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The Honorable Janeen Sollman, Chair
Senate Committee on Energy and Environment
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Senator Sollman,
The department is following up on questions raised by the committee during the public hearing on Senate Bill 222 related to smallmouth bass (SMB) impacts on native salmon/steelhead.

Background
SMB are a warm water fish that is native to the eastern and central United States but have been widely introduced across the west and are now present in many Oregon waterways. Among coastal Oregon rivers, their distribution is currently limited to the Umpqua and Coquille River basins.

Impacts to native salmon/steelhead
SMB directly affect salmon and steelhead by predating on juveniles during stream rearing and outmigration. They may also impact populations indirectly through competition. The impact of SMB on salmon can be very significant; for example, substantial losses of juvenile salmon have been documented in the Columbia, Snake, and Yakima rivers. The rapid decline of fall Chinook salmon to near-extirpation in Oregon's Coquille River has been attributed primarily to the introduction of SMB. SMB activity and distribution is correlated with temperature so as many of Oregon's rivers warm, the Department expects predation impacts to worsen.

Control of smallmouth bass
Efforts to control SMB populations have varied in their effectiveness. No practical biological or chemical controls are presently available, though efforts are underway to develop these tools. Previous efforts to control SMB by ODFW have included direct removal by agency staff and partners, adjusting angling regulations to promote increased angling, tournaments for removal, and research to inform management needs. A general conclusion of these efforts is that once smallmouth bass are established in a novel habitat, both ongoing suppression and efforts at eradication are challenging and costly (i.e., requiring significant staff and time). The most cost effective and successful strategy to control SMB invasions currently known is to identify and eliminate new illegal introductions before they have the chance to become established (see Appendix A).

Existing monitoring

ODFW does not currently conduct systematic monitoring for SMB. SMB may be detected as a result of other monitoring (associated with salmon steelhead or habitat surveys) or from angler reports. There have recently been unverified sightings in the Coos, Millicoma, and Siuslaw Rivers.

Given the threat posed by SMB in flowing waterbodies and the lack of effective control measures, the department, in cooperation with OSU, has explored low-cost methods to improve early detection. This involves taking water samples and testing for the presence of smallmouth bass DNA. The Department recently conducted a pilot of this methodology in the Coos, Millicoma, Siuslaw, and Siletz and are currently analyzing these to evaluate reports of smallmouth bass in these rivers. This tool could be deployed broadly to support monitoring and eradication efforts targeting smallmouth bass.

To focus future monitoring, the department has also developed a model (appendix A) to assess the suitability of Oregon's coastal rivers to support smallmouth bass, and work is currently underway to apply this model broadly across the coastal basins. Once completed, this model will provide valuable guidance to direct future monitoring and early intervention to prevent the further spread of smallmouth bass in flowing waterbodies.

I hope this information addresses the committee's question and please feel free to reach out if there are any follow-ups needed

Regards, Shaun

Shaun Clements

Deputy Director

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REDD

Fish Research, Evaluation, Data and Decision Support

Assessing Vulnerability of Oregon Coastal River Basins to Smallmouth Bass

REDD Project Overview

Background

Smallmouth bass (*Micropterus dolomieu*) occur naturally in eastern and central North America, extending from southern Canada through the central United States. However, the species has been introduced outside of its native range throughout the United States and in other countries, often with significant impacts on aquatic ecosystems (Loppnow et al. 2013). Smallmouth bass can outcompete and directly consume native species, leading to declines in populations of native fishes and invertebrates (Jackson 2002). For example, the introduction of smallmouth bass in Oregon's Coquille River has been implicated in the near extirpation of the fall Chinook salmon population in that basin, and anecdotal observations suggest impacts on other native species. After smallmouth bass have become established in novel habitats, suppression or eradication of the species is difficult and resource intensive (Loppnow et al. 2013). Efforts to prevent new introductions and to strategically allocate monitoring resources to support early detection and intervention can be informed by assessing vulnerability of habitats to colonization and establishment of smallmouth bass.

Vulnerability to Colonization and Establishment of Smallmouth Bass

Vulnerability of unoccupied habitats to colonization and establishment by invasive species can be framed as the combination of risks associated with three stages (Vander Zanden and Olden 2008):

Stage 1 – Can the species reach the novel habitat?

