# Effect of Net Colours on Efficiency of Monofilament Gillnets for Catching Some Fish Species in Lake Beyşehir

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**Abstract**

Experiments were conducted with monofilament gillnets of different colours (black, white, blue, yellow, red, light green, dark green and brown) in Lake Beyşehir of Turkey from May 1998 to August 1999, to compare their capture efficiencies on tench, *Tinca tinca* L., carp, *Cyprinus carpio* L., pikeperch, *Stizostedion lucioperca* (L.), and chub, *Leuciscus lepidus* Heckel.

Most fish were caught in the red, yellow, brown and blue gillnets for tench, carp, pikeperch and chub. The total catch of four species was the highest in the red nets. Generally, the colour of conventional gillnets in the lake is light green. The catching efficiency of this colour was lower than the other colours for each species. The results showed that it is possible to select species by choice of net colour.

*Key Words*: gillnet, net colour, fishing efficiency, tench, carp, pikeperch, chub.

## Introduction

Gillnets are used widely in the coastal and inland fisheries of the world because of their versatility, low cost, and ease of operation. A total of 44 583 t of freshwater fish were caught in Turkey in 1995 (Atay, 1998), usually with gillnets and trammel nets. Thus, these gears are important in inland fisheries of Turkey. The efficiency of these net types are influenced by mesh size, exposed net area, floatation, mesh shape and hanging ratios, visibility and type of netting material in relation with stiffness, and breaking strength. Knowledge of the efficiency of gillnets is important for the reconstruction of the population in fish stock (Machiels *et al*., 1994).

In this paper, the effect of net colour of monofilament gillnets on fish capture efficiency was investigated in Lake Beyşehir. The colour of gillnets has the greatest effect in day fishing or in fishing in limpid water. Visibility of the nets depends on net colour and the tone contrast with the background, which can be affected by the time of day, and the seasonal changes in water clarity or colour (Backiel and Welcomme, 1980). Andreev (1966) recommended that dark-coloured nets should be used in good light or clear water and light-coloured nets in turbid water. Fish are known as myopic, therefore they can see 10 m at a 20 m depth from the surface (Taşdemir, 1997). Fish can distinguish colours, and also different coloured nets may show significant differences in catches (Backiel and Welcomme, 1980).

Gillnets are made with fine twines that are chosen to be relatively invisible to the fish, particularly at low light intensities. When a net is invisible, the target fish are unaware of its presence and then swim into it, and may become trapped by the meshes (Wardle *et al*., 1991). Gillnets of different colours are used by fishermen in inland water fisheries of Turkey, but the colour of the nets is chosen by the net seller. Generally, they do not considered any criteria. In this paper, the effect of colour on the capture of tench, *Tinca tinca* L., carp, *Cyprinus carpio* L., pikeperch, *Stizostedion lucioperca* (L.), and chub, *Leuciscus lepidus* Heckel, by monofilament gillnets of different colours were investigated.

## Materials and Methods

Experiments were conducted in Lake Beyşehir, which is the largest natural fresh water lake of Turkey. The lake is in the central Anatolia region of Turkey (37°33'-37°59'N, 31°19'-31°44'E). It has a surface of 690 $km^{2,}$ and its mean depth is 6 m (Balık, 1997). In the lake there are tench, carp, pikeperch, chub and nose, *Chondrostoma nasus* L. Pikeperch and tench were introduced into the lake in 1978 (Erdem *et al*., 1985) and in the early 1990s (Balık *et al*., 1997). Nose was rarely caught in the experimental nets. In Lake Beyşehir, there were 916 boats and 1519 fishermen in 1996 (Balık, 1997).

Capture experiments were carried out simultaneously in the same area of the lake to give approximately identical fishing conditions from May 1998 to August 1999. A total of 46 sets of gillnets with 8 different colours were used. The colours of the nets were black, white, blue, yellow, red, light green, dark green, and brown. Except for the net colours all characteristics of the nets were similar. Individual

nets had a length of 120 m and their mesh sizes were 36 mm (knot to knot). The depth and the hanging ratio of each net were 50 meshes and 0.60. The net twine diameters were Ø 18 mm. Nets were joined to one another with 2 m intervals from their float and lead lines. In each experiment, the positions of the nets were changed in turn. In the fishing experiments, all nets were set between 9.00 and 10.00 am, and hauled in the following day between 8.00 and 9.00 am. The fish caught in each net were counted and weighed for each species.

