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**An angler and creel survey of the walleye (*Sander vitreus*) fishery at Summersville
Reservoir, West Virginia**

Dustin Shane Wichterman

**Thesis Submitted to the Davis College of Agriculture, Natural Resources, and
Design
at West Virginia University
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for the degree of
Master of Science
in
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**Key Words: Angler Creel Survey, Catch and Harvest Rates, Summersville Lake,
WV, Human Dimensions, Demographics, Angler Satisfaction**

Abstract

An angler and creel survey of the walleye (*Sander vitreus*) fishery at Summersville Reservoir, West Virginia

Dustin Shane Wichterman

Catch and harvest information and angler attitudes are important for management of the walleye fishery of Summersville Reservoir, WV, especially given previous estimates of high harvest proportions and low growth rates of walleyes. I used data from angler and creel surveys from November 28, 2008-October 31, 2009 to estimate monthly catch rates, harvest rates, total effort, and total catch of walleyes. Estimates were partitioned by boat anglers, bank anglers, anglers targeting walleyes, and all anglers. Also, angler attitudes were documented for fishing trip satisfaction and the sizes of “keepable” and trophy fish. A total of 84 survey days yielded 165 interviews (111 boat anglers, and 54 bank anglers). Boat angler surveys mostly represented completed trips (98 of 111 interviews), and bank angler surveys were primarily incomplete trips (40 of 54). Walleyes caught during our survey period rarely exceeded 381 mm (15 inches), and most (74.5%) were harvested. Catch rates, harvest rates, and estimates of effort and catch for walleyes were highest during December and March. Boat anglers had higher catch rates and harvest rates than those of bank anglers during all months, except March. A large percentage of anglers indicated that 356 mm to 381 mm (14 to 15 inches) walleye were “keepable.” Anglers considered trophy walleyes to be 457.2-889 mm (18-35 inches). Angler satisfaction of fishing trips ranged from low (rank = 1) to high (rank = 9), with the highest amount of anglers reporting a rank of 1 (35 boat anglers, 17 bank anglers) and a rank of 3 (15 boat anglers, 9 bank anglers). Although anglers harvested a high percentage of the walleye catch, catch and harvest rates for most months were low relative to those reported from other walleye fisheries. Angler dissatisfaction at Summersville Reservoir is likely associated with the slow growth rates, small size structure, and lack of “trophy-sized” fish. Future research on walleye diets, food availability, and walleye movements (daily and seasonal) would be useful toward answering questions about the slow growth rates and the small-size structure of walleyes within Summersville Reservoir.

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Table of Contents

Abstract	ii
Acknowledgements	iii
Table of Contents	iv
Table of Figures	vi
List of Appendices	viii
Chapter 1: Literature Review	1
Contents of the thesis	1
Why creel surveys are used	1
Analysis of data	4
Human Dimensions	5
Limitations with creel surveys: Ratio of means vs. means of ratios	6
Target species	8
Walleye Management: Catch, Harvest, and Effort	9
Study area: Summersville Lake	10
Literature cited	12
Chapter 2: An angler and creel survey of the walleye (<i>Sander vitreus</i>) fishery at Summersville Reservoir, West Virginia	16
Introduction	16
Methods	18
Angler survey methods	18
Creel and angler survey questions	19
Analysis: Catch rate and harvest rate estimation	20
Direct expansion of effort and catch from boat and bank angler data	20
Results	21
Catch rates, harvest rates, and harvest lengths	22
Total fishing effort and total catch from boat and bank angler data	23
Angler attitudes	25
Angler-reported information from previous fishing trips	26
Additional questions	26
Discussion	27

Literature cited.....	34
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List of Figures

Figure 1. Summersville Reservoir and the locations of access roads and boat ramps.	37
Figure 2. Geographic distribution of angler residences (zip codes). Zip codes of four non-resident anglers were not plotted (Belpre, OH; Elyria, OH; Humble, TX; and Manor, TX).....	39
Figure 3. Number of walleyes caught and harvested by month at Summersville Reservoir based on creel and angler surveys. Surveys were not conducted for November and August; no walleyes were reported during September surveys.	40
Figure 4. Length frequency of walleyes caught by boat and bank anglers based on fish measured during the creel survey.	40
Figure 5. Lengths considered by anglers to be “keepable” walleyes.....	41
Figure 6. Lengths considered by anglers to be “trophy” walleyes.	41
Figure 7. Angler responses to (A) changes in the overall walleye fishery during the last five years, and (B) changes to the size of walleyes during the last five years.....	42
Figure 8. Angler opinions on changes to the walleye fishing regulations, such as (A) size limits, (B) bag limits, and (C) size and bag limits.	42
Figure 9. Rank of angler satisfaction of the fishing trip (on the day of interview), where a rank of 1 means extremely dissatisfied and a rank of 9 means extremely satisfied.	43
Figure 10. Percent of walleye harvested from all walleye caught.	43
Figure 11. Percent of all walleye caught greater than 15 inches.	44
Figure 12. Percent of walleye kept from walleye caught greater than 15 inches.	44

List of Tables

Table 1. Residences of surveyed anglers and the estimated time (min) and distance (km) of travel to Summersville, WV.	45
Table 2. Percent of anglers that targeted four fisheries (walleye, black bass, crappie, and sunfish) or did not target a specific fishery (Any species) within Summersville Reservoir.	47
Table 3. Frequency of any species, black bass, and walleye fisheries targeted by month (November 2008-October 2009).The November period represents two survey days. There were no surveys during the month of August.	47
Table 4. Monthly catch rates and harvest rates of anglers targeting walleye estimated from boat (complete trips) and bank (incomplete trips) angler survey data at Summersville Reservoir, WV. Number of interviews followed by standard error are given in parentheses. An asterisk (*) indicates that no anglers were encountered during the survey period.	48
Table 5. Monthly catch rates and harvest rates for all anglers estimated from boat (complete trips) and bank (incomplete trips) angler survey data from Summersville Reservoir, WV. Number of interviews followed by standard error are given in parentheses. An asterisk (*) indicates that no anglers were encountered during the survey period.	49
Table 6. Total fishing effort and total catch for boat anglers estimated with angler survey data from Summersville Reservoir, WV. Standard errors are given in parentheses. An asterisk (*) indicates that no anglers were encountered during the survey period.	50
Table 7. Total fishing effort and total catch for bank anglers estimated with angler survey data from Summersville Reservoir, WV. Standard errors are given in parentheses. An asterisk (*) indicates that no anglers were encountered during the survey period.	51
Table 8. Total fishing effort and total catch for all anglers (boat and bank anglers combined) estimated with angler survey data from Summersville Reservoir, WV. Standard errors are given in parentheses. An asterisk (*) indicates that no anglers were encountered during the survey period.	52
Table 9. Comparison of walleye catch and harvest rates for all anglers (boat anglers, bank anglers, weekday and weekend combined) for two West Virginia reservoirs. An asterisk (*) indicates no available information..	53
Table 10. Expanded effort (hours) estimated from the number of parked vehicles (which also included an unknown proportion of vehicles associated with non-angling activities). The months of August and November were not sampled.	54

List of Appendices

Appendix A. Core and additional questions of the angler and creel survey at Summersville Reservoir.....	55
Appendix B. Data collected prior to each angler survey at Summersville Reservoir.....	57
Appendix C. Daily weather and water conditions for angler surveys on Summersville Reservoir (NM = water temperature not measured).	61
Appendix D. Counts of vehicles (VC) and bank anglers (BA) from angler surveys at Summersville Reservoir.....	64

Chapter 1: Literature Review

Contents of the thesis

This thesis includes a review of the literature on creel and angler surveys (Chapter 1) and a manuscript from an angler and creel study of the walleye fishery of Summersville Lake, WV (Chapter 2). Chapter 1 reviews angler and creel surveys, analysis methods, human dimensions information, and limitations of creel surveys. Chapter 1 also summarizes the species of interest (walleye) and the study area (Summersville Lake) for the angler and creel study of Chapter 2. The manuscript of Chapter 2 reports catch and harvest rates of walleyes, total effort of anglers and total catch of walleyes, and angler attitudes associated with the walleye fishery at Summersville Lake, WV.

Why creel surveys are used

Data from creel and angler surveys are useful for evaluating fisheries and fishery regulations, and aiding fishery management decisions (Matlock 1991). Creel surveys provide estimates related to catch and harvest, such as angling success, the proportion of fish released alive or harvested, and mean length at harvest (Baccante and Colby 1991). Additionally, angler surveys include information on human dimensions, such as angler demographics, opinions, and expectations (Pollock et al. 1994, Malvestuto 1996).

Angler and creel survey data aid fisheries professionals with management decisions for specific fisheries and specific bodies of water. Surveys provide catch and harvest data for specific angler groups, such as boat anglers versus bank anglers, or anglers targeting single species versus those targeting multiple species. Data from angler and creel surveys on diverse groups of anglers, as well as the differential effort, catch

rates, and harvest rates of angler groups, provide important information for managing a fishery (Pollock et al. 1994). One must have knowledge of available resources in order to correctly manage and utilize the resources (Rawson 1957, Matlock 1991). Creel surveys measure resource use through public interactions, and allow a variety of fishery parameters to be estimated, including catch rates, harvest rates, total effort, and total catch.

How creel surveys are used

Different methods are used for angler and creel surveys depending on available funding, personnel, and research questions. The size of the study area also influences the study design of an angler or creel survey. Methods include both passive and active techniques to obtain angler and creel survey information. Study designs and methods can be simple or complex. For example, mail surveys involve sending sampling forms to angler's residences, and do not require extensive sampling efforts. Access point surveys are more labor-intensive where creel clerks intercept anglers during or after fishing trips (Pollock et al. 1994).

When sampling the recreational creel, one must consider size and access of the study area. For example, if there is only one site, then the clerk would likely choose a single-access design. However, if a study area has multiple sites then one may choose to use a roving creel survey or a multiple access point method, where the clerk conducts interviews at multiple sites. Most methods allow for estimation of catch and harvest rates, total catch, and total effort, but it is important to select a method relevant to the sampling area (Pollock et al. 1994). For the Summersville Lake study (Chapter 2), I used a roving design for bank angler interviews, and a multiple access point design to interview boat

anglers at boat ramps. Bank angler interviews primarily represented incomplete trips, and boat angler interviews were predominantly completed trips. This was because I interviewed bank anglers while they were actually fishing and boat anglers as they were coming off of the water from a day of fishing.

Randomized survey designs are used to reduce bias in estimates of catch rates, harvest rates, total effort, and total catch (Pollock et al. 1994). Also, Malvestuto et al. (1978) discussed the importance of non-uniform probability sampling. Specifically, sampling units are often stratified into days, months, or years. Deroba et al. (2007) suggested that studies should be stratified seasonally to account for temporal variability. Angler and creel surveys are often stratified by weekends and weekdays because angler effort is often higher on weekends (Austen et al. 2007, Deroba 2007).

With roving creel surveys, the creel clerk moves from site to site during one or more sampling periods within a sampling day. Sampling periods within a single day are often randomized. The number of interviews often differs among morning, midday, and evening time periods. One study found that most interviews were taken in the latter part of the day (Deroba et al. 2007). Studies that use random sampling throughout the entire day reduce biases associated with time of day (Malvestuto et al. 1978, Hayne 1991, Beard et al. 1997).

As mentioned previously, angler and creel surveys are used to estimate total catch, total harvest, catch and harvest rates, and total effort for a sample area. Total catch is the number of fish caught in the sample area over a particular period of time. Harvest is the total number of individuals kept or harvested over a particular amount of time. Catch

and harvest rates are often estimated as means of the total number of fish (caught or harvested) divided by effort (the total number of hours fished; Pollock et al. 1994).

It is important to consider how information on groups of anglers is recorded, as a fishing party or individually. If the information is obtained for a group, then one must multiply the effort hours by the number of individuals present (Vandevalk et al. 2007). This allows the clerk to obtain estimates of the catch, harvest, and effort of the particular group without singling out individuals for interviews. Also, this can provide more time for interviews of other parties.

Analysis of data

Two of the most commonly used methods for analysis of creel survey data are the ratio of means method, and the means of ratio method. The ratio of means method is used to find the actual amount of catch for each day in the sample, and is often used for completed trip data. The catch rate is calculated by dividing the total daily catch by the total daily effort of all anglers. The means of ratios method estimates the average angler catch, and is used for incomplete fishing trips. Therefore, the selection of which method depends on the type of sampling used (incomplete versus complete trips). Access point surveys work well with the ratio of means method because data often represent completed fishing trips. Roving surveys work well with means of ratio method because the creel clerk is interviewing anglers during a fishing trip (which represents incomplete fishing trip data; Hayne 1991, Pollock et al. 1994, Jones et al. 1995, Rasmussen et al. 1998).

The choice of estimator is also based on the objectives of the study. Jones et al. (1995) found that when the objective is to produce a measure of angler satisfaction, it is

best to use the means of ratio method. However, when total catch is the target they found it depends on whether or not the fishery can be sampled with equal probability. Both estimates were found to have had decreased bias when over 100 anglers were interviewed, so a large sample size will produce better estimates (Jones et al. 1995, Austen et al. 2007). The ratio of means estimator has been found to have less bias than the other method, especially in the case that the means of ratio estimators have several trips with short durations. These shorter trip lengths can cause variances to be unstable (Lockwood 2004, Keefe et al. 2009).

