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Economic analysis of the Upper South River Special Regulation Area in Augusta County, Virginia

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Economic Analysis of the Upper South River Special Regulation Area in Augusta County, Virginia

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Abstract

The Upper South River Special Regulation Area (SRA) is a fishery in Augusta County, Virginia that opened as a trout fishery in January 2011. There is a need to estimate the economic impact of the fishery on the local community in order to find the value of the fishery. The economic value of the fishery is important because of its implications in the management practices as well as funding for future restoration and conservation projects.

In this study, the economic impact was estimated to be $78,181 from January 2011 through June 2012. This was calculated based on prior surveys and not from a survey to Upper South River SRA anglers. Most notably, the 2006 National Survey offered trip-related expenditures for Virginia anglers and non-Virginia anglers when fishing in Virginia, the 2011 South River Survey gave a percentage of expenditures that are spent within 20 miles of the river, and conversations with active anglers gave an estimate of angling effort. Upper South River SRA Permit application data was used to get geographic data of the anglers.

It is recommended that a future survey be conducted on Upper South River SRA permit applicants in order to further assess the economic impacts of the fishery on the local community. $78,181 is a conservative estimate of the economic impact and a focused survey can show the impact to be much larger. This document outlines the importance and procedure of natural resource valuation and has recommendations for a survey to continue the efforts to value the Upper South River SRA.

Chapter 1: Recreational Fishing

Commercial fishing is a major economic activity worldwide that provides food and jobs to many people, especially people that live in coastal regions. It has been estimated that the economic impact of the global marine fishing industry is $240 billion US dollars annually (Dyck & Sumaila, 2010). The overall economic impact of fisheries is even higher if inland fisheries and the ever-growing industry of aquaculture are included. It is easy to understand the importance of commercial fisheries as they offer a tangible product for the masses, fish for food. The importance of recreational fishing, on the other hand, is much harder to understand and evaluate.

Before recreational fisheries are discussed, it is important that some terms are defined. The European Anglers Alliance defines recreational fishing as fishing that is not deemed to be commercial fishing (European Anglers Alliance, 2004). This means that the fish cannot be sold, in order for the fishing activity to be considered recreational. Commercial fishing often requires state and federal licenses, as well as reports of the point of sale. Anglers are fisherman that line fish using the hooking method (European Anglers Alliance, 2004). This document will focus on recreational fisherman that practice angling.

Recreational fishing often requires a state license and/or permit. Recreational catches are not reported to the state, as are commercial catches, but are rather ascertained by state surveys (Florida Fish and Wildlife Conservation Commission, 2012). A recreational angler in Virginia between the age of 16 and 65 years old is required to purchase an annual license. Lengths of coverage range from a temporary 5-day license to lifetime

coverage. Prices fluctuate based on age, residential status (prices are higher for nonresidents), and are based on saltwater or freshwater use (Virginia Marine Resources Commission, 2012). In some Virginia locations, an angler must also possess a permit that grants access to specific areas.

Popularity

Recreational fishing is an extremely popular pastime throughout America. There are 29.9 million anglers over the age of 16 who have a license, and 8.4 million children between the ages of 6 and 15 who fish (Allen & Southwick, 2008; Southwick & Duda, 2012). This means nearly 13% of Americans are anglers (Southwick & Duda, 2012). To put the popularity of fishing in perspective, there are more Americans fishing at least once in a year than playing golf (24.4 million) and tennis (10.4 million) combined. The National Sporting Goods Association ranked fishing twelfth out of 46 recreation activities, preceded only by walking, exercising (of various forms including using equipment, aerobic exercise, at a sports club, and weightlifting), swimming, camping, hiking, running, and bowling. Fishing is ranked higher in popularity than other activities such as baseball and softball, basketball, soccer, yoga and skiing (National Sporting Goods Association, 2011).

Fishing is a nationwide activity with anglers in every state. The largest number of anglers over the age of 16 is in Florida with 2,727,000 reported in 2006. Texas has the second largest number with 2,527,000. North Dakota has the fewest number of anglers with 106,000. Florida also has the largest number of non-resident anglers in the nation with 885,000 people who travel to Florida and fish (Allen & Southwick, 2008). According to 2004 numbers, Virginia anglers numbered approximately 996,800

individuals who took 3.6 million fishing trips. Therefore, the average angler took approximately 3.6 trips per year (Kirkley, Murray, & Duberg, 2005).

Motivation

There are many reasons why people choose fishing as their recreational activity of choice. Motivational factors for recreational anglers can be broken up into catch and non-catch categories (Pitcher & Hollingworth, 2002). Catch motivations include 'take' factors such as catching to eat and catching for trophy. In addition to 'take' factors, catch motivations include fish availability, desire to improve fishing skills, testing fishing gear, the challenge or thrill of the catch, regulations that support fishing activities, and catch and release for sport. Non-catch motivations include personal factors such as relaxation, solitude, to escape from routine, to spend time with family and friends, to have fun and adventure, and to obtain personal achievement. In addition to personal factors, environmental factors such as weather, wilderness, access to water, and water quality also play a role in angler motivation (Pitcher & Hollingworth, 2002).

There are many perceived benefits of recreational fishing that lend themselves to angler motivation. In a 2012 survey study of over 4,700 anglers (Southwick & Duda, 2012), over 40% responded that the most important reason they chose to fish was 'for the sport/recreation/fun', and nearly 40% also reported 'for relaxation/to get away' as an important reason to fish. About 15% of active anglers selected 'to catch fresh fish to eat' and 'to be with family and friends' as important reasons for selecting fishing as a recreational activity (Southwick & Duda, 2012).

In the same 2012 survey, participants were asked about their perceived disadvantages to fishing. Interestingly, when asked what disadvantages of fishing exist that would make other recreational activities more attractive, over 70% of anglers responded ‘none’. The disadvantages identified were too much time to prepare, traveling too far, and cost of purchasing equipment - however, each of these disadvantages were selected by fewer than 5% of responders. This demonstrates that the amount of money anglers spend on their sporting equipment and trip related expenses is not a deterrent to their recreational fishing activities or a reason to participate in other recreational activities (Southwick & Duda, 2012).

Anglers do not all value the same motivational factors, but are rather distinguished by different subcultures of anglers who share similar motivations and interests. Various angler motivations need to be considered in the management of a fishery, especially the distinct motivational factors of the anglers that visit a specific fishery. For example, if an angler on a particular river is motivated by catching fish to bring home to eat, catch-and-release management would not be beneficial to the angler and that angler would find other rivers to fish. Alternatively, an angler who is motivated by the thrill of catching fish would not be served by a fishery that is so over-populated that any sporting chance is removed.

Management

It is important that recreational fisheries are effectively managed to ensure the health of the environment and ecosystem, as well as to ensure that fish levels are maintained for the sustainability of the sport (NSW Department of Primary Industries, 2012; Schramm & Cooke, 2007). Fishery management requires a delicate balance to make certain that

resources are not wasted due to under-harvest, while also being careful to ensure that a fish population is not over-harvested (Fletcher & Wallace, 1996). Furthermore, there are many factors to consider that affect fish populations in fisheries, including the available food supply, water flow, the number of young fish produced each year, and habitat loss and damage, that need to be accounted for in any fishery management plan (Fletcher & Wallace, 1996).

Unfortunately, many of the world's fisheries have not been adequately managed. Approximately 50% of the world's commercial and recreational fisheries are fully exploited, meaning that there is no opportunity for further fishing. The number of the world's fisheries that are overexploited, depleted or recovering has risen from 10% in 1974 to 25% in 2005 (Hindson, Hoggarth, Krishna, Mees, & O'Neill, 2005). It is important that fisheries are properly managed to minimize or prevent the increasing trend towards overexploited or depleted fisheries so that the both the ecosystems and the sport can be supported.

Recreational marine and near coastal fisheries (0-3 miles from coast) are managed at a national level by the National Oceanic and Atmospheric Administration (NOAA) Fisheries, with the exception of Florida and Texas which are instead managed by their individual state governments (NOAA Fisheries, n.d.). Unlike recreational marine fisheries, there are no federal entities that manage inland fisheries; this responsibility instead falls to individual states. In Virginia, the responsibility of inland fisheries management falls to the Virginia Department of Game and Inland Fisheries (DelVecchio, Friedman, & Unsworth, 2010).

Nongovernmental organizations such as the Trout Unlimited (TU) also support inland fisheries management and participate in the conservation and restoration of inland fisheries. TU is a national organization comprised of 400 chapters with more than 140,000 volunteers, lawyers, policy experts, and scientists (Trout Unlimited, n.d.). The conservational professionals in TU came up with a method to assess the health of fish species in their native environment called the Conservation Success Index (CSI). This tool allows TU to measure progress in their goals of conservation, protection, and restoration of fisheries and their watersheds. TU works closely with local communities, state, and federal partners in order to achieve these goals (Trout Unlimited, n.d.). As the largest inland fishery conservation organization in the United States, fisheries managers often seek a good working relationship with their local TU chapter.

There are two broad varieties of fishery management: input controls and output controls. Input controls regulate the anglers' intensity in fishing, such as by regulating the size of boats and nets, limiting the number of licenses available, or controlling designated fishing areas. Output controls regulate the fish that come out from the water, such as limiting the number of fish caught in a time period or setting bag limits (NSW Department of Primary Industries, 2012; Cochane, ed., 2002).

Unlike commercial fishing management, the management of recreational fisheries is less about maintaining a maximum sustained yield and more about determining a yield that improves the quality of fishing perceived by anglers (Sigler & Sigler, 1990). As discussed in the previous section, recreational anglers fish for many different reasons. Although some recreational anglers are motivated by catching a lot of fish to take from the fishery, more are concerned with the quality and behaviors of the fish they catch and

the environment that they are fishing in (Sigler & Sigler, 1990; Pitcher & Hollingworth, 2002). Many of the fishery management practices for recreational fisheries work toward this goal.

Several of the fishery management practices for recreational fisheries are explained below.

Catch-and-release

Lee Wulff, a famous fly fisherman and conservationist once said, "A good game fish is too valuable to be caught only once" (North Carolina Trout Unlimited, 2010). From this concept sprung the idea of catch-and-release fishery management that TU started promoting in the early 1960s and still promotes today. When TU started as a small group in Michigan, they fought against Michigan's management practices of indiscriminate stocking of catchable-sized trout. They achieved their goal of replacing the stocking method with stream improvement programs, fingerling planting and protective fishing regulations designed to protect the wild, native fish (North Carolina Trout Unlimited, 2010).

