



United States Department of the Interior



FISH AND WILDLIFE SERVICE
Division of Migratory Bird Management
Branch of Assessment and Decision Support
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MEMORANDUM

TO: Mark Seamans

FROM: Joshua Dooley

DATE: 18 August 2022

SUBJECT: Atlantic Population Canada Goose Integrated Population Model 2023
Abundance Prediction

In fall 2020, the Atlantic Flyway Council adopted the use of an integrated population model (IPM) to inform harvest management decisions for Atlantic Population Canada geese (AP CAGO; Dooley 2019). The AP CAGO harvest strategy considers setting hunting regulations based on the IPM out-year prediction of breeding pairs. **The AP CAGO IPM predicted 2023 median number of breeding pairs was 180,500 (95% CI = 124,500–249,500; Figure 1, Table 2).**

Input data included in the AP CAGO IPM were provided in Table 1. Aerial surveys and banding operations resumed in 2022 after not being conducted in 2020 and 2021 due to the COVID-19 pandemic. The IPM predicted adult harvest probability for the 2022–23 hunting season is 0.034 (95% CI = 0.026–0.045; Figure 1, Table 2). The IPM predicted August 2022 juvenile:adult age ratio is 1.36 (95% CI = 1.10–1.62), which is similar to the observed 1997–2019 average (1.38). Average temperature during May 2022 at Kuujuaq, Québec was 1.3°C ($\bar{x}_{1997-2021} = 1.5^\circ\text{C}$), and the proportion of snow/ice cover on the Ungava Peninsula on 15 June 2022 was 0.12 ($\bar{x}_{1997-2021} = 0.41$). In last year's memo, the out-year (2022) median breeding pair prediction from the IPM was 153,000 (95% CI = 92,000–235,000), which was -6.5% lower than the observed 2022 aerial survey breeding pair estimate of $163,714 \pm 16,711$ (SE; Harvey et al. 2022).

