BOOK REVIEW

Breeding Bird Atlas of Nevada County, California, by Steven Rose and Diane Rose. 2019. Sponsored by Sierra Foothills Audubon Society, Grass Valley, California; published by Steven Rose. 398 pp. Includes 168 color maps, one grayscale map, and 20 color illustrations. Softcover. $30.00 (includes shipping and tax; order from http://sierrafoothillsaudubon.org/). ISBN 978-0-578-60753-5.

A biological atlas maps the distribution, and sometimes the abundance, of a group of species (most commonly breeding birds) within a defined geographic area during a set time period. These atlases have dramatically advanced distributional studies over earlier ones based on randomly collected specimens or anecdotal observations by attempting to obtain comparable coverage within each (or a random sample) of the equal-sized blocks in an atlas grid overlain on the study area. The first breeding bird atlases began in Britain and Ireland in the mid-1960s (Lord and Munns 1970, Sharrock 1976). The concept quickly spread throughout the world but has been applied mostly in the northern hemisphere (Dunn and Weston 2008). The first atlas project in North America, for two counties in Maryland, was initiated in 1971 (Klimkiewicz and Solem 1978), but most subsequent work has been conducted at larger scales. From 1979 to 2018, atlases have been completed for 9 of Canada's 13 provinces and territories, of which 6 have completed second atlases. They have been completed for 41 of the 50 United States, of which 18 have completed second atlases (Beck et al. 2018).

By contrast, California has taken a county-by-county approach. As of 2020, atlases have been initiated or completed for all or part of 22 of the state's 58 counties; most of which are coastal, and concentrated around San Francisco Bay. Of the 22, 16 have been published in one form or another (Roberson and Tenney 1993, Shuford 1993, Burridge 1995, Shuford and Metropulos 1996, Gallagher 1997, SAS 2001, Berner et al. 2003, SFFO 2003, Unitt 2004, Hunter et al. 2005, Bousman 2007, Glover 2009, Richmond et al. 2011, Rippey 2014, Allen et al. 2016, volume reviewed here). Field work for a second atlas has been completed in Sonoma County, initiated in Sacramento and Santa Cruz counties, and is in the planning stages in Marin County. In three counties field work for first atlases was completed over 25 years ago, but the results have yet to be published. Two of these, however, plan to publish results of their first and second atlases in the same volume. Three atlases were initiated (two long ago, one fairly recently) but never completed with no current plans to do so.

California's latest published atlas, for Nevada County, traversing the northern Sierra Nevada, is organized by five chapters. Description of Nevada County (9 pp.) has sections on location and population, geology, major geographic features, climate and rainfall, major roads, land use, major habitat types, and elevation zones. At 958 square miles, this sparsely populated county (97,182 persons in 2012) is relatively small in size, stretching about 68 miles west to east and from 9 to 26 miles north to south. Elevations range from 250 feet in the Sierra foothills on the west slope to three peaks slightly over 9000 feet at the Sierra crest to 5200 feet on the east slope at the county's border with the state of Nevada. Land in the county is 63% private, 35% public (mostly in central and eastern portions and at higher elevations).

Supporting this information, to a limited degree, is a color-shaded relief map on the inside front cover showing the grid of numbered atlas blocks for Nevada County in relation to surrounding counties and the western edge of the state of Nevada. The only other landmarks shown are major highways and the location of the county's three incorporated cities (Nevada City, Grass Valley, Truckee). Despite inclusion of a gazetteer, those not familiar with the county will have difficulty locating place names mentioned in the text given other towns, major rivers, lakes or reservoirs, prominent mountain peaks, state parks and wildlife areas, or other geographic features are not

shown. A map showing these would have been extremely helpful, as well as maps depicting elevation contours, the distribution of major vegetation types, and the six elevation zones discussed.

The county's climate varies from Mediterranean on the west slope, with warm to hot, dry summers and wet, cold, rainy winters, to continental on the east slope, with cool to warm and dry summers with occasional thunderstorms and very cold, snowy winters. Precipitation, mostly as snow, is highest on the upper west slope. "Rainfall" (presumably "precipitation" including snowfall) data are provided for the five years of field work on which the atlas is based, 2014–2018, for two locations, one each on the west and east slopes. These data show drought during the first two years and precipitation over 200% of "normal" in the winter preceding the fourth year. It would have been valuable to also present precipitation data for the period directly prior to the atlas period, as the effects of drought are cumulative and California experienced a severe drought starting in the winter of 2011–12, i.e., two years prior to initiation of the field work.

