Fig. S1. Schematic top- and side-view representations of the approximate angular projections of the foveae into the visual field (dashed-dotted lines; see assumptions in Methods) for (a) American tree sparrows, (b) chipping sparrows, (c) dark-eyed juncos, (d) Eastern towhees, (e) field sparrows, (f) song sparrows, and (g) white-throated sparrows. The triangle represents the beak, the vertical dashed line represents the axis passing through the center of the beak, and the horizontal dashed line represents the axis passing through the posterior nodal point of both eyes.

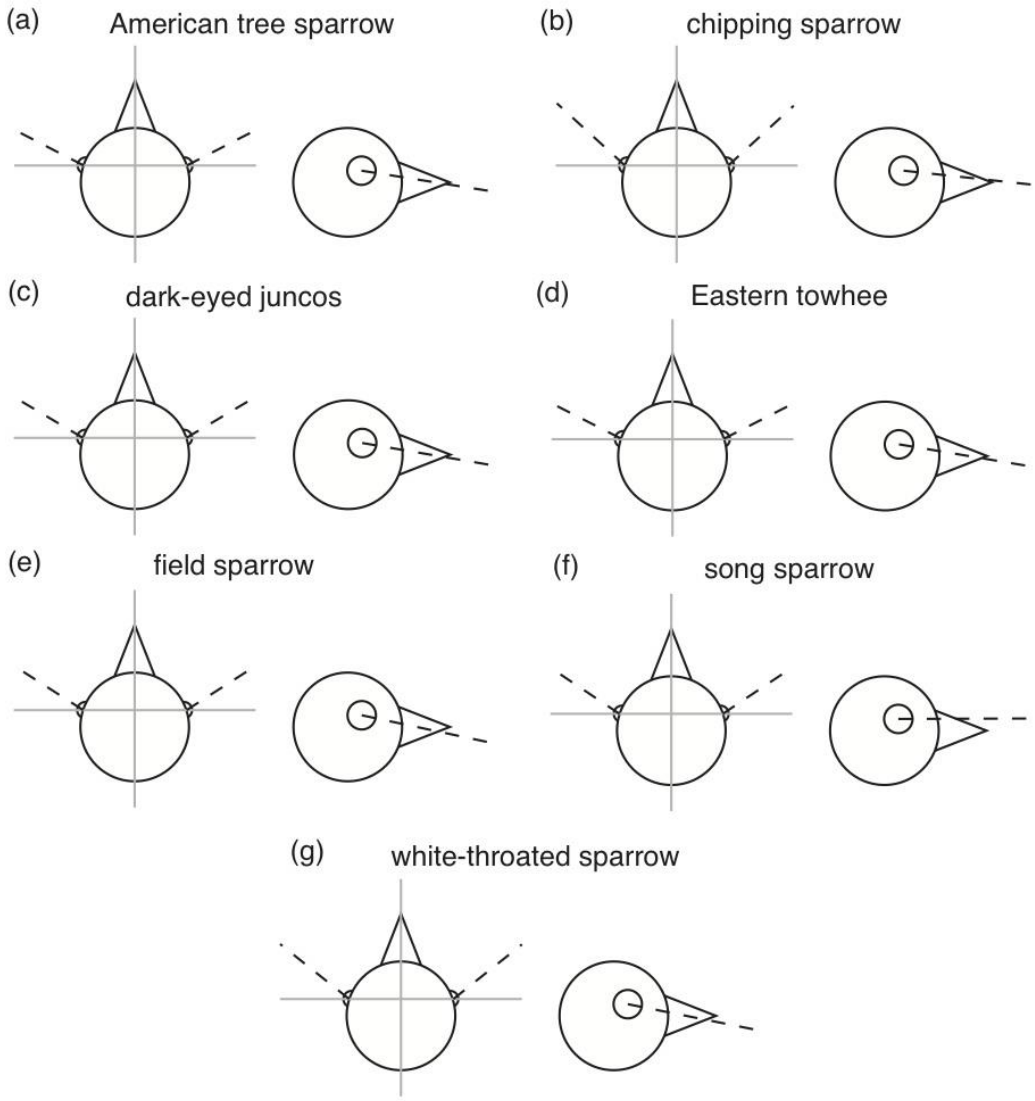

Fig. S2. Configuration of the visual field in the horizontal plane (90° - 270°) while the eyes are at rest in the (a) American tree sparrow, (b) chipping sparrow, (c) dark-eyed junco, (d) Eastern towhee, (e) field sparrow, (f) song sparrow, and (g) white-throated