Human Dimensions

The field of human dimensions is described as the science of using the thoughts and attitudes of the general public in making wildlife and fisheries management decisions (Wilde et al. 1996, Manfredo et al. 1998). In a general sense, human dimension data focus on the angler instead of the fish. For example, angler demographics provide information on angler residences, and on the proportion of in-state versus out-of-state anglers using a fishery (Churchill et al. 2002). Angler survey questions that address opinions on regulation changes, such as size limits and bag limits, are useful to fishery management decision-making processes (Matlock 1991). Also, data from survey questions on angler expectations, such as sizes of “keepable” and “trophy” fish are useful toward regulation changes. Human dimensions data gathered from surveys can be as important to fisheries management as biological data in some instances (Wilde et al. 1996). These data can allow decision makers to make choices that more strongly support their constituency’s thoughts and opinions, and by combining this information with

biological data one can provide a much more satisfied community of anglers (Wilde et al. 1996, Churchill et al. 2002).

Angler attitudes are important aspects of human dimensions data, such as attitudes about changing regulations, trophy sizes, stocking, or harvestable fish sizes (Churchill et al. 2002, Simson 2008). Wilde et al. (1996) found that most fisheries agencies (>50%) thought that support of regulations, angler attitudes and opinions, satisfaction, and economic information ranked among the highest importance as human dimensions information.

Limitations with creel surveys: Ratio of means vs. means of ratios

Numerous studies have been conducted to examine the relationship between ratio of means and means of ratios estimators (Fierstine et al. 1978, Lockwood et al. 1999, Lockwood 2004, Keefe et al. 2009). Some have expressed concern about the potential for bias associated with the means of ratios equation, because catch rate and total catch are based on incomplete trips, essentially extrapolating an amount based upon what the angler has caught previously. This equation also is based upon the assumption that the amount of fish caught per hour does not change. If the number of fish caught increases or decreases after the initial interview, then the equation can provide biased estimates (Pollock et al. 1994, Lockwood 2004, Keefe et al. 2009).

There are many assumptions associated with angler and creel surveys. An important assumption is that anglers accurately recall their catch totals. Catch and harvest rates are based upon angler recollection. Anglers often over or underestimate catch, harvest, and effort (Malvestuto et al. 1978, Mallison and Cichra 2004). Therefore, this must be taken into consideration when interviewing anglers. Lengths of fishing trips must

be correctly determined, and clerks must measure this in a consistent manner. Rates can be skewed because of angler experience, and fishing trips are assumed to have uniform catch and harvest rates during the trip. If assumptions are violated, then estimates are likely to be biased.

Another factor to consider with both incomplete and complete fishing trips is the length of the fishing trip at the time of the interview. Phippen and Bergsen (1987) debated that fishing time could either be considered from the time the angler left the car, or could be measured as the amount of time that fishing lines are in the water. One must consider such factors, while also acknowledging that the estimate is based from the angler's memory and could be exaggerated (Malvestuto et al. 1978).

Both catch and harvest rates can be biased because of differential angling abilities. Experienced anglers often catch more fish (Baccante et al. 1995, Jones et al. 1995). VanDeValk et al. (2007) found that larger party sizes often reduce estimates of catch rates. Also, some angler groups practice catch and release fishing, whereas others do not (Ker 2007). If study objectives are focused on the total angling population, but data are based on a specific group, then harvest rates could be over or underestimated.

Angler catch and harvest rates do not always reflect population density as expected. For instance, VanDeValk et al. (2005) found that angler catch rates for walleye are not always related to population abundance, and that catch rates can vary based upon the competition for available resources. They found that when prey abundance declined, then walleyes became more susceptible to angling. Also, anglers caught a greater amount of fish during periods of lower walleye abundance. However, Beard et al. (1997) suggested that walleye catch rates are proportional to walleye density. This relationship

was also supported by Serns and Kempinger (1981), who also found that older walleyes were less vulnerable to angling.

All of the aforementioned variables must be taken into consideration in order to conduct a successful creel survey. Catch rate estimators can vary on the amount of bias associated with them. Angler recollection can play an important role on how viable the information is. The length of the time the angler spends fishing the area can affect catch rates as well. The abilities and techniques used by anglers can produce varying results, and have the potential to create bias in both directions. Also, when managing the resource, agencies must take into consideration the fact that not all catch rates reflect population abundances. Careful examination of these variables will produce less bias.

Target species

For the study at Summersville Lake, the species of interest was the walleye (*Sander vitreus*), which are a highly sought after sport fish in many regions (Johnson et al. 1988, Mion et al. 1998). Walleyes support economical benefit through both sport and commercial fisheries (Rose et al. 1999). Walleye harvest rates are often high, because of their status as an excellent table fish (Palmer et al. 2005). Walleyes are affected by water clarity, temperature, habitat structure, and overall quality issues including pH (Lester et al. 2004). They prefer and proliferate in areas of good water quality, productive systems with low water clarity, and areas with good structure to provide baitfish habitat. Walleyes act as a terminal predator, and through predation have the ability to affect the population abundance and structure of many different prey species (Rose et al. 1999).

Walleyes occur in both lotic and lentic systems, and are stocked in many areas. The native distribution of walleye is generally limited to the natural lakes and rivers of

Canada and the northern United States (Carlander 1997, Zipfel 2006). However, reproducing populations exist in many rivers and lakes throughout the Mississippi drainage, and across the eastern and western United States (Mion et al. 1998, Ickes et al. 1999, Rose et al. 1999). Some bodies of water do not support walleye reproduction, and are stocked annually by agencies in order to please the public (Johnson et al. 1988).

Walleye Management: Catch, Harvest, and Effort

Estimates of catch rates of walleyes based on angler and creel surveys differ among regions and water bodies, including values of 0.04-0.56 walleye/hr for Island Lake Reservoir, MN (Frohnaue 2008), 0.04-0.47 walleyes/hr for Oneida Lake, NY (VanDeValk et al. 2005), and 0.20 walleye/hr in Northern Wisconsin (Beard et al. 1997). Harvest rate estimates also differ, with estimates reported as 0.03 walleyes/hr in Northern Wisconsin (Deroba et al. 2007), 0.65 walleyes/hr in Wisconsin (Staggs et al. 1990), and 0.84 walleyes/hr (Frohnaue 2008). Catch and harvest rates are affected by time of year, angling pressure, size and age structure, and angler specialization.

Catch and harvest of walleyes vary temporally, and tend to increase when water temperatures are cool. Walleyes move more frequently during cooler water periods, and may move from the pelagic areas to inland banks in an attempt to find prey, which increases their susceptibility to anglers. Catch rates often increase during the spawning period when fish congregate in smaller areas, and are more susceptible to angling (Olson 1958). Also, catch rates of walleyes often increase during their preferred foraging periods of early morning, late evening, and night (Lester et al. 2004).

Walleye catch and harvest differ during warm months due to increases in the amount of total anglers using the fishery. Many anglers do not have the ability or

equipment to successfully target walleye. Specialized groups of anglers, such as anglers that target walleyes, have the greatest angling success (Baccante 1995). Therefore, when there is an increase in unspecialized anglers it can cause catch and harvest rates to be biased based upon dilution of the catch rates (Baccante 1995, Jones et al. 1995).

Study area: Summersville Lake

Summersville Reservoir, located one mile south of Summersville, WV, is a 1052 hectare (2600 acre) impoundment on the Gauley River in south-central West Virginia and supports an established recreational walleye (*Sander vitreus*) fishery. The reservoir, impounded in 1966 for flood control, undergoes a draw-down period that begins each year during fall. During draw-down, reservoir elevation is lowered from 1652 to 1575 ft during mid September, and remains at low levels during winter. With increased rainfall and higher river discharges during spring, the lake is elevated during April (United States Army Corps of Engineers 2009). The reservoir has five boat ramps: the “Winter Ramp” near the dam, Salmon Run boat ramp, Long Point boat ramp, and two ramps at Battle Run. During draw-down, the Battle Run boats ramps are closed when reservoir elevations are < 1624 and 1649 ft, and the Salmon Run boat ramp is closed at a reservoir elevation ≤ 1639 ft. All boat ramps and adjacent areas are open to bank angling and the use of small boats year-round, except the Long Point boat ramp where the marina restricts bank fishing access.

Walleyes are targeted by boat and bank anglers during all months, but effort increases during the draw down period from fall through spring (Shingleton 1992, 1993). The reservoir also provides year-round fishing opportunities for several other game

fishes, including channel catfish (*Ictalurus punctatus*), rockbass (*Ambloplites rupestris*), smallmouth bass (*Micropterus dolomieu*), spotted bass (*M. punctulatus*), largemouth bass (*M. salmoides*), black crappie (*Pomoxis nigromaculatus*), white crappie (*P. annularis*), and bluegill (*Lepomis macrochirus*).

Summary

This first thesis chapter provided a review of angler and creel surveys, analysis methods, human dimensions information, and limitations of creel surveys. Also, this chapter summarized the species of interest (walleye) and the study area (Summersville Lake) for the angler and creel study of Chapter 2. The following manuscript (Chapter 2) reports catch and harvest rates of walleyes, total effort of anglers and total catch of walleyes, and angler attitudes associated with the walleye fishery at Summersville Lake, WV.

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Chapter 2: An angler and creel survey of the walleye (*Sander vitreus*) fishery at Summersville Reservoir, West Virginia

Introduction

Summersville Reservoir, a 1052 hectare (2600 acre) flood-control impoundment on Gauley River in south-central West Virginia, provides a year-round recreational walleye fishery for boat and bank anglers. An annual water level draw-down occurs during fall for flood-control, which influences angler access and walleye catch rates within the reservoir. The West Virginia Division of Natural Resources (WVDNR) manages the walleye fishery of Summersville Reservoir and sets regulations, based in part, on fishery dependent and fishery independent data. Current estimates of catch rates, harvest rates, total fishing effort, and total catch are needed to aid management decisions on the walleye fishery in Summersville Reservoir and these data are obtainable from creel and angler surveys (Pollock et al. 1994). Also, survey data on attitudes and demographics of anglers are desirable for making informed management decisions regarding the walleye fishery at Summersville Reservoir.

Angler access at Summersville Reservoir is influenced by annual water level draw-down and availability of boat ramps. Reservoir elevation is lowered from 503.5 m (1652 feet) to 480.1 m (1575 ft) during September, remains at low levels during winter (but fluctuates with rain events), and is elevated to pre draw-down levels during April. The reservoir has four boat ramps (Salmon Run, Long Point, Battle Run, and the “Winter Ramp” near the dam, Figure 1). During water level draw-down, the Battle Run boat ramp is dewatered at reservoir elevations below 495 m (1624 ft), and the Salmon Run boat ramp is closed at a reservoir elevation below 499.6 m (1639 ft). All boat ramps and

adjacent areas are open to bank angling and the use of small boats year-round, except the Long Point boat ramp where the marina restricts bank fishing access.

During the early 1980s and early 1990s, the WVDNR found that anglers harvested a high percentage of their catch, but estimated relatively low catch rates of walleye in Summersville Reservoir (Ramsey and Pierce 1981; Shingleton 1992, 1993). A creel survey in 1980 estimated a catch of 476 walleyes (412 fish or 87% harvested) during a three month period, April – June (Ramsey and Pierce 1981). Five additional creel surveys during April 1990 – October 1990, November 1990 – March 1991, April 1991 – October 1991, November 1991 – March 1992, and April – October 1992 estimated catches of 359 (66% harvested), 241 (77% harvested), 643 (81% harvested), 841 (62% harvested), and 593 (87% harvested), respectively (Shingleton 1992, 1993). Based on these surveys, catch rates of walleyes in Summersville Reservoir by all anglers (estimated as total catch divided by total effort) ranged from 0.008 to 0.148 fish per hour (Ramsey and Pierce 1981; Shingleton 1992, 1993). Also, the ratio of walleyes harvested to total effort ranged from 0.006 to 0.092 fish per hour (Ramsey and Pierce 1981; Shingleton 1992, 1993). These estimates, however, are based on the combined effort (hours) of walleye anglers and anglers targeting other species. Separate estimates of catch rates and harvest rates are needed for bank anglers versus boat anglers, and walleye anglers versus all anglers.

Studies have also reported slow growth rates of walleyes within Summersville Reservoir. Wellman (2011) reported a narrow range of mean lengths from age 2 (378 mm, 14.9 inches) to age 10 (393 mm, 15.5 inches; Figure 2). Estimates of average lengths for age 3 and age 4 walleyes in 1991 were 414 mm (16.3 inches) and 450 mm (17.7

inches), and those for 1992 were 422 mm (16.6 inches) and 460 mm (18.1 inches) (Shingleton 1992, 1993). These estimates of age 3 and age 4 individuals are higher than those reported by Wellman (2011), but individuals older than age 4 were not reported by Shingleton (1992, 1993). Slow growth rates not only shape the age/length distribution of a walleye population, but also impact total catch, catch rates, and angler attitudes.

The goal of my study was to evaluate the walleye fishery at Summersville Reservoir using data from creel and angler surveys. My specific objectives were to (1) estimate catch and harvest rates of walleyes using catch and effort data, and (2) assess angler attitudes on current and previous fishing trip satisfaction, the quality of the fishery, bag limit and size limit changes, and the size of “keepable” and “trophy” fish. Current catch information and angler attitudes are important for management of the fishery, especially given previous estimates of high harvest proportions and low growth rates of walleyes.

Methods

Angler survey methods

I conducted creel and angler surveys of boat and bank anglers at Summersville Reservoir from 28 November 2008 through 31 October 2009. Boat angler surveys followed a point access design, and bank angler surveys followed a roving design (Pollock et al. 1994). In addition to angler surveys, I recorded the number of vehicles in parking areas and the number of bank anglers during each site visit. All months except August and November were represented in the survey period. Angler surveys were randomly selected for two 10-hour sample days per week (stratified for 1 weekend and 1 week day). The study design included site visits to all open boat ramps during each

survey day, but closures left only two or three boat ramps open during most of the study period. Each 10-hour sample day was partitioned into three rounds of visits to three or four access sites, where site visits within each round were randomized. The duration of each site visit ranged from 40 to 60 minutes.

