**Appendix I–Southeast Lake Michigan, Michigan and Indiana**

This appendix provides information on the numbers and information used in selecting the southeast portion of Lake Michigan as a Sea Duck Joint Venture key habitat site. All aerial survey data were collected during a project led by Kevin Kenow (U.S. Geological Survey Upper Midwest Environmental Sciences Center, La Crosse, Wisconsin; Kenow et al. 2021). Additional information that assisted in designating key site boundaries, especially those areas important for Long tailed Ducks (*Clangula hyemalis*), came from descriptions of habitat use and movements of Long-tailed Ducks radio-marked on Lake Michigan provided by Fara (2018).

**Brief Description of Aerial Surveys**

Aerial surveys were conducted during September through May, 2009 through 2014. Survey areas were selected to evaluate avian risk to Type E botulism and to provide information on waterbird distributions to inform offshore wind energy development. Timing and selection of areas to be surveyed in a given month were focused on these issues and were highly influenced by plane availability and weather conditions. Surveys were flown along fixed-width transects. Transects generally paralleled shorelines and extended up to 32 km (20 mi) offshore. Surveys were flown at an average air speed of about 200 km/h (125 mph) and at an altitude of about 61 to 76 m (200 to 250 ft) above the water using a U.S. Fish and Wildlife Service (USFWS) fixed-wing aircraft (Partenavia P.68 Observer[[1]](#footnote-1)). Two observers, one on each side of the plane, identified and tallied waterbirds within 200-m-wide (1/8-mi) strip transects on either side of the plane. Distances were established using a clinometer, and the portion of the transect band beneath the plane that was not observable was estimated at 70.4 m (35.2 x 2) and 88 m (44 x2) at 61 and 76 m above ground level (AGL), respectively.

**Brief Description of Appendix Contents**

This appendix contains nine tables and three figures. Tables S1, S4, and S7 provide the raw counts of sea ducks observed on (within the 200 m transect) and off (beyond the 200 m transect) transect for the surveys that were encompassed by the southeast Lake Michigan key site during fall (September–November), winter (December–February), and spring (March–May), respectively. An additional survey area (South End) is included for this key site, as the key site extends slightly into the survey area, but total number of sea ducks reported does not include counts from the South End survey. Raw counts do not account for the visibility factors that may affect bird detectability during aerial surveys; therefore, we estimated the number of sea ducks using a visibility correction factor (Hodges et al. 2008) and present those numbers in tables S2, S5, and S8 for fall, winter, and spring, respectively. The estimated counts for the South End survey area are not included in the total number of sea ducks reported. Tables S3, S6, and S9 provide the transect distance, observed area within the 200 m transect width at 61 m AGL, and the density of all sea ducks for both the raw and visibility-corrected counts for fall, winter, and spring, respectively. Results from the South End survey are not included in the totals. Figures 1, 2, and 3 illustrate the distribution of sea ducks by month for the fall, winter, and spring seasons, respectively. In addition, all figures outline the aerial survey areas encompassed by the southeast Lake Michigan, Michigan and Indiana, key site.

**References**

Fara, L. J. 2018. Migration patterns, habitat use, prey items, and hunter harvest of Long-tailed Ducks (*Clangula hyemalis*) that overwinter on Lake Michigan. MS thesis, Southern Illinois University Carbondale, Carbondale, Illinois.

Hodges, J. I., D. J. Groves, and B. P. Conant. 2008. Distribution and abundance of waterbirds near shore in Southeast Alaska. Northwestern Naturalist 89:85–96.

Kenow, K. P., Fox, T. J., Houdek, S. C., Fara, L. J., and Lubinski, B. 2021. Lake Michigan Sea Duck Survey Data, 2009-2014: U.S. Geological Survey data release, <https://doi.org/10.5066/P9FGR77R> .

Table S1. Raw counts of sea ducks, by species,1 observed on and off transect during aerial surveys conducted over Lake Michigan during fall (September–November). Survey areas listed are only those encompassed by the southeast Lake Michigan key site.2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Survey area | Survey date | On/Off transect | LTDU | WWSC | BLSC | SUSC | SCOT | COME | RBME | HOME | MERG | COGO | BUFF | **Total sea ducks** |
| Allegan-Berrien Counties, MI | 26 Sep 2012 | On | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 24 Oct 2012 | On | 25 | 62 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **87** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 27 Nov 2012 | On | 0 | 27 | 0 | 0 | 6 | 7 | 1 | 0 | 2 | 4 | 10 | **57** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 25–26 Nov 2013 | On | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 30 Oct 2013 | On | 15 | 0 | 0 | 0 | 25 | 0 | 8 | 0 | 35 | 0 | 0 | **83** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 19 Nov 2013 | On | 19 | 0 | 0 | 0 | 0 | 0 | 95 | 0 | 61 | 16 | 0 | **191** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 15 Nov 2010 | On | 1 | 3 | 0 | 0 | 0 | 1 | 1 | 0 | 0 | 0 | 0 | **6** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 27 Sep 2012 | On | 1 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 27 Nov 2012 | On | 1295 | 4 | 0 | 0 | 0 | 31 | 3 | 0 | 12 | 15 | 0 | **1360** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 26 Sep 2013 | On | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **3** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 29–30 Oct 2013 | On | 330 | 1 | 0 | 0 | 0 | 30 | 4 | 0 | 20 | 0 | 0 | **385** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 20 Nov 2013 | On | 4065 | 0 | 0 | 0 | 0 | 3 | 1 | 0 | 28 | 0 | 0 | **4107** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Oceana-Ottawa Counties, MI | 26 Sep 2012 | On | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |

Table S1. Continued.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Oceana-Ottawa Counties, MI | 24 Oct 2012 | On | 25 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1 | 0 | 0 | **26** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Oceana-Ottawa Counties, MI | 27 Nov 2012 | On | 1702 | 0 | 0 | 0 | 0 | 1 | 65 | 0 | 9 | 118 | 0 | **1895** |
| Off | 1150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1150** |
| Oceana-Ottawa Counties, MI | 26 Sep 2013 | On | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Oceana-Ottawa Counties, MI | 30 Oct 2013 | On | 155 | 0 | 0 | 0 | 183 | 0 | 0 | 0 | 0 | 0 | 2 | **340** |
| Off | 100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **100** |
| Oceana-Ottawa Counties, MI | 20 Nov 2013 | On | 6818 | 0 | 0 | 0 | 5 | 2 | 0 | 0 | 73 | 0 | 0 | **6898** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 15 Nov 2011 | On | 10 | 0 | 0 | 0 | 0 | 5 | 97 | 0 | 47 | 0 | 0 | **159** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 25–26 Sep 2012 | On | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 24 Oct 2012 | On | 3 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **3** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 28 Nov 2012 | On | 75 | 0 | 0 | 0 | 0 | 42 | 1545 | 0 | 183 | 0 | 0 | **1845** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 25 Sep 2013 | On | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 30 Oct  1 Nov 2013 | On | 1 | 0 | 0 | 0 | 0 | 0 | 15 | 0 | 0 | 0 | 0 | **16** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 19 Nov 2013 | On | 68 | 4 | 0 | 0 | 0 | 22 | 213 | 0 | 954 | 30 | 0 | **1291** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| **Total Southeast Lake**  **Michigan key site** | | **On** | **14,454** | **97** | **0** | **0** | **219** | **75** | **178** | **0** | **241** | **153** | **12** | **15,439** |
| **Off** | **1250** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **1250** |

1 LTDU = Long tailed Duck (*Clangula hyemalis*), WWSC = White-winged Scoter *(Melanitta deglandi*), BLSC = Black Scoter (*Melanitta americana*), SUSC = Surf Scoter (*Melanitta perspicillata*), SCOT = unidentified scoter species, COME = Common Merganser (*Mergus merganser*), RBME = Red-breasted Merganser (*Mergus serrator*), HOME = Hooded Merganser (*Lophodytes cucullatus*), MERG = unidentified merganser species, COGO = Common Goldeneye (*Bucephala clangula*), and BUFF = Bufflehead (*Bucephala albeola*).

