

## Article

# Error Distribution Model to Standardize LPUE, CPUE and Survey-Derived Catch Rates of Target and Non-Target Species

Régis Santos<sup>1,2\*</sup>, Osman Crespo<sup>1,2</sup>, Wendell Medeiros-Leal<sup>1,2</sup>, Ana Novoa-Pabon<sup>1</sup> and Mário Pinho<sup>1,2</sup>

<sup>1</sup>Oceanos-UAc Instituto de Investigação em Ciências do Mar, Universidade dos Açores. Rua Prof. Dr. Frederico Machado, 4, 9900-138 – Horta, Faial, Portugal.

<sup>2</sup>IMAR Instituto do Mar, Departamento de Oceanografia e Pescas, Universidade dos Açores. Rua Prof. Dr. Frederico Machado, 4, 9901-862 – Horta, Faial, Portugal.

\* Correspondence: regisvinicius@gmail.com, Tel. (+351) 292 200 469

**Table S2.** Deviance analysis table of explanatory variables for GLM formulations for thornback ray *Raja clavate* (RJC), blackbelly rosefish *Helicolenus dactylopterus* (BRF), and common mora *Mora moro* (RIB) catch rates (CPUE; kg days at sea<sup>-1</sup> vessel<sup>-1</sup>) from the Azorean commercial fishery. Significant ( $P < 0.05$ ) factors and interaction that accounted for 5% or more of the variability are in bold.

|  | RJC  |          |         |             |         | BRF  |         |         |             |         | RIB  |          |         |             |         |
|--|------|----------|---------|-------------|---------|------|---------|---------|-------------|---------|------|----------|---------|-------------|---------|
|  | d.f. | Res Dev  | Δ Dev.  | %Dev.       | p-value | d.f. | Res Dev | Δ Dev.  | %Dev.       | p-value | d.f. | Res Dev  | Δ Dev.  | %Dev.       | p-value |
| <b>Gamma (CPUE + c)</b>  |      |          |         |             |         |      |         |         |             |         |      |          |         |             |         |
| Null   |      | 110087.9 |         |             |         |      | 91123.4 |         |             |         |      | 126115.2 |         |             |         |
| Year   | 26   | 104930.2 | 5157.7  | <b>8.4</b>  | < 0.001 | 26   | 83606.9 | 7516.5  | <b>10.8</b> | < 0.001 | 26   | 113042.6 | 13072.6 | <b>12.4</b> | < 0.001 |
| Year Quarter   | 3    | 104376.9 | 553.4   | 0.9         | < 0.001 | 3    | 83255.7 | 351.3   | 0.5         | < 0.001 | 3    | 112603.8 | 438.8   | 0.4         | < 0.001 |
| Year Quarter Vessel  | 4    | 101170.2 | 3206.7  | <b>5.2</b>  | < 0.001 | 4    | 62303.4 | 20952.3 | <b>30.2</b> | < 0.001 | 4    | 87766.5  | 24837.3 | <b>23.6</b> | < 0.001 |
