



North Coast and Cascades Network Landbird Monitoring

Report for the 2022 Field Season

Natural Resource Data Series NPS/NCCN/NRDS—2023/1401





ON THIS PAGE

2022 field crew at North Cascades National Park Complex

THE INSTITUTE FOR BIRD POPULATIONS / MANDY HOLMGREN

ON THE COVER

Townsend's Warbler (*Setophaga townsendi*), Olympic National Park

THE INSTITUTE FOR BIRD POPULATIONS / MELISSA MARSHALL

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Report for the 2022 Field Season

Natural Resource Data Series NPS/NCCN/NRDS—2023/1401

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Executive Summary

The North Coast and Cascades Network (NCCN) continued to implement the Network's Landbird Monitoring Protocol in 2022, in partnership with The Institute for Bird Populations. The protocol was initially field-tested with data collected from the annual panel only, as part of protocol development during 2005–2006, and has subsequently been implemented fully (including data collection on the annual panel as well as five alternating panels) for the past 15 years (2007–2021), except for 2017 when data collection was temporarily suspended to reallocate resources for a 5-year data synthesis. In 2022, we conducted 1,189 point counts at point count survey stations along 68 transects in the large wilderness parks of the NCCN, including Mount Rainier National Park (MORA), North Cascades National Park Complex (NOCA), and Olympic National Park (OLYM). We also conducted 72 point counts at Lewis and Clark National Historical Park (LEWI), including 36 at Cape Disappointment, 28 at Fort Clatsop, 5 at Sunset Beach, and 3 at Yeon.

Across the three large parks, we documented the presence of 130 species and one hybrid, 105 of which were detected during point counts. For 57 species (all species for which we amassed at least 96 point count detections over the period 2005–2022), we present the total number of detections of each species on each park's annual panel transects during the 2005–2022 field seasons. We caution, however, that these detection totals have not been adjusted for differences in survey effort, observer effects, or potential differences in detectability of birds between years; such adjustments will be made in conjunction with trend analyses in a future multi-year report.

The number of bird detections on annual-panel transects across all three large parks decreased by 650 between 2021 and 2022, though the magnitude of change varied among the parks. At both MORA and OLYM detections decreased between 2021 and 2022. When factoring in the number of point counts conducted each year, both parks saw a decrease in the average number of birds per count (a decrease of 9% at MORA and 24% at OLYM). At NOCA there was very little change in the number of detections between 2021 and 2022.

A measurable part of the overall decrease in detections across the Network in 2022 was due to a high number of red crossbill detections in 2021, particularly at MORA and OLYM. We detected them in higher numbers in both of these parks than in any of the previous 15 years, but in 2022 our detections dropped to numbers more similar to previous years. Several other species were also detected in slightly lower numbers in the three large parks in 2022 than in 2021, which contributed to the overall decrease in detections. Golden-crowned kinglet and Pacific wren detections in particular decreased across all three parks between 2021 and 2022. Despite these slight changes, overall detection numbers of most species across the parks were not markedly different between the two years. Interpretation of these results will be completed as part of the next multi-year trend analysis, which will account for annual variation in survey effort, observer effects, and detection probability.

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Introduction

Many bird species in North America have declined substantially during the past half century, with an estimated 3 billion birds, nearly 30% of the total, lost since the 1970s (Rosenberg et al. 2019). Causes of these losses are varied and in some instances are not fully understood, but in the Pacific Northwest have historically included outright habitat loss as well as forest management practices that discouraged the development of old-growth conditions and greatly reduced the extent of old-growth forest conditions throughout the region (Bolsinger and Waddell 1993). Landscapes that have been managed for timber production have been largely converted to early- and mid-successional forests (Bunnell et al. 1997), with increased fragmentation as well as a variety of altered structural characteristics that likely affect bird community composition. Species that breed in the subalpine and alpine zones face other stressors, including recreation impacts and ecological changes resulting from alterations of the natural fire regime.

More recently, climate change has been increasingly understood to be both a driver of recent changes in bird populations and is the greatest known threat in the coming decades (Thomas et al. 2004). Climatic warming and drying may negatively affect birds directly through physiological stress (Khaliq et al. 2014, McKechnie 2019), or indirectly through changes in vegetation (including changes prompted by climate-altered fire regimes), reduced prey availability, phenological shifts in prey availability, disease outbreaks, or other ecological changes (Crick 2004, Albright et al. 2010, Auer and Martin 2013, Matthews et al. 2011, Scridel et al. 2018). Ecological consequences may be complex and inter-related and depend on traits of individual species (Cormont et al. 2011, Tingley et al. 2012) and ecosystems (Albright et al. 2010), with montane ecosystems considered particularly susceptible to effects of climate change (IPCC 2013, 2014).

Climatic and other stressors are expected to increase in the coming years, and challenge national park resources (National Park System Advisory Board Science Committee 2012, Monahan and Fisichelli 2014). Understanding the responses of bird populations to these stressors is critical, especially in mountainous regions where steep and complex terrain can function as climate refugia that can be harnessed in contemporary plans for critical habitat management and species conservation in the face of climate change (Morelli et al. 2016). However, disentangling implications of recent climate change for bird populations across the broader landscape is challenging, in part because of confounding factors associated with habitat loss and changing land use and land management (Scridel et al. 2018). Fortunately, national parks provide opportunities to assess effects of climate change in the absence or diminution of some of these confounding factors (Silsbee and Peterson 1991, Simons et al. 1999, Siegel et al. 2012), although migratory bird species may nevertheless be affected by such factors during other portions of their annual life cycle.

The three large parks in the North Coast and Cascades Network (NCCN)—Olympic National Park (OLYM), North Cascades National Park Service Complex (NOCA), and Mount Rainier National Park (MORA)—range from sea level to nearly 4,400 m and contain huge tracts of late-successional conifer forest on the Olympic Peninsula and the west slope of the Cascades, as well as large areas dominated by subalpine and alpine plant communities. NOCA also contains substantial tracts of

more arid conifer forest typical of the east side of the Cascades, which hosts a somewhat distinct avifauna (Altman 2000) compared to other areas in the three large parks. San Juan Island National Historical Park (SAJH), in the rain shadow of the Olympic Mountains, contains small but important examples of coastal prairie and Garry Oak (*Quercus garryana*) woodlands, plant communities that are fairly rare in western Washington (Atkinson and Sharpe 1985) and host unusual bird communities (Lewis and Sharpe 1987, Siegel et al. 2009d). Lewis and Clark National Historical Park (LEWI) contains lowland wetlands as well as coastal and upland forests and extends our program's area of inference substantially southward. Avian inventory projects assessing park- and/or habitat-specific abundance of all commonly occurring bird species at all five parks (Siegel et al. 2009a, Siegel et al. 2009b, Siegel et al. 2009c, Siegel et al. 2009d, Wilkerson et al. 2009a), have provided baseline information for assessing changes in bird abundance and distribution over time due to climate change or other factors, as well as reference information for assessing recent trends within the parks and the effects of more intensive land management practices elsewhere in the region (Siegel et al. 2012, Ray et al. 2017a, Ray et al. 2019).

National parks in the NCCN and elsewhere fulfill vital roles as both refuges for bird species dependent on late-successional forest conditions (North American Bird Conservation Initiative, U.S. Committee 2011), and as reference sites for assessing the effects of climate change, land use, and land cover changes on bird populations throughout the larger Pacific Northwest region (Silsbee and Peterson 1991, Siegel et al. 2012). Additionally, long-term monitoring of landbirds throughout the NCCN provides information valuable for decision-making about important management issues in the parks, including visitor impacts, fire management, and the effects of introduced species.

The specific objectives of the NCCN Landbird Monitoring Project are:

- 1) To detect trends in the density of as many landbird species (including passerines, near passerines, and galliformes) as possible throughout accessible areas of five NCCN parks during the breeding season.
- 2) To track changes in the breeding season distribution of landbird species throughout accessible areas of the three large wilderness parks.

In this report we make basic comparisons between data collected in 2022 and the previous 15 years of data collection (Siegel et al. 2008, Wilkerson et al. 2009b, 2010, Holmgren et al. 2011–2017, 2019–2022). This report and previous annual reports for the Landbird Monitoring Project are intended primarily as administrative data reports. More comprehensive analyses of these data, including trend analysis that accounts for the potentially confounding effects of variation in detectability and sampling effort, are conducted in conjunction with periodic detailed trend analyses. The first trend analysis report summarizes data from 2005–2012 (Saracco et al. 2014). An analytical framework has been developed for this project that integrates several recent developments in Bayesian N-mixture modeling to assess landbird trends and evaluate the role of climatic and other spatiotemporal variables in driving those trends, yielding a technical report and two published papers (Ray et al. 2017a, 2017b, 2019).

Study Area

The study area for the NCCN Landbird Monitoring Project (Figure 1) includes areas of MORA, NOCA and OLYM that are accessible by foot and lie within one km of a road or trail, as well as all of SAJH (including both American Camp and English Camp) and portions of LEWI.

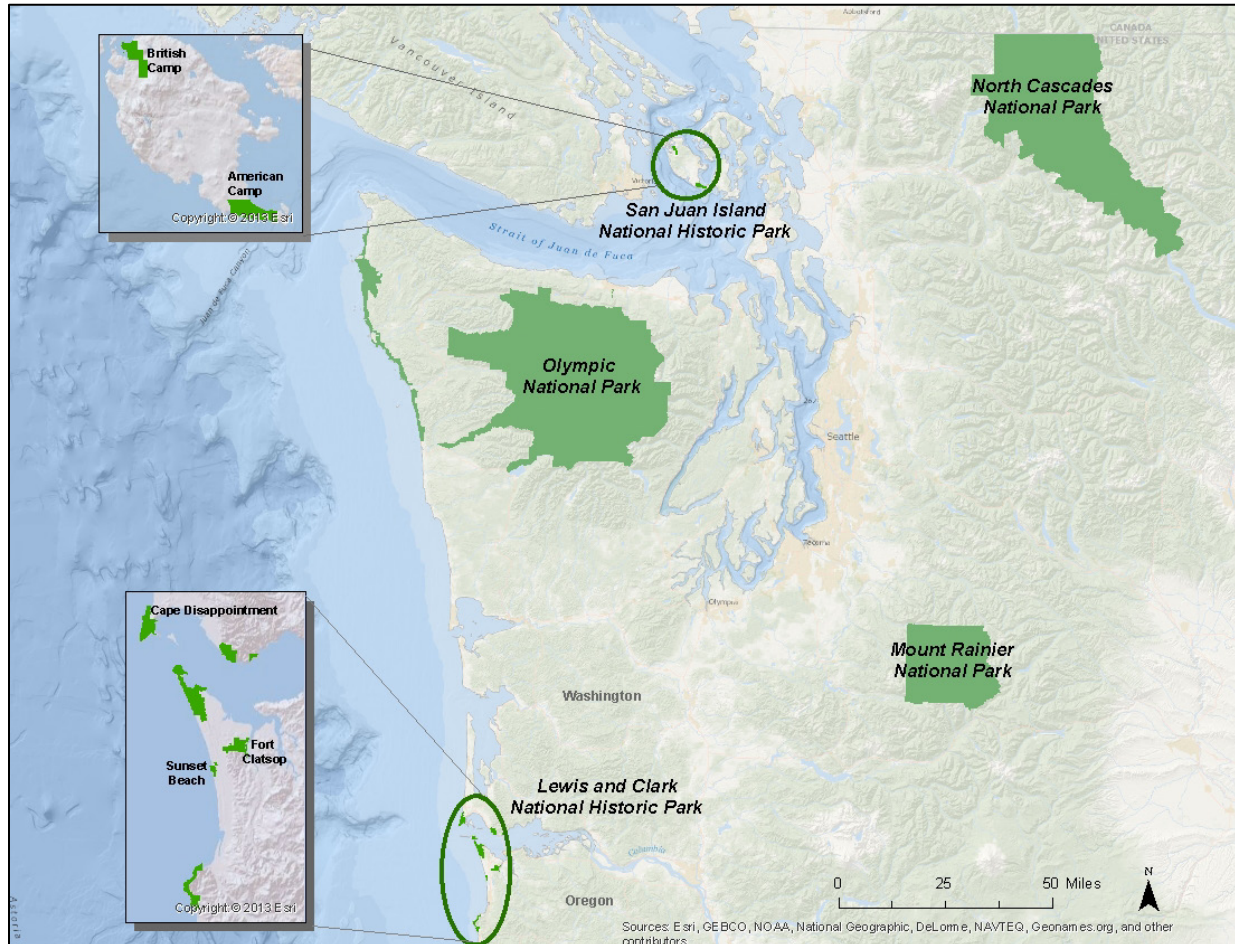


Figure 1. National Park Service units participating in the North Coast and Cascades Network Landbird Monitoring Project.

Methods

Sample Design

A detailed description of the sample design for the NCCN Landbird Monitoring Project is provided in the NCCN Landbird Monitoring Protocol (Siegel et al. 2007). In brief, the sample design for the three large parks utilizes six panels of transects in each park. At NOCA and at OLYM each panel includes four low-elevation transects (transect starting points <650 m), four mid-elevation transects (transect starting points between 650 m and 1,350 m) and four high-elevation transects (transect starting points >1,350 m). At MORA the sample design is the same as at the other two large parks, except there are only two low-elevation transects in each panel, and the cutoff between low-elevation transects and mid-elevation transects is 800 m rather than 650 m. All transect starting points are on park roads or trails, and the transects consist of a line of approximately 10–20 points, extending perpendicularly (or as close to perpendicularly as topographic and physiographic features allow) in both directions away from the trail.

In 2022, we implemented the full study design in the three large parks for the fifteenth year, including surveys of the annual panel ('Ann1') as well as the fifth alternating panel ('Alt6') (Figures 2–4). The protocol was initially field-tested with data collected from the annual panel only as part of protocol development during 2005–2006, and has subsequently been implemented fully (including data collection on the annual panel as well as all of the five alternating panels) for the past 15 years (2007–2022), except for 2017 when data collection was temporarily suspended to reallocate resources for a 5-year data synthesis (Ray et al. 2018). Results from each of the first 15 years of full implementation are presented in Siegel et al. (2008), Wilkerson et al. (2009b, 2010), and Holmgren et al. (2011–2017, 2019–2022). Multi-year trend analyses are provided in Saracco et al. (2014) and Ray et al. (2017a).

At the two smaller parks (LEWI and SAJH), the sample design consists of a systematic grid of point count survey stations, with the two parks scheduled to be surveyed in alternating years. In the summer of 2022, we surveyed the grid at LEWI (Figure 5). Multi-year trend analyses for the small parks are provided in Ray et al. (2019).

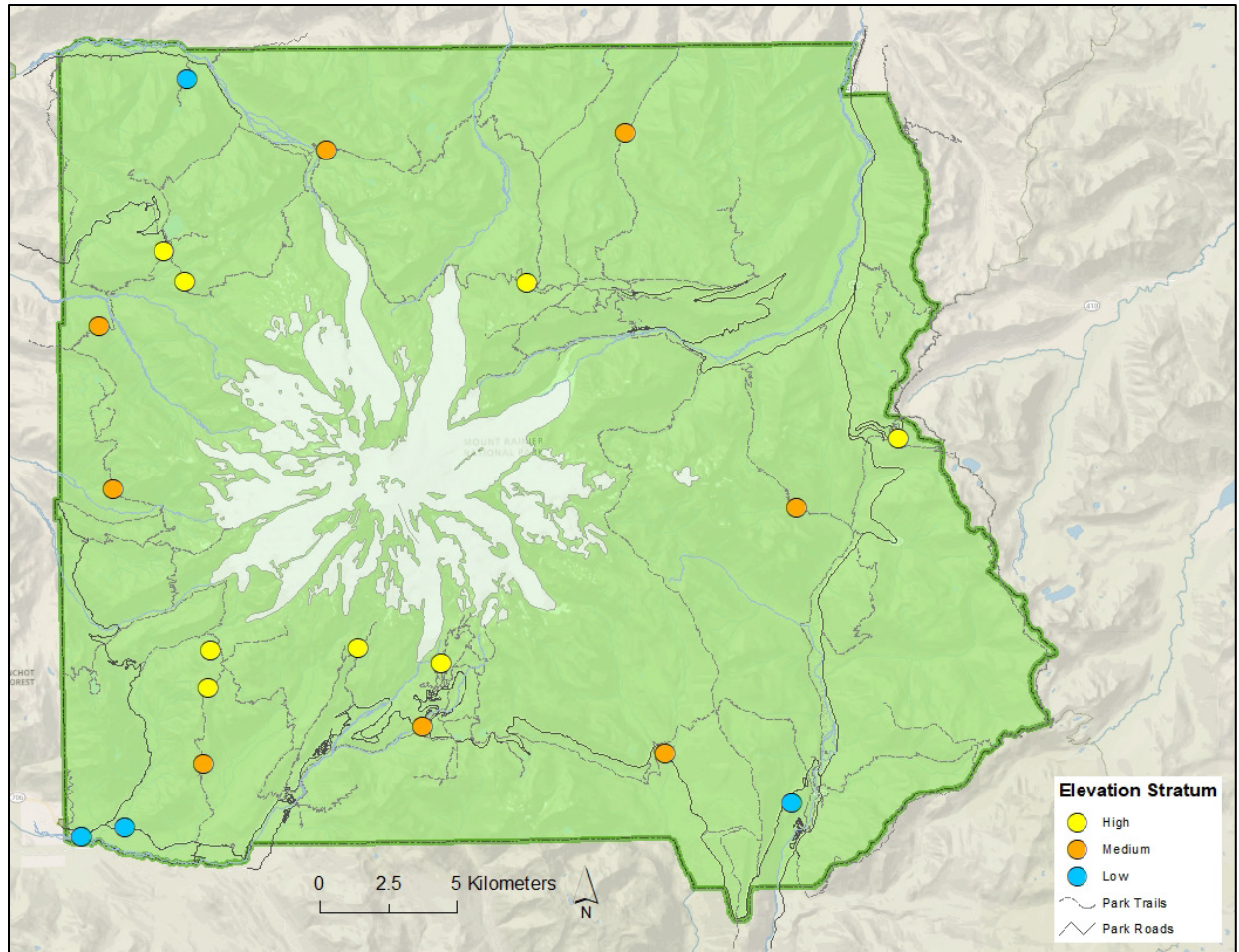


Figure 2. Approximate locations of transects conducted at Mount Rainier National Park in 2022.