In coastal Oregon rivers, the lack of freshwater connectivity among river basins means that human intervention (illegal introduction) is the only significant vector for the arrival of smallmouth bass into unoccupied basins. The likelihood of dispersal by this mechanism is difficult to predict given the nature of illegal behavior. However, we expect the probability of dispersal by illegal introduction to be related to accessibility (at source and introduction sites) and ability to capture or procure individuals for translocation. After introduction into an unoccupied basin, the extent of secondary spread within the basin will be a function of habitat access and suitability. Where smallmouth bass have become established in coastal Oregon rivers, it appears they have occupied the extent of currently suitable habitat within relatively short timeframes.

Stage 2 – Establishment: Can the novel habitat support a self-sustaining population?

Establishment of a self-sustaining population of smallmouth bass requires habitat conditions that support the species across all life stages. Habitat requirements may be determined experimentally or inferred based on distributions of established populations. For smallmouth bass on the coast, we intend to assess habitat suitability based on published thresholds for readily available physical and hydrological variables.

Stage 3 – Impact: Will there be undesired consequences of establishment in the novel habitat?

Undesired consequences for establishment of smallmouth bass in currently unoccupied coastal basins include impacts on threatened or sensitive species, game species and their fisheries, and other native species, including local or regional endemic species. Consideration of impact should include direct and indirect ecological, economic, and social impacts.

By considering each of these stages, limited monitoring resources can be strategically allocated to support early detection of new introductions in the most vulnerable habitats (Vander Zanden and Olden 2008; Tucker et al. 2020). Given the difficulties of predicting and controlling Stage 1, this project is currently focused on Stage 2.

Project Objectives

Our objectives are to:

1) Assess habitat suitability for smallmouth bass in currently unoccupied watersheds on the Oregon coast.
2) Identify criteria to use, along with modeled habitat suitability, to assess the vulnerability of currently unoccupied watersheds to colonization and establishment by smallmouth bass.
3) Identify a suite of potential sentinel monitoring locations to support early detection of smallmouth bass in vulnerable coastal basins.

Objective 1 (habitat suitability modeling) is the focus of our initial effort in this project. For this effort, we will use information from distributions in currently occupied basins and published habitat suitability thresholds. The remainder of this project overview describes development of the model which will be used for Objective 1.

Existing Coastal Smallmouth Bass Populations

To our knowledge, smallmouth bass are only broadly established in the Umpqua and Coquille river basins on the Oregon coast. Other coastal Oregon river basins are currently unoccupied except for several lakes and reservoirs in the Rogue, Umpqua, and coastal lakes basins (ODFW 2024). The presence of these well-established populations offers an opportunity to validate the performance of habitat suitability modeling prior to use in currently unoccupied areas. The known distributions of smallmouth bass within these basins are described below.

Umpqua River

Smallmouth bass were illegally introduced into the Umpqua River basin in the early 1970s (Daily et al. 1990; Gray 2005), and the species was well established throughout the mainstem Umpqua and South Umpqua rivers by 1985 (Daily et al. 1990). Based on surveys in 1987 and 1988, Daily et al. (1990) concluded that the species occupied most of the suitable habitat within the basin (Umpqua mainstem, S. Umpqua, Cow Creek). Relative growth rates suggested good habitat in the Umpqua and South Umpqua rivers but lower quality habitat in the Cow Creek sub-basin.

Daily et al. (1990) did not survey the North Umpqua River above Winchester Dam due to less suitable habitat conditions for smallmouth bass (cooler water temperatures and high gradient). The authors also noted a lack of observations of smallmouth bass in the dam's fishway, but contemporary records indicate passage by smallmouth bass and other centrarchid sunfishes (Table 1). Despite observations of passage at Winchester Dam, we assume that ODFW's current fish habitat distribution data layer for smallmouth bass (derived from surveys, observations, and professional judgment over many years; ODFW 2024), which terminates a short distance upstream from the dam (Figure 3, Panel B), accurately represents the species' distribution due to lower habitat suitability in the North Umpqua River. The assumption of lower habitat suitability in the North Umpqua sub-basin is evaluated later in this document.

