The following supplement accompanies the article

Monitoring trends in sea turtle populations: walk or fly?

Melissa L. Warden, Heather L. Haas, Paul M. Richards,
Kenneth A. Rose, Joshua M. Hatch*

*Corresponding author: joshua.hatch@noaa.gov

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Supplement 1. Stochastic vital rates

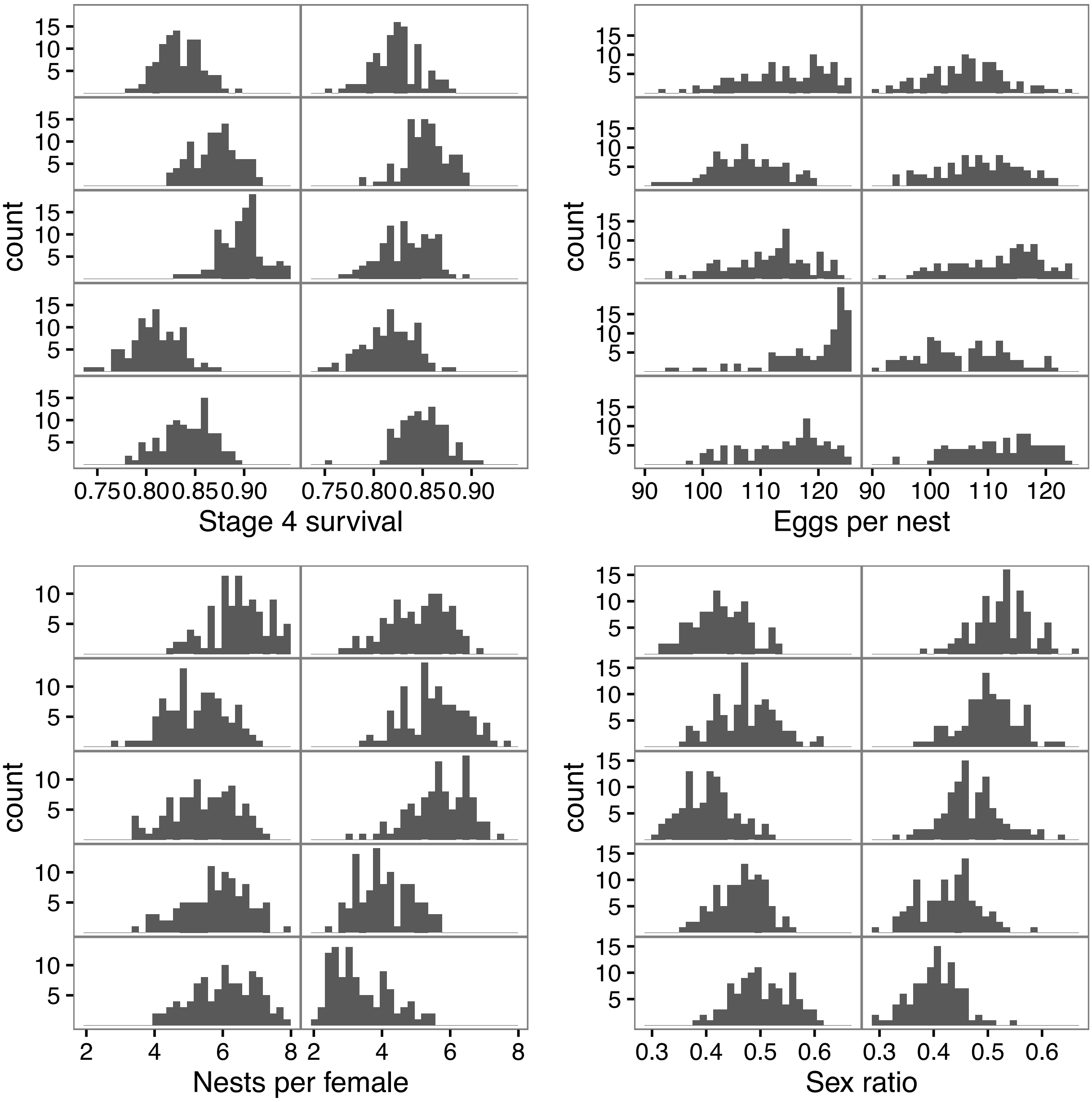


Figure S1. Histogram of 100 annual vital rates from a randomly selected set of 10 simulations. See Supplement 2 for stochastic remigration intervals. Survival rates for eggs and stages 1-3 had shapes similar to the distributions shown for stage 4 survival.