Catch-and-release is a popular method of recreational fishery management. Resulting in no harvest, angler support for catch-and-release methods has grown in the past thirty years. Indeed, approximately 60% of all fish captured by anglers are released, even when the caught fish could have been legally harvested (Schramm & Cooke, 2007). There are various reasons for an angler to practice catch-and-release: the angler could think the fish is not of a high enough quality to warrant harvest, the angler could have reached his or

her legal limit but wishes to continue fishing recreationally, or the fishery is designated as catch-and-release and so the angler cannot harvest the catch (Schramm & Cooke, 2007).

The motivation for a catch-and-release focuses around the act of the capture and not consumption, so the release of the fish does not matter (Sigler & Sigler, 1990). TU advocates the practice of catch-and-release even when fishery management does not require it because of the benefits to trout populations (Harris, 2010). Catch-and-release is most beneficial where there are valuable populations that are facing heavy fishing pressure. When harvests are banned in these situations, trout populations can increase and potentially be sustained (Harris, 2010).

There are several techniques that should be utilized by anglers to ensure the released fish are not damaged (NYS Dept. of Environmental Conservation, 2012). Firstly, caught fish should be handled as little as possible and released quickly. This limits the exhaustion of the fish and in turn increases the chances the fish will return to full health. Fish should be out of the water less than thirty seconds because over thirty seconds of air exposure causes delayed mortality. Secondly, artificial lures and barbless hooks are important to use if releasing the fish because they are less abrasive. If the hook is lodged deep in the fish, it is better for the angler to leave the hook in it as struggling to remove the hook will exhaust the fish. Lastly, when it is warm outside and the river or stream's temperature is higher than normal, trout should not be fished because the environmental conditions are already straining the trout. In these conditions, catching a trout will damage and exhaust the fish too much for them to survive (NYS Dept. of Environmental Conservation, 2012).

Put-and-Take

Put-and-take is a method of periodically restocking a body of water to maintain a fish population (Tucker, 2009; Fletcher & Wallace, 1996). This is a traditional management practice to replenish fish from a hatchery into a fishery. However, there are several issues associated with the put and take method. Generally, fish are overfished in put-and-take fisheries soon after restocking because anglers want to take advantage of the abundance of fish when stocking events are announced. The problem of over-fishing in this instance can be attributed to Garrett Hardin's "tragedy of the commons" (Hardin, 1968) because there is a shared resource and no single angler has an incentive to harvest less fish because someone else will benefit from harvesting the fish instead. In addition, fish are accustomed to being pellet fed in hatcheries (Maryland Department of Natural Resources, 2012). Fish that are pellet fed and then released in the fishery could provide less enjoyment for anglers because these fish do not have natural feeding behaviors and so may not to respond to fishing techniques, lowering the catches.

Delayed Harvest

Delayed harvest is a management technique, primarily used in trout fisheries, that combines catch-and-release and put-and-take methods. From the fall to the spring a delayed harvest fishery offers high quality catch-and-release fishing. After the spring, the fishery is open for harvest under regular state regulations until the following fall. Periodic restocking of the river is also required to account for injuries and natural mortality (Georgia Department of Natural Resources, 2006). The delayed harvest method allows for the fish to spawn before they are removed from the fishery. It also gives fish a longer time in the water than traditional stocking methods, allowing them to develop natural

feeding behaviors (Maryland Department of Natural Resources, 2012). High catch rates can then be enjoyed for a longer time than traditional put-and-take fisheries (Georgia Department of Natural Resources, 2006).

Creel Limits and Minimum Sizes

Creel limits are the amount of fish that an angler can legally harvest from a fishery, usually expressed in fish per day. There is a separate creel limit for different types of fish. In addition to creel limits, fish size minimums allow for fish to live longer so that they can spawn before being harvested. Different types of fish have different length limits that are measured from the tip of the snout to the end of the tail (VDGIF, 2012a). Both of these management tools are designed to limit the depletion of fish resources.

Chapter 2: Trout and the South River

Trout

Trout are in the same family as salmon (*Salmonidae*) and several species including the brown trout (*Salmo trutta*), brook trout (*Salvelinus fontalis*), cutthroat trout (*Salmo clarki*), rainbow trout(*Salmo gairdneri*), and lake trout (*Salvelinus namayiush*) can be found all over the United States (North Carolina State University, 2008). Optimal habitats for trout are clear and cold, spring-fed rivers with a moderate flow, stable vegetated river banks, and a lot of stream cover. Dissolved oxygen levels need to be above 7 mg/l during spawning season and above 5-6 mg/l during other times of the year. Turbidity needs to be under 50 NTU, although trout prefer it to be much less turbid than 50 NTU, especially rainbow and brook trout (North Carolina State University, 2008).

Although some suspended solids are required during spawning season, embeddedness is not desired in a trout habitat (North Carolina State University, 2008). Embeddedness is the degree that gravel-sized particles are surrounded, enclosed or covered by smaller particles and is expressed as a percentage. Under 25% embeddedness is desired and if levels are above 50%, trout will begin to abandon the habitat. Different species of trout have different tolerances to temperature changes. As adults, brown trout like 12-19 degrees C with an upper limit of 27 degrees C whereas brook trout like 11-16 degrees C and have an upper limit of 24 degrees C. Brown trout replace brook trout in rivers that become too warm and turbid (North Carolina State University, 2008).

Trout species that are found in the South River are rainbow trout, brook trout, and brown trout (Bugas, September 5, 2012). Rainbow trout are native to the rivers and lakes west of the Rocky Mountains in the United States (National Geographic, 2012). They have been introduced around the world because of their value as a game fish and because they are a good fish to eat. Although they have different coloring and patterns based on habitat, age, and spawning conditions, they are generally blue-green or yellow-green with a pink streak and small black dots on the back and fins. Life expectancy in the wild is 4 to 6 years where they grow to an average length of 20 to 30 inches and about eight pounds. They are carnivores, preying on insects, crustaceans, and small fish. Although rainbow trout have a healthy worldwide population, they are considered a non-native pest species in some areas (National Geographic, 2012). Figure 1 shows an example of a rainbow trout.

Figure 1. Image of a rainbow trout.

Brook trout on the other hand are the only trout native to most of the eastern United States, as shown in Figure 2 (National Parks Service, 2012). They have been introduced all over the world, but not as extensively as brown or rainbow trout (Trout Unlimited, 2012). Breeding males are medium to dark olive with pale yellow wavy lines and scattered small red spots highlighted in pale blue. When they are not breeding, the coloring is less apparent and paler. Brook trout in mountain stream habitats live an

average of three years where they grow to between 6 to 13 inches. In larger streams or pools they can live longer, up to six years, and grow larger, approaching 16 inches (Trout Unlimited, 2012). Figure 3 shows an example of a brook trout.

Figure 2. Historic map of the brook trout range.

Figure 3. Image of a brook trout.

Brown trout are native to Europe, but have been introduced all over the world (Staley, 2007). They are brown or golden brown on their bodies with dark spots all over back and sides. Unlike brook and rainbow trout, brown trout tails have few spots if any. They grow

to an average size of 12 -14 inches. Brown trout tend to live longer and grow bigger while tolerating a wider range of habitat types than rainbow and brook trout (Staley, 2007). Figure 4 shows an example of a brown trout.

Figure 4. Image of a brown trout.

Trout Anglers

In 2006, 27% of American freshwater fishermen fished for trout, accounting for 6.8 million anglers (Harris, 2010). The only fish species that were sought after by freshwater fishermen more than trout were black bass, panfish, and catfish. Trout anglers fished for trout an average of 11 days a year - accounting for 75 million fishing days nationally in a year. Although these numbers are large and make up a large percentage of freshwater fishing totals, trout fishing has declined in the decade preceding 2006. In 1996, there were approximately 9 million trout anglers making up 31% of freshwater fishermen. From 1996 to 2006, there was a reduction in 2.2 million trout anglers and the percentage of freshwater fishermen that sought after trout decreased by 4% (Harris, 2010).

Trout fishing attracts a particular demographic that is important to take into consideration when considering angler motivation and fishery management. In 2006, 79% of trout anglers were male and 21% were female (Harris, 2010). This was just a little more male dominant than the percentages of all anglers in 2006 (75% male and 25% female (2006 National Survey)).

Trout anglers' age varied widely in 2006 with 3% under the age 17, 7% between 18 and 24 years old, 16% between 25 and 34 years old, 25% between the ages of 35 and 44, 24% between 45 and 54 years old, 16% between the ages of 55 and 64, and 10% over the age of 65 (Harris, 2010). Figure 5 shows a bar graph of the trout angler age breakdown where the 2006 data is displayed in red and the 2001 data is displayed in blue. The ages of trout anglers were mostly found in the middle-aged range, but trends from 2001 to 2006 show the population of trout anglers is getting older. In 2001, a vast majority of trout anglers were between ages 35-44. Although in 2006 a majority of trout anglers were also between the ages 35-44, the percentage gap was smaller with an increase in percentages for every older age group over the 35-44 range as seen in Figure 5 (Harris, 2010).

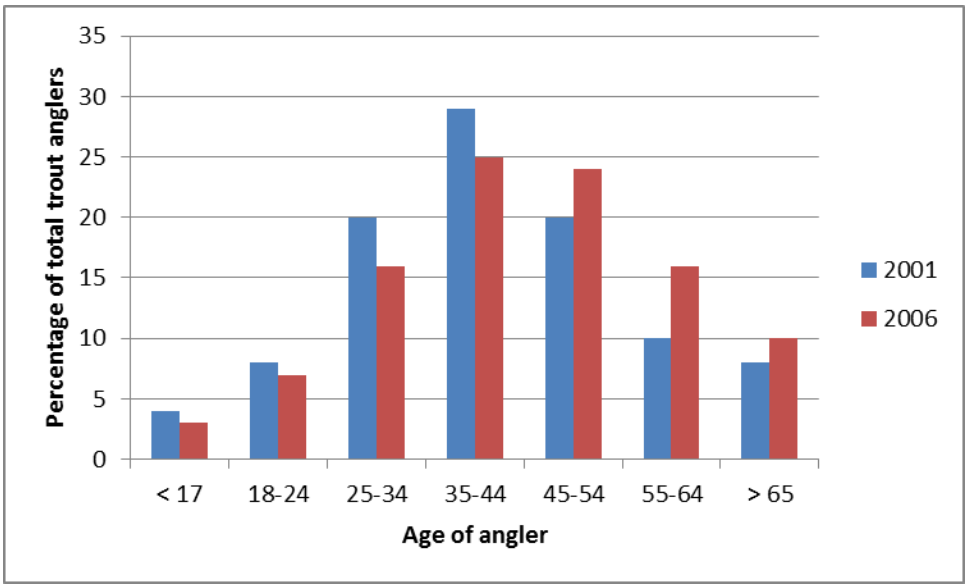


Figure 5. The ages of trout anglers in 2001 and 2006 expressed in percentages of total anglers.

