Center for Energy and Environmental Sustainability

# THE ECONOMIC IMPACT OF THE 2005 SHENANDOAH RIVER FISH KILL: A PRELIMINARY ASSESSMENT

*Prepared for the Shenandoah River Fish Kill Task Force*

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## INTRODUCTION

This report provides a preliminary assessment of the value of recreational sport fishing in the north-central Shenandoah Valley as well as of economic losses associated with the 2005 fish kill on the Shenandoah River. Estimates are derived from two data sources: fishing license data from the Virginia Department of Game and Inland Fisheries, and angler spending in the Commonwealth calculated by the US Fish and Wildlife Service.

The economic contributions of freshwater anglers to the Commonwealth and the Shenandoah Valley are considerable. In 2001, freshwater sport fishing generated nearly $205 million in direct spending in Virginia (US Department of Interior, 2003). In the seven Shenandoah Valley counties[1] affected by the ongoing fish kills, we estimate that freshwater anglers generated $16.2 to $21.4 million in economic value for local businesses and the Commonwealth in 2001.

The 2005 fish kill had an observable effect on trends in the number of individuals acquiring fishing licenses. We estimate that the fish kill resulted in about 2,100 fewer licensed anglers in the region, equating to approximately $686,000 in lost retail sales and revenues to the state.

It is important to recognize that these estimates are preliminary and, in many ways, conservative. For example, they do not account for the multiplier effect of angler spending in the local economy, nor do they provide a refined calculation of lost revenue to the Commonwealth (e.g., by discriminating between sales, fuel, and specialized equipment taxes). In addition, the calculations are based only on freshwater sport fishing. Because of the gruesome nature of the ongoing fish kills, they undoubtedly affect public perceptions of—and confidence in—water quality in the Shenandoah River watershed. It is therefore possible that the fish kills are having subtle but important spillover effects on other forms of river recreation in the Shenandoah Valley, such as canoeing, rafting, and swimming. Slower rates of growth in river recreation and tourism within the Shenandoah Valley may be a long term result if the fish kills continue unabated and unexplained.

## BACKGROUND ON THE FISH KILL

The Shenandoah River flows through Rockingham, Page, Shenandoah, Clarke, Frederick, and Warren counties and includes Augusta as part of its headwaters (fig. 1). These seven rural counties represent virtually all of the Shenandoah Valley, and together account for about 6% of the state population. From April to July 2005, a number of acute fish kills decimated 80 percent of the adult smallmouth bass and redbreast sunfish population in the South Fork Shenandoah (Pure Water Forum, 2006). The fish kill was not isolated to the South Fork, however, and incidents were reported throughout the watershed (fig. 2). Similar fish kills occurred on the South Branch Potomac in 2002, on the North Fork Shenandoah in 2004 and 2006, and on the South River (a tributary of the Shenandoah) in 2006 (Virginia Department of Environmental Quality, 2006).

The cause of these fish kills remains unknown, although evidence points to a number of interactive stressors that make certain species vulnerable to common bacteria (Pure Water Forum, 2006). The Shenandoah River Fish Kill Task Force, led jointly by the Virginia Department of Environmental Quality and the Virginia Department of Game and Inland Fisheries, is investigating these fish kills and ongoing reports of fish deaths.

[1] The counties of Augusta, Clarke, Frederick, Page, Rockingham, Shenandoah, and Warren.

