

# 2020 Public Mountain Trout Water angler survey: Exploring characteristics of recreational trout anglers and attitudes towards reduction of regulatory stream classifications



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## Executive Summary

From January 21, 2020 to March 31, 2020 the North Carolina Wildlife Resources Commission (WRC) surveyed anglers who used the State's Public Mountain Trout Waters (PMTW) in 2019 to understand their perceptions of two proposed regulatory changes aimed at reducing the total number of PMTW classifications:

- Combining Catch-and-Release Artificial Flies Only (CRAFO) and Catch-and-Release artificial Lures Only (CRALO) classifications into one new classification hereby referred to as 'Catch-and-Release Artificial Flies and Lures Only Waters'.
- Removal of the Wild Trout/Natural Bait (WILD-NB) classification; all WILD-NB waters become Wild Trout Waters (WILD) waters.

PMTW anglers were asked a variety of questions related to where they fish, how they fish, their trust in WRC's mountain trout fisheries management, their attitudes towards the two regulation changes, and their demographics.

Approximately 36,000 surveys were sent to a random sample of customers within the WRC's license database who held trout privileges. Of the 36,000 distributed surveys, 3,609 license holders responded, 1,745 of which fished in PMTW in 2019. The anglers in the sample exhibited some similarity to demographic characteristics to earlier studies of PMTW anglers, but based on multiple criteria, caution should be taken when generalizing the results to the greater PMTW community.

PMTW anglers were grouped into three attitude clusters based on their acceptability, support, and perceived impact of each regulation change: positive, neutral, and negative attitudes. Most of the analyses within this report focused on examining patterns between these three clusters for both proposed PMTW changes.

When considering the removal of WILD-NB and combination of CRAFO and CRALO waters, most PMTW anglers held positive or neutral attitudes (i.e., they were generally more supportive, accepting, and positively impacted). For both of these regulatory changes, there were many anglers who held positive attitudes because the new policies would result in simpler regulations. However, some additional patterns emerged when exploring associations between attitudes and various factors. Therefore, most of the analyses here within are focused on anglers with special interests (i.e., those with negative attitudes towards the regulatory changes), as they are more likely to be impacted disproportionately by the two proposed regulations.

When considering the WILD-NB change, 53% held positive attitudes, 32% held neutral attitudes, and 13% held negative attitudes. Positive attitudes were most strongly associated with anglers who fish in WILD waters but not WILD-NB waters, and the use of fly tackle. When discussing what influenced their positive attitudes, anglers most frequently discussed conflicts with using natural bait to fish for trout and conservation implications. Generally, anglers with negative attitudes towards the WILD-NB change had lower incomes and less trust in the WRC. While use and trust are conventionally expected to impact attitudes, the disproportional impact on lower income anglers is an important finding, as these regulatory changes were proposed to reduce barriers to angling in PMTW. These anglers also had a relatively strong connection to these waters due to heritage and the opportunities they provide.

When considering combining CRAFO and CRALO waters, 54% held positive attitudes, 33% held neutral attitudes, and 13% held negative attitudes. Anglers who fished in CRALO waters

but not CRAFO had more frequent positive attitudes towards the change. Additionally, a common theme associated with positive attitude was ‘opportunity’, in which anglers liked the idea of having additional available public angling water. CRAFO anglers who did not fish in CRALO waters, and Trout Unlimited members, were more likely to hold negative attitudes compared to non-members. Unlike the WILD-NB change, perceived crowding had an impact on attitudes, as anglers with negative attitudes towards the policy thought CRAFO waters were more crowded than anglers with positive or neutral attitudes. While combining the two catch-and-release classifications will increase PMTW access for non-fly specialist anglers, the regulation may lead to conflict between the fly and non-fly communities due to crowding and different angling ethos. Introducing additional unifying educational efforts to promote trout conservation could help address such conflicts.

Future studies could further highlight the heterogeneity of attitudes and motivations of this diverse stakeholder group to help the WRC guide its management, and increase use and satisfaction associated with North Carolina’s trout fishery.

## Introduction

As the North Carolina Wildlife Resources Commission (WRC) seeks to simplify the regulatory structure of Public Mountain Trout Waters (PMTW), investigating the socio-psychological components of these angling systems can provide insightful information to managers. The 2013 North Carolina Trout Resources Management Plan established a framework “to use science-based decision making and biologically sound management principles to enhance the quality and quantity of brook trout, rainbow trout, and brown trout populations for continued and varied trout angling opportunities” (*North Carolina Trout Resources Management Plan*, 2013). This plan also supports the goals and objectives of WRC’s broader Strategic Plan (*North Carolina Wildlife Resources Commission Strategic Plan*, 2010). Following this framework, WRC staff applied social science approaches to study the PMTW angling community’s perceptions of two management changes and angler characteristics. The present investigation further explored the feasibility and potential angler response to a new PMTW regulatory structure.

### ***Brief History of Public Mountain Trout Waters in North Carolina***

The WRC manages approximately 5,500 miles of PMTW in Western North Carolina. These waters are on the southern edge of cold-water fishery habitats and limited to small high-altitude streams with low productive capacity for wild (self-sustaining) trout stocks. Brook trout (*Salvelinus fontinalis*) is the state’s only endemic salmonid species and genetically unique from other stocks of brook trout outside the region (Hayes et al., 1996; McCracken et al., 1993).

Intensive commercial logging in the late 19<sup>th</sup> century marked the decline of brook trout populations and catalyzed the foundation of stocking programs for non-native trout species: western rainbow trout (*Oncorhynchus mykiss*), European brown trout (*Salmo trutta*), and northeastern U.S. brook trout (King 1937). Through time, these efforts displaced the majority of North Carolina’s brook trout populations to elevations greater than 3,000 feet above sea level. Today, rainbow, brown, and brook trout are stocked seasonally by the WRC to provide recreational fisheries where habitat conditions no longer support significant wild trout populations. As such, the WRC stocks approximately 900,000 hatchery-raised trout annually from the Armstrong, Marion, and Bobby N. Setzer state fish hatcheries. Since 2007, the WRC only stocks sterile triploid trout to protect the genetic integrity of self-sustaining brook trout populations (Rash, 2019). However, historic stockings before this change have led to naturally reproducing populations of non-native trout species. For the remainder of this report ‘wild’ trout is referred to as naturally reproducing populations of non-native trout and native brook trout. In addition, the WRC manages all streams with allopatric brook trout populations solely for conservation of this species and does not introduce non-native trout in these waters. However, the WRC does restore brook trout populations in previously degraded watersheds (*North Carolina Trout Resources Management Plan*, 2013).

The WRC hatchery program, various habitat conditions across the mountain region, and diverse angling interests have led to a variety of fishing regulations throughout the agency’s history. Records of PMTW regulations are incomplete but occur back to 1921. Available regulation records for western North Carolina trout streams do not include a classification structure (i.e., a section of water given a name and specific set of regulations) until 1941, with the establishment of ‘Trout Streams’. Prior to this date, regulations were all encompassing except a few specific stream sections (*Digest of Conservation Laws*, 1941). The records available show that until 1972, there were no gear restrictions for trout angling in classified streams, but all waters had size and

creel limits. In 1972, the WRC added new classifications based on catch and gear specializations: Native Trout Waters (which included non-native species), Trophy Trout Waters, and Research Streams, with the latter two of being artificial fly-only regulations (*Regulations Digest*, 1972). All other trout waters had a seven fish creel limit, no gear limits, and no length limits (except in September and October). In 1974, Native Trout Waters added a gear restriction by limiting anglers to only artificial lures with a single hook (*Regulations Digest*, 1974). In 1977, the WRC officially classified previously unclassified waters as General Trout Waters and imposed a creel limit and species-specific length limits. Gear restrictions and classifications were left unaltered until 1990, in which the WRC established its first catch-and-release (CR) specific classification, only allowing single-hook, artificial lures (*Regulations Digest*, 1990). After years of partitioning trout resources among interest groups with efforts to improve angler satisfaction, in 1991 the agency overhauled the classifications system to the seven different stream classifications the public recognizes today (*Regulations Digest*, 1991).

**Catch-and-Release/Artificial Flies Only Trout Waters (CRAFO)**

These waters and their tributaries, except as noted, may be fished only with artificial flies having one single hook. No trout may be harvested or possessed while fishing these streams. In 2019, 76 stream miles were classified as CRAFO waters.

**Catch-and-Release/Artificial Lures Only Trout Waters (CRALO)**

These waters and their tributaries, except as noted, may be fished only with artificial lures having one single hook. No trout may be harvested or possessed while fishing these streams. In 2019, 98 stream miles and two acres of impoundments were classified as CRALO waters.

**Wild Trout Waters (WILD)**

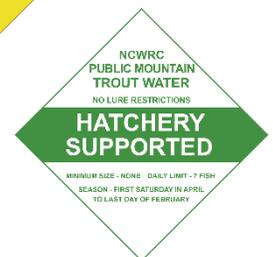
In all Wild Trout Waters, the minimum length limit is seven inches and the creel limit is four trout per day. Only artificial lures with one single hook may be used. It is unlawful to possess any live bait while fishing these waters. All Public Mountain Trout Waters on game lands are Wild Trout Waters unless classified and posted otherwise. Tributaries to Wild Trout Waters are not included. In 2019, 3,997 stream miles and 36 acres of impoundments were classified as WILD waters.

**Wild Trout/Natural Bait Waters (WILD-NB)**

These waters and their tributaries, except as noted, may be fished with artificial lures or natural bait, except live fish. Lures and natural baits are restricted to one single hook. The minimum length limit is seven inches, and the daily creel limit is four trout. In 2019, 260 stream miles and 0.5 acres of impoundments were classified as WILD-NB waters.

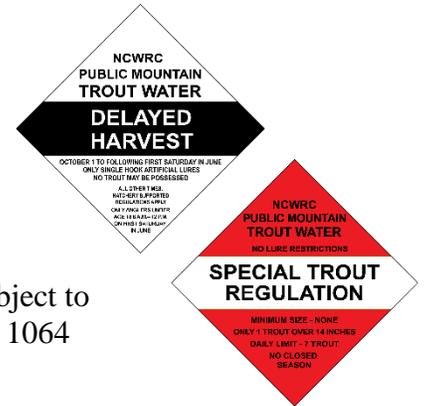
**Hatchery Supported Trout Waters (HS)**

In Hatchery Supported Trout Waters there is no size limit or bait restriction, and the creel limit is seven trout per day. Tributaries are not included unless noted. In 2019, 873 stream miles and 1529 acres of impoundments were classified as HS waters.



### **Delayed Harvest Trout Waters (DH)**

Delayed Harvest Trout Waters, excluding tributaries except as noted, have lure and harvest regulations that vary during the year, and on the first Saturday in June, there is a period when only youth under the age of 18 may fish. In 2019, 84 stream miles and 4 acres of impoundments were classified as DH waters.



### **Special Regulation Trout Waters (SR)**

These portions of PMTW, excluding tributaries except as noted, are subject to watercourse-specific, special regulations. In 2019, 10 stream miles and 1064 acres of impoundments were classified as SR waters.

### ***Problem Statement***

Previous survey-based studies have examined anglers’ relationships and perceptions of PMTW management (Responsive Management, 2007, 2015c, 2015a, 2015b; Responsive Management & Southwick Associates, 2009). The latest angler satisfaction measures reported in 2015, found that 76% of PMTW trout anglers were satisfied with the North Carolina’s trout fishing and 82% of respondents were satisfied with the current regulations (Responsive Management, 2015c). When asked about what could make anglers more satisfied, the most common items discussed were ‘changes to types of waters/types of bait allowed’, ‘more consistency across counties/areas/less confusing regulations’, and a ‘change creel limits’. Therefore, the WRC decided to explore the following PMTW classification changes.

- Combining CRAFO and CRALO classifications into one new classification hereby referred to as ‘Catch-and-Release Artificial Flies and Lures Only Waters.’ This new stream classification would follow the same gear regulations allowed in Wild Trout Waters, without harvest.
- Removal of the WILD-NB classification; all WILD-NB waters become WILD waters.

While older studies may provide some evidence of stakeholder impacts as a result of these two regulatory changes, they were not context specific. In 2007, when asked about universal PMTW gear restrictions, angler attitudes were understandably mixed towards which type of gear should be allowed (Responsive Management, 2007). Further heterogeneity of angling preferences was echoed when anglers were asked about universal creel and size limits. The WRC established seven PMTW classifications to cater to various angling interests, so diverse patterns of response to these questions is unsurprising. Consistent with the WRC’s mission for science-based decision making, a deeper understanding into factors that influence diverse perceptions towards removal of WILD-NB waters and combining CR regulations could help guide these specific rule changes and understand potential impacts.

### ***PMTW anglers***

The seven PMTW classifications provide various opportunities for frontcountry and backcountry anglers, as the streams are spread throughout the entire western portion of North Carolina. Some trout streams are easily accessible (e.g., flow directly through towns) while others are remote (e.g., require off-trail foot travel). The diversity of access and regulatory structure compliments the heterogeneity of angler motivations, specializations, and attitudes towards angling (Bryan, 1977; Fedler & Ditton, 1994; Graefe, 1981). To understand perspectives on reducing the number of PMTW classifications, it is useful to explore diverse aspects of the PMTW angler population.

Results from both 2006 and 2015 studies indicate that HS waters are the most frequented PMTW classification, followed by either WILD or DH waters (Responsive Management, 2007, 2015c). The 2015 study found that about 38% of the sample fished in WILD-NB, but only 3% stated they fish these waters the most. Similarly, 42% and 47% of sampled anglers said that they fished in CRAFO and CRALO, but only 6% and 3%, respectively, stated they fish these waters the most. Despite angler's preferences for fishing in HS waters, which has no bait restrictions, the most preferred bait used type is artificial flies. Most anglers, however, use multiple types of bait throughout the year. Additionally, most anglers practice catch-and-release (54%), regardless of PMTW classification. By updating these data, the WRC can better assess the number of anglers who could be impacted by these regulation changes and understand perspectives based on PMTWs fished.

As noted above, trout anglers utilize a variety of gears, but of them, fly angling is often a unique association with trout fishing. Fly fishing is often perceived as a solitary activity, described as, “‘the quiet sport’...many anglers enjoy the solitude of standing in a river alone, casting delicate flies to fish and soaking in the sights and sounds of nature” (Rosenbauer, 2017). While 61% of anglers in the 2015 study used artificial flies to fish, only 17% typically fished alone and 16% stated that their primary motivation for fishing was to be with family and friends (Responsive Management, 2015c). While perhaps a social activity for some, fly fishing technique, and etiquette typically requires more space between anglers compared to other angling methods, such as casting spoons or spinners. In 2015, 66% of anglers stated that ‘crowding on the water’ was a problem when trout fishing. This was the most salient problem across the 2015 sample and could impact anglers’ evaluations of combining CR waters due to perceived influx of CRALO anglers into historic CRAFO waters (Needham, Vaske, Whittaker, & Donnelly, 2014; Shelby & Vaske, 2007).

Crowding is “a negative evaluation of density and involves a value judgement that the density or number of encounters with other visitors is too many” (Shelby & Vaske, 2007). Perceived crowding emphasizes that the concept is subjective, unique to individuals, and usually self-reported. The recreation literature has studied this concept extensively and found that different activity groups (e.g., ‘consumptive’ vs ‘non-consumptive’) will perceive crowding differently based on their expectations (Kalisch & Klaphake, 2007; Tarrant et al., 1997; Yow et al., 2008). Combining CRAFO and CRALO waters mixes trout angling specialists and could lead to additional perceived crowding or conflict. Additionally, WILD-NB anglers may need to shift their angling effort to more popular DH or HS waters to fish with natural bait. These effects should be explored to better understand impacts of the regulatory changes and motivations for angling by specialist groups.

While CRAFO, CRALO, and WILD-NB waters are preferred for only a few anglers, the strength of preferences for these classifications is unknown. Although the present effort seeks to understand preferences and attitudes across all anglers, organized angling groups are often most effective at communicating interests, which can make it challenging to understand relative value of PMTW attributes across the angling public. As the WRC is charged with equitable distribution of public trust resources, and PMTW classifications are a form of resource allocation, research should examine the relative influence of special interests before allocation decisions are made. Random sampling and examining special interest group membership can better assess relative impacts of the two proposed regulatory changes. In a 2007 random sample of PMTW anglers, only 8% were members of Trout Unlimited (TU) and 2% were members of

the Federation of Fly Fishers (FFF), therefore one should expect similar proportions in 2020 (Responsive Management, 2007).

Trust in collaborative natural resource management strategies has long been an important factor in conservation social science research and is thought to be a multifaceted phenomenon (Stern & Coleman, 2015). While exploring the component parts of trust is inherently valuable to understanding PMTW trout anglers, the present study focuses primarily on institutional trust “the willingness to rely on those with formal responsibility for decision making and management of public resources” (Schroeder & Fulton, 2017) between trout anglers and WRC mountain trout management. Various studies across multiple contexts have shown this concept to relate to acceptance of management decisions (Idrissou et al., 2013; Olsen & Shindler, 2010; Schroeder et al., 2017; Schroeder & Fulton, 2017). Conversely, lack of institutional trust may lead to additional public involvement in decision processes (Smith et al., 2013). Comparing general acceptability of WRC decision making, and acceptability of specific regulatory changes could further test the generalizability of these findings.

Attitudes towards an object, policy, or idea is a complex cognitive phenomenon. Angler’s attitudes towards combining CR classification and removing the WILD-NB classifications are likely multifaceted. It is commonly accepted that attitudes hold three components: cognitive (belief and evaluation), affective (feeling and emotion), and conative (response and action) (Eagly & Chaiken, 1993; Fishbein, 1963; Jain, 2014; Schiffman & Kanuk, 1995; Spooner, 1989). As cognitive aspects of attitudes relate to the beliefs of an object, perceived impact could evaluate this component as respondents are considering what they believe about the outcomes or the policy changes. Acceptability could examine the affective component of attitudes towards the policy change as it illustrates a respondent’s feelings; however, acceptability differs from acceptance due to the different temporal scales. Acceptability of a policy is an evaluation of a change before it is implemented, where acceptance is an evaluation after it is implemented (Schade & Schlag, 2003; Schuitema et al., 2010). Lastly, support or opposition to a change could examine the conative or behavioral intention as it denotes a favorable mental decision. Because acceptability and support both indicate a positive evaluation towards policy, they are often used synonymously (Dreyer & Walker, 2013). However, this questions the nature of support as a behavioral intent or an evaluation towards a stimuli. Because this discrepancy is not clear in the literature, support is treated as, and argued to be, a component of an attitude. In summary, this study does not explicitly examine overt behavior, but rather an individual’s behavioral intention.

While attitudinal measures are generally consistent towards a particular set of stimuli, they may vary. For example, support transcends affective attitudes; therefore, it is possible for individuals to find policy changes acceptable but not actively support them (Dreyer et al., 2015). This distinction is important in the PMTW context as attitudinal measures are examined for structural patterns.

### ***Objectives***

The present project seeks to address the following objectives:

- O1:** Understand North Carolina angler attitudes towards combining CRAFO and CRALO classifications into one Catch-and-Release classification.
- O2:** Understand North Carolina angler attitudes towards removing the WILD-NB classification, and shifting all previous WILD-NB waters to WILD waters.

**O3:** Understand what characteristics of North Carolina trout anglers influence attitudes towards the proposed management changes.

These objectives contribute to the Trout Resources Management Plan (*North Carolina Trout Resources Management Plan, 2013*) by addressing and informing the following:

- Program Area 1. Trout Management:
  - Goal 2. Provide diverse, high-quality trout fishing opportunities.
  - Goal 3. Provide a sound regulatory structure to manage PMTW.
- Program Area 3. Research
  - Goal 1. Obtain routine measurements of social and economic data regarding trout management programs.
  - Goal 3. Evaluate alternative trout management practices.
- Program Area 5. Education and Communication.
  - Goal 4. Continue to cultivate interactions with trout anglers.

## Methods

### Sampling

A sample frame was provided by WRC's Information Technology Data Management team and included a list of WRC license holders who held privileges that permitted recreational fishing in PMTW waters in 2019<sup>1</sup>. Historically, many inland fishing licenses required anglers to purchase special PMTW privileges however, on September 1<sup>st</sup>, 2019 the WRC implemented a rule change that provided PMTW fishing privileges to all freshwater angling license holders (coastal fishing specific licenses were exempt). The sample was limited to license holders who had both email and mailing addresses, and license holders at least 18 years of age at time of license purchase. Also, multiple individuals in the database use the same contact email. To reduce repeated mailings to the same email addresses, we randomly selected one individual from the set of repeated emails. Of the 1,363,393 total number of potential PMTW anglers in the database, these criteria resulted in a total sample frame of 399,114 potential PMTW license holders. Desired final sample size was calculated based on the below equation, which includes a finite population correction to account for the size of the target population:

$$n = \frac{(N * p * q)}{\left\{ (N - 1) * \left( \frac{MoE}{z} \right)^2 + (p * q) \right\}}$$

where

- $n$  = completed sample size needed for desired level or precision,
- $N$  = size of the target population,
- $p$  = the proportion being tested,
- $q = 1 - p$ ,
- $MoE$  = the desired margin of sampling error, and
- $z$  = the  $z$ -score or critical value for the desired level of confidence.

Variables  $p$  and  $q$  are measures of variation in the answers to a question of interest. A  $p$  of 50% is the most conservative value as it is equivalent to 50% of the population answering "yes" to a yes/no question. This value was used to consider variation to an entire survey, not one specific question. Per standard scientific approaches, an  $MoE$  of 3% and a  $z$  of 1.96 (corresponding to a

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<sup>1</sup> List of WRC licenses that have PMTW privileges: Res Inland Fish, NR Inland Fish, Comp Inland Fish, Ltime Comp Inland Fish w/CRFL, Perm Disabled State Fish w CRFL, Sportsman, Res Sportsman Adult w CRFL, Sportsman Youth w CRFL, Sportsman Infant w CRFL, NonRes Sportsman Adult w CRFL, Res Ltime Over 70 Sportsman w CRFL, Disabled Combo H/F/CRFL Basic, Disabled Sportsman w CRFL, Ltime H/F/Trap/CRFL Disabled Vet, Special Trout Fishing, Res Hunt/Fish Guide License, NonRes Hunt/Fish Guide License, Fish for Adult Home Care w/CRFL, Fish for Legally Blind w/CRFL, Lifetime Comp Over 70 Fish w CRFL, Ltime Comp Inland Fish, Dis Inland Fish, Lifetime Fishing Over age 70, Res Sportsman Adult, NonRes Sportsman Adult, Res Ltime Over 70 Sportsman, Disabled Sptm, Dis Hunt/Inland Fish, Age 65 Sportsman, Ltime Age 65 Comp Inland Fish, Res Inland Fish 10-Day, NR Inland Fish 10-Day, Unified Sptm/CRFL, Unified Inland/CRFL, Unified Sptm/CRFL Infant, Res Uni Sptm/CRFL Adult, NR Uni Sptm/CRFL Adult, Unified Age 65 Sptm/CRFL, Uni Disabled Vet Sptm/CRFL, Uni Totally Disabled Sptm/CRFL, Ltime Unified Inland/CRFL, Uni Blind Inland/CRFL, Uni Adlt Care Hme Inland/CRFL, Mtn Heritage Trout 3-Day Fish, Senior Sportsman, Ltime Senior Comp Inland Fish, Unified Senior Sptm/CRFL, Fallen Wildlife Officer Memorial LifeTime Sportsman License, Sportsman Youth, Sportsman Infant, and Unified Sptm/CRFL Youth

95% confidence interval) were applied. Based on a calculated  $n$ , 95 out of 100 times a question's estimate will be within 3% age points of the true population.

*Table 1: Estimated percentage of PMTW anglers residing in WRC Management Districts residence based on results from the 2015 PMTW angler survey*

District	Estimated percent of PMTW trout anglers
1	2.6%
2	9.4%
3	9.3%
4	2.1%
5	8.1%
6	11.4%
7	16.2%
8	18.6%
9	22.0%
Out of state	18.3%

To reduce survey fatigue of this valuable stakeholder group and to attempt to achieve a representative sample, proportionate sampling, a process in which strata are sampled at rates equal to their size in the population, was used to further stratify the sampled population (Dillman et al., 2014). The present investigation involved two strata in which proportionate sampling was employed, North Carolina residency and WRC Management District. The proportionate sampling approach used results from a 2015 survey investigating North Carolina PMTW trout anglers that used a similar sampling frame of license holders (Responsive Management, 2015c). The study found that 18% of potential PMTW anglers fished in PMTW waters, of which 82% were North Carolina residents and 18% resided elsewhere. The proportion of North Carolina residents who fish for mountain trout varied across WRC Management Districts (Table 1). The high proportion of individuals in Districts 7, 8, and 9 was unsurprising as these areas encompass all mountain trout waters. These proportions were used to sample North Carolina residents based on estimated PMTW angling rates in their district of residence.

In addition to considering PMTW angler rate across anglers in the sample, two additional assumptions were made: 1) rate of incorrect contact information, and 2) response rate. The previously mentioned 2015 study found that the WRC license database had an 80% contact information accuracy rate (Responsive Management, 2015c). In other words, 20% of contact information provided was incorrect (failed mail addresses and bounced email addresses). Lastly, we assumed a 20% response rate from trout angling respondents. This assumption was based on previous WRC surveys and the 2014 study which yielded a 20% response rate.

Considering our stratified proportionate sampling and assumptions, we distributed 36,013 surveys to unique individuals (Figure 1).

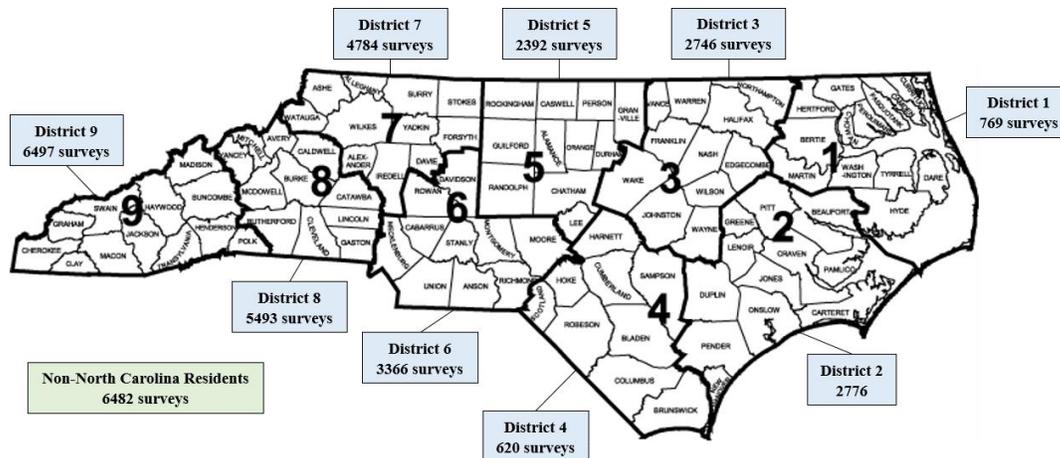


Figure 1: Number of 2020 PMTW surveys distributed to anglers in WRC Management Districts and non-North Carolina residents based on proportional stratified random sampling

## Questionnaire design

### Screening questions

Following standard ethical guidelines, respondents were provided a confidentiality statement and brief description of the research. The first question screened for informed consent and adult respondents. If the respondent was not an adult or did not consent to participate in the survey, the survey ended.

Consenting participants encountered a second screening question used to identify trout anglers from the stratified random sample, “In 2019, did you fish for trout in NC’s Public Mountain Trout Waters? This does not include fishing for trout in Piedmont region ponds or impoundments.” If respondents did not fish in PMTW in 2019, they were prompted to explain why before the survey ended. Adult respondents who consented to participate in the study and fished PMTWs in 2019 received the full version of the questionnaire.

### Angler characteristics

PMTW anglers were asked a series of questions related to their fishing preferences, fishing experience, attitudes towards the WRC, subjective crowding of different PMTW classified streams, and angling group membership ([Appendix D](#)). The survey questions explored angler PMTW use with multiple metrics; dichotomous (yes or no) use, rankings of importance, number of days fished in 2019, and if anglers wished they had fished an unfished classification. Images of PMTW classification signs were included with the title of the classification to ease respondent’s cognitive burden.

To understand angler characteristics beyond PMTW use, the survey included questions on gear types most often used, years fishing for mountain trout in North Carolina, subjective skill level, and primary reason for mountain trout angling. These questions were used verbatim from the 2015 PMTW Trout Angler Survey for comparison (Responsive Management, 2015c). WRC definitions of gear type selections (artificial flies, artificial lures, and natural bait) were not provided.

Each angler was presented a simple measure of perceived crowding for each PMTW classification they fished in 2019. The scale, developed by Heberlein & Vaske (1977) was modified in the present study by presenting an 8-point Likert scale rather than the original 9-point scale to create an even numbered unipolar scale (Vaske & Shelby, 2008). A response of 1 or 2 indicated ‘not at all crowded’, 3 or 4 indicated ‘slightly crowded’, 5 or 6 indicated ‘moderately crowded’, and 7 or 8 indicated ‘extremely crowded’. Researchers recommend creating dichotomous breakpoints for frontcountry settings, i.e., 1 through 4 and 5 through 9 on the original scale (Vaske & Donnelly, 1997). Waters within PMTW however, vary in their level of remoteness and were therefore not classified into the four aforementioned categories.

