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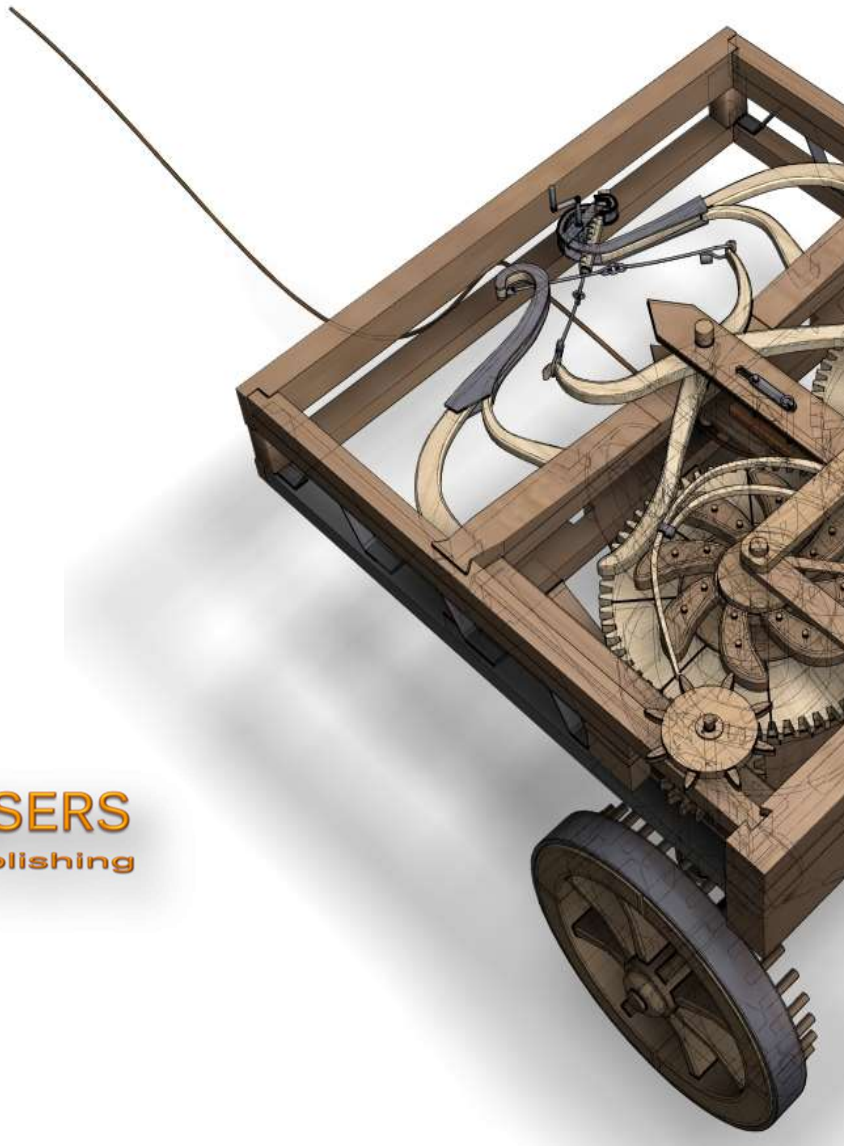

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Journal of Environmental Management and Tourism

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Stakeholder Perceptions of Socio-Ecological System Improvements: A Place-Based Study of Stream Habitat Enhancements

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Abstract:

Aquatic habitat enhancement projects typically occur in degraded socio-ecological systems. A major goal of these projects is to improve the ecosystem services that the streams provide to humans. In this work, we investigated how visitors at West Virginia's Holly River State Park perceived the impact of an aquatic habitat enhancement project on ecosystem services provided by the Laurel Fork. The 172 surveyed visitors gave their current perceptions of the ecosystem services provided by the stream, as well as how they believed the ecosystem services would change upon completion of the aquatic habitat enhancement project. Results indicate that both anglers and non-anglers thought that the enhancement project would negatively impact the aesthetics and cultural ecosystem services provided by the stream. However, they felt that the provisioning ecosystem services, and recreation opportunities provided by the stream would improve. Our study highlights how important stakeholders' perceptions are to habitat enhancement success.

Keywords: social sciences; human dimensions; habitat enhancement; socio-ecological systems; ecosystem services.

JEL Classification: Q22; Q57; Z10.

Introduction

Researchers at West Virginia University, West Virginia Division of Natural Resources, and the USDA Natural Resource Conservation Service developed a partnership with the goal of enhancing degraded aquatic habitat in West Virginia. The focus of their enhancement of the Laurel Fork at Holly River State Park was to create complex habitat structures for native and stocked trout while providing other recreational opportunities for non-anglers. J-hooks and cross vanes were strategically placed to appear as natural pool-riffle sequences to stream users as these sequences are essential for trout spawning and protection.