| Year Quarter Vessel Gear   | 4    | 67871.9  | 33298.3 | <b>54.2</b> | < 0.001 | 4    | 38516.3 | 23787.1 | <b>34.3</b> | < 0.001 | 4    | 54129.4  | 33637.1 | <b>32.0</b> | < 0.001 |
| Year Quarter Vessel Gear Depth   | 2    | 67804.9  | 67.0    | 0.1         | 0.006   | 2    | 32572.9 | 5943.4  | <b>8.6</b>  | < 0.001 | 2    | 57546.7  | 0.0     | 0.0         | 1.000   |
| Year Quarter Vessel Gear Depth Target  | 3    | 53608.0  | 14196.9 | <b>23.1</b> | < 0.001 | 3    | 24075.8 | 8497.1  | <b>12.3</b> | < 0.001 | 3    | 29330.7  | 28216.0 | <b>26.8</b> | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter   | 73   | 52322.4  | 1285.6  | 2.1         | < 0.001 | 73   | 23828.9 | 246.9   | 0.4         | < 0.001 | 73   | 28215.0  | 1115.7  | 1.1         | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel                           | 78   | 50067.2  | 2255.3  | 3.7         | < 0.001 | 77   | 22710   | 1118.9  | 1.6         | < 0.001 | 77   | 25451.2  | 2763.8  | 2.6         | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear               | 83   | 48717.6  | 1349.5  | 2.2         | < 0.001 | 82   | 21919.4 | 790.6   | 1.1         | < 0.001 | 82   | 24474.0  | 977.1   | 0.9         | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear Year × Target | 43   | 48619.4  | 98.3    | 0.2         | 1.000   | 69   | 21833.5 | 85.9    | 0.1         | 0.645   | 45   | 24367.7  | 106.3   | 0.1         | 0.997   |
| <b>Gamma (CPUE + 1)</b>  |      |          |         |             |         |      |         |         |             |         |      |          |         |             |         |
| Null   |      | 53255.7  |         |             |         |      | 92770.3 |         |             |         |      | 67931.9  |         |             |         |
| Year   | 26   | 50173.0  | 3082.7  | <b>9.6</b>  | < 0.001 | 26   | 85200.2 | 7570.1  | <b>10.8</b> | < 0.001 | 26   | 60007.0  | 7925.0  | <b>14.1</b> | < 0.001 |
| Year Quarter   | 3    | 49836.9  | 336.1   | 1.0         | < 0.001 | 3    | 84845.5 | 354.7   | 0.5         | < 0.001 | 3    | 59776.5  | 230.5   | 0.4         | < 0.001 |
| Year Quarter Vessel  | 4    | 47877.0  | 1959.9  | <b>6.1</b>  | < 0.001 | 4    | 63689.3 | 21156.2 | <b>30.0</b> | < 0.001 | 4    | 46607.7  | 13168.8 | <b>23.4</b> | < 0.001 |
| Year Quarter Vessel Gear   | 4    | 31416.2  | 16460.8 | <b>51.2</b> | < 0.001 | 4    | 39361.8 | 24327.5 | <b>34.5</b> | < 0.001 | 4    | 31807.5  | 14800.2 | <b>26.3</b> | < 0.001 |



