Habitat and Population Objectives for Landbirds in Priority Upland and Riparian Habitats in the Puget Lowlands Ecoregion

Pacific Coast Joint Venture

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Purpose and Need

The Pacific Coast Joint Venture (PCJV) partnership is updating its Implementation Plans with an emphasis on science-based, quantitative habitat objectives that are directly linked to bird populations. To facilitate this, the PCJV partnership is conducting modeling and analyses to determine the habitat capacity of the Joint Venture area to contribute to continental bird population objectives. The biological objectives (i.e., habitat objectives and population objectives) established as a result of these analyses will provide PCJV partners with a numerical context within which to stimulate conservation action and gauge the regional perspective of their local conservation actions.

Scope

The Puget Lowlands is a Level III Ecoregion that includes all or parts of 14 counties and 9 Level IV ecoregions in western Washington. For practical purposes herein, the Puget Lowlands Ecoregion (PLE) was further subdivided into the North Puget Sound Focus Area (NPSFA) and the South Puget Sound Focus Area (SPSFA).

Priority habitats for landbirds in the PLE are riparian, grassland, and oak. Among the three priority habitats, 11 focal species and five additional priority species were identified as important in the biological objective-setting process. Focal species are used to capture the habitat needs of the avian community by directing conservation towards a few species associated with a suite of habitat conditions within a habitat type. Priority species are included to supplement the focal species and support the priorities of PCJV agency partners.

Methods

The process to set landbird habitat and population objectives included analyses and modeling of breeding bird habitat relationships and geospatial data, along with projections of future land use/management for a suite of focal/priority species. Habitat objectives are the output of the analyses and modeling process, and population objectives are the conversion of the habitat objectives to bird populations. All the habitat objectives are based on an analysis of 10-year projections of future land use and management relative to current land use and management, except the habitat objectives for securing conservation status for percent of private lands. Population objectives are abundance objectives (i.e., number of birds) converted to percent changes that result from the outcomes of projected future available habitat. Habitat objectives are given in hectares. One hectare (ha) equals approximately 2.471 acres.

Results

The following habitat objectives are 10-year objectives (with conversion to annual objectives) most associated with the traditional emphasis of PCJV partners, including habitat protection, restoration, and enhancement. Within each of the habitat sections in the text, additional habitat objectives are presented which include objectives for limits on habitat loss or degradation. Population objectives for each of the focal and priority species also are presented below.

Habitat Objectives: Protection

The PCJV objectives to secure the protection and conservation status (e.g., acquisitions or easements) of existing private land grassland, oak, and riparian habitats in the PLE are summarized in the following table.

Habitat Type: Geography	Current Private Habitat(ha)	10-year Objective (%)	10-year Objective (ha)	AnnualObjective (ha)
Grassland: PLE	1,453	+ 13	+ 193	+ 19
Grassland: NPSFA	495	+ 10	+ 50	+ 5
Grassland: SPSFA	958	+ 15	+ 144	+ 14
Oak: PLE	5,802	+ 4	+ 240	+ 24
Oak: NPSFA	137	+ 20	+ 27	+ 3
Oak: SPSFA	5,665	+ 4	+ 227	+ 23
Riparian: PLE	71,231	+ 2	+ 1,425	+ 143
Riparian: NPSFA	39,858	+ 2	+ 797	+ 80
Riparian: SPSFA	31,373	+ 2	+ 628	+ 63

All numbers are rounded for convenience; more precise numbers are presented in Results section.
10-year Objective = 2020.

Habitat Objectives: Restoration

The PCJV objectives to conduct habitat restoration in grassland, oak, and riparian habitats in the PLE are summarized in the following table.

Habitat Type: Geography	Current Habitat (ha)	10-year Objective (%)	10-year Objective (ha)	AnnualObjective (ha)
Grassland: PLE (Private)	1,222	+ 4	+ 45	+ 5
Grassland: PLE (Public)	5,635	+ 8	+ 452	+ 45
Grassland: NPSFA (Private)	410	+ 3	+ 12	+ 1
Grassland: NPSFA (Public)	464	+ 23	+ 108	+ 11
Grassland: SPSFA (Private)	812	+ 4	+ 32	+ 3
Grassland: SPSFA (Public)	5,171	+ 7	+ 344	+ 34
Oak: PLE (Private)	5,111	+ 3	+ 134	+ 13
Oak: PLE (Public)	3,360	+ 14	+ 471	+ 47
Oak: NPSFA (Private)	100	+ 8	+ 8	+ 1
Oak: NPSFA (Public)	120	+ 22	+ 27	+ 3
Oak: SPSFA (Private)	5,011	+ 2	+ 108	+ 11
Oak: SPSFA (Public)	3,240	+9	+ 279	+ 28
Riparian: PLE (Private)	68,467	+ 1	+ 685	+ 68
Riparian: PLE (Public)	17,615	+ 6	+ 1,103	+ 110
Riparian: NPSFA (Private)	38,663	+ 1	+ 387	+ 39
Riparian: NPSFA (Public)	12,300	+ 5	+ 568	+ 57
Riparian: SPSFA (Private)	29,804	+ 1	+ 298	+ 30
Riparian: SPSFA (Public)	5,315	+ 10	+ 536	+ 54

Current habitat is the amount that would exist today after subtracting projected habitat losses to development and degradation, and status changes from protection (i.e., private to public) over the next 10 years. These amounts have been taken "off the top" to avoid double counting in later analyses. Thus, the amount of current habitat is less than the actual amount existing now (and presented above in Habitat Objectives: Protection), and the 10-year objective (%) is the percent after these changes.
All numbers are rounded for convenience; more precise numbers are presented in Results section.
10-year Objective =2020.

Habitat Objectives: Enhancement

The PCJV objectives to conduct habitat enhancement in riparian habitats in the PLE are summarized in the following table.

Habitat Type: Geography	Current Habitat (ha)	10-year Objective (%)	10-year Objective (ha)	AnnualObjective (ha)
Riparian: PLE (Private)	68,467	+ 1	+ 685	**+ 68**
Riparian: PLE (Public)	17,615	+ 4	+ 780	**+ 78**
Riparian: NPSFA (Private)	38,663	+ 1	+ 387	**+ 39**
Riparian: NPSFA (Public)	12,300	+ 3	+ 362	**+ 36**
Riparian: SPSFA (Private)	29,804	+ 1	+ 298	**+ 30**
Riparian: SPSFA (Public)	5,315	+ 8	+ 418	**+ 42**

Current habitat is the amount that would exist today after subtracting projected habitat losses to development and degradation, and status changes from protection (i.e., private to public) over the next 10 years. These amounts have been taken "off the top" to avoid double counting in later analyses. Thus, the amount of current habitat is less than the actual amount existing now (and presented above in Habitat Objectives: Protection), and the 10-year objective (%) is the percent after these changes.
All numbers are rounded for convenience; more precise numbers are presented in Results section.
10-year Objective = 2020.

Focal Species Population Objectives: Oak Habitats

The PCJV objectives to enhance suitability of oak habitats in order to increase populations of focal species in the PLE are summarized in the following table.

Species: Geography	Current Population (# birds)	10-yearObjective (%)	10-yearObjective (# birds)	AnnualObjective (# birds)
Purple Finch: PLE				
Purple Finch: NPSFA	49	+ 12	+ 6	+ 1
Purple Finch: SPSFA				
House Wren: PLE				
House Wren: NPSFA	104	+ 25	+ 25	+ 3
House Wren: SPSFA				
Chipping Sparrow: PLE	2,453	+ 17	+ 410	+ 41
Chipping Sparrow: NPSFA	125	+ 26	+ 32	+ 3
Chipping Sparrow: SPSFA	2,328	+ 16	+ 378	+ 38
Black-capped Chickadee: PLE				
Black-capped Chickadee: NPSFA				
Black-capped Chickadee: SPSFA	2,153	+ 1	+ 13	+ 1
Western Wood-pewee: PLE				
Western Wood-pewee: NPSFA				
Western Wood-pewee: SPSFA	6,676	+ 5	+ 345	+ 35

10-year Objective = 2020.
Blank cells indicate the species is not a focal species for this geographic area.

Focal Species Population Objectives: Grassland Habitats

The PCJV objectives to enhance suitability of grassland habitats in order to increase populations of focal species in the PLE are summarized in the following table.

Species: Geography	Current Population (# birds)	10-year Objective (%)	10-year Objective (# birds)	AnnualObjective (# birds)
Savannah Sparrow: PLE	20.334	+ 2	+ 436	**+ 44**
Savannah Sparrow: NPSFA	1,030	- 0.2	- 2	**- 0.2**
Savannah Sparrow: SPSFA	19,303	+ 2	+ 438	**+ 44**
Western Meadowlark: PLE				
Western Meadowlark: NPSFA				
Western Meadowlark: SPSFA	3,713	+ 2	+ 87	**+ 9**

10-year Objective = 2020.

Focal Species Population Objectives: Riparian Habitats

The PCJV objectives to enhance suitability of riparian habitats in order to increase populations of focal species in the PLE are summarized in the following table.

Species: Geography	Current Population (# birds)	10-year Objective (%)	10-year Objective (# birds)	Annual Objective (# birds)
Swainson's Thrush: PLE	161,273	+ 2	+ 2,190	**+ 219**
Swainson's Thrush: NPSFA	135,334	+ 1	+ 1,743	**+ 174**
Swainson's Thrush: SPSFA	25,939	+ 2	+ 446	**+ 45**
Yellow Warbler: PLE	35,293	+ 2	+ 592	**+ 59**
Yellow Warbler: NPSFA	8,028	+ 2	+ 131	**+ 13**
Yellow Warbler: SPSFA	27,215	+ 2	+ 461	**+ 46**
Willow Flycatcher: PLE	56,656	+ 2	+ 1,263	**+ 126**
Willow Flycatcher: NPSFA	39,838	+ 2	+ 962	**+ 96**
Willow Flycatcher: SPSFA	16,818	+ 2	+ 301	**+ 30**
Downy Woodpecker: PLE	8,978	+ 1	+ 97	**+ 10**
Downy Woodpecker: NPSFA	7,773	+ 1	+ 71	**+ 7**
Downy Woodpecker: SPSFA	1,204	+ 2	+ 26	**+ 3**

10-year Objective = 2020.

Priority Species Population Objectives

The PCJV objectives to increase populations of priority species in the PLE are summarized in the following table.

Species	Priority Habitat Association(s)	Population Estimate	10-year Objective
Great-blue Heron	Riparian and Grassland	<1,000	**>1,200**
Oregon Vesper Sparrow	Grassland and Oak Savannah	200-300	**>500**
Purple Martin	Riparian	500-600	**>1,000**
Streaked Horned Lark	Grassland	200	**400**
Western Bluebird	Grassland and Oak Savannah	500-600	**>1,000**

10-year Objective = 2020.

Introduction

The Pacific Coast Joint Venture (PCJV) partnership is updating its Implementation Plans with an emphasis on science-based, quantitative habitat objectives that are directly linked to bird populations. To facilitate this, the PCJV partnership is conducting modeling and analyses to establish biological objectives (habitat and population objectives) to determine the habitat capacity of the Joint Venture area to contribute to continental bird population objectives. For landbirds, these continental population objectives are in the Partners in Flight (PIF) North American Landbird Conservation Plan (Rich et al. 2004).http://www.partnersinflight/cont_plan/

The United States portion of the PCJVprepared a Strategic Plan in 1993 that covered wetland habitats in coastal areas of Washington, Oregon and a portion of northwestern California. The plan included habitat objectives for wetland habitats and population objectives for waterfowl that were subjective and based on professional judgment. The Washington component of the plan was updated in 1996. Geographic expansion of the PCJV resulted in the development of new Strategic Plans for southeast Alaska (2003), the Willamette Valley of Oregon (2004), coastal northern California (2004), and Hawaii (2005). All of these plans focused on waterfowl conservation in wetland habitats, with limited or no development of biological objectives for other species or other habitats.

In recent years, with the emergence of the North American Bird Conservation Initiative (NABCI), Joint Ventures are being expected to be the delivery mechanism for the conservation of all habitats and their associated bird species. Additionally, there has been an increased emphasis on strengthening the science of the biological foundations on which the Joint Ventures deliver conservation. This document represents the first attempt of the PCJV to both address bird conservation in upland habitats, and provide quantitative objectives for bird species and habitats through a scientific modeling process. Consequently, it meets the comprehensive content technical expectations for population objectives and habitat objectives in the Desired Characteristics for Habitat Joint Venture Partnerships (i.e., the Matrix).

Previous PCJV plans were based on Focus Areas, which weremostly locally-derived political or ecological boundaries. There were 13 Focus Areas in the original PCJV plan that increased to at least 18 with subsequent geographic expansion. In an attempt to promote consistency and ecological concepts, the planning unit for this updated PCJV plan is the EPA's Level III Ecoregions (Omernik 1987). Within these ecoregions, finer-scale planning units (i.e., Focus Areas) also are presented to meet the needs of local partners.

