

## Have North Pacific killer whales switched prey species in response to depletion of the great whale populations?

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**Appendix 1.** Whale biomass was calculated using actual length data from the BIWS/IWC catch database. Weights were estimated for each whale caught, based on length/weight curves developed for each species ( $W = aL^b$ ,  $W$  = weight,  $L$  = length in meters) (Table A1). Many of the whale lengths in the BIWS/IWC dataset were recorded in feet, so the data were converted from feet to meters as appropriate.

See Mizroch (1983) for the method of calculation, and Lockyer (1976) for the weight/length parameters used to predict the weight of most of the species listed in Tables A1 to A3. For Baird's beaked whales *Berardius bairdii*, the curve parameters were estimated using the weight/length relationships reported in Balcomb (1989). Mean biomass estimates in metric tons as well as minimum, maximum and mean lengths in meters are shown in Table A2 for all North Pacific catches and in Table A3 for catches from 50° N and above.

As an interesting sidenote worthy of future study, the mean weights are in all cases much lower than those presented in Perez (1990) and Trites & Pauly (1998). This discrepancy is hard to explain, because weights estimated from catch data should tend to be biased high. Whalers targeted larger whales as a matter of course, there were minimum length limits, and in cases where a whaler may have accidentally caught an undersize whale, it was not uncommon to round the length up to the minimum length allowed.

Table A1. Growth parameters:  $W = aL^b$

| Species name                      | a      | b      | Source         |
|-----------------------------------|--------|--------|----------------|
| <i>Eubalaena glacialis</i>        | 0.0124 | 3.06   | Lockyer (1976) |
| <i>Balaenoptera acutorostrata</i> | 0.0076 | 3.23   | Lockyer (1976) |
| <i>Balaenoptera borealis</i>      | 0.0242 | 2.43   | Lockyer (1976) |
| <i>Balaenoptera edeni</i>         | 0.0122 | 2.74   | Lockyer (1976) |
| <i>Balaenoptera musculus</i>      | 0.0046 | 3.09   | Lockyer (1976) |
| <i>Balaenoptera physalus</i>      | 0.0015 | 3.46   | Lockyer (1976) |
| <i>Berardius bairdii</i>          | 0.0425 | 1.8788 | Balcomb (1989) |
| <i>Eschrichtius robustus</i>      | 0.0051 | 3.28   | Lockyer (1976) |
| <i>Megaptera novaeangliae</i>     | 0.0158 | 2.59   | Lockyer (1976) |
| <i>Physeter macrocephalus</i>     | 0.0196 | 2.74   | Lockyer (1976) |

Appendix 1 (continued)

Table A2. Mean weight in metric tons (mt), minimum, maximum and mean lengths in m for whales caught throughout the North Pacific. Bowhead whales were omitted from this table due to small sample size

