the roving creel survey was estimated via:

$$v(\bar{e}_h) = {s_h}^2 \frac{1}{n_h}\left(\frac{N_h - n_h}{N_h}\right)$$

Where S_h^2 is the sample variance, N_h is the number of sampling days within stratum h, which for this study was 60 for weekdays and 24 for weekends, and n_h is the number of samples occurred during stratum h, which was 18 days for both weekday and weekend surveys.

The variance of the creel effort stratum estimate for roving creels was estimated via:

$$v(\hat{e}_h) = {N_h}^2 v(\bar{e}_h)$$

Which is the variance of the mean effort from the roving creel survey multiplied by the number of sampling days within stratum h.

Hybrid roving/camera creel

Effort for the hybrid roving/camera creel was estimated via:

$$e = \sum_{n=1}^{n_c} a_i\, t_i + \sum_{n=1}^{N_h} e_c$$

Where n_c was the number of roving creels conducted and e_c was the estimated effort from regression model between trailer hours from digital cameras and angler hours from roving creel surveys when roving creel surveys were not conducted.

Variance for the hybrid roving/camera creel was estimated via:

$${\sigma_i}^2 = {\sigma_r}^2 + {SD_r}^2$$

Where σ_r^2 is the variance of the predicted means from the regression model between trailer hours from digital cameras and angler hours from roving creel surveys and SD_r is the residual standard deviations from the same model.

Comparison of roving and access point creel surveys

I compared estimates of fishery metrics between roving and access point creel surveys to better understand whether the weekend access point creel surveys conducted by ADCNR are representative. My field sampling methods for this objective were identical to objective 1 for both the roving and access creel surveys. The metrics I compared include target species, species specific catch rates, catch rate of size specific classes for black bass species and crappie, harvest rate of bass and crappie, percent of anglers tournament associated (pre-fishing and tournament fishing), and anglers' resident status. Because access point creels were only conducted on weekends for consistency with ADCNR methods, all possible combinations of creel survey type (access, roving) and day type (weekday, weekend) were not available. Thus, I created a new factor that I will refer to as "survey type" and had three levels representing the available combinations of creel survey type and day type (access weekend, roving weekend, roving weekday).

Comparison were made between survey types based on generalized linear models and general linear mixed effect models that had significant variables for each analysis. Covariates that were included as possible factors included season and reservoir. For the proportion of anglers targeting bass a generalized linear model was used to relate proportion to creel type. Total black bass catch rates used a general linear mixed effects model to relate catch rate to creel type with an additive effect of both season and reservoir along with a random effect of individual day. Catch rate of black bass greater than 330mm was related to creel type with a reservoir x season interaction. Catch rate of black bass greater than 406mm was related to creel type with a general linear mixed effects model with an additive effect of season and a random effect of day. Proportion of bass caught that were harvested was modeled using a generalized linear model with the proportion of bass caught that were harvested related to creel type. Proportion of anglers targeting crappie was modeled using a generalized linear model of proportion of anglers crappie fishing and creel type with an additive effect of season. Crappie catch rates was related to creel type with a linear model that incorporated a reservoir x creel interaction. A partial likelihood ratio test was used to determine significant difference between a general linear mixed effects model and a general linear model (p-value = 1). Proportion of crappie caught that were harvested and proportion of anglers that were resident of Alabama were both modeled using a generalized linear model of proportion of crappie harvest relating to creel type with an additive effect of season. Lastly, the proportion of anglers associated with tournament fishing, both pre-fishing and tournament fishing, was modeled using a generalized linear model with the best fit model relating tournament participation to creel type with an additive effect of reservoir.

III. Results:

Relationships between time-lapse boat trailer counts and concurrent creel surveys

Boat ramp trailer counts were a statistically significant predictor of aerial census counts of fishing boats at these reservoirs. The best fitting model included additive effects of trailer count, season, and day type, and a season x day type interaction (p-value <0.001, $r^2 = 0.80$, $F_{8,125} = 62.32$, cv=43.60%; Figure 1). Overall, log aerial boat counts increased by a factor of 0.76 per unit increase in log boat trailer count (p-value < 0.001). On weekdays, aerial boat counts per unit trailer count were highest in spring, intermediate in summer and winter, and lowest in fall (Figure 2), which suggests that a higher proportion of trailers were associated with fishing boats on weekdays in spring. Aerial count per trailer count was lowest in fall. On weekends, aerial boat counts per unit trailer count were still highest in spring, which exceeded summer and fall counts by 1.42 and 0.51 (Figure 3). However, aerial count per trailer count was lowest in summer. The relationship between boat ramp trailer counts and aerial census counts were consistent across all reservoir and did not appear in the final model based on stepwise regression.

Access-point creel survey estimates of angler effort were significantly related to concurrent boat ramp trailer counts from digital cameras. The best fitting model included additive terms for camera effort, season, and a camera effort x season interaction (p-value

<0.001, $r^2 = 0.64$, $F_{8,130} = 29.22$, cv = 70.20%; Figure 4). The relationship between access effort and camera effort was significantly less steep in fall (slope = 0.54; ±0.36 CI) than the other seasons (spring = 1.11, summer = 1.22, winter = 1.24). Reservoir was not significant in the model for the relationship between access point effort and camera trailer effort.

Roving creel survey estimates of angler effort were significantly related to concurrent reservoir wide trailer counts from digital cameras. The best fitting model included additive terms for camera effort, season, and day type, and a camera effort x season interaction (p-value $<$ 0.001, $r^2 = 0.64$, $F_{8,130} = 29.22$, cv=76.14%; Figures 5). Overall, weekday angler effort was 0.36 log hours (±0.27; ±95% CI) less than weekend (p-value = 0.01; Figures 6-7). The relationship between roving effort and camera effort was steepest in winter (slope = 0.96; ±0.20) compared to the other seasons (spring = 0.63, summer = 0.32, fall = 0.65). Reservoir was not found to be significant for inclusion in this model.

Incorporating time-lapse trailer counts into roving creel effort estimates

The effects of incorporating boat ramp trailer counts into roving creel survey estimates of angler effort varied across seasons and reservoirs. There were no consistent changes in the magnitude of effort estimates with the inclusion of trailer counts (Figure 8). For example, spring effort estimates for Harris Reservoir was 33,320hrs from roving creel and 32,165hrs from hybrid roving/camera creel. However, the precision of effort estimates increased substantially with the inclusion of the trailer count data, and these improvements in precision were consistent across reservoirs and season (Figure 8). For example, the coefficient of variation of angler effort (angler hours) decreased from 74% to 18% at Harris Reservoir in spring. Similarly, the CV also decreased from 110% to 25% at Mitchell Reservoir in summer.

The CV of seasonal fishing effort estimates was negatively related to the number of roving creel surveys that were conducted. The coefficient of variation is highest in summer and fall. The coefficient of variation at the sampling frequency used for other objectives in this study, 36 samples per season, ranged from 27.45%, summer, to 15.80%, winter (Figure 9). At the fewest roving creels conducted, 12 samples per season, the CV ranged from 48.83% to 27.78% when calculating effort estimates for half day samples.

Comparison of roving and access point creel surveys

<u>Proportion Targeting Black Bass</u>

There was no significant difference in the proportion of anglers targeting bass across all survey types (access/roving weekday p-value = 0.13, access/roving p-value = 0.88, and roving weekday/roving weekend p-value = 0.18; Table 2).