Table S1. Continued.

2 The South End survey area is only partially within the southeast Lake Michigan key site; as such, the south end survey area counts are not included in the total counts for the southeast Lake Michigan key site.

Table S2. Estimated counts of sea ducks, by species or species groups,1 observed on and off transect during aerial surveys conducted over Lake Michigan during fall (September–November) using a visibility correction factor (Hodges et al. 2008). Correction factor multipliers are shown in parentheses under each species or species group. Survey areas listed are only those encompassed by the southeast Lake Michigan key site.2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Survey area | Survey date | On/Off transect | LTDU  (3.46) | SCOTERS  (1.74) | MERGANSERS  (1.45) | COGO  (1.60) | BUFF  (3.26) | **Total sea ducks** |
| Allegan-Berrien Counties, MI | 26 Sep 2012 | On | 0 | 0 | 0 | 0 | 0 | **0** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 24 Oct 2012 | On | 87 | 108 | 0 | 0 | 0 | **194** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 27 Nov 2012 | On | 0 | 57 | 15 | 6 | 33 | **111** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 25–26 Nov 2013 | On | 0 | 0 | 0 | 0 | 0 | **0** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 30 Oct 2013 | On | 52 | 44 | 62 | 0 | 0 | **158** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 19 Nov 2013 | On | 66 | 0 | 226 | 26 | 0 | **318** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 15 Nov 2010 | On | 3 | 5 | 3 | 0 | 0 | **12** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 27 Sep 2012 | On | 3 | 0 | 0 | 0 | 0 | **3** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 27 Nov 2012 | On | 4481 | 7 | 67 | 24 | 0 | **4578** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 26 Sep 2013 | On | 10 | 0 | 0 | 0 | 0 | **10** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 29–30 Oct 2013 | On | 1142 | 2 | 78 | 0 | 0 | **1222** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 20 Nov 2013 | On | 14,065 | 0 | 61 | 0 | 0 | **14,126** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Oceana-Ottawa Counties, MI | 26 Sep 2012 | On | 0 | 0 | 0 | 0 | 0 | **0** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |

Table S2. Continued.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Oceana-Ottawa Counties, MI | 24 Oct 2012 | On | 87 | 0 | 1 | 0 | 0 | **88** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Oceana-Ottawa Counties, MI | 27 Nov 2012 | On | 5889 | 0 | 109 | 189 | 0 | **6186** |
| Off | 3979 | 0 | 0 | 0 | 0 | **3979** |
| Oceana-Ottawa Counties, MI | 26 Sep 2013 | On | 0 | 0 | 0 | 0 | 0 | **0** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Oceana-Ottawa Counties, MI | 30 Oct 2013 | On | 536 | 318 | 0 | 0 | 7 | **861** |
| Off | 346 | 0 | 0 | 0 | 0 | **346** |
| Oceana-Ottawa Counties, MI | 20 Nov 2013 | On | 23,590 | 9 | 109 | 0 | 0 | **23,708** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 15 Nov 2011 | On | 35 | 0 | 216 | 0 | 0 | **251** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 25–26 Sep 2012 | On | 0 | 0 | 0 | 0 | 0 | **0** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 24 Oct 2012 | On | 10 | 0 | 0 | 0 | 0 | **10** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 28 Nov 2012 | On | 260 | 0 | 2567 | 0 | 0 | **2826** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 25 Sep 2013 | On | 0 | 0 | 0 | 0 | 0 | **0** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 30 Oct–  1 Nov 2013 | On | 3 | 0 | 22 | 0 | 0 | **25** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 19 Nov 2013 | On | 235 | 7 | 1724 | 48 | 0 | **5126** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| **Total Southeast Lake**  **MI key site** | | **On** | **50,011** | **550** | **219** | **189** | **7** | **30,843** |
| **Off** | **4325** | **0** | **0** | **0** | **0** | **4325** |

1 LTDU = Long-tailed Duck (*Clangula hyemalis*), SCOTERS = Scoter species, MERGANSER = Merganser species, COGO = Common Goldeneye (*Bucephala clangula*), and BUFF = Bufflehead (*Bucephala albeola*).

2 The South End survey area is only partially within the southeast Lake Michigan key site; as such, the south end survey area counts are not included in the total counts for the southeast Lake Michigan key site.

Table S3. Fall (September–November) density estimates for all sea ducks combined using both raw counts and visibility corrected (Hodges et al. 2008) count estimates for observations on transect. Survey areas listed are only those encompassed by the southeast Lake Michigan key site.1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Survey area | Survey date | Transect distance (km) | Transect area (km2) at 61 m AGL | Raw count density  (sea ducks/km2) | Corrected count density  (sea ducks/km2) |
| Allegan-Berrien Counties, MI | 26 Sep 2012 | 388.8 | 128.1 | 0 | 0 |
| Allegan-Berrien Counties, MI | 24 Oct 2012 | 391.6 | 129.1 | 0.7 | 1.5 |
| Allegan-Berrien Counties, MI | 27 Nov 2012 | 385.5 | 127.2 | 0.4 | 0.9 |
| Allegan-Berrien Counties, MI | 25–26 Sep 2013 | 376.4 | 124.1 | 0 | 0 |
| Allegan-Berrien Counties, MI | 30 Oct 2013 | 377.5 | 124.4 | 0.7 | 1.3 |
| Allegan-Berrien Counties, MI | 19 Nov 2013 | 378.1 | 124.6 | 1.5 | 2.5 |
| Ludington Bay | 15 Nov 2010 | 555.2 | 183.0 | <0.1 | 0.1 |
| Ludington Bay | 27 Sep 2012 | 210.6 | 69.4 | 0 | 0 |
| Ludington Bay | 27 Nov 2012 | 154.9 | 51.1 | 26.6 | 89.7 |
| Ludington Bay | 26 Sep 2013 | 147.2 | 48.5 | 0.1 | 0.2 |
| Ludington Bay | 29–30 Oct 2013 | 146.8 | 48.4 | 8.0 | 25.3 |
| Ludington Bay | 20 Nov 2013 | 148.1 | 48.8 | 84.1 | 284.9 |
| Oceana-Ottawa Counties, MI | 26 Sep 2012 | 456.7 | 150.5 | 0 | 0 |
| Oceana-Ottawa Counties, MI | 24 Oct 2012 | 352.5 | 116.2 | 0.2 | 0.8 |
| Oceana-Ottawa Counties, MI | 27 Nov 2012 | 456.2 | 150.4 | 12.6 | 41.1 |
| Oceana-Ottawa Counties, MI | 26 Sep 2013 | 347.0 | 114.4 | 0 | 0 |
| Oceana-Ottawa Counties, MI | 30 Oct 2013 | 342.3 | 112.8 | 3.0 | 7.6 |
| Oceana-Ottawa Counties, MI | 20 Nov 2013 | 345.9 | 114.0 | 60.5 | 207.9 |
| South End1 | 15 Nov 2011 | 335.3 | 110.5 | 1.4 | 2.3 |
| South End1 | 25–26 Sep 2012 | 572.6 | 188.7 | 0 | 0 |
| South End1 | 24 Oct 2012 | 322.4 | 106.3 | <0.1 | 0.1 |
| South End1 | 28 Nov 2012 | 581.4 | 191.6 | 9.6 | 14.7 |
| South End1 | 25 Sep 2013 | 583.9 | 192.5 | 0 | 0 |
| South End1 | 30 Oct–1–Nov 2013 | 578.2 | 190.6 | 0.1 | 0.1 |
| South End1 | 19 Nov 2013 | 583.0 | 192.2 | 6.7 | 10.5 |
| **Total Southeast Lake Michigan key site** | | **3556.8** | **1172.4** | **2.8** | **4.4** |

1 The South End survey area is only partially within the southeast Lake Michigan key site; as such, the total fall density estimate for the southeast Lake Michigan key site does not include data from the south end survey area.

