**SUPPLEMENTARY INFORMATION**

**Influence of El Niño Southern Oscillation (ENSO) and wetland conditions (water surface area and water salinity) on the abundance and spatial distribution of two flamingo species in lowland wetlands of central Argentina**

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**This supporting information contains the following items:**

**• Table S1.** Characteristics of the 24 wetlands where flamingo surveys were carried out.

**• Table S2.** Abundance of the Andean and Chilean Flamingos in the surveyed wetlands.

**• Figure S1.** Figures showing the variables used to characterize wetlands and years.

**• Figure S2.** Results of the generalized linear mixed models for Andean and Chilean Flamingos.

**• Figure S3.** Residuals of the generalized linear mixed models for Andean and Chilean Flamingos.

Table S1. Characteristics of the 24 wetlands where flamingo surveys were carried out in Pampa de las Lagunas from 2008 to 2022. The water surface area of each wetland for each year was calculated based on satellite images corresponding to the flamingo counting date or nearby days. For each wetland, the number of surveys in which the conductivity was measured is shown. Based on water salinity wetlands were classified as subhaline (0.5–3 g/l), hypohaline (3–20 g/l), mesohaline (20–50 g/l), and hyperhaline (> 50 g/l).

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|   | Coordinates | Altitude | Water surface area (km2) | Water conductivity (mS/cm) | Water salinity | # surveys |
| Wetland | S | W | (m a.s.l.) | Mean | Min | Max | Mean | Min | Max | Mean | Min | Max | Conduct. |
| Bella Vista | -34.210085 | -61.983545 | 99 | 2.64 | 0 | 3.44 | 16.20 | 2.68 | 40.02 | Hypo | Sub | Meso | 13 |
| Carmen Norte | -34.168009 | -62.125360 | 106 | 1.57 | 0 | 3.13 | 14.05 | 5.23 | 27.40 | Hypo | Hypo | Meso | 12 |
| Carmen Sur | -34.194336 | -62.146065 | 104 | 0.94 | 0.44 | 1.63 | 12.98 | 3.98 | 23.56 | Hypo | Hypo | Meso | 11 |
| Encadenada 1 | -33.940002 | -61.847692 | 99 | 3.54 | 2.45 | 6.09 | 2.53 | 1.74 | 3.78 | Sub | Sub | Sub | 11 |
| Encadenada 3 | -33.987719 | -61.744753 | 91 | 2.40 | 2.15 | 2.90 | 4.02 | 1.06 | 9.44 | Hypo | Sub | Hypo | 13 |
| Encadenada 4 | -34.018543 | -61.674146 | 90 | 4.55 | 3.49 | 6.06 | 3.11 | 0.92 | 6.74 | Sub | Sub | Hypo | 11 |
| Encadenada 5 | -34.057331 | -61.638890 | 91 | 10.18 | 8.71 | 12.79 | 2.94 | 1.88 | 4.28 | Sub | Sub | Hypo | 5 |
| La Badenia | -33.690797 | -62.342933 | 112 | 3.42 | 0.14 | 7.72 | 13.97 | 2.51 | 64.64 | Hypo | Sub | Hyper | 13 |
| La Dulce | -33.760232 | -62.503793 | 117 | 0.81 | 0.07 | 1.24 | 6.02 | 1.54 | 19.63 | Hypo | Sub | Hypo | 11 |
| La Picasa | -34.333587 | -62.251209 | 103 | 193.51 | 117.15 | 379.35 | 12.91 | 1.92 | 25.70 | Hypo | Sub | Meso | 11 |
| Las Tunas | -33.731266 | -62.534454 | 112 | 15.63 | 3.99 | 27.46 | 58.23 | 19.20 | 221.60 | Meso | Hypo | Hyper | 13 |
| Los Flamencos | -34.234696 | -61.992713 | 101 | 0.91 | 0.12 | 1.16 | 4.60 | 1.98 | 9.80 | Hypo | Sub | Hypo | 11 |
| M1 | -33.892277 | -62.241912 | 114 | 1.43 | 0.77 | 1.92 | 6.95 | 1.69 | 17.00 | Hypo | Sub | Hypo | 12 |
| Maggiolo | -33.778273 | -62.275091 | 108 | 13.69 | 3.27 | 29.34 | 8.66 | 2.22 | 19.51 | Hypo | Sub | Hypo | 13 |
| Martín García | -34.174980 | -61.967258 | 96 | 5.51 | 1.87 | 8.77 | 12.44 | 5.08 | 17.98 | Hypo | Hypo | Hypo | 13 |
| Melincué | -33.702283 | -61.470719 | 84 | 79.08 | 50.88 | 146.31 | 4.19 | 1.38 | 8.83 | Hypo | Sub | Hypo | 15 |
| Morgan Norte | -34.214756 | -61.837866 | 94 | 2.84 | 0.09 | 3.84 | 12.10 | 1.96 | 23.02 | Hypo | Sub | Hypo | 12 |
| Morgan Sur | -34.243726 | -61.852755 | 94 | 2.50 | 1.02 | 4.03 | 11.43 | 2.25 | 19.10 | Hypo | Sub | Hypo | 12 |
| MT2 | -34.085191 | -61.998847 | 104 | 1.94 | 0 | 4.48 | 4.48 | 3.72 | 6.71 | Hypo | Sub | Hypo | 4 |
| MT3 | -34.116504 | -62.018251 | 102 | 4.07 | 0.74 | 6.17 | 10.96 | 3.60 | 22.20 | Hypo | Sub | Hypo | 12 |
| MT4 | -34.151141 | -62.010936 | 101 | 0.41 | 0 | 1.14 | 3.11 | 1.05 | 6.10 | Sub | Sub | Hypo | 9 |
| Picasa 2 | -34.245457 | -62.135347 | 103 | 1.14 | 0 | 4.49 | 13.08 | 5.98 | 24.80 | Hypo | Hypo | Meso | 7 |
| Quirno | -33.957757 | -61.478290 | 92 | 44.65 | 23.61 | 62.39 | 4.34 | 1.46 | 10.40 | Hypo | Sub | Hypo | 8 |
| Sancti Spiritu | -33.988836 | -62.247322 | 112 | 8.89 | 0.85 | 14.11 | 8.99 | 2.33 | 32.00 | Hypo | Sub | Meso | 10 |