In this study, we examined visitor perceptions of how a place-based aquatic habitat enhancement project could change the ecosystem services offered by a public stream, the Laurel Fork. We compared visitor perceptions of current ecosystem services to expected future ecosystem services that the stream would provide

for visitors after the completion of an aquatic habitat enhancement project. The purpose of this study was to: (1) Determine how Holly River State Park visitors perceived the enhancement project would alter the provisioning and cultural ecosystem services provided by the Laurel Fork; (2) How the perceptions would vary between two user groups (*i.e.* anglers and non-anglers); and (3) To better understand visitor awareness of the habitat enhancement project and visitor interest in supporting future enhancement projects spearheaded by the West Virginia Division of Natural Resources.

1. Literature Review

Streams have been important to human society since the beginning of time (Naiman 2013). Streams serve as important socio-ecological systems and have allowed humans to receive goods and services for centuries (Burkhard, Petrosillo and Costanza 2010; Chowdhury and Behera 2021; Petrosillo, Aretano and Zurlini 2015; Pope *et al.* 2016; Oteros-Rozas, *et al.* 2014). The goods and services that benefit humans are referred to as ecosystem services, which can be further broken down into provisioning and cultural ecosystems services (Scholte, Todorova and van Teeffelen 2016).

The raw materials obtained by humans from ecosystems such as food, water, energy, and fisheries are provisioning ecosystem services (Aguilar-Fernandez *et al.* 2020. Li, Omani, Chaubey and Wei 2017). These products are an integral part of communities and economies around the world (Pullanikkatil *et al.* 2020; Teoh *et al.* 2018). At Holly River State Park in Hacker Valley, West Virginia, provisioning ecosystems services include supporting trout and other diverse fish populations, providing a suitable environment for tree growth for timber, and serves as a water supply for agriculture. Beyond material goods, other basic human needs are provided through cultural ecosystems services (Karabulut *et al.* 2015). At Holly River State Park, cultural ecosystems services provided include hiking, recreational fishing, beautiful scenery, and a peaceful vacation site. These services shape the way that people experience the world and can impact their connection to the location (Darvill and Lindo 2015; Jonesc *et al.* 2020; Rodriguez 2015).

Ecosystem services are declining due to ecosystem and habitat degradation (Banerje, Benerjee and Palit 2021; De Groot *et al.* 2013; Dou *et al.* 2021). Many credit the Industrial Revolution as the origin of decline in ecosystem services due to the increase of pollutants (Palmer and Filoso 2009). For the past century, human practices such as agriculture, urbanization, and natural resource extraction only added to that pollution (Darko *et al,* 2021; Strayer and Dudgeon 2010). The ultimate recipient of this pollution has been the world's waterways, and thus, streams (Ding *et al.* 2021; Naiman *et al.* 1995; Sanchez *et al.* 2014). For example, acid mine drainage in the Laurel Fork at Holly River led to low pH levels and degradation of suitable fish habitat. With pollution and the resulting degradation of streams recently reaching an all-time high, US waterways are offering less than ideal cultural and provisioning ecosystems services (Beier, Caputo, Lawrence and Sullivan 2017; Gleick 2003; Palmer, Hondula and Koch 2014). The decline in these services often leads to a decrease in fisheries management funding, as fewer fishing licenses are purchased when stakeholder satisfaction declines.

In recent years, researchers and managers have attempted to restore degraded ecosystems to improve ecosystem services (Aronson *et al.* 2020; Barthelemy and Armani 2015; Saunders *et al.* 2020). These restorations are usually smaller scale, but they still require tremendous organization and funding (Bernhardt *et al.* 2005; Brancalion *et al.* 2019). Some researchers believe that micro scale habitat enhancement is a more time and cost-efficient method to improve degraded ecosystems because it allows managers to target diverse goals in a smaller area (Beheshti *et al.* 2022; Maynard 2013; Sparks, Biber, Cebrian and Sheehan 2012). The specific aims of aquatic habitat enhancement include manipulating the stream landscape so that it represents a natural, undisturbed habitat and creates complex structures for the refuge of native species (Billman *et al.* 2013; Louhi *et al.* 2016). This not only improves provisioning ecosystem services offered by streams, it also provides the opportunity to improve other ecosystem services as well (Pope *et al.* 2016).

Habitat enhancement requires an understanding of both the ecological science and the human-landscape interactions found in socio-ecological systems (Bliss and Fischer 2011; Westoby, Becken and Laria 2020). Failure to understand the human-landscape interactions can lead to dissatisfied stakeholders and a decrease in management funds (Gray *et al.* 2017; Shield, Gopalakrishnan and Chan-Halbrendt 2009). Aquatic habitat improvement projects, especially those of streams in park settings, should include plans to improve ecosystem services for a broad array of stakeholders due to the varying types of visitors (Dewulf *et al.* 2005; Hein, van Koppen, de Groot and van Ireland 2006; Takyi and Seidel 2017). Many of the visitors at state parks are there for recreational and social activities such as camping, hiking, and swimming. These individuals tend to value cultural services more than provisioning services that socio-ecological systems like streams provide (Buijs 2009; Kondolf

and Yang 2008). On the other hand, anglers tend to prioritize provisioning services (Marttila, Kyllonen and Karjalainen 2016).