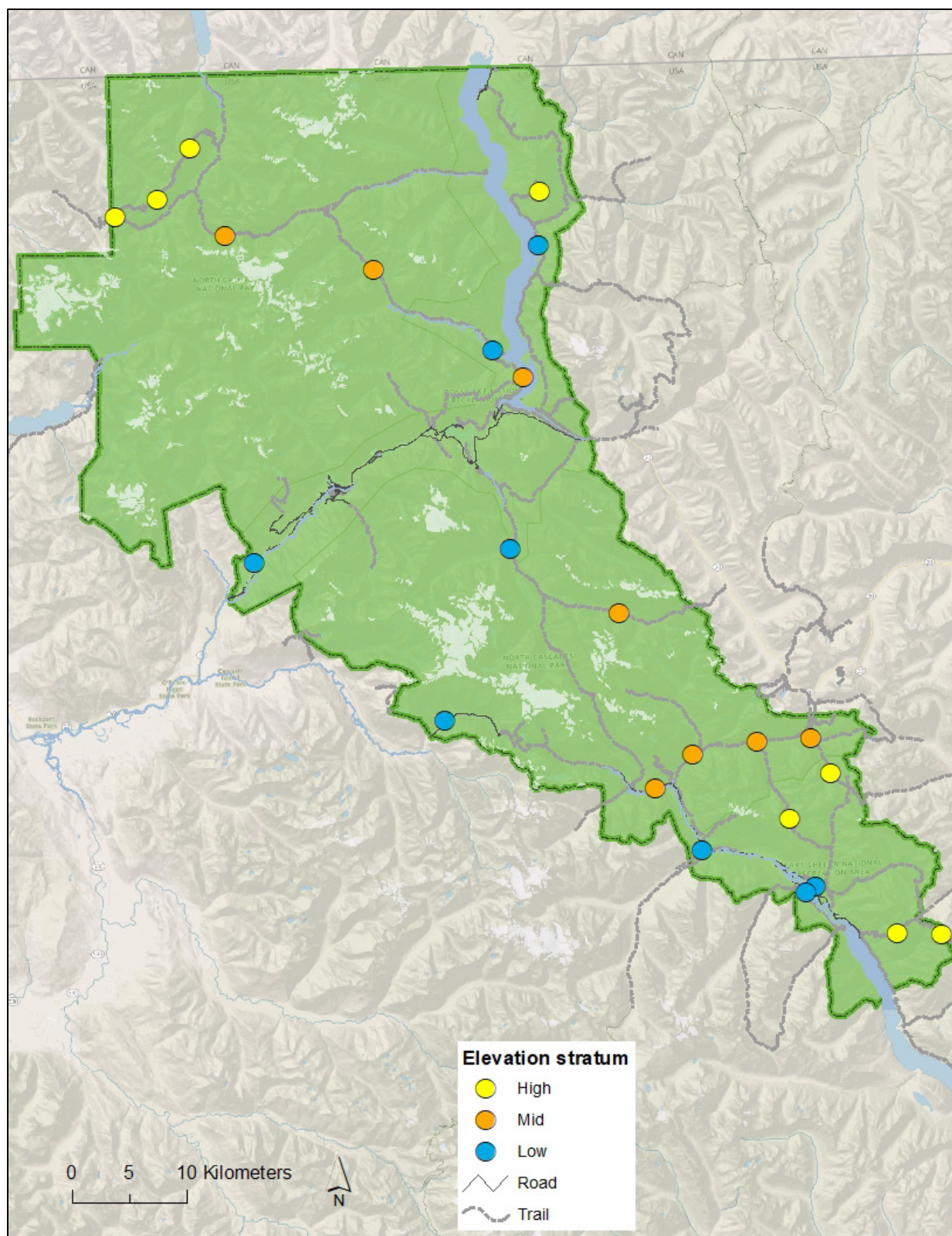


Figure 3. Approximate locations of transects conducted at North Cascades National Park Complex in 2022.

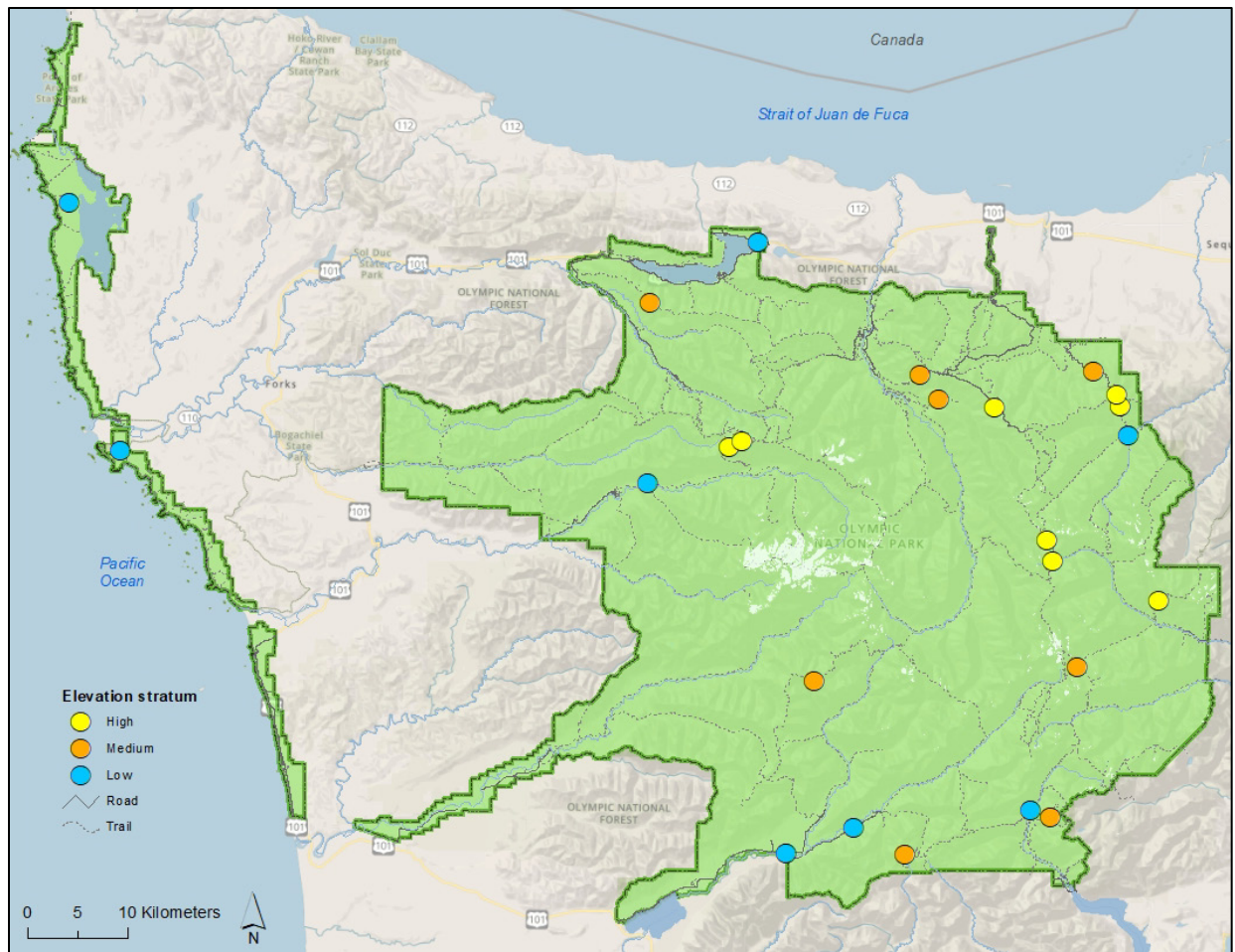


Figure 4. Approximate locations of transects conducted at Olympic National Park in 2022.

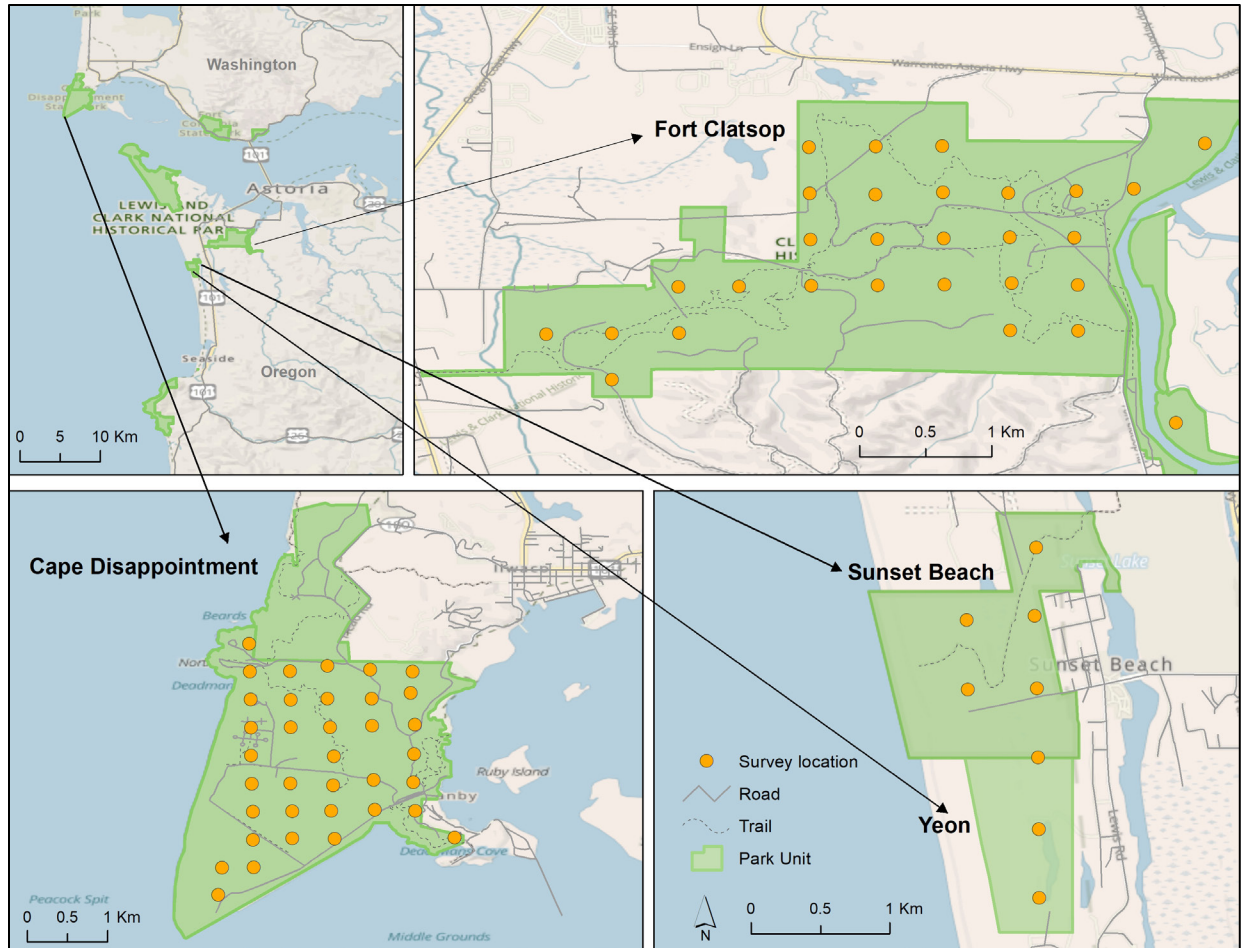


Figure 5. Locations of point count stations surveyed at Lewis and Clark National Historical Park in 2022; adjacent point count stations are 350 m apart.

Crew Training and Certification

Mandy Holmgren, a Staff Biologist with The Institute for Bird Populations, served as the 2022 Field Lead. Mandy began training five field technicians on April 30, including one returning crew member, who assisted with training. Training followed guidelines described in the NCCN Landbird Monitoring Protocol (Siegel et al. 2007). Two additional technicians were returning from previous years, so there were only two new crew members. The official training session extended later than in previous years due to an outbreak of COVID-19 on the crew, which led to a temporary suspension of training. By the end of the official training session on May 25, neither of the two new field technicians had passed the rigorous point count certification exam. However, both passed the exam within two weeks of the end of training, and were able to begin collecting data. All individuals who collected data during the 2022 field season (Table 1) were employees or volunteers of The Institute for Bird Populations.

Table 1. Observers who conducted point counts in the North Coast and Cascades Network in 2022.

Observer	Role
Pearl Barry	Technician
Gabrielle Bedeian	Technician
Eric Guzman	Technician
Mandy Holmgren	Field Lead
Melissa Marshall	Technician
Quinn McMahon	Technician
Matt Schumaker	Technician
Carter Urnes	Technician

Data Collection

All point count data were collected between June 7 and July 27 at MORA, between June 4 and July 31 at NOCA, and between May 27 and July 30 at OLYM. At the three large parks, low-elevation transects were generally surveyed first, followed by the mid-elevation transects, and finally the high-elevation transects.

Data collection followed the detailed procedures explained in the NCCN Landbird Monitoring Protocol (Siegel et al. 2007). Crew members generally worked in pairs to survey a single transect each morning. Crew members were provided maps and coordinates of all point count station locations on the transects, as well as narrative descriptions of point count stations and the travel routes between successive stations. These were used to locate the same point count stations that were previously established and surveyed. Beginning within 10 minutes of official sunrise, each observer conducted a point count, and then continued along the transect route, conducting another point count every 200 m until 3.5 hours after official local sunrise.

At each point count station, observers recorded the starting time, scored the degree of noise interference caused by such factors as flowing water or wind, recorded the weather conditions, and then began the seven-minute point count. The point count was partitioned into three time intervals (0–3:00, 3:01–5:00, and 5:01–7:00). Observers noted each time interval in which they detected each individual bird. Birds observed in the first three minutes allow comparison with Breeding Bird Survey data (Sauer et al. 2019), which are based on three-minute counts. Observers estimated the horizontal distance, to the nearest meter, to each bird detected. The observers also recorded whether the distance estimates were based on an aural or visual detection, and whether the bird ever sang during the point count. Prior to 2011 we used point counts with durations of only five minutes broken into two time intervals (0–3:00, 3:01–5:00), but in 2011 we added the third time interval to make the data more useful for analysis within an occupancy modeling framework that relies on detection or non-detection of individual birds within multiple time intervals to estimate detection probability.

After completing their last point count each morning, observers retraced their steps back to the starting point. Along the way, they conducted a brief habitat assessment at each of the survey points. The brief habitat assessment consisted of characterizing habitat within a 50-m radius of the survey

point, noting the primary (and secondary, if appropriate) plant community type, canopy cover class, and tree size class, according to the categories developed by Pacific Meridian Resources (1996). While conducting the habitat assessments, observers also used Global Positioning System (GPS) units to collect location data files. Where necessary, observers amended narrative descriptions of the point locations.

Whenever crew members detected species thought to be rare in the park or difficult to detect during diurnal point count surveys, they completed “Rare Bird Report Forms”, including descriptions of the birds’ appearance, behavior, and precise location. These reports covered not only birds detected during point counts, but also birds detected while sampling vegetation, hiking between transects, relaxing at camp in the evening, or at any other time during the field season, including the pre-season training session. Additionally, crew members recorded a complete list of all incidental bird species detected in the park throughout the field season, including common species that might not have been recorded during point counts or were not rare enough to warrant a rare bird report.

After completing their fieldwork each day, partners reviewed each other’s data forms for missing or incorrectly recorded data, discussed any interesting or surprising bird detections, and completed a Transect Visit Log summarizing the day’s efforts.

Data Management

The Landbird monitoring protocol for national parks in the North Coast and Cascades Network (Siegel et al. 2007) requires crews working at each large park to enter as much of their own data into the NCCN Landbird Monitoring Project’s Microsoft Access database throughout the field season as they can. The crew worked three additional days at the end of the field season to continue entering and verifying data. The Field Lead finished verifying the remaining data after the field season. Data entry procedures followed the guidelines in Siegel et al. (2007).

The project database includes built-in quality assurance components such as pick-lists and validation rules to test for missing data or illogical combinations. After entering the data, the Field Lead verified the database records for complete and accurate transcription by retrieving and visually comparing the data associated with each sampling event against the original forms.

Once all data for the season were entered and verified, the Field Lead conducted a rigorous quality review on the data set by running a set of pre-built validation queries to check for completeness, missing or out-of-range values, logical consistency, and structural integrity. Errors identified during this review were corrected where possible, and annotations related to specific issues raised by each query were stored within the project database as needed and appropriate. The data set was then certified as complete and ready for use. Output for this report was generated using standard summary queries in the project database.

After the field season, field forms were scanned and stored with digital records. Photographic images were processed to remove poor quality or duplicative files, given names according to convention, and organized according to project requirements. GPS data associated with sampling events were

downloaded and processed, and the resulting coordinate data were then uploaded into the project database.

Data Analysis

We summarized and tabulated data according to the template in Siegel et al. (2007). Climate data for the 2022 season were sourced from the Office of the Washington State Climatologist (2022). We present survey results without making any adjustments for detectability, which may vary substantially by species, habitat, observer, or other factors. In conjunction with periodic trend analyses for this monitoring project, factors affecting detectability of birds during point counts are assessed quantitatively, allowing for annual results to be adjusted to account for variable detectability (Buckland et al. 2001, Nichols et al. 2009, Ray et al. 2017b). Results in this report that have not yet been adjusted to account for detectability should be viewed as provisional only.

Results

2022 Field Season

We completed our fifteenth year of full implementation of the NCCN Landbird Monitoring Project with the experience gained from two pilot field seasons (2005 and 2006) and 14 previous years of full protocol implementation. Our procedures for season preparation, data collection, data management, data analysis, and reporting have all been well vetted, and required no substantial changes this year.