In comparison to all freshwater anglers, trout anglers tend to complete more years of education (Harris, 2010). In 2006, 20% of trout anglers completed four years of college and 13% went on to further graduate studies. These percentages combined (33%) are

higher than the U.S. percentages of 27% and the freshwater angler percent of 26%. Trout anglers are more educated than the general public and other anglers (Harris, 2010).

In addition to being higher educated anglers, trout anglers also enjoy a higher income than other freshwater anglers and the general U.S. population. In 2006, 63% of trout anglers were from a household with an income of over $50,000 whereas only 57% of freshwater anglers and 50% of the general U.S. population had over $50,000 of household income. This difference is most notably shown when comparing household incomes of $100,000 and above: 24% of trout anglers, 18% of freshwater anglers and 17% of the general U.S. population fell in the $100,000 and above household income range (Harris, 2010).

South River

The South River originates near Greenville, Virginia and feeds the South Fork Shenandoah River after flowing 50 miles north, flowing through Waynesboro, Virginia (VDGIF, 2012b). Figure 6 shows the Shenandoah River watershed and the South River is the feeder river on the bottom right. There are different areas of the river that can be used for different activities based on geography and regulations. Upstream of Waynesboro, the river is considered a stream with minimal flow with a history of drying up seasonally in some locations. Downstream but before reaching Waynesboro, natural springs cool the river and increase the river's flow. When the river is flowing through downtown Waynesboro, smallmouth bass, rock bass and redbreast sunfish populations can begin to be found. In the lower South River, brown trout, rainbow trout, bullhead catfish, and carp can be found (VDGIF, 2012b).

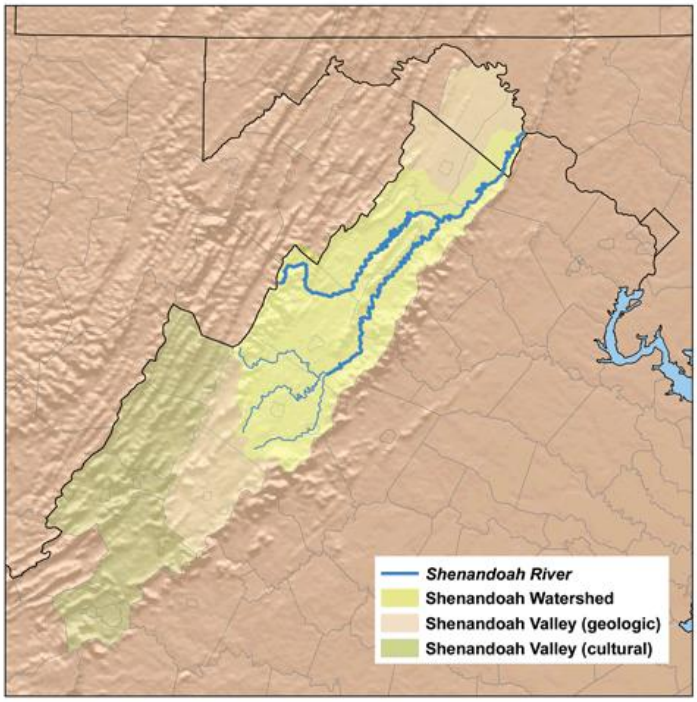


Figure 6. Shenandoah River watershed including the South River.

Contamination

In 1970, mercury contamination was found in the South River concentrated around Waynesboro (Virginia Department of Environmental Quality, 2010). The E.I duPont deNemours and Company (Dupont) plant used mercury during its manufacturing of fibers from 1929 to 1950 and contaminated the river because of miss-storage of the substance. At the time, there were not the strict storage regulations that there are now. Du Pont established a trust fund in 1984 for a 100-year monitoring program for mercury in the South River because of a legal settlement. The mercury was expected to decrease in the water and sediment, but twenty years of data concludes that the mercury levels remained stable (Virginia Department of Environmental Quality, 2010).

The reason mercury is such a concern is that its methylated version bioaccumulates (Princeton University, 2004). Once mercury reaches a body of water, methylmercury is

formed in a process called mercury methylation. Bioaccumulation is when concentrations of the material increase when moving up the food chain; so, top predators have the highest amounts of the material. Mercury is the only heavy metal known to do this. Bioaccumulation starts when the methylmercury diffuses through the membranes of autotrophs. Normal mercury diffuses out, but methylmercury stays because it is reactive. The autotrophs are eaten by herbivores, which require a large amount to live, as they are not getting the full energy the autotroph had. So all the methylmercury the autotroph had now resides in the herbivore. The herbivore is then eaten by a carnivore, which also requires many herbivores to survive. So the methylmercury in each of those herbivores, which came from many autotrophs, now is in the carnivore. That carnivore can then be eaten by another higher level predator. The methylmercury content is magnified with each trophic level in the food web (Princeton University, 2004).

The U.S. Environmental Protection Agency states that it is only safe to consume 0.10 micrograms methylmercury per kg human body weight per day (Nisichawayasihk Cree Nation, 2002). This means that the more you weigh the more fish you can safely eat, because the concentration of methylmercury in someone who weighs more will be lower than in someone who weighs significantly less (Nisichawayasihk Cree Nation, 2002).

The concern around mercury in a river is the potential harmful impacts to human health. When mercury reaches certain concentrations in the human body it becomes poisonous (FDA, 1999). The best way to determine mercury exposure in a human is by determining the concentrations of mercury in hair and blood samples. The normal concentrations of mercury in a person who has not been exposed to mercury are expected to be 2 ppm in hair and 8 ppb in blood. If concentrations of mercury exceed these

numbers then adverse effects will be seen. The nervous system is the most sensitive to the effects of methylmercury and toxicologists have determined that the lowest concentration of mercury in adults associated with toxic effects is 200 ppb in blood and 50 ppm in hair (FDA, 1999).

Mercury greatly affects developing fetuses and small children because their organs are developing rapidly and they are very vulnerable to damage (Oregon Health Authority, 2007). When methlymercury is ingested it is absorbed into the blood stream through the gastrointestinal track and then it easily crosses the blood-brain barrier causing an accumulation of methylmercury in the central nervous system (Isaacson & Jensen, 1992). Mercury is extremely dangerous to the human body because it can kill neurons. It inhibits proteins, disrupts mitochondria functions, directly affects ion exchange in neurons, and it disrupts the function of neurotransmitters. Neuron loss in the cerebellum and throughout the cerebral cortex can be seen in children's brains after death due to mercury poisoning (Isaacson & Jensen, 1992). High levels of exposure to mercury can result in tremors, loss of sensation in extremities, vision and hearing loss, and even developmental and behavioral abnormalities (Oregon Health Authority, 2007). The degree of exposure to mercury affects the severity of the symptoms seen in a person.

Because of the known health concerns associated with mercury in fish, there was concern that the mercury levels were not decreasing in the South River. In November 2000, the South River Science Team was created to study and monitor the mercury levels in the South River and inform the public of the health concerns associated with eating mercury contaminated fish (DelVecchio, Friedman, & Unsworth, 2010). This team includes individuals from industry, government, citizens groups, academic institutions,

and private researchers and was formed voluntarily by Du Pont and DEQ (Virginia Department of Environmental Quality, 2010). This is an ongoing issue with the South River downstream of the old Du Pont plant.

Management

The Virginia Department of Game and Inland Fisheries (VDGIF) is the regulatory authority over the Commonwealth of Virginia's inland fisheries. With a budget of $55 million, VDGIF is responsible for the management of inland fisheries, wildlife and recreational boating in Virginia. The VDGIF has four primary goals: to manage wildlife and inland fish at optimum populations; to allow access to wildlife and inland fish for recreation, hunting, and fishing; to promote safety; and to provide education and awareness of resources and habitats (DelVecchio, Friedman, & Unsworth, 2010). The VDGIF plays a major role in the management of the South River and frequently stocks the river throughout the year (Shenandoah Valley Trout Unlimited, 2011).

Management practices and regulations vary depending on location on the South River (VDGIF, 2012b). A Statewide Freshwater Fishing License is required year-round and a Special Trout License is required from October 1 to June 15 through the whole river with the exception of the Upper South River Special Regulation Area. The whole river also has a creel limit of 6 trout per day over 7 inches unless other regulations are in place that restrict catch rates or sizes. Smallmouth and largemouth bass have a creel limit of 5 per day with no size limit and sunfish and rock bass have a creel limit of 50 per day combined with no size limit (VDGIF, 2012b).

The delayed harvest trout area in Waynesboro between Rife Loth Dam and North park is catch-and-release with artificial lures only from October 1 – May 31. The Lower South River is stocked (put-and-take) with catchable rainbow and brown trout between the Grand Caverns and Grottoes. Ridgeview Park in Waynesboro is also a put-and-take trout fishery (VDGIF, 2012b).

Upper South River Special Regulation Area

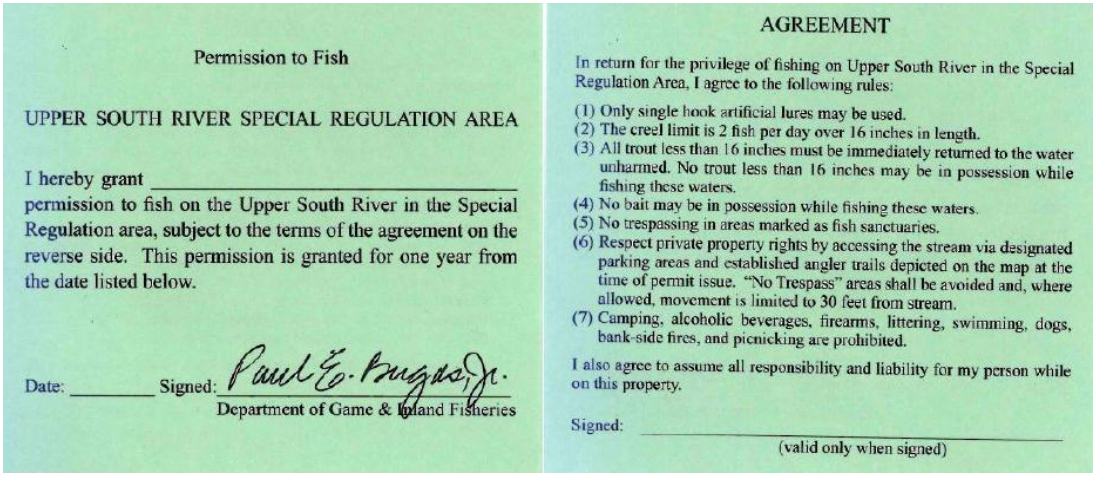
The Upper South River Special Regulation Area (SRA) opened on Jan 1, 2011 through a collaboration between the Shenandoah Valley Trout Unlimited Chapter (SVTU) and the VDGIF, with the support of Dominion Resources, Du Pont, and landowners along the river (Shenandoah Valley Trout Unlimited, 2011). The Upper South River SRA was is a portion of the South River from North Oak Lane Bridge in Waynesboro to a sign located 1.5 miles above the Rt. 626 Bridge (VDGIF, 2012c). This is where the natural springs cool the river and increase its flow, creating a habitat for trout, as shown in Figure 7. There is also a lot of natural shade cover on this portion of the river allowing the water to remain cold longer in the summer. In the Upper South River SRA, there is a creel limit of two trout that are longer than 16 inches. Anglers are also required to only use single-hook artificial lures (VDGIF, 2012c).