Coquille River

Smallmouth bass were illegally introduced into the Coquille River. By 2011, ODFW confirmed the presence of multiple age classes, indicating that the species had been established in the river for multiple spawning cycles (likely since the late 1990s to early 2000s). By 2023, the species distribution within the Coquille River basin had reached the Forest Service boundary above Powers in the South Fork, Laverne Park in the North Fork, and Sandy Creek in the Middle Fork. Given the rapid colonization of most suitable habitat in the Umpqua basin to the north, we expect that the current distribution in the Coquille basin closely delineates the extent of suitable habitat.

Habitat Suitability in Unoccupied Coastal Basins

Habitat suitability or species distribution models have been developed to predict distributions of smallmouth bass in northwest streams outside of coastal Oregon. Rubenson and Olden (2020) developed a species distribution model for smallmouth bass in Columbia basin tributaries, and White et al. (2023) modeled fine-scale habitat overlap between smallmouth bass and juvenile Chinook salmon in the Willamette River. Jones et al. (2020) used water temperature as a coarse proxy for smallmouth bass distribution in the Umpqua River basin, but the authors acknowledged that other physical controls may act to constrain the species' distribution. To our knowledge, no habitat suitability or species distribution models for smallmouth bass have been broadly applied to Oregon's coastal basins.

Selection of Habitat Suitability Thresholds

Our approach uses spatial overlays of physical and hydrological variables to classify stream reaches as unsuitable, marginal, or highly suitable. We used published thresholds for several physical and hydrological variables likely to influence habitat suitability for smallmouth bass. We considered habitat to be highly suitable for smallmouth bass where:

1) Depth > 0.5 meters (reviewed in White et al. 2023).
2) Streamflow < 0.05 m/s (reviewed in White et al. 2023).
3) Stream Slope > 0.07 (reviewed in White et al. 2023).
4) August Maximum Weekly Average Water Temperature > 14 °C (Rubenson and Olden, 2019). For temperature, we used the 2040 projections from NorWeST (Isaak et al. 2017). These projections are more likely to reflect recent warm years and capture risk due to climate warming than the NorWeST 1993-2011 baseline.

We considered habitat to be marginal where physical thresholds (1 through 3) were met but where temperatures were projected to be cooler (<21 °C; Edwards et al. 1983).

Data were derived from spatial data layers compiled by Terrain Navigator (NetMap; Benda et al. 2007). NetMap modeled bankfull channel depth (m) as a power function of mean annual flow, drainage area and/or precipitation (Leopold and Maddock 1953, Clarke et al. 2008). Annual precipitation data came from PRISM (http://prism.oregonstate.edu) using one or more regression models (Lorensen et al. 1994). Stream flow velocity was predicted using the Manning equation at bankfull hydraulic geometry. Hydraulic radius must be calculated, and the roughness coefficient (n) was a set function of channel slope (S). n=0.05 when S>0.08; n = 0.03 when S > 0.08 and channel width < 30 m; n = 0.025 when S > 0.08 and channel width > 30 m.

Reach gradient was calculated from digital elevation models (commonly 10-m DEMs) at the scale of channel segments (20 – 200 m). The DEM-inferred gradient using the DEM-delineated flow path used a nine-point surface polynomial as described by Zevenbergen and Thorne (1987). The default channel gradient calculation in NetMap used a dynamic window length that ranges from 500 m in lower, less steep areas of valleys (~0.001) to 50 m in the steeper portions of valleys (~0.20). Gradient was calculated over a specified length scale; rise over run. NetMap fit a 2nd-order polynomial over a specified length and determined the first derivative at the center point. The gradient was calculated for each point or node (scale based on the DEM used, commonly 10 m). All point values were averaged to derive a slope gradient for the reach, which may have lengths of 50 to 200 m.