Creel and angler survey questions

During each interview, I recorded angler type (boat or bank angler), trip status (incomplete or complete trip), and number of anglers in the fishing party. I also asked for permission to count and measure walleyes (total length, mm) from angler creels, and asked questions to determine the following: angler residence (zipcodes, to estimate mean travel distance and mean travel time), start time of fishing trip (to estimate hours of fishing effort), species of fish targeted, and numbers of fish caught, kept, and released (to estimate catch and harvest; Appendix A).

Angler responses to additional survey questions provided information on the number of days per year anglers fish for walleyes, the percent of walleyes kept on an average fishing trip, the percent of walleyes caught that exceed 15 inches (381 mm) on an average fishing trip, and the percent of walleyes greater than 15 inches (381 mm) kept on an average fishing trip. I recorded the following information based on angler attitudes: angler satisfaction of the fishing trip (rank scores 1-9 based upon overall trip satisfaction), lengths that anglers would consider as “trophy” and “keepable” walleyes, the quality of the walleye fishery at Summersville Reservoir within the last five years, and opinions about future bag limit and size limit changes for the walleye fishery at Summersville Reservoir. Two questions were unrelated to the walleye fishery at

Summersville: (1) What warmwater fish species do you fish for most often in West Virginia?; (2) Do you fish other West Virginia waters for walleye?

Analysis: Catch rate and harvest rate estimation

Using data from boat anglers (primarily completed trips), I estimated catch and harvest rates of walleyes as the ratio of mean catch to mean effort and as the ratio of mean harvest to mean effort (Hoenig et al. 1997, Pollock et al. 1997). For data from bank anglers (primarily incomplete trips), I used the mean of ratios estimator (Hoenig et al. 1997, Pollock et al. 1997) to estimate catch and harvest rates of walleyes.

Direct expansion of effort and catch from boat and bank angler data

For boat anglers, direct expansion of effort and catch for each sample month followed the methods of Pollock et al. (1994) for multiple access sites and two strata (weekday and weekend). I used mean values of daily fishing effort and daily catch for weekday and weekend strata to estimate total fishing effort and total catch. I estimated total fishing catch and effort separately for weekday and weekend strata by multiplying the catch rate or mean daily effort by the total week or weekend days within the month. Weekday and weekend estimates were summed to obtain a monthly estimate. I calculated variances for total effort and total catch using equations provided in Pollock et al. (1994). These variances took into account the number of values in a sample, other variances, and the number of days available to sample, each of which varied depending on the weekend, weekday, or catch rate used.

I used counts of bank anglers and the length of time of survey routes for each site visit to estimate daily effort, weekend and weekday total effort, and monthly total effort. I estimated weekend, weekday, and monthly total catch by multiplying the bank angler

catch rate (from the mean of ratios estimator) by the weekend, weekday, and monthly estimates of total effort, respectively. I calculated variances for total effort and total catch following Pollock et al. (1994).

Direct expansion of effort from vehicle count data

The time interval count method (vehicle counts) was also used to estimate effort for all anglers following the methods of Pollock et al. (1994). The number of parked vehicles was counted at each access site during each site visit. The number of parked vehicles at all access sites was converted to daily averages of angler party hours and direct expansion was used to estimate total angler party hours for weekdays and weekends. For each month, weekday and weekend estimates were summed to estimate total angler party hours. Total angler hours of effort for each month were estimated by multiplying the estimate of angler party hours by the average number of anglers per party. Vehicle count data does not include information on angler types, so total angler hours could not be partitioned by boat anglers vs. bank anglers, or by walleye anglers vs. all anglers.

Results

A total of 84 survey days yielded 165 interviews (111 boat anglers, and 54 bank anglers). Boat angler surveys mostly represented completed trips (98 of 111 interviews), and bank angler surveys were primarily incomplete trips (40 of 54; Appendix B). I could not conduct surveys on eight days of ice cover during part of January and February (Appendix C). I also did not conduct surveys within the months of November or August, except data collected on 28 November were included in the analysis for December.

Most interviews were with West Virginia resident anglers (97.6%; Figure 3).

Using a GIS-based navigator, I estimated the travel distances [mean = 82.7 km (51.3 miles), SE = 6.01] and travel times (mean = 56.5 minutes, SE = 3.69) between West Virginia residence zipcodes and Summersville, West Virginia (Table 1). A large proportion of anglers (45.9%) were within 50 road kilometers (31 miles) of Summersville, WV. Residences within 100 road kilometers (62 miles) of Summersville, WV, represented 65.4% of anglers. Angler residences from farther distances (> 100 road km) were often close to interstate corridors, possibly reflecting driving time or population centers (Figure 3).

Walleye anglers comprised 18.8% of anglers within the survey (Table 2). The highest numbers of interviews of walleye anglers occurred in March (n=7), and December (n=5; Table 3). Numbers of interviews of all anglers were highest in April (n=26), May (n=43) and June (n=21). The number of walleyes caught and reported was highest during the period from 28 November to December 31 (n = 38), representing 53.5% of all walleyes caught. Twenty walleyes were caught and reported on 28 November, and 18 walleyes were caught during interviews within December. I interpret this as evidence that November was also a month with a relatively high walleye catch. March was the only other month with a relatively high walleye catch (n = 17).

Catch rates, harvest rates, and harvest lengths

Anglers within the survey caught 71 walleyes (55 harvested, 16 released; Figure 4). Boat and bank anglers harvested 76.1% (38 of 53 walleyes) and 94% (17 of 18), respectively. Walleye anglers typically had higher catch rates and higher harvest rates of walleyes than those of all anglers (Tables 4 and 5). The December period (which included the last weekend in November) had the highest catch and harvest rates, where

boat anglers had weekday and weekend catch rates of 0.94 and 1.10 walleyes per hour, respectively (Figure 4, Table 4). Boat angler harvest rates for the December period were 0.58 (weekday) and 0.81 (weekend) walleyes per hour (Table 4). Relatively few bank anglers reported catches of walleyes during the study, except for bank anglers targeting walleyes during March and April. The March estimates of catch and harvest rates for bank anglers were 0.88 walleyes/hr (weekday) and 0.26 walleyes/hr (weekend). In April, a weekend catch rate of 0.62 walleyes/hr was estimated for bank anglers. Lengths were measured or reported by anglers from 60 of 71 walleyes caught; mean= 378.6 mm (14.9 inches), SE = 4.6, range 304-455 mm (11.9-17.9 inches) (Figure 5). The mean length of walleyes harvested by boat anglers mean=378.29 (14.9 inches), SE=5.97, range 330-455 (12.9-17.9 inches), n=38 was similar to that of bank anglers mean= 377.1 (14.8 inches), SE = 7.0, range 340-440mm (13.3-17.3 inches), n=17 (Figure 5).

Total fishing effort and total catch from boat and bank angler data

Estimates of fishing effort and total catch of boat anglers exceeded those of bank anglers (Tables 6 and 7). For boat anglers targeting walleye, the estimates of fishing effort and catch were highest during the December period, where an estimated 728 hours of effort produced an estimated 624.5 walleyes (Table 6). For all boat anglers (including those targeting walleyes), estimates of fishing effort were highest during December (1152.7 hours) and May (2029.6 hours), but the estimates of walleye catches differed between December (609.8 walleyes) and May (13.5 walleyes; Table 6).

The highest frequency of bank anglers was recorded at Salmon Run (54.0%) and the lowest was at Long Point Marina (3.2%), with a remaining distribution of Battle Run (28.6%), Brock's Bridge (9.5%), and Winter Ramp (4.8%). For bank anglers targeting

walleyes, estimates of both fishing effort and walleye catches were highest for March (80.8 hours and 62.8 walleyes) and April (13.5 hours and 8.3 walleyes; Table 7). For all bank anglers (including those targeting walleyes), estimates of fishing effort were highest during April (52.8 hours, 11.9 walleyes), May (114.5 hours, 0.0 walleyes), and June (124.5 hours, 0.0 walleyes; Table 7).

Estimates of total effort and total catch of walleyes during 5 months of low water levels (October – March, excluding November) exceeded those for the months of April – September (excluding August; Table 8). Estimates of total effort and total catch of anglers targeting walleyes (boat and bank anglers combined) were 908.9 hours and 778.8 walleyes during October – March, and 968.5 hours and 29.6 walleyes during April – September (Table 8). For all boat and bank anglers (including those targeting walleyes), estimates of total effort and total catch were 3467.9 hours and 887.1 walleyes during October – March, and 5716.9 hours and 29.4 walleyes during April – September (Table 8).

Total fishing effort from vehicle counts

Counts of vehicles were lowest during late fall and winter and highest during spring and summer, and early fall (October) (Appendix D). The three lowest estimates of total angler effort from vehicle count data were from December (1162.4 hrs), January (55.6 hrs), and February (404.4 hrs) and the three highest estimates were from April (10767.7 hrs), May (29713.4 hrs) and June (21978.0 hrs; Table 10). All vehicles parked and counted at access sites, however, did not represent anglers; therefore, the total angler effort was likely overestimated with this method. Although the proportion of angler vehicles at access sites was not estimated, it is likely that a lower proportion of angler

vehicles were present during the high recreation use periods of spring and summer months.

Angler attitudes

I obtained angler opinions for sizes of “keepable” and “trophy” walleyes, the quality of the walleye fishery, size and bag limit changes, and angler satisfaction of the fishing trip on the day of the interview (Appendix A). Many anglers considered the length of a “keepable” walleye to be between 12 (304.8 mm) and 15 inches (381 mm) ($n = 78$, mean = 342.9 mm or 13.5 inches, SE = 0.57, range from 8-28 inches; Figure 6). Anglers considered “trophy” walleyes to be 18 (457.2 mm) to 35 inches (888.9 mm) ($n=61$, mean = 695.9 mm or 27.4 inches, SE = 0.68; Figure 7)

In a two-part question related to the change in the walleye fishery within the last 5 years, anglers responded to whether the overall walleye fishing has improved (7 % of responses), no response (7% of responses), stayed the same (12%), worsened (21%), or did not know (53%; Figure 8), and if walleye size has improved (4%), no response (7% of responses), stayed the same (15%), worsened (21%), or did not know (53%; Figure 8). Angler opinions of possible future fishing regulations changes were as follows: size limit (42% support, 4% oppose, 53% no response), bag limit (40% support, 7% oppose, 52% no response), size and bag limit (38% support, 4% oppose, 57% no response; Figure 9). Angler satisfaction with the fishing trip (on the day of the interview) ranged from low (rank = 1) to high (rank = 9), with peaks for rank 1 (35 boat anglers, 17 bank anglers) and rank 3 (15 boat anglers, 9 bank anglers, Figure 10)

Angler-reported information from previous fishing trips

I asked several questions regarding walleye angling in addition to the core set of questions (Appendix A). One set of three questions was as follows: On an average fishing trip to Summersville Reservoir, (a) what percent of all walleyes you catch do you keep?, (b) what percent of walleyes you catch are greater than 15 inches?, and (c) what percent of walleyes you catch greater than 15 inches do you keep? Responses for percentages of all walleyes kept ranged from 0 to 100% with peaks at 0% (11 boat anglers, 1 bank angler), 20% (6 boat anglers, 4 bank anglers), 50% (12 boat anglers, 1 bank angler), 80% (7 boat anglers, 3 bank anglers), and 100% (6 boat anglers, 4 bank anglers, Figure 11). Most responses for percentages of >15 inch walleyes caught were 50% or less (46 boat anglers, 18 bank anglers), with only 15 responses over 50% (12 boat anglers, 3 bank anglers, Figure 12). Responses for percentages of >15 inch walleyes kept ranged from 0 to 100%, and the two highest frequencies of angler responses were for 0 % (14 boat anglers, 1 bank anglers) and 100% (15 boat anglers, 12 bank anglers, Figure 13). Sixty-five of 165 anglers reported that they never fish for walleyes at Summersville Reservoir, and the remaining 100 anglers reported from 1 to 300 walleye fishing trips per year at Summersville Reservoir (mode = 3, mean = 28.2, SE =5.02).

Additional questions

Out of 144 responses, 98 indicated that they primarily fished for black bass in West Virginia, but others primarily fished for walleye (n=26), any species (14), catfish (12), crappie (4), hybrid striped bass (2), and sunfish (1). Anglers provided a list of other places fished for walleye: Kanawha River (14 anglers), Gauley River (9), New River (8), Ohio River (7), Elk River (4), Burnsville Tailwaters (1), and Guyandotte River (1).

Additional reservoirs fished for walleye included Burnsville Lake (5 anglers), Stonewall Jackson Lake (4), Sutton Lake (2), R. D. Bailey Lake (1), and Stephens Lake (1).

Discussion

My data on the size of walleyes and the percent of walleyes harvested are consistent with data from previous studies during the 1980s, 1990s, and 2000s (Ramsey and Pierce 1981; Shingleton 1992, 1993; Wellman 2011). Walleyes reported during my survey period rarely exceeded 15 inches, and most (74.5%) were harvested. All studies have reported a small-size structured population of walleyes within Summersville Reservoir. Previous studies, however, did not partition estimates of catch rates and harvest rates of walleyes between boat and bank anglers and between walleye anglers and all anglers. My data provide evidence that walleye anglers contribute to a large proportion of estimates of catch rates, harvest rates, and total catches of walleyes. Further, my study found that catch rates, harvest rates, and total catches of walleyes are highest at low water levels during the lake draw-down period, a finding consistent with that of previous studies.

Catch rates, harvest rates, and estimates of effort and catch for walleyes were highest during December and March. Also, data for November based on one weekend provided evidence that November was a month with relatively high catch rates and harvest rates of walleyes, but these data were included with December estimates. These results are not unexpected, given that walleyes are known to actively forage during late fall and winter periods, a time when many other gamefishes are less active. January and February could also be months of relatively high catch rates and harvest rates because of the colder water temperatures making them more vulnerable to anglers, but ice cover

during these months prevented angling efforts during our study. Catch rates are expected to decrease from spring to summer if walleyes move from shallow areas to deeper pelagic areas (Deroba et al. 2007a, 2007b). Deroba (2007b) also suggested that catch rates may decline during summer when tourists and non-local anglers comprise a larger proportion of all anglers. This dilution effect on catch rates may also result from an increase in party size during warmer months, because some members in large parties are often less skilled at angling (VanDeValk et al. 2007).