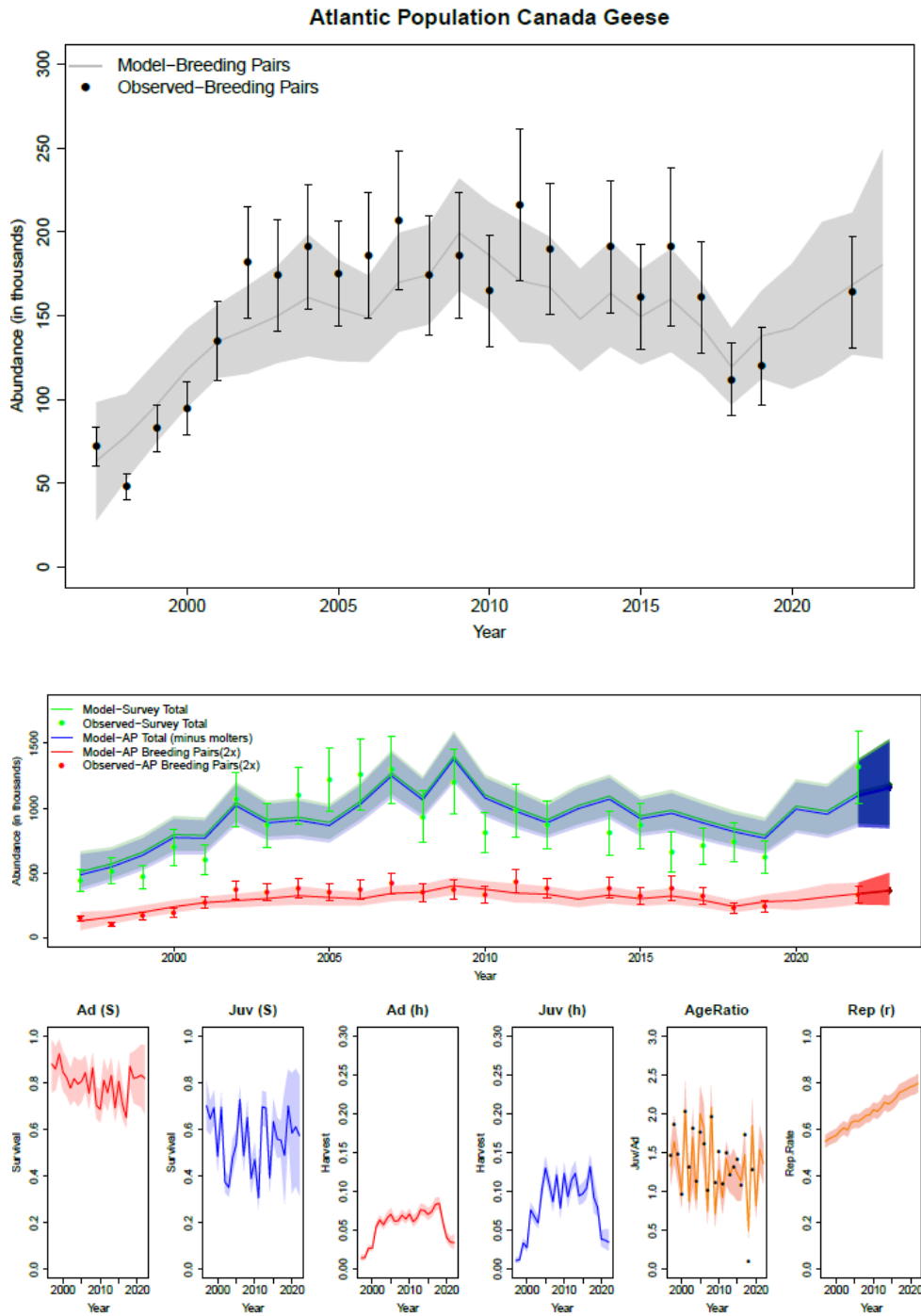
LITERATURE CITED

- Dooley, J. L. 2019. Atlantic Population Canada Goose Integrated Population Model. Unpubl. Report to Atlantic Flyway Technical Section. U. S. Fish and Wildlife Service, Laurel, MD. November 2019.
- Harvey, W., C. Lepage, J. Lefebvre, and R. Spangler. 