Fisheries Research 204 (2018) 316–323

Contents lists available at ScienceDirect

Fisheries Research

journal homepage: www.elsevier.com/locate/fishres

Factors influencing return-to-creel of hatchery catchable-sized Rainbow Trout stocked in Idaho lentic waters

John D. Cassinelli*, Kevin A. Meyer

Idaho Department of Fish and Game, 1414E Locust Lane, Nampa, ID 83686, United States

ARTICLE INFO

Handled by Chennai Guest Editor

Keywords:
Rainbow Trout
Hatchery trout
Return-to-creel
Tagged trout
Angler returns

ABSTRACT

In recent years, increases in hatchery rearing and transport costs coupled with stagnate or declining funding has often resulted in reduced numbers of hatchery fish stocked in public waters. This has intensified the need to better understand how to maximize return-to-creel rates of hatchery trout by identifying factors contributing to better post-stocking performance. From 2011 through 2014, we tagged 50,745 catchable-sized hatchery Rainbow Trout *Oncorhynchus mykiss* and stocked them into 54 different lentic waters in Idaho (mostly impoundments) across 226 individual stocking events. Angler tag returns (n = 5092) were used to generate water-specific estimates of angler return rates (i.e., the proportion of stocked fish caught by anglers) and average days-at-large of captured fish. We then modeled water-specific angler return rates and days-at-large against a suite of water- and stocking-specific characteristics to determine what factors most influenced both angler returns and fishery longevity. First-year angler return rates across all four study years averaged 23% and ranged from 0% to 76% for individual stocking events; the variation in angler returns was best explained by mean fish length at stocking, water size, rearing hatchery, and water elevation. Average days-at-large for angled fish in individual waters varied from a low of 10 d to a high of 297 d, and this variation was best explained by water size, stocking season, and the rearing hatchery. We found the highest angler returns for larger trout stocked into smaller waters at lower elevations. However, these smaller waters also had shorter fisheries, requiring more frequent stocking to prolong the fisheries through the entire angling season. When considering these findings, managers must also consider the balance between angler catch, effort, and satisfaction as they work towards maximizing the benefit to anglers from put-and-take fisheries.

1. Introduction

Numerous state and provincial agencies in North America use hatchery trout as a means to create or enhance fisheries, stocking either fingerlings for put-and-grow fisheries or catchable-sized trout for put-and-take fisheries. Over time, many agencies have gradually stocked fewer fingerling trout, switching their production largely to catchable-sized fish (Cresswell, 1981; Halverson, 2008), because larger trout survive better and return to creel at higher rates (Leitritz, 1970; Wiley et al., 1993; Yule et al., 2000) than do smaller trout. Catchable-sized hatchery trout (herein, catchables) have become an important component of many fisheries management programs in coldwater habitats, because they provide instantaneous fisheries once they are stocked. This is especially important in altered habitats such as impounded reservoirs, which typically do not support wild trout populations, and often do not provide adequate conditions to sustain trout over a sufficient time period for put-and-grow fisheries to develop (Trushenski et al., 2010).

While catchable stocking programs continue to be used as a fishery management tool and valued by anglers, hatchery rearing and transport costs continue to rise precipitously (IDFG, 2011), and funding of hatchery programs has remained unchanged or declined (Pergams and Zaradic, 2008; USFWS, 2011). As a result, since 2008 the Idaho Department of Fish and Game (IDFG) has reduced the number of catchable Rainbow Trout *Oncorhynchus mykiss* annually stocked in Idaho waters from 2.4 to 1.9 million fish. Such economizing has intensified the desire to (1) better understand how to maximize return-to-creel rates of hatchery catchables, and (2) identify what factors contribute to better harvest of hatchery fish. Numerous factors have been shown to influence post-stocking performance of catchables, including (but not limited to) the temperature, size, elevation, water quality, and fish species composition of the water being stocked, hauling distance from the hatchery, fish size-at-stocking, stocking season, hatchery feed used, and stocking density (e.g., Wiley et al., 1993; Yule et al., 2000; Barnes et al., 2009; Koenig and Meyer, 2011; Ashe et al., 2014). While not all of these factors can be controlled by hatchery staff or fisheries managers to

* Corresponding author.
E-mail address: john.cassinelli@idfg.idaho.gov (J.D. Cassinelli).

https://doi.org/10.1016/j.fishres.2018.03.005
Received 24 August 2017; Received in revised form 7 December 2017; Accepted 1 March 2018
Available online 20 March 2018
0165-7836/

boost angler return-to-creel rates, it is nevertheless valuable to understand the effect such factors have on post-release performance of catchables, regardless of the level of control that can be exerted on them. This is especially true at broad scales and through time, because post release catchable performance is notoriously inconsistent (e.g., Wiley et al., 1993; Koenig and Meyer, 2011; Patterson and Sullivan, 2013), making it difficult to establish overarching relationships that can be used to guide stocking strategies. The primary objective of our study was to determine what factors most influenced the angler catch rates of catchables stocked into lowland lentic waters throughout the state of Idaho, across multiple stocking events, and over multiple years.

In addition to understanding the factors that influence the angler returns of catchables, it is also important for managers to better understand what factors might influence the duration of catchable fisheries post-stocking. If a desirable percentage of the stocked trout are caught by anglers, but all of the catch occurs in a short period of time post-stocking, receiving waters might need to be stocked more than once during the angling season to maintain return rates acceptable to anglers. Besides the speed at which angler harvest occurs in the fishery, the biggest factor influencing the longevity of a catchable fishery is fish survival after stocking. While numerous studies have shown poor survival of hatchery catchables stocked into streams (Miller, 1952; Reimers, 1963; Ersbak and Haase, 1983; High and Meyer, 2009), hatchery trout survival in lentic waters is generally higher, and more variable (Wiley et al., 1993). Waters with low to moderate angler exploitation and high catchable survival should produce a prolonged fishery, whereas waters having high angler exploitation, low survival, or a combination of both, should produce a much shorter fishery. A secondary objective of our study was to determine what factors influenced the longevity of the fishery subsequent to each stocking.

