**SUPPLEMENTARY MATERIAL**

**Artificial light improves escapement of fish from a trawl net**

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***Table S1.*** *Factors (a and b) used in the length weight equation for fish bycatch species and QSC, R2 goodness of fit values, number of individuals per subsample (n) and the transformation used in the linear equation.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Species | Factor |  |  |  |  |
| **a** | **b** | **R2** | **n** | **Transformation** |
| Lemon sole | -10.407373 | 2.829204 | 0.8936 | 172 | ln |
| Dab | -11.303324 | 2.957324 | 0.9298 | 107 | ln |
| Plaice | -12.824653 | 3.224888 | 0.9652 | 138 | ln |
| Whiting | -12.038805 | 3.034202 | 0.9176 | 79 | ln |
| Haddock | -12.32826 | 3.12748 | 0.9407 | 89 | ln |
| Cod | -11.487862 | 3.001368 | 0.9671 | 35 | ln |
| QSC | -8.08176 | 2.831494 | 0.9599 | 400 | ln |

*Table S2. Tow characteristics described for each paired tow per site, indicating the treatment, the total no. of tows, mean warp (m), mean tow duration, and mean speed per site(km-1). Environmental parameters are displayed as total/mean swept area (ha1), mean depth (m) (EMODnet.EU), ambient light levels (HOBO loggers), for the grouped control and treatment tows for each treatment per site. Catch data on the total no. of bycatch individuals caught and total and mean no. of QSC bags caught in the control (C ) and treatment (T) groups per treatment in each site are also reported*.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Site | Shallow | | Deep | |
| Treatment | SMP | SMP+L | SMP | SMP+L |
| No. of paired tows | 19 | 21 | 9 | 9 |
| Tow duration (mins) | 60.35 | | 62.83 | |
| Mean speed (knts) | 2.35 | | 2.33 | |
| Warp (m) | 130 | | 75 | |
| Ambient light  Av. lux | 906.14  (±23.69) | | 897.25  (±0) | |
| Water depth (m) | Min Mean Max | | Min Mean Max | |
|  | -29.24 -33.85 -40.28 | | -45.56 -64.98. -95.38 | |
| Mean water depth per treatment (m) | C=-34.23 | C=-33.54 | C= -66 | C= -63.65 |
| T=-34.25 | T=-33.46 | T= -65.64 | T= -64.6 |
| Mean swept area (km) | C= 6.12 | C=6.35 | C=6.46 | C=6.81 |
| T=6.09 | T=6.31 | T=6.43 | T=6.88 |
| Total swept area (km) | C=116.21 | C=133.39 | C=58.11 | C=61.33 |
| T=115.62 | T=132.55 | T=57.88 | T=61.96 |
| Total no. of all bycatch individuals | C=1169 | C=1297 | C=1121 | C=1373 |
| T= 913 | T=1062 | T=1450 | T=909 |
| Av. No. of QSC bags per tow | C=1.18 T=1.14 | C=0.9 T=0.83 | C=1.06 T=0.77 | C=3.66 T=1.17 |
| Total no. of QSC bags | C=22.5 T=21.75 | C=19 T=18.75 | C=9.5 T=6.9 | C=16 T=10.5 |