Barriers

In our mapping of habitat suitability, we included habitats upstream from natural barriers that exceed jump heights for smallmouth bass (0.6 m; Meixler et al. 2009). We opted to include these habitats because even complete barriers can be subverted by illegal introductions, and any barrier that is less than 100% effective at preventing passage is unlikely to prevent establishment of species with high reproductive potential like smallmouth bass (i.e., high fecundity, parental care of offspring, etc.), particularly over the long term. We also did not include larger dams with fishways as barriers to smallmouth bass because there is a substantial body of information indicating that the species is capable of traversing dams with passage facilities. Within Oregon, we are aware of observations of smallmouth bass traversing fishways at Winchester Dam (Umpqua River, ODFW data), Three Mile Falls Dam (Umatilla River; Richards 2023), Willamette Falls (Willamette River, ODFW data; Figure 1), and Bonneville Dam (Columbia River; Kock and Hanson 2023). In the eastern United States and Canada, the species has been documented traversing a wide range of passage facilities including Denil, vertical slot, side-baffle spiral, and pool-weir designs (*Denil*: Harrison and Speaker 1950; Katopodis 1992; Bunt et al. 1999; 2001; Reid 2007; *Vertical Slot*: Ryckman 1986; Dexter and Ledet 1997; Reid 2007; Perillo and Butler 2009; Thiem et al. 2013; Kleinschmidt Associates 2022; VDWR, undated; *Side-Baffle Spiral*: Kynard et al. 2012; *Pool-Weir*: Ryckman 1986; Dexter and Ledet 1997).

Model Performance

Below, we compare modeled habitat suitability with the known distributions of smallmouth bass in the Umpqua and Coquille river basins. We compare distributions in the Umpqua basin by sub-basins (Lower, Middle/North, South/Cow Creek) to provide greater resolution in this large watershed.

Lower Umpqua

Modeled high suitability habitat for smallmouth bass in the lower Umpqua River is distributed throughout the mainstem river and the lower portions of Elk Creek (Figure 2A). The model did not indicate any high suitability habitat in the Smith River sub-basin (Figure 2A). The ODFW fish habitat distribution data layer for smallmouth bass and the description in Daily et al. (1990) are generally consistent with the modeled high suitability habitat except for some areas of modeled high suitability habitat in the middle to upper reaches of Elk Creek (Figure 2B).

Middle and North Umpqua

The model identifies high suitability habitat for smallmouth bass throughout the mainstem Middle Umpqua River and lower portions of Oldham Creek (Figure 3A). High suitability habitat is well aligned with the ODFW fish distribution data layer for smallmouth bass (Figure 3B). Almost no habitat in the North Umpqua basin was classified as highly suitable for smallmouth bass. Most high-suitability habitats in the North Umpqua River exist below Winchester dam in the lower ~5 miles above the confluence with the South Umpqua River, and the limited marginal habitat in the basin exists primarily in two mainstem reaches below Rock Creek (Figure 3A). This is consistent with expectations of marginal habitat specified by Daily et al. (1990). It is possible that the spatial data layers supporting the model do not accurately depict habitat suitability in the pool behind Winchester Dam or the potential for seasonal velocity and/or vertical barriers in the mainstem North Umpqua River above the confluence with Rock Creek (i.e., The Narrows, Deadline Falls).

South Umpqua/Cow Creek

Most of the mainstem South Umpqua River up to the confluence with Jackson Creek (above Tiller, OR) is classified as high suitability, as are the lower reaches of Lookingglass Creek (near Winston, OR) and lower Cow Creek (near Riddle, OR) (Figures 3A and 4A). This is consistent with ODFW's fish habitat distribution data layer (Figures 3B and 4B) and the Daily et al. (1990) characterization of habitat in Cow Creek as marginal relative to habitat in the mainstem South Umpqua River.

Coquille

The model indicates highly suitable habitat for smallmouth bass through much of the mainstem Coquille River basin above the extent of saltwater and including the lower North Fork, the Middle Fork to near the confluence with Sandy Creek, and the South Fork to Gaylord, Oregon (with patchy high suitability reaches up to the Forest Service Boundary above Powers, Oregon). This coincides well with the ODFW fish distribution data layer. The model suggests marginally suitable habitat in the North and East forks, where very low summer flows and lower temperatures are likely to reduce habitat suitability.

Next Steps

Our initial classifications of habitat suitability for smallmouth bass match expectations and appear to accurately delineate the species' distributions in two established populations on the Oregon coast. We plan to continue to refine the model and apply it to unoccupied basins coastwide in Oregon. We will then develop criteria to characterize vulnerability risk, and we will coordinate with managers to identify candidate locations for sentinel monitoring.

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Tables & Figures

Table 1. Records of centrarchid sunfishes at the Winchester Dam counting station. At least one additional smallmouth bass was observed passing the dam in 2024.