|  | RJC  |          |         |       |         | BRF  |          |         |       |         | RIB  |          |         |       |         |
|--|------|----------|---------|-------|---------|------|----------|---------|-------|---------|------|----------|---------|-------|---------|
|  | d.f. | Res Dev  | Δ Dev.  | %Dev. | p-value | d.f. | Res Dev  | Δ Dev.  | %Dev. | p-value | d.f. | Res Dev  | Δ Dev.  | %Dev. | p-value |
| Year Quarter Vessel Gear Depth   | 2    | 30849.2  | 566.9   | 1.8   | < 0.001 | 2    | 33229.1  | 6132.7  | 8.7   | < 0.001 | 2    | 27677.1  | 4130.4  | 7.3   | < 0.001 |
| Year Quarter Vessel Gear Depth Target  | 3    | 23248.6  | 7600.7  | 23.6  | < 0.001 | 3    | 24651.6  | 8577.5  | 12.2  | < 0.001 | 3    | 14052.6  | 13624.5 | 24.2  | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter   | 72   | 22821.2  | 427.3   | 1.3   | < 0.001 | 73   | 24397.1  | 254.5   | 0.4   | < 0.001 | 73   | 13600.2  | 452.4   | 0.8   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel                           | 77   | 21782.8  | 1038.4  | 3.2   | < 0.001 | 77   | 23250.5  | 1146.6  | 1.6   | < 0.001 | 77   | 12100.8  | 1499.4  | 2.7   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear               | 79   | 21171.2  | 611.6   | 1.9   | < 0.001 | 82   | 22440.9  | 809.6   | 1.1   | < 0.001 | 82   | 11699.1  | 401.7   | 0.7   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear Year × Target | 39   | 21116.4  | 54.9    | 0.2   | 0.964   | 69   | 22353.3  | 87.6    | 0.1   | 0.665   | 45   | 11629.8  | 69.3    | 0.1   | 0.787   |
| <b>Lognormal (CPUE + c)</b>  |      |          |         |       |         |      |          |         |       |         |      |          |         |       |         |
| Null   |      | 52286.1  |         |       |         |      | 61934.1  |         |       |         |      | 30247.7  |         |       |         |
| Year   | 26   | 51309.5  | 976.5   | 5.0   | < 0.001 | 26   | 59346.6  | 2587.5  | 6.2   | < 0.001 | 26   | 29722.3  | 525.4   | 3.0   | < 0.001 |
| Year Quarter   | 3    | 51244.2  | 65.3    | 0.3   | < 0.001 | 3    | 59315.9  | 30.7    | 0.1   | < 0.001 | 3    | 29705.1  | 17.2    | 0.1   | < 0.001 |
| Year Quarter Vessel  | 4    | 49822.3  | 1421.9  | 7.2   | < 0.001 | 4    | 45876.6  | 13439.2 | 32.3  | < 0.001 | 4    | 26298.7  | 3406.4  | 19.7  | < 0.001 |
| Year Quarter Vessel Gear   | 4    | 43399.0  | 6423.3  | 32.6  | < 0.001 | 4    | 33911.4  | 11965.2 | 28.7  | < 0.001 | 4    | 24912.9  | 1385.8  | 8.0   | < 0.001 |
| Year Quarter Vessel Gear Depth   | 2    | 42827.4  | 571.5   | 2.9   | < 0.001 | 2    | 31121.2  | 2790.2  | 6.7   | < 0.001 | 2    | 23654.7  | 1258.2  | 7.3   | < 0.001 |
| Year Quarter Vessel Gear Depth Target  | 3    | 34738.1  | 8089.3  | 41.1  | < 0.001 | 3    | 21948.5  | 9172.7  | 22.0  | < 0.001 | 3    | 14202.8  | 9451.9  | 54.5  | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter   | 72   | 34486.2  | 251.9   | 1.3   | < 0.001 | 72   | 21810.6  | 138.0   | 0.3   | < 0.001 | 73   | 14092.8  | 110.0   | 0.6   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel                           | 76   | 33293.3  | 1192.9  | 6.1   | < 0.001 | 78   | 20771.2  | 1039.3  | 2.5   | < 0.001 | 77   | 13115.5  | 977.3   | 5.6   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear               | 81   | 32659.3  | 634.0   | 3.2   | < 0.001 | 83   | 20360.8  | 410.4   | 1.0   | < 0.001 | 81   | 12974.3  | 141.3   | 0.8   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear Year × Target | 37   | 32602.7  | 56.6    | 0.3   | 0.090   | 71   | 20267.3  | 93.5    | 0.2   | < 0.001 | 44   | 12915.9  | 58.3    | 0.3   | < 0.001 |
| <b>Lognormal (CPUE + 1)</b>  |      |          |         |       |         |      |          |         |       |         |      |          |         |       |         |
| Null   |      | 23830.9  |         |       |         |      | 63385.3  |         |       |         |      | 16511.2  |         |       |         |
