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Cover Photos, A Least Tern pair nested in New Hampshire for the first time since 1960. Photographed by Len Medlock on eggs on 7/1/15 and feeding a new chick on 7/7/15 at Hampton Beach State Park.

IN CELEBRATION OF

Michael J. Bartlett

Mike Bartlett birding in Belize, taken by Bob Quinn in 2016.

With this issue we celebrate Mike Bartlett's retirement as President of NH Audubon and honor his many contributions to NH Audubon and the conservation of birds and wildlife. Mike's leadership at NH Audubon was instrumental in the revitalization of the organization and the strengthening of its programs. Prior to NH Audubon, Mike was Supervisor of the New England Field Office at the US Fish & Wildlife Service where he led efforts to protect endangered species, restore habitat, and mitigate natural resource damage. We are grateful for all he accomplished for NH Audubon and for conservation during his long career.

In This Issue

New Hampshire Bird Records is published quarterly by New Hampshire Audubon's Conservation Department. Thank you to the many observers who submit their sightings to NH eBird (www.ebird.org/nh), the source of data for this publication. Records are selected for publication and not all species reported will appear in the issue. The published sightings typically represent the highlights of the season. All records are subject to review by the NH Rare Birds Committee and publication of reports here does not imply future acceptance by the Committee. Please contact the Managing Editor if you would like to report your sightings but are unable to use NH eBird.

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Research

Identifying Hybrid Saltmarsh-Nelson's Sparrows – Appearances Aren't Everything

by Jennifer Walsh & Adrienne Kovach

Hybridization, the interbreeding of two separate species populations, is common in nature and thought to occur in roughly 10% of all birds (Grant and Grant 1992). When species interbreed, their hybrid offspring may be expected to express intermediate plumage or morphologies (structural features) relative to the two parental species. There are many reasons, however, including complex patterns of gene flow (genetic introgression) resulting from frequent backcrossing, which can lead to a lack of a clear intermediate morphology in mixed individuals. This scenario presents challenges for using morphology to distinguish hybrid from pure individuals in interbreeding populations.

Saltmarsh (*Ammodramus caudacutus caudacutus*) and Nelson's (*A. nelsoni subvirgatus*) Sparrows provide an example of hybridizing taxa for which hybrid identification has been challenging. The two species breed in coastal marshes of the northeastern US and Maritime Canada and their ranges overlap from Thomaston, Maine to Newburyport, Massachusetts (Greenlaw and Woolfenden 2007, Hodgman et al 2002). Hybridization is known to occur where the two species overlap, as confirmed by genetic studies (Shriver et al 2005, Walsh et al 2011). Until recently, however, the extent of hybridization between Saltmarsh and Nelson's Sparrows has been difficult to quantify and has therefore remained largely unknown.

There are slight, but consistent and observable, differences in plumage and morphology between the two species (Greenlaw 1993, Shriver et al. 2005), which have been used by researchers to identify the species in the field. Shriver et al. (2005) developed an index to differentiate the species using 13 plumage and bill traits, with hybrids classified as those having an intermediate composite score of these traits. Further study revealed that plumage differences were subtle in the hybrid zone and that plumage intermediacies were not always apparent in sympatric populations (populations co-occurring in the same geographic area; Walsh et al. 2011). The realization that we had a limited understanding of hybrid morphology prompted us to investigate genetic and morphological variation across the hybrid zone. Specifically, we were interested in determining whether the key traits that are useful for differentiating between Nelson's and Saltmarsh Sparrows could be used to identify pure and hybrid individuals in the field.

To capture the full extent of morphological and genetic variation across the hybrid zone, it was important to sample a large number of individuals from numerous marshes throughout the hybrid zone and neighboring allopatric (pure) populations. To achieve this, we undertook a transect sampling approach, which included 34 marshes across approximately 800 km from Lubec, Maine to Madison, Connecticut. Within the documented overlap zone, we sampled 23 marshes at approximately 10 km intervals. We also sampled an additional four marshes to the north of the overlap zone (pure Nelson's Sparrow range) and seven marshes to the south (pure Saltmarsh Sparrow range).

