**Ecosphere**

**Coastal and Marine Ecology**

**Availability of Chinook and Sockeye Salmon as Prey to Cook Inlet Beluga Whales**

**Appendix S1: Supplemental Tables**

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Table S1. Salmon availability by year and species in major Cook Inlet river systems. Run size is in number of fish and biomass is in metric tons.

|  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** | **Chinook - Kenai** | | **Chinook - Susitna** | | **Sockeye - Kasilof** | | **Sockeye - Kenai** | | **Sockeye - Susitna** | |
|  | **Run Size** | **Biomass** | **Run Size** | **Biomass** | **Run Size** | **Biomass** | **Run Size** | **Biomass** | **Run Size** | **Biomass** |
| 1968 | - | - | - | - | 133,038 | 368 | 485,350 | 1,344 | - | - |
| 1969 | - | - | - | - | 121,242 | 336 | 1,374,607 | 3,807 | - | - |
| 1970 | - | - | - | - | 376,511 | 1,043 | 2,268,567 | 6,283 | - | - |
| 1971 | - | - | - | - | 391,215 | 1,084 | 2,096,342 | 5,806 | - | - |
| 1972 | - | - | - | - | 459,937 | 1,274 | 797,838 | 2,210 | - | - |
| 1973 | - | - | - | - | 303,099 | 840 | 1,481,394 | 4,103 | - | - |
| 1974 | - | - | - | - | 400,433 | 1,109 | 1,176,475 | 3,259 | - | - |
| 1975 | - | - | - | - | 559,772 | 1,550 | 2,766,654 | 7,663 | - | - |
| 1976 | - | - | - | - | 626,029 | 1,734 | 3,982,111 | 11,030 | - | - |
| 1977 | - | - | - | - | 922,771 | 2,556 | 1,287,189 | 3,565 | - | - |
| 1978 | - | - | - | - | 633,660 | 1,755 | 2,498,147 | 6,919 | - | - |
| 1979 | - | - | 95,887 | 628 | 1,655,157 | 4,584 | 2,946,941 | 8,162 | - | - |
| 1980 | - | - | 85,677 | 483 | 1,503,070 | 4,163 | 9,396,553 | 26,027 | - | - |
| 1981 | - | - | 87,010 | 521 | 1,049,571 | 2,907 | 6,055,839 | 16,774 | - | - |
| 1982 | - | - | 93,961 | 611 | 989,790 | 2,742 | 6,662,138 | 18,453 | - | - |
| 1983 | - | - | 126,573 | 743 | 535,031 | 1,482 | 3,228,788 | 8,943 | - | - |
| 1984 | - | - | 143,315 | 896 | 442,643 | 1,226 | 2,195,918 | 6,082 | - | - |
| 1985 | - | - | 142,101 | 910 | 602,194 | 1,668 | 8,255,121 | 22,865 | - | - |
| 1986 | 74,884 | 330 | 163,438 | 928 | 883,581 | 2,447 | 4,446,321 | 12,315 | - | - |
| 1987 | 93,412 | 460 | 153,356 | 897 | 608,627 | 1,686 | 3,906,522 | 10,820 | - | - |
| 1988 | 88,366 | 512 | 182,855 | 1,173 | 611,995 | 1,695 | 2,653,395 | 7,349 | - | - |
| 1989 | 52,066 | 291 | 153,876 | 969 | 615,866 | 1,706 | 3,696,870 | 10,240 | - | - |
| 1990 | 40,998 | 222 | 134,504 | 793 | 873,107 | 2,418 | 4,611,345 | 12,773 | - | - |
| 1991 | 46,961 | 246 | 111,630 | 726 | 822,198 | 2,277 | 1,902,582 | 5,270 | - | - |
