Supplementary Information

# Table S1: Datasets

| **Species** | **Tag no** | **Sex** | **Release**  **Date** | **Release**  **Latitude** | **Release**  **Longitude** | **ReCapture**  **Date** | **ReCapture**  **Latitude** | **ReCapture**  **Longitude** | **Days at**  **Liberty** | **Displacement**  **(km)** | **Tag**  **Manufacturer1** | **Tag**  **Model2** | **Max**  **Depth (m)** |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| *Raja brachyura* | A01775 | F | 2010-01-08 | 50.3679 | -4.1734 | 2010-04-09 | 50.2734 | -3.9342 | 91 | 19.99 | CTL | LL | 100 |
| *Raja brachyura* | A01840 | M | 2010-04-13 | 50.3008 | -4.1165 | 2010-05-17 | 50.2549 | -3.9361 | 33 | 13.81 | CTL | LL | 100 |
| *Raja brachyura* | A01846 | M | 2010-04-13 | 50.3008 | -4.1165 | 2010-06-13 | 50.0353 | -4.0457 | 60 | 29.99 | CTL | LL | 100 |
| *Raja brachyura* | A01852 | F | 2010-04-15 | 50.2601 | -3.9339 | 2010-07-19 | 50.2558 | -3.8750 | 94 | 4.22 | CTL | LL | 100 |
| *Raja brachyura* | A05885 | F | 2010-04-15 | 50.2597 | -4.0041 | 2010-04-25 | 50.2466 | -3.8689 | 9 | 9.73 | CTL | LL 2MB | 200 |
| *Raja brachyura* | A05886 | F | 2010-04-15 | 50.2591 | -4.0203 | 2010-07-30 | 50.3408 | -4.2742 | 105 | 20.22 | CTL | LL 2MB | 200 |
| *Raja brachyura* | A05908 | F | 2010-06-10 | 50.3307 | -4.1336 | 2010-08-05 | 50.3214 | -4.2449 | 55 | 7.98 | CTL | LL 2MB | 200 |
| *Raja brachyura* | A05927 | F | 2010-07-14 | 50.3175 | -4.1332 | 2010-09-18 | 50.2565 | -3.9307 | 65 | 15.92 | CTL | LL 2MB | 200 |
| *Raja brachyura* | A05950 | F | 2010-11-24 | 50.2990 | -4.1061 | 2012-10-10 | 50.1563 | -3.8983 | 685 | 21.70 | CTL | LL 2MB | 200 |
| *Raja brachyura* | A05962 | M | 2010-11-24 | 50.2990 | -4.1061 | 2011-11-20 | 50.2500 | -3.5750 | 360 | 38.18 | CTL | LL 2MB | 200 |
| *Raja brachyura* | A06014 | F | 2010-11-24 | 50.2990 | -4.1061 | 2011-01-25 | 50.2752 | -4.0323 | 61 | 5.88 | CTL | SL 2MB | 200 |
| *Raja brachyura* | B0357a | M | 2012-01-16 | 50.3340 | -4.1635 | 2012-04-27 | 50.2513 | -3.9037 | 101 | 20.65 | Star Oddi | milli-F | 100 |
| *Raja clavata* | A01711 | F | 2009-09-07 | 50.3334 | -4.1959 | 2009-10-02 | 50.3338 | -4.1897 | 25 | 0.45 | CTL | LL | 100 |
| *Raja clavata* | A01711a | F | 2009-10-13 | 50.3318 | -4.1672 | 2010-02-07 | 50.3281 | -4.1912 | 117 | 6.93 | CTL | LL | 100 |
| *Raja clavata* | A01735 | F | 2009-09-07 | 50.3334 | -4.1959 | 2009-12-05 | 50.3280 | -4.1912 | 89 | 0.68 | CTL | LL | 100 |
| *Raja clavata* | A01736 | M | 2009-09-10 | 50.3074 | -4.2193 | 2010-09-17 | 50.2144 | -4.2882 | 372 | 11.45 | CTL | LL | 100 |
| *Raja clavata* | A01764 | F | 2008-07-15 | 50.3231 | -4.2411 | 2011-06-02 | 50.3118 | -4.2522 | 1052 | 1.48 | CTL | LL | 100 |
| *Raja clavata* | A01767 | F | 2008-07-16 | 50.3900 | -4.2006 | 2010-06-04 | 50.3413 | -4.1571 | 688 | 6.24 | CTL | LL | 100 |
| *Raja clavata* | A01770 | F | 2008-11-05 | 50.3128 | -4.1322 | 2008-12-16 | 50.2689 | -3.9216 | 41 | 15.76 | CTL | LL | 100 |
| *Raja clavata* | A01770a | M | 2009-10-02 | 50.3365 | -4.1563 | 2010-05-15 | 50.3296 | -4.1912 | 225 | 4.81 | CTL | LL | 100 |