Table S4. Raw counts of sea ducks, by species,1 observed on and off transect during aerial surveys conducted over Lake Michigan during winter (December–February). Survey areas listed are only those encompassed by the southeast Lake Michigan key site.2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Survey area | Survey date | On/Off transect | LTDU | WWSC | BLSC | SUSC | SCOT | COME | RBME | HOME | MERG | COGO | BUFF | **Total sea ducks** |
| Allegan-Berrien Counties, MI | 8 Dec 2011 | On | 0 | 0 | 0 | 0 | 80 | 22 | 0 | 0 | 47 | 163 | 0 | **313** |
| Off | 0 | 0 | 0 | 0 | 0 | 179 | 0 | 0 | 13 | 0 | 0 | **192** |
| Allegan-Berrien Counties, MI | 13 Feb 2012 | On | 96 | 25 | 0 | 0 | 0 | 131 | 5 | 0 | 38 | 197 | 15 | **507** |
| Off | 2 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2** |
| Allegan-Berrien Counties, MI | 6 Feb 2013 | On | 1699 | 15 | 0 | 0 | 0 | 1510 | 0 | 0 | 0 | 17 | 0 | **3241** |
| Off | 1150 | 6 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1156** |
| Allegan-Berrien Counties, MI | 24–25 Feb 2013 | On | 2984 | 37 | 0 | 0 | 0 | 154 | 375 | 0 | 202 | 116 | 0 | **3868** |
| Off | 1300 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1300** |
| Allegan-Berrien Counties, MI | 13 Dec 2013 | On | 82 | 14 | 0 | 0 | 104 | 768 | 0 | 0 | 125 | 2460 | 16 | **3569** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 9 Jan 2014 | On | 2687 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 0 | 72 | 0 | **2761** |
| Off | 700 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **700** |
| Allegan-Berrien Counties, MI | 3 Feb 2014 | On | 26 | 0 | 0 | 0 | 150 | 0 | 0 | 0 | 0 | 0 | 0 | **176** |
| Off | 10 | 0 | 0 | 0 | 200 | 0 | 0 | 0 | 0 | 0 | 0 | **300** |
| Ludington Bay | 8 Dec 2010 | On | 1226 | 2 | 0 | 0 | 0 | 46 | 0 | 0 | 0 | 0 | 0 | **1274** |
| Off | 700 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **700** |
| Ludington Bay | 21 Jan 2012 | On | 768 | 62 | 0 | 0 | 0 | 124 | 2 | 0 | 110 | 3130 | 0 | **4196** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 4 Feb 2013 | On | 2850 | 74 | 0 | 0 | 0 | 415 | 0 | 0 | 4 | 53 | 0 | **3396** |
| Off | 1100 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **1100** |
| Ludington Bay | 25 Feb 2013 | On | 1743 | 115 | 0 | 0 | 0 | 3 | 2 | 0 | 1 | 21 | 0 | **1885** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 18 Dec 2013 | On | 2629 | 8 | 0 | 0 | 25 | 10 | 0 | 0 | 8 | 172 | 0 | **2852** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 3 Feb 2014 | On | 1038 | 52 | 0 | 0 | 500 | 0 | 0 | 0 | 0 | 0 | 0 | **1590** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |

Table S4. Continued.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Oceana-Ottawa Counties, MI | 20 Jan 2012 | On | 9468 | 0 | 0 | 0 | 0 | 692 | 0 | 0 | 50 | 112 | 0 | **10,322** |
| Off | 700 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 80 | 0 | 0 | **780** |
| Oceana-Ottawa Counties, MI | 4–6 Feb 2013 | On | 2703 | 7 | 0 | 0 | 0 | 64 | 1 | 0 | 0 | 13 | 0 | **2788** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Oceana-Ottawa Counties, MI | 25 Feb 2013 | On | 3651 | 5 | 0 | 0 | 0 | 41 | 2 | 0 | 341 | 169 | 0 | **4209** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 100 | 100 | 0 | **200** |
| Oceana-Ottawa Counties, MI | 19 Dec 2013 | On | 12,637 | 0 | 0 | 0 | 0 | 22 | 0 | 0 | 3 | 624 | 0 | **13,286** |
| Off | 8650 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 2700 | 0 | **11,350** |
| Oceana-Ottawa Counties, MI | 9 Jan 2014 | On | 5377 | 0 | 0 | 0 | 2 | 2 | 0 | 0 | 149 | 60 | 0 | **5590** |
| Off | 2850 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **2850** |
| Oceana-Ottawa Counties, MI | 3 Feb 2014 | On | 10 | 60 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **70** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 9 Dec 2010 | On | 93 | 110 | 1 | 0 | 0 | 1057 | 0 | 0 | 0 | 0 | 3 | **1264** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 7 Dec 2011 | On | 6 | 0 | 0 | 0 | 0 | 4 | 0 | 0 | 320 | 41 | 0 | **371** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 15 Feb 2012 | On | 263 | 38 | 0 | 0 | 0 | 40 | 302 | 0 | 99 | 15 | 0 | **757** |
| Off | 150 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **150** |
| South End2 | 24 Feb 2013 | On | 1180 | 27 | 0 | 0 | 0 | 132 | 286 | 0 | 502 | 36 | 0 | **2163** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 12–13 Dec 2013 | On | 115 | 0 | 0 | 0 | 0 | 413 | 231 | 0 | 119 | 213 | 1 | **1092** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 8 Jan 2014 | On | 539 | 25 | 0 | 0 | 20 | 279 | 0 | 0 | 72 | 35 | 0 | **970** |
| Off | 300 | 0 | 0 | 0 | 5 | 0 | 0 | 0 | 300 | 0 | 0 | **605** |
| South End2 | 2 Feb 2014 | On | 4725 | 36 | 0 | 0 | 47 | 14 | 672 | 0 | 8 | 177 | 0 | **5679** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| **Total Southeast Lake**  **Michigan key site** | | **On** | **51,674** | **476** | **0** | **0** | **861** | **4006** | **387** | **0** | **1078** | **7379** | **32** | **65,893** |
| **Off** | **17,162** | **6** | **0** | **0** | **200** | **179** | **0** | **0** | **193** | **2800** | **0** | **20,630** |

1 LTDU = Long-tailed Duck (*Clangula hyemalis*), WWSC = White-winged Scoter *(Melanitta deglandi*), BLSC = Black Scoter (*Melanitta americana*), SUSC = Surf Scoter (*Melanitta perspicillata*), SCOT = unidentified scoter species, COME = Common Merganser (*Mergus merganser*), RBME = Red-breasted

Table S4. Continued.