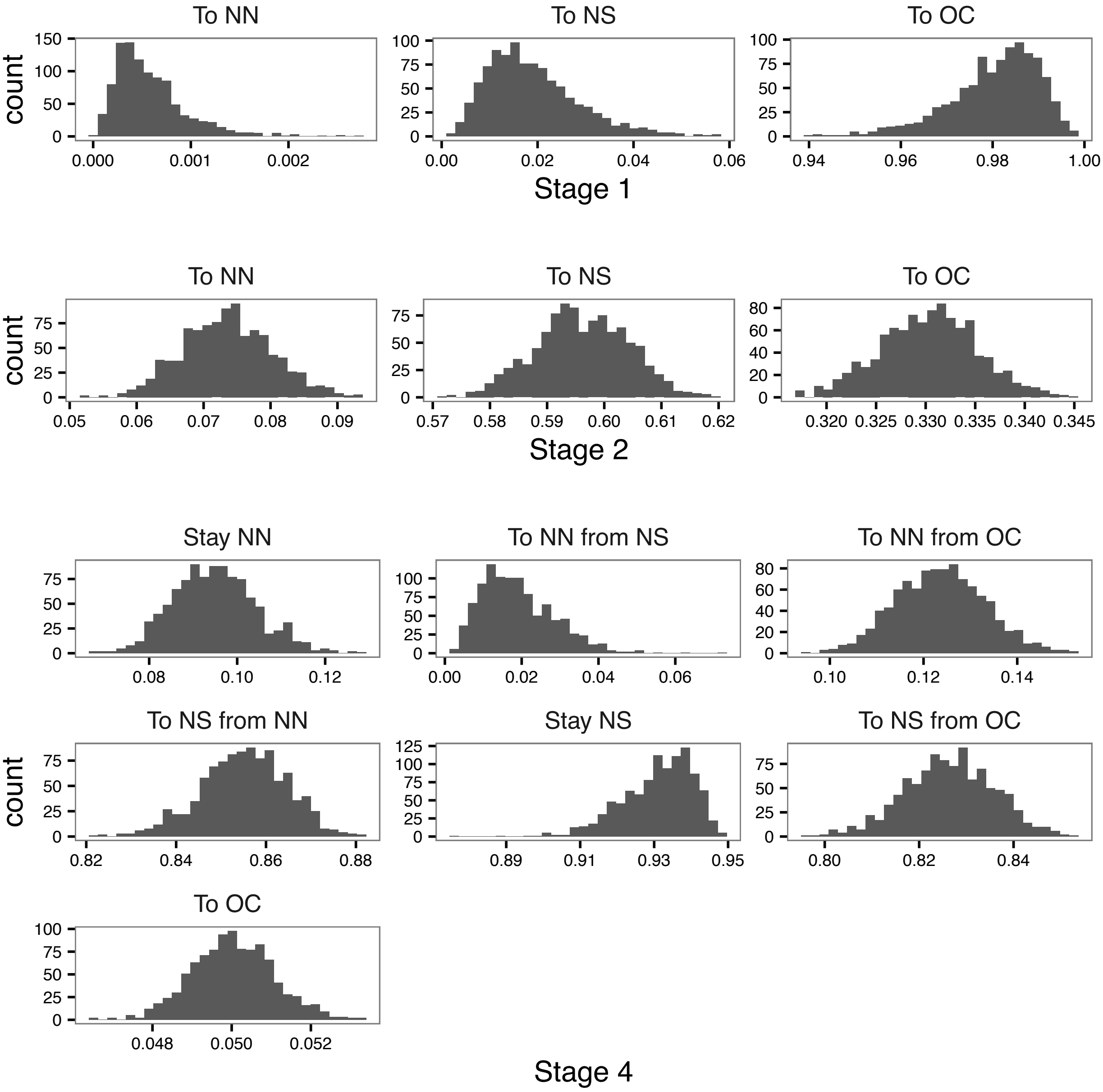


Figure S2. Stochastic stage-specific probabilities for movement between regions, with 2000 random samples (samples shown were drawn post hoc from the distribution described in Methods). Stages 2 and 3 are parameterized identically and so only stage 2 is shown. For stages 1-3, the probability of moving to or staying in a destination region is the same regardless of the origin, and so only “To NN”, “To NS”, and “To OC” are shown. The same is true for “To OC” for stage 4, whereas the probabilities of moving to NN or NS for stage 4 depend on the origin. NN = neritic north, NS = neritic south, OC = oceanic.