***Table S3.*** *The total abundance of bycatch individuals or the no. of marketable QSC bags caught per site, average estimated biomass (kg) and standard deviation of the catch of QSC, haddock, whiting, cod and flatfish caught per tow, the swept area and WPUA by hectare, in each treatment (SMP, SMP+L) for the paired tows and the percentage change between control and treatment nets.*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Species** | **Depth range** | **Treatment** | **Abundance** | **Av. Biomass/ tow** | **Av. WPUA kg/ha** | **% ∆ (WPUA)** |
|  |  |  | No. of QSC bags |  |  |  |
| **Queen scallop** | 45-95m | Control | 20.5 | 59.79 (±67.35) | 9.82 (±11.03) |  |
|  |  | SMP & SMP+L | 14.4 | 42.0 (±44.47) | 6.98 (±7.70) | -28.92 |
|  | 45-95m | Control | 9.5 | 36.94 (±37.58) | 6.51 (±7.67) |  |
|  |  | SMP | 6.9 | 26.83 (±26.25) | 4.50 (±4.68) | -30.87 |
|  | 45-95m | Control | 11 | 128.33 (±99.50) | 19.78 (±15.38) |  |
|  |  | SMP+L | 7.5 | 87.5 (±63.10) | 14.44 (±11.30) | -26.99 |
|  | 29-40m | Control | 41.5 | 36.31 (±37.83) | 5.79 (±5.86) |  |
|  |  | SMP & SMP+L | 40.5 | 35.44 (±49.3) | 5.85 (±7.78) | +1.03 |
|  | 29-40m | Control | 22.5 | 41.45 (±35.58) | 6.88 (±6.20) |  |
|  |  | SMP | 21.75 | 40.07 (±44.74) | 7.05 (±8) | - 2.46 |
|  | 29-40m | Control | 19 | 31.67 (±40.05) | 4.81 (±5.51) |  |
|  |  | SMP+L | 18.75 | 31.25 (±53.84) | 4.77 (±7.6) | + 0.91 |
|  |  |  | No. of bycatch individuals |  |  |  |
| **Haddock** | 29-40m | Control | 47 | 0.74 (±0.81) | 0.12 (±0.06) |  |
|  |  | SMP | 16 | 0.30 (±0.33) | 0.05 (±0.06) | -58.33 |
|  | 29-40m | Control | 56 | 0.74 (±0.76) | 0.12 (±0.05) |  |
|  |  | SMP+L | 25 | 0.32 (±0.28) | 0.05 (±0.05) | -58.33 |
|  | 45-95m | Control | 93 | 3.08 (±2.78) | 0.48 (±0.57) |  |
|  |  | SMP | 139 | 4.40 (±3.23) | 0.68 (±0.57) | +41.67 |
|  | 45-95m | Control | 206 | 6.04 (±3.10) | 0.89 (±0.44) |  |
|  |  | SMP+L | 113 | 3.24 (±2.66) | 0.47 (±0.44) | -47.19 |
| **Whiting** | 29-40m | Control | 45 | 0.43 (±0.47) | 0.07 (±0.07) |  |
|  |  | SMP | 8 | 0.07 (±0.10) | 0.01 (± 0.02) | -85.71 |
|  | 29-40m | Control | 70 | 0.49 (±0.51) | 0.08 (±0.08) |  |
|  |  | SMP+L | 16 | 0.13 (±0.16) | 0.02 (±0.03) | -75.00 |
| **Flatfish** | 29-40m | Control | 251 | 2.10 (±1.06) | 0.34 (±0.17) |  |
|  |  | SMP | 266 | 2.10 (±0.97) | 0.35 (±0.16) | +2.94 |
|  | 29-40m | Control | 298 | 2.35 (±1.13) | 0.37 (±0.17) |  |
|  |  | SMP +L | 267 | 2.25 (±0.99) | 0.36 (±0.16) | -2.70 |
|  | 45-95m | Control | 513 | 7.31 (±4.85) | 1.13 (±0.84) |  |
|  |  | SMP | 513 | 7.65 (±5.75) | 1.19 (±0.89) | +5.31 |
|  | 45-95m | Control | 526 | 9.50 (±5.66) | 1.40 (±0.80) |  |
|  |  | SMP+L | 382 | 7.14 (±4.75) | 1.04 (±0.73) | -25.71 |
| **Cod** | 29-40m | Control | 11 | 0.51 (±0.79) | 0.08 (±0.13) |  |
|  |  | SMP | 15 | 0.85 (±0.55) | 0.14 (± 0.09) | +75% |
|  | 29-40m | Control | 9 | 0.43 (±0.58) | 0.07 (±0.10) |  |
|  |  | SMP+L | 14 | 0.69 (±0.79) | 0.11 (±0.12) | +57% |

***Table S4.*** *Intercept only linear model outputs. Models were conducted on the relative catch (lnRR of WPUA, kg/ha) of QSC. The factors for each model are displayed, with treatments analysed separately per site, the estimate (± standard error, SE) is the mean lnRR response for the treatment and it indicates whether the catch has increased or decreased relative to the control (+, - ), t value and p values are noted.*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Species** | **Depth range** | **Treatment** | **d.f** | **Estimate** | **t- value** | **P** |
| Queen scallop | 29-40m | SMP & SMP+L | 39 | -0.29 (±0.23) | -1.25 | 0.22 |
| 29-40m | SMP | 18 | -0.34 (±0.36) | -0.95 | 0.36 |
| 29-40m | SMP+L | 20 | -0.25 (±0.32) | -0.79 | 0.44 |
| 45-95m | SMP & SMP+L | 11 | -0.15 (±0.26) | -0.58 | 0.57 |
| 45-95m | SMP | 8 | -0.13 (±0.36) | -0.37 | 0.72 |
| 45-95m | SMP+L | 2 | -0.22 (±0.13) | -1.75 | 0.22 |
| Haddock | 29-40m | SMP | 13 | -0.88 (±0.40) | -2.21 | 0.05 |
| 29-40m | SMP+L | 15 | -0.49 (±0.37) | -1.31 | 0.21 |
| 45-95m | SMP | 7 | 0.47 (±0.21) | 2.29 | 0.06 |
| 45-95m | SMP + L | 8 | -0.94 (±0.24) | -3.92 | 0.004\*\* |
| Whiting | 29-40m | SMP | 14 | -1.39 (±0.50) | -2.79 | 0.01\* |
| 29-40m | SMP+L | 18 | -1.19 (±0.45) | -2.66 | 0.01\* |
| Flatfish | 29-40m | SMP | 18 | -0.03 (±0.16) | -0.20 | 0.84 |
| 29-40m | SMP+L | 20 | -0.01 (±0.17) | -0.03 | 0.98 |
| 45-95m | SMP | 8 | 0.06 (±0.23) | 0.28 | 0.79 |
| 45-95m | SMP+L | 8 | -0.34 (±0.11) | -3.18 | 0.01\* |
|  |  |  |  |  |  |

