

Electronic Supplementary Material (ESM)

Foraging and fasting can influence contaminant concentrations in animals: an example with mercury contamination in a free-ranging marine mammal

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The Electronic Supplementary Material contains 7 pages, 3 tables and 3 figures.

Table S1. Sample sizes (n) and total Hg (THg) concentrations ($\mu\text{g/g}$) quantified in blood, muscle, and hair of adult female and male (sub-adult 3, sub-adult 4, and adult age classes) northern elephant seals (*Mirounga angustirostris*) in paired samples from individuals sampled at the start and end of the post-breeding or post-moulting foraging trip or the start and end of the breeding or moulting fast on land. THg concentrations are shown as median and range (parentheses) in either wet weight (ww) or dry weight (dw).

| Time in Year | Females | | | Males | | |
|--------------------|-------------|--------------|---------------|-------------|--------------|---------------|
| | Blood (ww) | Muscle (dw) | Hair (dw) | Blood (ww) | Muscle (dw) | Hair (dw) |
| <i>Foraging</i> | | | | | | |
| Post-breeding trip | $n = 51$ | $n = 42$ | $n = 51$ | $n = 4$ | --- | $n = 4$ |
| Pre-trip | 0.60 | 5.04 | 16.74 | 0.79 | --- | 11.79 |
| (late breeding) | (0.28-1.14) | (1.21-10.15) | (4.97-23.89) | (0.25-0.97) | --- | (3.52-17.73) |
| Post-trip | 0.43 | 5.85 | 12.70 | 0.69 | --- | 8.01 |
| (early moulting) | (0.20-0.65) | (2.59-8.80) | (4.79-24.82) | (0.34-0.76) | --- | (4.47-26.34) |
| Post-moulting trip | $n = 31$ | $n = 27$ | $n = 31$ | $n = 2$ | --- | $n = 2$ |
| Pre-trip | 0.50 | 4.55 | 17.63 | --- | --- | --- |
| (late moulting) | (0.29-0.73) | (2.55-8.15) | (6.10-32.43) | (0.34-0.91) | --- | (14.20-66.69) |
| Post-trip | 0.33 | 4.59 | 13.24 | --- | --- | --- |
| (early breeding) | (0.18-0.60) | (1.90-7.51) | (2.82-24.47) | (0.23-0.59) | --- | (9.33-31.31) |
| <i>Fasting</i> | | | | | | |
| Breeding fast | $n = 10$ | $n = 9$ | $n = 10$ | $n = 7$ | $n = 5$ | $n = 8$ |
| Early fast | 0.35 | 4.29 | 19.88 | 0.54 | 6.93 | 19.56 |
| (early breeding) | (0.26-0.44) | (3.70-5.26) | (10.17-22.25) | (0.22-1.06) | (3.87-13.77) | (5.60-39.69) |
| Late fast | 0.71 | 5.13 | 18.39 | 0.92 | 9.49 | 13.73 |
| (late breeding) | (0.55-1.08) | (4.56-7.04) | (12.46-23.89) | (0.25-1.27) | (5.16-12.53) | (3.52-38.46) |
| Moulting fast | $n = 9$ | $n = 9$ | $n = 9$ | --- | --- | --- |
| Early fast | 0.45 | 6.17 | 10.90 | --- | --- | --- |
| (early moulting) | (0.21-0.65) | (3.04-8.75) | (4.79-15.56) | --- | --- | --- |
| Late fast | 0.56 | 4.59 | 22.42 | --- | --- | --- |
| (late moulting) | (0.29-0.72) | (3.46-6.59) | (10.41-30.78) | --- | --- | --- |

*Note that individual seals may be included in both the foraging and the fasting datasets if they were sampled three or more times (i.e., sampled during late breeding, early moulting and late moulting). This is a subset of data presented previously [29].

