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Supplementary Online Material for

DO ARCHIVAL LIGHT-LEVEL GEOLOCATORS AND STABLE HYDROGEN ISOTOPES PROVIDE COMPARABLE ESTIMATES OF BREEDING-GROUND ORIGIN?

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Methods

Sex.—Ovenbirds (*Seiurus aurocapilla*) are monomorphic and cannot be reliably sexed when captured during the non-breeding season. A subset of individuals captured at Font Hill Nature Preserve, St. Elizabeth Parish, Jamaica, were sexed genetically using blood samples taken from the brachial artery (C. Tonra et al. unpubl. data). The morphological data (tarsus, wing, tail, bill length from tip to nares, bill width, and bill depth measured at the nares) of genetically sexed individuals captured in Jamaica, as well as morphometric data from individuals breeding at Hubbard Brook Experimental Forest (HBEF), were used as prior probabilities in a discriminant function analysis using leave-one-out cross validation (Dechaume-Moncharmont et al. 2011) to determine the sex of Ovenbirds captured in Jamaica and Florida. We assigned a sex to an individual if the posterior probability was >80%; we classified the individual as "sex unknown" if the posterior probability was <80%. The number of individuals that were reliably sexed (posterior probability >80%) using a discriminant function analysis based on morphometric data was 117 of 193 individuals (61%; Jamaica: n = 41 males, n = 33 females; Florida: n = 40 males, n = 3 females).

Geolocator.—Light data were transformed into latitude (stationary) and longitude using BASTRAK software (British Antarctic Survey). Both noon and midnight locations were used to determine breeding locations. Ovenbirds were assumed to remain on their territory during the breeding season; thus, locations should not have been affected by either diurnal or nocturnal movements during the breeding season. Transition events were inspected for smooth light transitions during sunrise and sunset. Transition events that encompassed shading events, were abrupt or shallow, or exhibited "peaks" prior to sunrise were considered low-quality transitions (McKinnon et al. 2013). Low-quality transitions increase the uncertainty associated with the time of sunrise and sunset, which are used to determine geographic location; thus, they were removed from the analysis. The amount of low-quality transitions was due to a large number of shading events during transitions, particularly during sunrise. Ovenbirds inhabit deciduous and mixed-deciduous coniferous forests. Their domed nests are located on the ground, and they forage primarily on the forest floor (Van Horn and Donovan 1994), all of which likely increased the number of shading events during transition events.

Stable isotopes.—We used a general linear mixed model to determine the discrimination relationship between δ^2H_P and δ^2H_F of adult Ovenbirds sampled at validation locations throughout the eastern portion of their breeding distribution. We included validation location as a random intercept in the model to allow for regional differences in the discrimination relationship between δ^2H_P and δ^2H_F. We created one site-specific feather isoscape for each validation location using the equation $\delta H_{F\text{site-specific}}$ = site-specific intercept + 1.15 * δH_P (Table S1). We used geolocator breeding estimates to determine which site-specific isoscape to use for assigning origin using δ^2H_F. If the 75% kernel density estimate (KDE) produced from geolocator data overlapped one of our validation locations (n = 10 of 12 birds), we used that site-specific isoscape to determine breeding origin using δ^2H_F. The standard deviation of the residuals from the general linear mixed model that included validation site as a random intercept was used to determine origin using the spatially explicit normal probability density function (Royle and Rubenstein 2004). The spatially explicit normal probability density function was then normalized by dividing by the sum of the density function across the surface. This produced a spatially explicit, probability-based map of origin.

Ovenbird relative abundance determined from breeding-bird survey data (Sauer et al. 2011) was transformed into a probability surface by dividing each cell within the raster by the sum of the raster layer. The resulting probability surface of Ovenbird abundance was used as a prior probability in a Bayesian framework to determine a bird's origin using δ^2H_F. Following the formula for Bayes's rule, the product of the Ovenbird abundance and the spatially explicit normal probability density function produced the posterior probability of breeding origin based on δ^2H_F values. The posterior probability of

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origin was then reclassified into a binary surface of likely (1) and unlikely (0) origin using a 3:1 odds ratio (Chabot et al. 2012), where the upper 75% of the posterior probability was reclassified as likely origin.

