



The Effect of Hook Size, Spinner Colour and Fishing Season on Catching Efficiency in Angling for Rainbow Trout, *Oncorhynchus mykiss* (Walbaum, 1792)

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ABSTRACT

In this study, we aimed to determine the effects of hook size, spinner colour and fishing season on catching efficiency in angling for rainbow trout in Karakaya Dam Lake (Malatya, Turkey). Field studies were conducted monthly for a total of 48 fishing operations between May 2013 and April 2014 and again from January 2015 to December 2015. Fishing activities were carried out using fishing gear with three spinner colours (yellow, blue or red), three hook sizes (No. 2: 2 cm; No. 3: 3 cm; or No. 4: 4 cm) and in different seasons (spring, summer, autumn or winter) by three anglers. At the end of the study, 336 rainbow trout, 13.2–56.5 cm in length and 28.6–2,174.6 g in weight, were caught. The most efficient season for catching fish was in the winter. The mean catch per unit effort (CPUE) values for red, blue and yellow coloured spinners were 0.108, 0.051 and 0.036, respectively. The mean CPUE values for No. 2, No. 3 and No. 4 hooks were 0.049, 0.088 and 0.066, respectively. The mean yield per unit effort (YPUE) for No. 2, No. 3 and No. 4 hooks were 9.88, 24.13 and 19.78, respectively ($p < 0.05$). In conclusion, we recommend using No. 3-sized hooks in the winter season for maximum fishing efficiency of rainbow trout in Karakaya Dam Lake.

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Authors' Contribution

TA and MC designed the study. TA performed fishing experiments. TA and MC evaluated data and wrote different parts of the article.

Key words

Different colour, Spinner, Angling, CPUE, YPUE

INTRODUCTION

Recreational fishing constitutes the dominant use of wild fish stocks in all freshwater regions of industrialized countries, it is also prominent in many coastal (FAO, 2012) and inland water ecosystems. Recreational fisheries science has made great strides in understanding how various factors influence the catchability of fish (Anderson and LeRoy Heman, 1969; Ward *et al.*, 2013). However, there has been little effort in understanding how lure colour influences these factors (Moraga *et al.*, 2015), which is the focus of this study. *Oncorhynchus mykiss* is a popular and intensively managed recreational species targeted by anglers at the Karakaya Dam Lake (Malatya, Turkey). These fish are frequently caught by anglers using various spinner, spoon of varying colours and sizes. Recreational fishing is a socially and economically important use of fishery resources in most parts of the world (Cooke and Scramm, 2007).

Lure colour may affect catch rates for both longline fisheries (Hsieh *et al.*, 2001) and amateur fishing

(Moraga *et al.*, 2015; Wilde *et al.*, 2003). In this study we performed an experimental assessment of whether different lure colours (red, blue or yellow), seasons (winter, spring, summer or autumn) and spinner sizes (No. 2, No. 3 or No. 4) affect the catch rate. We chose *O. mykiss* because it is one of the most targeted species for amateur fisheries in the world and is not a species native to Karakaya Dam Lake. This species was introduced after trout aquaculture activities in a net cage (Ateşşahin *et al.*, 2011, 2015; Cİlbiz and Yalın, 2017).

Here, we present one of the first studies to evaluate the role of different spinner colours and hook sizes on the catch per unit effort (CPUE) and the yield per unit effort (YPUE) during different seasons for *O. mykiss* at an important recreational fishery in Turkish inland waters.

MATERIALS AND METHODS

The aim of this study was to determine the effect of hook size, spinner colour and fishing season on catching efficiency in angling for rainbow trout in Karakaya Dam Lake. Karakaya Dam Lake, located in Eastern Anatolia (Turkey), is one of the region's largest and most important water sources, both for irrigation and fisheries (Ozmen *et al.*, 2006) (Fig. 1).