sparrow. Shown are the size of the binocular field, lateral field, and blind area, along with the projection of the bill. Values are averaged across all individuals measured per species.

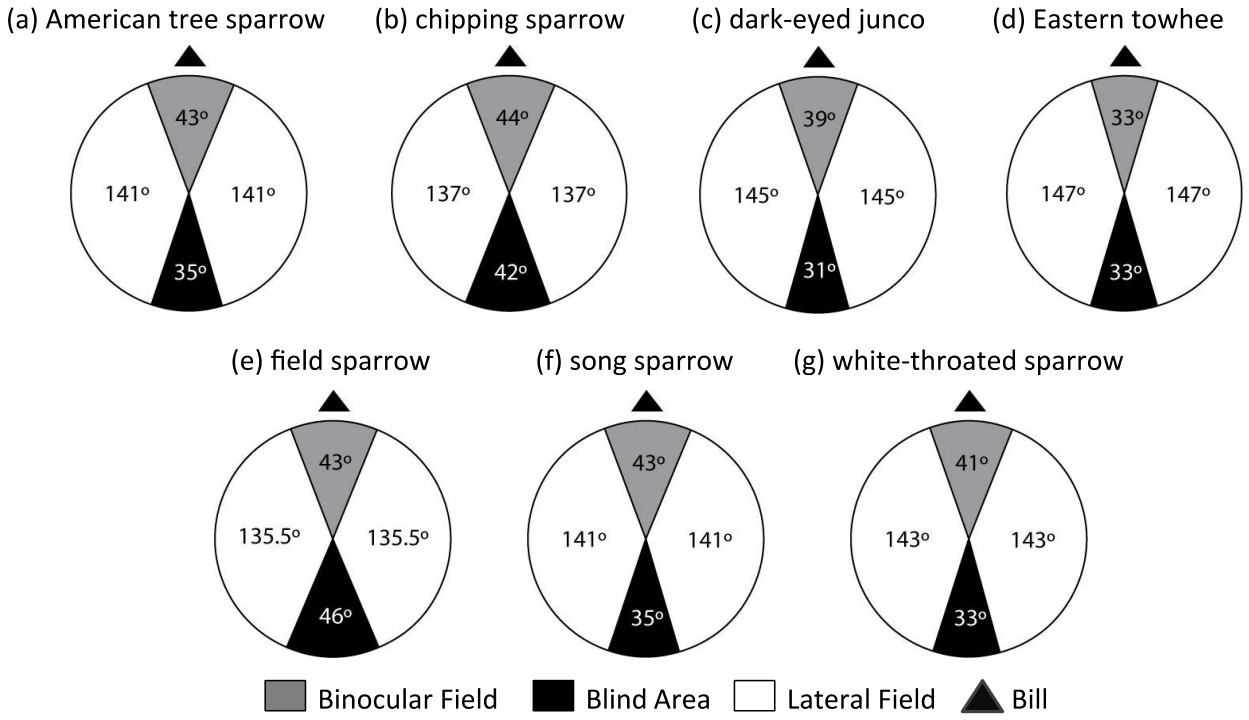

Fig. S3. Median-sagittal angular separation of the retinal field margins per 10° of elevation around the head of (a) American tree sparrows, (b) chipping sparrows, (c) dark-eyed juncos, (d) Eastern towhees, (e) field sparrows, (f) song sparrows, and (g) white-throated sparrows. Positive values represent binocular field overlap, whereas negative values represent blind areas. Values are averaged across all individuals measured per species. The front of the head is at 90°, back of the head is at 270°, and above the head is at 0° (above the head). Arrows indicate projection of the bill-tip in relation to the ground (all horizontally placed at 90°).

