A Rooftop Bird Survey of Facebook's Living Roof
Three Year Report

Team: Mackenzie Mossing, Shani Kleinhaus, Carolyn Knight, Ralph Schardt
Santa Clara Valley Audubon Society
Jennifer Rycenga
Sequoia Audubon Society

Introduction

Designed by Frank Gehry and CMG Landscape Design, Facebook's Building 20 in Menlo Park includes a 9-acre living roof designed with a palette of native and habitat-creating trees, shrubs, grasses and flowers. The vegetation creates a complex landscape, with bands of habitat that simulate California landscapes, from grasslands to oak savannas and meadows. The building incorporates bird-safe glass with fritting to provide birds with visual cues to minimize the risk of bird strikes.

Through a partnership with Facebook, the Santa Clara Valley and Sequoia chapters of the Audubon Society initiated monthly bird surveys of the living roof in June 2015 (shortly after the building was completed and populated with employees). In these surveys we recorded the species and numbers of birds observed on the roof and documented bird behaviors.

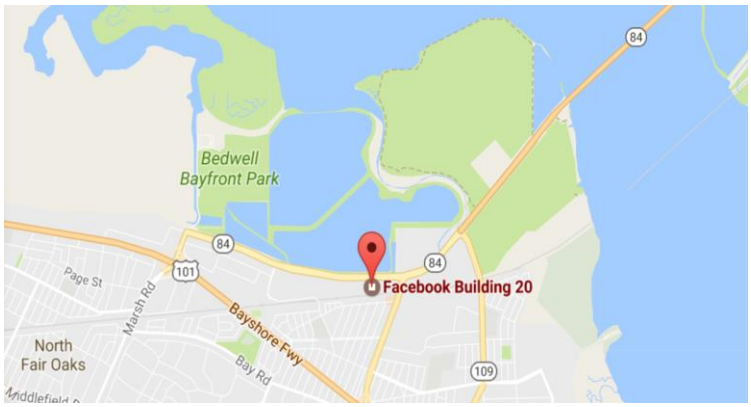
Over the course of three years, 142 individuals from the Bay Area and beyond have participated in the surveys. In October 2017, Assemblyman Marc Berman and California District 24 staff joined us for the survey. The monthly bird survey appeared in the San Francisco Chronicle in February 2017, see http://www.sfgate.com/business/article/Rooftop-garden-at-Facebook-draws-bird-lovers-10907250.php.

This report covers our findings in the months between June 2015 and May 2018. During this time period the Facebook living roof has become a complex breeding and foraging habitat, rich with resources for local, migratory, and wintering bird species.

Site description

The rectangular 9-acre roof of Facebook Building 20 parallels Highway 84 along the San Francisco Bay in the City of Menlo Park. The roof comprises 12 habitat bands, each including a specific palette of trees, shrubs, and flowers. The roof features grassy areas at the western and eastern edges and a central lawn. There are several shade structures and cafes on the roof for employee use. Building 21 was completed in Spring 2018 just west of Building 20. It includes a landscaped roof and a landscaped bridge connecting the two buildings.

Figure 1: Area Map



Methods and Results

We surveyed using the Strip Transect Method (Ralph, 1993). This entailed walking a fixed path in a fixed amount of time: counterclockwise around the main loop, from approximately 7:40 am to approximately 9:10 am. Surveys were usually conducted on the first Friday of each month. All sightings were recorded on a survey form (Appendix I) that specified, for each sighting:

- Species Name
- Number of Individuals
- Location (associated with the nearest Way-finding Place Marker on the rooftop; see Appendix II)
- Activity/behavior

When individuals or flocks could be identified as having been counted earlier in the survey, either because of distinctive features or because of their patterns of movement, then they were counted only once. We recorded temperature, wind, and weather during the survey and in the past 24 hours.

After each roof survey was completed, we continued to survey the ground-level park on the northeastern side of the building. These surveys were completed between 9:15am and 10:00am.

We documented our observations using two citizen-science projects:

- **eBird** is a citizen science-based, national database administered by the Cornell Lab of Ornithology and the National Audubon Society. eBird provides rich data sources for basic information on bird abundance and distribution at a variety of spatial and temporal scales. Reports to eBird help deepen our understanding of local, regional, and international trends in bird populations and bird migration.
- **iNaturalist** is another citizen science-based, international database for all life forms.

In monthly surveys between June 2015 and May 2018, 3,602 birds were observed on the roof, representing 43 avian species. On average, 100 birds comprising 13 species were seen during each survey. The Dark-eyed Junco is the most common species on the roof, with 824 total sightings (Appendix III). On average, 22 juncos were documented during each survey. The four next most common birds were Anna's Hummingbirds (360 sightings), Lesser Goldfinches (320), House Finches (304), and American Crows (258).

Birds that flew over the roof but did not stop on the roof were designated with the term "flyover". Sixteen avian species were observed flying over the roof, but did not stop on the roof. These observations were reported to eBird as they provide important regional and migration information, however we did not include them in analysis and in discussion of birds' use of the living roof.