| *Raja clavata* | A01772 | F | 2009-12-04 | 50.3479 | -4.1501 | 2010-05-07 | 50.3281 | -4.1912 | 154 | 3.66 | CTL | LL | 100 |
| *Raja clavata* | A01773 |  | 2009-11-11 | 50.3353 | -4.1673 | 2009-12-09 | 50.3024 | -4.1654 | 28 | 3.67 | CTL | LL | 100 |
| *Raja clavata* | A01798 | F | 2010-01-20 | 50.3292 | -4.1655 | 2010-05-15 | 50.3296 | -4.1923 | 114 | 1.91 | CTL | LL | 100 |
| *Raja clavata* | A01799 |  | 2009-02-12 | 50.3292 | -4.1655 | 2009-02-12 |  |  | 0 | 0.00 | CTL | LL | 100 |
| *Raja clavata* | A05888 | F | 2010-04-23 | 50.3402 | -4.1614 | 2010-07-22 | 50.3413 | -4.1571 | 89 | 0.33 | CTL | LL 2MB | 200 |
| *Raja clavata* | A05895 | F | 2011-02-09 | 50.2946 | -4.1289 | 2011-05-15 | 50.2500 | -3.9167 | 94 | 15.89 | CTL | LL 2MB | 200 |
| *Raja clavata* | A05952 | F | 2010-10-07 | 50.3187 | -4.1365 | 2011-01-26 | 50.3317 | -4.1883 | 110 | 3.96 | CTL | LL 2MB | 200 |
| *Raja clavata* | A05959 | M | 2010-11-03 | 50.3623 | -4.1874 | 2011-03-27 | 50.3628 | -4.1349 | 143 | 3.73 | CTL | LL 2MB | 200 |
| *Raja clavata* | A05961 | F | 2010-11-04 | 50.3621 | -4.1905 | 2011-01-30 | 50.3383 | -4.1683 | 86 | 3.08 | CTL | LL 2MB | 200 |
| *Raja clavata* | A05984 | M | 2010-04-21 | 50.3485 | -4.1537 | 2010-04-22 | 50.3413 | -4.1571 | 0 | 0.84 | CTL | SL 2MB | 200 |
| *Raja clavata* | A06000 | F | 2010-06-10 | 50.3307 | -4.1336 | 2010-07-25 | 50.3167 | -4.1667 | 44 | 2.82 | CTL | SL 2MB | 200 |
| *Raja clavata* | A06001 | F | 2010-06-10 | 50.3307 | -4.1336 | 2010-07-25 | 50.3167 | -4.1667 | 44 | 2.82 | CTL | SL 2MB | 200 |
| *Raja clavata* | A06009 | F | 2010-08-12 | 50.2475 | -3.9910 | 2010-08-18 | 50.2830 | -4.1475 | 5 | 11.82 | CTL | SL 2MB | 200 |
| *Raja clavata* | A06015 | F | 2010-11-24 | 50.2990 | -4.1061 | 2011-02-11 | 50.2250 | -4.0583 | 78 | 8.91 | CTL | SL 2MB | 200 |
| *Raja clavata* | A06026 | M | 2010-11-04 | 50.3621 | -4.1905 | 2010-12-16 | 50.3486 | -4.1325 | 41 | 4.39 | CTL | SL 2MB | 200 |
| *Raja clavata* | B0324 | F | 2012-05-24 | 50.2901 | -4.2749 | 2012-07-10 | 50.3245 | -4.2362 | 46 | 4.72 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0334 | M | 2011-05-19 | 50.3619 | -4.1800 | 2011-12-29 |  |  | 223 | 0.00 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0336 | M | 2011-05-19 | 50.3619 | -4.1800 | 2013-01-24 | 50.2872 | -3.9227 | 615 | 20.09 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0340 | F | 2011-07-07 | 50.3261 | -4.2540 | 2012-06-26 |  |  | 354 | 0.00 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0342 | F | 2011-07-28 | 50.3083 | -4.1823 | 2012-04-03 |  |  | 249 | 0.00 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0343 | F | 2011-07-28 | 50.3083 | -4.1823 | 2011-09-01 | 50.3350 | -4.2450 | 34 | 5.36 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0344 | F | 2011-07-28 | 50.3083 | -4.1823 | 2012-04-28 |  |  | 274 | 0.00 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0345 | F | 2011-07-28 | 50.3083 | -4.1823 | 2012-04-24 |  |  | 270 | 0.00 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0347 | F | 