APPENDIX A. Material and methods for *Supplementary* information

Modelling visual ranges

Surface light levels were logged continuously underway, and vertical profiles of light attenuation were also measured multiple times in all four basins (Klevjer et al., 2020). The data obtained during the vertical profiles were combined with CTD data to make empirical models of light attenuation (Klevjer et al., 2020). These empirical models were combined with the surface levels to estimate light levels at the depths of the DSLs, but optical properties are also important in the epipelagic realm. In an effort to attempt to quantify the influence of the *in situ* optical conditions on ecology in the epipelagic, we used the combination of the empirical attenuation models, measured surface light, and *in situ* fluorescence levels to parametrize a model of visual search rates (Aksnes and Giske, 1993). Visual range for a pelagic planktivore feeding on *Calanus finmarchicus* were parametrised following (Varpe and Fiksen, 2010):

$$r_{(t,d)}^2 e^{\left(c_{(t,d)} r_{(t,d)}\right)} = C_p A_p E' \frac{I_{(t,d)}}{K_e + I_{(t,d)}}, r \geq 0.05$$

$$r_{(t,d)} = \sqrt{C_p A_p E' \frac{I_{(t,d)}}{K_e + I_{(t,d)}}}, r < 0.05$$

Here $r_{(t,d)}$ is the visual range at time t and depth d, c is the optical beam attenuation, C_p is the prey contrast (0.3; Aksnes and Utne, 1997), A_p is the prey image area ($3x10^{-6}$ m for *Calanus finmarchicus*; Aksnes and Utne 1997), E' is the visual capacity, K_e is a composite saturation parameter, and $I_{(t,d)}$ is the total organism perceived irradiance at time t and depth d. E' and K_e were scaled such that r equalled 30 cm (e.g. 1 BL for an adult herring) when c and I were not limiting, following Varpe and Fiksen (2010). Details of the model can be found in Aksnes and Giske (1993), Aksnes and Utne (1997) and Varpe and Fiksen (2010).

$c_{(t,d)}$ and $I_{(t,d)}$ were computed dynamically along the transect. Using the wavelength specific surface irradiance and the wavelength resolved empirical attenuation model, wavelength resolved light levels at depth were estimated for each timestep (t):

$$E_{(wl,d)} = E_{(wl,0^-)} e^{-k_{(wl,d)} d}$$

and total organism perceived irradiance (in photons m^{-2} s^{-1}) were estimated as:

$$I_{(t,d)} = \sum_{wl=440}^{540} E_{(wl,d)}\, x\, HerringSensitivity_{wl}$$

Herring eye sensitivity at wavelength was taken from Blaxter (1964) and scaled so that the sensitivity at the wavelength of maximum sensitivity (502 nm) was 1. $I_{(t,d)}$ thereby giving a measure of the light available to a herring eye, “herring-lux”. Wavelength specific values for $c_{(t,d,wl)}$ were estimated based on vertical profiles of chlorophyll fluorescence at the closest CTD station using the formula of Voss (1992), and a single value was computed by calculating a weighted average of the wavelength specific c values, using the wavelength specific irradiances ($E_{(wl,d)}$) as weights. Based on these input values visual ranges were estimated using an optimization procedure in R (R Core Team, 2020). The results were evaluated either directly as visual range or as clearance efficiency (volume searched per unit time) calculated as:

$$Volume\,searched = 0.5\, x \times r^2 \times v \times t$$

where v is swimming speed (2 BL s^{-1}, e.g. 60 cm s^{-1}; Varpe and Fiksen, 2010) and t is timestep.

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