| Year   | 26   | 23386.3  | 444.6   | 4.7   | < 0.001 | 26   | 60746.0  | 2639.3  | 6.2   | < 0.001 | 26   | 16227.8  | 283.3   | 2.8   | < 0.001 |
| Year Quarter   | 3    | 23356.3  | 29.9    | 0.3   | < 0.001 | 3    | 60715.5  | 30.5    | 0.1   | < 0.001 | 3    | 16218.0  | 9.8     | 0.1   | < 0.001 |
| Year Quarter Vessel  | 4    | 22793.7  | 562.6   | 6.0   | < 0.001 | 4    | 46965.8  | 13749.7 | 32.3  | < 0.001 | 4    | 14619.2  | 1598.8  | 16.0  | < 0.001 |
| Year Quarter Vessel Gear   | 4    | 19876.8  | 2916.9  | 30.9  | < 0.001 | 4    | 34676.3  | 12289.4 | 28.9  | < 0.001 | 4    | 13899.5  | 719.7   | 7.2   | < 0.001 |
| Year Quarter Vessel Gear Depth   | 2    | 19625.5  | 251.3   | 2.7   | < 0.001 | 2    | 31802.2  | 2874.1  | 6.8   | < 0.001 | 2    | 13152.8  | 746.7   | 7.5   | < 0.001 |
| Year Quarter Vessel Gear Depth Target  | 3    | 15326.6  | 4298.9  | 45.5  | < 0.001 | 3    | 22522.2  | 9280.0  | 21.8  | < 0.001 | 3    | 7170.3   | 5982.5  | 59.8  | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter   | 72   | 15214.1  | 112.5   | 1.2   | < 0.001 | 72   | 22380.1  | 142.1   | 0.3   | < 0.001 | 73   | 7117.1   | 53.3    | 0.5   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel                           | 77   | 14708.5  | 505.6   | 5.4   | < 0.001 | 76   | 21325.4  | 1054.7  | 2.5   | < 0.001 | 76   | 6619.2   | 497.9   | 5.0   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear               | 82   | 14436.7  | 271.8   | 2.9   | < 0.001 | 78   | 20909.8  | 415.6   | 1.0   | < 0.001 | 79   | 6548.6   | 70.6    | 0.7   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear Year × Target | 41   | 14391.6  | 45.2    | 0.5   | < 0.001 | 68   | 20816.2  | 93.6    | 0.2   | < 0.001 | 43   | 6502.6   | 46.0    | 0.5   | < 0.001 |
| <b>Tweedie</b>   |      |          |         |       |         |      |          |         |       |         |      |          |         |       |         |
| Null   |      | 305649.8 |         |       |         |      | 372650.9 |         |       |         |      | 313296.8 |         |       |         |
| Year   | 26   | 297722.7 | 7927.1  | 7.0   | < 0.001 | 26   | 348003.0 | 24647.9 | 10.1  | < 0.001 | 26   | 288338.6 | 24958.2 | 10.0  | < 0.001 |
| Year Quarter   | 3    | 296820.2 | 902.5   | 0.8   | < 0.001 | 3    | 346909.4 | 1093.6  | 0.4   | < 0.001 | 3    | 287495.5 | 843.1   | 0.3   | < 0.001 |
| Year Quarter Vessel  | 4    | 291780.3 | 5039.8  | 4.5   | < 0.001 | 4    | 277847.9 | 69061.5 | 28.2  | < 0.001 | 4    | 238075.6 | 49419.9 | 19.8  | < 0.001 |
| Year Quarter Vessel Gear   | 4    | 236226.2 | 55554.2 | 49.3  | < 0.001 | 4    | 200585.2 | 77262.7 | 31.6  | < 0.001 | 4    | 153389.7 | 84685.9 | 33.9  | < 0.001 |
| Year Quarter Vessel Gear Depth   | 2    | 234692.9 | 1533.3  | 1.4   | < 0.001 | 2    | 176334.0 | 24251.2 | 9.9   | < 0.001 | 2    | 131269.9 | 22119.9 | 8.8   | < 0.001 |
| Year Quarter Vessel Gear Depth Target  | 3    | 211444.3 | 23248.6 | 20.6  | < 0.001 | 3    | 144009.2 | 32324.7 | 13.2  | < 0.001 | 3    | 80655.9  | 50614.0 | 20.2  | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter   | 72   | 207595.9 | 3848.4  | 3.4   | < 0.001 | 73   | 142596.6 | 1412.6  | 0.6   | < 0.001 | 72   | 76075.8  | 4580.2  | 1.8   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel                           | 77   | 201553.5 | 6042.4  | 5.4   | < 0.001 | 78   | 137555.0 | 5041.6  | 2.1   | < 0.001 | 76   | 69638.1  | 6437.6  | 2.6   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear               | 79   | 193637.5 | 7916.0  | 7.0   | < 0.001 | 85   | 128676.7 | 8878.3  | 3.6   | < 0.001 | 79   | 65286.8  | 4351.4  | 1.7   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear Year × Target | 35   | 192939.0 | 698.5   | 0.6   | 0.518   | 71   | 128057.9 | 618.8   | 0.3   | 0.612   | 42   | 63154.4  | 2132.4  | 0.9   | < 0.001 |