2011-07-28 | 50.3083 | -4.1823 | 2012-03-31 | 50.3317 | -4.2414 | 246 | 4.94 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0348 | F | 2011-07-28 | 50.3083 | -4.1823 | 2012-04-16 | 50.3373 | -4.2740 | 262 | 7.28 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0353 | M | 2011-10-21 | 50.3627 | -4.1782 | 2012-07-28 | 50.3702 | -4.1319 | 280 | 3.39 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0355 | M | 2011-10-21 | 50.3627 | -4.1782 | 2012-07-28 | 50.3455 | -4.1530 | 280 | 2.62 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0357 | F | 2011-12-07 | 50.3215 | -4.1346 | 2011-12-21 |  |  | 13 | 0.00 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0374a | F | 2012-07-02 | 50.2987 | -4.1868 | 2012-10-07 | 50.3259 | -4.2368 | 96 | 4.67 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0385 | M | 2012-03-27 | 50.3176 | -4.1811 | 2012-04-28 |  |  | 31 | 0.00 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0386 | M | 2012-03-27 | 50.3176 | -4.1811 | 2012-05-08 |  |  | 41 | 0.00 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0387 | M | 2012-03-27 | 50.3176 | -4.1811 | 2012-06-01 | 50.3445 | -4.2725 | 65 | 7.16 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0389 | M | 2012-03-27 | 50.3176 | -4.1811 | 2012-04-02 |  |  | 5 | 0.00 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0391 | M | 2012-03-27 | 50.3176 | -4.1811 | 2012-04-11 |  |  | 14 | 0.00 | Star Oddi | milli-F | 100 |
| *Raja clavata* | B0394 | M | 2012-03-27 | 50.3176 | -4.1811 | 2012-04-11 |  |  | 14 | 0.00 | Star Oddi | milli-F | 100 |
| *Raja microocellata* | A01709 | F | 2009-06-25 | 50.2955 | -4.1963 | 2010-05-24 | 50.2422 | -3.8743 | 333 | 23.67 | CTL | LL | 100 |
| *Raja microocellata* | A01783 | F | 2010-01-15 | 50.3095 | -4.1908 | 2010-04-28 | 50.3204 | -4.2410 | 102 | 3.76 | CTL | LL | 100 |
| *Raja microocellata* | A01786 | F | 2010-01-15 | 50.3095 | -4.1908 | 2010-07-09 | 50.2632 | -3.8983 | 174 | 21.44 | CTL | LL | 100 |
| *Raja microocellata* | A01787 | F | 2010-01-15 | 50.3095 | -4.1908 | 2010-04-23 |  |  | 98 | 0.00 | CTL | LL | 100 |
| *Raja microocellata* | A01789 | F | 2010-01-15 | 50.3095 | -4.1908 | 2010-04-29 | 50.0181 | -4.9638 | 103 | 63.96 | CTL | LL | 100 |
| *Raja microocellata* | A01794 | M | 2010-01-15 | 50.3095 | -4.1908 | 2010-08-02 | 50.3288 | -4.2341 | 198 | 3.75 | CTL | LL | 100 |
| *Raja microocellata* | A01795 | M | 2010-01-15 | 50.3095 | -4.1908 | 2010-04-10 | 50.3406 | -4.1617 | 84 | 4.03 | CTL | LL | 100 |
| *Raja microocellata* | A01810 | M | 2010-02-24 | 50.3013 | -4.1067 | 2010-05-26 |  |  | 90 | 0.00 | CTL | LL | 100 |
| *Raja microocellata* | A01811 | F | 2010-02-24 | 50.3013 | -4.1067 | 2010-05-21 | 50.3413 | -4.1571 | 85 | 5.71 | CTL | LL | 100 |
| *Raja microocellata* | A01813 | M | 2010-02-24 | 50.3013 | -4.1067 | 2010-03-10 | 50.2742 | -3.9100 | 13 | 14.31 | CTL | LL | 100 |
| *Raja microocellata* | A05967 | F | 2010-12-08 | 50.3098 | -4.2104 | 2012-01-08 |  |  | 395 | 0.00 | CTL | LL 2MB | 200 |