Figure 7. Cold spring that cools the waters of the Upper South River.

Landowners are a crucial component of the SRA because they grant access for anglers to the river. Anglers are asked to respect land ownership and stay within 30 feet of the river and also respect the signage. There are some landowners near the river who are not participating landowners and their property is restricted. Five parking lots are scattered along the river in the SRA area for anglers to park in and signs are posted to guide anglers to allowed areas of the river (Shenandoah Valley Trout Unlimited, 2011).

A free permit is required in order to fish the Upper South River SRA (Shenandoah Valley Trout Unlimited, 2011). There are six places that give out permits. The newest and easiest way to get a permit is online at the VDGIF website, which was recently launched in the summer of 2012. It is also possible to get a permit by mail from Dominion Outdoors and the VDGIF Verona office by sending a written request and a self-addressed stamped envelope. Finally, in-person applications are available at Stone Soup Books & Cafe in Waynesboro, Dominion Outdoors in Fishersville, South River Fly

Shop in Waynesboro, Mossy Creek Fly Fishing in Harrisonburg, and the VDGIF office in Verona (Shenandoah Valley Trout Unlimited, 2011). The Mossy Creek Fly Fishing in Harrisonburg stopped giving out permits when the VDGIF online application became available, but the other four locations are still active. Figure 8 shows the front and the back of the permit given to applicants for the Upper South River SRA.



Permission to Fish

UPPER SOUTH RIVER SPECIAL REGULATION AREA

I hereby grant _____ permission to fish on the Upper South River in the Special Regulation area, subject to the terms of the agreement on the reverse side. This permission is granted for one year from the date listed below.

Date: _____ Signed: Paul E. Bugas, Jr.
Department of Game & Inland Fisheries

AGREEMENT

In return for the privilege of fishing on Upper South River in the Special Regulation Area, I agree to the following rules:

(1) Only single hook artificial lures may be used.
(2) The creel limit is 2 fish per day over 16 inches in length.
(3) All trout less than 16 inches must be immediately returned to the water unharmed. No trout less than 16 inches may be in possession while fishing these waters.
(4) No bait may be in possession while fishing these waters.
(5) No trespassing in areas marked as fish sanctuaries.
(6) Respect private property rights by accessing the stream via designated parking areas and established angler trails depicted on the map at the time of permit issue. "No Trespass" areas shall be avoided and, where allowed, movement is limited to 30 feet from stream.
(7) Camping, alcoholic beverages, firearms, littering, swimming, dogs, bank-side fires, and picnicking are prohibited.

I also agree to assume all responsibility and liability for my person while on this property.

Signed: _____
(valid only when signed)

Figure 8. Copy of a free permit for the Upper South River SRA.

The Uppers South River SRA has been stocked by the VDGIF even before it opened as a special regulations area for fishing. Figure 9 shows the stocking history from April 2008 to September 2012 (Bugas, September 5, 2012). The lengths are expressed in inches and are in ranges of length for 2008 and 2009 and are in average length from 2010 to 2012. There have been five stocking events since 2008 with over 40,000 trout of various species and maturity introduced. Primarily brown trout were introduced with single incidents of brook trout being introduced in 2009 and rainbow trout in 2012 (Bugas, September 5, 2012).

Date	Species	Number	Length (in)
4/1/2008	Brown	18,000	3-4 in
2/1/2009	Brook	1,000	6-8 in
2/1/2009	Brown	1,000	6-8 in
4/28/2010	Brown	2,457	7.8 in
1/31/2011	Brown	4,851	8
9/5/2012	Brown	8,040	5.9
9/5/2012	Rainbow	5,005	9.3

Figure 9. Upper South River SRA stocking history as of September 5, 2012 from VDGIF data.

In addition to stocking the river, the VDGIF performs regular sampling events in order to assess the fish and the fishery. Sampling events occurred in August 2010, September 2011, and August 2012 in two locations of the SRA, the Lyndhurst and City Spring areas (Bugas, September 13, 2012). Since most of the trout stocked were brown trout, brown trout were the focus of sampling efforts. Electrofishing was used to shock the fish and they were measured and weighed (Bugas, September 13, 2012).

Figure 10 shows the results of the sampling efforts from 2010 to 2012 expressed in catch per unit effort (CPUE), or the number of fish caught per hour (Bugas, September 13, 2012). Young fish are those fish under 200 mm (7.87 inches), intermediate are 200 mm – 410 mm (7.87 inches – 16.14 inches), and harvestable are above 410mm (16.14 inches). These numbers are calculated by counting the number of fish caught from each length range and dividing that number by the amount of time of the sampling event in seconds over 3,600 in order to be expressed in fish per hour (Bugas, September 13, 2012). This data helps the VDGIF monitor the health of the fishery and adjust their management practices.

	CPUE	
2010	**Lyndhurst**	**City Spring**
Young	5.0	3.3
Intermediate	73.9	26.5
Harvestable	1.7	0.0
Total	75.6	29.8
2011	**Lyndhurst**	**City Spring**
Young	2.9	0.0
Intermediate	56.0	25.7
Harvestable	1.4	0.0
Total	57.4	25.7
2012	**Lyndhurst**	**City Spring**
Young	0.0	9.8
Intermediate	84.0	20.9
Harvestable	0.0	1.4
Total	84.0	32.1

Figure 10. Results from the VDGIF sampling events from 2010 to 2012 on the Upper South River SRA.

Chapter 3: Recreational Fishery Economics

Economic Activity

Recreational fishing has a large impact on the American economy, both in terms of retail sales and generated tax revenues, and by directly or indirectly supporting American jobs. According to the American Sportfishing Association, anglers spent $600 million in license sales in 2006. In addition, "special federal excise taxes and import duties on fishing gear, pleasure boats and boat fuel added up to another $600 million in 2006, under the long-running Sport Fish Restoration Act" (Allen & Southwick, 2008). In total, this represents a direct $1.2 billion investment in nationwide recreational fishing - greater than the Gross State Products of 23 states (Allen & Southwick, 2008).

Retail Sales

2006 estimates from the American Sportfishing Association demonstrate that anglers generate $45 billion annually in retail sales. This number was calculated based on anglers' nationwide expenses. Expense amounts range from over $4 billion spent on food and nearly $2 billion spent on lodging, to over $370 million spent on ice sales and even $125 million spent on tackle boxes. Based on total sales, "If fishing were ranked as a corporation, it would be 47 on the 2007 Fortune 500 list of America's largest companies based on total sales. That's more than Microsoft or Time Warner" (Allen & Southwick, 2008). It is estimated that in 2006, sportfishing activities generated over $816,000,000 in retail sales in Virginia (Allen & Southwick, 2008), up from 2004 angler expenditures of $655,121,863 (Kirkley, Murray, & Duberg, 2005).

Taxes

Federal, state, and local governments all receive tax revenues from recreational fishing. In 2006, the federal government accrued $9 billion in federal taxes generated by angler spending (Allen & Southwick, 2008). Florida rakes in the most from angler expenditures at $4.4 billion. It is followed by Texas with $3.3 billion, and Minnesota with $2.8 billion. These states also have some of the largest number of both resident and non-resident anglers, and so accrue more taxes both from retail sales of equipment, lodging, and food, as well as taxes from selling state licenses and permits. In Virginia, 2006 estimates show sport fishing activities generated $76,182,884 in state and local taxes (Allen & Southwick, 2008).

Jobs

Fishing activities support jobs both directly and indirectly. Direct jobs include fishing guides and sales clerks in fishing stores. Indirect jobs are from the trickle effect of fishing dollars spent in the community, including hotel employees and truckers that help ship equipment. According to American Sportfishing Association, recreational fishing supported over 1 million jobs nationwide in 2006 (Allen & Southwick, 2008). In Virginia, sport fishing supported 9,000 - 15,000 jobs, depending on how this number is defined (Allen & Southwick, 2008; Kirkley, Murray, & Duberg, 2005).

Economic Methods

The economic importance of recreational fishing can be evaluated by expenditures and net economic values. Expenditures are a good way to evaluate the importance of an activity to local, regional, and national economies. On the other hand, net economic values can evaluate economic benefit to individuals and societies. Net economic values

take into account the fact that money spent on an activity would be spent whether the activity was available or not, meaning that the money spent could be displaced from another activity and therefore have no net economic benefit to individuals or society (Harris, 2010).

Expenditures

The economic output, and therefore the economic impact, of trout anglers can be calculated by accounting for the impact of the expenditures that the anglers spend on their fishing activities (Harris, 2010). These expenditures include gear and equipment needed to partake in the sport along with all of the trip-related expenses such as transportation, lodging, and food. The economic impact measured through expenditures is a good way to value an activity's benefit to a community. Economic impact can be measured in the amount of additional jobs created, personal income that is added in a region, or the amount of money that flows into a community by anglers. Measuring the amount of money that flows into a community is the easiest method because it comes directly from angler activity expenditures and represents a flow of money into the local economy (Pollock, Jones, & Brown, 1994, Chapter 1). In this evaluation method, it is impossible to evaluate the value to the angler.