Habitat enhancement is a relatively new concept when compared to ecosystem restoration. Few studies have been performed on the societal importance of ecosystem restoration, and fewer still have been performed on micro-scale habitat enhancement projects (Wortley, Hero and Howes 2013). However, the studies that have explored the societal importance of ecosystem restoration have shown major improvements to economies and cultural activities after restoration (Satz *et al.* 2013; Teoh, Sun, Pienkowski and Carrasco 2018; Yurui *et al.* 2021). This place-based knowledge can inform the integrated management of both local and regional stream restoration and enhancement efforts around the world.

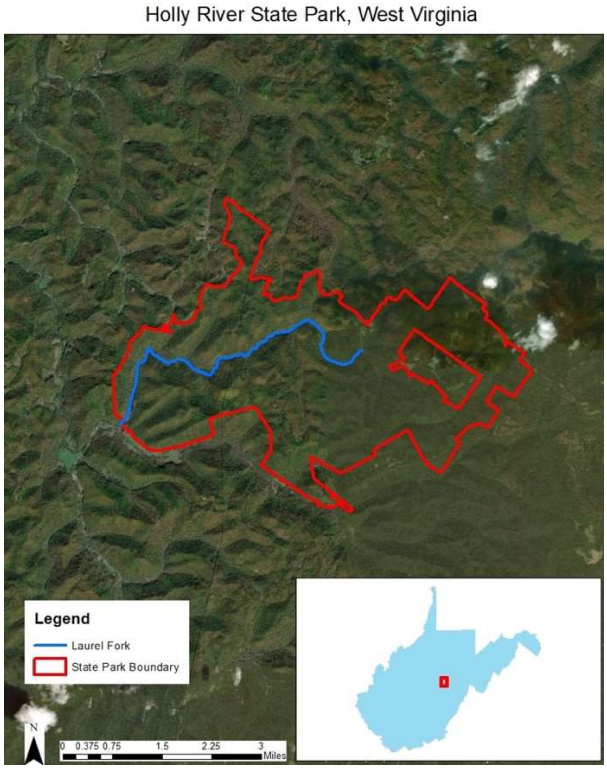
2. Methodology

Study Site

Our study stream, Laurel Fork, is located in the Tygart Valley watershed of central West Virginia. The stream flows through Holly River State Park, the second most visited non-resort West Virginia state park (See Figure 1). Most of the visitors at the state park are campers, but many anglers and hikers visit the park as well. Each Labor Day Weekend, the Holly River State Park Foundation oversees the Holly River State Park Festival in which hundreds of visitors from across the United States visit the park for a festival of food, art, and a 5K run.

Prior to the creation of the park in 1938, the land was primarily used for agriculture, with the surrounding area containing vast resources of coal and timber. Agriculture and natural resource removal in the area were ultimately harmful to the Laurel Fork. Additionally, acid mine drainage significantly altered the pH of the stream, affecting fish habitat and populations. To address this acidification, a liming station was built on an upstream section of the stream so that the limestone used could raise the pH of the water to more suitable levels. The liming station is no longer in use, as coal mining in the area has dwindled. However, the negative effects of human activities are still evident in the stream.

Figure 1. Map displaying Holly River State Park and the Laurel Fork in West Virginia, United States.



The Laurel Fork is a cold-water fishery, with water temperatures and quality sufficient to support both native and stocked trout. The West Virginia Division of Natural Resources stocks the stream with trout twice a month in the spring. However, the previous degradation of the stream is still apparent from the minimal fish habitat. To address this issue, our stream enhancement project at Holly River State Park took place in the summers of 2018 and 2019. Consisting of construction of 41 flow structures over a three mile stretch of stream,

the constructed j-hooks and cross vanes enhanced the pool-riffle sequences that are essential for trout spawning and protection.

Questionnaire

A prepared questionnaire was used to gather visitors' perceptions of the aquatic habitat enhancement project by conducting in-person interviews at the Holly River campground area and park office during the summer of 2019. Interviews followed the field techniques set forth by the USDA National Visitor Use Monitoring handbook. The sampling approach set forth by the handbook reduces bias in the interviewing process by setting defined interview sites and interview techniques (English, Kocis, Zamoch and Arnold 2002; English, White, Bowker and Winter 2020).