| Species name                      | Sex      | Mean weight (mt) | SD mean weight (mt) | Mean length (m) | SD mean length (m) | Minimum length (m) | Maximum length (m) | Sample size |
|-----------------------------------|----------|------------------|---------------------|-----------------|--------------------|--------------------|--------------------|-------------|
| <i>Eubalaena glacialis</i>        | Combined | 58.01            | 26.71               | 15.46           | 2.42               | 10.75              | 21.34              | 27          |
| <i>Eubalaena glacialis</i>        | Female   | 62.53            | 36.45               | 15.66           | 3.09               | 11.35              | 21.34              | 11          |
| <i>Eubalaena glacialis</i>        | Male     | 54.90            | 18.04               | 15.32           | 1.93               | 10.75              | 17.07              | 16          |
| <i>Balaenoptera acutorostrata</i> | Combined | 3.58             | 1.82                | 6.53            | 1.08               | 3.10               | 12.20              | 12090       |
| <i>Balaenoptera acutorostrata</i> | Female   | 3.61             | 1.93                | 6.52            | 1.14               | 3.60               | 12.10              | 5748        |
| <i>Balaenoptera acutorostrata</i> | Male     | 3.57             | 1.71                | 6.54            | 1.03               | 3.10               | 12.20              | 6322        |
| <i>Balaenoptera acutorostrata</i> | Unknown  | 3.10             | 1.99                | 6.23            | 1.08               | 4.90               | 8.80               | 20          |
| <i>Balaenoptera borealis</i>      | Combined | 13.75            | 2.70                | 13.54           | 1.11               | 8.23               | 21.00              | 60578       |
| <i>Balaenoptera borealis</i>      | Female   | 14.22            | 2.95                | 13.72           | 1.20               | 8.54               | 19.00              | 28774       |
| <i>Balaenoptera borealis</i>      | Male     | 13.33            | 2.38                | 13.37           | 0.99               | 8.23               | 21.00              | 31802       |
| <i>Balaenoptera borealis</i>      | Unknown  | 14.09            | 2.15                | 13.72           | 0.86               | 13.11              | 14.33              | 2           |
| <i>Balaenoptera edeni</i>         | Combined | 12.72            | 1.82                | 12.60           | 0.67               | 7.93               | 15.90              | 11613       |
| <i>Balaenoptera edeni</i>         | Female   | 13.16            | 1.96                | 12.76           | 0.71               | 7.93               | 15.85              | 5494        |
| <i>Balaenoptera edeni</i>         | Male     | 12.32            | 1.58                | 12.46           | 0.59               | 9.45               | 15.90              | 6119        |
| <i>Balaenoptera musculus</i>      | Combined | 71.41            | 15.89               | 22.57           | 1.79               | 9.15               | 27.44              | 3300        |
| <i>Balaenoptera musculus</i>      | Female   | 74.12            | 17.38               | 22.83           | 1.94               | 9.15               | 27.44              | 1459        |
| <i>Balaenoptera musculus</i>      | Male     | 69.26            | 14.24               | 22.37           | 1.63               | 10.06              | 26.83              | 1841        |
| <i>Balaenoptera physalus</i>      | Combined | 36.45            | 9.13                | 18.39           | 1.36               | 8.54               | 25.00              | 45486       |
| <i>Balaenoptera physalus</i>      | Female   | 38.78            | 10.08               | 18.71           | 1.47               | 8.54               | 25.00              | 22319       |
| <i>Balaenoptera physalus</i>      | Male     | 34.22            | 7.45                | 18.09           | 1.16               | 9.76               | 23.60              | 23162       |
| <i>Balaenoptera physalus</i>      | Unknown  | 29.73            | 7.18                | 17.38           | 1.16               | 16.16              | 19.21              | 5           |
| <i>Berardius bairdii</i>          | Combined | 3.22             | 0.44                | 9.98            | 0.78               | 5.49               | 12.60              | 618         |
| <i>Berardius bairdii</i>          | Female   | 3.28             | 0.39                | 10.09           | 0.68               | 6.50               | 11.70              | 165         |
| <i>Berardius bairdii</i>          | Male     | 3.19             | 0.46                | 9.94            | 0.81               | 5.49               | 12.60              | 453         |
| <i>Eschrichtius robustus</i>      | Combined | 15.51            | 6.13                | 11.33           | 1.43               | 5.50               | 18.29              | 751         |
| <i>Eschrichtius robustus</i>      | Female   | 17.20            | 6.51                | 11.69           | 1.50               | 7.62               | 15.24              | 357         |
| <i>Eschrichtius robustus</i>      | Male     | 14.21            | 5.18                | 11.09           | 1.17               | 7.93               | 18.29              | 384         |
| <i>Eschrichtius robustus</i>      | Unknown  | 5.52             | 4.24                | 7.92            | 1.99               | 5.50               | 10.67              | 10          |
| <i>Megaptera novaeangliae</i>     | Combined | 25.24            | 7.90                | 12.05           | 1.29               | 5.49               | 18.00              | 7186        |
| <i>Megaptera novaeangliae</i>     | Female   | 26.69            | 8.65                | 12.27           | 1.38               | 5.79               | 18.00              | 3147        |
| <i>Megaptera novaeangliae</i>     | Male     | 24.11            | 7.06                | 11.88           | 1.19               | 5.49               | 17.80              | 4038        |
| <i>Megaptera novaeangliae</i>     | Unknown  | 35.79            | -                   | 13.72           | -                  | 13.72              | 13.72              | 1           |
| <i>Physeter macrocephalus</i>     | Combined | 19.98            | 7.72                | 12.33           | 1.67               | 4.27               | 20.80              | 245625      |
| <i>Physeter macrocephalus</i>     | Female   | 13.64            | 2.30                | 10.86           | 0.66               | 4.27               | 17.90              | 61336       |
| <i>Physeter macrocephalus</i>     | Male     | 22.09            | 7.74                | 12.82           | 1.61               | 7.30               | 20.80              | 184283      |

Appendix 1 (continued)