In the present study, institutional trust was measured using a series of five Likert scale questions; two measuring trust and three measuring acceptability of WRC mountain trout fisheries management modified from Schroeder & Fulton (2017) to fit the PMTW context. This framework has been suitable in recent case studies, so was deemed applicable for the present investigation (Gigliotti et al., 2020; Riley et al., 2018; Wald et al., 2018).

#### *Attitudes towards PMTW classification changes*

All respondents were presented a description of the two proposed PMTW regulatory changes with visual aids to reduce cognitive burden:

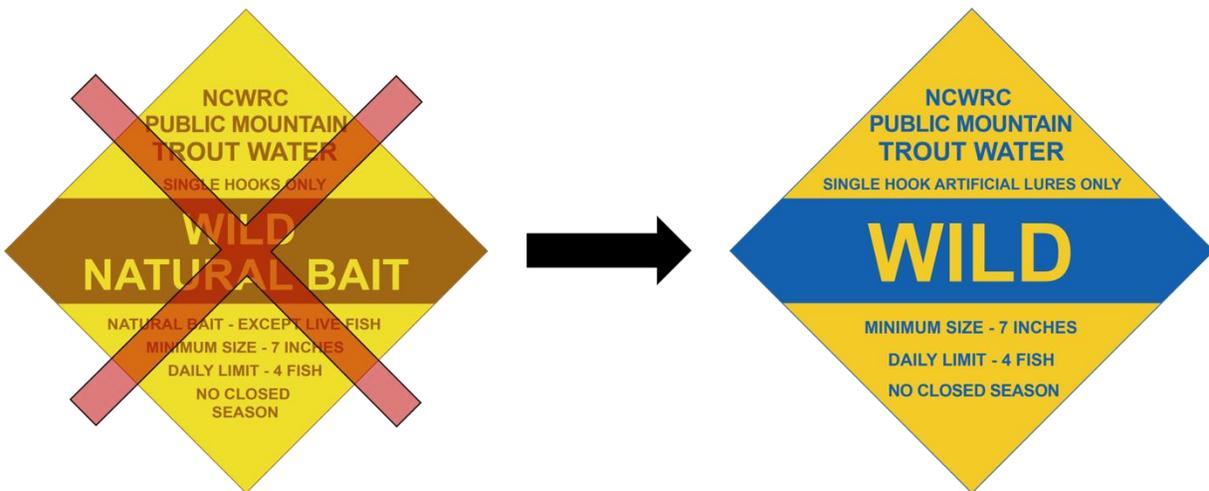


Figure 2: Image describing the hypothetical PMTW regulation change removing all WILD-NB waters and reclassifying them as WILD waters

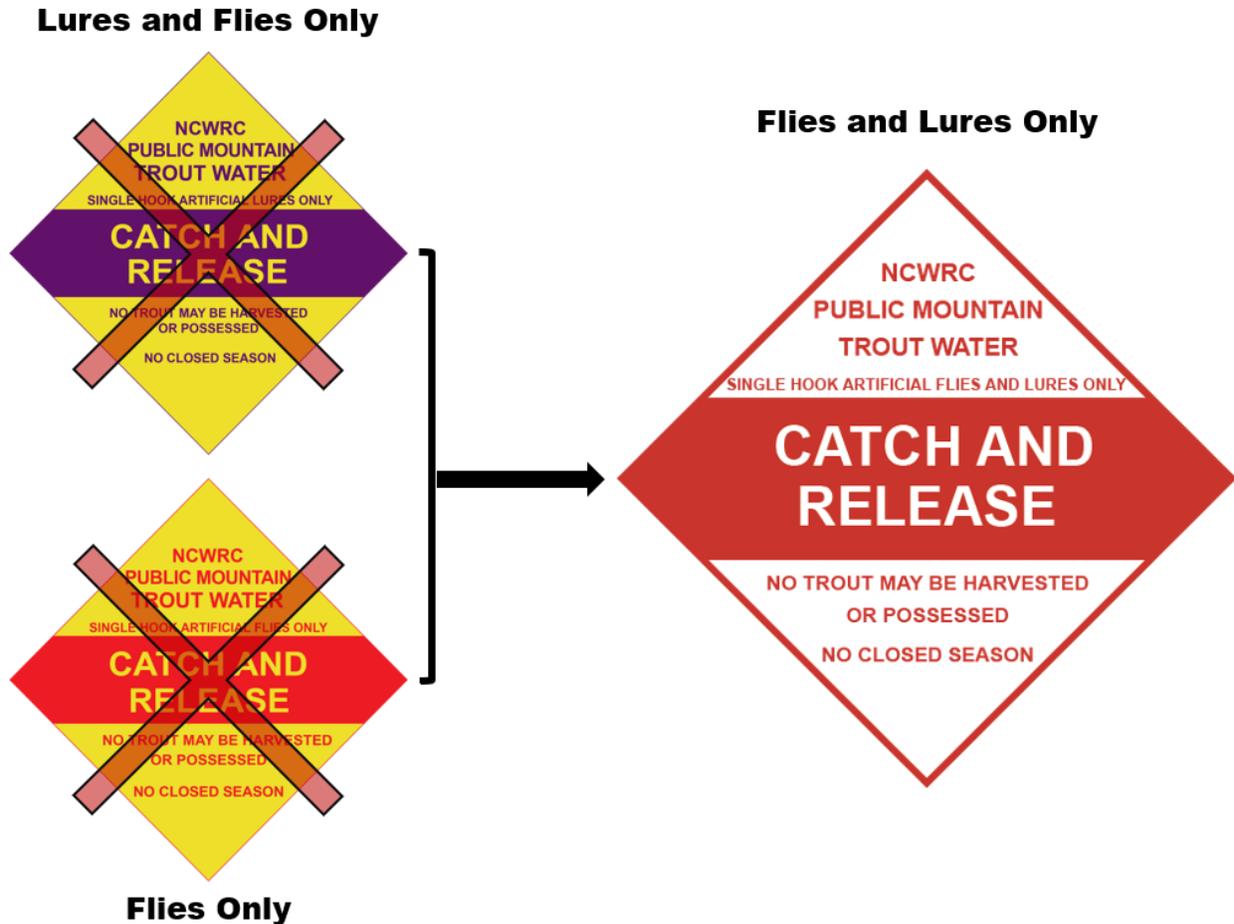


Figure 3: Image describing the hypothetical regulation PMTW regulation change combining CRALO and CRAFO Waters into the new Catch-and-Release Artificial Flies and Lures Only Waters classification

To explore angler’s attitudes towards these two changes, they were asked to rate their level of acceptability and support measured on a 5-point bipolar Likert scales adapted from Vagias (2006). Also, anglers were asked to share their desirability of agreement and strength of perceived impact these changes would have on their trout angling experiences, measured on a 5-point bipolar scale.

### ***Questionnaire pre-tests***

To ensure comprehension, validity, and appropriateness of the online questionnaire, drafts were pre-tested with a convenience sample of novice and avid trout anglers based in Raleigh and western North Carolina ( $n = 10$ ). During pre-tests, anglers were interviewed and asked a series of probing questions relating to their cognitive processing of questions (Collins, 2003).

### ***Survey recruitment***

Qualtrics, an online survey platform, was used to design survey questions and collect responses (Qualtrics, 2019). Respondents from the stratified random sample were sent an initial incentivized participation invitation email, with a link to the survey, three follow up reminder invitations, and a final thank you email to individuals who completed the questionnaire (Appendix A). All survey links were unique to each respondent and could only be used to

complete the questionnaire once. This approach allowed respondent survey data to be merged with the individual's data in the WRC license database. Single use survey links removed 'ballot stuffing'; the ability of individuals to complete surveys multiple times to intentionally bias results.

In order to bolster response rates and improve representation of anglers, a raffle incentive was used (Pedersen & Nielsen, 2016; Singer & Ye, 2013). Each individual in the random sample was notified that if they complete the survey, they would be entered into a drawing for one of six \$50 Bass Pro Shop gift cards. Only respondents who reached the end of the survey were eligible for entry into the drawing. This includes respondents who did not fish in PMTWs in 2019, i.e., they answered 'no' to the trout angling screening question. Winners were selected randomly and received an e-gift card in April 2020.

### *Analysis*

Survey responses were merged with WRC license database data. Personal identifiable information (i.e., Internet Protocol and email addresses) were removed from the final dataset prior to analysis. The final dataset was entered in IBM's Statistical Package for the Social Sciences for the following analytical procedures (IBM Corp., 2017).

#### *Non-response bias*

Non-response bias, the phenomenon in which respondents and non-respondents vary based on survey variables, is often tested based on the "continuum of resistance" (Filion, 1976; Lin & Schaeffer, 1995). Under this model, later respondents to survey recruitment efforts required more effort to participate and are therefore more similar to non-respondents, whereas early respondents are less similar. To test for non-response bias, this model was applied by examining differences between late (anglers who responded after the final reminder on March 23<sup>rd</sup>, 2020) and early respondents (responded before March 23<sup>rd</sup>, 2020 reminder).

#### *Cronbach's alpha*

In the present study, multiple variables were measured using Likert style questions to improve measurement reliability, "the consistency of responses to a set of questions designed to measure a given concept" (Vaske, 2008). To examine the measurement reliability of constructs, an internal consistency reliability measure called Cronbach's alpha ( $\alpha$ ) was used to estimate how consistently anglers responded to items in a scale (Cronbach, 1946). This statistic measure's internal correlation between a respondent's answers. Measured from 0 to 1,  $\alpha$  values between 0.65 and 0.90 have been considered 'adequate' and were used here (Streiner, 2003; Vaske, 2008). An  $\alpha$  is strongly affected by the number of items in a scale, therefore  $\alpha$  values above 0.90 indicate redundancies and should be shortened. This analysis used listwise deletion, which eliminates individuals who did not answer all the questions.

#### *Pearson Chi-Squared Test of Independence*

Pearson Chi-squared ( $\chi^2$ ) test for independence examined significant differences between frequencies of two or more dichotomous or categorical variables (e.g., support/oppose and HS/DH/WILD anglers). This test compared the true frequencies (i.e., observed counts) against what would be expected if there was no relationship between the two variables. The Pearson  $\chi^2$  procedure was completed through a crosstabulation of the two variables and the greater the difference between observed and expected frequencies, the greater the likelihood of significantly

different distributions, a larger  $\chi^2$  statistic, and a significant statistical relationship. If statistically insignificant, knowing the value of one variable does not help predict the other, which helped determine if the two variables were statistical independent (Vaske, 2008). Conversely, if the test were significant, there was an association between the two variables and knowing one helped predict the other.

Because  $\chi^2$  tests are heavily influenced by sample size, effect sizes were used to measure of strength of relationships between the two variables in question. Because all crosstabulations were greater than 2x2, the Cramer's *V* effect size statistic was used (Cramér, 1999). The interpretation provided in this text followed the guidelines provided by Vaske (2008) where 0.10 is a minimal effect, 0.30 is a typical effect, and 0.50 is a substantial effect.

#### *Ordinary least squares regression*

In situations where the dependent variable was continuous or scalar, ordinary least squares (OLS) regression was used. When used, model assumptions were tested. This analysis helps to predict the effect one variables has on another, e.g., angler's trust in WRC's effects on general policy acceptance.

#### *Cluster analysis*

To group respondents based on patterns of responses to regulatory change attitude questions, k-means cluster was used. K-means clustering is an exploratory analysis tool that attempts to partition observations into a number of clusters predetermined by the practitioner, where observations in clusters are very similar within their own cluster but also very different from observations in other clusters (MacQueen, 1967). This technique is used often in natural resources to account for the heterogeneity of stakeholders by using data to identify subgroups within a population.

Due to the algorithms involved, this method supports continuous or scalar data. While not the most robust method for clustering respondents based on ordinal (e.g., Likert scale) responses, it is commonly used in the literature to group responses based on Likert scale questions (Don Carlos et al., 2009; Jansujwicz et al., 2013; Kaval, 2007; Kim et al., 2010; Kyle et al., 2007; Needham et al., 2004; Vaske et al., 2011). Because this methodology was used to group response patterns related to regulatory changes, the grouping hypothesis were based on institutional assumptions, while also formed by attitude theory as responses to attitudinal stimuli likely have some organizational structure (DeFleur & Westie, 1963). In other words, individuals who strongly support have high levels of acceptability for, and would be positively impacted by, regulation changes are likely distinct from those who oppose, find the change unacceptable, and are negatively impacted. Therefore, we created three attitude clusters: positive, negative, and neutral. This approach is arguably more robust than hand placing respondents into clusters based on scores of the three attitudinal variables; this method would have subjectively determined clusters.

#### *Analysis of variance tests*

To further explore the validity of regulation attitude clusters, one-way multivariate analysis of variance (MANOVA) was completed. This method explored differences in means of various Likert scale variables among the attitude cluster groups. This helped illustrate if clusters were theoretically consistent and to explore distinct characteristics of the cluster groups. Analysis of

variance (ANOVA) is very similar to MANOVA, but only compares group means of one variable. This was used to examine various Likert responses across regulation attitude clusters.

Eta ( $\eta$ ) and partial eta-squared ( $\eta^2$ ) were used to determine effect size of ANOVA and MANOVA. Specifically, an  $\eta$  (corresponding  $\eta^2$  value) of 0.10 (0.01) indicates a minimal effect, a 0.243 (0.06) indicates a typical effect, and a 0.372 (0.14) indicates a substantial effect (Vaske, 2008).

### *Qualitative analysis*

Open ended responses provided clarifying statements on why respondents answered a particular way to the regulatory attitudinal measures. Qualitative coding was completed in Microsoft Excel (Microsoft Corporation, 2020) following the approach in Babbie (2013) (Microsoft Corporation, 2020). For each separate regulation change, responses were first classified using open coding, a process in which the researcher suggests codes based on their interpretation of the data.

Following open coding, emergent themes of the open codes were grouped by important general concepts or themes (i.e., axial coding). Quotations expressive of these themes were selected based on clarity and generalizability to the theme. Because qualitative results were meant to support and help describe angler's perspectives on the two regulatory changes, they were coded by a single researcher. Therefore, tests of interrater reliability were not completed.

# Results

## *Frequencies*

### *Response*

The Qualtrics questionnaire was open for 70 days from January 21, 2020 to March 31, 2020. Following the initial email on January 21, reminders were sent on February 3, March 2, and March 23, 2020. Each reminder email was successful at gathering additional responses (Figure 4).

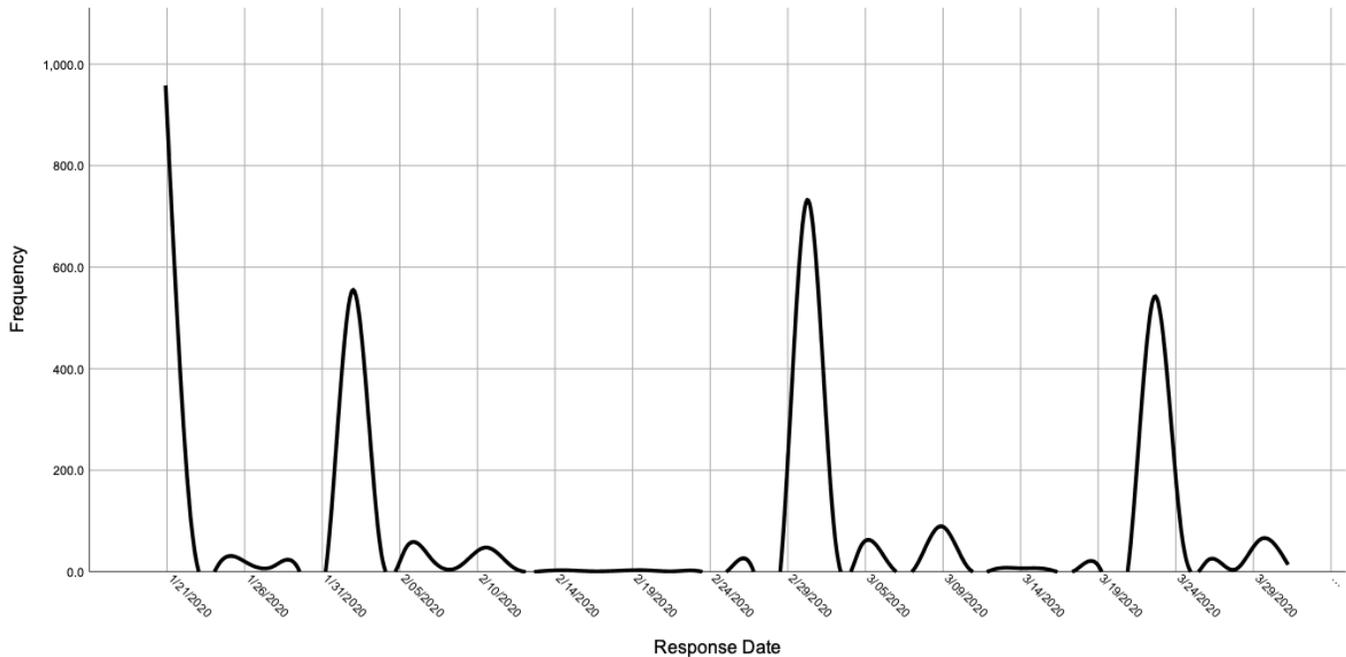


Figure 4: Frequency of responses by date of the 2020 PMTW survey. Initial questionnaire email was sent on January 21, with reminders on February 3, March 2, and March 23, 2020.

Of the 36,013 surveys distributed, 711 emails bounced (i.e., rejected by a server and returned to sender), four were marked as spam, five failed (e.g., address was not properly formatted), and 530 potential respondents opted-out of receiving future emails. In total, 3,690 individuals responded to the survey yielding a 11% response rate. About 50% of these respondents fished PMTW in 2019 and the other 50% did not, resulting in a sample size of 1,745 PMTW trout anglers, about 5% of the random sample.

When comparing early and late survey respondents, no statistically significant differences were found. While this analysis does not identify any evidence of non-response bias, it is unlikely that it was eliminated from this study.

### *Demographics*

Most trout anglers were white and male (84% white; 93% male; [Appendix B29](#) and [Appendix B30](#)), had less than a 4-year college degree (71%; [Appendix B28](#)), had household incomes over \$50,000 (77%; [Appendix B31](#)), and were North Carolina residents (81%; [Appendix B35](#); Table 2). The majority of trout anglers were 45 years old or older (63%; [Appendix B32](#)) and the mean

age of the full sample was about 52 years old ( $SD = 15.14$ ). Of the North Carolina residents, most respondents resided in WRC District 9 (35%), District 8 (19%), and District 7 (14%), which was expected as proportional random sampling weighted these areas more heavily ([Appendix B34](#)). These three districts however, also had a higher proportion of trout anglers respond to the survey relative to the number of individuals sampled (9%, 6%, 5%, respectively) than the other six districts ( $\leq 3\%$ ).

The majority of demographic variables in 2020 were within  $\pm 5\%$  of frequencies from the 2015 survey, but a few had larger disparities. Specifically, the 2020 sample had less trout anglers with Bachelor's, Master's and Doctoral/Professional degrees. In 2020, 29% of respondents preferred not to respond to the education demographic questions, while the 2015 sample had a refusal rate of 1% for the same question. The discrepancies of education levels are also present when comparing the 2015 study to a 2006 study using the same education responses (Bachelor's  $\pm 10\%$ , High school or equivalent  $\pm 12\%$ , Not a high school graduate  $\pm 8\%$ ; Responsive Management 2006). In general, because the true demographic composition of trout anglers is unknown and refusal rates were higher in the present study, data were not weighted by any demographic characteristics.

Table 2: Demographic frequency comparisons of PMTW anglers from the 2020 and 2015 PMTW angler surveys (Responsive Management, 2015c).

Variable	2020 (n = 1,745)	2015 (n = 2,112)
	Percent of respondents <sup>a</sup>	Percent of respondents <sup>a</sup>
<b>Education</b>		
Less than high school	0.6%	3.0%
High school graduate	11.1%	15.0%
Some college but no degree	18.1%	19.0%
Associate degree	13.4%	13.0%
Bachelor's degree	11.2%	30.0%
Master's degree	5.0%	11.0%
Doctoral/Professional	1.5%	7.0%
<b>Gender</b>		
Male	82.9%	90.0%
Female	6.1%	10.0%
<b>Race</b>		
White	84.2%	
Black	0.1%	
American Indian or Alaska Native	0.4%	
Asian	0.8%	
Hispanic, Latino, or Spanish	0.5%	
Other	0.2%	
Mixed Race	1.9%	
<b>Income</b>		
Less than \$20,000	1.8%	
\$20,000 to \$34,999	6.2%	
\$35,000 to \$49,999	10.3%	
\$50,000 to \$74,999	17.5%	
\$75,000 to \$99,999	15.1%	
\$100,000 to \$149,999	16.0%	
\$150,000 or more	12.6%	
Age	51.63 <sup>b</sup> (15.14)	49.73
<b>Age groups</b>		
18 to 24 years old	4.5%	5.0%
25 to 34 years old	12.3%	14.0%
35 to 44 years old	17.1%	17.0%
45 to 54 years old	18.1%	21.0%
55 to 64 years old	23.7%	21.0%
65 years or older	24.2%	19.0%
<b>State of Residence</b>		
North Carolina	80.7%	82.0%
Other states	19.0%	18.0%
<b>WRC's Management District Residence</b>		
District 1	0.3%	2.6%
District 2	1.8%	9.4%
District 3	2.6%	9.3%
District 4	0.2%	2.1%
District 5	2.8%	8.1%
District 6	6.1%	11.4%
District 7	14.2%	16.2%
District 8	18.7%	18.6%
District 9	34.8%	22.0%

<sup>a</sup>Values do not sum to 100% as frequencies do not include missing data and participants who answered, 'Prefer not to share'

<sup>b</sup>Standard deviation in parenthesis

### *Angling specific characteristics*

About 59% of trout angler respondents have been fishing for mountain trout in North Carolina for more than 10 years ([Appendix B6](#)). There was little variance in the percentage of anglers who have been fishing for 5 to 10 years, 3 to 5 years, 1 to 2 years, and less than 1 year (11%, 12%, 10%, and 7%, respectively). Despite the high proportion of anglers fishing over 10 years, only 12% labeled themselves as ‘expert’ anglers ([Appendix B7](#)). Most self-identified as ‘advanced’ (44%) or ‘intermediate’ (32%) anglers. Only 11% identified as ‘beginner’ anglers.

Artificial flies were the most favored bait/tackle among the trout angling sample (50%), followed by natural bait (25%) and artificial lures (23%; [Appendix B3](#)). While 1% of respondents selected ‘Other’, all valid open-ended descriptions of gear type fell into one of the three aforementioned categories, but were more specific (e.g., rooster tails, Berkeley power worms, homemade flies, crickets).

When asked about the main reason for fishing for mountain trout in North Carolina, the top three motivators were for relaxation (25%), to be close to nature (24%), and for the sport (23%; [Appendix B4](#)). Sixteen percent of trout anglers were primarily motivated by being with family or friends, 8% by catching fresh food, and 1% by catching large fish. About 3% of trout anglers responded with ‘other’ and wrote in their own primary motives, with many writing-in ‘all of the above’.

In regard to group membership, most trout anglers were not members of the listed organizations (64%; [Appendix B27](#)). Of the listed groups, Trout Unlimited was the organization that had the most members within the sample (19%), and the remaining groups (private fishing club, Meetup fly fishing group, Backcountry Hunters and Anglers, and Federation of Fly Fishers) all fell below 4% membership of the anglers in the sample. Of the 3% of respondents who listed ‘other’, Project Healing Waters was the most common write-in response.

### *PMTW use*

Over half the trout anglers fished DH and HS waters (59.7% and 69.0%, respectively), making those two classifications the most popular amongst the sample (Table 3; [Appendix B9](#)). SR waters were the least visited classification. DH waters were ranked the most preferred classification, followed by HS, WILD, and CRAFO waters ([Appendix B9](#)). DH and HS waters also had the highest median of average fishing effort with 6 and 7 angling days, respectively ([Appendix B17](#)). While these two classifications are the most popular, and on average, these two waters perceived to be between slightly and moderately crowded (DH = 4.16 and HS = 4.06; [Appendix B19](#)). WILD waters and WILD-NB were the least crowded PMTW classification according to trout anglers in the sample (WILD = 1.69 and WILD-NB = 1.94). In general, most PMTW anglers (84%) perceived crowding to have a negative impact on their trout angling experience ([Appendix B20](#)).

WILD and WILD-NB waters were the most frequently chosen classification that anglers wished they had fished in 2019 ([Appendix B17](#)). Because most anglers had fished DH and HS streams in 2019, these two classifications were the least frequently chosen PMTW classifications that anglers wished they had fished in 2019.

Table 3: Results of the classification specific questions based on angling experiences in 2019. CRAFO = Catch-and-Release/Artificial Flies Only Waters, CRALO = Catch-and-Release/Artificial Lures Only Waters, DH = Delayed Harvest Waters, HS = Hatchery Supported Waters, SR = Special Regulation Waters, WILD = Wild Trout Waters, WILD-NB = Wild Trout/Natural Bait Waters.

PMTW Classification	Percentage of anglers who used classification		Rank order of preference across all anglers	Median number of days fished <sup>a</sup>	Mean crowding score <sup>b</sup>	Percentage of anglers who wished they fished classification <sup>c</sup>
	2020	2015				
CRAFO	26.7%	42.0%	4	5 (1-100)	3.00	12.0%
CRALO	17.4%	47.0%	6	4 (1-90)	2.55	12.6%
DH	59.7%	61.0%	1	6 (1-160)	4.16	9.2%
HS	69.0%	74.0%	2	7 (1-150)	4.06	4.8%
SR	7.2%	21%	7	3 (1-101)	2.39	16.4%
WILD	37.1%	59.0%	3	5 (1-260)	1.69	19.4%
WILD-NB	9.9%	21%	5	3 (1-60)	1.94	16.9%

<sup>a</sup>Range in parenthesis

<sup>b</sup>Measured on a unipolar scale of ‘1-Not at all crowded’ to ‘8-Extremely crowded’

<sup>c</sup>Percentages do not include responses from anglers who said they fished the classification in 2019

### *Attitudes towards PMTW changes*

When given a description of the proposed WILD-NB to WILD waters regulation change, 18% of anglers thought this change was either totally unacceptable or somewhat unacceptable, 51% thought it was somewhat acceptable or perfectly acceptable, and 22% were neutral (Table 4, [Appendix B21-B23](#)). Sixteen percent of trout anglers opposed this change, while 18% of trout anglers who found it unacceptable. Conversely, 52% supported this change and 53% of trout angler who found it acceptable. Twenty-seven percent shared neutral support. Fifteen percent of anglers shared that the change would have with strong or somewhat negative impacts to their mountain trout fishing experience, while 28% of trout anglers shared that the change would have a strong or somewhat positive impact. Almost half (49%) of trout anglers indicated the change would have no impact on their angling experience.

When considering the combination of CRAFO and CRALO waters into ‘Catch-and-Release Artificial Flies and Lures Only Waters,’ 15% of anglers thought this change was either totally unacceptable or somewhat unacceptable, 53% thought it was somewhat acceptable or perfectly acceptable, and 22% were neutral (Table 4, [Appendix B24-B26](#)). Thirteen percent of trout anglers opposed this change and 15% of trout angler who found it unacceptable. Forty-nine percent shared support for this change, while 53% of trout anglers who found it acceptable. Twenty-seven percent shared neutral support. Sixteen percent of trout anglers shared that this change would have strong or somewhat negative impacts on their mountain trout fishing experience, while 26% shared it would have a strong or somewhat positive impact. Forty nine percent of trout anglers indicated the change would have no impact.

Table 4: Frequencies of attitudinal questions towards the PMTW regulatory changes: reclassifying Wild Trout/Natural Bait (WILD-NB) as Wild Trout Waters (WILD) and combining Catch-and-Release/Artificial Flies Only Waters (CRAFO) and Catch-and-Release/Artificial Lures Only Waters (CRALO) into a new classification.

Attitudinal statements	Response frequencies				
	Totally unacceptable	Somewhat unacceptable	Neutral	Somewhat acceptable	Perfectly acceptable
How acceptable is this change?					
WILD-NB to WILD	10.3%	7.7%	21.5%	10.9%	41.4%
Combine CRAFO and CRALO	7.7%	7.1%	22.2%	15.2%	37.9%
How much do you support or oppose this change?	Strongly oppose	Somewhat oppose	Neutral	Somewhat support	Strongly support
WILD-NB to WILD	7.9%	8.0%	27.0%	15.7%	33.3%
Combine CRAFO and CRALO	6.9%	6.4%	27.4%	18.6%	30.7%
What type of impact would this change have on your mountain trout fishing experience?	Strong negative impact	Somewhat negative impact	No impact	Somewhat positive impact	Strong positive impact
WILD-NB to WILD	5.1%	9.5%	49.0%	12.9%	15.4%
Combine CRAFO and CRALO	5.5%	9.5%	49.1%	12.8%	13.2%

### Attitude clusters

K-means clustering successfully grouped anglers into three attitudinal based clusters: positive, neutral, and negative. For both WILD-NB and CR regulation changes, attitudes towards the regulation changes were significantly dependent on which cluster group the individual belonged to (Tables 5 and 6;  $F = 1258.21$ ,  $p < 0.001$ , Partial  $\eta^2 = 0.70$  and  $F = 1069.09$ ,  $p < 0.001$ , Partial  $\eta^2 = 0.67$ , respectfully). There was also a substantial significant difference in means of attitude components (acceptability, support, impact) based on cluster groups (Vaske 2008). Specifically, all the positive clusters had significantly higher means, the neutral clusters all had means around the mid-point of all scales, and the negative clusters all had significantly lower mean scores for the three attitudinal measures (all  $p$ -values  $< 0.003$ ). In total when considering the WILD-NB change, 53% of trout anglers held positive attitudes, 32% held neutral attitudes, and 13% held negative attitudes. When considering combining CRAFO and CRALO waters, 54% of trout anglers held positive attitudes, 33% held neutral attitudes, and 13% held negative attitudes.