The season started off with a near-average to slightly above average snowpack across all three parks on May 1. However, in contrast to 2021, precipitation was well above average and temperatures were well below average in May, which ranked both the eighth coldest and eighth wettest May on record statewide (Office of Washington State Climatologist data). The snowpack melted slowly, and new snow was even picked up during the first half of the month in some locations. The first two-thirds of June also remained much colder and wetter than usual, which made for difficult surveying conditions. It was very challenging to plan trips and transect visits in June because of the showery weather, having very few days with no chance of precipitation during much of the month. There was little rain after the first part of July, but several heat waves made backcountry travel challenging.

2022 Bird Counts

In 2022 we surveyed all of the 68 intended transects in the large parks, including 34 transects from the annual-panel, and 34 transects from the fifth alternating panel (Table 2 and 3). We also conducted 72 point counts at LEWI, including 36 at Cape Disappointment, 28 at Fort Clatsop, 5 at Sunset Beach, and 3 at Yeon.

Table 2. North Coast and Cascades Network landbird monitoring transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks that were surveyed in 2022.

Park	Panel	Elevation	Transect	No. of points surveyed
MORA	Ann1	Low	4001	18
MORA	Ann1	Low	4005	14
MORA	Ann1	Mid	4002	16
MORA	Ann1	Mid	4004	21
MORA	Ann1	Mid	4009	17
MORA	Ann1	Mid	4012	21
MORA	Ann1	High	4003	18
MORA	Ann1	High	4007	24
MORA	Ann1	High	4011	18
MORA	Ann1	High	4014	24
MORA	Alt6	Low	4031	17

Table 2 (continued). North Coast and Cascades Network landbird monitoring transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks that were surveyed in 2022.

Park	Panel	Elevation	Transect	No. of points surveyed
MORA	Alt6	Low	4034	13
MORA	Alt6	Mid	4077	18
MORA	Alt6	Mid	4078	22
MORA	Alt6	Mid	4081	20
MORA	Alt6	Mid	4084	18
MORA	Alt6	High	4058	21
MORA	Alt6	High	4062	20
MORA	Alt6	High	4064	18
MORA	Alt6	High	4067	19
NOCA	Ann1	Low	1013	18
NOCA	Ann1	Low	1017	15
NOCA	Ann1	Low	1020	18
NOCA	Ann1	Low	1023	18
NOCA	Ann1	Mid	1015	20
NOCA	Ann1	Mid	1018	21
NOCA	Ann1	Mid	1022	17
NOCA	Ann1	Mid	1024	14
NOCA	Ann1	High	1014	22
NOCA	Ann1	High	1016	18
NOCA	Ann1	High	1019	16
NOCA	Ann1	High	1021	25
NOCA	Alt6	Low	1068	15
NOCA	Alt6	Low	1070	14
NOCA	Alt6	Low	1074	19
NOCA	Alt6	Low	1075	17
NOCA	Alt6	Mid	1047	13
NOCA	Alt6	Mid	1051	14
NOCA	Alt6	Mid	1053	19
NOCA	Alt6	Mid	1056	16
NOCA	Alt6	High	1072	16
NOCA	Alt6	High	1088	15
NOCA	Alt6	High	1090	17
NOCA	Alt6	High	1092	17
OLYM	Ann1	Low	3001	14

Table 2 (continued). North Coast and Cascades Network landbird monitoring transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks that were surveyed in 2022.

Park	Panel	Elevation	Transect	No. of points surveyed
OLYM	Ann1	Low	3121	19
OLYM	Ann1	Low	3126	18
OLYM	Ann1	Low	3134	20
OLYM	Ann1	Mid	3122	18
OLYM	Ann1	Mid	3123	17
OLYM	Ann1	Mid	3130	11
OLYM	Ann1	Mid	3200	24
OLYM	Ann1	High	3124	14
OLYM	Ann1	High	3125	16
OLYM	Ann1	High	3127	16
OLYM	Ann1	High	3128	15
OLYM	Alt6	Low	3172	15
OLYM	Alt6	Low	3177	10
OLYM	Alt6	Low	3181	17
OLYM	Alt6	Low	3182	21
OLYM	Alt6	Mid	3187	23
OLYM	Alt6	Mid	3190	15
OLYM	Alt6	Mid	3195	13
OLYM	Alt6	Mid	3198	15
OLYM	Alt6	High	3189	17
OLYM	Alt6	High	3191	17
OLYM	Alt6	High	3192	15
OLYM	Alt6	High	3196	18

Table 3. Summary history of North Coast and Cascades Network landbird monitoring transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks completed through 2022.

Park	Elevation Stratum	Number of transects completed																
		2005 ^a	2006 ^a	2007 ^b	2008 ^c	2009 ^d	2010 ^e	2011 ^f	2012 ^b	2013 ^c	2014 ^d	2015 ^e	2016 ^f	2018 ^b	2019 ^c	2020 ^d	2021 ^e	2022 ^f
MORA	Low	2	2	4	4	4	4	4	4	4	4	4	4	4	4	4	4	4
MORA	Medium	4	4	8	8	8	8	6	8	8	8	8	8	8	8	8	8	8
MORA	High	4	4	8	8	8	7	3	8	8	8	8	8	8	8	8	8	8
ALL	All	10	10	20	20	20	19	13	20	20	20	20	20	20	20	20	20	20
NOCA	Low	4	4	8	8	7	8	8	8	8	8	7	8	8	8	8	8	8
NOCA	Medium	4	4	7	7	8	8	8	8	7	8	8	8	8	8	8	8	8
NOCA	High	4	4	7	5	8	6	5	8	8	8	8	7	8	7	8	8	8
ALL	All	12	12	22	20	23	22	21	24	23	24	23	23	24	23	24	24	24
OLYM	Low	4	4	8	8	8	8	8	8	8	8	8	8	8	8	8	8	8
OLYM	Medium	4	3	8	7	8	8	7	8	8	8	8	7	8	8	8	8	8
OLYM	High	4	4	7	8	8	8	8	8	8	8	8	8	8	8	8	8	8
ALL	All	12	11	23	23	24	24	23	24	24	24	24	23	24	24	24	24	24

^a Only the annual panel transects were surveyed in 2005 and 2006, during the protocol development phase of the project.

^b The annual panel along with the first alternating panel were surveyed in 2007, 2012, and 2018.

^c The annual panel along with the second alternating panel were surveyed in 2008, 2013, and 2019.

^d The annual panel along with the third alternating panel were surveyed in 2009, 2014, and 2020.

^e The annual panel along with the fourth alternating panel were surveyed in 2010 and 2015, and 2021.

^f The annual panel along with the fifth alternating panel were surveyed in 2011, 2016, and 2022.

Appendix A provides a detailed multi-year survey history of all transects sampled in the large parks to date. In 2022 we conducted 377 individual point counts at MORA, 414 point counts at NOCA and 398 point counts at OLYM (Table 2). During the 1,189 point counts in the three large parks, we counted 10,682 individual birds. Across the three large parks, we documented the presence of 130 species and one hybrid (Table 4), 105 of which were detected during point counts. The remaining 25 species were recorded only as incidental detections or on “Rare Bird Report Forms.”

Table 4. All species recorded in the three large North Coast and Cascades Network parks during the 2022 field season, including the pre-season training session.

Species	Scientific Name
Canada Goose	<i>Branta canadensis</i>
Wood Duck *	<i>Aix sponsa</i>
Mallard	<i>Anas platyrhynchos</i>
Ring-necked Duck *	<i>Aythya collaris</i>
Harlequin Duck *	<i>Histrionicus histrionicus</i>
Bufflehead *	<i>Bucephala albeola</i>
Barrow's Goldeneye	<i>Bucephala islandica</i>
Common Merganser	<i>Mergus merganser</i>
Red-breasted Merganser *	<i>Mergus serrator</i>
Ruffed Grouse	<i>Bonasa umbellus</i>
White-tailed Ptarmigan *	<i>Lagopus leucura</i>
Sooty Grouse	<i>Dendragapus fuliginosus</i>
Band-tailed Pigeon	<i>Patagioenas fasciata</i>
Eurasian Collared-dove *	<i>Streptopelia decaocto</i>
Common Nighthawk	<i>Chordeiles minor</i>
Black Swift	<i>Cypseloides niger</i>
Vaux's Swift	<i>Chaetura vauxi</i>
Rufous Hummingbird	<i>Selasphorus rufus</i>
Calliope Hummingbird	<i>Selasphorus calliope</i>
Virginia Rail *	<i>Rallus limicola</i>
Black Oystercatcher *	<i>Haematopus bachmani</i>
Whimbrel *	<i>Numenius phaeopus</i>
Spotted Sandpiper	<i>Actitis macularius</i>
Greater Yellowlegs *	<i>Tringa melanoleuca</i>
Marbled Murrelet	<i>Brachyramphus marmoratus</i>
California Gull *	<i>Larus californicus</i>
Common Loon	<i>Gavia immer</i>
Pelagic Cormorant *	<i>Phalacrocorax pelagicus</i>
Great Blue Heron *	<i>Ardea herodias</i>

* Species that were detected only at times other than during point counts.

Table 4 (continued). All species recorded in the three large North Coast and Cascades Network parks during the 2022 field season, including the pre-season training session.

Species	Scientific Name
Turkey Vulture *	<i>Cathartes aura</i>
Osprey	<i>Pandion haliaetus</i>
Golden Eagle	<i>Aquila chrysaetos</i>
Sharp-shinned Hawk *	<i>Accipiter striatus</i>
Cooper's Hawk *	<i>Accipiter cooperii</i>
Bald Eagle	<i>Haliaeetus leucocephalus</i>
Red-tailed Hawk	<i>Buteo jamaicensis</i>
Northern Pygmy-Owl	<i>Glaucidium gnoma</i>
Barred Owl	<i>Strix varia</i>
Belted Kingfisher	<i>Megaceryle alcyon</i>
Williamson's Sapsucker	<i>Sphyrapicus thyroideus</i>
Red-naped Sapsucker	<i>Sphyrapicus nuchalis</i>
Red-breasted Sapsucker	<i>Sphyrapicus ruber</i>
American Three-toed Woodpecker	<i>Picoides dorsalis</i>
Downy Woodpecker	<i>Picoides pubescens</i>
Hairy Woodpecker	<i>Picoides villosus</i>
Northern Flicker	<i>Colaptes auratus</i>
Pileated Woodpecker	<i>Dryocopus pileatus</i>
Merlin	<i>Falco columbarius</i>
Peregrine Falcon *	<i>Falco peregrinus</i>
Red-naped x Red-breasted Sapsucker Hybrid	<i>Sphyrapicus nuchalis x ruber</i>
Olive-sided Flycatcher	<i>Contopus cooperi</i>
Western Wood-Pewee	<i>Contopus sordidulus</i>
Willow Flycatcher	<i>Empidonax traillii</i>
Hammond's Flycatcher	<i>Empidonax hammondi</i>
Dusky Flycatcher	<i>Empidonax oberholseri</i>
Western Flycatcher	<i>Empidonax difficilis</i>
Say's Phoebe	<i>Sayornis saya</i>
Hutton's Vireo	<i>Vireo huttoni</i>
Cassin's Vireo	<i>Vireo cassinii</i>
Warbling Vireo	<i>Vireo gilvus</i>
Red-eyed Vireo	<i>Vireo olivaceus</i>
Canada Jay	<i>Perisoreus canadensis</i>
Steller's Jay	<i>Cyanocitta stelleri</i>
Clark's Nutcracker	<i>Nucifraga columbiana</i>

* Species that were detected only at times other than during point counts.

Table 4 (continued). All species recorded in the three large North Coast and Cascades Network parks during the 2022 field season, including the pre-season training session.

Species	Scientific Name
American Crow	<i>Corvus brachyrhynchos</i>
Common Raven	<i>Corvus corax</i>
Horned Lark *	<i>Eremophila alpestris</i>
Tree Swallow	<i>Tachycineta bicolor</i>
Violet-green Swallow	<i>Tachycineta thalassina</i>
Northern Rough-winged Swallow	<i>Stelgidopteryx serripennis</i>
Barn Swallow	<i>Hirundo rustica</i>
Black-capped Chickadee	<i>Poecile atricapillus</i>
Mountain Chickadee	<i>Poecile gambeli</i>
Chestnut-backed Chickadee	<i>Poecile rufescens</i>
Red-breasted Nuthatch	<i>Sitta canadensis</i>
White-breasted Nuthatch	<i>Sitta carolinensis</i>
Brown Creeper	<i>Certhia americana</i>
Canyon Wren *	<i>Catherpes mexicanus</i>
House Wren	<i>Troglodytes aedon</i>
Pacific Wren	<i>Troglodytes pacificus</i>
American Dipper	<i>Cinclus mexicanus</i>
Golden-crowned Kinglet	<i>Regulus satrapa</i>
Ruby-crowned Kinglet	<i>Regulus calendula</i>
Western Bluebird	<i>Sialia mexicana</i>
Mountain Bluebird	<i>Sialia currucoides</i>
Townsend's Solitaire	<i>Myadestes townsendi</i>
Veery	<i>Catharus fuscescens</i>
Swainson's Thrush	<i>Catharus ustulatus</i>
Hermit Thrush	<i>Catharus guttatus</i>
American Robin	<i>Turdus migratorius</i>
Varied Thrush	<i>Ixoreus naevius</i>
Gray Catbird	<i>Dumetella carolinensis</i>
European Starling *	<i>Sturnus vulgaris</i>
Cedar Waxwing	<i>Bombycilla cedrorum</i>
American Pipit	<i>Anthus rubescens</i>
Evening Grosbeak	<i>Coccothraustes vespertinus</i>
Pine Grosbeak	<i>Pinicola enucleator</i>
Gray-crowned Rosy-Finch	<i>Leucosticte tephrocotis</i>
House Finch *	<i>Haemorhous mexicanus</i>

* Species that were detected only at times other than during point counts.

Table 4 (continued). All species recorded in the three large North Coast and Cascades Network parks during the 2022 field season, including the pre-season training session.

Species	Scientific Name
Purple Finch	<i>Haemorhous purpureus</i>
Cassin's Finch	<i>Haemorhous cassinii</i>
Red Crossbill	<i>Loxia curvirostra</i>
Pine Siskin	<i>Spinus pinus</i>
American Goldfinch *	<i>Spinus tristis</i>
Chipping Sparrow	<i>Spizella passerina</i>
Fox Sparrow	<i>Passerella iliaca</i>
Dark-eyed Junco	<i>Junco hyemalis</i>
White-crowned Sparrow	<i>Zonotrichia leucophrys</i>
Golden-crowned Sparrow *	<i>Zonotrichia atricapilla</i>
Savannah Sparrow	<i>Passerculus sandwichensis</i>
Song Sparrow	<i>Melospiza melodia</i>
Lincoln's Sparrow	<i>Melospiza lincolni</i>
Spotted Towhee	<i>Pipilo maculatus</i>
Bullock's Oriole *	<i>Icterus bullockii</i>
Red-winged Blackbird	<i>Agelaius phoeniceus</i>
Brown-headed Cowbird	<i>Molothrus ater</i>
Orange-crowned Warbler	<i>Oreothlypis celata</i>
Nashville Warbler	<i>Oreothlypis ruficapilla</i>
MacGillivray's Warbler	<i>Geothlypis tolmiei</i>
Common Yellowthroat	<i>Geothlypis trichas</i>
American Redstart	<i>Setophaga ruticilla</i>
Yellow Warbler	<i>Setophaga petechia</i>
Yellow-rumped Warbler	<i>Setophaga coronata</i>
Black-throated Gray Warbler	<i>Setophaga nigrescens</i>
Townsend's Warbler	<i>Setophaga townsendi</i>
Townsend's x Hermit Warbler hybrid	<i>Setophaga townsendi x occidentalis</i>
Wilson's Warbler	<i>Cardellina pusilla</i>
Western Tanager	<i>Piranga ludoviciana</i>
Black-headed Grosbeak	<i>Pheucticus melanocephalus</i>
Lazuli Bunting	<i>Passerina amoena</i>

* Species that were detected only at times other than during point counts.

For the annual-panel transects only, the number of individuals of each species detected during point counts (unlimited radius) and the number of transects on which each species was detected are provided in Table 5. On the annual-panel transects we detected 52 bird species during point counts at MORA, 77 species plus one hybrid during point counts at NOCA, and 57 species during point counts

at OLYM (Table 5). Pooling detections on annual-panel transects across all species, we amassed 1,244 individual bird detections (average of 6.51 detections/point) at MORA, 2,339 detections (average of 10.54 detections/point) at NOCA, and 1,662 detections (average of 8.23 detections per point) at OLYM (Table 5). The five most frequently detected species on the annual-panel transects in 2022 were: dark-eyed junco (410 detections), pine siskin (349 detections), Pacific wren (311 detections), varied thrush (299 detections), and American robin (275 detections).

Pooling data across the annual-panel transects as well as the transects in the fifth alternating panel (“Alt6”), the number of individuals of each species detected during point counts (unlimited radius) and the number of transects on which each species was detected are provided in Table 6. Using data pooled across all transects, we detected 56 bird species during point counts at MORA, 85 species and one hybrid during point counts at NOCA, and 76 species during point counts at OLYM (Table 6). Considering data from both panels, the five most frequently detected species were: dark-eyed junco (800 detections), pine siskin (796 detections), red crossbill (678 detections), Pacific wren (630 detections), and varied thrush (623 detections).

Table 5. Number of transects with detections and number of individual detections for each species detected during point counts on annual-panel transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks in 2022.