Fisher's exact tests were used to determine the degree of overlap between origin estimates produced by geolocators and δ^2H_F. The amount of overlap between the two methods was quantified in two ways (see text). The number of overlapping raster cells was not used because each 75% KDE was a different size and overlapped a different number of raster cells. The percentage of overlap was classified into >25% and <25% overlap to be consistent with both the 3:1 odds ratio reclassification of δ^2H_F and the 75% KDE produced with geolocator data.

Literature Cited

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Table S1. Sex of Ovenbirds that received geolocators. Sex was determined using a discriminant function analysis (see supplemental Methods) using morphometric measurements from individuals of known sex captured at Hubbard Brook Experimental Forest (HBEF), New Hampshire, and genetically sexed individuals captured in Jamaica as prior probabilities.

	2010		2011		
	HBEF	Jamaica	HBEF	Jamaica	Florida
Male	16	4	34	10	12
Female	1	3	0	1	1
Unknown sex	0	4	0	6	5
n	17	11	34	17	18

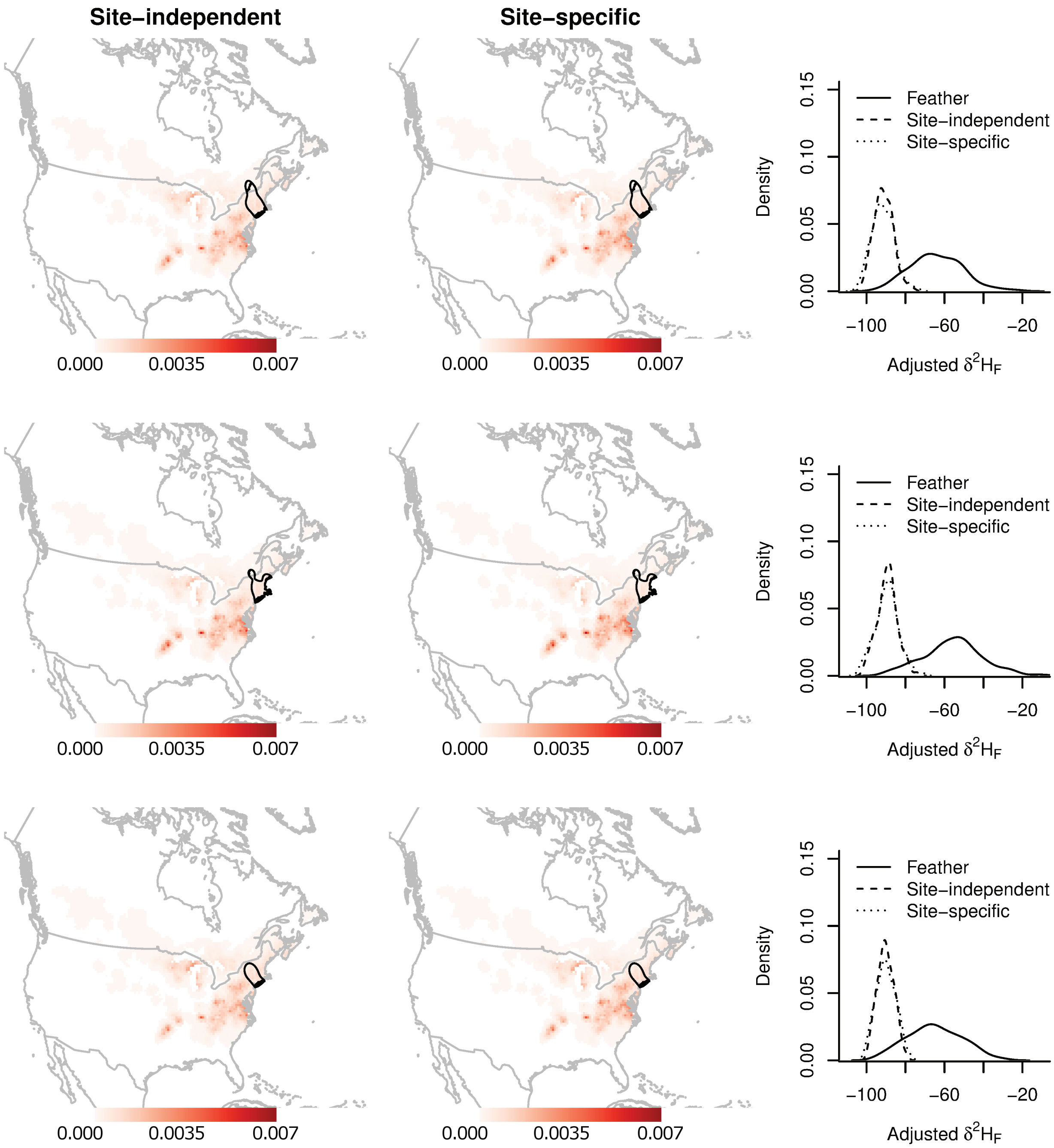

FIG. S1. Posterior probability of origin using δ^2H_F and bird relative abundance with site-independent and site-specific discrimination equations for the 6 birds fitted with geolocators captured at Font Hill Nature Preserve, St. Elizabeth Parish, Jamaica, during the non-breeding season (see Fig. 2 caption).

