Groundwater, Streamflow, & Sustainability in Central OR

ZACH FREED / SUSTAINABLE WATER PROGRAM DIRECTOR / TNC OR

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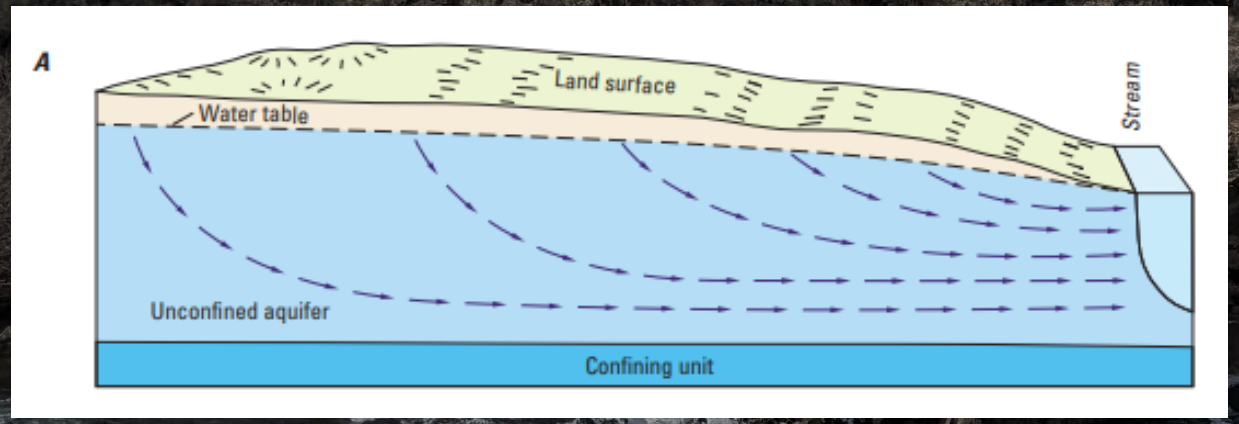
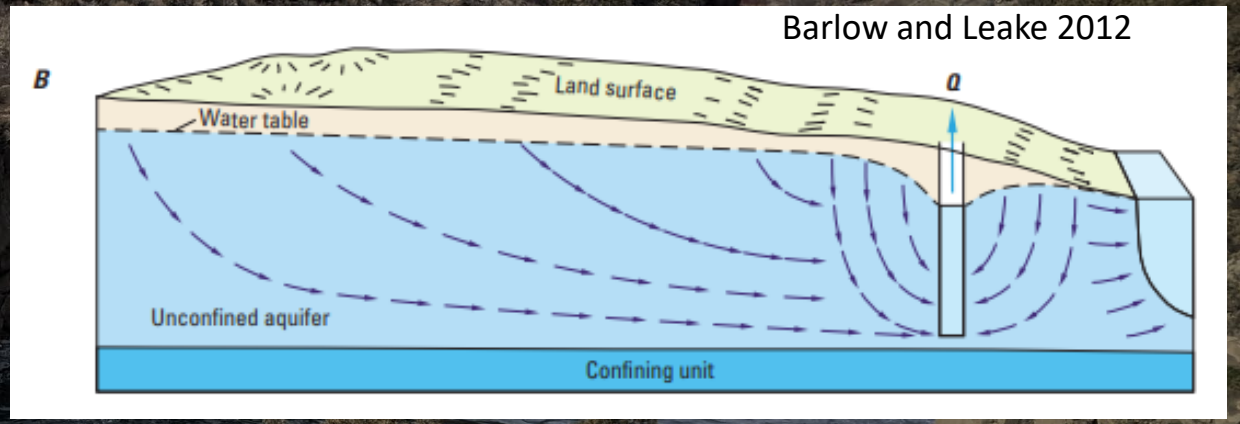
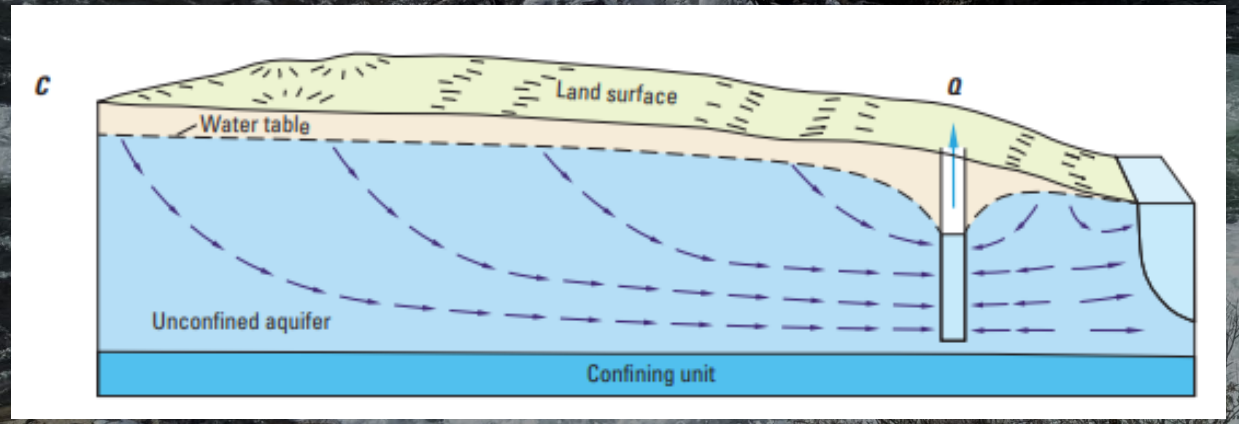
Interconnected

