# Online supplementary material for 'Drifting FADs equipped with echo-sounder buoys increase fishing efficiency in tropical tuna purse seine fisheries'

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# List of Tables

Table S1: Years of fishing and number of sets for each vessel found in our logbook data. Vessels are listed by their unique numerical identifiers. A final fishing year of 2017 indicates that the vessel was still active at the end of our dataset. The first two lines of the table, corresponding to vessel numbers 482 and 502, are highlighted to indicate that they have been removed from further analyses due to the short temporal period that they cover.

| Vessel | Number of sets | First year of fishing | Last year of fishing |
|---|---|---|---|
| **482** | **301** | **2010** | **2012** |
| **502** | **327** | **2010** | **2012** |
| 572 | 1005 | 2010 | 2017 |
| 600 | 984 | 2010 | 2017 |
| 693 | 1118 | 2010 | 2017 |
| 706 | 969 | 2010 | 2017 |
| 760 | 1123 | 2010 | 2017 |
| 796 | 806 | 2010 | 2014 |
| 861 | 659 | 2012 | 2017 |
| 873 | 579 | 2012 | 2017 |
| 887 | 627 | 2014 | 2017 |
| 888 | 556 | 2014 | 2017 |
| 889 | 644 | 2014 | 2017 |
| 890 | 544 | 2014 | 2017 |
| 891 | 638 | 2014 | 2017 |

Table S2: Number of FOB sets per vessel per year.

| Vessel | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|
| 572 | 141 | 120 | 109 | 154 | 120 | 115 | 141 | 105 |
| 600 | 120 | 137 | 114 | 146 | 105 | 89 | 160 | 113 |
| 693 | 129 | 124 | 95 | 126 | 166 | 158 | 118 | 202 |
| 706 | 127 | 146 | 97 | 136 | 87 | 116 | 161 | 99 |
| 760 | 183 | 130 | 146 | 139 | 111 | 97 | 134 | 181 |
| 796 | 186 | 166 | 148 | 177 | 129 | | | |
| 861 | | | 67 | 93 | 106 | 74 | 165 | 154 |
| 873 | | | 5 | 84 | 91 | 137 | 106 | 156 |
| 887 | | | | | 138 | 137 | 151 | 201 |
| 888 | | | | | 99 | 119 | 144 | 194 |
| 889 | | | | | 130 | 129 | 182 | 203 |
| 890 | | | | | 106 | 88 | 200 | 150 |
| 891 | | | | | 100 | 133 | 209 | 196 |

Table S3: Number of FOB sets per category per year. The set categories are: *F*=foreign FOB; *O-E*=owned buoy without echosounder; *O+E*=owned buoy with echosounder.

| Category | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|
| F | 662 | 543 | 528 | 602 | 1009 | 925 | 1090 | 952 |
| O-E | 224 | 107 | 38 | 46 | 30 | 5 | | |
| O+E | | 173 | 215 | 407 | 449 | 462 | 781 | 1002 |

Table S4: ANOVA table for a series of nested GAM models culminating in model A2.[a]

| | Resid. Df | Resid. Dev | Df | Deviance | Pr(>Chi) | |
|---|---|---|---|---|---|---|
| NULL | 8556.000 | 6822.431 | | | | |
| te(lon,lat,by=season) | 8309.560 | 6236.151 | 246.4397920 | 586.280082 | 0.0000000 | *** |
| vessel | 8294.019 | 6200.718 | 15.5411568 | 35.432823 | 0.0003422 | *** |
| s(year) | 8287.535 | 6174.044 | 6.4838603 | 26.674061 | 0.0000336 | *** |
| category | 8288.211 | 6166.348 | -0.6754396 | 7.695639 | | |

[a] See Table 1 in article for model details.

Table S5: Full details related to regression coefficients for set category for GAM model A2.[a]

| | Estimate | Std. Error | t value | Pr(>\|t\|) | |
|---|---|---|---|---|---|
| Intercept (Cat. *F*) | 21.995327 | 1.0466217 | 21.015548 | 0.0000000 | *** |
| Category *O-E* | -2.257334 | 1.8567341 | -1.215755 | 0.2241126 | |
| Category *O+E* | 1.978698 | 0.5073965 | 3.899707 | 0.0000971 | *** |

[a] See Table 1 in article for details.

Table S6: ANOVA table for GLM model L1.[a]

| | Df | Deviance | Resid. Df | Resid. Dev | Pr(>Chi) | |
|---|---|---|---|---|---|---|
| NULL | | | 8556 | 6822.431 | | |
| cwp55 | 37 | 140.192132 | 8519 | 6682.239 | 0.0000000 | *** |
| vessel | 12 | 34.786879 | 8507 | 6647.452 | 0.0002437 | *** |
| season | 3 | 57.139683 | 8504 | 6590.312 | 0.0000000 | *** |
| year | 1 | 4.439897 | 8503 | 6585.872 | 0.0302915 | * |
| category | 2 | 18.689165 | 8501 | 6567.183 | 0.0000514 | *** |

[a] See Table 1 in article for model details.

Table S7: Full details related to regression coefficients for year and set category for GLM model L1.[a]

| | Estimate | Std. Error | t value | Pr(>\|t\|) | |
|---|---|---|---|---|---|
| Intercept (Cat. *F*) | 21.7018495 | 2.9572835 | 7.3384406 | 0.0000000 | *** |
| Year | 0.3263619 | 0.1877009 | 1.7387341 | 0.0821177 | . |
| Category *O-E* | 0.2032647 | 2.1688165 | 0.0937215 | 0.9253326 | |
| Category *O+E* | 2.5000673 | 0.5587157 | 4.4746677 | 0.0000078 | *** |

[a] See Table 1 in article for model details.