| 1992 | 62,033 | 326 | 115,462 | 677 | 531,547 | 1,472 | 2,985,521 | 8,269 | - | - |
| 1993 | 72,497 | 389 | 107,907 | 670 | 823,631 | 2,281 | 1,815,411 | 5,028 | - | - |
| 1994 | 65,307 | 358 | 76,038 | 503 | 528,846 | 1,465 | 2,190,577 | 6,067 | - | - |
| 1995 | 56,059 | 295 | 99,769 | 586 | 747,477 | 2,070 | 3,467,716 | 9,605 | - | - |
| 1996 | 52,668 | 255 | 99,752 | 520 | 664,537 | 1,841 | 4,440,636 | 12,300 | - | - |
| 1997 | 55,104 | 281 | 169,124 | 980 | 859,551 | 2,381 | 5,706,183 | 15,805 | - | - |
| 1998 | 50,991 | 265 | 149,526 | 872 | 1,417,988 | 3,928 | 6,110,186 | 16,924 | - | - |
| 1999 | 56,422 | 281 | 138,946 | 785 | 1,224,014 | 3,390 | 2,834,218 | 7,850 | - | - |
| 2000 | 50,918 | 248 | 134,329 | 805 | 1,905,095 | 5,277 | 3,592,804 | 9,951 | - | - |
| 2001 | 54,965 | 282 | 142,211 | 823 | 1,186,368 | 3,286 | 2,066,731 | 5,724 | - | - |
| 2002 | 65,790 | 333 | 156,762 | 886 | 1,618,449 | 4,483 | 2,433,103 | 6,739 | - | - |
| 2003 | 83,003 | 418 | 172,955 | 875 | 1,111,831 | 3,080 | 3,571,675 | 9,893 | - | - |
| 2004 | 110,512 | 550 | 207,722 | 1,172 | 788,004 | 2,183 | 6,128,504 | 16,975 | - | - |
| 2005 | 100,203 | 530 | 151,738 | 794 | 798,322 | 2,211 | 4,726,621 | 13,092 | - | - |
| 2006 | 68,272 | 371 | 136,535 | 781 | 628,535 | 1,741 | 3,602,249 | 9,978 | 476,723 | 1,320 |
| 2007 | 53,250 | 266 | 117,076 | 705 | 935,360 | 2,591 | 3,278,984 | 9,082 | 595,002 | 1,648 |
| 2008 | 50,706 | 262 | 70,263 | 456 | 1,104,536 | 3,059 | 3,872,577 | 10,726 | 461,893 | 1,279 |
| 2009 | 33,709 | 180 | 60,858 | 248 | 1,167,513 | 3,234 | 3,491,861 | 9,672 | 332,178 | 920 |
| 2010 | 26,535 | 122 | 68,840 | 366 | 560,416 | 1,552 | 2,901,136 | 8,036 | 312,841 | 867 |
| 2011 | 32,976 | 163 | 59,533 | 305 | 815,928 | 2,260 | 1,663,333 | 4,607 | 548,276 | 1,519 |
| 2012 | 26,702 | 127 | 52,942 | 240 | 696,722 | 1,930 | 3,632,385 | 10,061 | 327,342 | 907 |
| 2013 | 16,115 | 82 | 86,714 | 473 | 669,125 | 1,853 | 2,551,971 | 7,068 | 430,679 | 1,193 |
| 2014 | 16,147 | 74 | 75,539 | 357 | 820,652 | 2,273 | 3,858,000 | 10,686 | 296,345 | 821 |
| 2015 | 27,178 | 133 | 107,252 | 546 | 861,371 | 2,386 | 2,695,533 | 7,466 | 438,383 | 1,214 |
| 2016 | 31,525 | 137 | 86,824 | 371 | 1,486,959 | 4,119 | - | - | - | - |
| 2017 | 38,582 | 165 | 49,239 | 268 | - | - | - | - | - | - |
| 2018 | 21,580 | 95 | 41,078 | 170 | - | - | - | - | - | - |
| 2019 | 17,434 | 79 | 54,482 | 284 | - | - | - | - | - | - |
| 2020 | 14,702 | 75 | 43,390 | 146 | - | - | - | - | - | - |
| 2021 | 16,812 | 79 | 64,660 | 328 | - | - | - | - | - | - |
| 2022 | - | - | 34,601 | 163 | - | - | - | - | - | - |