The Puget Lowlands Ecoregion (PLE) includes all or parts of 14 counties and 9 Level IV ecoregions in Washington (Figure 1). For practical purposes herein, the PLE is further subdivided into the North Puget Sound Focus Area (NPSFA) which includes parts or all of six counties: King, Snohomish, Skagit, Whatcom, San Juan, and Island, and the South Puget Sound Focus Area (SPSFA) which includes parts or all of eight counties; Clallam, Jefferson, Kitsap, Pierce, Thurston, Mason, Lewis, and Cowlitz.
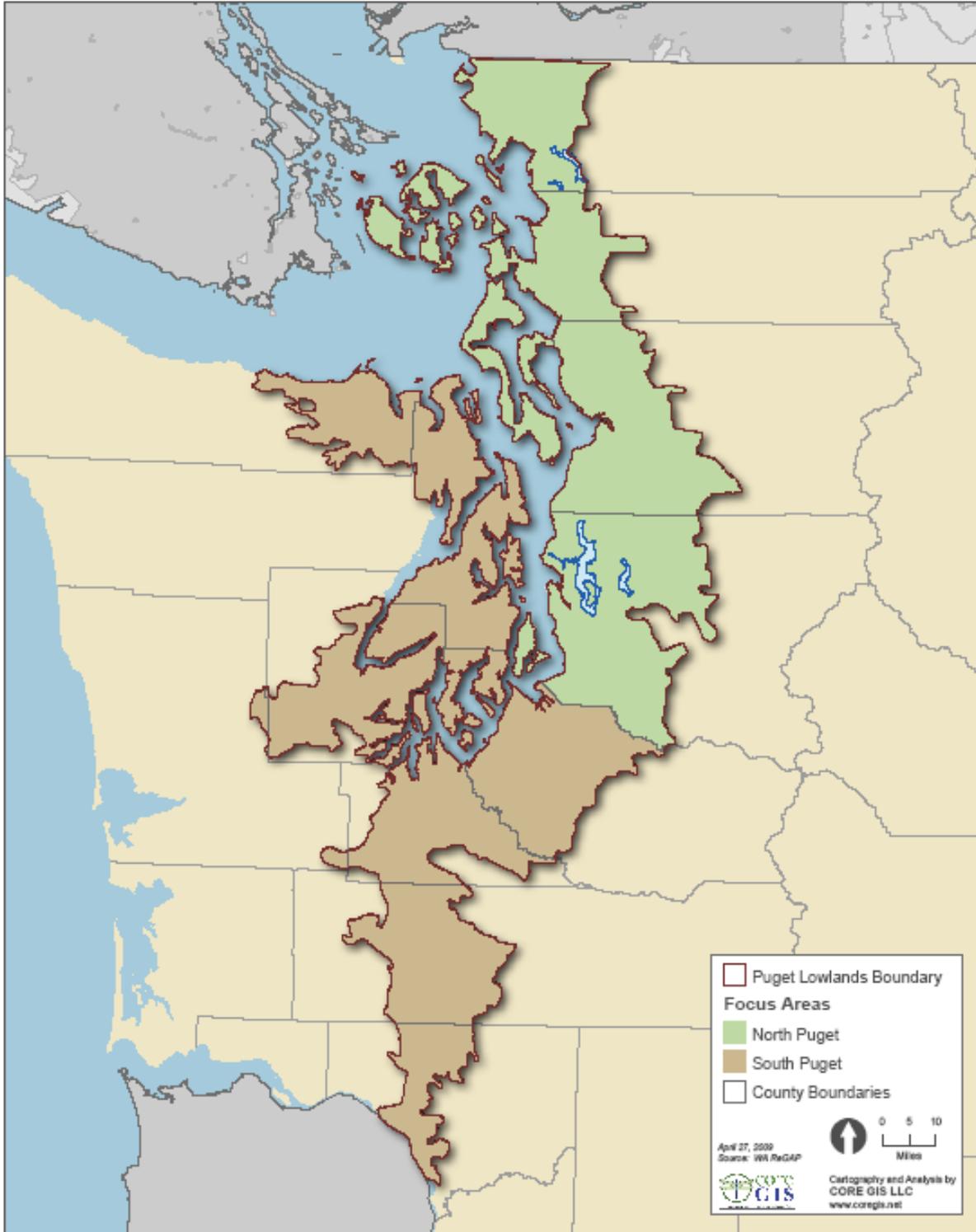
Figure 1: Puget Lowlands Ecoregion

Preface on Landbird Biological Objectives

The biological objectives presented herein are the first attempt of the PCJV partnership to develop quantitative biological targets to support actions of PCJV partners for landbird conservation. PCJV partners and others are encouraged to use the objectives as a numerical context within which to stimulate and gauge the regional perspective of their local conservation actions.

The modeling and analyses to establish the biological objectives are based on the currently best available geospatial and bird-habitat data. However, there are noteworthy data deficiencies and therefore assumptions had to be made to conduct the analyses. The assumptions are documented and PCJV partners are encouraged to seek opportunities to test the assumptions and improve the quality and quantity of the data used in the modeling for future updated analyses.

The biological objectives are based on the premise that a quantitative target is more likely to stimulate conservation action than a descriptive, qualitative target that does not provide any numerical context for the desired outcome or a means of tracking progress towards it. Because of the aforementioned issues of data quality and quantity, PCJV partners and others should not consider the biological objectives as rigid thresholds, with consequences of noncompliance, but as numerical targets to stimulate conservation action in the trajectory of the objective. Users should also recognize the potential dynamic nature of the biological objectives, which will be reanalyzed over time as warranted by new data and/or changing ecological, social, and/or political conditions.

It is important to recognize that landbird conservation includes many non-biological objectives (e.g., policy, education) that are not the emphasis of the PCJV partnership. Although objectives for these conservation activities are not provided herein, many of the PCJV partners do address these types of conservation activities as part of their mandate or mission. These partners should use these biological objectives in concert with or in support of their work on other aspects of bird conservation.

Use of Focal Species for Biological Objectives

Focal species were used to provide an opportunity to efficiently capture the habitat needs of many bird species by directing conservation towards a few species associated with a suite of desired habitat conditions within a habitat type (Lambeck 1997).The emphasis is on the *representativeness* of the speciesrelative to a habitat or habitat condition. The assumption with this approach is that *conservation directed towards the collective needs of a suite of focal species that represent the range of desired habitat conditions for birds should also address the habitat needs of most if not all of the other bird species occurring in that habitat type.*The rationale for emphasizing a suite of focal species is to not only capture the needs of many other species, but also to draw immediate attention to the habitats and habitat conditions most in need of conservation or most important to bird conservation in a functioning ecosystem.

Methods for Setting Biological Objectives

Conceptual Approach: *Breeding bird-habitat relationships were modeled and geospatial analyses conducted at multiple scales to estimate current habitat availability and population size for a suite of focal/priority bird species. Habitat and bird population objectives were established by projectingchanges in the quantity and quality of future land conditions from a variety of factors.*

The process to set landbird biological objectives (habitat objectives and population objectives) included analyses and modeling of breeding bird habitat relationships and geospatial data, along with projections of future land use/management for a suite of focal/priority species. Habitat objectives are the output of the analysis process, and population objectives are the conversion of the habitat objectives to bird populations. All the habitat objectives are based on an analysis of projections of future land use/management relative to current land use/management, except the habitat objectives for securing conservation status for percent of private lands. Population objectives are abundance objectives (i.e., number of birds) converted to percentages that result from the outcomes of projected future available habitat. Population objectives for primary population parameters such as reproduction, survivorship, or recruitment into the population are not provided, but should be provided in future iterations to provide population objectives for both primary and secondary population parameters.

The biological objectives are not presented as spatially-explicit below the level of Focus Area because of the aforementioned data deficiencies and the "newness" of setting quantitative objectives for landbirds. However, the modeling process is spatially-explicit to the available level of geospatial data on land ownership; thus PCJV partners can be provided with this level of spatial detail. Additionally, many other planning efforts in the Pacific Northwest and within the PLE provide geospatial recommendations for prioritized conservation (e.g., State Wildlife Action Plans and Ecoregional Assessments of The Nature Conservancy), including some specific to birds such as the Important Bird Areas programs of the American Bird Conservancy (www.abcbirds.org) and State Audubon chapters (www.oregoniba.org and http://wa.audubon.org/science_IBAWashington.html). PCJV partners are encouraged to look to these plans for recommendations on spatial prioritization to help direct their bird and habitat conservation efforts, and to use these biological objectives in a complementary manner for finer-scale habitat and population targets.

A 10-year timeframe was used for setting biological objectives, based on the likely time-frame of updating PCJV plans. For more practical purposes, annual objectives also are presented, and 5-year objectives could be easily calculated.

Projections of habitat change due to climate change are not included in the modeling process, due to the absence of completed climate change models for the priority habitats in the PLE at this time. When these become available, the plan will be updated to include this important parameter in the analysis process.

1. Access, review, and integrate appropriate geospatial data for the study area, especially bird distribution, ecoregions, land cover/habitat types, land conditions, and land ownership.

The two GIS layers used to provide geospatial coverage for the PLE were the recently completed Northwest Gap Analysis Project for western Washington (NWGAP; gapanalysis.nbii.gov), and an oak-grassland GIS layer completed approximately five years ago by the Washington Department of Natural Resources (WDNR; Chappell et al. 2003). The former is a modeled effort of remote sensing imagery, and the latter was developed using aerial photography interpretation and field verification.

For oak habitats, the NWGAP and WDNR layers were merged,because oak habitats were mapped in each effort. The NWGAP layer included only one oak habitat type, North Pacific Oak Woodland. The WDNR layer included four oak types: Oak-Dominant Forest or Woodland Canopy, Oak-Conifer Forest or Woodland Canopy, Scattered Oak Canopy, and Urban Oak Canopy. The merging of the two layers resulted in the following nine oak categories

    North Pacific Oak Woodland (NPOW)
    Oak-Conifer
    Oak-Conifer/NPOW
    Oak-Dominant
    Oak-Dominant/NPOW
    Scattered Oak
    Scattered Oak/NPOW
    Urban Oak
    Urban Oak/NPOW

For grassland habitats, there is no NWGAP layer, so the following five WDNR grassland categories were used:

    Native Grassland
    Non-Native (Exotic) Grassland
    Semi-Native Grassland
    Shrubland Potentially Restorable To Grassland
    Unsurveyed Grassland

For riparian habitats, only the NWGAP layer was used. It included the following two riparian habitat types:

    North Pacific Hardwood Conifer Swamp
    North Pacific Lowland Riparian Forest and Shrubland

The North Pacific Lowland Riparian Forest and Shrubland habitat type was separated into Lowland Riparian Forest and Lowland Riparian Shrubland, using an assumption regarding the ratio of the two (see Assumptions and Rationale).

After developing the GIS layers for habitat types, a land ownership GIS layer was created,using the Protected Lands Database developed by CommEnSpace as a starting point. This was modified with recent spatial error corrections and a substantial number of additional protected lands.

2. Identify the priority habitats for establishing habitat objectives, based on the priorities of PCJV partners and the practicalities of the capacity of the PCJV partnership.
The three priority habitats for landbirds in the PLE are riparian, grassland, and oak. This is based on the prioritization of these habitat types for landbirds in the Oregon-Washington Partners in Flight (PIF) bird conservation plan for the westside lowlands and valleys (Altman 2000), and their prioritization in the Washington Comprehensive Wildlife Conservation Strategy (http://wdfw.wa.gov/wlm/cwcs/cwcs.htm). Analyses and objectives for conifer forests (another priority habitat) were not conducted because of limited PCJV activities in these habitats at this time. However, it is anticipated that future iterations will include conifer forest objective-setting.

3. Select a suite of focal species that represent the range of desired habitat conditions for birds in the priority habitat, and include any priority species identified by partners (e.g., State "Strategy Species", USFWS "Birds of Conservation Concern").
Eleven focal bird species were selected among the three priority habitat types (Table 1) These were selected based on a review of the bird-habitat relationship literature and the Oregon-Washington Partners in Flight Bird Conservation Plan relevant to the PLE (i.e., Westside Lowlands and Valleys; Altman 2000) to determine the bird species that best met the following criteria:
   ● regularly occur as breeding species throughout the geographic area under consideration,
   ●are strongly associated with the habitat and the habitat is a primary habitat type for the species, and they reach some of their highest breeding densities in this habitat type,
   ●are strongly associated with an important habitat attribute or condition within the habitat such that they would demonstrate responses to management or restoration targeted at the habitat attribute or condition, and
   ●are readily monitored using standard techniques to be able to track progress towards objectives at multiple scales.

Table 1. Landbird focal species targeted for conservation within priority oak, grassland, and riparian habitats of the Puget Lowlands Ecoregion.

Priority Habitat/Species	NPSFA	SPSFA
Grassland		
Savannah Sparrow	X	X
Western Meadowlark		X
Oak		
Black-capped Chickadee		X
Chipping Sparrow	X	X
House Wren	X	
Purple Finch	X	
Western Wood-pewee		X
Riparian		
Downy Woodpecker	X	X
Swainson's Thrush	X	X
Willow Flycatcher	X	X
Yellow Warbler	X	X

Differences in focal species between the NPSFA and SPSFA in oak and grassland habitats where due to range limitations

In addition to the 11 focal species, five priority species were also recognized from bird conservation partner priority lists, including the Washington Department of Fish and Wildlife Comprehensive Wildlife Conservation Strategy (http://wdfw.wa.gov/wlm/cwcs/cwcs.htm) and the U.S. Fish and Wildlife Service (USFWS) Birds of Conservation Concern (USFWS 2008, http://www.fws.gov/migratorybirds/) to supplement the focal species and support the priorities of PCJV agency partners. (Table 2). Additionally, two focal species, Willow Flycatcher and Purple Finch, also are priority species on the USFWS Birds of Conservation Concern list.

Table 2. Landbird priority species targeted for conservation within priority oak, grassland, and riparian habitats of the Puget Lowlands Ecoregion.

Species	Priority Habitat Association(s)	Conservation Lists
Great-blue Heron	Riparian and Grassland	**WDFW**
Oregon Vesper Sparrow	Grassland and Oak Savannah	**WDFW, USFWS**
Purple Martin	Riparian	**WDFW**
Streaked Horned Lark	Grassland	**WDFW, USFWS**
Western Bluebird	Grassland and Oak Savannah	**WDFW**

WDFW = Washington Department of Fish and Wildlife
USFWS = U.S. Fish and Wildlife Service

Biological objective-setting for priority species was not based on the modeling process as described herein because their small populations (<1000 birds for each species) are not conducive to the habitat-based methods described for setting biological objectives. Also, their conservation goals often are already the focus of other programs/initiatives.   Population estimates and objectives for priority species are presented based on other sources or by professional judgment, with the assumption that the habitat objectives for focal bird species will support the population objectives for priority bird species.