| *Raja microocellata* | A05969 | M | 2011-01-19 | 50.3187 | -4.1330 | 2011-01-21 | 50.2931 | -4.0417 | 1 | 7.09 | CTL | LL 2MB | 200 |
| *Raja microocellata* | A05970 | M | 2011-01-19 | 50.3187 | -4.1330 | 2011-09-01 |  |  | 224 | 0.00 | CTL | LL 2MB | 200 |
| *Raja microocellata* | A05972 | M | 2011-01-19 | 50.3187 | -4.1330 | 2011-05-05 | 50.2627 | -3.8832 | 105 | 18.83 | CTL | LL 2MB | 200 |
| *Raja microocellata* | A05982 | F | 2010-04-13 | 50.3008 | -4.1165 | 2010-06-18 | 50.2459 | -4.7814 | 65 | 47.70 | CTL | SL 2MB | 200 |
| *Raja microocellata* | A05984a | F | 2010-05-07 | 50.3160 | -4.1721 | 2011-03-26 | 50.3504 | -4.3167 | 322 | 8.08 | CTL | SL 2MB | 200 |
| *Raja microocellata* | A05990 | M | 2011-01-19 | 50.3187 | -4.1330 | 2011-08-02 | 50.3333 | -4.2333 | 194 | 7.32 | CTL | SL 2MB | 200 |
| *Raja microocellata* | A06016 | F | 2010-12-08 | 50.3098 | -4.2104 | 2011-07-11 | 50.3125 | -4.5845 | 214 | 26.60 | CTL | SL 2MB | 200 |
| *Raja microocellata* | B0341 | F | 2011-07-20 | 50.3137 | -4.1789 | 2011-07-27 | 50.3054 | -4.4901 | 6 | 22.14 | Star Oddi | milli-F | 100 |
| *Raja microocellata* | B0360 | F | 2012-01-16 | 50.3340 | -4.1635 | 2012-05-04 |  |  | 108 | 0.00 | Star Oddi | milli-F | 100 |
| *Raja microocellata* | B0361 | F | 2012-01-16 | 50.3340 | -4.1635 | 2012-12-10 | 50.2669 | -3.9026 | 328 | 20.00 | Star Oddi | milli-F | 100 |
| *Raja microocellata* | B0373 | M | 2012-01-16 | 50.3340 | -4.1635 | 2013-02-23 | 50.2044 | -3.7599 | 403 | 32.14 | Star Oddi | milli-F | 100 |
| *Raja microocellata* | B0374 | M | 2012-01-16 | 50.3340 | -4.1635 | 2012-04-11 |  |  | 85 | 0.00 | Star Oddi | milli-F | 100 |
| *Raja microocellata* | B0405a | M | 2013-05-16 | 50.3175 | -4.1861 | 2013-06-02 | 50.3588 | -4.3231 | 17 | 10.76 | Star Oddi | milli-F | 100 |
| *Raja montagui* | A01797 | M | 2010-01-15 | 50.3095 | -4.1908 | 2011-04-26 | 50.3413 | -4.2760 | 465 | 7.01 | CTL | LL | 100 |
| *Raja montagui* | A01805 | F | 2010-01-28 | 50.2783 | -4.0795 | 2010-03-08 | 50.2742 | -3.9100 | 38 | 12.06 | CTL | LL | 100 |
| *Raja montagui* | A01806 | F | 2010-01-28 | 50.2783 | -4.0795 | 2010-03-11 | 50.2753 | -4.0322 | 41 | 3.38 | CTL | LL | 100 |
| *Raja montagui* | A01837 | M | 2010-04-08 | 50.3020 | -4.1567 | 2010-06-02 | 50.2580 | -3.9183 | 54 | 17.65 | CTL | LL | 100 |
| *Raja montagui* | A01837a | M | 2010-06-09 | 50.2733 | -3.9350 | 2011-04-10 | 50.2617 | -3.9167 | 304 | 1.84 | CTL | LL | 100 |
| *Raja montagui* | A01866 | F | 2010-04-15 | 50.2601 | -3.9339 | 2010-06-02 | 50.2580 | -3.9183 | 47 | 1.13 | CTL | LL | 100 |
| *Raja montagui* | A05883 | F | 2010-04-15 | 50.2597 | -4.0041 | 2010-07-08 | 50.2279 | -3.9620 | 83 | 4.64 | CTL | LL 2MB | 200 |
| *Raja montagui* | A05887 | M | 2010-04-15 | 50.2591 | -4.0203 | 2011-04-04 | 50.2595 | -3.9840 | 353 | 2.58 | CTL | LL 2MB | 200 |
| *Raja montagui* | A05928 | F | 2010-07-14 | 50.3175 | -4.1332 | 2012-04-29 | 50.2530 | -3.9037 | 654 | 17.83 | CTL | LL 2MB | 200 |
| *Raja montagui* | A05983 | F | 2010-04-15 | 50.2597 | -4.0041 | 2011-01-20 | 50.0260 | -3.7410 | 279 | 32.08 | CTL | SL 2MB | 200 |

