Received: 9 November 2020 | Accepted: 9 November 2020

DOI: 10.1111/csp2.324

CORRIGENDUM

Conservation Science and Practice
A journal of the Society for Conservation Biology
Open Access
WILEY

High collocation of sand lance and protected top predators: Implications for conservation and management

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Following publication, we noticed two duplicate observations in the dataset that led to an inflation of the number of humpback whales at one site in spring 2015. After removing the duplicates, the number of humpback whales in spring 2015 decreased from 25 to 11 (Table 1, Figure S2) and the global index of

TABLE 1 Updated summary of standardized surveys including number of sites and counts of sand lance, humpback whales and great shearwaters per cruise. Only the humpback whale total for spring 2015 has been modified from the original manuscript. Cruises were conducted in spring and fall of each year starting in fall 2013. Summer cruises were added starting in 2018. The number of sites surveyed each cruise varied (see Figures S1–S3 for details

Cruise	Sites surveyed	Sand lance	Humpback whale	Great shearwater
Fall 2013	20	0	1	0
Spring 2014	13	0	19	1
Fall 2014	22	85	16	410
Spring 2015	33	30	11	0
Fall 2015	40	19	41	396
Spring 2016	40	8	0	0
Fall 2016	30	124	23	31
Spring 2017	41	19	0	0
Fall 2017	42	4	0	18
Spring 2018	39	5	58	0
Summer 2018	41	9	12	39

TABLE 3 Updated global index of collocation values calculated for all possible cruises and species comparisons. Only the sand lance—humpback whale global index of collocation value for spring 2015 was modified from the original manuscript. Global index of collocation measures overlap at a regional scale and ranges from 0 to 1, where 0 indicates each population is concentrated on a single but different location (no individuals of either species co-occurred at any site) and 1, where the centers of gravity coincide. Spring cruises typically occurred before great shearwaters arrive in the sanctuary for summer foraging, and therefore, we did not consider any metrics including shearwaters during spring

Cruise	Sand lance and humpbacks	Sand lance and shearwaters	Humpbacks and shearwaters
Fall 2013	No sand lance	No sand lance	No bird data*
Spring 2014	No sand lance	—	—
Fall 2014	0.7	0.99	0.64
Spring 2015	0.68	—	—
Fall 2015	Not enough data†	Not enough data†	0.95
Spring 2016	No whales	—	—
Fall 2016	0.96	0.98	0.97
Spring 2017	No whales	—	—
Fall 2017	No whales	Not enough data†	No whales
Spring 2018	0.98	—	—
Summer 2018	0.92	0.96	0.95

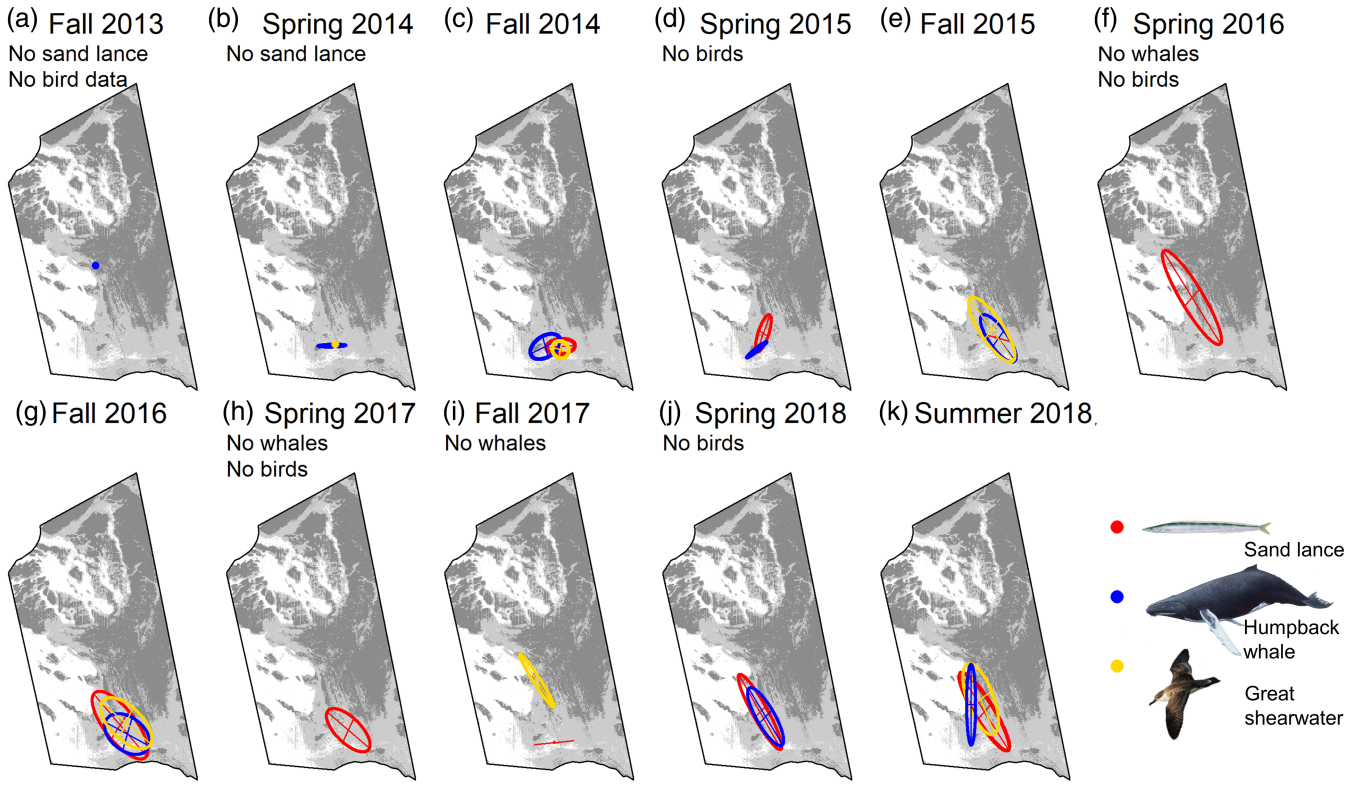

FIGURE 2 Updated spatial overlap of sand lance, humpback whales and great shearwaters in Stellwagen Bank National Marine Sanctuary by cruise. Only spring 2015 has been modified from the original manuscript. Cross-hairs represent the center of gravity or the mean location of the sampled population. Ellipses represent the inertia or the variance of the location of the sampled population and describes the dispersion of the population around its center of gravity variance. The center of gravity and inertia were only calculated when species were observed at >2 sites. Single dots indicate only one individual was observed at one site. Lines indicate that individuals were only observed at two sites. Dark gray = gravel substrate, light gray = sand substrate, white = mud substrate

collocation for humpback whales and sand lance in spring 2015 decreased from 0.78 to 0.68 (Table 3, Figures 2 and S4). This modification does not change the conclusions of this paper.

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SUPPORTING INFORMATION

Additional supporting information may be found online in the Supporting Information section at the end of this article.