Merganser (*Mergus serrator*), HOME = Hooded Merganser (*Lophodytes cucullatus*), MERG = unidentified merganser species, COGO = Common Goldeneye (*Bucephala clangula*), and BUFF = Bufflehead (*Bucephala albeola*).

2 The South End survey area is only partially within the southeast Lake Michigan key site; as such, the south end survey area counts are not included in the total counts for the southeast Lake Michigan key site.

Table S5. Estimated counts of sea ducks, by species or species groups.1 observed on and off transect during aerial surveys conducted over Lake Michigan during winter (December–February) using a visibility correction factor (Hodges et al. 2008). Correction factor multipliers are shown in parentheses under each species or species group. Survey areas listed are only those encompassed by the southeast Lake Michigan key site.2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Survey area | Survey date | On/Off transect | LTDU  (3.46) | SCOTERS  (1.74) | MERGANSERS  (1.45) | COGO  (1.60) | BUFF  (3.26) | **Total sea ducks** |
| Allegan-Berrien Counties, MI | 8 Dec 2011 | On | 0 | 139 | 100 | 261 | 3 | **503** |
| Off | 0 | 0 | 278 | 0 | 0 | **278** |
| Allegan-Berrien Counties, MI | 13 Feb 2012 | On | 332 | 44 | 252 | 315 | 49 | **992** |
| Off | 7 | 0 | 0 | 0 | 0 | **7** |
| Allegan-Berrien Counties, MI | 6 Feb 2013 | On | 5879 | 26 | 2190 | 27 | 0 | **8121** |
| Off | 3979 | 10 | 0 | 0 | 0 | **3989** |
| Allegan-Berrien Counties, MI | 24–25 Feb 2013 | On | 10,325 | 64 | 1,60 | 186 | 0 | **11,635** |
| Off | 4498 | 0 | 0 | 0 | 0 | **4498** |
| Allegan-Berrien Counties, MI | 13 Dec 2013 | On | 284 | 205 | 1295 | 3936 | 52 | **5772** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 9 Jan 2014 | On | 9297 | 0 | 3 | 115 | 0 | **9415** |
| Off | 2422 | 0 | 0 | 0 | 0 | **2422** |
| Allegan-Berrien Counties, MI | 3 Feb 2014 | On | 90 | 261 | 0 | 0 | 0 | **351** |
| Off | 346 | 348 | 0 | 0 | 0 | **694** |
| Ludington Bay | 8 Dec 2010 | On | 4242 | 3 | 67 | 0 | 0 | **4312** |
| Off | 2422 | 0 | 0 | 0 | 0 | **2422** |
| Ludington Bay | 21 Jan 2012 | On | 2657 | 108 | 342 | 5008 | 0 | **8115** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 4 Feb 2013 | On | 9861 | 129 | 608 | 85 | 0 | **10,682** |
| Off | 3806 | 0 | 0 | 0 | 0 | **3806** |
| Ludington Bay | 25 Feb 2013 | On | 6031 | 200 | 9 | 34 | 0 | **6273** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 18 Dec 2013 | On | 9096 | 57 | 26 | 275 | 0 | **9455** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |

Table S5. Continued.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Ludington Bay | 3 Feb 2014 | On | 3591 | 960 | 0 | 0 | 0 | **4552** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Oceana-Ottawa Counties, MI | 20 Jan 2012 | On | 32,759 | 0 | 1076 | 179 | 0 | **34,014** |
| Off | 2422 | 0 | 116 | 0 | 0 | **2538** |
| Oceana-Ottawa Counties, MI | 4–6 Feb 2013 | On | 9352 | 12 | 94 | 21 | 0 | **9480** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Oceana-Ottawa Counties, MI | 25 Feb 2013 | On | 12,632 | 9 | 557 | 270 | 0 | **13,468** |
| Off | 0 | 0 | 145 | 160 | 0 | **305** |
| Oceana-Ottawa Counties, MI | 19 Dec 2013 | On | 43,724 | 0 | 36 | 998 | 0 | **44,759** |
| Off | 29,929 | 0 | 0 | 4320 | 0 | **34,249** |
| Oceana-Ottawa Counties, MI | 9 Jan 2014 | On | 18,604 | 3 | 219 | 96 | 0 | **18,923** |
| Off | 9861 | 0 | 0 | 0 | 0 | **9861** |
| Oceana-Ottawa Counties, MI | 3 Feb 2014 | On | 35 | 104 | 0 | 0 | 0 | **139** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 9 Dec 2010 | On | 322 | 193 | 1533 | 0 | 10 | **2057** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 7 Dec 2011 | On | 21 | 0 | 470 | 66 | 0 | **556** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 15 Feb 2012 | On | 910 | 66 | 639 | 24 | 0 | **1640** |
| Off | 519 | 0 | 0 | 0 | 0 | **519** |
| South End2 | 24 Feb 2013 | On | 4083 | 47 | 1334 | 58 | 0 | **5521** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 12–13 Dec 2013 | On | 398 | 0 | 1106 | 341 | 3 | **1848** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 8 Jan 2014 | On | 1865 | 78 | 509 | 56 | 0 | **2508** |
| Off | 1038 | 9 | 435 | 0 | 0 | **1482** |
| South End2 | 2 Feb 2014 | On | 16,349 | 144 | 1006 | 283 | 0 | **17,782** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |

Table S5. Continued.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Total Southeast Lake**  **Michigan key site** | **On** | **178,791** | **2324** | **7934** | **11,806** | **104** | **200,961** |
| **Off** | **59,692** | **358** | **539** | **4480** | **0** | **65,069** |

1 LTDU = Long-tailed Duck, SCOTERS = Scoter species, MERGANSER = Merganser species, COGO = Common Goldeneye (*Bucephala clangula*), and BUFF = Bufflehead (*Bucephala albeola*).

2 The South End survey area is only partially within the southeast Lake Michigan key site; as such, the south end survey area counts are not included in the total counts for the southeast Lake Michigan key site.

