**Haul-out behavior and detectability of bearded, ribbon, and spotted seals in the Bering and Chukchi Seas**

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**Appendix B. Fixed effect estimates and type III hypothesis tests for seal haul-out models**

Here we provide estimates of fixed effects for generalized linear mixed pseudo-models (Ver Hoef et al. 2009) fitted to binary seal haul-out records.

Table B1. Type III hypothesis tests of significance for generalized linear mixed pseudo-models fitted to bearded seal (*Erignathus barbatus*) haul-out records. Main effects included “age.sex” (4 levels: young-of-year; subadult; adult female; adult male), solar hour effect (the first 6 terms of a Fourier series were used; specified here as “sin1” through “cos3”), day-of-year (cubic-polynomial; “day,” “day2,” and “day3” specify linear, quadratic, and cubic effects, respectively), temperature at 2m above surface (“temp2”), wind speed (“wind”), barometric pressure (“pressure”), precipitation (“precip”). We also included interactions among some of these main effects (denoted with a colon). For instance, the “temp2:wind” interaction was an attempt to account for a possible wind chill effect.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Effect** | **Num.df** | **Denom.df** | **F** | **p-value** |
| age.sex | 3 | 37986 | 2.37 | 0.07 |
| sin1 | 1 | 37986 | 8.38 | 0.00 |
| cos1 | 1 | 37986 | 10.53 | 0.00 |
| sin2 | 1 | 37986 | 14.35 | 0.00 |
| cos2 | 1 | 37986 | 62.37 | 0.00 |
| sin3 | 1 | 37986 | 1.07 | 0.30 |
| cos3 | 1 | 37986 | 3.70 | 0.05 |
| day | 1 | 37986 | 16.62 | 0.00 |
| day2 | 1 | 37986 | 10.04 | 0.00 |
| day3 | 1 | 37986 | 10.12 | 0.00 |
| Northing | 1 | 37986 | 2.25 | 0.13 |
| temp2 | 1 | 37986 | 24.76 | 0.00 |
| wind | 1 | 37986 | 129.11 | 0.00 |
| pressure | 1 | 37986 | 16.90 | 0.00 |
| precip | 1 | 37986 | 0.01 | 0.94 |
| temp2:wind | 1 | 37986 | 11.20 | 0.00 |
| sin1:day | 1 | 37986 | 44.18 | 0.00 |
| cos1:day | 1 | 37986 | 1.02 | 0.31 |
| sin2:day | 1 | 37986 | 3.27 | 0.07 |
| cos2:day | 1 | 37986 | 7.32 | 0.01 |
| sin3:day | 1 | 37986 | 0.69 | 0.41 |
| cos3:day | 1 | 37986 | 0.70 | 0.40 |
| sin1:day2 | 1 | 37986 | 0.01 | 0.90 |
| cos1:day2 | 1 | 37986 | 0.32 | 0.57 |
| sin2:day2 | 1 | 37986 | 1.10 | 0.29 |
| cos2:day2 | 1 | 37986 | 0.78 | 0.38 |
| sin3:day2 | 1 | 37986 | 2.84 | 0.09 |
| cos3:day2 | 1 | 37986 | 4.01 | 0.05 |
| day:Northing | 1 | 37986 | 1.66 | 0.00 |
| day2:Northing | 1 | 37986 | 1.67 | 0.00 |

Table B2. Type III hypothesis tests of significance for generalized linear mixed pseudo-models fitted to ribbon seal (*Histriophoca fasciata*) haul-out records. Main effects included “age.sex” (4 levels: young-of-year; subadult; adult female; adult male), solar hour effect (the first 6 terms of a Fourier series were used; specified here as “sin1” through “cos3”), day-of-year (cubic-polynomial; “day,” “day2,” and “day3” specify linear, quadratic, and cubic effects, respectively), temperature at 2m above surface (“temp2”), wind speed (“wind”), barometric pressure (“pressure”), precipitation (“precip”). We also included interactions among some of these main effects (denoted with a colon). For instance, the “temp2:wind” interaction was an attempt to account for a possible wind chill effect.