Table S2. Change and percent change (final-initial/initial) of total Hg (THg) concentrations ($\mu\text{g/g}$) for paired samples of blood, muscle, and hair from adult northern elephant seals (*Mirounga angustirostris*). Paired samples were collected at the start and end of a foraging trip (post-breeding trip or post-moulting trip) or at the start and end of a fasting period on land (breeding or moulting). THg concentrations were quantified using wet weight (ww) for blood and dry weight (dw) for muscle and hair. Sample size (n) is followed by median, and range (parentheses).

| Time in Year | Females | | | | Males | | |
|-------------------------------|--|---|---|---|---|---|--|
| | Δ blood (ww) | Δ muscle (dw) | Δ hair (dw) | Δ mass (kg) | Δ blood (ww) | Δ muscle (dw) | Δ hair (dw) |
| <i>Foraging</i> | | | | | | | |
| Short trip (post-breeding) | $n = 51$ -0.19 (-0.53 to 0.06) -31% (-55 to 22%) | $n = 42$ 0.77 (-2.75 to 4.47) 15% (-43 to 309%) | $n = 51$ -3.33 (-8.11 to 2.05) -18% (-49 to 13%) | $n = 52$ 57 (-43 to 115) 17% (-9 to 40%) | $n = 4$ -0.10 (-0.22 to 0.09) -12% (-22 to 34%) | --- | $n = 4$ 0.31 (-7.24 to 8.61) 11% (-43 to 49%) |
| Long trip (post-moulting) | $n = 31$ -0.14 (-0.35 to 0.00) -29% (-54 to 0%) | $n = 27$ -0.19 (-3.47 to 2.65) -6% (-43 to 86%) | $n = 31$ -3.54 (-23.18 to 5.27) -16% (-74 to 66%) | $n = 31$ 179 (94 to 246) 55% (31 to 77%) | $n = 2$ --- (-0.32 to -0.11) --- (-35 to -32%) | --- | $n = 2$ --- (-35.37 to -4.87) --- (-53 to -34%) |
| <i>Fasting</i> | | | | | | | |
| Breeding fast | $n = 10$ 0.34 (0.25 to 0.64) 97% (69 to 153%) | $n = 9$ 0.80 (-0.30 to 3.35) 21% (-6 to 91%) | $n = 10$ 0.84 (-3.21 to 5.38) 5% (-17 to 53%) | $n = 10$ -145 (-167 to -103) -30% (-36 to -24%) | $n = 7$ 0.15 (-0.01 to 0.70) 23% (-2 to 123%) | $n = 5$ 1.70 (-1.24 to 3.84) 31% (-10 to 65%) | $n = 8$ -2.08 (-7.31 to -0.99) -15% (-37 to -2%) |
| Moulting fast | $n = 9$ 0.09 (0.04 to 0.17) 30% (7 to 37%) | $n = 9$ -0.86 (-2.23 to 0.42) -14% (-29 to 14%) | $n = 9$ 9.69 (1.26 to 19.95) 65% (14 to 368%) | $n = 9$ -109 (-93 to -132) -27% (-33 to 24%) | --- | --- | --- |

Table S3. A subset of eight adult female northern elephant seals (*Mirounga angustirostris*) that were sampled for total mercury (THg) in blood ($\mu\text{g/g}$ wet weight) during at least four consecutive time periods from 2012 – 2014. The first samples were collected late in the 2012 moult and the last samples were collected early in the 2014 breeding fast, with the exception of T35, who was sampled from late breeding 2011 to early breeding 2012. Blood THg concentrations and mass (kg) are shown for each female at all sampling periods.