Table S6. Winter (December–February) density estimates for all sea ducks combined using both raw counts and visibility corrected (Hodges et al. 2008) count estimates for observations on transect. Survey areas listed are only those encompassed by the southeast Lake Michigan key site.1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Survey area | Survey date | Transect distance (km) | Transect area (km2) at 61 m AGL | Raw count density  (sea ducks/km2) | Corrected count density  (sea ducks/km2) |
| Allegan-Berrien Counties, MI | 8 Dec 2011 | 292.9 | 96.5 | 3.2 | 5.2 |
| Allegan-Berrien Counties, MI | 13 Feb 2012 | 484.0 | 159.5 | 3.2 | 6.2 |
| Allegan-Berrien Counties, MI | 6 Feb 2013 | 360.4 | 118.8 | 27.3 | 68.4 |
| Allegan-Berrien Counties, MI | 24–25 Feb 2013 | 387.3 | 127.7 | 30.3 | 91.1 |
| Allegan-Berrien Counties, MI | 13 Dec 2013 | 378.2 | 124.7 | 28.6 | 46.3 |
| Allegan-Berrien Counties, MI | 9 Jan 2014 | 364.7 | 120.2 | 23.0 | 78.3 |
| Allegan-Berrien Counties, MI | 3 Feb 2014 | 92.9 | 30.6 | 5.7 | 11.5 |
| Ludington Bay | 8 Dec 2010 | 547.5 | 180.5 | 7.1 | 23.9 |
| Ludington Bay | 21 Jan 2012 | 208.8 | 68.8 | 61.0 | 117.9 |
| Ludington Bay | 4 Feb 2013 | 205.6 | 67.8 | 50.1 | 157.6 |
| Ludington Bay | 25 Feb 2013 | 203.2 | 67.0 | 28.1 | 93.7 |
| Ludington Bay | 18 Dec 2013 | 148.2 | 48.8 | 58.4 | 193.6 |
| Ludington Bay | 3 Feb 2014 | 24.4 | 8.0 | 198.8 | 566.0 |
| Oceana-Ottawa Counties, MI | 20 Jan 2012 | 465.6 | 153.5 | 67.3 | 221.6 |
| Oceana-Ottawa Counties, MI | 4–6 Feb 2013 | 355.9 | 117.3 | 23.8 | 80.8 |
| Oceana-Ottawa Counties, MI | 25 Feb 2013 | 357.0 | 117.7 | 35.8 | 114.5 |
| Oceana-Ottawa Counties, MI | 19 Dec 2013 | 340.9 | 112.4 | 118.2 | 398.3 |
| Oceana-Ottawa Counties, MI | 9 Jan 2014 | 340.0 | 112.1 | 49.9 | 168.9 |
| Oceana-Ottawa Counties, MI | 3 Feb 2014 | 129.1 | 42.6 | 1.6 | 3.3 |
| South End1 | 9 Dec 2010 | 851.6 | 280.7 | 4.5 | 7.3 |
| South End1 | 7 Dec 2011 | 319.0 | 105.1 | 3.5 | 5.3 |
| South End1 | 15 Feb 2012 | 588.4 | 193.9 | 3.9 | 8.5 |
| South End1 | 24 Feb 2013 | 509.8 | 168.0 | 12.9 | 32.9 |
| South End1 | 12–13 Dec 2013 | 583.6 | 192.4 | 5.7 | 9.6 |
| South End1 | 8 Jan 2014 | 257.3 | 84.8 | 11.4 | 29.6 |
| South End1 | 2 Feb 2014 | 367.2 | 121.0 | 46.9 | 146.9 |
| **Total Southeast Lake Michigan key site** | | **5686.6** | **1874.5** | **35.2** | **107.2** |

1 The South End survey area is only partially within the southeast Lake Michigan key site; as such, the total fall density estimate for the southeast Lake Michigan key site does not include data from the south end survey area.

Table S7. Raw counts of sea ducks, by species,1 observed on and off transect during aerial surveys conducted over Lake Michigan during spring (March–May). Survey areas listed are only those encompassed by the southeast Lake Michigan key site.2

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Survey area | Survey date | On/Off transect | LTDU | WWSC | BLSC | SUSC | SCOT | COME | RBME | HOME | MERG | COGO | BUFF | **Total sea ducks** |
| Allegan-Berrien Counties, MI | 14 Mar 2012 | On | 198 | 0 | 0 | 0 | 0 | 0 | 12 | 0 | 1 | 93 | 0 | **304** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 4 Apr 2012 | On | 36 | 0 | 0 | 0 | 0 | 11 | 17 | 0 | 18 | 24 | 0 | **106** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 21–22 Mar 2013 | On | 766 | 90 | 0 | 0 | 172 | 580 | 210 | 0 | 2 | 110 | 0 | **1930** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 3–4 Apr 2013 | On | 4852 | 2 | 0 | 0 | 63 | 75 | 0 | 0 | 54 | 20 | 0 | **5066** |
| Off | 980 | 0 | 0 | 0 | 0 | 0 | 2 | 0 | 4 | 0 | 0 | **986** |
| Allegan-Berrien Counties, MI | 25 Apr 2013 | On | 565 | 0 | 0 | 0 | 0 | 30 | 53 | 0 | 0 | 14 | 0 | **662** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 6 May 2014 | On | 143 | 0 | 0 | 0 | 0 | 4 | 31 | 0 | 18 | 2 | 0 | **198** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 17 Mar 2010 | On | 1291 | 45 | 0 | 0 | 0 | 54 | 0 | 0 | 0 | 12 | 0 | **1402** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 15 Mar 2011 | On | 645 | 99 | 0 | 0 | 0 | 21 | 0 | 0 | 0 | 3 | 0 | **768** |
| Off | 30 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **30** |
| Ludington Bay | 4 Apr 2012 | On | 62 | 0 | 0 | 0 | 0 | 19 | 4 | 0 | 1 | 0 | 0 | **86** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 22 Mar 2013 | On | 263 | 2 | 0 | 0 | 0 | 130 | 15 | 0 | 1 | 4 | 0 | **415** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 4 Apr 2013 | On | 132 | 0 | 0 | 0 | 0 | 2 | 0 | 0 | 2 | 0 | 0 | **136** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 26 Apr 2013 | On | 10 | 1 | 0 | 0 | 0 | 4 | 24 | 0 | 0 | 0 | 0 | **39** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 6 May 2014 | On | 59 | 0 | 0 | 0 | 0 | 9 | 1 | 0 | 4 | 0 | 0 | **73** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |

Table S7. Continued.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Oceana-Ottawa Counties, MI | 14 Mar 2012 | On | 854 | 0 | 0 | 0 | 0 | 5 | 0 | 0 | 1 | 0 | 0 | **860** |
| Off | 114 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **114** |
| Oceana-Ottawa Counties, MI | 4 Apr 2012 | On | 105 | 0 | 0 | 0 | 0 | 1 | 12 | 0 | 8 | 5 | 0 | **131** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Oceana-Ottawa Counties, MI | 21–22 Mar 2013 | On | 2681 | 27 | 0 | 0 | 3 | 43 | 0 | 0 | 0 | 1 | 0 | **2755** |
| Off | 700 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **700** |
| Oceana-Ottawa Counties, MI | 4 Apr 2013 | On | 589 | 0 | 0 | 0 | 0 | 9 | 0 | 0 | 19 | 18 | 0 | **635** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Oceana-Ottawa Counties, MI | 25 Apr 2013 | On | 157 | 0 | 0 | 0 | 0 | 32 | 15 | 0 | 0 | 0 | 0 | **204** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| Oceana-Ottawa Counties, MI | 6 May 2014 | On | 116 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **116** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 15 Mar 2011 | On | 375 | 16 | 0 | 0 | 0 | 510 | 0 | 0 | 0 | 101 | 0 | **1002** |
| Off | 0 | 0 | 0 | 0 | 0 | 331 | 0 | 0 | 0 | 0 | 0 | **331** |
| South End2 | 6–7 Apr 2011 | On | 2073 | 4 | 0 | 0 | 0 | 485 | 0 | 0 | 0 | 1 | 0 | **2563** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 13 Mar 2012 | On | 254 | 0 | 0 | 0 | 0 | 70 | 346 | 0 | 93 | 88 | 0 | **851** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 3–4 Apr 2012 | On | 478 | 0 | 0 | 0 | 0 | 85 | 129 | 0 | 20 | 19 | 0 | **731** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 21 Mar 2013 | On | 744 | 0 | 0 | 0 | 0 | 198 | 169 | 0 | 27 | 22 | 1 | **1161** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 3 Apr 2013 | On | 2022 | 10 | 0 | 0 | 19 | 153 | 43 | 0 | 85 | 27 | 0 | **2359** |
| Off | 600 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **600** |
| South End2 | 24 Apr 2013 | On | 206 | 0 | 0 | 0 | 0 | 41 | 195 | 0 | 69 | 23 | 0 | **534** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 24 Mar 2014 | On | 4157 | 22 | 0 | 0 | 23 | 520 | 427 | 0 | 10 | 37 | 0 | **5196** |
| Off | 4550 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **4550** |
| South End2 | 5–6 May 2014 | On | 41 | 0 | 0 | 0 | 0 | 46 | 80 | 0 | 39 | 38 | 3 | **247** |
| Off | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | **0** |

Table S7. Continued.