<u>Black Bass Catch Rates:</u>

Total bass catch rates from weekend access creels were 0.23 (±0.19; 95% CI) fish/hr less than roving weekday creels (p-value = 0.02), but access and roving weekend creels were not statistically different (p-value = 0.78). There was a significant difference between roving weekday and roving weekend total bass catch rates, with roving weekday catch rates being 0.22 (±0.20; ±95% CI) fish/hr greater than roving weekend creels (p-value = 0.036). Catch rates of black bass greater than 330mm from access creels were 0.17 (±0.16; ±95% CI) fish/hr less than roving weekday creels (p-value = 0.03), but access and roving weekend creels did not differ (p = 0.82). Catch rates of black bass greater than 330mm from roving weekday creels were 0.18 (±0.16; ±95%CI) fish/hr greater than roving weekend creels (p-value = 0.03). Lastly, we found no difference in catch rates of bass greater than 406mm between access and both roving weekday and weekend creels (p-value = 0.14 and 0.24). However, catch rate from roving weekday creels of black bass greater than 406mm in were 0.09 (±0.09; ±95%CI) fish/hr greater than roving weekend creels (p-value = 0.05).

Proportion of Catch Harvested: Black Bass

The proportion of bass caught that were harvested during weekend access creels were 0.18 (0.05 – 0.50; ±95% C.L.) times that of bass harvested from roving weekday creels (p-value = 0.002), but access and roving weekend creels were not statistically different. Black bass caught by anglers interviewed in roving weekday creels was 2.39 (1.02 – 5.88; ±95% C.L.) times more likely to be harvested than black bass caught by anglers interviewed from roving weekend creels (p-value = 0.05). There was no difference between the survey methods in the proportion of bass that were greater than 406mm that were harvested.

Proportion Targeting Crappie

There was no difference in the proportion of anglers targeting crappie across all survey methods (access/roving weekday p-value = 0.07, access/roving weekend p-value = 0.76, and roving weekday/roving weekend p-value = 0.13).

Crappie Catch Rates

Due to an interaction between reservoir and creel type, differences in catch rate were analyzed at the reservoir scale. Crappie catch rates from access creels at Harris were 1.95 (±1.43; ±95%CI) fish/hr less than Harris roving weekday creels (p-value = 0.01) and Crappie catch rates from access creels at Harris were 1.62 (±1.35, ±95%CI) fish/hr less than Harris roving weekend creels (p-value = 0.03). Crappie catch rates from Harris did not differ between roving weekday and roving weekend creels (p-value = 0.66). There was no difference in crappie catch rate between all survey methods for Mitchell reservoir (access/roving weekday p-value = 0.89, access/roving weekend p-value = 0.36, and roving weekday/roving weekend p-value =

0.31). Crappie catch rates from roving weekday creels were 1.72 (±1.65; 95%CI) fish/hr greater than roving weekend creels (p-value = 0.04), however, no differences were detected between roving weekday and access (p-value = 0.05) and roving weekend and access (p-value = 0.80).

Proportion of Catch Harvested: Crappie

Crappie caught by anglers interviewed during weekend access creels was 0.26 (0.009 – 0.73; ±95% C.L.) times as likely to be harvested than crappie caught by anglers from roving weekend creels (p-value = 0.01). There was no difference between access and roving weekday (p-value = 0.07) and roving weekday and roving weekend (p-value = 0.07) in the proportion of crappie that were harvested.

Proportion Resident

The proportion of anglers that were Alabama residents did not differ among creel survey types (access/roving weekday p-value = 0.84, access/roving weekend p-value = 0.93, and roving weekday/roving weekend p-value = 0.78).

Proportion Tournament Anglers

Anglers questioned during access point creel surveys were 2.58 (1.17 – 5.97; ±95% C.L.) times as likely to be tournament associated compared to anglers questioned during roving weekday creels (p-value = 0.02), however there was no difference between access and roving weekend (p-value = 0.60) and roving weekday and roving weekend (p-value = 0.07).

IV. Discussion:

Inclusion of Digital Cameras in Creel Surveys

I evaluated time lapse photos of boat trailers at boat ramp parking lots as an index of angler effort and found significant associations between trailer counts and independent estimates of angler effort from aerial, roving, and access point surveys. Other investigators are increasingly demonstrating the incorporation of digital photography into creel surveys to observe angling pressure at groins and shore-based fishing (Smallwood et al. 2012), at nearshore artificial reefs (Keller et al. 2016), multiple lakes (Fitzsimmons et al. 2012), and streams (Hining and Rash 2016). However, few have reported the associations between digital effort counts/indices and independent effort estimates such as aerial or roving creels. My estimates of the strength of these relationships (R^2: 0.64-0.8) was similar to the few estimates that have been reported by other investigators. Hartill et al. (2016) reported R^2 values ranging from 0.71-0.77 between trailer counts and effort estimates from an access point creel survey of the number of boats returning daily to three different ramps on New Zealand's North Island. Stahr and Knudsen (2018) documented high correlation between camera counts of boats exiting a boat ramp and in-person counts at an Arizona Reservoir. The tighter association found by Stahr and Knudsen (2018) likely relates to their ability to identify individual fishing boats entering and exiting the water, which required a large amount of time to review images.

Seasonal and day type (weekend vs weekday) effects appear to be important when predicting angler effort from time-lapse trailer counts. These covariates were found to be statistically significant covariates in all of my models, except that day type effects were omitted from models that predicted access creel effort because these were only conducted on weekends. Similarly, van Poorten and Brydle (2018) reported significant seasonal and day type effects on the proportion of boaters fishing in their models that related vehicle counts from traffic counters with angler effort at Kawkawha Lake in British Columbia. These effects were likely important because the proportion of trailers associated with boats that are fishing varies according to weekly and seasonal cycles, with more non-fishing recreational activity occurring during summer and on weekends. One of the most important shortcomings of using time-lapse boat trailer counts to predict fishing effort is the inability to differentiate the type of recreational activity being performed from trailers observed in digital cameras (Steffe et al. 2017). The improved prediction of fishing effort when including these variables in my analysis suggests that perhaps reasonable predictions of fishing effort could be made with time-lapse trailer counts without being able to identify fishing boat trailers. I speculate that effort predictions could be improved further if fishing boat trailers could be identified on time lapse photos, however, this is often unfeasible due to substantial overlap in trailer style among different types of boats.

Time-of-day and reservoir effects were not significant covariates for predicting angler effort from time lapse trailer counts in my analysis. The absence of reservoir effects may allow for generalizations to other systems, if our findings hold up to additional site-specific evaluations. The similarity of these relationships across reservoirs suggests that the proportion of trailers at boat ramps that are associated with fishing boats and the proportion of anglers accessing the reservoirs via public boat ramps are similar across these reservoirs. Additional research will be needed to better understand the generality of these findings across a wider set of reservoirs.

Weak reservoir effects on these relationships may have been related to the fact that I was able to place cameras at all of the public boat ramps at each reservoir. This approach may have minimized additive reservoir effects by essentially capturing most of the trailer effort at each reservoir, and thus presented a best-case scenario for the performance of trailer counts as an index of fishing effort. Extending this approach to larger reservoirs, with many public and private boat ramps will require sampling from the pool of available ramps for camera placement. I anticipate that without complete coverage of all ramps on the water body, variance in the effort estimates would increase. Overflow parking is another complication, and trailers in these areas were only partially sampled at each ramp in my study.   This would present a problem and was during large fishing tournaments or holidays when parking extends down entry roads or parking occurs in non-traditional locations. If trailers are unable to be enumerated during high flow events, cameras would underestimate effort on these days. Therefore, a great deal of planning should be utilized for the number of cameras and their locations when designing coverage from digital cameras frame of view.

