Supplementary Material

**Trade-offs between foraging reward and mortality risk drive sex-specific foraging strategies in sexually dimorphic northern elephant seals**

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TABLE S1. Eigenvalues and percentage of variation explained for principal components (PCs) 1-5. These results were obtained from principal components analysis of 31 foraging variables from 130 adult northern elephant seals (14 males, 116 females) sampled at Año Nuevo colony (California, USA).

|  |  |  |
| --- | --- | --- |
| **PC** | **Eigenvalue** | **% Variation** |
| PC1 | 7.73 | 24.94 |
| PC2 | 5.47 | 17.63 |
| PC3 | 4.23 | 13.63 |

TABLE S2. Principal component (PC) loadings for each of the 31 foraging variables from adult male and female northern elephant seals sampled at Año Nuevo colony (California, USA) for PCs 1-3. Bolded values show the variables that were significant correlated with each PC (p<0.005).

|  |  |  |  |
| --- | --- | --- | --- |
| **Variable** | **PC1** | **PC2** | **PC3** |
| Distance to continental shelf edge (km) | **-0.28** | 0.08 | **0.55** |
| Proportion of time spent feeding | **-0.34** | **0.21** | -0.08 |
| Foraging area (km2) | 0.14 | **0.27** | **0.19** |
| Proportion of transit dives | **-0.40** | **0.30** | -0.14 |
| Proportion of pelagic foraging dives (PFD) | **-0.47** | 0.07 | **0.54** |
| Proportion of drift dives | **0.58** | **-0.47** | **0.18** |
| Proportion of benthic foraging dives (BFD) | **0.36** | 0.14 | **-0.81** |
| Max depth, day PFD (m) | **-0.33** | -0.01 | **0.84** |
| Dive duration, day PFD (min) | **0.63** | -0.03 | **0.60** |
| Bottom time, day PFD (min) | **0.86** | -0.10 | 0.17 |
| Post-dive interval, day PFD (min) | -0.10 | **0.67** | **-0.40** |
| No. vertical excursions, day PFD | **0.76** | **-0.37** | 0.03 |
| Efficiency, day PFD (unitless) | **0.73** | -0.17 | **-0.38** |
| Max depth, night PFD (m) | **-0.28** | -0.13 | **0.75** |
| Dive duration, night PFD (min) | **0.75** | **0.28** | **0.27** |
| Bottom time, night PFD (min) | **0.84** | **0.28** | 0.00 |
| Post-dive interval, night PFD (min) | -0.03 | **0.73** | **-0.27** |
| No. vertical excursions, night PFD | **0.84** | -0.01 | -0.12 |
| Efficiency, night PFD (unitless) | **0.67** | 0.14 | **-0.29** |
| Max depth, day BFD (m) | **0.24** | **0.67** | **0.43** |
| Dive duration, day BFD (min) | **0.49** | **0.53** | **0.42** |
| Bottom time, day BFD (min) | **0.65** | 0.12 | **0.21** |
| Post-dive interval, day BFD (min) | **0.18** | **0.72** | **-0.23** |
| No. vertical excursions, day BFD | **0.46** | **-0.64** | 0.16 |
| Efficiency, day BFD (unitless) | **0.18** | **-0.69** | **-0.22** |
| Max depth, night BFD (m) | **0.33** | **0.55** | 0.12 |
| Dive duration, night BFD (min) | **0.55** | **0.55** | **0.30** |
| Bottom time, night BFD (min) | **0.56** | 0.07 | 0.16 |
| Post-dive interval, night BFD (min) | 0.06 | 0.15 | 0.07 |
| No. vertical excursions, night BFD | **0.30** | **-0.69** | 0.07 |
| Efficiency, night BFD (unitless) | 0.14 | **-0.61** | -0.04 |