At each marsh, we captured sparrows using mist nets during the breeding seasons of 2012 and 2013, resulting in a total of 290 captured individuals. We scored each sparrow for the 13 traits of the plumage index of Shriver et al. (2005, see Figure 1). Plumage traits included bill color, the color and definition of the face, the color of the back, the width and definition of the whisker line and crown, and the amount and definition of streaking on the breast and flanks (Table

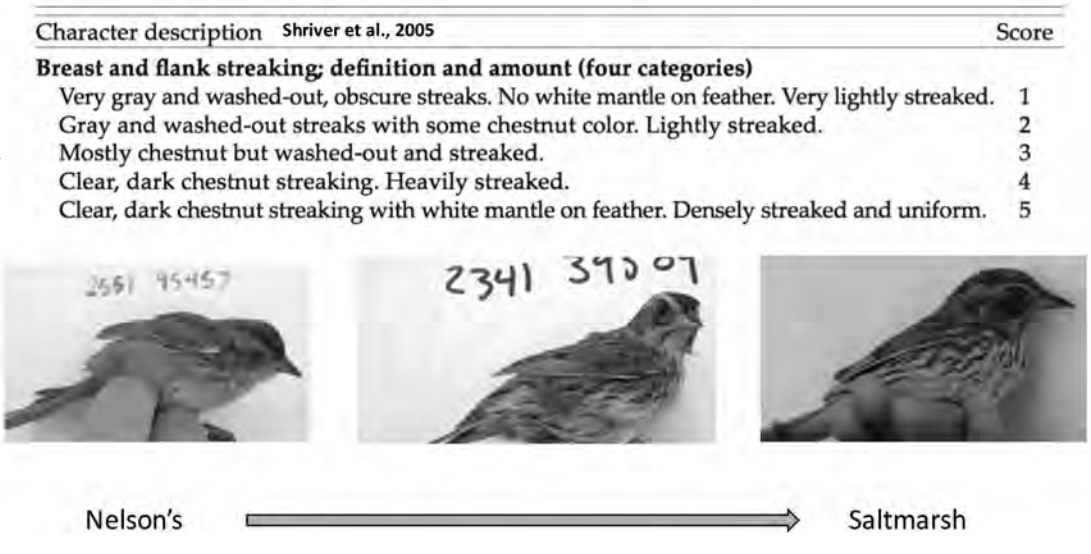

Figure 1. Pictures of individuals that exhibit pure Nelson's, pure Saltmarsh, and intermediate plumage features for traits that were found to be most important in discriminating between the species. These traits include the definition and darkness of streaking on the breast and flanks (darker in Saltmarsh Sparrows and more washed out in Nelson's Sparrows) and the color of the face (dull yellow in Nelson's Sparrows and dark orange in Saltmarsh Sparrows).

1). Plumage scores for each individual trait ranged from 1 – 5, with lower numbers representative of Nelson's Sparrows and higher numbers representative of Saltmarsh Sparrows. Thus, the final plumage scores ranged from 13 (pure Nelson's Sparrow) to 65 (pure Saltmarsh Sparrow)(Shriver et al 2005). We also collected standard structural measurements, including: tarsus length; bill width, depth, and length; unflattened wing chord; and weight. In addition, we took a blood sample for genetic analyses.

We used DNA from blood samples to classify individuals as pure Nelson's Sparrow, pure Saltmarsh Sparrow, backcrossed in the direction of Nelson's Sparrow (offspring from mating between a hybrid and a pure Nelson's Sparrow), backcrossed in the direction of Saltmarsh Sparrow (offspring from a mating between a hybrid and a pure Saltmarsh Sparrow), or first generation (F1) hybrid (offspring from a mating between a pure Saltmarsh and pure Nelson's Sparrow). We compared the morphological data collected in the field to the genetic classification.

Our sampling of the Saltmarsh-Nelson's Sparrow hybrid zone revealed that hybridization and backcrossing are frequent between Nelson's and Saltmarsh Sparrows, with 52% of the sampled individuals identified as genetically mixed. However, 47% of these admixed individuals turned out to be descendants of hybrids and only 3% were first generation hybrids (a true 50-50 cross). This suggests that hybrids mate with pure individuals frequently and that at least some genes move freely and frequently across the hybrid zone.

Plumage and structural measurements varied substantially across hybrid populations, with genetically mixed individuals displaying a complex and unpredictable mosaic of traits from the parental species rather than a clear intermediate hybrid phenotype (physical appearance of an individual). These morphological patterns posed a challenge for accurate hybrid identification in the field. Backcrossed individuals were typically morphologically indistinguishable from the more genetically similar parental species. Our results indicate that hybrid identification in the absence of genetic data will not accurately distinguish pure from mixed individuals and will likely substantially overestimate genetically "pure" individuals within a population.

While the phenotypic traits could not distinguish pure and hybrid individuals, they proved highly reliable in separating birds with primarily Saltmarsh Sparrow gene pools (pure Saltmarsh and backcrossed-Saltmarsh Sparrows) from birds with primarily Nelson's Sparrow gene pools (pure Nelson's and backcrossed-Nelson's Sparrows). This finding is promising for monitoring or other efforts that do not require consideration of hybrid status. Further, correlation with genetic data revealed that certain traits were more consistent in separating the pure species, perhaps because they introgress

Table 1. Description of 13 plumage traits used to differentiate Saltmarsh and Nelson's Sparrows. Pure parental individuals display these features, receiving a score of 1 for Nelson's and 5 for Saltmarsh Sparrow, respectively. Hybrids have intermediate features and receive a score of 2-4, accordingly. Adapted from Shriver et al. (2005).