4. Develop a biological parameters database for each focal bird species in each priority habitat that includes the type (coarse scale) and condition (fine scale) of suitable habitat for each species, and the distribution of the species across the landscape (i.e. habitat-specific and condition-specific density estimates).
The database also should include as appropriate any of the following geospatial and/or biological parameters:
> ● limiting factors for a species presence and/or density (e.g., elevation), and
> ● shape, size, and configuration of landscape components (e.g., patch size, fragmentation, connectivity),
> ●vital rates essential for population maintenance (e.g., reproduction, survival), and
> ●unique habitat features the species is associated with that are often not components of GIS layers (e.g., snags, canopy cover).

The focal species database for the PLE did not include any of the aforementioned optional parameters. Focal/priority species elevation distinctions are not a factor in the habitats analyzed (i.e., mostly all lowland in this ecoregion), there is no data on limiting factors for patch size or fragmentation among the focal/priority species, and there is no data on vital rates or the degree of association with unique habitat features.

Relationships between focal species and each habitat type and condition were determined from a literature review and species density estimates for each habitat type or condition (Table 3) were derived from local data sets (Appendix A).Data were compiledfrom four different sources to provide breeding season density estimates; spot-mapping, area searches,variable radius point counts analyzed in program Distance, and fixed radius point counts. Spot-mapping is generally recognized as producing the best density estimates, because the effort is intensive and territories are mapped. Area searches also provide reasonable density estimates because the area is defined and the entire area is surveyed, not sampled. Variable radius point counts analyzed in program DISTANCE can provide good density estimates because they account for differences in detectability among species. Fixed radius point counts (i.e., 50 meter counts) are best used for indices of relative abundance and not density estimates, because they do not account for differences in detectability within the fixed radius. However, data were used from fixed radius point counts because of a limited amount of other types of data (often only fixed-radius point count data were available). Additionally, analyses of oak datacomparing density estimates between fixed-radius point counts and program DISTANCE indicated similar results for approximately half the species (B. Altman unpublished data).

Table 3. Ecoregional mean density estimates (birds/ha) for focal landbird species in priority habitats in the Puget Lowlands Ecoregion.

Habitat	North Puget Sound Focus Area				South Puget Sound Focus Area			
Oak	PUFI	HOWR	CHSP		BCCH	WWPE	CHSP	
Oak-dominant	0.17	0.46	0.57		0.25	0.65	0.20	
Oak-conifer	0.05	0.01	0.00		0.13	0.12	0.01	
Scattered oak	0.17	0.46	0.57		0.25	0.65	0.20	
Urban oak	0.17	0.46	0.57		0.25	0.65	0.20	
Grassland	SAVS				SAVS	WEME		
Native	0.63				2.22	0.66		
Non-native	0.51				0.91	0.30		
Semi-native	0.57				1.42	0.45		
Riparian	SWTH	WIFL	YWAR	DOWO	SWTH	WIFL	YWAR	DOWO
Hardwood conifer swamp	1.07	0.46	0.04	0.05	0.25	0.29	0.19	0.01
Lowland riparian forest	1.43	0.37	0.08	0.09	0.33	0.23	0.38	0.02
Lowland riparian shrubland	0.72	0.46	0.08	0.00	0.56	0.23	0.42	0.00

PUFI = Purple Finch; HOWR = House Wren: CHSP = Chipping Sparrow; BCCH = Black-capped Chickadee; WWPE = Western Wood-pewee; WEME = Western Meadowlark; SAVS = Savannah Sparrow; SWTH = Swainson's Thrush; WIFL = Willow Flycatcher; YWAR = Yellow Warbler; DOWO = Downy Woodpecker

5. Conduct geospatial analyses to characterize current habitat availability for each focal species based on integration of habitat and ownership classifications in GIS layers (1) with suitable habitat parameters (4).
Area of habitat availability for each focal species by ownership was calculated by adding the area of all polygons in the GIS layer that were considered suitable habitat.

6. Estimate current population size of each focal species at desired scales (e.g., BCR subregions, National Wildlife Refuges) by multiplying habitat-specific mean bird density estimates (4) and area of current habitat availability by ownership (5).

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A pair correction factor was included in the calculation of population size to account for the bias of males in most of the density estimate data used(see Assumptions and Rationale).

7. Coordinate with principal conservation partners to discuss and quantify projected land use or land management activities or changes (e.g., development, resource extraction, habitat creation, habitat restoration, habitat enhancement, natural succession) that would impact land use and habitat relevant to birds, and create quantitative databases and geospatial layers (if projections are spatially specific) that reflect these projections. Professional consultation with land managers/ecologists/biologists and professional judgment were used to quantify projected future land use/management activities. Relative stability of habitats and potentially favorable management was assumed on lands owned or managed by conservation organizations (e.g., The Nature Conservancy) or public agencies (e.g., State Parks, National Wildlife Refuges). Some degree of loss of habitat and/or limited potentially favorable management and negative effects of lack of management on private lands was also assumed.

8. Access, review, and integrate available analyses that project future changes (e.g., population growth, land use changes) that would impact land use and habitat relevant to birds, and create quantitative databases and geospatial layers (if possible) that reflect these projections. The geospatial data of a Futures Analyses conducted by CommEnSpace for the Cascade Land Conservancy for Pierce, King, and Snohomish counties was overlaid on the National Land Cover Database to determine the amount of each habitat type that would be lost during the 20-year period from 2000-2020. The results for these three counties were extrapolated to the entire PLE (see Assumptions and Rationale).

9. Apply data and geospatial analyses from projected land management (7) and projected land-use or socio-economic changes (8) to modify current habitat availability (5) and calculate future habitat availability by ownership for each focal species.

10. Estimate future populations of each focal species at desired scales (e.g., BCR subregions, National Wildlife Refuges) by multiplying habitat-specific or habitat condition-specific bird density estimates (4) and area of future habitat availability by ownership (9).

11. Establish preliminary habitat objectives for each habitat or habitat condition at desired scales (e.g., BCR subregions, National Wildlife Refuges) by subtracting current habitat (5) from future habitat (9) and converting the raw number to a percent difference from current habitat (e.g., change habitat in a prescribed manner by X percent).

12. Establish preliminary population objectives for each focal species at desired scales (e.g., BCR, BCR Subregions, National Wildlife Refuges) by subtracting the current population estimate (6) from the future population estimate (10) and converting the raw number to a percent difference from current population estimate (e.g., increase population by X percent).

Results: Oak Habitats

Oak habitats comprise 9,021.06 ha within the PLE (Figure 2), with over 97% (8,791.27 ha) occurring in the SPSFA (Table 4). Land ownership is predominately private (64%) with similar ratios between the NPSFA (68% private) and SPSFA (64% private).
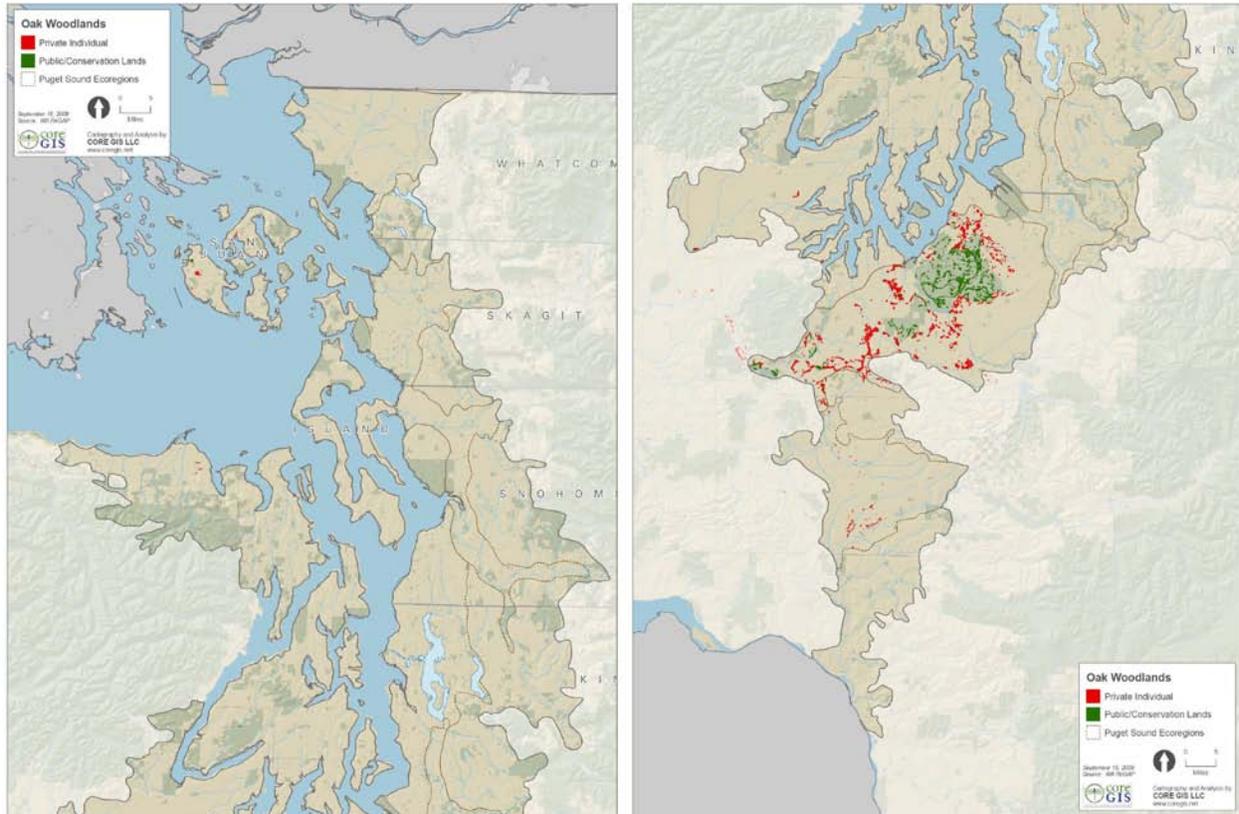
Figure 2.Oak habitats in the Puget Lowlands Ecoregion.

Table 4.Current oak habitat amounts by ownership and future projections of oak habitat changes that would impact bird populations in the Puget Lowlands Ecoregion in the next 10 years.

North Puget Sound Focus Area	Oak Hectares	Oak Habitat Loss (%) [1]		Oak Habitat Change (%) [1]	
Ownership		Development [2]	Degradation [3]	Restoration (+) [4]	Succession (-) [5]
Public/Conservation (~ 32%)					
National Park Service	31.82	0	0	30	0
Bureau of Land Management	8.53	0	0	30	0
Army Corps of Engineers	6.37	0	0	0	5
U.S. Coast Guard	2.71	0	5	0	5
Washington Dept Natural Resources	0.55	0	0	0	0
Washington State Parks	17.87	0	0	20	0
San Juan County	0.14	0	0	0	0
The Nature Conservancy	15.03	0	0	70	0

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San Juan Preservation Trust	9.88	0	0	20	0
	92.90				
Private (~ 68%)	136.89	5	5	20	5
Future Conservation Unknown				**39**	**0**

South Puget Sound Focus Area	Oak Hectares	Oak Habitat Loss (%) [1]		Oak Habitat Change (%) [1]	
Ownership		Development [2]	Degradation [3]	Restoration (+) [4]	Succession (-) [5]
Public/Conservation (~ 36 %)					
Fort Lewis Military Installation	2434.87	1	4	25	1
McChord Air Base	205.39	1	10	5	5
Scatter Creek WMA	67.00	0	10	25	5
Chehalis Wildlife Area	0.02	0	0	0	0
Glacial Heritage Preserve	42.68	0	5	90	1
Mima Mound Preserve	13.34	0	5	90	0
Camp Murray NG	21.79	0	5	5	2
Nisqually Indian Reservation	0.44	0	0	0	0
Chehalis Indian Reservation	157.53	0	5	5	5
Capitol State Forest	0.70	0	0	0	0
Mountain View Memorial Park	17.24	0	0	0	2
Fort Borst Park	6.14	0	3	0	0
Fort Steilacoom Park	24.54	0	0	0	2
Harry Todd Park	4.36	0	3	0	1
Lake Sylvia State Park	0.93	0	0	0	0
Schafer State Park	39.68	0	5	5	0
Millersylvania State Park	1.23	0	0	0	0
Tolmie State Park	14.20	0	5	5	0
WA DNR Trust land	68.56	0	5	10	2
Western State Hospital	2.23	0	0	0	0
Pacific Road	2.09	0	0	0	0
South Puget Prairie	1.08	0	0	0	0
Thurston County Parks	0.08	0	0	0	0
	3126.12				
Private (~ 64 %)					
Scatter Creek Corridor	630.52	5	5	12	2
Black River/Mima Corridor	240.19	5	5	8	2
Chehalis Valley	185.80	5	5	3	5
Fords Prairie	47.25	5	5	3	5
Grand Mound	136.13	5	5	3	5
Lacey	689.40	5	5	3	5
Lakewood/Steilacoom	847.45	5	5	3	5
Nisqually	1352.49	5	5	3	5
Parkland/Spanaway	341.44	5	5	3	5
Tumwater/Tenino	843.38	5	5	3	5
No Regional Designation	351.10	5	5	3	5
Private Total	5665.15				
Future Conservation Unknown				16	**2**

[1] These numbers are "optimistically realistic, ball-park projections" of future habitat changes by ownership. The percents that are lightly shaded are based on conversations between the PCJV Landbird Science Coordinator and biologists/ecologists/managers employed by the agencies/organizations listed (see Acknowledgments). Numbers not highlighted in a color were assumptions projected by the PCJV Landbird Science Coordinator based on general knowledge of the type and degree of land management conducted by that agency/organization relative to the

projections of other agencies/organizations. Zeros that are darkly shaded indicate that oak-dominant or oak-conifer habitat is not present for that loss or change to occur.