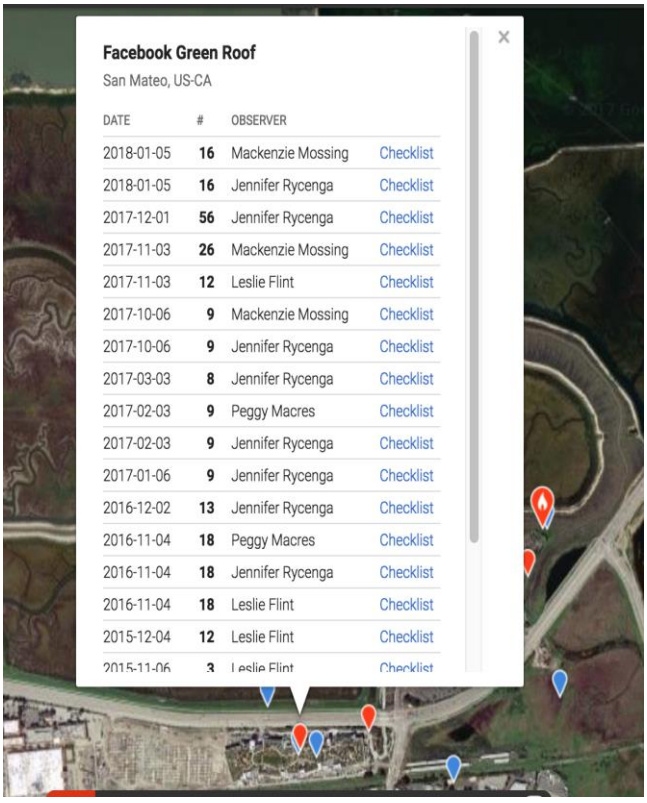


Figure 2: An example of an eBird summary, showing the date, number of birds, and observer name. This list for the Yellow-rumped Warbler reveals that flocks arrive on the roof in the fall and spend winter there before migrating north in the spring.

Additionally, some species were observed in the ground-level park or perched on the pylons and electric wires in the vicinity of the building. We reported these species to eBird and included them in discussion.

Appendix III provides documentation of the number of individual birds from each species observed on the roof during each monthly survey. Appendix IV provides photographs and description of these species including distribution, natural history, and documented behaviors on the roof.

Starting in late 2017, we used iNaturalist to document occurrences of all life forms on the roof. Since the inception of the iNaturalist project, 151 species of birds, plants, mammals, insects, spiders, mollusks, fungi and galls have been documented on the roof. The iNaturalist project for the roof can be accessed at https://www.inaturalist.org/projects/facebook-roof-building-20.

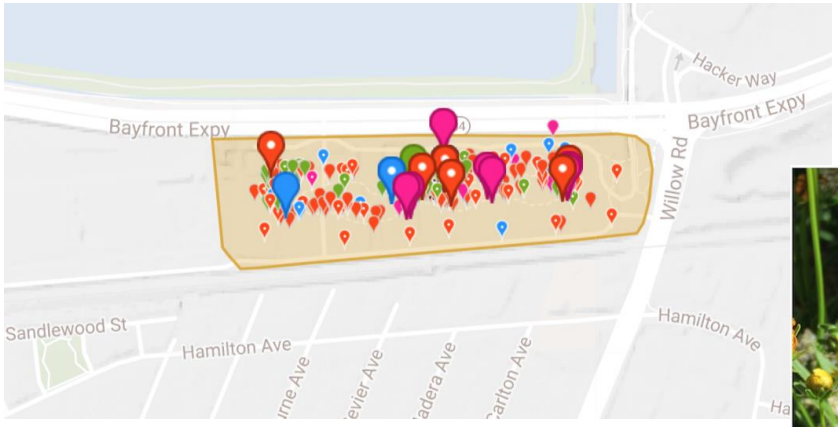


Figure 3: iNaturalist map of the roof / Anise swallowtail (photo: Jennifer Rycenga)

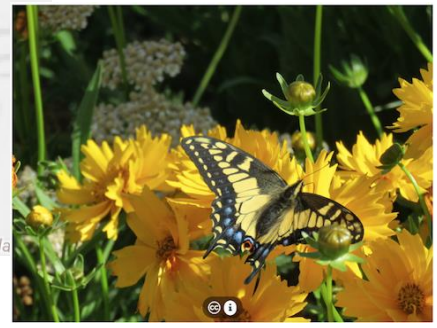


Figure 4: iNaturalist insect observations on the roof.