|  | RJC  |          |        |       |         | BRF  |          |         |       |         | RIB  |          |        |       |         |
|--|------|----------|--------|-------|---------|------|----------|---------|-------|---------|------|----------|--------|-------|---------|
|  | d.f. | Res Dev  | Δ Dev. | %Dev. | p-value | d.f. | Res Dev  | Δ Dev.  | %Dev. | p-value | d.f. | Res Dev  | Δ Dev. | %Dev. | p-value |
| <b>Binomial (proportion of positive catches)</b>   |      |          |        |       |         |      |          |         |       |         |      |          |        |       |         |
| Null   |      | 23811.9  |        |       |         |      | 35390.3  |         |       |         |      | 13289.8  |        |       |         |
| Year   | 26   | 23342.2  | 469.7  | 4.7   | < 0.001 | 26   | 34851.4  | 538.9   | 0.5   | < 0.001 | 26   | 12795.5  | 494.2  | 7.1   | < 0.001 |
| Year Quarter   | 3    | 23312.0  | 30.2   | 0.3   | < 0.001 | 3    | 34850.4  | 0.9     | 0.0   | 0.823   | 3    | 12785.7  | 9.9    | 0.1   | 0.020   |
| Year Quarter Vessel  | 4    | 22423.2  | 888.8  | 8.8   | < 0.001 | 4    | 30379.6  | 4470.9  | 4.2   | < 0.001 | 4    | 9778.2   | 3007.5 | 43.3  | < 0.001 |
| Year Quarter Vessel Gear   | 4    | 19272.2  | 3150.9 | 31.2  | < 0.001 | 4    | 22888.3  | 7491.3  | 7.0   | < 0.001 | 4    | 8172.5   | 1605.7 | 23.1  | < 0.001 |
| Year Quarter Vessel Gear Depth   | 2    | 19031.4  | 240.8  | 2.4   | < 0.001 | 2    | 19918.4  | 2969.8  | 2.8   | < 0.001 | 2    | 7688.7   | 483.8  | 7.0   | < 0.001 |
| Year Quarter Vessel Gear Depth Target  | 3    | 17222.3  | 1809.1 | 17.9  | < 0.001 | 3    | 18231.8  | 1686.6  | 1.6   | < 0.001 | 3    | 6529.8   | 1158.9 | 16.7  | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter   | 74   | 17043.7  | 178.6  | 1.8   | < 0.001 | 73   | 18078.3  | 153.5   | 0.1   | < 0.001 | 73   | 6346.7   | 183.1  | 2.6   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel                           | 77   | 270471.6 | 0.0    | 0.0   | 1.000   | 78   | 299955.3 | 0.0     | 0.0   | 1.000   | 78   | 106040.4 | 0.0    | 0.0   | 1.000   |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear               | 83   | 267155.6 | 3316.0 | 32.9  | < 0.001 | 83   | 463305.1 | 0.0     | 0.0   | 1.000   | 83   | 120313.7 | 0.0    | 0.0   | 1.000   |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear Year × Target | 44   | 368798.7 | 0.0    | 0.0   | 1.000   | 71   | 373051.8 | 90253.3 | 83.9  | < 0.001 | 45   | 150013.7 | 0.0    | 0.0   | 1.000   |
| <b>Gamma (positive catches)</b>  |      |          |        |       |         |      |          |         |       |         |      |          |        |       |         |
| Null   |      | 6083.4   |        |       |         |      | 16254.3  |         |       |         |      | 4631.7   |        |       |         |
| Year   | 24   | 5763.1   | 320.4  | 12.5  | < 0.001 | 26   | 14695.7  | 1558.6  | 17.1  | < 0.001 | 24   | 4135.7   | 496.0  | 19.2  | < 0.001 |
| Year Quarter   | 3    | 5731.2   | 31.9   | 1.2   | < 0.001 | 3    | 14560.1  | 135.5   | 1.5   | < 0.001 | 3    | 4126.0   | 9.7    | 0.4   | 0.056   |
| Year Quarter Vessel  | 4    | 5711.9   | 19.3   | 0.8   | < 0.001 | 4    | 12607    | 1953.1  | 21.4  | < 0.001 | 4    | 4009.4   | 116.7  | 4.5   | < 0.001 |
| Year Quarter Vessel Gear   | 4    | 5066.2   | 645.7  | 25.2  | < 0.001 | 4    | 11759.8  | 847.2   | 9.3   | < 0.001 | 2    | 3943.6   | 65.8   | 2.5   | < 0.001 |