Angler hours of effort based on vehicle counts are likely overestimated. Summersville Reservoir is a multi-use recreational area, and parked vehicles could not be reasonably attributed to anglers. I initially predicted that parked vehicles during fall and winter would be associated with angling, but discovered that hiking and hunting are common fall and winter activities at the reservoir. Also, a relatively high proportion of vehicles associated with non-angling activities were present during high use times of spring and summer. Because of uncertainty of the exact recreational or other activity associated with parked vehicles, I suggest that the effort estimates based on vehicle counts (Table 10) should be used with caution.

Catch rates of walleyes from my study varied in comparison to other studies within WV reservoirs based upon the season. For April-June, estimated catch rates at Summerville Reservoir were similar between my study (0.007-0.009 walleyes/hr) and Ramsey and Pierce (1981; 0.008 walleyes/hr). For April-October, catch rates were similar between my study (0.009) and Shingleton (1992, 1993; 0.01-0.018; Table 9). For December-March, the catch rate from my study (0.353) was higher than those of Shingleton (1992, 1993; 0.058-0.148; Table 9). Monthly catch rates (estimated as total

catch divided by total effort) for walleyes within Tygart Reservoir, WV, ranged from 0.08 to 0.61 walleyes/hr (Jernejcic 1986; Table 9). Baccante (1995) summarized walleye catch rates ranging from 0.02 to 0.61 walleyes/hr from 31 studies within Alberta, Ontario, Minnesota, Wisconsin, and northern Ohio. Catch rates from these northern fisheries, however, may not be directly comparable to those for Summersville Reservoir. Baccante (1995) indicated that low catch rate estimates can result from angler preference for artificial bait instead of live bait. My survey did not determine if anglers at Summersville Reservoir primarily used artificial or live bait.

Harvest rates also varied among the seasons of the study, and were similar to catch rates in most seasons. For April-June, the estimate of harvest rate from my study (0.00 walleyes/hr) was similar to that of Ramsey and Pierce (1981; 0.007 walleyes/hr). The harvest rate from April-October for my study (0.00 walleyes/hr) was slightly lower than that of Shingleton (1992, 1993; 0.006-0.016), but December-March had higher harvest rates (0.272, my study; 0.044-0.092, Shingleton 1992, 1993). My study, however, did not encompass the months of November and August, which affects the comparisons of catch and harvest rates among studies.

Boat anglers had higher catch rates and harvest rates than those of bank anglers during all months, except March. Most of the March catch was at the Brock's Bridge site, which is located in the headwater region of the lake (Figure 1). Spawning behavior during March likely increased walleye susceptibility to bank anglers in this area. In some fisheries, estimates of boat angler catch and harvest rates can exceed those of bank anglers, which may result from increased mobility and access, or the use of electronics by boat anglers (VanDeValk et al. 2005, Johnson et al. 1988). Also, boat angler surveys at

access points (boat ramps) often represent completed trips, where bank angler interviews during roving surveys often represent incomplete trips. Inaccurate reporting of trip duration for incomplete trips is not expected (McEachron et al. 1986, Mallison and Cichra 2004), but catch rate estimates from complete and incomplete trips can differ (Keefe et al. 2009). During March, walleye bank anglers targeted walleyes during the peak feeding time within evening or crepuscular hours, so catch rates were relatively high for this angler group. If catch rates are higher during crepuscular hours, then data from incomplete trips may often exclude the time with higher catch rates. Boat anglers, generally do not make the trip for one or two evening hours of fishing, so catch rate and harvest rate estimates from boat anglers often include hours during the day when walleyes are not likely to be caught.

An important addition to our study, compared to previous studies, was questions regarding angler attitudes. Approximately half of all walleye anglers (18 of 31) did not catch a walleye during the fishing trip, which likely explains the high number of dissatisfied anglers (19 of 32 walleye anglers reported a low satisfaction rank of 3 or less). The general opinion of anglers who were concerned with the walleye fishery varied. Twenty-one percent of anglers reported that overall walleye fishing (number and size of fish) has worsened in the past five years, which is also another likely contributor to low satisfaction rates. But, 19% of anglers reported that the number and size of walleyes had improved or stayed the same. Many anglers were not opposed to management regulations; 91%, 85%, and 90% of anglers (excluding those with no response) within the survey approved of bag limits, size limits, or both, respectively.

A large percentage of anglers indicated that 14 inch and 15 inch walleyes were “keepable” fish, but I do not know if this common angler opinion is influenced by the existing small size structure of the population, or if the angler opinion and associated harvest of 14 and 15 inch fish influence the small-size structure of the population. The percentage of fish harvested is relatively high, but the overall effort and catch seem relatively low during most months of the year. It is not known what levels of total effort and harvest rates would be required to cause growth overfishing in a walleye population in an oligotrophic reservoir, such as Summersville Reservoir.

My access site creel and angler survey was designed to obtain completed trip information from boat anglers at boat ramps, but also included a roving component of obtaining incomplete trip information from bank anglers fishing in the vicinity of boat ramps. A common concern for point-access creel surveys involves whether survey sites represent angler access. If high-use access areas are not sampled, then effort and catch estimates will be inaccurate and biased (Hayne 1991). Our spatial coverage was likely adequate, given the limited number of boat ramps, and one bank fishing site (Brocks Bridge) on the reservoir. It is possible that other areas within the reservoir were used by bank anglers or anglers in small boats (which can be launched without a boat ramp). However, much of the shoreline is wooded without road access. Also, steep banks and cliffs limit access for much of the reservoir during the water draw-down period.

My survey design of morning, mid-day, and evening rounds may have underestimated catch rates and harvest rates of the walleye fishery at Summersville Reservoir. If night fishing is common, then my design missed fish caught and harvested during that time. Walleyes are susceptible to angling during low-light hours (Ali et al.

1997, Deroba et al. 2007, Lester et al. 2004, Niemuth et al. 1972, Olson 1958). Much of my sampling time occurred during the time of day when walleyes are not known to actively forage. A survey design that targets crepuscular hours may provide as much information at less of a cost in man-hours and travel costs. This could increase the creel clerk's ability to contact anglers specifically targeting walleye (Ali et al. 1997, Deroba et al. 2007); however, several creel clerks would be needed to simultaneously cover multiple sites.

Future studies should focus on the causal factors of low growth rates. Angler catch rates and angler satisfaction are directly influenced by walleye growth rates (VanDeValk et al. 2005). Slow rates of growth are supported by the narrow size distribution of walleye from this study, and the length-age distribution data from separate studies of Wellman (2011). One explanation for slow growth is an inadequate forage base. Shingleton (1992, 1993) discussed the forage base within Summersville Reservoir, and several efforts have been made to introduce emerald shiners, threadfin shad, and brook silversides, but more studies are needed to assess the forage base. Productivity also influences the forage base, and Summersville Reservoir is a low-fertile reservoir (Phosphorus , total mg/L < 0.02; Marchese 2011). High densities of fishes can also cause reduced growth rates, although we do not have estimates of walleye densities within the reservoir. Also, overfishing could explain the current size structure, given that walleyes with faster growth would have a higher probability of being harvested. This could cause selection against faster growing individuals within the population.

Walleye mortality associated with passage through the dam outlet should be another focus for future research, because dam-induced mortality could be associated

with the perceived low growth rate and the small size structure of walleyes. Ramsey and Pierce (1981) predicted 100% mortality for fish passing through the Howell Bunger outlet structure of Summersville Dam. Fish mortality has been noted downstream of the dam, with dead walleyes as the most frequently encountered (Ramsey and Pierce 1981). This is likely to occur infrequently, but could have an effect if there are an abundance of walleye in the area during a larger than normal outflow event. Jernejcic (1986) reported walleye migration through Tygart Dam, another reservoir within West Virginia, where walleyes $\leq$ age 2 migrated out of the lake using the tail-water dam. We do not have historic or recent estimates of dam-induced mortality of walleyes. Further research is needed to determine the extent of dam-induced mortality of walleyes.

The slow growth rates of walleyes within Summersville Reservoir are a management concern, and likely influenced my data from creel and angler surveys. Although anglers harvest a high percentage of the walleye catch, the catch rates and harvest rates are low relative to those reported from other walleye fisheries. However, Summersville Reservoir is a small, oligotrophic system with low productivity (Marchese 2011), and low catch and harvest rates may be common for this fishery. The walleye fishery in Summersville Reservoir is seasonal, and catch and harvest rates and total effort and total catch are highest during the water level draw-down period which extends from September to April. Slow growth rates, lack of “trophy-sized” fish, and small size structure of the walleye population are likely associated with angler dissatisfaction. Future research on diets, food availability, and movements (daily and seasonally) would be useful toward answering questions about growth rates and size structure of walleyes within Summersville Reservoir.

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Figure 1. Summersville Reservoir and the locations of access roads and boat ramps.

Figure 2. Mean length-at-age data from 2008, 2009, and 2010 walleye assessments of Summersville Reservoir (reprinted from Wellman 2011).

Figure 2. Geographic distribution of angler residences (zip codes). Zip codes of four non-resident anglers were not plotted (Belpre, OH; Elyria, OH; Humble, TX; and Manor, TX).

Figure 3. Number of walleyes caught and harvested by month at Summersville Reservoir based on creel and angler surveys. Surveys were not conducted for November and August; no walleyes were reported during September surveys.

Figure 4. Length frequency of walleyes caught by boat and bank anglers based on fish measured during the creel survey.

Figure 5. Lengths considered by anglers to be “keepable” walleyes.

Figure 6. Lengths considered by anglers to be “trophy” walleyes.

Figure 7. Angler responses to (A) changes in the overall walleye fishery during the last five years, and (B) changes to the size of walleyes during the last five years.

Figure 8. Angler opinions on changes to the walleye fishing regulations, such as (A) size limits, (B) bag limits, and (C) size and bag limits.

Figure 9. Rank of angler satisfaction of the fishing trip (on the day of interview), where a rank of 1 means extremely dissatisfied and a rank of 9 means extremely satisfied.

Figure 10. Percent of walleye harvested from all walleye caught.

Figure 11. Percent of all walleye caught greater than 15 inches.

Figure 12. Percent of walleye kept from walleye caught greater than 15 inches.

Table 1. Residences of surveyed anglers and the estimated time (min) and distance (km) of travel to Summersville, WV.

Town	Time	Kilometers	Frequency
Ansted, WV	28	38.6	1
Barboursville, WV	126	210.8	1
Beckley, WV	53	75.6	3
Belle, WV	80	96.5	1
Buchannon, WV	141	133.5	1
Burnwell, WV	64	80.5	1
Cannelton, WV	61	72.4	2
Canvas, WV	12	11.3	2
Charleston, WV	88	144.8	14
Charlton Heights, WV	50	61.1	1
Charmco, WV	47	51.5	1
Clendenin, WV	74	114.2	1
Coal City, WV	70	93.3	2
Craigsville, WV	28	27.4	1
Culloden, WV	117	188.3	1
Danville, WV	116	191.5	1
Duck, WV	49	70.8	2
Edmond, WV	30	41.8	2
Elizabeth, WV	149	173.8	1
Elkins, WV	105	117.5	1
Elkview, WV	17	127.1	2
Fairdale, WV	72	93.3	1
Farmington, WV	122	188.3	1
Fayetteville, WV	27	40.2	5
Fenwick, WV	36	35.4	1
Flatwoods, WV	44	66.0	1
French Creek, WV	92	117.5	1
Gassaway, WV	44	61.1	1
Given, WV	120	189.9	2
Glen Daniel, WV	68	90.1	1
Harts, WV	144	231.7	1
Hico, WV	21	29.0	1
Hinton, WV	88	128.7	1
Holden, WV	142	236.5	1
Huntington, WV	138	228.5	2
Hurricane, WV	112	185.0	2
Kanawha Falls, WV	47	56.3	1
Kenova, WV	141	236.5	1
Keslers Cross Lanes, WV	23	22.5	2

Table 1. Continued.

Keyser, WV	210	336.3	1
Kincaid, WV	54	67.6	1
Leivasy, WV	29	30.6	5
Lewisburg, WV	76	91.7	1
Lochgelly, WV	34	48.3	1
Logan, WV	143	236.5	1
Lumberport, WV	105	164.1	1
Mabie, WV	107	170.6	1
Minden, WV	38	53.1	2
Mount Lookout, WV	16	19.3	10
Mount Nebo, WV	12	12.9	8
Nallen, WV	26	29.0	6
Oak Hill, WV	35	51.5	3
Parkersburg, WV	154	262.3	1
Peytona, WV	98	119.1	1
Pineville, WV	100	123.9	1
Princeton, WV	87	138.4	1
Procious, WV	79	107.8	1
Rainelle, WV	50	62.8	4
Richwood, WV	42	40.2	3
Sandyville, WV	130	215.6	1
Scott Depot, WV	109	175.4	2
Stollings, WV	146	238.1	1
Sumerco, WV	115	177.0	1
Summersville, WV	3	1.6	21
Sutton, WV	40	57.9	1
Swiss, WV	40	35.4	3
Upperglade, WV	48	46.7	1
Wayne, WV	164	249.4	1
Webster Springs, WV	63	64.4	1
Welch, WV	136	154.5	1
Weston, WV	73	114.2	2
Wheeling, WV	194	323.4	1
Winfield, WV	116	181.8	1
Mean values for WV	56.5	82.7	
Out-of-state			
Belpre, OH	156	263.9	1
Elyria, OH	333	542.2	1
Humble, TX	1145	1950.1	1
Manor, TX	1227	2143.2	1

Table 2. Percent of anglers that targeted four fisheries (walleye, black bass, crappie, and sunfish) or did not target a specific fishery (Any species) within Summersville Reservoir.