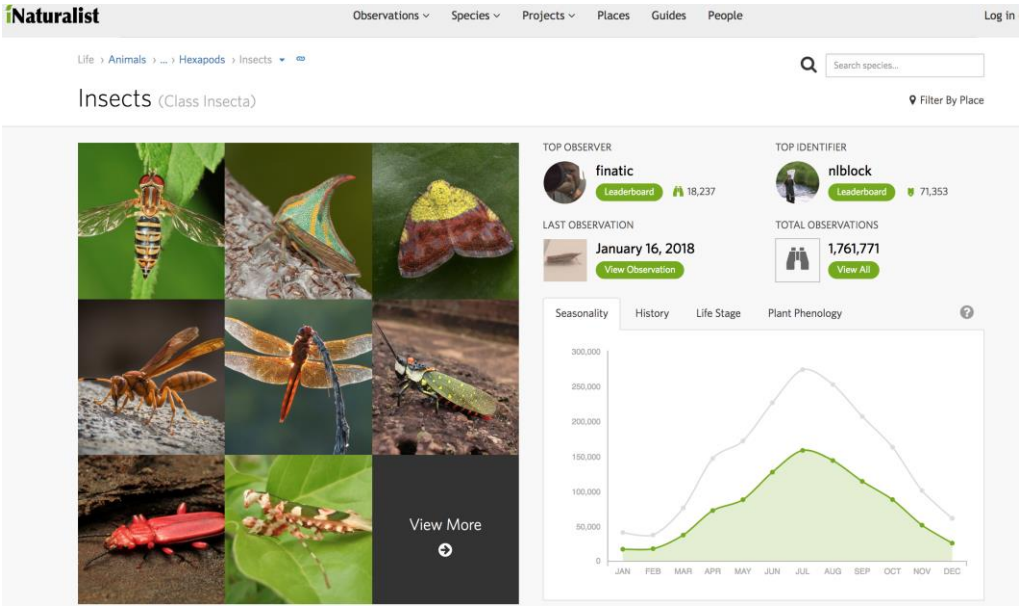


Figure 5: Number of species observed on the roof

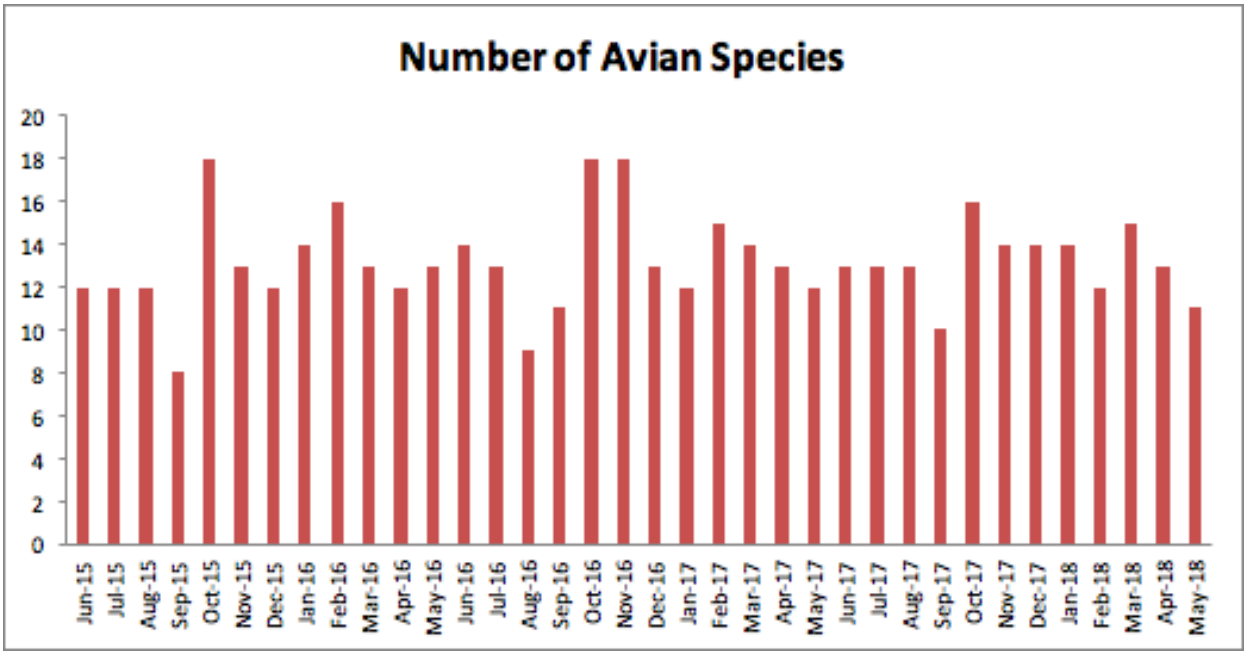


Figure 6: Number of birds observed on the roof

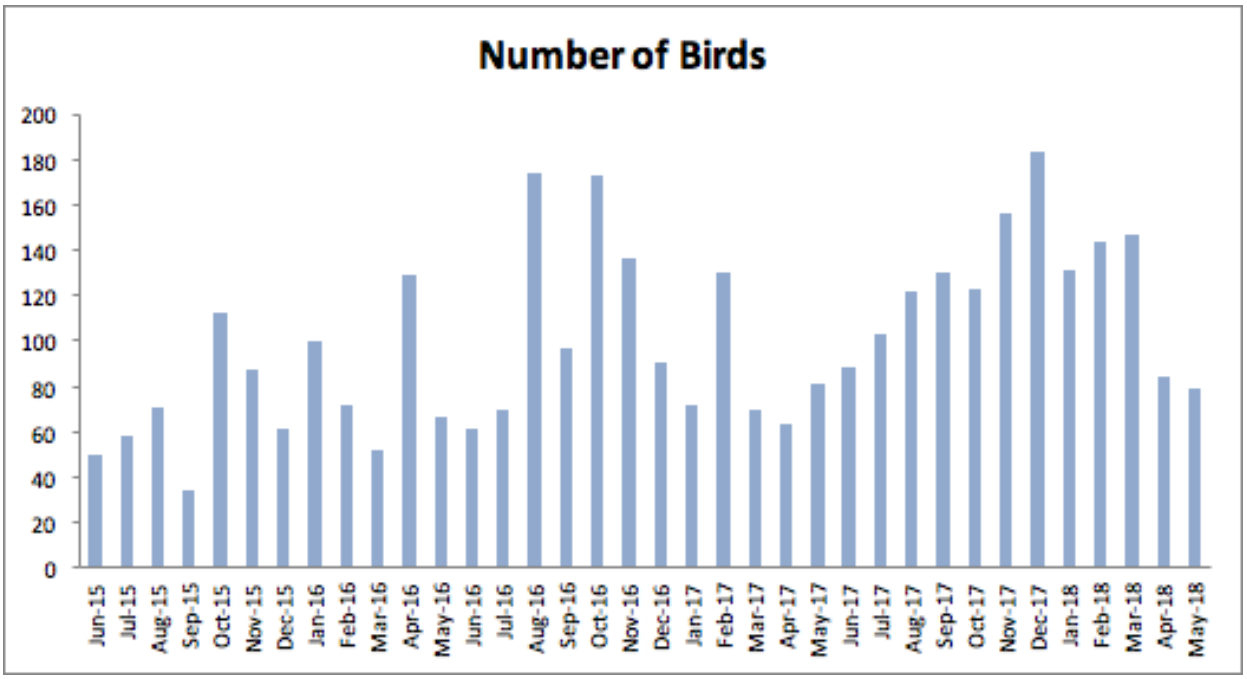


Figure 7: Cumulative number of species observed over time

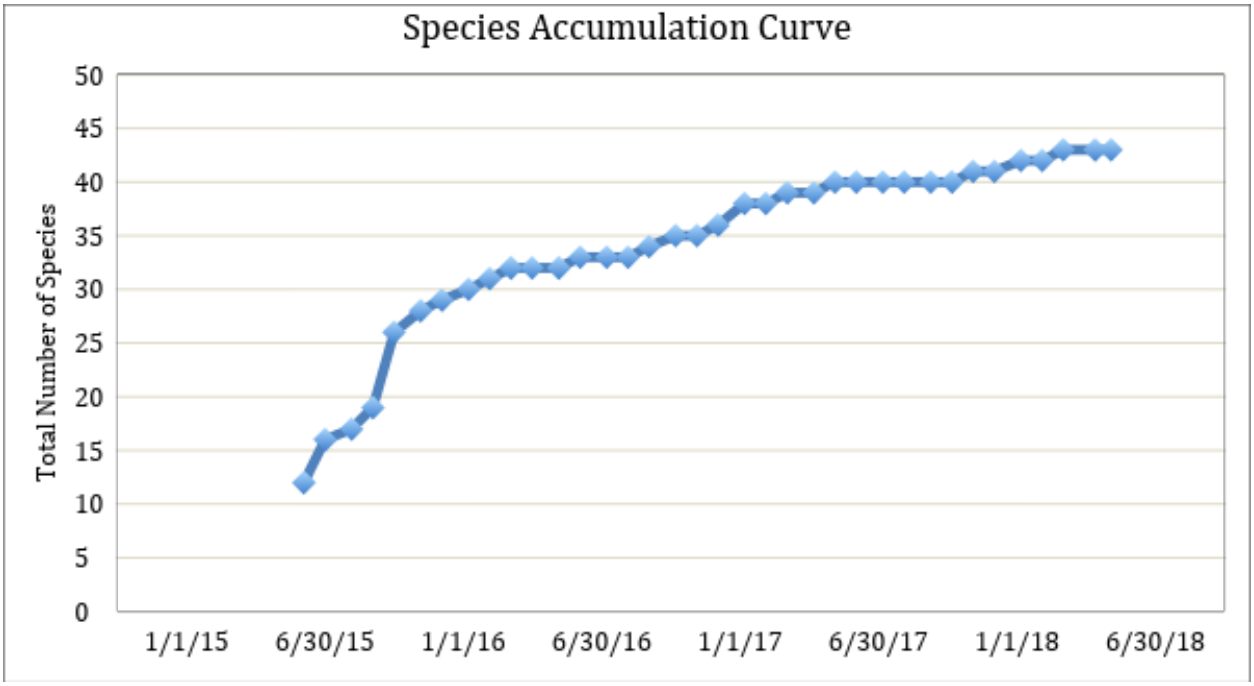