# List of Figures

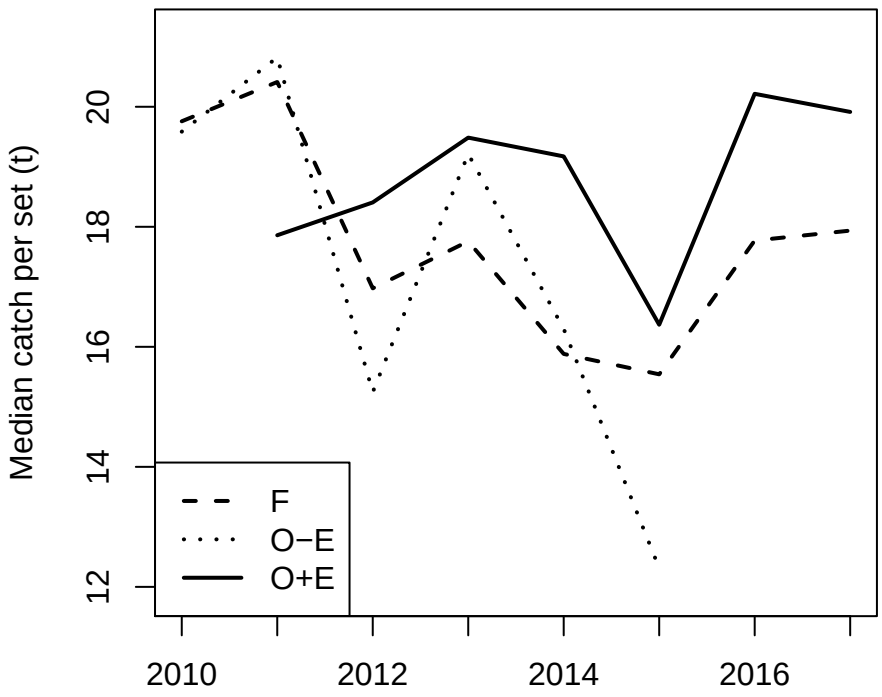


Figure S1: Median catch per set for each of the three set categories between 2010 and 2017. The set categories are: *F*=foreign FOB; *O-E*=owned buoy without echosounder; *O+E*=owned buoy with echosounder.

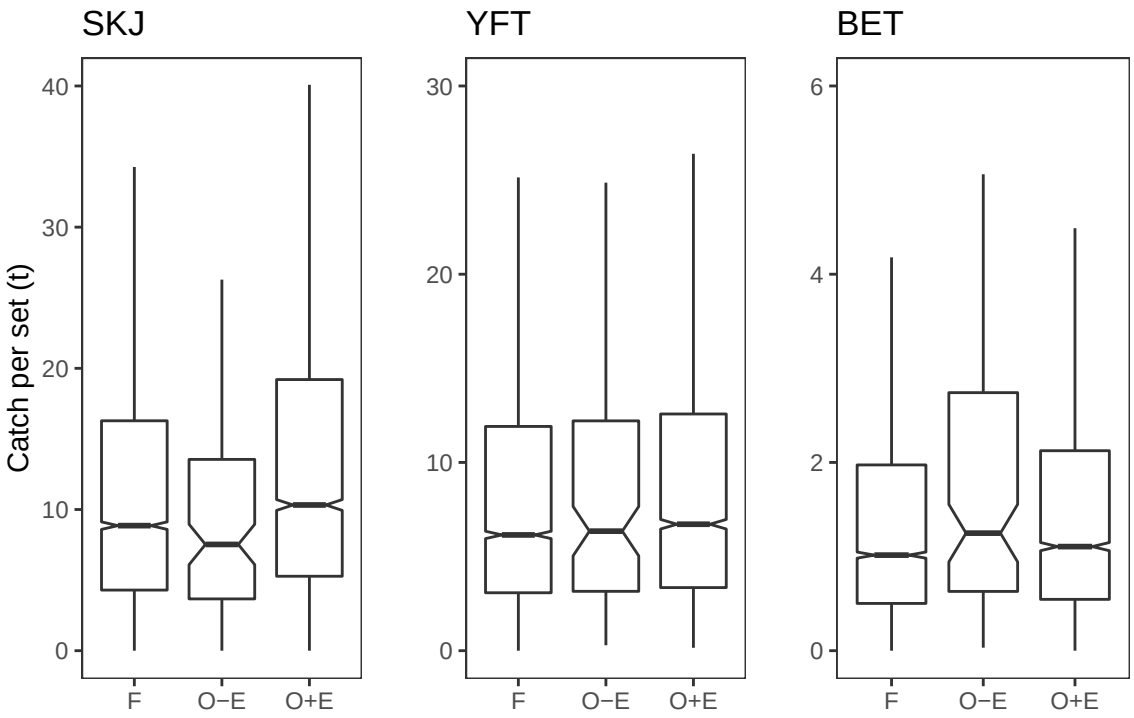


Figure S2: Boxplot of catch per set for each of the three set categories and species between 2012 and 2017. The set categories are: *F*=foreign FOB; *O-E*=owned buoy without echosounder; *O+E*=owned buoy with echosounder. The species are SKJ=skipjack; YFT=yellowfin and BET=bigeye.