Species	Number of transects with detections				Number of individual detections			
	MORA	NOCA	OLYM	ALL	MORA	NOCA	OLYM	Total
Common Merganser	1	–	1	2	1	–	1	2
Ruffed Grouse	–	–	1	1	–	–	1	1
Sooty Grouse	4	5	7	16	8	11	17	36
Band-tailed Pigeon	1	–	6	7	2	–	10	12
Common Nighthawk	–	1	1	2	–	1	1	2
Black Swift	–	2	–	2	–	21	–	21
Vaux's Swift	5	3	2	10	18	16	12	46
Rufous Hummingbird	2	3	5	10	4	8	12	24
Calliope Hummingbird	–	1	–	1	–	2	–	2
Spotted Sandpiper	1	1	2	4	2	1	2	5
Marbled Murrelet	–	–	1	1	–	–	1	1
Osprey	–	–	1	1	–	–	1	1
Golden Eagle	–	–	1	1	–	–	1	1
Bald Eagle	–	–	1	1	–	–	1	1
Northern Pygmy-Owl	–	1	–	1	–	1	–	1
Barred Owl	1	–	–	1	2	–	–	2
Belted Kingfisher	–	1	1	2	–	1	2	3
Red-naped Sapsucker	–	1	–	1	–	1	–	1
Red-breasted Sapsucker	2	4	–	6	5	19	–	24
Red-naped x Red-breasted Sapsucker Hybrid	–	1	–	1	–	1	–	1
American Three-toed Woodpecker	–	1	–	1	–	1	–	1
Downy Woodpecker	–	2	–	2	–	2	–	2
Hairy Woodpecker	7	8	5	20	14	14	7	35

* This classification includes individuals identified in the field as Townsend's warblers, hermit warblers, Townsend's/hermit warbler hybrids, and unidentified Townsend's/hermit warblers.

Table 5 (continued). Number of transects with detections and number of individual detections for each species detected during point counts on annual-panel transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks in 2022.

Species	Number of transects with detections				Number of individual detections			
	MORA	NOCA	OLYM	ALL	MORA	NOCA	OLYM	Total
Northern Flicker	–	4	7	11	–	5	20	25
Pileated Woodpecker	3	3	2	8	5	3	2	10
Olive-sided Flycatcher	2	7	7	16	3	26	24	53
Western Wood-Pewee	–	5	1	6	–	31	1	32
Willow Flycatcher	–	1	–	1	–	1	–	1
Hammond's Flycatcher	6	8	7	21	20	119	28	167
Dusky Flycatcher	–	2	–	2	–	3	–	3
Western Flycatcher	7	4	9	20	30	21	146	197
Say's Phoebe	–	1	–	1	–	1	–	1
Hutton's Vireo	–	–	1	1	–	–	1	1
Cassin's Vireo	–	4	–	4	–	16	–	16
Warbling Vireo	1	9	6	16	1	58	34	93
Red-eyed Vireo	–	1	–	1	–	9	–	9
Canada Jay	4	1	6	11	10	3	21	34
Steller's Jay	8	5	7	20	30	7	25	62
Clark's Nutcracker	1	1	–	2	2	12	–	14
American Crow	–	1	2	3	–	2	4	6
Common Raven	4	1	5	10	7	2	9	18
Tree Swallow	–	1	–	1	–	2	–	2
Violet-green Swallow	1	2	–	3	3	25	–	28
Barn Swallow	1	–	–	1	2	–	–	2
Mountain Chickadee	3	2	–	5	7	23	–	30
Chestnut-backed Chickadee	8	12	11	31	67	96	63	226

* This classification includes individuals identified in the field as Townsend's warblers, hermit warblers, Townsend's/hermit warbler hybrids, and unidentified Townsend's/hermit warblers.

Table 5 (continued). Number of transects with detections and number of individual detections for each species detected during point counts on annual-panel transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks in 2022.

Species	Number of transects with detections				Number of individual detections			
	MORA	NOCA	OLYM	ALL	MORA	NOCA	OLYM	Total
Red-breasted Nuthatch	10	10	8	28	64	81	70	215
White-breasted Nuthatch	–	1	–	1	–	1	–	1
Brown Creeper	8	8	9	25	23	21	30	74
House Wren	–	1	–	1	–	1	–	1
Pacific Wren	9	11	11	31	90	85	136	311
American Dipper	1	1	2	4	2	1	3	6
Golden-crowned Kinglet	7	9	11	27	41	37	123	201
Ruby-crowned Kinglet	–	2	1	3	–	9	2	11
Townsend's Solitaire	1	3	2	6	1	6	4	11
Veery	–	1	–	1	–	3	–	3
Swainson's Thrush	2	8	5	15	10	132	40	182
Hermit Thrush	7	5	7	19	61	73	66	200
American Robin	9	12	11	32	67	98	110	275
Varied Thrush	8	11	12	31	125	91	83	299
Gray Catbird	–	1	–	1	–	1	–	1
Cedar Waxwing	–	2	–	2	–	16	–	16
American Pipit	2	–	2	4	24	–	6	30
Evening Grosbeak	2	5	3	10	3	43	17	63
Pine Grosbeak	1	2	5	8	4	2	6	12
Gray-crowned Rosy-Finch	1	–	1	2	2	–	1	3
Purple Finch	–	1	–	1	–	7	–	7
Cassin's Finch	2	3	–	5	3	19	–	22
Red Crossbill	5	7	7	19	67	96	62	225

* This classification includes individuals identified in the field as Townsend's warblers, hermit warblers, Townsend's/hermit warbler hybrids, and unidentified Townsend's/hermit warblers.

Table 5 (continued). Number of transects with detections and number of individual detections for each species detected during point counts on annual-panel transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks in 2022.

Species	Number of transects with detections				Number of individual detections			
	MORA	NOCA	OLYM	ALL	MORA	NOCA	OLYM	Total
Pine Siskin	8	7	8	23	125	164	60	349
Chipping Sparrow	1	6	2	9	1	32	3	36
Fox Sparrow	2	2	–	4	11	10	–	21
Dark-eyed Junco	10	10	11	31	116	115	179	410
White-crowned Sparrow	2	1	2	5	7	10	8	25
Savannah Sparrow	1		–	1	1	–	–	1
Song Sparrow	1	5	2	8	3	22	9	34
Spotted Towhee	–	1	–	1	–	1	–	1
Brown-headed Cowbird	–	1	–	1	–	3	–	3
Orange-crowned Warbler	–	1	1	2	–	1	1	2
Nashville Warbler	–	6	–	6	–	56	–	56
MacGillivray's Warbler	–	9	1	10	–	57	3	60
Common Yellowthroat	–	1	–	1	–	1	–	1
American Redstart	–	1	–	1	–	1	–	1
Yellow Warbler	1	5	2	8	2	57	5	64
Yellow-rumped Warbler	6	11	6	23	25	139	31	195
Black-throated Gray Warbler	2	2	4	8	3	10	28	41
Townsend's/Hermit Warbler*	12	9	10	31	110	79	73	262
Wilson's Warbler	3	4	5	12	4	7	38	49
Western Tanager	1	10	4	15	2	142	12	156
Black-headed Grosbeak	2	6	2	10	4	36	6	46
Lazuli Bunting	–	2	–	2	–	8	–	8
All species pooled	–	–	–	–	1,244	2,339	1,662	5,245

* This classification includes individuals identified in the field as Townsend's warblers, hermit warblers, Townsend's/hermit warbler hybrids, and unidentified Townsend's/hermit warblers.

Table 5 (continued). Number of transects with detections and number of individual detections for each species detected during point counts on annual-panel transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks in 2022.

Species	Number of transects with detections				Number of individual detections			
	MORA	NOCA	OLYM	ALL	MORA	NOCA	OLYM	Total
Number of detections per point (all species pooled)	n/a	n/a	n/a	n/a	6.5	10.54	8.23	8.53

* This classification includes individuals identified in the field as Townsend's warblers, hermit warblers, Townsend's/hermit warbler hybrids, and unidentified Townsend's/hermit warblers.

Table 6. Number of transects with detections and number of individual detections for each species detected during point counts (annual- and alternating-panel transects combined) at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks in 2022.

Species	Number of transects with detections				Number of individual detections			
	MORA	NOCA	OLYM	ALL	MORA	NOCA	OLYM	ALL
Canada Goose	–	–	1	1	–	–	22	22
Mallard	–	–	1	1	–	–	1	1
Barrow's Goldeneye	–	–	1	1	–	–	2	2
Common Merganser	1	–	2	3	1	–	3	4
Ruffed Grouse	–	–	1	1	–	–	1	1
Sooty Grouse	8	12	13	33	13	25	32	70
Band-tailed Pigeon	3	1	11	15	4	1	21	26
Common Nighthawk	–	1	1	2	–	1	1	2
Black Swift	–	3	–	3	–	32	–	32
Vaux's Swift	8	5	3	16	24	21	14	59
Rufous Hummingbird	3	7	12	22	5	14	29	48
Calliope Hummingbird	–	5	–	5	–	19	–	19
Spotted Sandpiper	1	2	2	5	2	6	2	10
Marbled Murrelet	–	–	2	2	–	–	2	2

* This classification includes individuals identified in the field as Townsend's warblers, hermit warblers, Townsend's/hermit warbler hybrids, and unidentified Townsend's/hermit warblers.

Table 6 (continued). Number of transects with detections and number of individual detections for each species detected during point counts (annual- and alternating-panel transects combined) at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks in 2022.

Species	Number of transects with detections				Number of individual detections			
	MORA	NOCA	OLYM	ALL	MORA	NOCA	OLYM	ALL
Common Loon	–	1	1	2	–	2	1	3
Osprey	–	1	1	2	–	1	1	2
Golden Eagle	–	–	1	1	–	–	1	1
Bald Eagle	–	–	2	2	–	–	2	2
Red-tailed Hawk	–	–	1	1	–	–	1	1
Northern Pygmy-Owl	–	1	1	2	–	1	2	3
Barred Owl	2	–	–	2	3	–	–	3
Belted Kingfisher	–	1	3	4	–	1	4	5
Williamson's Sapsucker	–	1	–	1	–	1	–	1
Red-naped Sapsucker	–	1	–	1	–	1	–	1
Red-breasted Sapsucker	5	5	3	13	12	20	12	44
Red-naped x Red-breasted Sapsucker Hybrid	–	1	–	1	–	1	–	1
American Three-toed Woodpecker	1	2	–	3	1	2	–	3
Downy Woodpecker	–	2	1	3	–	2	1	3
Hairy Woodpecker	8	12	14	34	15	19	24	58
Northern Flicker	4	9	16	29	4	11	37	52
Pileated Woodpecker	4	6	6	16	8	9	9	26
Merlin	–	–	1	1	–	–	1	1
Olive-sided Flycatcher	7	15	15	37	13	44	58	115
Western Wood-Pewee	–	9	1	10	–	53	1	54
Willow Flycatcher	–	1	1	2	–	1	1	2
Hammond's Flycatcher	8	15	15	38	25	179	90	294

* This classification includes individuals identified in the field as Townsend's warblers, hermit warblers, Townsend's/hermit warbler hybrids, and unidentified Townsend's/hermit warblers.

Table 6 (continued). Number of transects with detections and number of individual detections for each species detected during point counts (annual- and alternating-panel transects combined) at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks in 2022.

Species	Number of transects with detections				Number of individual detections			
	MORA	NOCA	OLYM	ALL	MORA	NOCA	OLYM	ALL
Dusky Flycatcher	–	6	–	6	–	24	–	24
Western Flycatcher	14	5	18	37	78	24	277	379
Say's Phoebe	–	1	–	1	–	1	–	1
Hutton's Vireo	–	–	3	3	–	–	7	7
Cassin's Vireo	–	9	–	9	–	34	–	34
Warbling Vireo	2	18	10	30	2	88	62	152
Red-eyed Vireo	–	2	–	2	–	10	–	10
Canada Jay	11	7	10	28	30	13	32	75
Steller's Jay	13	12	12	37	45	23	50	118
Clark's Nutcracker	1	4	–	5	2	26	–	28
American Crow	–	1	3	4	–	2	6	8
Common Raven	4	3	9	16	7	5	22	34
Tree Swallow	–	2	1	3	–	3	1	4
Violet-green Swallow	1	3	1	5	3	26	7	36
Northern Rough-winged Swallow	–	1	1	2	–	1	1	2
Barn Swallow	1	–	–	1	2	–	–	2
Black-capped Chickadee	–	–	1	1	–	–	1	1
Mountain Chickadee	3	8	–	11	7	47	–	54
Chestnut-backed Chickadee	18	22	22	62	148	156	142	446
Red-breasted Nuthatch	20	21	17	58	128	178	150	456
White-breasted Nuthatch	–	2	–	2	–	3	–	3
Brown Creeper	16	16	17	49	56	42	65	163

* This classification includes individuals identified in the field as Townsend's warblers, hermit warblers, Townsend's/hermit warbler hybrids, and unidentified Townsend's/hermit warblers.

Table 6 (continued). Number of transects with detections and number of individual detections for each species detected during point counts (annual- and alternating-panel transects combined) at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks in 2022.

Species	Number of transects with detections				Number of individual detections			
	MORA	NOCA	OLYM	ALL	MORA	NOCA	OLYM	ALL
House Wren	–	4	–	4	–	6	–	6
Pacific Wren	19	20	22	61	228	128	274	630
American Dipper	2	1	3	6	3	1	4	8
Golden-crowned Kinglet	17	19	21	57	109	92	220	421
Ruby-crowned Kinglet	–	4	3	7	–	13	5	18
Western Bluebird	–	–	1	1	–	–	1	1
Mountain Bluebird	–	1	–	1	–	1	–	1
Townsend's Solitaire	3	9	3	15	3	16	5	24
Veery	–	1	–	1	–	3	–	3
Swainson's Thrush	4	19	8	31	13	275	65	353
Hermit Thrush	15	12	16	43	156	123	143	422
American Robin	17	20	21	58	93	137	195	425
Varied Thrush	18	19	22	59	314	139	170	623
Gray Catbird	–	1	–	1	–	1	–	1
Cedar Waxwing	–	7	2	9	–	26	14	40
American Pipit	3	1	4	8	25	4	16	45
Evening Grosbeak	6	14	7	27	32	147	25	204
Pine Grosbeak	3	3	7	13	9	6	12	27
Gray-crowned Rosy-Finch	2	1	1	4	3	2	1	6
Purple Finch	–	3	–	3	–	12	–	12
Cassin's Finch	3	8	–	11	7	41	–	48
Red Crossbill	8	15	13	36	71	314	293	678

* This classification includes individuals identified in the field as Townsend's warblers, hermit warblers, Townsend's/hermit warbler hybrids, and unidentified Townsend's/hermit warblers.

Table 6 (continued). Number of transects with detections and number of individual detections for each species detected during point counts (annual- and alternating-panel transects combined) at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks in 2022.

Species	Number of transects with detections				Number of individual detections			
	MORA	NOCA	OLYM	ALL	MORA	NOCA	OLYM	ALL
Pine Siskin	17	18	18	53	324	331	141	796
Chipping Sparrow	2	13	3	18	2	61	6	69
Fox Sparrow	3	4	–	7	16	18	–	34
Dark-eyed Junco	20	21	22	63	205	211	384	800
White-crowned Sparrow	2	2	3	7	7	12	14	33
Savannah Sparrow	1	–	–	1	1	–	–	1
Song Sparrow	1	5	5	11	3	22	21	46
Lincoln's Sparrow	1	–	–	1	1	–	–	1
Spotted Towhee	–	3	1	4	–	16	1	17
Red-winged Blackbird	–	–	1	1	–	–	2	2
Brown-headed Cowbird	–	1	–	1	–	3	–	3
Orange-crowned Warbler	–	1	3	4	–	1	11	12
Nashville Warbler	–	13	–	13	–	162	–	162
MacGillivray's Warbler	1	18	4	23	1	101	9	111
Common Yellowthroat	–	1	2	3	–	1	3	4
American Redstart	–	1	–	1	–	1	–	1
Yellow Warbler	1	9	5	15	2	72	9	83
Yellow-rumped Warbler	10	23	11	44	60	255	58	373
Black-throated Gray Warbler	2	5	6	13	3	17	52	72
Townsend's/Hermit Warbler*	16	18	16	50	174	205	153	532
Wilson's Warbler	5	4	9	18	6	7	63	76
Western Tanager	4	20	9	33	5	312	38	355

* This classification includes individuals identified in the field as Townsend's warblers, hermit warblers, Townsend's/hermit warbler hybrids, and unidentified Townsend's/hermit warblers.

Table 6 (continued). Number of transects with detections and number of individual detections for each species detected during point counts (annual- and alternating-panel transects combined) at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks in 2022.

Species	Number of transects with detections				Number of individual detections			
	MORA	NOCA	OLYM	ALL	MORA	NOCA	OLYM	ALL
Black-headed Grosbeak	2	9	4	15	4	60	13	77
Lazuli Bunting	–	3	–	3	–	16	–	16
All species pooled	–	–	–	–	2,518	4,544	3,620	10,682
Detections per point (all species pooled)	–	–	–	–	6.68	10.98	9.10	8.98
Number of species detected during point counts	56	85	76	105	n/a	n/a	n/a	n/a

* This classification includes individuals identified in the field as Townsend's warblers, hermit warblers, Townsend's/hermit warbler hybrids, and unidentified Townsend's/hermit warblers.

We combined detections of Townsend's warbler, hermit warbler, Townsend's/hermit warbler hybrids, and unidentified Townsend's/hermit warblers in Tables 5 and 6, and Figures 6-15. These two species hybridize extensively at MORA and OLYM, and are very difficult to tell apart within these hybrid zones. All detections in this report listed as Townsend's/hermit warblers at NOCA are likely Townsend's warblers.

Marbled murrelet, one of two bird species occurring in these parks that is listed under the Endangered Species Act (the other being northern spotted owl), was detected at times other than a point count this year and was documented on "Rare Bird Report Forms." This species was also detected during point counts at OLYM. Detections of these species at times other than point counts are summarized in Table 7.

For 57 species (all species for which we amassed at least 96 point count detections over the period 2005–2022), we present the total number of detections of each species on each park's annual panel transects during the 2005–2022 field seasons (Figures 6–15). We caution, however, that these detection totals have not been adjusted for differences in survey effort, observer effects, or potential differences in detectability of birds between years; such adjustments will be made in conjunction with trend analyses in a future multi-year report.

At LEWI our 72 point counts yielded 1,538 detections of 64 species (Table 8), a detection rate of 21.36 birds per point. The most frequently detected species was Swainson's thrush (133 detections), followed by Wilson's warbler (100 detections), western flycatcher (99 detections), Caspian tern (94 detections), and American robin (89 detections).