[2] Development = Oak habitat that will be "permanently lost" due to development in the next 10 years (e.g., trees removed for buildings, roads, etc.).

[3] Degradation = Oak-conifer habitat (i.e., currently >25% both oak and conifer in the canopy) that will be "permanently lost" in the next 10 years due to the absence of restoration and continued degradation by conifer encroachment rendering the area "unrestorable" and unsuitable habitat for oak bird species. These are areas that are already close to being "unrestorable" and would not likely have any attempts to "restore" them in the next 10 years.

[4] Restoration = Oak-conifer habitat (i.e., currently >25% both oak and conifer in the canopy) that will likely be "restored" to oak-dominant habitat (i.e., >25% oak and <25% conifer in the canopy) in the next 10 years resulting in greater suitability and densities of oak-associated bird species.

[5] Succession = Oak-dominant habitat (i.e., >25% oak and <25% conifer in the canopy) that will "succeed" to oak-conifer habitat in the next 10 years due to the absence of restoration and continued degradation by conifer encroachment. These are areas that are currently oak-dominant habitat but are close to being oak-conifer habitat and would not likely have any attempts to "restore" them in the next 10 years resulting in reduced suitability for oak-associated bird species.

Based on the current habitat availability and projected future changes in oak habitat, PCJV habitat objectives are summarized in the following Table 5 and described in following text.

Table 5.Habitat objectives for oak habitats in the Puget Lowlands Ecoregion.

	Current Habitat (ha)	10-year Objective (%)	10-year Objective (ha)	**Annual Objective (ha)**
Protection: PLE	5,802.04	+ 4.14	+ 240.31	**+ 24.03**
Protection: NPSFA	136.89	+ 20.00	+ 27.38	**+ 2.74**
Protection: SPSFA	5,665.15	+ 4.00	+ 226.61	**+ 22.66**
Restoration: PLE (Private)	5,110.77	+ 2.63	+ 134.16	**+ 13.42**
Restoration: NPSFA (Private)	99.78	+ 8.09	+ 8.07	**+ 0.81**
Restoration: SPSFA (Private)	5,010.99	+ 2.16	+ 108.43	**+ 10.84**
Restoration: PLE (Public)	3,360.18	+ 14.03	+ 471.33	**+ 47.13**
Restoration: NPSFA (Public)	120.21	+ 22.40	+ 26.93	**+ 2.69**
Restoration: SPSFA (Public)	3,239.97	+ 8.60	+ 278.64	**+ 27.86**

Current habitat for protection is the existing amount of habitat. Current habitat for restoration is the amount that would exist today after subtracting projected habitat losses to development and degradation, and status changes from protection (i.e., private to public) over the next 10 years. These amounts have been taken "off the top" to avoid double counting in later analyses. Thus, the amount of current habitat is less than the actual amount existing now (and presented above in Habitat Objectives: Protection), and the 10-year objective (%) is the percent after these changes.
10 year objective = 2020

Pacific Coast Joint Venture Oak Habitat Objectives

● Secure conservation status (e.g., acquisitions, easements) for ≥ 4.14% of private land oak habitats in the Puget Lowlands Ecoregion including ≥ 20% in the North Puget Sound Focus Area and ≥ 4% in the South Puget Sound Focus Area.

 Amount (PLE): ≥ 240.31 ha [5,802.04 ha total] or ≥ 24.03 ha/year
 Amount (NPSFA): ≥ 27.38 ha [136.89 ha total] or ≥ 2.74 ha/year

Amount (SPSFA): $\geq$ 226.61 ha [5,665.15 ha total] or $\geq$ 22.66 ha/year

● Conduct habitat restoration (i.e., conversion of oak-conifer to oak-dominant habitat) on $\geq$ 14.03% of public/conservation lands in the Puget Lowlands Ecoregion including $\geq$ 22.40% in the North Puget Sound Focus Area and $\geq$ 8.60% in the South Puget Sound Focus Area.
      Amount (PLE): $\geq$ 471.33 ha [3,360.18 ha total] or $\geq$ 47.13 ha/year
      Amount (NPSFA): $\geq$ 26.93 ha [120.21 ha total] or $\geq$ 2.69 ha/year
      Amount (SPSFA): $\geq$ 278.64 ha [3,239.97 ha total] or $\geq$ 27.86 ha/year

● Conduct habitat restoration (i.e., conversion of oak-conifer to oak-dominant habitat) on $\geq$ 2.63% of private landsin the Puget Lowlands Ecoregion including $\geq$ 8.09% in the North Puget Sound Focus Area and $\geq$ 2.16% in the South Puget Sound Focus Area.
      Amount (PLE): $\geq$134.16 ha [5,110.77 ha total] or $\geq$ 13.42 ha/year
      Amount (NPSFA): $\geq$ 8.07 ha [99.78 ha total] or $\geq$ 0.81 ha/year
      Amount (SPSFA): $\geq$ 108.43 ha [5,010.99 ha total] or $\geq$ 10.84 ha/year

● Ensure $\leq$ 0.82% permanent loss of oak habitats from development on public/conservation lands in the Puget Lowlands Ecoregion including $\leq$ 0.01% in the North Puget Sound Focus Area and $\leq$ 0.85% in the South Puget Sound Focus Area.
      Amount (PLE): $\leq$ 26.40 ha [3,219.02 ha total] or $\leq$ 2.64 ha/ year
      Amount (NPSFA): $\leq$ 0.00 ha [92.90 ha total] or $\leq$ 0.00 ha/year
      Amount (SPSFA): $\leq$ 26.40 ha [3,126.12 ha total] or $\leq$ 2.64 ha/year

● Ensure $\leq$ 5.00% permanent loss of oak habitats from development on private landsin the Puget Lowlands Ecoregion including $\leq$ 5.00% in the North Puget Sound Focus Area and $\leq$ 5.00% in the South Puget Sound Focus Area.
      Amount (PLE): 290.06 ha [5,802.04 ha total] or 29.01 ha/year
      Amount (NPSFA): $\leq$ 6.84 ha [136.89 ha total] or $\leq$ 0.68 ha/year
      Amount (SPSFA): $\leq$ 283.26 ha [5,665.15 ha total] or $\leq$ 28.33 ha/year

● Ensure $\leq$ 5.39% permanent loss of oak-conifer habitats from degradation on public/conservation lands in the Puget Lowlands Ecoregion including $\leq$ 0.11% in the North Puget Sound Focus Area and $\leq$ 5.56% in the South Puget Sound Focus Area.
      Amount (PLE): $\leq$ 106.36 ha [1,972.70 ha total] or $\leq$ 10.64 ha/year
      Amount (NPSFA): $\leq$ 0.07 ha [62.09 ha total] or $\leq$ 0.01 ha/year
      Amount (SPSFA): $\leq$ 106.29 ha [1,910.61 ha total] or $\leq$ 10.63 ha/year

● Ensure $\leq$ 5.22% permanent loss of oak-conifer habitats from degradation on private landsin the Puget Lowlands Ecoregion including $\leq$ 5.00% in the North Puget Sound Focus Area and $\leq$ 5.22% in the South Puget Sound Focus Area.
      Amount (PLE): $\leq$ 147.18 ha [2,821.67 ha total] or $\leq$ 14.72 ha/year
      Amount (NPSFA): $\leq$ 2.88 ha [57.67 ha total] or $\leq$ 0.29 ha/year
      Amount (SPSFA): $\leq$ 144.30 ha [2,764.00 ha total] or $\leq$ 14.43 ha/year

● Ensure ≤ 1.41% change of oak-dominant habitat to oak-conifer habitat from succession on public/conservation lands in the Puget Lowlands Ecoregion including ≤ 0.13% in the North Puget Sound Focus Area and ≤ 1.44% in the South Puget Sound Focus Area.

      Amount (PLE): ≤ 27.07 ha [1,927.34 ha total] or ≤ 2.71 ha/year
      Amount (NPSFA): ≤ 0.06 ha [47.77 ha total] or ≤ 0.01 ha/year
      Amount (SPSFA): ≤ 27.01 ha [1,879.57 total] or ≤ 2.70 ha/year

● Ensure ≤ 5.00% change of oak-dominant habitats to oak-conifer habitats from succession on private lands in the Puget Lowlands Ecoregion including ≤ 5.00% in the North Puget Sound Focus Area and ≤ 5.00% in the South Puget Sound Focus Area.

      Amount (PLE): ≤ 113.09 ha [2,267.35 ha total] or ≤ 11.32 ha/year
      Amount (NPSFA): ≤ 2.54 ha [50.89 ha total] or ≤ 0.25 ha/year
      Amount (SPSFA): ≤ 110.65 ha [2,216.46 ha total] or ≤ 11.07 ha/year

Based on current habitat availability and projected future changes in oak habitat, PCJV population objectives for focal species are summarized in Table 6 and described in the following text.

Table 6. Population objectives for oak focal species in the Puget Lowlands Ecoregion.

Species: Geography	Current Population (# birds)	10-year Objective (%)	10-year Objective (# birds)	**Annual Objective (# birds)**
Purple Finch: PLE				
Purple Finch: NPSFA	49.39	+ 11.82	+ 5.84	**+ 0.58**
Purple Finch: SPSFA				
House Wren: PLE				
House Wren: NPSFA	103.62	+ 24.50	+ 25.39	**+ 2.54**
House Wren: SPSFA				
Chipping Sparrow: PLE	2,453.13	+ 16.72	+ 410.12	**+ 41.01**
Chipping Sparrow: NPSFA	125.43	+ 25.84	+ 32.41	**+ 3.24**
Chipping Sparrow: SPSFA	2,327.70	+ 16.23	+ 377.71	**+ 37.77**
Black-capped Chickadee: PLE				
Black-capped Chickadee: NPSFA				
Black-capped Chickadee: SPSFA	2,152.96	+ 0.60	+ 12.84	**+ 1.28**
Western Wood-pewee: PLE				
Western Wood-pewee: NPSFA				
Western Wood-pewee: SPSFA	6,676.07	+ 5.17	+ 345.07	**+ 34.51**

10-year Objective = 2020.
Blank cells indicate the species is not a focal species for this geographic area.

Pacific Coast Joint Venture Oak Focal Bird Species Population Objectives

● Enhance suitability of oak habitats to increase populations of Purple Finch by ≥ 11.82% in the North Puget Sound Focus Area.

      Amount (NPSFA): ≥ 5.84 birds [49.39birds total] or ≥0.58 birds/year

● Enhance suitability of oak habitats to increase populations of House Wren by ≥ 24.50% in the North Puget Sound Focus Area.

     Amount (NPSFA): ≥ 25.39 birds [103.62 birds total] or ≥ 2.54 birds/year

● Enhance suitability of oak habitats to increase populations of Chipping Sparrow by ≥ 16.72% in the Puget Lowlands Ecoregion including ≥ 25.84% in the North Puget Sound Focus Area and ≥ 16.23% in the South Puget Sound Focus Area.

     Amount (PLE): ≥ 410.12 birds [2,453.13 birds total] or ≥ 41.01 birds/year
     Amount (NPSFA): ≥ 32.41 birds [125.43 birds total] or ≥ 3.24 birds/year
     Amount (SPSFA): ≥ 377.71 birds [2.327.70birds total] or ≥ 37.77 birds/year

● Enhance suitability of oak habitats to increase populations of Black-capped Chickadee by ≥ 0.60% in the South Puget Sound Focus Area.

     Amount (SPSFA): ≥ 12.84 birds [2,152.96 birds total] or ≥ 1.28 birds/year

● Enhance suitability of oak habitats to increase populations of Western Wood-pewee by ≥ 5.17% in the South Puget Sound Focus Area.

     Amount (SPSFA): ≥ 345.07 birds [6,676.07 birds total] or ≥ 34.51 birds/year

Results: Grassland Habitats

Grassland habitats comprise 7,960.05 ha within the PLE (Figure 3), with over 87% (6,985.18 ha) occurring in the SPSFA (Table 7). Land ownership is predominately public (83%) although with very different proportions in the NPSFA (48% public) and SPSFA (86% public).
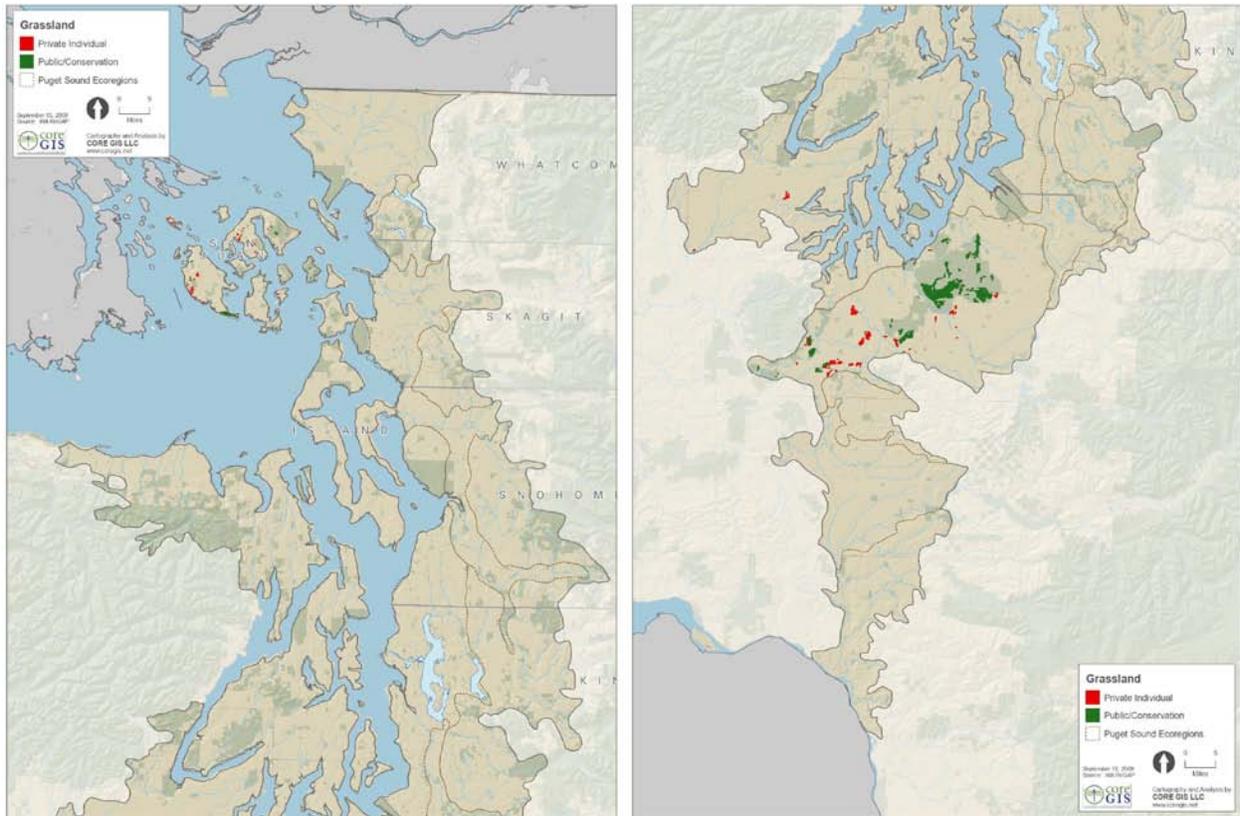
Figure 3.Grassland habitats in the Puget Lowlands Ecoregion.