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| --- | --- | --- | --- | --- |
| **Effect** | **Num.df** | **Denom.df** | **F** | **p-value** |
| age.sex | 3 | 76680 | 14.18 | 0.00 |
| sin1 | 1 | 76680 | 8.05 | 0.00 |
| cos1 | 1 | 76680 | 758.76 | 0.00 |
| sin2 | 1 | 76680 | 1.04 | 0.31 |
| cos2 | 1 | 76680 | 76.02 | 0.00 |
| sin3 | 1 | 76680 | 0.09 | 0.77 |
| cos3 | 1 | 76680 | 49.83 | 0.00 |
| day | 1 | 76680 | 0.68 | 0.41 |
| day2 | 1 | 76680 | 4.88 | 0.03 |
| day3 | 1 | 76680 | 9.96 | 0.00 |
| temp2 | 1 | 76680 | 4.01 | 0.05 |
| wind | 1 | 76680 | 76.64 | 0.00 |
| pressure | 1 | 76680 | 15.24 | 0.00 |
| precip | 1 | 76680 | 0.00 | 0.98 |
| temp2:wind | 1 | 76680 | 2.41 | 0.12 |
| sin1:day | 1 | 76680 | 4.45 | 0.03 |
| cos1:day | 1 | 76680 | 38.03 | 0.00 |
| sin2:day | 1 | 76680 | 0.06 | 0.80 |
| cos2:day | 1 | 76680 | 20.58 | 0.00 |
| sin3:day | 1 | 76680 | 0.45 | 0.50 |
| cos3:day | 1 | 76680 | 4.10 | 0.04 |
| sin1:day2 | 1 | 76680 | 6.49 | 0.01 |
| cos1:day2 | 1 | 76680 | 48.83 | 0.00 |
| sin2:day2 | 1 | 76680 | 1.04 | 0.31 |
| cos2:day2 | 1 | 76680 | 2.86 | 0.09 |
| sin3:day2 | 1 | 76680 | 1.57 | 0.21 |
| cos3:day2 | 1 | 76680 | 2.10 | 0.15 |
| age.sex:day | 3 | 76680 | 7.64 | 0.00 |
| age.sex:day2 | 3 | 76680 | 52.15 | 0.00 |
| age.sex:day3 | 3 | 76680 | 15.13 | 0.00 |

Table B3. Type III hypothesis tests of significance for generalized linear mixed pseudo-models fitted to spotted seal (*Phoca largha*) haul-out records. Main effects included “age.sex” (4 levels: young-of-year; subadult; adult female; adult male), solar hour effect (the first 6 terms of a Fourier series were used; specified here as “sin1” through “cos3”), day-of-year (cubic-polynomial; “day,” “day2,” and “day3” specify linear, quadratic, and cubic effects, respectively), temperature at 2m above surface (“temp2”), wind speed (“wind”), barometric pressure (“pressure”), precipitation (“precip”). We also included interactions among some of these main effects (denoted with a colon). For instance, the “temp2:wind” interaction was an attempt to account for a possible wind chill effect.

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| --- | --- | --- | --- | --- |
| **Effect** | **Num.df** | **Denom.df** | **F** | **p-value** |
| age.sex | 3 | 51995 | 2.04 | 0.11 |
| sin1 | 1 | 51995 | 7.36 | 0.01 |
| cos1 | 1 | 51995 | 318.93 | 0.00 |
| sin2 | 1 | 51995 | 2.78 | 0.10 |
| cos2 | 1 | 51995 | 75.43 | 0.00 |
| sin3 | 1 | 51995 | 9.82 | 0.00 |
| cos3 | 1 | 51995 | 50.28 | 0.00 |
| day | 1 | 51995 | 19.52 | 0.00 |
| day2 | 1 | 51995 | 24.21 | 0.00 |
| day3 | 1 | 51995 | 14.67 | 0.00 |
| temp2 | 1 | 51995 | 11.08 | 0.00 |
| wind | 1 | 51995 | 9.85 | 0.00 |
| pressure | 1 | 51995 | 0.38 | 0.54 |
| precip | 1 | 51995 | 5.10 | 0.02 |
| temp2:wind | 1 | 51995 | 1.53 | 0.22 |
| sin1:day | 1 | 51995 | 37.05 | 0.00 |
| cos1:day | 1 | 51995 | 21.31 | 0.00 |
| sin2:day | 1 | 51995 | 0.30 | 0.59 |
| cos2:day | 1 | 51995 | 24.19 | 0.00 |
| sin3:day | 1 | 51995 | 1.87 | 0.17 |
| cos3:day | 1 | 51995 | 0.23 | 0.63 |
| sin1:day2 | 1 | 51995 | 2.63 | 0.11 |
| cos1:day2 | 1 | 51995 | 65.69 | 0.00 |
| sin2:day2 | 1 | 51995 | 0.64 | 0.42 |
| cos2:day2 | 1 | 51995 | 0.49 | 0.48 |
| sin3:day2 | 1 | 51995 | 6.67 | 0.01 |
| cos3:day2 | 1 | 51995 | 19.85 | 0.00 |
| age.sex:day | 3 | 51995 | 5.07 | 0.00 |
| age.sex:day2 | 3 | 51995 | 9.15 | 0.00 |
| age.sex:day3 | 3 | 51995 | 10.40 | 0.00 |