Table S2. Data used to fit the integrated population dynamics model. The variables are described in Table 3.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** |  |  |  |  |  |  |  |  |
| 2005 | 285 | 21 | 0.04 | 0.02 | 0.08 | 0.02 | 0.88 | 0.03 |
| 2006 | 268 | 23 | 0.08 | 0.03 | 0.20 | 0.03 | 0.71 | 0.04 |
| 2007 | 358 | 26 | 0.06 | 0.02 | 0.12 | 0.02 | 0.82 | 0.02 |
| 2008 | 283 | 14 | 0.06 | 0.02 | 0.20 | 0.03 | 0.74 | 0.03 |
| 2009 | 342 | 23 | 0.04 | 0.01 | 0.18 | 0.02 | 0.79 | 0.02 |
| 2010 | 415 | 35 | 0.06 | 0.02 | 0.26 | 0.03 | 0.67 | 0.03 |
| 2011 | - | - | 0.05 | 0.01 | 0.21 | 0.02 | 0.74 | 0.02 |
| 2012 | 336 | 17 | 0.06 | 0.01 | 0.25 | 0.02 | 0.69 | 0.02 |
| 2013 | - | - | 0.06 | 0.01 | 0.16 | 0.02 | 0.78 | 0.02 |
| 2014 | 379 | 22 | 0.12 | 0.02 | 0.19 | 0.03 | 0.69 | 0.03 |
| 2015 | - | - | 0.06 | 0.02 | 0.28 | 0.03 | 0.66 | 0.03 |
| 2016 | 247 | 19 | 0.11 | 0.01 | 0.20 | 0.02 | 0.69 | 0.02 |
| 2017 | - | - | 0.10 | 0.02 | 0.26 | 0.03 | 0.64 | 0.03 |
| 2018 | 269 | 28 | - | - | - | - | - | - |

Table S3. Correlation matrix displaying the Pearson correlation between July catch-per-unit-effort statistics from the offshore test fishery located west of Anchor Point between 1979 and 2022. The probability that the Pearson correlation differs from zero is shown in parentheses.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | **Sockeye** | **Pink** | **Chum** | **Coho** |
| **Sockeye** | 1.00 (0.00) | 0.20 (0.20) | 0.19 (0.21) | -0.14 (0.36) |
| **Pink** | 0.20 (0.20) | 1.00 (0.00) | 0.55 (0.00) | 0.35 (0.02) |
| **Chum** | 0.19 (0.21) | 0.55 (0.00) | 1.00 (0.00) | 0.01 (0.93) |
| **Coho** | -0.14 (0.36) | 0.35 (0.02) | 0.01 (0.93) | 1.00 (0.00) |

Table S4. CIBW abundance and age composition, 2005 to 2017. The standard deviation of the estimate is provided in parenthesis. The variables are described in Table 2.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Year** |  |  |  |  |  |  |  |
| 2005 | 303 (17) | 10 (5) | 35 (5) | 268 (16) | 0.03 (0.02) | 0.11 (0.01) | 0.86 (0.02) |
| 2006 | 296 (15) | 32 (9) | 52 (7) | 243 (15) | 0.1 (0.02) | 0.16 (0.02) | 0.74 (0.03) |
| 2007 | 310 (17) | 20 (5) | 45 (5) | 265 (15) | 0.06 (0.01) | 0.14 (0.01) | 0.8 (0.02) |
| 2008 | 299 (12) | 19 (7) | 61 (6) | 239 (12) | 0.06 (0.02) | 0.19 (0.02) | 0.75 (0.02) |
| 2009 | 329 (15) | 12 (4) | 63 (5) | 266 (13) | 0.03 (0.01) | 0.19 (0.01) | 0.78 (0.01) |
| 2010 | 357 (21) | 26 (8) | 95 (10) | 262 (17) | 0.07 (0.02) | 0.25 (0.02) | 0.68 (0.02) |
| 2011 | 348 (33) | 20 (5) | 79 (9) | 268 (26) | 0.05 (0.01) | 0.22 (0.02) | 0.73 (0.02) |
| 2012 | 342 (15) | 22 (3) | 89 (7) | 253 (13) | 0.06 (0.01) | 0.24 (0.01) | 0.7 (0.01) |
| 2013 | 349 (24) | 21 (5) | 63 (7) | 286 (20) | 0.06 (0.01) | 0.17 (0.01) | 0.77 (0.02) |
| 2014 | 361 (20) | 48 (10) | 78 (9) | 283 (18) | 0.12 (0.02) | 0.19 (0.02) | 0.69 (0.02) |
| 2015 | 292 (46) | 18 (6) | 85 (14) | 206 (33) | 0.06 (0.01) | 0.28 (0.02) | 0.67 (0.02) |
| 2016 | 253 (18) | 31 (4) | 58 (6) | 194 (14) | 0.11 (0.01) | 0.21 (0.01) | 0.68 (0.01) |
| 2017 | 250 (29) | 28 (6) | 71 (10) | 179 (21) | 0.1 (0.02) | 0.26 (0.02) | 0.64 (0.02) |