Table 5: MANOVA comparing differences in three attitude measures between three PMTW angler cluster groups created based on responses to support/acceptability/impact questions related to reclassifying Wild Trout/Natural Bait (WILD-NB) as Wild Trout Waters (WILD,) Wilk's Lambda = 0.09,  $F(6,3190) = 1258.27$ ,  $p < 0.001$ , Partial  $\eta^2 = 0.70$ <sup>1</sup>.

	Cluster 1 'Positive' ( $n = 855$ )		Cluster 2 'Neutral' ( $n = 499$ )		Cluster 3 'Negative' ( $n = 246$ )		Df	F	Partial $\eta^2$
	Mean	SD	Mean	SD	Mean	SD			
Acceptability	4.84 <sup>a</sup>	0.37	2.88 <sup>b</sup>	0.74	1.48 <sup>c</sup>	0.53	2	4683.8 <sup>***</sup>	0.85
Support	4.56 <sup>a</sup>	0.68	3.13 <sup>b</sup>	0.32	1.45 <sup>c</sup>	0.51	2	2704.1 <sup>***</sup>	0.77
Impact	3.81 <sup>a</sup>	0.87	3.02 <sup>b</sup>	0.52	1.82 <sup>c</sup>	0.71	2	704.3 <sup>***</sup>	0.47

<sup>1</sup>Means with different letter superscripts are significantly different from other clusters a  $p < 0.05$  based on Tamhane's T2 post-hoc test

\*\*\*  $p < 0.003$  accounting for Bonferroni's correction on  $\alpha = 0.01$ .

Table 6: MANOVA comparing differences in three attitude measures between three PMTW angler attitude cluster groups created based on responses to support/acceptability/impact questions related to combining Catch-and-Release/Artificial Flies Only Waters (CRAFO) and Catch-and-Release/Artificial Lures Only Waters (CRALO) into a new classification, Wilk's Lambda = 0.11,  $F(6,3120) = 1069.09$ ,  $p < 0.001$ , Partial  $\eta^2 = 0.67$ <sup>1</sup>.

	Cluster 1 'Positive' (n = 850)		Cluster 2 'Neutral' (n = 513)		Cluster 3 'Negative' (n = 202)		Df	F	Partial $\eta^2$
	Mean	SD	Mean	SD	Mean	SD			
Acceptability	4.77 <sup>a</sup>	0.42	2.99 <sup>b</sup>	0.65	1.46 <sup>c</sup>	0.50	2	4246.4 <sup>***</sup>	0.85
Support	4.55 <sup>a</sup>	0.60	3.09 <sup>b</sup>	0.51	1.41 <sup>c</sup>	0.49	2	2967.4 <sup>***</sup>	0.79
Impact	3.75 <sup>a</sup>	0.85	2.95 <sup>b</sup>	0.48	1.55 <sup>c</sup>	0.52	2	834.9 <sup>***</sup>	0.52

<sup>1</sup>Means with different letter superscripts are significantly different from other clusters a  $p < 0.05$  based on Tamhane's T2 post-hoc test

<sup>\*\*\*</sup> $p < 0.003$  accounting for Bonferroni's correction on  $\alpha = 0.01$

### Trust and acceptance

Overall, PMTW anglers appear to have relatively high trust in WRC mountain trout management and willingness to accept their management decisions (Appendix B5). Upon reliability analysis of the trust and acceptance scales, both scales exhibited acceptable levels of internal reliability ( $\alpha = 0.90$  and  $\alpha = .083$ , respectively; Table 7). Means for both of these variables were calculated for each angler, conditional on responding to at least two of the Likert scale questions.

Table 7: Results of reliability analysis using Cronbach alpha of measures of PMTW angler's institutional trust in WRC's mountain trout fisheries management and PMTW angler's acceptance of WRC's mountain trout fisheries management decisions.

	Item total correlation	Alpha if item deleted	Cronbach alpha ( $\alpha$ )
Institutional trust <sup>a</sup>			0.90
To what extent do you consider WRC's mountain trout fisheries management to be trustworthy?	0.81	-	
To what extent do you trust WRC's mountain trout fisheries management?	0.81	-	
Acceptance of management decisions <sup>a</sup>			0.83
To what extent do you accept the decisions of WRC's mountain trout fisheries management?	0.67	0.80	
To what extent are you willing to accept the decisions of WRC's mountain trout fisheries management?	0.77	0.70	
To what extent do you intend to respect the future decisions of WRC's mountain trout fisheries management?	0.65	0.81	

<sup>a</sup>Measured on a 5-point Likert scale of '1-Not at all' to '5-Very much'

The results of the OLS regression model indicated trust alone accounts for 62% of the variance in acceptability of decisions made by WRC's mountain trout fisheries management, indicating a strong model fit in social sciences (Table 8). Because there was only one independent variable in the model, comparisons of standardized  $\beta$  to determine relative effects is not necessary. An angler's mean trust score in WRC mountain trout fisheries management had a significant effect on their acceptance of general agency's decisions in this context. With a mean trust score increase of 1, one can expect an increase in mean acceptability score of 0.65 ( $B = 0.65$ ,  $p < 0.001$ ).

Similar models were run to examine the effect of trust in WRC mountain trout management and acceptability of the specific WILD-NB and CR regulation changes. Both models exhibited very poor model fit and therefore effects of trust on acceptability of the changes were weak or negligible.

Table 8: OLS regression of the influence of PMTW angler mean institutional trust in WRC's mountain trout fisheries management on PMTW angler acceptance of WRC's mountain trout management decisions.

Independent variables	<i>B</i>	SE ( <i>B</i> )	Standardized $\beta$	<i>t</i>
Intercept	1.67	0.06	-	30.67***
Mean trust score <sup>a</sup>	0.65	0.01	0.79	51.97***

Model fit: Adjusted  $R^2 = 0.62$

<sup>a</sup>Mean trust was calculated from two institutional trust questions measured on a 5-point Likert scale (Table 7)

\*\*\*Significant to the  $p < 0.001$  level

### ***WILD-NB regulation change***

#### *Quantitative analysis*

Comparison of WILD-NB regulation attitude clusters explored differences in trust in WRC's mountain trout fisheries management, perceived crowding of WILD and WILD-NB waters, and age. There were significant differences in trust between the attitude groups, which had a minimal to typical effect ( $F = 19.46$ ,  $p < 0.001$ ,  $\eta = 0.16$ ; Vaske 2008). Specifically, anglers who held positive attitudes towards the WILD-NB change were more trusting than those who held neutral or negative attitudes ( $M = 4.44$ ). Neutral and negative groups' mean trust scores, however, were not different from each other ( $M = 4.24$  and  $M = 4.12$ , respectively). There was also a very minimal significant difference of ages between the three attitude clusters, with positive ( $M = 52.45$ ) and negative ( $M = 53.07$ ) attitude clusters being slightly older than the neutral ( $M = 50.11$ ;  $F = 4.68$ ,  $p < 0.01$ ,  $\eta = .01$ ). Lastly, mean perceived crowding scores of WILD or WILD-NB waters were not significantly different between attitude clusters.

Table 9: ANOVA results of differences in means of trust, crowding, and age between PMTW angler cluster groups with different attitudes towards reclassifying Wild Trout/Natural Bait (WILD-NB) as Wild Trout Waters (WILD)<sup>+</sup>.

	Cluster 1 'Positive' ( <i>n</i> = 855)		Cluster 2 'Neutral' ( <i>n</i> = 499)		Cluster 3 'Negative' ( <i>n</i> = 246)		<i>df</i>	<i>F</i>	$\eta$
	Mean	SD	Mean	SD	Mean	SD			
Trust <sup>‡</sup>	4.44 <sup>a</sup>	0.77	4.24 <sup>b</sup>	0.78	4.12 <sup>b</sup>	0.88	2	19.46***	0.16
WILD crowding <sup>×</sup>	1.68	1.20	1.75	1.30	1.70	1.10	2	0.18	0.00
WILD-NB crowding <sup>×</sup>	1.91	1.35	2.19	1.63	1.82	1.25	2	0.88	0.01
Age	52.45 <sup>a</sup>	14.46	50.11 <sup>b</sup>	15.21	53.07 <sup>a</sup>	14.44	2	4.68**	0.01

<sup>+</sup>Means with different letter superscripts are significantly different from other clusters a  $p < 0.05$  based on Tamhane's T2 post-hoc test

<sup>‡</sup>Measured on a unipolar 5-point Likert scale of '1-Not at all' to '5-Very much'

<sup>×</sup>Measured on a unipolar 8-point Likert scale of '1-Not at all crowded' to '8-Extremely crowded'

\*\*  $p < 0.01$

\*\*\*  $p < 0.001$

Pearson  $\chi^2$  tests examined whether there is an association between WILD-NB attitude clusters and various angler characteristics (Table 10). There was a minimal to typical significant association between regulation attitude groups and WILD or WILD-NB use patterns ( $\chi^2 = 164.77, p < 0.001, V = 0.23$ ). Many more anglers who fished in WILD-NB waters only held negative attitudes (56%) than positive attitudes (16%) towards the WILD-NB regulation change. However, anglers who fished both of the wild water classifications held more positive attitudes (44%) than negative attitudes (34%). In general, respondents who did not fish in WILD-NB waters held more positive attitudes towards the regulation change.

There was a significant but minimal association between District 9 residency and attitudes towards the WILD-NB regulation change ( $\chi^2 = 13.27, p < 0.001, V = 0.09$ ). While only slightly different, more District 9 residents held negative attitudes towards the change (20%) than non-District 9 anglers (13%). There was also a significant but minimal association between income category and attitude clusters ( $\chi^2 = 26.38, p < 0.01, V = 0.10$ ). There is a slight pattern in which lower income groups were less favorable of the change, while higher incomes were more favorable of the change. Although there was also a minimal significant association between the number of years an angler fished and attitude clusters, the only clear pattern regarding this comparison is that more experienced anglers hold relatively more negative attitudes towards the regulation change compared to less experienced anglers ( $\chi^2 = 28.48, p < 0.001, V = 0.09$ ).

The type of bait or tackle that anglers used had the strongest association with attitudes towards the WILD-NB change ( $\chi^2 = 322.09, p < 0.001, V = 0.32$ ). Unsurprisingly, more anglers who use primarily natural bait held negative attitudes towards the change (36%) compared to the relative number of anglers who held negative attitudes in the other bait/tackle groups ( $\leq 14\%$ ).

Table 10: Pearson  $\chi^2$  test of independence results comparing frequencies of response to dichotomous or categorical variables between cluster groups of PMTW anglers with different attitudes towards reclassifying Wild Trout/Natural Bait (WILD-NB) as Wild Trout Waters (WILD)<sup>a</sup>.

Categories	<i>n</i>	Cluster 1 'Positive' ( <i>n</i> = 855)	Cluster 2 'Neutral' ( <i>n</i> = 499)	Cluster 3 'Negative' ( <i>n</i> = 246)	$\chi^2$	Cramer's <i>V</i>
User groups					164.77***	0.23
WILD-NB only	57	15.8%	28.1%	56.1%		
WILD only	512	68.2%	22.9%	9.0%		
Both WILD and WILD-NB	103	43.7%	22.3%	34.0%		
Neither WILD nor WILD-NB	928	48.7%	37.0%	14.3%		
Residency					13.27***	0.09
District 9	554	50.7%	29.4%	19.9%		
Non-District 9	1042	54.8%	32.2%	13.0%		
Income					26.38**	0.10
Less than \$20,000	30	36.7%	43.3%	20.0%		
\$20,000 to \$34,999	108	48.1%	34.3%	17.6%		
\$35,000 to \$49,999	178	46.6%	34.8%	18.5%		
\$50,000 to \$74,999	303	49.2%	31.0%	19.8%		
\$75,000 to \$99,999	262	53.8%	32.4%	13.7%		
\$100,000 to \$149,999	280	57.1%	30.4%	12.5%		
\$150,000 or more	219	64.4%	24.2%	11.4%		
Number of years fishing					28.48***	0.09
Less than 1 year	119	54.6%	39.5%	5.9%		
1-2 years	158	56.3%	34.8%	8.9%		
3-5 years	192	60.9%	27.1%	12.0%		
5-10 years	177	56.5%	29.9%	13.6%		
More than 10 years	952	50.6%	30.7%	18.7%		
Bait/Tackle most often used					319.45***	0.32
Artificial flies	800	72.3%	22.8%	5.0%		
Artificial lures	366	43.7%	42.1%	14.2%		
Natural bait	402	26.9%	37.1%	36.1%		

<sup>a</sup>Cell entries are percentages of group members who supported or opposed the regulation change

\*\*Significant to the  $p \leq 0.01$  level

\*\*\*Significant to the  $p \leq 0.001$  level

### Qualitative analysis

While exploring angler's open-ended responses to the two regulation changes, five unique themes (axial codes) emerged from the data: opportunity, conflict, angling styles, management, and conservation (Figure 5). While more specific codes (open codes) were identified and could have been used to better represent the richness of this data, all seemed to fall into these five broad themes. 'Opportunity' refers to contexts related to experiences, experience levels, providing equal opportunities, heritage, future generations, barriers to participation, and recruitment of new anglers. 'Conflict' refers to observational contexts in which the respondent observed, was negatively impacted by, or disliked other anglers' actions. Throughout this theme, 'they' was a strong indicator of conflict and was often used when referring to litter, poaching,

crowding, overfishing, and trout mortality or injury resulting from behaviors of other anglers, usually with different angling techniques. Many anglers discussed how ‘angling style’ or preferences influenced their answers, generally discussing fly-fishing, trout size, catch rates, CR, harvest beliefs, and the sporting nature of trout angling. Some anglers discussed ‘management’ and its issues and implications resulting from the two changes. These comments related to liberty, regulatory complexity, enforcement, trust, maintaining the status quo, and suitability of the change. Lastly, statements labeled ‘conservation’ related to wild or native stocks, scenic environments, invasive species, overharvest, trout mortality/injury, and stewardship. Trout mortality/injury and overfishing in the conservation context were distinct from ‘conflict’ as respondents were talking about impacts on trout populations, as opposed to directly identifying culprits.

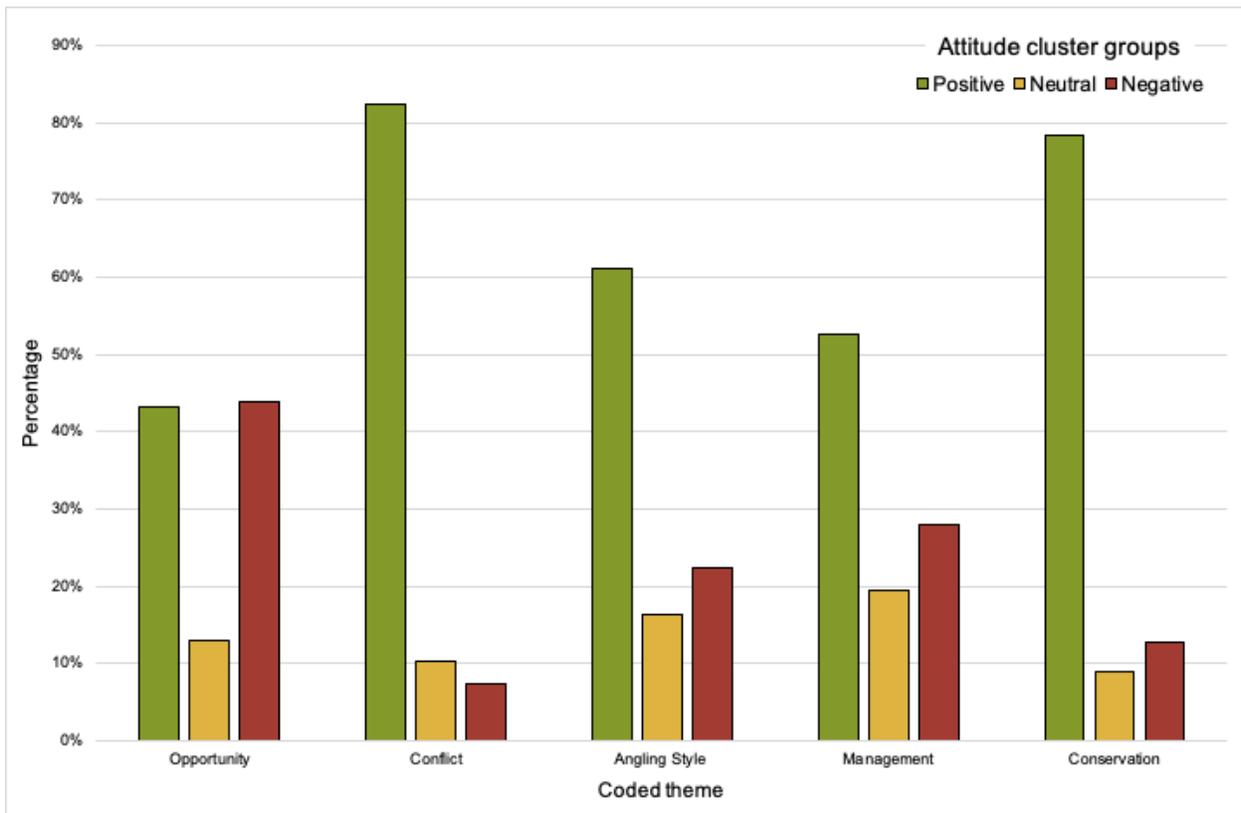


Figure 5: Frequency of emergent themes (axial codes) of PMTW angler's open-ended comments relating to reclassifying Wild Trout/Natural Bait (WILD-NB) as Wild Trout Waters (WILD).

Despite efforts to reduce similarities between themes, doing so was quite difficult as many statements had multiple layers or were discussing relationships between themes. Therefore, a single statement could have multiple themes.

While opportunity was discussed at a similar frequency between anglers with negative and positive attitudes towards the WILD-NB change, it was often used in different contexts. Many anglers with negative attitudes discussed the heritage of WILD-NB waters and how this classification helps recruit young anglers and retain lower income anglers.

*“Most of the people where I fish are middle to low income, not magazine cover duded-up Orvis fly fishing wannabees. This is unacceptable because it restricts a lot of local people*

*from streams they and their past family members fished with yellow jacket larva, red wigglers (from cow pies) etc.”*

*“This type of fishing is an important way to introduce the next generation of anglers. Not only is it a great way to fish, but it is also an affordable way that does not require much of an investment. As our economy is turning down in these uncertain times, removing these wild natural bait waterways would be poor decision. There are very few of them as it is, and this would not make any type of positive impact.”*

While some anglers with positive attitudes towards the change mirror the above sentiments, many were more often focused (but not always) on the specifically maintaining healthy wild stocks for the future anglers. Many also felt that this would not reduce opportunities for natural bait anglers, as the HS and DH classifications are adequate places for fishing with natural bait.

*“Bait-fisherman typically use bait to catch fish for the frying pan, perfectly fine, however, the opportunity to catch wild trout is a privilege that best marries nature, sport and skill with greater chance of catch and release. Preserving wild trout for future generations is critical.”*

*“Wild trout waters have every right to be protected so future generations can enjoy. We have plenty of other areas to fish natural baits. More hatchery supported waters with good fishing will help minimize crowding in other smaller rivers.”*

Discussing conflict was more prevalent in statements made by the positive attitude cluster group. Most conflict topics focused on crowding, litter left behind by natural bait anglers, poaching and trout mortality because of poor fish handling. Oftentimes, this attitude group generalized to the larger natural bait angling population.

*“I would be hopeful that these changes would prevent the large amount of poaching that is going on with impunity on five streams that I fly fish...I seen more worm containers then beer cans, treble hooks rages, etc. I've been fly fishing all over the country for 70 years and I have never witnessed the lawless that exist on North Carolina trout streams.”*

*“Natural Bait’ tends to be a magnet for liter and fisherman who do not respect the fishery. It is very common to see a ‘Natural Bait’ fisherman leaving packages and garbage and taking far more than a daily limit of fish.”*

While few anglers with negative attitudes towards the change discussed conflict items, a common theme was how crowding on DH and HS has drawn them to WILD-NB waters.

*“Enjoy being able to catch some native fish without having to use artificial bait. These creeks are usually a lot less crowded than hatchery supported waters. Good place to go to get away from crowds”*

Angling style was a common theme used amongst anglers with positive attitudes towards the change. In general, many discussed how CR and artificial lure/fly angling was a more holistic and sporting way to fish for wild trout and this change will help spread this ethos, while using natural bait provided an ‘unfair’ (unsporting) advantage.

*“I support this change because it would set aside more waters where fishermen/women fishing artificial lures and flies do not have to compete with bait fishermen/women who have an advantage and tend to take more fish vs. catch-and-release.”*

*“To me, trout fishing is about the experience rather than bringing home dead fish. Killing the fish cheapens the experience. I understand that everyone does not feel this way, so I support the idea of having different types of water.”*

*“Need to protect all native and wild trout. Live bait makes it too easy and will eventually wipe out the native and wild trout. Trout fishing is a sport, not a meal producer. Flies should be the only acceptable ‘lure’.”*

Conversely, anglers who oppose the regulation change are simply interested in fishing their preferred method, generally with natural bait. Many consider this the most natural way and primarily fish for food.

*"I am a sportsman who likes to harvest for my table. I am not a scientific angler, focusing on the manner or special technique."*

*"I want to be able to live bait and like to keep the fish I catch"*

*Why is it unfair to use what's in nature to catch fish? I don't believe it's an unfair advantage just preference.*

Reduction of classifications and enforcement were very common topics when angler's with positive attitudes towards the change were discussing management.

*"Poaching is a big problem in NC trout waters. Something needs to be done to give these meat fisherman a place to go that satisfies their need. We desperately need more enforcement."*

*"I would totally support he change and would hope that it would be strictly enforced. I hate trying to fish legally with artificial flies in a catch and release setting when other people are using corn and pulling out big stringers of fish! I don't have to catch fish but it would be nice for them to still be there for me"*

*Fewer regulations the better. Since I'm new to trout fishing all the areas seem confusing.*

However, some anglers with negative attitudes towards the change also mentioned perplexing classifications, but that changing all WILD-NB waters to WILD waters would increase confusion. Also, this group commonly questioned the validity of the change because creel limits would not be modified, as such they often provided alternatives.

*"There too many regulations, it gets confusing and discourages beginning fishermen. Allow natural bait in all streams."*

*I strongly disagree with a couple of things when it comes to mountain trout waters. I feel that I should be able to catch any size fish with a seven fish limit. I honestly believe if this were changed you would see less pouching of mountain trout. I feel I should also be able to use natural bait for mountain trout. 4 fish seven inches is not enough for a meal, raise the limit to seven.*

Lastly, conservation was a major theme throughout the comments made by anglers who support the change. Most frequently, it was related to the protection of wild trout and stewardship, by using methods less injurious to fish.

*"I believe that this will be a great, positive change. Though I do not have much experience on natural bait waters, I do know that the impact on the fishery can be detrimental. This is due to the nature of a passive hook set (fish eats the bait entirely) as well as anglers taking advantage of creel limits. Harvesting from a stable fishery is more than acceptable and even beneficial, but over harvesting (especially native brook trout) can degrade the overall health of a system."*

*"Fully support it due to cultural stereotypes that in my experience hold true. Bait fishermen tend to be less careful about the environment and the fish. At the very least, the use of artificial lures and flies self-selects anglers who are more serious about the sport as opposed to folks who are fishing for food."*

While conservation was not a major focus for many anglers opposing the change, those that were focused on how natural bait has a lower impact on the ecosystem and if trout in WILD-NB waters are not being depleted, then the change is unnecessary.

“Natural baits, if locally sourced, are biodegradable. Artificial lures are mostly plastic. Seems obvious if you look at it this way.”

“I was pleased to see WRC add this class of water so “bait fisherman” could have more chances to fish back country waters the traditional way of early trout fishing. As long as these waters can support a sustainable # of trout, I see no reason to change. I realize the Eddie Bauer folks don’t approve of bait fishing, but this is a very old way to catch supper for us locals.”

As the reader might observe, many of these quotations transcend multiple themes. This highlights the diverse structure of angler mental models surrounding trout fishing with natural bait.

## CR regulation change

### Quantitative analysis

Comparison of CR regulation attitude clusters explored differences in trust in WRC’s mountain trout fisheries management, perceived crowding of CRAFO and CRALO waters, and age (Table 11). There was a significant, but minimal, differences in trust towards the WRC’s mountain trout fisheries management and attitudes towards the regulation change ( $F = 4.74, p < 0.01, \eta = 0.08$ ; Vaske 2008). Positive cluster members had a higher mean trust score ( $M = 4.38$ ) than neutral ( $M = 4.25$ ) and negative clusters ( $M = 4.27$ ). ANOVA highlighted minimal to typical differences in perceived crowding of CRAFO waters between the three attitude clusters ( $F = 14.96, p < 0.01, \eta = 0.17$ ). The negative cluster thought that CRAFO waters were more crowded ( $M = 3.57$ ) than the positive ( $M = 2.86$ ) and neutral clusters ( $M = 2.69$ ). There were not significant differences between the three attitude clusters and perceived CRAFO crowding and age.

Table 11: ANOVA results of differences in means of trust, crowding, and age between PMTW angler cluster groups with different attitudes towards combining Catch-and-Release/Artificial Flies Only Waters (CRAFO) and Catch-and-Release/Artificial Lures Only Waters (CRALO) into a new classification<sup>†</sup>.

	Cluster 1 'Positive' (n = 850)		Cluster 2 'Neutral' (n = 413)		Cluster 3 'Negative' (n = 202)		df	F	$\eta$
	Mean	SD	Mean	SD	Mean	SD			
Trust <sup>‡</sup>	4.38 <sup>a</sup>	0.78	4.25 <sup>b</sup>	0.80	4.27 <sup>ab</sup>	0.89	2	4.74 <sup>**</sup>	0.08
CRALO crowding <sup>×</sup>	2.49	1.75	2.58	1.59	2.89	1.87	2	0.85	0.08
CRAFO crowding <sup>×</sup>	2.86 <sup>a</sup>	1.84	2.69 <sup>a</sup>	1.88	3.57 <sup>b</sup>	2.31	2	6.45 <sup>**</sup>	0.17
Age	51.59	15.22	51.21 <sup>b</sup>	15.37	54.01	14.96	2	2.59	0.06

<sup>†</sup>Means with different letter superscripts are significantly different from other clusters a  $p < 0.05$  based on Tamhane’s T2 post-hoc test

<sup>‡</sup>Measured on a unipolar 5-point Likert scale of ‘1-Not at all’ to ‘5-Very much’

<sup>×</sup>Measured on a unipolar 8-point Likert scale of ‘1-Not at all crowded’ to ‘8-Extremely crowded’

<sup>\*\*</sup> $p < 0.01$

<sup>\*\*\*</sup> $p < 0.001$

Additional Pearson  $\chi^2$  tests examined whether there is an association between CR attitude clusters and various angler characteristics (Table 12). There was a minimal to typical significant association between regulation attitude groups and CRAFO or CRALO use patterns ( $\chi^2 = 109.68, p < 0.001, V = 0.19$ ). Many more anglers who used CRAFO waters but not CRALO waters held negative attitudes (27%) towards the CR regulation change than anglers who use both CRAFO

and CRALO waters (9%), only CRALO waters (3%), or neither (13%). Anglers who fished CRALO waters only, held much more positive attitudes (75%) towards the regulation change than the other three use groups ( $\leq 54\%$ ).

There was a minimal to typical significant association between primary bait/tackle used and attitude cluster ( $\chi^2 = 126.11, p < 0.001, V = 0.20$ ). Anglers who mainly use artificial flies held more negative attitudes (28%) towards combining the two CR classifications than artificial lure (3%) and natural bait (8%) anglers. Conversely, artificial lure anglers held the most positive attitudes towards the change (64%), but at not as large of a margin as the difference in negative attitudes between artificial flies and artificial lure users.

Associations between attitude clusters and angling groups membership was also explored. Membership to the Federation of Fly Fishers was not included as the sample size did not meet assumptions of the Pearson  $\chi^2$  test (expected counts in some cells  $< 5$ ). There was a typical significant association between Trout Unlimited membership and attitudes towards combining CR classifications ( $\chi^2 = 71.79, p < 0.001, V = 0.22$ ). While most TU members held positive attitudes towards the change (54%), a higher proportion of members held negative attitudes (27%) than non-TU members (10%). There was a weaker but similar trend between Meetup Fly Fishing group members, where a higher proportion of members opposed the change (28%) than non-Meetup members (13%) ( $\chi^2 = 10.85, p < 0.01, V = 0.08$ ).

There were not significant associations between income groups, number of years fishing, and Backcountry Hunters and Anglers membership and the three CR attitude groups.

