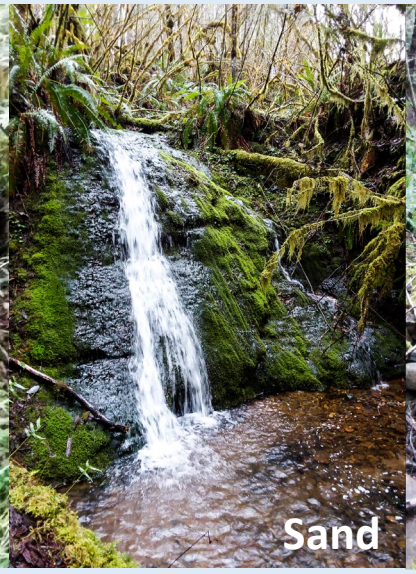
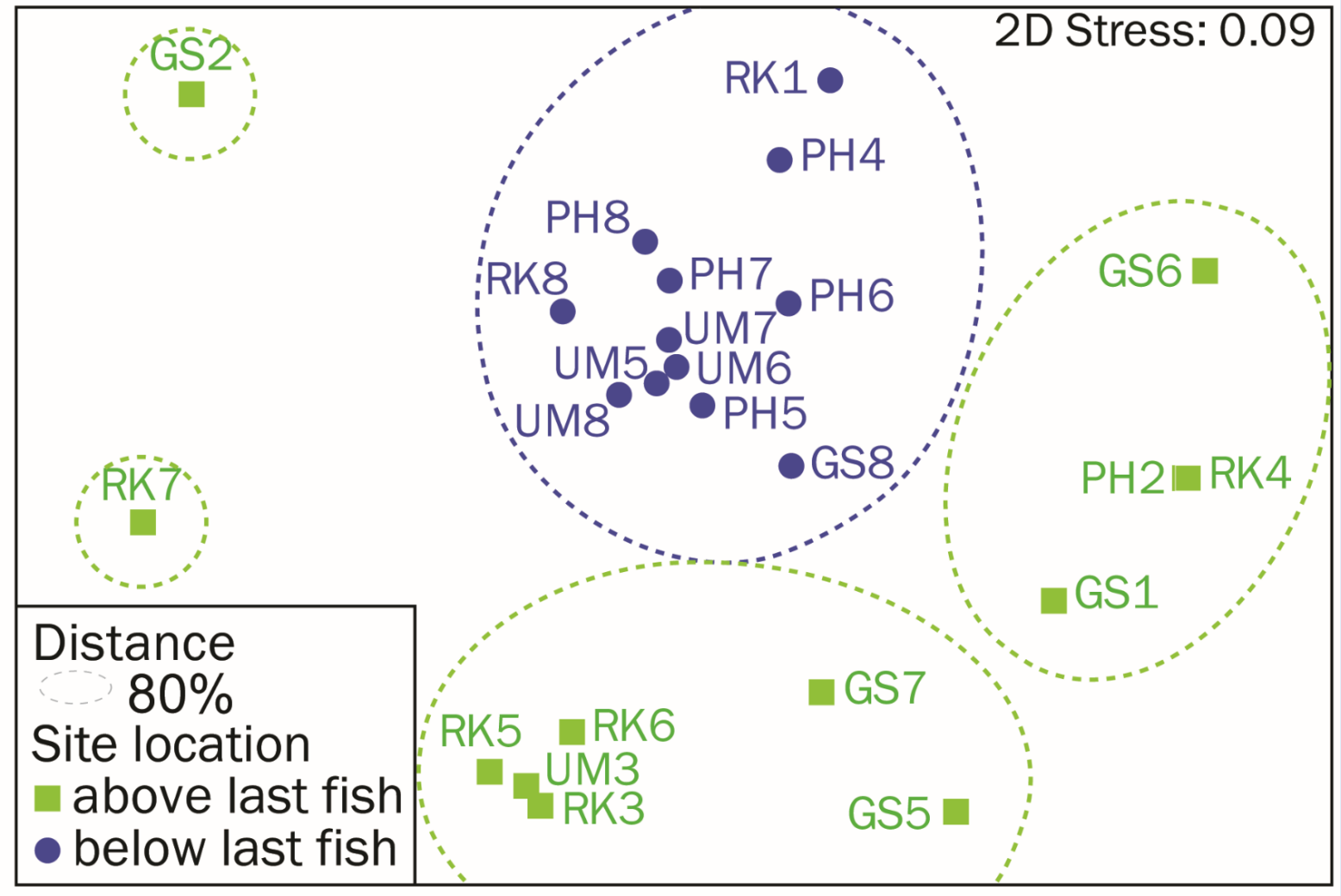
Exploring the upper distribution limits of fish in streams



Brooke Penaluna
Research Fish Biologist
H.J. Andrews Experimental Forest Lead Scientist
PNW Research Station
USDA Forest Service

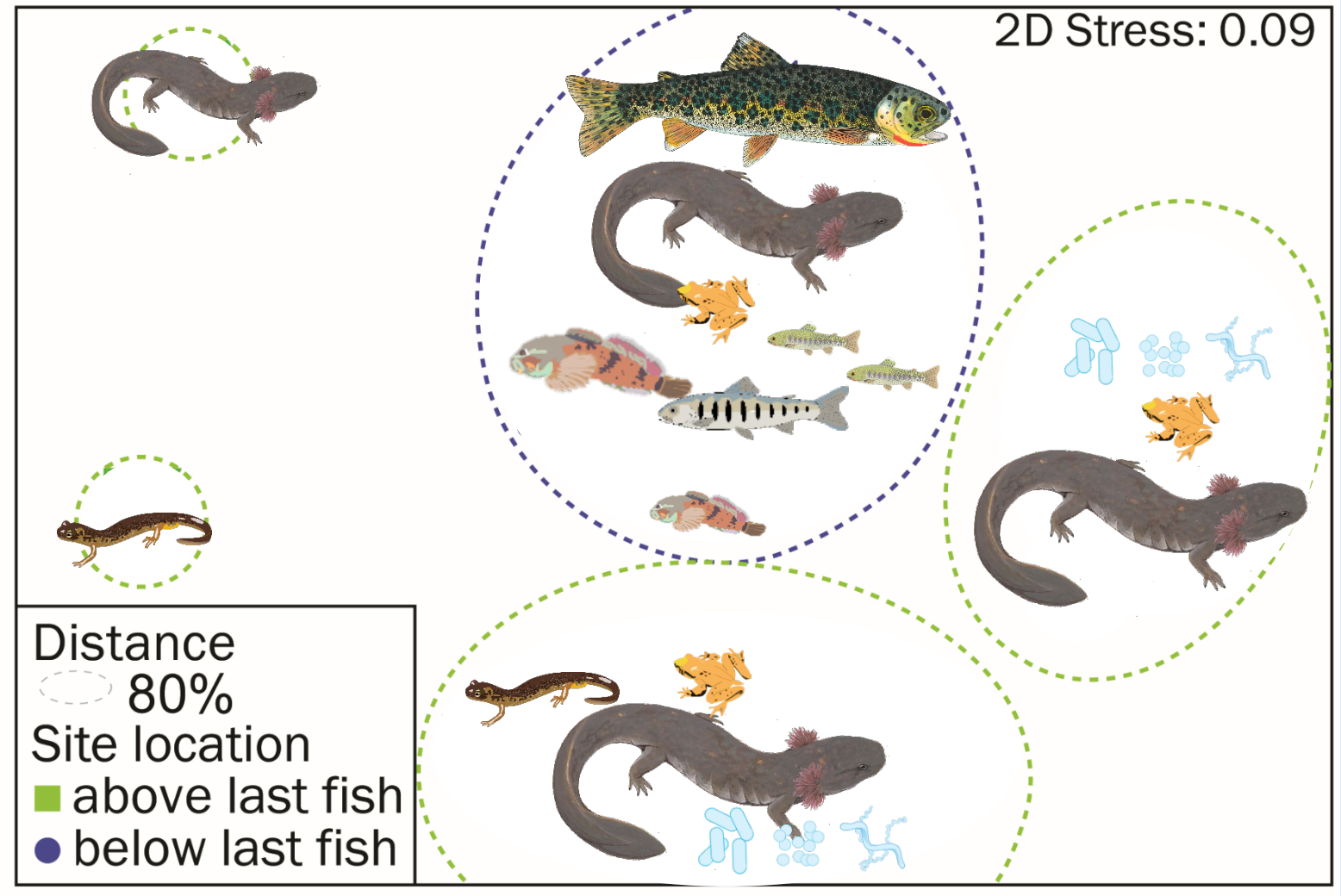
Lookout Creek old-growth forest, H.J. Andrews Experimental Forest, Photo Tom Iraci