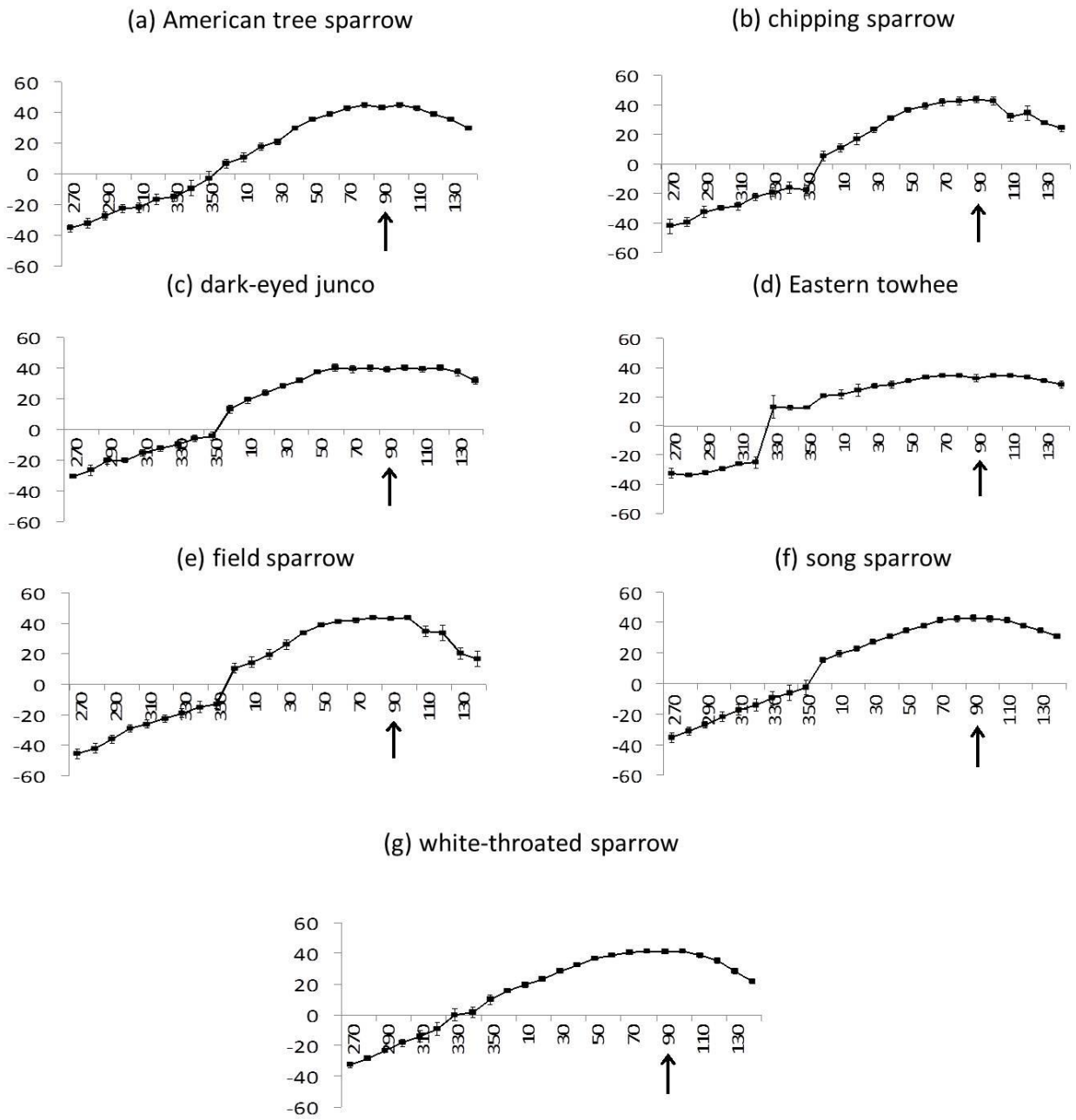

Fig. S4. Degree of eye movements in the direction of each elevation of (a) American tree sparrows, (b) chipping sparrows, (c) dark-eyed juncos, (d) Eastern towhees, (e) field sparrows, (f) song sparrows, and (g) white-throated sparrows. Eye movements are shown in the medial sagittal plan from the left side of the bird's head. Values are averaged across all individuals measured per species. Some values are not shown for the American tree sparrow because we were not successful at measuring eye movements above its head.