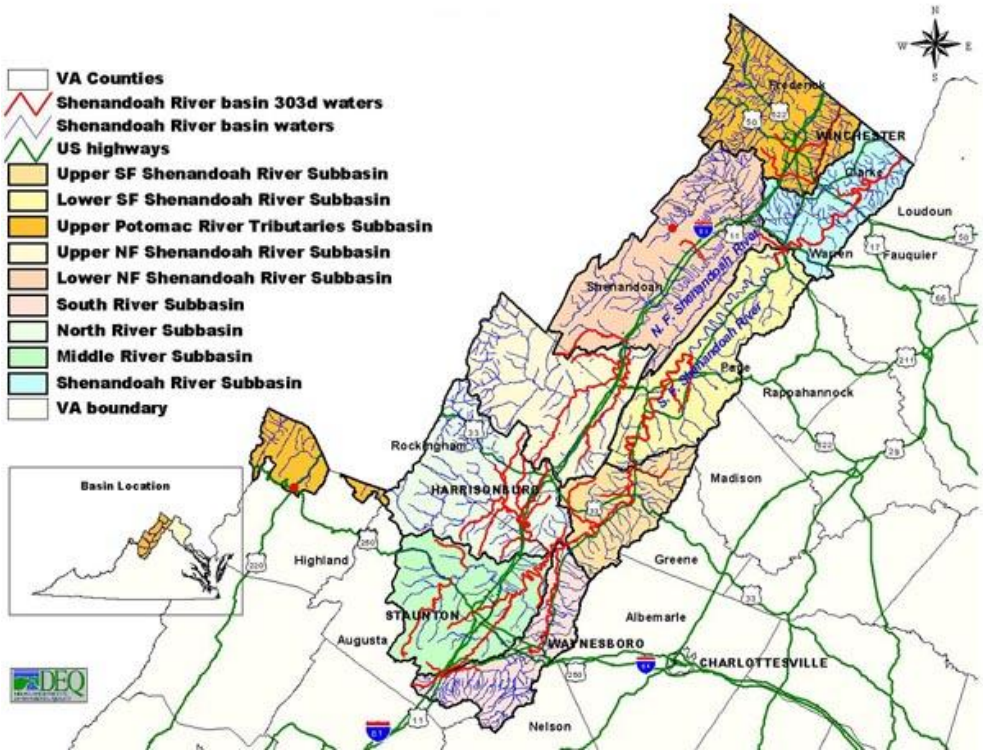


FIG. 1—SHENANDOAH RIVER BASIN
SOURCE: Virginia Dept. of Environmental Quality

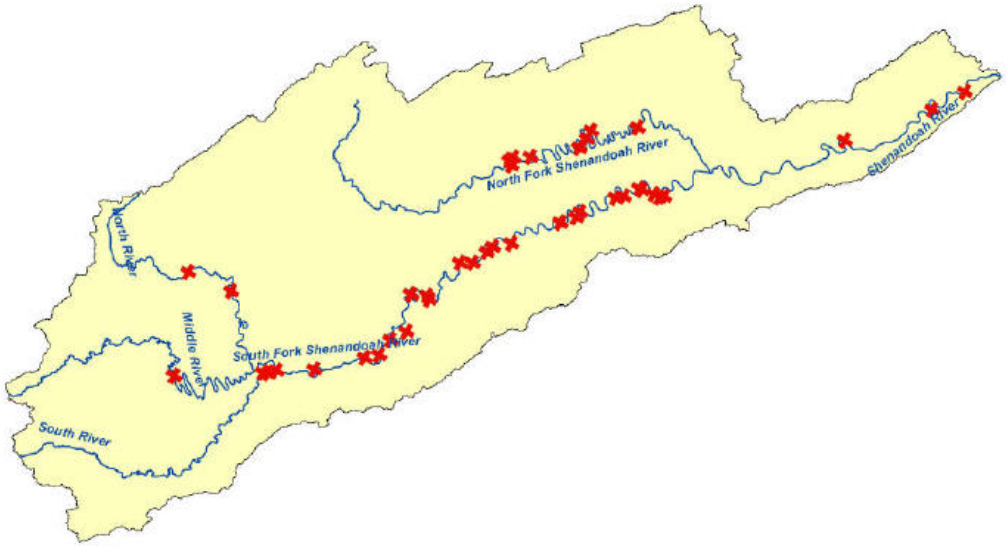


FIG. 2—FISH KILL REPORTS JANUARY – JULY 2005.
SOURCE: Pure Water Forum

## SCOPE OF FRESHWATER SPORT FISHING IN THE AFFECTED COUNTIES

Freshwater sport fishing in the United States is a popular form of recreation, but it is also in decline (US Department of Interior, 2003; American Sportfishing Association, 2006). From 1991 to 2001, the number of freshwater anglers in Virginia remained essentially unchanged (Department of Interior, 2003), but Commonwealth license data suggest that the sport has been diminishing in popularity since about 2000-2001. Nonetheless, the number of licensed anglers in Virginia is not trivial: in 2005, about 451,000 people obtained freshwater fishing permits of one type or another (table 1).