Table S2. Andean and Chilean Flamingo presence and abundance recorded in 24 wetlands at Pampa de las Lagunas from 2008 to 2022. For each wetland, the relative abundance of each flamingo species is calculated as the number of individuals recorded through the Survey period weighed by the number of years that tHipos wetland was Surveyed. Total abundance: 62,866 Andean Flamingos and 346,303 Chilean Flamingos. Wetlands are arranged in alphabetical order.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | # of Surveys | Andean Flamingo |  | Chilean Flamingo |
| Wetland |  | % presence | Min | Max | Rel. abund. (%) |  | % presence | Min | Max | Rel. abund. (%) |
| Bella Vista | 14 | 35.71 | 0 | 2539 | 6.80 |  | 92.86 | 0 | 2402 | 1.74 |
| Carmen Norte | 14 | 21.43 | 0 | 959 | 2.14 |  | 42.86 | 0 | 5093 | 2.59 |
| Carmen Sur | 14 | 42.86 | 0 | 507 | 1.73 |  | 71.43 | 0 | 1472 | 2.15 |
| Encadenada 1 | 13 | 0.00 | 0 | 0 | 0.00 |  | 53.85 | 0 | 511 | 0.38 |
| Encadenada 3 | 14 | 42.86 | 0 | 3475 | 6.96 |  | 71.43 | 0 | 2785 | 3.93 |
| Encadenada 4 | 13 | 30.77 | 0 | 2616 | 4.45 |  | 92.31 | 0 | 7310 | 3.69 |
| Encadenada 5 | 12 | 16.67 | 0 | 87 | 0.16 |  | 58.33 | 0 | 8615 | 3.65 |
| La Badenia | 13 | 7.69 | 0 | 29 | 0.05 |  | 61.54 | 0 | 8602 | 3.44 |
| La Dulce | 12 | 0.00 | 0 | 0 | 0.00 |  | 83.33 | 0 | 2500 | 1.36 |
| La Picasa | 13 | 38.46 | 0 | 80 | 0.33 |  | 76.92 | 0 | 25806 | 17.41 |
| Las Tunas | 14 | 0.00 | 0 | 0 | 0.00 |  | 100.00 | 1 | 7030 | 5.20 |
| Los Flamencos | 14 | 21.43 | 0 | 34 | 0.11 |  | 100.00 | 5 | 785 | 0.77 |
| M1 | 14 | 7.14 | 0 | 4 | 0.01 |  | 64.29 | 0 | 6775 | 4.54 |
| Maggiolo | 14 | 21.43 | 0 | 23 | 0.05 |  | 100.00 | 58 | 14280 | 10.57 |
| Martín García | 15 | 60.00 | 0 | 5632 | 12.62 |  | 86.67 | 0 | 16243 | 14.21 |
| Melincué | 15 | 73.33 | 0 | 9904 | 40.65 |  | 93.33 | 0 | 4190 | 6.30 |
| Morgan Norte | 15 | 40.00 | 0 | 3245 | 12.65 |  | 66.67 | 0 | 3358 | 3.02 |
| Morgan Sur | 14 | 42.86 | 0 | 1974 | 5.28 |  | 85.71 | 0 | 2334 | 2.65 |
| MT2 | 14 | 14.29 | 0 | 53 | 0.09 |  | 71.43 | 0 | 807 | 0.82 |
| MT3 | 14 | 21.43 | 0 | 2765 | 4.69 |  | 78.57 | 0 | 4919 | 2.92 |
| MT4 | 14 | 7.14 | 0 | 2 | 0.00 |  | 57.14 | 0 | 253 | 0.17 |
| Picasa 2 | 10 | 10.00 | 0 | 13 | 0.02 |  | 60.00 | 0 | 914 | 0.41 |
| Quirno | 10 | 20.00 | 0 | 683 | 1.19 |  | 80.00 | 0 | 1610 | 1.36 |
| Sancti Spiritu | 14 | 7.14 | 0 | 4 | 0.01 |  | 85.71 | 0 | 17076 | 6.72 |



**Figure S1.** Figures showing the characterization of the wetlands based on the Mean Area and the Mean Conductivity, and the years based on the Mean Annual Z-score for Area or Conductivity. For all figures, wetlands and years are arranged from lower to Higher area or conductivity. For each wetland, 15 values for area and conductivity are shown as gray circles. For each year, boxplots contain the values for all wetlands.



**Figure S2.** Results of the generalized linear mixed models for Andean Flamingo (*Phoenicoparrus andinus*) and Chilean Flamingo (*Phoenicopterus chilensis*). Mean and confidence intervals are shown. Red circles denote that the factor or the interaction between factors are significant.



**Figure S3.** Residual diagnostics based on the DHARMa library for the generalized linear mixed models for Andean Flamingo (*Phoenicoparrus andinus*) and the Chilean Flamingo (*Phoenicopterus chilensis*).