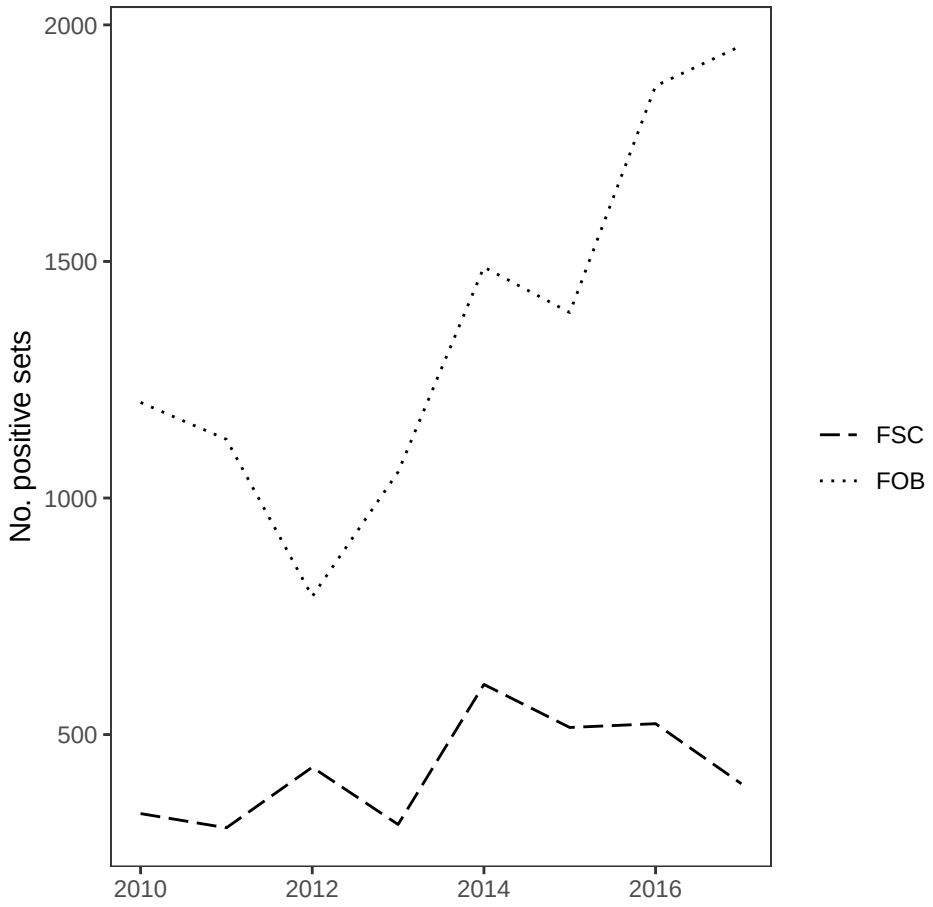


Figure S3: Number of positive sets by schooltype between 2010 and 2017. The school types are: FOB=floating object; FSC=free school.

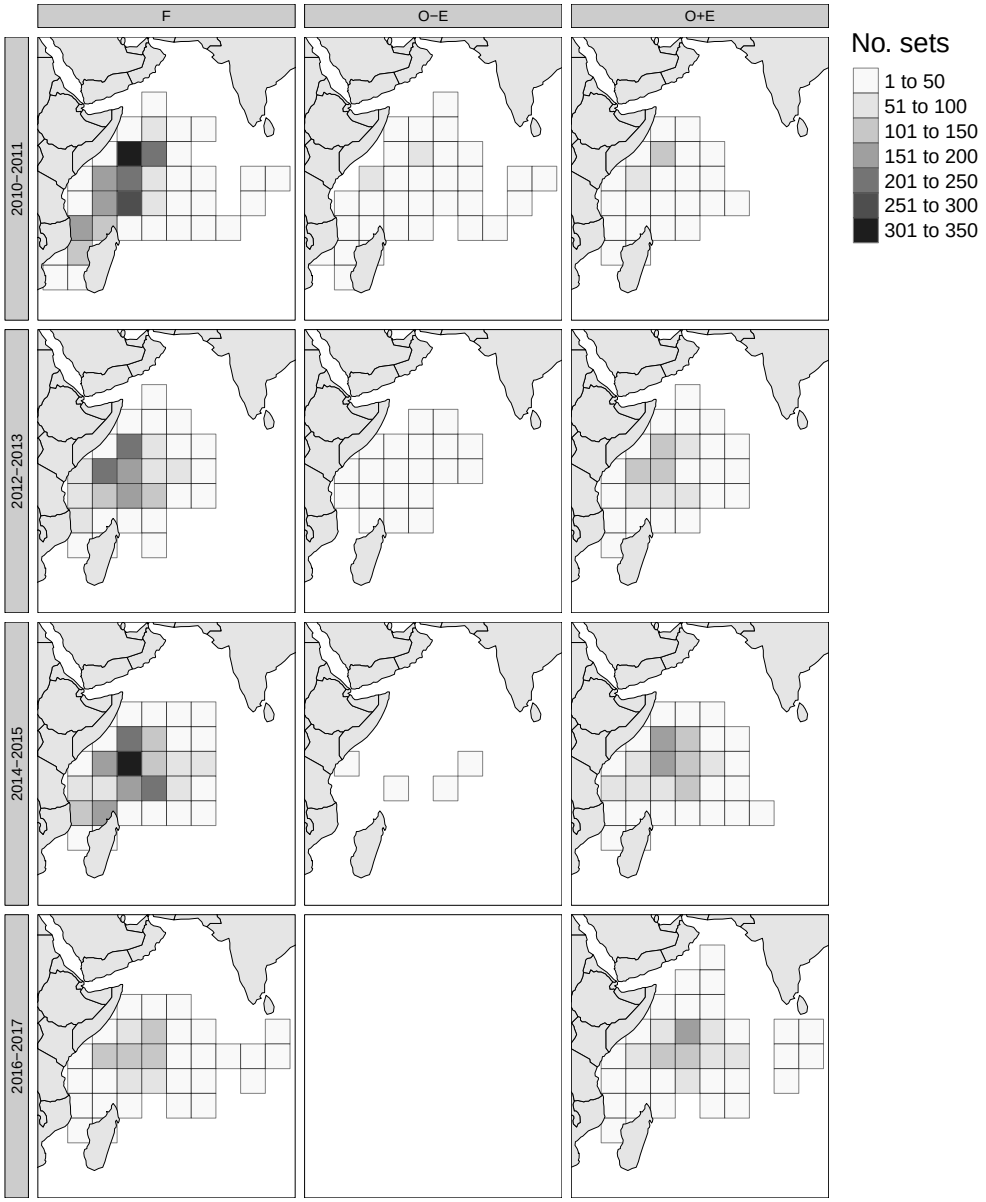


Figure S4: Number of FOB sets (including null sets) in each $5° \times 5°$ cell by year and set category for the period 2010 to 2017. Each row corresponds to a pair of years (increasing from top to bottom), whereas each column corresponds to a set category (from left to right: *F*, *O-E* and *O+E*). The set categories are: *F*=foreign FOB; *O-E*=owned buoy without echosounder; *O+E*=owned buoy with echosounder. Note that all $5° \times 5°$ cells present in the raw data have been included in this analysis, but the two outlier vessels active only in 2010-2012 have been excluded.

