Range-wide Assessment of Strategic Management Opportunities for Wild Winter and Summer Steelhead *Oncorhynchus mykiss* in the Western Contiguous United States

Version 1.0, November 2014

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TROUT UNLIMITED

Executive summary

Steelhead management on the west coast of the continental United States occurs within multiple state and federal jurisdictions. Despite the listing of the majority of populations under the Endangered Species Act, steelhead have not been subject to a range-wide assessment that spans those boundaries. Trout Unlimited gathered public, spatial datasets related to steelhead (*Oncorhynchus mykiss*) distribution, populations, habitat quality, and future threats in California, Oregon, Washington, and Idaho to provide such an assessment. We summarized and interpreted data within populations and subwatersheds using Conservation Success Index methods to describe patterns within the data and identify key opportunities for conservation actions. These products are also presented as a Steelhead Conservation Atlas in support of the newly launched Wild Steelhead Initiative.

Winter and summer steelhead persist in roughly two-thirds of their historical distribution in the western continental United States; more loss of distribution has occurred for inland versus coastal populations. Population factors – productivity and abundance, hatchery influence, and life history diversity – vary widely across the range. Habitat condition is also highly variable, but with impaired habitat connectivity for inland populations and least impaired overall conditions in formally protected areas. Future security factors include an assessment of climate change risk; risk increases south and inland within the distribution of steelhead.

By comparing population integrity and habitat integrity for steelhead populations and considering future threats, we identify strategic opportunities for protection, restoration, and reintroduction. The data presented in this assessment are provided as web maps and can be queried to further inform steelhead management and conservation. As with any compilation of spatial data at the scale of the US west coast, this rangewide assessment is most useful when supplemented with on-the-ground, local information and updated at a regular interval.

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Cover photo: Middle Fork Salmon River, Idaho – Kurt Fesenmyer
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1.0 Introduction

Within the diversity of North American rainbow trout (*Oncorhynchus mykiss*), the large, anadromous steelhead is the most charismatic. The steelhead form is an adaptation to the diverse environments of the Pacific Rim and enables the species to take advantage of the productivity of the Pacific Ocean and recolonize watersheds following local extinctions during the wide range of climates and volcanic activity that characterize the west coast during the last 50,000 years (Quinn 2005). Within the continental US, steelhead occupy an impressive range of habitats, from the Mexican border to temperate rainforests on the Oregon, Washington and Alaska coasts to high deserts in the interior of Idaho.

In addition to occupying these diverse habitats, steelhead today display a diversity of life history strategies, including a variety of freshwater and ocean residency times, diverse freshwater and estuarine habitat use, and repeat spawning. The two primary life histories of steelhead are distinguished by the timing of adult returns. Winter-run, or ocean-type, steelhead become sexually mature in the ocean, initiate their freshwater migration in the winter or spring, and spawn that spring. This life history tends to have a coastal distribution in river systems where rain is the primary form of precipitation. In contrast, summer-run, or stream-type, steelhead migrate into large rivers during the summer, mature in freshwater, and spawn the following spring. Summer steelhead have a more inland distribution and tend to occur in watersheds where flow regimes are driven by snow melt.

Steelhead are primarily managed by state fish and wildlife agencies, but the National Marine Fisheries Service (NMFS) is responsible for ensuring that management of steelhead protected under the Endangered Species Act is consistent with this federal law. For management purposes, steelhead populations in the continental United States are grouped into 15 Distinct Population Segments (DPS). These DPS span jurisdictional and ecological boundaries (Table 1, Figure 1), are reproductively isolated from each other, and represent important components of the evolutionary legacy of steelhead. Today, one steelhead DPS is listed as "endangered" and 10 others are listed as "threatened" under the Endangered Species Act (see Table 1). The basic unit of each DPS is a population, which group fish with similar genetic characteristics within discrete watershed

Table 1. Distinct Population Segments and status under the ESA, listed from northern Washington to southern California

DPS Name	Status
Puget Sound	*Threatened*
Olympic Peninsula	Not Warranted
Washington Coast	Not Warranted
Lower Columbia River	*Threatened*
Middle Columbia River	*Threatened*
Upper Columbia River	*Threatened*
Snake River Basin	*Threatened*
Upper Willamette River	*Threatened*
Oregon Coast	Species of Concern
Klamath Mtns Province	Not Warranted
Northern California	*Threatened*
Central California Coast	*Threatened*
California Central Valley	*Threatened*
South-Central CA Coast	*Threatened*
Southern California	*Endangered*

Figure 1: Steelhead distinct population segment boundaries – California, Oregon, Idaho, and Washington

boundaries that share similar environmental conditions. Populations range in size from the 3,517 acre Hardy Creek, California winter steelhead population to the 22 million acre Lower John Day River, Oregon summer steelhead population. Although genetically similar or identical, *non-migratory, or resident, rainbow trout are managed as a separate entity by the US Fish and Wildlife Service and are not considered here* due to limited on-the-ground spatial information on the relationship of local resident rainbow trout populations with anadromous steelhead.

Wild steelhead populations (i.e., steelhead not bred in hatcheries) have declined substantially in most rivers within their native range in the western United States. Despite their perilous state, wild steelhead have not received the level of effort and resources that has been dedicated to recovery of wild Pacific salmon species, particularly Chinook and Coho. While salmon habitat restoration efforts have undoubtedly helped wild steelhead in river systems where both are found, there are substantial differences in habitat needs, life histories, and fisheries management to warrant a suite of conservation actions designed to address the unique and varied needs of wild steelhead across their native range. Accordingly, Trout Unlimited, with expert staff and many passionate steelhead anglers among its roughly 150,000 members, has launched an ambitious Wild Steelhead Initiative to protect remaining wild steelhead populations and to rebuild depleted populations in the western US.

The assessment described in this report provides the scientific foundation for this initiative. To our knowledge, it is the only range-wide assessment of steelhead populations in the continental United States that characterizes the relative condition of steelhead populations, habitats, and future threats. Our specific assessment objectives are to:

- Gather and summarize the available spatial data related to the distribution and condition of steelhead populations across the entire west coast of the contiguous US;
- Describe the habitat conditions of freshwater and estuarine habitats used by steelhead;
- Describe the pattern of the human disturbance within the steelhead range;
- Characterize the pattern of future threats that likely threaten the persistence of wild steelhead; and
- Combine the above to identify key opportunities for conservation actions.

2.0 Methods

We combined the results of several recent assessments to characterize the condition and status of steelhead populations, their habitats, and threats to their persistence in the future. Each assessment applies uniform data and methods across the broad geography of the Pacific Coast of the continental US, providing a consistent framework for comparisons across subregions.

2.1 Distribution

We summarized current and historical winter and summer steelhead distribution from a variety of datasets at the population scale to characterize loss in distribution. Current distribution data for steelhead are provided by a variety of state and federal fisheries management agencies (California Department of Fish and Game and Pacific States Marine Fisheries Commission 2007; California Department of Fish and Game and Pacific States Marine Fisheries Commission 2009; StreamNet GIS Data 2011). For historical distribution, we relied on sources of actual historical distribution where they exist (Chandler 2001; Hamilton et al. 2005; Washington Department of Fish and Wildlife 2008), but primarily relied on intrinsic potential models (Agrawal et al. 2005; Benda et al. 2007; Interior Columbia Technical Recovery Team 2006; NOAA-SWFRC 2004a; NOAA-SWFRC 2004b; NOAA-SWFRC 2004c) as a proxy for historical distribution. Intrinsic potential models approximate the quality of habitats for juvenile rearing on a 1 (best) to 0 (worst) scale, based on the interactive effects of slope, channel confinement, and stream flow (Agrawal et al. 2005; Burnett et al. 2007), and thus provide both a maximum potential distribution and a measure of relative habitat potential for a species. Previous summaries of intrinsic potential and historical distribution data have identified 10 kilometers of connected habitat and 16 intrinsic-potential kilometers (the product of intrinsic potential score x distance) as important thresholds for steelhead viability at the population level (Bjorkstedt et al. 2005; Lindley et al. 2006). By summarizing the mean intrinsic potential scores at the population scale, we identified the populations with the greatest amount of habitat preferred by juvenile steelhead – moderately steep, confined reaches – regardless of the amount of total habitat available. Intrinsic potential data are available for all winter steelhead DPS except the Middle Columbia River. Intrinsic potential data for summer steelhead are available only for populations in the Middle Columbia River, Upper Columbia River, and Snake River Basin DPS.

2.2 Population Integrity

We used the North American Salmon Stronghold Partnership (NASSP) expert database to characterize steelhead population condition and integrity. Led by the Wild Salmon Center, the NASSP process gathers experts from government agencies, academic institutions, tribes, and conservation organizations to evaluate populations for three criteria - population viability, percent natural origin, and life history diversity. Experts assign categorical scores for each criterion to each population; scores range from 5 through 1, reflecting exceptional through poor condition (Table 2), and information is also collected on the confidence each expert has on the scores presented. The NASSP database synthesizes these scores across the Pacific Northwest and California, providing a consistent assessment across regions at the population scale. Examining the individual and summed scores allows us to compare the relative condition of populations to the relative condition of habitats and presence of future threats across the continental US range of steelhead. Oregon scores date from 2011, Olympic Peninsula and Washington Coast scores date from 2010, California scores are from 2009, and all regions were scored in 2008. Due to missing scores, we supplemented Puget Sound scores by using run size and genetic data from NOAA's Salmon Population Summary Database (NMFS 2012) and scoring populations following the NASSP rules in Table 2.

2.3 Hatcheries

While hatcheries can augment total adult steelhead returns, there is widespread evidence that hatchery fish have less genetic diversity and reduced fitness relative to wild fish (Araki et al. 2009; Araki et al. 2007; Chilcote M.W. et al. 1986; McLean et al. 2003) and that steelhead consistently lose reproductive performance when wild fish are mixed with hatchery fish (Byrne et al. 1992; Chilcote 2003; Chilcote et al. 2011), even across run timings (Kostow and Zhou 2006). We used several assessments of hatchery practices to characterize the role specific facilities and outplanting locations likely play within populations and contrasted these against

Table 2: North American Salmon Stronghold Partnership expert population assessment categories and scoring rules

Indicator	Scale and Definition	General Scoring Rules*	Relevance to Conservation
Population viability	Population; productivity and abundance of a population relative to others in DPS and in absolute terms	5 = Highly viable, exhibiting high productivity or abundance 4 = Above average viability 3 = Moderate productivity and abundance 2 = Below average viability 1 = Critically low viability	Large, productive populations are less vulnerable to extirpation.
Hatchery influence	Population; percentage of natural origin spawners within a population	5 = > 95% 4 = 75 - 95% 3 = 50 - 74% 2 = 25 - 49% 1 = 0 - 24%	Hatchery fish exhibit less genetic diversity and reduced fitness relative to wild fish.
Life history diversity	Population; variety of life histories - age/year class, fecundity, run timing, and other traits - present in a population	5 = All life history strategies present 4 = Robust, multiple, &/or rare life histories, representing majority of historical 3 = Few life histories present and modest representation of historical 2 = Few life histories present and significantly simplified from historical 1 = Extremely simplified or single life history strategy	Contributes to genetic variation for responding to environmental change and allows for use of a greater variety of habitats, mitigating risks over space and time.

the NASSP database hatchery influence scores. For listed populations, we summarized the stock reports produced by NOAA's Salmon and Steelhead Hatchery Assessment Group (NMFS 2003; NMFS 2005); for non-listed populations, we summarized the presence of steelhead hatcheries or outplantings by population based on data assembled by the Hatchery Scientific Review Group in 2003 -2005 for the Olympic Peninsula and Washington Coast DPS and Oregon Department of Fish and Wildlife hatchery operations plans from 2011 and 2012 for the Oregon Coast and Klamath Mountains Province DPS. Based on information in these other assessments, we assigned a stock category score when possible. Table 3 describes the scoring scheme used by the NOAA Salmon and Steelhead Hatchery Assessment Group.