Year	Smallmouth Bass	Largemouth Bass	Unknown Bass	Sunfish
1980	8			
1981			8	
1986			1	
1988		7		
1990	1			
1991	1	2	1	
2007	2			
2010		2		
2012				1
2013	27	1		4
2014	2			1
2016	1			

Figure 1. Smallmouth bass are known to ascend fishways at passage facilities, including in Oregon. Here, a bass moves through the passage viewing window at the Willamette Falls fishway.

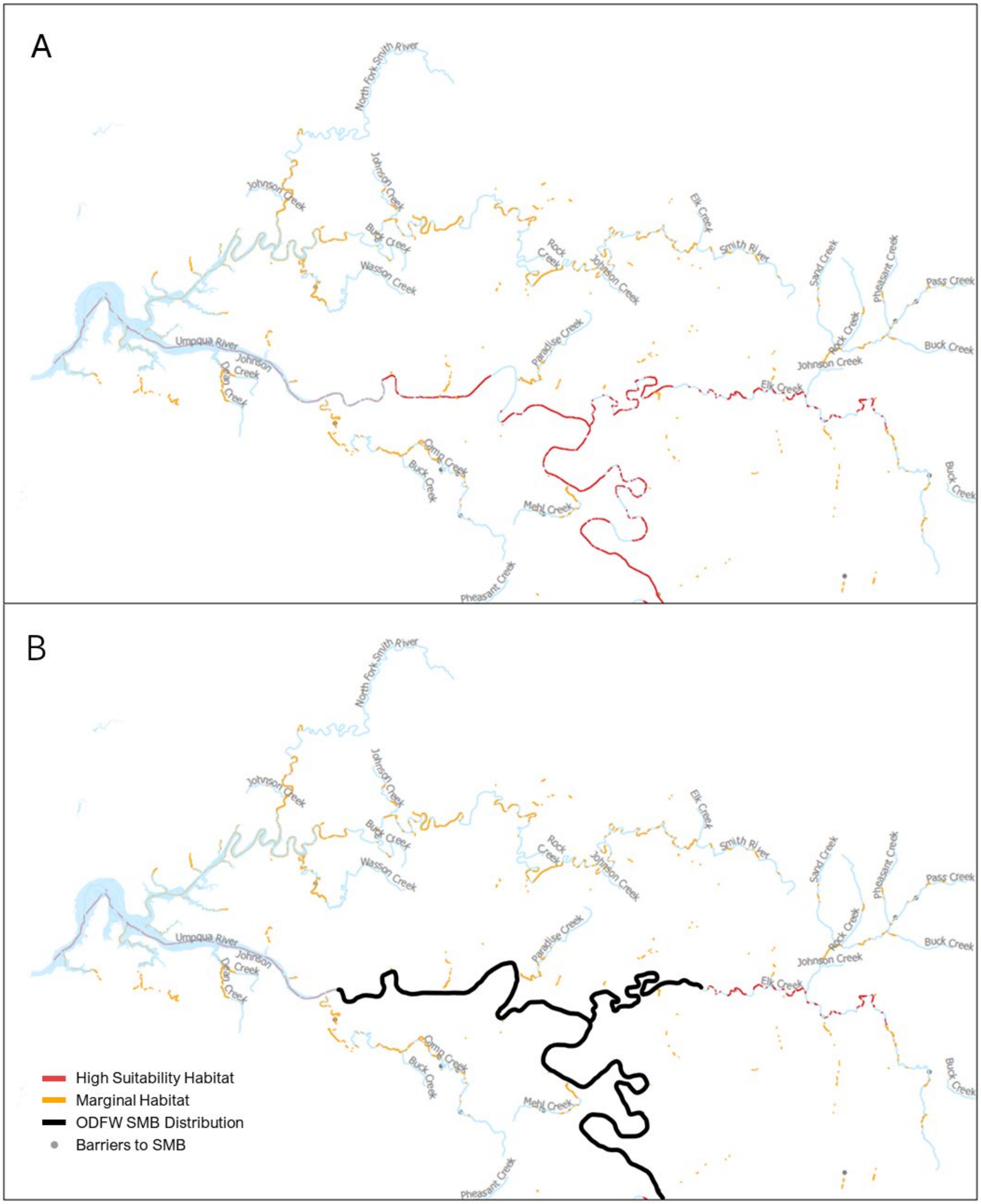

Figure 2. Panel A – Modeled habitat suitability for smallmouth bass in the Lower Umpqua River basin. Panel B – Smallmouth bass distribution depicted in ODFW's fish habitat distribution data layer. Note that some high suitability habitat in the lower mainstem upstream of Camp Creek is partially obscured by the estuary spatial layer.