In addition to expenditures, an economic multiplier is needed in order to fully assess economic impact (Pollock, Jones, & Brown, 1994, Chapter 6; Mundy & Purcell, 2004). Expenditures measure the direct impact, but an economic impact should also include indirect and induced impacts. If lunch costs the customer 20 dollars, the 20 dollar expenditure paid to the restaurant is a direct impact. The 20 dollars then goes to paying wages, purchasing food and other items, pay rent, and so on- which in turn are indirect

impacts. If those indirect impacts are spent in the study area, then they need to be captured in the economic impact (Mundy & Purcell, 2004).

Induced impacts occur when employees who received wages from the original expenditure spend their wages in the study area (Mundy & Purcell, 2004). If an employee of the restaurant spends her wages (part of the original 20 dollar expenditure in the above example) at the drug store in town, the drug store enjoys some of the economic impact from the original lunch expense. This is a chain reaction effect that lessens as dollars move further from the original expense, hence it being called a "ripple effect" (Mundy & Purcell, 2004). The additional local impacts are represented with a sales multiplier. A multiplier of 1 would mean that no additional impacts are felt in the region from the direct expenditures whereas a multiplier of 2 would mean that for every dollar of direct expenditure, there are two dollars of economic benefit to the region of interest (Pollock, Jones, & Brown, 1994, Chapter 16).

The indirect and induced effects that are felt in the study area are reflected in the economic multiplier. If the original restaurant spends most of its money outside of the area of study, then the multiplier would be much smaller than if the restaurant spends most of its money in the area of study (Pollock, Jones, & Brown, 1994, Chapter 16; Mundy & Purcell, 2004). Multipliers can vary widely between neighboring regions, so multipliers must be calculated specifically for certain industries and regions (Pollock, Jones, & Brown, 1994, Chapter 16; Mundy & Purcell, 2004).

There are two different types of multipliers that are equally valid and similar multipliers, Type II and Type III (Mundy & Purcell, 2004). Type II is based on induced

impacts having a linear relationship between the income and consumption spending, whereas Type III is based on a nonlinear relationship. This means that in Type II, extra income would result in the same extra spending whereas in Type III, extra income would result in a different extra spending (Mundy & Purcell, 2004). Input-Output models are used to calculate multipliers of Type II and Type III based on different industries and regions, with the most popular being IMPLAN and RIMS II (Mundy & Purcell, 2004; MIG, 2012; Daley, 1997).

RIMS II was developed in the 1980s by the Bureau of Economic Analysis (BEA) as a replacement of its predecessor I-O model, RIMS of the 1970s (Daley, 1997). It includes data from around 500 U.S. industries and the BEA's regional economic accounts. The data in RIMS II allows the model to reflect a region's industrial structure and trading patterns. One of the major advantages of the RIMS II model is the fact that multiple counties and multiple industries can be accounted for. In order for the multiplier to be most effective, the user must know and provide detailed information on the output in the geographical region and industry (Daley, 1997). Output information might be hard to figure out in rural areas or niche industries.

IMPLAN, developed by the U.S. Forest Service, is a popular I-O model that is readily available to the public sector (MIG, 2012; Pollock, Jones, & Brown, 1994, Chapter 16). When a customer purchases multipliers from IMPLAN, they get the entire IMPLAN software package (MIG, 2012), as opposed to RIMS II where you view results online (Daley, 1997). Otherwise, IMPLAN is very similar to RIMS II.

Net Values

Net economic value, or consumer surplus, is the measure of the amount that people are willing to pay over and above the amount they actually spend on an activity. This is measured by subtracting the expenditures from the participants' "willingness to pay" (Harris, 2010). Willingness to pay is calculated through participant surveys. Consumer surplus is the net benefit from consuming the good or service, or the consumer's net value of the good (Guthrie, ed., 1991, pp. 299-315). In modeling consumer surplus, the demand function is the maximum amount an individual is willing to pay for each unit of a good or service. The benefit received from each unit of a good measured in dollars is also represented by the demand function because an individual will not pay more than the benefit from consuming the good (Guthrie, ed., 1991, pp. 299-315). Therefore, willingness to pay for a good is equivalent to the benefit derived from that good.

Contingent valuation is a way to estimate the net economic benefit value using net willingness to pay. This is done with a survey asking participants to consider their expenses and to determine the cost that would have caused them not to partake in the activity (Carson & Hanemann, 2005). Contingent valuation is a very popular and reviewed method of applying a monetary value to environmental goods. It helps decision makers identify the public's interest. When special interest groups are lobbying for projects, contingent valuation can help prove that the value of the environmental good is larger than the project proposed by the special interest group. Inversely, contingent valuation can show decision makers that an environmental project is not worth the expense when the public who are footing the bill have an aggregate willingness to pay that is smaller than the cost of the project (Carson & Hanemann, 2005).

Survey Methods

Surveys are a major component of fisheries management and fisheries valuation; they are a good way to collect data on fishery and angler activity because they are a tool for measuring the effectiveness of harvest regulations, fish stocking efforts, and habitat enhancements. Traditionally, creel surveys have been used in order to estimate angler effort and harvest. Angler surveys have expanded and can be conducted over the phone, through mail, and aerially. In addition to traditional angler surveys, social and economic surveys help to assess the value of fishing to anglers and the local and regional economies (Pollock, Jones, & Brown, 1994, Chapter 2).

There are seven basic survey methods used in angler surveys that can be subdivided into two categories: on-site and off-site surveys. On-site methods are access point, roving, and aerial surveys and off-site methods are mail, telephone, and door-to-door surveys. These survey methods can be combined or used alone in angler surveys. Each method has strengths and weaknesses and should be used accordingly with the purpose of the survey at hand (Pollock, Jones, & Brown, 1994, Chapter 2).

On-Site Methods

The basis of on-site methods is sampling based on a list of fishing location and times. Anglers are then counted and interviewed during on-site surveys while they are fishing or as they are leaving from their fishing activities. While access point and roving surveys can be used to estimate both effort and catch, aerial surveys can only estimate effort since interviews are not possible with this method. One advantage of on-site over off-site methods is the fact that the surveyor can verify some of the angler responses; that is, the

surveyor is more likely accurately report sizes and species of a fish caught than an angler (Pollock, Jones, & Brown, 1994, Chapter 5).

Off-Site Methods

Unlike on-site methods, off-site methods are interviews by mail, phone, or door to door based on a list of anglers. Although off-site methods are more expensive and complex, they allow the surveyor the opportunity to sample angler's opinions from the entire fishing experience as well as estimating effort and catch. However, it does depend on self-reported data which causes some bias because of anglers' memories, embellishments, knowledge, and truthfulness (Pollock, Jones, & Brown, 1994, Chapter 5). For the purposes of this project, mail surveys will be discussed further, as they are used later in the final chapter of this paper.

Mail Surveys

Mail surveys can either be used as add-on surveys to on-site surveys or can be conducted based on a list such as licenses or boat owners. Add-on surveys can be used to estimate the economic activity associated with recently completed fishing trips and to get more detailed information than what was collected in the field. Mail surveys conducted based on lists are most often used for socioeconomic assessments. If the license data is electronic, it is easy to use simple random or stratified random samples in order to determine who is surveyed. If the data is not electronic, it is much harder to use these sampling techniques and a systematic random sampling method would be required (Pollock, Jones, & Brown, 1994, Chapter 6).

Once a sampling group is determined and the survey is created (survey content will be discussed later), surveys are ready to be mailed out. The first mailing should include a personal professional cover letter, the questionnaire, a pre-paid return envelope, and possibly an incentive to complete the survey. The incentive could be a small amount of money or an entry into a lottery to receive prizes such as shirts and hats. A postcard can be sent a week after the first mailing to thank those who have already returned the survey and kindly remind those who have not responded to mail theirs in (Pollock, Jones, & Brown, 1994, Chapter 6).

A second mailing should be sent out about three weeks after the first to those who had not responded at that point. The second mailing includes the same elements as the first but with a different cover letter expressing the importance of responding. Four weeks after the second mailing, a third mailing should be sent out with certified mail if cost permits. Telephone follow-up surveys can be used in order to assess those who did not fill out the mail survey. This allows the bias from non-respondents to be accounted for. Unfortunately, some license lists do not include telephone numbers or some anglers move or have disconnected phones. In these cases, door-to-door follow-up interviews can be conducted (Pollock, Jones, & Brown, 1994, Chapter 6).

It is important to get as many responses as possible to limit the non-response bias that non-response introduces to the results of a survey. Generally, non-respondents differ from respondents in their angling efforts and opinions. If an angler is really serious about the sport, he or she is more likely to respond to a survey than casual anglers. Also, these two groups are likely to fill out the survey differently as they may not fish as often or invest as much into the sport. Therefore, if only 60% of anglers respond, it is not accurate

to assume the other 40% would answer the survey similarly to the respondents (Pollock, Jones, & Brown, 1994, Chapter 6).

Non-response bias can be estimated or eliminated based on responses in the alternative follow-up survey methods over the phone or door-to-door (Connelly & Brown, 1995). The two groups can be separated into two strata: the response stratum and the non-response stratum. If responses on average are equal between the two strata, there is no non-response bias because the response stratum still represents the whole population. If not, the bias needs to be estimated and used in the analysis ((Connelly & Brown, 1995; Pollock, Jones, & Brown, 1994, Chapter 6).

Mail surveys have some weaknesses. The list used to conduct the survey may be incomplete. Licenses may only be required for a certain age of anglers such as only anglers between the ages of 16 and 65. This leaves entire sub-groups of anglers out of the survey. Also, illegal anglers would also not be on lists and therefore would not be included in the survey. Mail surveys also take a long time to complete with several mailings and follow-up surveys. Lastly, memory bias can be severe if the experiences in question are from a long time before the survey (Connelly & Brown, 1995). Despite all of these disadvantages, mail surveys are still commonly used because of the minimal cost and effort needed in comparison to other survey methods (Pollock, Jones, & Brown, 1994, Chapter 6).

Economic Analysis Surveys

Economic surveys are important to determine the value of fisheries, but it is vital that they are designed and interpreted correctly. Asking anglers about the costs accrued on a

fishing trip seems like an easy way to estimate economic value, but wrong questions can return biased or inaccurate responses. As discussed in the economics methods section of this chapter, there are two major ways to conduct the economic study; based on expenditures or net value (Pollock, Jones, & Brown, 1994, Chapter 16). For this section, economic impact surveys through expenditures will be discussed.

Economic Impact Surveys

Trip expenditures are estimated through an economic impact survey. These expenditures are measured per trip, meaning the total amount of money spent in the locality of the fishery from when the angler leaves their house to when they return home. This includes transportation costs such as gasoline, lodging costs if applicable, and any other money spent in the locality not related to fishing. On-site surveys cannot be used to estimate these expenditures because anglers have not completed their entire trip at the time of interview (Ditton & Hunt, 2001). Off-site methods are better to estimate this value because they capture expenses throughout the entirety of the fishing trip (Pollock, Jones, & Brown, 1994, Chapter 16).