	Plumage Score	
Trait	Nelson's Sparrow (1)	Saltmarsh Sparrow (5)
Amount of Streaking on Breast	Obscure Streaks	Uniform and Densely Streaked
Definition of Streaking on Breast	Gray	Dark Chestnut
Amount of Streaking on Flanks	Obscure Streaks	Uniform and Densely Streaked
Definition of Streaking on Flanks	Gray	Dark Chestnut
Whisker Line Definition	Gray, Not Clearly Defined from Throat	Dark and Clearly Defined
Whisker Line Width	Thick	Very thin
Face Color	Face is Washed-Out Orange to Yellow	Bright Orange Face
Face Definition	No Separation from Face Patch	Clear Definition from White Throat by Thin Whisker Strip
Back Color	Gray, No Different from Nape	Chestnut, Dark Brown
Back Streaking	No Streaking	White Streaking on Outer Side of Back
Crown Width	5 mm Wide	Almost Identical to Lateral Stripes
Crown Definition	Gray	Chestnut
Bill Color	Entire lower mandible and bottom of upper mandible is blue	Lower mandible and bottom of upper mandible is yellow

(movement of genes from one species into another) less freely between them. These traits, including darkness, uniformity and clearness of the streaking found on the breast and flanks and the definition of the crown and face (Figure 1), may play an important adaptive ecological role or function in sexual selection. From a practical perspective, focusing on these key traits may assist future species identification efforts. We caution, however, that care is needed when identifying these species in the field, given our finding that reliance purely on morphological data my lead to misidentification because of the complexities of hybrid plumage. While using song may assist with identification, we currently lack knowledge about characteristics of song in hybrids. Future studies of hybrid song may provide additional insights for field identification.

The inability to distinguish between pure and hybrid sparrows based on their appearance may pose conservation challenges. Although we are still unsure of the impacts of extensive hybridization between Saltmarsh and Nelson's Sparrows, hybridization can lead to a number of negative consequences in natural populations. For this reason, effective monitoring of hybridizing populations of Saltmarsh and Nelson's Sparrows will be important in the future. Both species are a high conservation priority in the northeastern United States (United States Department of Interior 2008) and the Saltmarsh Sparrow is considered globally vulnerable to extinction (International Union for Conservation of Nature Red List criteria, Birdlife International 2004). Continued monitoring within the hybrid zone will aid in defining management priorities for these species.

Within New Hampshire, we have sampled numerous sites both in Great Bay (Chapman's Landing and Lubberland Creek), along the Squamscott River, and near the coast (Hampton and Rye). Patterns of hybridization tend to be variable among sites, however we have identified a few F1 (50:50) hybrids at Lubberland Creek in Newmarket, NH.

For more details on this study: The research is presented in the journal *The Auk: Ornithological Advances* in the article "Relationship of phenotypic variation and genetic admixture in the Saltmarsh–Nelson's sparrow hybrid zone." (Walsh et al., 2015).

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Jen Walsh is a postdoctoral researcher at the Cornell Lab of Ornithology. Her research interests include the application of genetic and genomic approaches to address fundamental questions in avian ecology and evolution.

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Both authors are collaborators in the Saltmarsh Habitat and Avian Research Program, a group of academic, governmental and nonprofit collaborators gathering information for the conservation of tidal-marsh birds.

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Abbreviations Used

BBC	Brookline Bird Club
BBS	Breeding Bird Survey
CA	Conservation Area
CC	Country Club
CFT	NH Audubon Chapter Field Trip
FT	Field Trip
IBA	Important Bird Area
L.	Lake
LPC	Loon Preservation Committee
NA	Natural Area
NHA	New Hampshire Audubon
NHBR	New Hampshire Bird Records
NHRBC	NH Rare Birds Committee
NWR	National Wildlife Refuge
PMRO	Pack Monadnock Raptor Observatory
PO	Post Office
R.	River
Rd.	Road
Rt.	Route
SF	State Forest
SP	State Park
SPNHF	Society for the Protection of NH Forests, Concord
T&M	Thompson & Meserves (Purchase)
TNC	The Nature Conservancy
WMA	Wildlife Management Area
WMNF	White Mountain National Forest
WS	NHA Wildlife Sanctuary
~	approximately
WTP	Wastewater Treatment Plant

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