Trailer counts from time lapse cameras serve as an index of fishing effort rather than a census, therefore they must be trained to estimates of total angler effort. The inclusion of an intercept creel survey method allows for validation in estimating angler effort (Hartill et al. 2016; Taylor et al. 2018). Including an intercept creel survey method additionally provides information about harvest, species targeting, and catch rate which offers value to fisheries managers and stock assessment scientist that is unobtainable from camera surveys alone. With the large temporal coverage from the time-lapse digital cameras, it is expected that accuracy will be higher due to the larger sampling size (Steffe et al. 2008).

My study suggests that the inclusion of time-lapse digital cameras has the potential to increase the precision of angler effort estimates. I found that if 12 roving creels were able to be performed per season to determine relationship between trailer hours and angler effort from roving creel, then the hybrid survey would have CVs ranging from 28-49% in comparison to CVs of 72-143% from pure roving creel effort estimates at the same sampling frequency. Thus, the hybrid roving/camera creel allows for inclusion of fishery metrics and a large reduction in error associated with effort estimates. Similarly, Hartill et al. (2016) used the coefficient of variation to determine the precision of annual traffic estimates with a reduction in the number of days surveyed from cameras. They reported precision initially improving with an increase in sampling effort, but the rate of improvement greatly decreased with increasing sampling. For their three boat ramps, they could not declare an optimal level of effort but deemed 60 days as suitable for the annual sampling frequency. A reduction in the number of digital photos required to be analyzed could also aide in the reduction of creel cost. Future work should evaluate optimal digital camera sampling frequency as it relates to the precision of effort estimates.

Roving vs Access Creel Surveys

An intensive intercept creel survey is the gold standard for detecting changes in a fishery, but this approach may be impractical and too costly for many state agencies (Steffe et al. 2008). For this reason, the Alabama Department of Conservation and Natural Resources has made the decision to conduct only weekend access point creel surveys to maximize the number of angler contacts per unit of effort. However, estimates of fishery metrics may differ between different creel survey types. Newman et al. (1997) utilized a stratified roving creel in conjunction with a mandatory creel census. They observed few significant differences in all parameters tested; such as angling effort which was found to have non-significant differences in month-day type strata for all three months and day type except for the month of May weekday. Using the same stratum design, they only detected significant differences in harvest rate of walleye on weekend strata in June and July. Similar observations were also seen by Barnes et al. (2014), where a creel census was utilized and compared to a modeled access point creel survey. They observed significant differences only from a full census creel to a “one-third” survey (16 hours per week) in total catch of rainbow trout and green sunfish.

When comparing the recreational angling characteristics between roving and access creel surveys in my study, differences in fishery metrics were observed. This finding indicates that weekend access creel surveys on reservoirs in Alabama may not be representative for weekday fishery metrics. One metric that differed between weekday roving and weekend access was the proportion of anglers that were tournament associated. This is not a surprising finding as the majority of tournament activities occur on the weekends and are hosted at major boat ramps where the access creels are being conducted. Considering that most tournaments are mandatory catch-and-release, it is not surprising that I also found differences in the proportion of total bass harvested with harvesting being more likely on weekdays. Thus, I would predict that estimates of black bass harvest mortality to be biased low if using only weekend access creels to broadly represent the overall fishery metrics for a reservoir.

Access creels are only able to intercept anglers who are using boat ramps as their means of accessing a body of water, which may introduce bias if fishery metrics differ between anglers using different modes of access to the reservoir. This dynamic may have been at play in my study. I observed differences within weekend samples between roving and access creels in the proportion of crappie harvested. This finding suggests that access creels may not fully represent reservoir wide fishery metrics in Alabama. Access creels do not have the capability to intercept anglers who launched from private locations, such as a private boat slip, or shore anglers fishing from piers and docks. Once again, this underestimation in harvest and mortality due to fishing impacts multiple estimates and parameters commonly used by fisheries managers and stock assessment scientist. My findings suggest that methodological decisions for reservoir creel surveys in Alabama should be carefully considered when balancing tradeoffs between the efficiency in conducting the surveys and the accuracy of their estimates.

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Tables:

Table 1: Physical characteristics of each reservoir.

	Harris	Mitchell	Jordan
year filled	1983	1922	1928
river impounded	Tallapoosa	Coosa	Coosa
size (acres)	10,660	5,850	6,800
shoreline (miles)	271	147	188
shoreline development ratio	19	14	16
public paved ramps	6	2	2

Table 2: Comparison of recreational angling fishery metrics from roving weekday, roving weekend, and access point creel samples. Groups with the same letters are not statistically different.

	Roving Weekday	Roving Weekend	Access Weekend
proportion of anglers targeting bass	0.75	0.84	0.85
black bass catch rate (fish/hr)	0.94^{a}	0.71^{b}	0.68^{b}
black bass catch rate >330mm (fish/hr)	0.68^{a}	0.49^{b}	0.47^{b}
black bass catch rates >406mm (fish/hr)	0.25^{a}	0.17^{b}	0.17^{ab}
proportion of bass harvested	0.28^{a}	0.14^{b}	0.06^{b}
proportion of bass>406mm harvested	0.27	0.17	0.25
proportion of anglers targeting crappie	0.16	0.08	0.07
crappie catch rate Harris Reservoir (fish/hr)	1.64^{a}	1.97^{a}	3.60^{b}
crappie catch rate Mitchell Reservoir (fish/hr)	1.67	0.79	1.56
crappie catch rate Jordan Reservoir (fish/hr)	1.92^{a}	0.20^{b}	0.40^{ab}
proportion of crappie harvested	0.62^{ab}	0.70^{a}	0.41^{b}
proportion of anglers resident of Alabama	0.81	0.84	0.84
proportion of anglers tournament associated	0.16^{a}	0.29^{ab}	0.33^{b}