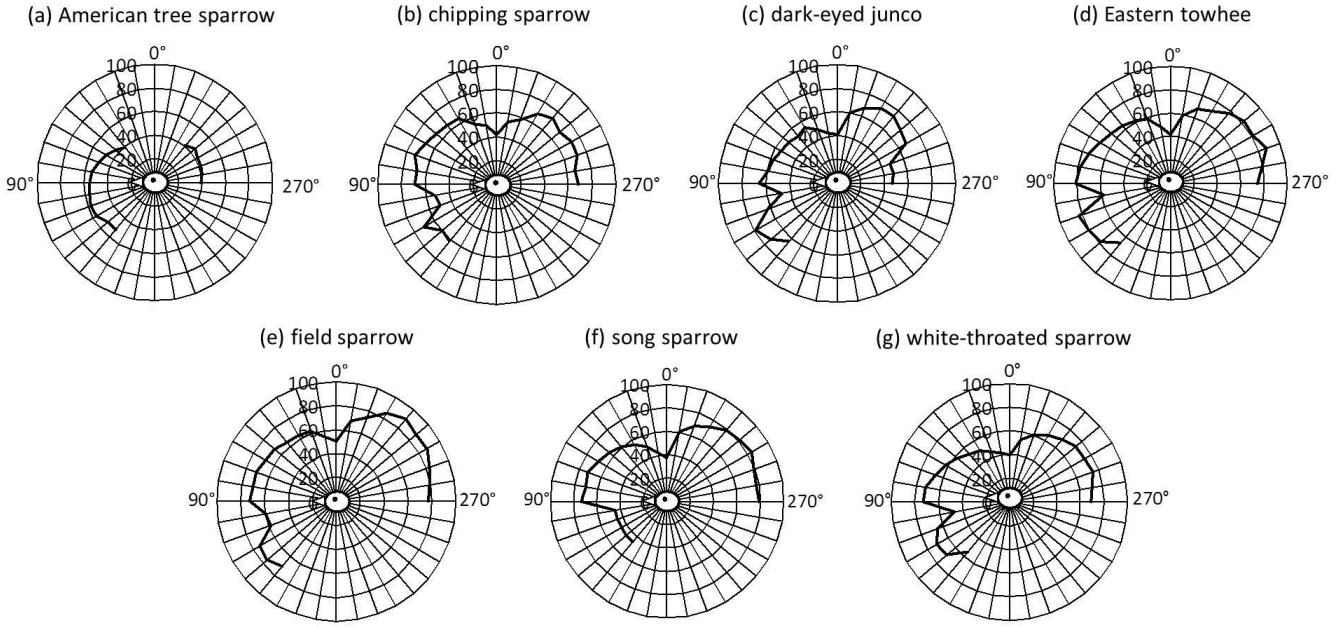

Fig. S5. The configuration of the visual field in the horizontal plane (90° - 270°) while the eyes are converged maximally forward (e.g., rotated forward) in (a) American tree sparrows, (b) chipping sparrows, (c) dark-eyed juncos, (d) Eastern towhees, (e) field sparrows, (f) song sparrows, and (g) white-throated sparrows. Shown are the size of the binocular field, lateral field, and blind area, along with the projection of the bill. Values are averaged across all individuals measured per species.