Figure 8: Cumulative number of species observed by season

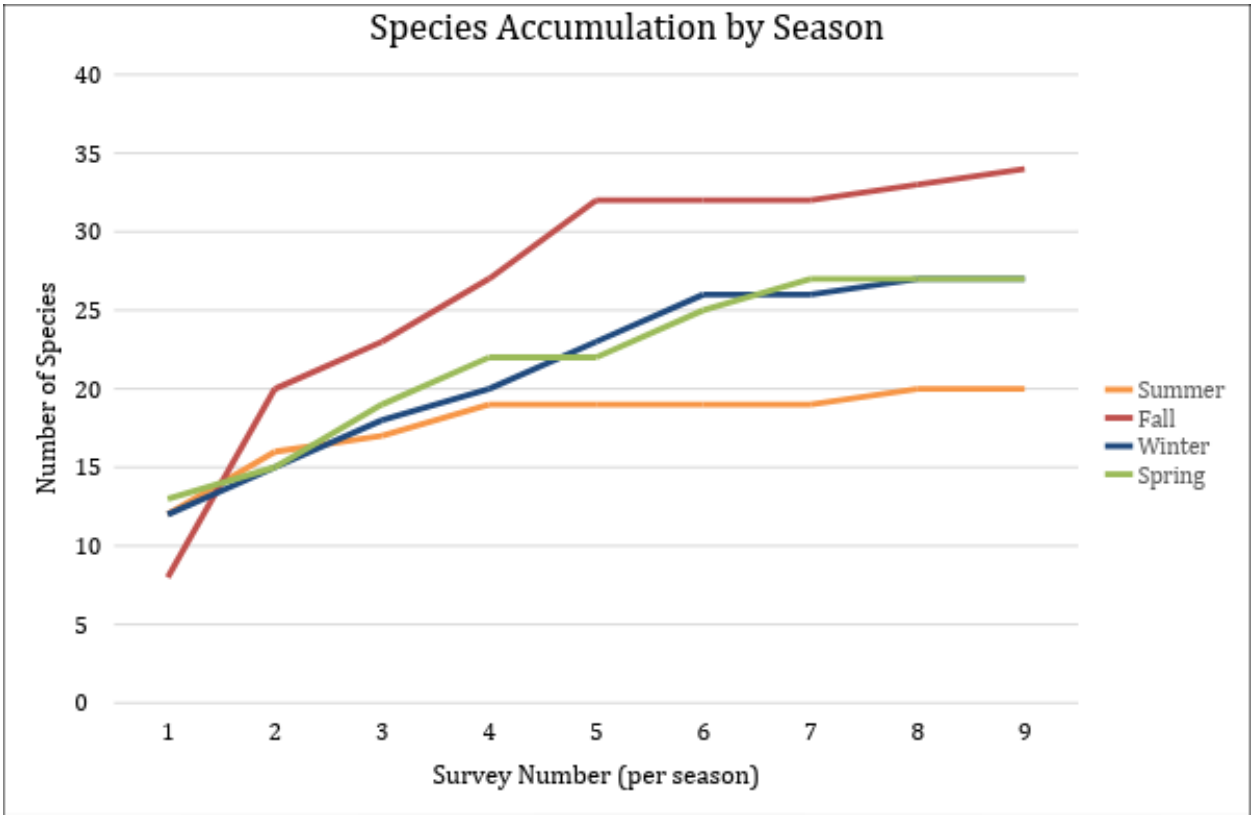


Table 1: Species found in tree palette bands on the roof and in the ground-level park

Region	A	B	C	D	E	F	H	Ground Park
Tree Species	Coast Live Oak, Holly Oak, Ginko and Chinese Flame tree	Coast Live Oak, Big Leaf Maple and California Buckeye	White Alder, Sweet Gum, Chinese Pistache and Fremont Poplar	Coast Live Oak, Camphor Tree and Eastern Redbud	Chinese Flame tree, Crape Myrtle and Chitalpa	Cajeput Tree and Crape Myrtle	Zelkova, Saucer Magnolia and Chinese Elm	White Alder, Monterey Cypress, Ginko, Coast Live Oak, Holly Oak and Southern Live Oak
Number of Bird Species	24	31	27	20	20	25	17	26