The upper fish boundary is important ecologically



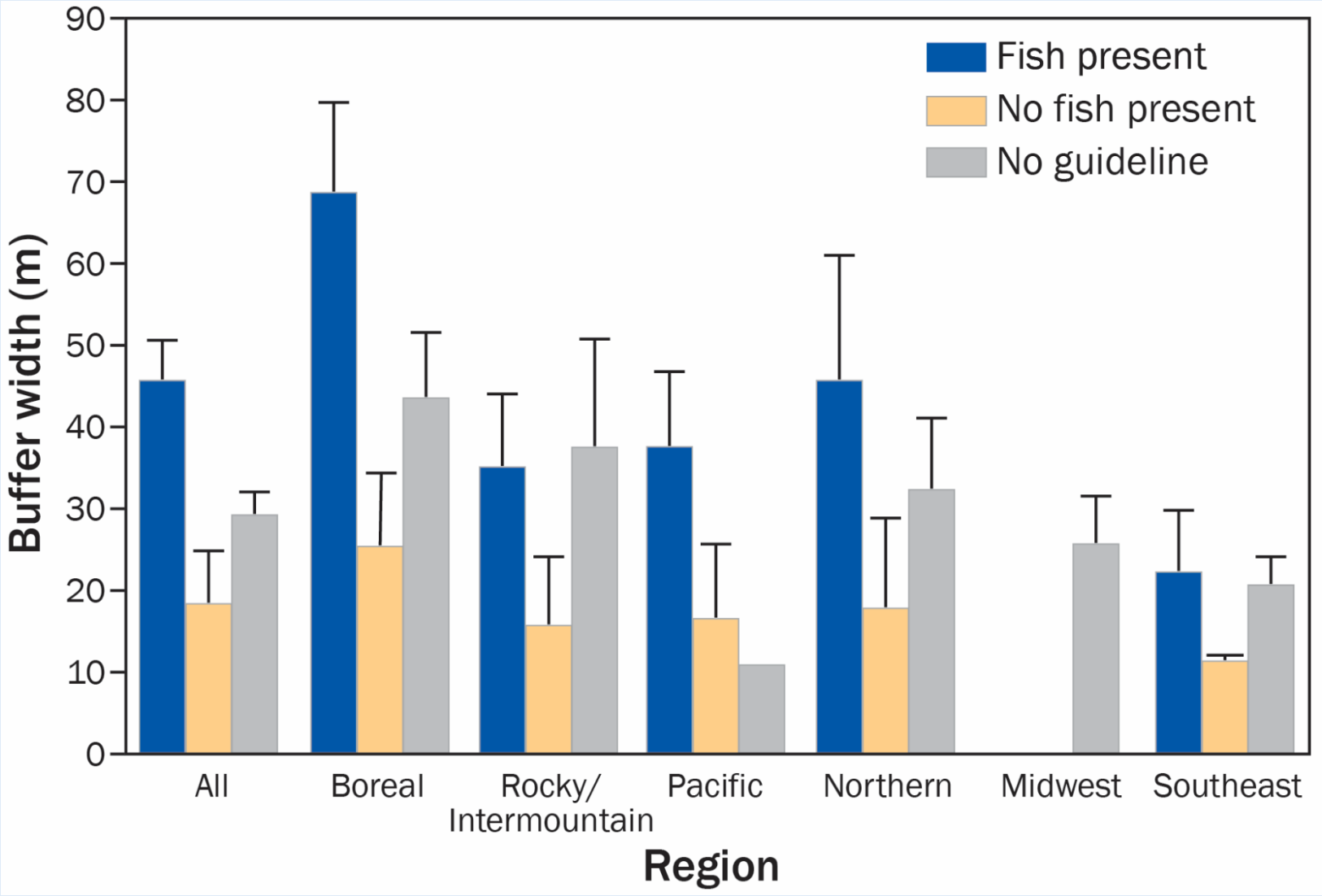
Penaluna et al. 2023, J. of Biogeography

The upper fish boundary is important ecologically



Penaluna et al. 2023, J. of Biogeography

The upper fish boundary is important for forest-management purposes

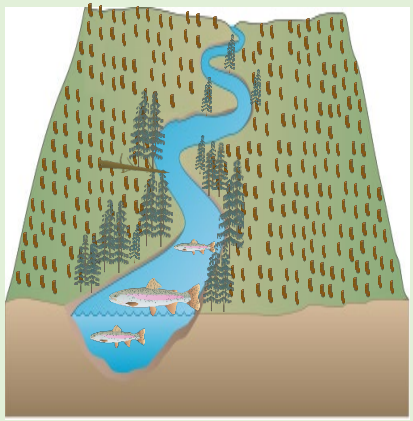


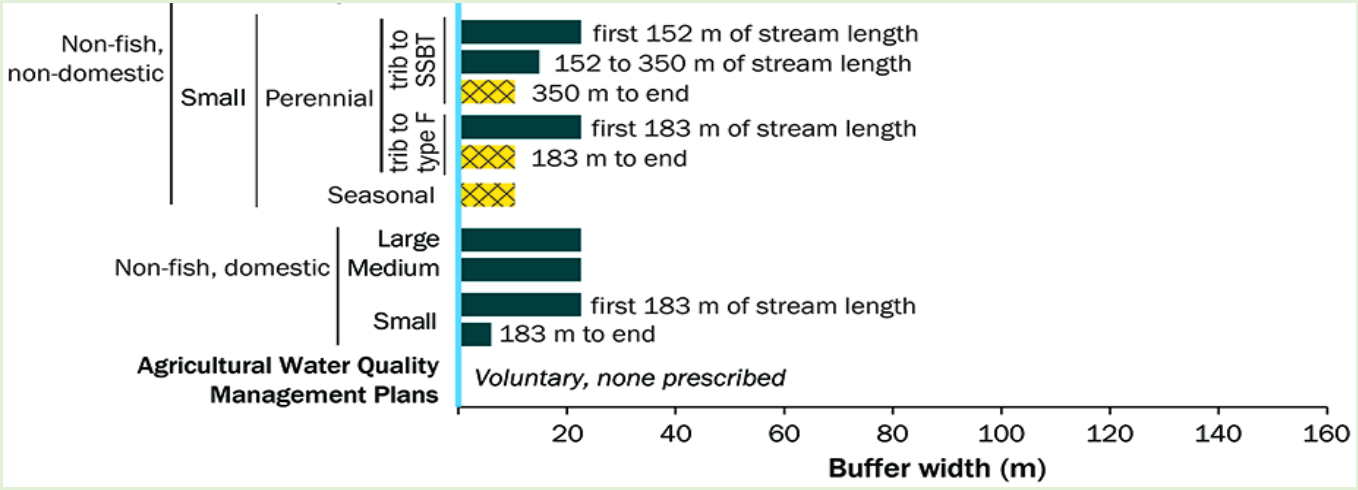
Lee, Smyth, and Boutin 2004, J. of Envr. Mgmt.

Trask Watershed Study, Tillamook watershed

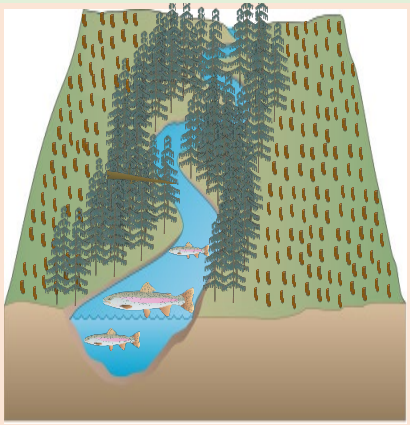
Trask Watershed Study, Tillamook watershed