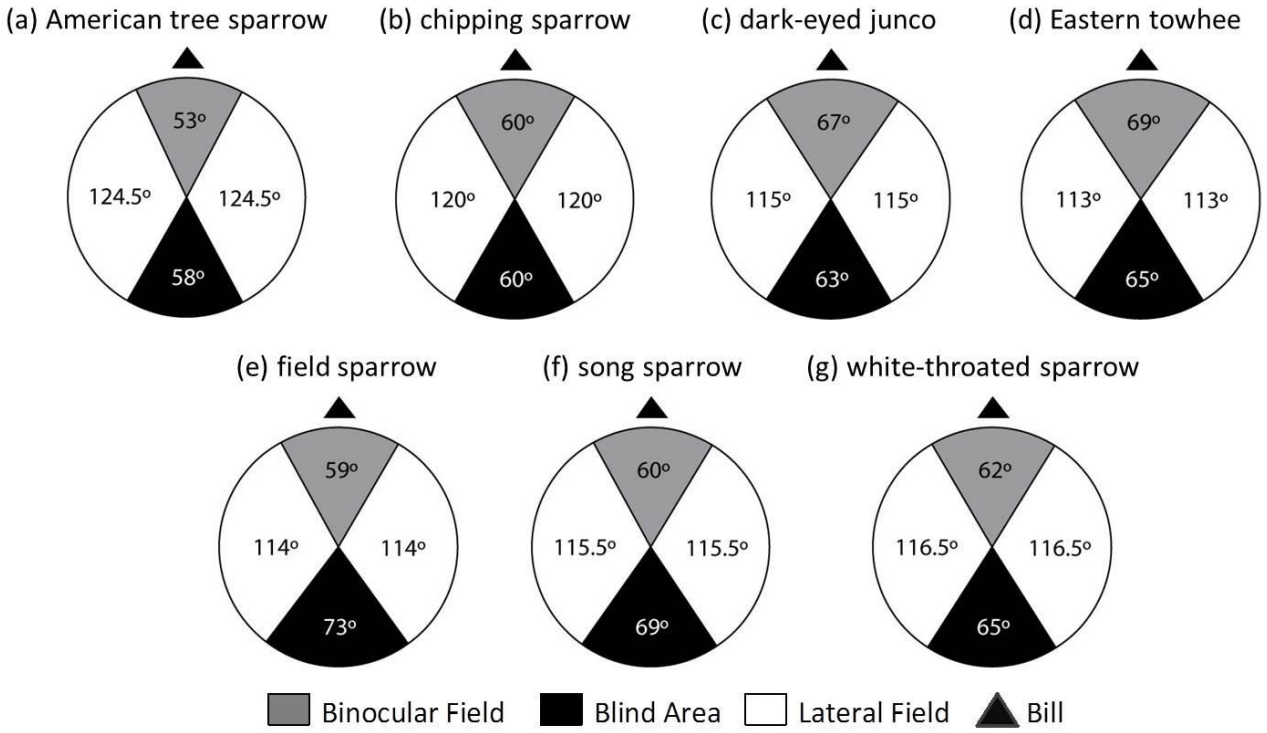

Fig. S6. Orthographic projection of the boundaries of the retinal fields of the two eyes around the head while the eyes are converged maximally forward for (a) American tree sparrows, (b) chipping sparrows, (c) dark-eyed juncos, (d) Eastern towhees, (e) field sparrows, (f) song sparrows, and (g) white-throated sparrows. Values are averaged across all individuals measured per species. The eyes are converged in the direction of the elevation being measured, so the figures do not represent the visual field at any particular given moment but rather the value of maximal convergence in the direction of each elevation. A latitude and longitude coordinate system was used with the head of the animal at the center of the globe. The grid is set at 20° intervals, the equator aligned vertically in the median sagittal plane (the horizontal plane, 90° - 270°). The projection of the bill tips are presented for orientation purposes. The dotted lines represent the extrapolated binocular field assuming that the retinal margin follows a circular projection, suggesting that the individuals could see their bill tips. Some values are not shown for the American tree sparrow because we were not successful at measuring eye movements above its head.