2.4 Habitat Integrity

We used information from Trout Unlimited's Conservation Success Index (CSI) to characterize the relative condition of instream habitats used by current and historical steelhead populations. The CSI is a watershed-scale assessment of data related to a species' distribution, habitat

Table 3: NOAA Salmon and Steelhead Hatchery Assessment Group stock categories

Stock Category	Definition
1	Characterized by no more than minimal divergence between hatchery stock and local populations and regular, substantial incorporation of natural origin fish into hatchery broodstock
2	No more than moderately diverged from local, natural populations and founded by native populations from the local watershed (2a), founded non-locally, but from populations within the DPS (2c), or founded non-locally, but from populations within the DPS and planted into watersheds lacking a native population (2b)
3	Substantial divergence from local natural populations and founded locally (3a), founded from within-DPS populations (3c), or founded from outside the DPS, but planted in watersheds historically lacking steelhead (3b)
4	Founded by sources outside of the DPS or extremely divergent from local populations

features, and future threats (Williams et al. 2007). This assessment uses California salmon and steelhead CSI generated in 2010 (v1.5) and Pacific Northwest CSI data produced in 2011 (v1.3). The CSI assembles available spatial data from national or state resource management agencies in a database, summarizes the data by watershed (6^{th} field hydrological unit code, or HUC 12), and assigns a categorical score to the summary based on the best scientific understanding of the influence of the particular data on salmon. Scores range from 5 through 1, reflecting exceptional through poor condition; we summarized area-weighted average scores for individual and total, summed indicators by population and DPS. The five indicators take into account a variety of factors related to watershed condition (primarily roads), temperature, watershed connectivity (barriers), water quality (primarily land uses), and flow regime. Table 4 provides an overview of the scale, definition, scoring rules, and relevance of the five habitat integrity indicators in the CSI; additional information on data sources, a scoring framework, and the most up-to-date CSI results can be found at www.tu.org/csi.

Estuaries are critical rearing habitats for many other salmonids, but have only recently been acknowledged as productive habitats for juvenile steelhead, especially in small, direct-ocean tributaries (Bond et al. 2008; Hayes et al. 2008). The Nature Conservancy's (TNC) Conservation Assessment of West Coast (USA) Estuaries provides a classification and evaluation of estuaries, their contributing watersheds, and the threats to their proper function (Gleason et al. 2011). We used the characterization of estuary types along with the summary metrics provided for each estuary – impairment warranting 303d listing, physical modifications of estuary structure (primarily dikes), and the presence of marinas and ports. We also used a measure from the CSI describing the potential estuary area, defined using elevation and sea level, and the proportion of the potential estuary area that has been converted to agriculture or urban land use. We combined these to compare the relative condition of estuaries with population integrity results from the NASSP.

Table 4: CSI Habitat Integrity indicators and overview of scale, definition, scoring rules, and relevance. General scoring rules are abbreviated. More detailed descriptions and application by run are available at www.tu.org/csi

Indicator	**Scale and Definition**	**General Scoring Rules***	**Relevance to Conservation**
Watershed condition	Watershed; mean road density, ratio of road miles within riparian zone to stream miles, 303d listing for sediment, and sand and gravel mining	5 = Road den < 1.6 mi/mi², < 0.05 mi road/mi stream, & 0 instream mines 4 = Road den < 2.5 mi/mi² and < 0.1 mi riparian road/mi stream 3 = any 303d for sediment or road den < 3 mi/mi² & < 0.25 mi riparian road/mi stream 2 = Road den < 4.7 mi/mi² and < 0.5 mi riparian road/mi stream 1 = Road den ≥ 4.7 mi/mi² or ≥ 0.5 mi riparian road/mi stream	Roads contribute sediment, embedding spawning substrates & increasing turbidity. Roads & mines in the riparian zone alter instream structure & processes.
Temperature	Watershed; % of stream mi. exceeding species-specific August air temp threshold, 303d listing for temperature, and riparian vegetation height	5 = < 20% of watershed exceeding and riparian vegetation > 20m 4 = < 40% of watershed exceeding and riparian vegetation > 10m 3 = any 303d for temperature or < 60% of watershed exceeding & riparian veg > 5m 2 = < 80% of watershed exceeding and riparian vegetation > 1m 1 = ≥ 80% of watershed exceeding and riparian vegetation ≤ 1m	High temperatures reduce habitat suitability. Shade from riparian vegetation can mitigate temperatures.
Watershed connectivity	Watershed; Proportion of watershed accessible and barrier count between watershed & sea	5 = At least 90% of watershed accessible and less than 0.2 barrier per 20 mi of migratory corridor OR no salmon/steelhead historically 4 = 50 - 90% of watershed accessible and 0.2 - 2 barriers per 20 mi of migratory corridor 3 = 30– 50% of watershed accessible and 2 - 5 barriers per 20 miles of migratory corridor 2 = 1– 30% of watershed accessible and > 5 barriers per 20 miles of migratory corridor 1 = Access blocked due to barrier	Hydrological connectivity provides increased habitat area & supports multiple life stages. Even passable barriers pose threats from predation & entrainment.
Water quality	Watershed; 303d listing for toxins and nutrients, % area urban and agriculture, count of active mines, count active oil/gas wells	5 = < 5% urban/ag, 0 mines, and < 50 wells 4 = < 15% urban/ag, < 4 mines, and < 200 oil/gas wells 3 = any 303d for toxin/nutrient, < 27% urban/ag, < 7 mines, & < 300 oil/gas wells. 2 = < 57% urban/ag, < 10 mines, and < 400 oil/gas wells 1 = ≥ 57% urban/ag, ≥ 10 mines, and ≥ 400 oil/gas wells	Impaired water quality, including reduced dissolved oxygen, presence of toxins & pollutants, & increased turbidity reduces habitat suitability.

Indicator	Scale and Definition	General Scoring Rules*	Relevance to Conservation
Flow regime	Watershed; miles of canal, count of dams, acre-feet of dam storage, and ratio of diversions to stream miles	5 = 0 dams, < 1 miles canal, and < 0.4 diversions/mile 4 = 1 dam, < 250 ac-ft storage, and < 5 miles canal 3 = 2 dams, < 1000 ac-ft storage, and < 10 miles canal 2 = < 5 dams, < 2500 ac-ft storage, and < 20 miles canal 1 = ≥ 5 dams, ≥ 2500 ac-ft storage, and ≥ 20 miles canal	Natural flow regimes are critical to proper ecosystem function. Reduced or altered flows reduce capacity to support native salmonids.

2.5 Future Threats

Trout Unlimited's CSI also includes five future security indicators that anticipate the threats salmonids will face in the near future. Each CSI indicator is an interpretation of the relative threat to instream habitats from a variety of factors related to land conversion (urban and vineyard), resource extraction (renewable and non-renewable), climate change, sedimentation, and land stewardship. Table 5 describes the future security factors we summarize for each steelhead population and DPS.

The CSI assesses the vulnerability of steelhead to climate change based on three risk factors – increasing summer temperatures, changes in flow volume, and changes in winter precipitation regime. Increasing air temperatures will increase water temperatures, displacing species from portions of their current distribution (Mantua et al. 2010). Based on the observed relationship between the distribution of winter steelhead in California and August air temperature (Agrawal et al. 2005), the CSI calculates the average risk of exceeding this species-specific temperature threshold under current climate conditions (PRISM Group 2008) and using forecasts for 2050 (Maurer et al. 2007). The CSI also assesses the potential for changes in flow volume as a function of total annual precipitation and flow regimes. The CSI summarizes total annual precipitation forecasts for 2050 (Maurer et al. 2007) and base flow index (Wolock 2003), the ratio of base flow to total flow expressed as a percentage, by watershed. High base flow watersheds have groundwater or snow melt dominated flows, while low base flow watersheds have surface run-off dominated flows. Finally, the CSI identifies areas vulnerable to changes in flow timing. Transitions in winter precipitation regimes throughout the western United States – especially from snow to rain - may be associated with changes in spring peak flow timing and magnitude, summer low flow magnitude, and increased likelihood of rain-on-snow events (Mantua et al. 2010). For each watershed, we predict the transition in precipitation regime, where regimes include snow-dominated (Dec – Feb mean temperature < - 1°C), mixed (Dec – Feb mean temperature between – 1°C and 1°C), and rain-dominated (Dec – Feb mean temperature > 1°C), based on current climate and forecasts for 2050.

Table 5: CSI Future indicators and overview of scale, definition, scoring rules, and relevance. General scoring rules are abbreviated. More detailed descriptions and application by run are available at www.tu.org/csi

Indicator	**Scale and Definition**	**General Scoring Rules***	**Relevance to Conservation**
Land conversion	Watershed; amount of undeveloped private land suitable to conversion to urban or vineyard development	5 = < 20% 4 = 20 - 39% 3 = 40 - 59% 2 = 60 - 79% 1 = ≥ 80%	Conversion of lands from natural habitats will reduce habitat quality and availability and increase water use.
Resource extraction	Watershed; % area vulnerable to resource extraction based on timber, wind, geothermal, coal, oil & gas, mineral, and solar resources; new dams	5 = 0% subject to new resource development; no new dams 4 = 1 -10% subject to new resource development; 1-2 new dams in HUC8 3 = 11 -25% subject to new resource development; 3-5 new dams in HUC8 2 = 26 -50% subject to new resource development; > 5 new dams in HUC8 1 = > 50% subject to new resource development; ≥ 1 local new dam	Increased non-renewable and renewable resource development will increase road densities, modify natural hydrology, and increase likelihood of pollution.
Climate change	Watershed; susceptibility to impacts from changes in summer temperatures, winter precip. regime, and annual precip. volume	5 = Low risk across all three factors 4 = Low risk across two factors, moderate for one 3 = Moderate risk across two factors, low for one 2 = Moderate risk across three factors 1 =High risk for any factor	Climate change threatens salmonids because of warmer water temps, changes in peak flows, & increased intensity and frequency of disturbance.
Sedimentation	Watershed; amount of watershed area with inherent slope instability	5 = 0 – 5% of watershed at risk 4 = 5 -1 0% of watershed at risk 3 = 10 -20% of watershed at risk 2 = 20 – 30% of watershed at risk 1 = > 30% of watershed at risk	Landslides, both natural & induced by anthropogenic activities, cause sedimentation
Land stewardship	Watershed; amount of federal or state lands with regulatory or Congressionally-established habitat protections	5 = > 30% stream habitat or > 50% watershed protection 4 = > 20% stream habitat and > 25% watershed protection 3 = > 10% stream habitat and > 25% watershed protection 2 = > 1% stream habitat and > 25% watershed protection 1 = < 25% watershed protection	Stream habitats & watersheds with higher portions of protected lands will experience less anthropogenic disturbance than other lands

Factors not addressed by this assessment include the effect of harvest and disease on populations and future threats from invasive species.

2.6 Conservation Strategies

Taken together, the CSI, NASSP database, TNC estuary assessment, and NMFS hatchery evaluations provide a qualitative assessment of population, habitat, and threat data of consistent sources and scales for characterizing watersheds. By comparing factors from the combined products across populations and DPS, we can categorize populations according to generalized conservation strategies such as protection, population restoration, and habitat restoration and identify outliers from the general pattern that likely represent exceptional opportunities for specific conservation actions across the west coast. We present opportunities at the population scale, given recent evidence of the importance of concentrating restoration efforts in order to produce measurable changes in fish abundance (Roni et al. 2010). For all strategies, we use a conservative threshold of 15 miles (25 km) of currently occupied habitat (or historically occupied habitat in the case of reintroduction strategy) to focus on populations capable of viability in isolation (Bjorkstedt et al. 2005; Lindley et al. 2006). Recovery plans and local knowledge will provide important information on fine-scale condition and opportunities within populations.

3.0 Results: Distribution

Winter run steelhead once occupied a watershed area of 71.5 million acres in the western continental US, with populations ranging from the Otay River near San Diego and the Mexican border to Dakota Creek on the Canadian border (Figure 2). Winter run persist in 65% of their historical habitats, with the greatest reductions in distribution occurring at the southern extent (79% lost in the Southern California DPS) and interior valleys of California and Oregon (65% lost in the Central Valley DPS and 46% lost in the Willamette Valley DPS). Populations on the coasts of Oregon and Washington have experienced the least decline, with no loss in the Olympic Peninsula DPS, only 1% lost in the Washington Coast DPS, and 5% lost in the Oregon Coast DPS (Figure 2, Table 6).

Summer steelhead historically occupied at least 67 million acres, with a southern extent of distribution in the Mattole and Middle Fork Eel Rivers in California and an interior distribution over 1,000 miles up the Columbia River into northern Nevada. Summer run have been lost from over 22 million acres, or 33%, of this range. Like winter run, the greatest losses in distribution have occurred in the interior basins, with extirpation in 44% of the historical watershed area in the Snake River Basin DPS and 38% in the Upper Columbia River DPS. Summer run distribution also remains relatively intact in coastal Washington systems, with 100% remaining in the Olympic Peninsula DPS (Figure 2, Table 6).