Each interview began with a prepared 30-second introduction describing the project. This introduction included before and after pictures of an on-site cross-vane that was constructed during the previous year. Current and past activities of visitors were used to determine whether the visitor was an angler or non-angler. The questionnaire included both fixed-choice and open-ended questions. The fixed-choice questions were mainly used to gather perceptions of the project and their satisfaction levels of stream characteristics, while open-ended questions were used to collect additional comments and suggestions for future enhancement projects. The answers to the open-ended questions were not analysed for this study but were instead given to the West Virginia Division of Natural Resources for their own analysis.

Table 1. Examples of statements asked to interview participants.

Current/ Expected	Ecosystem Service	Strongly Disagree	Disagree	Somewhat Disagree	Neutral	Somewhat Agree	Agree	Strongly Agree
Cultural								
Current	The stream landscape is currently natural.	1	2	3	4	5	6	7
Expected	Aquatic habitat enhancement helps the stream become more natural.	1	2	3	4	5	6	7
Provisioning								
Current	The stream is currently full of diverse fish communities.	1	2	3	4	5	6	7
Expected	Aquatic habitat enhancement helps increase the diversity of fish communities.	1	2	3	4	5	6	7

Statements in the form of a 7-point Likert scale were used to measure visitors' perceptions of the stream before and after the enhancement project. These statements were derived from previous works that evaluate provisioning and cultural ecosystem services (Marttila, Kyllonen and Karjalainen 2016; Tunstall, Penning-Rowsell, Tapsell and Eden 2000). Statements were organized in the following pre-constructed blocks: current provisioning ecosystem services, expected provisioning ecosystem services, current cultural ecosystem services, and expected cultural ecosystem services. Table 1 demonstrates how statements were presented during the interview. Statements utilizing a 7-point Likert scale were also used to gather satisfaction level with stream characteristics, including projected outcomes of the enhancement. Demographic data was collected at the end of the interview, when visitors were asked their age, state of residence, and gender. We also recorded the number of visitors in each group. Scientific terminologies such as ecosystem services were not discussed during the interview.

Figure 2. Before (left) and after (right) picture of an enhancement site at Holly River State Park

This picture was shown to visitors before each interview.

Data Analysis

The data collected for the fixed-choice questions were analysed using IBM SPSS version 26.0. Data were analysed as a whole to determine how all visitors perceived the project, as well as split into the angler and non-angler subgroups. Anglers were categorized as those who planned to or had previously fished the Laurel Fork. Non-anglers were the visitors who had no plans to fish on the current trip and had not fished the Laurel Fork during previous trips. Current and expected Likert values were compared using paired t-tests. The before-after difference in anglers' and non-anglers' Likert values were compared using an independent t-test.

3. Results

Response Rate

We approached 175 individuals to gather their perceptions of the aquatic habitat enhancement project. Of those 175 attempted surveys, 172 were completed for a response rate of 98.3%.

Visitor Demographics and Trip Characteristics

We collected demographic data to better understand the population being surveyed (Table 2). Ninety percent of Holly River State Park visitors surveyed resided in West Virginia. However, visitors also traveled from seven other states. The majority (82%) of those visiting from out of state were non-anglers. Our surveyed population was approximately 66% male, and males made up the majority of the angling population (78%). In those that were not visiting to fish, the gender gap was much smaller (58% male, 42% female). While all age groups 18 and above were surveyed as part of the study population, young adults were by far the least represented (4.1%). One-third of responses were from middle-aged adults, and this age group was over-represented in the angler population (48%). The senior age group (61+) were more likely to be non-anglers, contributing 33% of the non-angling population.

Table 2. Demographics of Holly River State Park visitors for anglers and non-anglers. Cell values are frequency numbers for the visitors surveyed.

Variables	Whole Population (n=172)	Angler (n=73)	Non-anglers (n=99)
State of Residence			
West Virginia Resident	155	70	85
Non-WV Resident	17	3	14
California	1	0	1
Florida	1	0	1
Michigan	1	0	1
North Carolina	1	0	1

Variables	Whole Population (n=172)	Angler (n=73)	Non-anglers (n=99)
New York	1	1	0
Ohio	7	2	5
Pennsylvania	5	0	5
Sex			
Male	114	57	57
Female	58	16	42
Age			
18-25	7	4	3
26-39	40	15	25
40-54	62	35	27
55-60	17	6	11
61 Plus	46	13	33

Table 3 shows the trip characteristics of the visitors. Over 75% of the surveyed visitors were at the park primarily for camping. Although only 7% of the angler subgroup was visiting the park with the primary purpose of fishing, all of them indicated that they either had plans to fish on the current trip or had previously fished at the park. Of 26 visitors that responded with other activities, 22 were visiting for the Holly River State Park Festival and 5K Run.