| Seal ID | Age* | Late moult 2012 | | Early breeding 2013 | | Late breeding 2013 | | Early moult 2013 | | Late moult 2013 | | Early breeding 2014 | |
|---------|----------|--------------------|------|------------------------|------|-----------------------|------|---------------------|------|--------------------|------|------------------------|------|
| | | THg | Mass | THg | Mass | THg | Mass | THg | Mass | THg | Mass | THg | Mass |
| U848 | 6 | 0.58 | 337 | 0.44 | 519 | 1.08 | 352 | 0.65 | 433 | 0.69 | 325 | 0.45 | 520 |
| T35* | 6 | --- | --- | --- | --- | 1.00 | 347 | 0.55 | 423 | 0.64 | 327 | 0.55 | 508 |
| S126 | 13 | 0.57 | 354 | 0.36 | 566 | 0.77 | 421 | 0.53 | 459 | --- | --- | --- | --- |
| T379 | 8 | --- | --- | 0.39 | 499 | 0.76 | 347 | 0.50 | 430 | 0.67 | 306 | --- | --- |
| X349 | 5 | --- | --- | 0.40 | 456 | 0.76 | 317 | 0.44 | 366 | 0.50 | 257 | --- | --- |
| U754 | 6 | 0.50 | 299 | 0.31 | 484 | 0.56 | 342 | 0.41 | 399 | --- | --- | --- | --- |
| X387 | ≥ 7 | --- | --- | --- | --- | 0.46 | 310 | 0.34 | 388 | 0.44 | 259 | 0.22 | 469 |
| 4534 | 4 | --- | --- | --- | --- | 0.42 | 301 | 0.32 | 364 | 0.39 | 267 | 0.19 | 460 |

*Age is from late breeding 2013, except for T35 (late breeding 2011), when all seals were sampled at the same time.

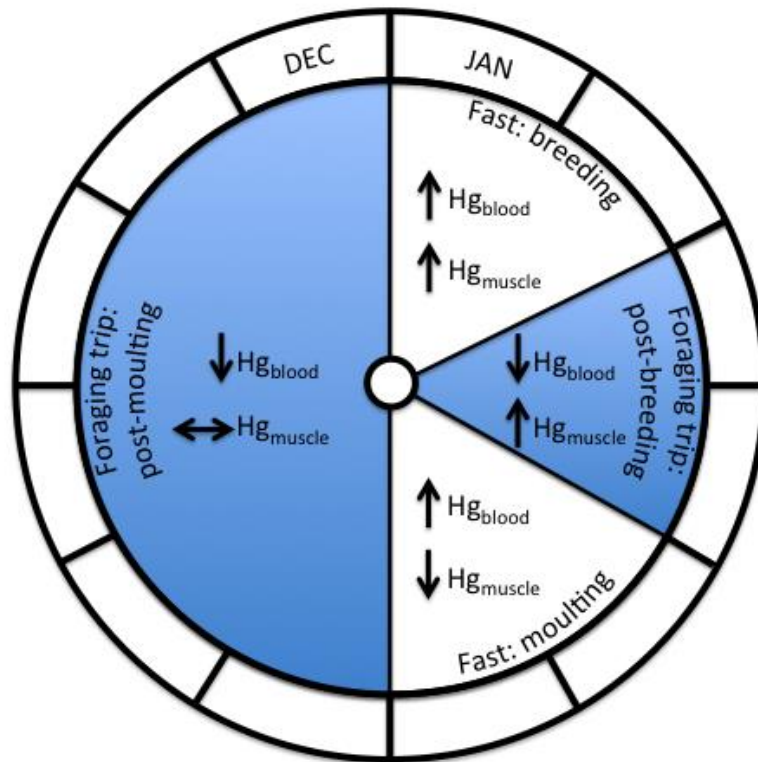


Figure S1. One year in the life of an adult female northern elephant seal (*Mirounga angustirostris*) with the direction of change for mercury concentrations in blood and muscle over the course of the two annual foraging trips and fasting periods.