1 CTL=Ceefas Technology Ltd.

2 LL=Long life; SL=Slimline.

# Table S2: Displacements

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Species** | **N** | **Median** | **25%** | **75%** |
| *Raja brachyura* | 11 | 20.22 | 4.56 | 29.99 |
| *Raja clavata* | 26 | 4.20 | 1.87 | 7.19 |
| *Raja microocellata* | 18 | 11.03 | 5.34 | 23.26 |
| *Raja montagui* | 9 | 5.65 | 1.49 | 17.74 |

Differences are significant (Kruskal-Wallis One Way Analysis of Variance on Ranks; p <0.001).

# Supplementary Methods and Results

Length and weight distributions

Table S3: Size and weight of tagged animals

While the *R. clavata* in this study are slightly larger than the other species, no other differences between species are significant. Maximum total lengths are for the species, not the animals in this study.

|  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | **Length (mm)** | | | | **Body width (mm)** | | | **Weight (g)** | | |
| **Species** | **N** | **Max TL** | **Median** | **25%** | **75%** | **Median** | **25%** | **75%** | **Median** | **25%** | **75%** |
| *R. brachyura* | 12 | 1200 | 696 | 626 | 754 | 510 | 449 | 534 | 2612 | 1829 | 3052 |
| *R. clavata* | 43 | 1050 | 728 | 586 | 840 | 495 | 410 | 575 | 2484 | 1334 | 4006 |
| *R. microocellata* | 24 | 910 | 623 | 581 | 697 | 454 | 428 | 498 | 1897 | 1415 | 2558 |
| *R. montagui* | 10 | 800 | 667 | 643 | 695 | 434 | 408 | 466 | 1981 | 1736 | 2761 |



Figure S1: Species length and weight distributions

In the sample of animals tagged in this study there is considerable overlap in both weight and length.

## Using a mixed effect model to account for individual variation

The mixed effects model used was:

MeanDepth ~ Species + Week + (1 | Individual)

The null model used to test the significance of the Species factor was

MeanDepth ~ Week + (1 | Individual).

Summarised output and results from the linear modelling exercise are shown below.

Model summary:

Random effects:

Groups Name Variance Std.Dev.