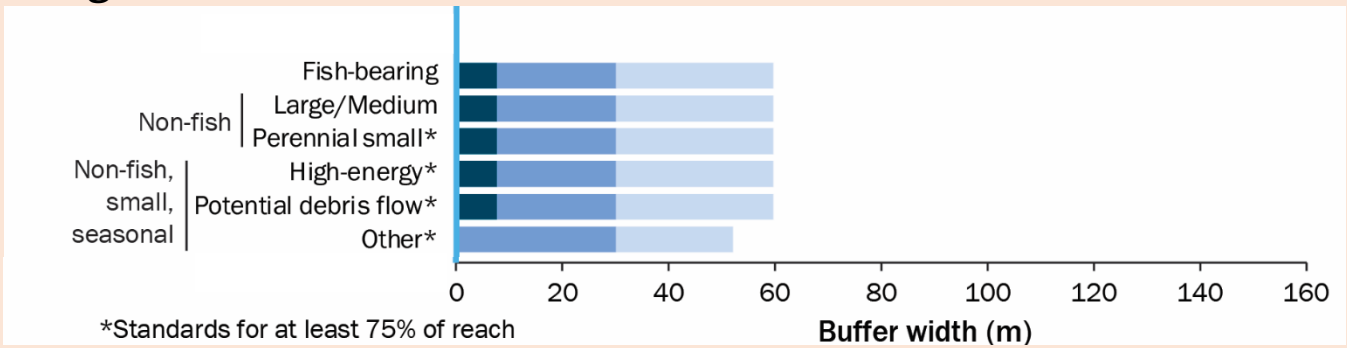
Forest Practices Administrative Rules



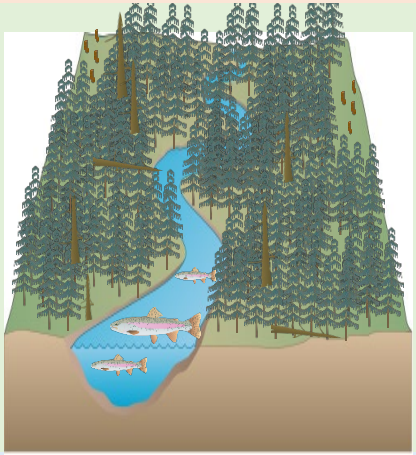


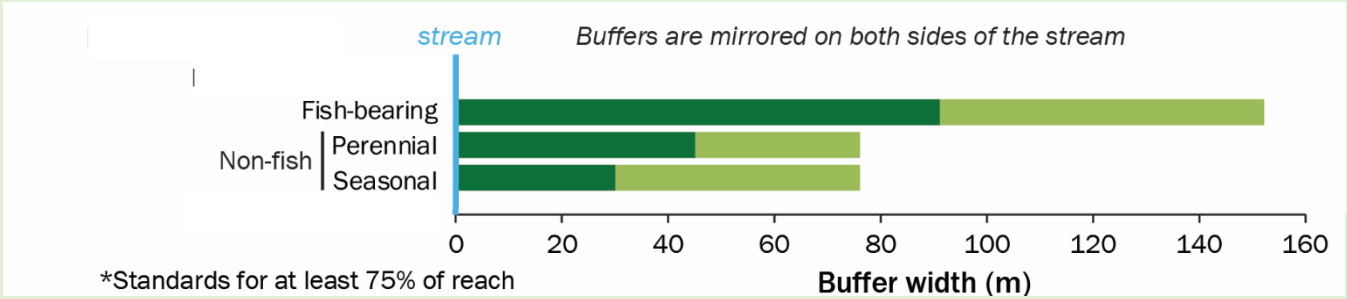
Oregon State Forest Plans





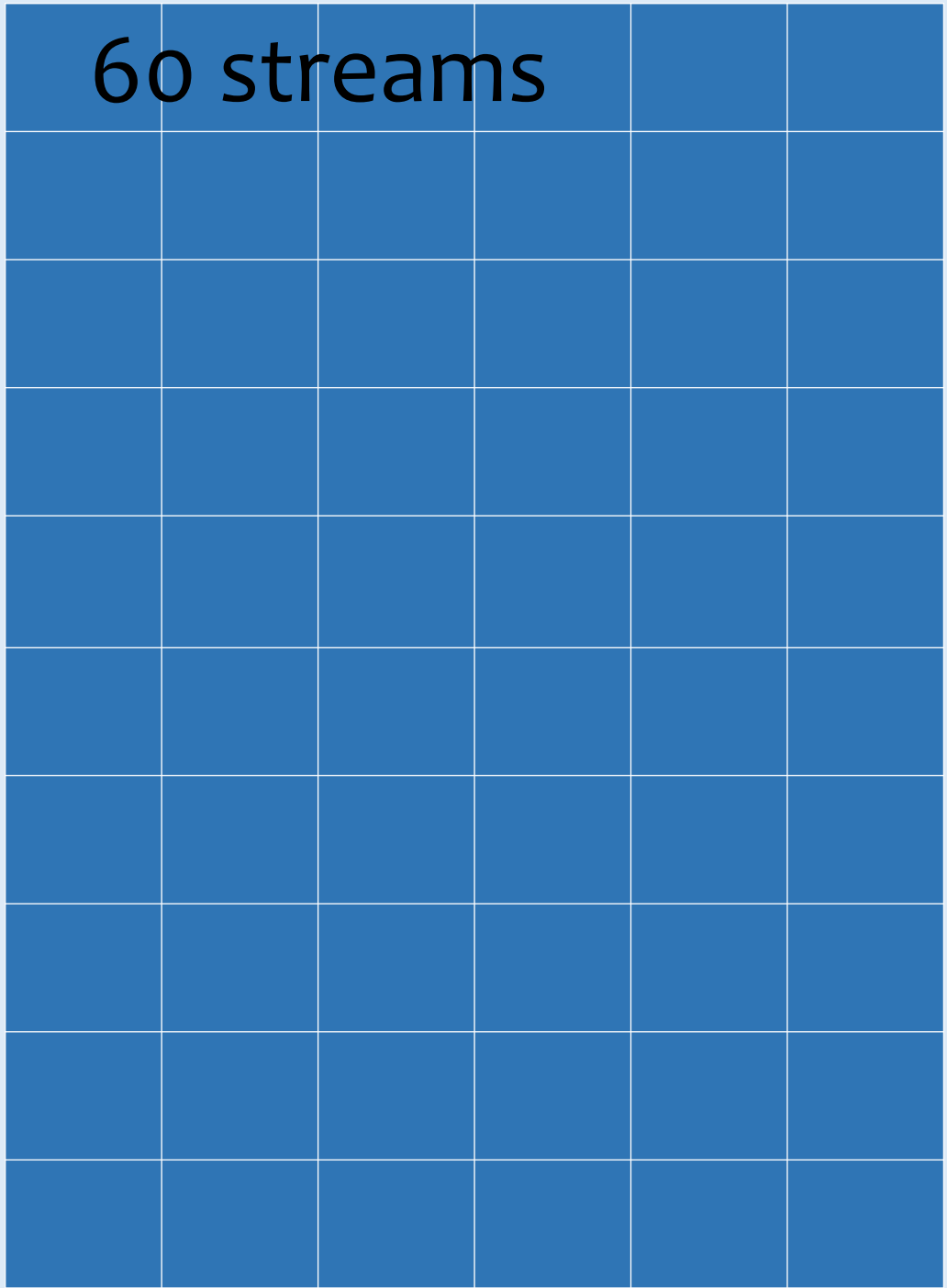
Northwest Forest Plan






Creek Water Aquatics
drain fitting option

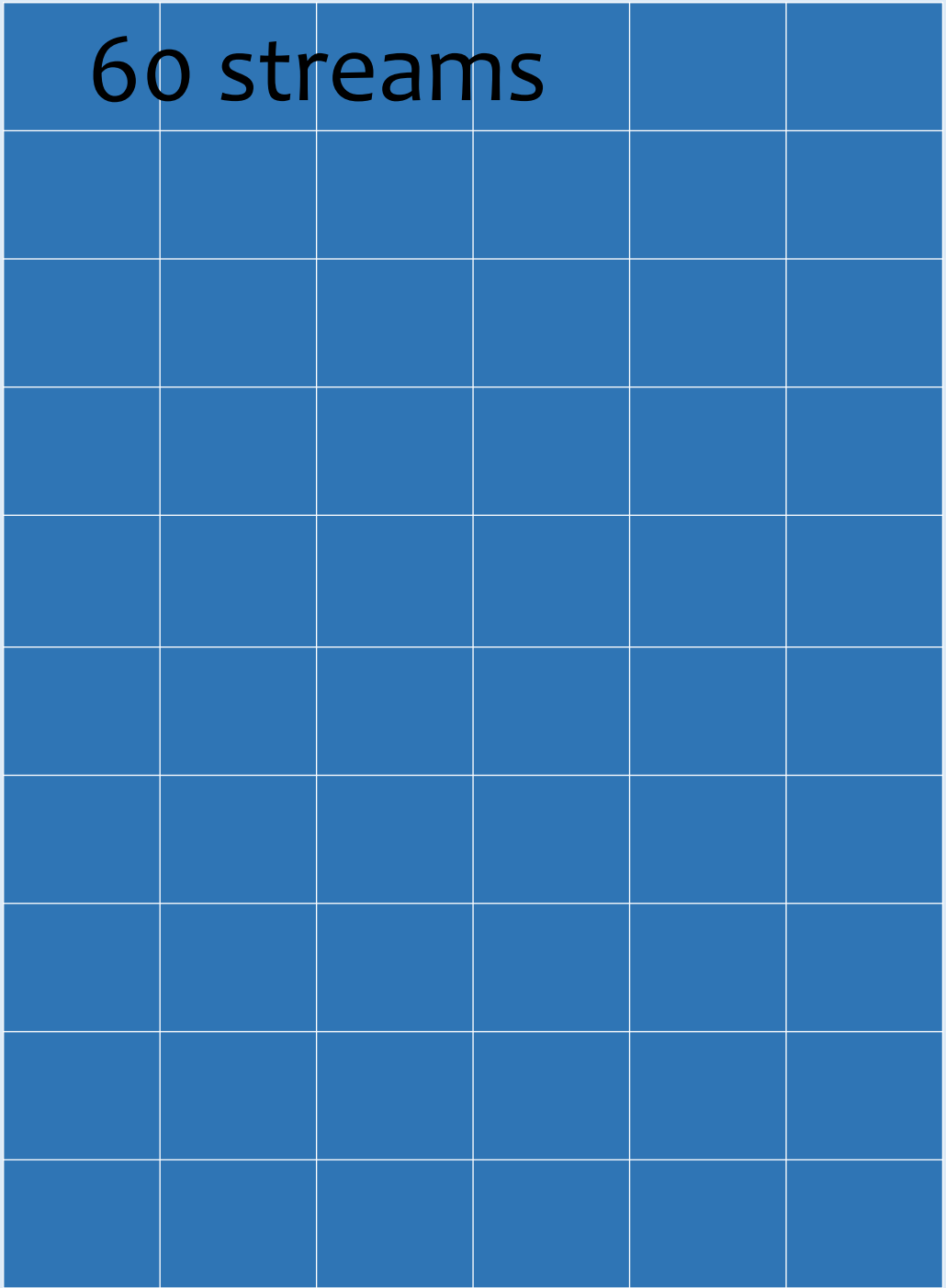
What fish is the upper-most fish in western PNW streams?