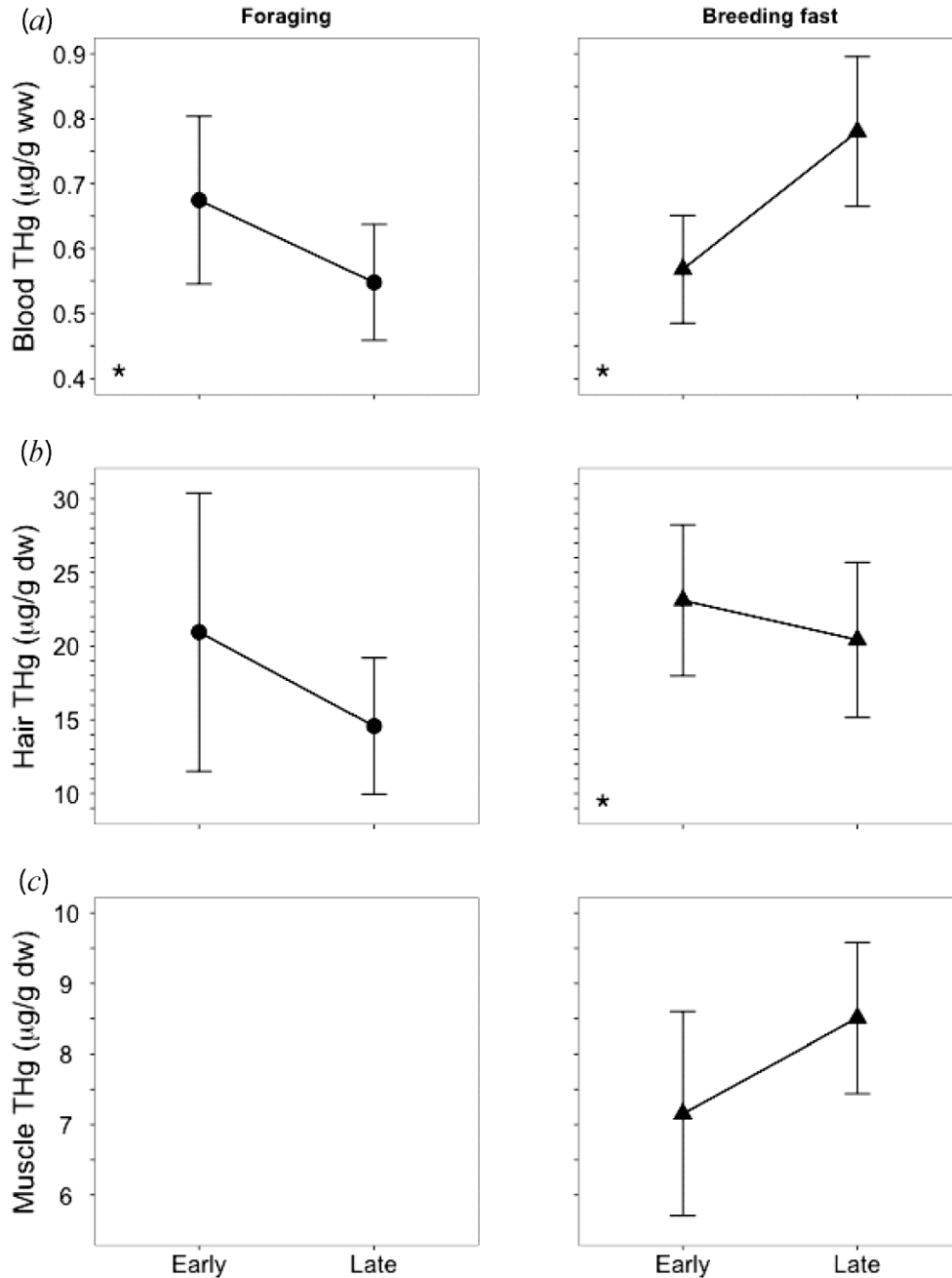


Figure S2. Blood (a), hair (b), and muscle (c) samples were collected from the same adult male northern elephant seals (*Mirounga angustirostris*) before and after one of the two annual foraging trips (post-breeding and post-moulting trips) or early and late during one of the two annual fasting periods (breeding and moulting fasts) and analyzed for total mercury (THg) concentrations. THg concentrations are reported as mean \pm standard error in wet weight (ww) for blood and dry weight (dw) for hair and muscle. Asterisks indicate significant differences ($p \leq 0.05$) between the tissues collected before and after a foraging trip or early and late in a molting period. Muscle samples were not collected from males before and after foraging (c).