Figure 2: Current and historical distribution of winter and summer steelhead runs on the west coast of the continental United States

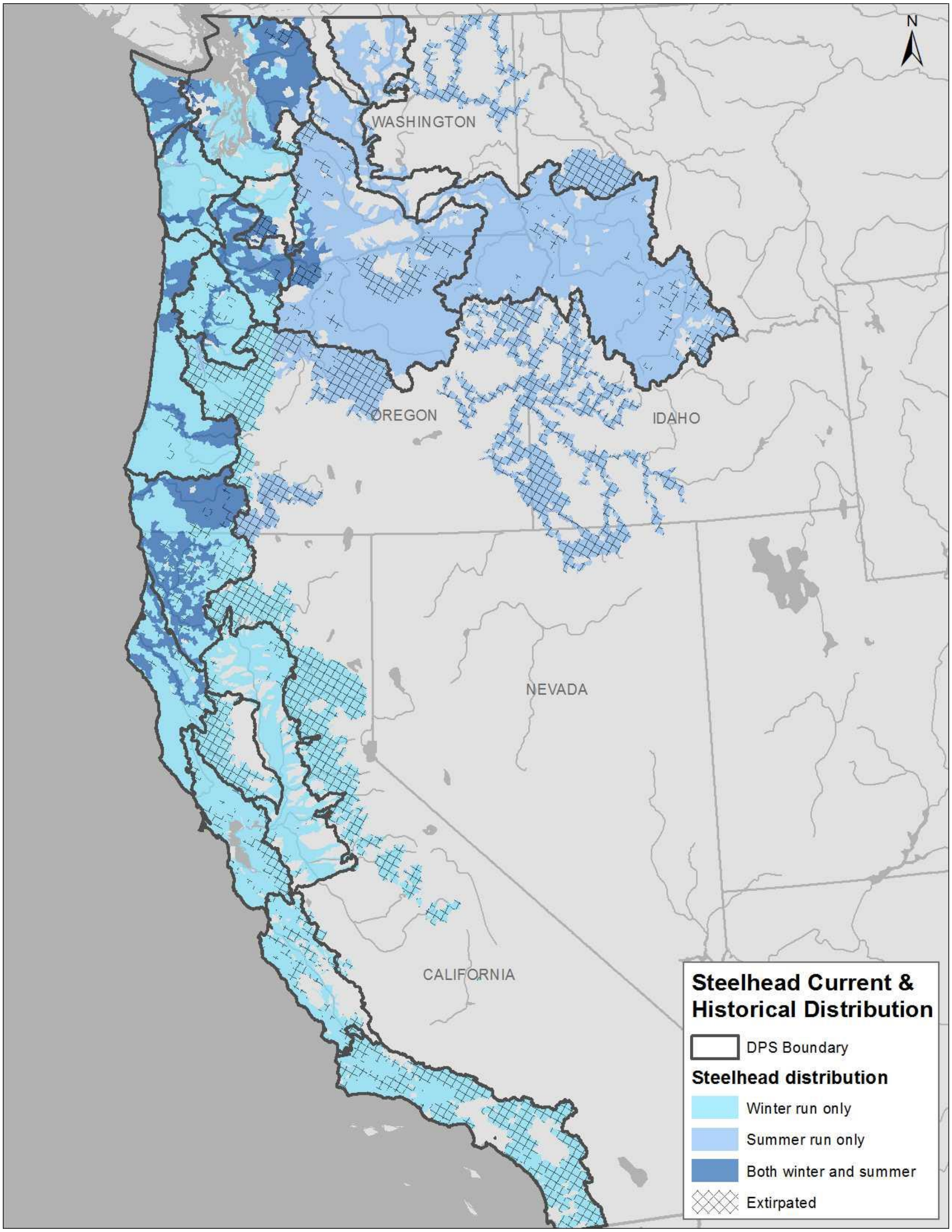


Table 6: Watershed area currently and historically occupied by steelhead runs by DPS in millions of acres, with percent remaining. Extirpated populations outside of current DPS boundaries were assigned to the logical DPS (i.e. Owyhee River summer steelhead are summarized here as Snake River Basin).

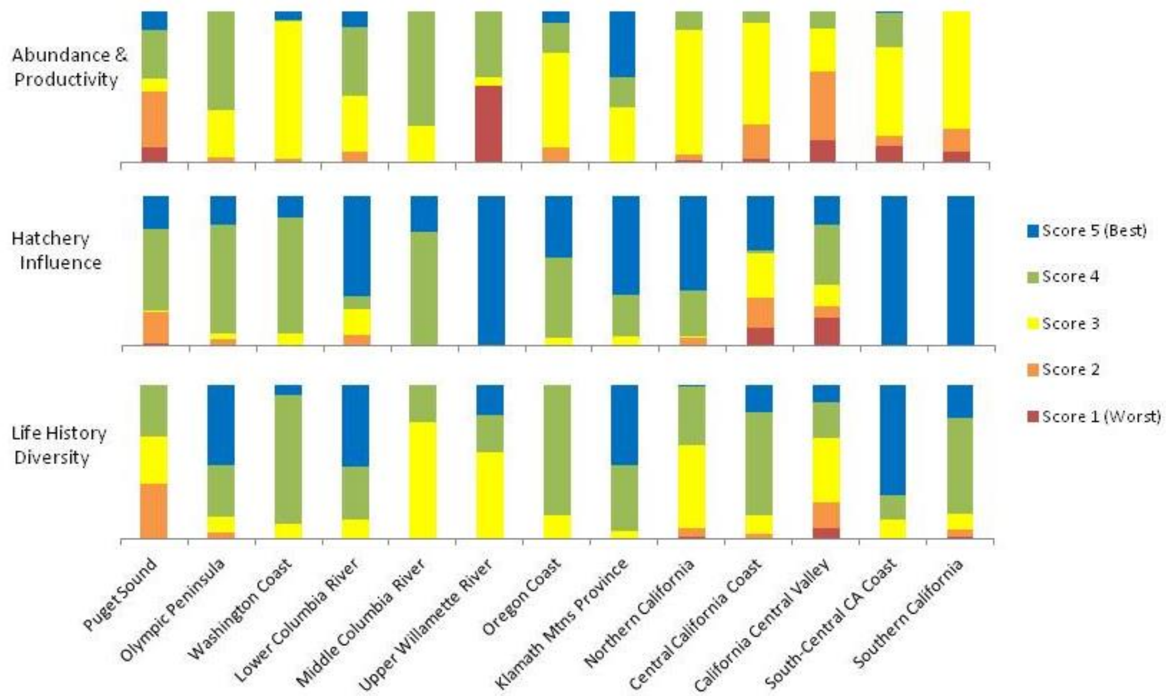
DPS	Winter Run - Historical	Winter Run - Current	Summer Run - Historical	Summer Run - Current
Puget Sound	6.0	5.6 (94%)	3.4	3.1 (91%)
Olympic Peninsula	1.6	1.6 (100%)	1.0	1.0 (100%)
Washington Coast	3.2	3.2 (99%)	0.5	0.5 (95%)
Lower Columbia River	4.1	3.6 (87%)	2.1	1.9 (85%)
Middle Columbia River	1.2	1.1 (92%)	17.8	12.4 (70%)
Upper Columbia River	-	-	5.9	3.7 (62%)
Snake River Basin	-	-	28.4	15.8 (56%)
Upper Willamette River	6.4	3.4 (54%)	-	1.7[1]
Oregon Coast	6.9	6.6 (95%)	1.4	1.4 (100%)
Klamath Mtns Province	9.0	6.7 (74%)	5.4[2]	4.1 (76%)[2]
Northern California	4.4	3.8 (86%)	1.0[2]	1.0 (100%)[2]
Central California Coast	3.6	2.6 (70%)	-	-
California Central Valley	14.9	5.3 (35%)	-	-
South-Central CA Coast	3.0	1.8 (58%)	-	-
Southern California	7.0	1.4 (21%)	-	-
Total[3]	71.5	46.7 (65%)	67.1	44.8 (67%)

[1] Introduced
[2] Historical distribution data lacking in California; distribution likely greatly reduced
[3] Includes several small watersheds outside of DPS boundaries

3.2 Results: Conditions of extant populations – population factors

Figure 3 charts the relative distribution of NASSP stronghold scores for winter steelhead within each DPS. Coastal DPS – Olympic Peninsula, Washington Coast, Oregon Coast, and Klamath Mountains Province – have the strongest populations; given that these DPS are not ESA-listed, this is not surprising. Populations in the Puget Sound and Lower Columbia DPS received the greatest number of high scores for any listed DPS. Interior Columbia winter steelhead populations in the Middle Columbia and Upper Willamette DPS received relatively low life history diversity scores; some Upper Willamette Basin populations had among the lowest abundance and productivity scores, as well. Winter steelhead populations within the Central Valley appear to have lost portions of their historical abundance, genetic integrity, and life history diversity. Despite low abundance and productivity, South-Central California Coast and Southern California steelhead have relatively little hatchery influence and high life history diversity. Figure 4 maps the pattern of the total, or summed, population factors. Highest overall winter steelhead population scores were assigned to the Clatskanie River (Washington Coast), Scappoose and Sandy Rivers (Lower Columbia), Mainstem Rogue and Applegate Rivers

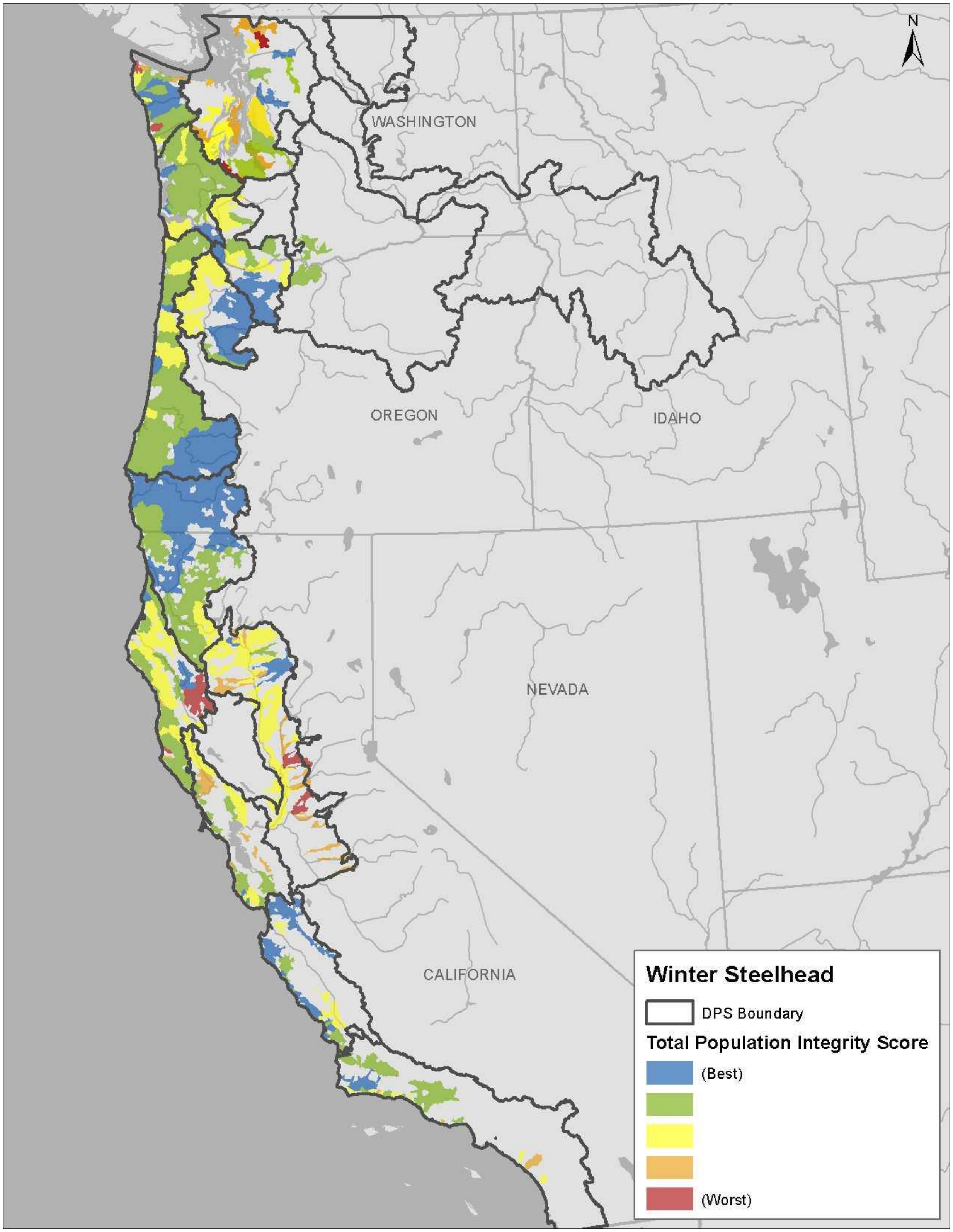
Figure 3: Frequency of scores for winter-run steelhead population factors evaluated by the North American Salmon Stronghold Partnership within each DPS. Frequency of scores is length-weighted by distribution of the run in each population by DPS.



(Klamath Mountains Province), Little Sur River (South-Central California Coast), Molalla and Pudding Rivers (Washington Coast), Clearwater River (Olympic Peninsula), and Antelope, Mill, and Deer Creeks (Central Valley California).