Table7.Current grassland/prairie habitat amounts by ownership and future projections of grassland/prairie habitat changes that would impact bird populations in the Puget Lowlands Ecoregion in the next 10 years.

North Puget Sound Focus Area	Grassland Hectares	Grassland Habitat Loss (%) [1]		Grassland Habitat Change (%) [1]	
Ownership		Development [2]	Succession [3]	Degradation [4]	Restoration [5]
Public/Conservation (~ 48%)					
U.S. Fish and Wildlife Service	8.49	0	0	0	**25**
National Park Service	237.44	0	0	0	**30**
Bureau of Land Management	18.84	0	0	0	**10**
U.S. Coast Guard	16.24	0	1	3	**0**
Washington Dept Natural Resources	31.54	0	0	2	**10**
Washington Dept Fish and Wildlife	1.84	0	0	0	**0**
Washington State Parks	81.15	0	0	2	**8**

	Grassland Hectares	Development	Succession	Degradation	Restoration
King County	0.34	3	1	3	**0**
San Juan County	10.26	3	1	3	**0**
Skagit County	4.27	3	0	3	**0**
The Nature Conservancy	25.57	0	0	0	**70**
San Juan Preservation Trust	34.26	0	0	3	**10**
City of Anacortes	10.17	3	0	3	**0**
	480.41				
Private (~ 52%)	494.46	3	2	3	**3**
	974.87				
Future Conservation Unknown	180.01			2	**17**

South Puget Lowlands	Grassland	Grassland Habitat Loss (%) [1]		Grassland Habitat Change (%) [1]	
Ownership	Hectares	Development [2]	Succession [3]	Degradation [4]	Restoration [5]
Public/Conservation (~ 86%)					
Chehalis/Nisqually Reservations	42.76	2	2	5	**1**
County Fairgrounds	105.82	2	1	0	**0**
Fort Lewis Military Installation	4,863.52	1	0	3	**10**
Glacial Heritage Preserve	177.99	0	0	0	**50**
McChord Army Base	311.14	2	2	5	**2**
Mima Mounds Preserve	150.45	0	0	0	**50**
Scatter Creek Wildlife Area	237.48	0	0	2	**5**
Shaefer State Park	20.22	0	0	0	**5**
South Puget Prairie	35.45	0	0	0	**50**
Thurston County Parks	0.89	2	0	0	**2**
Washington Dept Natural Resources	12.20	0	0	2	**20**
Washington Dept Fish and Wildlife	32.69	0	1	2	**5**
The Nature Conservancy	35.41	0	0	0	**90**
Thurston Land Trust	0.84	0	0	0	**10**
	6026.86				
Private (~ 14%)	958.32	10	5	8	**2**
Future Conservation Unknown				2	**30**

[1] These numbers are "optimistically realistic projections" of future habitat changes by ownership. The percents that are lightly shaded are based on conversations between the PCJV Landbird Science Coordinator and biologists/ecologists/managers employed by the agencies/organizations listed (see Acknowledgments). Numbers not highlighted in a color were assumptions projected by the PCJV Landbird Science Coordinator based on general knowledge of the type and degree of land management conducted by that agency/organization relative to the projections of other agencies/organizations. Zeros that are darkly shaded indicate that grassland type is not present for that loss or change to occur.

[2] Development = Grassland habitat (<25% cover shrubs or conifer trees and <10% cover oak) that will be "permanently lost" due to development in the next 10 years (i.e., converted to areas dominated by non-vegetation or converted to non-suitable agricultural habitat).

[3] Succession = Semi-native or non-native grassland habitat (<25% cover shrubs or conifer trees and < 10% cover oak) that will "succeed" to non-grassland types such as shrublands, old fields, etc. in the next 10 years due to the absence of management/restoration and continuing degradation by woody encroachment. These are areas that are close to being non-grassland habitat and would not likely have any attempts to "restore" them in the next 10 years resulting in loss of suitability for grassland-associated bird species.

[4] Degradation = Native (>50% cover of natives) or semi-native (10-50% cover of natives) grassland habitat (<25% cover shrubs or conifer trees and <10% cover oak) that will likely be converted to non-native grassland habitat in the next 10 years due to the absence of management/restoration resulting in lower habitat suitability and lower densities of grassland-associated birds.

[5] Restoration = Non-native (<10% cover of natives) or semi-native (10-50% cover of natives) grassland habitat (<25% cover shrubs or conifer trees and <10% cover oak) that will likely be restored to native or semi-native grassland habitat in the next 10 years through control of invasive trees and shrubs resulting in greater suitability and higher densities of grassland-associated bird species.

Based on the current habitat availability and projected future changes in grassland habitat, PCJV habitat objectives are summarized in Table 8 and described in the following text.

Table 8.Habitat objectives for grassland habitats in the Puget Lowlands Ecoregion.

Habitat Type: Geography	Current Habitat (ha)	10-year Objective (%)	10-year Objective (ha)	Annual Objective (ha)
Protection: PLE	1,452.78	+ 13.30	+ 193.25	**+ 19.33**
Protection: NPSFA	494.46	+ 10.00	+ 49.50	**+ 4.95**
Protection: SPSFA	958.32	+ 15.00	+ 143.75	**+ 14.38**
Restoration: PLE (Private)	1,221.99	+ 3.66	+ 44.78	**+ 4.48**
Restoration: NPSFA (Private)	409.89	+ 3.00	+ 12.30	**+ 1.23**
Restoration: SPSFA (Private)	812.10	+ 4.00	+ 32.48	**+ 3.25**
Restoration: PLE (Public)	5,635.23	+ 8.02	+ 451.91	**+ 45.19**
Restoration: NPSFA (Public)	463.75	+ 23.21	+ 108.12	**+ 10.81**
Restoration: SPSFA (Public)	5,171.48	+ 6.64	+ 343.79	**+ 34.38**

Current habitat for protection is the existing amount of habitat. Current habitat for restoration is the amount that would exist today after subtracting projected habitat losses to development and degradation, and status changes from protection (i.e., private to public) over the next 10 years. These amounts have been taken "off the top" to avoid double counting in later analyses. Thus, the amount of current habitat is less than the actual amount existing now (and presented above in Habitat Objectives: Protection), and the 10-year objective (%) is the percent after these changes.
10 year objective = 2020

Pacific Coast Joint Venture Grassland Habitat Objectives

● Secure conservation status (e.g., acquisitions, easements) for ≥ 13.30% of private land grassland habitats in the Puget Lowlands Ecoregion including ≥ 10.00% in the North Puget Sound Focus Area and ≥ 15.00% in the South Puget Sound Focus Area.
    Amount (PLE): ≥ 193.25 ha [1,452.78 ha total] or ≥ 19.33 ha/year
    Amount (NPSFA): ≥ 49.50 ha [494.46 ha total] or ≥ 4.95 ha/year
    Amount (SPSFA): ≥ 143.75 ha [958.32 ha total] or ≥ 14.38 ha/year

● Conduct habitat restoration (i.e., non-native or semi-native grassland changed to semi-native or native grassland) on ≥ 8.02% of grassland habitats on public/conservation lands in the Puget Lowlands Ecoregion including ≥ 23.31% in the North Puget Sound Focus Area, and ≥ 6.64% in the South Puget Sound Focus Area.
    Amount (PLE): ≥ 451.91 ha [5,635.23 ha total] or ≥ 45.19 ha/year
    Amount (NPSFA): ≥ 108.12 ha [463.75 ha total] or ≥ 10.81 ha/year
    Amount (SPSFA): ≥ 343.79 ha [5,171.48 ha total] or≥ 34.38 ha/year

● Conduct habitat restoration (i.e., non-native or semi-native grassland changed to semi-native or native grassland) on ≥ 3.66% of grassland habitats on private lands in the Puget Lowlands Ecoregion including ≥ 3.00% in the North Puget Sound Focus Area, and ≥ 4.00% in the South Puget Sound Focus Area.
     Amount (PLE): ≥ 44.78 ha [1,221.99 ha total] or ≥4.48 ha/year
     Amount (NPSFA): ≥ 12.30 ha [409.89 ha total] or ≥ 1.23 ha year
     Amount (SPSFA): ≥ 32.48 ha [812.10 ha total] or≥ 3.25 ha year

● Ensure ≤ 0.90% permanent loss of grassland habitats from development on public/conservation land in the Puget Lowlands Ecoregion including ≤ 0.16% in the North Puget Sound Focus Area and ≤ 0.96% in the South Puget Sound Focus Area.
     Amount (PLE): ≤ 58.60 ha [6,507.27 ha total] or ≤ 5.86 ha/year
     Amount (NPSFA): ≤ 0.75 ha [480.41 ha total] or ≤ 0.08 ha/year
     Amount (SPSFA): ≤ 57.85 ha [6,026.86 ha total] or ≤ 5.79 ha/year

● Ensure ≤ 7.62% permanent loss of grassland habitats from development on private lands in the Puget Lowlands Ecoregion including ≤ 3.00% in the North Puget Sound Focus Area and ≤ 10.00% in the South Puget Sound Focus Area.
     Amount (PLE): ≤ 110.66 ha [1,452.78 ha total] or ≤ 11.07 ha/year
     Amount (NPSFA): ≤ 14.83 ha [494.46 ha total] or ≤ 1.48 ha/year
     Amount (SPSFA): ≤ 95.83 ha [958.32 ha total] or ≤ 9.58 ha/year

● Ensure ≤ 0.13% permanent loss of grassland habitats from succession on public/conservation lands in the Puget Lowlands Ecoregion including ≤ 0.06% in the North Puget Sound Focus Area and ≤ 0.14% in the South Puget Sound Focus Area.
     Amount (PLE): ≤ 8.73 ha [6,507.27 ha total] or ≤ 0.87 ha/year
     Amount (NPSFA): ≤ 0.27 ha [480.41 ha total] or ≤ 0.03 ha/year
     Amount (SPSFA): ≤ 8.46 ha [6,026.86 ha total] or ≤ 0.85 ha/year

● Ensure ≤ 3.96% permanent loss of grassland habitats from succession on private lands in the Puget Lowlands Ecoregion including ≤ 2.00% in the North Puget Sound Focus Area and ≤ 5.00% in the South Puget Sound Focus Area.
     Amount (PLE): ≤ 57.56 ha [1,452.78 ha total] or ≤ 5.76 ha/year
     Amount (NPSFA): ≤ 9.64 ha [494.46 ha total] or ≤ 0.96 ha/year
     Amount (SPSFA): ≤ 47.92 ha [958.32 ha total] or ≤ 4.79 ha/year

● Ensure ≤ 2.74%degradation (change of native or semi-native grassland to semi-native or non-native grassland) on public/conservation lands in the Puget Lowlands Ecoregion including ≤ 2.47% in the North Puget Sound Focus Area and ≤ 2.75% in the South Puget Sound Focus Area.
     Amount (PLE): ≤ 130.72 ha [4,763.53 ha total] or ≤ 13.07 ha/year
     Amount (NPSFA): ≤ 3.78 ha [152.80 ha total] or ≤ 0.38 ha/year
     Amount (SPSFA): ≤ 126.94 ha [4,610.73 ha total] or ≤ 12.69 ha/year

● Ensure ≤ 6.82% degradation (change of native or semi-native grassland to semi-native or non-native grassland) on private lands in the Puget Lowlands Ecoregion including ≤ 3.00% in the North Puget Sound Focus Area and ≤ 8.00% in the South Puget Sound Focus Area.

Amount (PLE): ≤ 19.19 ha [281.50 ha total] or ≤ 1.92 ha/year
Amount (NPSFA): ≤ 2.00 ha [66.57 ha total] or ≤ 0.20 ha year
Amount (SPSFA): ≤ 17.19 ha [214.93 ha total] or ≤ 1.72 ha year

Based on current habitat availability and projected future changes in grassland habitat, PCJV population objectives for focal species are summarized in Table 9 and described in the following text.

Table 9.Population objectives for focal species in grassland habitats in the Puget Lowlands Ecoregion.

Species: Geography	Current Population (# birds)	10-year Objective (%)	10-year Objective (# birds)	Annual Objective (# birds)
Savannah Sparrow: PLE	20,333.75	+ 2.07	+ 435.56	+ 43.56
Savannah Sparrow: NPSFA	1,030.40	- 0.20	- 2.06	- 0.21
Savannah Sparrow: SPSFA	19,303.35	+ 2.27	+ 437.62	+ 43.76
Western Meadowlark: PLE				
Western Meadowlark: NPSFA				
Western Meadowlark: SPSFA	3,712.79	+ 2.34	+ 86.80	+ 8.68

10-year Objective = 2020.