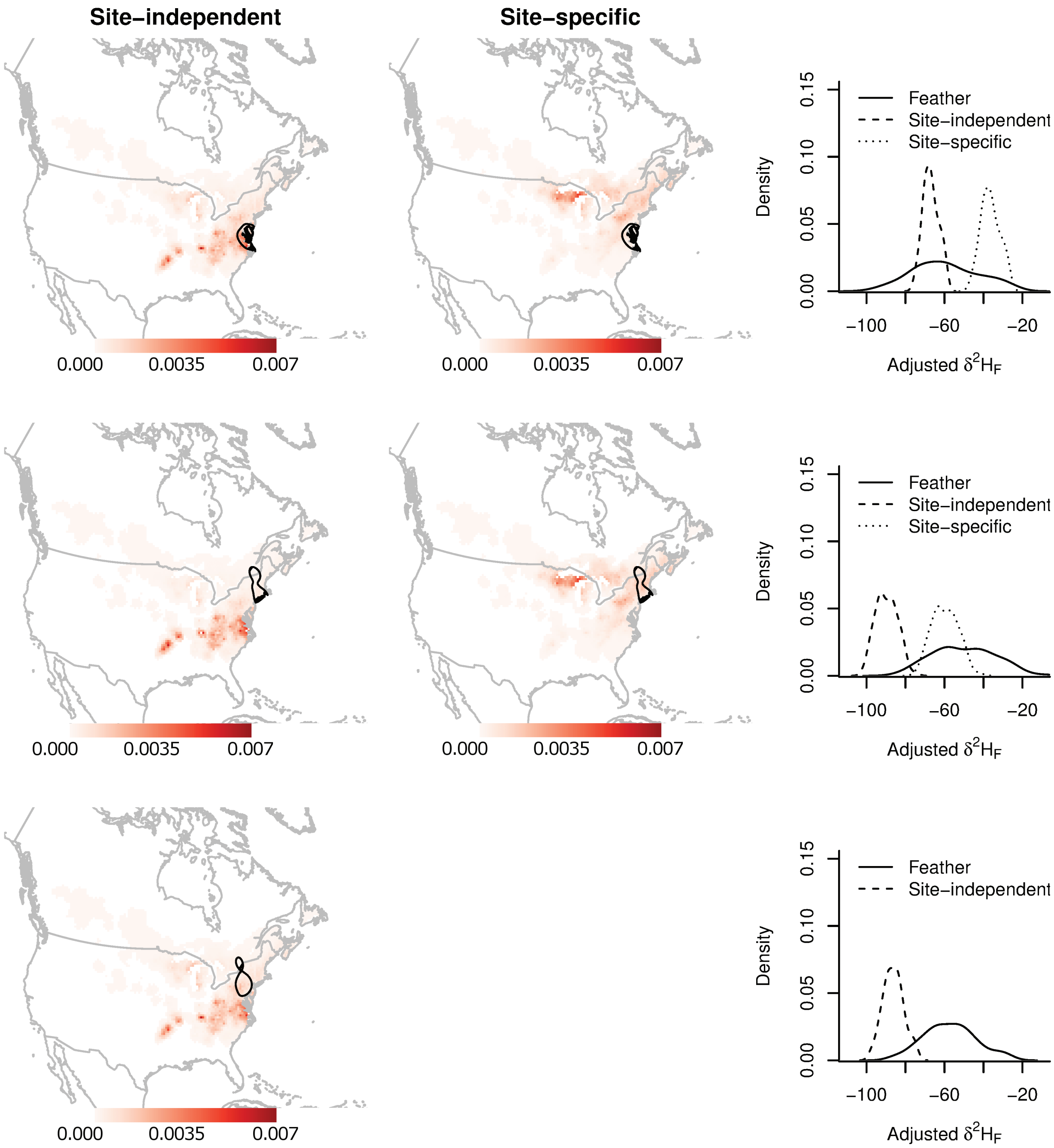

Fig. S1. *Continued.*

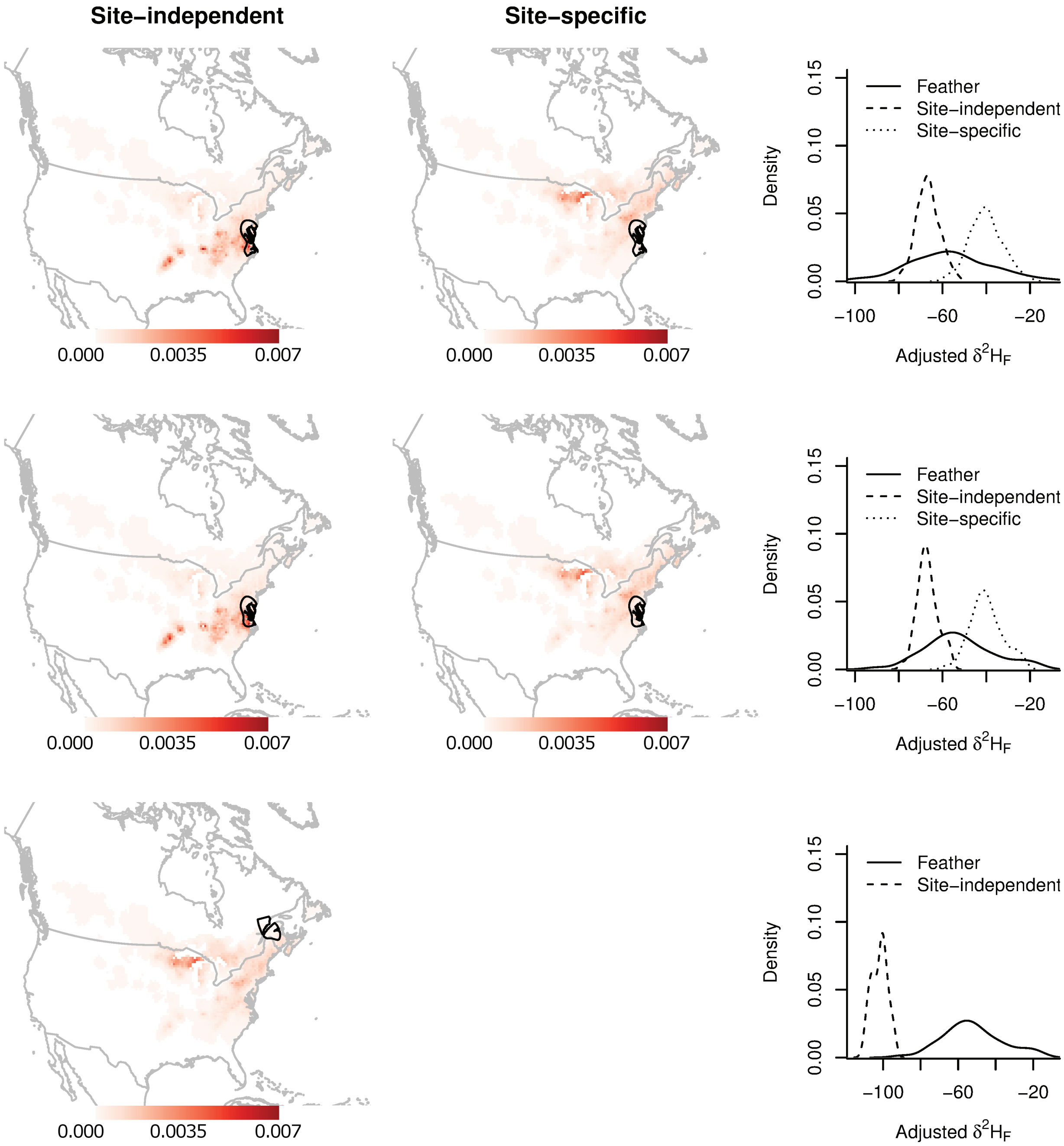

Fig. S2. Posterior probability of origin using δ^2H_F and bird relative abundance with site-independent and site-specific discrimination equations for birds captured in Everglades National Park, Florida, during the non-breeding season (see Fig. 2 caption).