Figure 9: Total number of avian species per habitat zone

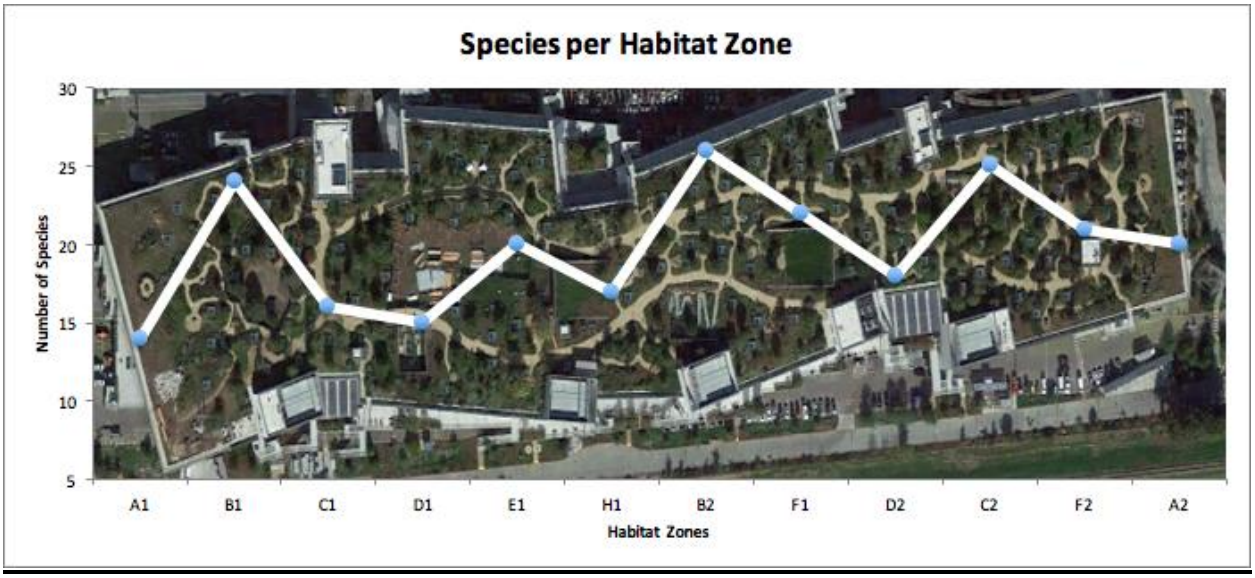


Figure 10: Total number of birds per habitat zone

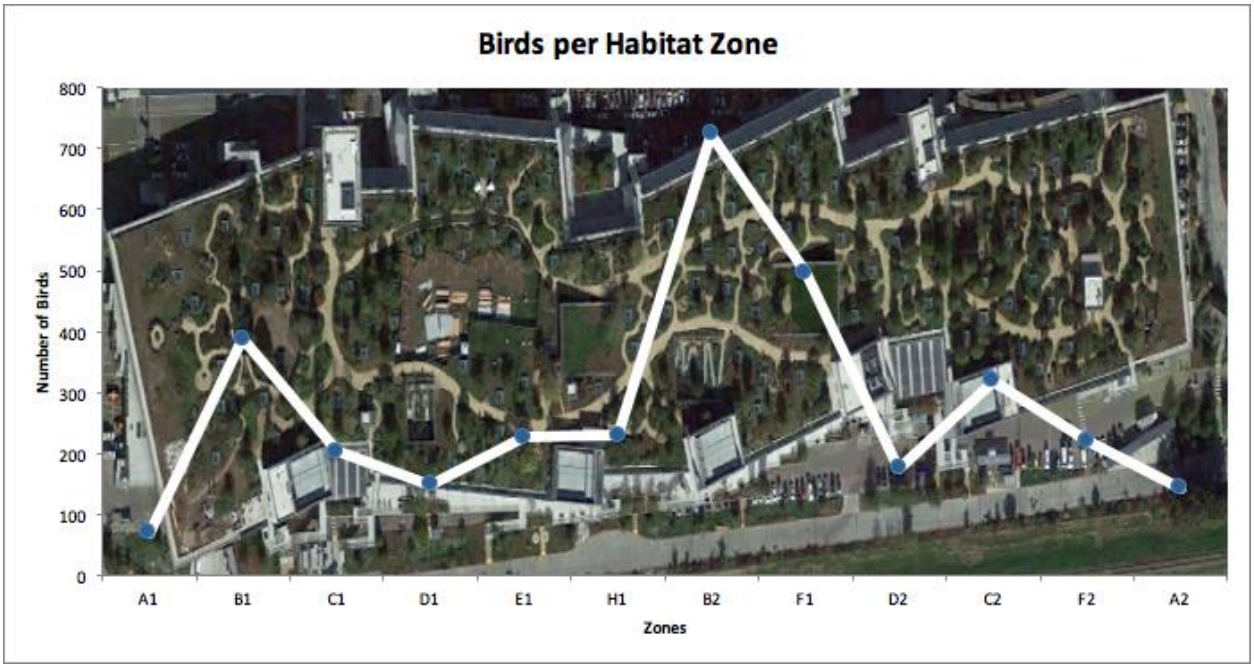
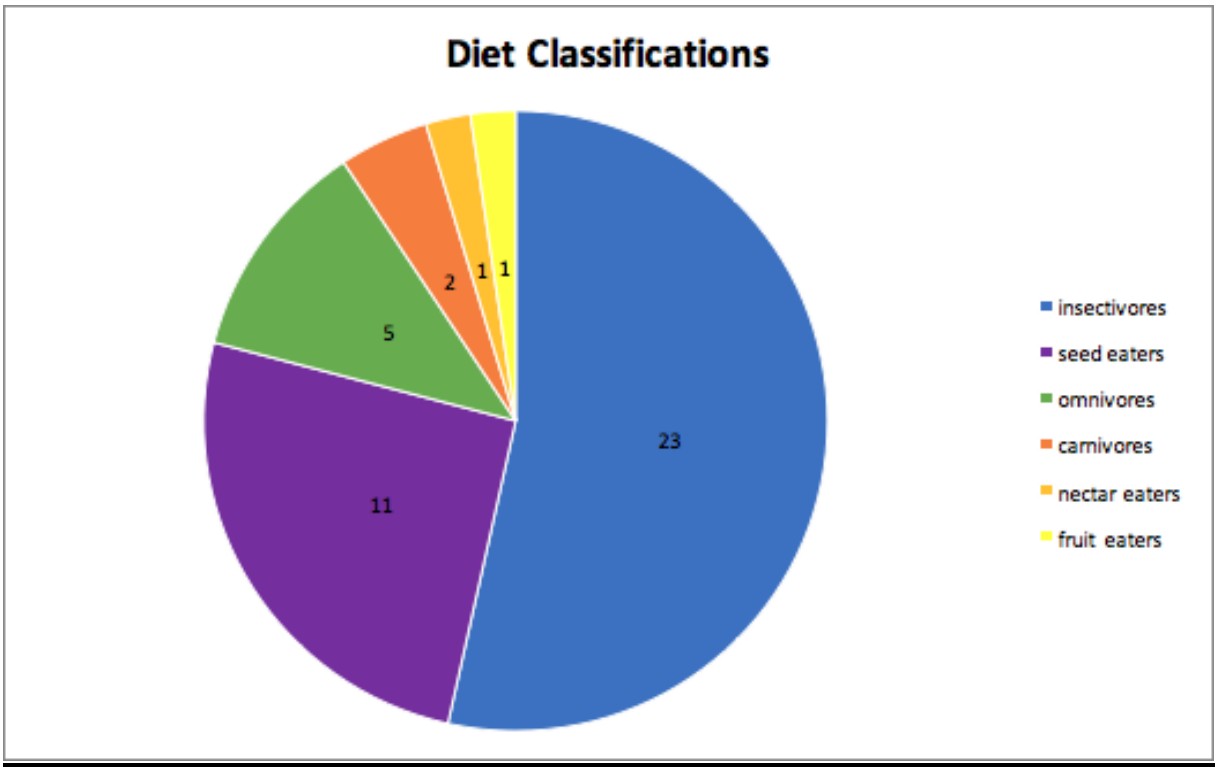