Summer steelhead populations have relatively low to moderate abundance scores across all DPS, with the exception of some populations in the Middle Columbia and Klamath Mountains Province, and all of the Oregon Coast (Figure 5). Hatchery influence scores are high for most summer steelhead populations across DPS, but with moderate scores on the Oregon Coast and some populations with low scores in the Puget Sound. Life history diversity scores vary across DPS; populations in the Puget Sound and Middle Columbia receive the lowest scores and all other scores are moderate to high. Summer run steelhead summed population factor scores are mapped in Figure 6. The populations receiving the highest total scores are the North Fork Trinity, New, and Rogue Rivers (Klamath Mountains Province), Joseph Creek (Snake River Basin), North Fork John Day (Middle Columbia River), Kalama River (Lower Columbia River), and Siletz River (Oregon Coast).

Figure 4: Total Population Integrity score for winter-run steelhead by population. Total Population Integrity score is the sum of scores for three population factors: abundance and productivity, hatchery influence, and life history diversity.



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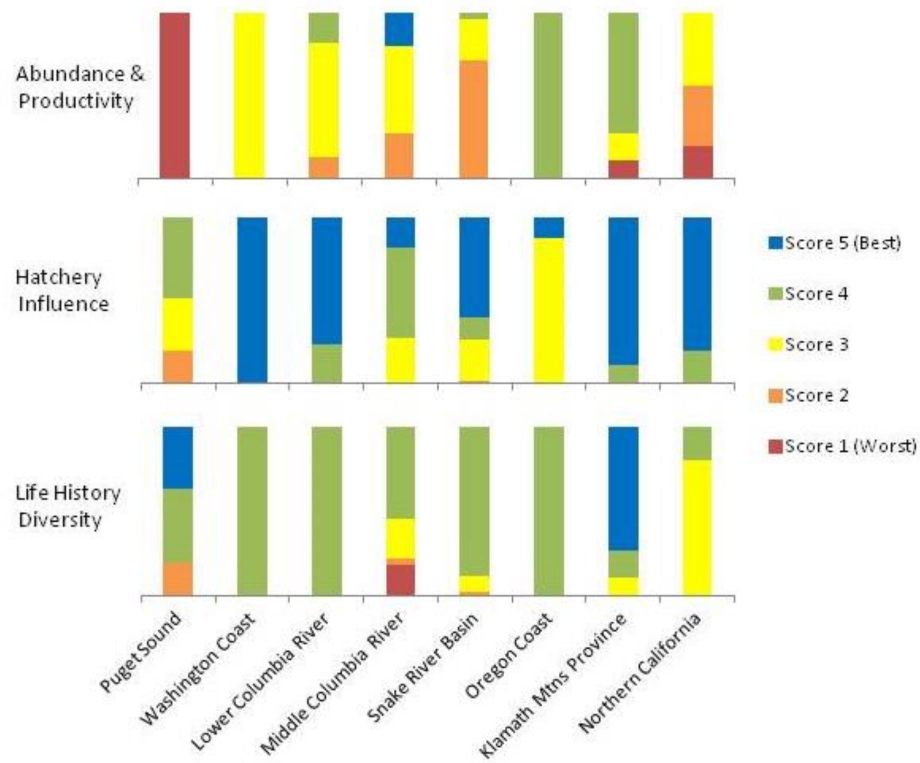


3.3 Results: Conditions of extant populations – hatcheries

Figure 7 depicts the location of winter and summer run steelhead hatcheries and hatchery outplantings. Stocked fish are widely present across west coast steelhead distribution. The pattern of Salmon and Steelhead Hatchery Assessment Group stock classifications generally corresponds to the NASSP database genetic integrity scores.

3.4 Results: Conditions of extant populations – habitat factors

Figure 8 displays the relative frequency of CSI habitat integrity scores of watersheds currently occupied by winter or summer run steelhead by DPS. Watershed condition scores, which assess road densities, roads in the riparian zone, and sedimentation of in-stream habitats, are lowest in coastal and interior DPS with the most productive forests, reflecting the current and historical impacts of industrial forestry on the west coast. Highest watershed condition scores are associated with wilderness areas in the interior of the Olympic Peninsula and Snake River Basin. Temperature scores by DPS, which are lowest where watershed average summer temperatures exceed 24°C, are oriented along two gradients: a cool-to-warm, north-south gradient, and a cool-warm-cool gradient as elevations shift from sea level to mid-elevations to high elevations. Connectivity scores, an interpretation of local and downstream barrier counts,

Figure 6: Total Population Integrity score for summer-run steelhead by population. Total Population Integrity score is the sum of scores for three population factors: abundance and productivity, hatchery influence, and life history diversity.

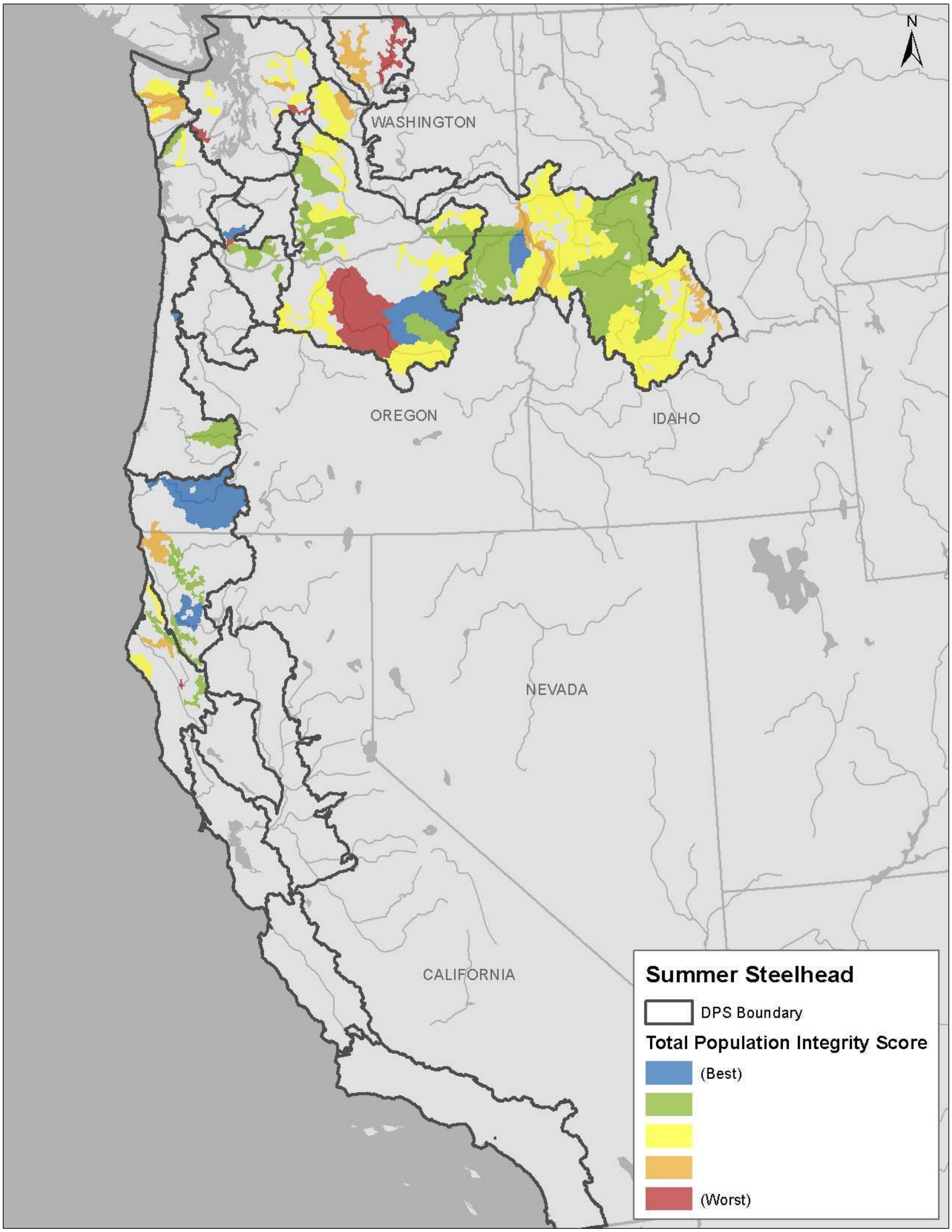


Figure 7: Locations of hatcheries and hatchery outplantings by steelhead run type. Labels denote NOAA's Salmon and Steelhead Hatchery Assessment Group stock classifications from Table 3. (S) denotes summer run steelhead classification only, when both run types are present .