TABLE S3. Results of hierarchical clustering analysis of PCs 1-3 of foraging variables from adult male and female northern elephant seals sampled at Año Nuevo colony (California, USA). Seals grouped into three naturally occurring clusters, termed ‘foraging strategies’. Cluster 1 is the post-breeding female strategy. Cluster 2 is the adult male foraging strategy. Cluster 3 is the post-molt female strategy.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Seal ID** | **Sex** | **Year** | **Season** | **PC1** | **PC2** | **PC3** | **Cluster** |
| 2006009 | F | 2006 | Breeding | -0.97 | -1.11 | 0.52 | 1 |
| 2006010 | F | 2006 | Breeding | -4.45 | -0.78 | -0.62 | 1 |
| 2006012 | F | 2006 | Breeding | -3.54 | -1.46 | -0.06 | 1 |
| 2006014 | F | 2006 | Breeding | -2.60 | 1.13 | -1.45 | 1 |
| 2006015 | F | 2006 | Breeding | -0.78 | -1.13 | 1.87 | 1 |
| 2006016 | F | 2006 | Breeding | -0.64 | -0.49 | -0.32 | 1 |
| 2006017 | F | 2006 | Breeding | 0.33 | -0.32 | -2.27 | 1 |
| 2006018 | F | 2006 | Breeding | -1.85 | -2.78 | -0.63 | 1 |
| 2006019 | F | 2006 | Breeding | -0.21 | -0.27 | -1.05 | 1 |
| 2006020 | F | 2006 | Breeding | -2.17 | -0.12 | 0.27 | 1 |
| 2006021 | F | 2006 | Breeding | -1.65 | -1.59 | 0.49 | 1 |
| 2006022 | F | 2006 | Breeding | -0.72 | -1.98 | -0.17 | 1 |
| 2006025 | F | 2006 | Breeding | -0.62 | -2.47 | 0.95 | 1 |
| 2006026 | F | 2006 | Breeding | -3.15 | -0.35 | 1.04 | 1 |
| 2006027 | F | 2006 | Breeding | -0.29 | -0.64 | 0.59 | 1 |
| 2007004 | F | 2007 | Breeding | -5.37 | 0.92 | -0.31 | 1 |
| 2007005 | F | 2007 | Breeding | -1.49 | 0.22 | 1.79 | 1 |
| 2007007 | F | 2007 | Breeding | -1.80 | 0.19 | 0.14 | 1 |
| 2007009 | F | 2007 | Breeding | -4.35 | 1.42 | 0.81 | 1 |
| 2007010 | F | 2007 | Breeding | -4.28 | 2.66 | 1.17 | 1 |
| 2007014 | F | 2007 | Breeding | -3.35 | -0.76 | 0.87 | 1 |
| 2007015 | F | 2007 | Breeding | -0.41 | -1.24 | 0.40 | 1 |
| 2007016 | F | 2007 | Breeding | -2.20 | 0.04 | -1.03 | 1 |
| 2007017 | F | 2007 | Breeding | -1.25 | 1.22 | 1.07 | 1 |
| 2007019 | F | 2007 | Breeding | -3.37 | 1.35 | 1.59 | 1 |
| 2007020 | F | 2007 | Breeding | -2.66 | 0.00 | 0.60 | 1 |
| 2010011 | F | 2010 | Breeding | -1.88 | -2.36 | 0.31 | 1 |
| 2010013 | F | 2010 | Breeding | -0.36 | -0.40 | 0.28 | 1 |
| 2010015 | F | 2010 | Breeding | -3.81 | -1.36 | 0.93 | 1 |
| 2010016 | F | 2010 | Breeding | -1.25 | -2.18 | 0.68 | 1 |
| 2010018 | F | 2010 | Breeding | -2.66 | -1.23 | -0.66 | 1 |
| 2010022 | F | 2010 | Breeding | -2.49 | -0.75 | 0.30 | 1 |
| 2010023 | F | 2010 | Breeding | -1.92 | -1.40 | 0.49 | 1 |
| 2010025 | F | 2010 | Breeding | -1.73 | -2.02 | -0.82 | 1 |
| 2010027 | F | 2010 | Breeding | -1.68 | -1.42 | 0.38 | 1 |
| 2010029 | F | 2010 | Breeding | -1.00 | -1.95 | -0.17 | 1 |
| 2010033 | F | 2010 | Breeding | -0.76 | -0.98 | -0.14 | 1 |
| 2010040 | F | 2010 | Breeding | 1.27 | -0.64 | 0.26 | 1 |
| 2011002 | F | 2011 | Breeding | 0.04 | -1.74 | 1.65 | 1 |
| 2011003 | F | 2011 | Breeding | 0.74 | -1.42 | -0.16 | 1 |
| 2011004 | F | 2011 | Breeding | -4.73 | 0.88 | -0.75 | 1 |