VI. Figures:

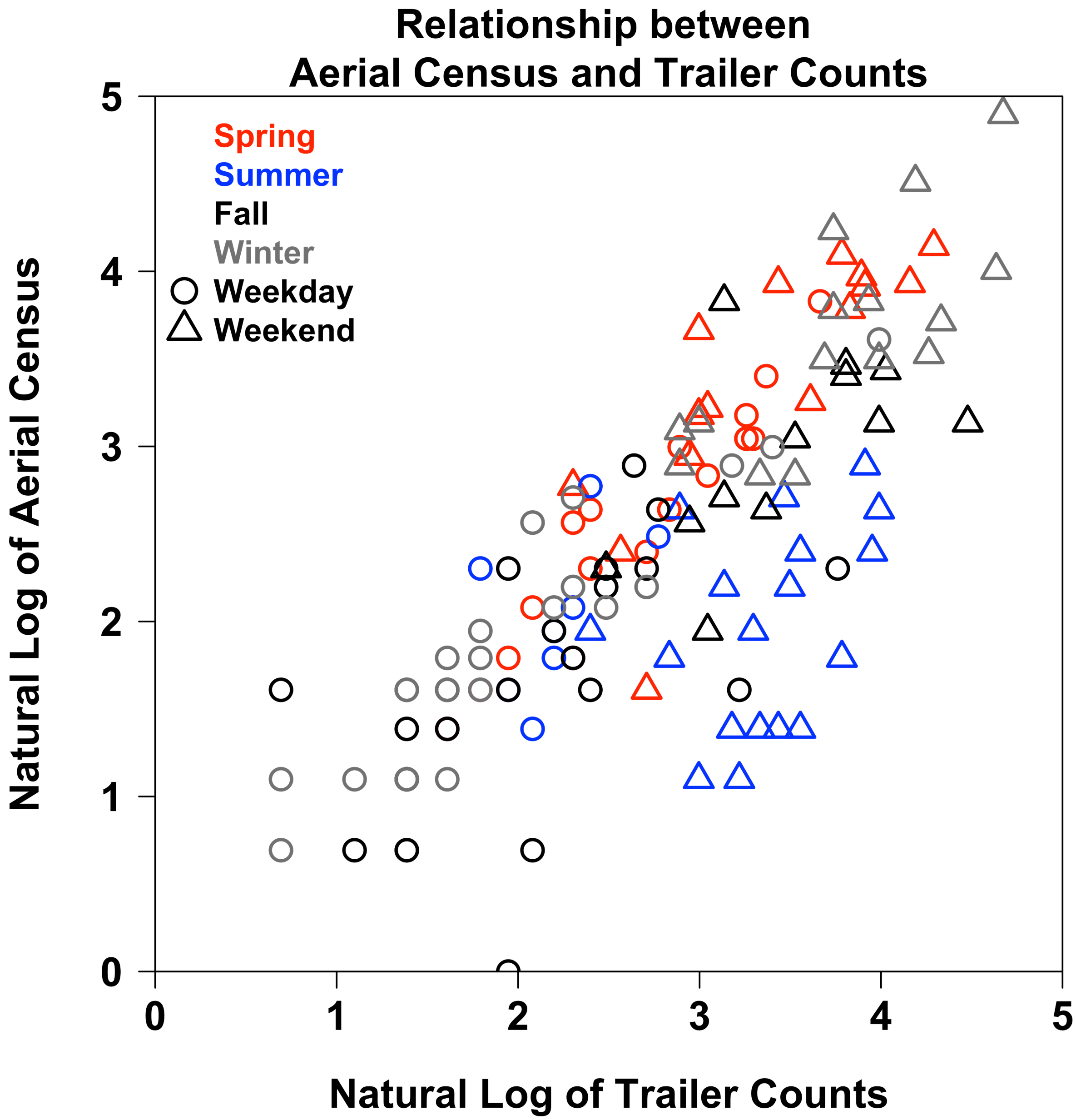

Figure 1: Relationship between aerial census counts of angling boats and trailer counts observed from most proximate time-lapse digital camera photos on concurrent sample reservoir.

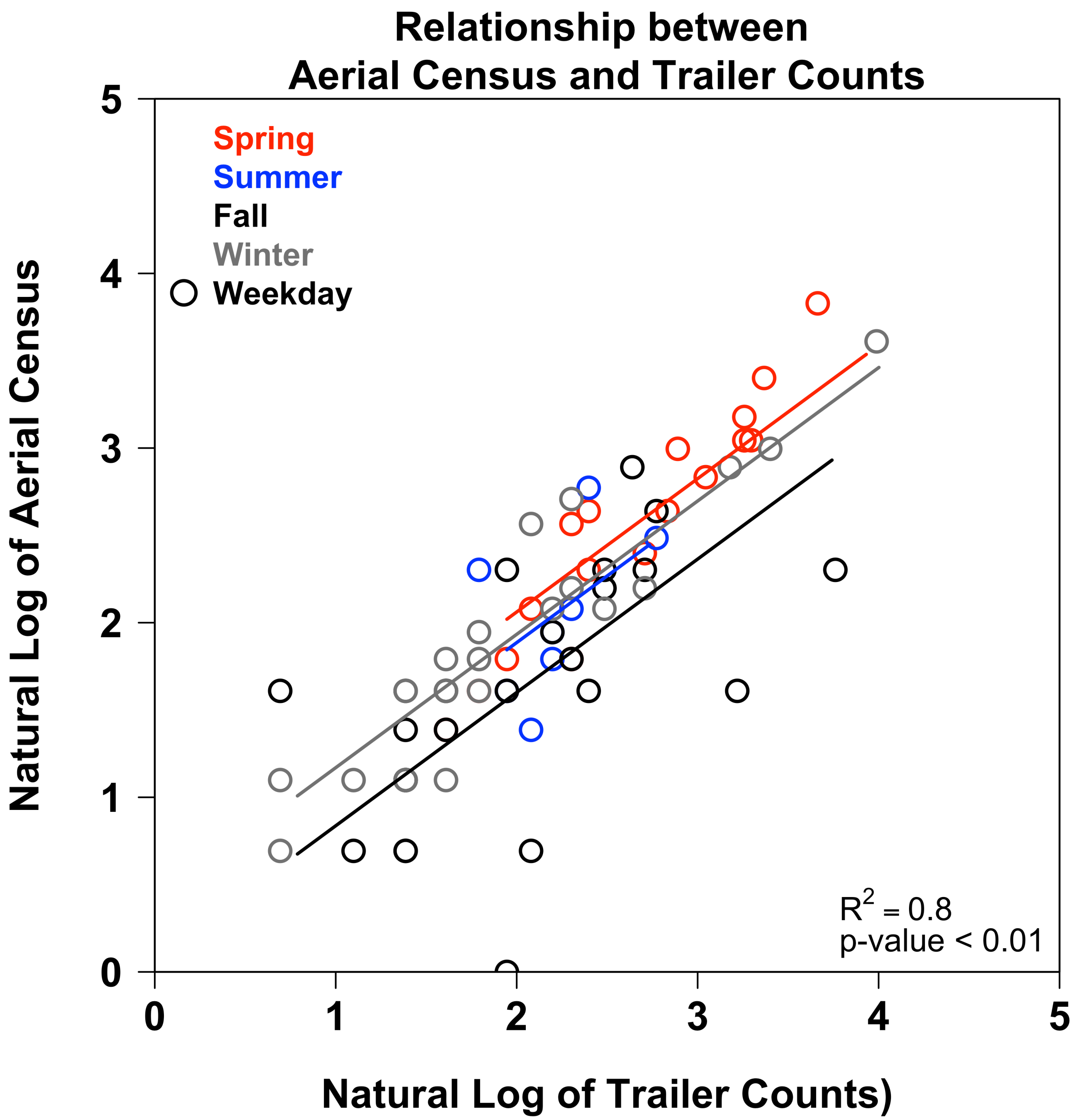

Figure 2: Relationship between weekday aerial census counts of angling boats and trailers counts observed from most proximate time-lapse digital camera photos on current sample reservoir. Best fit model composed of an interaction of day type (weekday vs weekend) x trailer count with an additive effect of season.