Pacific Coast Joint Venture Grassland Focal Bird Species Population Objectives

● Enhance suitability of grassland habitats to increase populations of Savannah Sparrow by ≥ 2.07% in the Puget Lowlands Ecoregion including ≥ -0.20% in the North Puget Sound Focus Area and ≥ 2.27% in the South Puget Sound Focus Area.
        Amount (PLE): ≥ 435.56 birds [20,333.75 birds total] or ≥ 43.56 birds/year
        Amount (NPSFA): ≥ -2.06 birds [1,030.40 birds total] or ≥ -0.21 birds/year
        Amount (SPSFA): ≥ 437.62 birds [19,303.35 birds total] or ≥ 43.76 birds/year

● Enhance suitability of grassland habitats to increase populations of Western Meadowlark by ≥ 2.34% in the South Puget Sound Focus Area.
        Amount (SPSFA): ≥ 86.80 birds [3,712.79 birds total] or ≥ 8.68 birds/year

Results: Riparian Habitats

Riparian habitats comprise 87,642.86 ha within the PLE (Figure 4), with approximately 59%
(51,525.55 ha) occurring in the NPSFA (Table 10). Land ownership is predominately private
(81%) with proportions in the NPSFA (77% private) and SPSFA (87% private).
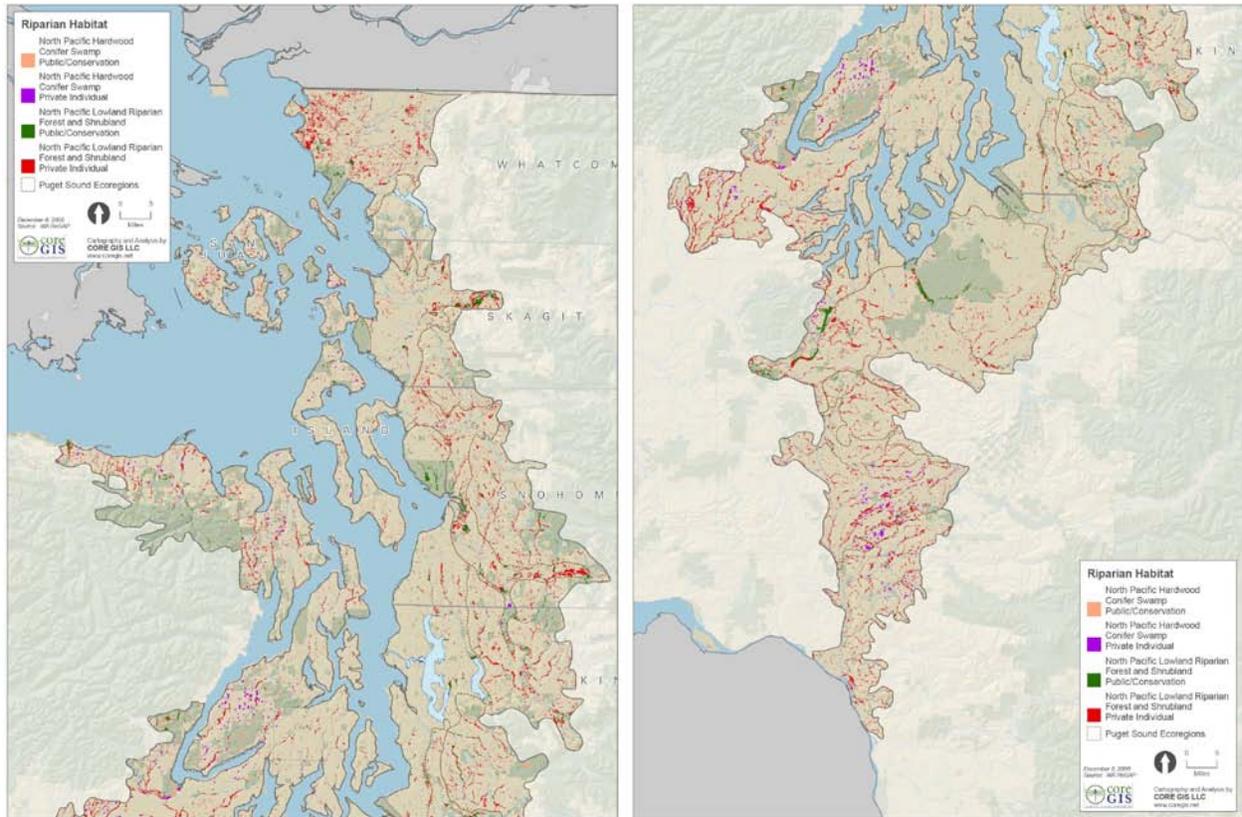
Figure 4. Riparian habitats in the Puget Lowlands Ecoregion.

Table10.Current riparian habitat amounts by ownership and future projections of riparian habitat
changes that would impact bird populations in the PLE in the next 10 years.

North Puget Sound Focus Area	Riparian	Riparian Habitat Loss (%) [1]		Riparian Habitat Change (%) [1]	
Ownership	Hectares	Development [2]	Degradation [3]	Restoration [4]	Expansion [5]
Public/Conservation (~20%)					
Federal					
Unknown	6.50	0	1	0	**0**
National Park Service	454.54	0	0	10	**0**
Bureau of Land Management	7.85	0	0	10	**5**
Bureau of Indian Affairs	15.98	0	1	2	**0**
U.S. Forest Service	1893.30	0	0	5	**2**
Army Corps of Engineers	178.18	0	1	2	**2**
U.S. Navy	2.57	0	1	0	**0**
State					
Unknown	40.08	0	1	0	**0**

Department of Ecology	22.61	0	1	5	**5**
University of Washington	6.22	0	1	0	**0**
Western Washington University	1.35	0	1	0	**0**
Department of Natural Resources	1853.23	0	1	3	**2**
Department of Fish and Wildlife	1139.80	0	1	15	**10**
Department of Transportation	7.32	2	2	0	**0**
State Parks	278.25	0	1	5	**2**
County					
San Juan	77.45	1	1	1	**1**
Island		1	1	1	**1**
King	1356.99	1	1	1	**1**
Snohomish	596.84	1	1	1	**1**
Skagit	183.20	1	1	1	**1**
Whatcom	87.34	1	1	1	**1**
Private Conservation					
Individual	7.31	0	1	0	**0**
Cascade Land Conservancy	171.15	0	0	7	**7**
The Nature Conservancy	244.40	0	0	10	**20**
San Juan Preservation Trust	109.40	0	0	7	**7**
Skagit Land Trust	138.38	0	0	7	**7**
Whatcom Land Trust	176.02	0	0	7	**7**
Puget Sound Electric	0.68	0	0	7	**7**
Tribal					
Lummi Nation	350.69	1	1	5	**2**
Muckleshoot	47.39	1	1	5	**10**
Stillaguamish	0.41	1	1	5	**10**
Swinomish	52.67	1	1	5	**10**
Tulalip	625.01	1	1	3	**2**
City Governments	1536.11	2	2	1	**1**
Private (~80%) X	39858.39	2	1	1	**1**
Future Conservation Unknown				5	**4**

South Puget Lowlands	**Riparian**	**Riparian Habitat Loss (%)** [1]		Riparian Habitat Change (%) [1]	
Ownership	**Hectares**	**Development** [2]	**Degradation** [3]	**Restoration** [4]	Expansion [5]
Public/Conservation (~13%)					
Federal					
U.S. Fish and Wildlife Service	717.38	0	0	25	**15**
United States of America	0.33	0	0	0	**0**
Bonneville Power	2.84	0	2	1	**1**
Bureau of Indian Affairs	36.64	0	1	1	**5**
U.S. Forest Service	65.49	0	0	10	**5**
U.S. Army	864.07	0	1	15	**8**
U.S. Navy	7.42	0	1	0	**0**
Tribal					
Chehalis Indian Reservation	329.24	1	1	7	**2**
Nisqually Indian Reservation	139.68	1	1	7	**2**
Port Madison Tribal	12.03	1	1	7	**2**
Puyallup Tribe	62.49	1	1	7	**2**
Skokomish Tribe	158.26	1	1	7	**2**
Squaxin Island Tribe	1.26	1	1	7	**2**

State				
State of Washington	63.76	1	1	2	**5**
Evergreen State College	4.35	0	0	1	**1**
University of Washington	6.89	0	1	0	**0**
Department of Natural Resources	1181.42	0	0	5	**10**
Department of Fish and Wildlife	227.07	0	0	15	**10**
Department of Transportation	16.02	2	2	1	**1**
State Parks	119.09	0	1	8	**2**
County				
King	0.56	1	2	2	**1**
Kitsap	26.72	1	2	2	**1**
Lewis	12.58	1	2	2	**1**
Pierce	67.91	1	2	2	**1**
Thurston	163.53	1	2	2	**1**
Cowlitz	61.61	1	2	2	**1**
Grays Harbor	0.15	1	2	2	**1**
Private Conservation				
Cascade Land Conservancy	4.73	0	0	10	**10**
The Nature Conservancy	66.68	0	0	25	**15**
Nisqually Basin Land Trust	41.48	0	0	8	**10**
Great Peninsula Conservancy	3.11	0	0	8	**10**
Tahoma Land Conservancy	2.45	0	0	8	**10**
Thurston Land Trust	0.55	0	0	8	**10**
Capitol Land Trust	18.35	0	0	8	**10**
Bainbridge Island Trust	0.10	0	0	8	**10**
City Governments (n=24)	258.49	5	3	1	**1**
Private Individual (~87%)	31,372.64	4	2	1	**1**
Future Conservation Unknown				6	**5**

[1] These numbers are "optimistically realistic, ball-park projections" of future habitat changes by ownership. The percents that are lightly shaded are based on conversations between the PCJV Landbird Science Coordinator and biologists/ecologists/managers employed by the agencies/organizations listed (see Acknowledgments). Numbers not highlighted in a color were assumptions projected by the PCJV Landbird Science Coordinator based on general knowledge of the type and degree of land management conducted by that agency/organization relative to the projections of other agencies/organizations.

[2] Development = Riparian habitat that will be "permanently lost" due to development in the next 10 years (i.e., trees and shrubs removed for agriculture, houses, roads, etc.).

[3] Degradation = Riparian habitat that will be "lost" in the next 10 years due to negative hydrologic changes (e.g., dams, water diversions, lowered water tables).

[4] Restoration = Riparian habitat that will likely be "restored" in quality through understory plantings, invasive species control, or hydrologic improvements that would result in enhanced structural diversity and greater suitability and densities for riparian associated bird species.

[5] Expansion = Riparian habitat that will likely be increased in amount through plantings and/or positive hydrologic changes to expand the riparian zone in the next 10 years resulting in more riparian shrub habitat for riparian associated bird species.

Based on current habitat availability and projected future changes in riparian habitat, PCJV habitat objectives are summarized in Table 11 and described in the following text.

Table 11.Habitat objectives for riparian habitats in the Puget Lowlands Ecoregion.

Habitat Type: Geography	Current Habitat (ha)	10-year Objective (%)	10-year Objective (ha)	Annual Objective (ha)
Protection: PLE	71,230.94	+ 2.00	+ 1,424.62	**+ 142.47**
Protection: NPSFA	39,858.30	+ 2.00	+ 797.17	**+ 79.72**
Protection: SPSFA	31,372.64	+ 2.00	+ 627.45	**+ 62.75**
Restoration: PLE (Private)	68,466.56	+ 1.00	+ 684.67	**+ 68.47**
Restoration: NPSFA (Private)	38,662.55	+ 1.00	+ 386.63	**+ 38.66**
Restoration: SPSFA (Private)	29,804.01	+ 1.00	+ 298.04	**+ 29.80**
Restoration: PLE (Public)	17,614.75	+ 6.26	+ 1,103.36	**+ 110.34**
Restoration: NPSFA (Public)	12,299.66	+ 4.62	+ 567.62	**+ 56.76**
Restoration: SPSFA (Public)	5,315.09	+ 10.01	+ 535.74	**+ 53.57**
Enhancement: PLE (Private)	68,466.56	+ 1.00	+ 684.67	**+ 68.47**
Enhancement: NPSFA (Private)	38,662.55	+ 1.00	+ 386.63	**+ 38.66**
Enhancement: SPSFA (Private)	29,804.01	+ 1.00	+ 298.04	**+ 29.80**
Enhancement: PLE (Public)	17,614.75	+ 4.43	+ 780.13	**+ 78.01**
Enhancement: NPSFA (Public)	12,299.66	+ 2.94	+ 362.15	**+ 36.22**
Enhancement: SPSFA (Public)	5,315.09	+ 7.86	+ 417.98	**+ 41.80**

Current habitat for protection is the existing amount of habitat. Current habitat for restoration is the amount that would exist today after subtracting projected habitat losses to development and degradation, and status changes from protection (i.e., private to public) over the next 10 years. These amounts have been taken "off the top" to avoid double counting in later analyses. Thus, the amount of current habitat is less than the actual amount existing now (and presented above in Habitat Objectives: Protection), and the 10-year objective (%) is the percent after these changes.
10 year objective = 2020

Pacific Coast Joint Venture Riparian Habitat Objectives

● Secure conservation status (e.g., acquisitions, easements) for ≥ 2.00% of private land riparian habitats in the Puget Lowlands Ecoregion including ≥ 2.00% in the North Puget Sound Focus Area and ≥ 2.00% in the South Puget Sound Focus Area.
      Amount (PLE): ≥ 1,424.62 ha [71,230.94 ha total] or ≥ 142.47 ha/year
      Amount (NPSFA): ≥ 797.17 ha [39,858.30 ha total] or ≥ 79.72 ha/year
      Amount (SPSFA): ≥ 627.45 ha [31,372.64 ha total] or ≥ 62.75 ha/year