Table 12 Pearson  $\chi^2$  test of independence results comparing frequencies of response to dichotomous or categorical variables between cluster groups of PMTW anglers with different attitudes towards combining Catch-and-Release/Artificial Flies Only Waters (CRAFO) and Catch-and-Release/Artificial Lures Only Waters (CRALO) into a new classification<sup>a</sup>.

Categories	<i>n</i>	Cluster 1 'Positive' ( <i>n</i> = 850)	Cluster 2 'Neutral' ( <i>n</i> = 413)	Cluster 3 'Negative' ( <i>n</i> = 202)	$\chi^2$	Cramer's <i>V</i>
User groups					109.68***	0.19
CRALO only	122	74.6%	22.1%	3.3%		
CRAFO only	285	48.4%	24.9%	26.7%		
Both CRALO and CRAFO	151	53.6%	37.7%	8.6%		
Neither CRALO nor CRAFO	1007	54.3%	32.8%	12.9%		
Income					20.21	0.09
Less than \$20,000	30	46.7%	43.3%	10.0%		
\$20,000 to \$34,999	108	52.8%	37.0%	10.2%		
\$35,000 to \$49,999	177	50.3%	41.8%	7.9%		
\$50,000 to \$74,999	301	57.5%	31.6%	11.0%		
\$75,000 to \$99,999	258	54.3%	33.3%	12.4%		
\$100,000 to \$149,999	277	54.5%	21.4%	14.1%		
\$150,000 or more	217	58.5%	24.9%	16.6%		
Number of years fishing					13.70	0.10
Less than 1 year	115	55.7%	39.1%	5.2%		
1-2 years	153	60.8%	30.7%	8.5%		
3-5 years	186	53.8%	29.6%	16.7%		
5-10 years	173	53.2%	33.5%	13.3%		
More than 10 years	936	53.5%	32.8%	13.7%		
Bait/Tackle most often used					126.11***	0.20
Artificial flies	785	54.8%	24.8%	20.4%		
Artificial lures	358	64.2%	33.0%	2.8%		
Natural bait	390	44.4%	47.9%	7.7%		
TU membership					71.79***	0.22
Member	292	53.8%	19.5%	26.7%		
Not a member	1268	54.4%	35.8%	9.8%		
Backcountry Hunters and Anglers membership					1.27	0.03
Member	44	61.4%	25.0%	13.6%		
Not a member	1516	54.1%	33.0%	12.9%		
Meetup Fly Fishing Group membership					10.85**	0.08
Member	47	53.2%	19.1%	27.7%		
Not a member	1513	54.3%	33.2%	12.5%		

<sup>a</sup>Cell entries are percentages of group members who supported or opposed the regulation change

\*\*Significant to the  $p \leq 0.01$  level

\*\*\*Significant to the  $p \leq 0.001$  level

### Qualitative analysis

While the open coding process on angler's qualitative responses to the CR change yielded different specific codes to the WILD-NB qualitative analysis, they were all able to be grouped into the five aforementioned themes (Figure 6). While the responses had similar themes, the contexts were quite different. Anglers who hold positive attitudes towards the change discussed 'opportunity' and 'management' much more frequently than anglers with negative attitudes. Conversely, anglers with negative attitudes discussed 'conflict' and 'conservation' more frequently than anglers with positive attitudes.

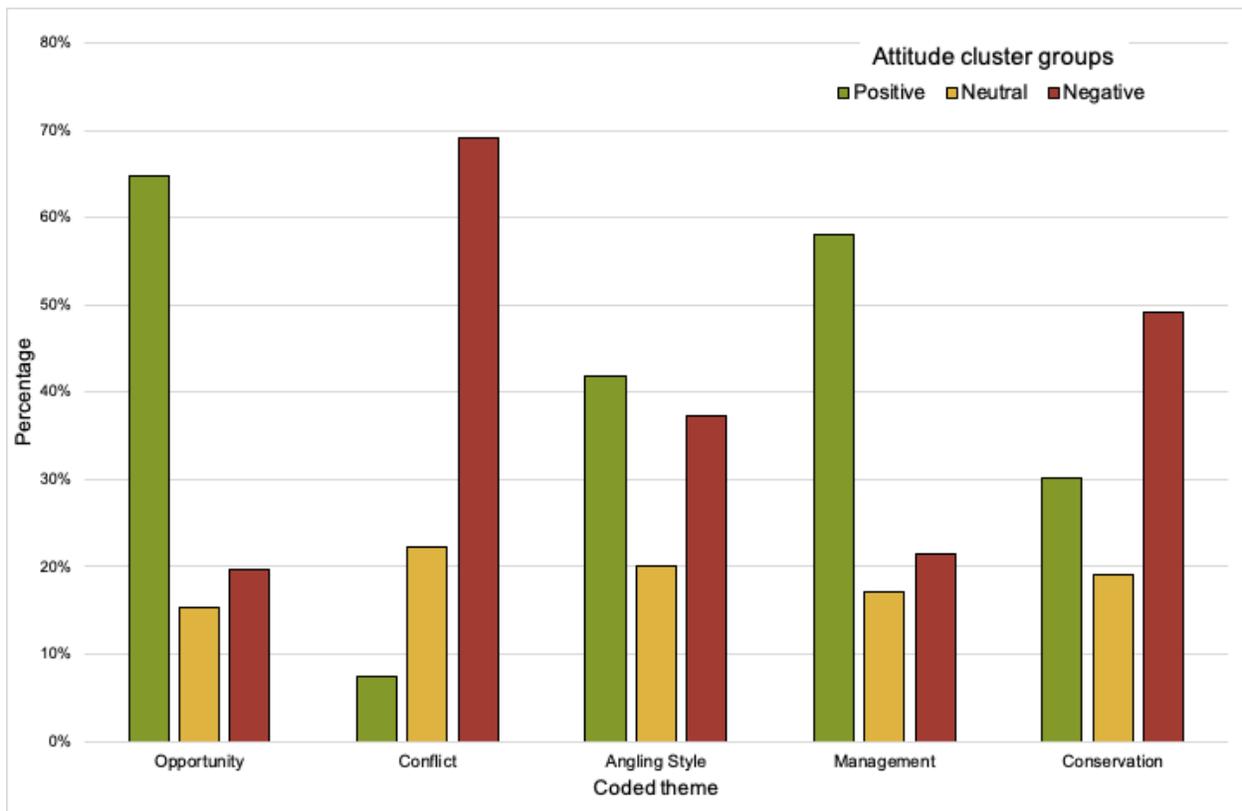


Figure 6: Frequency of emergent themes (axial codes) of open-ended comments relating to combining Catch-and-Release/Artificial Flies Only Waters (CRAFO) and Catch-and-Release/Artificial Lures Only Waters (CRALO) into a new classification.

Anglers who held positive attitudes towards combining CRAFO and CRALO waters were mainly concerned about providing choices to anglers, opening up new waters, sharing spaces, and appeared to be morally opposed to any regulations that exclude others. Financial costs of fly fishing were occasionally discussed.

*“Most fly fishers have family including children that do not fly fish. In a family outing, this change would allow the entire family to fish regardless of the bait, without traveling and without changing the body of water.”*

*"I both fly fish and fish with bait and other artificial lures. I don't believe it is fair to anglers who do not fly fish to prohibit them from fishing any streams. I understand not allowing bait in all streams, but I do not feel any artificial lure should be restricted."*

*Fly-fishing only sections unnecessarily restrict spin anglers from some waterways, without scientific basis. As a fly angler, I support the move to a more inclusive regulation.*

Whereas anglers with negative attitudes towards this change were concerned about preserving the heritage of fly angling in North Carolina and reducing fly-only opportunities. Many responses related to 'opportunity' were described in a conflict context.

*"I see it. And it makes sense. However, I prefer to have a few locations where FLIES ONLY are acceptable. Fly fishing is the historic and artful sport of angling for trout... There are more than 3,000 miles of trout water in WNC. Please keep a small , or very small, percentage for flies only."*

*"This would eliminate the opportunity for people who fly fish to have a place that would give them an opportunity to not have to compete with other lures."*

Poaching, crowding, trout injury, and spin angler's general negligence of regulations were common conflict items, mostly among those who did not want to see the two CR classifications merged. There was a lot of discussion related to the use of barbed and treble hooks, with many anglers encouraging the WRC to ensure all single hook lures are barbless.

*"I'm coming to fly fish. I don't want to be crowded out by people using lures. If I choose to use lures I'll fish that kind of stream. But if I want to fly fish I know I can get away from the people with lures."*

*"Fly fishermen should have streams where they are not disturbed by spin fishermen who move in on them and cast heavy lures that disturb the water and then move out after making a few casts."*

*"First off- that regulation sign will be misinterpreted as 'Single Hook Fly' and use of 'Artificial Lures'. The average angler does not purchase single hook lures or drop the trebles and replaces with single hooks. Fact. Secondly, trout strike spinners more often than fly. I believe this will increase catch rate and possibly affect by increase the mortality rates of fish in those waters. It isn't that I think rooster tails are less ethical than a woolly bugger, but the anglers using them are often less angling mature and haven't progressed to the satisfying challenges of flies fishing. Another way to say that, they are still novice in angling skill and very likely haven't matured to conservative views of wild fish management. Many many spin fishing anglers do not practice C&R"*

While relating to conflict, angling style between lure and fly anglers was present throughout the comments. According to many, the angling etiquette and sporting nature of fly fishing does not merge well with the angling style of lure fishing. This was a common topic discussed by anglers with negative attitudes towards the regulations.

*"This change would infringe on the beauty of fly fishing. Fly fishing is a sacred art that needs it's own fisheries."*

*"Preserving designated areas for flyfishing only accomplishes two important goals: 1) improves each individuals connection with nature. Anyone who has studied a stream, studied the hatch, learned casting technique, quietly entered the water and presented their fly in a manner that invokes a strike has the potential to experience a oneness and peace with nature that typically is not achieved by chunking a painted piece of lead over and over again (obviously subjective, however, many, many flyfishermen and women know what i'm talking about); 2) in a world of instant gratification, flyfishing teaches dedication, education, patience and EARNED gratification, all cultural attributes that need to be preserved. Their is a time and place for flies and lures but they don't need to be in the same stretch of water."*

*“Typically fisherman that are using artificial lures that are not flies are less respect of rules and regs and etiquette in my experience.”*

Conversely, anglers supporting the change had very different viewpoints on the distinctions between fly and lure angling, viewing the two styles as compatible if done responsibly.

*“Although I prefer dry fly fishing, I have caught many trout on a small single hook spinner when I was younger. As long as the spin fishermen are careful releasing the fish, it is acceptable. Catching a trout on a single hook spinner is not that much different than catching one on a weighted streamer.”*

*“I don't see the distinction between artificial lures and artificial flies (they are both artificial means of fooling the fish), so the combining makes sense to simplify. Maybe you will get some snobby fly fishers who don't want spinning rods around, but that is silly.”*

There were many anglers who held positive attitudes towards the change because it would simplify the classifications and reduce confusion. This sentiment was most often shared by respondents with positive attitudes towards the CR change. There were also many comments from both positive and negative attitude groups on tackle definition ambiguity and enforcement issues of combing the waters.

*“One big problem is that in my 30 years of fishing these waters I have never been checked by anyone. You will need to be able to enforce these changes or it want work.”*

*-Angler with positive attitude towards the CR change*

*“Based on the definitions provided above, it seems that such lures with ambiguous construction (eg: single hook "Joe's Flies") will be easier to classify and therefore regulate (also for the public to understand and abide by those regulations). If there were no verbiage to continue the single hook requirement, I would likely oppose this move. There is one point that remains unclear from the above definitions, and that is whether additional single hooks can be added to the "single hook artificial lure", since it is specifically disallowed in the previous definition of "single hook artificial fly". Worth clarifying in either case, I think.”*

*-Angler with positive attitude towards the CR change*

*“If there was enforcement might be ok but once we get spinning rods on the river who is going to make sure the rules are being followed. We have enough poaching as it is”*

*-Angler with negative attitude towards the CR change*

Relating to the differences in fishing etiquette of artificial lure and fly anglers, these comments transcended methodology and highlighted the perceived variability of conservation ethics between the two groups.

*“While can respect artificial lures as I have done so. ----- It might be a stereotype, but I think flyfishers are generally more concerned with the trout and habitat health. So prefer that people fish with flies on streams where you are encouraging a sustainable population of trout.”*

*“Need to preserve the sport of fly fishing. Artificial lures such as spinners have no place on a trout stream. This change would also make it too crowded on the best trout streams. Fly fishermen need waters where spin fishermen are not plunking lures in beautiful quiet trout waters. Please leave some waters for serious fly fishermen so they can practice the art of fly fishing. Spin fishermen also tend to be meat fishermen - no matter the rules. Fly fishermen follow the rules to preserve the productivity of the streams and protect the fish by carefully unhooking them in the water and releasing them so they will survive to be caught another day. Too many spin fishermen just pull the hooks out and toss them back - dooming many trout.”*

Many anglers with positive attitudes towards the combination of CRAFO and CRALO waters felt that this change would have no impact on the sustainability of the CR trout fisheries as they do not perceive different impacts based on gear types.

*“I fish flies only, but because this is catch and release only, combining artificial lure fisherman with fly fisherman in this case it should have no impact.”*

## **Discussion**

The majority of anglers held positive or neutral attitudes towards removing the WILD-NB classification and shifting all previous WILD-NB waters to WILD waters and combining CRAFO and CRALO classifications into one CR classification. The analysis of attitude cluster groups highlighted a variety of patterns that helped explain some of the variance in angler perceptions towards these future regulations.

The structure of attitudes towards removing the WILD-NB classification and combining CRAFO and CRALO waters were consistent with institutional and theoretical hypotheses; there was clear clustering of respondents with positive, neutral, and negative attitudes indicating that support, acceptability, and impacts held similar internal organizational structure (DeFleur & Westie, 1963). These clusters appear to have face validity as all three represented a distinct attitudinal group derived from bipolar Likert measures. By accounting for the heterogeneity of these three attitudinal groups, analyses could examine the factors associated with varying perspectives on PMTW regulation changes.

### ***WILD-NB change***

While most anglers held positive or neutral attitudes towards the WILD-NB regulation change, these anglers were also less likely to use the affected WILD-NB waters. Specifically, anglers who primarily used flies and anglers who fished in WILD but not WILD-NB waters held more positive attitudes than all other groups. It appears that these attitudes may also be framed by an individual's positions on keeping trout and perceived conservation implications of natural bait. Conversely, anglers who fished in WILD-NB waters made up a small but dedicated proportion of the PMTW angling population and they did not want the classification to disappear. This is further exemplified in the comments from the anglers who discussed the heritage of these waters and how long-standing traditions encourage sustainable recruitment of new anglers.

Surprisingly, while all WILD-NB are in WRC Management District 9 ([Appendix C3](#)) there were minimal effects of angler's residence within this district on attitudes towards this regulation change. Therefore, it is clear that actual usage of WILD-NB waters is a stronger predictor of attitudes towards the change.

Unlike the CR change, lower income groups may be disproportionately impacted by removing the WILD-NB classification, as lower income anglers were generally less favorable of the regulation change. As stated by anglers with negative attitudes towards this change, natural bait is perceived to be much cheaper than any form of lure, so there is potential for lower income anglers to be displaced. This displacement has potential to impact the already crowded areas, where natural bait is allowed (i.e., DH and HS waters). While many HS and DH waters are adjacent to WILD-NB, HS and DH waters may not provide the appropriate attributes to satisfy anglers (solitude, remoteness). Many anglers even stated that they pursue opportunities in WILD-NB waters because of the crowds in the stocked streams. Deeper investigations into the motivations of this small angling group may further highlight if these motivators are important factors in PMTW choice.

## *CR change*

While most trout anglers hold positive or neutral attitudes towards combining CRAFO and CRALO waters, there appears to be passionate fly-angling and conservation-oriented community opposed the change. Conversely, anglers who fish in CRALO but not CRAFO waters had the highest frequencies of positive attitudes. This appears to be related to improving opportunities for all anglers. The apparent conflict between avid fly and non-fly anglers is not new, and is rooted in the different subcultural perceptions of what CR fisheries mean; e.g., harvest regulation, philosophy, conservation, management strategy (Aas et al. 2002; Arlinghaus et al. 2007). Also, evidence from this project highlights that PMTW anglers appreciated CR for ‘consumptive’ and ‘non-consumptive’ reasons; to preserve the opportunity to re-catch a trout, but also for the population’s conservation. The additional dichotomy of angling for sport and angling for food produces additional conflicts and challenges for the WRC.

North Carolina has 76 stream miles classified as CRAFO waters, which are spread across three stream order-3 watersheds (excluding the portion of the Elk River on Les-McRae College property; [Appendix C2-C3](#)). CRALO waters, however, have about 98 miles spread across 8 classified areas. While not as accessible as the popular HS and DH waters, CRAFO waters received only slightly less perceived crowding scores. Fly anglers who thought CRAFO waters were more crowded held negative attitudes towards the CR regulation change more frequently than fly anglers who thought CRAFO waters were less crowded. This is unsurprising given the norms of solitude, meditative, and even ‘lived religious’ experiences many fly angler specialists pursue (Snyder, 2007).

The frequency of Trout Unlimited members who held positive attitudes towards the change were similar to the frequency of non-members. This similarity, however, is not reflected in the frequency of negative attitudes. Voluntary CR fly anglers have historically been conservation oriented (Arlinghaus et al. 2007). Therefore, it is unsurprising that many members of a conservation non-profit held more frequent negative attitudes towards removing the fly-only designation. Many descriptive comments highlighted the perception that trout caught and released with artificial flies generally experience lower injury and mortality rates compared to CR using artificial lures. While there is no documentation as to the original purpose of establishing CR waters in North Carolina, these statements describe that many anglers value such waters for their conservation potential. Quantitative results indicate that membership to Trout Unlimited may be representing this value system. The qualitative descriptions describing negative attitudes towards the CR change further highlight that conservation ethics certainly had some impact on attitudes towards combining CRAFO and CRALO waters.

Crowding and angling specialization are not mutually exclusive, as illustrated by the comments on angling etiquette. Therefore, it is important to reflect on the extent to which angling specialists represent the PMTW population as a whole as regulations that favor special interests generally tend to restrict use by competing users (Gigliotti & Peyton, 1993; Langenau, 1982). Since 1921, artificial fly-only restrictions have been used in North Carolina and this long-standing tradition is rooted in some angler’s heritage, similar to that of fishing with natural bait. These are important cultural considerations as the WRC manages public trust mountain trout resources in an equitable manner.

Due to the specialization of fly anglers, conflicts may arise between angling groups if the two CR classifications are combined. To mitigate potential conflicts, unifying outreach efforts related

to conservation messaging may be beneficial. For example, while the WRC has created a pamphlet on proper trout handling for release, it is not widely distributed nor presented in the 2019–2020 Regulations Digest. Data from the present study may inform appropriate presentation of such research materials. In addition, the WRC may wish to communicate science-based information related to effects of gear, handling, and release on individual trout. Finally, further angler R3 (recruitment, retention, and reactivation) educational efforts focused on trout handling during CR angling may also help present a unified message. These efforts aimed at all CR anglers could reduce tensions between angling groups (Arlinghaus et al., 2007; Taylor & White, 1992).

### ***Enforcement***

When considering their attitudes towards the WILD-NB and CR changes, many anglers cited their concerns with enforcement, which were primarily rooted in poaching and disregard for gear restrictions. WRC's Law Enforcement Division is responsible for difficult and costly task of monitoring angler use across all 5,500 miles of PMTW, while also enforcing hunting and boating regulations. These recreational fisheries are difficult to monitor, but compliance with regulations is a key element of effective PMTW management.

Compliance is a complicated phenomenon and many factors influence this aspect of angler behavior (Mackay et al., 2018). Non-compliance can be accidental or deliberate, making enforcement only one method to encourage anglers to comply with existing and new regulations. Because this appears to be a salient source of conflict among angling groups, the WRC could utilize additional communications tools 'nudge' PMTW anglers towards compliance. These approaches use sociopsychological approaches that reduce barriers to acting in one's own self-interest (Hansen, 2016; Sunstein & Thaler, 2008). Some examples of 'nudging' include, framing of policies using persuasive and simple messaging, and using social norms such as sharing other angler's behaviors.

While compliance helps establish effective PMTW management, it also appears to impact some angler's perceptions and satisfaction with North Carolina's mountain trout fishery. Future work to craft an appropriate 'nudging' compliance strategy would require additional research and monitoring of angler perceptions.

### ***Trust and acceptance***

In both the WILD-NB and CR regulatory changes, trust appears to play a role in attitudes towards the changes. General trust in WRC's mountain trout fisheries management was shown to have a positive effect on an individual's acceptance of general regulation changes but had very little or no effect on the acceptability of the context specific PMTW changes. When examining trust in WRC across the three attitudinal cluster groups, the differences were minimal. All three cluster groups across both changes had relatively high trust in WRC's mountain trout management, but different levels of acceptability of the regulation changes.

By definition, acceptance relates to a cognitive decision or behavior after a policy is implanted, whereas acceptability is an evaluation of policy before implementation. In the present study, institutional trust impacts acceptance of general WRC mountain trout policies much stronger than it impacts the acceptability the two context specific regulation changes presented. In other words, while an untrusting angler may not find the two policy changes acceptable upfront, increased institutional trust shows some promise in their acceptance of the decision in the future.

Additionally, while the WRC's mountain trout fisheries management is likely to experience disproportional objections to the policy during the rule review cycle (i.e., vocal support of favored regulation changes is uncommon), they can expect these stakeholders to eventually accept the agency's decision. This pattern is consistent with previous evaluations of acceptability/acceptance, as levels of acceptability may be lower before a policy is implemented than levels of acceptance after implementation (Dreyer et al., 2017).

### ***PMTW use***

Although the present study was not designed to understand angling preferences and trade-offs associated with angler's decision making, it does point to the interesting dynamics of PMTW use. While ranked the third highest in angler preference and the third most frequently used, WILD waters appear to be underutilized. They are the most abundant classification in the state and 19% of anglers wished they had fished them in 2019, the highest proportion in the sample. While the reasons behind the desire to fish WILD waters was not explored in this study, these waters are the least crowded and may provide a sense of solitude.

Nearly three quarters of the anglers in the study were motivated by being close to nature, relaxation, and the sport of angling while only a cumulative 9% were motivated by catching fish for food and catching large fish. Despite the low proportion of anglers who are motivated by catch oriented goals, the majority of anglers still target HS or DH waters, which are perceived to be the most crowded. This pattern highlights varying subjective definitions of 'nature' and 'relaxation' as many anglers appear to use the most crowded areas to fulfil desires for immersion in nature and relaxation. While crowding has a mostly negative impact on PMTW anglers, this did not deter them from ranking these 'crowded' areas as their most preferred waters to fish.

This points to other important drivers of site choice among North Carolina trout anglers. HS and DH waters appear to be more easily accessible to the public as they are in higher order streams at lower altitudes ([Appendix C1-C3](#)). Also, these PMTWs are stocked and angler's may be more drawn to them by their perceived advantage of catching more fish. The present investigation, however, did not explicitly examine motivations for PMTW site choice. Further analysis could help identify characteristics of anglers that are drawn to certain stream classifications.

### ***Study Limitations***

The present study did not examine specific locations of PMTW use, so all streams were treated as homogenous within their classifications. However, the two proposed regulatory changes may disproportionately affect heavily visited sections of PMTW. For example, the Davidson River section of CRAFO waters is directly upstream from both the Bobby R. Setzer State Fish Hatchery and one of the most popular HS sections in the state (*Assessing Recreation, Access, and Scenery on the Nantahala and Pisgah National Forests*, 2014). It is likely that this section of CRAFO water may become more crowded than the other two CRAFO sections, due to the nature of this location. A similar phenomenon may also be expected in relation to easily accessible WILD-NB waters.

Additionally, the PMTW reclassification survey was open for over two months, and four reminder email initiations were sent, resulting in a final sample size of trout anglers large enough to capture 95% of the variance with a 3% margin of error (Vaske, 2008). Despite this large sample size, an official response rate of PMTW anglers could not be accurately calculated as the proportion of this group within the original sample frame was unknown.

The demographic composition of trout anglers in the sample (majority white, older males) is fairly common across conservation social science initiatives in North Carolina and the United States (US Department of the Interior et al. 2014; 2016). Based on the previous studies with the same population, there is little reason to believe that results are bias towards this demographic group (Responsive Management 2006, 2015c; Responsive Management and Southwick Associates 2009). However, while the demographic characteristics of the present investigation and the 2015 survey may appear to fairly close, the 2015 study had very low refusal rates. Because of this discrepancy, the relative frequencies of the demographics could not be compared accurately.

Also, the sampling methods used in the present study required potential survey participants to have email and mailing addresses on file with the WRC. This filtering eliminated over two-thirds of the full sample frame and introduced coverage error into the data collection. Coverage error occurs when there is a difference between respondents in the sample and those who were not covered in the sampling criteria, despite belonging to the total population (Dillman et al. 2014).

The combination of an unknown response rate of PMTW anglers, incomparable demographics from previous studies, and large reduction of sample by selection criteria indicate that managers should proceed with caution in generalizing these results to the greater PMTW angling community. The conclusions from this research do not represent North Carolina mountain trout anglers as a whole, but only represent the anglers within the sample. However, the findings may represent potential trends of the larger angling community and may be used critically in future decision making.

### ***Conclusion***

The two aforementioned regulatory changes were not proposed to fulfil an ecological goal (e.g., reduce mortality), but rather to simplify the management structure to reduce barriers for anglers. While there was majority support for both changes, management must assess the equity of these two regulatory changes and consider how it will impact present and future PMTW angler satisfaction. Future interagency social science work could help monitor the effects of these changes and highlight the heterogeneity of attitudes and motivations of this diverse stakeholder group. Such efforts will help the WRC guide its management and increase use and satisfaction associated with North Carolina's trout fishery.

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# Appendices

## *Appendix A: Outreach materials*

*A1: 1<sup>st</sup> email invite – all potential respondents in random sample*

Subject: Please share you N.C. trout angling experiences with the WRC

Hello \${m://FirstName},

**Please join other anglers in sharing your experiences trout fishing in North Carolina. We want to hear from you even if you do not trout fish often!**

Complete the survey by March 31, 2020 for a chance to win one of six \$50 Bass Pro Shop Gift Cards\*.

Your participation in this study will help the N.C. Wildlife Resources Commission develop policies that benefit the trout fishery and anglers like you!

The N.C. Wildlife Resources Commission is responsible for managing the state’s mountain trout by creating fishing rules, stocking trout, studying the number of trout in streams, protecting native Brook trout, and completing research. Because you had a license that allowed you to fish for mountain trout in North Carolina in 2019, the N.C. Wildlife Resources Commission is eager to hear from you about your experiences and perspectives on trout fishing.

**This survey is open until March 31, 2020.**

- Please allow 10-15 minutes to complete the survey
- Participation is voluntary and you may stop at any time
- Responses will be combined, kept confidential, and will not be used to identify you

**Visit this link to complete the online survey:** \${l://SurveyLink?d=Take%20the%20Survey}

Or copy and paste the URL below into your internet browser:

\${l://SurveyURL}

If you have any questions, please email [surveys@ncwildlife.org](mailto:surveys@ncwildlife.org) or call 919-707-4002.

Thank you for your time and participation!

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\* Participants who complete the survey will be entered into a drawing to win one of six \$50 Bass Pro Shop Gift Cards. Winners will be randomly selected and notified via email after the survey closes. If a raffle winner does not respond by 11:59pm, 14 days after the email notification, a new winner will be randomly selected and notified.

Follow the link to opt out of future emails:

\${l://OptOutLink?d=Click here to unsubscribe}

*A2: 2<sup>nd</sup> email invite – all unfinished potential respondents in random sample*

Subject: Reminder: Share your experience trout angling with the WRC

Hello \${m://FirstName},

A while ago we sent you a survey asking about your experiences angling in North Carolina. We would really love to hear from you, even if you do not fish very often or are a beginner angler!

**Also, you have a chance to win one of six \$50 gift cards to Bass Pro Shops!\***

Please participate, as your input helps the N.C. Wildlife Resources Commission develop policies that benefit the fisheries and anglers like you!

This is the final reminder email, and the survey will close on March 31st, 2020.

**Follow this link to the Survey:**

[\\${l://SurveyLink?d=Take the Survey}](#)

Or copy and paste the URL below into your internet browser:

[\\${l://SurveyURL}](#)

If you have any questions, please email [surveys@ncwildlife.org](mailto:surveys@ncwildlife.org) or call 919-707-4002.

Thank you for your time and participation!

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\* Participants who complete the survey will be entered into a drawing to win one of six \$50 Bass Pro Shop Gift Cards. Winners will be randomly selected and notified via email after the survey closes. If a raffle winner does not respond by 11:59pm, 14 days after the email notification, a new winner will be randomly selected and notified.

Follow the link to opt out of future emails:

[\\${l://OptOutLink?d=Click here to unsubscribe}](#)

*A3: 3<sup>rd</sup> email invite – all unfinished potential respondents in random sample*

Subject: Please share your N.C. trout angling experiences with the WRC

Hello \${m://FirstName},

A while ago we sent you a survey asking about your experiences angling in North Carolina. We would really love to hear from you, even if you do not fish very often or are a beginner angler!

**Also, you have a chance to win one of six \$50 gift cards to Bass Pro Shops!\***

Please participate, as your input helps the N.C. Wildlife Resources Commission develop policies that benefit the fisheries and anglers like you!