Table 3. Trip characteristics at Holly River State Park for both angler and non-angler visitors. Cell values are frequency numbers for the visitors surveyed unless indicated as an average of those frequencies

Variables	Whole Population (n=172)	Anglers (n=73)	Non-anglers (n=99)
Main Activity			
Fishing	2	2	0
Fly Fishing	3	3	0
Hiking	4	0	4
Camping	132	64	68
Sight-Seeing	4	0	4
Swimming	1	0	1
Other	26	4	22
Stay Type			
Day Visitor	40	7	33
Overnight Visitor	132	66	66
Average Length of Stay			
Day Visitor	4.75 Hours	5.75 Hours	4.58 Hours
Overnight Visitor	4.01 Days	3.77 Days	4.28 Days
Repeat/First Time Visitor			
Repeat Visitor	164	73	91
First Time Visitor	8	0	8
Average Group Size	3.14	3.15	3.13

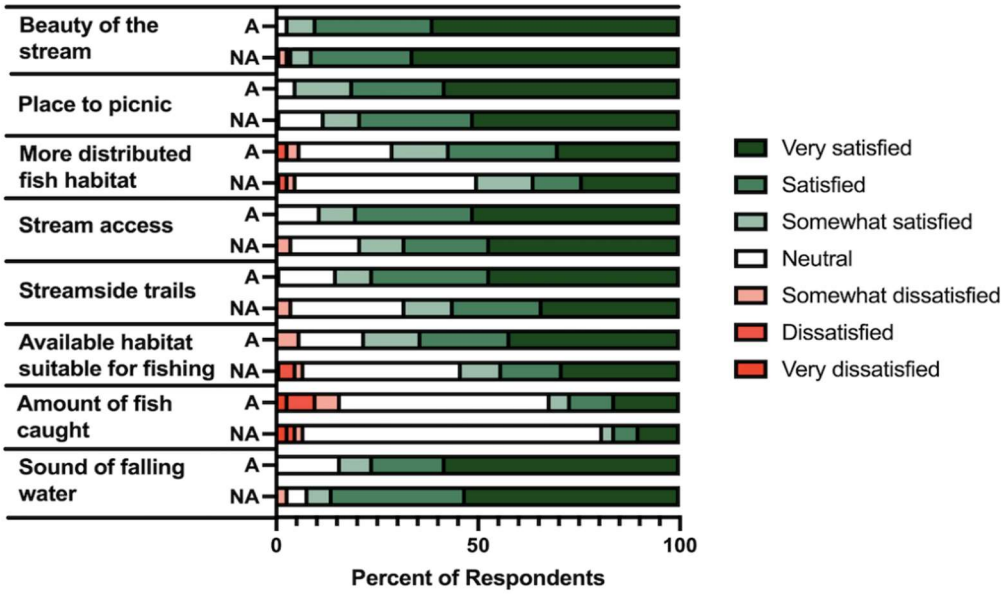
The visitors at Holly River State Park often return for yearly trips with family or friends. Every angler surveyed was a repeat visitor to the park, and slightly more than 90% of non-anglers return to the park for camping or to attend the festival. Over two-thirds of guests came with someone else, contributing to an average group size of 3.14 people. The average length of stay for camping visitors was 4.01 days, and those who were visiting the park for a day trip stayed for an average of 4.75 hours. Anglers were more likely to stay overnight than non-anglers (90.4% of anglers, 66.7% of non-anglers).

Trip Satisfaction and Satisfaction with Stream Characteristics

Surveyed visitors were asked how to rank how satisfied they were with their current trip to Holly River State Park on a 5-point Likert scale. Almost 92% of surveyed visitors expressed satisfaction with their current visit (94.5% of anglers, 89.9% of non-anglers). The majority of dissatisfied visitors stated that their dissatisfaction was related to camping conditions (*i.e.* weather, facility issues). The dissatisfaction was never due to the stream condition or the aquatic habitat enhancement project.

Visitors were also asked to rank their satisfaction levels of the current stream characteristics on a 7-point Likert scale (Figure 3). The stream characteristic and project outcome that earned the highest satisfaction level among surveyed visitors was the beauty of the stream (97.3% of anglers, 96.0% of non-anglers). Streamside places to picnic, stream access, and the sound of falling water also had high satisfaction levels overall. The only characteristic with notable dissatisfaction was the amount of fish caught within the angler population.

Figure 3. Distribution of answers to the question, "How satisfied are you with ___?" Comparing the answers of anglers (A) to non-anglers (NA). Answers are indicated as percentage of subset population.



Cultural Ecosystem Services

Survey respondents were asked to rank their level of agreement with the ecosystem service statements provided in Table 3 on a 7-point Likert scale. Overall, participants felt that the aquatic habitat enhancement project would make the stream significantly less natural, beautiful, and pleasant sounding.

Table 4. Statistics for paired t-tests comparing current and expected cultural ecosystem services (n=172).