The seven fish kill affected counties together account for 12 percent of Commonwealth freshwater fishing licenses[2] (table 1). As seen in table 1, the region affected by the fish kill appears to represent a somewhat disproportionate share of freshwater fishing licenses in Virginia, and in some categories, considerably so. Even though these counties represent only 6 percent of the state population, they account for 12 percent of all freshwater licenses, one-fifth of all residential trout permits, and 15 percent of all non-resident 5-day permits. Although disproportionate to population, these figures are consistent with the prevalence of fishable waters in the region: the Shenandoah River measures 3,200 river miles, about 13 percent of the state total.[3]

TABLE 1. NUMBER OF FRESHWATER FISHING LICENSES, 2005

| TYPE OF LICENSE | NUMBER OF LICENSES ISSUED IN FISH KILL AFFECTED COUNTIES | NUMBER OF LICENSES ISSUED IN THE COMMONWEALTH | FISH KILL COUNTIES AS A PERCENTAGE OF COMMONWEALTH TOTAL |
|---|---|---|---|
| Resident, over 65 | 1,798 | 22,730 | 8% |
| Resident, statewide annual | 31,664 | 335,579 | 9% |
| Resident, trout | 16,158 | 77,934 | 21% |
| Resident, city/county of residence | 1,277 | 14,192 | 9% |
| Resident, 5-day freshwater | 1,055 | 9,413 | 11% |
| Non-resident, statewide annual | 963 | 14,417 | 7% |
| Non-resident, trout | 445 | 3,584 | 12% |
| Non-resident, 5-day freshwater | 8,076 | 55,211 | 15% |
| Total freshwater licenses | 61,436 | 533,060 | 12% |
| Total, excluding trout[1] | 44,833 | 451,542 | 10% |

[1]To fish in stocked trout waters, anglers must have both a trout license as well as one of the other freshwater permits. Total licenses excluding trout is the better estimate of the number of unique individuals who purchased licenses.
SOURCE: Virginia Department of Game and Inland Fisheries, unpublished data.

Table 1 also illustrates the popularity of different types of fishing in the Shenandoah Valley. The river itself provides warm water fishing for bass, panfish, catfish, and so forth. However, a number of creeks and streams in the watershed provide excellent cold water fishing for trout. Indeed, Mossy Creek (in Augusta County) was rated as one of the top five spring creeks in the nation by *Field and Stream* magazine, and is regularly featured in the magazine's "Where to Go" section.

[2] All towns and cities are included in these county totals.
[3] The Commonwealth reports just over 25,000 river miles of fishable waters in Virginia (Virginia Department of Game and Inland Fisheries, 2005). Shenandoah river miles were calculated using a Geographic Information System (GIS) database for the Shenandoah watershed. [Personal communication with Dr. Thomas Benzing, Center for Energy and Environmental Sustainability, James Madison University, June 22, 2006.]

It is possible to estimate the economic value of freshwater sport fishing in the Shenandoah Valley by combining Commonwealth license data with angler spending estimates provided by the US Department of Interior. Every five years the US Fish and Wildlife Service conducts its national *Survey of Fishing, Hunting, and Wildlife-Associated Recreation*. The most recent data available indicate that freshwater anglers spent an average of $279 per person in Virginia in 2001 (US Department of Interior, 2003). Assuming that anglers in the fish kill affected counties also spent an average of $279 per year within this region,[4] direct spending[5] in 2001 for these seven counties amounts to approximately $15.5 million.[6]

Because not all anglers necessarily obtain a legal permit to fish, it is possible that this aggregate spending figure is higher. Based on sampling data from the *2001 Survey of Fishing, Hunting, and Wildlife-Associated Recreation*, the US Fish and Wildlife Service estimated that 721,000 freshwater anglers (both resident and non-resident) fished in Virginia in 2001.[7] This represents about 175,000 more individuals than freshwater licenses issued that year.[8] If we assume that the proportion of anglers in the Shenandoah Valley relative to the Commonwealth as a whole is equivalent to the proportion that obtain fishing licenses, then there could have been as many as 73,420 freshwater anglers the Shenandoah watershed in 2001 rather than just the 55,614 who were licensed to fish. At $279 per person, this results in approximately $20.5 million in angler spending in the region. Retail spending associated with freshwater sport fishing in the Shenandoah watershed is thus estimated at about $15.5 to $20.5 million in 2001.