● Conduct habitat restoration (e.g., enhanced structural diversity) on ≥ 6.26% of riparian habitats on public/conservation lands in the Puget Lowlands Ecoregion including ≥ 4.62% in the North Puget Sound Focus Area and ≥ 10.01% in the South Puget Sound Focus Area.
      Amount (PLE): ≥ 1,103.26 ha [17,614.75 ha total] or ≥ 110.34 ha/year
      Amount (NPSFA): ≥ 567.62 ha [12,299.66 ha total] or ≥ 56.76 ha/year
      Amount (SPSFA): ≥ 535.74 ha [5,315.09 ha total] or ≥ 53.57 ha/year

● Conduct habitat restoration (e.g., enhanced structural diversity) on ≥ 1.00% of riparian habitats on private lands in the Puget Lowlands Ecoregion including ≥ 1.00% in the North Puget Sound Focus Area and ≥ 1.00% in the South Puget Sound Focus Area.
      Amount (PLE): ≥ 684.67 ha [68,466.56 ha total] or ≥ 68.47 ha/year
      Amount (NPSFA): ≥ 386.63 ha [38,662.55 ha total] or ≥ 38.66 ha/year
      Amount (SPSFA): ≥ 298.04 ha [29,804.01 ha total] or ≥ 29.80 ha/year

● Conduct habitat enhancement (i.e., expansion of the area of riparian vegetation) on ≥ 4.43% of riparian habitats on public/conservation lands in the Puget Lowlands Ecoregion including ≥ 2.94% in the North Puget Sound Focus Area and ≥ 7.86% in the South Puget Sound Focus Area.
      Amount (PLE): ≥ 780.13 ha [17,614.75 ha total] or ≥ 78.01 ha/year
      Amount (NPSFA): ≥ 362.15 ha [12,299.66 ha total] or ≥ 36.22 ha/year
      Amount (SPSFA): ≥ 417.98 ha [5,315.09 ha total] or ≥ 41.80 ha/year

● Conduct habitat enhancement (i.e., expansion of the area of riparian vegetation) on ≥ 1.00% of riparian habitats on private lands in the Puget Lowlands Ecoregion including ≥ 1.00% in the North Puget Sound Focus Area and ≥ 1.00% in the South Puget Sound Focus Area.
      Amount (PLE): ≥ 684.67 ha [68,466.56 ha total] or ≥ 68.47 ha/year
      Amount (NPSFA): ≥ 386.63 ha [38,662.55 ha total] or ≥ 38.66 ha/year
      Amount (SPSFA): ≥ 298.04 ha [29,804.01 ha total] or ≥ 29.80 ha/year

● Ensure ≤ 0.59% permanent loss of riparian habitats from development on public/conservation lands in the Puget Lowlands Ecoregion including ≤ 0.55% in the North Puget Sound Focus Area and ≤ 0.70% in the South Puget Sound Focus Area.
      Amount (PLE): ≤ 88.89 ha [15,111.76 ha total] or ≤ 8.89 ha/year
      Amount (NPSFA): ≤ 64.65 ha [11,667.25 ha total] or ≤ 6.47 ha/year
      Amount (SPSFA): ≤ 24.24 ha [3,444.51 ha total] or ≤ 2.42 ha/year

● Ensure ≤ 2.44% permanent loss of riparian habitats from development on private lands in the Puget Lowlands Ecoregion including ≤ 2.00% in North Puget Sound Focus Area and ≤ 3.00% in the South Puget Sound Focus Area.
      Amount (PLE): ≤ 1,738.35 ha [71,230.94 ha total] or ≤ 173.84 ha/year
      Amount (NPSFA): ≤ 797.17 ha [39,858.30 ha total] or ≤ 79.72 ha/year
      Amount (SPSFA): ≤ 941.18 ha [31,372.64 ha total] or ≤ 94.12 ha/year

● Ensure ≤ 0.81% loss of riparian habitats from degradation (e.g., negative hydrologic changes) on public/conservation lands in the Puget Lowlands Ecoregion including ≤ 0.86% in the North Puget Sound Focus Area and ≤ 0.69% in the South Puget Sound Focus Area.
      Amount (PLE):≤ 132.95 ha [16,411.92 ha total] or ≤ 13.30 ha/year
      Amount (NPSFA): ≤ 100.15 ha [11,667.25 ha total] or ≤ 10.02 ha/year
      Amount (SPSFA): ≤ 32.80 ha [4,744.67 ha total] or ≤ 3.28 ha/year

● Ensure ≤ 1.44% loss of riparian habitats from degradation (e.g., negative hydrologic changes) on private lands in the Puget Lowlands Ecoregion including ≤ 1.00% in the North Puget Sound Focus Area and ≤ 2.00% in the South Puget Sound Focus Area.
      Amount (PLE): ≤ 1,026.03 ha [71,230.94 ha total] or ≤ 102.60 ha/year

Amount (NPSFA): ≤ 398.58 ha [39,858.30 total] or ≤ 39.86 ha/year

Amount (SPSFA): ≤ 627.45 ha [31,372.64 total] or ≤ 62.75 ha/year

Based on current habitat availability and projected future changes in riparian habitat, PCJV population objectives for focal species are summarized in Table 12 and described in the following text.

Table 12.Population objectives for focal species in riparian habitats in the Puget Lowlands Ecoregion.

Species: Geography	Current Population (# birds)	10-year Objective (%)	10-yearObjective (# birds)	Annual Objective (# birds)
Swainson's Thrush: PLE	161,272.91	+ 1.63	+ 2,189.52	**+ 218.95**
Swainson's Thrush: NPSFA	135,334.43	+ 1.29	+ 1,743.34	**+ 174.33**
Swainson's Thrush: SPSFA	25,938. 48	+ 1.72	+ 446.18	**+ 44.62**
Yellow Warbler: PLE	35,292.81	+ 1.68	+ 592.45	**+ 59.25**
Yellow Warbler: NPSFA	8,027.80	+ 1.63	+ 130.96	**+ 13.10**
Yellow Warbler: SPSFA	27,215.01	+ 1.70	+ 461.49	**+ 46.15**
Willow Flycatcher: PLE	56,656.35	+ 2.23	+ 1,263.09	**+ 126.31**
Willow Flycatcher: NPSFA	39,838.10	+ 2.42	+ 962.22	**+ 96.22**
Willow Flycatcher: SPSFA	16,818.25	+ 1.79	+ 300.87	**+ 30.09**
Downy Woodpecker: PLE	8,977.52	+ 1.08	+ 97.11	**+ 9.71**
Downy Woodpecker: NPSFA	7,773.26	+ 0.91	+ 70.64	**+ 7.06**
Downy Woodpecker: SPSFA	1,204.26	+ 2.20	+ 26.47	**+ 2.65**

10-year Objective = 2020.

Pacific Coast Joint Venture Riparian Focal Bird Species Population Objectives

● Enhance suitability of riparian habitats to increase populations of Swainson's Thrush by ≥ 1.22% in the Puget Lowlands Ecoregion including ≥ 1.29% in the North Puget Sound Focus Area and ≥ 0.83% in the South Puget Sound Focus Area.

Amount (PLE): ≥ 1,958.69 birds [161,272.91 birds total] or ≥ 195.87 birds/year

Amount (NPSFA): ≥ 1,743.34 birds [135,334.43 birds total] or ≥ 174.33 birds/year

Amount (SPSFA): ≥ 215.35 birds [25,938 birds total] or ≥ 21.54 birds/year

● Enhance suitability of riparian habitats to increase populations of Yellow Warbler by ≥ 0.99% in the Puget Lowlands Ecoregion including ≥ 1.63% in the North Puget Sound Focus Area and ≥ 0.80% in the South Puget Sound Focus Area.

Amount (PLE): ≥ 349.76 birds [35,292.81 birds total] or ≥ 34.98 birds/year

Amount (NPSFA): ≥ 130.96 birds [8,027.80 birds total] or ≥ 13.10 birds/year

Amount (SPSFA): ≥ 218.80 birds [27,215.01 birds total] or ≥ 21.88 birds/year

● Enhance suitability of riparian habitats to increase populations of Willow Flycatcher by ≥ 1.97% in the Puget Lowlands Ecoregion including ≥ 2.42% in the North Puget Sound Focus Area and ≥ 0.90% in the South Puget Sound Focus Area.

      Amount (PLE): ≥ 1,114.34 birds [56,656.35 birds total] or ≥ 111.43 birds/year
      Amount (NPSFA): ≥ 962.22 birds [39,838.10 birds total] or ≥ 96.22 birds/year
      Amount (SPSFA): ≥ 152.12 birds [16,818.25 birds total] or ≥ 15.21 birds/year

● Enhance suitability of riparian habitats to increase populations of Downy Woodpecker by ≥ 0.90% in the Puget Lowlands Ecoregion including ≥ 0.91% in the North Puget Sound Focus Area and ≥ 0.81% in the South Puget Sound Focus Area.

      Amount (PLE): ≥ 80.38 birds [8,977.52 birds total] or ≥ 8.04 birds/year
      Amount (NPSFA): ≥ 70.64 birds [7,773.26 birds total] or ≥ 7.06 birds/year
      Amount (SPSFA): ≥ 9.74 birds [1,204.26birds total] or ≥ 0.97 birds/year

Results: Priority Bird Species Population Objectives

Two of the priority species, Streaked Horned Lark and Western Bluebird, have been extirpated from the NPSFA, and Oregon Vesper Sparrow only occurs in a small population in the NPSFA (<25 birds on San Juan Island). Thus, the population estimates in Table 13 are exclusively (Western Bluebird and Streaked Horned Lark) or nearly exclusively (Oregon Vesper Sparrow) for the SPSFA.

Table 13. Population estimates and objectives for priority bird species in the Puget Lowlands Ecoregion.

Species	Priority Habitat Association(s)	Population Estimate	10-year Objective
Great-blue Heron	Riparian and Grassland	< 1,000	**>1,200**
Oregon Vesper Sparrow	Grassland and Oak Savannah	200-300	**>500**
Purple Martin	Riparian	500-600	**>1,000**
Streaked Horned Lark	Grassland	200	**400**
Western Bluebird	Grassland and Oak Savannah	500-600	**>1,000**

10-year Objective = 2020.
Population Estimate Sources: Great-blue Heron = B. Altman pers. obs.; Oregon Vesper Sparrow = Rogers (2000) and S. Pearson pers. comm.; Purple Martin = www.orwapif.org/pdf/puma_interim_objective.pdf; Streaked Horned Lark = Streaked Horned Lark Working Group, Sept 25, 2009; Western Bluebird = D. Clouse, J. Lynch, E. Delvin pers. comm.

Western Bluebird is the focus of an ongoing reintroduction effort to the San Juan Islands from an expanding population in the SPSFA (B. Altman pers. comm.). Streaked Horned Lark is declining in the SPSFA (S. Pearson pers. comm.), and although there are no current plans for reintroduction to the NPSFA, it has been discussed if the status of the SPSFA population improves. In addition to the population objectives for these species in the PLE, another population objective is to reestablish viable breeding populations for each species in the extirpated areas of the NPSFA.

Purple Martin populations have expanded throughout the PLE in the last 10 years through the advent of nest box programs led by citizen scientists. An Interim Population Objective for western Washington has been established by the Western Purple Martin Working Group (>1,500 pairs: www.orwapif.org/pdf/puma_interim_objective.pdf), but his has not been portioned by ecoregion. Thus, the PLE population objective for > 1,000 birds is a proportion of the western Washington objective which includes coastal populations outside the PLE. Because nest structures have been the limiting factor for this species, habitat objectives are not necessary.

The Great-blue Heron population in western Washington has been declining due to low productivity and high rates of colony failure for several reasons including habitat loss and colony disturbance. Conservation issues related to population declines from colony disturbances will need to be addressed by the appropriate agencies.

Acknowledgments

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Appendix A. Bird Density Data Sources and Summary

Riparian (North Puget Lowlands):
● Skagit Wildlife Area - area search data from two years and three plots visited three times (n=2) plus fixed radius point count data from two years and five points visited three times (n=2) (R. Milner pers. comm.)
● Snohomish County along Skykomish River – spot-mapping data from one year and one plot (n=1) (American Birds 35:88)
● Snohomish County – spot-mapping data from one year and eight plots (n=8) (Stiles 1980)
● Whatcom County near Acme – spot-mapping data from one year and one plot (n=1) (American Birds 35:89)
● San Juan Island National Historical Park – 5 variable radius Distance analyzed point counts in red alder habitat in 2002 (n=1) (Siegel et al. 2002)
● Ecoregional Mean Densities (15 data points weighed equally):
    Downy Woodpecker = 0.09 birds/ha
    Swainson's Thrush = 1.43 birds/ha
    Willow Flycatcher = 0.37 birds/ha
    Yellow Warbler = 0.08 birds/ha
Note: all these data are from riparian forests

Riparian (South Puget Lowlands):
● McChord Air Base – 3 fixed-radius point counts in riparian forests (The Nature Conservancy of Washington 1995)
    Swainson's Thrush – 0.33 birds/ha
● McChord Air Base – 6 fixed-radius point counts in riparian shrub (The Nature Conservancy of Washington 1995)
    Swainson's Thrush – 0.56 birds/ha
    Yellow Warbler = 1.39 birds/ha
    Willow Flycatcher = 0.28 birds/ha
● Fort Lewis Military Installation – 131 fixed-radius point counts in riparian mixed (Resources Northwest and Pentec Environmental 1995)
    Downy Woodpecker = 0.02 birds/ha
    Swainson's Thrush – 0.08 birds/ha
    Yellow Warbler = 0.38 birds/ha
    Willow Flycatcher = 0.23 birds/ha
● Ecoregional Mean Densities (134 data points weighed equally):
    Downy Woodpecker = 0.02 birds/ha
    Swainson's Thrush = 0.33 birds/ha
    Willow Flycatcher = 0.23 birds/ha
    Yellow Warbler = 0.38 birds/ha

Grassland (North Puget Lowlands):
● San Juan Island National Historical Park – 42 fixed-radius point counts in 2002 (Seigel et al. 2002)
    Savannah Sparrow = 1.39 birds/ha (n = 42 detections)
● San Juan Island private lands - 26 fixed-radius point counts in 2007 (K. Foley pers. comm.)