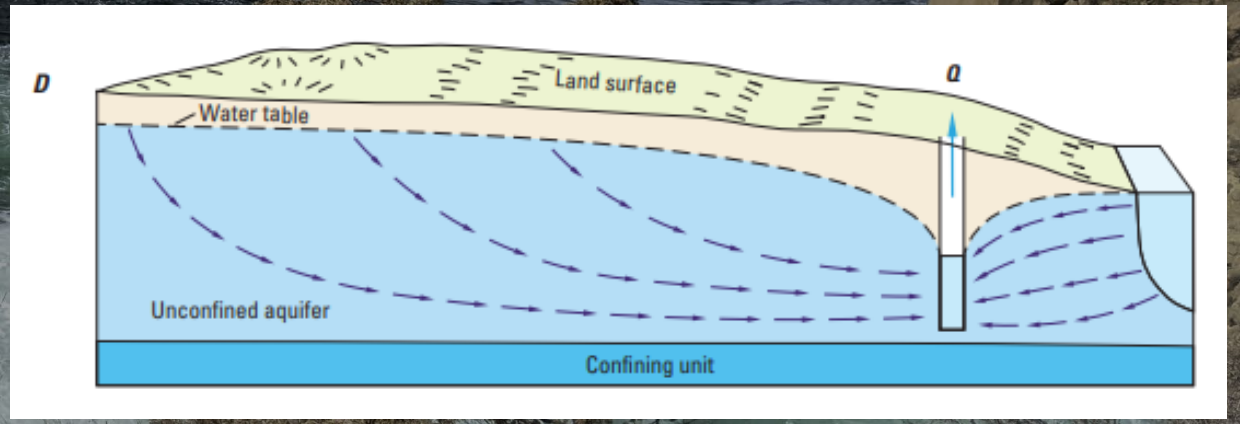
GROUNDWATER & SURFACE FLOWS

Barlow and Leake 2012









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Interconnected

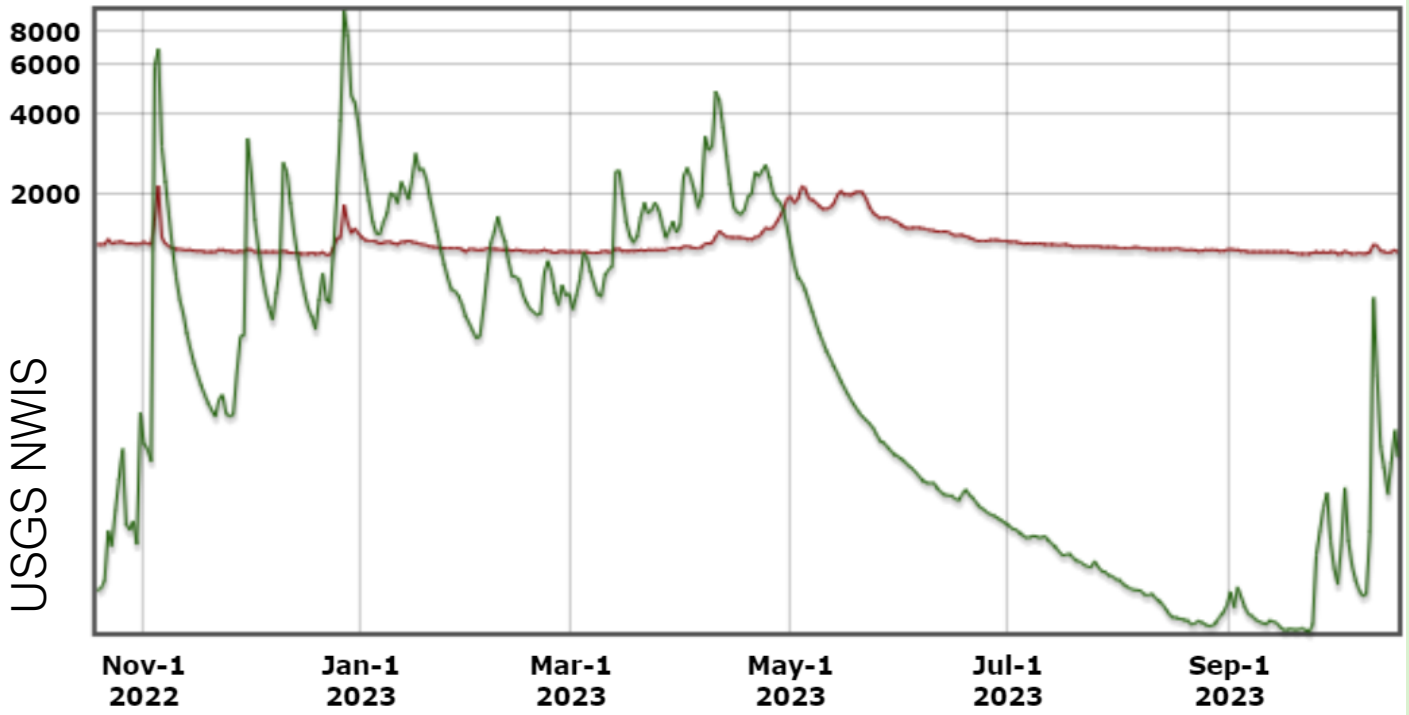
GROUNDWATER & SURFACE FLOWS

GROUNDWATER IS STREAMFLOW

RIVERS ARE GROUNDWATER DEPENDENT ECOSYSTEMS

GROUNDWATER DEPLETION IS STREAMFLOW DEPLETION

USGS 14091500 Metolius (Brown)
USGS 14302480 Trask River (Green)



Groundwater Dependent Rivers

- Summer and fall flows
- Drought-resilient
- Cold-water refugia
- "Oases of the future"[1]

[1] Cartwright et al. 2021

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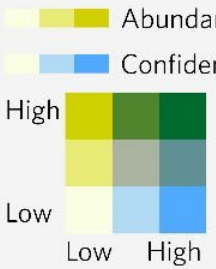
Oregon GDE Atlas 2022