The Commonwealth also gains from angler expenditures in the form of tax and license revenue. It is not possible from the available data to estimate fish license revenues, boat titling and registration fees, general sales versus accommodation taxes, and so forth. A conservative estimate of the fiscal benefits of sport fishing recreation is simply to multiply angler spending by the state sales and use tax; in 2001, this was 3.5 percent for the Commonwealth and 1 percent for localities in the Shenandoah watershed. Freshwater sport fishing in the region thus contributed about $542,500 - $717,500 in state sales tax and about $155,000 – $205,000 in local sales tax.

In sum, a preliminary conservative assessment of the economic value of freshwater sport fishing in the fish kill affected counties is therefore in the range of $16.2 to $21.4 million for 2001.[9] This figure presumes that the $279 in average annual spending is characteristic of anglers in the Shenandoah watershed, and that this money gets spent entirely within the seven counties under consideration.[10] It also assumes that each freshwater fishing license represents one unique

[4] At present there are no data to suggest that angler spending in the Shenandoah watershed is more or less than the estimated state average. Data from a 2005 creel survey for the Shenandoah River, which would allow more precise estimates, are not yet available.

[5] Angler spending is assumed to be retail sales, and does not include sales or fuel taxes.

[6] There were a total of 73,946 freshwater licenses issued in these counties in 2001. If trout licenses are excluded (because trout anglers must hold both a trout and general freshwater permit), then we estimate that 55,614 unique individuals obtained freshwater permits in 2001.

[7] This estimate is for anglers aged 16 and over. (The USFWS survey only includes individuals over 16.) Note that individuals under 16 do not need a permit to fish in the Commonwealth.

[8] Again, excluding trout licenses because of the two-license requirement for trout fishing. See footnote 6.

[9] An alternative way of estimating the economic value of sport fishing is to apportion total state freshwater angler spending according to the percentage of total state river miles in the watershed (Anderson & Associates, 2001). That method was rejected for this study because more appropriate data were available (license data with which to estimate the number of local anglers).

[10] It is not unreasonable to assume that angler spending will occur in the localities where the licenses are purchased. A 2000 survey indicated that 50 percent of Virginia anglers travel less than one hour for a day's fishing and 84 percent travel less than two hours. See McMullin, Duda, and Wright (2000).

individual.[11] It does not account for the multiplier effect of angler spending in the local economy or indirect fiscal effects, such as business income tax revenue created by angler retail sales.

## IMPACT OF THE 2005 FISH KILL ON ANGLING

Commonwealth license data are used here to determine the impact of the 2005 fish kill on angling in the affected counties. In order to isolate the effects of the fish kill, other potential drivers of the trends in license data must be accounted for.

Figure 3 presents trends in licenses in the fish kill affected counties relative to all other counties in the Commonwealth. The number of licenses has been indexed to the year 2000 in order to illustrate annual changes more directly. The data in Figure 3 also exclude trout licenses to more accurately represent the number of unique individuals obtaining fishing permits (trout anglers must hold two permits, one for trout and one for freshwater angling generally).