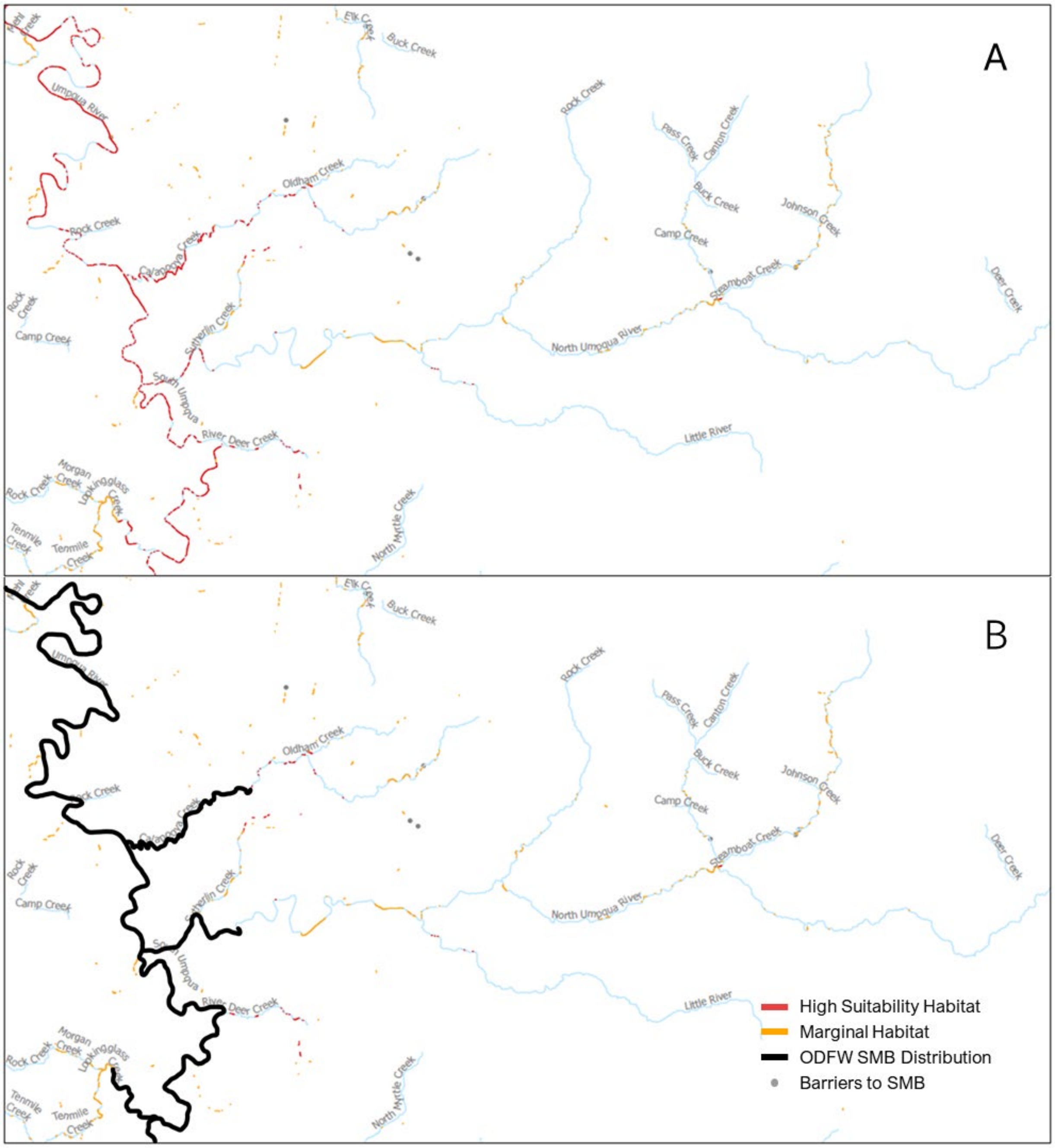

Figure 3. Panel A – Modeled habitat suitability for smallmouth bass in the Middle and North Umpqua River and lower South Umpqua basins. Panel B – Smallmouth bass distribution depicted in ODFW's fish habitat distribution data layer.