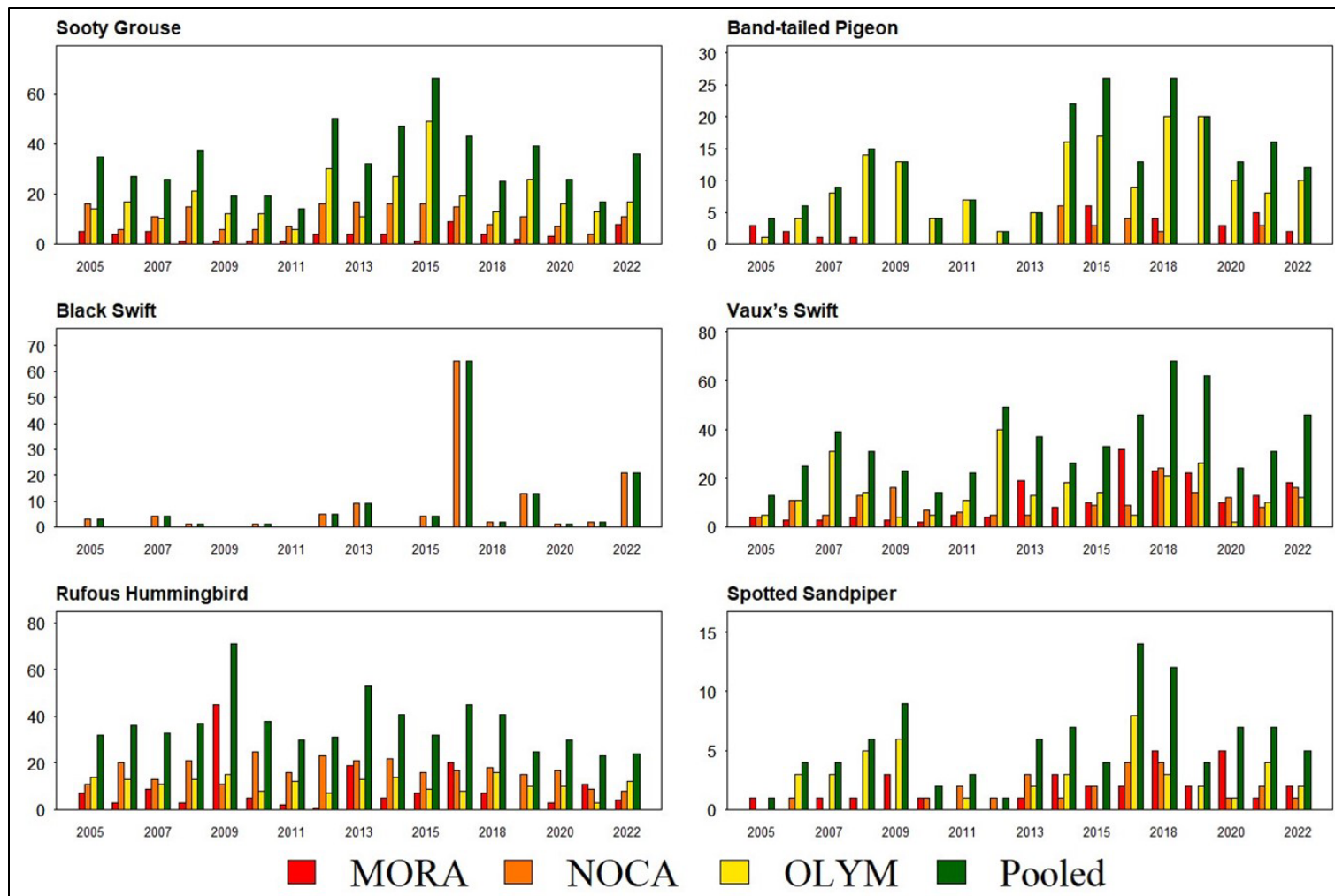


Figure 6. Number of times each species (Sooty Grouse, Band-tailed Pigeon, Black Swift, Vaux's Swift, Rufous Hummingbird, and Spotted Sandpiper) was detected on annual-panel transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks, and all three parks pooled (always presented in that order) during the 2005–2022 field seasons. Figures 6–15 include all species for which we amassed at least 96 point count detections on annual-panel transects over the 17 years indicated. Numbers of detections are unadjusted for differences in survey effort or potential differences in detectability of birds between years. These adjustments will be made in conjunction with periodic trend analyses.

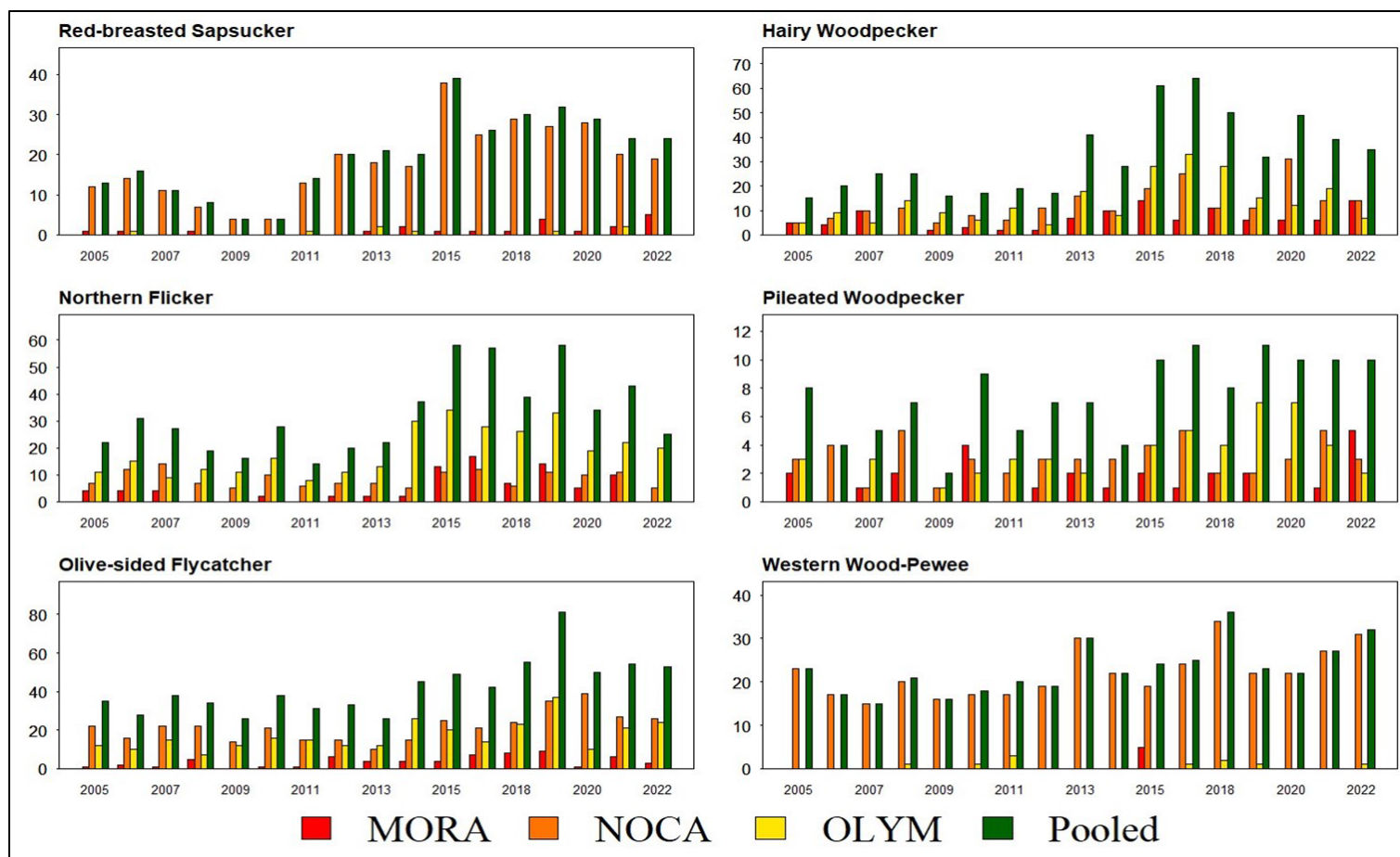


Figure 7. Number of times each species (Red-breasted Sapsucker, Hairy Woodpecker, Northern Flicker, Pileated Woodpecker, Olive-sided Flycatcher, and Western Wood-Pewee) was detected on annual-panel transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks, and all three parks pooled (always presented in that order) during the 2005–2022 field seasons. Figures 6–15 include all species for which we amassed at least 96 point count detections on annual-panel transects over the 17 years indicated. Numbers of detections are unadjusted for differences in survey effort or potential differences in detectability of birds between years. These adjustments will be made in conjunction with periodic trend analyses.

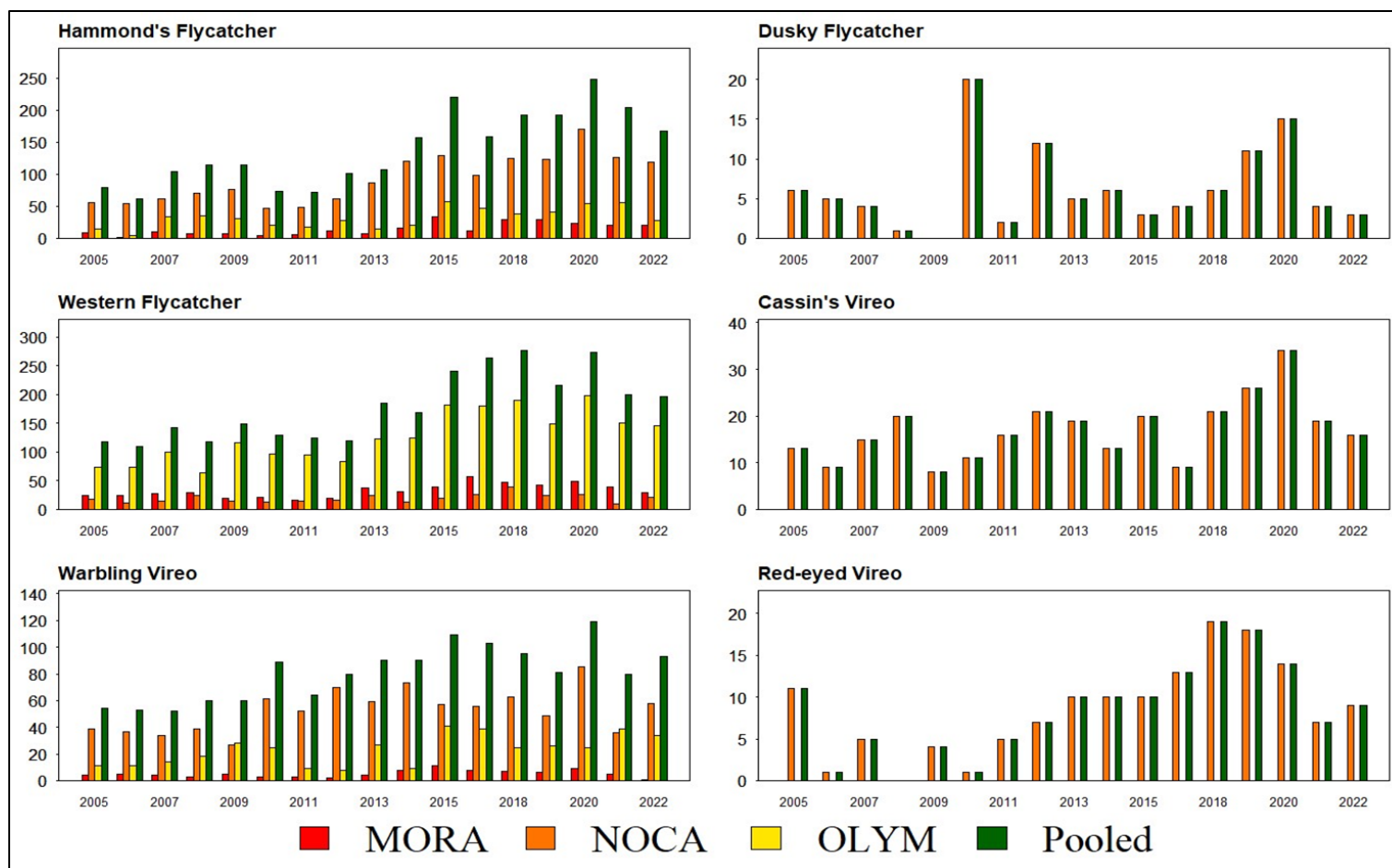


Figure 8. Number of times each species (Hammond's Flycatcher, Dusky Flycatcher, Western Flycatcher, Cassin's Vireo, Warbling Vireo, and Red-eyed Vireo) was detected on annual-panel transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks, and all three parks pooled (always presented in that order) during the 2005–2022 field seasons. Figures 6–15 include all species for which we amassed at least 96 point count detections on annual-panel transects over the 17 years indicated. Numbers of detections are unadjusted for differences in survey effort or potential differences in detectability of birds between years. These adjustments will be made in conjunction with periodic trend analyses.

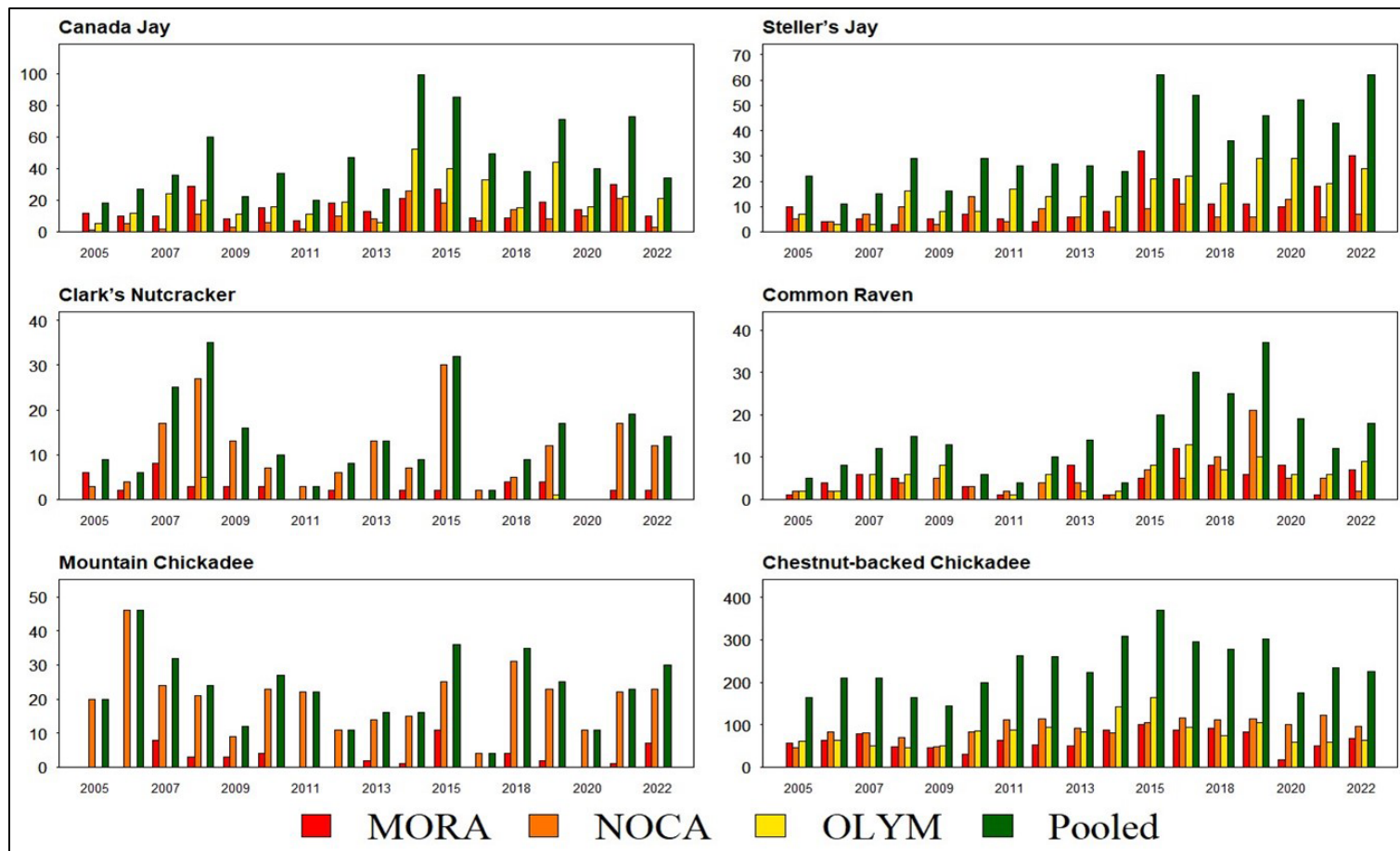


Figure 9. Number of times each species (Canada Jay, Steller's Jay, Clark's Nutcracker, Common Raven, Mountain Chickadee, Chestnut-backed Chickadee) was detected on annual-panel transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks, and all three parks pooled (always presented in that order) during the 2005–2022 field seasons. Figures 6–15 include all species for which we amassed at least 96 point count detections on annual-panel transects over the 17 years indicated. Numbers of detections are unadjusted for differences in survey effort or potential differences in detectability of birds between years. These adjustments will be made in conjunction with periodic trend analyses.