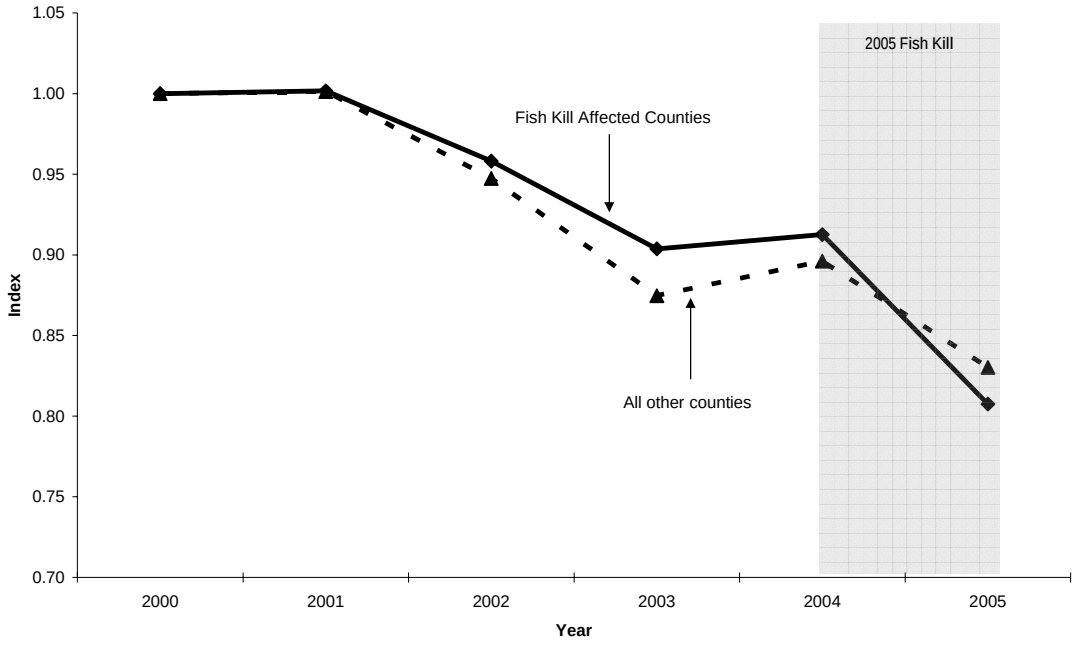


FIG. 3—NUMBER OF FRESHWATER FISHING LICENSES 2000-2005, EXCLUDING TROUT, INDEXED TO 2000
SOURCE: Calculated by the author using unpublished data from the Virginia Department of Game and Inland Fisheries.

As illustrated in Figure 3, there was a notable decline in fishing permits across the Commonwealth in 2005, the year of the fish kill. License purchases are notoriously sensitive to a number of factors, however, including changes in fees and even precipitation (American Sportfishing Association, 2005).

There were in fact changes in fees and license options beginning in 2005. Non-resident 5-day permits increased in price from $6 to $10, and the Commonwealth introduced a variety of combined fresh and saltwater fishing licenses (Virginia Department of Game and Inland Fisher-

[11] Excluding trout licenses. See notes 6 and 8.

ies, 2005). It is likely that some of the decline in freshwater fishing licenses is due to demand price elasticity for non-resident 5-day permits, and the data support this possibility. The decline in this category was the largest for all license types from 2004-2005, and accounts for 29 percent of the total decrease in freshwater licenses (excluding trout licenses). Cross-price elasticity between the freshwater and combined freshwater/saltwater permits—as well as between the non-resident 5-day and yearly permits—may also have affected the trend from 2004-2005, but data are not yet available to assess this relationship precisely.

Another likely factor contributing to the Commonwealth-wide license declines in 2005 was the increased cost of petroleum that occurred over the summer of 2005. By September, the price of gasoline nationally averaged $1.04 per gallon more than in September 2004, and was often over 50 cents per gallon higher even before Hurricane Katrina struck (Energy Information Administration, 2006). Rising gas prices undoubtedly had an impact on people's willingness and ability to travel.

Unfortunately, it is simply not possible to explain exactly why licenses declined somewhat dramatically throughout Virginia during this one-year period. Changes in license structure and fees probably had an influence, as did transportation costs. Preliminary analysis of regional license trends by the American Sportfishing Association suggests that declines may have been a broad pattern across the northeastern United States, but findings are tentative and only for the first quarter of 2005.[12]

Nevertheless, Figure 3 does illustrate one significant point: from 2004-2005, the decline in licenses was pronouncedly greater in the fish kill affected counties than the rest of the Commonwealth. Detailed rate of change data are presented in Table 2.

Table 2. Trends in Commonwealth Freshwater Fishing Licenses, 2000-2005

| Type of License | Fish Kill Affected Counties | | All Other Counties | |
|---|---|---|---|---|
| | Average Annual Rate of Change, 2000-2004 | Annual Change, 2004-2005 | Average Annual Rate of Change, 2000-2004 | Annual Change, 2004-2005 |
| | in percent (%) | | in percent (%) | |
| Resident, over 65 | -6 | -6 | -4 | 0 |
| Resident, statewide annual | -2 | -8 | -2 | -8 |
| Resident, trout | -2 | -1 | -3 | 3 |
| Resident, city/county of residence | -9 | -19 | -6 | -1 |
| Resident, 5-day freshwater | -6 | -15 | -4 | -2 |
| Non-resident, statewide annual | 2 | -5 | 1 | 11 |
| Non-resident, trout | 4 | -5 | 5 | -2 |
| Non-resident, 5-day freshwater | -1 | -23 | -4 | -16 |
| Total, All licenses excluding trout | -2 | -12 | -3 | -7 |

SOURCE: Calculated by the author using unpublished data from the Virginia Department of Game and Inland Fisheries.