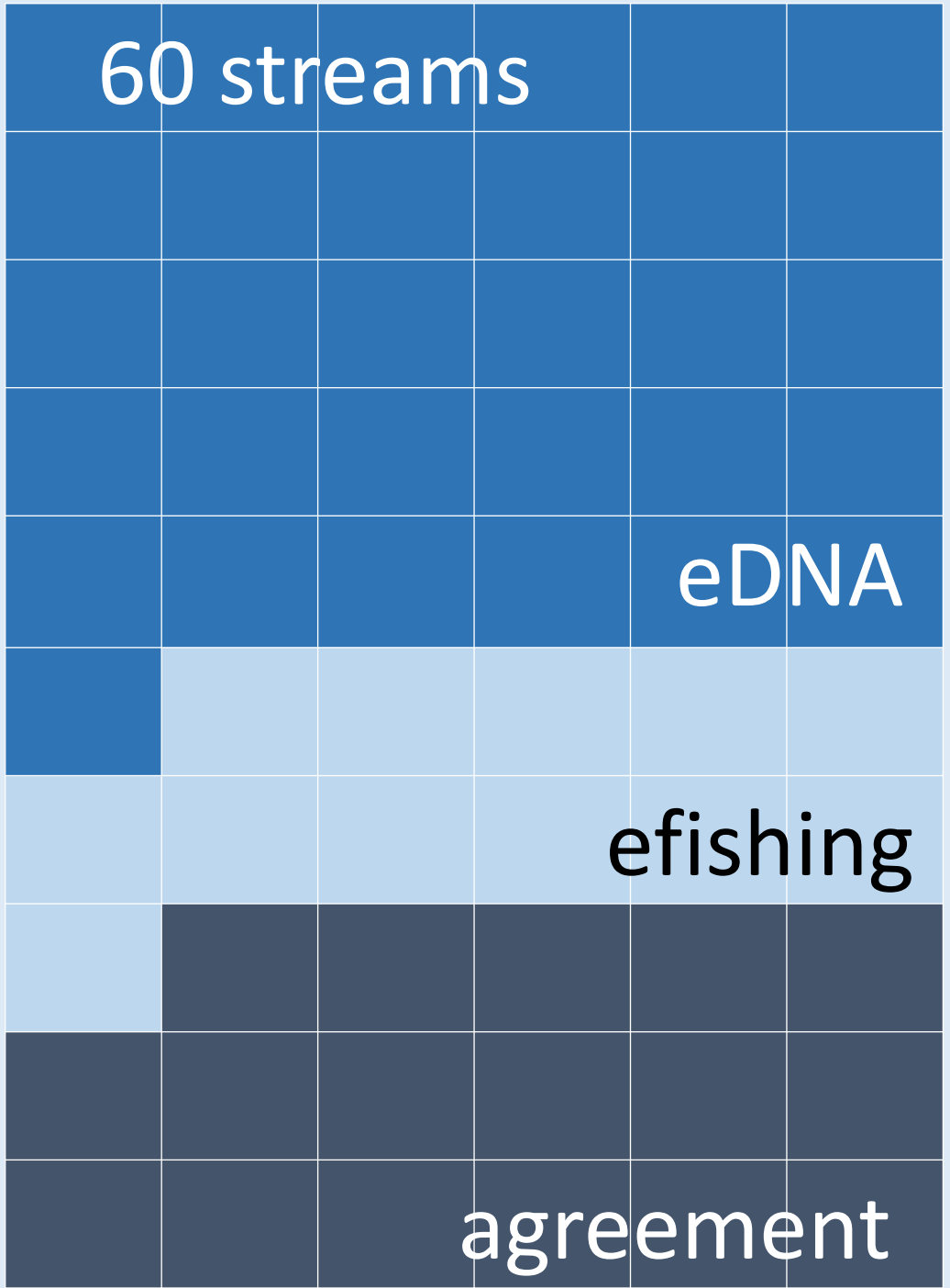
Penaluna et al.
2021 Ecosphere

60 streams

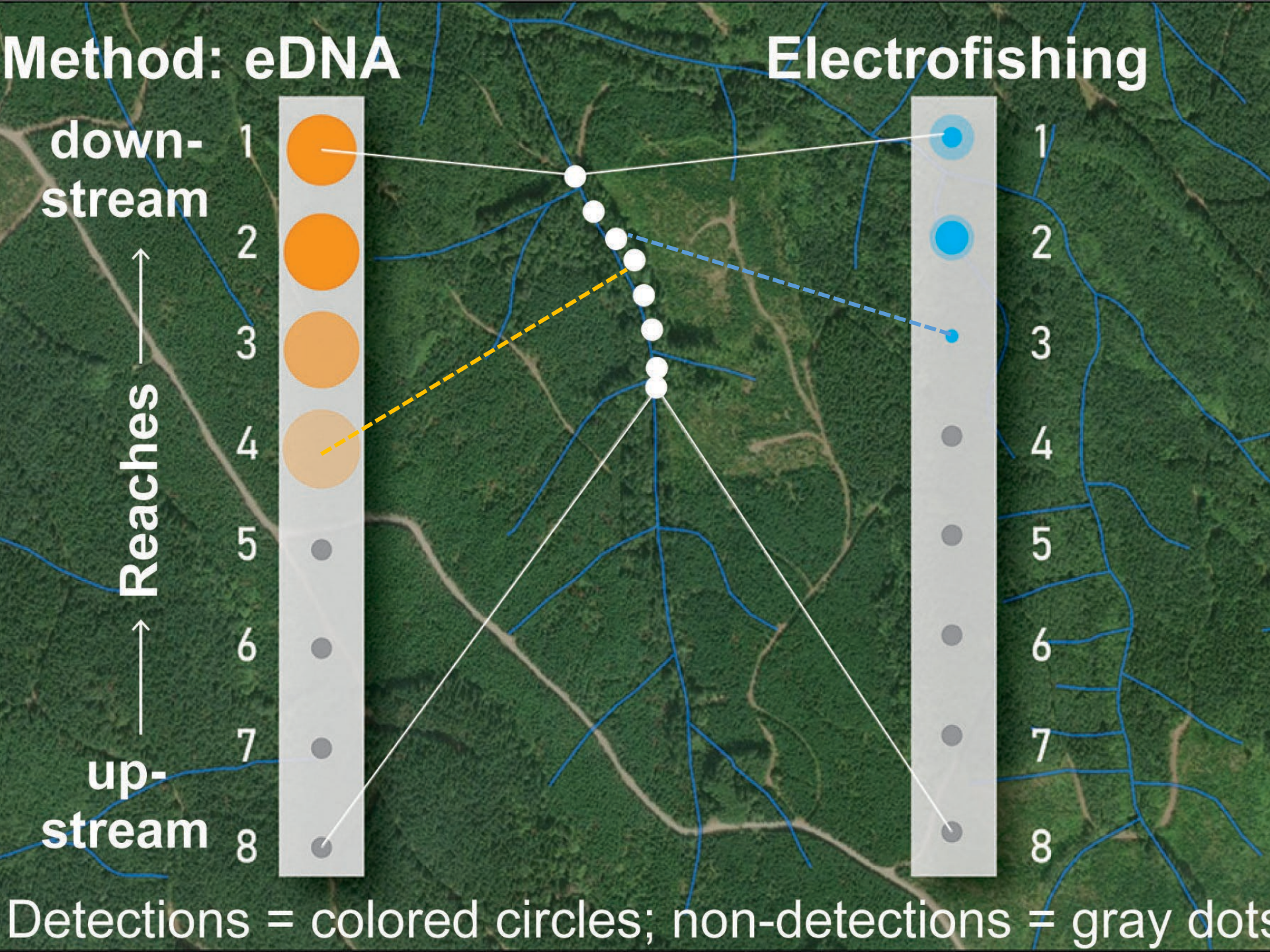
Penaluna et al.
2021 Ecosphere



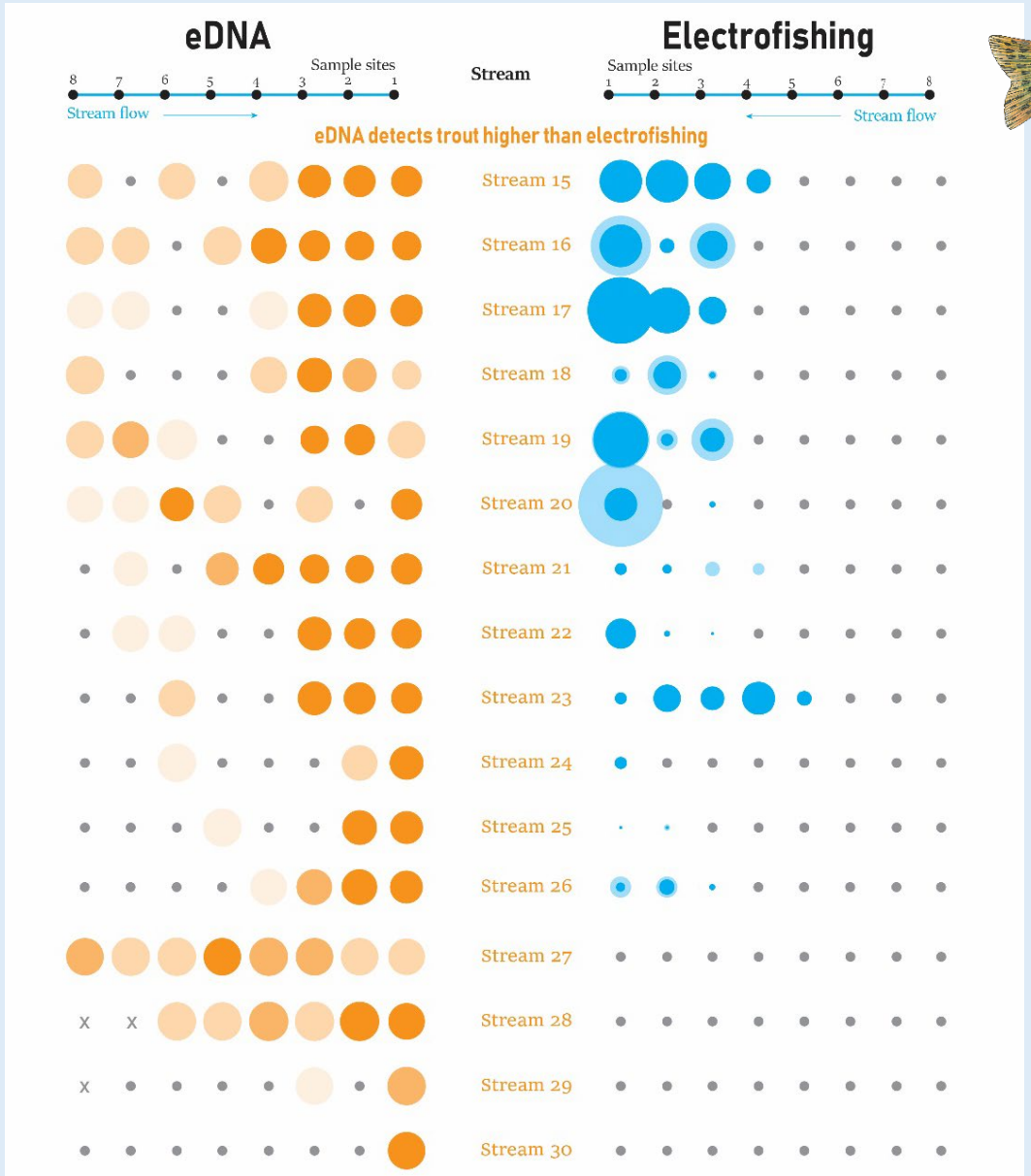
Penaluna et al.
2021 Ecosphere



Penaluna et al.
2021 Ecosphere