	Ecosystem Service	Mean Difference	Std. Deviation	Std. Error Mean	P	t	d
Pair 1	Aquatic habitat enhancement helps stream landscapes become more natural - Stream is currently natural	-0.331	0.937	0.071	<.001	-4.639	0.353
Pair 2	Aquatic habitat enhancement helps stream landscapes become more beautiful - Stream is currently beautiful	-0.291	0.929	0.071	<.001	-4.105	0.313
Pair 3	Aquatic habitat enhancement helps streams become more pleasant sounding - Stream is currently pleasant sounding	-0.308	1.141	0.087	<.001	-3.541	0.270
Pair 4	Aquatic habitat enhancement helps streams become fuller of recreational opportunities - Stream is currently full of recreational opportunities	0.395	1.255	0.09566	<.001	4.133	0.315
Pair 5	Aquatic habitat enhancement helps streams become fuller of fishing opportunities. - Stream is currently full of fishing opportunities	0.878	1.791	0.137	<.001	6.423	0.490

The two cultural ecosystem services that participants felt would significantly improve after completion of the project were the availability of additional recreational activities and an increase in recreational fishing.

A positive mean difference value indicated a perceived improvement to the ecosystem service while a negative mean difference value indicated a perceived decline. The calculated mean difference of -0.331 for Pair 1 signifies those visitors perceived that natural aesthetics would decline more so than other cultural ecosystem services. While visitors perceived that both sounds and beauty provided by the stream would decline due to the project, they felt that sound would be more negatively impacted. An independent t-test was used to analyse the difference in expected changes between user groups (Table 5). There was no significant difference between angler and non-angler perceptions for the individual cultural ecosystem services offered by the Laurel Fork.

Table 5. Statistics for independent t-test comparing anglers' (n=73) and non-anglers (n=99) perceptions of cultural ecosystem service changes.

	Ecosystem Service	User Group	Mean Difference	Std. Deviation	Std. Error Mean	P	t	d
Pair 1	Aquatic habitat enhancement helps stream landscapes become more natural - Stream is currently natural	Angler	-0.400	0.893	0.104	.430	-0.791	.135
		Non-angler	-0.283	0.970	0.097			
Pair 2	Aquatic habitat enhancement helps stream landscapes become more beautiful - Stream is currently beautiful	Angler	-0.330	0.893	0.103	.648	-0.461	.082
		Non-angler	-0.263	0.965	0.097			
Pair 3	Aquatic habitat enhancement helps streams become more pleasant sounding - Stream is currently pleasant sounding	Angler	-0.210	1.054	0.123	.312	-1.013	.192
		Non-angler	-0.384	1.201	0.121			
Pair 4	Aquatic habitat enhancement helps streams become fuller of recreational opportunities - Stream is currently full of recreational opportunities	Angler	0.340	1.145	0.134	.636	0.47	.083
		Non-angler	0.434	1.334	0.134			
Pair 5	Aquatic habitat enhancement helps streams become fuller of fishing opportunities. Stream is currently full of fishing opportunities	Angler	0.920	2.040	0.239	.803	0.25	.050
		Non-angler	0.848	1.593	0.160			

Although there were no significant statistical differences between the two user groups on cultural ecosystem services, several meaningful comparisons can still be made. Anglers believed that natural aesthetics will be most negatively impacted upon completion of the enhancement project. However, the non-angler population responded that pleasant sounds will be the most negatively impacted. Interestingly, sound is the cultural ecosystem service that anglers think will decline the least. Non-anglers also believe that aquatic habitat enhancement will improve the recreational opportunities provided by the Laurel Fork more so than the anglers.

Provisioning Ecosystem Services

Study respondents were asked to rank provisioning ecosystem service statements on a 7-point Likert scale based on whether they agreed with the statement or not (Table 6). Participants felt that the project would significantly improve all provisioning ecosystem services, including biological diversity and fish abundance.

Table 6. Statistics for paired t-tests comparing current and expected provisioning ecosystem services (n=172).

	Ecosystem Service	Mean Difference	Std. Deviation	Std. Error Mean	P	t	d
Pair 1	Aquatic habitat enhancement helps streams become more abundant with diverse fish communities - Stream is currently abundant with diverse fish communities	1.483	1.489	0.114	<.001	13.06	.996
Pair 2	Aquatic habitat enhancement helps streams become more abundant with desired fish species - Stream is currently abundant with desired fish species	1.471	1.645	0.125	<.001	11.73	.894

The surveyed population believed that both of the stated provisioning services would improve. The mean difference values of 1.483 and 1.471 for Pairs 1 and 2 indicate that the public thinks the project will help improve the diversity of fish communities slightly more so than the abundance of desired fish species. There were no significant differences between the two sampled user groups for perceptions on changes in provisioning ecosystem services (Table 7), with both groups predicting that the enhancement would improve the diverse fish communities and increase the desired fish species found in the Laurel Fork. The non-angler group projected a slightly greater improvement to the abundance of desired and diverse fish communities.

Table 7. Statistics for independent t-tests comparing anglers' (n=73) and non-anglers' (n=99) perceptions of provisioning ecosystem service changes.