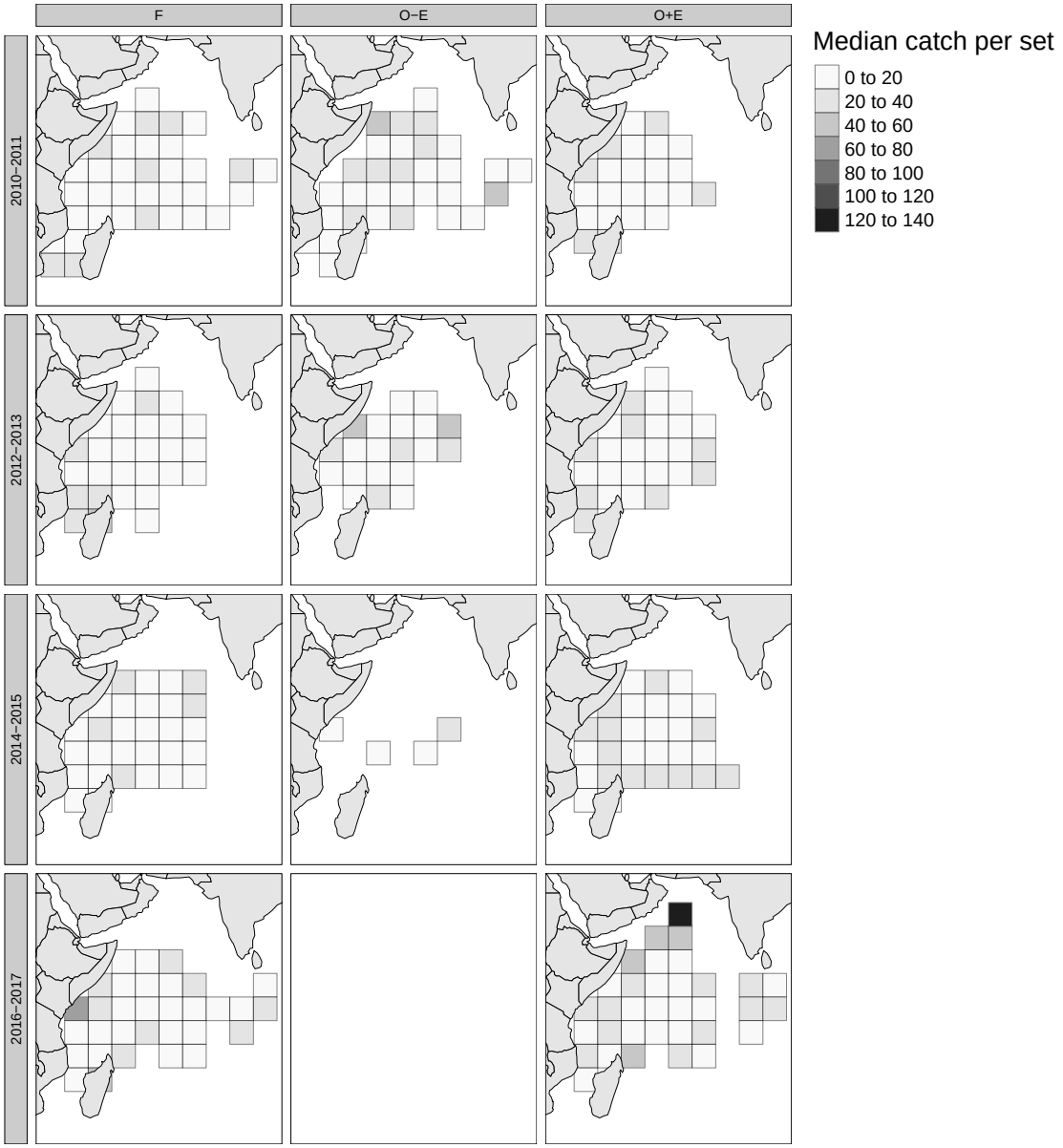


Figure S5: Median catch per sets (including null sets) in each $5° \times 5°$ cell by time period and buoy category for the period 2010 to 2017. Each row corresponds to a pair of years (increasing from top to bottom), whereas each column corresponds to a buoy category (from left to right: *F*, *O-E* and *O+E*). The set categories are: *F*=foreign FOB; *O-E*=owned buoy without echosounder; *O+E*=owned buoy with echosounder. Note that all $5° \times 5°$ cells present in the raw data have been included in this analysis, but the two outlier vessels active only in 2010-2012 have been excluded.