This is the final reminder email, and the survey will close on March 31st, 2020.

**Follow this link to the Survey:**

[\\${l://SurveyLink?d=Take the Survey}](#)

Or copy and paste the URL below into your internet browser:

[\\${l://SurveyURL}](#)

If you have any questions, please email [surveys@ncwildlife.org](mailto:surveys@ncwildlife.org) or call 919-707-4002.

Thank you for your time and participation!

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\* Participants who complete the survey will be entered into a drawing to win one of six \$50 Bass Pro Shop Gift Cards. Winners will be randomly selected and notified via email after the survey closes. If a raffle winner does not respond by 11:59pm, 14 days after the email notification, a new winner will be randomly selected and notified.

Follow the link to opt out of future emails:

[\\${l://OptOutLink?d=Click here to unsubscribe}](#)

*A4: Final email invite – all unfinished potential respondents in random sample*

Subject: Please share your N.C. angling experiences with the WRC

Hello \${m://FirstName},

The North Carolina Wildlife Resources Commission is interested in hearing about your experiences angling in North Carolina. We would really love to hear from you, even if you do not fish very often or are a beginner angler!

**Also, you have a chance to win one of six \$50 gift cards to Bass Pro Shops!\***

Please participate, as your input helps the N.C. Wildlife Resources Commission develop policies that benefit the fisheries and anglers like you!

We thought we would send out one more reminder email, as many individuals are staying at home during the COVID-19 pandemic. This is the last reminder email (we promise), and the survey will close on March 31st, 2020.

**Follow this link to the Survey:**

[\\${l://SurveyLink?d=Take the Survey}](#)

Or copy and paste the URL below into your internet browser:

[\\${l://SurveyURL}](#)

If you have any questions, please email [surveys@ncwildlife.org](mailto:surveys@ncwildlife.org) or call 919-707-4002 (limited access). Thank you for your time and participation!

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\* Participants who complete the survey will be entered into a drawing to win one of six \$50 Bass Pro Shop Gift Cards. Winners will be randomly selected and notified via email after the survey closes. If a raffle winner does not respond by 11:59pm, 14 days after the email notification, a new winner will be randomly selected and notified.

Follow the link to opt out of future emails:

[\\${l://OptOutLink?d=Click here to unsubscribe}](#)

*A5: Thank you email – all respondents who completed the survey*

Subject: Trout Angling Survey Thank You

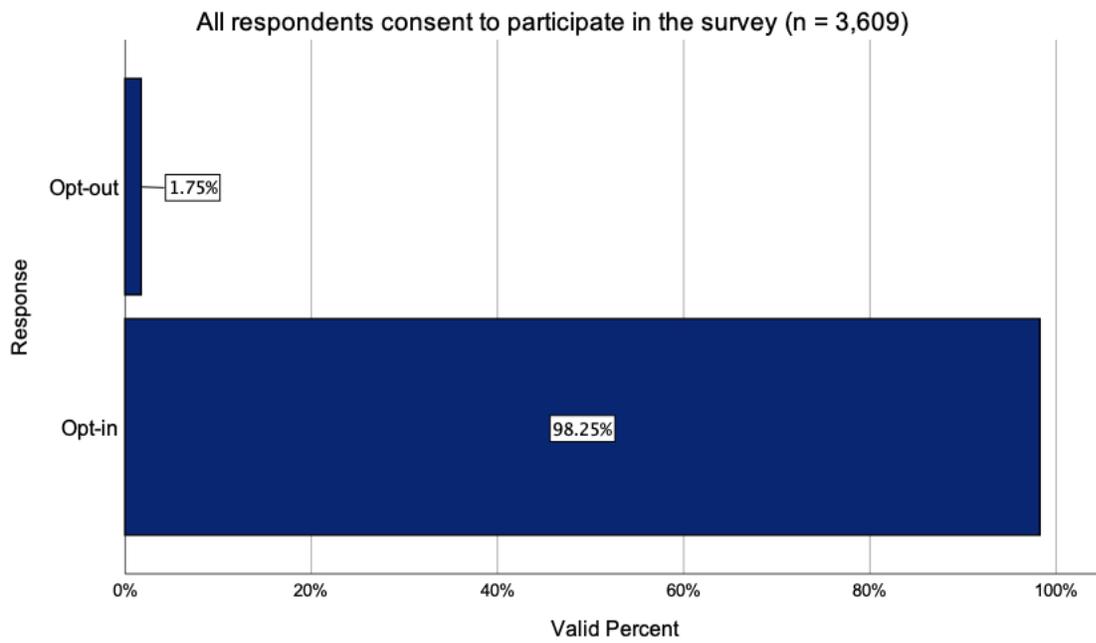
Thank you for participating in the Trout Angling Survey. We really appreciate your responses!

If you won one of the six Bass Pro Shop Gift Cards, a N.C. WRC Staff Member will be emailing you in the next couple of weeks.

Follow the link to opt out of future emails:  
\${1://OptOutLink?d=Click here to unsubscribe}

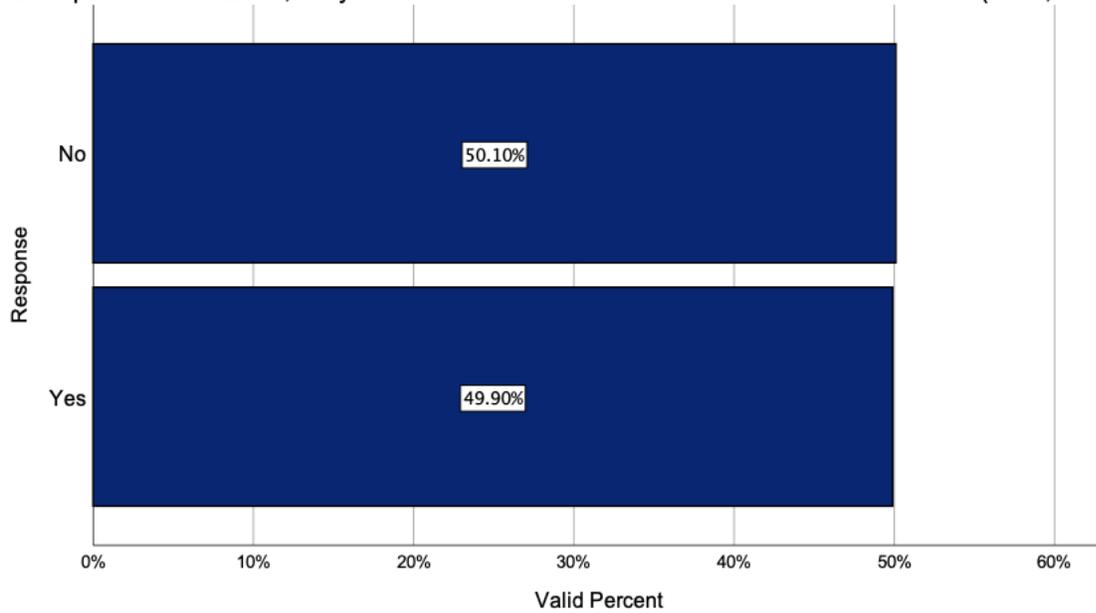
**Appendix B: Frequency figures of all survey questions**

*B1: Screening question 1: Consent to participate and at least 18 years old*

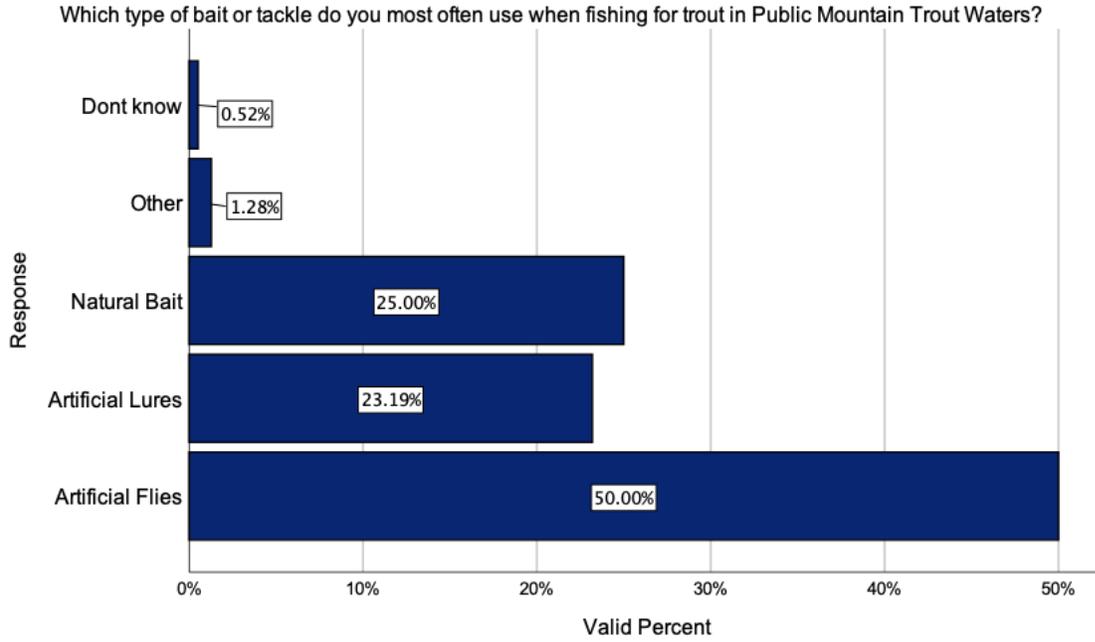


*B2: Screening question 2: Angling in PMTWs in 2019*

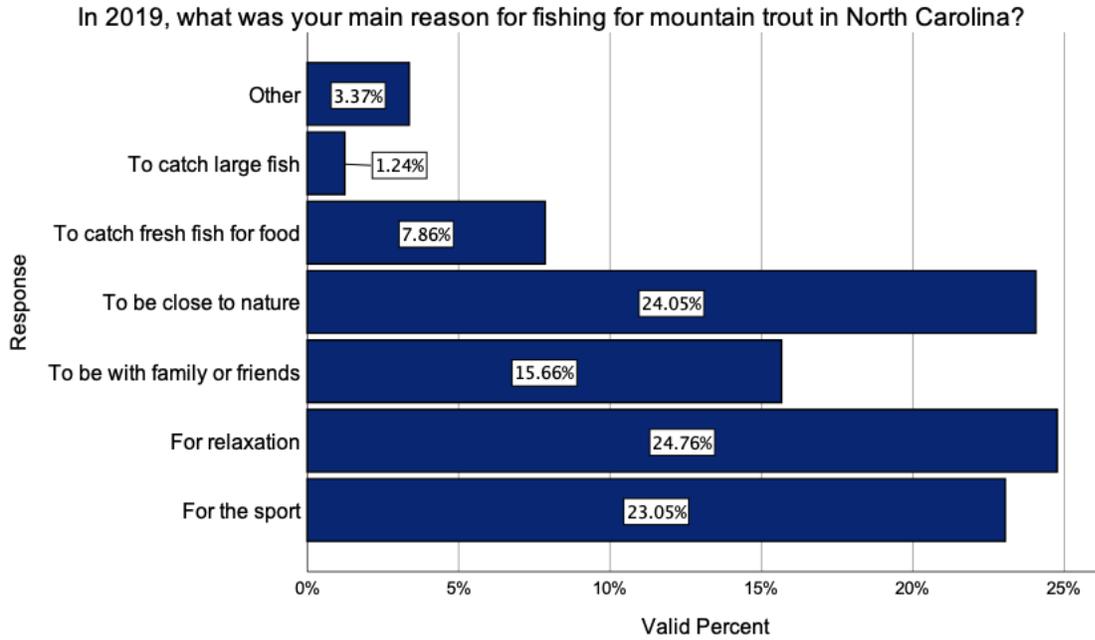
All responses to 'In 2019, did you fish for trout in NC's Public Mountain Trout Waters?' (n = 3,497)



*B3: Bait or tackle used most often*

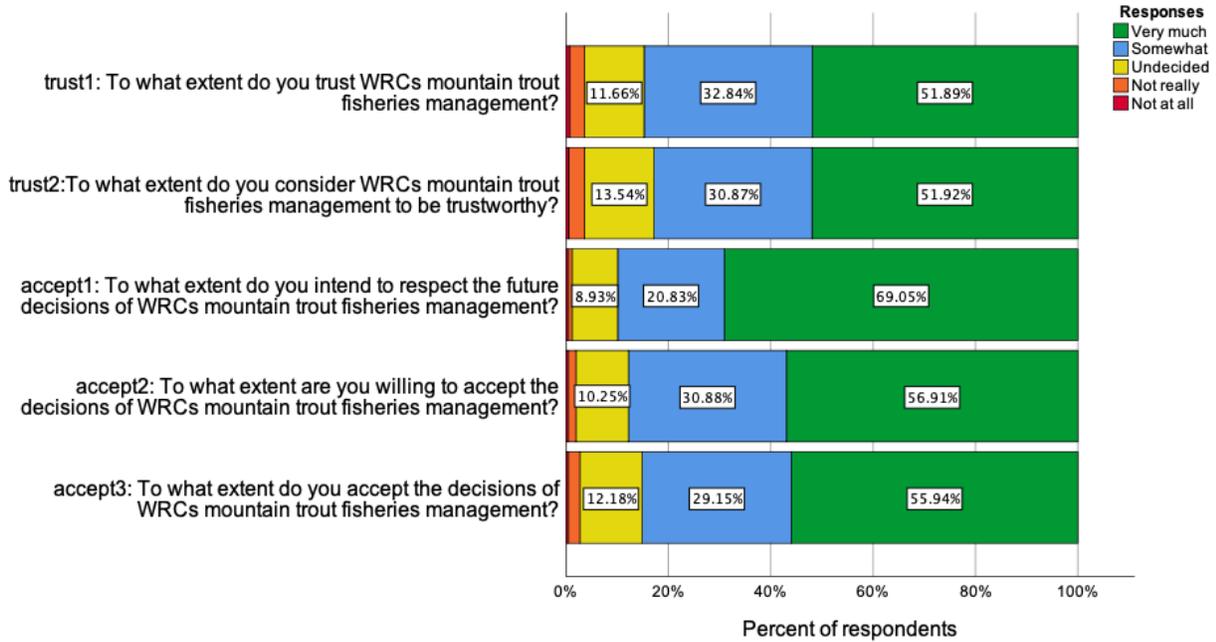


*B4: Motives for angling in PMTWs*



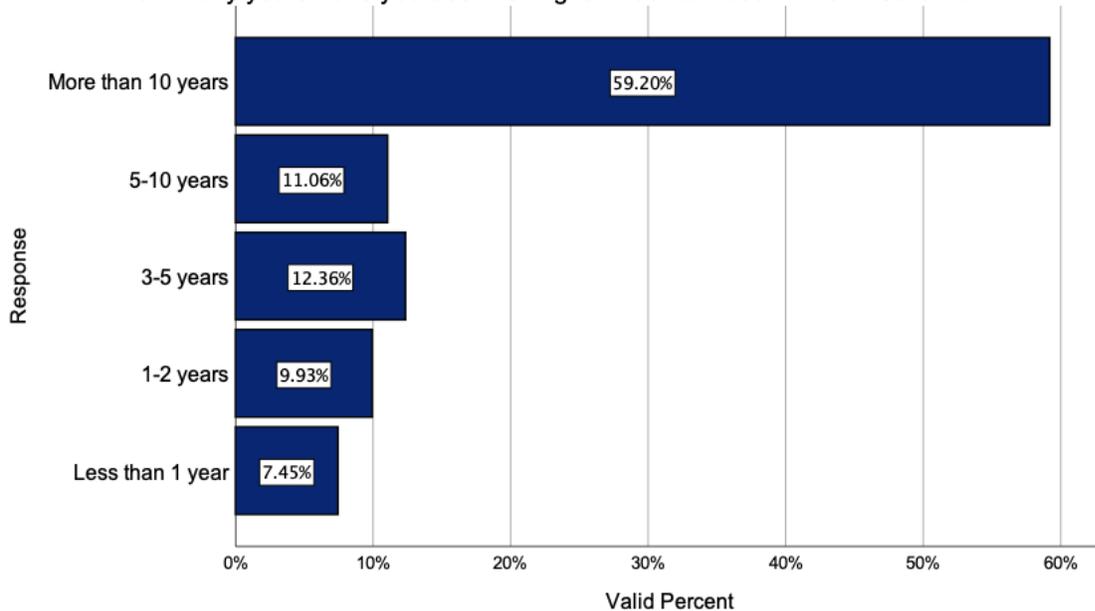
*B5: Trust and acceptance in WRC's mountain trout fisheries management*

PMTW angler's trust and acceptability in WRC's mountain trout fishery management

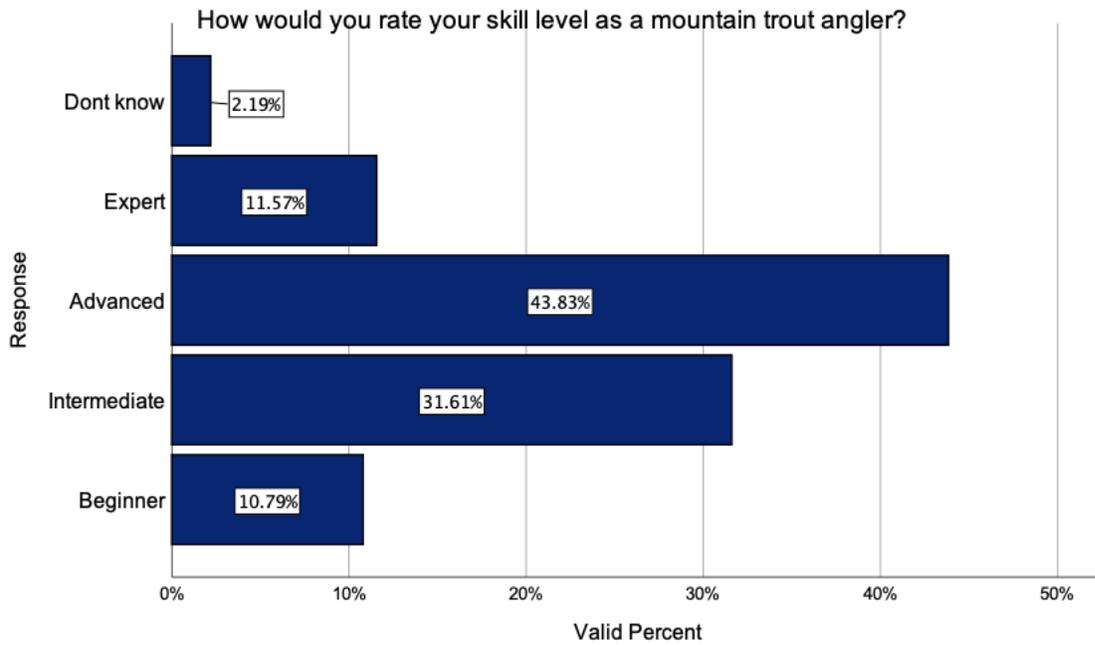


*B6: Number of years fishing for mountain trout*

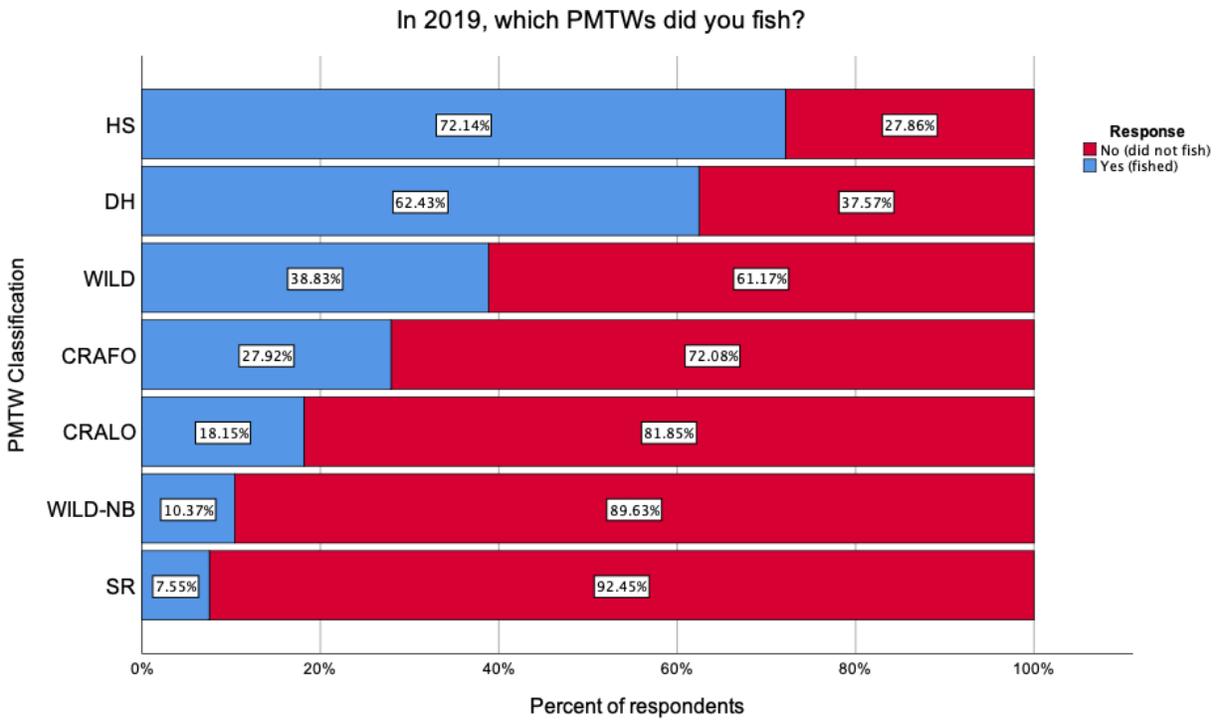
How many years have you been fishing for mountain trout in North Carolina?



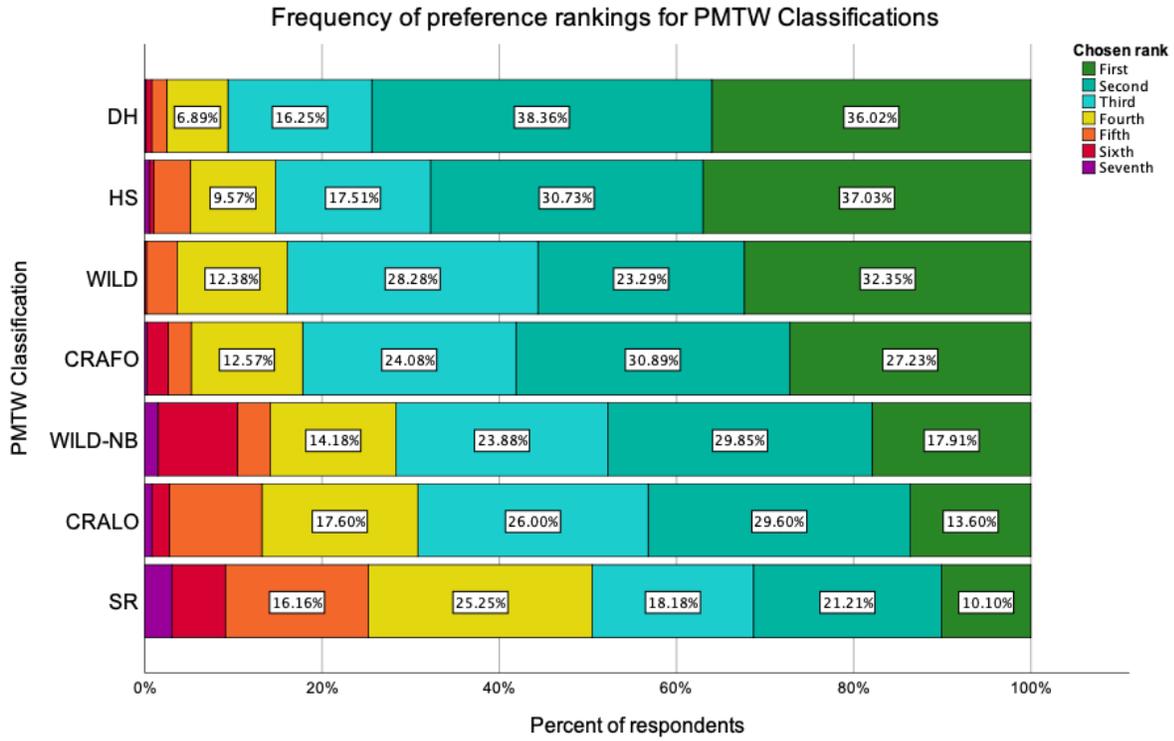
*B7: Angling skill level*



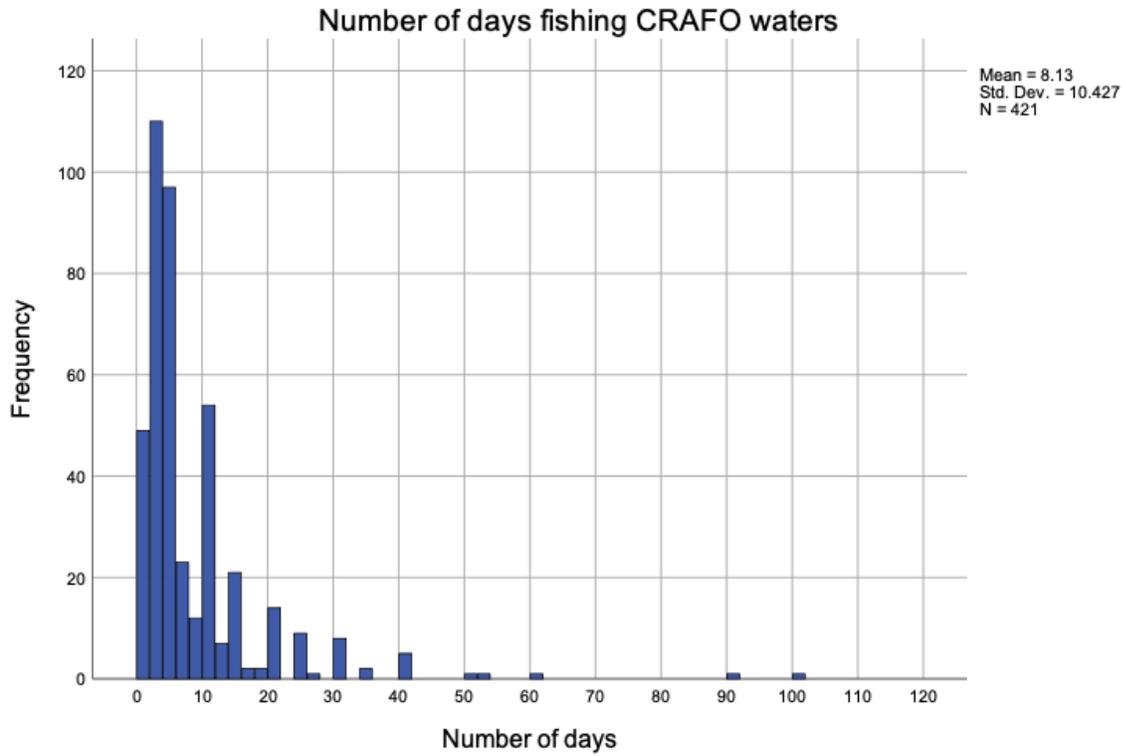
*B8: PMTWs fished*



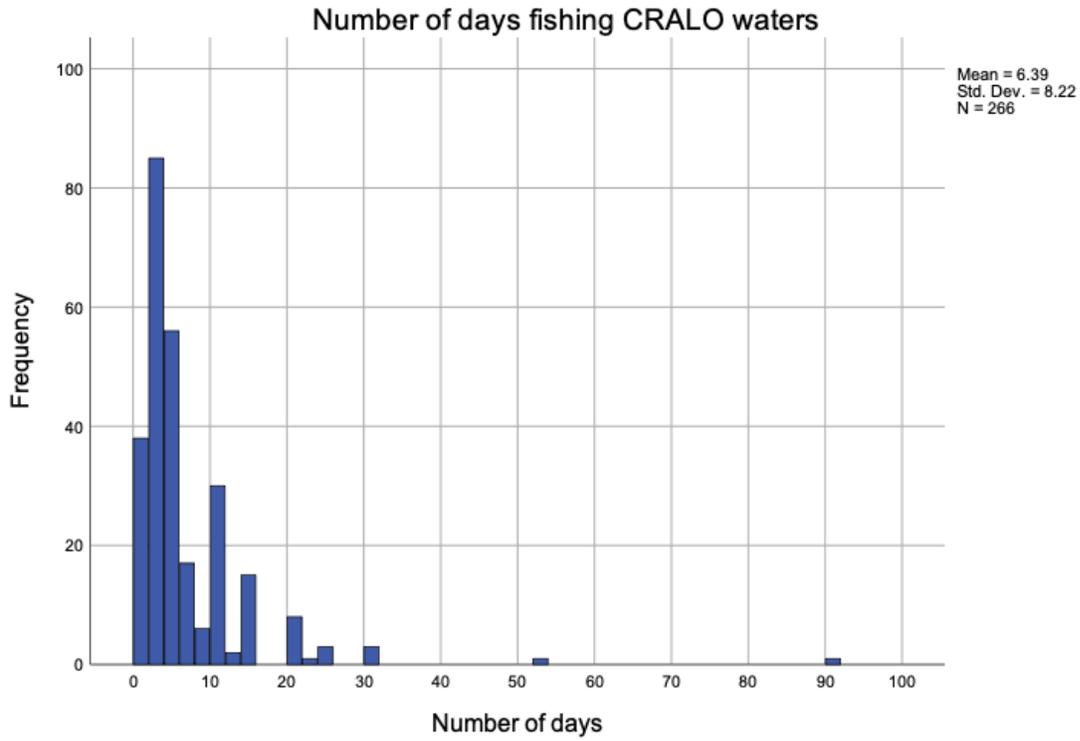
B9: PMTW preference rankings



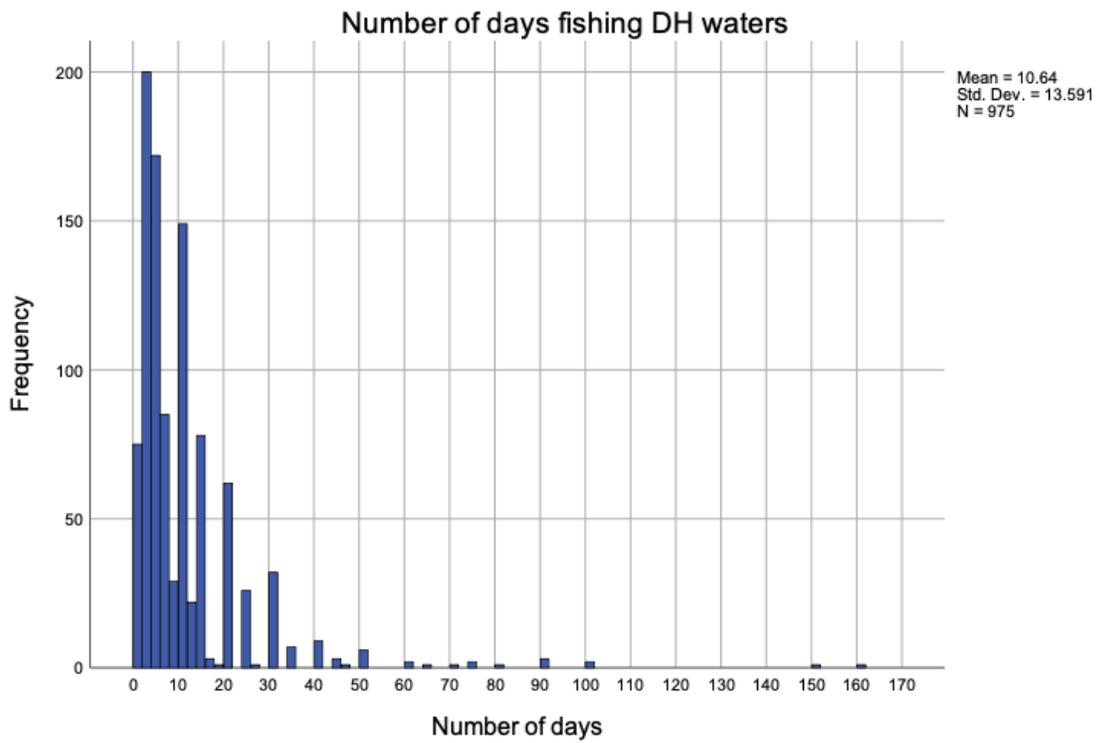
B10: Number of days fishing CRAFO waters



