BRIEFING PAPER

Diel vertical migration hypotheses explain size-dependent behaviour in a freshwater piscivore

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Summary

- Diel vertical migration (DVM) is characterized as ascent at dusk and descent at dawn. Several hypotheses predict DVM behaviour as a response to light, feeding opportunities, predator avoidance and bio-energetics. No studies examine whether DVM hypotheses can explain individual behavioural characteristics in top-level predators. This study examines whether bull trout, *Salvelinus confluentus*, show size-dependent daily and seasonal patterns in DVM that are consistent with DVM hypotheses.

- Using implanted acoustic transmitters the researchers found that swimming depths of bull trout were shallowest at night, deepest during the day and showed clear patterns of DVM across all seasons. Although not explicitly tested, size-dependent DVM patterns could be explained as predator avoidance behaviour. Results indicate that light is a proximate trigger, while feeding opportunities and predator avoidance are the most parsimonious DVM hypotheses to explain body-size-dependent behaviour.

Context

The mechanisms and causes of DVM are linked to proximate triggers such as changes in light intensity and hydrostatic pressure as well as responses to thermal gradients, as well as bio-energetic efficiency, feeding opportunities and predator avoidance. DVM has been well studied in planktivorous fish populations only. Piscivores may exhibit DVM in relation to the same proximate triggers and ultimate causes as their prey species, however studies to support this are rare.

Adfluvial bull trout have low thermal tolerance and feed on vertically migrating kokanee salmon (*Oncorhynchus nerka*). As bull trout are easily captured by angling, sampling and tagging (using acoustic telemetry) took place in spring and autumn. After one year, data collected from the 187 tagged fish demonstrated typical DVM patterns, i.e. bull trout descended at dawn and ascended at dusk. This pattern was least pronounced in winter and spring and most pronounced in summer and autumn. There was an overall shift in depth and vertical movement in relation to light, which supports other studies linking DVM to light sensitivity, predator avoidance and foraging efficiency.

Deeper depths recorded in summer and autumn demonstrated that these cold-water fish seek deeper water during warmer periods. DVM in winter, when water depths are of a similar temperature, indicated that bio-energetic requirements cannot explain DVM across seasons. Proximate cues from light, feeding opportunities and predator avoidance are likely to be the primary drivers of DVM in this system. This study highlights the need to consider animal behaviour hypotheses at the individual level.