ANOVA was executed to test the significance of differences in the number of fish caught in the different-coloured gillnets (Çömlekçi, 1988).

## Results

### Catch by number

Altogether, 2070 tench, 311 carp, 157 pikeperch and 102 chub were caught in the fishing experiments (Table 1).

Most fish were caught in the nets of red (15%), yellow (14.5%), brown (19%) and blue colours (20.6%) for tench, carp, pikeperch, and chub. The proportion of fish caught in the red net was the highest (14.5%) (Table 2).

The red gillnets caught 1.16, 1.18, 1.23, 1.23, 1.23, 1.24 and 1.30 times more fish than black, white, blue, light green, dark green, yellow and brown nets for tench (Table 3). Yellow, brown and blue gillnets were more effective than the other colours for carp, pikeperch, and chub. The listing of the net colours in order at fishing efficiency for fish species are shown in Table 4. In respect to the capture of all species, the red net was the most effective. Black, white, light green, yellow, blue, dark green and brown-coloured nets followed this net. The differences between catches of gillnets of different colours were statistically not significant ($P>0.05$).

## Discussion

Net colour affects the catching efficiency of gillnets for the capturing of tench, carp, pikeperch, and chub in Lake Beyşehir. Most fish were caught with red, yellow, brown and blue nets for tench, carp, pikeperch and chub. It was shown that the visibility of nets of the same colour by species might be different, because the reaction to the net colour varies with the species of fish (Hamley, 1975). Observations in the aquarium on cod showed that when confronted by

**Table 1.** Numbers of tench, carp, pikeperch and chub caught with gillnets of different colours (L: light, D: dark).

| Species | Black | White | Blue | Yellow | Red | L. Green | D. Green | Brown | Total |
|---|---|---|---|---|---|---|---|---|---|
| Tench | 267 | 263 | 253 | 250 | 310 | 253 | 252 | 222 | 2070 |
| Carp | 41 | 37 | 37 | 45 | 41 | 40 | 28 | 42 | 311 |
| Pikeperch | 15 | 20 | 14 | 23 | 19 | 24 | 14 | 28 | 157 |
| Chub | 13 | 14 | 21 | 8 | 14 | 12 | 11 | 9 | 102 |
| Total | 336 | 334 | 325 | 326 | 384 | 329 | 305 | 301 | 2640 |

**Table 2.** The percent distributions of the number of tench, carp, pikeperch and chub caught with gillnets of different colours.

| Species | Black | White | Blue | Yellow | Red | L. Green | D. Green | Brown |
|---|---|---|---|---|---|---|---|---|
| Tench | 12.9 | 12.7 | 12.2 | 12.1 | 15.0 | 12.2 | 12.2 | 10.7 |
| Carp | 13.2 | 11.9 | 11.9 | 14.5 | 13.2 | 12.9 | 9.0 | 13.5 |
| Pikeperch | 9.6 | 12.7 | 8.9 | 14.7 | 12.1 | 15.3 | 8.9 | 17.8 |
| Chub | 12.7 | 13.7 | 20.6 | 7.8 | 13.7 | 11.8 | 10.8 | 8.8 |
| Total | 12.7 | 12.7 | 12.3 | 12.3 | 14.5 | 12.5 | 11.6 | 11.4 |

**Table 3.** The relative efficiencies of gillnets of different colours derived from the catching amounts for each net. [Ratio=catch of the most effective-coloured net / catch of each one of the other nets, for each species].