Supplement 2. Stochastic remigration interval

Table S1. Probabilities of remigrating in 1, 2, 3, 4, or 5 years (SEFSC 2009), plus mean remigration interval (RI).

years								
1	0.011	0.013	0.014	0.016	0.017	0.002	0.003	0.003
2	0.369	0.391	0.412	0.431	0.449	0.145	0.160	0.176
3	0.367	0.365	0.362	0.358	0.353	0.326	0.339	0.350
4	0.183	0.170	0.159	0.148	0.139	0.254	0.248	0.241
5	0.069	0.061	0.053	0.047	0.042	0.273	0.250	0.229
RI	2.927	2.875	2.825	2.779	2.74	3.651	3.582	3.514

1	0.004	0.004	0.023	0.026	0.029	0.033	0.036	0.023
2	0.192	0.207	0.238	0.254	0.270	0.285	0.299	0.238
3	0.360	0.369	0.504	0.506	0.505	0.503	0.500	0.504
4	0.234	0.227	0.119	0.112	0.105	0.099	0.093	0.119
5	0.210	0.193	0.116	0.102	0.090	0.080	0.071	0.116
RI	3.454	3.398	3.067	3.01	2.954	2.908	2.861	3.067

1	0.026	0.029	0.033	0.036	0.063	0.070	0.078
2	0.254	0.270	0.285	0.299	0.365	0.385	0.402
3	0.506	0.505	0.503	0.500	0.323	0.320	0.316
4	0.112	0.105	0.099	0.093	0.123	0.115	0.107
5	0.102	0.090	0.080	0.071	0.126	0.110	0.097
RI	3.01	2.954	2.908	2.861	2.884	2.81	2.743

Supplement 3. Using separate reproductive values by threat scenario

For all impact scenarios, we used the average projection matrix $\overline{\mathbf{A}}$ from the no impact scenario to estimate reproductive values (RVs), but RVs can be affected by survival and fecundity (Heppell 2005), so we also explored using impact-specific RVs. We estimated impact-specific RVs as average RVs from the average projection matrix $\overline{\mathbf{A}}_{ik}$ or as annual RVs estimated from the annual projections matrices $\mathbf{A}_{ijk}$, where i = simulation, j = year, and k = impact scenario. We applied impact scenarios over specific timeframes, but the average impact-specific RVs represented the average over the entire 100 years. As a result, the estimated adult equivalents were affected for years that were not affected by the impact (Figure S3, for years 1-10, compare black line for average RV (top row) to black line for same impact scenario in Figure 2). The annual impact-specific RVs resulted in a lot of variability in the number of adult equivalents that were estimated annually (Figure S3 bottom row). These RVs might represent the effects of changing population dynamics, but they were subject to modeling effects from the eigenvalue analysis that were not reflective of what would truly be happening in nature (Figure S3, see spike at year of impact for "Annual RV, Threat to stage 1").