| 2011005 | F | 2011 | Breeding | -3.70 | -2.04 | -0.15 | 1 |
| 2011007 | F | 2011 | Breeding | -1.07 | 1.88 | 0.40 | 1 |
| 2011008 | F | 2011 | Breeding | -0.28 | -0.98 | 1.13 | 1 |
| 2011009 | F | 2011 | Breeding | -2.52 | -2.36 | 0.04 | 1 |
| 2011010 | F | 2011 | Breeding | -3.24 | -1.78 | -0.05 | 1 |
| 2011013 | F | 2011 | Breeding | 1.84 | -2.53 | -0.12 | 1 |
| 2011014 | F | 2011 | Breeding | -2.57 | -0.14 | 0.44 | 1 |
| 2011015 | F | 2011 | Breeding | -0.94 | -0.85 | 0.50 | 1 |
| 2011016 | F | 2011 | Breeding | -0.97 | -1.57 | -0.05 | 1 |
| 2011017 | F | 2011 | Breeding | -0.96 | -2.15 | -0.40 | 1 |
| 2011018 | F | 2011 | Breeding | 0.17 | -1.78 | 0.18 | 1 |
| 2011019 | F | 2011 | Breeding | -0.37 | -1.42 | 1.56 | 1 |
| 2011020 | F | 2011 | Breeding | -2.73 | -1.69 | -0.18 | 1 |
| 2013005 | F | 2013 | Breeding | -0.64 | 0.91 | 1.89 | 1 |
| 2013006 | F | 2013 | Breeding | 1.05 | -0.94 | 0.35 | 1 |
| 2013008 | F | 2013 | Breeding | -1.66 | 0.58 | 0.10 | 1 |
| 2013009 | F | 2013 | Breeding | -1.10 | 0.42 | 1.57 | 1 |
| 2013011 | F | 2013 | Breeding | 0.40 | -3.53 | -0.13 | 1 |
| 2013014 | F | 2013 | Breeding | -0.67 | -1.27 | 1.27 | 1 |
| 2013016 | F | 2013 | Breeding | -3.66 | -1.83 | -0.87 | 1 |
| 2013018 | F | 2013 | Breeding | -2.84 | -0.66 | -0.86 | 1 |
| 2013019 | F | 2013 | Breeding | -2.42 | 1.16 | 1.21 | 1 |
| 2013022 | F | 2013 | Breeding | -1.48 | -2.59 | -0.79 | 1 |
| 2015002 | F | 2015 | Breeding | -1.35 | -1.78 | 0.45 | 1 |
| 2015003 | F | 2015 | Breeding | 0.25 | -0.44 | -0.80 | 1 |
| 2015007 | F | 2015 | Breeding | -5.39 | -1.57 | -2.35 | 1 |
| 2015009 | F | 2015 | Breeding | -1.39 | -1.71 | 0.32 | 1 |
| 2015010 | F | 2015 | Breeding | 0.08 | -1.87 | -0.12 | 1 |
| 2015013 | F | 2015 | Breeding | 1.80 | -5.12 | 0.76 | 1 |
| 2015014 | F | 2015 | Breeding | 0.72 | -4.55 | 1.17 | 1 |
| 2015015 | F | 2015 | Breeding | 3.88 | -5.93 | 1.86 | 1 |
| 2015016 | F | 2015 | Breeding | 0.10 | -6.08 | -0.26 | 1 |
| 2015018 | F | 2015 | Breeding | -1.22 | -1.56 | -1.56 | 1 |
| 2006044 | F | 2006 | Molt | -2.02 | 2.61 | 1.05 | 1 |
| 2006057 | F | 2006 | Molt | -1.98 | 2.64 | 0.43 | 1 |
| 2006058 | F | 2006 | Molt | -3.43 | 0.84 | -1.88 | 1 |
| 2006059 | F | 2006 | Molt | -3.51 | 2.48 | 0.52 | 1 |
| 2008035 | F | 2008 | Molt | -2.59 | 1.54 | 0.69 | 1 |
| 2008042 | F | 2008 | Molt | 0.50 | 0.06 | 0.77 | 1 |
| 2008048 | F | 2008 | Molt | 0.83 | 1.66 | -0.53 | 1 |
| 2010073 | F | 2010 | Molt | -1.23 | 2.34 | 0.62 | 1 |
| 2010078 | F | 2010 | Molt | 0.15 | -0.73 | 0.14 | 1 |
| 2015026 | F | 2015 | Molt | 3.35 | -3.65 | 2.13 | 1 |
| 2015027 | F | 2015 | Molt | 1.26 | -0.96 | 1.73 | 1 |
| 2015031 | F | 2015 | Molt | -0.75 | 2.65 | -0.20 | 1 |
| 2015033 | F | 2015 | Molt | -0.12 | 1.83 | 0.09 | 1 |
| 2015036 | F | 2015 | Molt | -0.49 | 1.09 | -0.76 | 1 |
| 2011045 | M | 2011 | Breeding | 0.76 | 1.95 | -2.11 | 1 |
| 2006028 | M | 2006 | Breeding | 2.38 | 3.32 | -5.41 | 2 |
| 2006029 | M | 2006 | Breeding | -0.17 | 0.54 | -11.21 | 2 |
| 2006033 | M | 2006 | Breeding | 2.30 | -0.33 | -7.69 | 2 |
| 2010042 | M | 2010 | Breeding | 3.78 | 0.68 | -3.34 | 2 |