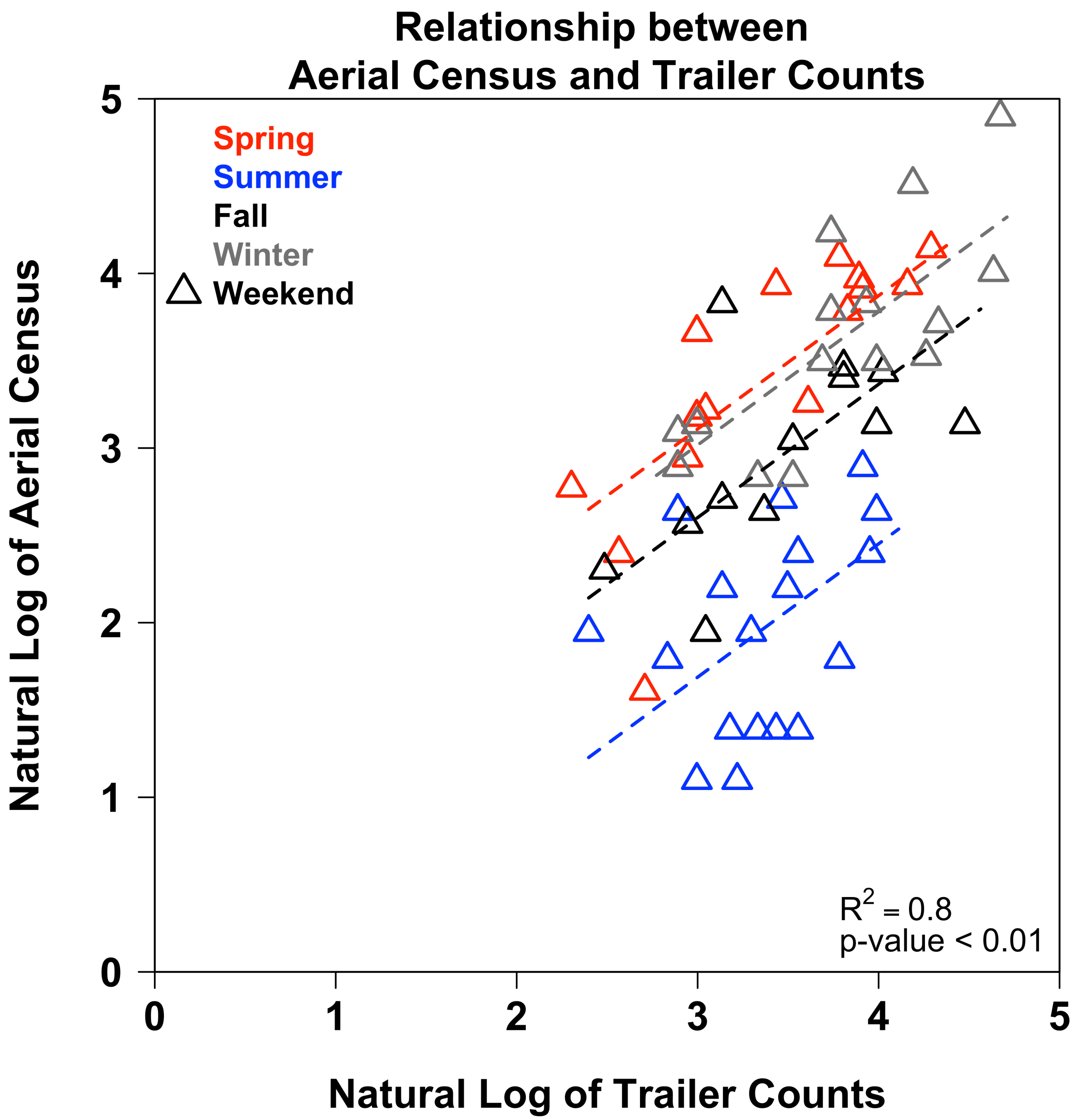

Figure 3: Relationship between weekend aerial census counts of angling boats and trailers counts observed from most proximate time-lapse digital camera photos on current sample reservoir. Best fit model composed of an interaction of day type (weekday vs weekend) x trailer count with an additive effect of season.

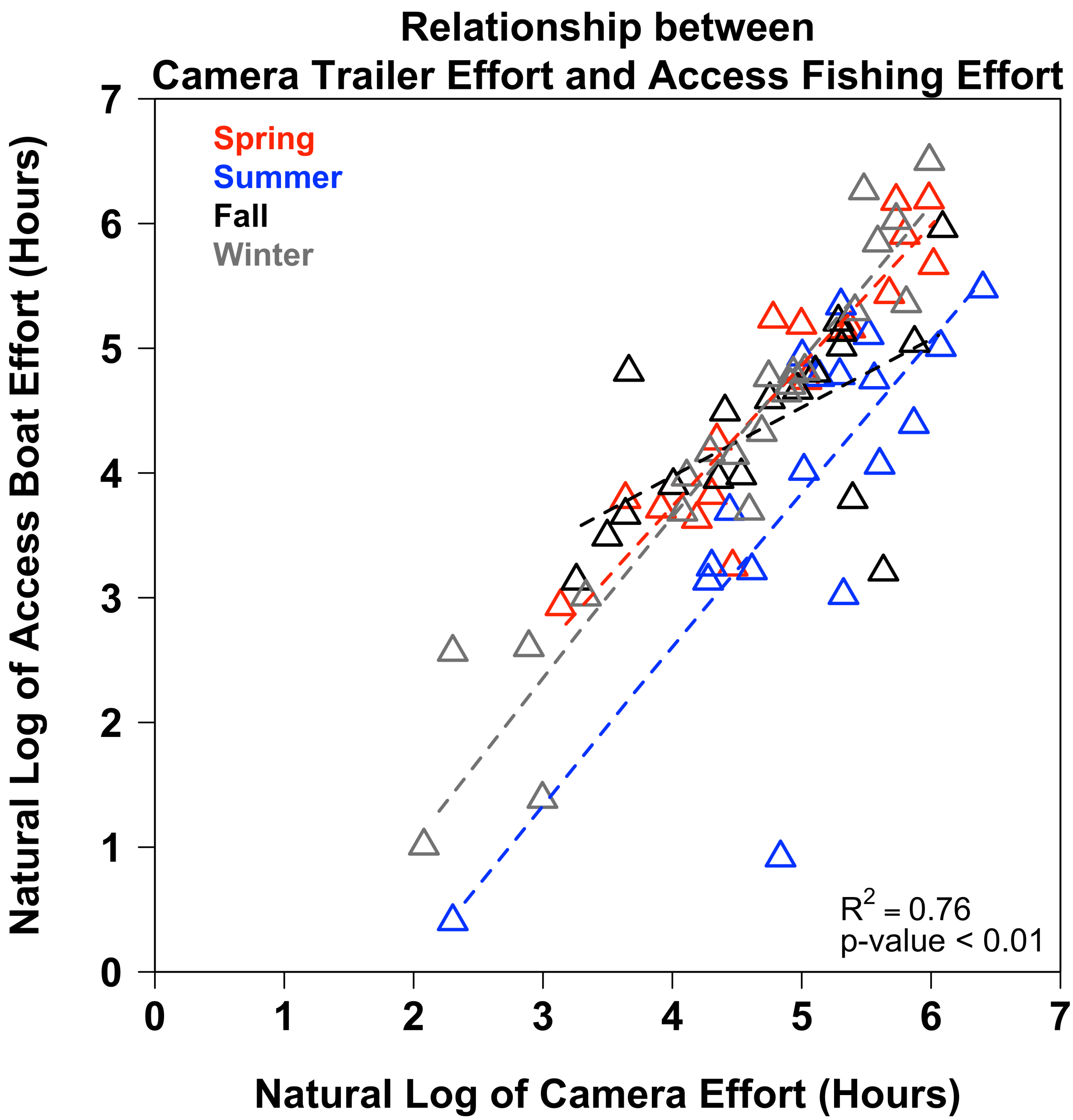

Figure 4: Relationship between camera trailer effort from all camera located at the ramp that the concurrent access creel survey was located and access fishing boat effort. Best fit model composed of a linear model with an interaction of season x camera effort.