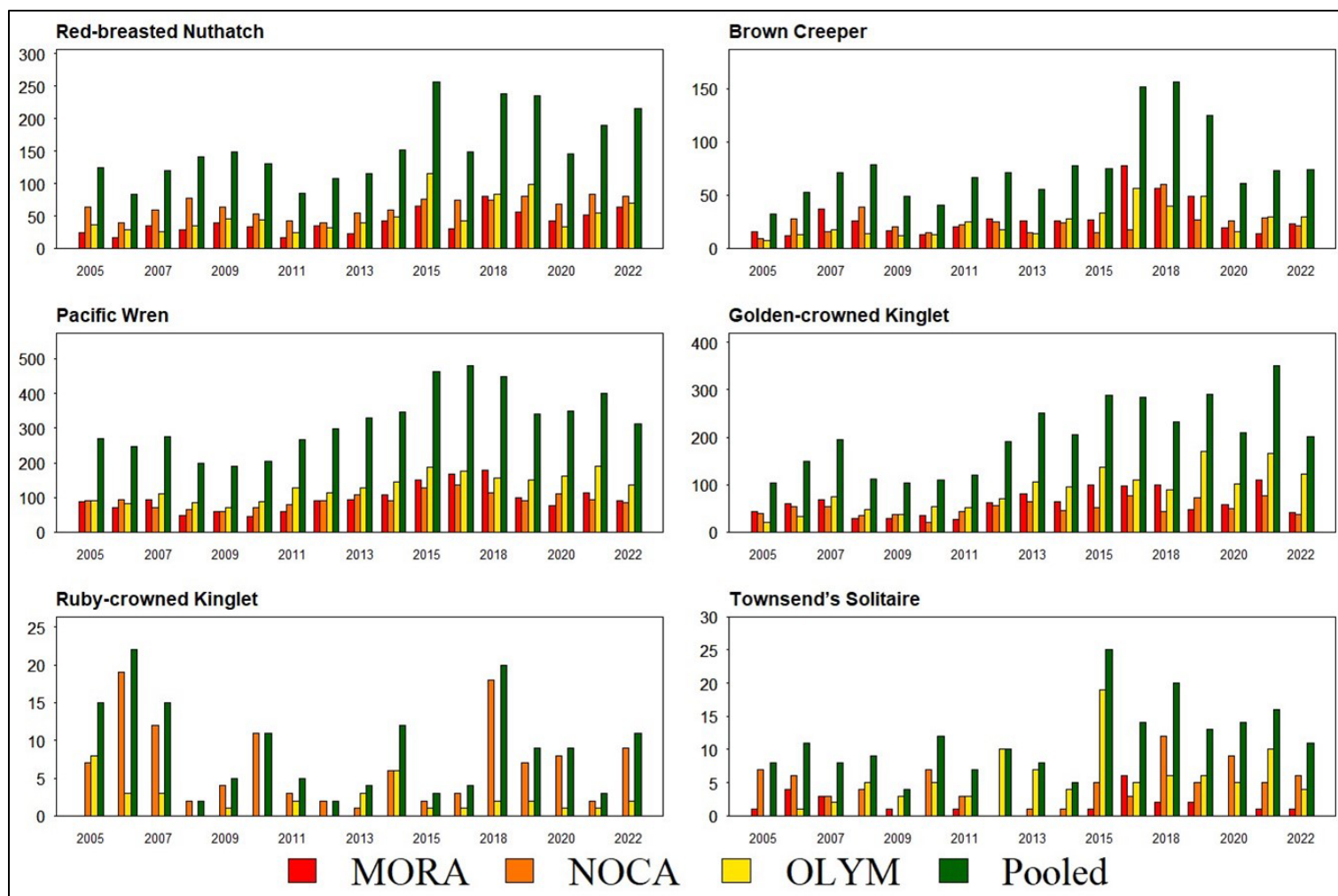


Figure 10. Number of times each species (Red-breasted Nuthatch, Brown Creeper, Pacific Wren, Golden-crowned Kinglet, Ruby-crowned Kinglet, and Townsend's Solitaire) was detected on annual-panel transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks, and all three parks pooled (always presented in that order) during the 2005–2022 field seasons. Figures 6–15 include all species for which we amassed at least 96 point count detections on annual-panel transects over the 17 years indicated. Numbers of detections are unadjusted for differences in survey effort or potential differences in detectability of birds between years. These adjustments will be made in conjunction with periodic trend analyses.

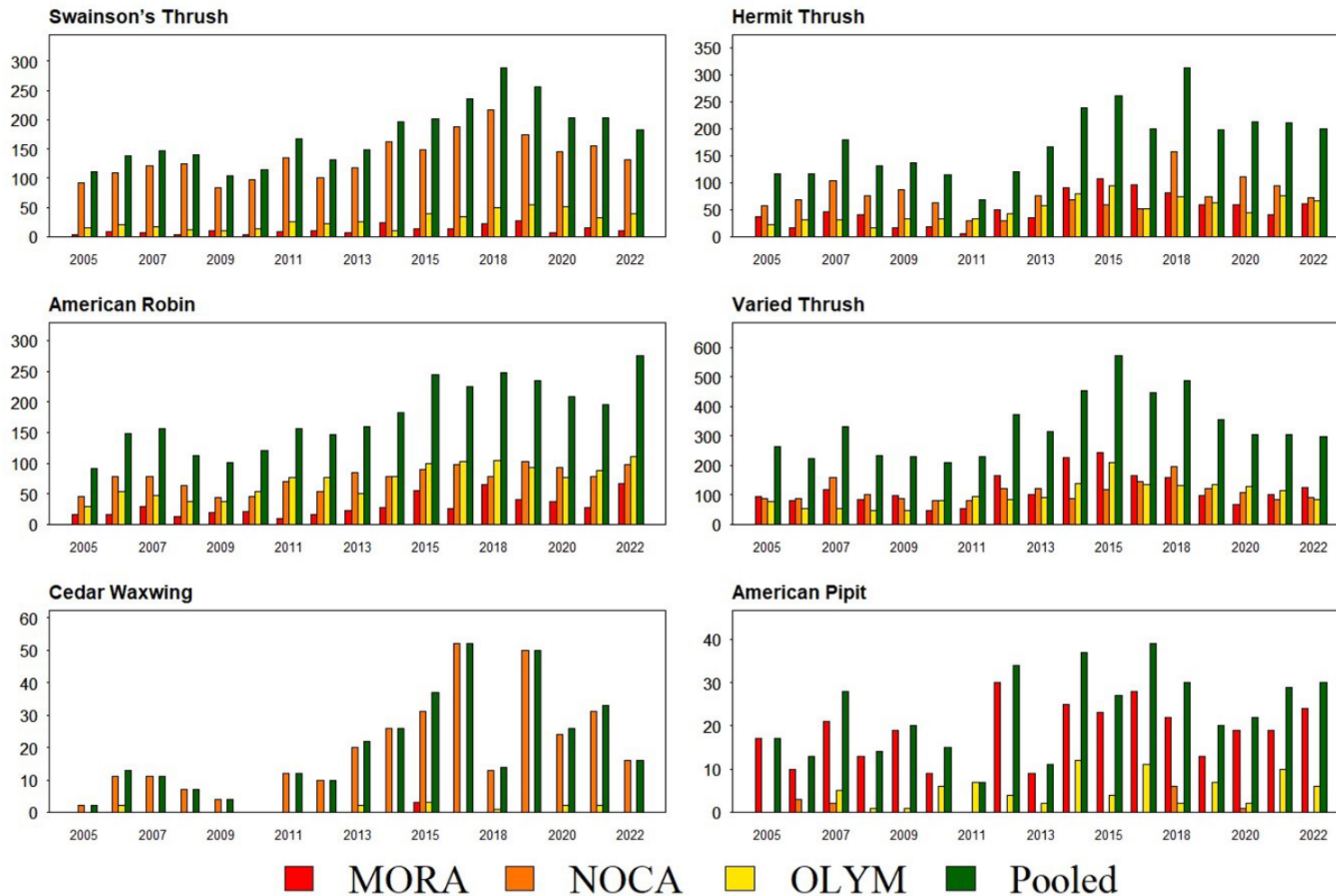


Figure 11. Number of times each species (Swainson's Thrush, Hermit Thrush, American Robin, Varied Thrush, Cedar Waxwing, and American Pipit) was detected on annual-panel transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks, and all three parks pooled (always presented in that order) during the 2005–2022 field seasons. Figures 6–15 include all species for which we amassed at least 96 point count detections on annual-panel transects over the 17 years indicated. Numbers of detections are unadjusted for differences in survey effort or potential differences in detectability of birds between years. These adjustments will be made in conjunction with periodic trend analyses.

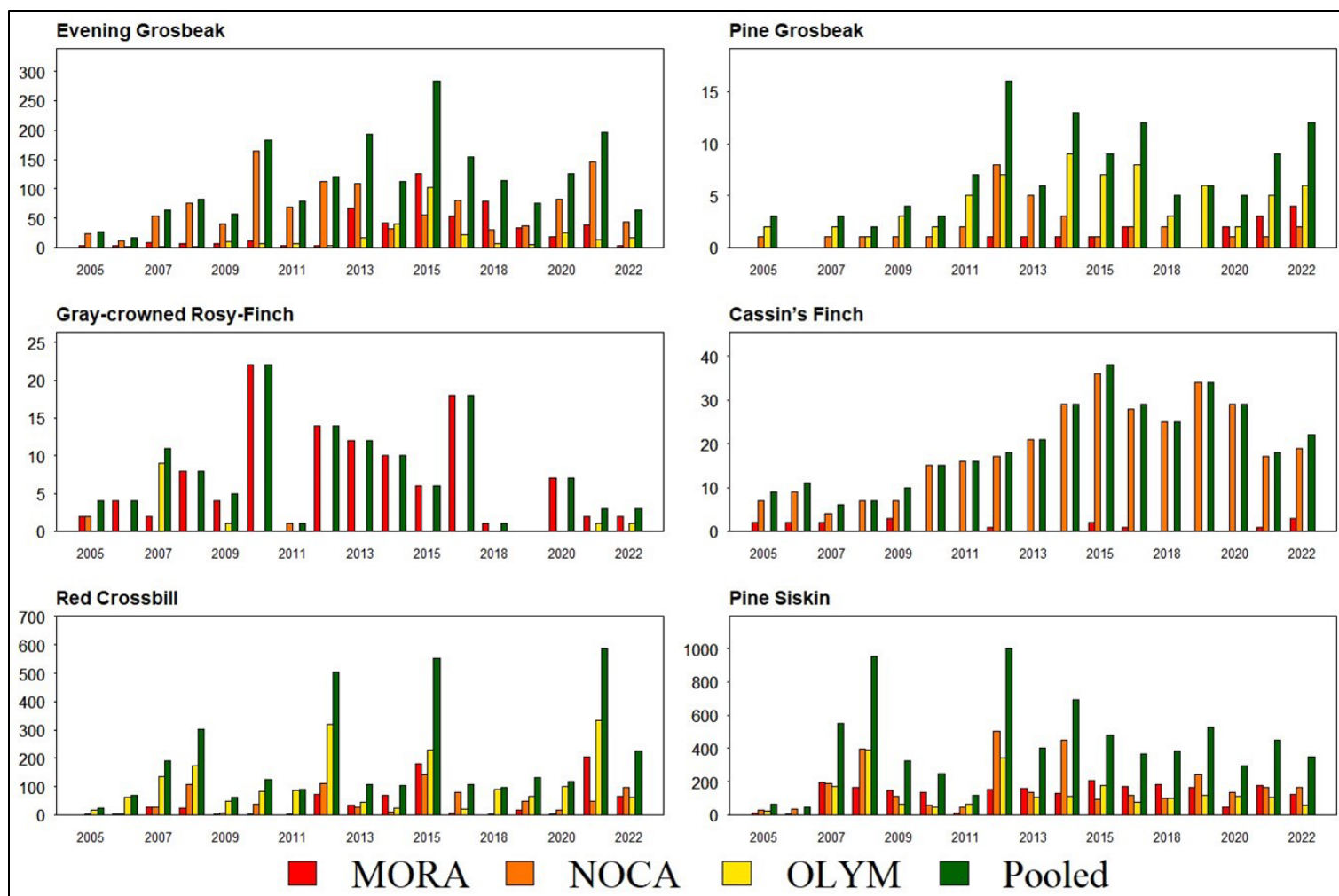


Figure 12. Number of times each species (Evening Grosbeak, Pine Grosbeak, Gray-crowned Rosy-Finch, Cassin's Finch, Red Crossbill, and Pine Siskin) was detected on annual-panel transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks, and all three parks pooled (always presented in that order) during the 2005–2022 field seasons. Figures 6–15 include all species for which we amassed at least 96 point count detections on annual-panel transects over the 17 years indicated. Numbers of detections are unadjusted for differences in survey effort or potential differences in detectability of birds between years. These adjustments will be made in conjunction with periodic trend analyses.

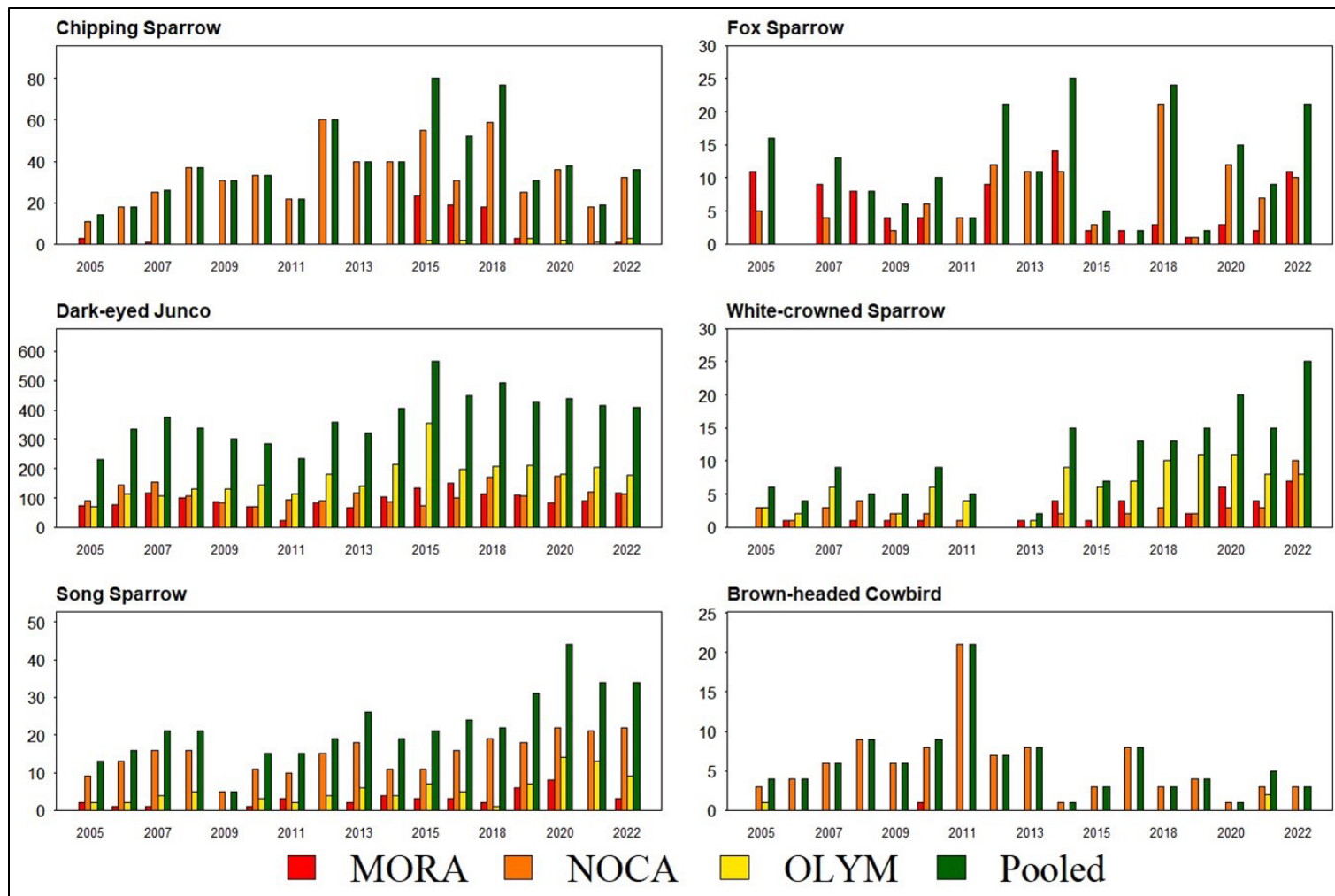


Figure 13. Number of times each species (Chipping Sparrow, Fox Sparrow, Dark-eyed Junco, White-crowned Sparrow, Song Sparrow, and Brown-headed Cowbird) was detected on annual-panel transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks, and all three parks pooled (always presented in that order) during the 2005–2022 field seasons. Figures 6–15 include all species for which we amassed at least 96 point count detections on annual-panel transects over the 17 years indicated. Numbers of detections are unadjusted for differences in survey effort or potential differences in detectability of birds between years. These adjustments will be made in conjunction with periodic trend analyses.