2. Methods

From 2011 to 2014, catchable Rainbow Trout were raised from eggs either purchased from Troutlodge, Inc. (all-female triploids) or fertilized internally from IDFG's Hayspur strain (mixed-sex triploids). These two sources annually provide nearly all of the eggs used in the IDFG hatchery trout program. Fish were reared at eight different hatcheries for this study, but the vast majority of fish (roughly 90%) were reared at the three largest IDFG hatchery trout facilities (i.e., Hagerman, Nampa, and American Falls fish hatcheries). At all facilities, fish were reared on single-use spring water at 13–15 °C. Fry were started in small concrete vats and were fed using a combination of either hand-feeding and belt feeders. After reaching 60–80 mm in length (depending on the facility), fish was inventoried and moved to outdoor concrete raceways (usually in 30 m × 3 m × 1 m sections) and fed by hand-feeding, belt feeders, or tractor-pulled feed carts. Other rearing conditions and practices, such as inventorying, raceway density, and truck loading differed little among hatcheries. Fish was reared to catchable size, with a target of 255 mm (total length) at time of stocking.

To evaluate post-stocking performance of catchables from each stocking event, a subsample of catchables was tagged prior to stocking with 70-mm fluorescent orange T-bar anchor tags (Dell, 1968). Fish were collected for tagging by crowding them within raceways and capturing them with dip nets. This ensured a representative sample was collected from the entire raceway. Fish were sedated, measured to the nearest mm, and tagged just under the dorsal fin following the methods of Guy et al. (1996). After tagging, trout were returned to an empty section of raceway or to a holding pen in the raceway for at least 12 h. Within 48 h of tagging, tagged fish were loaded by dip net onto stocking trucks with the normal lot of untagged fish and transported to stocking locations. Mortalities and shed tags were rare (< 1%), but they were collected and recorded before loading fish for transport.

Stocking locations to receive tagged fish were scattered across the state of Idaho (Fig. 1). Stocking locations were selected from waters on IDFG's annual catchable stocking program, and we targeted lentic

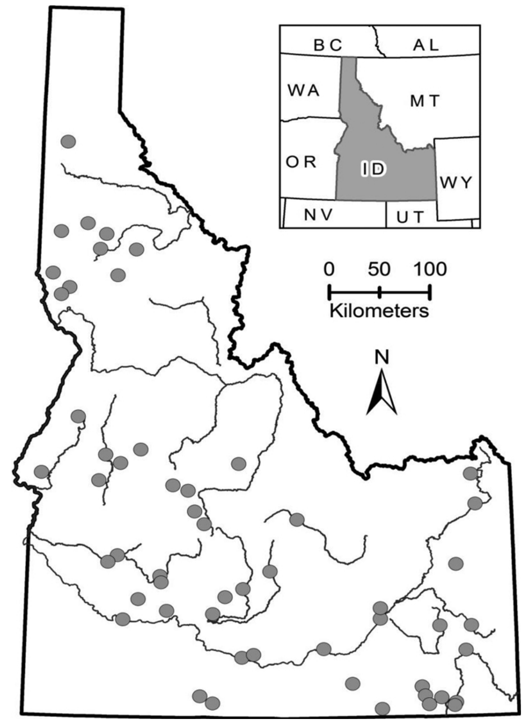

Fig. 1. Lentic waters stocked from 2011 to 2014 as part of an Idaho-wide evaluation of factors influencing the return-to-creel of catchable-sized hatchery Rainbow Trout.

waters that received the bulk of all catchables stocked each year so that we were annually evaluating the performance of a majority of the catchables that IDFG stocks. Stocking events occurred from March through November annually. All stocked waters included in this study were managed under general trout rules with a daily trout limit of 6 fish with no size limit.

We generally tagged 100–400 fish for each stocking event, depending on how many untagged fish were also being stocked, but we never tagged more than 10% of the fish being stocked. Overall stocking numbers for each water were determined by regional fishery managers based on local knowledge of the receiving water – including water quality, food availability, presence of other species, expected harvest, and fishing pressure – as well as factors such as statewide stocking budget and fish availability, but there were no strict guidelines on choosing stocking density. Most waters were stocked only one time in a calendar year but multiple times across the duration of the study, and usually during multiple seasons (except winter).

Angler catch data was based on the anchor tags that were reported by anglers. For a detailed description of the angler tag reporting system we used, see Meyer et al. (2012) and Meyer and Schill (2014). In short, anglers could report tags using the IDFG "Tag-You're-It" phone system or website (set up specifically for this program), as well as at regional IDFG offices or by mail. To facilitate angler reporting of tagged fish, anchor tags were labeled with "IDFG" and a tag reporting phone number on one side, with a unique tag number on the reverse side. Each year, a subset of study waters received $50 reward tags in addition to standard non-reward tags. In locations that received reward tags, rewards were distributed at a constant rate of 10% of the total tags stocked. Reward tags were identical to non-reward tags in size, shape, and color, but contained additional text ("Reward") and the reward amount ("$50").

To estimate the reporting rate (λ) of non-reward tags, we used the high-reward method (Pollock et al., 2001) and equation:

$$\lambda = \frac{R_r/R_t}{N_r/N_t}$$