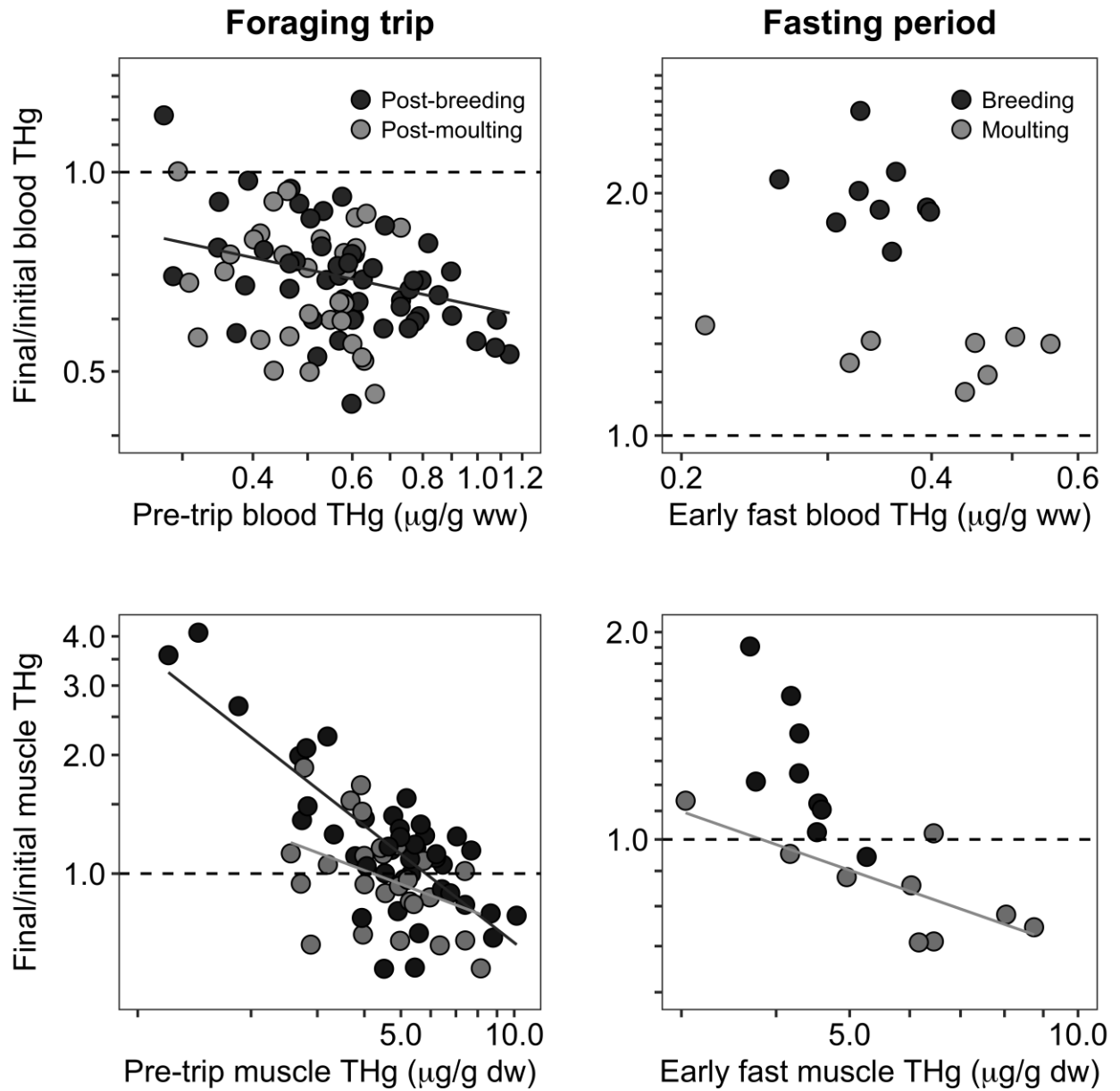


Figure S3. The proportional change in blood or muscle total mercury (THg) concentrations during a foraging or fasting period in adult female northern elephant seals (*Mirounga angustirostris*) related to the tissue THg concentration at the start of the fasting or foraging period. Blood THg concentrations are shown in wet weight (ww) and muscle THg concentrations are shown in dry weight (dw). The solid line is model-generated and plotted for significant relationships, using the mean final/initial mass for the time period. The dotted line at zero indicates the separation of seals that increased in THg concentrations from those that decreased in THg concentrations in between sampling events.