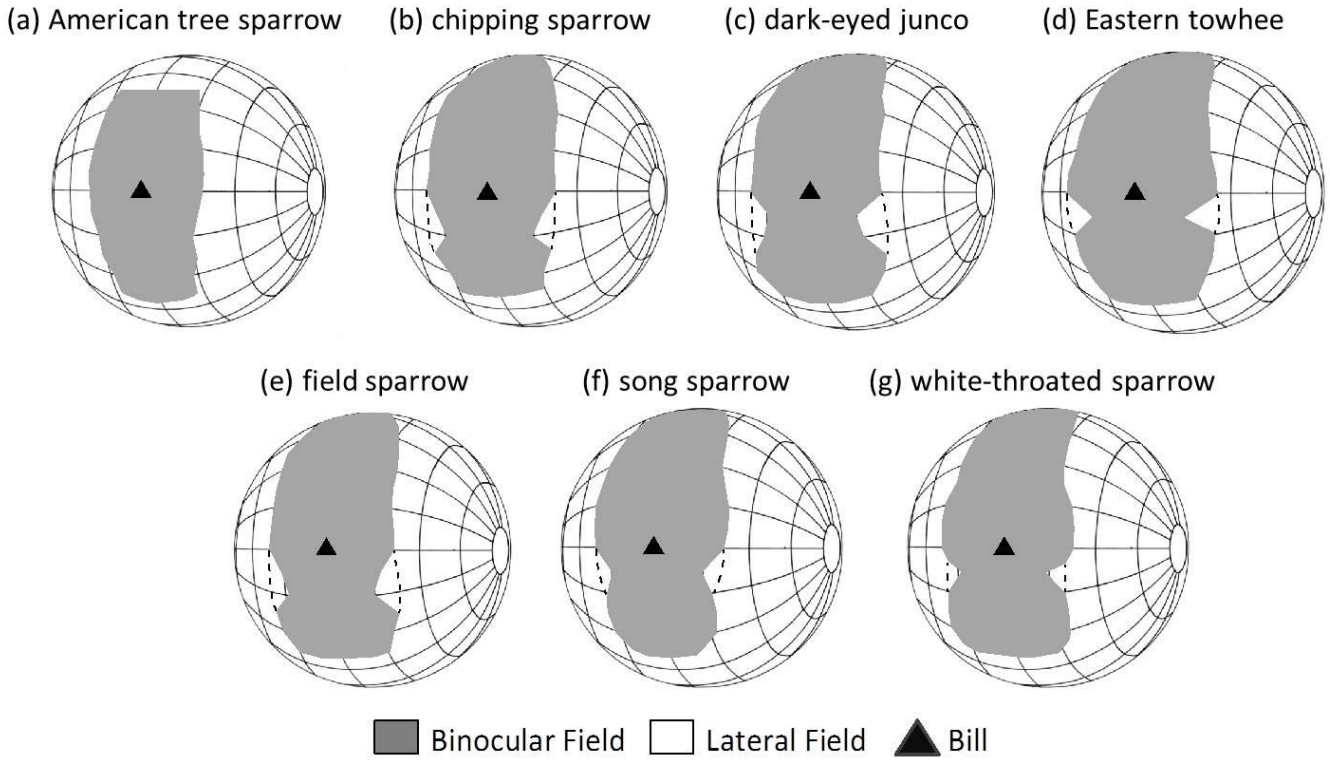

Fig. S7. Phylogenetic Tree of all nine Emberizid species studied. The tree was modified from Carson and Spicer (2003)