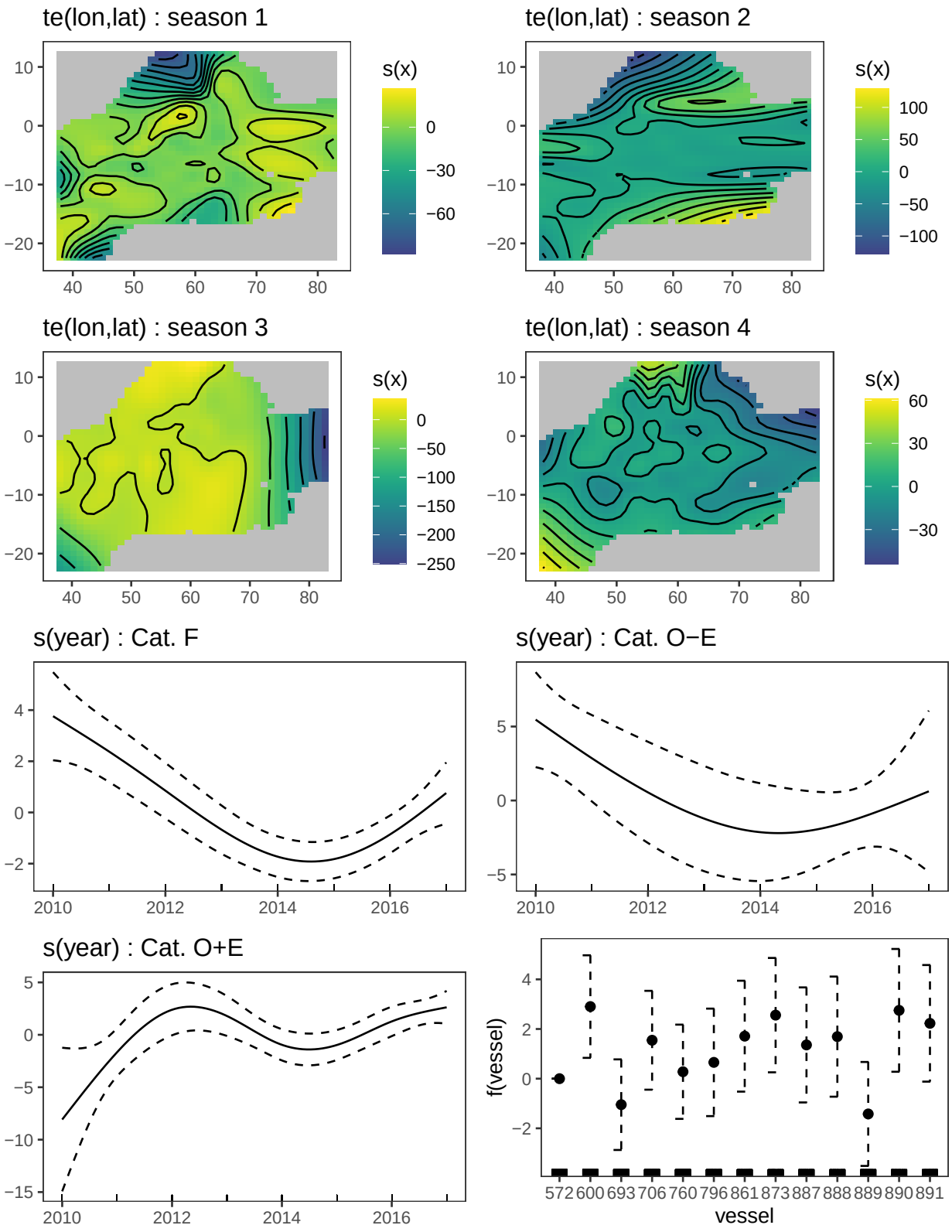


Figure S6: Plot of effects estimated from GAM model A1. Parameters are : lat= latitude; lon= longitude; *F*= foreign FOB; *O-E*= owned buoy without echosounder; *O+E*= owned buoy with echosounder.

