Fly Findr

HOW TROUT SEE *and what light does under water*

Snell's window, ripples, which colors water removes first, muddy and stained water, low light, UV and polarized light. Every claim is tied to a published study, and where no study exists this guide says so.



97°
Snell's window on calm water

45%
Reaction distance left at 30 NTU

0.03 lux
Brown trout still fed steadily

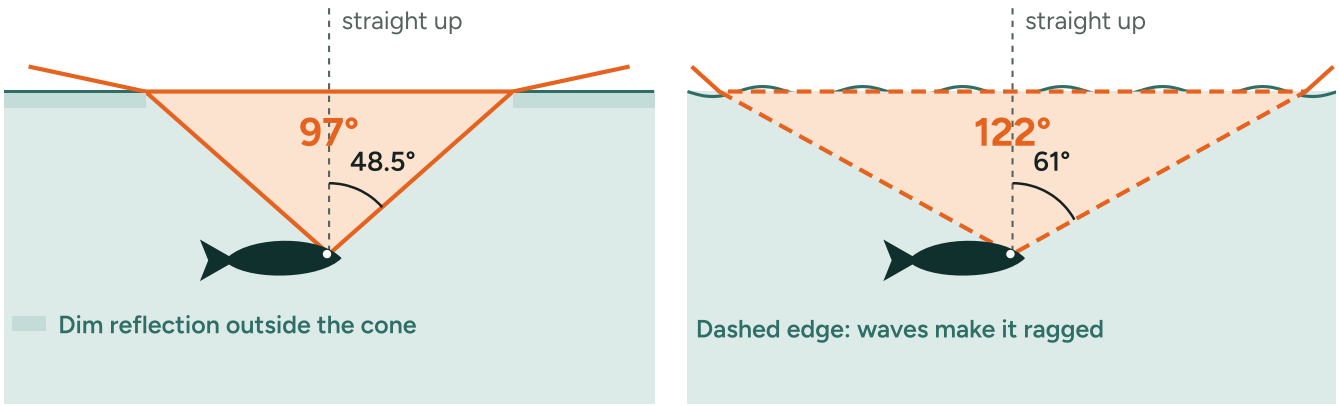
By Cade Bagley · Part 1 of How a trout senses the world · flyfindr.co/blog/how-trout-see

SNELL'S WINDOW *and ripples*

All the light from the sky above a calm surface is squeezed into a cone 97 degrees wide, 48.5 degrees each side of straight up. Outside it, a fish looking up sees a dim reflection of the water below. Waves widen the window to about 122 degrees at a 16 degree slope, and almost 180 degrees under breaking waves.

Snell's window on calm and rippled water

The cone a trout sees the sky through, from a calculation for flat water and for waves



Williamson and others 2024 · Lynch 2015

What is and isn't known

- The window and its size are optics, calculated for smooth or idealized surfaces. No trout were tested.
- One review, reasoning from masu salmon work, suggests distant objects through the window are unlikely to look sharp, so movement may be noticed before shape.
- No study has tested whether ripple, or staying low, keeps a trout from noticing an angler.

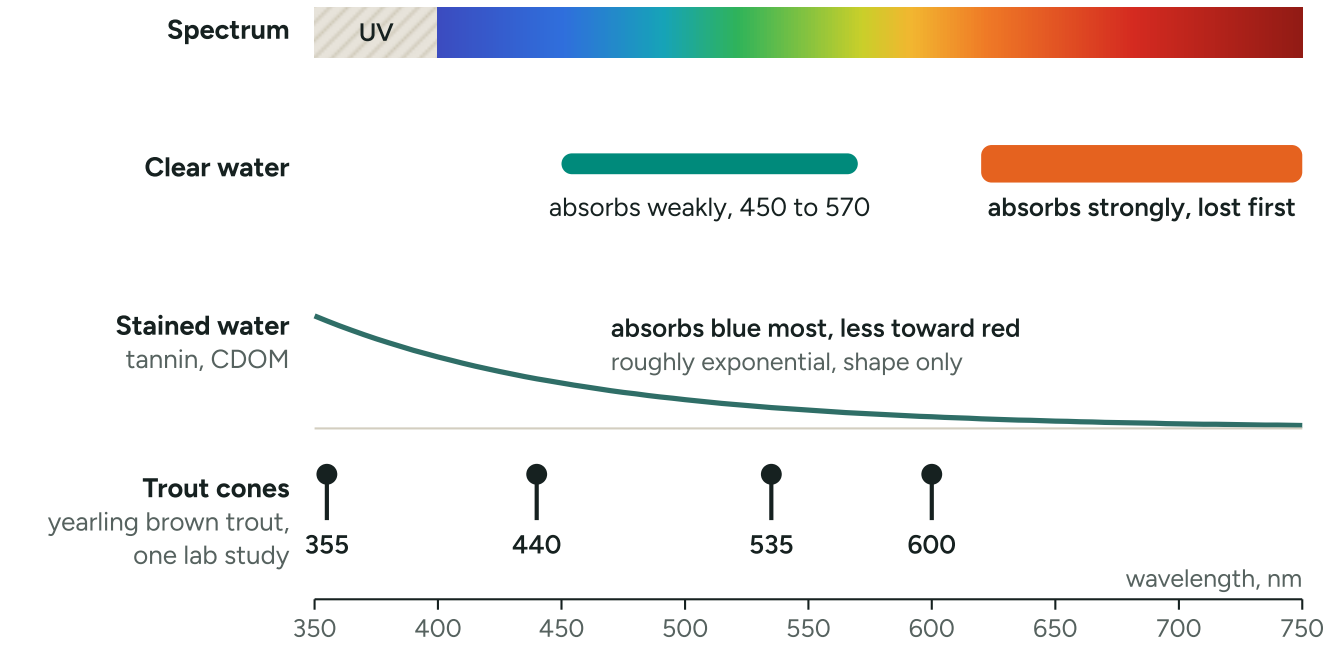
Inference, not tested on flies or catch. A rippled surface gives a fish a wider view of the sky than a calm one does.