Figure 11: Diet classifications of birds on the roof



Discussion

Survey teams

Survey teams included up to ten people and comprised friends and members of Santa Clara Valley Audubon Society and Sequoia Audubon Society, led by expert Audubon birders. Occasionally, Facebook employees joined us. In three years, 142 individuals have participated in the surveys.

Bird Species

Of the 43 species observed using the living roof habitat (Appendix III), 30 were common backyard birds of the San Francisco Peninsula: seed eaters, insectivores, omnivores, hummingbirds, and the occasional raptor. The remaining 13 species were wintering birds or neotropical migrant species that stopped on the roof while migrating north or south. Flocks of Yellow-rumped Warblers, White-crowned Sparrows, and Golden-crowned Sparrows winter on the roof. Appendix IV provides a full description of each bird species and Appendix V is a tri-fold brochure with pictures of the most common species seen on the roof.

Number of species

The number of species counted per survey fluctuated between 8 and 18 (Figure 5). Most, but not all of the non-migratory species are common backyard bird species in this region. The number of species peaked every October as we observed the arrival of migratory and wintering species.

The species accumulation curve (Figure 7) shows the rate at which new species were documented on the living roof. Initial surveys in 2015 were conducted during the summer and only resident species were observed at that time. A spike in the number of species occurred in Fall 2015 as migratory and wintering birds arrived on the roof. Although the accumulation of species continued gradually over time, additional surveying did not result in a large increase of new species, causing the curve to smooth and plateau.

Figure 8 demonstrates species accumulation by season. Surveys in the fall (September-November) resulted in a greater accumulation of species over time due to the detection of migrants and the arrival of wintering birds. Surveys in the summer (June-August) resulted rarely observed new species; only resident, breeding species were observed. Spring and winter surveys had similar rates of species accumulation.

Non-native species

We observed a number of non-native species on the roof including European Starlings, House Sparrows, Eurasian Collared-Doves, and Rock Pigeons (Appendix III). Humans introduced many of these species to North America in the 19th and 20th centuries. Some of these species, such as the starlings, have had devastating impacts on native bird populations by outcompeting native species for nesting sites, habitat, and food. However, these species are now an intrinsic component of our local avifauna.

Brood parasitism

The Brown-headed Cowbird is an obligate parasitic nester that lays its eggs in the nests of other birds, which then raise the Cowbird young as their own. Mature cowbirds have been seen on the rooftop, as well as juvenile cowbirds being fed by adult Dark-eyed Juncos.