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Total Southeast Lake**  **Michigan key site** | **On** | **13,524** | **266** | **0** | **0** | **238** | **1029** | **394** | **0** | **129** | **306** | **0** | **15,866** |
| **Off** | **1824** | **0** | **0** | **0** | **0** | **0** | **2** | **0** | **4** | **0** | **0** | **1830** |

1 LTDU = Long-tailed Duck (*Clangula hyemalis*), WWSC = White-winged Scoter *(Melanitta deglandi*), BLSC = Black Scoter (*Melanitta americana*), SUSC = Surf Scoter (*Melanitta perspicillata*), SCOT = unidentified scoter species, COME = Common Merganser (*Mergus merganser*), RBME = Red-breasted Merganser (*Mergus serrator*), HOME = Hooded Merganser (*Lophodytes cucullatus*), MERG = unidentified merganser species, COGO = Common Goldeneye (*Bucephala clangula*), and BUFF = Bufflehead (*Bucephala albeola*).

2 The South End survey area is only partially within the southeast Lake Michigan key site; as such, the south end survey area counts are not included in the total counts for the southeast Lake Michigan key site.

Table S8. Estimated counts of sea ducks, by species or species groups,1 observed on and off transect during aerial surveys conducted over Lake Michigan during spring (March–May) using a visibility correction factor (Hodges et al. 2008). Correction factor multipliers are shown in parentheses under each species or species group. Survey areas listed are only those encompassed by the southeast Lake Michigan key site.2

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Survey area | Survey date | On/Off transect | LTDU  (3.46) | SCOTERS  (1.74) | MERGANSERS  (1.45) | COGO  (1.60) | BUFF  (3.26) | **Total sea ducks** |
| Allegan-Berrien Counties, MI | 14 Mar 2012 | On | 685 | 0 | 19 | 149 | 0 | **853** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 4 Apr 2012 | On | 125 | 0 | 67 | 38 | 0 | **230** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 21–22 Mar 2013 | On | 2650 | 456 | 1148 | 176 | 0 | **4431** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 3–4 Apr 2013 | On | 16,788 | 113 | 187 | 32 | 0 | **17,120** |
| Off | 3391 | 0 | 9 | 0 | 0 | **3400** |
| Allegan-Berrien Counties, MI | 25 Apr 2013 | On | 1955 | 0 | 120 | 22 | 0 | **2098** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Allegan-Berrien Counties, MI | 6 May 2014 | On | 495 | 0 | 77 | 3 | 0 | **575** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 17 Mar 2010 | On | 4467 | 78 | 78 | 19 | 0 | **4643** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 15 Mar 2011 | On | 2232 | 172 | 30 | 5 | 0 | **2439** |
| Off | 104 | 0 | 0 | 0 | 0 | **104** |
| Ludington Bay | 4 Apr 2012 | On | 215 | 0 | 35 | 0 | 0 | **249** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 22 Mar 2013 | On | 910 | 3 | 212 | 6 | 0 | **1132** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 4 Apr 2013 | On | 457 | 0 | 6 | 0 | 0 | **463** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 26 Apr 2013 | On | 35 | 2 | 41 | 0 | 0 | **77** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Ludington Bay | 6 May 2014 | On | 204 | 0 | 20 | 0 | 0 | **224** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |

Table S8. Continued.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Oceana-Ottawa Counties, MI | 14 Mar 2012 | On | 2955 | 0 | 9 | 0 | 0 | **2964** |
| Off | 394 | 0 | 0 | 0 | 0 | **394** |
| Oceana-Ottawa Counties, MI | 4 Apr 2012 | On | 363 | 0 | 30 | 8 | 0 | **402** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Oceana-Ottawa Counties, MI | 21–22 Mar 2013 | On | 9276 | 52 | 62 | 2 | 0 | **9392** |
| Off | 2422 | 0 | 0 | 0 | 0 | **2422** |
| Oceana-Ottawa Counties, MI | 4 Apr 2013 | On | 2038 | 0 | 41 | 29 | 0 | **2107** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Oceana-Ottawa Counties, MI | 25 Apr 2013 | On | 543 | 0 | 68 | 0 | 0 | **611** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| Oceana-Ottawa Counties, MI | 6 May 2014 | On | 401 | 0 | 0 | 0 | 0 | **401** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 15 Mar 2011 | On | 1298 | 28 | 740 | 162 | 0 | **2226** |
| Off | 0 | 0 | 480 | 0 | 0 | **480** |
| South End2 | 6–7 Apr 2011 | On | 7173 | 7 | 703 | 2 | 0 | **7884** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 13 Mar 2012 | On | 879 | 0 | 738 | 141 | 0 | **1758** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 3–4 Apr 2012 | On | 1654 | 0 | 339 | 30 | 0 | **2024** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 21 Mar 2013 | On | 2574 | 0 | 571 | 35 | 3 | **3184** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 3 Apr 2013 | On | 6996 | 50 | 407 | 43 | 0 | **7497** |
| Off | 2076 | 0 | 0 | 0 | 0 | **2076** |
| South End2 | 24 Apr 2013 | On | 713 | 0 | 442 | 37 | 0 | **1192** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |
| South End2 | 24 Mar 2014 | On | 14,383 | 78 | 1388 | 59 | 0 | **15,908** |
| Off | 15,743 | 0 | 0 | 0 | 0 | **15,743** |
| South End2 | 5–6 May 2014 | On | 142 | 0 | 239 | 61 | 10 | **452** |
| Off | 0 | 0 | 0 | 0 | 0 | **0** |

Table S8. Continued.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Total Southeast Lake**  **Michigan key site** | **On** | **46,794** | **876** | **2250** | **489** | **0** | **50,411** |
| **Off** | **6311** | **0** | **9** | **0** | **0** | **6320** |

1 LTDU = Long-tailed Duck (*Clangula hyemalis*), SCOTERS = Scoter species, MERGANSER = Merganser species, COGO = Common Goldeneye (*Bucephala clangula*), and BUFF = Bufflehead (*Bucephala albeola*).

2 The South End survey area is only partially within the southeast Lake Michigan key site; as such, the south end survey area counts are not included in the total counts for the southeast Lake Michigan key site.

