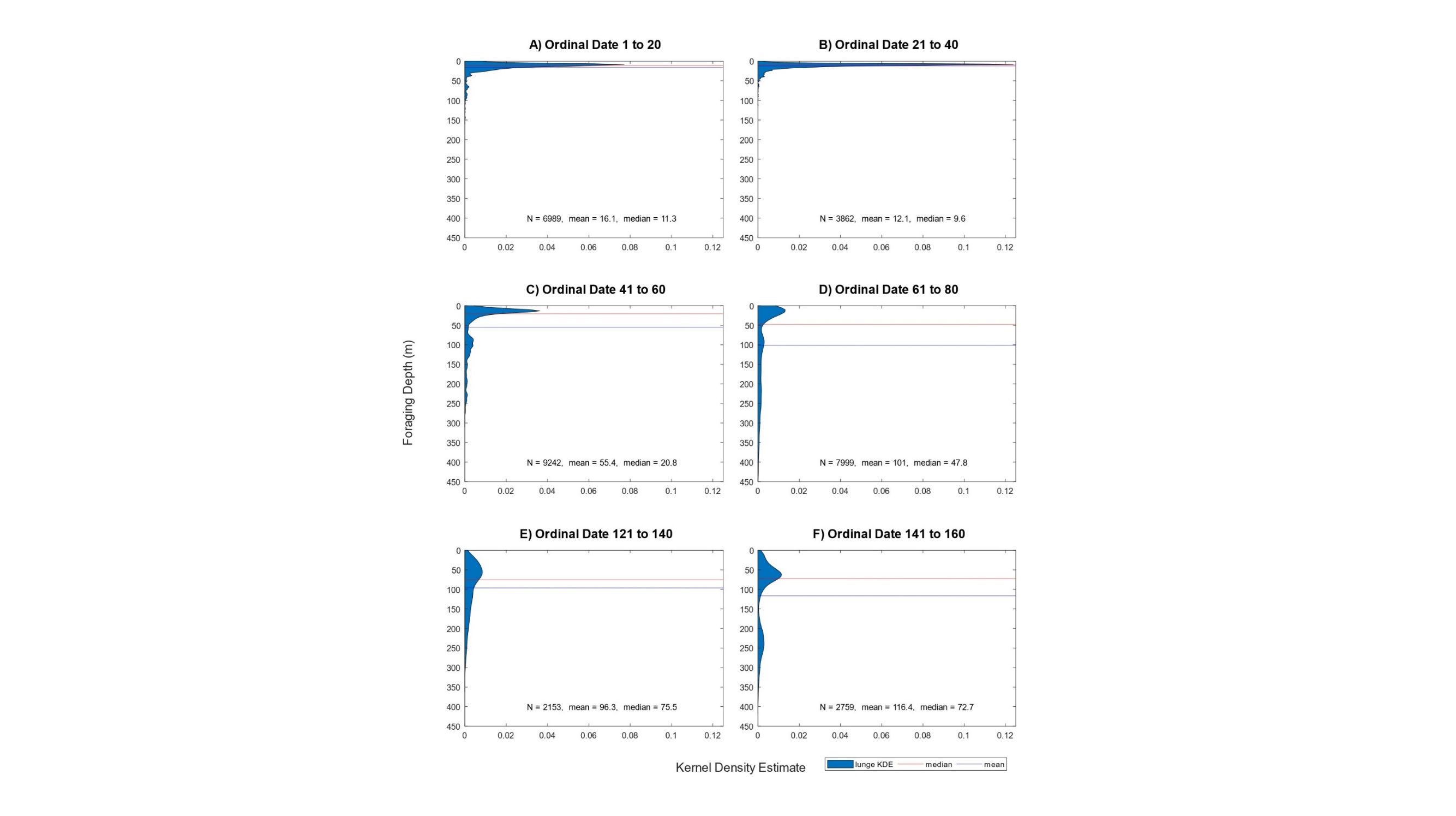
# APPENDIX S1

**Authors:** Nichols R.C., Cade D.E., Kahane-Rapport S., Goldbogen J., Stimpert A., Nowacek D., Read A., Johnston D. W., Friedlaender A.

**Manuscript Title**: Intra-seasonal variation in feeding rates and diel foraging behavior in a seasonally fasting mammal, the humpback whale

**Journal Name:** Royal Society *Open Science*

**Appendix S1: Figure S1 – Kernel Density Estimates of Lunge Depths by Analysis Period:** Each plot represents foraging depths for each 20-day analysis periods (A-F). Median and mean are represented by a solid red and blue line, respectively.