The region of interest needs to be defined to accurately assess the economic impact. Fishing trip expenses occur in many different places and may not need to be included because they are out of the region of interest. For example, an angler may buy all of his supplies such as gas, food, and tackle near his house (outside of the region of interest) and not spend money until they return home. For this reason, the location of expenditures needs to be addressed in the survey. To do this, a question should be asked in matrix form where likely expenditures are listed with areas to enter values in different categories depending on the location of the expense. A map could be included in a mail survey in

order to help anglers identify the different regions included in the survey questions (Pollock, Jones, & Brown, 1994, Chapter 16).

The expenditures included in the study differ in different studies. If the study is interested in revenue collected from specific businesses such as bait shops and marinas, local and non-local anglers are included. If the study is interested in only new revenue in a region, only non-local anglers should be surveyed. However, if it is known that local anglers would fish in other areas without this fishery, local anglers are included when estimating new revenue in a region. This is important when evaluating the economic impact of a new fishery to accurately capture and measure data (Pollock, Jones, & Brown, 1994, Chapter 16).

The expenditures estimated from the survey will express the direct economic impact to the region. In addition to these direct expenditures, there are additional local impacts as the money circulates through the region of interest, giving the expenditure a rippling effect (Mundy & Purcell, 2004; Pollock, Jones, & Brown, 1994, Chapter 16). The additional local impacts are represented with a sales multiplier. A multiplier of 1 would mean that no additional impacts are felt in the region from the direct expenditures whereas a multiplier of 2 would mean that for every dollar of direct expenditure, there are two dollars of economic benefit to the region of interest (Mundy & Purcell, 2004; Pollock, Jones, & Brown, 1994, Chapter 16).

Chapter 4: Methodology and Results

While estimating the economic impact by ways of additional revenue in Augusta County and the city of Waynesboro, many different factors need to be considered. The simple calculation for this estimation can be found by multiplying the number of anglers that fish the Upper South River SRA by the number of days they fish a year and by the amount of money they spend during an average fishing day. In order to estimate the fishing activity on the Upper South River SRA, angler data from permit applications are used. As for the monetary value of an average fishing day, relevant studies in the field are used.

Over the entire analysis, Virginia residents and non-residents are differentiated because they are likely to spend a different amount of money on a day of fishing the Upper South River SRA. Non-residents will have higher transportation costs and are more likely to require lodging in the local community. For this reason, the number of Virginia resident anglers in the Upper South River SRA needs to be separated from non-resident anglers . Expenditure calculations also need to be differentiated between Virginia residents and non-residents. Finally, the years of study need to be separately calculated and organized in order to compare changes over time and allow for dollar inflation.

Fishing Activity

The goal of the fishing activity subchapter is to figure out how many anglers are fishing the Upper South River SRA in a given year using permit data. This section is divided into two sections. The first is the permit data entry and cleaning section, which details the procedure of data collection, entry, and organizing. The second section is the

permit data analysis that evaluates the permit data and ultimately estimates fishing activity in the Upper South River SRA.

Permit Data Entry and Cleaning

When someone applies for a permit to fish on the Upper South River SRA, they are required to give their name, address, and the date of application. Data was collected from the five different permit application locations discussed previously and compiled. No data was used from the online permits since that application process was not available until the summer of 2012. The Verona office of the Virginia Department of Game and Inland Fisheries houses all of the hard copies of the permit applications compiled for this study. Only permits applied for on or before June 30, 2012 are included in this study. Since the fishery was opened in January of 2011, this study accounts for a year and a half of permit data.

The date and zip code from every permit applicant was entered into an Excel file entitled "UpperSR_Permits.xlsx". Each permit application location has its own sheet in the file for the permits that were applied for there. They are stored in different sheets to ensure ease of updating since only some of the permit application data was entered and there is no identifying key to link the data entry to the hard copy of the permit application. Figure 11 shows a portion of the sheet entitled "DGIF" which is where the permit data collected from the Virginia Department of Game and Inland Fisheries is entered. Each of the other four data entry sheets ("StoneSoup", "DominionOutdoor", "MossyFlyFishing", and "SouthRiverFlyshop") is formatted similarly. The date was entered in a date format and the year and zip code were entered in as numbers so that arithmetic arguments could be used. When no zip code was included with the address,

the address was entered into Google Maps, http://www.google.com/maps, in order to find the zip code. The zip code is very important since it can be used to differentiate anglers that are Virginia residents and non-Virginia residents.

In addition to the five individual data entry sheets for the permit application locations, there are several essential sheets in the Excel file that are used for automated analysis of the data. Two of those sheets are the “Totals” and the “VA Totals” sheets. The “Totals” sheet has all of the zip codes found in the United States listed in a column and an additional column entitled Upper Permits that counts how many anglers were from the specific zip code. The zip codes were obtained from AggData LLC, a company that develops and updates data sets (AggData, 2012). The permit data set that was obtained from AggData LLC is one of twelve free data sets that they provide and was last updated on Febuary 16, 2012. The “VA Totals” sheet is similar to the “Totals” sheet except it only lists the zip codes that can be found in the state of Virginia.

DGIF	Year	Date	ZIP	Zipcode Check		Totals	
	2011	1-Jan-11	24401	1		**2010**	0
	2011	1-Jan-11	24401	1		**2011**	586
	2011	1-Jan-11	24401	1		**2012**	287
	2011	4-Jan-11	24486	1			
	2011	5-Jan-11	23114	1		**All**	873
	2011	5-Jan-11	23114	1		**ZC Check**	873
	2011	5-Jan-11	22152	1			
	2011	5-Jan-11	22802	1			
	2011	7-Jan-11	24421	1			
	2011	10-Jan-11	22701	1			
	2011	10-Jan-11	23831	1			
	2011	10-Jan-11	23834	1			
	2011	10-Jan-11	22042	1			
	2011	10-Jan-11	22042	1			
	2011	10-Jan-11	24486	1			
	2011	10-Jan-11	24486	1			
	2011	10-Jan-11	22802	1			
	2011	10-Jan-11	24578	1			
	2011	10-Jan-11	22701	1			
	2011	10-Jan-11	23831	1			

Figure 11. Example of the data entered into the Excel file "UpperSR_Permits.xlsx".

The Zipcode Check column in Figure 11 is designed to make sure that the zip code entered matches one from a list of all zip codes in the United States found in the "Totals" sheet of the Excel file. The Excel formula for this check is as follows:

=IF(ISERROR(MATCH(D2,Totals!B:B,0)),"not found",1).

This check will display "1" if the zip code is found in the list and "not found" if it is not. When entering data, this is a real-time check that allows the person entering the data to know there is a potential problem. During data entry, "not found" was displayed many times for several reasons. Firstly, as in all data entry projects, some zip codes were entered incorrectly. With the Zipcode Check, it is easy to immediately identify and correct this issue. Secondly, some permit applicants mixed up the numbers in their zip code. To correct this, Google Maps is used to find the accurate zip code. Lastly, some zip codes were simply not on the list on the "Totals" sheet. There were two fixes used for this

issue. The address was again inserted into Google Maps and for some a known zip code would come up. For those applicants with zip codes that were not on the "Totals" sheet and Google Maps showed the same corresponding zip code, a neighboring known zip code was used. This only occurs when the zip code is newer than the most recent update of the zip code list and does not alter the data since the zip code that was chosen was within ten miles of the angler's address.

The Totals column in Figure 11 shows a summary of all of the data entered on this sheet and therefore all of the permits from this particular permit application location. It is first totaled by year by counting all of the entries matching the years 2010, 2011, and 2012. The year 2010 is included because permits were given out in December 2010, even though the Upper South River SRA was not opened until January 2011. The 2010 data will be counted as 2011 data in the analysis. The three years are then added to each other and displayed as the All total in Figure 11. The ZC Check is the summation of the Zipcode Check column. These numbers should match if everything was entered correctly.

Permit Data Analysis

In order to interpret the data that was entered into the five data entry pages, the zip codes from the permit data need to be separated out and tallied. The Upper Permits column from the "Totals" sheet uses an Excel formula to count all of the permits from each sheet that match a particular zip code. This formula is as follows:

=COUNTIF(DGIF!D:D,B2)+COUNTIF(StoneSoup!D:D,B2)+COUNT IF(DominionOutdoor!D:D,B2)+COUNTIF(MossyFlyFishing!D:D,B2) +COUNTIF(SouthRiverFlyshop!D:D,B2).

The totals from the Upper Permits column are checked against the summation of the totals from each of the five data entry sheets to assure accuracy. These totals are displayed on the "Totals" sheet. The "VA Totals" sheet only lists the zip codes that can be found in the state of Virginia and instead of counting permits like the "Totals" sheet, it looks up that number from the "Totals" sheet. For this, the following Excel formula is used:

=LOOKUP(VATotals!B2,Totals!B:B,Totals!C:C).

From this, not only can the number of permits applied for over the year and a half period be identified, but this number can be parsed into Virginia residents and non-residents which will be useful during the economic analysis.

For this analysis, it is important to analyze the data per year since permits only remain valid for one year and to identify trends over time. To do this, the totals for the years 2011 and 2012 are tallied on separate Excel sheets entitled "Total2011" and "Total2012". A portion of "Total2011" can be found in Figure 12.

Totals	Zipcodes	Upper Permits		Virginia	Zipcodes	Upper Permits
	00501	0			20041	0
	00544	0			20105	1
	00601	0			20106	0
	00602	0			20109	0
	00603	0			20110	0
	00604	0			20111	0
	00605	0			20112	1
	00606	0			20115	0
	00610	0			20117	0
	00611	0			20119	0
	00612	0			20120	2
	00613	0			20121	2
	00614	0			20124	1
	00616	0			20129	0
	00617	0			20130	0
	00622	0			20132	0
	00623	0			20135	1
	00624	0			20136	0
	00627	0			20137	0
	00631	0			20141	0
	00636	0			20143	0
	00637	0			20144	0
	00638	0			20147	1
	00641	0			20148	0
	00646	0			20151	1
	00647	0			20152	1
	00650	0			20155	2

Figure 12. Example of the yearly totals of permit data found in the"Total2011" sheet of "UpperSR_Permits.xlsx".