2022. A breeding pair survey of Canada Geese in northern Québec - 2022. Maryland Department of Natural Resources and Canadian Wildlife Service, Québec Region. Report to Atlantic Flyway Technical Section. July 2022.

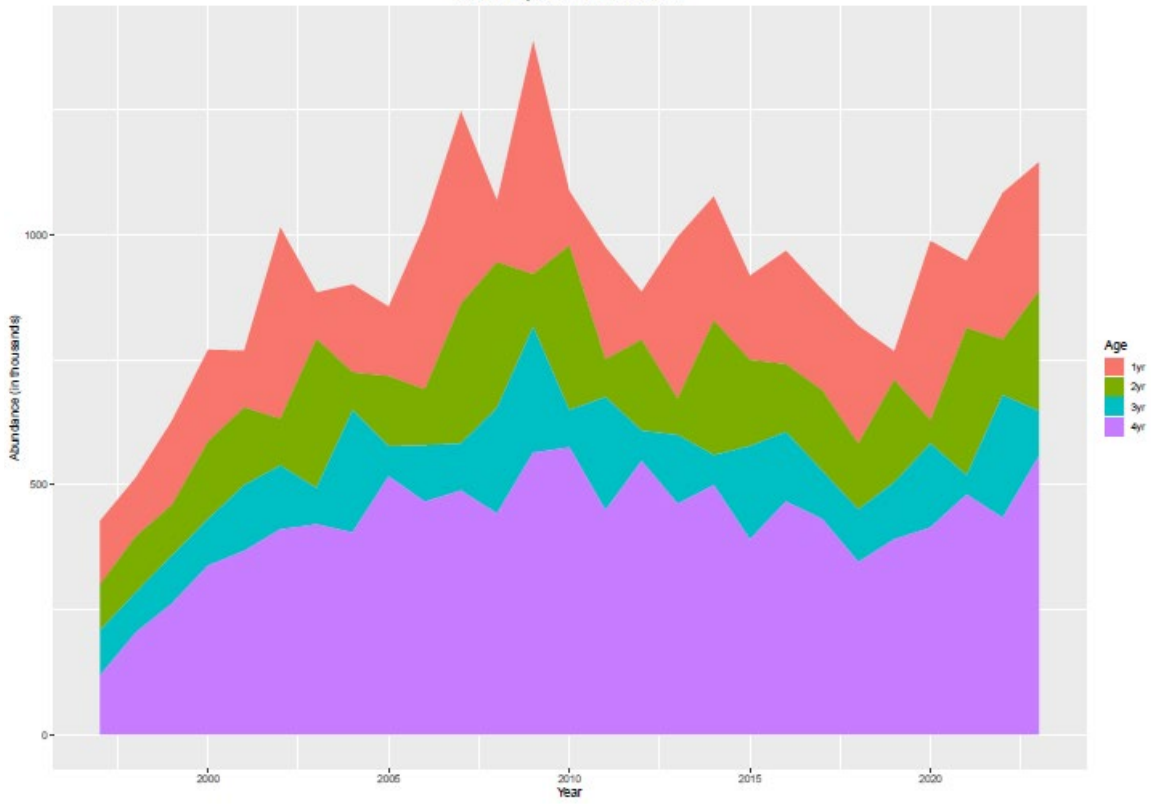
Table 1. Input data included in the Atlantic Population Canada goose integrated population model and summarized band-recovery data, 1997–2022.