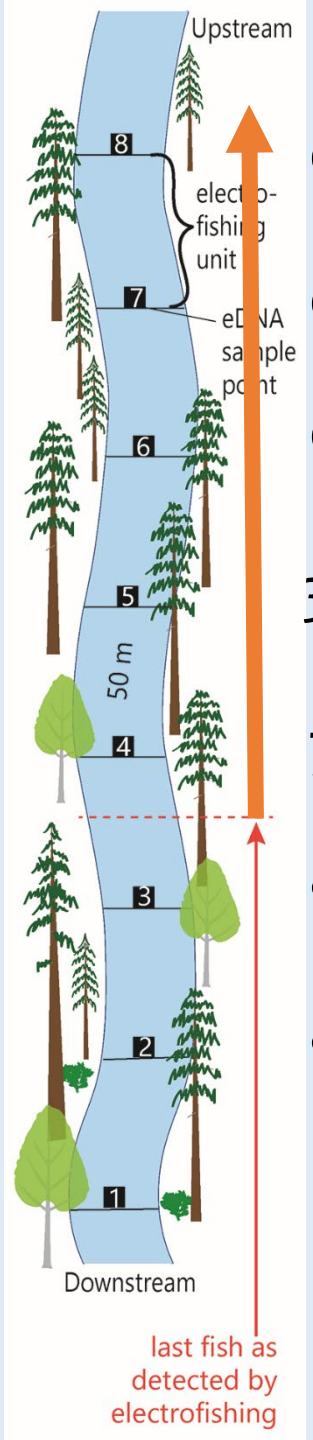

Method: eDNA
Electrofishing
down-stream
Reaches
up-stream
1
2
3
4
5
6
7
8
Detections = colored circles; non-detections = gray dots

Trout eDNA was detected above efishing uppermost fish in 31 streams (52%) by 50-250m