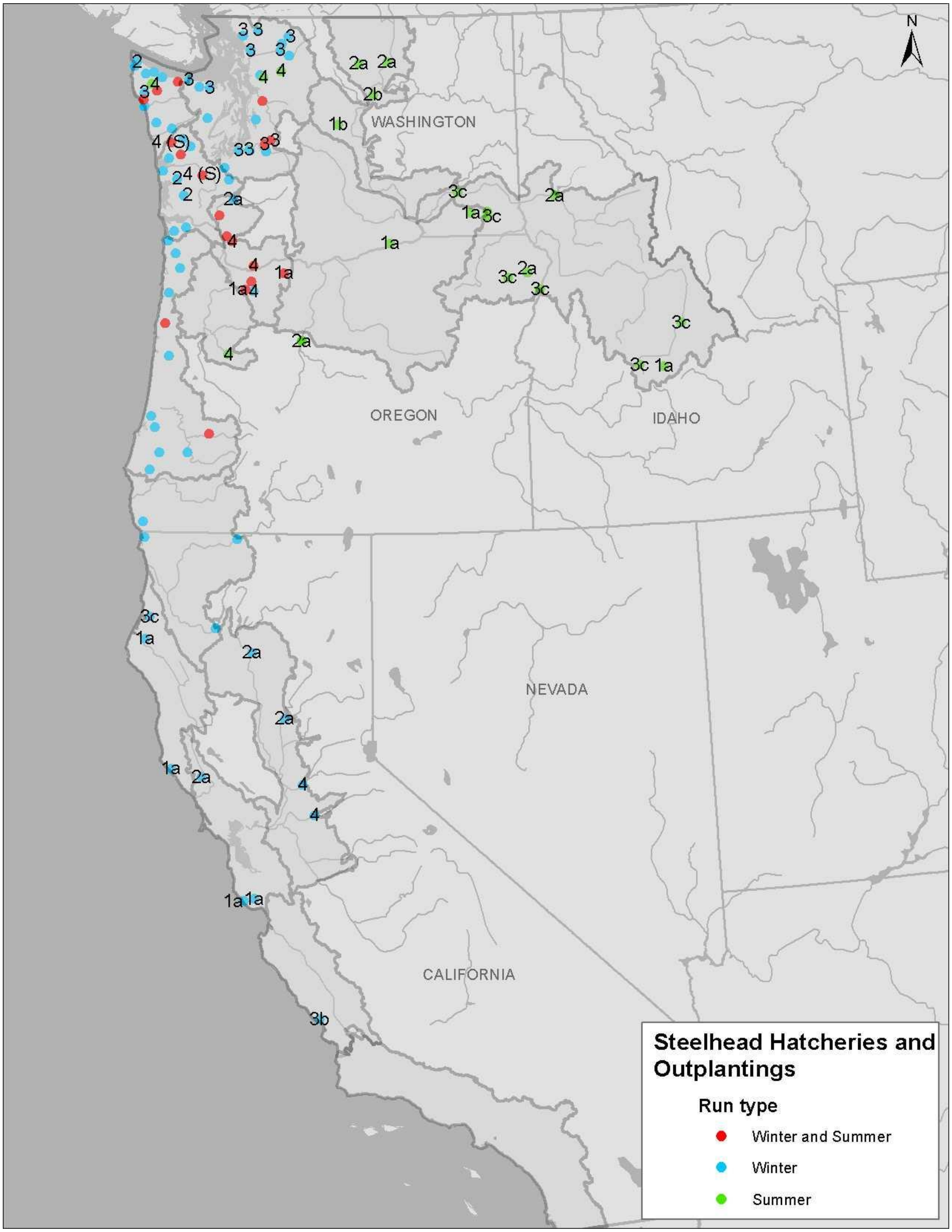
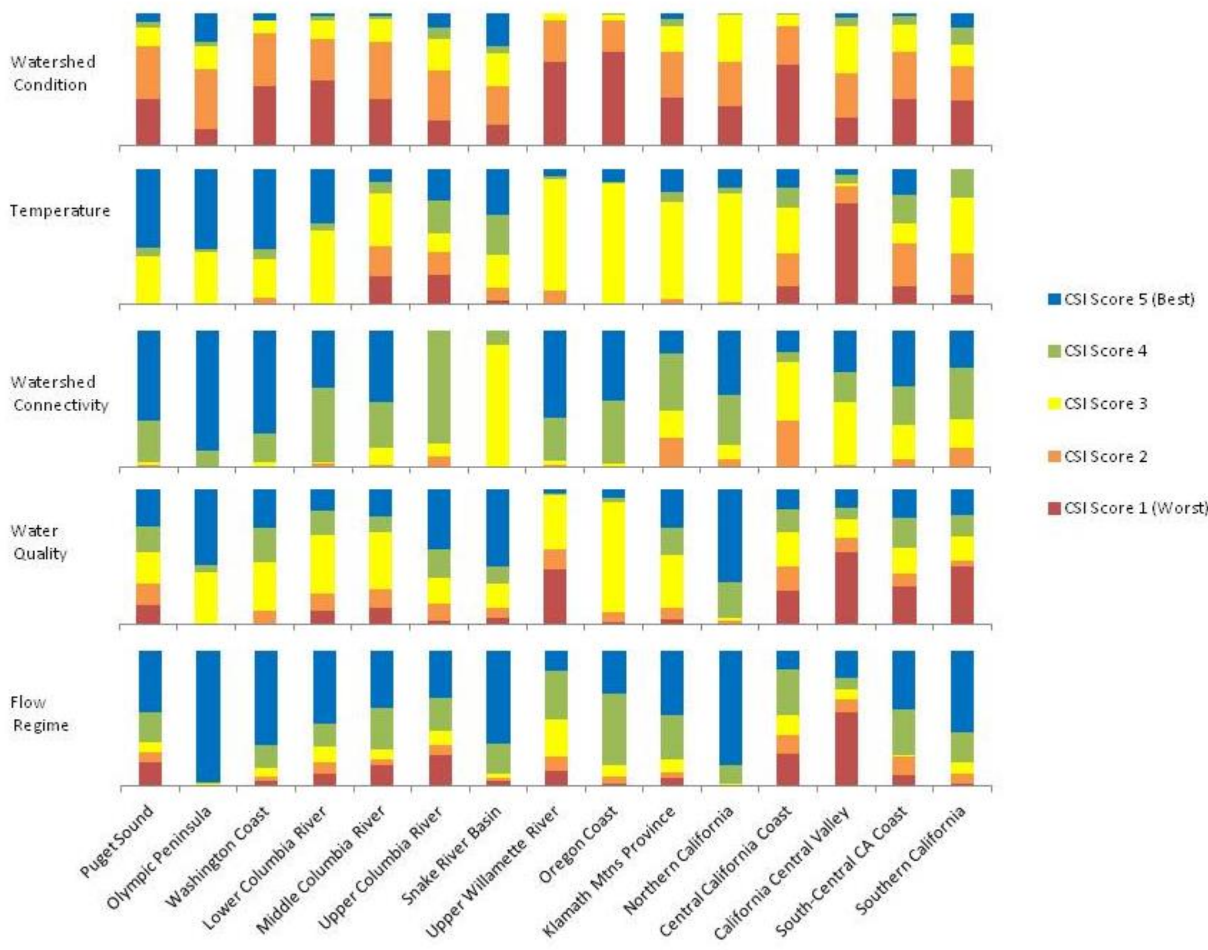
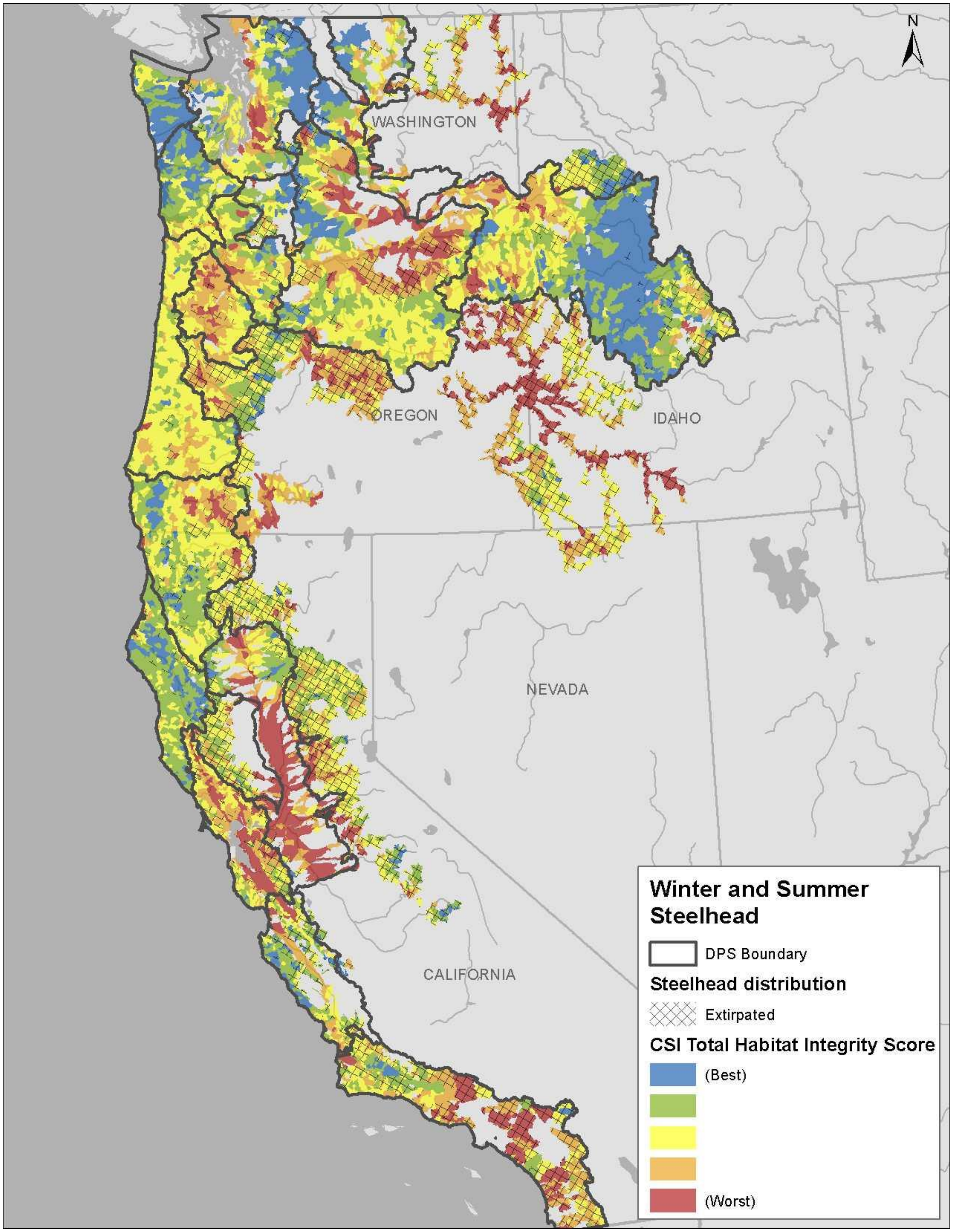


Figure 8: Frequency of Conservation Success Index Habitat Integrity scores for watersheds occupied by winter or summer steelhead by DPS. Frequency of scores is area-weighted by occupied watershed area within each DPS.



generally decrease with increasing distance from the Pacific and are highest in the DPS with the lowest agricultural land use – Olympic Peninsula, Puget Sound, and Washington and Oregon Coasts. Low water quality scores reflect a large footprint of urban areas, agriculture, mines, and oil and gas development in the Central Valley and south in California and in the Upper Columbia Basin. Flow regime scores track the amount of water storage and delivery infrastructure in watersheds. These scores are varied within all DPS, with the exception of the Olympic Peninsula, reflecting the presence of both highly altered flows and minimally impacted watersheds within individual DPS. The largest patches of high integrity habitats are associated with federally designated wilderness areas in central Idaho, Olympic National Park, the northern Cascades of Washington, the Klamath-Siskiyou Range in Oregon, and the Coast Range of Monterey County, California (Figure 9).

Figure 9: Total Conservation Success Index Habitat Integrity score for steelhead by watershed. Total Habitat Integrity score is the sum of scores for five watershed factors: watershed condition, temperature, watershed connectivity, water quality, and flow regime.



Estuary habitat area averages just over 1% of the freshwater habitat area within populations that encompass estuaries; outliers with larger estuary areas include Novato Creek, Sonoma Creek, and the Petaluma River, all direct tributaries to the large San Francisco Bay, and the Scappoose River, a direct tributary at the mouth of the Columbia River. Conversion of the near-shore, tidally influenced estuary habitat to agricultural and urban land use has occurred in 40% of the estuary area within extant populations that encompass estuaries. Significant estuary modifications, including ports and armoring, occur in over half of estuaries used by steelhead.

3.5 Results: Future threats to extant populations

Figure 10 displays the relative frequency of CSI future security scores for watersheds currently occupied by winter or summer steelhead by DPS. Land conversion scores reflect the risk of conversion of undeveloped lands into urban, exurban, or vineyard land uses. Because of a large

Figure 10: Frequency of Conservation Success Index Future Security scores for watersheds occupied by winter or summer steelhead by DPS. Frequency of scores is area-weighted by occupied watershed area within each DPS.

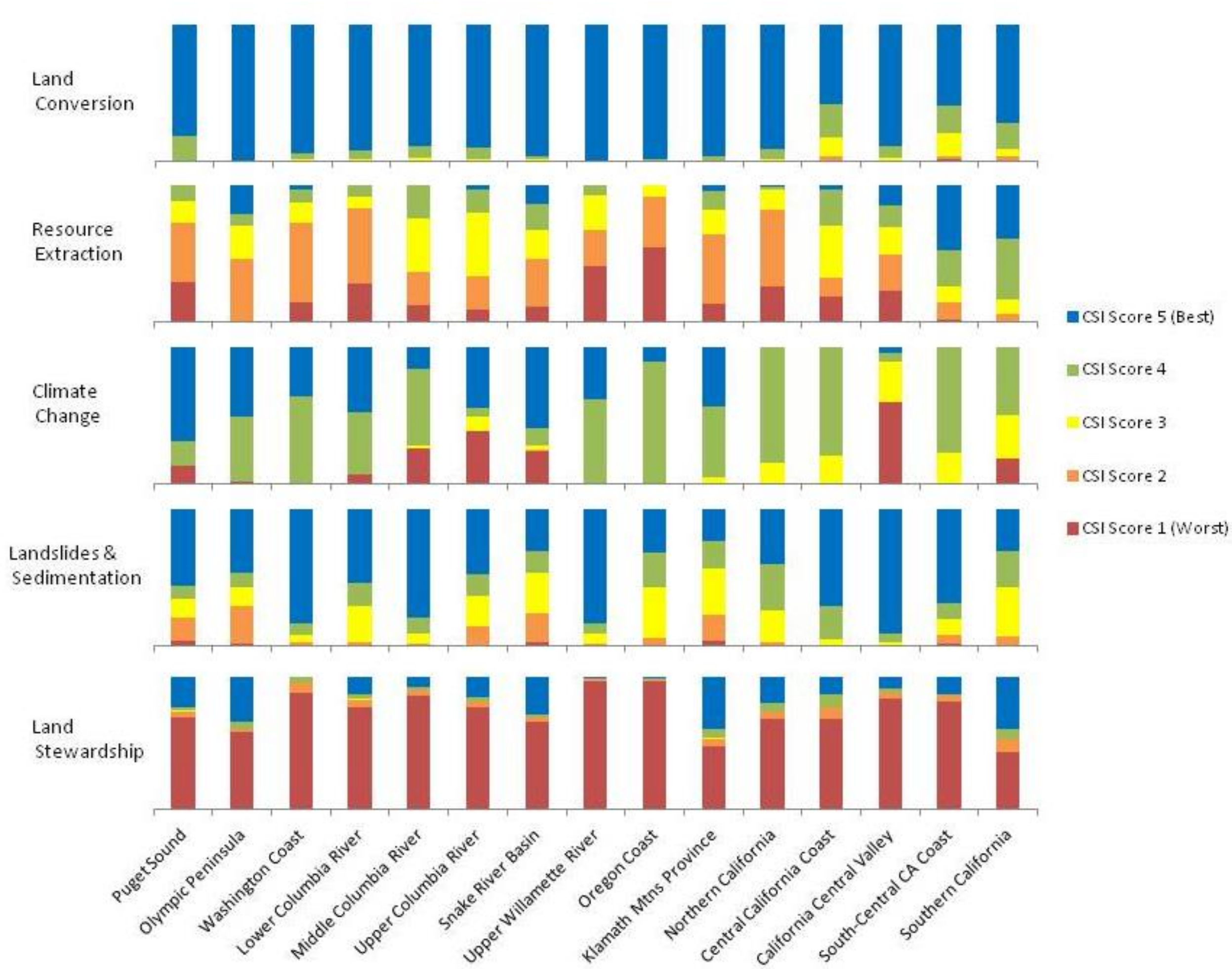


Figure 11: Conservation Success Index climate change score for steelhead by watershed. Climate change score is a composite analysis of the risk to steelhead from increasing summer temperatures, changes in winter precipitation regime, and changes in flow volume associated with change in annual precipitation amounts.