| Year | Survey abundance (in thousands) | | Banding age ratio | Env. Covariate | | Harvest Regulations (days, bag) | | | | | | | |
|------|------------------------------------|-------|----------------------|----------------|---------------|---------------------------------|-----|-----------|---|--------|---|-------|-----|
| | Breeding Pairs | Total | | MayTemp | Prop. SnowIce | Ches. | | MidAtl/NE | | Canada | | Total | |
| | | | Juv:Ad | | | d | b | d | b | d | b | d | b |
| 1997 | 72 | 443 | 1.47 | 1.5 | 0.25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1998 | 48 | 513 | 1.86 | 2.9 | 0.09 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1999 | 83 | 468 | 1.48 | 2.8 | 0.61 | 6 | 1 | 15 | 1 | 20 | 3 | 41 | 5 |
| 2000 | 95 | 694 | 0.96 | 0.8 | 0.83 | 6 | 1 | 15 | 1 | 20 | 3 | 41 | 5 |
| 2001 | 135 | 602 | 2.03 | 4.8 | 0.07 | 30 | 1 | 30 | 2 | 30 | 5 | 90 | 8 |
| 2002 | 182 | 1068 | 1.31 | -1.1 | 0.65 | 45 | 1 | 45 | 2 | 45 | 5 | 135 | 8 |
| 2003 | 174 | 864 | 1.82 | 4.7 | 0.18 | 45 | 1 | 45 | 2 | 45 | 5 | 135 | 8 |
| 2004 | 191 | 1095 | 1.13 | -0.6 | 0.76 | 45 | 1.5 | 45 | 3 | 45 | 5 | 135 | 9.5 |
| 2005 | 175 | 1218 | 1.77 | 4.7 | 0.08 | 45 | 2 | 45 | 3 | 45 | 5 | 135 | 10 |
| 2006 | 186 | 1262 | 1.61 | 5.3 | 0.26 | 45 | 2 | 45 | 3 | 45 | 5 | 135 | 10 |
| 2007 | 207 | 1296 | 1.02 | -1.7 | 0.84 | 45 | 2 | 45 | 3 | 45 | 5 | 135 | 10 |
| 2008 | 174 | 933 | 1.97 | 5.5 | 0.09 | 45 | 2 | 45 | 3 | 45 | 5 | 135 | 10 |
| 2009 | 186 | 1202 | 1.11 | -1.9 | 0.90 | 45 | 2 | 45 | 3 | 45 | 5 | 135 | 10 |
| 2010 | 165 | 810 | 1.52 | 1.2 | 0.28 | 45 | 2 | 45 | 3 | 60 | 5 | 150 | 10 |
| 2011 | 216 | 980 | 1.1 | -1.0 | 0.46 | 45 | 2 | 45 | 3 | 60 | 5 | 150 | 10 |
| 2012 | 190 | 871 | 1.5 | 1.9 | 0.10 | 50 | 2 | 50 | 3 | 60 | 5 | 160 | 10 |
| 2013 | — | — | 1.22 | 0.8 | 0.28 | 50 | 2 | 50 | 3 | 60 | 5 | 160 | 10 |
| 2014 | 191 | 807 | 1.32 | 1.7 | 0.13 | 50 | 2 | 50 | 3 | 60 | 5 | 160 | 10 |
| 2015 | 161 | 864 | 1.41 | 1.5 | 0.34 | 50 | 2 | 50 | 3 | 60 | 5 | 160 | 10 |
| 2016 | 191 | 663 | 1.08 | 0.9 | 0.45 | 50 | 2 | 50 | 3 | 60 | 5 | 160 | 10 |
| 2017 | 161 | 705 | 1.73 | 2.1 | 0.18 | 50 | 2 | 50 | 3 | 60 | 5 | 160 | 10 |
| 2018 | 112 | 738 | 0.1 | -5.1 | 0.99 | 50 | 2 | 50 | 3 | 60 | 5 | 160 | 10 |
| 2019 | 120 | 622 | 1.28 | 4.3 | 0.18 | 30 | 1 | 30 | 2 | 60 | 5 | 120 | 8 |
| 2020 | — | — | — | -0.8 | 0.94 | 30 | 1 | 30 | 2 | 30 | 3 | 90 | 6 |
| 2021 | — | — | — | 3.4 | 0.42 | 30 | 1 | 30 | 1 | 30 | 3 | 90 | 5 |
| 2022 | 164 | 1316 | — | 1.3 | 0.12 | 30 | 1 | 30 | 1 | 30 | 3 | 90 | 5 |