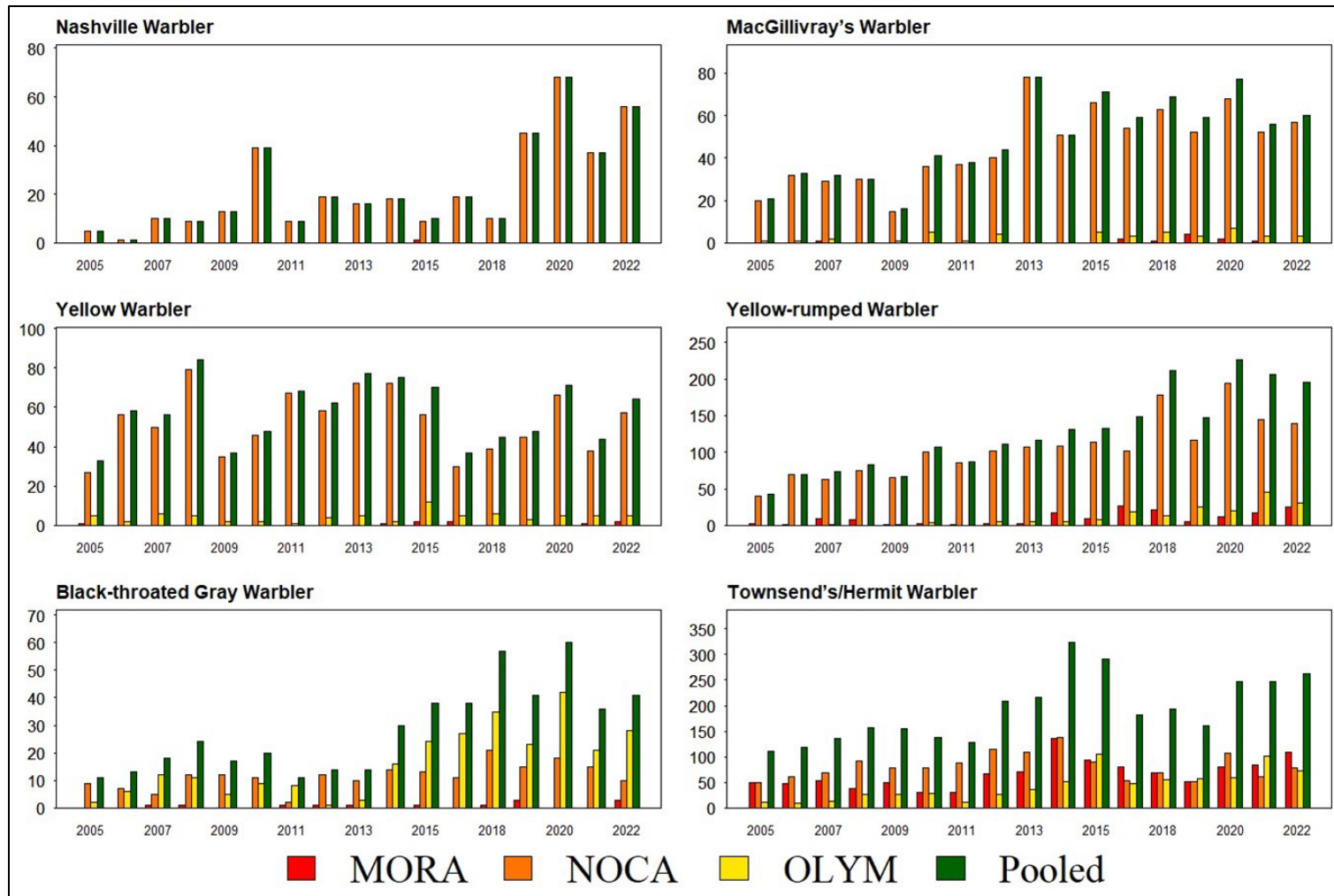


Figure 14. Number of times each species (Nashville Warbler, MacGillivray's Warbler, Yellow Warbler, Yellow-rumped Warbler, Black-throated Gray Warbler, and Townsend's/Hermit Warbler) was detected on annual-panel transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks, and all three parks pooled (always presented in that order) during the 2005–2022 field seasons. Figures 6–15 include all species for which we amassed at least 96 point count detections on annual-panel transects over the 17 years indicated. Numbers of detections are unadjusted for differences in survey effort or potential differences in detectability of birds between years. These adjustments will be made in conjunction with periodic trend analyses.

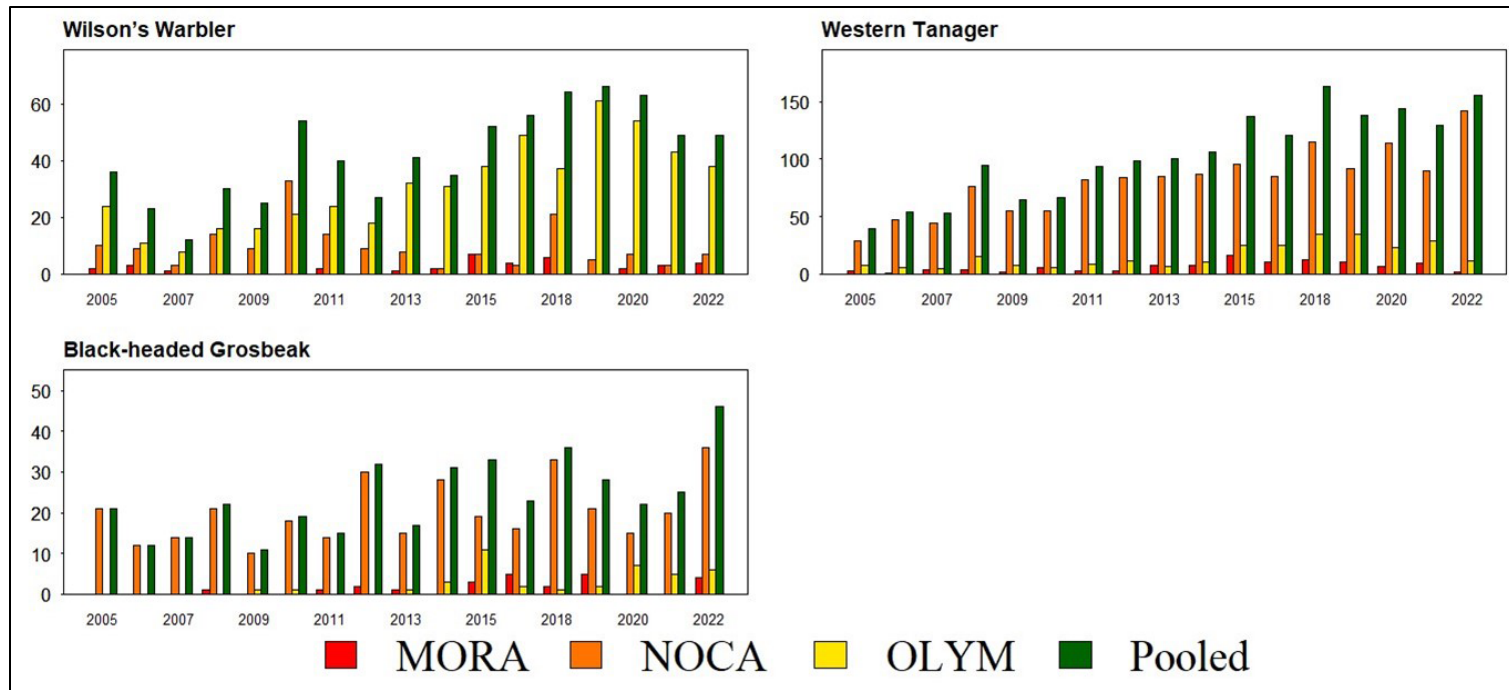


Figure 15. Number of times each species (Wilson's Warbler, Western Tanager, and Black-headed Grosbeak) was detected on annual-panel transects at Mount Rainier (MORA), North Cascades (NOCA), and Olympic (OLYM) National Parks, and all three parks pooled (always presented in that order) during the 2005–2022 field seasons. Figures 6–15 include all species for which we amassed at least 96 point count detections on annual-panel transects over the 17 years indicated. Numbers of detections are unadjusted for differences in survey effort or potential differences in detectability of birds between years. These adjustments will be made in conjunction with periodic trend analyses.

Table 7. Species listed under the Endangered Species Act recorded on “Rare Bird Detection Forms” in each park in 2022, excluding individuals that were also detected during point counts.

Species	Number of birds detected (excluding individuals also detected during point counts)		
	Mount Rainier	North Cascades	Olympic
Marbled Murrelet	–	–	1
Spotted Owl	–	–	–

Table 8. Number of points with detections and number of individual detections for each species detected during point counts at Lewis and Clark National Historical Park in 2022.

Species	Number of points with detections	Number of individual detections
Canada Goose	7	13
Mallard	6	9
Band-tailed Pigeon	11	13
Eurasian Collared-dove	1	1
Anna’s Hummingbird	3	3
Rufous Hummingbird	5	7
Caspian Tern	4	94
Double-crested Cormorant	1	1
Great Blue Heron	1	1
Turkey Vulture	2	6
Bald Eagle	7	7
Belted Kingfisher	1	1
Downy Woodpecker	6	6
Hairy Woodpecker	7	8
Northern Flicker	11	11
Pileated Woodpecker	1	1
Olive-sided Flycatcher	13	13
Western Wood-Pewee	5	6
Willow Flycatcher	2	2
Western Flycatcher	54	99
Hutton’s Vireo	4	4
Warbling Vireo	20	23
Steller’s Jay	21	29
American Crow	33	54

Table 8 (continued). Number of points with detections and number of individual detections for each species detected during point counts at Lewis and Clark National Historical Park in 2022.

Species	Number of points with detections	Number of individual detections
Common Raven	15	17
Tree Swallow	4	7
Violet-green Swallow	4	13
Barn Swallow	14	33
Black-capped Chickadee	9	11
Chestnut-backed Chickadee	25	37
Bushtit	2	8
Red-breasted Nuthatch	5	6
Brown Creeper	14	14
Pacific Wren	42	72
Marsh Wren	8	21
Bewick's Wren	5	5
Golden-crowned Kinglet	26	39
Swainson's Thrush	59	133
American Robin	51	89
Varied Thrush	2	2
European Starling	3	5
Cedar Waxwing	11	25
Evening Grosbeak	2	2
House Finch	3	4
Purple Finch	24	37
Red Crossbill	9	19
Pine Siskin	7	17
American Goldfinch	12	17
Dark-eyed Junco	20	27
White-crowned Sparrow	16	36
Savannah Sparrow	2	3
Song Sparrow	35	64
Spotted Towhee	8	12
Red-winged Blackbird	11	26
Brown-headed Cowbird	23	34
Orange-crowned Warbler	23	29
Common Yellowthroat	17	26
Yellow Warbler	12	18

Table 8 (continued). Number of points with detections and number of individual detections for each species detected during point counts at Lewis and Clark National Historical Park in 2022.

Species	Number of points with detections	Number of individual detections
Yellow-rumped Warbler	5	7
Black-throated Gray Warbler	13	19
Hermit Warbler	13	21
Wilson's Warbler	53	100
Western Tanager	32	41
Black-headed Grosbeak	23	30

2022 Bird Counts Compared to Previous Years

The number of bird detections on annual-panel transects across all three large parks decreased by 650 between 2021 and 2022, though the magnitude of change varied among the parks. At both MORA and OLYM detections decreased between 2021 and 2022. When factoring in the number of point counts conducted each year, both parks saw a decrease in the average number of birds per count (a decrease of 9% at MORA and 24% at OLYM). At NOCA there was very little change in the number of detections between 2021 and 2022.

Some of this overall decrease in detections across the Network is due to a high number of red crossbill detections in 2021, particularly at MORA and OLYM. We detected them at higher numbers in both of these parks than in any of the previous 15 years, but in 2022 our detections dropped to numbers more similar to previous years. Several other species were also detected in slightly lower numbers in the three large parks in 2022 than in 2021, which contributed to the overall decrease in detections. Golden-crowned kinglet and Pacific wren detections in particular decreased across all three parks between 2021 and 2022. Despite these slight changes, overall detection numbers of most species across the parks were not markedly different between the two years.

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Appendix A: Detailed Survey History

Appendix A1. Detailed survey history of each transect sampled in the large parks to date.

Park	Panel	Elevation Class	Number of points surveyed																	
			Transect	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2018	2019	2020	2021	2022
MORA	Ann1	Low	4001	10	12	12	12	12	10	11	14	16	16	15	15	15	16	18	18	18
MORA	Ann1	Low	4005	11	11	11	11	12	9	10	13	13	14	14	14	14	14	14	12	14
MORA	Ann1	Mid	4002	11	11	11	12	11	13	13	15	15	15	16	14	17	17	16	17	16
MORA	Ann1	Mid	4004	18	17	18	18	13	15	10	17	17	18	18	20	19	19	15	19	21
MORA	Ann1	Mid	4009	14	14	15	15	11	13	10	15	15	15	16	17	17	17	17	17	17
MORA	Ann1	Mid	4012	16	16	14	19	19	13	–	17	19	20	23	24	23	23	21	25	21
MORA	Ann1	High	4003	12	12	12	12	12	10	12	13	14	15	15	15	16	16	14	17	18
MORA	Ann1	High	4007	20	20	20	20	20	20	–	20	20	20	25	22	21	24	22	25	24
MORA	Ann1	High	4011	13	11	14	17	17	15	–	16	16	17	17	17	17	17	17	17	18
MORA	Ann1	High	4014	10	16	14	16	16	15	–	17	17	18	22	24	22	22	20	24	24
MORA	Alt2	Low	4006	–	–	10	–	–	–	–	9	–	–	–	–	12	–	–	–	–
MORA	Alt2	Low	4008	–	–	9	–	–	–	–	12	–	–	–	–	13	–	–	–	–
MORA	Alt2	Mid	4015	–	–	11	–	–	–	–	12	–	–	–	–	11	–	–	–	–
MORA	Alt2	Mid	4017	–	–	12	–	–	–	–	13	–	–	–	–	14	–	–	–	–
MORA	Alt2	Mid	4020	–	–	9	–	–	–	–	8	–	–	–	–	16	–	–	–	–
MORA	Alt2	Mid	4026	–	–	10	–	–	–	–	11	–	–	–	–	13	–	–	–	–
MORA	Alt2	High	4016	–	–	19	–	–	–	–	20	–	–	–	–	21	–	–	–	–
MORA	Alt2	High	4019	–	–	20	–	–	–	–	20	–	–	–	–	21	–	–	–	–
MORA	Alt2	High	4027	–	–	13	–	–	–	–	14	–	–	–	–	17	–	–	–	–
MORA	Alt2	High	4075	–	–	14	–	–	–	–	11	–	–	–	–	22	–	–	–	–
MORA	Alt3	Low	4010	–	–	–	13	–	–	–	–	14	–	–	–	–	17	–	–	–
MORA	Alt3	Low	4018	–	–	–	12	–	–	–	–	14	–	–	–	–	15	–	–	–
MORA	Alt3	Mid	4028	–	–	–	11	–	–	–	–	12	–	–	–	–	14	–	–	–
MORA	Alt3	Mid	4042	–	–	–	12	–	–	–	–	13	–	–	–	–	15	–	–	–
MORA	Alt3	Mid	4044	–	–	–	15	–	–	–	–	16	–	–	–	–	17	–	–	–
MORA	Alt3	Mid	4048	–	–	–	13	–	–	–	–	12	–	–	–	–	15	–	–	–
MORA	Alt3	High	4029	–	–	–	14	–	–	–	–	14	–	–	–	–	16	–	–	–
MORA	Alt3	High	4030	–	–	–	12	–	–	–	–	15	–	–	–	–	18	–	–	–
MORA	Alt3	High	4032	–	–	–	15	–	–	–	–	15	–	–	–	–	16	–	–	–
MORA	Alt3	High	4033	–	–	–	18	–	–	–	–	19	–	–	–	–	20	–	–	–
MORA	Alt4	Low	4021	–	–	–	–	12	–	–	–	–	13	–	–	–	–	16	–	–
MORA	Alt4	Low	4022	–	–	–	–	17	–	–	–	–	17	–	–	–	–	18	–	–
MORA	Alt4	Mid	4057	–	–	–	–	10	–	–	–	–	14	–	–	–	–	16	–	–

Appendix A1 (continued). Detailed survey history of each transect sampled in the large parks to date.

Park	Panel	Elevation Class	Number of points surveyed																	
			Transect	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2018	2019	2020	2021	2022
MORA	Alt4	Mid	4060	–	–	–	–	24	–	–	–	–	24	–	–	–	–	25	–	–
MORA	Alt4	Mid	4061	–	–	–	–	15	–	–	–	–	17	–	–	–	–	19	–	–
MORA	Alt4	Mid	4065	–	–	–	–	13	–	–	–	–	15	–	–	–	–	16	–	–
MORA	Alt4	High	4035	–	–	–	–	12	–	–	–	–	14	–	–	–	–	15	–	–
MORA	Alt4	High	4036	–	–	–	–	14	–	–	–	–	16	–	–	–	–	17	–	–
MORA	Alt4	High	4039	–	–	–	–	11	–	–	–	–	13	–	–	–	–	15	–	–
MORA	Alt4	High	4043	–	–	–	–	18	–	–	–	–	19	–	–	–	–	21	–	–
MORA	Alt5	Low	4024	–	–	–	–	–	25	–	–	–	–	25	–	–	–	–	27	–
MORA	Alt5	Low	4025	–	–	–	–	–	9	–	–	–	–	15	–	–	–	–	17	–
MORA	Alt5	Mid	4068	–	–	–	–	–	9	–	–	–	–	15	–	–	–	–	15	–
MORA	Alt5	Mid	4073	–	–	–	–	–	13	–	–	–	–	19	–	–	–	–	19	–
MORA	Alt5	Mid	4074	–	–	–	–	–	13	–	–	–	–	15	–	–	–	–	15	–
MORA	Alt5	Mid	4076	–	–	–	–	–	15	–	–	–	–	17	–	–	–	–	18	–
MORA	Alt5	High	4045	–	–	–	–	–	12	–	–	–	–	21	–	–	–	–	21	–
MORA	Alt5	High	4046	–	–	–	–	–	10	–	–	–	–	13	–	–	–	–	14	–
MORA	Alt5	High	4052	–	–	–	–	–	12	–	–	–	–	16	–	–	–	–	16	–
MORA	Alt5	High	4083	–	–	–	–	–	–	–	–	–	–	18	–	–	–	–	19	–
MORA	Alt6	Low	4031	–	–	–	–	–	–	10	–	–	–	–	13	–	–	–	–	17
MORA	Alt6	Low	4034	–	–	–	–	–	–	10	–	–	–	–	12	–	–	–	–	13
MORA	Alt6	Mid	4077	–	–	–	–	–	–	12	–	–	–	–	18	–	–	–	–	18
MORA	Alt6	Mid	4078	–	–	–	–	–	–	9	–	–	–	–	22	–	–	–	–	22
MORA	Alt6	Mid	4081	–	–	–	–	–	–	10	–	–	–	–	19	–	–	–	–	20
MORA	Alt6	Mid	4084	–	–	–	–	–	–	–	–	–	–	–	17	–	–	–	–	18
MORA	Alt6	High	4058	–	–	–	–	–	–	–	–	–	–	–	19	–	–	–	–	21
MORA	Alt6	High	4062	–	–	–	–	–	–	–	–	–	–	–	19	–	–	–	–	20
MORA	Alt6	High	4064	–	–	–	–	–	–	10	–	–	–	–	15	–	–	–	–	18
MORA	Alt6	High	4067	–	–	–	–	–	–	13	–	–	–	–	17	–	–	–	–	19
NOCA	Ann1	Low	1013	12	11	14	12	11	9	13	15	15	15	–	15	15	15	17	17	18
NOCA	Ann1	Low	1017	13	12	9	12	12	12	13	14	14	15	14	15	15	15	15	15	15
NOCA	Ann1	Low	1020	15	12	13	15	16	12	16	17	17	18	18	17	17	18	18	18	18
NOCA	Ann1	Low	1023	18	19	19	20	21	20	21	21	21	21	22	22	21	22	22	21	18
NOCA	Ann1	Mid	1015	12	16	17	17	15	15	16	17	17	19	18	19	18	18	19	20	20
NOCA	Ann1	Mid	1018	16	21	21	23	22	25	25	23	25	25	24	25	25	23	23	25	21
NOCA	Ann1	Mid	1022	13	13	11	13	14	13	14	15	15	17	16	18	17	18	19	18	17
NOCA	Ann1	Mid	1024	9	10	11	12	10	11	10	13	13	13	14	14	15	14	15	14	14

Appendix A1 (continued). Detailed survey history of each transect sampled in the large parks to date.