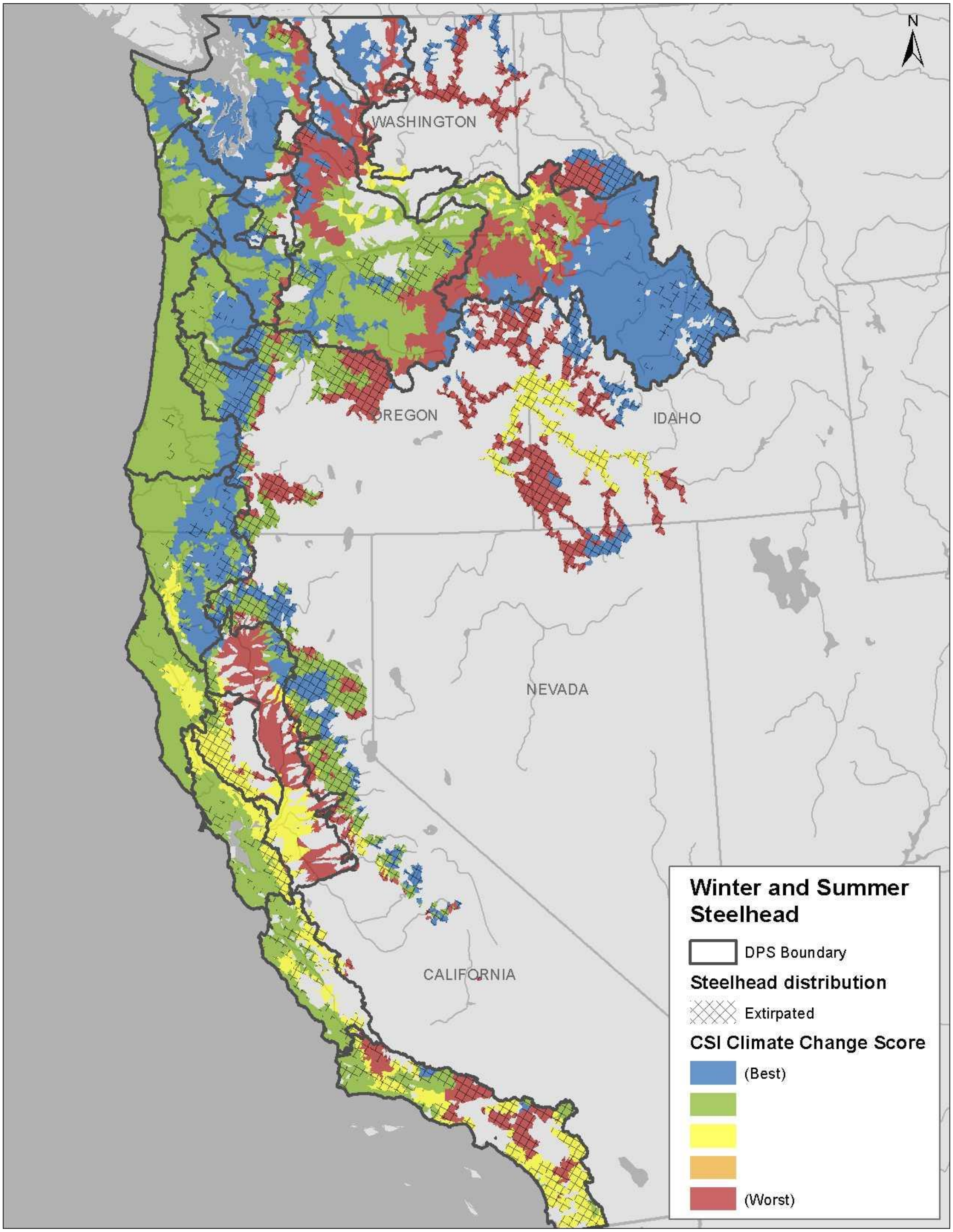
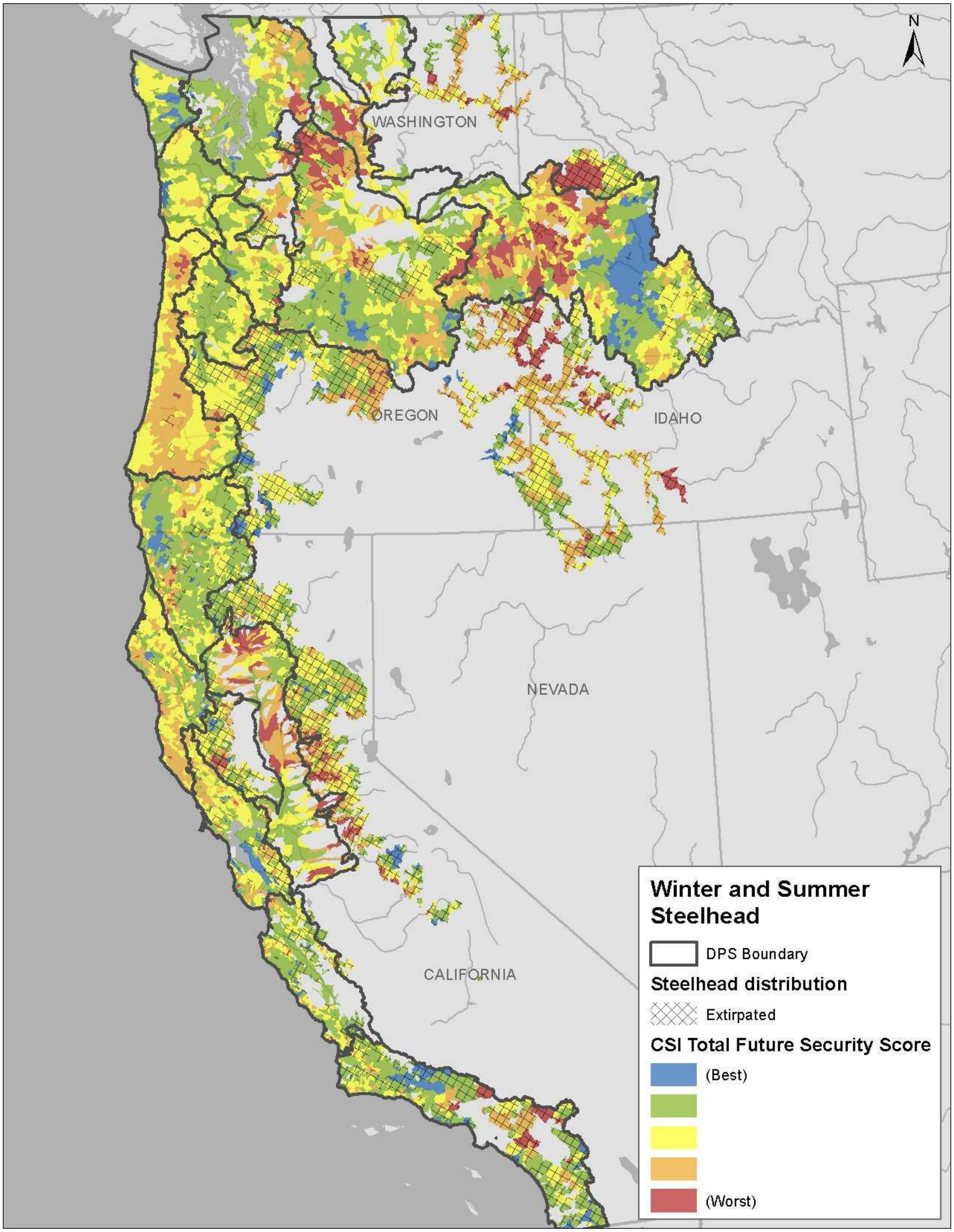


Figure 12: Total Conservation Success Index Future Security score for steelhead by watershed. Total Future Security score is the sum of scores for five watershed factors: land conversion, resource extraction, climate change, landslides and sedimentation, and land stewardship.



base of public lands that constrain urban growth and policy rules in Oregon, the risk of new urban development is relatively low. Vineyard development, with its attendant year-round water use, and urban growth represent a moderate risk in a number of watersheds in the Central California Coast, South-Central California Coast, and Southern California DPS. Risk of development of natural resources – timber, oil and gas, and renewable energies such as geothermal and wind resources – is widespread across all DPS, but highest in several coastal DPS with significant, high value forest coverage.

The pattern of climate change scores (Figure 11) aligns along an elevational gradient. The climate change risk in low elevation, coastal systems is mitigated by the influence of a relatively cool, rainy maritime climate. Similarly, highest elevation, interior watersheds are at low risk when their winter precipitation regime is forecast to remain snow-dominated. Highest climate change threats, reflected in low scores, is predicted in interior, low elevation watersheds, like the Central Valley, where summer temperatures are likely to increase, and in interior mid-elevations that are forecast to shift from snow-dominated winter precipitation to mixed and rain-driven regimes.

Vulnerability of watersheds to sedimentation from increased landslide frequency is relatively low, but greatest in the Klamath Mountains Province, Olympic Peninsula, and Snake River Basin DPS. Land stewardship scores are low across all DPS, with some high scores in the DPS with the greatest proportion of formally protected areas. Figure 12 illustrates the pattern of total, or summed, CSI future security scores across the historical distribution of steelhead. The largest patches of high scores with existing steelhead populations occur in central Idaho, Olympic National Park, the lower John Day River, Oregon, and the Smith River, California.

3.6 Results: Interpretation through general conservation strategies

The watershed-scale scores described in this assessment provide a perspective across the distribution of wild steelhead on their population condition, habitat integrity and future threats. By comparing and ranking population integrity scores and habitat integrity scores, we identify a general conservation strategy that is likely appropriate for each population (Figure 13, Figure 14). In general, protection strategies are appropriate in populations with relatively high scores for total population integrity from the NASSP database and total habitat integrity in the CSI. We identify restoration strategies for populations with relatively high scores across NASSP and CSI factors, but individual or multiple limiting factors – populations with a larger set of limiting factors are presented as less of a restoration priority than populations with single or few limitations. Future security scores from the CSI provide an overlay for representing the likelihood of success of conservation actions, given the threat factors assessed in the CSI. Combined, the conservation values represented by the watershed scale scores and the conservation strategies for populations can be used as a coarse-scale filter and supplemented with additional and more detailed information sources to identify place-based project needs and opportunities. A generalized conceptual model of how the watershed-scale scores and interpreted strategies can be combined with critically important local information to help prioritize conservation actions and screen projects is shown in Figure 15 (Dauwalter et al. 2012).

Figure 13: Conservation Success Index conservation strategies for winter steelhead by watershed. By juxtaposing population integrity scores against habitat integrity scores, we identify several general conservation strategies – protection and restoration focused on habitats, populations, or both - that are likely appropriate for each watershed.