Table S9. Spring (March–May) density estimates for all sea ducks combined using both raw counts and visibility corrected (Hodges et al. 2008) count estimates for observations on transect. Survey areas listed are only those encompassed by the southeast Lake Michigan key site.1

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Survey area | Survey date | Transect distance (km) | Transect area (km2) at 61 m AGL | Raw count density  (sea ducks/km2) | Corrected count density  (sea ducks/km2) |
| Allegan-Berrien Counties, MI | 14 Mar 2012 | 385.9 | 127.2 | 2.4 | 6.7 |
| Allegan-Berrien Counties, MI | 4 Apr 2012 | 388.6 | 128.1 | 0.8 | 1.8 |
| Allegan-Berrien Counties, MI | 21–22 Mar 2013 | 389.3 | 128.3 | 15 | 34.5 |
| Allegan-Berrien Counties, MI | 3–4 Apr 2013 | 382.0 | 125.9 | 40.2 | 136.0 |
| Allegan-Berrien Counties, MI | 25 Apr 2013 | 387.5 | 127.7 | 5.2 | 16.4 |
| Allegan-Berrien Counties, MI | 6 May 2014 | 288.3 | 95.0 | 2.1 | 6.0 |
| Ludington Bay | 17 Mar 2010 | 260.0 | 85.7 | 16.4 | 54.2 |
| Ludington Bay | 15 Mar 2011 | 255.1 | 84.1 | 9.1 | 29.0 |
| Ludington Bay | 4 Apr 2012 | 203.6 | 67.1 | 1.3 | 3.7 |
| Ludington Bay | 22 Mar 2013 | 158.3 | 52.2 | 8.0 | 21.7 |
| Ludington Bay | 4 Apr 2013 | 206.8 | 68.2 | 2.0 | 6.8 |
| Ludington Bay | 26 Apr 2013 | 157.1 | 51.8 | 0.8 | 1.5 |
| Ludington Bay | 6 May 2014 | 149.5 | 49.3 | 1.5 | 4.6 |
| Oceana-Ottawa Counties, MI | 14 Mar 2012 | 462.8 | 152.5 | 5.6 | 19.4 |
| Oceana-Ottawa Counties, MI | 4 Apr 2012 | 462.2 | 152.3 | 0.9 | 2.6 |
| Oceana-Ottawa Counties, MI | 21–22 Mar 2013 | 353.8 | 116.6 | 23.6 | 80.5 |
| Oceana-Ottawa Counties, MI | 4 Apr 2013 | 354.9 | 117.0 | 5.4 | 18.0 |
| Oceana-Ottawa Counties, MI | 25 Apr 2013 | 354.8 | 116.9 | 1.7 | 5.2 |
| Oceana-Ottawa Counties, MI | 6 May 2014 | 241.1 | 79.5 | 1.5 | 5.1 |
| South End1 | 15 Mar 2011 | 508.0 | 167.4 | 6.0 | 13.3 |
| South End1 | 6–7 Apr 2011 | 623.0 | 205.3 | 12.5 | 38.4 |
| South End1 | 13 Mar 2012 | 586.2 | 193.2 | 4.4 | 9.1 |
| South End1 | 3–4 Apr 2012 | 579.6 | 191.0 | 3.8 | 10.6 |
| South End1 | 21 Mar 2013 | 584.9 | 192.8 | 6.0 | 16.5 |
| South End1 | 3 Apr 2013 | 584.8 | 192.8 | 12.2 | 38.9 |
| South End1 | 24 Apr 2013 | 583.9 | 192.5 | 2.8 | 6.2 |
| South End1 | 24 Mar 2014 | 584.9 | 192.8 | 27.0 | 82.5 |
| South End1 | 5–6 May 2014 | 584.5 | 192.7 | 1.3 | 2.3 |
| **Total Southeast Lake Michigan key site** | | **5841.6** | **1925.4** | **8.3** | **26.2** |

1 The South End survey area is only partially within the southeast Lake Michigan key site; as such, the total fall density estimate for the southeast Lake Michigan key site does not include data from the south end survey area.

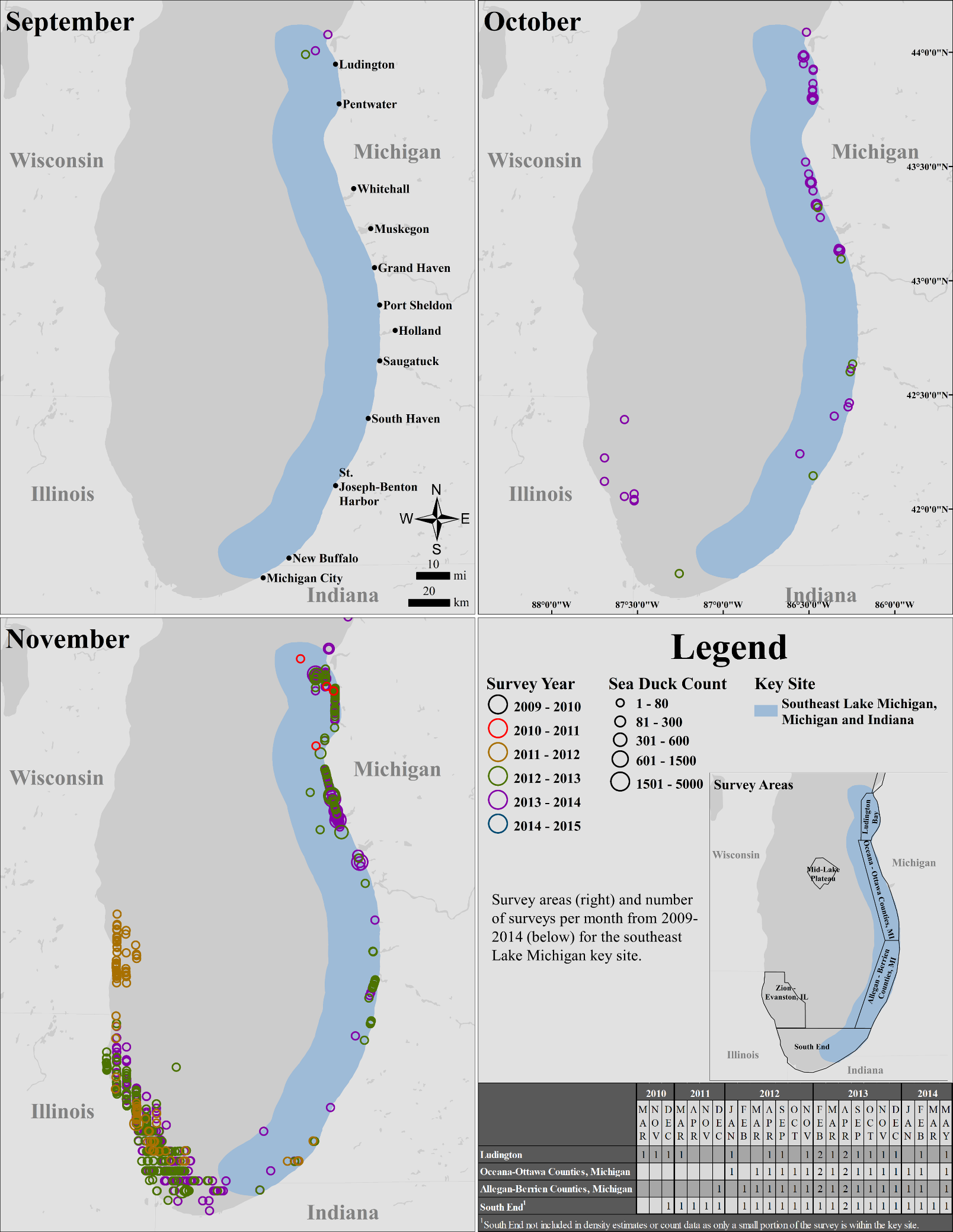


Figure S1. Maps depict sea duck counts from aerial surveys conducted over Lake Michigan from 2009–2014 during fall (September–November) for the Southeast Lake Michigan, Michigan and Indiana key site, by month.

