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Enhancing Handline Catch Efficiency for Atlantic Cod: Two Studies of Short-Wavelength Modifications

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Background

- Most fish depend on light to forage¹, and the visual sensitivities of fish are strongly influenced by the light quality within their habitat^{1,2}.
- Atlantic Cod (*Gadus morhua*) are maximally sensitive in the range of 490 to 550 nm³, which aligns with the light available between 50 – 70 m⁴ (Fig 1).

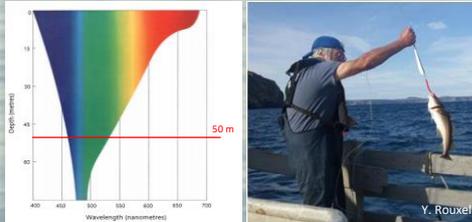


Figure 1: The attenuation of the visible light spectrum in clear water. Adapted from Levine and MacNichol (1984).

Figure 2: Atlantic Cod caught by handline and Norwegian jig.

- Different fishing gears have various catch rates and selectivity, with advantages and disadvantages to each⁵.
- Owing to high catch rates, gillnets are the preferred gear of inshore fishers in the NW Atlantic⁵. Gillnets, however catch considerable non-target fish, birds and other marine organisms⁵.
- The handline's simple design creates minimal bycatch⁵ and high-quality live catch, but at a lower rate⁵.

Therefore, in these studies we modified Norwegian jigs with light as an attempt to enhance handline catch rate.

Hypothesis

The visual sensitivity of fishes predisposes them to avoid predators and forage efficiently in their habitat-specific light conditions.

Predictions

- Green fluorescent Norwegian jigs will enhance the handline catch rate of Atlantic Cod.
- Green LED lights attached above jigs will enhance the handline catch rate of Atlantic Cod.

Methods



Figure 3: Newfoundland study sites Musgrave Harbour (MH) and Portugal Cove (PC).

- Fluorescent jig experiment data were collected in Musgrave Harbour, August – September 2017.

Fluorescent jig tests (n = 306 fish, 7 trips):	
Control	Silver Norwegian jig
Variable	Fluorescent Norwegian jig
Gear	Traditional handline

- LED experiment data were collected in Musgrave Harbour and Portugal Cove, August – September 2018.

Green LED tests (n = 130 fish, 4 trips):	
Control	Silver Norwegian jig
Variable	Silver Norwegian jig with LED
Gear	Traditional handline and rod



Figure 4: Green-fluorescent Norwegian jig.



Figure 5: Fishtek Marine® UltraBright ProGlow submersible green LEDs, (λ = 520nm, 0.7 lumen) with quarter for scale.

Results

Catch rates were calculated using the equation

$$\text{Catch Rate} = \text{Total cod catch} / \text{Total soak time} / \text{Lines}$$

The green fluorescent jig increased cod catch rate (cod/min/line) marginally, from 0.414 for the control jig, to 0.457 for the fluorescent jig.

- Size of catch did not vary between tests.

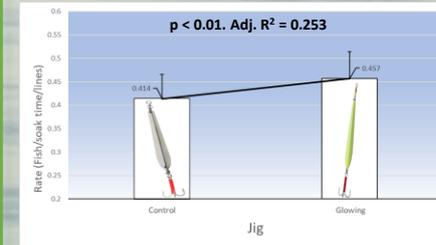


Figure 6: Rate of cod catch by silver and fluorescent Norwegian jigs.

The green LED attachment increased cod catch rate (cod/min/line) dramatically, from 0.474 for the control to 0.931 with the LED.

- Size of catch did not vary between tests.
- Gear type had no significant effect.

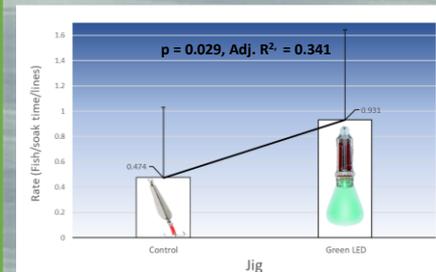


Figure 7: Rate of cod catch by silver Norwegian jig, with and without green LED attachment.

Summary

- The fluorescent jig increased catch rate slightly, with no effect on the size of fish caught.
 - The green LED increased catch rate greatly, with no effect on the size of fish caught.
- Enhancements may entice fishermen to handline by increasing catch efficiency, thus producing a higher quality catch (as well as mitigating bycatch) compared to gillnets⁵.
 - Neither modification is expensive, nor adds effort or complications to handling. Both can be easily incorporated into commercial and recreational fishing activities.

Future Research

- LED experiments were part of a pilot study, where more data and a true negative control are needed to make a full conclusion about effectiveness.
- Similar experiments testing the influence of other wavelengths or intensities of light on catch rate should be considered.
- These findings may be applicable to other taxa and other fisheries.
- The use of light in long-line fisheries should be tested for both catch efficiency and bycatch mitigation.

Acknowledgments

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