Breeding species

Behavioral evidence shows that Anna's Hummingbirds, Dark-eyed Juncos, Lesser Goldfinches, Bushtits, European Starlings, Brown-headed Cowbirds and House Finches bred on the roof. Observations of their behavior include adults collecting nesting material, courting and preening, as well as chicks begging for food.

A Bushtit nest dangles from a Coast Live Oak on the roof *(photo by Atul Chaudhari)*

Number of birds

From June 2015 through May 2018, 3,602 birds were documented on the roof. As demonstrated by Figure 6, the lowest numbers of birds were recorded in the spring of each year when wintering birds left for their breeding grounds. Following this decline, the number of birds gradually increased between spring and winter as fledglings emerged from their nests in the summer and migrants and wintering birds arrived in the fall. A record number of birds was seen in December 2017 with 183 individual sightings. The vegetation on the roof has grown and matured since the inception of the program, thus we saw more birds in 2017-2018 surveys than in previous years.

Ground-level Park, pylons and electric wires

The ground-level park is small and landscaped with larger trees, primarily conifers (conifers are absent on the rooftop). We found 24 species in the ground-level park. Most species sighted on the ground were also present on the rooftop, but Chestnut-backed Chickadees were common in the ground-level park and rarely observed on the roof – probably due to their preference of conifers and dense woods.

Rock Pigeons, Eurasian Collared-Doves, Mourning Doves, and European Starlings often perched on the electrical wires in the vicinity of the building. American Crows, Common Ravens, Red-tailed Hawks, and other raptors often perched on nearby electrical pylons.

Tree palettes and habitat bands

Table 1 shows the relationship between tree palettes and number of bird species. Areas planted with tree palette B [Coast Live Oak, Big Leaf Maple and California Buckeye] and C [White Alder, Sweet Gum, Chinese Pistache, and Fremont Poplar] continue to attract more bird species than others. It appears that tree palettes that include a larger proportion of native tree species attract more bird species. In addition, birds are attracted to the fruit and the seed produced by the non-native Sweet Gum and Chinese Pistache trees.

Figures 9 and 10 demonstrate that birds prefer to congregate in the center of the roof. This association is attributed to the large diversity of flowers and seed-bearing plants that were planted in Habitat Zones B2 and F1. Additionally, the interior of the roof offers birds protection from wind and a stronger sense of security than on the edges of the roof. Birds also tended to congregate in other habitat bands that provide native trees, complex vegetation structure, and a variety of seed-bearing flowering plants. Grassy areas at the edges and the lawn attracted fewer species and fewer individual birds.

Food sources on the roof

Of the 43 avian species observed on the roof, 23 are primarily insectivores, 11 are primarily seedeaters, and 5 are omnivores (Figure 11). Anna's Hummingbirds feed primarily on nectar and are the lone nectar eaters that have been sighted on the rooftop. Cedar Waxwings feed primarily on fruit and berries. Red-shouldered Hawks and Cooper's Hawks were the only carnivorous species that perched on the roof during 36 months of surveying, although Red-tailed Hawks and Peregrine Falcons have been observed flying over the roof, potentially foraging. Food sources on the roof are described in Appendix VI.

While we have not specifically monitored for invertebrates in our surveys, many mature and immature insects and arachnids amid the rooftop vegetation including spiders, beetles, butterflies, and flies have been observed. Manzanita shrubs and oak trees infected with wasp galls also provide food for insectivorous birds. Flower seed heads, grasses, shrubs, and trees planted on the roof produce seeds for foraging seed-dependent birds. Facebook maintenance crews did not remove senescing flowers and allowed seeds to develop and serve as forage for birds.

Omnivorous birds consume both seeds and insects. Around the rooftop cafes, gulls, crows, ravens, pigeons and juncos foraged on human food crumbs left behind on the ground.

Raw data
Appendix VII contains all of the raw data compiled between June 2015 and May 2018.

House Finch (left), White-crowned Sparrow (middle), and Bewick's Wren (right) on the roof
(photos: Jennifer Rycenga)

List of Appendices
Appendix I: survey form
Appendix II: map of roof
Appendix III: clean data
Appendix IV: bird descriptions
Appendix V: brochure
Appendix VI: food sources
Appendix VII: raw data

References

Ralph, C. John et. Al.,1993. Handbook of Field Methods for Monitoring Landbirds. United States Department of Agriculture Forest Service Pacific Southwest Research Station
General Technical Report PSW-GTR-144-www

eBird. By the Cornell Lab of Ornithology and Audubon. http://ebird.org/

Acknowledgements

We thank Facebook for funding this project and providing Santa Clara Valley Audubon Society and Sequoia Audubon Society with the opportunity to survey the living roof. Lauren Swezey has enthusiastically encouraged us and communicated the survey efforts to Facebook employees, and Facebook's security team provided logistics support.

A special thanks to lead birders David McIntyre and Jennifer Rycenga for helping us to identify birds on the roof. We thank birders and volunteers from Santa Clara Valley Audubon Society and Sequoia Audubon Society who participated in the surveys.

Shani Kleinhaus, Ph.D., Environmental Advocate for the Santa Clara Valley Audubon Society, directed the project.