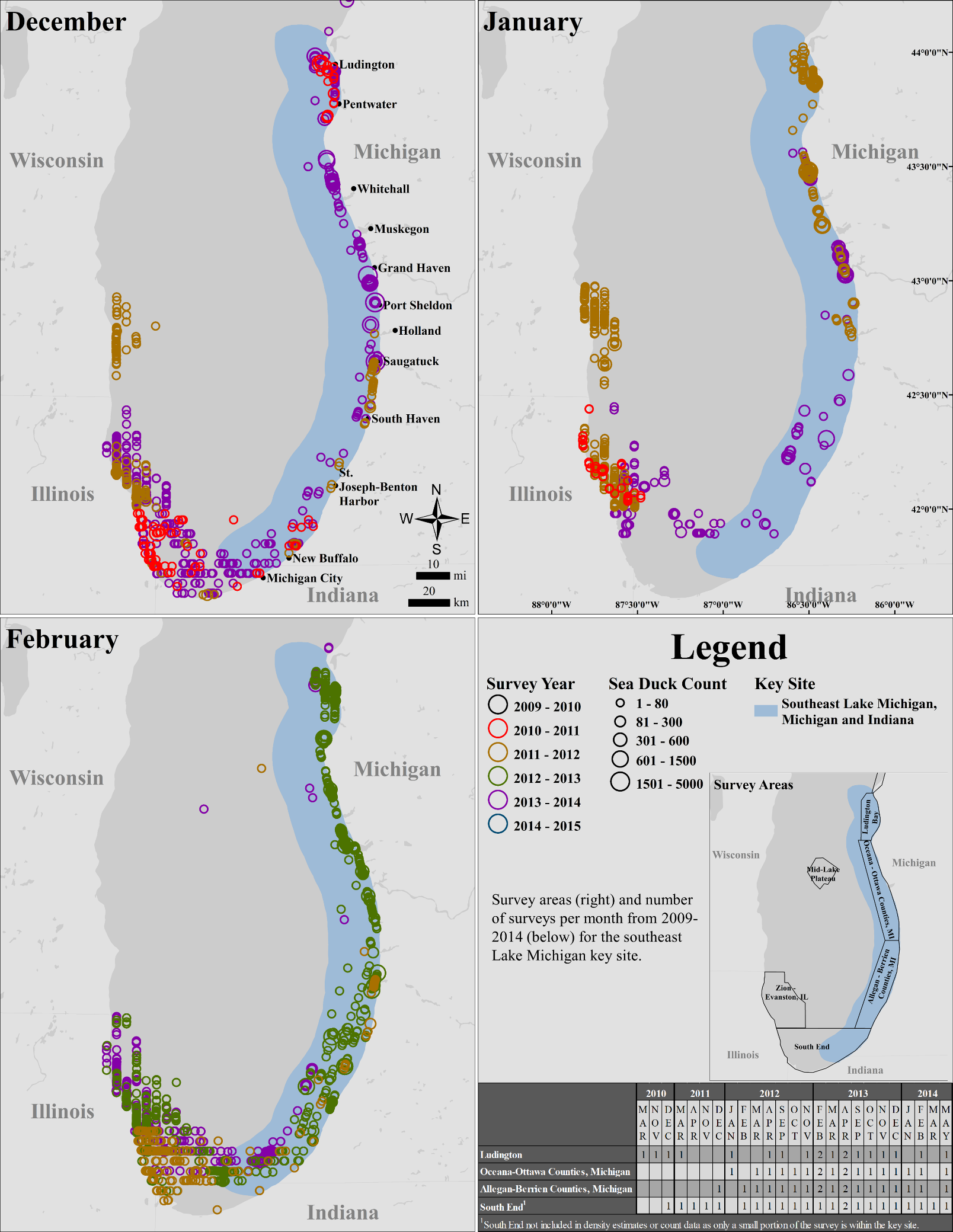


Figure S2. Maps depict sea duck counts from aerial surveys conducted over Lake Michigan from 2009–2014 during winter (December–February) for the Southeast Lake Michigan, Michigan and Indiana key site, by month.

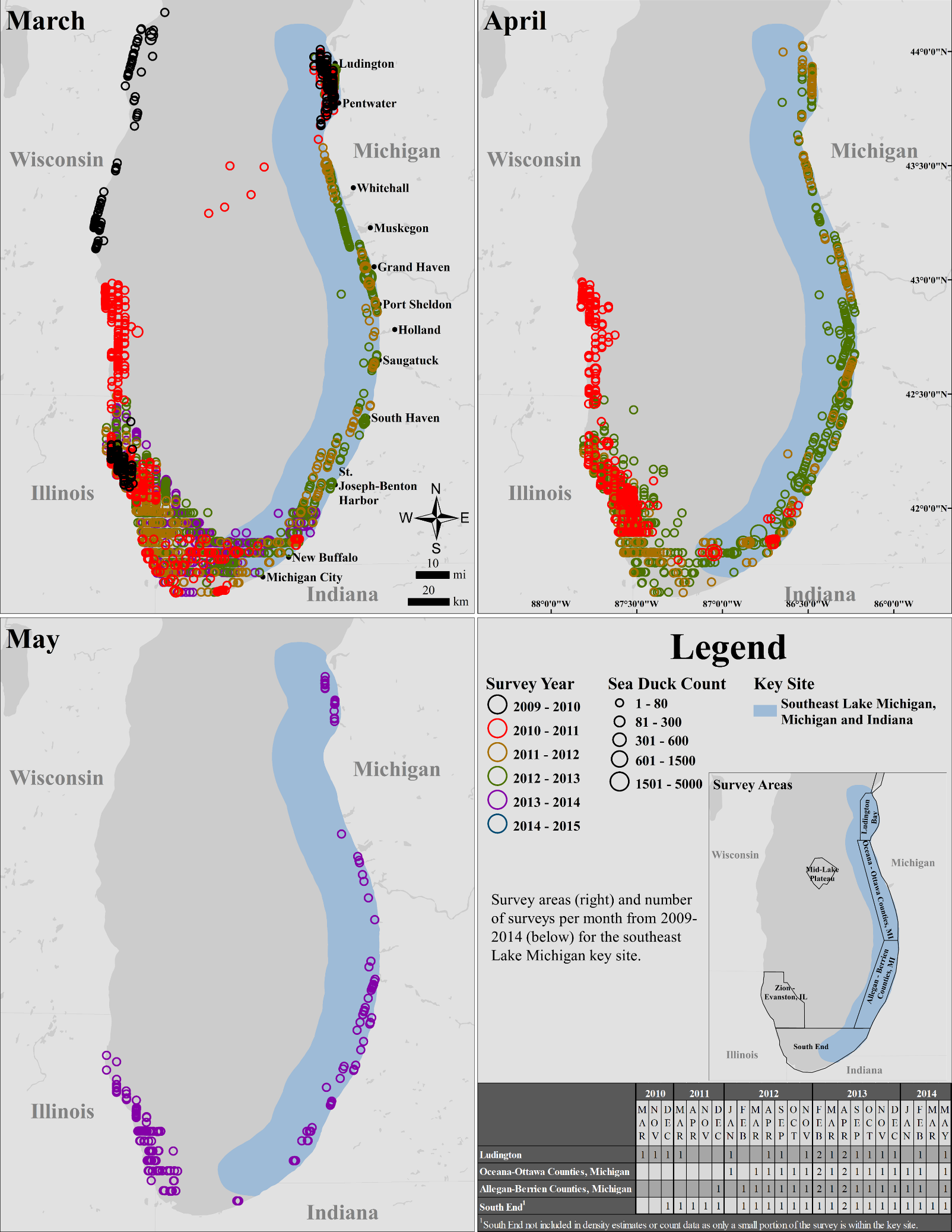


Figure S3. Maps depict sea duck counts from aerial surveys conducted over Lake Michigan from 2009–2014 during spring (March–May) for the Southeast Lake Michigan, Michigan and Indiana key site, by month.

1. Any use of trade, firm, or product names is for descriptive purposes only and does not imply endorsement by the U.S. government. [↑](#footnote-ref-1)