**Appendix S1: Table S2 – Tag Deployment Information:** Included are all deployments included in the final analysis. Deployment latitudes and longitudes are presented in decimal degrees. The total data time refers to the number of hours in which the tag recorded data, while also being attached to the animal.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Tag ID | Tag Type | Deployment Datetime | Deployment Latitude | Deployment Longitude | Total Data Time (Hours On-Whale) |
| mn150321-3 | CATS | 3/21/2015 15:41 | -64.6486 | -62.1889 | 5.9 |
| mn150321-5 | CATS | 3/21/2015 16:07 | -64.6479 | -62.1875 | 2.1 |
| mn160113-11 | CATS | 1/13/2016 4:31 | -64.9050 | -64.2483 | 29.6 |
| mn170218-31 | CATS | 2/18/2017 11:04 | -65.1732 | -64.1224 | 17.6 |
| mn170220-30 | CATS | 2/20/2017 10:00 | -64.6431 | -62.6212 | 2.5 |
| mn170320-30 | CATS | 3/20/2017 14:00 | -64.6342 | -62.6119 | 31.1 |
| mn170322-30 | CATS | 3/22/2017 17:14 | -64.8732 | -64.1824 | 6.5 |
| mn180106-27 | CATS | 1/6/2018 17:51 | -64.8860 | -64.4423 | 57.0 |
| mn180107-21 | CATS | 1/7/2018 13:44 | -64.9422 | -64.1807 | 13.0 |
| mn180107-22 | CATS | 1/7/2018 14:24 | -64.9403 | -64.1747 | 11.3 |
| mn180107-23 | CATS | 1/7/2018 10:53 | -64.9766 | -64.0549 | 5.1 |
| mn180125-42 | CATS | 1/25/2018 7:01 | -64.9836 | -63.5083 | 16.8 |
| mn180227-40 | CATS | 2/27/2018 14:12 | -64.7990 | -62.6962 | 9.6 |
| mn180227-41 | CATS | 2/27/2018 10:36 | -64.7855 | -62.7226 | 26.2 |
| mn180227-43 | CATS | 2/27/2018 14:32 | -64.7976 | -62.6959 | 27.1 |
| mn180227-44 | CATS | 2/27/2018 9:03 | -64.7950 | -62.7012 | 38.4 |
| mn180227-46 | CATS | 2/27/2018 7:27 | -64.7930 | -62.6991 | 27.2 |
| mn180228-47 | CATS | 2/28/2018 13:55 | -64.8394 | -62.6551 | 21.2 |
| mn180302-27 | CATS | 3/2/2018 16:06 | -64.8034 | -62.7200 | 20.1 |
| mn180302-47 | CATS | 3/2/2018 12:41 | -64.8303 | -62.6854 | 24.5 |
| mn190106-40 | CATS | 1/6/2019 18:45 | -64.9157 | -64.1876 | 27.2 |
| mn190203-22 | CATS | 2/3/2019 7:55 | -64.9719 | -64.2761 | 33.0 |
| mn190203-23 | CATS | 2/3/2019 8:04 | -64.9788 | -64.2781 | 10.5 |
| mn190205-27 | CATS | 2/5/2019 20:06 | -64.7471 | -64.1098 | 24.6 |
| mn190205-40 | CATS | 2/5/2019 19:50 | -64.7607 | -64.1161 | 37.6 |
| mn190212-27 | CATS | 2/12/2019 10:14 | -64.7768 | -64.0996 | 7.0 |
| mn190212-40 | CATS | 2/12/2019 11:09 | -64.7767 | -64.1033 | 6.0 |
| mn190215-40 | CATS | 2/15/2019 9:28 | -64.7561 | -63.1437 | 15.0 |
| mn190225-40 | CATS | 2/25/2019 8:11 | -64.8028 | -62.7565 | 7.8 |
| mn190228-40 | CATS | 2/28/2019 13:00 | -64.8644 | -62.5419 | 9.2 |
| mn190228-42 | CATS | 2/28/2019 9:14 | -64.8779 | -62.4888 | 43.3 |
| mn190228-44 | CATS | 2/28/2019 9:42 | -64.8779 | -62.4888 | 17.6 |
| mn190301-44 | CATS | 3/1/2019 16:01 | -64.8956 | -62.5567 | 22.9 |
| mn190304-40 | CATS | 3/4/2019 11:22 | -64.8474 | -62.5470 | 11.0 |
| mn190304-42 | CATS | 3/4/2019 10:23 | -64.8590 | -62.5787 | 11.0 |
| mn190305-44 | CATS | 3/5/2019 9:40 | -64.8638 | -62.5365 | 33.0 |
| mn190306-42 | CATS | 3/6/2019 12:10 | -64.8328 | -62.6526 | 18.5 |
| mn190306-45 | CATS | 3/6/2019 11:15 | -64.8269 | -62.6192 | 9.7 |
| mn190309-44b | CATS | 3/9/2019 14:47 | -64.8623 | -62.5385 | 22.9 |
| mn200312-58 | CATS | 3/12/2020 15:49 | -64.5042 | -61.6299 | 3.8 |
| mn200312-71 | CATS | 3/12/2020 16:41 | -64.4995 | -61.6276 | 4.9 |
| mn200313-60 | CATS | 3/13/2020 11:40 | -64.5019 | -61.6142 | 13.6 |
| mn200313-70 | CATS | 3/13/2020 16:10 | -64.4945 | -61.6345 | 18.3 |
| mn200313-59 | CATS | 3/13/2020 16:18 | -64.4946 | -61.6429 | 25.3 |
| mn200315-58 | CATS | 3/15/2020 9:03 | -64.5738 | -61.9919 | 5.2 |
| mn200315-70 | CATS | 3/15/2020 15:00 | -64.6979 | -62.2009 | 12.9 |
| mn200315-54 | CATS | 3/15/2020 16:32 | -64.6978 | -62.2002 | 18.3 |
| mn200105-52 | CATS | 1/5/2020 21:10 | -64.7681 | -64.2141 | 5.1 |
| mn200105-53 | CATS | 1/5/2020 21:41 | -64.8496 | -64.2382 | 12.4 |
| mn200105-42 | CATS | 1/5/2020 22:54 | -64.7759 | -64.2291 | 11.4 |
| mn200108-52 | CATS | 1/8/2020 19:28 | -64.8373 | -63.9719 | 15.9 |
| mn200108-53 | CATS | 1/8/2020 18:58 | -64.8391 | -63.9545 | 19.8 |
| mn200124-42 | CATS | 1/24/2020 8:53 | -64.7525 | -64.1203 | 9.5 |
| mn200204-52 | CATS | 2/4/2020 20:07 | -64.8928 | -64.1900 | 22.5 |
| mn200204-44 | CATS | 2/4/2020 20:51 | -64.9048 | -64.1971 | 12.1 |
| mn200219-52 | CATS | 2/19/2020 18:42 | -64.7838 | -64.0809 | 8.9 |
| mn09\_136a | DTAG | 5/16/2009 9:09 | -64.8680 | -62.4803 | 23.9 |
| mn09\_140a | DTAG | 5/20/2009 10:58 | -64.8760 | -62.5760 | 23.0 |
| mn09\_148a | DTAG | 5/28/2009 9:48 | -64.6812 | -62.2127 | 27.4 |
| mn09\_152a | DTAG | 6/1/2009 10:49 | -64.6821 | -62.2211 | 23.8 |
| mn10\_132a | DTAG | 5/12/2009 9:58 | -64.5761 | -62.2985 | 24.1 |
| mn10\_133a | DTAG | 5/13/2009 12:03 | -64.5650 | -62.3944 | 23.6 |
| mn10\_139a | DTAG | 5/19/2009 11:02 | -64.5932 | -62.2597 | 22.2 |
| mn10\_139b | DTAG | 5/19/2009 11:52 | -64.5930 | -62.2376 | 28.0 |
| mn10\_144a | DTAG | 5/24/2010 14:05 | -64.5833 | -62.2171 | 21.8 |
| mn10\_146a | DTAG | 5/24/2010 14:05 | -65.0561 | -63.4653 | 20.5 |
| mn10\_151a | DTAG | 5/26/2010 15:17 | -64.5781 | -62.2084 | 29.1 |
| mn10\_155a | DTAG | 6/4/2010 9:42 | -65.0481 | -63.4565 | 24.7 |
| mn10\_155b | DTAG | 6/4/2010 10:48 | -65.0411 | -63.4490 | 23.6 |