COLOR *and UV*

Pure water absorbs little light from about 450 to 570 nm and absorbs red, about 620 to 750 nm, strongly, so red goes first. Tannin stain (CDOM) absorbs blue most and shifts the light toward longer wavelengths.

Which colors water removes first

Absorption across the spectrum in clear water and in tannin-stained water, with one study's trout cone peaks



Mobley, Ocean Optics Web Book · Bowmaker and Kunz 1987

Trout eyes

- One lab study found four cone types in yearling brown trout, peaks near 600, 535, 440 and 355 nm. Two-year-olds had lost the UV cones.
- Rainbow trout under 30 g showed a UV peak at 360 nm. Fish over 60 g showed none.
- One retina study found UV cones still present in the upper rear retina of larger rainbow trout. Adult UV vision is unsettled.

What it means

- UV helped juvenile rainbow trout a few weeks old find zooplankton, 32.1 mm against 26.8 mm.
- No study has tested UV fly materials or fly color on catch.

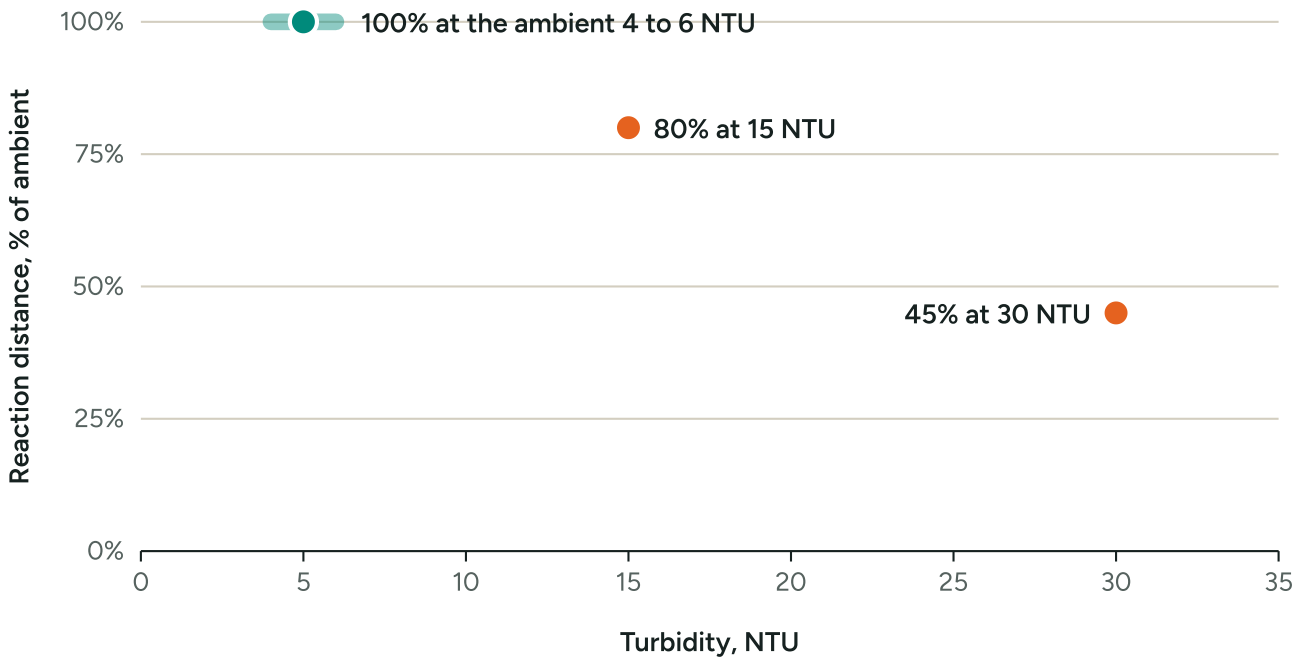
> **Inference, not tested on flies or catch.** Trout of the size most anglers catch, well over 60 grams, are not expected to see UV with most of the retina.