Distribution and Abundance of GDEs



Orienting Features

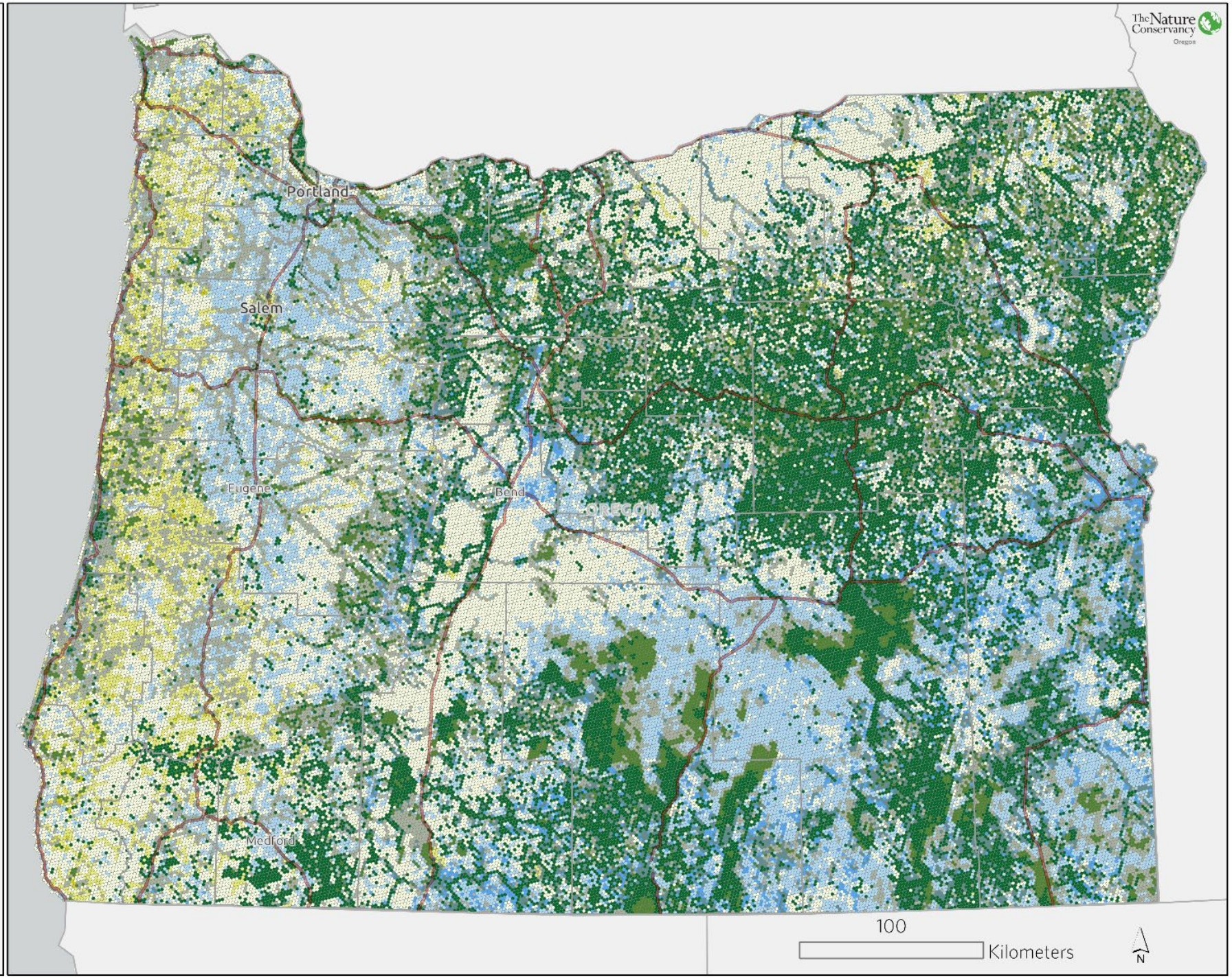
Highways

Counties

Groundwater-dependent ecosystems are unevenly distributed across Oregon. All five types of GDEs (springs, rivers, wetlands, lakes, and species) have been combined into a bivariate index of abundance and confidence. The abundance of different GDE types is standardized relative to their total distribution and summed. Confidence reflects the standardized sum of indicators across all GDE types.