	Ecosystem Service	Angler/Non-angler	Mean Difference	Std. Deviation	Std. Error Mean	P	t	d
Pair 1	Aquatic habitat enhancement helps streams become more abundant with diverse fish communities - Stream is currently abundant with diverse fish communities	Angler	1.420	1.490	0.174	.735	0.34	.072
		Non-angler	1.525	1.494	0.150			
Pair 2	Aquatic habitat enhancement helps streams become more abundant with desired fish species - Stream is currently abundant with desired fish species	Angler	1.420	1.747	0.205	.753	0.32	.057
		Non-angler	1.505	1.574	0.158			

Project Awareness and Support

Researchers measured the surveyed visitors' awareness of the aquatic habitat enhancement project before reading a summary of the project (Table 8). Before hearing the summary, awareness of the aquatic habitat enhancement project was low in both anglers and non-anglers (37% of anglers, 21% of non-anglers). However, 88% of visitors indicated that they had an interest in and supported the project after learning of its existence (88% anglers, 88% non-anglers). Slightly less than one-fifth of these visitors indicated that they would like to volunteer

for future aquatic habitat enhancement projects in West Virginia. Out of these 34 visitors, 58% of them were anglers.

Table 8. Participant's awareness and support for the project. Cell values are percentages of the visitors surveyed.

Variables	Whole Population (n=172)	Anglers (n=73)	Non-anglers (n=99)
Aware of Project			
Yes	27.9%	37.0%	21.2%
No	72.1%	63.0%	78.8%
Support for the Project			
Yes	87.8%	87.7%	87.9%
Indifferent	9.3%	10.9%	8.1%
No	2.9%	1.4%	4.0%
Interest in Volunteering			
Yes	19.8%	26.0%	15.2%
No	80.2%	74%	84.8%

Conclusion

In this work, we analysed the opinions of Holly River State Park visitors regarding the effectiveness of aquatic habitat enhancement to improve cultural and provisioning ecosystem services. Previous research of aquatic habitat enhancement has primarily focused on the measurable biological response to the enhancement (Stewart *et al.* 2009). However, little research has been conducted on public perceptions of habitat enhancement and how the enhancement will alter ecosystem services (Satz *et al.* 2013). While positive biological outcomes are certainly important, positive public opinions are critical to the success of conservation projects (Hunt, Sutton and Arlinghaus 2013; Metcalf *et al.* 2015). Streams in the United States are a public good that are managed by government agencies, funded by stakeholders. Positive attitudes of stakeholders towards habitat enhancement projects can result in better funding for future management projects.

Many of the visitors surveyed in this study were visiting Holly River State Park for social activities such as camping, hiking, or the Holly River State Park Festival, with very few visiting for the sole purpose of fishing. Participants often stated that this was due to the low amount of fish habitat and the low abundance of fish in the stream. These statements were further supported by the data collected in the satisfaction section of the questionnaire, as the stream characteristics with the lowest overall satisfaction levels were the amount of habitat suitable for fishing and the distribution of habitat suitable for fishing. Several statements from the angling population indicated dissatisfaction with the amount of fish caught. Despite the issues with fish habitat, the general study population was largely satisfied with the current aesthetic and recreation characteristics of the stream.

Interestingly, study respondents thought that aquatic habitat enhancement would reduce many of the cultural services offered by the Laurel Fork, while vastly improving the provisioning services offered. Retrospective studies performed after enhancement projects are completed have found that populations tend to believe these projects improved both cultural and provisioning ecosystem services (Marttila, Kyllonen and Karjalainen 2016). However, the inverse is seen prior to and during projects, with data indicating that visitors feel restoration and habitat enhancement may result in a visually unattractive area (van Marwijk *et al.* 2011). This is likely the case in our study population, due to visitors' already high satisfaction level with the aesthetic characteristics of the stream. Repeat visitors to natural areas have stronger perceptions of landscape characteristics than others due to attachment to place, and Holly River State Park is visited annually by most of the surveyed visitors due to their appreciation of the park's beauty and high levels of perceived cultural services (Alam 2011; Liu *et al.* 2020).

Visitors did tend to believe that two cultural services that the aquatic habitat enhancement project would improve are the abundance of recreational activities and recreational fishing. These ecosystem services provide many opportunities and benefits for humans in addition to fishing, such as swimming and paddling. Many participants note that the pools created by the flow structures provide swimming areas for children. Despite their belief that the habitat enhancement would reduce other cultural services provided by the Laurel Fork, visitors generally still supported the enhancement project. In fact, nearly 90% of visitors were of the supportive of the habitat enhancement, and approximately 20% indicated interest in volunteering for future habitat enhancement projects.

We initially hypothesized that the angler sub-sample would be more invested in the provisioning services offered by the stream than the non-angler sub-sample. Surprisingly, we found that the perceptions of anglers and

non-anglers were not significantly different for any of the cultural or provisioning ecosystem services. These results may be explained by awareness of both populations of the extent of stream degradation and the low provisioning ecosystem services the stream provides. In fact, several non-anglers commented that they would possibly fish the stream if there were more fish to catch.