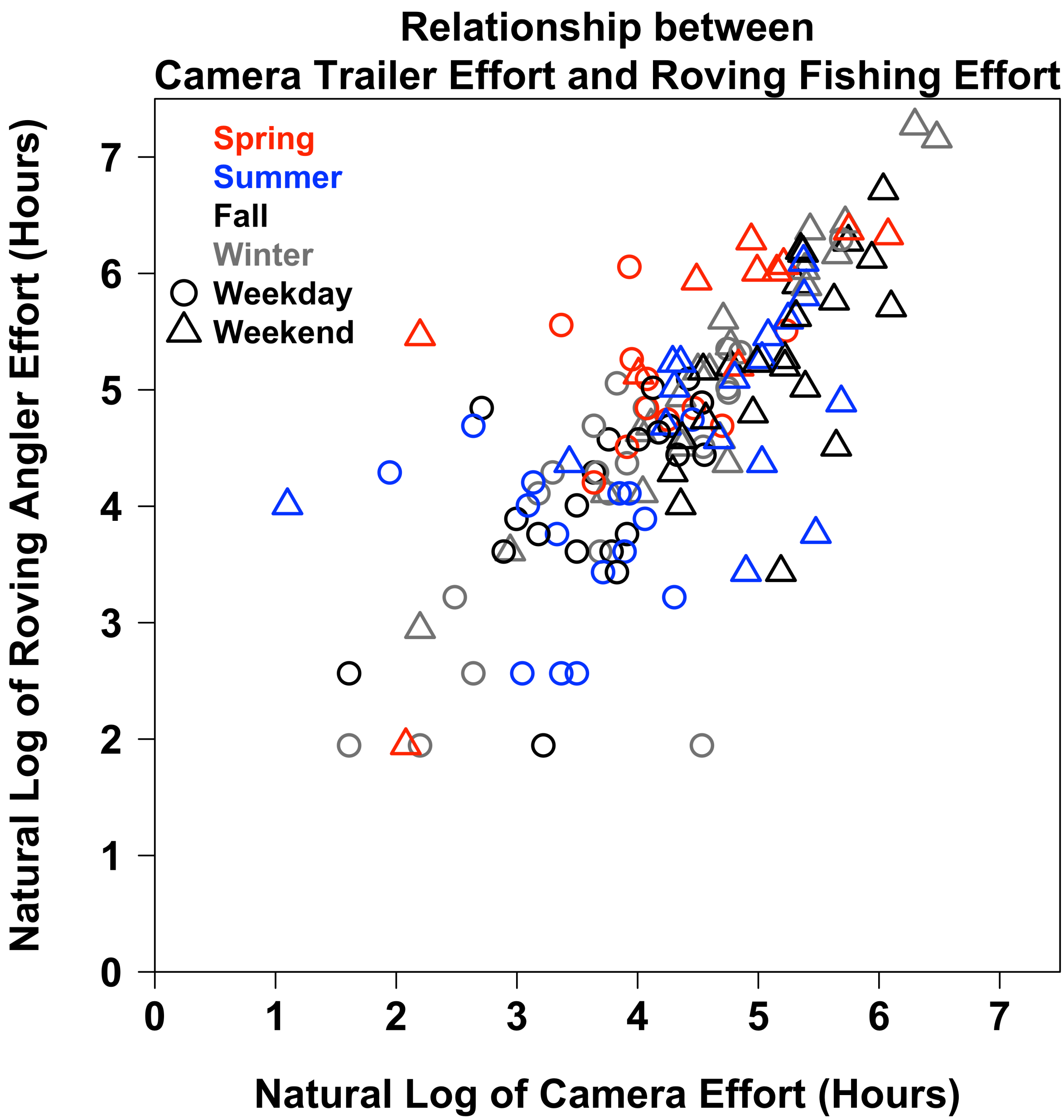

Figure 5: Relationship between camera trailer effort and roving fishing effort from concurrent samples.

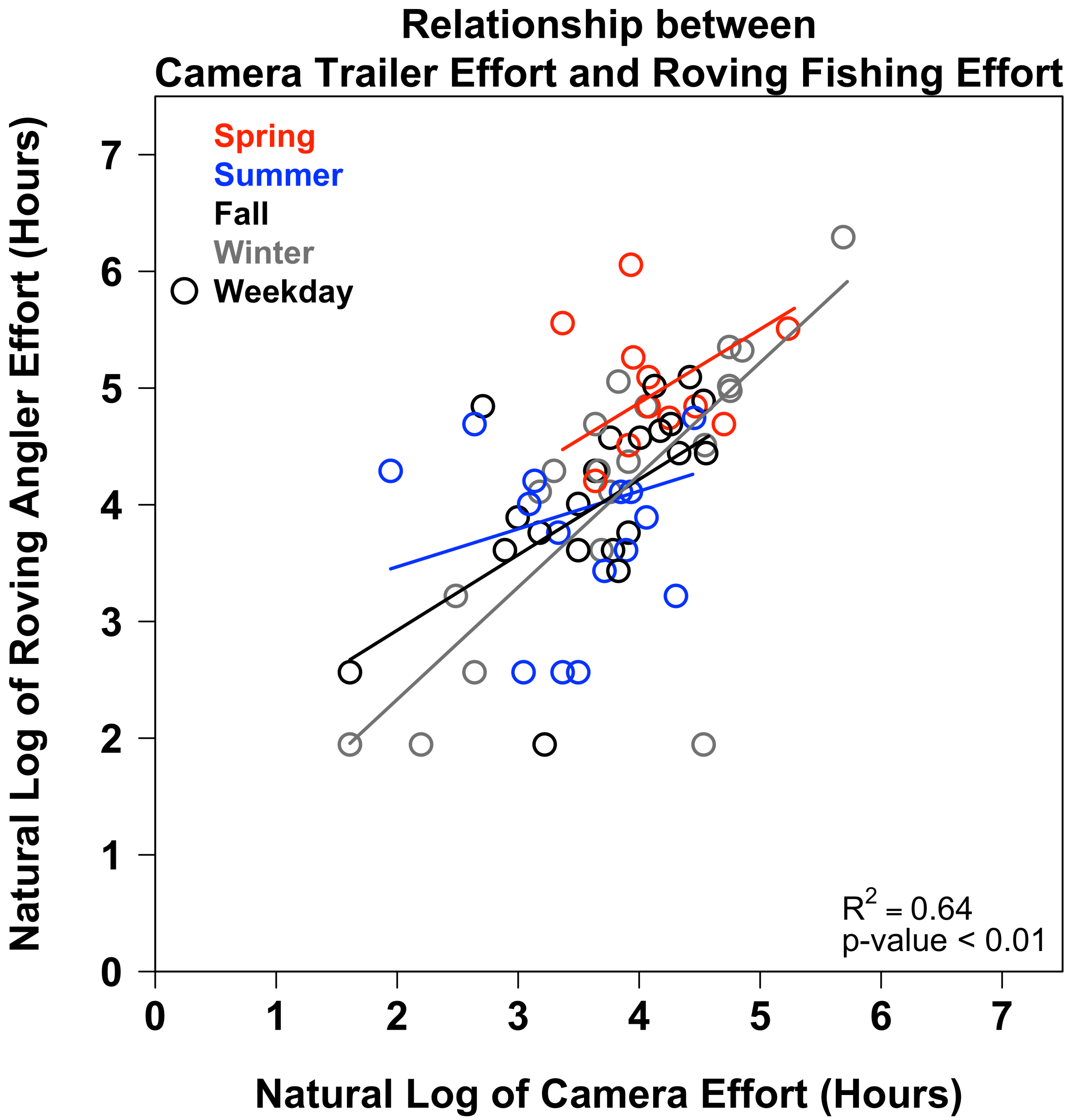

Figure 6: Weekday relationship between camera trailer effort and roving fishing effort from concurrent samples. Linear model incorporating a season x camera interaction with an additive effect of day type best explain our data.