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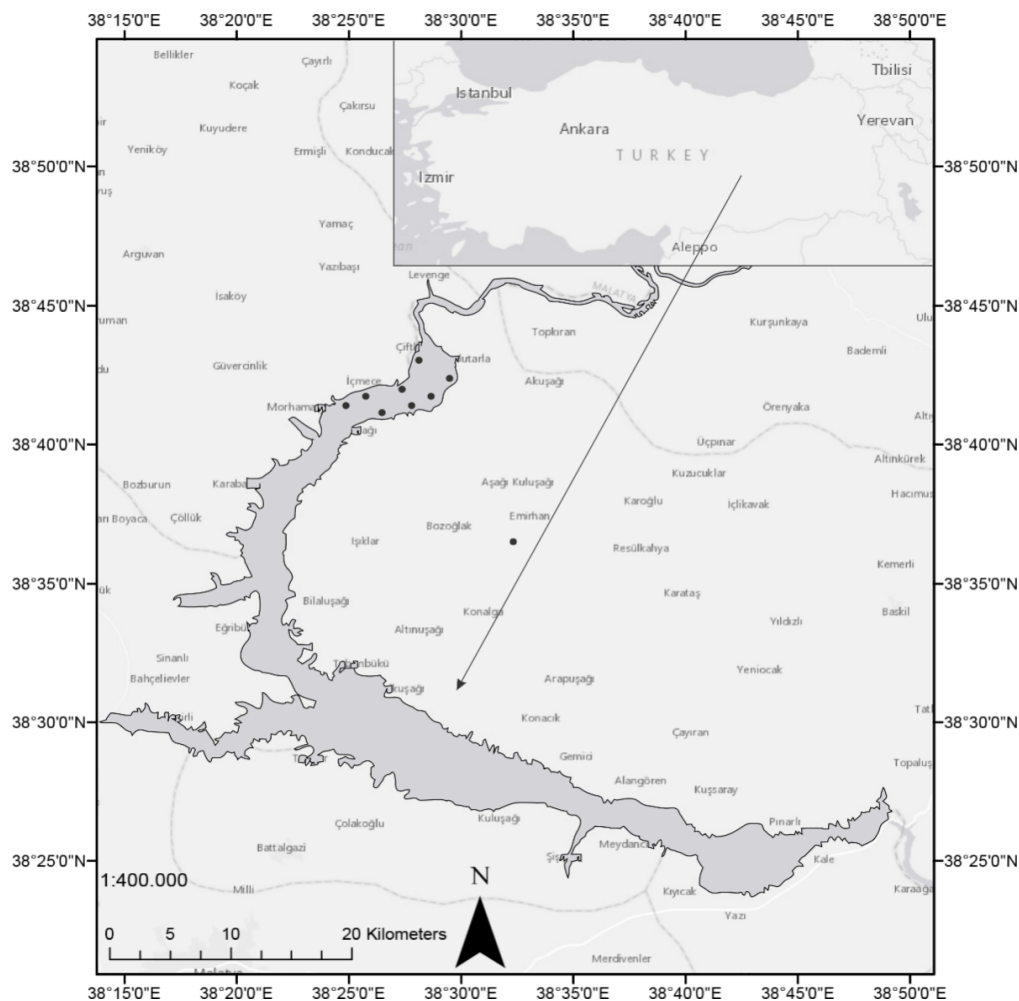


Fig.1. The study area and different fishing stations in Karakaya Dam Lake (Malatya, Turkey).

To control for angler skill, all *O. mykiss* were captured by the same experienced anglers (Rapp *et al.*, 2008). Each angler completed a survey designed to categorize anglers into a specific level of expertise (Meka, 2004). For the experimental angling activities, three anglers with similar levels of experience were selected (Alós *et al.*, 2009). We did not tag or mark fish that were released during our study.

Fishing gear and the duration of operations can significantly affect the catch composition (Kaykaç *et al.*, 2003). The CPUE and YPUE efficiency were calculated according to Aydın (2011).

A field study was conducted monthly with a total of 48 fishing operations lasting 4 hours each during May 2013 to April 2014 and again from January 2015 to December 2015. Fishing activities were carried out using fishing gear with three spinner colours (yellow, blue or red), three hook sizes (No. 2: 2 cm; No. 3: 3 cm; or No. 4: 4 cm) and in different seasons (winter, spring, summer or autumn) by

the same three anglers who had similar fishing experiences and tools. The duration of each sampling was fixed and limited to 4 hours. Experimental trials were carried out between 08:00 a.m. and 12:00 a.m. A technical plan for the use of the fishing line and spinner is shown in Figure 2. Caught fish were measured to within 1-mm accuracy and weighed to within 1-g accuracy. CPUE and YPUE values were calculated according to Godøy *et al.* (2003) and Aydın (2011). The changes in CPUE and YPUE values, according to hook sizes, spinner colour and fishing season, were statistically assessed using a one-way analysis of variance (ANOVA). The differences between groups were then tested using Tukey's honestly significant difference (HSD) test.