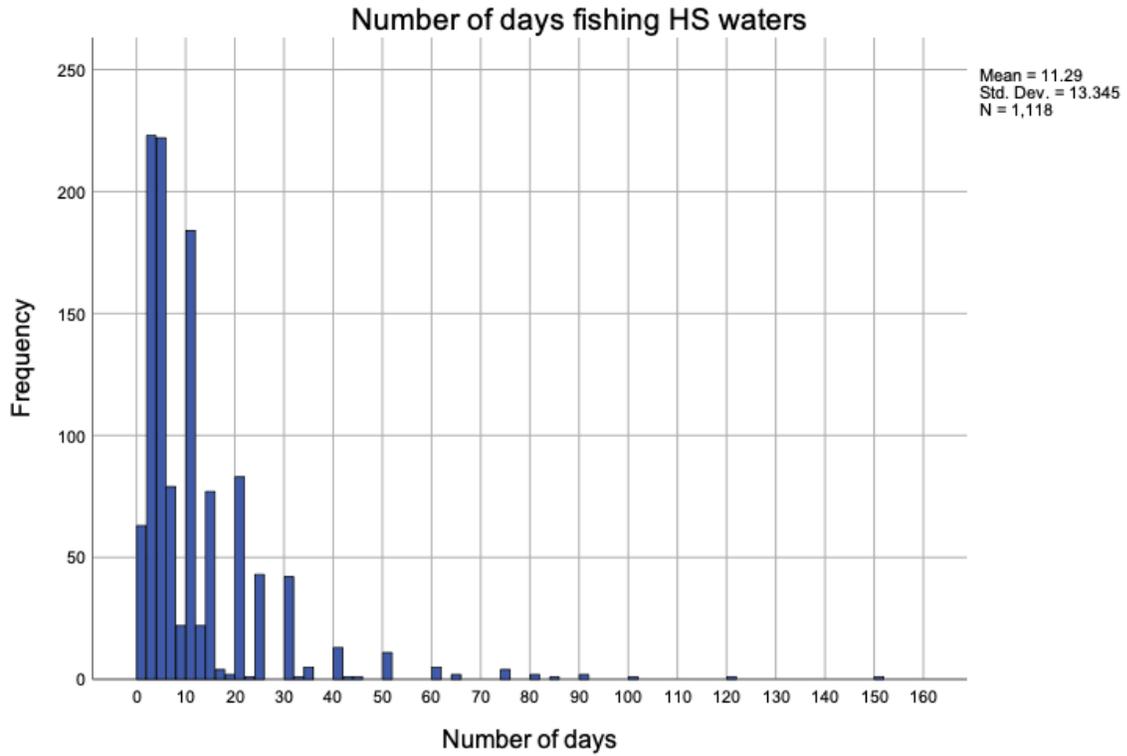
B11: Number of days fishing CRALO waters



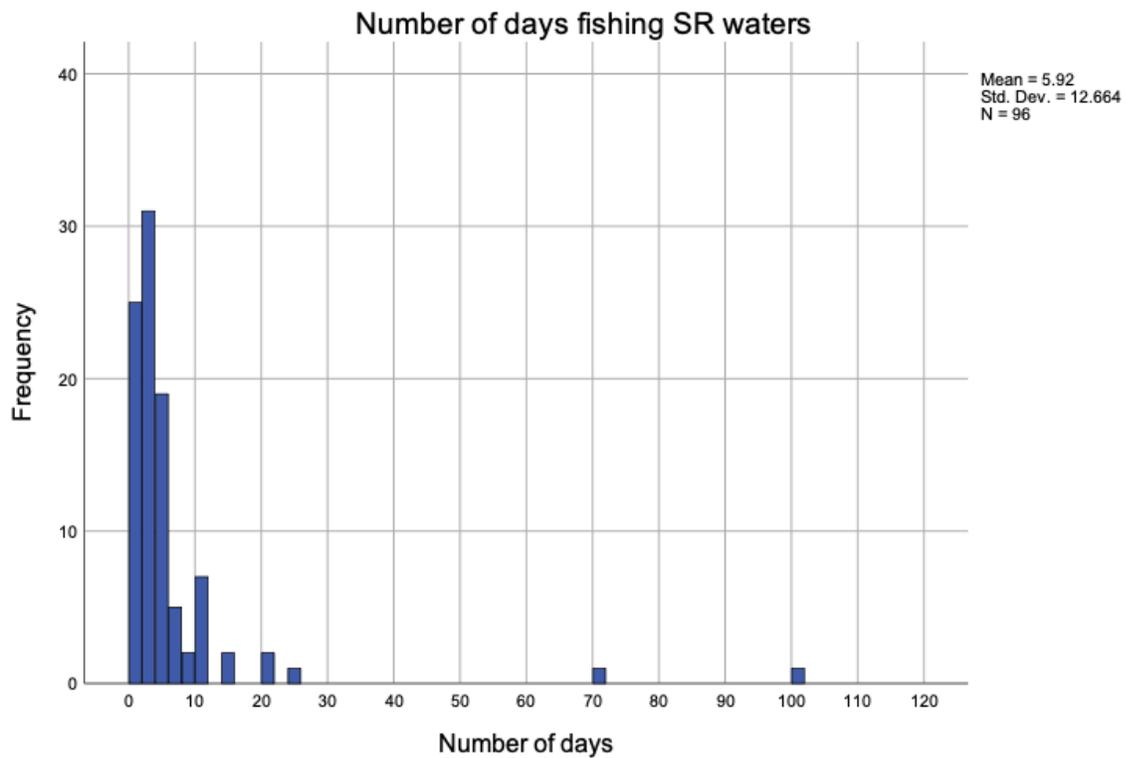
B12: Number of days fishing DH waters



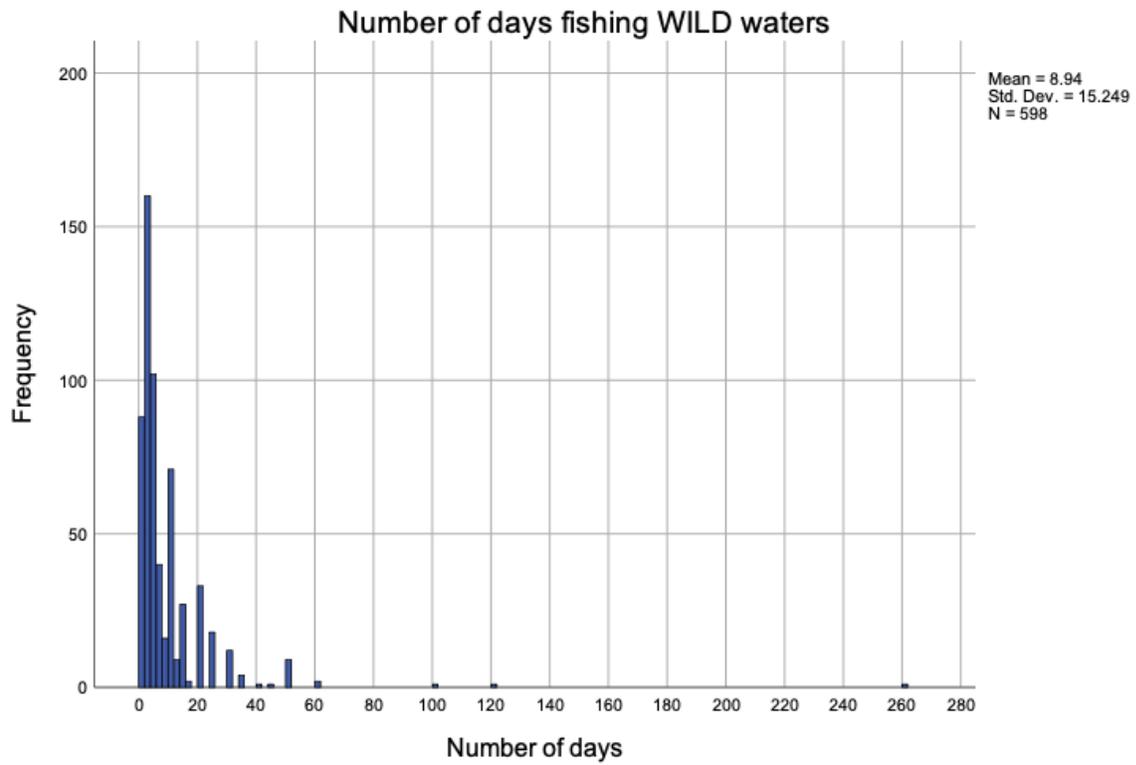
B13: Number of days fishing HS waters



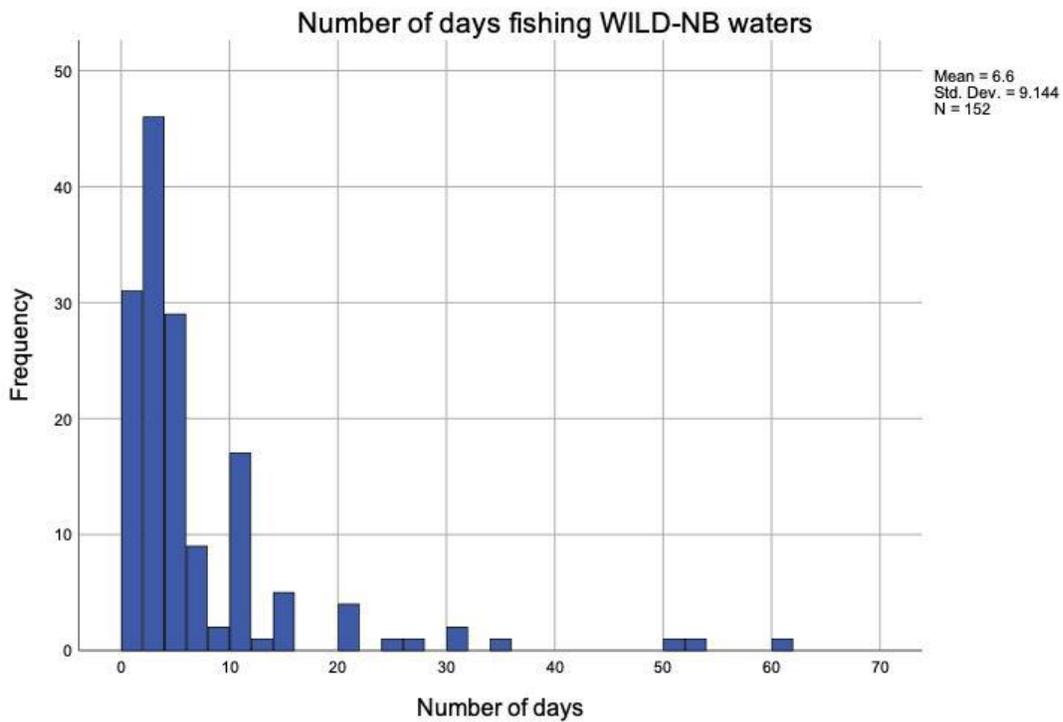
B14: Number of days fishing SR waters



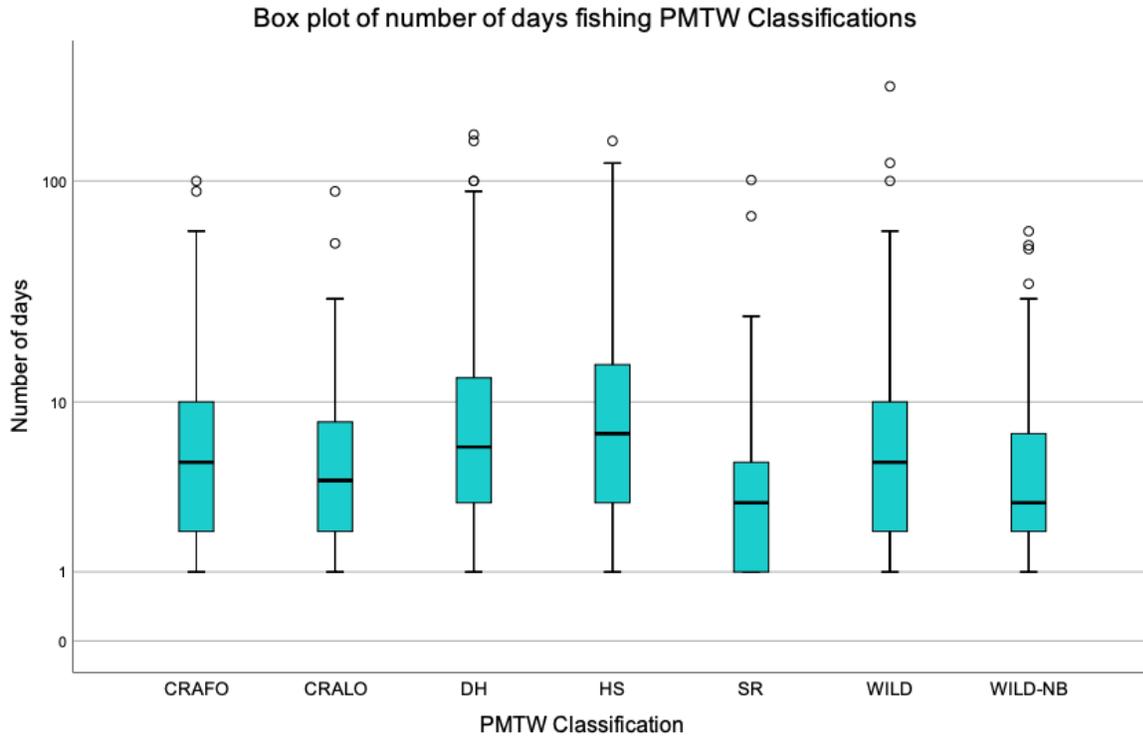
*B15: Number of days fishing WILD waters*



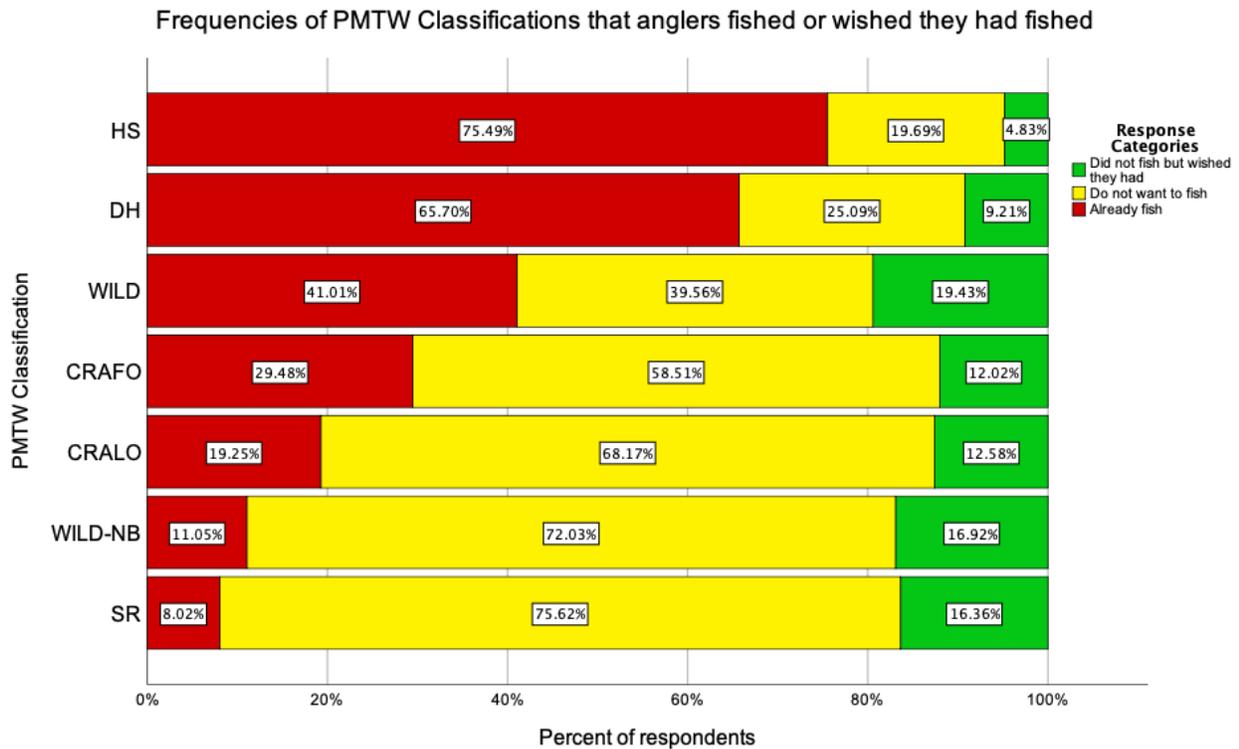
*B16: Number of days fishing WILD-NB waters*



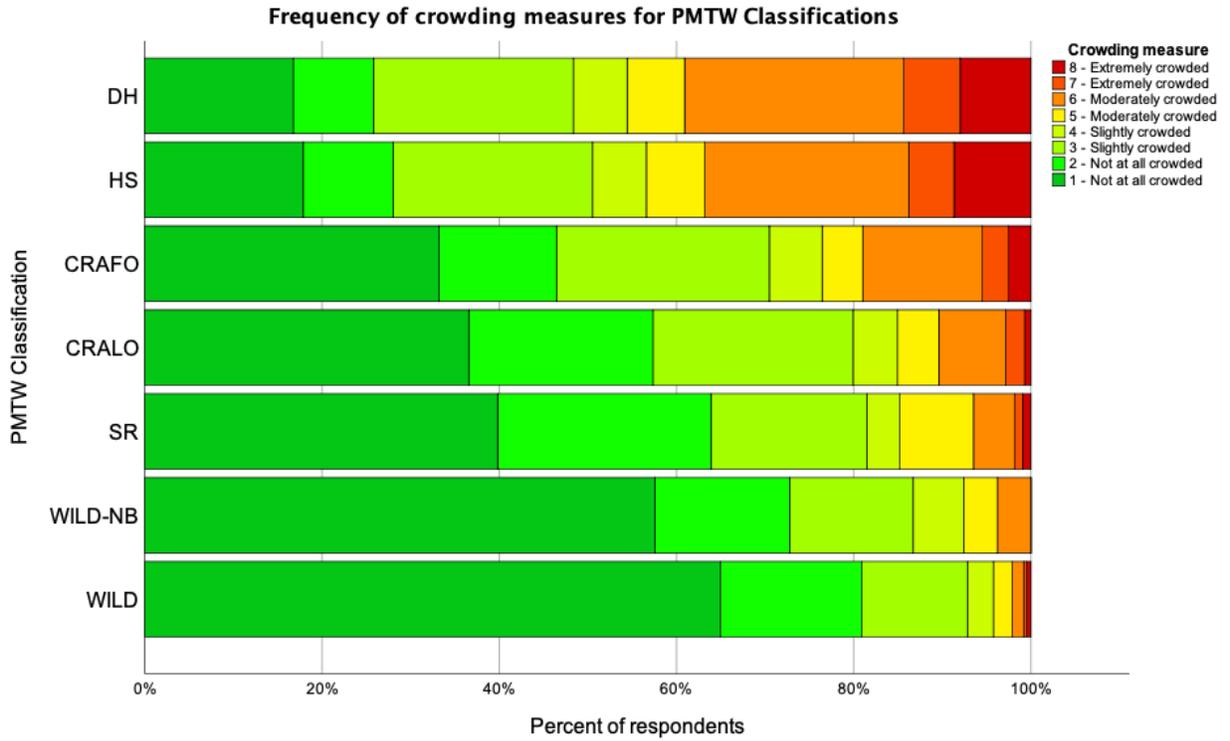
B17: Number of days fishing boxplot



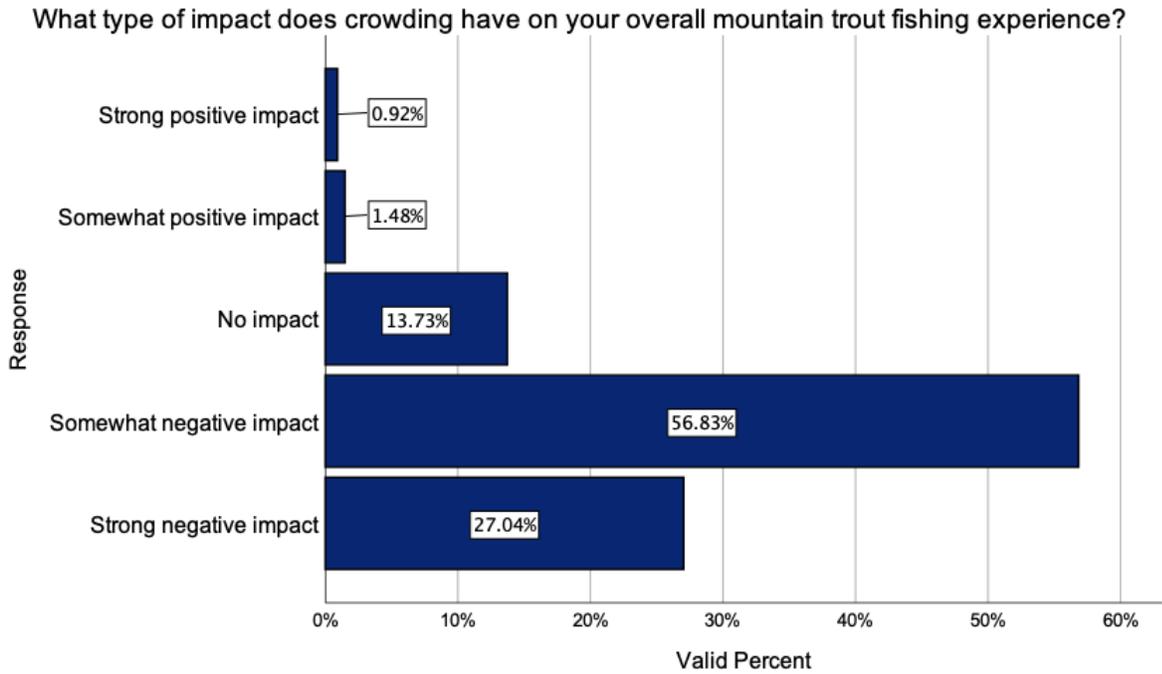
B18: Frequency of PMTWs that anglers wished they had fished in 2019