Figure 12 is calculated very similarly to the "Totals" sheet, but with a more complicated formula because it needs to count the permits with the matching zip code from the five data entry sheets that also have the desired year. The following formula is an example for the "Totals2011" sheet:

=COUNTIFS(DGIF!D:D,Total2011!B2,DGIF!B:B,"<2012")+COUNTIFS(StoneSoup!D:D,Total2011!B2,StoneSoup!B:B,"<2012")+COUNTIFS(DominionOutdoor!D:D,Total2011!B2,DominionOutdoor!B:B,"<2012")+COUNTIFS(MossyFlyFishing!D:D,Total2011!B2,MossyFlyFishing!B:B,"<2012")+COUNTIFS(SouthRiverFlyshop!D:D,Total2011!B2,SouthRiverFlyshop!B:B,"<2012")

This formula says "<2012" because both 2010 and 2011 entries need to be counted. The only difference needed to account for the 2012 data would be to change this to "=2012".

From the "Totals2011" and "Totals2012" sheets, totals of Virginia residents and non-residents can be identified in Figure 13. Of the 2,004 permits given out in 2011, 1,841 were given to Virginia residents and 163 were given to non-residents. For the first six months of 2012, 747 permits were given out with 684 of those going to Virginia residents and 63 to non-residents.

2011	# of Anglers
Virginia Resident	1841
Non-Virginia Resident	163
2012	# of Anglers
Virginia Resident	684
Non-Virginia Resident	63

Figure 13. Total permits from Virginia resident and non-Virginia resident from 2011 and 6 months of 2012.

Estimating Angler Effort

The numbers of anglers from Figure 13 are used to determine the number of fishing days on the Upper South River SRA. It is unknown how many times each angler who holds a permit fishes the Upper South River SRA. It is known that some anglers frequent the river, but it is also known that some anglers get the permit (since the permit is free) and never get around to fishing the Upper South River SRA. Without surveying the permit applicants to quantify fishing days per year, local river experts are needed for this estimation. Tommy Lawhorne and Kevin Little, owners of the South River Fly Shop in Waynesboro, lead guided trips on the Upper South River SRA and are on the Upper South River SRA often (K. Little & T. Lawhorne, Personal communication, September 24, 2012). They estimate that averages of six to seven people are on the river per day

throughout the year noting maximums of 15 anglers and minimums of 2 anglers. They also estimate that over the year and half time period, the fishing activity on average has been relatively constant (K. Little & T. Lawhorne, Personal communication, September 24, 2012).

With an average of 6.5 anglers on the Upper South River SRA per day over the year and a half period, 2,372.5 anglers would utilize the Upper South River SRA per year. Based on the 2011 total of 2,004 permits, permitted anglers fished an average of 1.184 days per year. Since the 2012 data only accounts for half of the year, only 1,186.25 anglers would be expected to utilize the Upper South River SRA in 2012. With 747 permits given out in 2012, permitted anglers fished an average of 1.588 days per year. Since Lawhorne and Little (K. Little & T. Lawhorne, Personal communication, September 24, 2012) have experienced the fishing activity to be relatively constant over the year and a half period, it is understandable that the fishing days per year in 2012 would be higher than 2011 with less permits given out in that year. A significant number of permits were given out at the beginning of 2011 due to the hype of a new fishery. This will be discussed in further detail in the next chapter. From those average fishing days per year, total fishing days on the Upper South River SRA can be calculated. These averages are displayed in Figure 14.

2011	# of Anglers	Fish Days/Year	Fishing Days
Virginia Resident	1841	1.184	2179.5
Non-Virginia Resident	163	1.184	193.0
2012	**# of Anglers**	**Fish Days/Year**	**Fishing Days**
Virginia Resident	684	1.588	1086.2
Non-Virginia Resident	63	1.588	100.0

Figure 14. Total estimated fishing days on the Upper South River SRA.

Figure 14 shows that an estimated 2,189.5 anglers were Virginia residents and 193 anglers were non-Virginia residents in 2011 and that 1,1086.2 anglers were Virginia residents and 100 were non-Virginia residents in 2012. These numbers from Figure 14 will be used in the economic analysis along with the angler expenditures to calculate the economic impact of the Upper South River SRA.

Angler Expenditures

The permit data is an important component of the economic analysis because it helps to assess the extent of the fishing activity on the Upper South River SRA. The other major component is the estimated amount of money that anglers spend while fishing the Upper South River SRA. The different methods of this economic valuation have been discussed in previous chapters. For this analysis, previous relevant surveys will be used to estimate the economic value of the Upper South River SRA to Waynesboro and Augusta County.

The U.S. Department of the Interior, Fish and Wildlife Service, the U.S. Department of Commerce, and the U.S. Census Bureau conducted a national comprehensive study entitled, "2006 National Survey of Fishing, Hunting, and Wildlife-Associated Recreation" (2006 National Survey). Although the survey was conducted in 2006, it was not released until November of 2007 with many additional reports and addendums released in the following years. The National Survey has been conducted every five years since 1955 with the most recent survey conducted in 2011 (2006 National Survey). Unfortunately, only some preliminary results have been released from the 2011 National Survey, so the 2006 National Survey is the most recent completed survey (U.S. Fish and

Wildlife Service, 2012). If the 2011 National Survey follows the 2006 National Survey's timeline, the final report should be released around November, 2012.

The 2006 National Survey was funded by the Multistate Conservation Grant Programs authorized by Sport Fish and Wildlife Restoration Acts (2006 National Survey). The Fish and Wildlife Service and the U.S. Census Bureau worked with State and Federal agencies along with nongovernmental organizations when developing the survey. Data collection screening occurred in April 2006 to determine national fishing, hunting and wildlife activity in particular households by the U.S. Census Bureau. Data collection interviews were conducted in three waves in April 2006, September 2006, and January 2007 based on the initial screening in April 2006. Interviews were conducted by phone with some exceptions of in person for those who could not be accessed by phone and included only those older than 15 years old. With 21,938 anglers and hunters interviewed, it was determined that statistically reliable results would be available for each state. Data collected in the survey included activities of these anglers such as fishing days per year, expenditures related to fishing, and location of fishing activities (2006 National Survey).

One of the reports to come out of the 2006 National Survey was the Virginia specific report (2006 National Survey: Virginia). In this report, fishing activity in Virginia was outlined and analyzed. It was estimated that a total of 858,000 people over the age of 15 fished in the state of Virginia, of whom 640,000 were Virginia residents and 218,000 were not. The survey also concluded that $2.4 billion were spent in 2006 on wildlife recreation in Virginia by residents and non-residents. Of that $2.4 billion, $734 million was spent on fishing activities (2006 National Survey: Virginia).

The fishing expenditures in the 2006 National Survey are broken down into two categories: trip-related expenditures and equipment and other expenditures (2006 National Survey: Virginia). The trip-related expenditures include food and lodging, transportation, guide fees, land use fees, boating costs, bait, and ice. The equipment and other expenditures include reels, rods, lines, lures, and other equipment related to fishing. It also includes tents, clothing, boats, campers, magazine subscriptions, and licenses (2006 National Survey: Virginia).

Since this study is looking at the economic impact of the Upper South River SRA on Waynesboro and Augusta County, only the trip-related expenditures are applicable. Anglers need equipment to fish the Upper South River SRA, but it is assumed that they already own equipment. The local fly shop cannot link major equipment sales directly to Upper South River SRA anglers. It is important to remember that this expenditure is comprised of all fishing in the state of Virginia and not just fly fishing in rivers. Bait is listed as trip-related expenditure and is not applicable to fly fishing since artificial flies are used instead. Although bait is generally cheaper than artificial flies, some anglers will not purchase flies every day they go fishing, as bait fisherman would need to do. For this reason, they are assumed to have similar economic impact.

Figure 15 shows the expenditures spent by Virginia residents and non-residents in 2006 (2006 National Survey: Virginia). It breaks it up by the type of expenditure and the percentage of the total expenditure shown for both expenditure types. 63.82 % of the Virginia resident expenditures were trip-related and 34.93% of non-Virginia resident expenditures were trip-related.

		Dollars	% of Total
Virginia resident	Total expenditures	$480,974,000	
	Trip-related	$306,956,000	**63.82%**
	Equipment and other	$174,018,000	36.18%
Non-Virginia resident	Total expenditures	$252,803,000	
	Trip-related	$88,308,000	**34.93%**
	Equipment and other	$164,495,000	65.07%

Figure 15. Angler expenditures in Virginia by residents and non-residents.

From the 2006 National Survey, the average total trip expenditure per day is identified. The average Virginia resident spends 36 dollars per fishing day in Virginia and the average non-Virginia resident spends 85 dollars per fishing day in Virginia. Figure 16 shows the calculation of trip-related expenditures per fishing day (2006 National Survey: Virginia). Virginia is a large state and some instate anglers could be spending more or less the same as out-of-state anglers on trip related expenditures. The 2006 National Survey is an average for residents and non-residents, so this resident difference is accounted for. Waynesboro residents may spend very little and a Virginia Beach resident may spend a lot, but on average it is assumed that they spend $22.98 per fishing day on trip related expenditures.

	Average trip expenditure per day	% Trip-related	Trip-related expenditure per day
Virginia resident	$36	63.82%	**$22.98**
Non-Virginia resident	$85	34.93%	**$29.69**

Figure 16. Trip-related expenditures per day for Virginia residents and non-residents.

Economic Analysis

The values for trip-related expenditures per day in Figure 16 are in 2006 dollars and need to be inflated to the 2011 and 2012 values in order to determine values during the

time of this study. It is important to inflate these values because the inflated value represents the different buying power of the dollar. The U.S. Department of Labor, Bureau of Labor Statistics' CPI Inflation Calculator was used to calculate the inflated values shown in Figure 17 (USDOL, 2012). The CPI Inflation Calculator works by using the average Consumer Price Index (CPI) from different years. The CPI is calculated based on the change in market cost of consumer goods and services purchased by urban households. This includes food and beverages, housing, apparel, transportation, medical care, recreation, education, and other goods and services (USDOL, 2012).

	Trip-related expenditure per day	2011 Value	2012 Value
Virginia resident	$22.98	$25.64	$26.26
Non-Virginia resident	$29.69	$33.13	$33.93

Figure 17. Values of angler expenditure estimates from 2006 survey inflated to 2011 and 2012 dollars.

The year specific values from Figure 17 are used in Figure 18 and Figure 19 in addition to the fishing days found in Figure 13 in order to calculate the total trip-related expenditures for 2011 and 2012.

2011	Fishing Days	Value ($)	Totals ($)
Virginia Resident	2179.5	$25.64	$55,883.08
Non-Virginia Resident	193.0	$33.13	$6,393.19
			$62,276.27

Figure 18. 2011 total trip-related expenditures.