[12] See American Sportfishing Association, *ASA/AFWA License Sales Indices* (http://www.asafishing.org/asa/statistics/participation/license_sales_trends.html). The Association plans on updating the national license indices in mid-to-late 2006.

The data in Table 2 indicate that the 2004-2005 license declines in the fish kill affected counties were dramatic relative to other counties in the Commonwealth during the same time period. All things being equal, reductions in the fish kill region during 2004-2005 ***should*** show roughly the same orders of magnitude as the rest of the Commonwealth. Clearly they do not. For example, the annual decrease in the city/county of residence fishing permits ***was 19 times greater*** in the fish kill affected counties than elsewhere. Trout anglers increased by three percent in the rest of the Commonwealth, but decreased by one percent in the fish kill region. Non-resident annual permits declined by 5 percent in the fish kill area, but increased 11 percent in other counties.[13] Figure 4 portrays the pronounced differences in the annual rate of change in fishing licenses between the fish kill region and the rest of the Commonwealth. In all instances, licenses in the Shenandoah watershed dropped more precipitously than the rest of Virginia.

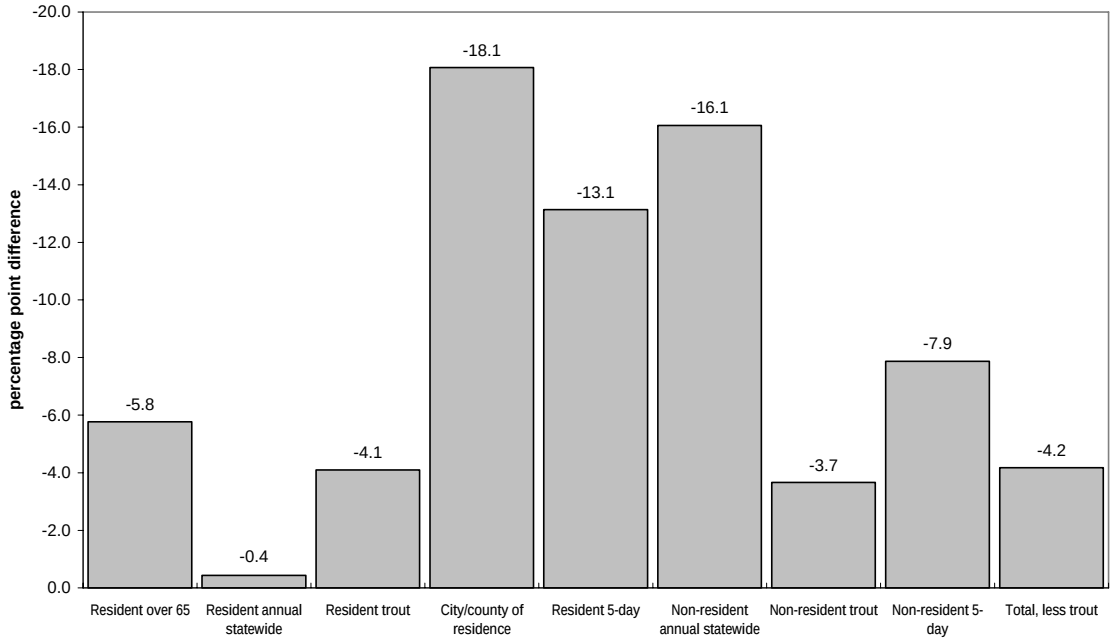


FIG. 4—PERCENTAGE POINT DIFFERENCE IN 2004-2005 RATE OF CHANGE IN FISHING LICENSES, FISH KILL AFFECTED COUNTIES RELATIVE TO THE REST OF THE COMMONWEALTH, BY TYPE OF LICENSE
SOURCE: Table 2.