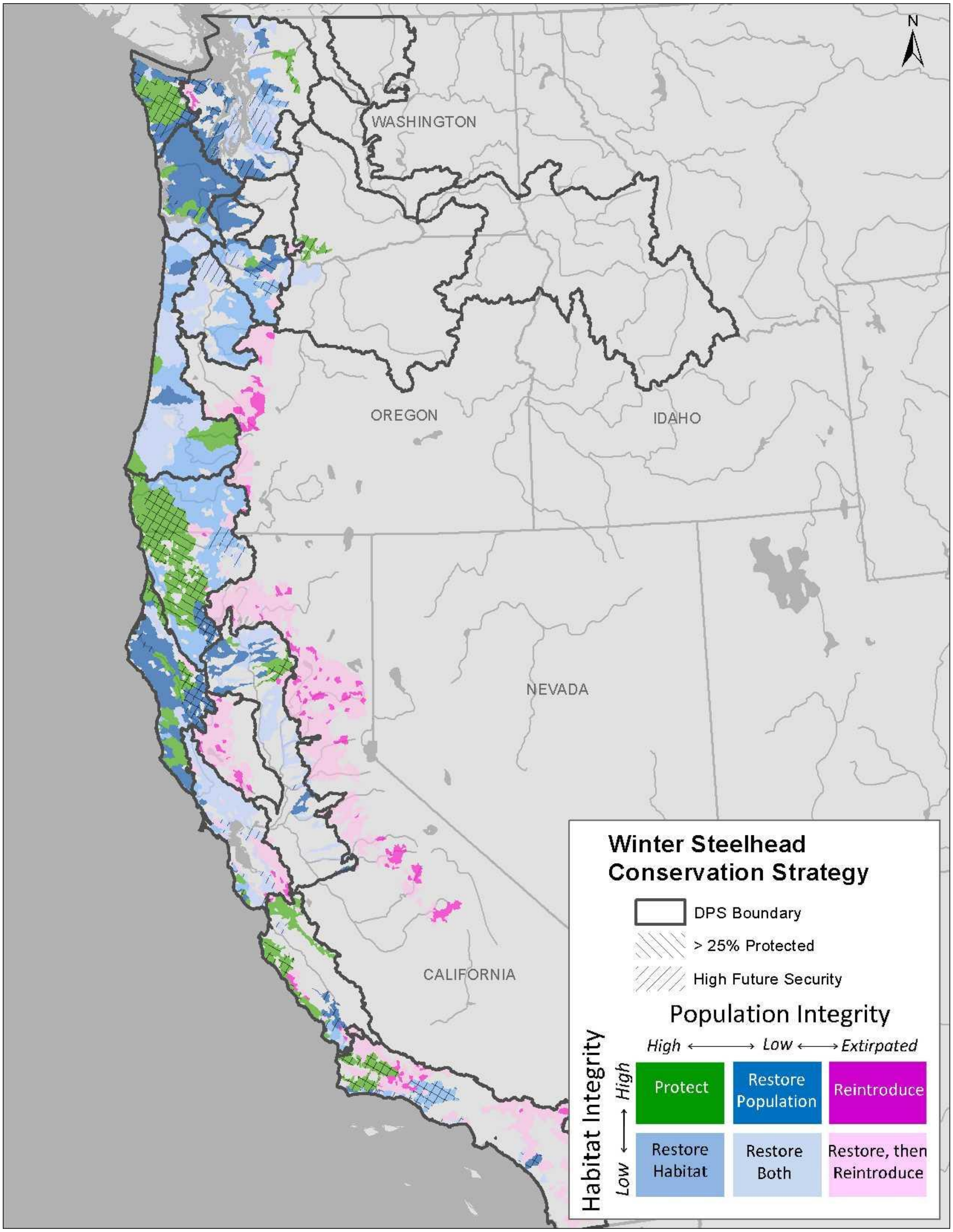


Figure 14: Conservation Success Index conservation strategies for summer steelhead by watershed. By juxtaposing population integrity scores against habitat integrity scores, we identify several general conservation strategies – protection and restoration focused on habitats, populations, or both - that are likely appropriate for each watershed.

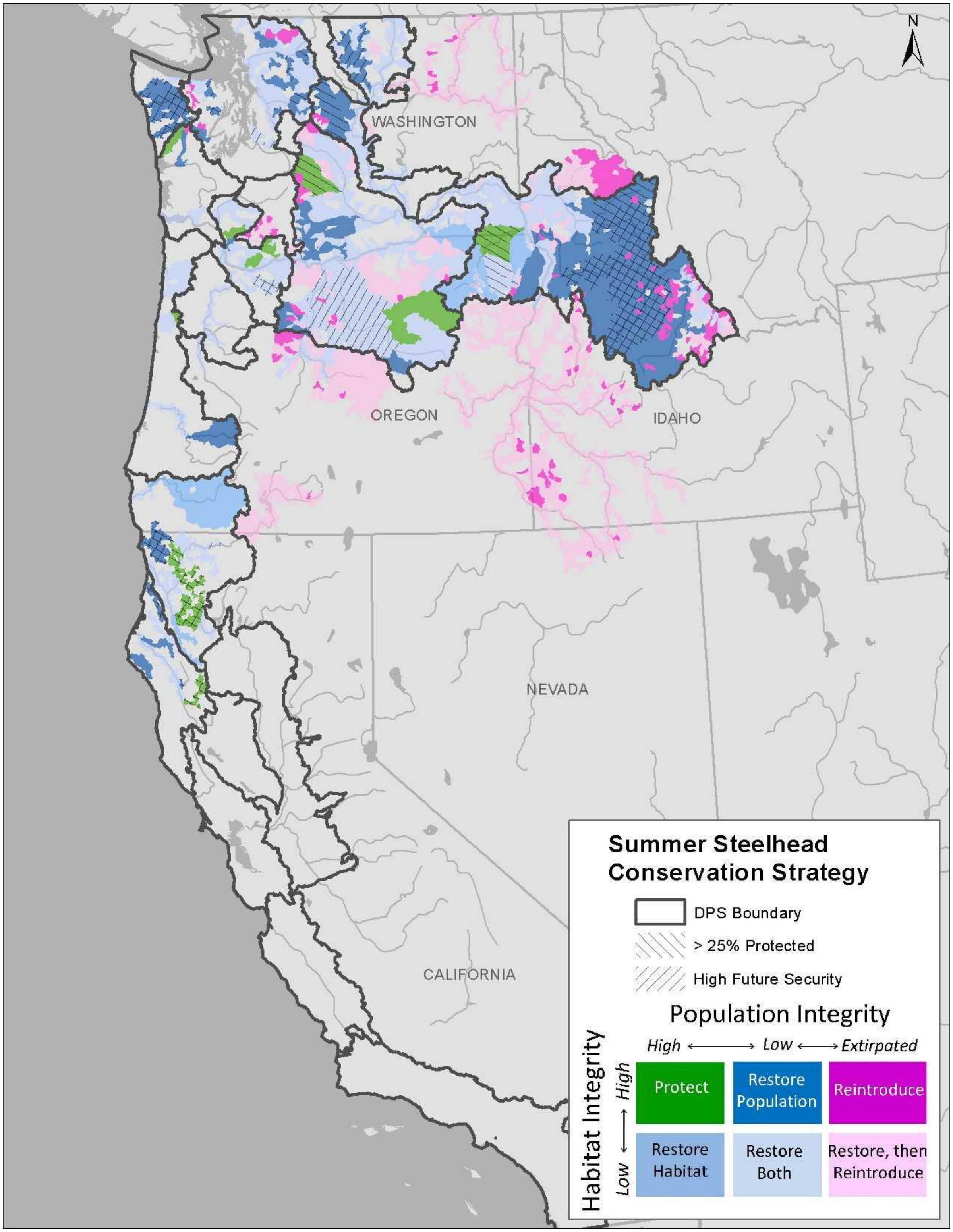
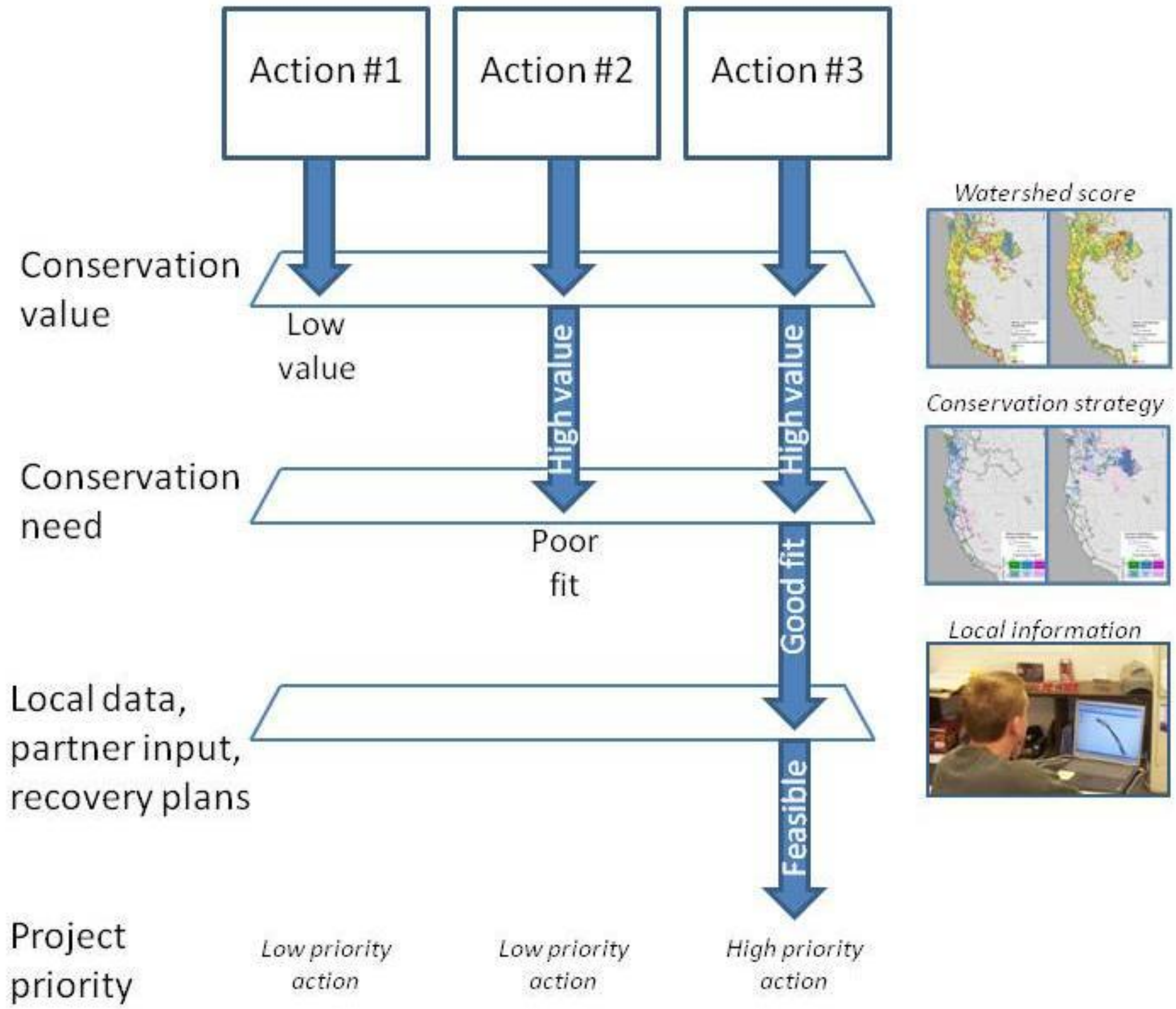


Figure 15: Conceptual model of how information within this rangewide assessment can be used with local knowledge to help screen and prioritize conservation actions. Adapted from Dauwalter et al. 2012.



3.7 Results: Populations with Strategic Management Opportunities

An alternate way to organize and interpret the scores for populations is to look at specific stressors or conditions that may be able to be addressed with a single strategic conservation action or management approach. Many of these steelhead conservation actions or approaches are strengths of Trout Unlimited or other conservation partners – protecting public lands, riparian restoration on private and public lands, affecting flows and water management to benefit fishes, and advocating for progressive policies for hatchery management. Table 8 provides an outline of the factors we used to identify steelhead conservation strategies across run timings. Ownership context is the key factor for guiding the type of individual protection strategy. We identify restoration strategies for populations with relatively high scores across NASSP and CSI factors, but individual limiting factors. We highlight select opportunities to address specific issues within these populations that could potentially bolster their productivity and secure them for the future (Table 9).

Table 8. Factors used to identify strategic management opportunities. Population Integrity, Habitat Integrity, and Future Security descriptors refer to the relative value of scores within the NASSP database and CSI; other factors describe metrics derived from the CSI and TNC West Coast Estuary Assessment. Only populations with at least 15 miles of occupied steelhead habitat are assigned protection or restoration strategies.

Conservation Strategy	**Conservation Focus**	**Population Integrity**	**Habitat Integrity**	**Future Security**	**Other Factors**
Protection	Major Strongholds	Highest	Highest	Highest	"Best of the best"
	Protected Public Lands	Highest	Very High	Very High	At least half in formally protected area
	Public Lands	Highest	Very High	Very High	At least half in public ownership
	Private Lands	Highest	Very High	Very High	Greater than 70% privately owned
Restoration	Climate Change Mitigation	Highest	Very High	Any	Moderate to low climate change scores (Future Security)
	Habitat Potential	Moderately high	Any	Any	Highest intrinsic potential scores
	Passage	Low Abundance/Productivity	Very High	Any	At least 5 major, passable downstream barriers
	Flows and Diversions	Low Abundance/Productivity	High	Any	Greater than 1 diversion per stream mile within population
	Dam Management	Low Abundance/Productivity	High	Any	Greater than 50 acre-feet of dam storage per stream mile within population
	Estuaries	Any	High	Any	Large estuary habitats associated with population
	Hatchery Management	Moderate	Very High	Highest	Active hatchery program within population
	Reintroduction	Extirpated	High	High	Population extirpation caused by loss of access to historical spawning grounds

Protection: Major Strongholds

Populations with the highest population integrity, habitat integrity and future security and at least 15 miles of occupied steelhead habitat represent the best remaining steelhead strongholds and warrant protection. From a big-picture perspective, these strongholds are secure; local knowledge and planning documents can guide fine-scale conservation actions within these basins.