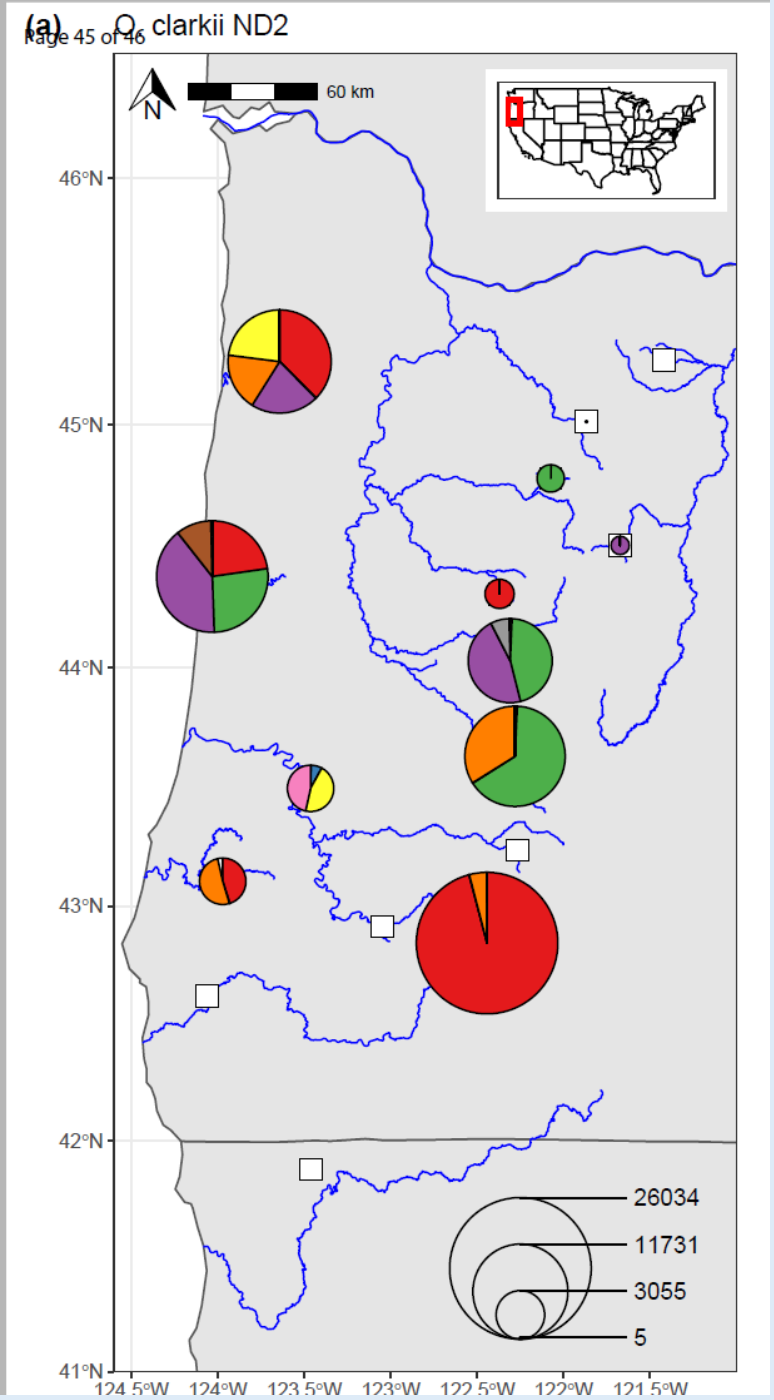
Penaluna et al. 2021, Ecosphere

eDNA		electrofishing
20%		0%
22%		0%
27%		0%
25%		3%
37%		7%
72%		80%
78%		83%
90%		88%



Results suggest extending the upper extent of fish beyond the known boundary

Penaluna et al. 2021



Coastal Cutthroat Trout

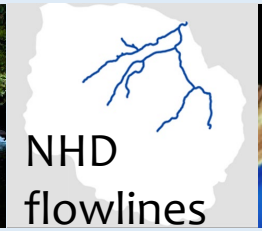
High genetic diversity, but especially in coastal rivers

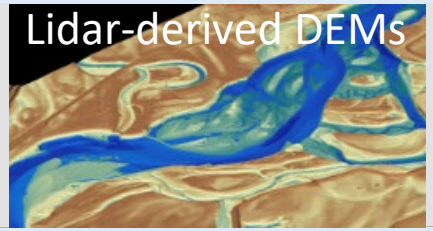
Some rivers have private haplotypes, including one coastal river and the Umpqua River

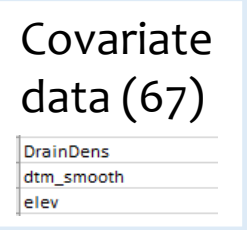
Moderate diversity in Willamette and Umpqua Rivers, but no share sequences

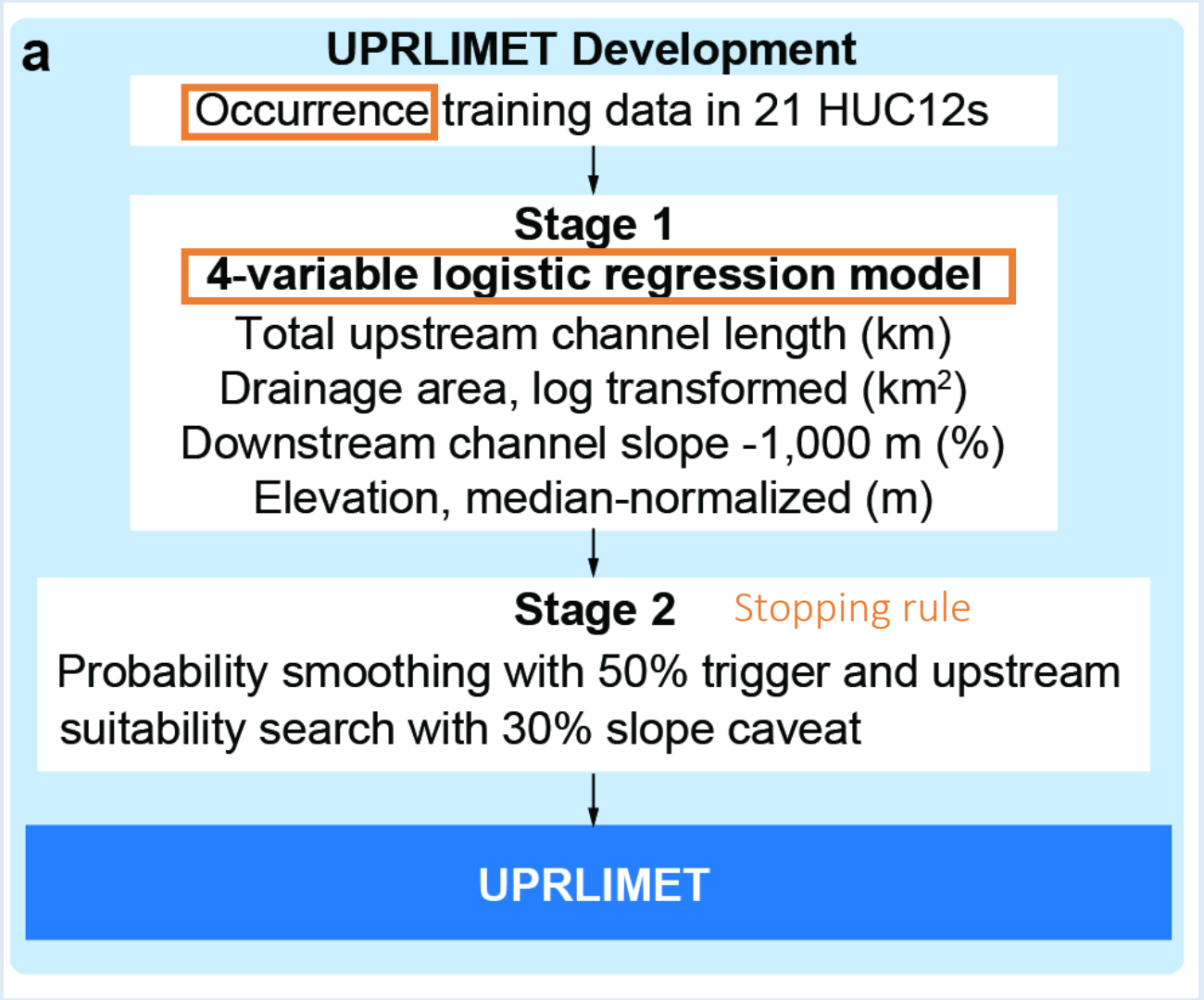
Lowest diversity in the Rogue River, but shared sequences with coastal streams and Willamette watershed