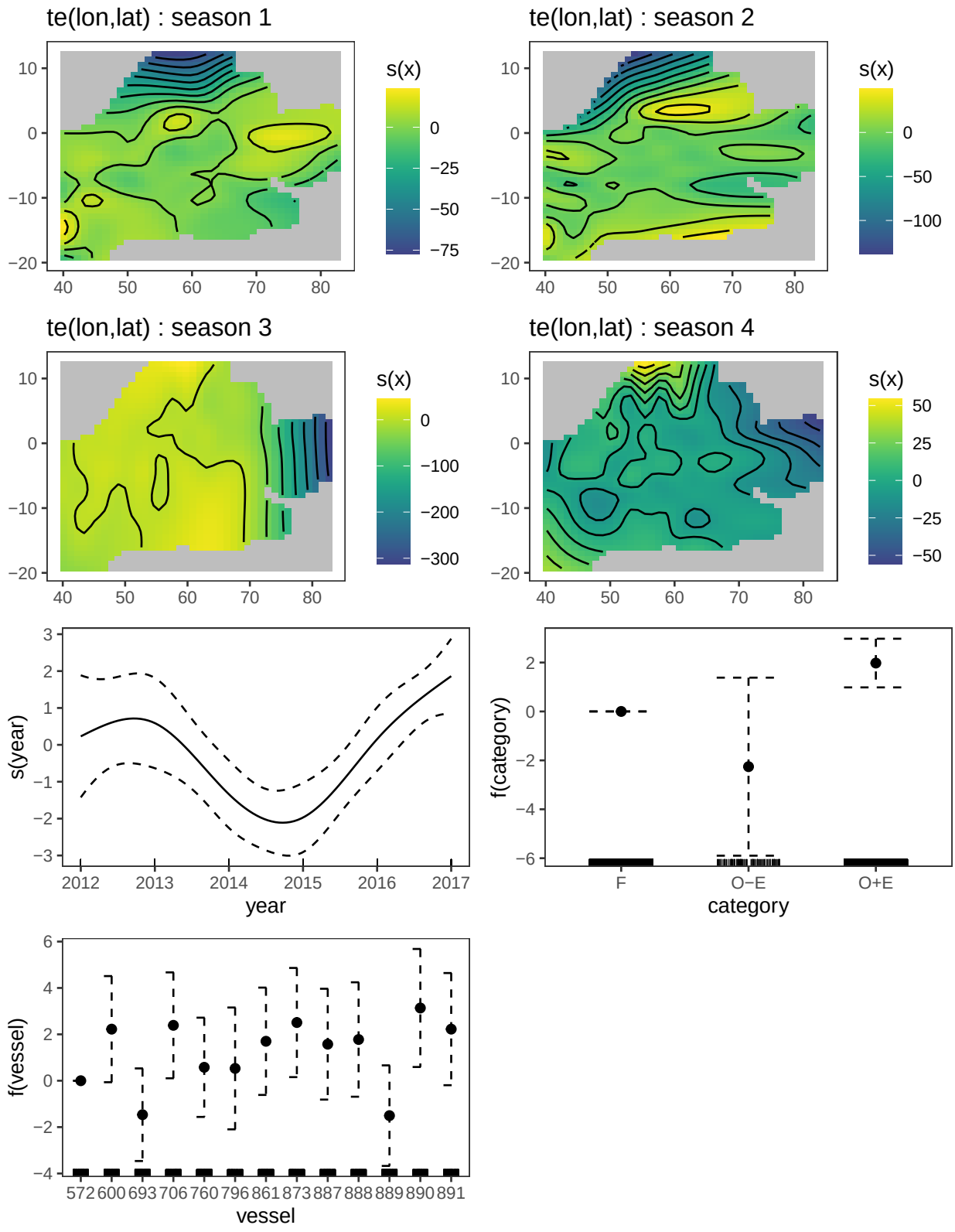


Figure S7: Plot of effects estimated from GAM model A2. Parameters are : lat= latitude; lon= longitude; *F*= foreign FOB; *O-E*= owned buoy without echosounder; *O+E*= owned buoy with echosounder.

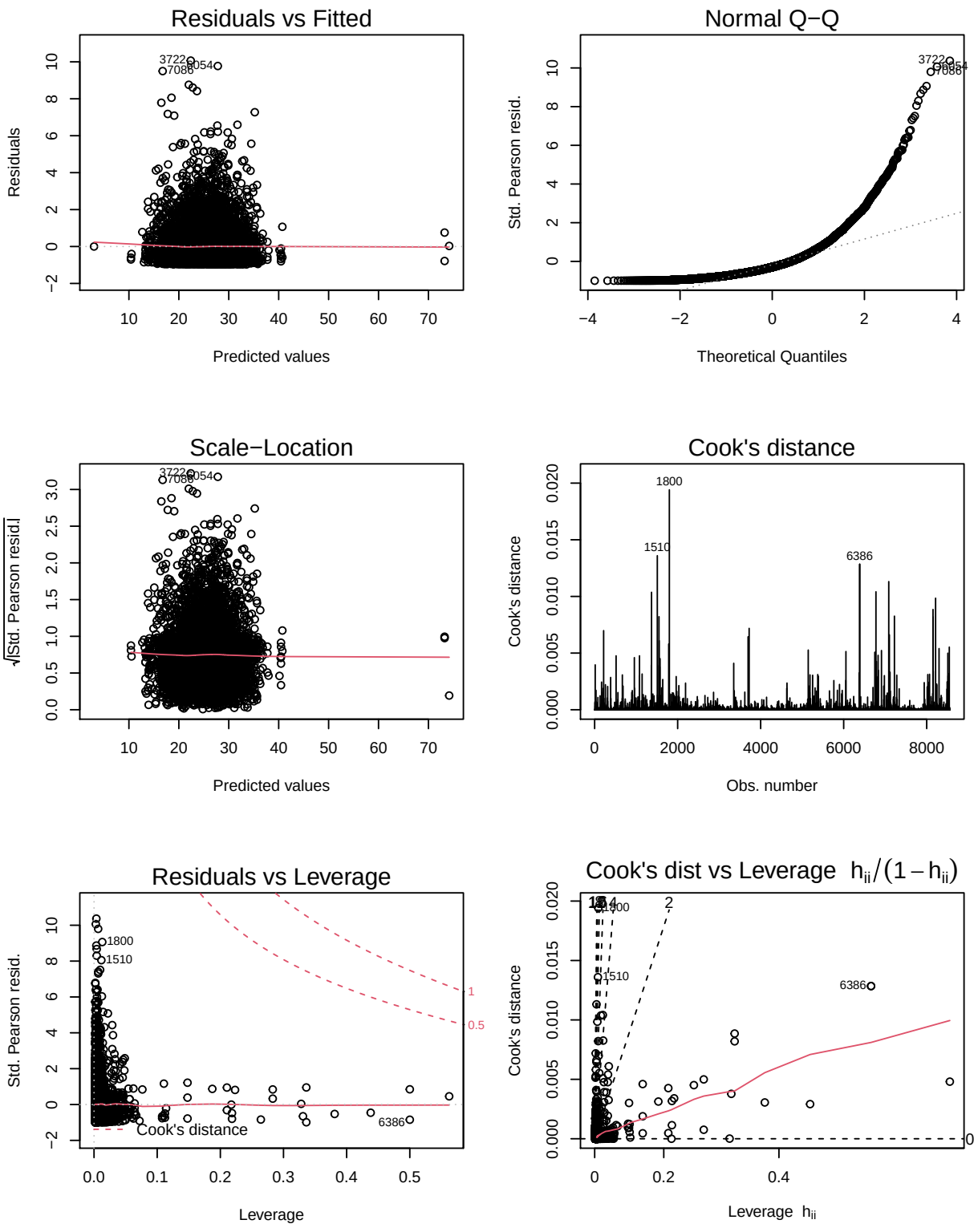


Figure S8: Plot of effects estimated from GLM model L1.