**Appendix S1: Table S3 – Extended GAMM Statistics Table:** Included are the summary statistics related to the hurdle model applied in our study. Two generalized additive mixed models were performed on hourly tag data to investigate seasonal foraging behavior of humpback whales.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  |  | | **Parametric** | | | **Smoothers** | | |  |
| **Model** | **Covariate** | **R2** | **n** | **Estimate** | **SE** | **t** | **edf** | **ref.df** | **F** | **p** |
| Presence/Absence |  | 0.263 | 1225 |  |  |  |  |  |  |  |
|  | DOY |  |  | -0.035 | 0.009 | -4.04 |  |  |  | 5.54E-05 |
|  | HOD |  |  |  |  |  | 2.98 | 9.00 | 2.89 | 1.01E-06 |
|  | MSE |  |  |  |  |  | 4.01 | 4.01 | 5.07 | 0.00046 |
| Hourly Feeding Rates |  | 0.337 | 870 |  |  |  |  |  |  |  |
|  | DOY |  |  |  |  |  | 1.60 | 1.60 | 7.75 | 7.49E-03 |
|  | MSE |  |  |  |  |  | 6.85 | 6.85 | 31.13 | < 2E-16 |
|  | MLD |  |  |  |  |  | 3.83 | 3.83 | 10.91 | 3.47E-08 |