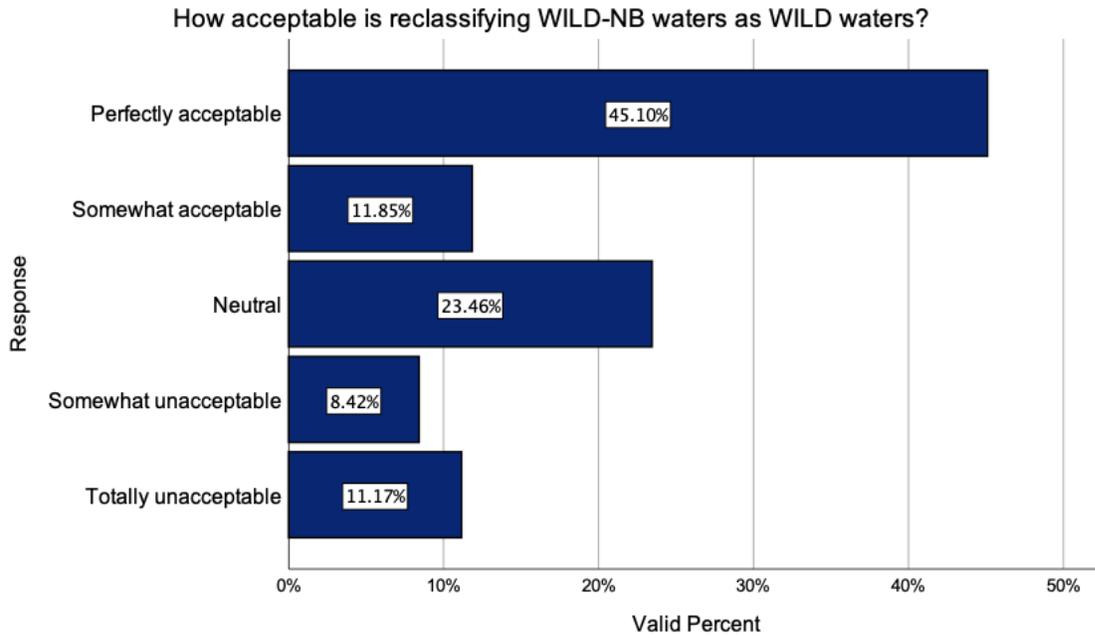
B19: PMTW crowding



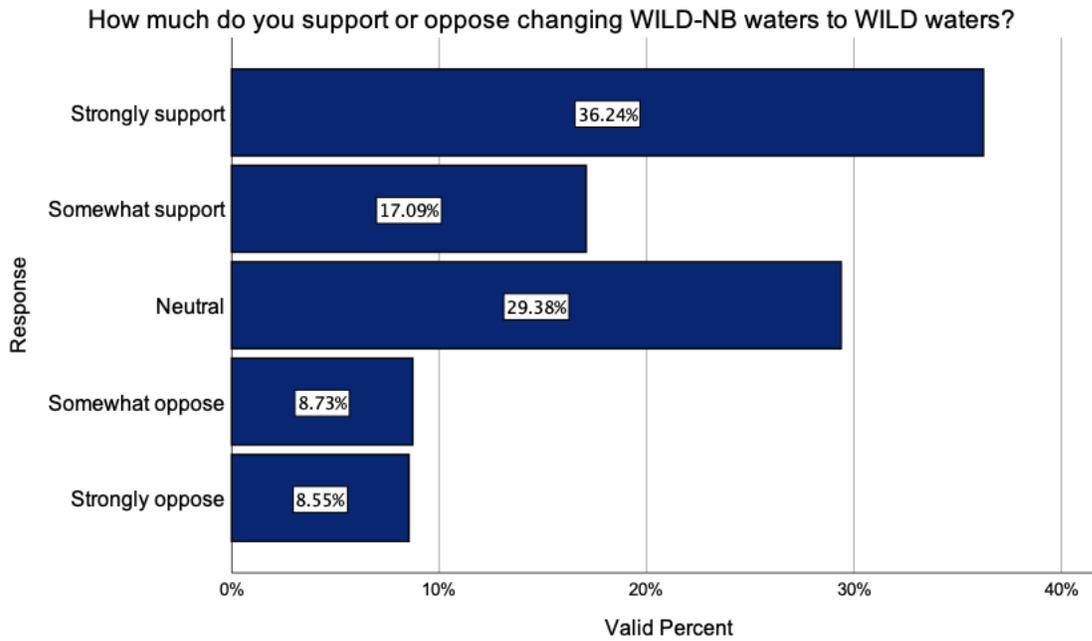
B20: Crowding impact



*B21: WILD-NB regulation change – Acceptability*

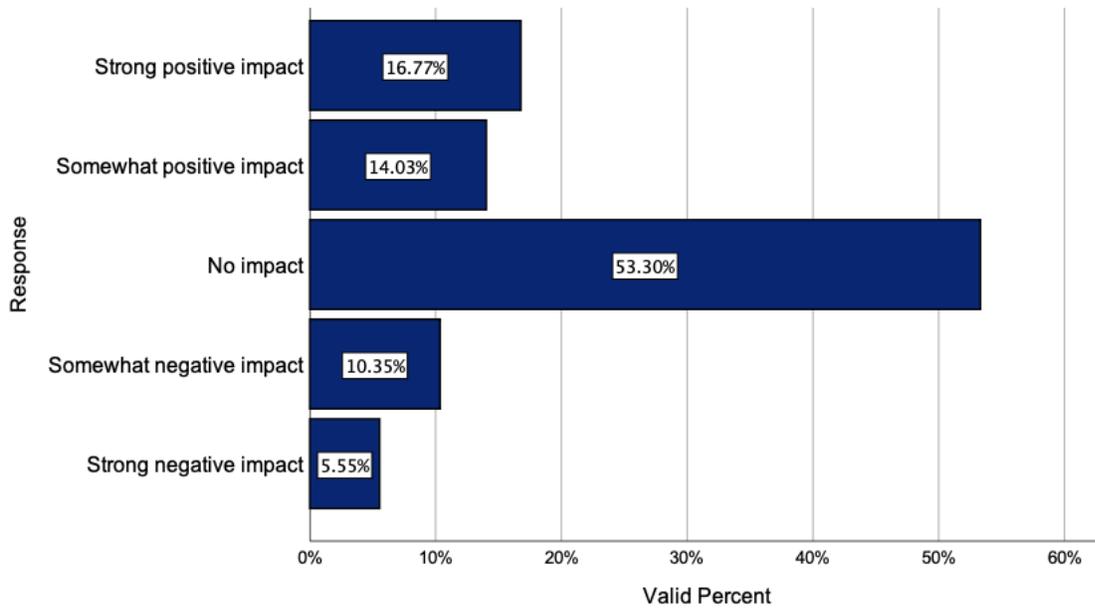


*B22: WILD-NB regulation change – Support/Opposition*



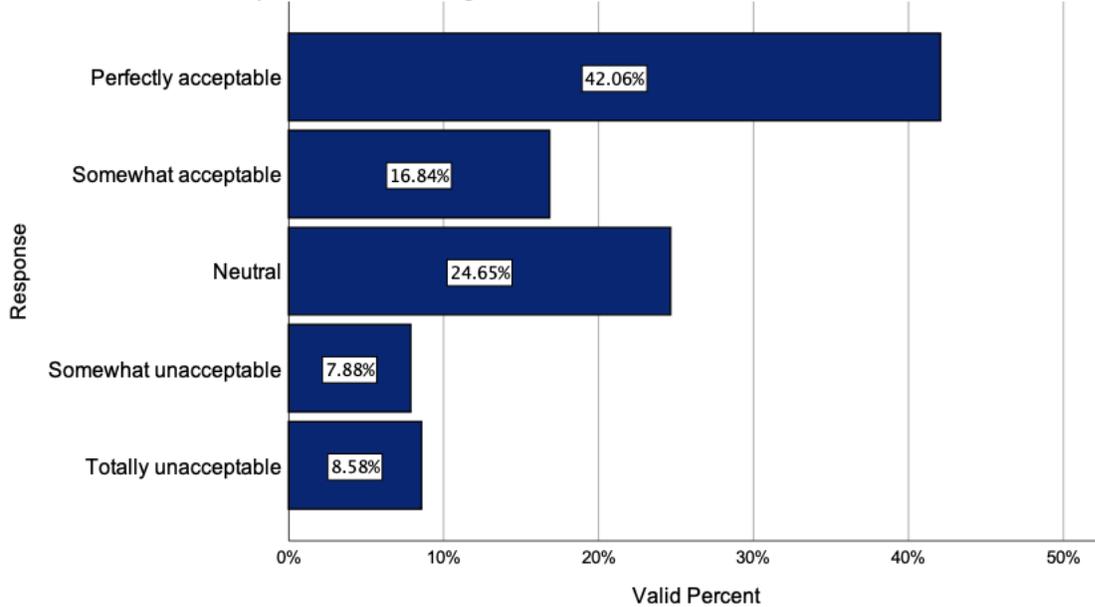
*B23: WILD-NB regulation change – Impact*

What type of impact would changing WILD-NB waters to WILD waters have on your mountain trout fishing experience?

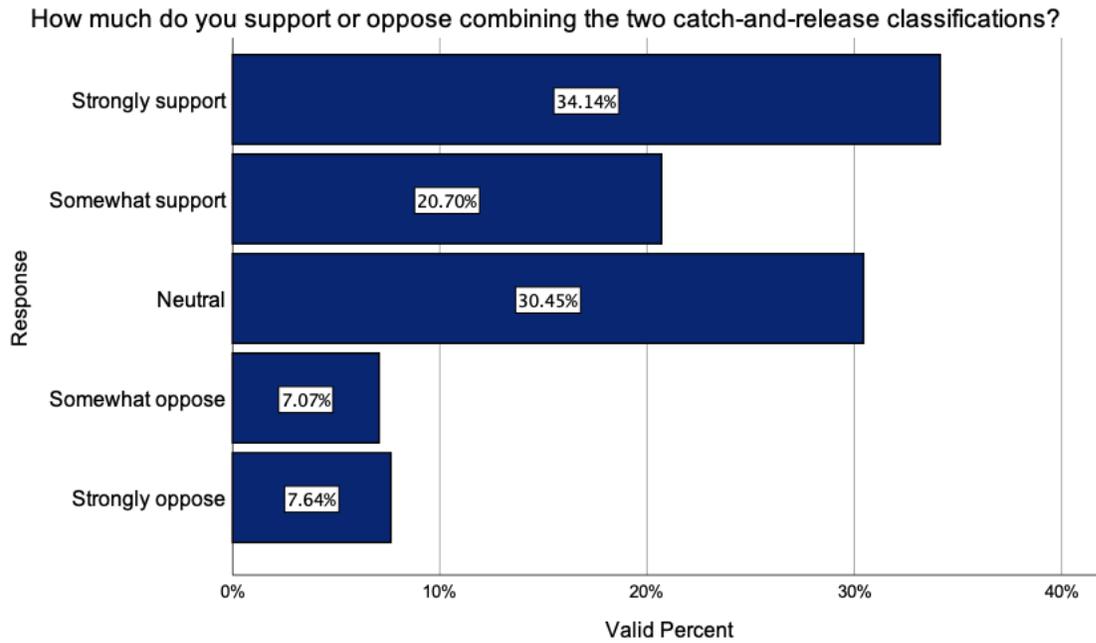


*B24: CR regulation change – Acceptability*

How acceptable is combining the two catch-and-release classifications?

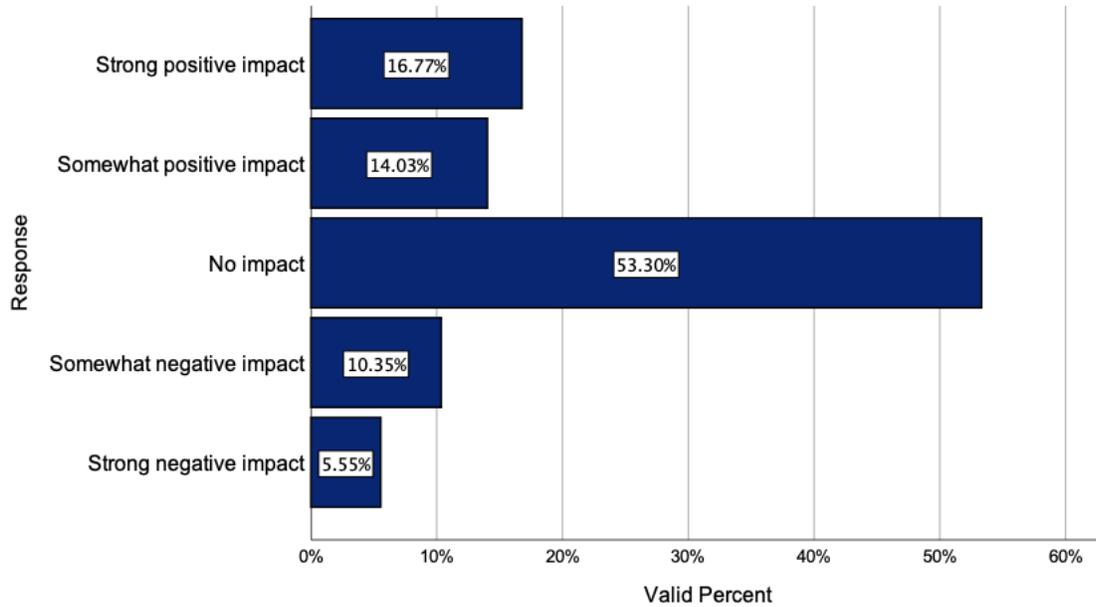


*B25: CR regulation change – Support/Opposition*

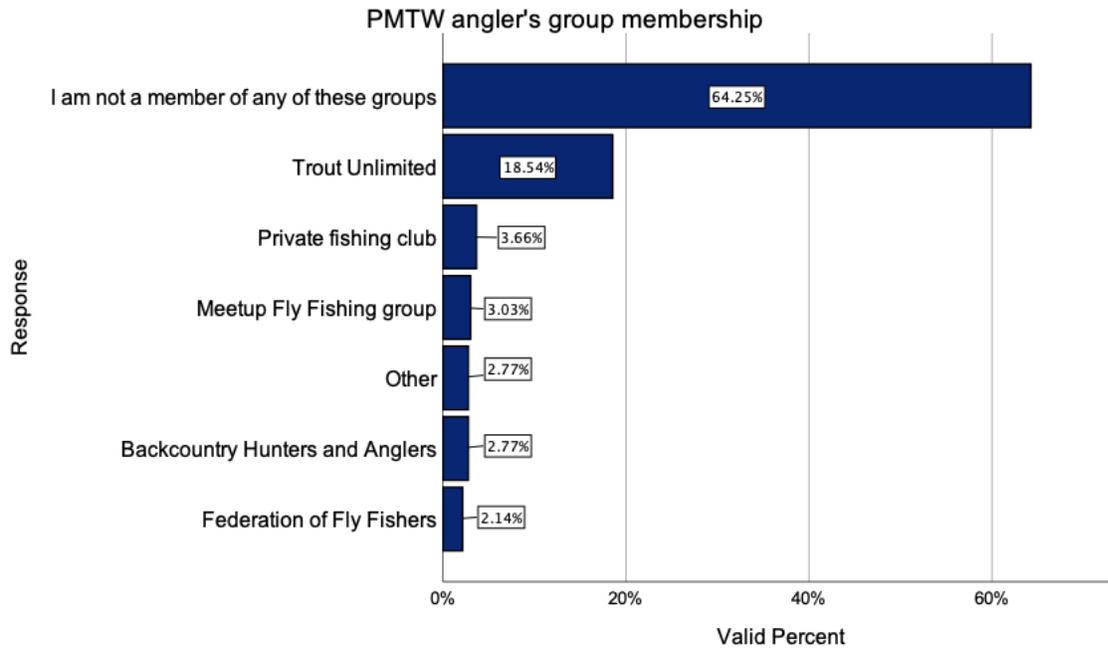


*B26: CR regulation change – Impact*

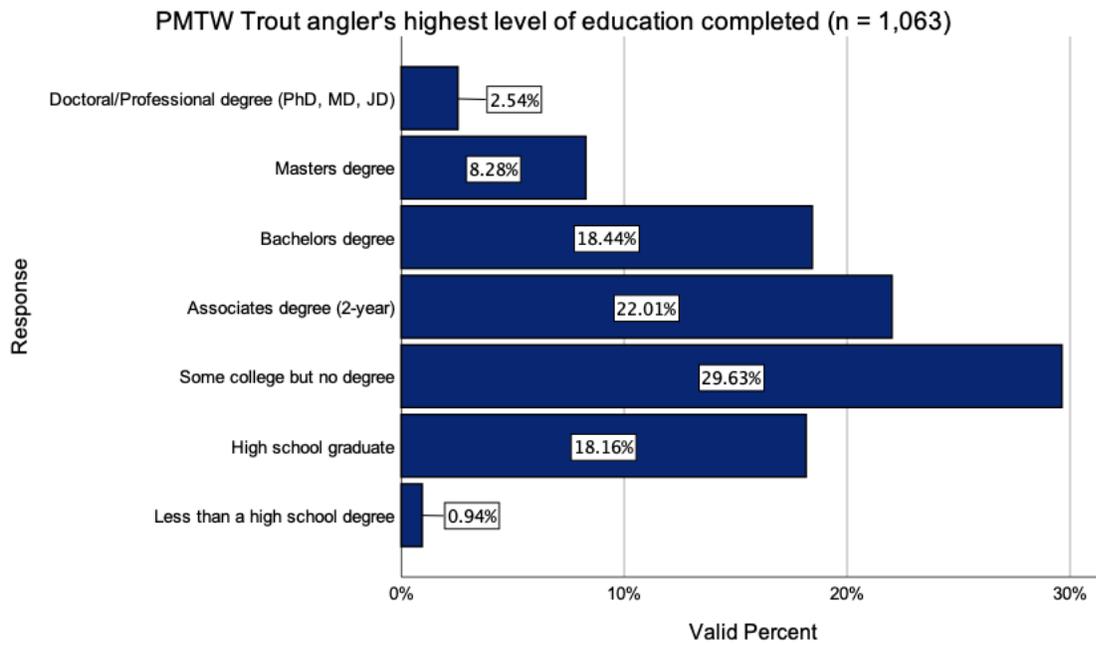
What type of impact would changing WILD-NB waters to WILD waters have on your mountain trout fishing experience?