*Table 5 ANOVA outputs comparing the relative catch (lnRR of WPUA, kg/ha) of marketable QSC and bycatch species caught in the SMP net compared to the SMP+L net per site.*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Species** | **Depth range** | **Factor** | **d.f** | **F value** | **p value** |
| **Queen scallop** | 29-40m | SMP~SMP+L | 38 | 0.03 | 0.85 |
| 45-95m | SMP~SMP+L | 10 | 0.02 | 0.89 |
| **Whiting** | 29-40m | SMP~SMP+L | 32 | 0.10 | 0.76 |
| **Haddock** | 29-40m | SMP~SMP+L | 28 | 0.53 | 0.47 |
| 45-95m | SMP~SMP+L | 15 | 19.44 | 0.0005\*\*\* |
| **Flatfish** | 29-40m | SMP~SMP+L | 38 | 0.01 | 0.91 |
| 45-95m | SMP~SMP+L | 16 | 2.61 | 0.13 |

***Table S6*** *The estimated parameters, z values and p values for the preferred averaged generalised linear models describing the relationship between the environmental parameters and the relative catch (lnRR of WPUA, kg/ha) of QSC, haddock, whiting, flatfish in the SMP+L and SMP paired tows.*

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Species** | **Depth range** | **Treatment** | **Parameters** | **Estimate** | **z value** | **P** |
| **Queen scallop** | 29-40m & 45-95m | SMP | (Intercept) | -0.93900 | 0.478 | 0.632 |
|  |  |  | Tidal coefficient | 0.03039 | 0.758 | 0.448 |
|  |  |  | Seastate | 0.15193 | 0.750 | 0.453 |
|  | 29-40m & 45-95m | SMP+L | (Intercept) | -0.3505 | 0.838 | 0.402 |
|  |  |  | Sea state | 0.1761 | 0.789 | 0.430 |
| **Haddock** | 29-40m & 45-95m | SMP + L | (Intercept) | -0.65 | 2.53 | 0.01\* |
|  |  |  | Cloud cover | 0.87 | 1.69 | 0.09 |
|  |  |  | Tidal coefficient | 0.75 | 1.45 | 0.15 |
|  | 29-40m & 45-95m | SMP | (Intercept) | -0.39 | 1.41 | 0.16 |
|  |  |  | Depth | -1.49 | 2.53 | 0.01\* |
|  |  |  | Cloud cover | 0.64 | 1.06 | 0.29 |
| **Whiting** | 29-40m | SMP+L | (Intercept) | -1.19 | 2.49 | 0.013 |
|  |  |  | Tidal coefficient | 1.10 | 1.13 | 0.26 |
|  |  |  | Seastate | 1.06 | 1.08 | 0.28 |
| **Flatfish** | 29-40m & 45-95m | SMP+L | (Intercept) | -0.11 | 0.84 | 0.40 |
|  |  |  | Cloudcover | 0.34 | 1.32 | 0.19 |
|  |  |  | Turbidity | -0.35 | 1.35 | 0.18 |
|  |  |  | Depth | 0.34 | 1.33 | 0.19 |
|  | 29-40m & 45-95m | SMP | (Intercept) | -0.01 | 0.02 | 0.99 |
|  |  |  | LuxAv | -0.30 | 1.09 | 0.28 |

***Video S7*** *Underwater footage taken from within the net, capturing a Spurdog (Squalus Acanthiai) escaping through the square mesh panel fitted with LED lights within the upper section of the net.*