Other than the fish kill, there are no obvious or compelling reasons why the license changes in the Shenandoah watershed should be so substantially worse in 2005 than elsewhere. Precipitation for the prime fishing season was normal (Southeast Regional Climate Center, 2006). Fish consumption advisories for much of the watershed have been in place for decades and remained unchanged, with minor exceptions (for details, see Virginia Department of Health, 2006). Macroeconomic conditions would not have affected the Shenandoah Valley differently than the rest of the Commonwealth. Pending the availability of new or different information, it is reasonable to conclude that the difference in trends may be attributed to the fish kill itself.

[13] It is likely that some non-resident anglers who would have fished the Shenandoah simply went elsewhere in Virginia to fish, resulting in higher rates of non-resident license purchases in those localities.

The 2004-2005 decrease in the number of individuals acquiring fishing licenses in the fish kill affected counties was 11.5 percent. In the rest of the Commonwealth, it was 7.3 percent. Assuming the difference between these two numbers is the impact of the fish kill, it is responsible for a net 4.2 percent decline in the number of licensed anglers in the Shenandoah watershed from 2004 to 2005. This equates to a loss of approximately 2,100 licensed anglers. Note, however, that from 2000-2004, the average annual decline in the number of fishing licenses in the fish kill counties averaged 1 percentage point less that the rest of the Commonwealth—the overall rate of decrease was slower (see table 2). It is possible that, in the absence of the fish kill, the rate of decline from 2004 to 2005 in the fish kill region would actually have been lower than the rest of the state. Our estimated loss of anglers is therefore understated.

We do not know if these "lost" anglers actually went fishing or not, or how much money they spent during 2005. In addition, we do not know how the fish kill affected the licensed anglers. It is likely that they reduced the frequency and duration of their fishing trips as well as associated spending, but we cannot say by how much. (The forthcoming Shenandoah creel survey will shed some light on this matter.) For the purpose of this analysis, we assume that the 2,100 lost anglers are individuals who chose not to fish at all during the year. In addition, we assume that licensed anglers did not change their level of activity over previous years or reduce their level of spending.

## ESTIMATES OF ECONOMIC LOSS DUE TO THE FISH KILL

Downturns in the scale and scope of angling have economic consequences. There are two principal sets of stakeholders who should be concerned about the economic impacts of the fish kill. First are the local businesses that benefit from angler spending. Anglers purchase a dizzying array of goods and services—ice, bait, boats, fuel, guide services, outfitter rentals, camping gear, tackle, accommodations, food, and so forth—that benefit local businesses directly and the local economy indirectly. As discussed previously, total spending (excluding multiplier effects) by anglers in the fish kill region is estimated at $15.5 to $20.5 million in 2001.

The second stakeholder is the Commonwealth itself. The state benefits indirectly through business income taxes for fishing-related enterprises. It also benefits directly in several critical ways:

1. Revenues from the sale of fishing licenses.
2. Revenues from the general sales tax.
3. Revenues from food and accommodation sales taxes, boat titling and registration fees, and fishing-related equipment sales taxes.
4. Federal assistance from the Federal Aid in Sport Fish and Wildlife Restoration Funds, a fund that is financed by taxes on motor boat fuel and fishing and hunting equipment.

In fact, the annual budget for the Virginia Department of Game and Inland Fisheries is almost entirely dependent on revenue from hunting and fishing licenses, Federal Aid in Sport Fish and Wildlife Restoration Funds, and state sales taxes on fishing and hunting related equipment.

Revenues accruing to the Commonwealth from freshwater sport fishing in the fish kill affected region are difficult to estimate because the available data from the US Fish and Wildlife Service do not provide the necessary level of detail. However, as estimated earlier, freshwater sport fishing in the region contributed about $697,500 to $922,500 in state and local sales tax.

The impact of the fish kill can be assessed against this broader economic picture. As discussed in the previous section, we estimate that the fish kill resulted in the loss of about 2,100 licensed anglers in 2005. This calculation is based on the assumption that the difference in the percentage change in licenses between the fish kill counties and the rest of the Commonwealth is attributable to the fish kill itself. Table 3 presents this data in more detail. As seen in Table 3, we estimate that there were 2,116 fewer licensed anglers in the Shenandoah watershed because of the fish kill. This results in a loss of $25,813 in license revenues to the Commonwealth.