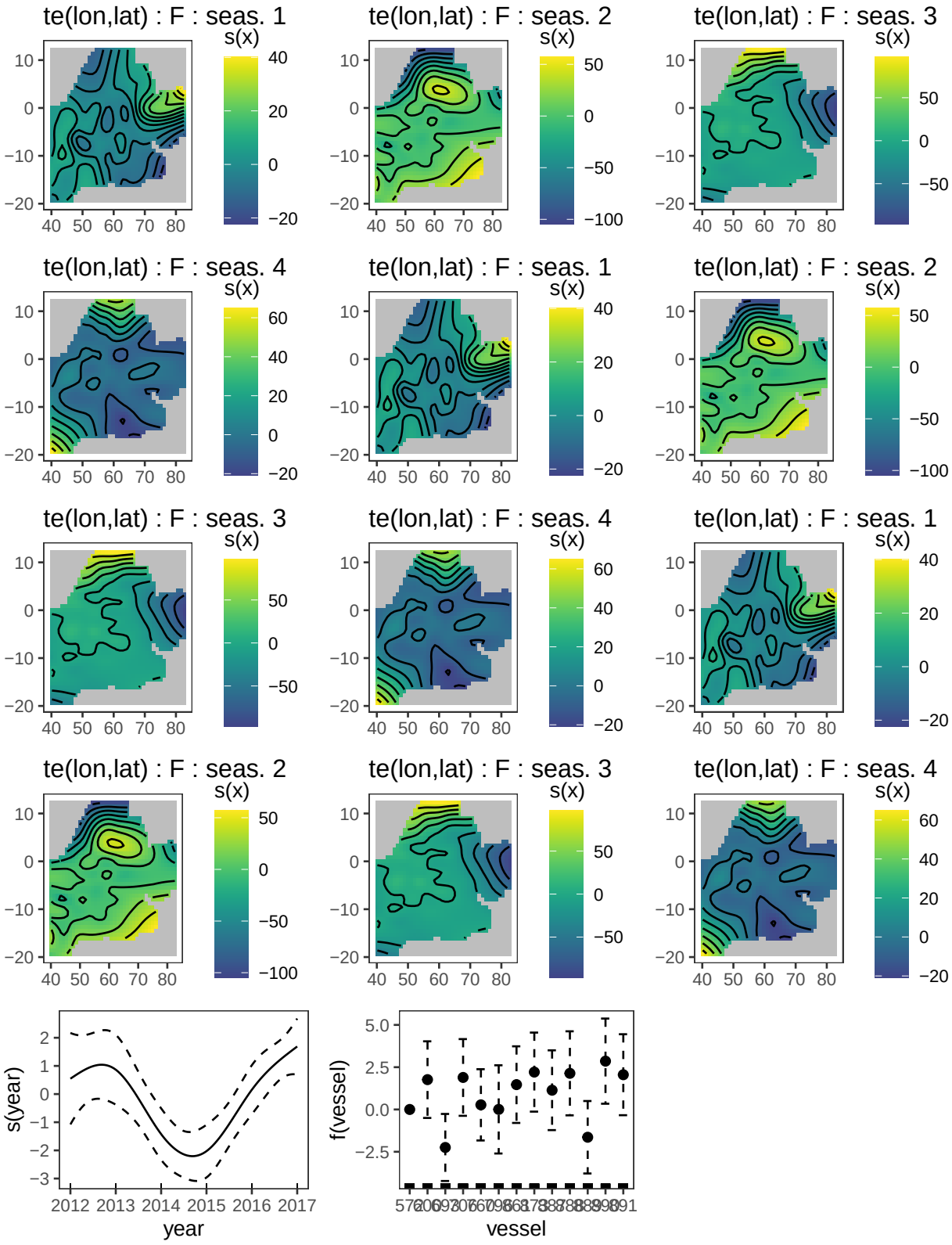


Figure S9: Plot of effects estimated from GAM model A3. Parameters are : lat= latitude; lon= longitude; *F*= foreign FOB; *O-E*= owned buoy without echosounder; *O+E*= owned buoy with echosounder.