Data Sources:
Hexagons: ODFW
Streams: National Hydrologic Dataset
Wetlands: National Wetlands Inventory
Springs: DOGAMI and TNC
GD Species: Oregon Biodiversity Information Center
Basemap: ESRI, State of Oregon GEO

Map produced by the The Nature Conservancy in Oregon, 2022



Freed et al. 2022

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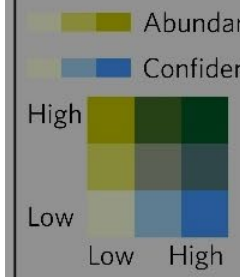

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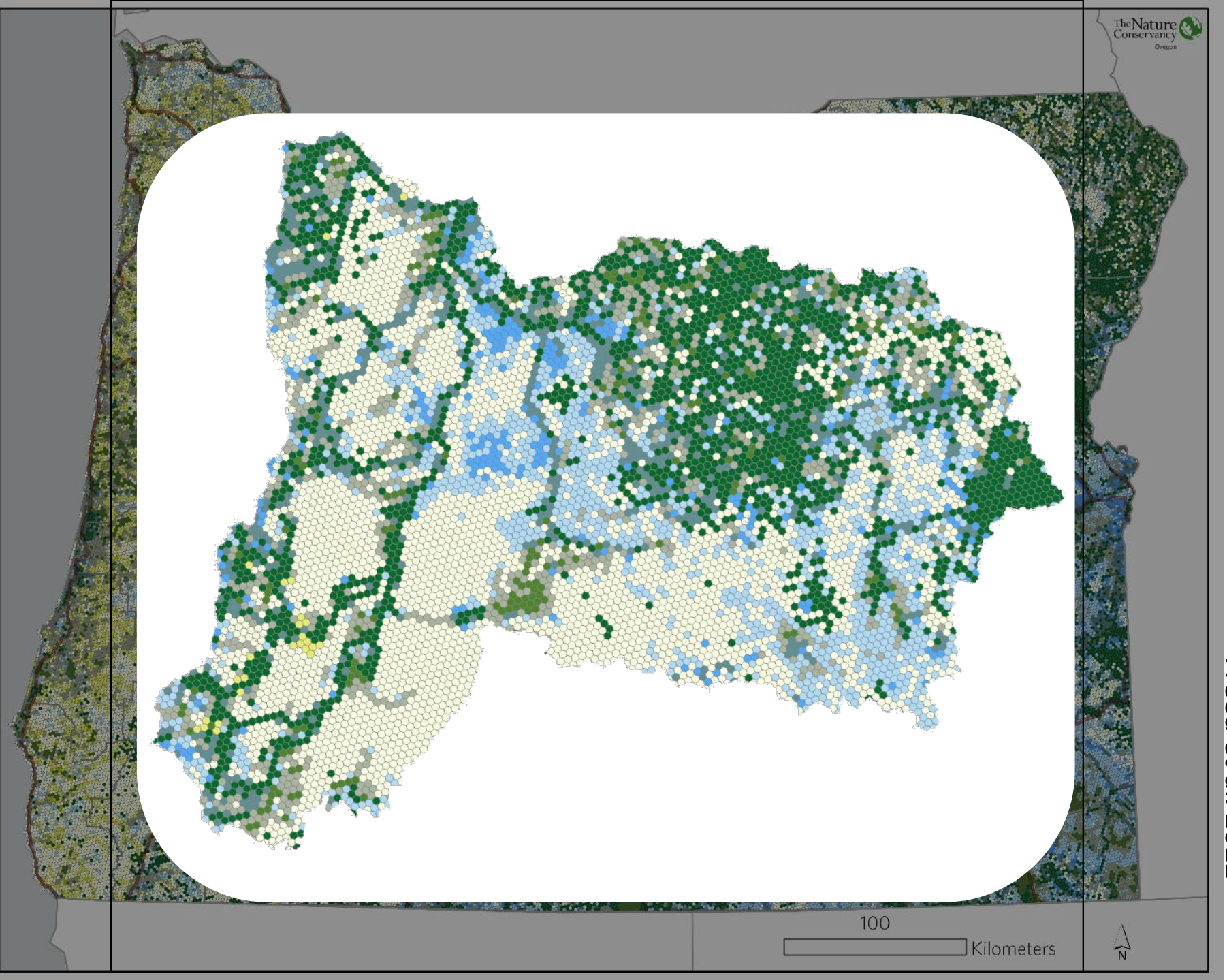