| Tench | Ratio | Carp | Ratio | Pikeperch | Ratio | Chub | Ratio |
|---|---|---|---|---|---|---|---|
| Red: Black | 1.16 | Yellow: Brown | 1.07 | Brown: Light Green | 1.17 | Blue: Red | 1.50 |
| Red: White | 1.18 | Yellow: Black | 1.10 | Brown: Yellow | 1.22 | Blue: White | 1.50 |
| Red: Blue | 1.23 | Yellow: Red | 1.10 | Brown: White | 1.40 | Blue: Black | 1.62 |
| Red: Light Green | 1.23 | Yellow: Light Green | 1.13 | Brown: Red | 1.47 | Blue: Light Green | 1.75 |
| Red: Dark Green | 1.23 | Yellow: White | 1.22 | Brown: Black | 1.87 | Blue: Dark Green | 1.91 |
| Red: Yellow | 1.24 | Yellow: Blue | 1.22 | Brown: Blue | 2.00 | Blue: Brown | 2.33 |
| Red: Brown | 1.40 | Yellow: Dark Green | 1.61 | Brown: Dark Green | 2.00 | Blue: Yellow | 2.63 |

**Table 4.** Listing of net colours in order at fishing efficiency for fish species.

| | Tench | Carp | Pikeperch | Chub |
|---|---|---|---|---|
| The most effective | Red | Yellow | Brown | Blue |
| ↓ | Black | Brown | Light Green | Red |
| ↓ | White | Black | Yellow | White |
| ↓ | Blue | Red | White | Black |
| ↓ | Light Green | Light Green | Red | Light Green |
| ↓ | Dark Green | White | Black | Dark Green |
| ↓ | Yellow | Blue | Blue | Brown |
| The least effective | Brown | Dark Green | Dark Green | Yellow |

such a net, the fish swam parallel to the netting then turned into the less visible material close to the panel joins (Stewart, 1984). It was reported by Narayanappa *et al*. (1977) that most of the catch was caught in white net, and this was followed by yellow, grey, green and blue nets in inland waters of Burla in India.

Steinberg (1985) reported the dark green gillnets to be the most effective for cod in the west part of Baltic Sea. The colour of conventional nets in Lake Beyşehir was commonly light green. In this study, the catching efficiency of the light green net was found lower than the other colours for each species. Additionally, catches of the light and dark green nets were similar for tench and chub, but the light green net was 1.43 and 1.71 times more effective than the dark green net for catching carp and pikeperch.

Kara (1992) found the dark red nets to be more efficient than the light red nets in the daylight for *Diplodus annularis* L. in the Aegean Sea. Steinberg and Bohl (1985) found the light green nets more effective than the dark of those on the capture of cod, turbot, and flounder in the North Sea. It is suggested that even the different tones of the same colour may be influential on the catching efficiency of gillnets for fish species.

Legget and Jones (1971) reported that American shad, *Alosa sapidissima*, avoided driftnets even on dark moonless nights. Presumably detecting net vibrations by their lateral lines, most commonly net avoidance depends on sight. Fishing is often undertaken at night when fish are less able to recognise existence of the net (Sainsbury, 1996), but in Lake Beyşehir, the nets in conventional fisheries are set in the mornings and hauled the next morning, thus the catching are almost continual. Fish caught in the nets are separated from the nets and again the nets are set into the lake. Therefore, visibility of the gillnets is important in commercial fishing. The visibility of the relatively invisible materials is decreased by reduced light intensity; this may be due to the day-to-night change or increased depth (Wardle *et al*., 1991). Lake Beyşehir is a shallow lake (its mean depth is 6 m), thus the sun and moonlight can penetrate up to the deep of the lake.

Tench is the dominant species in the lake, and during the trials the relative abundance of this species was much higher than the other species. We observed that the tench were being intensively caught in the nets of the fishermen, and this situation affected the catching effectiveness of the nets for the other species. The number of fish in the net reaches a saturation level and does not increase further (Hamley, 1975). Choosing the proper colour can reduce catches of unwanted species, without affecting catches of the target species (Steinberg, 1962; Jester, 1973). It will increase the catching efficiency of the nets if the yellow and brown nets are used instead of the light green nets for carp and pikeperch. Additionally, the results of the study showed that it is possible to choose a suitable net colour for the catching of target species in reconstruction of the population in fish stock assessment.

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