MUDDY WATER *and low light*

Turbidity is measured in NTU, nephelometric turbidity units. In artificial stream channels, wild rainbow trout reacted to food from 80 percent of their usual distance at 15 NTU and 45 percent at 30 NTU. How fast they chased it did not change.

Muddier water, shorter reaction distance

Rainbow trout reaction distance to food, as a share of the distance at ambient turbidity



Barrett, Grossman and Rosenfeld 1992 · wild rainbow trout, artificial stream channels

Muddy water

- Brook trout reacted to fewer prey as turbidity rose, but caught the ones they reacted to just as well.
- Juvenile Chinook fed most at 35 to 150 NTU.
- One lab stream study: cutthroat and coho fed off the bottom at 100 NTU with at least 70 percent of clear-water success.

Low light (lux)

- Brown trout and Arctic charr ate steadily from 50 down to 0.03 lux in tanks, and nothing in total darkness.
- Atlantic salmon parr: 35 percent of daytime efficiency under a full moon.
- One lab study: brown and brook trout thresholds about 0.005 lux, rainbow and cutthroat about 0.01 lux.

Inference, not tested on flies or catch. In muddy water a trout notices fewer food items but catches the ones it notices about as well. No study has tested fly size or color in turbid water.

FISHING LORE *against the studies*

What anglers say	What the studies show	Verdict
Trout can't see an angler who stays outside their window	The window is 97 degrees on calm water, and outside it is a dim reflection. No study tested how trout react to an angler at a measured angle or distance.	Partly supported by optics, untested on trout
Ripples hide you from the fish	Waves widen the window to about 122 degrees, or nearly 180 under breaking waves.	Not supported. The optics point the other way
Trout are color blind or can't see red	Yearling brown trout had four cone types, and rainbow trout chose among egg colors. Water removing red is an optics effect and says nothing about the eye.	Contradicted
UV materials attract adult trout	Larger rainbow trout and two-year-old brown trout lacked UV sensitivity in lab tests. UV helped only small juveniles.	No angling study
Fly color decides whether a trout takes	One spinner study in one reservoir found red caught most. Lab work points to contrast with the background.	One spinner study, no fly study
Polarized light helps trout see flies	Juveniles found prey farther under polarized light in a lab, but daytime polarization in one water type stayed below the detection threshold.	Juvenile lab evidence only, no fishing test
Trout can't find food in muddy water, so fish big dark flies	Reaction distance falls, but feeding held up in a field study and in bottom feeding at 100 NTU. Nothing tested fly size or color.	Partly contradicted, no fly study
Trout won't feed at night	Brown trout fed at 0.001 lux in a lab, and trout in a stream channel ate drifting ants at night.	Contradicted in part
Brown trout see better in the dark than rainbows	Brown and brook trout had thresholds about half those of rainbow and cutthroat trout.	Supported by one lab study
Trout have a blind spot behind and below them	Nobody has measured a trout blind zone.	No study
Bright sun blinds trout and stops feeding	Rod pigment drops in direct sun in a lab. No study measured feeding in glare.	No study

References. Allison 2003; Atessahin 2019; Barrett 1992; Berg 1985; Bowmaker 1987; Browman 1992; Browman 1994; Carleton 2020; Cheng 2007; Degner 2001; Douglas 1982; Dunbrack 1984; Elliott 2011; Fraser 1997; Ginetz 1973; Gregory 1993; Hansen 2013; Harvey 2008; Hawryshyn 1989; Henderson 1985; Jenkins 1969; Lynch 2015; Mobley, Ocean Optics Web Book; Novales Flamarique 2001; Novales Flamarique 2013; Novales Flamarique 1997; Parkyn 2000; Rader 2007; Rahmann 1979; Ramsden 2008; Sabbah 2013; Shashar 2011; Silverman 2024; Sweka 2001; Vogel 1999; White 2007; Williamson 2024. Full citations and links at flyfindr.co/blog/how-trout-see.