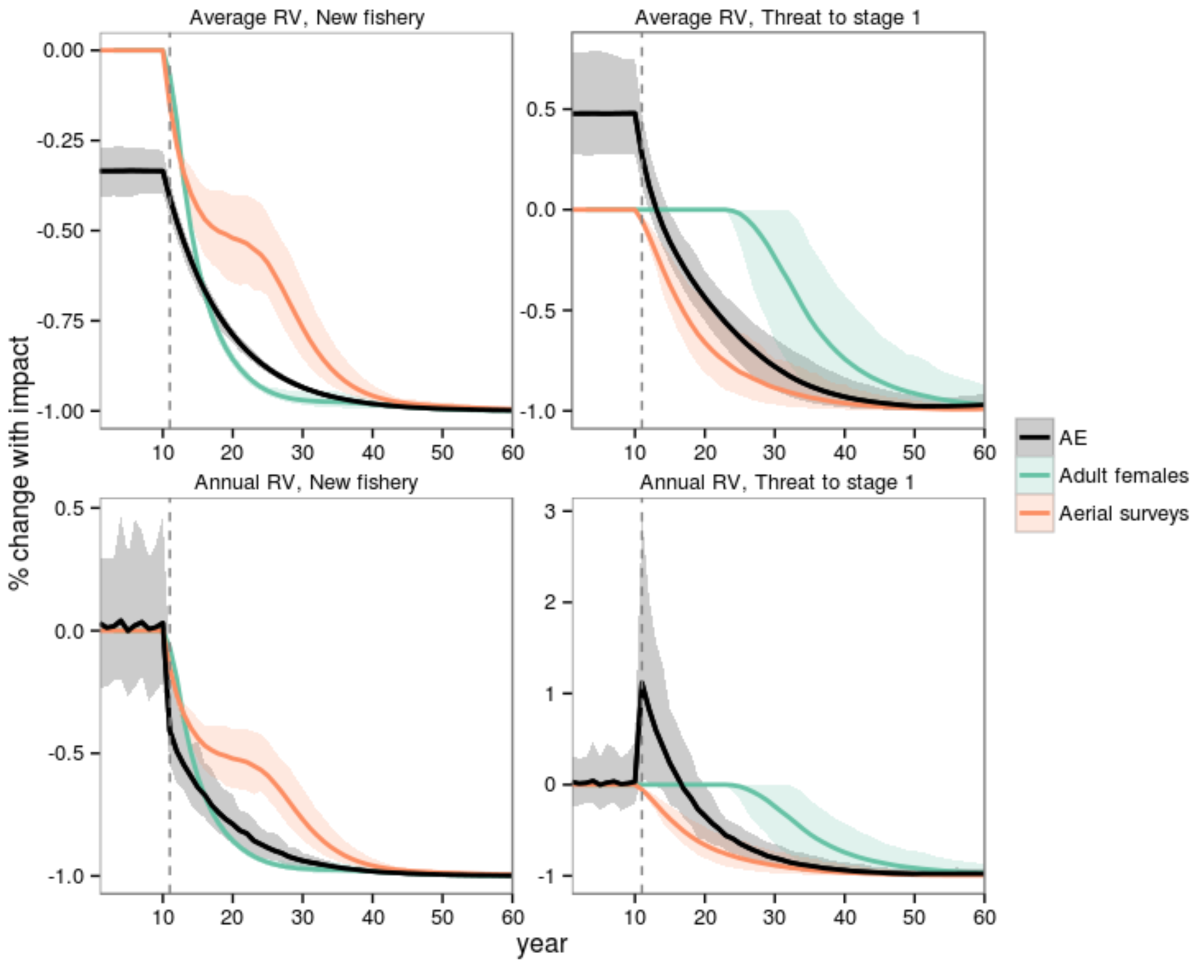


Figure S3. Select panels from Figure 2 but using impact-specific reproductive values (RVs) to estimate adult equivalents. RVs were calculated either as average RV across the entire time series (top row) or as annual RVs (bottom row).

Supplement 4. Using simulation to determine coefficient of variation (CV) of abundance estimate in Table 9 of loggerhead preliminary abundance report (NEFSC & SEFSC 2011)

The NOAA Fisheries Northeast Fisheries Science Center (NEFSC) and Southeast Fisheries Science Center (SEFSC) conducted aerial surveys of the northwestern Atlantic continental shelf in the summer of 2010, with preliminary abundance estimates reported in a reference document (NEFSC & SEFSC 2011). Our simulated sampling error for aerial surveys was based upon information in this report.

Table 5 of NEFSC & SEFSC (2011) gives the mean surface abundance (μ below, not adjusted for availability bias) for loggerheads (including positively identified loggerheads plus the portion of unidentified turtles assigned as loggerheads):

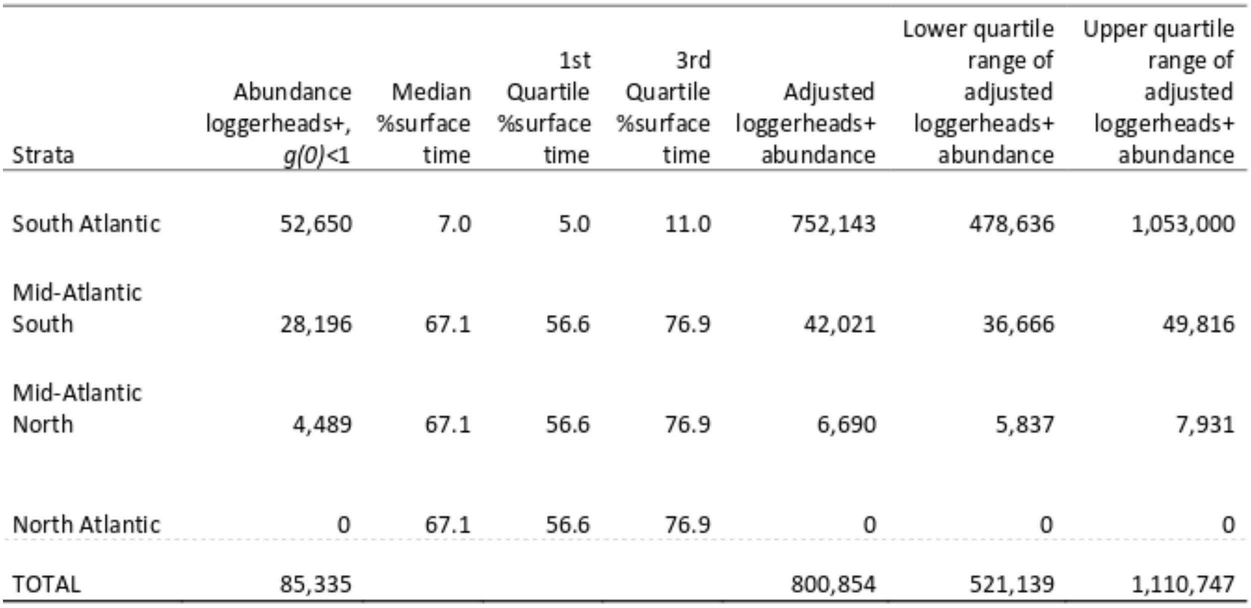
South Atlantic (NS): μ = 52,650, CV = 0.133
Mid-Atlantic south (NN): μ = 28,196, CV = 0.165
Mid-Atlantic north (NN): μ = 4,489, CV = 0.484.