Fisheries target	Angler surveys	Percent
Walleye	31	18.8
Black Bass	75	45.5
Any species	53	32.1
Crappie	4	2.4
Sunfish	2	1.2

Table 3. Frequency of any species, black bass, and walleye fisheries targeted by month (November 2008-October 2009). The November period represents two survey days. There were no surveys during the month of August.

Month	Any species	Black bass	Walleye
Nov	1	2	1
Dec	3	2	3
Jan	1	0	1
Feb	1	0	2
Mar	1	5	7
Apr	9	14	3
May	15	25	3
June	9	8	4
July	5	5	3
September	4	3	1
October	4	10	3

Table 4. Monthly catch rates and harvest rates of anglers targeting walleye estimated from boat (complete trips) and bank (incomplete trips) angler survey data at Summersville Reservoir, WV. Number of interviews followed by standard error are given in parentheses. An asterisk (*) indicates that no anglers were encountered during the survey period.

Month/yr	Boat anglers				Bank anglers			
	Catch rate		Harvest rate		Catch rate		Harvest rate	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Dec-08	0.94 (2, 0.44)	1.10 (3, 0.49)	0.58 (2, 0.30)	0.81 (3, 0.36)	*	*	*	*
Jan-09	*	0.20 (1, 3)	*	0.00 (1, 0.00)	*	0.20 (1, 0.04)	*	0.20 (1, 0.04)
Feb-09	0.22 (2, 0.28)	*	0.00 (2, 0.00)	*	*	*	*	
Mar-09	*	0.00 (2, 0.00)	*	0.00 (2, 0.00)	0.88 (2, 0.02)	0.26 (3, 0.53)	0.88 (2, 0.02)	0.26 (3, 0.53)
Apr-09	*	0.00 (1, 0.00)	*	0.00 (1, 0.00)	*	0.62 (2, 0.62)	*	0.00 (2, 0.00)
May-09	0.20 (1, 1.6)	0.00 (2, 0.00)	0.00 (1, 0.00)	0.00 (2, 0.00)	*	*	*	*
Jun-09	0.00 (1, 0.00)	0.04 (3, 0.14)	0.00 (1, 0.00)	0.00 (3, 0.00)	*	*	*	*
Jul-09	0.00 (1, 0.00)	0.00 (1, 0.00)	0.00 (1, 0.00)	0.00 (1, 0.00)	*	0.00 (1, 0.00)	*	0.00 (1, 0.00)
Sep-09	*	0.00 (1, 0.00)	*	0.00 (1, 0.00)	*	*	*	*
Oct-09	0.00 (1, 0.00)	0.34 (2, 0.37)	0.00 (1, 0.00)	0.26 (2, 0.32)	*	*	*	*

Table 5. Monthly catch rates and harvest rates for all anglers estimated from boat (complete trips) and bank (incomplete trips) angler survey data from Summersville Reservoir, WV. Number of interviews followed by standard error are given in parentheses. An asterisk (*) indicates that no anglers were encountered during the survey period.

Month/yr	Boat anglers				Bank anglers			
	Catch rate		Harvest rate		Catch rate		Harvest rate	
	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend	Weekday	Weekend
Dec-08	0.53 (5, 0.25)	0.52 (7, 0.57)	0.46 (5, 0.28)	0.45 (7, 0.59)	0.00 (1, 0.00)	0.00 (1, 0.00)	0.00 (1, 0.00)	0.00 (1, 0.00)
Jan-09	*	0.13 (2, 2.9)	*	0.07 (2, 2.3)	*	0.20 (1, 0.20)	*	0.20 (1, 0.20)
Feb-09	0.09 (3, 0.16)	*	0.09 (3, 0.16)	*	*	*	*	*
Mar-09	*	0.24 (8, 0.15)	*	0.03 (8, 0.05)	0.88 (2, 0.02)	0.26 (3, 0.53)	0.88 (2, 0.02)	0.26 (3, 0.53)
Apr-09	0.00 (1, 0.00)	0.00 (12, 0.00)	0.00 (1, 0.00)	0.00 (12, 0.00)	0.08 (7, 0.50)	0.07 (5, 0.27)	0.00 (7, 0.00)	0.00 (5, 0.00)
May-09	0.02 (7, 0.05)	0.00 (26, 0.00)	0.08 (7, 0.00)	0.00 (26, 0.00)	0.00 (2, 0.00)	0.00 (10, 0.00)	0.00 (2, 0.00)	0.00 (10, 0.00)
Jun-09	0.00 (3, 0.00)	0.01 (8, 0.03)	0.00 (3, 0.00)	0.00 (8, 0.00)	0.00 (5, 0.00)	0.00 (6, 0.00)	0.00 (5, 0.00)	0.00 (6, 0.00)
Jul-09	0.00 (1, 0.00)	0.00 (5, 0.00)	0.00 (1, 0.00)	0.00 (5, 0.00)	0.00 (4, 0.00)	0.01 (5, 0.001)	0.00 (4, 0.00)	0.01 (5, 0.001)
Sep-09	0.00 (3, 0.00)	0.00 (3, 0.00)	0.00 (3, 0.00)	0.00 (3, 0.00)	0.00 (2, 0.00)	*	0.00 (2, 0.00)	*
Oct-09	0.00 (3, 0.00)	0.04 (14, 0.04)	0.00 (3, 0.00)	0.02 (14, 0.03)	*	0.00 (1, 0.00)	*	0.00 (1, 0.00)

Table 6. Total fishing effort and total catch for boat anglers estimated with angler survey data from Summersville Reservoir, WV. Standard errors are given in parentheses. An asterisk (*) indicates that no anglers were encountered during the survey period.

Month/yr	Boat Angler Effort (hours)						Boat Angler Catch					
	Walleye anglers			All anglers			Walleye anglers			All anglers		
	Weekday	Weekend	Total	Weekday	Weekend	Total	Weekday	Weekend	Total	Weekday	Weekend	Total
Dec-08	625 (101.1)	103.3 (32.1)	728.3 (106.1)	745 (64.9)	407.7 (112.4)	1152.7 (128.2)	587 (98.9)	37.5 (22.0)	624.5 (101.3)	397.7 (54.2)	212.1 (68.4)	609.8 (87.2)
Jan-09	*	37.8 (6.5)	37.8 (6.5)	*	112.4 (23.8)	112.4 (23.8)	*	7.6 (2.5)	7.6 (2.5)	*	15.2 (3.2)	15.2 (3.2)
Feb-09	259 (90.4)	*	259 (90.4)	509 (536.6)	*	509 (536.6)	56.5 (20.7)	*	56.5 (20.7)	45.5 (20.7)	*	45.5 (20.7)
Mar-09	*	109 (59.2)	109 (59.2)	*	509.3 (17.3)	509.3 (17.3)	*	0.00 (0.00)	0.00 (0.00)	*	120 (19.2)	120 (19.2)
Apr-09	*	93.3 (93.3)	93.3 (93.3)	110.5 (110.5)	696.7 (45.3)	807.2 (58.1)	*	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
May-09	68.2 (11.3)	122.2 (113.3)	190.4 (113.8)	669.8 (61.03)	1359.8 (59.4)	2029.6 (85.2)	15.2 (2.5)	0.00 (0.00)	15.2 (2.5)	13.5 (4.20)	0.00 (0.00)	13.5 (4.20)
Jun-09	281.2 (281.2)	147.3 (35.9)	428.5 (283.5)	565.6 (84.7)	262.5(35.6)	828.1 (91.9)	0.00 (0.00)	6.1 (2.10)	6.1 (2.10)	0.00 (0.00)	3.5 (2.20)	3.5 (2.20)
Jul-09	170.5 (170.5)	3 (3)	173.5 (170.5)	170.5 (170.5)	402.9 (49.3)	573.4 (177.5)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Sep-09	*	62.6 (62.6)	62.6 (62.6)	680.3 (43.3)	265.5 (35.5)	945.8 (55.9)	*	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Oct-09	104.6 (104.6)	69.5 (15.0)	174.1 (105.6)	104.6 (44.7)	69.5 (82.2)	174.1 (93.5)	0.00 (0.00)	24 (8.00)	24 (8.00)	0.00 (0.00)	30.4 (17.6)	30.4 (17.6)

Table 7. Total fishing effort and total catch for bank anglers estimated with angler survey data from Summersville Reservoir, WV. Standard errors are given in parentheses. An asterisk (*) indicates that no anglers were encountered during the survey period.

Month/yr	Bank Angler Effort (hours)						Bank Angler Catch					
	Walleye anglers			All anglers			Walleye anglers			All anglers		
	Weekday	Weekend	Total	Weekday	Weekend	Total	Weekday	Weekend	Total	Weekday	Weekend	Total
Dec-08	*	*	*	21 (26.4)	25.3 (25.3)	46.3 (36.6)	*	*	*	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Jan-09	*	16.8 (1.9)	16.8 (1.9)	*	16.8 (1.9)	16.8 (1.9)	*	3.4 (3.4)	3.4 (3.4)	*	3.4 (3.4)	3.4 (3.4)
Feb-09	*	*	*	*	*	*	*	*	*	*	*	*
Mar-09	67.3 (62.1)	13.5 (7.8)	80.8 (62.7)	67.3 (62.1)	13.5 (7.8)	80.8 (62.6)	59.3 (1.9)	3.5 (8.5)	62.8 (75.8)	59.3 (1.9)	3.5 (8.5)	62.8 (8.7)
Apr-09	*	13.5 (13.5)	13.5 (13.5)	126.3 (21)	33.7 (13.9)	52.8 (25.2)	*	8.3 (12.8)	8.3 (12.8)	9.7 (64.8)	2.2(9.8)	11.9 (65.6)
May-09	*	*	*	33.7 (19.4)	80.8 (50.1)	114.5 (53.7)	*	*	*	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Jun-09	*	*	*	84.2 (53.2)	40.4 (17.4)	124.6 (56)	*	*	*	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Jul-09	0 (0.00)	6.7 (2.6)	6.7 (2.6)	44.9 (22.4)	47.1 (16.9)	92 (26.7)	*	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.05 (0.06)	0.05 (0.06)
Sep-09	*	*	*	42.1 (42.1)	*	42.1 (42.1)	*	*	*	0.00 (0.00)	*	0.00 (0.00)
Oct-09	*	*	*	*	15.3 (14.9)	15.3 (14.9)	*	*	*	*	0.00 (0.00)	0.00 (0.00)

Table 8. Total fishing effort and total catch for all anglers (boat and bank anglers combined) estimated with angler survey data from Summersville Reservoir, WV. Standard errors are given in parentheses. An asterisk (*) indicates that no anglers were encountered during the survey period.

Month/yr	Combined boat and bank angler effort (hours)						Combined boat and bank angler catch					
	Walleye anglers			All anglers			Walleye anglers			All anglers		
	Weekday	Weekend	Total	Weekday	Weekend	Total	Weekday	Weekend	Total	Weekday	Weekend	Total
Dec-08	625 (101.1)	103.3 (32.1)	240.4 (106.1)	766 (70.1)	433 (115.2)	1199 (134.9)	587 (98.9)	37.5 (22.0)	624.5 (101.3)	397.7 (54.2)	212.1 (68.4)	609.8 (87.2)
Jan-09	*	54.6 (6.7)	54.6 (6.7)	*	129.2 (23.8)	129.2 (23.8)	*	11 (4.2)	11 (4.2)	*	5.2 (3.2)	18.6 (4.6)
Feb-09	259 (90.4)	*	259 (90.4)	509 (536.5)	*	509 (536.5)	56.5 (20.7)	*	56.5 (20.7)	45.5 (20.7)	*	45.5 (20.7)
Mar-09	67.3 (62.1)	122.5 (59.7)	189.8 (86.2)	67.3 (62.1)	522.8 (17.3)	590.1 (65)	59.3 (1.9)	3.5 (8.5)	62.8 (8.7)	59.3 (1.9)	123.5 (21)	182.8(21.1)
Apr-09	*	106.8 (94.3)	106.8 (94.3)	236.8 (112.5)	730.4 (47.4)	966.8 (122)	*	8.3 (12.8)	8.3 (12.8)	9.7 (64.8)	2.2 (9.8)	11.9 (65.6)
May-09	68.2 (11.3)	122.2 (113.3)	190.4 (113.8)	703.5 (64)	1440.6 (77.7)	2144.1 (100.6)	15.2 (2.5)	0.00 (0.00)	15.2 (2.5)	13.5 (4.20)	0.00 (0.00)	13.5 (4.20)
Jun-09	281.2 (281.2)	147.3 (35.9)	428.5 (283.5)	649.8 (100.1)	302.9 (39.7)	952.7 (107.6)	0.00 (0.00)	6.1 (2.10)	6.1 (2.10)	0.00 (0.00)	3.5 (2.20)	3.5 (2.20)
Jul-09	170.5 (170.5)	9.7 (7.4)	180.2 (170.7)	215.4 (172)	450 (51.4)	665.4 (179.5)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.5 (0.06)	0.5 (0.06)
Sep-09	*	62.6 (62.6)	62.6 (62.6)	722.4 (60.4)	265.5 (35.5)	987.9 (70.1)	*	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)	0.00 (0.00)
Oct-09	104.6 (104.6)	69.5 (15.0)	174.1 (105.6)	273.5 (44.7)	767.1 (83.6)	1040.6 (93.7)	0.00 (0.00)	24.0 (8.00)	24.0 (8.00)	0.00 (0.00)	30.4 (17.6)	30.4 (17.6)

Table 9. Comparison of walleye catch and harvest rates for all anglers (boat anglers, bank anglers, weekday and weekend combined) for two West Virginia reservoirs. An asterisk (*) indicates no available information.