Figure 1 and Table 2. Atlantic Population Canada goose IPM posterior estimates (median/95% CI [line/shading]) of breeding pairs (top plot), total and breeding abundance indices (with 2023 out-year prediction in darker shading), other model parameters (middle plot; ad=adult; juv=juvenile; S=survival; h=harvest rate; AgeRatio=juvenile:adult at banding; r=reporting rate), and abundance indices by age class (bottom plot). Observed data values are included as points (bars=95% CL).



Atlantic Population Canada Geese



| Year | Abundance | | | | | | Survival | | | | Harvest | | | | Juv:Adult | |
|------|----------------|-------------------|---------------------|-------------------|-----------|-----------------------|----------|---------------|----------|---------------|---------|---------------|----------|---------------|-----------|-------------|
| | Breeding Pairs | | Breeding Pairs (2X) | | Total | | Adult | | Juvenile | | Adult | | Juvenile | | Age Ratio | |
| | median | 95% CI | median | 95% CI | median | 95% CI | median | 95% CI | median | 95% CI | median | 95% CI | median | 95% CI | median | 95% CI |
| 1997 | 63,500 | (28,000-98,500) | 127,000 | (56,000-197,000) | 507,000 | (386,000-666,000) | 0.882 | (0.760-0.986) | 0.703 | (0.599-0.810) | 0.015 | (0.011-0.019) | 0.011 | (0.008-0.015) | 1.33 | (1.08-1.59) |
| 1998 | 78,500 | (52,500-103,500) | 157,000 | (105,000-207,000) | 569,000 | (458,000-698,025) | 0.861 | (0.770-0.955) | 0.647 | (0.578-0.723) | 0.015 | (0.012-0.019) | 0.012 | (0.009-0.017) | 1.65 | (1.37-1.98) |
| 1999 | 97,000 | (75,000-123,000) | 194,000 | (150,000-246,000) | 658,000 | (546,000-792,000) | 0.926 | (0.844-0.988) | 0.694 | (0.624-0.769) | 0.027 | (0.024-0.032) | 0.034 | (0.028-0.040) | 1.36 | (1.13-1.64) |
| 2000 | 118,000 | (95,500-142,500) | 236,000 | (191,000-285,000) | 795,000 | (670,000-939,000) | 0.848 | (0.767-0.935) | 0.486 | (0.419-0.562) | 0.027 | (0.024-0.031) | 0.028 | (0.022-0.034) | 1.00 | (0.79-1.18) |
| 2001 | 134,500 | (113,000-156,500) | 269,000 | (226,000-313,000) | 790,000 | (670,000-927,000) | 0.823 | (0.744-0.906) | 0.696 | (0.633-0.760) | 0.054 | (0.049-0.060) | 0.077 | (0.068-0.086) | 2.05 | (1.73-2.43) |
| 2002 | 142,000 | (115,500-168,000) | 284,000 | (231,000-336,000) | 1,042,000 | (898,000-1,201,000) | 0.779 | (0.706-0.864) | 0.374 | (0.329-0.427) | 0.064 | (0.058-0.070) | 0.068 | (0.059-0.077) | 0.88 | (0.72-1.06) |
| 2003 | 150,000 | (122,000-180,000) | 300,000 | (244,000-360,000) | 909,000 | (781,000-1,054,000) | 0.819 | (0.727-0.914) | 0.352 | (0.313-0.398) | 0.057 | (0.052-0.064) | 0.060 | (0.053-0.068) | 1.71 | (1.07-2.07) |
| 2004 | 161,000 | (126,000-198,500) | 322,000 | (252,000-397,000) | 929,000 | (794,000-1,077,000) | 0.796 | (0.700-0.900) | 0.478 | (0.410-0.556) | 0.066 | (0.059-0.073) | 0.102 | (0.089-0.115) | 0.90 | (0.75-1.11) |
| 2005 | 154,500 | (123,000-183,500) | 309,000 | (246,000-367,000) | 889,000 | (761,000-1,030,000) | 0.807 | (0.719-0.898) | 0.536 | (0.480-0.599) | 0.071 | (0.063-0.079) | 0.131 | (0.118-0.145) | 2.01 | (1.67-2.36) |
| 2006 | 149,000 | (122,500-174,000) | 298,000 | (245,000-348,000) | 1,053,000 | (918,000-1,199,000) | 0.845 | (0.766-0.919) | 0.730 | (0.668-0.782) | 0.062 | (0.056-0.068) | 0.110 | (0.099-0.122) | 1.82 | (1.26-2.13) |
| 2007 | 170,000 | (140,500-199,500) | 340,000 | (281,000-399,000) | 1,271,000 | (1,110,000-1,446,000) | 0.758 | (0.690-0.837) | 0.488 | (0.421-0.563) | 0.063 | (0.057-0.069) | 0.087 | (0.075-0.101) | 0.75 | (0.58-0.88) |