Individual (Intercept) 75.26 8.675

Residual 60.30 7.765

Number of obs: 1828, groups: Individual, 89

Fixed effects:

Estimate Std. Error t value

(Intercept) 36.91548 2.64430 13.960

Speciesclavata -15.57413 2.97272 -5.239

Speciesmicroocellata -16.24245 3.21549 -5.051

Speciesmontagui 3.84400 3.86006 0.996

Week -0.04607 0.01326 -3.475

Correlation of Fixed Effects:

(Intr) Spcscl Spcsmc Spcsmn

Speciesclvt -0.876

Spcsmcrcllt -0.815 0.723

Speciesmntg -0.677 0.602 0.557

Week -0.108 -0.024 0.017 -0.004

Note that Week is not a significant factor. The difference in the intercepts corresponds well with the differences observed in mean depth for the four species.

A null model was used in an ANOVA analysis to determine the significance of the Species factor with the following result, showing Species to be highly significant.

|  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Model | Df | AIC | BIC | logLik | deviance | Chisq | Df | Pr(>Chisq) | Sig |
| null | 4 | 12997 | 13019 | -6494.4 | 12989 |  |  |  |  |
| lmer | 7 | 12955 | 12994 | -6470.5 | 12941 | 47.755 | 3 | 2.401e-10 | *p*<0.001 |

To check for linearity we plotted the residuals as shown in Figure S2.



Figure S: Residuals from the linear model

While there is some clumping on the left, there is no clear evidence of a lack of linearity.

# Supplementary figures



Figure S: Mean temperatures by depth

Mean temperatures computed for all individuals at depths of 0, 12, 24, 36 and 48 m. While the temperatures throughout the summer months are slightly cooler at deeper depths, it is clear that the waters are well mixed and that no clear depth / temperature relationship exists.

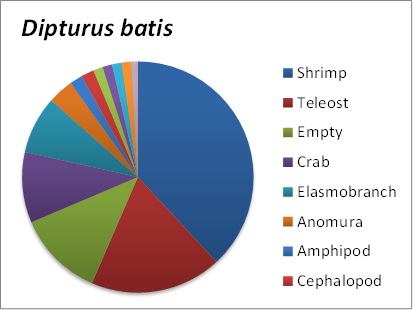
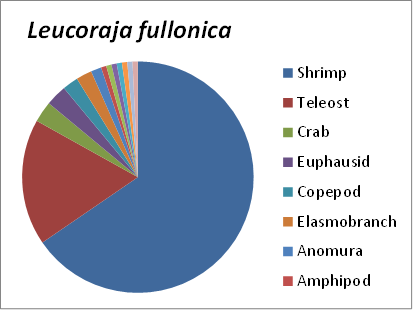
 

Figure S4: Stomach content analysis of the extirpated *D. batis* and *L. fullonica*

Data from Pinnegar (2014).







Figure S: R. clavata, original and randomised TAD matrices

The randomisation maintains both the overall occupancy structure and the TAD values but alters their distribution.







Figure S: R. brachyura original and randomised TAD matrices



Figure S: Weight vs maximum depth for the animals tagged in this study

No relationship was found between the weight and maximum recorded depth for the animals tagged in this study (R2 = 0.001, p = 0.72; SigmaPlot linear regression)