Weitemier et al. 2021



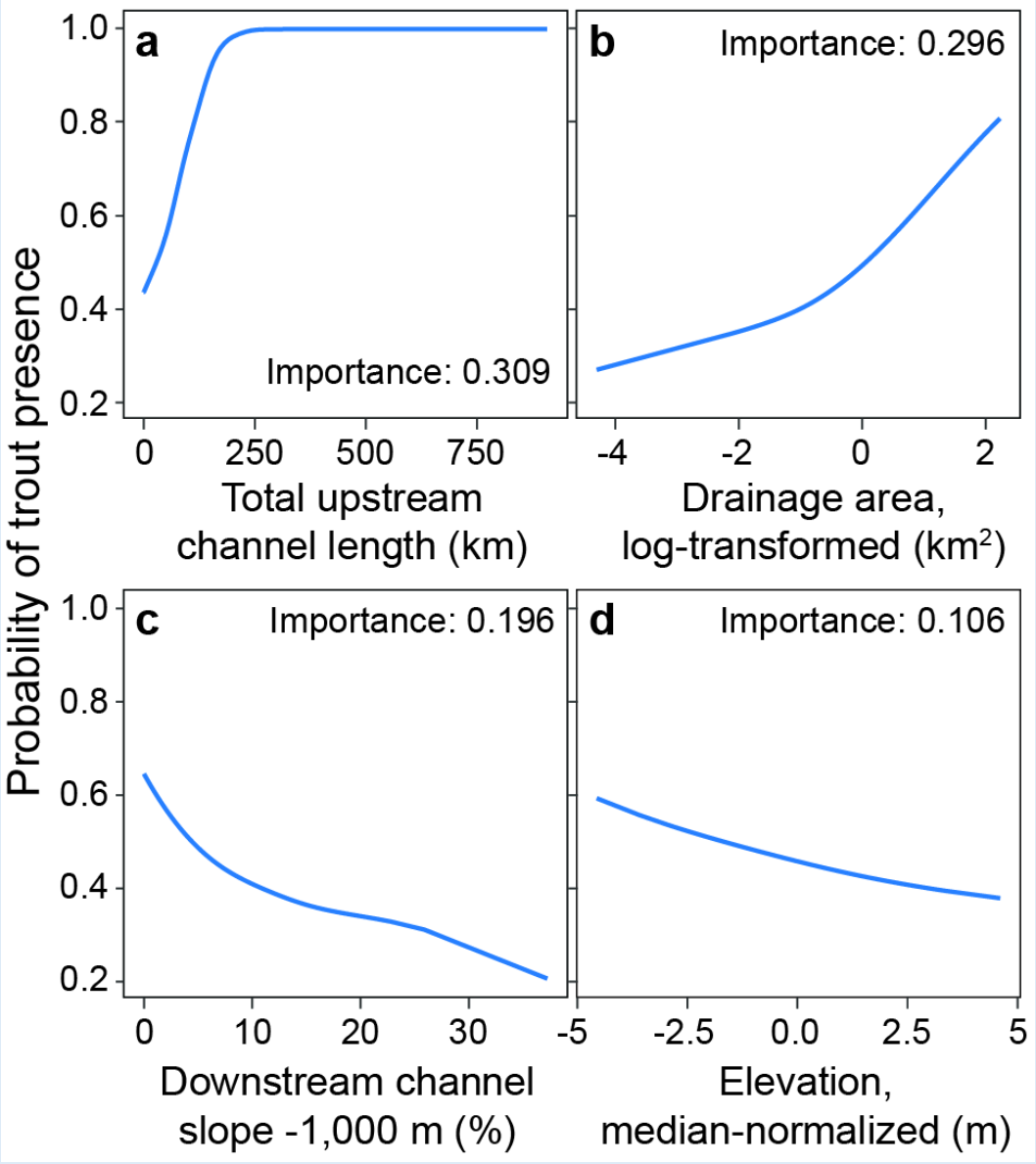






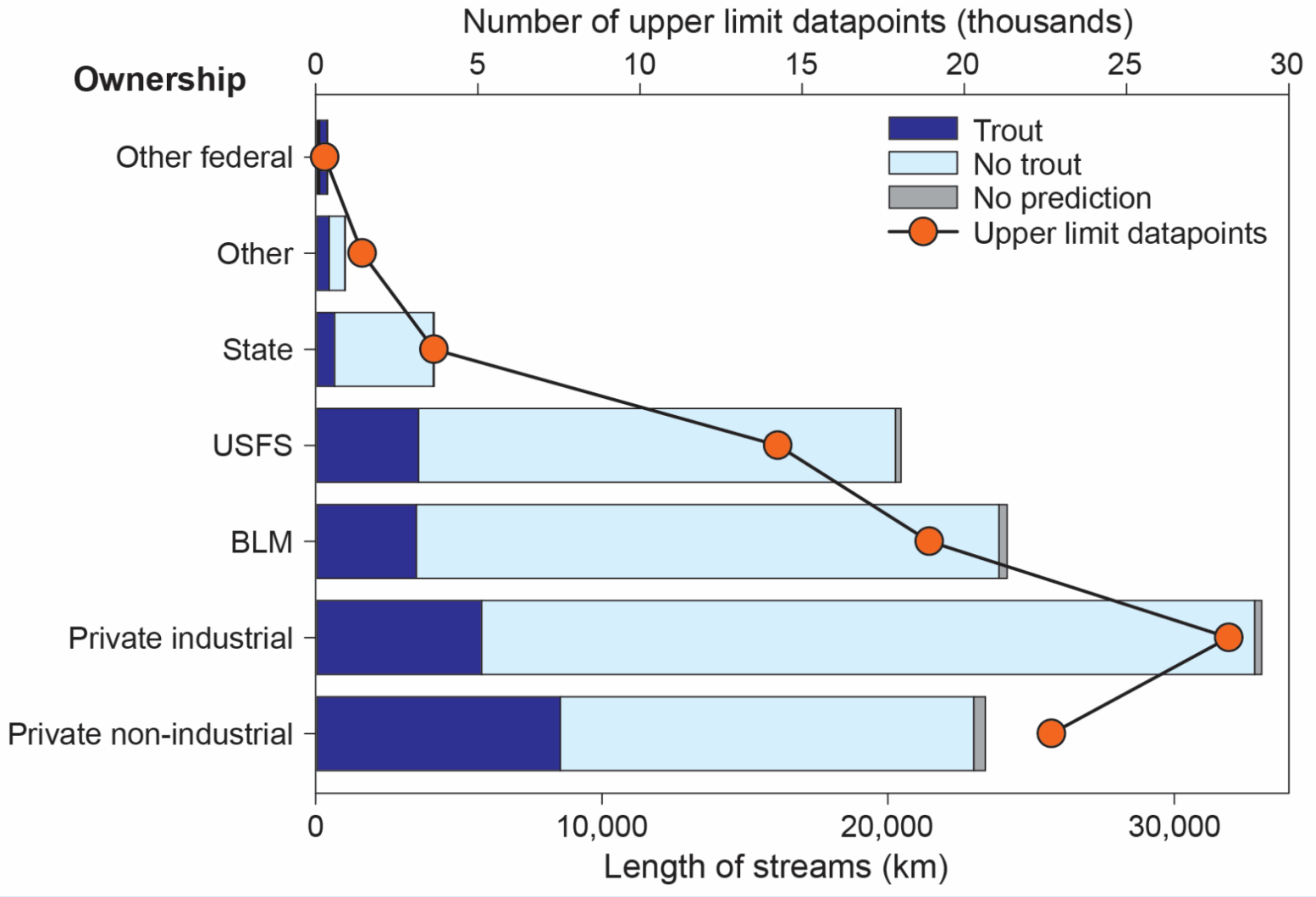
Penaluna et al. 2022, Scientific Reports

UPRLIMET depends on stream length above uppermost fish, drainage area, slope, and elevation



Penaluna et al. 2022, Scientific Reports

More fish on private lands than state, or USFS or BLM lands



Penaluna et al. 2022, Scientific Reports

Take Home Messages

- The upper extent of fish is important ecologically, politically, and for management purposes
- The use of multiple methods to identify upper-most fish allows them to play to each other's strengths
- eDNA is more sensitive than efishing at identifying the upper extent of fish in streams and it extends the upper most fish boundary
- UPRLIMET has the potential to facilitate collaboration by providing a spatially consistent, shared map of fish distributions