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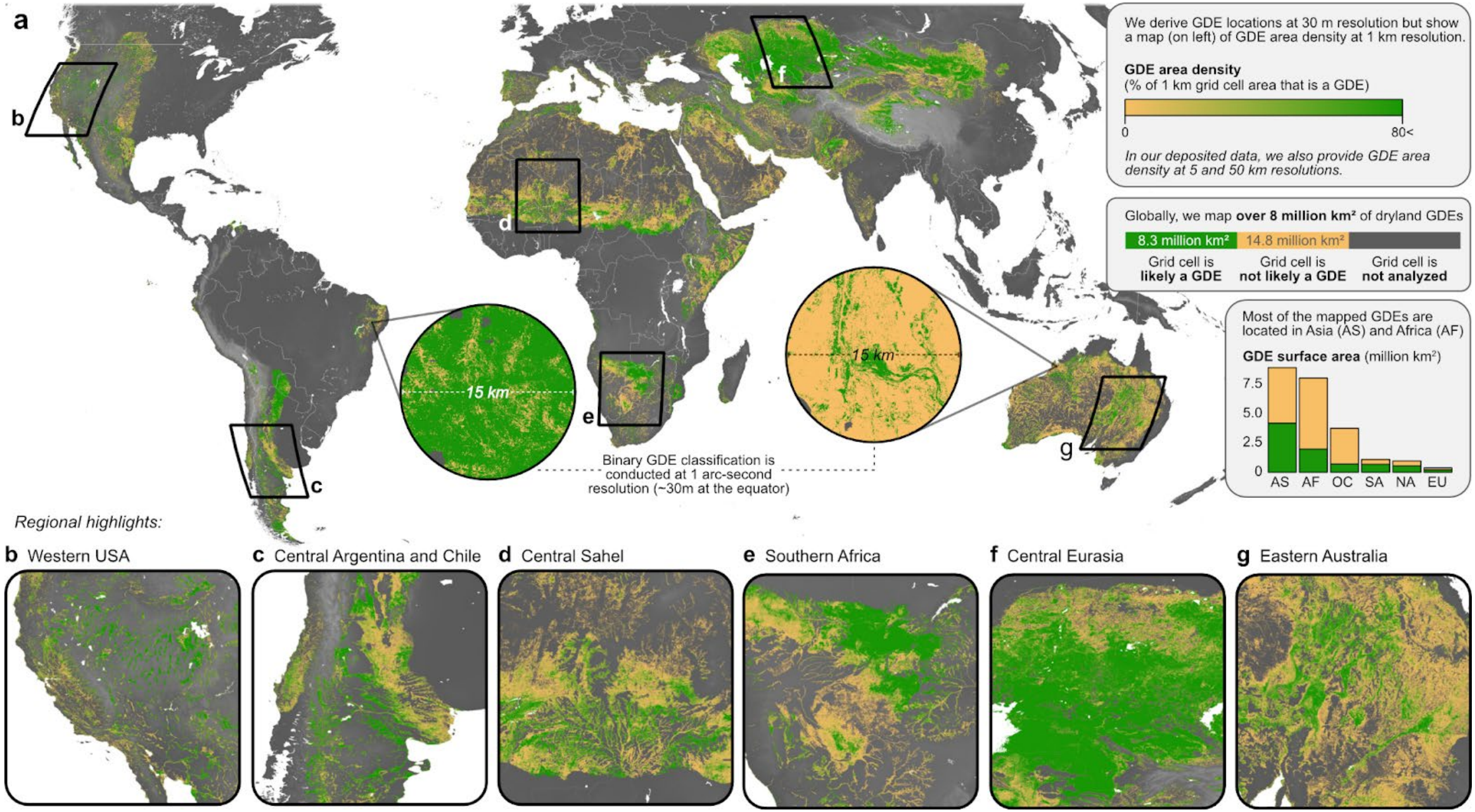
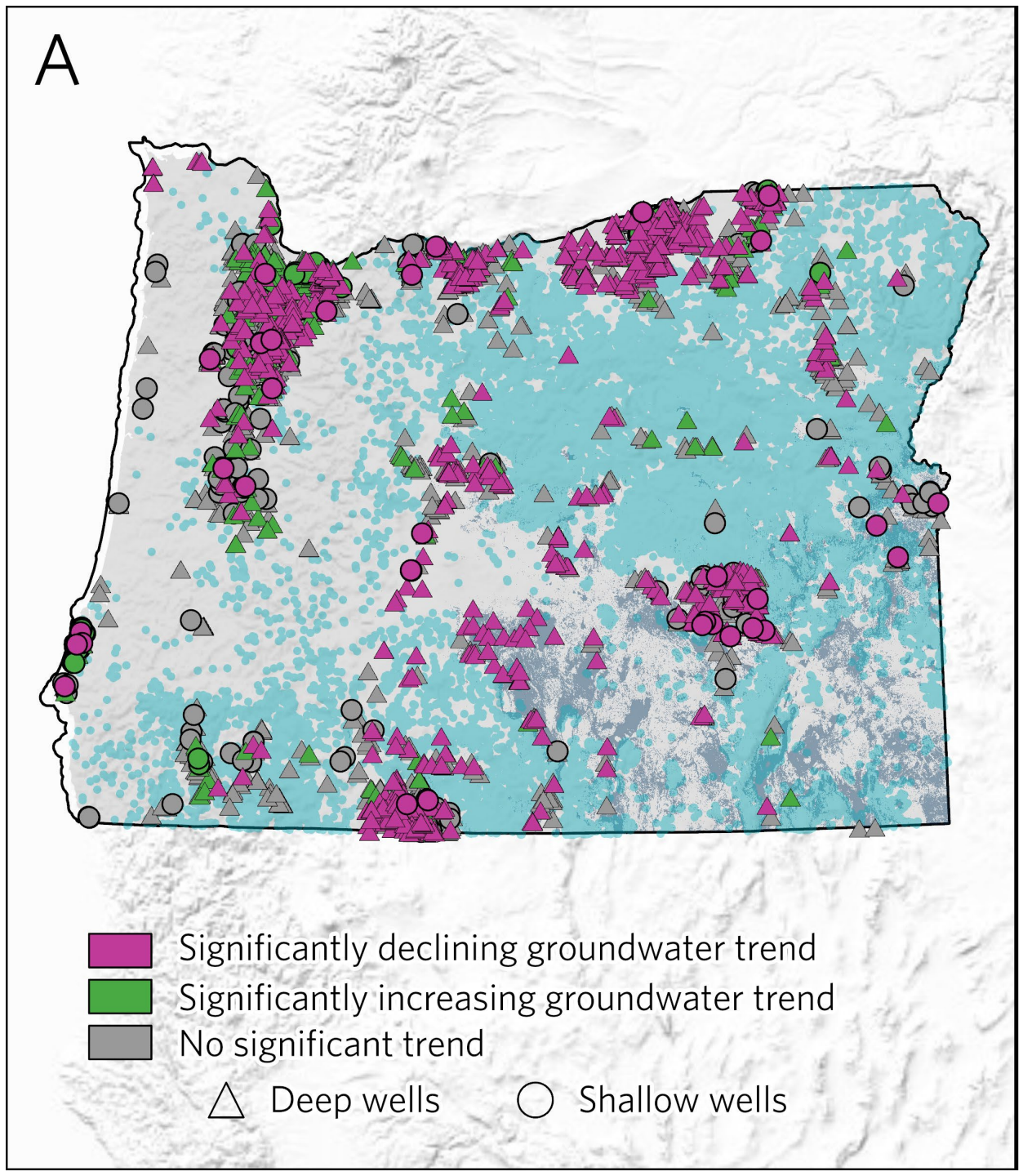