- Queets River winter steelhead (Olympic Peninsula)
- Quillayute/Bogachiel River winter steelhead (Olympic Peninsula)
- Smith River winter steelhead (Klamath Mountains Province)
- Big Sur/Little Sur River winter steelhead (South-Central California Coast)
- Islay Creek winter steelhead (South-Central California Coast)

Protection: Protected Federal Lands

Steelhead that occur within populations with intact habitats, high future security, significant protected areas, and at least 15 miles of occupied steelhead habitat represent opportunities for protection strategies focused on maintaining and securing these strong populations. Many of these populations are inland or the protected areas are in the headwaters, and steelhead must pass through less protected and less intact habitats to reach them; protecting these productive populations may require restoration activities to enhance migratory and rearing habitats downstream.

- Hoh River winter steelhead (Olympic Peninsula)
- Chetco River winter steelhead (Klamath Mountains Province)
- Salmon River winter and summer steelhead (Klamath Mountains Province)
- New River, North Fork Trinity River, and Dillon and Clear Creek summer steelhead (Klamath Mountains Province)
- Arroyo Seco winter steelhead (South-Central California Coast)

Protection: Federal Lands

Populations that occur within a large base of US Forest Service or Bureau of Land Management lands that lack formal protection status yet have high to moderately high population integrity, habitat integrity and future security and at least 15 miles of occupied steelhead habitat are candidates for protection efforts. These populations present opportunities for promoting federal land management policies that benefit steelhead or supporting conservation on private lands within the largely federal matrix.

- Sauk River winter steelhead (Puget Sound)
- Wind River summer steelhead and Sandy River winter steelhead (Lower Columbia River)
- Lower Grande Ronde River summer steelhead (Snake River Basin)
- Yachats/Ten Mile/Cummins River winter steelhead (Oregon Coast)
- Elk River, Illinois River, Winchuck River, Lower Trinity River, and Mid Klamath River winter steelhead (Klamath Mountains Province)
- South Fork Trinity River winter and summer steelhead (Klamath Mountains Province)
- Middle Fork Eel River summer steelhead (Northern California Coast)

Protection: Private Lands

Populations that occur within a large base of private land yet have high to moderately high population integrity, habitat integrity and future security and at least 15 miles of occupied steelhead habitat are candidates for protection efforts. These populations present opportunities for conservation actions that work collaboratively with private landowners to ensure the continued persistence of these strong populations.

- South Bay winter steelhead (Washington Coast)
- Kalama River summer steelhead (Lower Columbia River)
- Maple Creek (Northern California Coast)
- Pico Creek, Arroyo de la Cruz, Pajarao River, and Carmel River winter steelhead (South-Central California Coast)

Restoration: Climate Change Mitigation

Populations with high total population integrity, high overall habitat integrity, and at least 15 miles of occupied steelhead habitat, but with high climate change risk are locations where climate change mitigation strategies are priorities. The following population is predicted to have temperature limitations, and mitigation approaches can include restoration of shade and large wood in the riparian zone and dam management strategies.

- Clear Creek winter steelhead (Central Valley)

These populations at the southern extent of steelhead distribution have surface run-off flow regimes that lack the ability to buffer temperature extremes like groundwater or snow melt flow regimes can. Mitigation strategies in these systems include riparian and wetland restoration and dam management.

- North Fork Eel winter steelhead (Northern California)
- Pajaro River winter steelhead (South-Central California Coast)
- Santa Ynez River winter steelhead (Southern California)

Portions of these populations are forecast to shift from snow or mixed to rain-dominated winter precipitation regimes. An appropriate mitigation strategy is meadow and wetland restoration.

- North Fork John Day River summer steelhead (Middle Columbia River)
- Antelope/Mill/Deer Creek winter steelhead (Central Valley)

Restoration: Habitat Potential

These populations occur within basins that are well-suited for steelhead from a physical habitat perspective, have moderately high total population integrity ratings, and have at least 15 miles of currently occupied stream habitat. Occupied habitats in these systems are highly conducive to steelhead production, as reflected in high average intrinsic potential scores by reach, and have an inherent capacity to respond positively to restoration activities. Intrinsic potential data is lacking for some DPS; see methods for description of populations not included in this comparison.

- Pysht/Independents River winter steelhead (Olympic Peninsula)
- Abernathy Creek winter steelhead (Washington Coast)
- Clackamas River and Washougal River winter steelhead (Lower Columbia River)

Restoration: Habitat Potential, continued

- Deschutes Westside Tributaries & Upper John Day summer steelhead (Middle Columbia)
- Wilson River and South Coquille River winter steelhead (Oregon Coast)
- Wallowa River summer steelhead (Snake River Basin)

Restoration: Passage and Hydro-system Mitigation

Several Snake River Basin populations have low productivity and abundance, but high genetic integrity and life history diversity and occur in high integrity habitats that appear solely limited by their accessibility, reflected in high numbers of downstream barriers associated with the hydroelectric and flood control dams on the Snake River. Strategies focused on increasing the survival of migrating smolts and adults have great potential to restore these interior populations.

- Lochsa River summer steelhead (Snake River Basin)
- Selway River summer steelhead (Snake River Basin)
- Secesh River summer steelhead (Snake River Basin)
- South Fork Salmon River summer steelhead (Snake River Basin)
- Big, Camas, and Loon Creeks summer steelhead (Snake River Basin)

Restoration: Flows and Diversions

Populations with relatively limited hatchery influence and diverse life histories, but low productivity and abundance ratings and a relatively high average of at least one diversion per stream mile are candidates for restoration strategies focused on flows. Improvements to diversion efficiency may increase steelhead survival in these populations by increasing downstream flows and reducing entrainment.

- Washougal River winter and summer steelhead (Lower Columbia River)
- Klickitat River winter steelhead (Middle Columbia River)
- Sixes River winter steelhead (Oregon Coast)
- Pahsimeroi River, Upper Grande Ronde River, and Wallowa River summer steelhead (Snake River Basin)
- Battle Creek winter steelhead (Central Valley)
- San Gregorio, Pilarcitos, and Pescadero Creeks (Central California Coast)

Restoration: Dam Management

Dam management may be modified to benefit salmonids by seasonally altering out-flow volumes and temperatures. The following populations occur within highly regulated systems, but have depressed productivity and abundance, despite high genetic integrity and life history diversity scores and high overall habitat integrity.

- Tolt River summer steelhead (Puget Sound)
- Naches River summer steelhead (Middle Columbia River)
- Wallowa River summer steelhead (Snake River Basin)
- Pilarcitos Creek (Central California Coast)
- Santa Maria, Santa Ynez, and Ventura Rivers (Southern California)

Restoration: Estuaries
Several populations have low abundance and productivity ratings, but high habitat integrity scores within freshwater habitats juxtaposed with relatively low quality estuaries. These populations may benefit from estuary restoration opportunities that increase habitat complexity or serve to mitigate human alterations in the estuary.

- Skokomish River winter steelhead (Puget Sound)
- Humboldt Bay winter steelhead (Northern California Coast)
- Redwood Creek winter steelhead (Northern California Coast)
- Maple Creek winter steelhead (Northern California Coast)
- Garcia River winter steelhead (Northern California Coast)

Conversely, these populations have high abundance and productivity ratings and relatively moderately intact estuaries. These estuaries warrant protection and may benefit from restoration activities that increase the productivity of their contributing freshwater habitats.

- Queets and Quillayute/Bogachiel River winter steelhead (Olympic Peninsula)
- South Bay and Pistol River winter steelhead (Washington Coast)
- Smith River winter steelhead (Klamath Mountains Province)

Restoration: Hatchery Reform
Populations with moderately high population integrity ratings and high habitat integrity and future security scores, but with active hatchery programs may be candidates for altering or eliminating hatchery management to favor wild steelhead. Several populations have high abundance and productivity scores; these are among the strongest populations and with the highest quality habitats on the west coast:

- Queets River winter steelhead (Olympic Peninsula)
- Quillayute/Bogachiel winter steelhead (Olympic Peninsula)
- Hoh River winter steelhead (Olympic Peninsula)
- Chetco River winter steelhead (Klamath Mountains Province)
- Smith River winter steelhead (Klamath Mountains Province)

Two other populations have low abundance and productivity scores:

- East Fork Salmon River summer steelhead (Snake River Basin)
- Upper Mainstem Salmon River summer steelhead (Snake River Basin)

Restoration: Reintroduction
Improvements or modifications in fish passage can allow steelhead to reoccupy their historical habitats. Portions of the following basins historically supported steelhead runs, are currently inaccessible due to dams, and have high habitat integrity and future security.

- Elwha River winter and summer steelhead (Olympic Peninsula) – *passage work and reintroduction in progress*
- Metolius River summer steelhead (Middle Columbia River) – *passage work and reintroduction in progress*
- North Fork Clearwater River summer steelhead (Snake River Basin)
- San Antonio River winter steelhead (South-Central California Coast)
- Santa Maria, Santa Ynez, and Ventura River winter steelhead (Southern California)

5.0 Conclusion
Steelhead populations in the western contiguous United States persist at wide ranges of abundance and productivity, hatchery influence, and life history diversity. The landscapes that these populations occur within are equally diverse, exhibiting a wide range of habitat quality. By exploring the patterns of steelhead populations and the quality of their habitats, we describe several key human modifications that have contributed to the decline of steelhead, provide a rangewide overview of conservation values and needs, and present multiple opportunities where focused investment can protect some of the best remaining strongholds or restore populations limited by a single factor. The summary data collected for this assessment are available in tabular form and as interactive maps at www.tu.org/csi and can be queried and sorted to identify additional opportunities or help inform conservation needs for your local population.

Acknowledgements
This assessment relies on data provided by the state and federal agencies that manage wild steelhead in California, Oregon, Washington, and Idaho – we are grateful for their stewardship of the data included here. Jack Williams, Rob Masonis, Jeanette Howard, Dan Dauwalter, Amy Haak, and Paul Sparks provided helpful comments and contributed to the development of this report.

Table 9. Summary of population-specific conservation strategies by DPS. Winter-run steelhead populations are shown with a (W) and summer-run populations are shown with an (S).

	PROTECTION STRATEGIES				*RESTORATION STRATEGIES*							*REINTRODUCTION*
DPS	**Major Strongholds**	**Protected Federal Lands**	**Federal Lands**	**Private Lands**	**Climate Change Mitigation**	**Habitat Potential**	**Passage**	**Flows and Diversions**	**Dam Management**	**Estuaries**	**Hatchery Reform**	**Reintroduction**
Puget Sound			Sauk (W)						Tolt (S)	Skokomish (W)		
Olympic Peninsula	Queets (W) Quillayute/Bogachiel (W)	Hoh (W)				Pysht/Independents (W)				Queets (W) Quillayute/Bogachiel (W)	Queets (W) Quillayute/Bogachiel (W) Hoh (W)	Elwha (W & S)
Washington Coast				South Bay (W)		Abernathy Cr. (W)				South Bay (W) Pistol (W)		
Lower Columbia			Wind/Sandy (W)	Kalama (S)		Clackamas/Washougal (W)		Washougal (W & S)				
Middle Columbia					North Fork John Day (S)	Upper John Day (S) Deschutes Westside (S)		Klickitat (W)	Naches (S)			
Snake River Basin			Lower Grande Ronde (S)			Wallowa (S)	Lochsa (S) Selway (S) Secesh (S) SF Salmon (S) Big/Camas/Loon Cr. (S)	Wallowa (S) Pahsimeroi (S)	Wallowa (S)		EF Salmon (S) Upper Main Salmon (S)	NF Clearwater (S)
Upper Willamette												
Oregon Coast			Yachats/Ten Mile (W) Cummins (W)			Wilson (W) South Coquille (W)		Sixes (W)				
Klamath Mountains Province	Smith (W)	Salmon (W & S) Chetco (W) New/NF Trinity (S) Dillon/Clear Cr (S)	Elk (W) Illinois (W) Winchuck (W) Lower Trinity, Mid-Klamath (W) South Fork Trinity (W & S)							Smith (W)	Smith (W) Chetco (W)	
Northern California			Middle Fork Eel (S)	Maple Cr. (W)	North Fork Eel (W)					Maple Cr. (W) Humboldt Bay (W) Redwood Cr. (W) Garcia (W)		
Central California Coast								Pilarcitos Cr. (W) San Gregorio Cr. (W) Pescadero Cr. (W)	Pilarcitos Cr. (W)			
California Central Valley					Clear Cr. (W) Antelope/Mill/Deer Cr. (W)			Battle Cr. (W)				Feather (W) Merced (W)
South-Central California Coast	Big and Little Sur (W) Islay Cr. (W)	Arroyo Seco (W)		Pico Cr. (W) Arroyo de la Cruz (W) Pajaro (W) Carmel (W)	Pajaro (W)							San Antonio (W)
Southern California					Santa Ynez (W)				Santa Ynez (W) Santa Maria (W) Ventura (W)			Santa Ynez (W) Santa Maria (W) Ventura (W)

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