Figure S: Length vs maximum depth for the animals tagged in this study

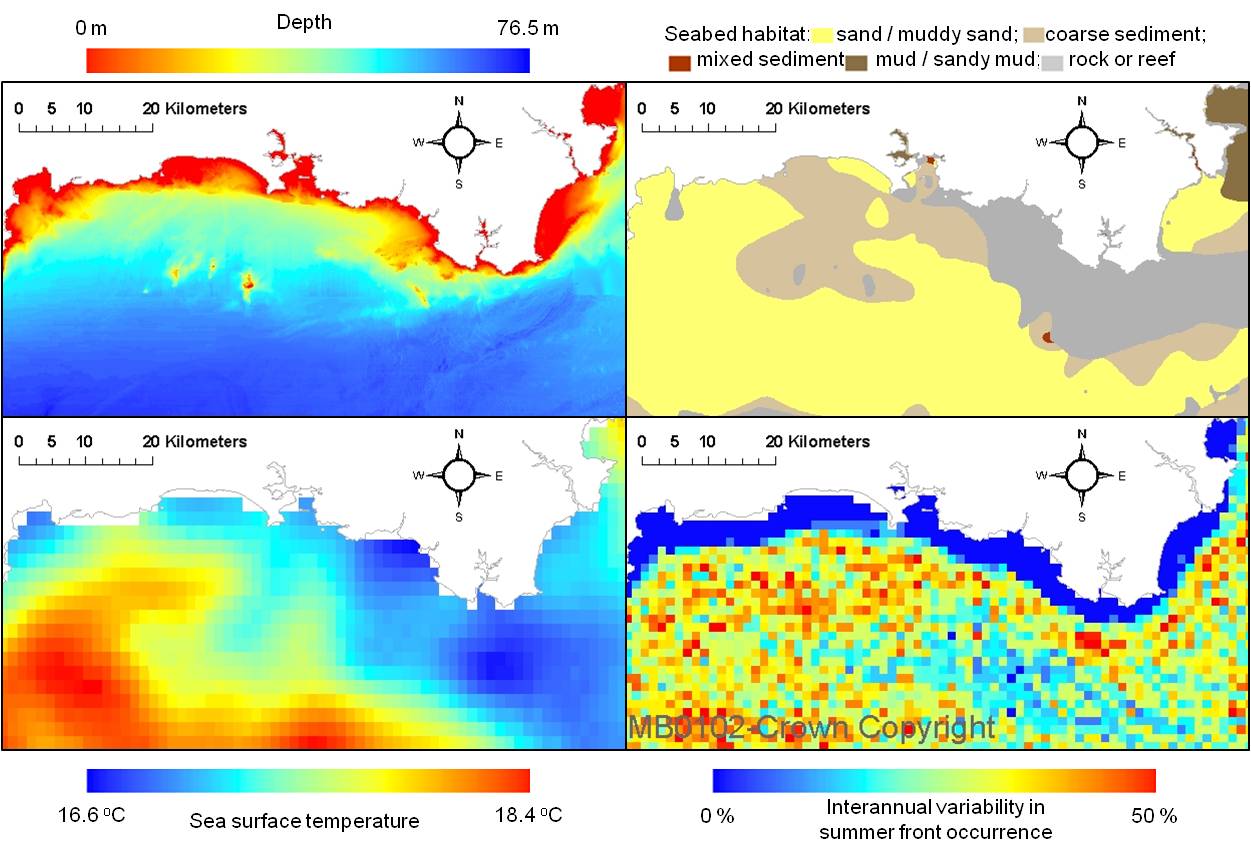
No relationship was found between the length and maximum recorded depth for the animals tagged in this study (R2 = 0.005, p = 0.52; SigmaPlot linear regression)

# Natural habitat heterogeneity

The area where tagged animals were tracked comprises a heterogeneous mosaic of habitats when characterised in terms of water depth, substratum type, water column environmental gradients and temporal scales of fluctuations in those gradients. The study area was located in the coastal waters of the western English Channel, from the city of Plymouth foreshore to approximately 40 km offshore, and spanning from Dodman Point (southeast Cornwall) in the west to Torbay (south Devon) in the east (see Figure S9). Water depth generally increases with distance from the shore, to a maximum depth of 76.5 m approximately 38 km due south of Par Sands (SE Cornwall), although the seabed shelves to 60 m more steeply in the eastern part of the study area (south of Start Point, S. Devon) (Figure S9a). Shallow rocky outcrops are found at the tidally exposed Eddystone Rocks which lie 18 km due south of Whitsand Bay, SE Cornwall and WNW of these rocks at Hand Deeps (min. depth, 7m). A further shallow rocky area known as the East Rutts (min. depth, 8 m) lies approximately 8 km WSW of Bolt Tail.