| 2011046 | M | 2011 | Breeding | 2.82 | 1.74 | -4.29 | 2 |
| 2006063 | M | 2006 | Molt | 2.26 | 1.21 | -5.28 | 2 |
| 2008049 | M | 2008 | Molt | 3.85 | 2.01 | -3.09 | 2 |
| 2008052 | M | 2008 | Molt | 2.19 | -0.58 | -6.72 | 2 |
| 2008053 | M | 2008 | Molt | 2.17 | 1.75 | -3.48 | 2 |
| 2008054 | M | 2008 | Molt | 3.60 | 0.13 | -4.62 | 2 |
| 2015055 | M | 2015 | Molt | 1.20 | 2.40 | -3.84 | 2 |
| 2007003 | F | 2007 | Breeding | 7.70 | 3.05 | -0.06 | 3 |
| 2010038 | F | 2010 | Breeding | 3.09 | 5.04 | 0.58 | 3 |
| 2011012 | F | 2011 | Breeding | 5.51 | -0.61 | 2.31 | 3 |
| 2015006 | F | 2015 | Breeding | 3.73 | 1.21 | 0.64 | 3 |
| 2015019 | F | 2015 | Breeding | 10.71 | -8.13 | 2.20 | 3 |
| 2015020 | F | 2015 | Breeding | 11.25 | -6.71 | -0.09 | 3 |
| 2006041 | F | 2006 | Molt | 2.17 | 1.43 | 1.27 | 3 |
| 2006048 | F | 2006 | Molt | 1.91 | 0.36 | 1.79 | 3 |
| 2006055 | F | 2006 | Molt | 0.55 | 2.75 | 2.09 | 3 |
| 2006061 | F | 2006 | Molt | 0.42 | 4.07 | 1.94 | 3 |
| 2008029 | F | 2008 | Molt | 2.20 | 3.59 | 2.16 | 3 |
| 2008030 | F | 2008 | Molt | 1.36 | 4.17 | 1.94 | 3 |
| 2008031 | F | 2008 | Molt | 2.31 | 4.04 | 2.63 | 3 |
| 2008033 | F | 2008 | Molt | 0.96 | 3.32 | 0.04 | 3 |
| 2008039 | F | 2008 | Molt | 0.25 | 2.52 | 1.42 | 3 |
| 2008041 | F | 2008 | Molt | 0.48 | 2.97 | 1.93 | 3 |
| 2008044 | F | 2008 | Molt | 0.47 | 2.00 | 1.07 | 3 |
| 2010064 | F | 2010 | Molt | 2.95 | 4.11 | 2.32 | 3 |
| 2010068 | F | 2010 | Molt | 2.22 | 2.74 | 1.82 | 3 |
| 2010069 | F | 2010 | Molt | 3.60 | 1.17 | 0.33 | 3 |
| 2010070 | F | 2010 | Molt | 2.45 | 1.84 | 2.35 | 3 |
| 2010071 | F | 2010 | Molt | 3.62 | 4.50 | 2.48 | 3 |
| 2010079 | F | 2010 | Molt | 2.25 | 3.04 | 0.96 | 3 |
| 2015029 | F | 2015 | Molt | 5.24 | -1.37 | 3.00 | 3 |
| 2015032 | F | 2015 | Molt | 1.92 | 0.89 | 1.08 | 3 |
| 2015037 | F | 2015 | Molt | 1.74 | 2.22 | 1.83 | 3 |
| 2015040 | F | 2015 | Molt | 1.80 | 2.89 | 2.65 | 3 |
| 2015041 | F | 2015 | Molt | 2.21 | 2.22 | 0.59 | 3 |
| 2010084 | M | 2010 | Molt | 3.25 | 1.93 | -1.53 | 3 |
| 2015057 | M | 2015 | Molt | 3.46 | 2.65 | -0.79 | 3 |

TABLE S4. Model selection from generalized linear models used to examine mortality rate patterns in adult male and female northern elephant seals sampled at the Año Nuevo colony (California, USA). Models and the null model (intercept only: bottom of table) are shown below. Variables included in each model are indicated by ‘X’. Season is the foraging trip (breeding or molt), year is when the seal was tracked. More details on the variables are in the main text.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Sex** | **Individual** | **Season** | **Year** | **loglik** | **AIC** | **ΔAIC** |
| X |  |  |  | -95.63 | 195.27 | 0.00 |
| X |  | X |  | -95.60 | 197.21 | 1.94 |
| X | X | X |  | -95.59 | 199.17 | 3.90 |
| X | X |  |  | -91.68 | 199.36 | 4.09 |
| X |  |  | X | -91.68 | 199.36 | 4.09 |
| X |  | X | X | -91.50 | 200.99 | 5.72 |
| X | X |  | X | -91.54 | 201.09 | 5.82 |
| X | X | X | X | -91.50 | 202.99 | 7.72 |
|  |  |  |  | -104.31 | 210.62 | 15.35 |