        Savannah Sparrow = 0.20 birds/ha
● San Juan Islands private lands 8 area search sites in 2007 (K. Foley pers. comm.)
        Savannah Sparrow = 0.11 birds/ha
● Ecoregional Mean Densities (mean of three densities weighed equally)
        Savannah Sparrow = 0.57 birds/ha

Grassland (South Puget Lowlands):
● Fort Lewis Military Installation – 131 fixed-radius point counts in semi-native in 1994
(Resources Northwest and Pentec Environmental 1995)
        Savannah Sparrow = 1.41 birds/ha
        Western Meadowlark =
● Glacial Heritage Preserve - 70 fixed-radius point counts in native in five years (E. Delvin pers.
comm.)
        Savannah Sparrow = 2.29 birds/ha
        Western Meadowlark =
●Morgan Property (TNC easement) – 9 fixed-radius point counts in semi-native in 2007 (E.
Delvin pers.comm.)
        Savannah Sparrow = 1.55 birds/ha
        Western Meadowlark =
● Weir Prairie on Fort Lewis - 9 fixed-radius point counts in 2006 (E. Delvin pers. comm.)
        Savannah Sparrow = 1.69 birds/ha
        Western Meadowlark =
● Ecoregional Mean Densities (mean of 140 point counts in semi-native and 79 point counts in
native weighed equally)
        Savannah Sparrow (native) = 2.22 birds/ha
        Savannah Sparrow (semi-native) = 1.42 birds/ha
        Western Meadowlark (native) = 0.66 birds/ha
        Western Meadowlark (semi-native) = 0.45 birds/ha

Oak (North Puget Sound):
● San Juan Islands private lands - 27 fixed-radius point counts at 10 sites in 2007 (K. Foley pers.
comm.)
        Chipping Sparrow = 0.71 birds/ha
        House Wren = 0.42 birds/ha
        Purple Finch = 0.09 birds/ha
● San Juan Islands private lands – 8 area search sites in 2007 (K. Foley pers. comm.)
        Chipping Sparrow = 0.34 birds/ha
        House Wren = 0.38 birds/ha
        Purple Finch = 0.13 birds/ha
● Young's Hill in San Juan Island NP – spot-mapping data from one plot in 2007 (B. Altman
unpubl. data)
        Chipping Sparrow = 0.67 birds/ha
        House Wren = 0.59 birds/ha
        Purple Finch = 0.30 birds/ha
● Ecoregional Mean Densities (mean of three methods weighed equally)
        Chipping Sparrow = 0.57 birds/ha

House Wren = 0.46 birds/ha
Purple Finch = 0.17 birds/ha

Oak (South Puget Sound):
● Fort Lewis Military Installation – 571 fixed-radius point counts over nine years (L.Randolph pers. comm.)
● Glacial Heritage Preserve - 75 fixed-radius point counts over six years (E. Delvin pers. comm.)
● Scatter Creek Wildlife Area – 200 fixed-radius point counts over seven years (K. McAllister pers. comm.)
● McChord Air Base - 43 fixed-radius point counts in one year (The Nature Conservancy of Washington 1995)
● All fixed radius point counts (weighted by effort)
    Chipping Sparrow = 0.34 birds/ha
    Black-capped Chickadee = 0.31 birds/ha
    Purple Finch = 0.29 birds/ha
    Western Wood-pewee = 0.68 birds/ha
● Scatter Creek Wildlife Area – 30 variable-radius point counts over 2 years (K. McAllister pers. comm.)
    Chipping Sparrow = 0.12 birds/ha
    Black-capped Chickadee = 0.18 birds/ha
    Purple Finch = 0.34 birds/ha
    Western Wood-pewee = 0.75
● Mayfield, Thurston County – one spot-mapping plot in 1978 (American Birds 1979)
    Chipping Sparrow = 0.13 birds/ha
    Black-capped Chickadee = 0.27 birds/ha
    Purple Finch = 0.21 birds/ha
    Western Wood-pewee = 0.53 birds/ha
● Ecoregional Mean Densities (mean of three methods weighed equally)
    Chipping Sparrow = 0.20 birds/ha
    Black-capped Chickadee = 0.25 birds/ha
    Purple Finch = 0.28 birds/ha
    Western Wood-pewee = 0.65 birds/ha

Appendix B. Assumptions and Rationale

Modeling Process
● Projected permanent habitat loss over the 10-year period is taken "off the top" prior to calculations of other changes.

> Rationale: When permanent habitat loss occurs anytime during the 10-year period, it negates any past or potential future gains or losses, so it is "cleared" from consideration at the beginning of the analyses.

● The "public/conservation unknown" ownership is the projected amount of habitat that would move from private to public/conservation ownership based on the objective to secure conservation status of some percent of private lands.

> Rationale: This is important to the calculations because moving land from private to public ownership results in better conservation projections for future land use/management for that land. The category is labeled unknown because it is not known which agencies/organizations will secure ownership of these existing private lands.

● Land management changes in the "public conservation unknown" category (e.g., restoration, degradation) are the mean of the amounts projected for these same changes by the most likely entities to conserve them (e.g., USFWS, WDFW, Land Trusts, State Parks).

> Rationale: Since the future conservation ownership is unknown, the default is the mean of most likely ownerships.

● All the quantitative habitat objectives are based on calculations of projected land use/management changes by the amount of area in each ownership. The only exception to this is the habitat objective to secure conservation status for private lands (i.e., move private lands to conservation lands), which is based on professional judgment on the amount of conversion that is likely to occur.

> Rationale: The change of status from private to conservation does not result in a change in habitat type or condition (at least not immediately), just the ownership and the potential future change in habitat type or condition.

● Bird species pair correction factors were included in the calculation to estimate populations.

> Rationale: All the breeding bird density data used (except spot-mapping) is biased towards males in varying degrees (due to greater detectability of males).   All males are assumed to be paired, and the second bird of a mated pair needed to be included for a population estimate. The pair correction factors were taken from analyses of several data sets evaluating this issue (B. Altman unpubl. data). The pair correction factor used for each of our focal species was 2.0 except for Western Meadowlark (1.50) and Black-capped Chickadee (1.25).

Geospatial Data
● Geospatial data adequately represent the habitats or geographic areas being considered.

> Rationale: The best available geospatial data coverage for the entire Focus Area was used, and its adequacy was assumed to develop the model.

Bird Densities
● The ecoregional mean density for each focal species is representative of the habitats or geographic area being considered.

Rationale: Sample sizes of bird density data for each habitat were variable and the degree of representativeness of those sample sizes for the variability of the habitat conditions on the landscape is unknown. However, whatever data was available was used and its adequacy assumed to develop the model.

● Willamette Valley oak-conifer bird densities are applicable to the North Puget Sound.

Rationale: There is no bird data from oak-conifer habitats in the PLE, and species densities in oak-conifer habitats are different than those in oak-dominant habitats (where there is data in the PLE). Thus, the Willamette Valley was the closest source for this type of data.

● Density estimates from fixed radius point counts (which don't account for differences in detectability) were used in conjunction with density estimates from spot-mapping or distance-analyzed variable circular plots data (which do account for differences in detectability).

Rationale: There are limited density data from spot-mapping or distance, so the relatively extensively available data from fixed radius point counts was used. Additionally, analyses of density estimates from fixed radius point counts in oak habitats suggest good correlation with those of distance-analyzed variable circular plots for some species (B. Altman unpubl. data).

● Density estimates in the riparian hardwood conifer swamp classification are reduced by 50% from those in riparian forest for Yellow Warbler and Downy Woodpecker, by 25% for Swainson's Thrush, and are increased by 25% for Willow Flycatcher.

Rationale: Nearly all the riparian bird data are from riparian forest habitat. The co-dominance of conifer in hardwood conifer swamp habitats reduces suitability for hardwood associated species like Yellow Warbler and Downy Woodpecker. The reduction in canopy cover in hardwood conifer swamp reduces suitability for Swainson's Thrush, but the open canopy and dense shrub layer is very suitable for Willow Flycatcher. The percent differences are based on professional judgment.

● Density estimates in riparian shrub are zero for Downy Woodpecker, reduced by 50% from those in riparian forest for Swainson's Thrush, the same for Yellow Warbler, and increased by 25% for Willow Flycatcher.

Rationale: Nearly all the riparian bird data are from riparian forest habitat. The absence of large trees and snags makes riparian shrub unsuitable for Downy Woodpecker, the lack of a tree canopy reduces suitability for Swainson's Thrush, and the dominance of shrub habitat enhances suitability for Willow Flycatcher compared to riparian forest. The percent differences are based on professional judgment.

● Mean density estimates for riparian restoration are 10% greater than the current ecoregional mean riparian density estimates.

Rationale: Bird data on restored riparian versus pre-restoration riparian was not available, but the increase in vegetative structural diversity in restored riparian should increase the suitability for focal species. Since the ecoregional mean riparian density estimate for each focal species already includes differing quality habitats (some of which are likely of poor quality), a slight overall increase in density would be expected, and 10% seems realistic.

● Mean density estimates for riparian enhancement relative to the current ecoregional mean riparian density estimates are Willow Flycatcher (same), Yellow Warbler (50% less), Swainson's Thrush (25% less), and Downy Woodpecker (0).

Rationale: Riparian enhancement in the next 10 years would result in a shrub/small tree layer that would have no value for Downy Woodpecker because of the lack of large trees (foraging) and snags (nesting), limited value for Swainson's Thrush which likes a dense understory but within the context of an overstory with a tree canopy, moderate value for Yellow Warbler which likes mature canopies and subcanopies but also uses the younger canopies of small trees, and complete value for Willow Flycatcher which prefers a dense shrub layer without a canopy.

Oak
● The merging of two GIS oak layers (NWGAP and WDNR) reduces the likelihood of errors of omission of oak habitat.

Rationale: The modeled layer (NWGAP) is consistent on process and thorough on coverage, but potentially weak on accuracy. The ground-truthed layer is strong on accuracy, but inconsistent on coverage (i.e., some places likely missed due to inaccessibility). The combination of the two layers also provides opportunities for field evaluation of concurrence/disagreement and development of correction factors.

● The amount of oak dominant versus oak-conifer in the North Pacific Oak Woodland classification in NWGAP is the same ratio as that in the WDNR layer for that site or ownership.

Rationale: The ecological classification North Pacific Oak Woodland in NWGAP can be dominated by oak or conifer, so with no further information provided, the same ratio as that indicated in the WDNR layer was assumed.

● There are no "gains" in oak habitat in the next 10 years.

Rationale: Despite current and likely future oak planting efforts, the time frame is too short for oak plantings to provide suitable habitat for oak focal bird species.

● The 5% loss of oak habitat to development on private lands is a modification of modeling data from Pierce County.

Rationale: This was based on the "Futures Analysis" for Pierce County (CommEnSpace 2005) of 9.3% loss of oak habitat in the 20 years from 2000 to 2020 which projected to 10 years would be a total loss of approximately 5%. This amount was assumed to apply to the entire PLE.

● Snags or nesting cavities in live trees are sufficient and suitable for House Wren and Black-capped Chickadee.

Rationale: This ecological feature is not mapped and it is a limiting factor for these species, so its availability was assumed in order to run the model.

Grassland
● Restoration refers to former grassland habitat degraded from woody invasives (shrubs and trees) that will be restored to herbaceous.

Rationale: Restoration work moving existing non-native (but still herbaceous) grassland towards a native grassland is not considered "restoration" here because the restoration from shrubs and trees to herbaceous is significantly more important from the perspective of a grassland bird than the "restoration" of non-native grassland to native grassland.

● The classification of Unsurveyed Grassland in NWGAP is the same ratio of native, semi-native, and non-native as is elsewhere on the site or ownership.

Rationale: Unsurveyed grassland can be any of the three types, so with no further information provided, the same ratio of each from geospatial data included in the WDNR layer was just assumed.

● Mean density estimates for grassland birds (i.e., Savannah Sparrow and Western Meadowlark) in non-native habitats in the South Puget Sound is the difference with semi-native habitats equivalent to difference between that of native and semi-native grasslands.

Rationale: Non-native grasslands are less suitable then native or semi-native grasslands. Data are only available for native and semi-native grasslands in the South Puget Sound, thus we used the same proportionate difference to provide density estimates in non-native grasslands.

Riparian
● The ratio of riparian forest to riparian shrub is 85:15 overall.

Rationale: The NWGAP geospatial data lumps riparian forest and riparian shrub so we had to separate them based on local professional judgment.

● The 2.44% loss of riparian habitat to development on private lands in the next 10 years is a modification of modeling data from King and Snohomish counties.

Rationale: This was based on the "Futures Analysis" for King and Snohomish Counties (CommEnSpace 2005) of 4.13% loss of Riparian Forest and Shrubland and 0.85% loss of Hardwood Conifer Swamp on private lands in the 20 years from 2000 to 2020, which projected to 10 years would be a total loss of 2.5%.

● The <1% loss of riparian habitat to development on public lands in the next 10 years is a modification of modeling data from King and Snohomish counties.

Rationale: This was based on the "Futures Analysis" for King and Snohomish Counties (CommEnSpace 2005) of 1.3% loss of Riparian Forest and Shrubland and 0.1% loss of Hardwood Conifer Swamp on public lands in the 20 years from 2000 to 2020, which projected to 10 years would be a total loss of 0.7%.

● Snags or nesting cavities in live trees are sufficient and suitable for Downy Woodpecker.

Rationale: This ecological feature is not mapped and it is a limiting factor for this species, so its availability was assumed in order to run the model.