The CPUE and YPUE values were calculated as shown below using the formulas recommended by Godøy *et al.* (2003) and later customized by Aydın (2011).

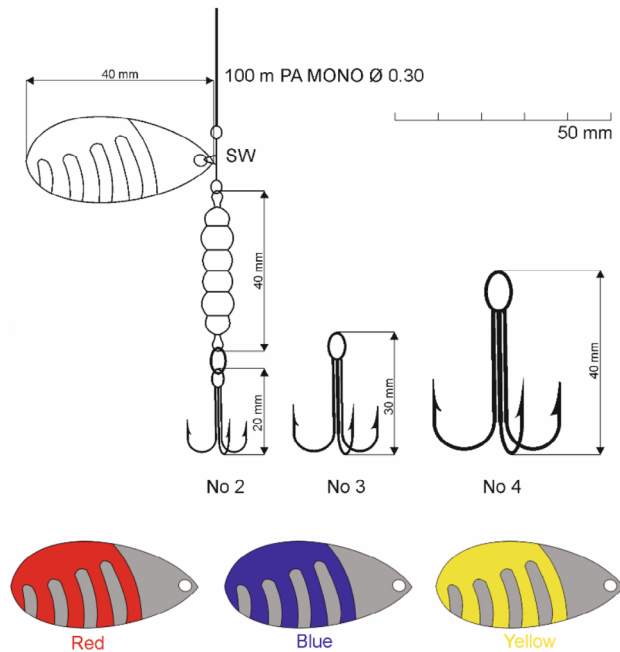


Fig. 2. Technical plan of different spinner sizes and colour types.

$$CPUE = \frac{\sum n}{\sum \text{number of hooks} \times \sum (\text{fishing trials} \times \text{angling time})}$$

$$YPUE = \frac{\sum \text{weight}}{\sum \text{number of hooks} \times \sum (\text{fishing trials} \times \text{angling time})}$$

RESULTS

Over the study period, 336 *O. mykiss* were caught, ranging in size from 13.2 to 56.5 cm ($n = 77$ for No. 2; $n = 145$ for No. 3; and $n = 114$ for No. 4). The catching percentages for No. 2, No. 3 and No. 4 hooks were 22.9%, 43.1% and 33.9%, respectively. The mean YPUE values for No. 2, No. 3 and No. 4 hooks were 9.88, 24.13 and 19.78, respectively (Table I). In terms of CPUE, the No. 3 hook was significantly better than the other hook sizes. However, in terms of YPUE, the No. 2 hook was significantly better than both the No. 3 and No. 4 hooks ($p < 0.05$) (Fig. 3).

When the fish that were caught were evaluated according to spinner colour, the catching percentages of red, blue and yellow spinners were 55.4%, 26.2% and 18.5%, respectively. The mean CPUE values for red, blue and yellow spinners were 0.108, 0.051 and 0.036, respectively. Furthermore, the mean YPUE values for red, blue and yellow hooks were 30.273, 12.809 and 8.886, respectively (Table II). In terms of the spinner colour effect on CPUE and YPUE values, the red spinner colour was the red spinner colour was significantly more efficient at catching fish than the blue and yellow colors ($p < 0.05$) (Fig. 4). According to seasons, the CPUE values for spring, summer, autumn and winter were 0.167, 0.120, 0.178 and 0.313, respectively, and YPUE values were 43.608, 31.744, 56.959 and 75.562, respectively (Table III). The differences were significant for both CPUE and YPUE values ($p < 0.05$) (Fig. 5).

Table I.- Statistical analysis of different spinner hook sizes for CPUE and YPUE values.

Hook Number	N	N (%)	Total Catch (g)	CPUE (Mean±SE)	YPUE (Mean±SE)
2	77	22.9%	15654.100	0.049±0.006 ^a	9.883±1.382 ^a
3	145	43.1%	39963.900	0.088±0.010 ^b	24.133±3.111 ^b
4	114	34.0%	34183.200	0.066±0.007 ^a	19.782±2.799 ^b

Table II.- Statistical analysis of different spinner colors for CPUE and YPUE values.