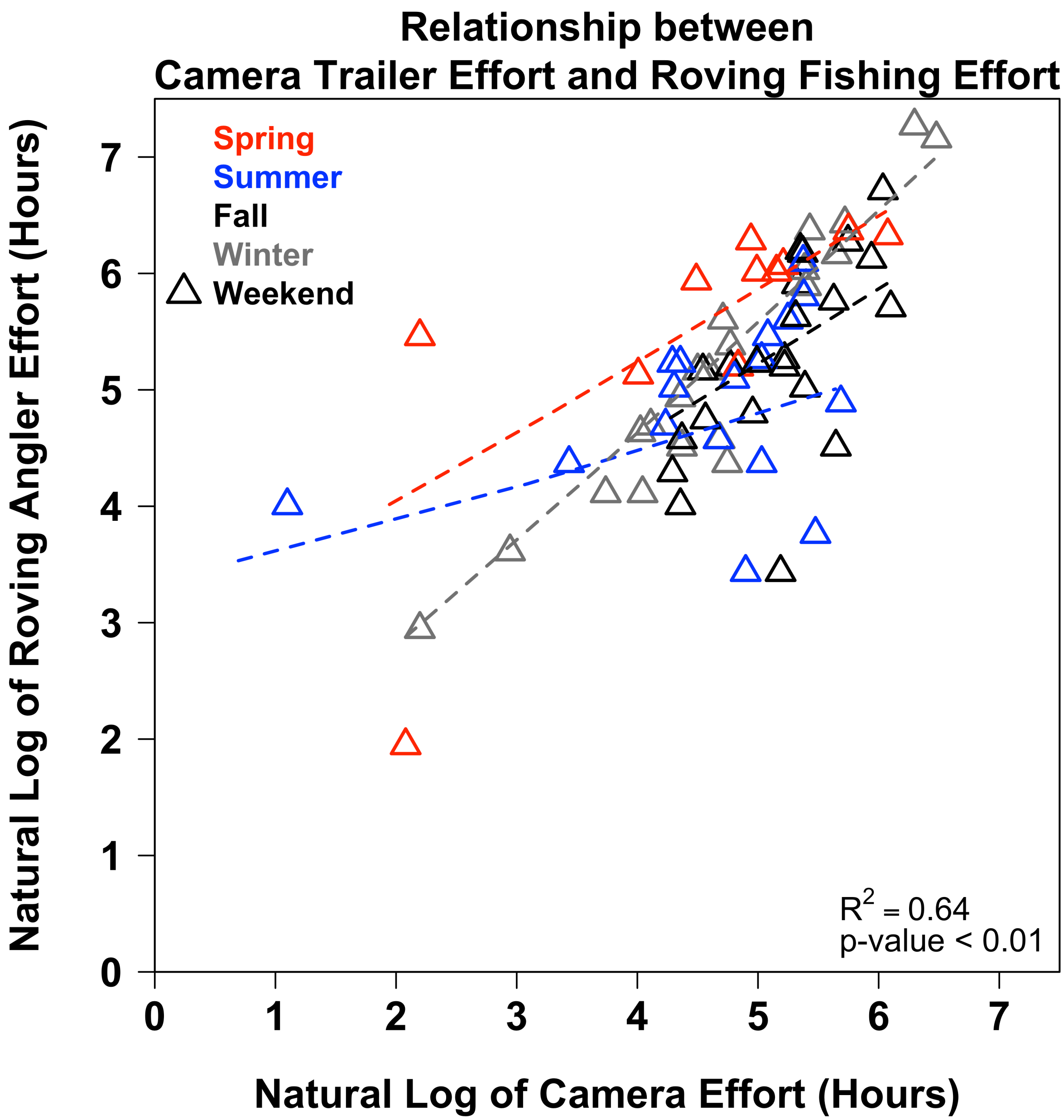

Figure 7: Weekend relationship between camera trailer effort and roving fishing effort from concurrent samples. Linear model incorporating a season x camera interaction with an additive effect of day type best explain our data.

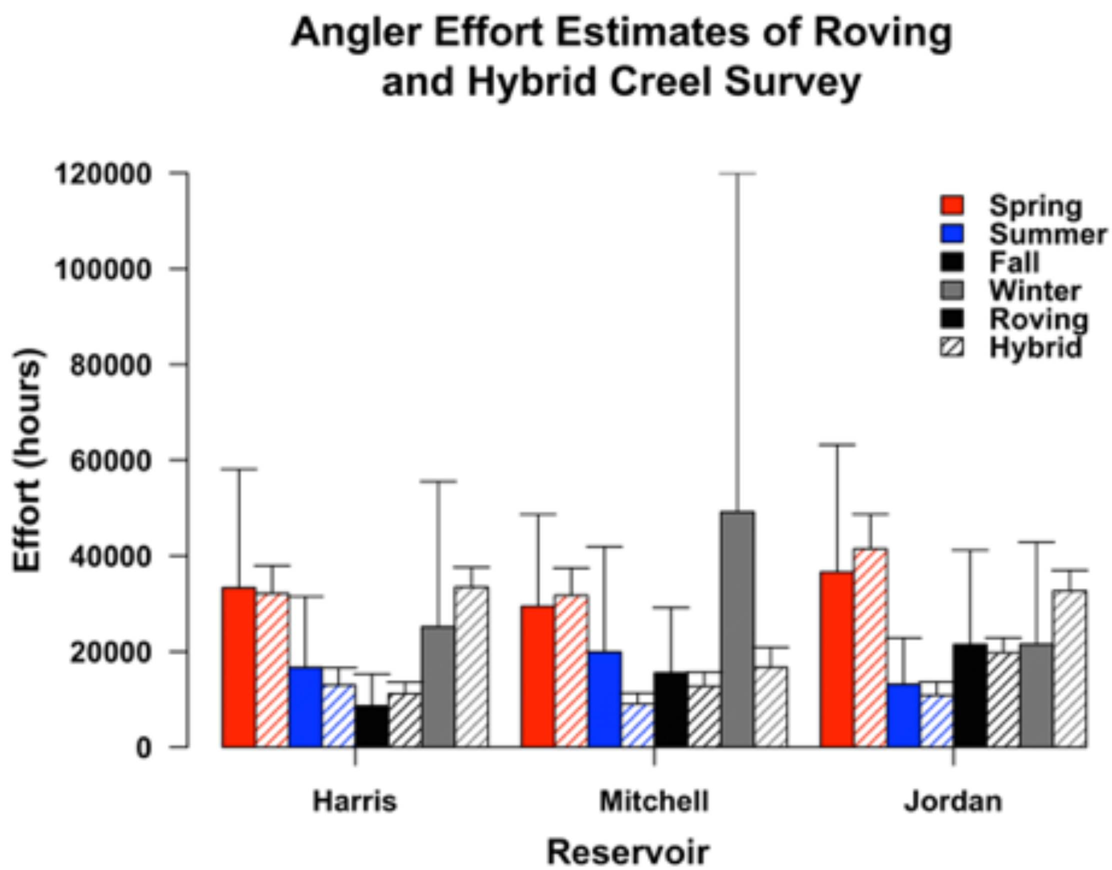

Figure 8: Angler effort estimates for pure roving creel survey and hybrid roving/camera creel expanded over seasons with standard error bars.