Author(s) of study	Reservoir	Months sampled	Total effort hours (E)	Walleye catch (C)	Walleye harvest (H)	C/E	H/E
Ramsey and Pierce (1981)	Summersville	Apr-June 1980	60459	476	412	0.008	0.007
Wichterman (this thesis)	Summersville	Apr-June 2009	4064	29	1	0.007	0.000
Shingleton (1992)	Summersville	Apr-Oct 1990	36991	359	238	0.010	0.006
Shingleton (1992)	Summersville	Apr-Oct 1991	35810	643	523	0.018	0.015
Shingleton (1993)	Summersville	Apr-Oct 1992	32555	593	517	0.018	0.016
Wichterman (this thesis)	Summersville	Apr-Oct 2009	6758	60	2	0.009	0.000
Shingleton(1992)	Summersville	Nov-Mar 1991	4167	241	185	0.058	0.044
Shingleton (1993)	Summersville	Nov-Mar 1992	5671	841	520	0.148	0.092
Wichterman (this thesis)	Summersville	Dec 2008-Mar 2009	2427	857	661	0.353	0.272
Jernejcic (1986)	Tygart	Mar-July	20,370	2051	*	0.101	*
Wichterman (this thesis)	Summersville	Mar-July	5,319	212	80	0.040	0.015

Table 10. Expanded effort (hours) estimated from the number of parked vehicles (which also included an unknown proportion of vehicles associated with non-angling activities). The months of August and November were not sampled.

Month	Effort (angler hours)				Total	SE
	Weekday	SE	Weekend	SE		
January	25.3	15.1	30.3	23.3	55.6	27.8
February	404.0	175.0	0.00	0.00	404.0	175.0
March	1230.3	160.5	1036.0	151.7	2266.3	220.8
April	3845.2	890.9	6922.0	1485.3	10767.7	1732.0
May	8508.0	1135.0	21205.3	2171.5	29713.4	2450.2
June	13471.1	2291.6	8506.9	536.8	21978.0	2353.6
July	4130.2	681.2	3149.3	998.5	7279.5	1208.8
September	3077.7	578.7	1313.1	89.6	4390.8	585.6
October	1708.8	275.4	2940.1	1182.4	4648.9	1214.1
December	854.7	191.9	307.7	23.0	1162.4	193.3

Appendix A. Core and additional questions of the angler and creel survey at Summersville Reservoir.

SUMMERSVILLE RESERVOIR ANGLER SURVEY

CORE QUESTIONS

1. *WHAT IS YOUR ZIP CODE ?* Use 5 digit Zip Codes. This is helpful when determining where anglers live and how far they are willing to travel to fish.
2. *WHEN DID YOU START FISHING TODAY ?* Only anglers fishing more than 30 minutes should be interviewed. If the angler has been fishing less than 30 minutes, contact later. Record in 24-hour clock
3. *HOW MANY ARE FISHING IN YOUR GROUP TODAY ?* If several anglers are present in a boat or on shore, use a separate angler interview form for each angler. If the fish are combined (i.e., not on separate stringers), use one angler interview form for all anglers in the group.
4. *WHAT FISH SPECIES ARE YOU TRYING TO CATCH TODAY ?*
Suggested Directed Effort Groups
Any Species Walleye Black Bass Crappie Sunfish
5. *HOW MANY FISH HAVE YOU (OR YOUR GROUP) CAUGHT AND KEPT TODAY ?* Ask this question exactly as written. If they have not caught and kept any fish, record the name of the species sought and caught as 0.
 - a. *May I See Them ?* Identify and count all fish.
 - b. *May I Measure Them ?* Measure all walleye. Record the total length to the nearest millimeter.
6. *HOW MANY FISH HAVE YOU (OR YOUR GROUP) CAUGHT AND RELEASED TODAY?*
 - a. Ask Angler Approximate Length Of Released Walleye ?
7. *HOW OFTEN DO YOU FISH SUMMERSVILLE RESERVOIR FOR WALLEYE ?* _____
8. ON A SCALE OF 1 TO 9, WHERE 1 MEANS EXTREMELY DISSATISFIED AND 9 MEANS EXTREMELY SATISFIED, HOW SATISFIED ARE YOU WITH TODAY'S FISHING TRIP AT THE SUMMERSVILLE RESERVOIR.
9. WHAT WARMWATER FISH SPECIES DID YOU FISH FOR MOST OFTEN IN WEST VIRGINIA? RANK 1 AS MOST OFTEN, TO 6 LEAST OFTEN.

Black Bass _____	Catfish _____	Sunfish _____	Crappie _____
Walleye _____	Musky _____	Hybrid STB _____	Any _____
10. HAVE YOU BEEN INTERVIEWED BEFORE DURING THIS FISHING SEASON AT SUMMERSVILLE RESERVOIR?
 - a. If the response is YES, interview is complete.
 - b. If the response is NO, ask additional questions

ADDITIONAL QUESTIONS

(if answer to #10 is NO)

1. ON AN AVERAGE FISHING TRIP TO SUMMERSVILLE RESERVOIR,
 - a. What Percent Of **All Walleye** You Catch Do You Keep: _____
 - b. What Percent Of **Walleye** You Catch Are Greater Than 15 Inches: _____
 - c. What Percent Of **Walleye Greater than 15-inches** You Catch Do You Keep: _____
2. WHAT LENGTH WOULD YOU CONSIDER A
"Keepable" Walleye: _____ "Trophy" Walleye: _____
3. IN THE LAST 5-YEARS, WOULD YOU CONSIDER
 - a. Overall **WALLEYE** fishing at Summersville Reservoir has
Improved _____ Stayed The Same: _____ Got Worst: _____ Don't Know: _____
 - b. The size of **WALLEYE** at Summersville Reservoir has
Improved _____ Stayed The Same: _____ Got Worst: _____ Don't Know: _____
4. THE WVDNR IS CONSIDERING FISHING REGULATIONS CHANGES FOR **WALLEYE** AT SUMMERSVILLE RESERVOIR.
WHAT IS YOUR OPINION OF THESE POTENTIAL CHANGES

<u>Size Limit:</u>	Support _____	Oppose _____	Do not care _____
<u>Bag Limit:</u>	Support _____	Oppose _____	Do not care _____
<u>Both:</u>	Support _____	Oppose _____	Do not care _____
5. DO YOU FISH OTHER WEST VIRGINIA WATERS FOR **WALLEYE**
Rivers: _____
Reservoirs: _____

ADDITIONAL INFORMATION WHICH MUST BE RECORDED

JUST PRIOR TO IN TERVIEW:

1. Is This A Completed Trip (i.e. Leaving Reservoir)
2. Was Angler Group Boat Or Bank Fishers
3. Exact Time Of Interview: **24-HOUR CLOCK**
4. Location Of Interview: By Reservoir Code

ADDITIONAL INFORMATION WHICH MUST BE RECORDED

AT START OF DAY:

1. Date
2. Weather Conditions
3. Water Conditions
4. Surface Water Temperature

INFORMATION TO BE COLLECTED TO DETERMINE OVERALL EFFORT

3 TIMES PER SAMPLE PERIOD

1. Number Of Vehicles At Each Parking Lot
2. Number Of Bank Anglers At Each Access Point
3. Time of information collected

Appendix B. Data collected prior to each angler survey at Summersville Reservoir.

Survey Number	Survey Day	Date	Completed trip (Y/N)	Angler Type	Interview Time	Interview Location
1	1	28-Nov	Y	boat	13:15	Long Point
2	1	28-Nov	N	boat	16:00	Salmon Run
3	1	28-Nov	Y	boat	16:30	Long Point
4	1	28-Nov	Y	boat	16:35	Long Point
5	1	28-Nov	Y	boat	17:00	Long Point
6	4	6-Dec	Y	boat	16:42	Winter Ramp
7	6	13-Dec	Y	boat	16:00	Winter Ramp
8	6	13-Dec	Y	boat	16:20	Winter Ramp
9	6	13-Dec	Y	boat	16:30	Winter Ramp
10	6	13-Dec	N	bank	17:00	Winter Ramp
11	8	20-Dec	N	boat	12:15	Salmon Run
12	8	20-Dec	Y	boat	16:20	Salmon Run
13	8	20-Dec	Y	boat	16:56	Salmon Run
14	10	3-Jan	Y	boat	12:10	Winter Ramp
15	10	3-Jan	Y	bank	14:30	Winter Ramp
16	25	26-Feb	Y	boat	11:43	Winter Ramp
17	25	26-Feb	Y	Boat	15:15	Winter Ramp
18	25	26-Feb	Y	boat	15:20	Winter Ramp
19	30	14-Mar	y	boat	14:00	Winter Ramp
20	30	14-Mar	n	bank	15:05	Brocks Bridge
21	31	17-Mar	n	bank	13:10	Brocks Bridge
22	31	17-Mar	n	bank	11:30	Brocks Bridge
23	32	22-Mar	y	boat	12:51	Winter Ramp
24	32	22-Mar	y	bank	15:30	Brocks Bridge
25	32	22-Mar	y	boat	13:50	Salmon Run
26	32	22-Mar	y	boat	16:15	Salmon Run
27	32	22-Mar	y	boat	17:15	Winter Ramp
28	32	22-Mar	y	boat	17:30	Winter Ramp
29	34	28-Mar	n	bank	14:12	Brocks Bridge
30	34	28-Mar	y	boat	16:20	Winter Ramp
31	34	28-Mar	y	boat	16:30	Winter Ramp
32	35	5-Apr	n	bank	12:45	Brocks Bridge
33	36	5-Apr	n	bank	9:25	Salmon Run
34	38	11-Apr	y	boat	9:00	Battle Run
35	38	11-Apr	y	boat	14:08	Long Point
36	38	11-Apr	y	boat	14:16	Long Point
37	38	11-Apr	y	boat	14:28	Long Point
38	38	11-Apr	y	boat	14:32	Long Point
39	39	17-Apr	n	bank	12:47	Battle Run

40	39	17-Apr	y	boat	12:50	Battle Run
41	39	17-Apr	n	bank	14:30	Salmon Run
42	39	17-Apr	n	bank	14:35	Salmon Run
43	40	18-Apr	y	boat	13:50	Salmon Run
44	40	18-Apr	y	boat	14:27	Salmon Run
45	40	18-Apr	y	boat	16:10	Salmon Run
46	40	18-Apr	n	bank	16:20	Salmon Run
47	41	20-Apr	n	bank	12:00	Battle Run
48	41	20-Apr	n	bank	12:10	Battle Run
49	42	26-Apr	y	boat	10:15	Salmon Run
50	42	26-Apr	n	boat	10:20	Salmon Run
51	42	26-Apr	y	boat	13:00	Battle Run
52	42	26-Apr	y	boat	13:05	Battle Run
53	42	26-Apr	n	bank	13:45	Salmon Run
54	42	26-Apr	n	bank	14:00	Salmon Run
55	43	27-Apr	Y	bank	14:13	Battle Run
56	43	27-Apr	n	bank	15:22	Salmon Run
57	43	27-Apr	y	boat	15:45	Salmon Run
58	44	3-May	n	bank	9:30	Salmon Run
59	44	3-May	y	boat	13:03	Long Point
60	44	3-May	y	boat	13:40	Battle Run
61	44	3-May	y	boat	16:10	Battle Run
62	44	3-May	y	boat	16:20	Battle Run
63	44	3-May	y	boat	17:20	Salmon Run
64	45	7-May	y	boat	14:32	Battle Run
65	45	7-May	y	boat	9:36	Battle Run
66	45	7-May	y	boat	12:31	Long Point
67	46	10-May	y	boat	10:33	Salmon Run
68	46	10-May	y	boat	11:40	Battle Run
69	46	10-May	y	boat	13:50	Long Point
70	46	10-May	y	boat	14:00	Long Point
71	46	10-May	y	boat	15:52	Salmon Run
72	47	11-May	y	boat	8:40	Salmon Run
73	47	11-May	y	boat	12:02	Salmon Run
74	47	11-May	n	bank	13:42	Battle Run
75	48	16-May	n	boat	9:54	Salmon Run
76	48	16-May	y	boat	10:30	Battle Run
77	48	16-May	y	boat	11:46	Battle Run
78	48	16-May	y	boat	13:25	Salmon Run
79	48	16-May	y	boat	13:35	Salmon Run
80	48	16-May	y	boat	15:41	Battle Run
81	48	16-May	y	boat	16:02	Battle Run
82	48	16-May	n	bank	16:23	Battle Run