The authors describe the 12 major habitats/plant communities thoroughly, but scientific names of the trees and shrubs mentioned are lacking. Defined by elevational ranges and dominant plant communities, six elevation zones are also described, and representative birds or species reaching their upper or lower elevational limits within each zone are listed. For birds, scientific names are lacking at their first mention but included later in the species accounts.

The chapter Methods includes sections on the schedule of field work, maps and grid, blocks, abundance estimates, data forms, data management, and adequacy of coverage. Methods generally followed those of many other county atlas projects in California and are clearly described. The county was overlain with a UTM grid of 126 5-km by 5-km atlas blocks; of these, 16 edge or partial blocks were either so small that they were not surveyed or were subsumed into adjacent full blocks. Of 111 blocks judged worthy of coverage, 110 were surveyed from 2014 to 2018. Atlas participants were provided digital maps with a variety of options for backgrounds, including Google Hybrid or Terrain, open street maps, and topographical maps, which could be panned, zoomed in and out, and printed for any block or part of a block. Criteria defining categories of evidence of breeding followed the recommendations of the North America Ornithological Atlas Committee (NORAC; Laughlin et al. 1990).

Observers initially recorded breeding data on paper field cards, or on comparable Excel spreadsheets from data recorded in field notebooks, which were submitted at the end of the breeding season. Drawbacks of adding data to field cards as the season progressed were the loss of some information on breeding phenology when lower-level codes were replaced later by higher ones. But in some of these cases, the date of the original, rather than the later, observation was retained. After several field seasons, observers were encouraged to use www.eBird.org to record atlas data, and many did so. Submitting atlas data by eBird avoided the problems discussed for field cards but required that each checklist be entered into the atlas database and that some of eBird's breeding codes be converted to the standard NORAC codes. Most data were entered in a database created for the project and double-checked for accuracy, with data on block survey time and other metrics of block coverage tracked by spreadsheet.

Because other atlas projects have found that participants are uncomfortable estimating bird abundance, the Roses themselves, as project leaders, "censused" each atlas block on at least two occasions to assess habitats and gain a general impression of the abundance of each species. They then made a subjective, order-of-magnitude estimate of the number of breeding pairs of each species in each atlas block by assigning each species to one of three categories, 1–9, 10–99, or ≥100 pairs (Allen et al. 2016). Next, they estimated the range of the total number of pairs of each species in the entire county by summing the minimum and the maximum estimates for all

blocks occupied by a species. Prior to this, they made further adjustments toward the lower end of the range estimate for an unspecified number of species that had numerous blocks with estimates of 10 to 99 pairs and were judged to not contain many more than 10 pairs per block. The overall subjective approach to estimating abundance with further undocumented adjustments does not instill much confidence that this methodology will provide reliable estimates of population change if repeated in the future. This is a problem faced by all atlas projects and one not easily overcome without point counts or other quantitative methods that allow rigorous statistical analyses (Beck et al. 2018, McCabe et al. 2018), which may not be practical for most county-level atlases. Many atlas projects are now relying on eBird checklists for recording data, but it appears too early to evaluate whether such data will provide robust estimates of population change when atlases are repeated.

To assess adequacy of coverage, the project initially set an arbitrary goal of surveying each block for 30 hours and confirming breeding for 30 species. After two years it became apparent that it would not be possible to do so for all blocks, particularly those at mid-to-high elevations on the west slope that are dominated by granite and difficult to access. Ultimately, however, the authors assessed coverage of each block empirically on the basis of its habitat diversity, the total survey hours to date, the potential for additional species or confirmations, and the difficulty of access (Shuford 1993). By these criteria, just 9 of 110 blocks were considered inadequately covered at the end of the project. But in the atlas these nine blocks are not identified, making it difficult for the reader to assess whether some species' observed distributions have been influenced by limits to survey coverage. It also was unclear if any special surveys for hard-to-detect or nocturnal species were undertaken. Were any owling routes covered, or were nocturnal species the purview of just those covering specific blocks? Regardless, the project leaders considered a sixth year of coverage in 2019 but decided against it after an evaluation of data from prior years suggested little would have been gained by doing so.