| 2008 | 174,500 | (145,000-204,500) | 349,000 | (290,000-409,000) | 1,087,000 | (949,000-1,245,000) | 0.865 | (0.778-0.931) | 0.652 | (0.582-0.724) | 0.070 | (0.063-0.077) | 0.122 | (0.110-0.134) | 2.09 | (1.56-2.38) |
| 2009 | 199,500 | (165,000-232,000) | 399,000 | (330,000-464,000) | 1,401,500 | (1,227,000-1,595,000) | 0.703 | (0.648-0.783) | 0.390 | (0.326-0.468) | 0.065 | (0.059-0.072) | 0.079 | (0.066-0.092) | 0.71 | (0.54-0.83) |
| 2010 | 186,000 | (153,500-217,500) | 372,000 | (307,000-435,000) | 1,102,000 | (965,000-1,259,000) | 0.687 | (0.631-0.772) | 0.472 | (0.410-0.546) | 0.071 | (0.065-0.078) | 0.124 | (0.111-0.138) | 1.28 | (1.07-1.53) |
| 2011 | 171,000 | (134,500-207,000) | 342,000 | (269,000-414,000) | 998,000 | (869,000-1,152,000) | 0.812 | (0.715-0.906) | 0.307 | (0.257-0.367) | 0.062 | (0.055-0.069) | 0.093 | (0.080-0.109) | 0.92 | (0.72-1.08) |
| 2012 | 167,000 | (133,000-197,000) | 334,000 | (266,000-394,000) | 909,000 | (793,000-1,044,025) | 0.758 | (0.681-0.849) | 0.698 | (0.619-0.767) | 0.066 | (0.059-0.073) | 0.115 | (0.101-0.130) | 1.43 | (1.08-1.64) |
| 2013 | 148,000 | (117,000-178,000) | 296,000 | (234,000-356,000) | 1,019,000 | (877,000-1,178,000) | 0.833 | (0.748-0.910) | 0.693 | (0.610-0.761) | 0.077 | (0.070-0.085) | 0.124 | (0.110-0.139) | 1.22 | (0.99-1.45) |
| 2014 | 163,500 | (131,500-194,500) | 327,000 | (263,000-389,000) | 1,092,000 | (942,000-1,258,000) | 0.694 | (0.635-0.780) | 0.394 | (0.334-0.464) | 0.076 | (0.069-0.084) | 0.095 | (0.083-0.107) | 1.34 | (0.95-1.55) |
| 2015 | 149,500 | (121,000-177,500) | 299,000 | (242,000-355,000) | 940,000 | (809,975-1,089,000) | 0.808 | (0.716-0.899) | 0.634 | (0.544-0.731) | 0.071 | (0.064-0.079) | 0.098 | (0.085-0.111) | 1.23 | (0.88-1.41) |
| 2016 | 160,000 | (128,500-190,000) | 320,000 | (257,000-380,000) | 983,000 | (842,000-1,142,000) | 0.710 | (0.646-0.794) | 0.560 | (0.480-0.652) | 0.074 | (0.067-0.082) | 0.104 | (0.091-0.118) | 1.14 | (0.89-1.32) |
| 2017 | 143,500 | (115,500-170,000) | 287,000 | (231,000-340,000) | 909,000 | (775,000-1,057,000) | 0.652 | (0.608-0.715) | 0.555 | (0.481-0.637) | 0.084 | (0.076-0.092) | 0.133 | (0.119-0.147) | 1.48 | (1.26-1.80) |
| 2018 | 119,500 | (97,000-142,500) | 239,000 | (194,000-285,000) | 841,000 | (718,000-980,000) | 0.873 | (0.787-0.928) | 0.489 | (0.280-0.768) | 0.085 | (0.078-0.093) | 0.093 | (0.073-0.117) | 0.50 | (0.40-0.59) |
| 2019 | 138,000 | (112,500-165,000) | 276,000 | (225,000-330,000) | 790,000 | (669,000-927,000) | 0.821 | (0.714-0.936) | 0.702 | (0.564-0.858) | 0.060 | (0.054-0.067) | 0.080 | (0.069-0.092) | 1.86 | (1.53-2.20) |
| 2020 | 142,500 | (106,500-181,000) | 285,000 | (213,000-362,000) | 1,015,000 | (832,000-1,223,000) | 0.825 | (0.705-0.949) | 0.585 | (0.326-0.843) | 0.041 | (0.035-0.048) | 0.039 | (0.030-0.050) | 0.81 | (0.66-0.98) |
| 2021 | 156,500 | (114,500-206,000) | 313,000 | (229,000-412,000) | 976,000 | (793,000-1,186,000) | 0.834 | (0.698-0.965) | 0.612 | (0.361-0.861) | 0.035 | (0.029-0.042) | 0.038 | (0.027-0.052) | 1.54 | (1.27-1.85) |
| 2022 | 168,500 | (127,000-211,512) | 337,000 | (254,000-423,025) | 1,121,000 | (881,000-1,379,000) | 0.821 | (0.668-0.963) | 0.574 | (0.317-0.832) | 0.034 | (0.026-0.045) | 0.035 | (0.024-0.051) | 1.36 | (1.10-1.62) |
| 2023 | 180,500 | (124,500-249,500) | 361,000 | (249,000-499,000) | | | | | | | | | | | | |