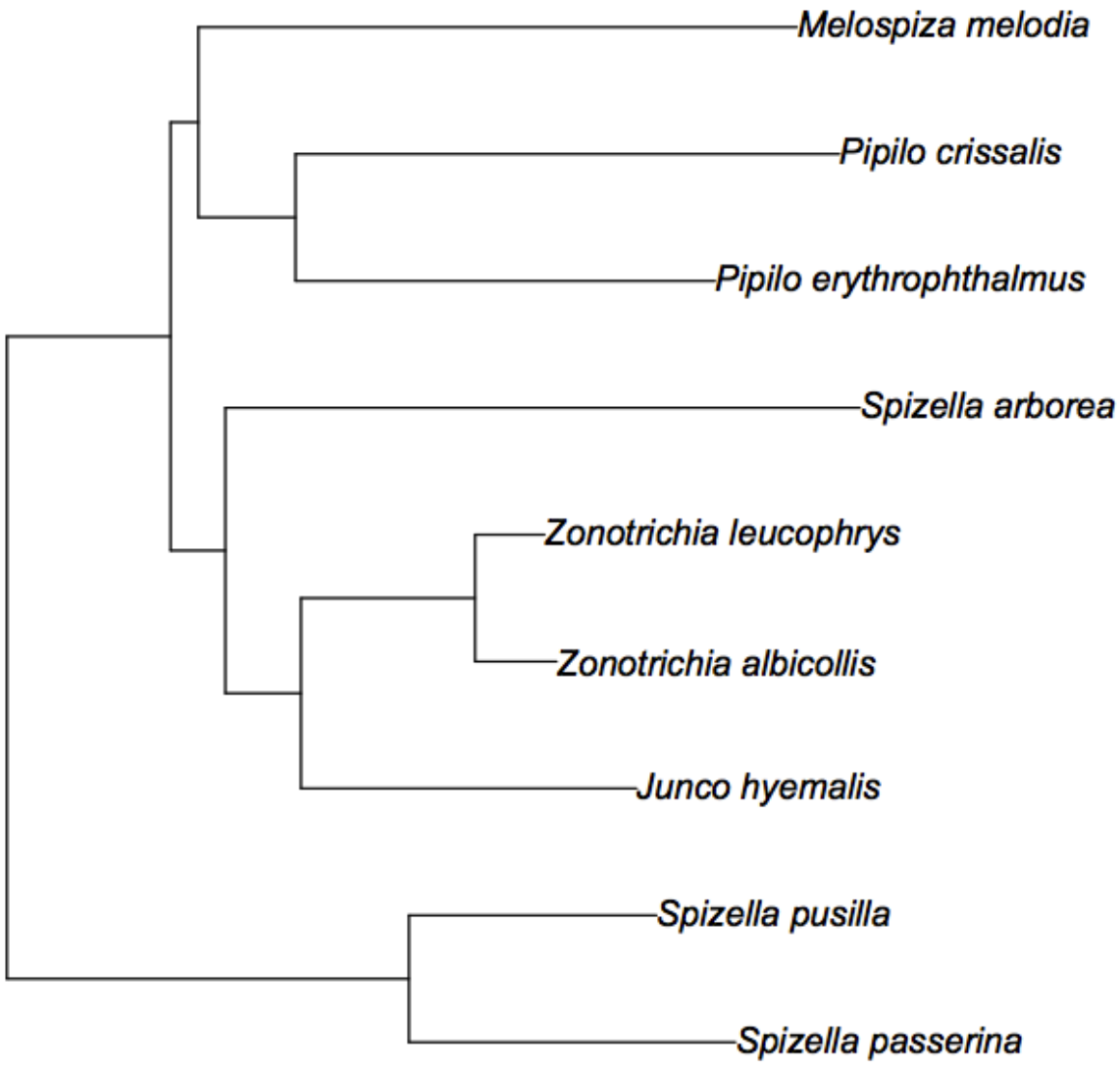

Table S1. Habitat use, foraging methods, main food types and usual predators of the nine emberizid sparrows used in this study