|  |  |  |  |  |  |  |  |
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|  |  |  |  |  |  |  |  |

Table S5. Rates of CIBW reproduction and survival, 2005 to 2017. The standard deviation of the estimate is provided in parenthesis. The variables shown in the table are described in Table 2.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Year** |  |  |  |  |  |
| 2005 | 0.24 (0.14) | 0.88 (0.06) | 0.89 (0.14) | 0.85 (0.15) | 0.89 (0.07) |
| 2006 | 0.26 (0.07) | 0.91 (0.04) | 0.71 (0.19) | 0.83 (0.19) | 0.97 (0.03) |
| 2007 | 0.15 (0.04) | 0.85 (0.06) | 0.86 (0.15) | 0.79 (0.2) | 0.87 (0.07) |
| 2008 | 0.16 (0.06) | 0.93 (0.04) | 0.85 (0.14) | 0.86 (0.16) | 0.97 (0.03) |
| 2009 | 0.09 (0.03) | 0.93 (0.05) | 0.89 (0.12) | 0.87 (0.14) | 0.95 (0.05) |
| 2010 | 0.2 (0.06) | 0.8 (0.07) | 0.66 (0.21) | 0.65 (0.26) | 0.91 (0.09) |
| 2011 | 0.15 (0.03) | 0.81 (0.08) | 0.79 (0.19) | 0.69 (0.25) | 0.88 (0.09) |
| 2012 | 0.17 (0.02) | 0.87 (0.06) | 0.56 (0.18) | 0.79 (0.21) | 0.95 (0.06) |
| 2013 | 0.15 (0.03) | 0.89 (0.06) | 0.85 (0.16) | 0.77 (0.22) | 0.94 (0.06) |
| 2014 | 0.34 (0.07) | 0.66 (0.11) | 0.8 (0.2) | 0.64 (0.26) | 0.67 (0.13) |
| 2015 | 0.18 (0.05) | 0.72 (0.1) | 0.47 (0.21) | 0.54 (0.28) | 0.85 (0.13) |
| 2016 | 0.32 (0.03) | 0.82 (0.09) | 0.83 (0.18) | 0.75 (0.23) | 0.86 (0.11) |
| 2017 | 0.32 (0.06) | 0.79 (0.09) | 0.72 (0.24) | 0.69 (0.26) | 0.89 (0.12) |

Table S6. The fat content of select CIBW prey species is summarized below. Note: Information on the fat density of certain CIBW prey species, including starry flounder, yellowfin sole, and shrimp, was not available and therefore these species are not included in the table.

|  |  |  |
| --- | --- | --- |
| **Species** | **Fat Content (% by Weight)** | **Source** |
| Eulachon | 20% | Csepp et al., 2017 |
| Pacific Herring | 13% | Csepp et al., 2017 |
| Chinook Salmon | 11% | O’Neill et al., 2014 |
| Sockeye Salmon | 11% | O’Neill et al., 2014 |
| Coho Salmon | 7% | O’Neill et al., 2014 |
| Pink Salmon | 5% | O’Neill et al., 2014 |
| Chum Salmon | 3% | O’Neill et al., 2014 |
| Walleye Pollock | 0.6% | Oliveira and Bechtel, 2006 |
| Pacific Cod | 0.6% | Oliveira and Bechtel, 2006 |