Table 3. Estimated Fish Kill Associated Decline in Fishing Licenses and Loss of License Revenue to the Commonwealth, 2005

| Type of License | Net reduction in licenses due to fish kill | Cost of license (dollars $) | Total revenue loss to the Commonwealth (dollars $) |
|---|---|---|---|
| Resident, over 65 | 110 | 1 | 110 |
| Resident, statewide annual | 149 | 12 | 1,787 |
| Resident, trout | 667 | 12 | 8,007 |
| Resident, city/county of residence | 284 | 5 | 1,418 |
| Resident, 5-day | 163 | 5 | 814 |
| Non-resident, statewide annual | 162 | 30 | 4,870 |
| Non-resident, trout | 17 | 30 | 516 |
| Non-resident, 5-day | 829 | 10 | 8,291 |
| Total, all licenses | N/A | N/A | $25,813 |
| Total, all licenses excluding trout | 2,116[1] | N/A | N/A |

[1]This figure does not sum from the presented data. Each license category experienced a different rate of change.
N/A: Not applicable.
NOTE: Total licenses excluding trout is the better estimate of the number of unique individuals who purchased licenses.
SOURCE: Calculated by the author using unpublished data from the Virginia Department of Game and Inland Fisheries.

Assuming that the 2,116 "lost anglers" are individuals who chose not to fish at all during the year—and therefore do not have any associated angling-related expenses—we can calculate the economic loss due to this lack of spending. The $279 average annual angler spending estimate provided by the 2001 US Fish and Wildlife survey equates to $297 in 2005 inflation-adjusted dollars.[14] This results in a loss of $628,452 in retail sales and of $31,423 in state and local sales taxes (table 4).

Table 4. Estimates of Economic Loss Due to the 2005 Fish Kill

| Type of Loss | Amount of Loss (dollars $) |
|---|---|
| Angler retail spending | 628,452 |
| Fishing licenses | 25,813 |
| State sales and use tax (4%) | 25,138 |
| Local sales and use tax (1%) | 6,285 |
| Total | $685,688 |

[14] Using the US implicit GDP price deflator (Bureau of Economic Analysis, 2006).

In sum, our preliminary estimate of the economic impact of the 2005 fish kill in the Shenandoah Valley is about $686,000 in lost retail sales and revenue to the Commonwealth. This is a conservative estimate, because it does not:

- Account for multiplier effects in the local economy.
- Provide a refined analysis of tax revenues, which are higher for some types of purchases.
- Include indirect fiscal impacts, such as the loss of business income taxes.
- Estimate reductions in the number of *non-licensed* anglers as a consequence of the fish kill (because of too much uncertainty in such estimates with the currently available information). Data suggest, however, that this group could represent as much as 25 percent of all anglers.

In addition, the estimate generously assumes that licensed anglers were as active in 2005 as in previous years. The likelihood is that licensed anglers did not fish as frequently or spend as much, but at present there is no way to reasonably estimate this reduced level of activity. The estimate is also understated because—based on past trends—the rate of decline in fishing licenses in the Shenandoah watershed has been slightly lower than that for the rest of the Commonwealth. In the absence of the fish kill, it is likely that this region would not have fared as badly in 2004-2005 as other counties, hence making the impact of the fish kill that much worse.

Finally, the estimate does not allow for negative spillover effects from the fish kill into other recreation sectors—we focus here only on freshwater sport fishing. It is possible that the ongoing fish kills are causing subtle downturns in other forms of river recreation in the Shenandoah Valley due to growing concerns over water quality. Slower rates of growth in river recreation and tourism within the Shenandoah Valley may be a long term result if the fish kills continue unabated and unexplained.

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## SOURCE OF FIGURES

Figure 1. Shenandoah River Basin. Virginia Department of Environmental Quality, http://www.deq.virginia.gov/tmdl/maps/lowres/shenrvr/shensb.html. [Accessed June 15, 2006.]

Figure 2. Fish kill Reports January-July 2005. Pure Water Forum, http://www.purewaterforum.org/fishkill/images/Fish%20Kill%20Reports_JantoJul05.jpg. [Accessed June 15, 2006.]