Species	Habitat	Foraging methods	Food Type	Predators	Reference
American Tree Sparrow	Forest edge, open scrubby grasslands	Scratching, hopping, gleaning, darting, pecking	Seeds, berries, insects	Hawks, owls	Naugler 1993
California Towhee	Forest edge, scrubby, dense vegetation	Pecking, scratching, gleaning	Seeds more than other vegetable matter, some insects	Hawks, owls, ground predators	Benedict et al. 2011
Chipping Sparrow	Open grassy, forest edges, human landscapes	Scratching, pecking, hopping, running, occasionally by wing	Seeds, grasses, some insects, invertebrates	Hawks, owls, mammalian ground predators	Middleton 1998
Dark-eyed Junco	Forest edge, harvested fields, parks	Gleaning, pecking, scratching, hopping	Seeds and arthropods	Hawks, owls, jays, ground predators	Nolan et al. 2002
Eastern Towhee	Forest edge, dense shrubs	Double scratching, pecking, running, hovering, gleaning, hawking, aerial pursuit	Seeds, fruits, many invertebrates	Hawks	Greenlaw 1996
Field Sparrow	Fields, woodland openings, forest edges	Pecking, perching, pouncing	Primarily grass seeds, some insects	Hawks	Carey et al. 2008
Song Sparrow	Forest edge, scrubby fields	Double scratching, hawking, aerial capture, pecking	Seeds, fruits, invertebrates	Hawks, owls, mammalian ground predators	Arcese et al. 2002
White-crowned sparrow	Forest edge to tundra, grassy	Hawks from perch, scratching, pecking	Seeds, fruits, plants, insects	Hawks, owls, ground predators	Chilton et al. 1995
White-throated sparrow	Edge, forests, dense shrubs	Double scratching, pouncing, gleaning, aerial capture, pecking	Seeds, fruits, many insects	Hawks, owls, mammalian ground predators	Falls & Kopachena 2010

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Table S2. Bill size measurements (length, width, depth, in mm) of nine emberizid sparrows

	length mean	length SE	width mean	width SE	depth mean	depth SE
American tree sparrow	8.75	0.14	4.77	0.09	5.83	0.11
California towhee	12.04	0.14	6.17	0.10	7.70	0.12
chipping sparrow	7.81	0.11	4.03	0.07	4.81	0.09
dark-eyed junco	9.35	0.10	4.55	0.07	5.66	0.08
Eastern towhee	11.42	0.09	5.44	0.06	7.59	0.07
field sparrow	7.58	0.14	4.00	0.10	5.04	0.12
song sparrow	10.72	0.18	5.28	0.12	6.52	0.15
white-crowned sparrow	9.63	0.13	4.96	0.09	6.28	0.11
white-throated sparrow	10.22	0.18	4.85	0.12	6.52	0.15

Table S3. Average number of grid sites deployed and eventually counted per retina, average asf (the ratio of the area of the counting frame to the area of the grid), average $\sum Q^-$ (sum of the total number of retinal ganglion cells counted), and average estimated total number of ganglion cells in the retina.

Species	# grid sites laid out	# grid sites counted	asf	$\sum Q^-$	Total RGCs
American tree sparrow	409.60 ± 2.84	378 ± 6	0.01247 ± 0.00379	22854.47 ± 1179.79	1841750.57 ± 120425.95
Chipping sparrow	410.75 ± 2.87	379 ± 9	0.01576 ± 0.00054	22292.99 ± 1615.64	1409253.08 ± 54827.08
Dark-eyed junco	406.80 ± 3.71	357 ± 11	0.01216 ± 0.00024	16492.90 ± 1292.92	1359735.79 ± 112505.59
Eastern towhee	413.00 ± 0.00	398 ± 7	0.00673 ± 0.00026	18353.67 ± 106.00	2732432.00 ± 90908.16
Field sparrow	407.20 ± 4.24	390 ± 6	0.01491 ± 0.00065	20284.00 ± 1092.44	1362862.54 ± 57873.74
Song sparrow	406.80 ± 1.24	377 ± 7	0.01082 ± 0.00038	17758.40 ± 809.07	1645727.81 ± 78272.79
White-throated sparrow	409.00 ± 3.34	376 ± 9	0.01133 ± 0.00052	19188.50 ± 697.35	1705752.48 ± 109274.70