| Year Quarter Vessel Gear Depth   | 2    | 5020.9   | 45.3   | 1.8   | < 0.001 | 2    | 11413.4  | 346.4   | 3.8   | < 0.001 | 2    | 3689.7   | 253.8  | 9.8   | < 0.001 |
| Year Quarter Vessel Gear Depth Target  | 3    | 3983.8   | 1037.1 | 40.5  | < 0.001 | 3    | 8028.2   | 3385.2  | 37.2  | < 0.001 | 3    | 2451.8   | 1238.0 | 47.9  | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter   | 62   | 3842.0   | 141.8  | 5.5   | < 0.001 | 72   | 7926.9   | 101.3   | 1.1   | < 0.001 | 53   | 2328.0   | 123.8  | 4.8   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel                           | 67   | 3581.0   | 261.1  | 10.2  | < 0.001 | 74   | 7615     | 311.9   | 3.4   | < 0.001 | 52   | 2139.5   | 188.5  | 7.3   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear               | 32   | 3561.4   | 19.5   | 0.8   | 0.969   | 37   | 7187.2   | 427.8   | 4.7   | < 0.001 | 16   | 2099.8   | 39.8   | 1.5   | 0.013   |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear Year × Target | 34   | 3525.6   | 35.9   | 1.4   | 0.444   | 71   | 7145.7   | 41.4    | 0.5   | 0.983   | 41   | 2049.0   | 50.8   | 2.0   | 0.523   |
| <b>Lognormal (positive catches)</b>  |      |          |        |       |         |      |          |         |       |         |      |          |        |       |         |
| Null   |      | 6185.7   |        |       |         |      | 18879.7  |         |       |         |      | 5471.0   |        |       |         |
| Year   | 24   | 5928.0   | 257.7  | 11.1  | < 0.001 | 26   | 17047.4  | 1832.3  | 17.4  | < 0.001 | 24   | 4727.7   | 743.3  | 24.8  | < 0.001 |
| Year Quarter   | 3    | 5916.5   | 11.5   | 0.5   | 0.009   | 3    | 16953.3  | 94.1    | 0.9   | < 0.001 | 3    | 4688.8   | 38.9   | 1.3   | < 0.001 |
| Year Quarter Vessel  | 4    | 5789.1   | 127.4  | 5.5   | < 0.001 | 4    | 14873.6  | 2079.6  | 19.8  | < 0.001 | 4    | 4534.3   | 154.5  | 5.2   | < 0.001 |
| Year Quarter Vessel Gear   | 4    | 5151.7   | 637.4  | 27.5  | < 0.001 | 2    | 13689.7  | 1183.9  | 11.3  | < 0.001 | 2    | 4476.2   | 58.2   | 1.9   | < 0.001 |
| Year Quarter Vessel Gear Depth   | 2    | 5123.4   | 28.3   | 1.2   | < 0.001 | 2    | 13296.2  | 393.5   | 3.7   | < 0.001 | 2    | 4276.4   | 199.8  | 6.7   | < 0.001 |
| Year Quarter Vessel Gear Depth Target  | 3    | 4252.4   | 871.0  | 37.5  | < 0.001 | 3    | 9204.4   | 4091.8  | 38.9  | < 0.001 | 3    | 2867.5   | 1408.9 | 47.1  | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter   | 65   | 4145.5   | 106.9  | 4.6   | < 0.001 | 72   | 9099.9   | 104.5   | 1.0   | 0.004   | 54   | 2741.2   | 126.3  | 4.2   | 0.013   |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel                           | 64   | 3927.8   | 217.7  | 9.4   | < 0.001 | 72   | 8806.7   | 293.2   | 2.8   | < 0.001 | 50   | 2560.4   | 180.8  | 6.0   | < 0.001 |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear               | 35   | 3901.2   | 26.6   | 1.1   | 0.829   | 35   | 8427.7   | 379.0   | 3.6   | < 0.001 | 12   | 2533.2   | 27.2   | 0.9   | 0.143   |
| Year Quarter Vessel Gear Depth Target Year × Quarter Year × Vessel Year × Gear Year × Target | 38   | 3865.7   | 35.5   | 1.5   | 0.559   | 62   | 8367.3   | 60.4    | 0.6   | 0.475   | 41   | 2479.7   | 53.5   | 1.8   | 0.783   |

c: 10% of the mean catch rate; d.f.: degrees of freedom; Res. Dev.: residual deviance; Δ Dev.: change in deviance; % Dev.: percent of deviance explained; p-value: based on chi-squared ( $\chi^2$ ) distribution and used to determine the explanatory variables that contributed significantly ( $p < 0.05$ ) to the deviance explained.