Park	Panel	Elevation Class	Number of points surveyed																	
			Transect	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2018	2019	2020	2021	2022
NOCA	Ann1	High	1014	15	19	19	–	20	–	–	20	21	21	22	22	23	–	23	22	22
NOCA	Ann1	High	1016	14	15	14	16	15	14	15	17	17	17	17	17	16	17	18	18	18
NOCA	Ann1	High	1019	12	12	10	12	12	12	12	13	13	13	14	–	14	14	15	16	16
NOCA	Ann1	High	1021	18	21	22	23	22	19	17	24	24	24	24	23	24	24	25	23	25
NOCA	Alt2	Low	1001	–	–	11	–	–	–	–	13	–	–	–	–	13	–	–	–	–
NOCA	Alt2	Low	1005	–	–	13	–	–	–	–	15	–	–	–	–	15	–	–	–	–
NOCA	Alt2	Low	1006	–	–	10	–	–	–	–	12	–	–	–	–	12	–	–	–	–
NOCA	Alt2	Low	1010	–	–	12	–	–	–	–	16	–	–	–	–	16	–	–	–	–
NOCA	Alt2	Mid	1003	–	–	12	–	–	–	–	15	–	–	–	–	15	–	–	–	–
NOCA	Alt2	Mid	1004	–	–	13	–	–	–	–	14	–	–	–	–	15	–	–	–	–
NOCA	Alt2	Mid	1009	–	–	–	–	–	–	–	16	–	–	–	–	17	–	–	–	–
NOCA	Alt2	Mid	1011	–	–	19	–	–	–	–	19	–	–	–	–	20	–	–	–	–
NOCA	Alt2	High	1002	–	–	18	–	–	–	–	20	–	–	–	–	20	–	–	–	–
NOCA	Alt2	High	1007	–	–	13	–	–	–	–	14	–	–	–	–	15	–	–	–	–
NOCA	Alt2	High	1008	–	–	–	–	–	–	–	14	–	–	–	–	14	–	–	–	–
NOCA	Alt2	High	1012	–	–	15	–	–	–	–	19	–	–	–	–	18	–	–	–	–
NOCA	Alt3	Low	1027	–	–	–	13	–	–	–	–	16	–	–	–	–	15	–	–	–
NOCA	Alt3	Low	1028	–	–	–	13	–	–	–	–	14	–	–	–	–	16	–	–	–
NOCA	Alt3	Low	1029	–	–	–	13	–	–	–	–	15	–	–	–	–	15	–	–	–
NOCA	Alt3	Low	1034	–	–	–	13	–	–	–	–	14	–	–	–	–	15	–	–	–
NOCA	Alt3	Mid	1025	–	–	–	15	–	–	–	–	15	–	–	–	–	15	–	–	–
NOCA	Alt3	Mid	1026	–	–	–	14	–	–	–	–	15	–	–	–	–	17	–	–	–
NOCA	Alt3	Mid	1031	–	–	–	19	–	–	–	–	20	–	–	–	–	18	–	–	–
NOCA	Alt3	Mid	1057	–	–	–	–	–	–	–	–	–	–	–	–	–	17	–	–	–
NOCA	Alt3	High	1032	–	–	–	–	–	–	–	–	13	–	–	–	–	15	–	–	–
NOCA	Alt3	High	1037	–	–	–	–	–	–	–	–	20	–	–	–	–	22	–	–	–
NOCA	Alt3	High	1039	–	–	–	20	–	–	–	–	20	–	–	–	–	22	–	–	–
NOCA	Alt3	High	1040	–	–	–	21	–	–	–	–	19	–	–	–	–	19	–	–	–
NOCA	Alt4	Low	1036	–	–	–	–	20	–	–	–	–	25	–	–	–	–	21	–	–
NOCA	Alt4	Low	1054	–	–	–	–	11	–	–	–	–	16	–	–	–	–	17	–	–
NOCA	Alt4	Low	1061	–	–	–	–	10	–	–	–	–	13	–	–	–	–	16	–	–
NOCA	Alt4	Low	1122	–	–	–	–	–	–	–	–	–	22	–	–	–	–	22	–	–
NOCA	Alt4	Mid	1033	–	–	–	–	20	–	–	–	–	23	–	–	–	–	23	–	–
NOCA	Alt4	Mid	1035	–	–	–	–	16	–	–	–	–	18	–	–	–	–	18	–	–
NOCA	Alt4	Mid	1038	–	–	–	–	13	–	–	–	–	18	–	–	–	–	18	–	–

Appendix A1 (continued). Detailed survey history of each transect sampled in the large parks to date.

Park	Panel	Elevation Class	Number of points surveyed																	
			Transect	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2018	2019	2020	2021	2022
NOCA	Alt4	Mid	1041	–	–	–	–	14	–	–	–	–	17	–	–	–	–	18	–	–
NOCA	Alt4	High	1048	–	–	–	–	11	–	–	–	–	13	–	–	–	–	17	–	–
NOCA	Alt4	High	1049	–	–	–	–	12	–	–	–	–	17	–	–	–	–	18	–	–
NOCA	Alt4	High	1050	–	–	–	–	13	–	–	–	–	16	–	–	–	–	17	–	–
NOCA	Alt4	High	1052	–	–	–	–	11	–	–	–	–	13	–	–	–	–	18	–	–
NOCA	Alt5	Low	1062	–	–	–	–	–	8	–	–	–	–	11	–	–	–	–	9	–
NOCA	Alt5	Low	1063	–	–	–	–	–	9	–	–	–	–	16	–	–	–	–	17	–
NOCA	Alt5	Low	1065	–	–	–	–	–	11	–	–	–	–	13	–	–	–	–	15	–
NOCA	Alt5	Low	1067	–	–	–	–	–	8	–	–	–	–	13	–	–	–	–	14	–
NOCA	Alt5	Mid	1042	–	–	–	–	–	15	–	–	–	–	17	–	–	–	–	18	–
NOCA	Alt5	Mid	1043	–	–	–	–	–	9	–	–	–	–	13	–	–	–	–	13	–
NOCA	Alt5	Mid	1044	–	–	–	–	–	11	–	–	–	–	15	–	–	–	–	15	–
NOCA	Alt5	Mid	1045	–	–	–	–	–	10	–	–	–	–	10	–	–	–	–	12	–
NOCA	Alt5	High	1055	–	–	–	–	–	13	–	–	–	–	16	–	–	–	–	16	–
NOCA	Alt5	High	1058	–	–	–	–	–	–	–	–	–	–	18	–	–	–	–	18	–
NOCA	Alt5	High	1060	–	–	–	–	–	9	–	–	–	–	14	–	–	–	–	16	–
NOCA	Alt5	High	1064	–	–	–	–	–	10	–	–	–	–	15	–	–	–	–	15	–
NOCA	Alt6	Low	1068	–	–	–	–	–	–	13	–	–	–	–	15	–	–	–	–	15
NOCA	Alt6	Low	1070	–	–	–	–	–	–	12	–	–	–	–	14	–	–	–	–	14
NOCA	Alt6	Low	1074	–	–	–	–	–	–	14	–	–	–	–	18	–	–	–	–	19
NOCA	Alt6	Low	1075	–	–	–	–	–	–	11	–	–	–	–	16	–	–	–	–	17
NOCA	Alt6	Mid	1047	–	–	–	–	–	–	13	–	–	–	–	15	–	–	–	–	13
NOCA	Alt6	Mid	1051	–	–	–	–	–	–	11	–	–	–	–	12	–	–	–	–	14
NOCA	Alt6	Mid	1053	–	–	–	–	–	–	13	–	–	–	–	19	–	–	–	–	19
NOCA	Alt6	Mid	1056	–	–	–	–	–	–	13	–	–	–	–	14	–	–	–	–	16
NOCA	Alt6	High	1072	–	–	–	–	–	–	–	–	–	–	–	9	–	–	–	–	16
NOCA	Alt6	High	1088	–	–	–	–	–	–	12	–	–	–	–	13	–	–	–	–	15
NOCA	Alt6	High	1090	–	–	–	–	–	–	–	–	–	–	–	16	–	–	–	–	17
NOCA	Alt6	High	1092	–	–	–	–	–	–	14	–	–	–	–	14	–	–	–	–	17
OLYM	Ann1	Low	3001	11	10	8	10	11	12	12	13	12	13	13	14	13	14	14	14	14
OLYM	Ann1	Low	3121	11	15	17	17	17	14	17	15	17	17	19	19	18	17	18	19	19
OLYM	Ann1	Low	3126	9	10	11	13	13	13	15	15	15	14	15	16	16	15	17	18	18
OLYM	Ann1	Low	3134	16	16	18	18	18	18	19	19	19	19	18	20	20	20	20	20	20
OLYM	Ann1	Mid	3122	14	12	14	–	16	16	–	16	17	18	18	–	18	17	18	17	18
OLYM	Ann1	Mid	3123	10	10	12	14	14	15	15	15	15	16	17	16	16	17	17	16	17

Appendix A1 (continued). Detailed survey history of each transect sampled in the large parks to date.

Park	Panel	Elevation Class	Number of points surveyed																	
			Transect	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2018	2019	2020	2021	2022
OLYM	Ann1	Mid	3130	9	9	8	9	9	9	9	10	10	10	10	10	10	8	11	11	11
OLYM	Ann1	Mid	3200	–	–	22	23	21	23	22	23	23	22	23	23	23	22	23	24	24
OLYM	Ann1	High	3124	9	10	10	11	11	11	11	12	12	13	14	14	13	14	14	14	14
OLYM	Ann1	High	3125	9	11	13	13	14	15	11	14	12	15	15	15	15	12	16	16	16
OLYM	Ann1	High	3127	7	9	13	15	14	15	15	15	15	15	16	15	16	16	16	16	16
OLYM	Ann1	High	3128	10	11	11	11	10	11	12	13	12	14	14	14	14	11	10	15	15
OLYM	Alt2	Low	3138	–	–	10	–	–	–	–	12	–	–	–	–	13	–	–	–	–
OLYM	Alt2	Low	3142	–	–	14	–	–	–	–	14	–	–	–	–	16	–	–	–	–
OLYM	Alt2	Low	3144	–	–	13	–	–	–	–	13	–	–	–	–	14	–	–	–	–
OLYM	Alt2	Low	3145	–	–	13	–	–	–	–	14	–	–	–	–	14	–	–	–	–
OLYM	Alt2	Mid	3133	–	–	8	–	–	–	–	16	–	–	–	–	16	–	–	–	–
OLYM	Alt2	Mid	3135	–	–	11	–	–	–	–	13	–	–	–	–	13	–	–	–	–
OLYM	Alt2	Mid	3137	–	–	10	–	–	–	–	11	–	–	–	–	11	–	–	–	–
OLYM	Alt2	Mid	3141	–	–	14	–	–	–	–	15	–	–	–	–	15	–	–	–	–
OLYM	Alt2	High	3132	–	–	19	–	–	–	–	19	–	–	–	–	18	–	–	–	–
OLYM	Alt2	High	3136	–	–	11	–	–	–	–	11	–	–	–	–	14	–	–	–	–
OLYM	Alt2	High	3139	–	–	16	–	–	–	–	13	–	–	–	–	16	–	–	–	–
OLYM	Alt2	High	3140	–	–	–	–	–	–	–	12	–	–	–	–	13	–	–	–	–
OLYM	Alt3	Low	3146	–	–	–	15	–	–	–	–	15	–	–	–	–	15	–	–	–
OLYM	Alt3	Low	3149	–	–	–	10	–	–	–	–	12	–	–	–	–	12	–	–	–
OLYM	Alt3	Low	3151	–	–	–	12	–	–	–	–	17	–	–	–	–	17	–	–	–
OLYM	Alt3	Low	3153	–	–	–	11	–	–	–	–	16	–	–	–	–	16	–	–	–
OLYM	Alt3	Mid	3143	–	–	–	10	–	–	–	–	11	–	–	–	–	9	–	–	–
OLYM	Alt3	Mid	3150	–	–	–	11	–	–	–	–	12	–	–	–	–	12	–	–	–
OLYM	Alt3	Mid	3152	–	–	–	11	–	–	–	–	13	–	–	–	–	13	–	–	–
OLYM	Alt3	Mid	3154	–	–	–	15	–	–	–	–	16	–	–	–	–	18	–	–	–
OLYM	Alt3	High	3147	–	–	–	19	–	–	–	–	19	–	–	–	–	22	–	–	–
OLYM	Alt3	High	3148	–	–	–	14	–	–	–	–	16	–	–	–	–	16	–	–	–
OLYM	Alt3	High	3156	–	–	–	10	–	–	–	–	11	–	–	–	–	13	–	–	–
OLYM	Alt3	High	3157	–	–	–	11	–	–	–	–	12	–	–	–	–	10	–	–	–
OLYM	Alt4	Low	3155	–	–	–	–	10	–	–	–	–	12	–	–	–	–	15	–	–
OLYM	Alt4	Low	3159	–	–	–	–	11	–	–	–	–	12	–	–	–	–	15	–	–
OLYM	Alt4	Low	3161	–	–	–	–	11	–	–	–	–	12	–	–	–	–	13	–	–
OLYM	Alt4	Low	3163	–	–	–	–	15	–	–	–	–	15	–	–	–	–	17	–	–
OLYM	Alt4	Mid	3160	–	–	–	–	10	–	–	–	–	12	–	–	–	–	12	–	–

Appendix A1 (continued). Detailed survey history of each transect sampled in the large parks to date.

Park	Panel	Elevation Class	Number of points surveyed																	
			Transect	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2018	2019	2020	2021	2022
OLYM	Alt4	Mid	3167	–	–	–	–	11	–	–	–	–	14	–	–	–	–	13	–	–
OLYM	Alt4	Mid	3168	–	–	–	–	10	–	–	–	–	15	–	–	–	–	16	–	–
OLYM	Alt4	Mid	3174	–	–	–	–	14	–	–	–	–	15	–	–	–	–	15	–	–
OLYM	Alt4	High	3158	–	–	–	–	14	–	–	–	–	18	–	–	–	–	19	–	–
OLYM	Alt4	High	3164	–	–	–	–	14	–	–	–	–	17	–	–	–	–	18	–	–
OLYM	Alt4	High	3171	–	–	–	–	12	–	–	–	–	15	–	–	–	–	16	–	–
OLYM	Alt4	High	3173	–	–	–	–	10	–	–	–	–	12	–	–	–	–	13	–	–
OLYM	Alt5	Low	3165	–	–	–	–	–	10	–	–	–	–	12	–	–	–	–	13	–
OLYM	Alt5	Low	3166	–	–	–	–	–	12	–	–	–	–	15	–	–	–	–	16	–
OLYM	Alt5	Low	3169	–	–	–	–	–	8	–	–	–	–	13	–	–	–	–	13	–
OLYM	Alt5	Low	3170	–	–	–	–	–	11	–	–	–	–	11	–	–	–	–	12	–
OLYM	Alt5	Mid	3178	–	–	–	–	–	11	–	–	–	–	14	–	–	–	–	16	–
OLYM	Alt5	Mid	3183	–	–	–	–	–	13	–	–	–	–	15	–	–	–	–	17	–
OLYM	Alt5	Mid	3184	–	–	–	–	–	16	–	–	–	–	20	–	–	–	–	20	–
OLYM	Alt5	Mid	3185	–	–	–	–	–	9	–	–	–	–	11	–	–	–	–	13	–
OLYM	Alt5	High	3175	–	–	–	–	–	12	–	–	–	–	15	–	–	–	–	14	–
OLYM	Alt5	High	3179	–	–	–	–	–	16	–	–	–	–	19	–	–	–	–	19	–
OLYM	Alt5	High	3180	–	–	–	–	–	16	–	–	–	–	19	–	–	–	–	19	–
OLYM	Alt5	High	3188	–	–	–	–	–	12	–	–	–	–	18	–	–	–	–	18	–
OLYM	Alt6	Low	3172	–	–	–	–	–	–	14	–	–	–	–	14	–	–	–	–	15
OLYM	Alt6	Low	3177	–	–	–	–	–	–	10	–	–	–	–	10	–	–	–	–	10
OLYM	Alt6	Low	3181	–	–	–	–	–	–	16	–	–	–	–	16	–	–	–	–	17
OLYM	Alt6	Low	3182	–	–	–	–	–	–	16	–	–	–	–	18	–	–	–	–	21
OLYM	Alt6	Mid	3187	–	–	–	–	–	–	20	–	–	–	–	21	–	–	–	–	23
OLYM	Alt6	Mid	3190	–	–	–	–	–	–	14	–	–	–	–	15	–	–	–	–	15
OLYM	Alt6	Mid	3195	–	–	–	–	–	–	12	–	–	–	–	13	–	–	–	–	13
OLYM	Alt6	Mid	3198	–	–	–	–	–	–	11	–	–	–	–	13	–	–	–	–	15
OLYM	Alt6	High	3189	–	–	–	–	–	–	16	–	–	–	–	16	–	–	–	–	17
OLYM	Alt6	High	3191	–	–	–	–	–	–	15	–	–	–	–	16	–	–	–	–	17
OLYM	Alt6	High	3192	–	–	–	–	–	–	14	–	–	–	–	15	–	–	–	–	15
OLYM	Alt6	High	3196	–	–	–	–	–	–	15	–	–	–	–	18	–	–	–	–	18

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