Color of Spinner	N	N (%)	Total Catch (g)	CPUE (Mean±SE)	YPUE (Mean±SE)
Red	186.00	55.4%	52311.90	0.108±0.012 ^b	30.273±4.224 ^b
Blue	88.00	26.2%	22133.70	0.051±0.005 ^a	12.809±1.247 ^a
Yellow	62.00	18.5%	15355.60	0.036±0.005 ^a	8.886±1.193 ^a

Table III.- Statistical analysis of different fishing seasons for CPUE and YPUE values.

Fishing Season	N	N (%)	Total Catch (g)	CPUE (Mean±SE)	YPUE (Mean±SE)
Autumn	77	22.9%	24606.1	0.178±0.029 ^a	56.959±14.441 ^a
Spring	72	21.4%	18838.7	0.167±0.026 ^a	43.608±5.878 ^a
Summer	52	15.4%	13713.5	0.120±0.013 ^a	31.744±4.095 ^a
Winter	135	40.3%	32642.9	0.313±0.031 ^b	75.562±5.042 ^b

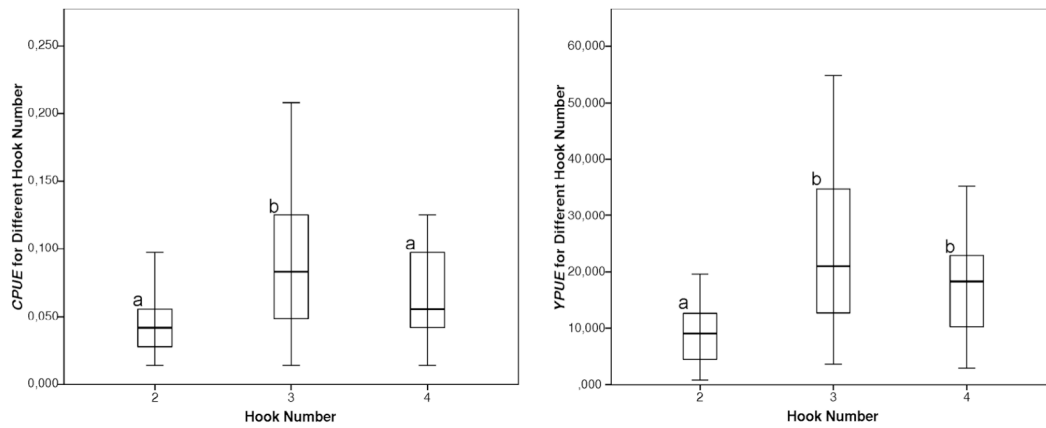


Fig. 3. CPUE and YPUE values for different hook sizes for angling *O. mykiss* from Karakaya Dam Lake (Malatya, Turkey).

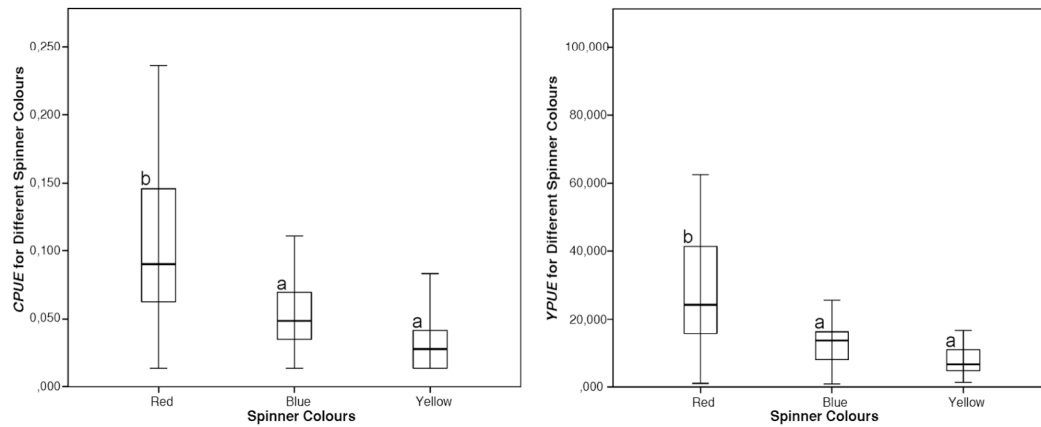


Fig. 4. CPUE and YPUE for different spinner colors used in catching *O. mykiss* from Karakaya Dam Lake (Malatya, Turkey).