Seabed substrates within the study site have been mapped by UKSeaMap 2010 (McBreen et al. 2011). This project derived an interactive map of broad scale predicted seabed habitat for the UK continental shelf, combining existing substrate data from a variety of sources to map the seabed substrates over the entire UK continental shelf (Figure S9b). Substrate type varies considerably throughout the study site from bedrock and the rocky outcrops mentioned above, through mixed sediments and sands to fine mud. This degree of variation in substrate type is supported by descriptions of the main collecting grounds in the study area in the Plymouth Marine Fauna (MBA 1957), which also describes other notable habitats including seagrass beds and both natural and artificial reefs, in the form of sea defences and shipwrecks. However, from the descriptions in this document it is also clear that there is also a large amount of variability even within these more general categories. For example, rock may be exposed to high levels of wave action and therefore be barren, it may be covered in encrusting faunal communities such as hydroids, ascidians and anemones, or, in more sheltered locations, it may provide a suitable substrate for the settlement of large kelps. Naturally, the fauna of these habitats also vary. Wave exposed and mobile sediments will likely be relatively barren. Immobile and burrowing species will have specific habitat requirements relating to sediment grain size and prey availability, and even relatively mobile species such as fish, cephalopods and crustaceans will exhibit habitat preferences. Thus, the study area supports heterogeneous habitats as measured by surveys spanning the last century and in terms of substratum type and the species that inhabit those seabed areas.

The water column above the seabed in this area is also variable. The western English Channel is a highly dynamic region with significant physical and biogeographical boundaries (Southward et al. 2005). For example, the area offshore of Plymouth is where the Ushant front, a seasonally persistent thermal tidal front, reaches its northern extent. This front is not only characterised by strong horizontal and vertical gradients in water temperature and other physical characteristics, it is also a hydrographic feature with high productivity, having high in situ primary growth and physical aggregation of phytoplankton and zooplankton assemblages (Le Fèvre 1986). This highly dynamic water column confers heterogeneity to the underlying benthos through stronger physical gradients and nutrient pulses in addition to direct input of particulate carbon which influences community structure and functioning (Southward et al. 2005). These general features are exemplified in example maps. For instance, a map of mean summer (June – Aug 2009) sea-surface temperature values from satellite-derived sea surface temperature data available from the Medspiration project (http://projets.ifremer.fr/cersat/Information/ Projects/MEDSPIRATION2) shows that whilst there is a general pattern of cooler water inshore, temperature values do not typically reflect the underlying bathymetric variation. There exists a stretch of cooler water (16.8 – 17.0oC) running SE from Start Point and water temperatures generally appear to increase with distance east or west of this line, to a maximum temperature of 18.4oC approximately 25 km due S of Fowey, SE Cornwall. Furthermore, figure S1d shows satellite-derived interannual variability in summer (June – August 1998 to 2008) front occurrence within the study site (Miller et al. 2010, Miller & Christodoulou 2014). Whilst it is not possible to detect oceanic fronts reliably from the satellite in the few kilometres immediately adjacent to the coastline, variability in front occurrence fluctuates widely across the rest of the study area, with values ranging from 0 to 48 %. Even between adjacent locations, variability ranges widely, the result being that it is difficult to draw contours around areas with similar variability values. An exception to this is the area running roughly NW to SE and lying 10 – 20 km offshore from Bolt Head. This area corresponds to the site of a frequent summer front (Miller et al. 2010) and thus experiences lower levels of inter-annual variability in summer front occurrence (typically 0 – 16 %) than other regions of the study area (typically 20 – 40 %). This area lies on the SW extremity of the low SST area previously identified. However, areas of high front variability are also associated with this cool area (for example, the area of high variability 5 km south of Bolt Head). Thus, there are no obvious patterns relating variability in frontal occurrence to bathymetry, habitat type or sea surface temperature.



c

d

a

b

Figure S9: The coastal region of the western English Channel where animals were tracked is highly heterogeneous. (a) Seabed depth ranges from 0 to 76.5 m (© Crown Copyright/SeaZone Solutions. All Rights Reserved. Licence No. 052006.001 31st July 2011) and across this range of depths, seabed sediment type varies from sand, through mud, coarse and mixed sediments, to rock (b) (UKSeaMap 2010). The pelagic marine environment is also variable with the region being characterised by frontal, transitional waters seasonally and mean summer sea surface temperatures ranging from 16.6 – 18.4 oC (c) together with high levels of interannual variability (0 – 50 %) in the occurrence of fronts during summer months (d) (MB0102-Crown Copyright).

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