The bare-bones chapter Results includes just one page of text with sections on the number of breeding species, species gained and lost, and most abundant or widespread species. In addition, three tables rank the top ten species with respect to abundance, the number of confirmed blocks, and the number of blocks where detected; a fourth table lists the number of blocks in which the most common representatives of 10 widespread families were detected. The atlas recorded 173 species with either possible, probable, or confirmed evidence of breeding. Of these, 155 species were confirmed breeding in the county, 9 for the first time. The authors were appropriately conservative in not considering the Cinnamon Teal (*Spatula cyanoptera*) and Sandhill Crane (*Antigone canadensis*) confirmed breeding in the county because such evidence was found in blocks straddling the county line but the birds' natal county could not be determined. Similarly, because families of Clark's Nutcrackers (*Nucifraga columbiana*) can move long distances after fledging and the adults may feed their young for many months, observations of fledglings or feeding young in seven atlas blocks were judged not sufficient to confirm the nutcracker's breeding in the county, though it almost certainly occurred. Two species, the Yellow-headed Blackbird (*Xanthocephalus xanthocephalus*) and Willow Flycatcher (*Empidonax traillii*), which bred in the county as recently as 2006, were considered extirpated as breeders during the atlas period.

The chapter Reading the Species Accounts (4 pp.) has sections on nomenclature, taxonomy, and subspecies; bird seasons; relative abundance; conventions and comments; and content of the species accounts. The species accounts (346 pp.) constitute over 90% of the main body of the book and are well researched and informative, representing the book's most noteworthy contribution. The accounts make the most of the atlas data and provide context from other relevant studies. Each of the 167 species accounts includes a map showing breeding distribution and a set of standard

sections (supplemented by four tables): summary, seasonal status, breeding distribution and habitat, breeding phenology and natural history, local and regional trends, and abundance (atlas data, other data). The atlas maps are smaller versions of the map on the inside front cover minus the block numbers and location of the three cities; I had to squint to read the numbers of the major highways. The species accounts are followed by two appendices (shorter accounts for six species of unconfirmed but possible breeders and four species of former breeders), a gazetteer, literature cited, and an index of bird names.

The brevity of the Results, and lack of a discussion, represent an opportunity for a further publication synthesizing the data in this atlas. Graphs could depict how many species fell within various categories of abundance or the number of blocks occupied. Important patterns of distribution could be discussed, and relevant literature could be compared. What species, or proportion of species, spanned the entire county west to east, or occurred mainly on the west slope, east slope, both slopes with a gap at higher elevations, or both higher elevations and the east slope? What might explain such patterns of distribution (perhaps occurrence with respect to key habitat types or the six elevation zones described)? How did patterns of distribution in Nevada County compare to what is known for other counties in the Sierra? How representative is the avifauna of Nevada County of the relatively low elevations of the northern Sierra (north of Sonora Pass), and how is it different or similar to that of the higher-elevation southern Sierra? The basis for such discussion can be found in the species accounts and the distribution maps. Did the precipitation patterns during and immediately preceding the atlas period influence the distribution or abundance of wetland-dependent or other species?

The authors are to be commended for tackling an atlas in a county with few observers, documenting the breeding avifauna of an area with a limited historical record, and for publishing a substantial book in the year following the completion of field work. A troubling trend in county atlases in California as a whole is the often long lag from completion of field work to publication, which is being partly offset by a recent trend of providing online access to preliminary maps during atlas field work and/or final maps after field work but before publication. Another unfortunate aspect of the county-by-county approach is the difficulty of assessing changes in breeding distribution across any of California's ecoregions, such as the Sierra Nevada, or the entire state, given the many counties without atlases and the long time over which atlases have been completed. The county atlases have been undertaken largely by local Audubon Society chapters, local or regional bird clubs, and highly motivated individuals. I hope that at some point atlas work in the state will be embraced by larger conservation and research organizations and government agencies so field work for an atlas for all, or large parts, of California can take place at the same time. In the meantime, there is much merit in fine-grained atlases at the county level, which might not be possible if the entire state were surveyed concurrently, given its large size and extensive remote areas. Hence the Nevada County atlas will be of great value for those interested in the breeding avifauna of the Sierra Nevada or those planning a first or second atlas for their county in this digital age.

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