83	49	21-May	y	boat	10:30	Salmon Run
84	49	21-May	y	boat	12:30	Battle Run
85	49	21-May	Y	bank	15:30	Salmon Run
86	50	24-May	Y	boat	9:30	Salmon Run
87	50	24-May	y	boat	10:17	Long Point
88	50	24-May	n	boat	10:35	Long Point
89	50	24-May	n	boat	11:00	Long Point
90	50	24-May	y	bank	12:25	Battle Run
91	50	24-May	y	bank	12:31	Battle Run
92	50	24-May	n	bank	13:38	Salmon Run
93	50	24-May	y	boat	14:00	Salmon Run
94	50	24-May	y	boat	15:03	Long Point
95	50	24-May	n	bank	16:22	Battle Run
96	52	31-May	n	bank	13:00	Salmon Run
97	52	31-May	n	bank	14:40	Salmon Run
98	52	31-May	n	bank	15:36	Salmon Run
99	52	31-May	y	boat	17:09	Salmon Run
100	52	31-May	y	boat	18:04	Long Point
101	52	31-May	n	boat	18:00	Long Point
102	52	31-May	n	bank	18:56	Battle Run
103	53	3-Jun	y	boat	14:15	Battle Run
104	54	7-Jun	y	boat	10:47	Salmon Run
105	54	7-Jun	y	bank	14:15	Battle Run
106	54	7-Jun	y	boat	18:00	Salmon Run
107	55	12-Jun	y	boat	9:38	Salmon Run
108	55	12-Jun	n	bank	14:20	Salmon Run
109	55	12-Jun	n	bank	15:14	Salmon Run
110	55	12-Jun	n	bank	15:18	Salmon Run
111	56	14-Jun	n	bank	12:23	Salmon Run
112	56	14-Jun	y	boat	13:43	Battle Run
113	56	14-Jun	n	bank	15:48	Salmon Run
114	56	14-Jun	n	bank	16:00	Salmon Run
115	56	14-Jun	n	boat	17:03	Long Point
116	57	18-Jun	y	bank	11:17	Battle Run
117	57	18-Jun	y	bank	16:22	Battle Run
118	58	20-Jun	y	boat	11:02	Battle Run
119	58	20-Jun	n	boat	17:29	Long Point
120	58	20-Jun	n	boat	17:43	Battle Run
121	59	24-Jun	y	boat	16:17	Salmon Run
122	60	28-Jun	y	boat	12:01	Battle Run
123	60	28-Jun	n	bank	16:09	Salmon Run
124	60	28-Jun	y	bank	16:22	Salmon Run
125	62	5-Jul	y	bank	8:10	Salmon Run

126	62	5-Jul	y	boat	17:00	Battle Run
127	62	5-Jul	n	bank	17:17	Battle Run
128	62	5-Jul	y	bank	17:43	Battle Run
129	63	10-Jul	y	boat	10:43	Salmon Run
130	63	10-Jul	y	bank	12:00	Battle Run
131	64	11-Jul	y	boat	9:30	Salmon Run
132	65	15-Jul	y	bank	17:30	Battle Run
133	66	18-Jul	y	boat	10:25	Long Point
134	66	18-Jul	N	boat	15:00	Long Point
135	66	18-Jul	y	boat	15:04	Long Point
136	66	18-Jul	n	bank	15:50	Salmon Run
137	66	18-Jul	n	bank	17:29	Battle Run
138	68	24-Jul	n	bank	9:45	Salmon Run
139	68	24-Jul	n	bank	16:50	Battle Run
140	69	9-Sep	n	bank	12:25	Salmon Run
141	69	9-Sep	n	bank	16:52	Battle Run
142	71	15-Sep	y	boat	12:53	Battle Run
143	71	15-Sep	y	boat	13:00	Battle Run
144	71	15-Sep	y	boat	15:20	Salmon Run
145	72	19-Sep	y	boat	14:32	Long Point
146	72	19-Sep	y	boat	17:02	Battle Run
147	74	27-Sep	n	boat	10:22	Battle Run
148	76	3-Oct	n	boat	11:04	Battle Run
149	76	3-Oct	y	boat	15:00	Long Point
150	76	3-Oct	y	boat	16:03	Salmon Run
151	78	10-Oct	y	boat	14:40	Long Point
152	78	10-Oct	y	boat	17:40	Battle Run
153	79	14-Oct	y	boat	16:41	Long Point
154	80	18-Oct	y	boat	14:28	Long Point
155	80	18-Oct	y	boat	14:45	Long Point
156	80	18-Oct	y	boat	15:00	Long Point
157	80	18-Oct	y	Boat	15:11	Long Point
158	80	18-Oct	y	Boat	15:20	Long Point
159	81	22-Oct	y	Boat	11:27	Winter Ramp
160	81	22-Oct	y	Boat	12:30	Long Point
161	82	25-Oct	y	Boat	11:02	Salmon Run
162	82	25-Oct	y	Boat	15:53	Long Point
163	82	25-Oct	y	Boat	15:59	Long Point
164	84	31-Oct	n	Bank	16:45	Long Point
165	84	31-Oct	y	Boat	17:24	Long Point

Appendix C. Daily weather and water conditions for angler surveys on Summersville Reservoir (NM = water temperature not measured).

Survey day Number	Sample date	Weather conditions and air temp (°C)	Water conditions	Water temp (°C)
1	28-Nov-08	Clear and Sunny, 7	Clear	9
2	29-Nov-08	Rain, overcast, 8	Clear	9
3	1-Dec-08	Snow, overcast, 1.7	Stained	9.5
4	6-Dec-08	Overcast, 1.7	Clear	7.8
5	10-Dec-08	Rain, 7.2	Clear	7.5
6	14-Dec-08	Clear, 7.2	Turbid	7
7	19-Dec-08	Rain, 14.3	Turbid	8.5
8	20-Dec-08	Overcast, 6.2	Turbid	6.2
9	1-Jan-09	Clear, 2.8	Clear	5
10	3-Jan-09	Clear, 8.3	Clear	4.8
11	8-Jan-09	Rain, 8.3	Turbid	4.6
12	10-Jan-09	Rain, 8.3	Turbid	5.2
13	14-Jan-09	Overcast, -2.8	Turbid	4.8
14	17-Jan-09	Clear, 1.7	Frozen	NM
15	19-Jan-09	Snow, -3.9	Frozen	NM
16	24-Jan-09	Snow, 7.2	Frozen	NM
17	26-Jan-09	Overcast, - 2.8	Frozen	NM
18	1-Feb-09	Clear, 12.8	Frozen	NM
19	5-Feb-09	Snow, - 9.4	Frozen	NM
20	8-Feb-09	Clear, 12.8	Frozen	NM
21	10-Feb-09	Rain/Sleet, 12.8	Frozen	NM
22	15-Feb-09	Clear, 1.7	Clear	4
23	20-Feb-09	Clear, -3.9	Clear	4.4
24	21-Feb-09	Clear, -3.9	Clear	3.2
25	26-Feb-09	Overcast, 5	Clear	2.5
26	1-Mar-09	Clear, -3.9	Clear	2.4
27	2-Mar-09	Clear, 7.2	Clear	4.8
28	7-Mar-09	Clear, 18.3	Clear	5.5
29	10-Mar-09	Clear, 12.8	Clear	5.8
30	14-Mar-09	Rain, 6	Clear	6.8
31	17-Mar-09	Partly Cloudy, 16	Turbid	5.8
32	22-Mar-09	Clear, 18.3	Clear	12
33	27-Mar-09	Overcast, 14	Clear	11.5
34	28-Mar-09	Overcast, Rain, 9	Turbid	11.3
35	30-Mar-09	Partly cloudy, 17	Turbid	11.4
36	5-Apr-09	Clear, 23.9	Stained	12

37	6-Apr-09	Rain, 6	Stained	12.2
38	11-Apr-09	Overcast, 6	Turbid	9.7
39	17-Apr-09	Sunny, 17	Turbid	13.8
40	18-Apr-09	Sunny, 22	Stained	14.1
41	20-Apr-09	Rain, 23.9	Stained	23
42	26-Apr-09	Sunny, 27	Clear	24.3
43	27-Apr-09	Sunny, 33	Clear	25.6
44	3-May-09	Overcast, Rain, 12	Clear	23.6
45	7-May-09	Rain, 18.3	Clear	22.4
46	10-May-09	Sunny, 21.4	Clear	23.9
47	11-May-09	Overcast, Drizzle, 23.4	Clear	24
48	16-May-09	Sunny, 28	Clear	24.5
49	21-May-09	Sunny, 25	Clear	19.3
50	24-May-09	Sunny, 27.2	Clear	25.1
51	26-May-09	Rain, 20	Clear	24.2
52	31-May-09	Partly Sunny, 23	Clear	23.7
53	3-Jun-09	Sunny, 27	Clear	25.3
54	7-Jun-09	Overcast, 26	Stained	23.2
55	12-Jun-09	Rain, 21	Clear	24
56	14-Jun-09	Sunny, 25	Clear	25.3
57	18-Jun-09	Overcast, 26	Clear	25.7
58	20-Jun-09	Sunny, 27.2	Clear	26.2
59	24-Jun-09	Sunny, 27.9	Clear	26.2
60	28-Jun-09	Sunny, 28	Clear	25.8
61	29-Jun-09	Partly Cloudy	Clear	25.7
62	5-Jul-09	Rain, 21	Stained	23.3
63	10-Jul-09	Rain, 26	Clear	24.8
64	11-Jul-09	Sunny, 28.8	Clear	25
65	15-Jul-09	Scattered Thunderstorms, 24	Clear	25.5
66	18-Jul-09	Clear, 21.9	Clear	25.9
67	22-Jul-09	Clear, 30	Clear	26.9
68	24-Jul-09	Rain, 22	Clear	26
69	9-Sep-09	Scattered Thunderstorms, 21	Clear	23.2
70	13-Sep-09	Sunny, 20.0	Clear	23.1
71	15-Sep-09	Partly Cloudy, 23	Clear	27.7
72	19-Sep-09	Sunny, 25	Clear	25.1
73	22-Sep-09	Partly Cloudy, 23. 2	Clear	23.7
74	27-Sep-09	Overcast, Drizzle, 18.3	clear	20.1
75	30-Sep-09	Cloudy, 10	Stained	19.2
76	3-Oct-09	Overcast, 20	Clear	18.9
77	9-Oct-09	Scattered Thunderstorms, 21	Clear	19.5
78	10-Oct-09	Rain, 17.7	Clear	19.9
79	14-Oct-09	Rain, 11.1	Clear	19.4

80	18-Oct-09	Overcast, Windy 8.5	Clear	17.8
81	22-Oct-09	Partly Cloudy, 19	Clear	18.4
82	24-Oct-09	Sunny, 15	Clear	17.8
83	29-Oct-09	Partly Cloudy, 16.6	Clear	17
84	31-Oct-09	Rain, 12.7	Clear	16.6

Appendix D. Counts of vehicles (VC) and bank anglers (BA) from angler surveys at Summersville Reservoir.

Battle Run										
Survey	Round 1			Round 2			Round 3			
	Day	time	VC	BA	time	VC	BA	time	VC	BA
38		848-930	4	0	1042-1124	4	0	1500-1542	1	0
39		1030-1112	2	0	1214-1256	9	0	1624-1706	4	0
40		910-1006	46	0	1228-1324	52	0	1651-1747	12	0
41		810-906	0	1	1234-1330	2	1	1455-1551	2	0
42		800-856	11	0	1223-1319	41	0	1645-1741	11	0
43		811-907	8	0	1033-1129	3	0	1353-1449	3	1
44		1015-1111	68	0	1339-1435	77	0	1600-1656	80	0
45		910-1006	8	0	1333-1429	8	0	1553-1649	2	0
46		911-1007	16	0	1134-1230	28	0	1655-1751	34	0
47		1010-1106	8	0	1334-1430	7	1	1656-1752	4	0
48		1011-1108	60	0	1108-1204	60	0	1530-1626	32	1
49		911-1007	8	0	1235-1331	13	0	1553-1649	5	0
50		800-856	70	0	1220-1316	100	2	1540-1636	75	0
51		912-1008	1	0	1232-1328	3	0	1550-1646	3	0
52		1210-1306	53	0	1306-1402	50	0	1830-1926	20	1
53		1111-1207	4	0	1333-1429	12	0	1700-1756	4	0
54		800-856	10	0	1326-1422	24	1	1600-1656	32	0
55		1015-1111	10	0	1111-1207	23	0	1637-1733	29	0
56		912-1008	15	0	1333-1429	25	0	1429-1525	41	0
57		1015-1112	3	0	1112-1208	4	1	1537-1633	4	1
58		1015-1111	18	0	1230-1326	25	0	1555-1651	30	0
59		1014-1110	1	0	1238-1334	3	0	1500-1556	8	0
60		1014-1110	8	0	1110-1206	11	0	1435-1531	24	0
61		800-856	4	0	1225-1321	8	0	1545-1641	11	0
62		911-1007	3	0	1133-1229	5	0	1656-1752	1	2
63		910-1006	2	0	1130-1226	2	1	1452-1548	6	0
64		1014-1110	3	0	1337-1433	3	0	1433-1529	7	0
65		1015-1111	1	0	1111-1207	3	0	1636-1732	2	1
66		910-1006	9	0	1330-1426	23	0	1655-1751	30	1
67		800-856	3	0	1122-1218	2	0	1600-1656	5	0
68		1015-1111	0	0	1238-1334	1	0	1604-1700	2	1
69		910-1006	2	0	1330-1426	0	0	1658-1754	1	1
70		1012-1108	1	0	1235-1331	1	0	1457-1553	0	0
71		910-1006	2	0	1230-1326	0	0	1542-1638	1	0
72		800-856	1	0	1123-1219	0	0	1644-1740	4	0
73		910-1006	0	0	1330-1426	0	0	1642-1738	0	0
74		1010-1106	1	0	1332-1428	2	0	1652-1748	2	0
75		910-1006	0	0	1333-1429	0	0	1429-1523	0	0
76		1011-1107	2	0	1107-1203	2	0	1630-1726	0	0
77		911-1007	1	0	1337-1433	3	0	1433-1529	0	0
78		800-856	1	0	1325-1421	0	0	1648-1744	3	0