The South Atlantic region roughly corresponds to our model's neritic south (NS), excluding the Gulf of Mexico; combining the Mid-Atlantic south and Mid-Atlantic north regions roughly corresponds to our neritic north (NN).

From NEFSC & SEFSC (2011) Table 9 (included below), the median, first, and third quartiles of percent surface time were as follows:

South Atlantic (NS): 7, 5, 11
Mid-Atlantic north and Mid-Atlantic south (NN): 67.1, 56.6, 76.9

Table 9 from NEFSC & SEFSC (2011):



Strata	Abundance loggerheads+, *g(0)*<1	Median %surface time	1st Quartile %surface time	3rd Quartile %surface time	Adjusted loggerheads+ abundance	Lower quartile range of adjusted loggerheads+ abundance	Upper quartile range of adjusted loggerheads+ abundance
South Atlantic	52,650	7.0	5.0	11.0	752,143	478,636	1,053,000
Mid-Atlantic South	28,196	67.1	56.6	76.9	42,021	36,666	49,816
Mid-Atlantic North	4,489	67.1	56.6	76.9	6,690	5,837	7,931
North Atlantic	0	67.1	56.6	76.9	0	0	0
TOTAL	85,335				800,854	521,139	1,110,747

CVs are not given in Table 9 because the preliminary analysis did not incorporate all types of variability, but the report does say that "the median percent surface time was considered to be the most appropriate preliminary measure of central tendency because the distributions of surface time were asymmetric." So we know that a flat distribution (uniform) is not appropriate for the distribution of the percent surface time.

To estimate a CV for the abundance in Table 9, we used simulations to (?):

1. Generate surface abundance estimates from μ and CV in Table 5
    a. For each of South Atlantic, Mid-Atlantic north, and Mid-Atlantic south, draw 10,000 samples from lognormal distribution with mean = $\ln\left(\mu^2/\sqrt{sd^2+\mu^2}\right)$ and sd = $\sqrt{\ln{(1+CV^2)}}$.
    b. Combine samples for Mid-Atlantic north and Mid-Atlantic south to get neritic north (NN).
2. Table 9 gives only the quartiles, not CV or SD, so experiment to find a distribution for % surface time that approximately fits:
    a. NN: beta dist with mean = 0.66 and sd = 0.14 gives median, 1st, and 3rd quartiles of 67.3, 56.7, 76.6 (versus 67.1, 56.6, 76.9 in the table).
    b. NS: beta dist with mean = 0.08 and sd = 0.04 gives median, 1st, and 3rd quartiles of 7.3, 4.9, 10.4 (versus, 7, 5, 11 in the table).
3. Draw 10,000 samples for % percent surface time from the NN and NS distributions in sections 2a and 2b.
4. Divide surface abundance estimates (section 1) by % surface time estimates (section 3) and calculate the CV of the resulting adjusted abundance estimate:
    a. NN
        i. Median, 1st and 3rd quartiles of simulated abundance: 48,670; 40,970; 59,890 (versus 48,711; 42,503; 57,747 in Table 9).
        ii. CV = 0.34.
    b. NS
        i. Median, 1st and 3rd quartiles of simulated abundance: 708,800; 501,400; 1,063,000 (versus 752,143; 478,636; 1,053,000 in Table 9).
        ii. CV = 0.79.
5. Notes
    a. We don't know the distribution for the % surface time, but we created a parametric distribution for it.
    b. The CV of the final abundance estimate was sensitive to changes in the % surface time.