Next Steps: UPRLIMET+

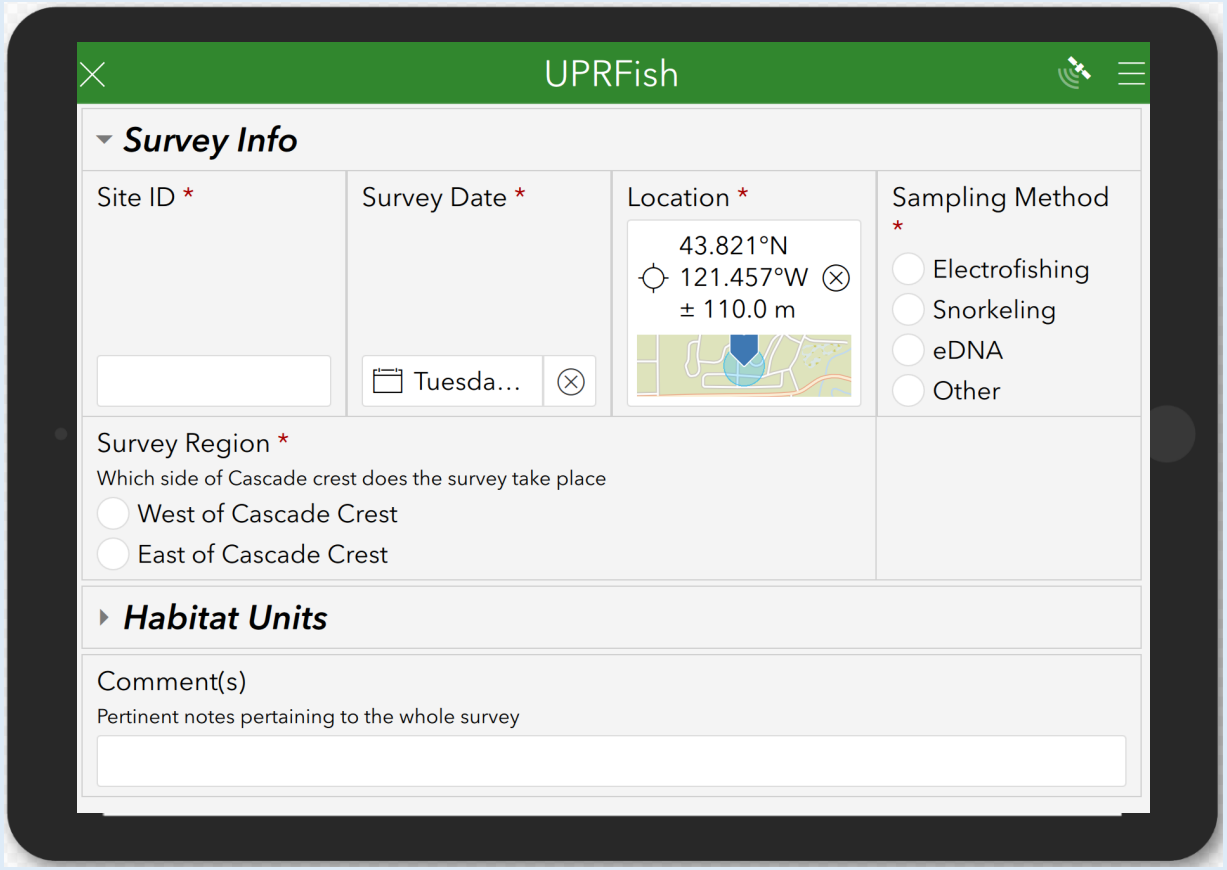
- Refine metrics in UPRLIMET+ by considering downscaling climate variables and incorporating riparian condition
- Add additional sites in OR, WA, and CA

	A	B	C
1	Shortname	Descriptive Name	Scale
2	*log10ba_ha	Log-transformed Drainage Area (hectares)	Local
3	aspect_cos	COS Aspect (Northness)	Patch
4	aspect_sin	SIN Aspect (Westness)	Patch
5	aspect_trasp	TRASP Aspect	Patch
6	avg_down_100	Downstream Channel Slope (%) - 100 m	Patch
7	avg_up_100	Upstream Channel Slope (%) - 100 m	Patch
8	Bedrock_Depth_fix	Depth to Bedrock (m)	Patch
9	cancov_2017	% Canopy Cover	Patch
10	cancov_con_2017	% Coniferous Canopy Cover	Patch
11	cancov_hdw_2017	% Hardwood Canopy Cover	Patch
12	curve	Combined Profile and Planimetric Curvature	Patch
13	d_slp1000_m	Downstream Channel Slope (%) - 1000 (m)	Patch
14	d_slp20_m	Downstream Channel Slope (%) - 20 (m)	Patch
15	d_slp30_m	Downstream Channel Slope (%) - 30 (m)	Patch
16	d_slp50_m	Downstream Channel Slope (%) - 50 (m)	Patch
17	distmouth_norm	Median-normalized Distance to Outlet (m)	Patch
18	DrainDens	Drainage Density (km / km2)	Patch
19	dtm_smooth	Elevation (m) (FCPG)	Patch
20	elev	Elevation (m)	Local
21	elev_norm	Median-normalized Elevation	Local
22	HAND	Local Height Above Nearest Drainage	Local
23	HAND_1	HAND (FCPG)	Patch
24	hload	Heatload Index	Patch
25	Hydro_Conductivity	Hydraulic Conductivity	Patch
26	Lith_Prov1	Lithologic Province 1 - Coast Range Sedimentary (Pro	Patch
27	Lith_Prov2	Lithologic Province 2- Coast Range Volcanic/ Coast R	Patch
28	Lith_Prov3	Lithologic Province 3 - High Cascades (Proportion of I	Patch
29	Lith_Prov4	Lithologic Province 4 - Klamath (Proportion of Basin)	Patch
30	Lith_Prov5	Lithologic Province 5 - Quaternary Sediment (Proport	Patch
31	Lith_Prov7	Lithologic Province 7 - Western Cascades (Proportion	Patch
32	log10ba	Log-transformed Drainage Area (square kilometers)	Local

Andres Olivos, postdoc

Field App Launch of UPRfish

- Standardized Crowd-Sourcing Protocol (and database) for Collecting Upper Limit of Fish in Streams in the Pacific Northwest
- Guides users through series of standardized questions



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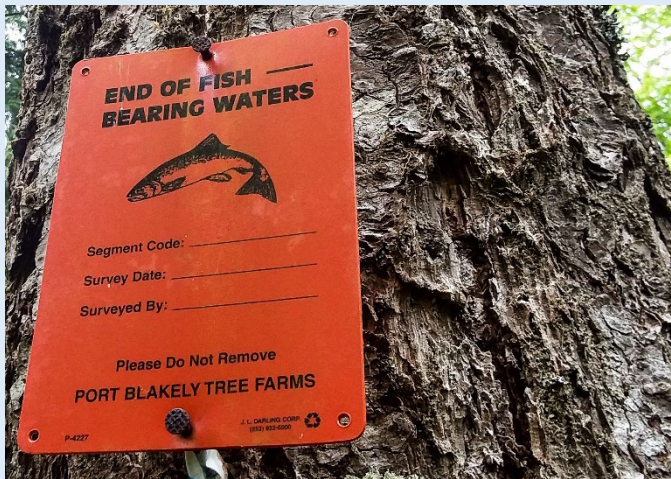
Graphics: Kelly Christiansen and Kathryn Ronnenberg



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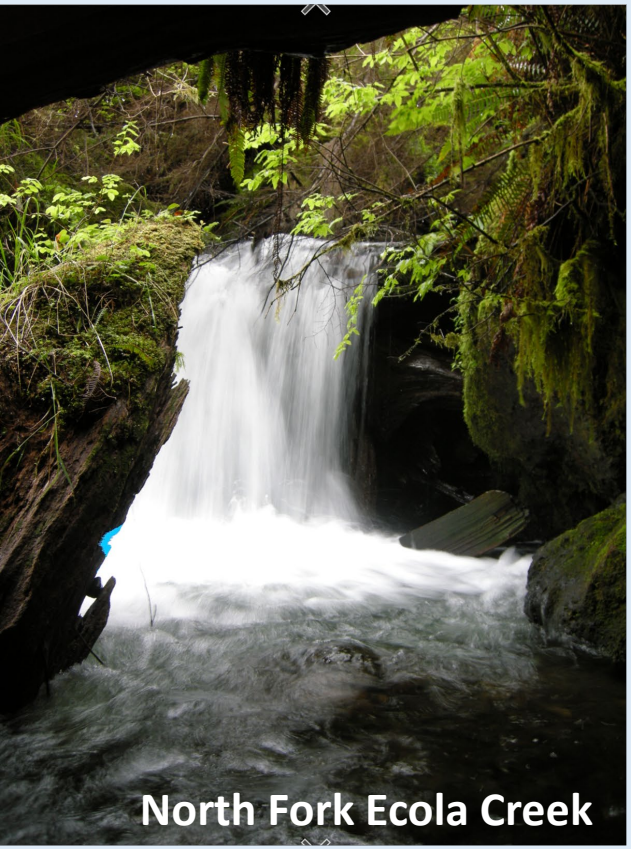
brooke.penaluna@usda.gov


Sand Creek


Muletail Creek


Panther Creek

Questions?


North Fork Ecola Creek


Nevergo Creek