Brock's Bridge									
Survey	Round 1			Round 2			Round 3		
Day	time	VC	BA	time	VC	BA	time	VC	BA
1	1000-1040	0	0	1330-1410	0	0		0	0
2	730-826	0	0	1323-1419	0	0	1640-1736	0	0
3	730-826	0	0	1205-1301	0	0	1635-1731	0	0
4	806-902	0	0	1237-1333	0	0	1333-1429	0	0
5	904-1039	0	0	1330-1426	0	0	1650-1746	0	0
6	700-756	0	0	1135-1231	0	0	1340-1436	0	0
7	700-756	0	0	1130-1226	0	0	1345-1441	0	0
8	802-858	0	0	1222-1318	0	0	1318-1414	0	0
9	1030-1126	0	0	1126-1222	0	0	1715-1811	0	0
10	1012-1106	0	0	1340-1436	0	0	1600-1656	0	0
11	925-1021	0	0	1146-1242	0	0	1350-1446	0	0
12	925-1021	0	0	1150-1246	0	0	1354-1450	0	0
13	812-908	0	0	1016-1112	0	0	1542-1638	0	0
22	700-756	0	0	1035-1131	0	0	420-516	0	0
23	700-756	0	0	1238-1334	0	0	1442-1538	0	0
24	812-908	0	0	1240-1336	0	0	1336-1432	0	0
25	812-908	0	0	1230-1326	0	0	1326-1422	0	0
26	1013-1109	0	0	1338-1434	0	0	1700-1756	0	0
27	700-756	0	0	1248-1344	0	0	1344-1441	0	0
28	912-1008	0	0	1138-1234	0	0	1606-1702	0	0
29	700-756	0	0	1242-1338	0	0	1338-1434	0	0
30	800-856	0	0	1350-1446	1	1	1713-1809	0	0
31	810-906	0	0	1230-1326	1	2	1430-1526	1	2
32	901-957	0	0	1124-1220	1	0	1446-1541	1	0
33	910-1006	0	0	1332-1428	0	0	1428-1524	0	0
34	802-858	0	0	1026-1122	0	0	1350-1446	1	1
35	801-857	0	0	1024-1120	0	0	1346-1442	0	0
36	700-756	0	0	1241-1337	0	0	1603-1659	0	0
37	1024-1120	0	0	1228-1324	0	0	1451-1547	0	0

Long Point									
Survey	Round 1			Round 2			Round 3		
Day	time	VC	BA	time	VC	BA	time	VC	BA
38	750-832	30	0	1230-1312	64	0	1404-1446	61	0
39	934-1016	4	0	1117-1159	7	0	1450-1532	14	0
40	1020-1116	5	0	1116-1212	5	0	1440-1536	19	0
41	700-756	2	0	1020-1116	3	0	1345-1441	3	0
42	911-1007	33	0	1112-1208	64	0	1433-1529	64	0
43	923-1019	12	0	1143-1239	20	0	1605-1701	9	0
44	800-856	8	0	1229-1325	30	0	1448-1544	16	0
45	1020-1116	12	0	1221-1317	11	0	1443-1539	8	0
46	800-856	19	0	1346-1442	35	0	1442-1538	47	0
47	900-956	15	0	1222-1318	17	0	1545-1641	17	0
48	800-856	12	0	1219-1315	34	0	1640-1736	21	0
49	800-856	14	0	1133-1229	20	0	1703-1759	7	0
50	1012-1108	90	0	1108-1204	98	0	1430-1526	83	0
51	800-856	3	0	1342-1438	5	0	1438-1534	6	0
52	1000-1056	64	0	1419-1515	64	0	1718-1814	33	0
53	1222-1318	31	0	1546-1642	24	0	1810-1906	14	0
54	910-1006	15	0	1112-1208	27	0	1450-1546	45	0
55	800-856	20	0	1322-1418	34	0	1525-1621	36	0
56	1024-1120	31	0	1120-1216	37	0	1642-1738	52	0
57	902-958	6	0	1224-1320	11	0	1427-1523	17	0
58	901-957	10	0	1341-1437	25	0	1704-1800	33	0
59	903-959	5	0	1350-1446	12	0	1702-1758	16	0
60	901-957	13	0	1323-1419	33	0	1648-1744	48	0
61	1012-1108	5	0	1337-1433	2	0	1433-1529	8	0
62	1022-1118	4	0	1235-1331	4	0	1544-1640	11	0
63	800-856	3	0	1342-1438	2	0	1342-1438	14	0
64	800-856	4	0	1226-1322	15	0	1545-1641	9	0
65	800-856	6	0	1222-1318	4	0	1424-1520	2	0
66	1021-1117	15	0	1117-1213	28	0	1441-1537	54	0
67	1011-1107	8	0	1346-1442	19	0	1710-1806	15	0
68	800-856	4	0	1350-1446	1	0	1715-1811	4	0
69	1021-1117	4	0	1117-1213	0	0	1544-1640	0	0
70	800-856	4	0	1346-1442	2	0	1608-1704	3	0
71	800-856	4	0	1340-1426	13	0	1642-1738	3	0
72	1011-1107	6	0	1335-1431	8	0	1431-1527	0	0
73	800-856	2	0	1218-1314	2	0	1430-1526	0	0
74	900-956	2	0	1120-1216	2	0	1542-1638	3	0
76	1020-1116	1	0	1222-1318	1	0	1540-1636	1	0
77	800-856	4	0	1320-1416	3	0	1416-1512	3	0
78	1012-1108	7	0	1225-1321	5	0	1646-1742	5	0
79	912-1008	2	0	1113-1209	0	0	1436-1532	4	0
81	800-856	4	0	1123-1219	6	0	1547-1643	2	0
82	800-856	94	0	1330-1426	92	0	1440-1536	0	0
83	1013-1109	3	0	1237-1333	6	0	1439-1535	4	1
84	910-1006	10	0	1111-1208	10	0	1542-1638	6	0
85	900-956	2	0	1343-1439	4	0	1707-1803	0	0
86	800-856	4	0	1318-1414	2	0	1641-1737	3	1
Salmon Run									

Survey	Round 1			Round 2			Round 3		
Day	time	VC	BA	time	VC	BA	time	VC	BA
1	820-900	0	0	1155-1235	0	0	1515-1555	1	0
2	836-932	0	0	1057-1153	1	0	1425-1521	2	0
3	941-1037	0	0	1311-1407	0	0	1530-1626	0	0
4	700-756	0	0	1023-1119	2	0	1435-1531	0	0
5	840-936	0	0	1046-1142	0	0	1430-1526	1	0
6	914-1010	0	0	1238-1334	3	3	1600-1656	0	0
7	806-902	0	0	1026-1122	0	0	1450-1546	0	0
8	700-756	0	0	1120-1216	0	0	1605-1701	2	0
9	800-856	0	0	1230-1326	0	0	1453-1549	0	0
10	911-1007	0	0	1113-1209	0	0	1700-1756	0	0
11	702-758	0	0	1248-1344	0	0	1452-1548	0	0
12	701-757	0	0	1251-1347	0	0	1615-1711	0	0
13	915-1011	0	0	1118-1214	0	0	1440-1537	0	0
22	810-906	0	0	1136-1232	0	0	1400-1456	0	0
23	923-1019	0	0	1019-1115	0	0	140-236	0	0
24	915-1011	0	0	1137-1233	0	0	1600-1656	0	0
25	913-1009	0	0	1009-1105	0	0	1548-1644	0	0
26	911-1007	0	0	1237-1333	0	0	1440-1536	0	0
27	923-1019	0	0	1145-1241	0	0	1604-1700	0	0
28	700-756	0	0	1240-1336	2	0	1503-1559	0	0
29	923-1019	2	0	1136-1232	3	0	1600-1656	4	0
30	902-958	0	0	1126-1222	0	0	1611-1708	0	0
31	911-1007	0	0	1007-1103	0	0	1330-1426	3	0
32	800-856	1	0	1345-1441	7	0	1546-1642	7	0
33	1011-1108	0	0	1108-1204	0	0	1651-1747	1	0
34	700-756	2	0	1249-1345	3	0	1450-1546	0	0
35	700-756	1	0	1245-1341	2	0	1448-1544	0	0
36	920-1016	4	1	1140-1236	4	0	1502-1558	4	0
37	800-856	0	0	1126-1222	0	0	1552-1648	0	0
38	945-1027	2	0	1317-1359	2	0	1559-1641	2	0
39	847-929	5	0	1404-1446	15	0	1537-1619	7	0
40	800-856	2	0	1340-1436	4	0	1541-1637	9	1
41	920-1016	1	0	1122-1218	1	0	1606-1702	0	0
42	1012-1108	28	1	1333-1429	26	2	1534-1630	17	0
43	700-756	4	0	1245-1341	7	0	1505-1601	2	1
44	903-959	1	1	1128-1224	1	1	1710-1806	2	0
45	800-856	3	0	1120-1216	4	0	1706-1802	1	0
46	1024-1120	9	0	1246-1342	13	0	1543-1639	15	0
47	800-856	4	0	1121-1217	9	0	1444-1540	12	0
48	900-956	8	0	1320-1416	13	0	1416-1512	15	0
49	1022-1118	9	0	1345-1441	12	0	1441-1537	10	0
50	911-1007	20	0	1330-1426	25	1	1652-1748	17	0

51	1023-1119	0	0	1119-1215	2	0	1700-1756	3	0
52	1100-1156	15	1	1520-1616	45	2	1616-1712	29	2
53	1000-1056	11	0	1445-1541	12	0	1911-2007	9	0
54	1011-1107	9	0	1214-1310	15	0	1712-1808	17	0
55	902-958	6	0	1222-1318	17	0	1423-1519	19	3
56	800-856	4	0	1221-1317	12	1	1540-1636	32	2
57	800-856	2	0	1325-1421	5	0	1647-1743	9	0
58	800-856	4	0	117-1213	6	0	1443-1539	12	0
59	800-856	0	0	1126-1222	5	0	1610-1706	18	0
60	800-856	2	0	1222-1318	11	0	1546-1642	16	2
61	910-1006	1	0	1114-1210	3	0	1654-1750	3	0
62	800-856	0	1	1347-1443	3	0	1443-1539	4	0
63	1020-1116	2	0	1231-1337	3	0	1603-1659	5	0
64	902-958	4	0	1125-1221	9	0	1646-1742	11	0
65	903-959	1	0	1323-1419	2	0	1525-1621	2	0
66	800-856	2	0	1218-1314	9	0	1543-1639	14	1
67	910-1006	2	0	1245-1341	0	0	1446-1542	4	0
68	902-958	4	1	1127-1223	2	0	1452-1548	3	0
69	800-856	1	0	1218-1314	3	1	1441-1537	1	0
70	901-957	2	0	1124-1220	3	0	1709-1805	0	0
71	1021-1117	2	0	1117-1213	1	0	1431-1527	16	0
72	910-1006	2	0	1234-1330	8	0	1532-1628	2	0
73	1021-1117	3	0	1117-1213	2	0	1531-1627	2	0
74	800-856	2	0	1221-1317	2	0	1441-1537	2	0
75	800-856	5	0	1121-1217	5	0	1641-1737	0	0
76	900-956	0	0	1218-1314	0	0	1517-1613	1	0
77	800-856	3	0	1113-1209	2	0	1545-1641	0	2
78	1012-1108	0	0	1214-1310	0	0	1537-1633	2	0
79	900-956	0	0	1224-1320	0	0	1446-1542	0	0
80	1021-1117	3	0	1117-1213	0	0	1541-1637	0	0
81	911-1007	2	0	1338-1434	1	0	1700-1756	0	0
82	1011-1106	3	0	1213-1309	0	3	1644-1740	0	0
83	800-856	0	0	1121-1217	1	0	1606-1702	0	0
84	900-956	2	0	1217-1313	2	0	1540-1636	0	0

Winter Ramp

Survey	Round 1			Round 2			Round 3		
Day	time	VC	BA	time	VC	BA	time	VC	BA
1	730-810	5	0	1100-1140	0	0	1425-1505	10	0
2	946-1042	1	0	1207-1303	1	0	1533-1629	0	0
3	835-931	0	0	1050-1146	0	0	1420-1516	0	0
4	917-1013	3	0	1127-1223	2	0	1545-1641	0	0
5	730-826	1	0	1157-1253	1	0	1540-1636	5	1
6	805-901	1	0	1025-1121	2	0	1450-1546	0	0
7	917-1013	0	0	1236-1332	0	0	1600-1656	0	0
8	915-1011	1	0	1011-1107	1	0	1500-1556	5	0
9	910-1006	0	0	1341-1437	1	0	1604-1700	0	0
10	800-856	0	0	1227-1324	2	1	1450-1546	1	1
11	814-910	0	0	1035-1131	0	0	1605-1701	0	0
12	813-909	0	0	1040-1136	0	0	1507-1603	0	0
13	700-756	0	0	1230-1326	0	0	1326-1424	0	0
22	917-1013	0	0	1250-1346	0	0	1510-1606	0	0
23	812-908	0	0	1126-1222	0	0	1552-1648	0	0
24	700-756	0	0	1025-1121	0	0	1446-1542	0	0
25	700-756	2	0	1120-1216	5	0	1437-1533	5	0
26	800-856	0	0	1125-1221	0	0	1550-1646	0	0
27	812-908	0	0	1033-1129	0	0	1455-1551	0	0
28	810-906	2	0	1024-1121	6	0	1350-1446	5	0
29	812-908	2	0	1033-1129	2	0	1450-1546	3	0
30	1015-1111	4	0	1238-1334	5	0	1500-1556	4	0
31	700-756	1	0	1118-1214	4	0	1540-1636	0	0
32	1012-1108	5	0	1235-1331	8	0	1558-1754	6	0
33	800-856	0	0	1220-1316	2	0	1540-1636	4	0
34	904-1010	2	0	1137-1233	4	0	1600-1656	3	0
35	912-1008	1	0	1135-1231	1	0	1600-1656	0	0
36	810-906	5	0	1030-1124	8	0	1351-1447	0	0
37	912-1008	0	0	1341-1437	0	0	1702-1748	0	0
79	1011-1107	0	0	1335-1431	0	0	1700-1754	0	0
80	910-1006	3	0	1218-1314	0	0	1652-1748	2	0
81	800-856	1	0	1126-1222	1	0	1550-1646	0	0
82	800-856	1	0	1336-1432	0	0	1432-1528	2	0
83	1010-1106	0	0	1232-1328	0	0	1455-1551	0	0
84	1010-1106	1	0	1106-1202	1	0	1430-1526	3	0