Table A3. Mean weight in metric tons (mt), minimum, maximum and mean lengths in m for whales caught in the North Pacific from 50°N and above. Bowhead whales were omitted from this table due to small sample size

| Species name                      | Sex      | Mean weight (mt) | SD mean weight (mt) | Mean length (m) | SD mean length (m) | Minimum length (m) | Maximum length (m) | Sample size |
|-----------------------------------|----------|------------------|---------------------|-----------------|--------------------|--------------------|--------------------|-------------|
| <i>Eubalaena glacialis</i>        | Combined | 54.21            | 14.38               | 15.36           | 1.40               | 12.80              | 17.07              | 11          |
| <i>Eubalaena glacialis</i>        | Female   | 52.28            | 11.12               | 15.24           | 1.10               | 14.02              | 16.16              | 3           |
| <i>Eubalaena glacialis</i>        | Male     | 54.93            | 16.06               | 15.41           | 1.57               | 12.80              | 17.07              | 8           |
| <i>Balaenoptera acutorostrata</i> | Combined | 5.37             | 2.73                | 7.51            | 0.81               | 5.90               | 12.00              | 128         |
| <i>Balaenoptera acutorostrata</i> | Female   | 5.51             | 2.02                | 7.60            | 0.71               | 5.90               | 11.10              | 61          |
| <i>Balaenoptera acutorostrata</i> | Male     | 5.27             | 3.27                | 7.44            | 0.88               | 6.20               | 12.00              | 66          |
| <i>Balaenoptera acutorostrata</i> | Unknown  | 3.21             |                     | 6.50            |                    | 6.50               | 6.50               | 1           |
| <i>Balaenoptera borealis</i>      | Combined | 14.74            | 2.49                | 13.95           | 0.98               | 9.15               | 18.00              | 12819       |
| <i>Balaenoptera borealis</i>      | Female   | 15.40            | 2.75                | 14.19           | 1.07               | 9.45               | 17.60              | 5382        |
| <i>Balaenoptera borealis</i>      | Male     | 14.27            | 2.16                | 13.77           | 0.86               | 9.15               | 18.00              | 7437        |
| <i>Balaenoptera musculus</i>      | Combined | 75.23            | 13.01               | 23.02           | 1.39               | 9.15               | 26.52              | 1665        |
| <i>Balaenoptera musculus</i>      | Female   | 78.47            | 14.03               | 23.32           | 1.52               | 9.15               | 26.52              | 735         |
| <i>Balaenoptera musculus</i>      | Male     | 72.67            | 11.53               | 22.78           | 1.22               | 14.63              | 26.52              | 930         |
| <i>Balaenoptera physalus</i>      | Combined | 37.01            | 8.58                | 18.49           | 1.25               | 8.54               | 25.00              | 28569       |
| <i>Balaenoptera physalus</i>      | Female   | 39.47            | 9.54                | 18.83           | 1.36               | 8.54               | 25.00              | 13906       |
| <i>Balaenoptera physalus</i>      | Male     | 34.68            | 6.77                | 18.18           | 1.05               | 10.67              | 22.26              | 14661       |
| <i>Balaenoptera physalus</i>      | Unknown  | 29.31            | 2.51                | 17.38           | 0.43               | 17.07              | 17.68              | 2           |
| <i>Berardius bairdii</i>          | Combined | 3.10             | 0.75                | 9.71            | 1.44               | 5.49               | 11.40              | 37          |
| <i>Berardius bairdii</i>          | Female   | 3.24             | 0.60                | 10.01           | 1.02               | 8.84               | 10.60              | 3           |
| <i>Berardius bairdii</i>          | Male     | 3.08             | 0.76                | 9.68            | 1.48               | 5.49               | 11.40              | 34          |
| <i>Eschrichtius robustus</i>      | Combined | 13.37            | 6.04                | 10.76           | 1.63               | 5.50               | 14.60              | 282         |
| <i>Eschrichtius robustus</i>      | Female   | 14.58            | 6.88                | 11.03           | 1.72               | 7.62               | 14.60              | 131         |
| <i>Eschrichtius robustus</i>      | Male     | 12.75            | 4.71                | 10.69           | 1.30               | 7.93               | 14.00              | 142         |
| <i>Eschrichtius robustus</i>      | Unknown  | 5.49             | 4.49                | 7.85            | 2.10               | 5.50               | 10.67              | 9           |
| <i>Megaptera novaeangliae</i>     | Combined | 25.21            | 7.66                | 12.06           | 1.26               | 6.71               | 17.68              | 3949        |
| <i>Megaptera novaeangliae</i>     | Female   | 26.43            | 8.24                | 12.24           | 1.34               | 6.71               | 16.80              | 1809        |
| <i>Megaptera novaeangliae</i>     | Male     | 24.18            | 6.98                | 11.90           | 1.17               | 6.71               | 17.68              | 2140        |
| <i>Physeter macrocephalus</i>     | Combined | 24.89            | 6.81                | 13.46           | 1.35               | 8.50               | 20.43              | 59861       |
| <i>Physeter macrocephalus</i>     | Female   | 16.29            | 2.19                | 11.61           | 0.58               | 8.50               | 15.90              | 3205        |
| <i>Physeter macrocephalus</i>     | Male     | 25.38            | 6.66                | 13.56           | 1.30               | 8.54               | 20.43              | 56656       |