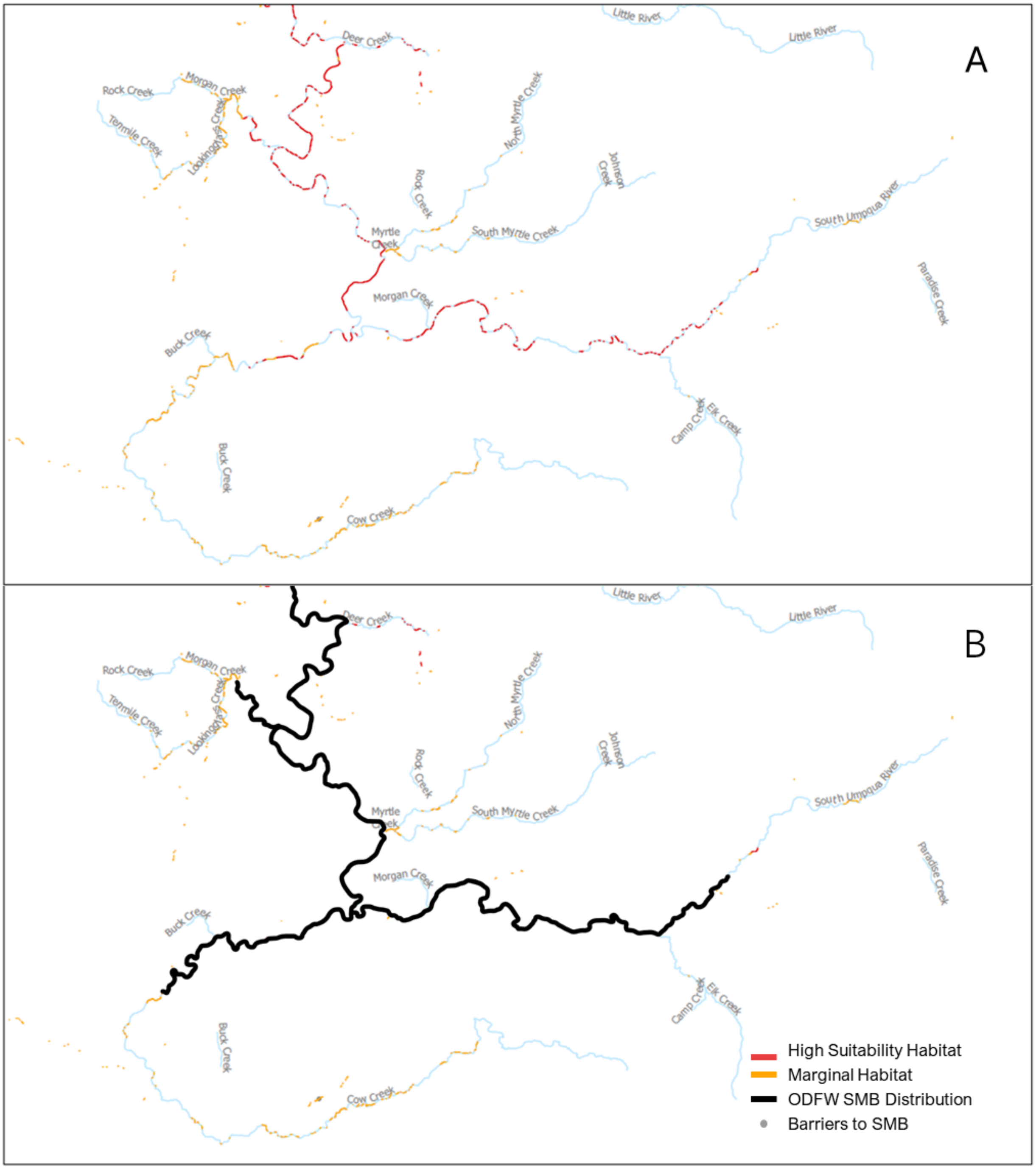

Figure 4. Panel A – Modeled habitat suitability for smallmouth bass in the South Umpqua River basin. Panel B – Smallmouth bass distribution depicted in ODFW's fish habitat distribution data layer.