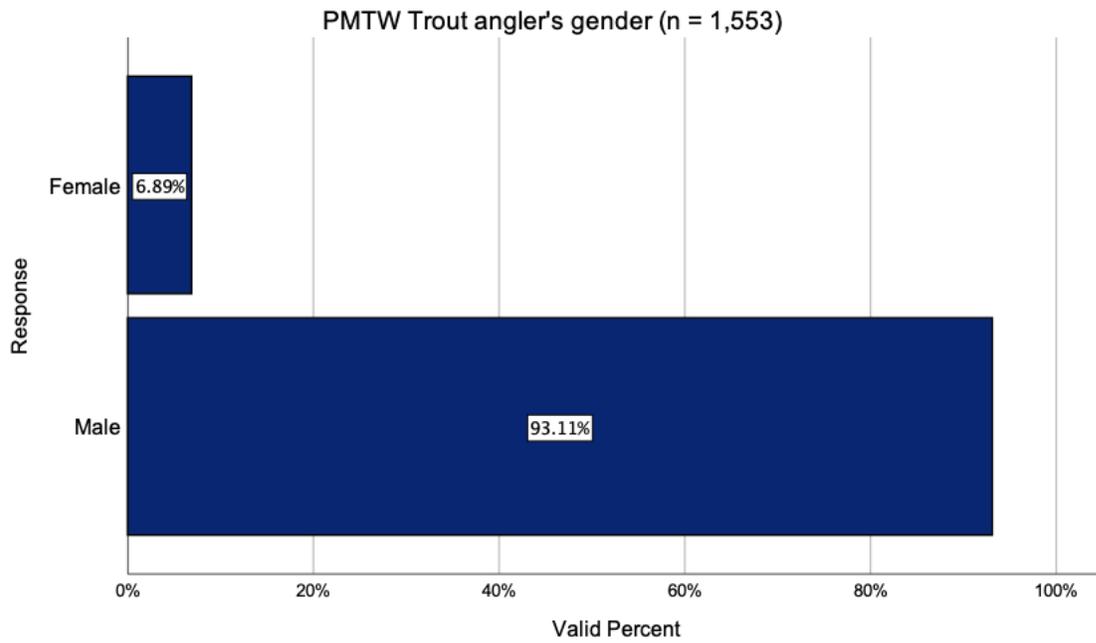
B27: Angling group membership



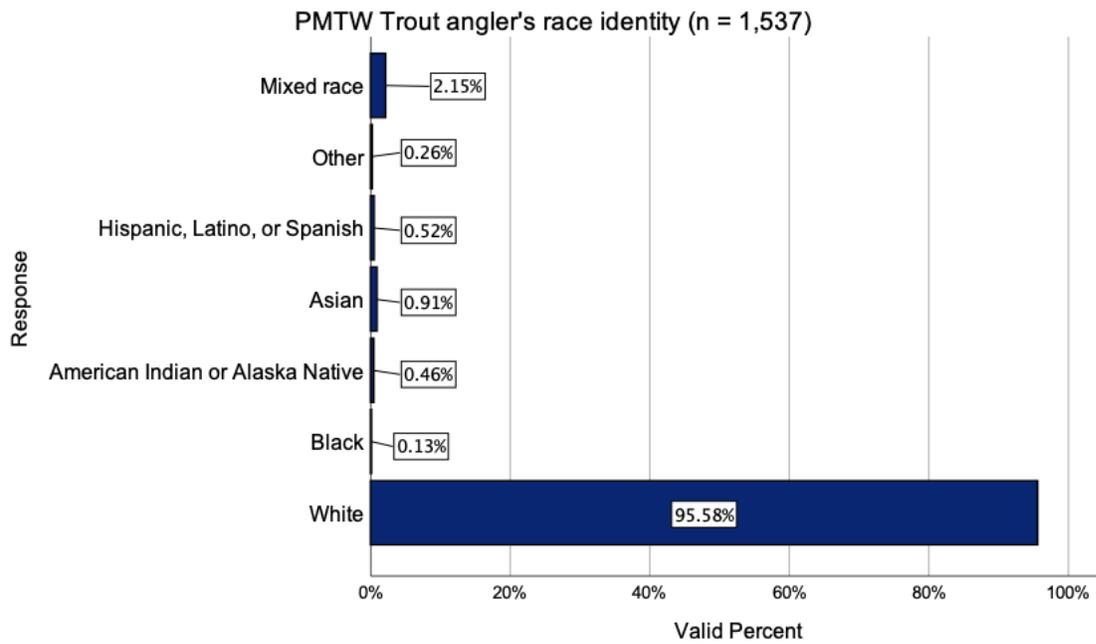
B28: Education



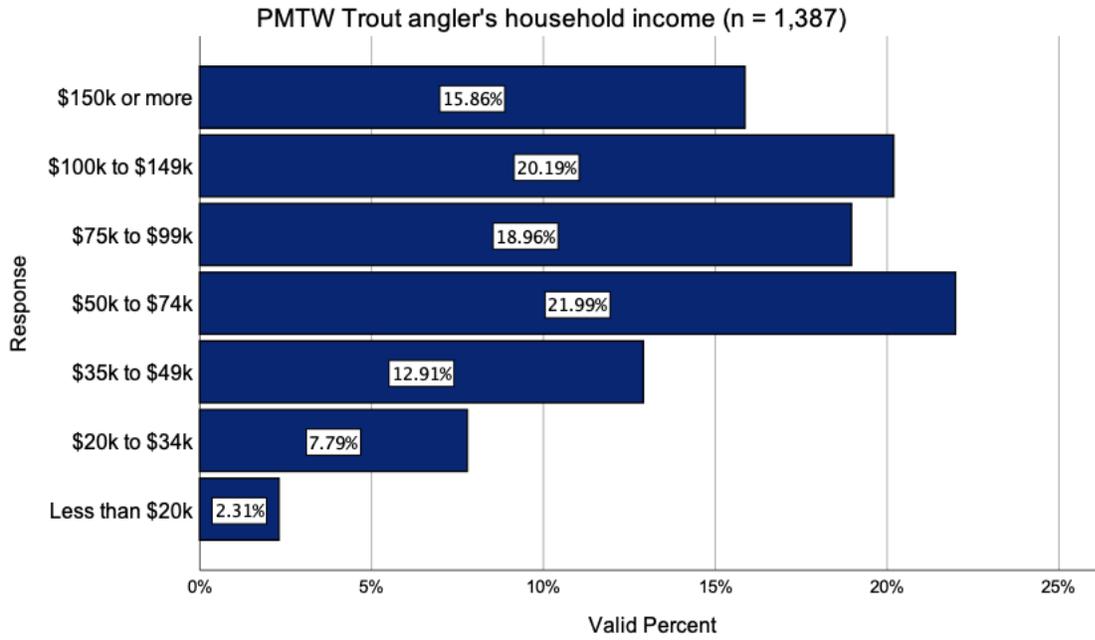
*B29: Gender*



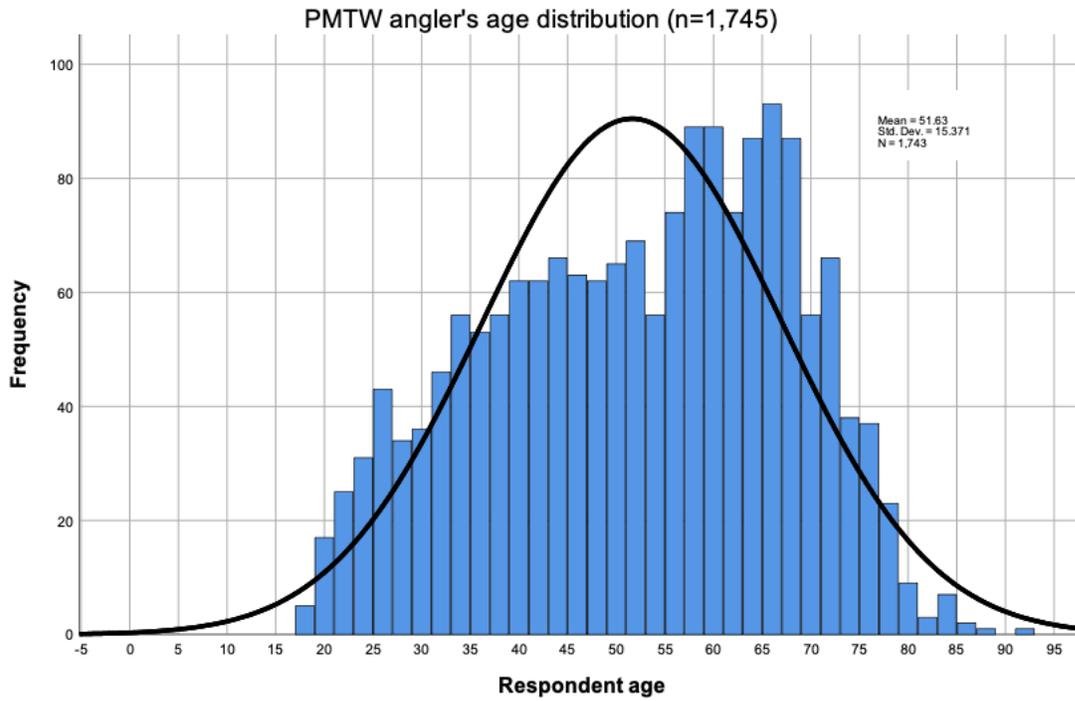
*B30: Race identity*



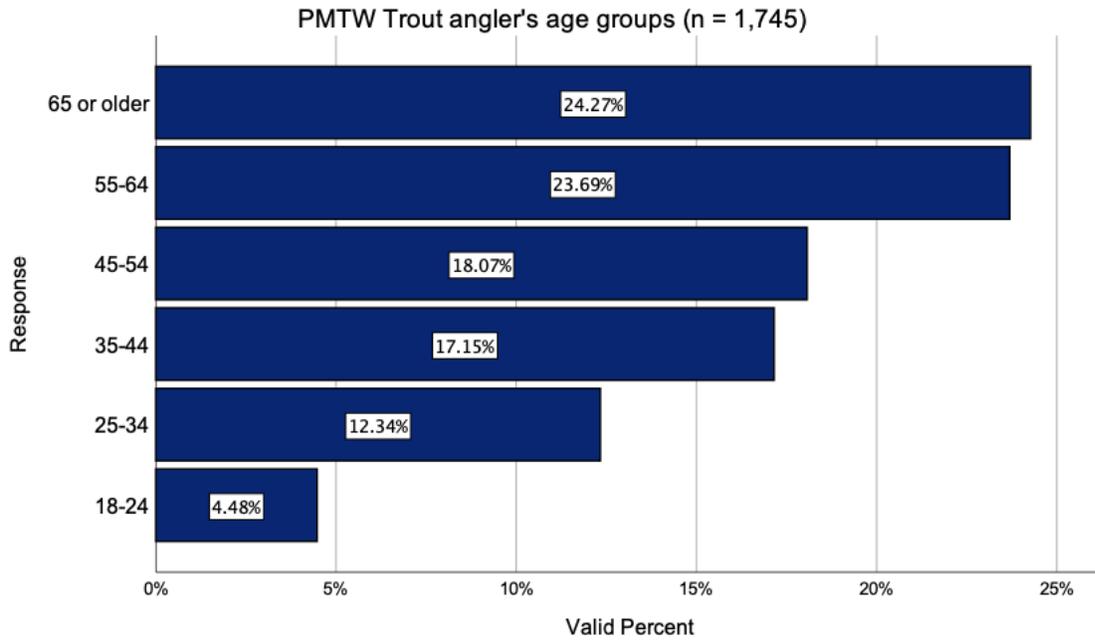
B31: Income



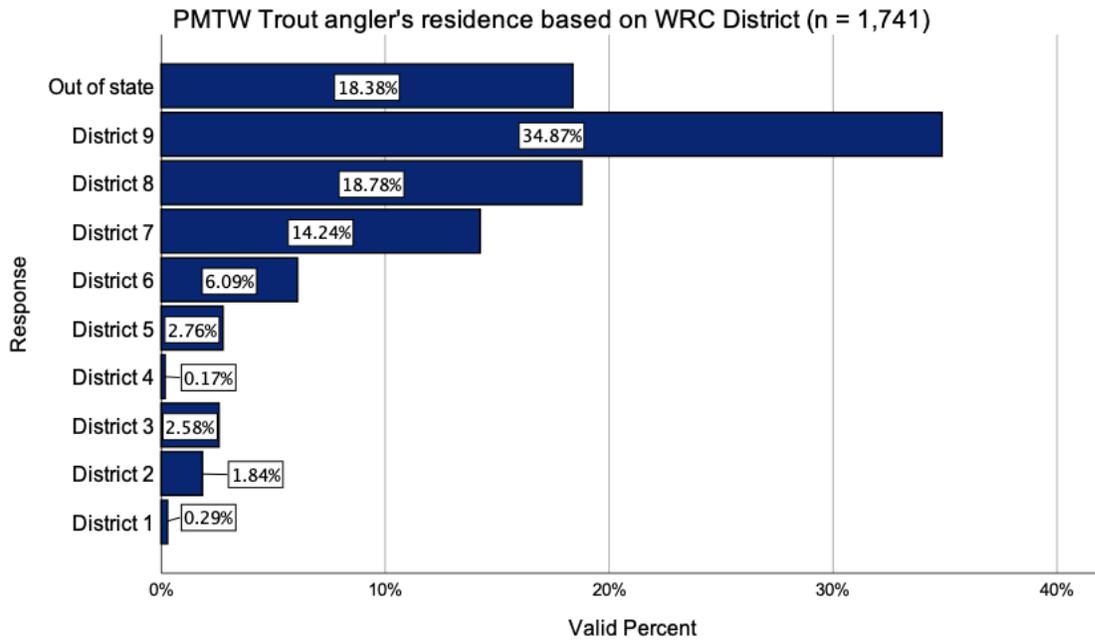
B32: Age



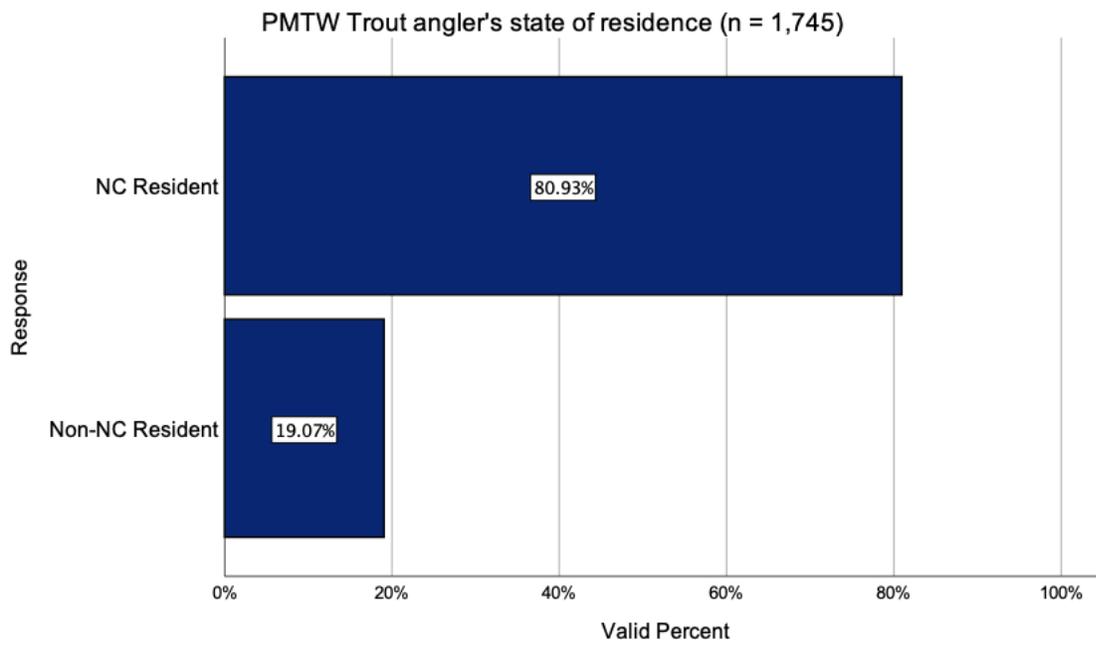
B33: Age group



B34: WRC Management District

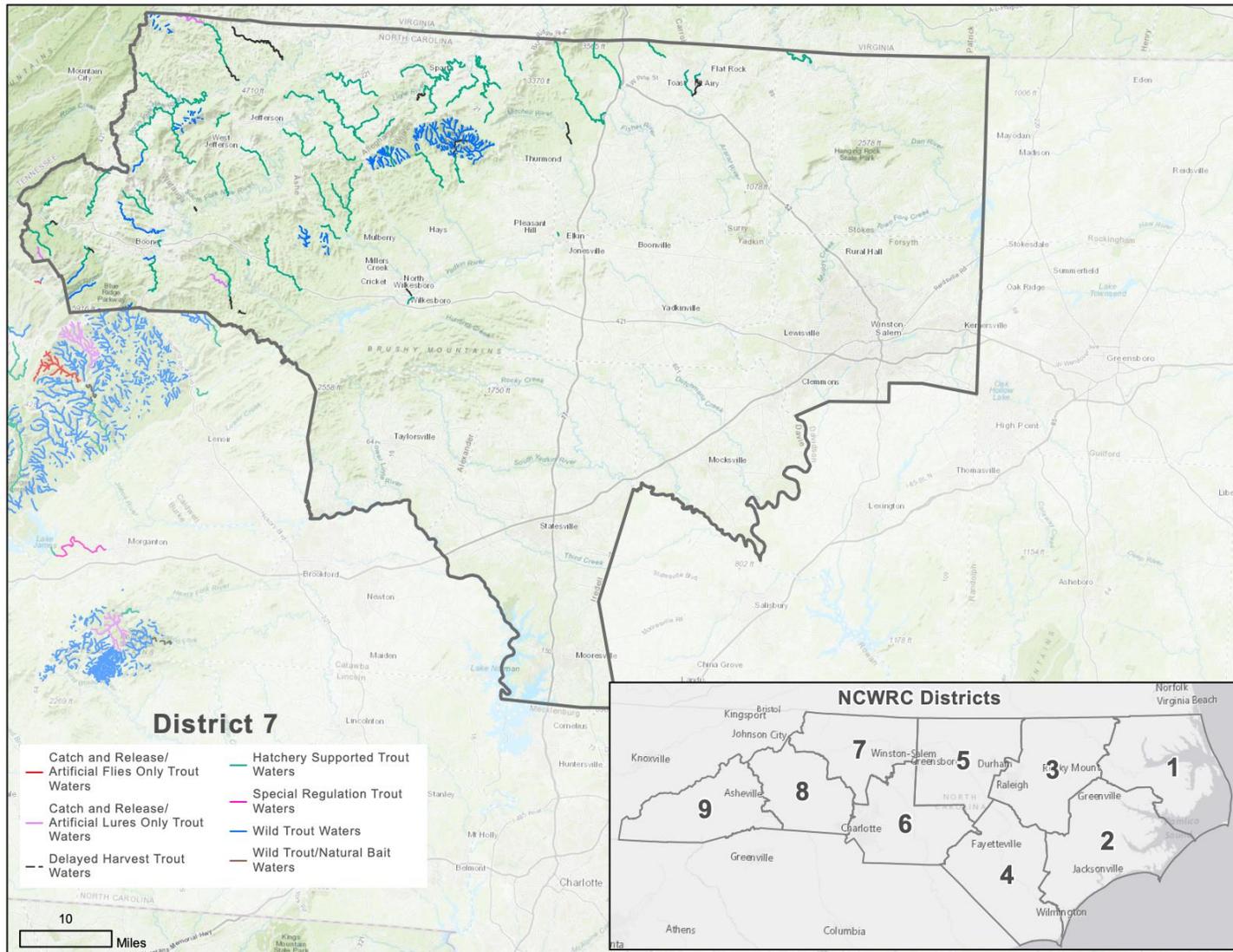


*B35: State of residence*

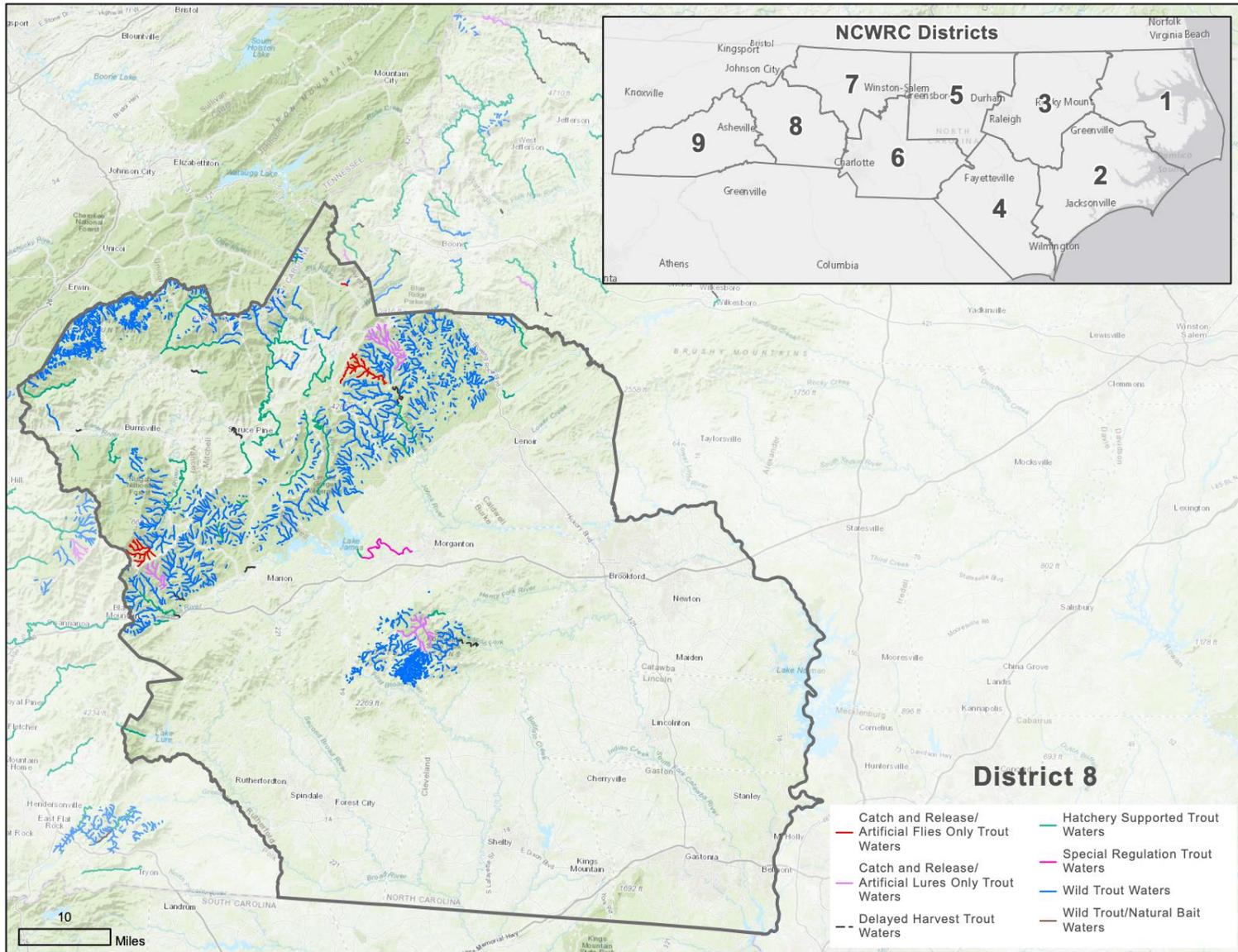


**Appendix C: PMTW Maps by WRC District**

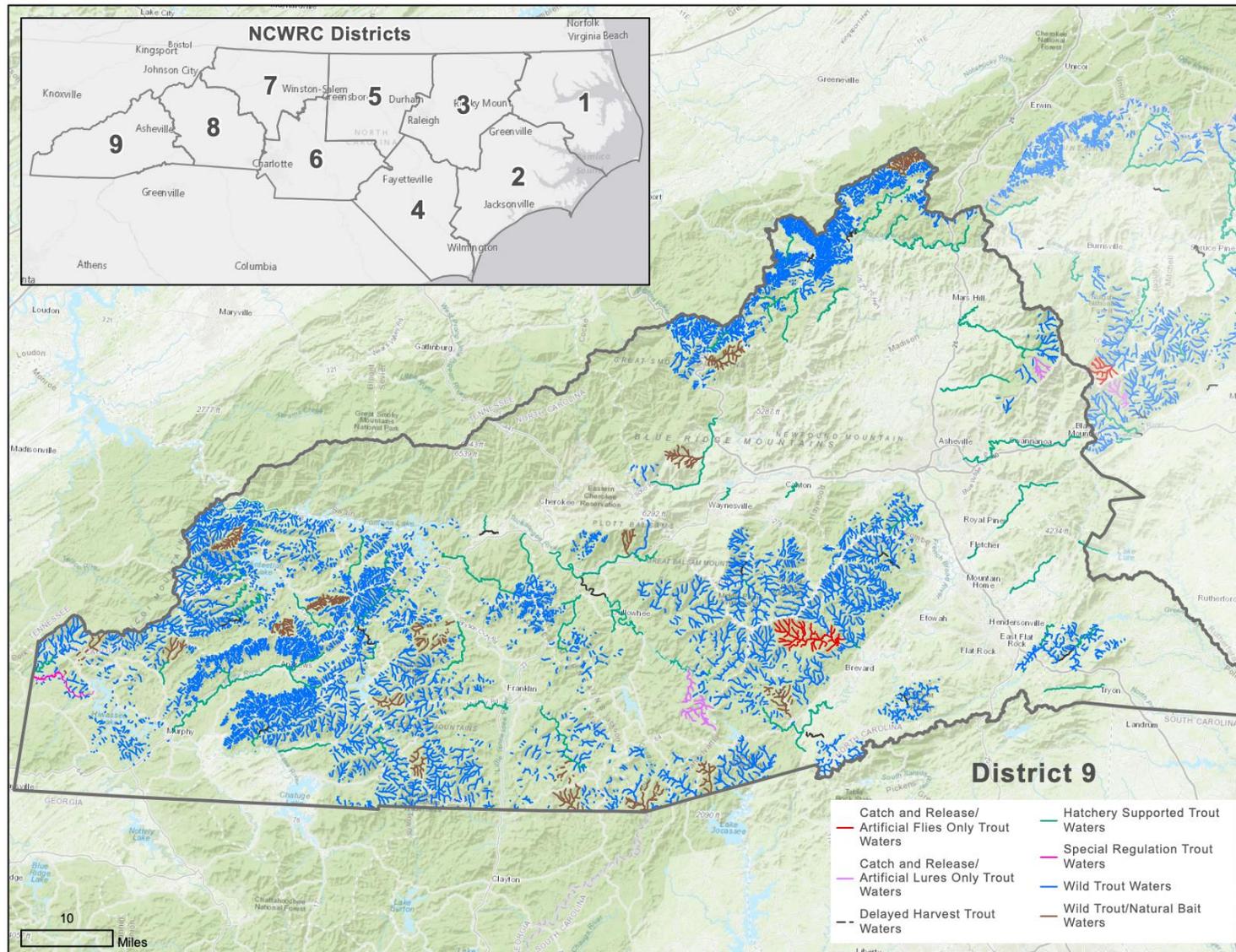
**CI: District 7**



C2: District 8



C3: District 9



## Appendix D: Copy of online questionnaire

### D1: Online questionnaire

The following questions are meant to help the N.C. Wildlife Resources Commission (WRC) understand your thoughts on mountain trout fishing in North Carolina.

You received this survey because you had a license that allowed you to fish mountain trout in North Carolina in 2019.

**We are interested in hearing from all anglers, even those who do not fish mountain trout very often!**

Information collected from this survey may be used to help WRC decision making. If you agree to take the survey, we ask that you answer the questions honestly and to the best of your knowledge. You do not have to answer every question and may stop at any point in the survey. Your participation is not required, and any information provided is confidential, will be combined with other responses, and will not be used to identify you.

Thank you for your time! We appreciate and value your input!

By selecting 'Yes' below, you are confirming you are at least 18 years old and agree to participate in this survey.

- Yes
- No, I do not wish to participate in this survey or I am younger than 18 years old

*Skip To: End of Survey If By selecting 'Yes' below, you are confirming you are at least 18 years old and agree to participa... = No, I do not wish to participate in this survey or I am younger than 18 years old*

End of Block: screen 1

Start of Block: Trout Angler Block

North Carolina's Public Mountain Trout Waters (PMTW) are designated water bodies in Western North Carolina that provide public access for fishing.

These are marked with one of the seven signs, seen below.



In 2019, did you fish for trout in NC's Public Mountain Trout Waters? **This does not include fishing for trout in Piedmont region ponds or impoundments.**

- Yes
- No

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Page Break

*Display This Question:*

*If North Carolina's Public Mountain Trout Waters (PMTW) are designated water bodies in Western North... = No*

Why did you choose not to fish in NC's Public Mountain Trout Waters in 2019? (Please explain briefly)

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*Skip To: End of Survey If Condition: Why did you choose not to f... Is Displayed. Skip To: End of Survey.*

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Page Break

Which type of bait or tackle do you most often use when fishing for trout in Public Mountain Trout Waters?  
(Please select one)

- Artificial Flies
- Artificial Lures
- Natural bait (corn, worms, eggs, Powerbait/other soft baits)
- Other (please describe) \_\_\_\_\_
- Don't know

When thinking about fishing for mountain trout in North Carolina, how much do you agree or disagree with the following statements?

	Strongly disagree	Disagree	Neither agree nor disagree	Agree	Strongly agree
A trout fishing trip can be successful even if no trout are caught					
When I go trout fishing, I am happy even if I don't catch any trout					
If I thought I wouldn't catch any trout, I wouldn't go trout fishing					
When I go trout fishing, I'm not satisfied unless I catch at least something					
The more trout I catch, the happier I am					
A successful trout fishing trip is one in which many trout are caught					
A full stringer is the best indicator of a good trout fishing trip					
I'm happiest with a trout fishing trip if I keep at least the limit					
I would rather catch 1 or 2 big trout than 10 smaller trout					
The bigger the trout I catch, the better the trout fishing trip					
I'm happiest with the trout fishing trip if I catch a challenging trout					
I like to trout fish where I know I have a chance to catch a "trophy" trout					
I usually eat the trout I catch					
I am happy even if I don't keep the trout I catch					
I want to keep all the trout I catch					
I am happy even if I release the trout I catch					

In 2019, what was your main reason for fishing for mountain trout in North Carolina?  
 (Please select one)

- For the sport
- For relaxation
- To be with family or friends
- To be close to nature
- To catch fresh fish for food
- To catch large fish
- Other (please describe) \_\_\_\_\_

The below questions are related to how you feel about the N.C. Wildlife Resources (WRC) Commission's mountain trout fishery management.

**WRC's mountain trout fisheries management creates fishing rules, stocks trout, studies the number of trout in streams, protects native Brook trout, and completes research.**

	Not at all	Not really	Undecided	Somewhat	Very much
To what extent do you accept the decisions of WRC's mountain trout fisheries management?					
To what extent do you consider WRC's mountain trout fisheries management to be trustworthy?					
To what extent are you willing to accept the decisions of WRC's mountain trout fisheries management?					
To what extent do you trust WRC's mountain trout fisheries management?					
To what extent do you intend to respect the future decisions of WRC's mountain trout fisheries management?					

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Page Break

How many years have you been fishing for mountain trout in North Carolina

- Less than 1 year
- 1-2 years
- 3-5 years
- 5-10 years
- More than 10 years

How would you rate your skill level as a mountain trout angler?

- Beginner
- Intermediate
- Advanced
- Expert
- Don't know

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Page Break

North Carolina has 7 types of Public Mountain Trout Water waters described below:

**Catch-and-Release-Artificial Flies Only Trout Waters**

These waters and their tributaries, except as noted, may be fished only with artificial flies having one single hook. No trout may be harvested or possessed while fishing these streams.

**Catch-and-Release-Artificial Lures Only Trout Waters**

These waters and their tributaries, except as noted, may be fished only with artificial lures having one single hook. No trout may be harvested or possessed while fishing these streams.

**Delayed Harvest Trout Waters**

Delayed Harvest Trout Waters, excluding tributaries except as noted, have lure and harvest regulations that vary during the year.

**Hatchery Supported Trout Waters**

In Hatchery Supported Trout Waters there is no size limit or bait restriction, and the creel limit is seven trout per day.

**Special Regulation Trout Waters**

These portions of Public Mountain Trout Waters, excluding tributaries except as noted, are subject to watercourse-specific, special regulations.

**Wild Trout Waters**

In all Wild Trout Waters, the minimum length limit is seven inches and the creel limit is four trout per day. Only artificial lures with one single hook may be used. All Public Mountain Trout Waters located on game lands are Wild Trout Waters unless classified and posted otherwise.

**Wild Trout-Natural Bait Waters**

These waters and their tributaries, except as noted, may be fished with artificial lures or natural bait, except live fish. Lures and natural baits are restricted to one single hook. The minimum length limit is seven inches, and the daily creel limit is four trout. These are the same restrictions as Wild Trout Waters, except anglers may use natural bait (worms, corn, eggs, etc.)

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In 2019, in which PMTW waters did you fish?

**This does not include fishing for trout in Piedmont region ponds or impoundments.**

Please click the "Back" button to view the descriptions of the PMTW waters.

(Select all that apply)

- Catch-and-Release-Artificial Flies Only Trout Waters
- Catch-and-Release-Artificial Lures Only Trout Waters
- Delayed Harvest Trout Waters
- Hatchery Supported Trout Waters
- Special Regulation Trout Waters
- Wild Trout Waters
- Wild Trout-Natural Bait Waters
- Don't know

*Skip To: change\_intro If In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Don't know*

*Skip To: freq\_crafo If Condition: In 2019, in which PMTW wate... Is Equal to 1. Skip To: In 2019, about how many days did you ....*

*Skip To: wish\_fish If Condition: In 2019, in which PMTW wate... Is Equal to 0. Skip To: Please select the waters that you wan....*

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Page Break



Please rank the PMTW waters that you fished in 2019 in order of preference, with "1" being the most preferred. (Drag items to order, with top of page being the highest preference)

*In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Catch-and-Release-Artificial Flies Only Trout Waters*

\_\_\_\_\_ Catch-and-Release-Artificial Flies Only Trout Waters

*In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Catch-and-Release-Artificial Lures Only Trout Waters*

\_\_\_\_\_ Catch-and-Release-Artificial Lures Only Trout Waters

*In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Delayed Harvest Trout Waters*

\_\_\_\_\_ Delayed Harvest Trout Waters

*In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Hatchery Supported Trout Waters*

\_\_\_\_\_ Hatchery Supported Trout Waters

*In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Special Regulation Trout Waters*

\_\_\_\_\_ Special Regulation Trout Waters

*In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Wild Trout Waters*

\_\_\_\_\_ Wild Trout Waters

*In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Wild Trout-Natural Bait Waters*

\_\_\_\_\_ Wild Trout-Natural Bait Waters

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Display This Question:

*If In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Catch-and-Release-Artificial Flies Only Trout Waters*

In 2019, about how many days did you fish *Catch-and-Release-Artificial Flies Only Trout* waters?  
(Please enter the number of days)

---

Display This Question:

*If In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Catch-and-Release-Artificial Lures Only Trout Waters*

In 2019, about how many days did you fish *Catch-and-Release-Artificial Lures Only Trout* waters?  
(Please enter the number of days)

---

Display This Question:

*If In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Delayed Harvest Trout Waters*

In 2019, about how many days did you fish *Delayed Harvest Trout* waters?  
(Please enter the number of days)

---

Display This Question:

*If In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Hatchery Supported Trout Waters*

In 2019, about how many days did you fish *Hatchery Supported Trout* waters?  
(Please enter the number of days)

---

Display This Question:

*If In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Special Regulation Trout Waters*

In 2019, about how many days did you fish *Special Regulation Trout* waters?  
(Please enter the number of days)

---

Display This Question:

*If In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Wild Trout Waters*

In 2019, about how many days did you fish *Wild Trout* waters?  
(Please enter the number of days)

---

*Display This Question:*

*If In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Wild Trout-Natural Bait Waters*

**In 2019, about how many days did you fish *Wild Trout-Natural Bait* waters?  
(Please enter the number of days)**

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When fishing in these waters, generally how crowded was your fishing location?  
 (1 = Not at all crowded and 9 = Extremely crowded)

	1-Not at all crowded	2	3-Slightly Crowded	4	5	6-Moderately Crowded	7	8-Extremely Crowded
<p><i>In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Catch-and-Release-Artificial Flies Only Trout Waters</i></p> <p>Catch-and-Release-Artificial Flies Only Trout Waters</p>								
<p><i>In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Catch-and-Release-Artificial Lures Only Trout Waters</i></p> <p>Catch-and-Release-Artificial Lures Only Trout Waters</p>								
<p><i>In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Delayed Harvest Trout Waters</i></p> <p>Delayed Harvest Trout Waters</p>								
<p><i>In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Hatchery Supported Trout Waters</i></p> <p>Hatchery Supported Trout Waters</p>								
<p><i>In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Special Regulation Trout Waters</i></p> <p>Special Regulation Trout Waters</p>								
<p><i>In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Wild Trout Waters</i></p> <p>Wild Trout Waters</p>								
<p><i>In 2019, in which PMTW waters did you fish? This does not include fishing for trout in Piedmont... = Wild Trout-Natural Bait Waters</i></p> <p>Wild Trout-Natural Bait Waters</p>								

What type of impact does crowding have on your overall mountain trout fishing experience?

- Strong negative impact
- Somewhat negative impact
- No impact
- Somewhat positive impact
- Strong positive impact

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Please select the waters that you wanted to fish in 2019, but were not able to:  
(Click on the sign to select one or more)



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The N.C. Wildlife Resources Commission has learned from previous surveys that some trout anglers feel there are too many types of Public Mountain Trout Waters.

As a result, the agency is looking for ways to provide many types of angling opportunities with fewer types of Public Mountain Trout Waters.

The following questions help us understand how you feel about two potential changes.

**These changes would not reduce the number of angling locations. The N.C. Wildlife Resources Commission is always working to provide more fishing locations.**

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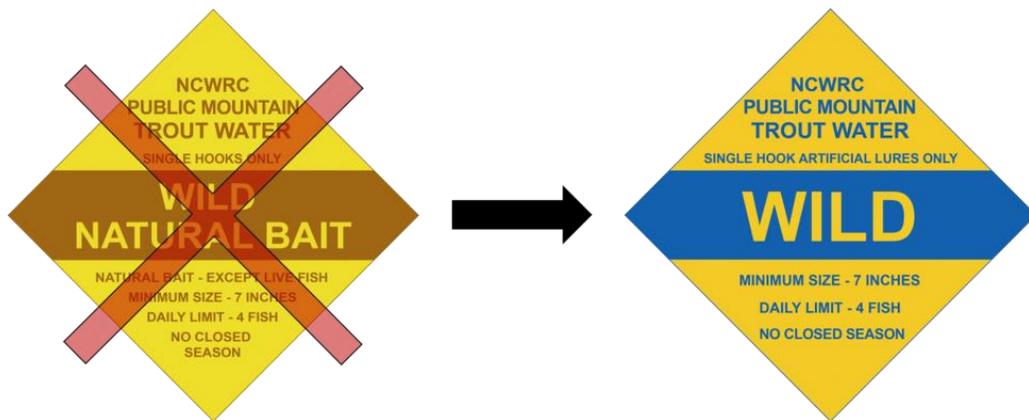
The N.C. Wildlife Resources Commission is considering removing the **Wild Trout-Natural Bait** water type completely.

"*Natural bait*" is any living or dead organism (plant or animal), or parts thereof, or prepared substances designed to attract fish by the sense of taste or smell.

With this change, all **Wild Trout-Natural Bait** waters would become **Wild Trout** waters and natural bait (worms, corn, eggs, powerbait, etc.) will not be allowed in these waters.

Natural bait (worms, corn, eggs, powerbait, etc) would still be allowed in *Hatchery Supported*, *Special Regulation*, and *Delayed Harvest* (during the first Saturday in June to October 1st time period) waters.

The image below describes the change.



How acceptable is this change?

- Totally unacceptable
  - Somewhat unacceptable
  - Neutral
  - Somewhat acceptable
  - Perfectly acceptable
- 

How much do you support or oppose this change?

- Strongly oppose
  - Somewhat oppose
  - Neutral
  - Somewhat support
  - Strongly support
-

What type of impact would this change have on your mountain trout fishing experience?

- Strong negative impact
- Somewhat negative impact
- No impact
- Somewhat positive impact
- Strong positive impact

In the space below, please share any other thoughts you have on this change. How will it impact you? Why do you support or oppose it? Why is it acceptable or unacceptable?

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The N.C. Wildlife Resources Commission is considering combining the two types of Catch-and-Release (CR) waters, *CR-Artificial Lures Only* and *CR-Artificial Flies Only* waters.

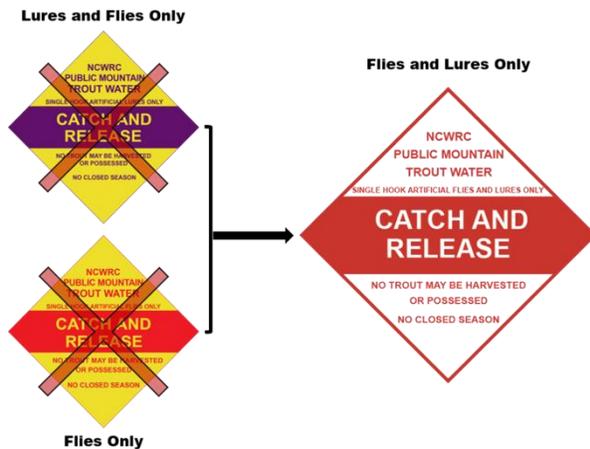
A "single hook artificial fly" is one single hook dressed with feathers, hair, thread, tinsel, rubber, or any similar material to which no additional hook, spinner, spoon, or similar device is added.

A "single hook artificial lure" is a fishing lure with one single hook that neither contains nor has been treated with any substance that attracts fish by the sense of taste or smell

With this change, fishing with single hook artificial lures would be allowed in all previous **CR-Artificial Flies Only** waters.

These waters still prohibit keeping trout and use of natural bait (worms, corn, Powerbait etc.).

The image below describes this change



How acceptable is this change?

- Totally unacceptable
- Somewhat unacceptable
- Neutral
- Somewhat acceptable
- Perfectly acceptable

How much do you support or oppose this change?

- Strongly oppose
- Somewhat oppose
- Neutral
- Somewhat support
- Strongly support

What type of impact would this change have on your mountain trout fishing activities?

- Strong negative impact
- Somewhat negative impact
- No impact
- Somewhat positive impact
- Strong positive impact

In the space below, please share any other thoughts you have on this change. How will it impact you? Why do you support or oppose it? Why is it acceptable or unacceptable?

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Are you a member of any of the following groups?  
(Select all that apply)

- Trout Unlimited
- Backcountry Hunters and Anglers
- Federation of Fly Fishers
- Private fishing club
- Meetup fly fishing group
- Other (please describe) \_\_\_\_\_
- I am not a member of any of these groups

End of Block: Trout Angler Block

---

Start of Block: Dems

**The following questions help us understand characteristics of North Carolina mountain trout anglers. We cannot identify you from your answers, and answers will not be shared with anyone.**

What is the highest level of education you have completed?

- Less than high school degree
- High school graduate (high school diploma or equivalent)
- Some college but no degree
- Associate's degree (2-year)
- Bachelor's degree
- Master's degree
- Doctoral/Professional degree (PhD, MD, JD)
- Other/Prefer not to share

What is your gender?

- Male
- Female
- Other/Prefer not to share

Choose one or more race(s) with which you identify:

- White
- Black or African American
- American Indian or Alaska Native
- Asian
- Middle Eastern or North African
- Hispanic, Latino or Spanish
- Native Hawaiian or Pacific Islander
- Prefer not to share
- Other \_\_\_\_\_

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Please select a choice below that best describes your 2019 household income.

- Less than \$20,000
- \$20,000 to \$34,999
- \$35,000 to \$49,999
- \$50,000 to \$74,999
- \$75,000 to \$99,999
- \$100,000 to \$149,999
- \$150,000 or more
- Other/Prefer not to share

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If you have any other comments, please type them here:

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End of Block: Dems

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