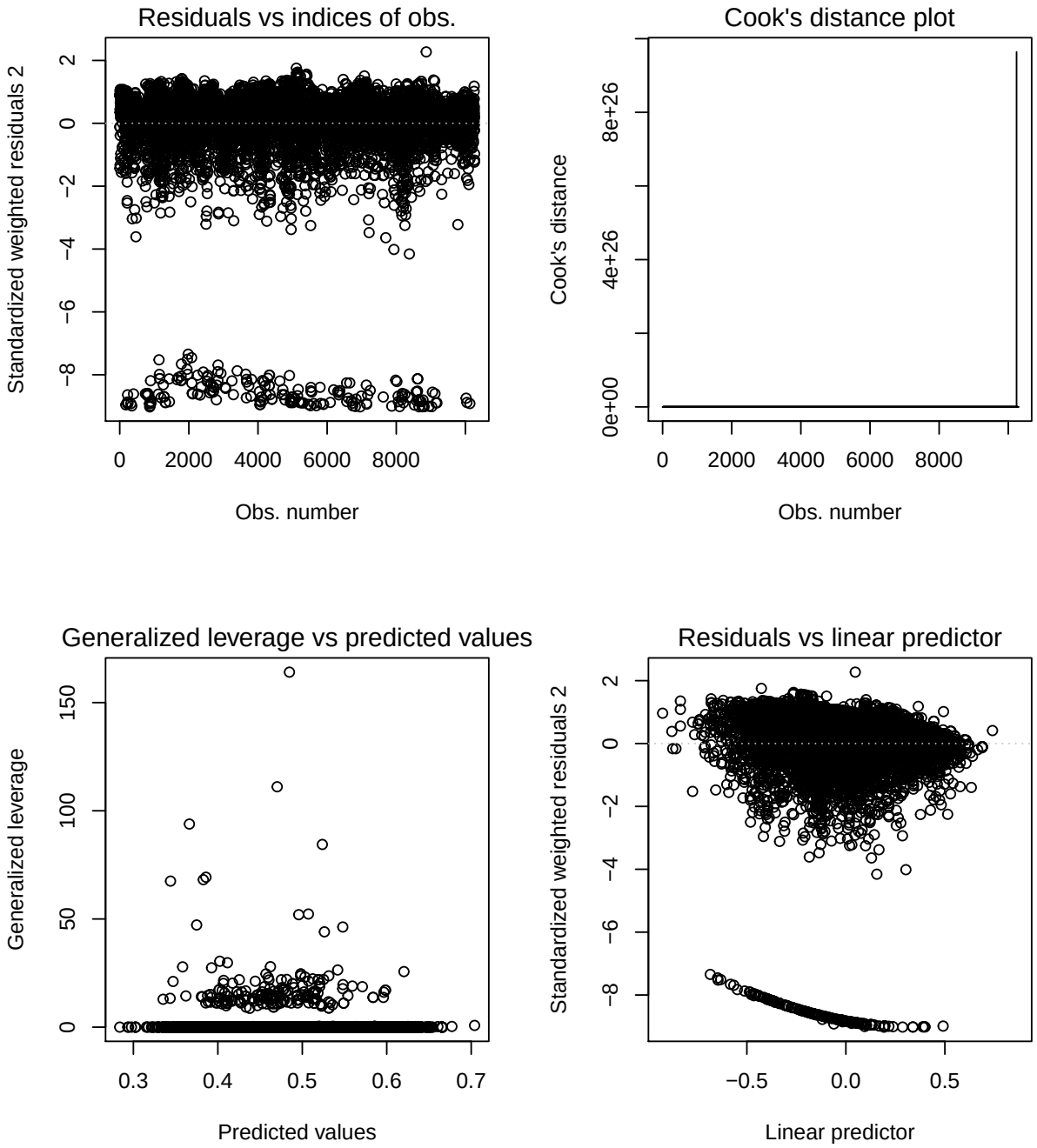


Figure S10: Plot of effects estimated from Beta regression model B1.

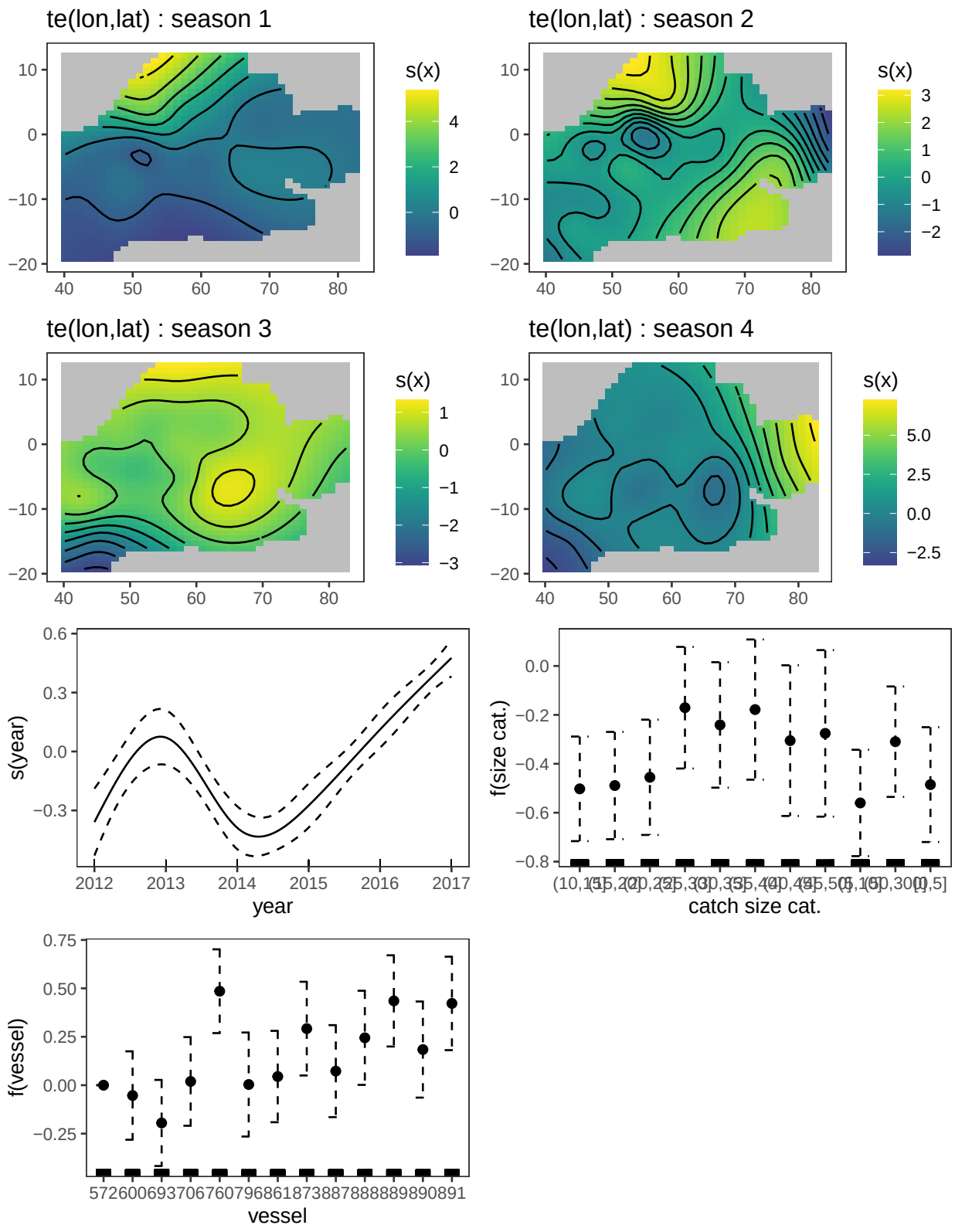


Figure S11: Plot of effects estimated from GAM model N1. Parameters are : lat= latitude; lon= longitude; *F*= foreign FOB; *O-E*= owned buoy without echosounder; *O+E*= owned buoy with echosounder.