2012	Fishing Days	Value ($)	Totals ($)
Virginia Resident	1086.2	$26.26	$28,523.74
Non-Virginia Resident	100.0	$33.93	$3,394.53
			$31,918.27

Figure 19. 2012 total trip-related expenditures.

Figure 18 shows that the total expenditures for 2011 are $62,276.27 and Figure 19 shows the total expenditures for 2012 are $31,918.27. These values represent the total expenditures that all of the anglers in that particular year spent on their day fishing at the Upper South River SRA.

A 2011 survey conducted by the VDGIF on a lower portion of the South River in Waynesboro concluded that 83% of the angling trip related expenditures were spent within 20 miles of the river (Bugas, 2011). This survey took place from May – September 2011 where 65 angling parties were interviewed on the South River between Waynesboro and Grottoes. Anglers were asked how much they spent on gas, food, bait or tackle, lodging, canoe rental, and other trip expenditures (Bugas, 2011). Since the expenditures in the South River Survey and the trip-related expenditures from the 2006 Nation Survey are similar and because the South River Survey was conducted only a few miles away from the Upper South River SRA, it is assumed that 83% of the expenditures estimated for the Upper South River SRA are spent within 20 miles of the Upper South River SRA. Figure 20 shows that the total estimate of expenditures from the Upper South River SRA spent in the local community are $78,181.47.

	Total Expenditures	Money Spent Locally
2011	$62,276.27	$51,689.30
2012	$31,918.27	$26,492.17
		$78,181.47

Figure 20. Money spent within 20 miles of the Upper South River SRA.

Chapter 5: Discussion

The economic impact of the Upper South River SRA as a fishery is important to estimate because it helps decision makers understand the value of the fishery in monetary terms. This estimate can justify government spending on restoration and conservation projects if the economic impact is larger than the costs of these projects. On the other hand, the estimated economic impact can show that the economic benefit is not enough to justify government spending and thus cut unnecessary government expenditures.

In this study, the economic impact of angling on the Upper South River SRA was estimated to be $78,181 from January 2011 through June 2012. This was calculated based on prior surveys and not from a survey specifically of Upper South River SRA anglers. Most notably, the 2006 National Survey offered trip-related expenditures for Virginia anglers and non-Virginia anglers when fishing in Virginia, the 2011 South River Survey gave a percentage of expenditures that are spent within 20 miles of the river, and conversations with active anglers gave an estimate of angling effort.

The $78,181 economic impact is the direct impact from anglers of the Upper South River SRA. This number does not express the true economic impact to Augusta County and the Waynesboro because a multiplier was not used to analyze the "ripple effect" of these expenditures. Without the "ripple effect", this estimated economic impact can be considered a conservative economic impact. The true economic impact could be twice this value if the multiplier is high, but conservatively it is estimated at $78,181.

Local Businesses Economic Benefit

The South River Fly Shop is the easiest business to identify direct benefit from the Upper South River SRA. The South River Fly Shop was opened in April 2011 in Waynesboro by owners Kevin Little and Tommy Lawhorne (K. Little & T. Lawhorne, Personal communication, September 24, 2012). It is located in the heart of Waynesboro's downtown district and offers fly fishing equipment and supplies from many different companies. They also offer guide trip services and share local knowledge of fishing conditions such as which flies are working on the water. The South River Fly Shop also holds fly tying classes and casting clinics (South River Fly Shop, 2012).

Little and Lawhorne had been talking about opening a fly shop in Waynesboro for about ten years before their goal was achieved (K. Little & T. Lawhorne, Personal communication, September 24, 2012). When the Upper South River SRA opened in January 2011, they started to seriously make plans to open the fly shop by writing a business plan and searching for a location for the shop. They opened the store in April 2011 only a few months later (K. Little & T. Lawhorne, Personal communication, September 24, 2012).

The South River Fly Shop became a permit application location when it opened. When anglers would come into the shop to apply for a permit, 50% of them would make a small purchase in the store for fewer than ten dollars on supplies for their fishing activities. Some of these purchases could be attributed to courtesy purchases for advice and local knowledge from the owners (K. Little & T. Lawhorne, Personal communication, September 24, 2012). In addition to purchases, the fly shop offers guided fishing trips on the Upper South River SRA for $150 for a half day and $225 - $250 for a full day (South River Fly Shop, 2012).

Lawhorne estimates that over 30% of the fly shop's revenue is directly associated with the Upper South River SRA. He also says that this percentage has steadily increased since they opened and he expects that percentage will increase until it is a majority of their business since it is the company's namesake river (K. Little & T. Lawhorne, Personal communication, September 24, 2012). With 30% of the revenue from a new business directly coming from activities on the Upper South River SRA, it is a clear direct economic benefit to Waynesboro.

The Speckled Trout Bed and Breakfast is a bed and breakfast in Waynesboro operated by husband and wife team Jim and Kay Heafner (The Speckled Trout, 2012). It is advertised as a fly fishing and wine tasting destination because of the ample fly fishing areas and vineyards in close proximity to the bed and breakfast. One of the rooms in The Speckled Trout is the Lefty Kreh Fly Fishing Library that houses an extensive collection of books on fly fishing techniques, characters, history, and places (The Speckled Trout, 2012). Based on conversations with the co-owner, Jim Heafner, The Speckled Trout has many guests who are fly fishermen. Of the fly fishermen who stay at The Speckled Trout, only a handful have stayed with them with the sole intent to fish the Upper South River SRA (J. Heafner, Personal communication, September 20, 2012). This demonstrates that fly fishing activities can draw people to the Upper South River SRA to fish and participate in other activities in the area.

Even though Upper South River SRA anglers are not generally staying at The Speckled Trout, as popularity of the Upper South River SRA increases, there should be more business for The Speckled Trout. Jim Heafner recommends the South River Fly Shop to guests which in turn increases awareness and support for the Upper South River

SRA because Little and Lawhorne in turn point anglers to the SRA (K. Little & T. Lawhorne, Personal communication, September 24, 2012). These guests who did not visit The Speckled Trout with the intent to fish the Upper South River SRA could come back with the intent to fish the SRA because of the two business' recommendations.

Stone Soup Books and Café in Waynesboro is one of the locations where anglers can apply for a permit to fish the Upper South River SRA. Their mission is "to provide a space in our community for people to gather and discuss or share books and ideas" (Stone Soup Books, 2012). Unlike other businesses that are permit application locations, Stone Soup Books does not offer items that anglers need for their fishing activities. According to Susan Hastings from Stone Soup Books, it is uncommon for an angler to enter the store to apply for a permit and purchase a book (S. Hastings, Personal communication, September 17, 2012). However, she has noticed anglers who have revisited the bookstore to eat lunch at the café.

Even though there are no direct economic benefits to Stone Soup Books and Café from the permit applicants when they come in for their permits, the charming atmosphere returns some anglers to the store. Since the demographics of trout anglers discussed in Chapter 2 show that trout anglers are generally more educated and with a higher income than other fishermen and the general American public, Stone Soup Books is a store that can be enjoyed by the trout angler demographic. Also, an out of town angler on the Upper South River SRA would likely not know about the café as a lunch spot without it being listed as a permit application location. Thus, simply listing the shop as a permit location can potentially increase the shop's revenue by raising the anglers' awareness of the store's existence.

These are just three of the many businesses in Waynesboro that benefit or have the ability to benefit directly from the Upper South River SRA. Other businesses such as restaurants, hotels, and gas stations cannot easily identify direct revenue from Upper South River SRA anglers.

Future Survey

In order to more accurately estimate the value of the Upper South River SRA, a comprehensive survey must be conducted. The survey should be conducted via the mail in the manner discussed in the survey methods section of chapter 3. The list of permit applications would be the potential list of l anglers surveyed. Since the permits are not electronic, systematic random sampling would need to be used in order to determine who is surveyed.

Once the list of survey participants is created, a survey would need to be created. A sample of questions for this survey can be found in Appendix A. The list of questions in Appendix A is a bare minimum survey aimed to determine angling efforts, economic impact, and angler demographics. The questions in Appendix A are not comprehensive and other questions could be asked if there are other objectives from the survey. For example, VDGIF might want to add questions to the survey about species and size of fish caught along with questions about angler attitudes and thoughts about the fishery management practices.

As discussed in chapter 3, second and third mailings need to occur if anglers are not responding to the survey. Unfortunately, the Upper South River SRA permits do not ask for telephone numbers of anglers. An incentive might be needed in the second and third

mailing to increase the response rate since follow-up surveys by phone are impossible and door-to-door interviews are improbable due to distance and cost issues. For example, an angler from New York does not respond, it is unlikely that the surveyor would drive to his or her house to attempt to conduct the survey.

Appendix A

Below is an example of the questions that would need to be on a survey for the Upper South River SRA in order to estimate fishing effort and economic impact:

1. **Have you ever gone fishing on the Upper South River SRA?**

   ____ Yes (Skip to Question 2)

   ____ No

   Why not?

   _____

   _____

   _____

****If you have not fished the Upper South River, please skip to question 5.****

2. **How many days did you fish the Upper South River SRA between January 1, 2011 and December 31, 2012? Count any partial day trips as full days.**

   _____ Days

3. **Please enter the expenditures made in Waynesboro, Augusta County, and the rest of Virginia during your most recent fishing trip to the Upper South River SRA and the number of days of the fishing trip:**

   _____ Days (Duration of most recent fishing trip.)

Expenditure	Place Where Expenditure Occurred		
	Waynesboro	Augusta County	Elsewhere in Virginia
Restaurant/bar	$	$	$
Grocery	$	$	$

Lodging	$	$	$
Lures, tackle, sporting goods	$	$	$
Gasoline	$	$	$
Guide fees	$	$	$
Souvenirs	$	$	$
Other expenditures	$	$	$

4. **In what year were you born?**

   _____

5. **Are you male or female?**

   ____ Male

   ____ Female

6. **How many years of school did you complete, counting 12 years for high school graduation, and 1 year for each additional year of college?**

   _____ Years

7. **Please select your 2012 household income:**

   ____ Under $10,000

   ____ $10-$19,999

   ____ $20-$29,999

   ____ $30-$39,999

   ____ $40-$49,999

   ____ $50-$69,999

   ____ $70-$99,999

____ Over $100,000

8. What is your race?

____ White (not of Hispanic origin)

____ White (of Hispanic origin)

____ Black or African-American

____ Asian or Pacific Islander

____ Native American Indian

____ Other

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