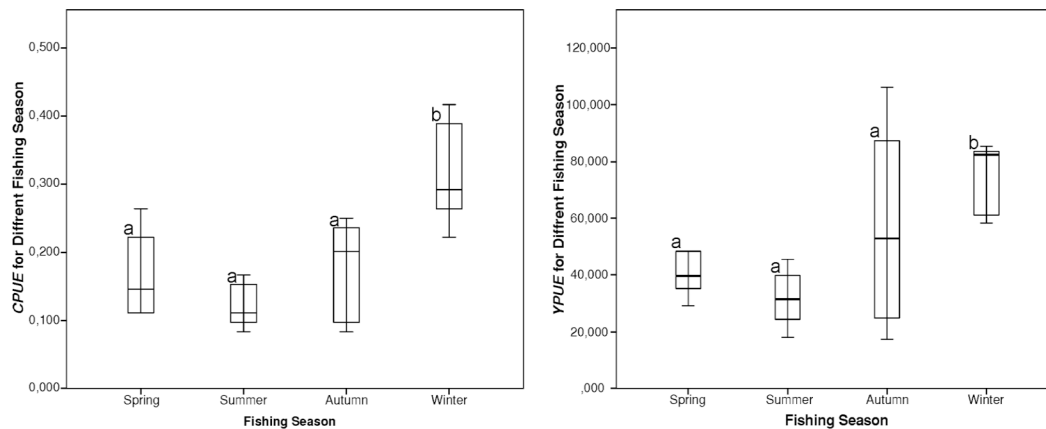


Fig. 5. CPUE and YPUE values for angling *O. mykiss* during different fishing seasons from Karakaya Dam Lake (Malatya, Turkey).

DISCUSSION

Recreational fishing studies in Turkey have, thus far, been generally focused on either the socioeconomics of the fishermen (Ünal *et al.*, 2010; Tunca *et al.*, 2012) or hook selectivity (Ateşşahin *et al.*, 2015; Öztekin *et al.*, 2018). There are many issues that directly or indirectly affect fisheries and the lake management of fisheries. The colours of natural or artificial bait used in recreational fishing have a direct impact on fishing efficiency. Several researchers have examined the effects of various colours of equipment (nets, longlines, hook lines, etc.) for their efficiency in catching different fish species (Balık and Çubuk, 2001; Orsay and Duman, 2010; Ulaş and Aydin, 2011; Akyasan *et al.*, 2016). Catching efficiencies with these fishing gear have been variable and depend on the fish species, the regions inhabited, fishing equipment and whether they are sea or freshwater fish.

This study showed that the CPUE and YPUE values for angling *O. mykiss* were positively related to different colours (red, blue and yellow), different spinner sizes and seasons (winter, spring, summer and autumn). Wilde *et al.* (2008) examined four lure sizes and five colour patterns to assess the effects on the number and length of largemouth bass captured by angling. Ulaş and Aydin (2011) reported that red coloured jigs were the most efficient compared with other colours for squid jigging efficiency. However, Altınagac (2006) determined that the green jigs were more efficient than the red ones.

Several studies have suggested there is a significant increase in CPUE when using small hooks (Alós *et al.*, 2009; Erzini *et al.*, 1996; Halliday, 2002) and gillnet fisheries (Dartay *et al.*, 2017). However, in our study, the No. 3 hook was significantly better than the No. 2 hook. Hsieh *et al.* (2001) suggested that lure colour is not a significant factor in determining catch rate in mackerel long line fisheries when the lure type is standardized. Our research suggests that a red colour is a significant factor in determining CPUE and YPUE values in Karakaya Dam Lake for *O. mykiss* ($p < 0.05$). Akyasan *et al.* (2016) found that, in chub mackerel (*Scomber japonicus*, Houttuyn, 1782), the brown colour was more efficient than other colours for CPUE and YPUE values.

The *O. mykiss* is not a species native to Karakaya Dam Lake; rather, it was introduced after the activities of the trout aquaculture in a net cage. These fish have an important place in the day-to-day fish populations of dam lakes. Thus, it is very important, in terms of economic value, for fish to be brought into recreational fisheries (Ateşşahin *et al.*, 2011). In conclusion, we recommend using No. 3-sized hooks during the winter season for maximum fishing efficiency of rainbow trout and suggest that red coloured

lures are a significant factor in determining CPUE and YPUE values in Karakaya Dam Lake.

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Statement of conflict of interest

We declare no conflicts of interest in this study.

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