This study aimed to increase understanding of public support and stakeholder perceptions regarding micro-scale aquatic habitat enhancement projects. Our key findings indicate that both anglers and non-anglers tend to believe that aesthetic characteristics of the stream may decline while provisioning services and recreational opportunities may improve upon completion of the small-scale project. We also found that after being informed of the enhancement project, visitors are likely to support the project and other management projects conducted in the future. Managers and biologists may use these findings to help better implement human dimensions for habitat enhancement projects in their own management areas. Gathering the perceptions of the public before, during, and after enhancement projects can improve stakeholder awareness and attitudes towards the project. While our study is limited to the views of the visitors at Holly River State Park during the summer and early fall, results from this study are relevant to stream enhancement projects in other regions. We suggest that similar research should be done comparing these social perceptions across different locations, as site specific patterns may exist across landscapes (Barthelemy and Armani 2015; Schaich, Bieling and Plieninger 2010). Additional longitudinal research should analyse the social context of habitat enhancement at different stages (*i.e.* before, during, after) of the enhancement project.

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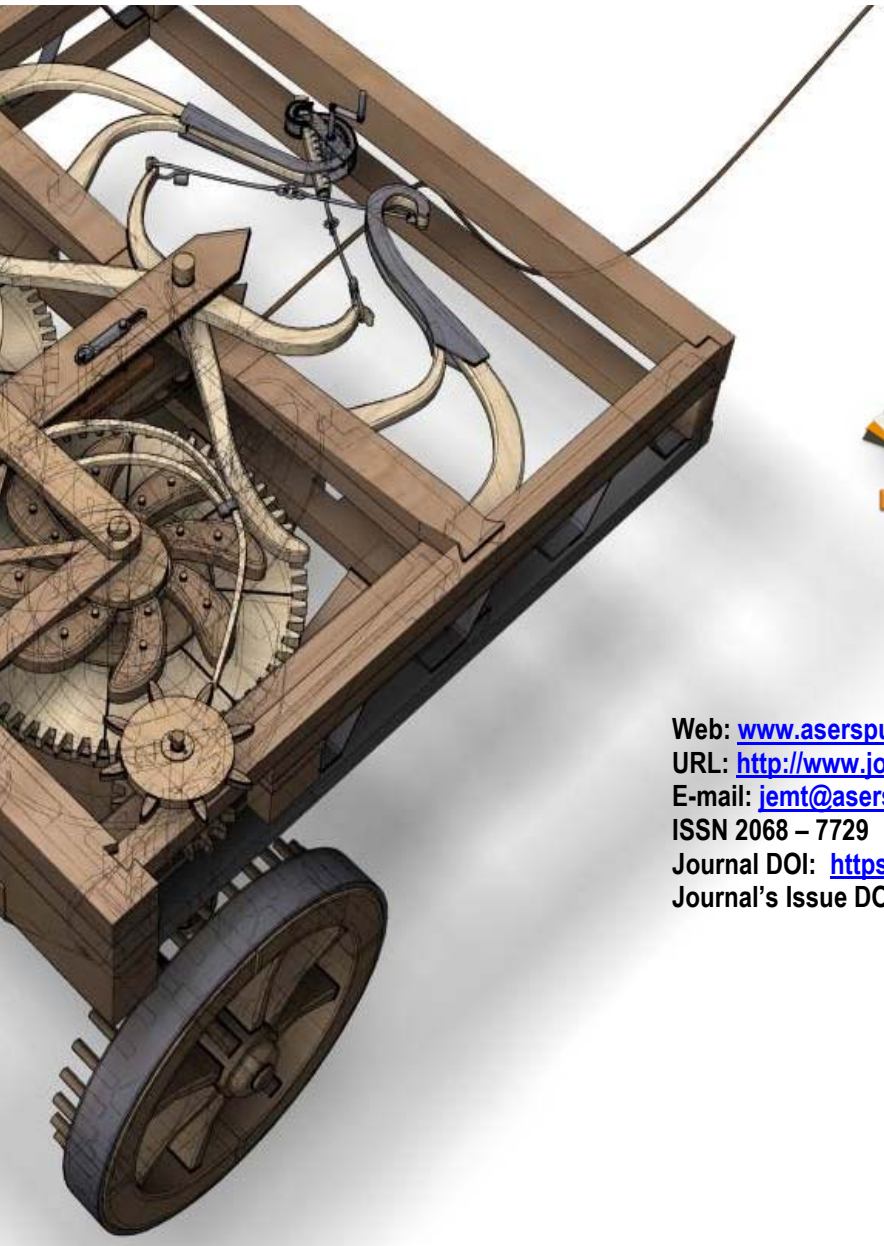

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