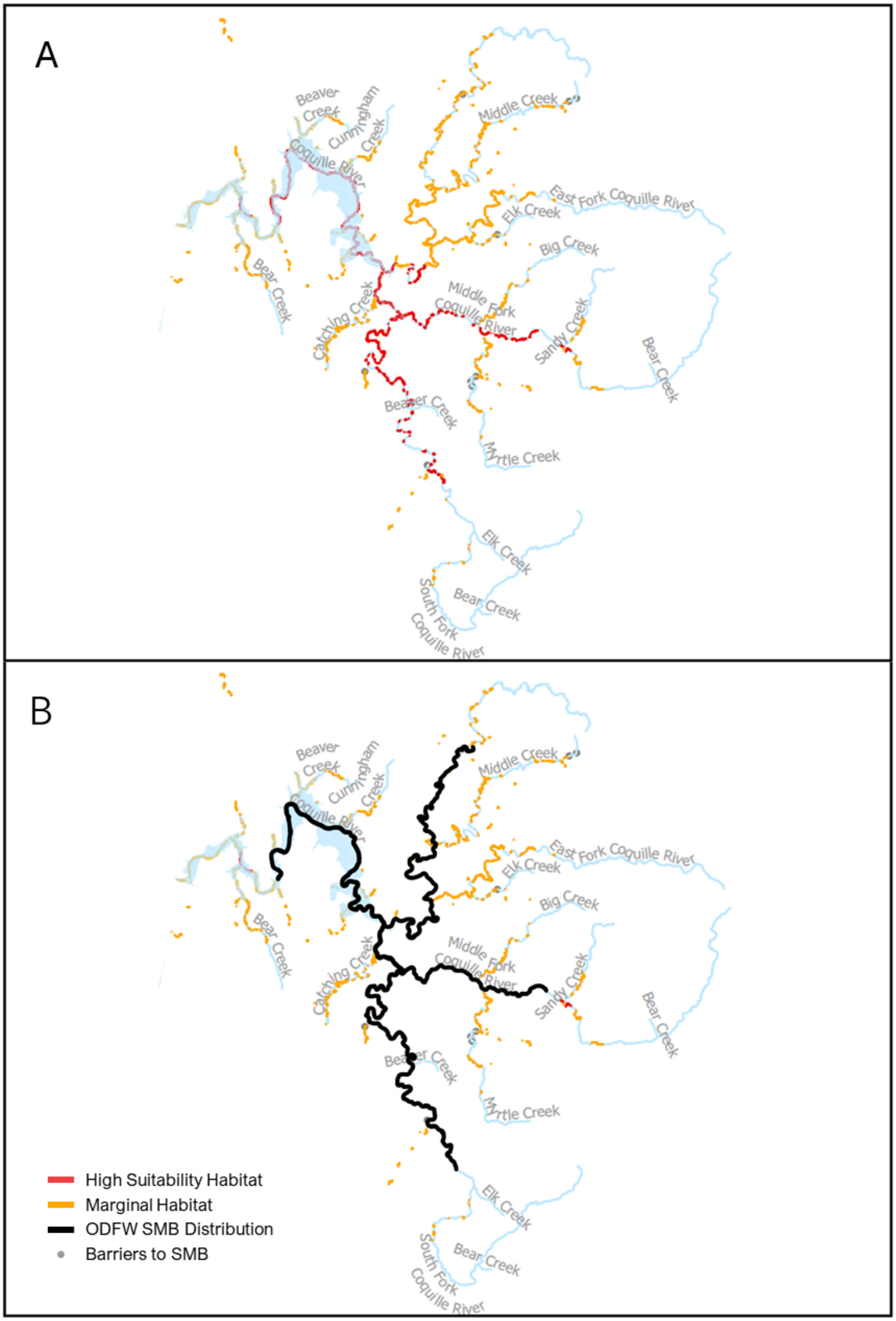

Figure 5. Panel A – Modeled habitat suitability for smallmouth bass in the Coquille River basin. Note that some high suitability habitat in the lower tidal freshwater mainstem is partially obscured by the estuary spatial layer. Panel B – Smallmouth bass distribution depicted in ODFW's fish habitat distribution data layer.