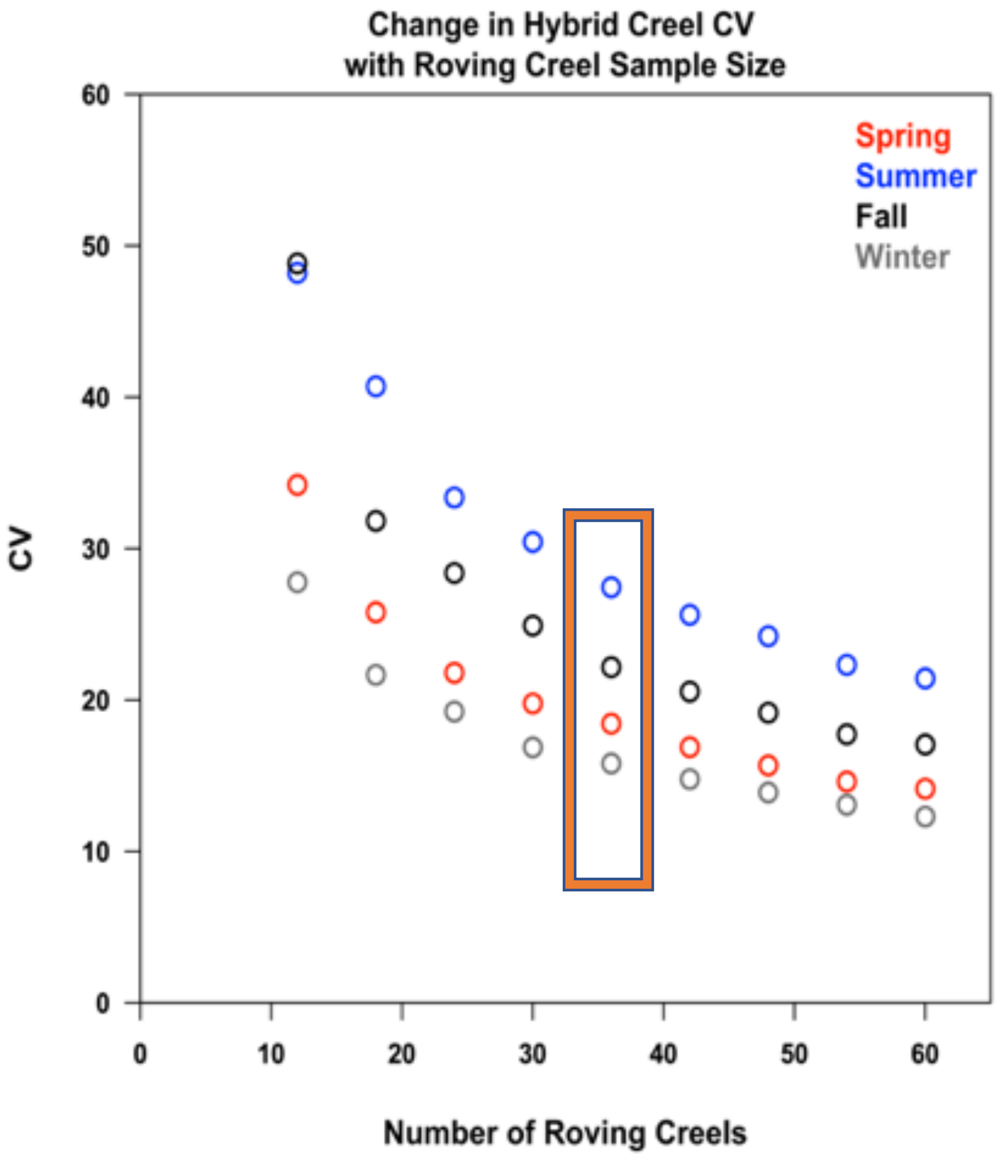

Figure 9: Coefficient of variation as a function of the number of days on which roving creel surveys were conducted in a hybrid survey design that included boat ramp trailers counts from time-lapse digital cameras on days that roving creels were not conducted. Different colors represent seasonality. The orange box signifies the baseline frequency of roving creels that was used during the data collection phase of this analysis. All other data points were obtained via resampling under a range of simulated roving creel frequencies.

VII. Appendix

Auburn Access Angler Survey

Reservoir:
Ramp:

Date: / / **Survey Time:** _______ **Trailers Start:**_______ **Angler Count:**______
Weather:____________ **Trailers End:**________ **Clerk:**_____________

		Angler Time	BLK Bass Harvest				BLK Bass Relsd.			Crappie Harv		Crappie Rel		Sunfish Sp.		Catfish		Other				Res/NonResident Non/Tourn/Prefish Angler/Pontoon/Shore Angler
#	No.	Start/End	Hrs	<13	>13	>16	<13	>13	>16	Hrs.	>9	<9	>9	Hrs.	No.	Hrs.	No.	Species	Hrs.	No.	Zone	Shoreline/Drop-Off/Open Water
1																						R N / NT T P / A P S / S D O
2																						R N / NT T P / A P S / S D O
3																						R N / NT T P / A P S / S D O
4																						R N / NT T P / A P S / S D O
5																						R N / NT T P / A P S / S D O
6																						R N / NT T P / A P S / S D O
7																						R N / NT T P / A P S / S D O
8																						R N / NT T P / A P S / S D O
9																						R N / NT T P / A P S / S D O
10																						R N / NT T P / A P S / S D O
11																						R N / NT T P / A P S / S D O
12																						R N / NT T P / A P S / S D O
13																						R N / NT T P / A P S / S D O
14																						R N / NT T P / A P S / S D O
15																						R N / NT T P / A P S / S D O
16																						R N / NT T P / A P S / S D O
17																						R N / NT T P / A P S / S D O
18																						R N / NT T P / A P S / S D O
19																						R N / NT T P / A P S / S D O
20																						R N / NT T P / A P S / S D O

Eckelbecker **Air Temp Start:**____ **End:** _____ **H20 Temp:**______ **Wind Speed:**_________ **Cloud Cover:**_________ **Page___ of ___**

Boats Missed: Rec. Boats:

Anglers Missed: Rec. Pontoons:

A-1: Blank datasheet used for access creel survey samples.

Auburn Roving Angler Survey

Reservoir:

Date: / / **Survey Time:** ____________ **Angler Count:**_________

Weather:____________ **Weekday** **Weekend** **Clerk:** _______________

			Angler Time	BLK Bass Harvest				BLK Bass Relsd.			Crappie Harv		Crappie Rel		Sunfish Sp.		Catfish		Other			Ramp	Res/NonResident Non/Tourn/Prefish Angler/Pontoon/Shore Angler
#	GPS	No.	Start/End	Hrs	<13	>13	>16	<13	>13	>16	Hrs.	>9	<9	>9	Hrs.	No.	Hrs.	No.	Species	Hrs.	No.	Used	Shoreline/Drop-Off/Open Water
1																							R N / NT T P / A P S / S D O
2																							R N / NT T P / A P S / S D O
3																							R N / NT T P / A P S / S D O
4																							R N / NT T P / A P S / S D O
5																							R N / NT T P / A P S / S D O
6																							R N / NT T P / A P S / S D O
7																							R N / NT T P / A P S / S D O
8																							R N / NT T P / A P S / S D O
9																							R N / NT T P / A P S / S D O
#																							R N / NT T P / A P S / S D O
#																							R N / NT T P / A P S / S D O
#																							R N / NT T P / A P S / S D O
#																							R N / NT T P / A P S / S D O
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#																							R N / NT T P / A P S / S D O
#																							R N / NT T P / A P S / S D O
#																							R N / NT T P / A P S / S D O

Eckelbecker **Air Temp Start:**____ **End:** _____ **H20 Temp:**______ **Wind Speed:**_________ **Cloud Cover:**_________ **Page___ of ___**

Boats Missed: Non-fishing Rec Boats: Stationary Rec:

Anglers Missed: Non-fishing Pontoons: Stationary Pontoon:

A-2: Blank datasheet used for roving creel survey samples.

Date: / /		**Weekday**	**Clerk:________**
Weather:		**Weekend**	

Harris:	**Start Time:_______**						
	End Time:________						
		1	2	3	4	5	6
	Angler Boats						
	Angler Pontoons						
	Boats Moving						
	NF Boats						
	NF Pontoons						
	Shore Anglers						

Comments:

Jordan:	**Start Time:_______**						
	End Time:________						
		1	2	3	4	5	6
	Angler Boats						
	Angler Pontoons						
	Boats Moving						
	NF Boats						
	NF Pontoons						
	Shore Anglers						

Comments:

Mitchell:	**Start Time:_______**						
	End Time:________						
		1	2	3	4	5	6
	Angler Boats						
	Angler Pontoons						
	Boats Moving						
	NF Boats						
	NF Pontoons						
	Shore Anglers						

Comments:

A-3: Blank datasheet used for aerial census counts