Rohde et al. 2024

Climate and Recharge

All groundwater comes from precipitation.

- Changes to timing and type of precipitation will affect groundwater recharge.
- Not all aquifers are equal: *renewability* vs. *climate-resilience* depends on flow paths.
- Even climate-resilient aquifers are vulnerable to unsustainable use



Saito and Freed 2022

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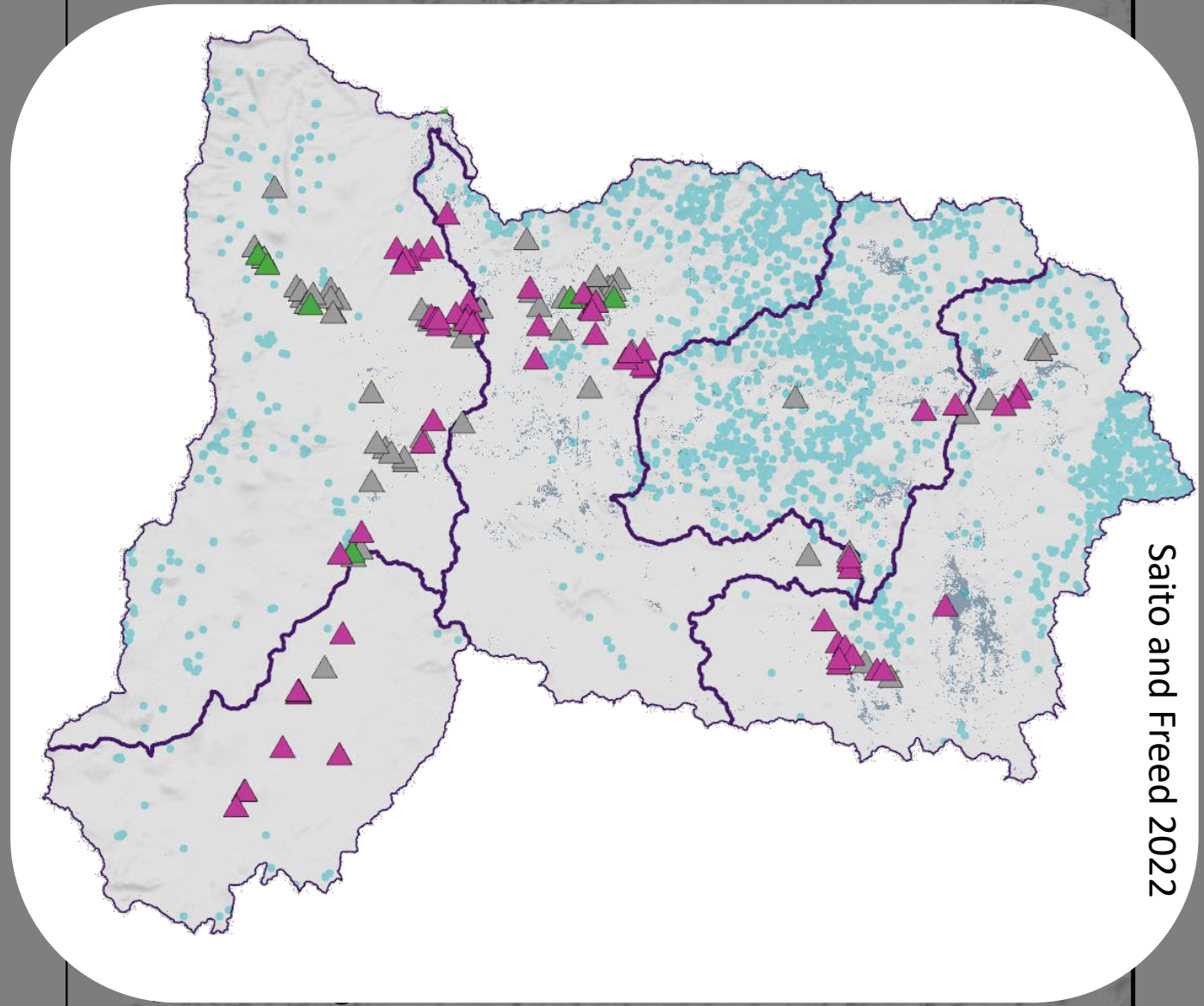


Saito and Freed 2022

△ Deep wells ○ Shallow wells

Ecosystem Thresholds

FOR GROUNDWATER LEVEL DECLINES

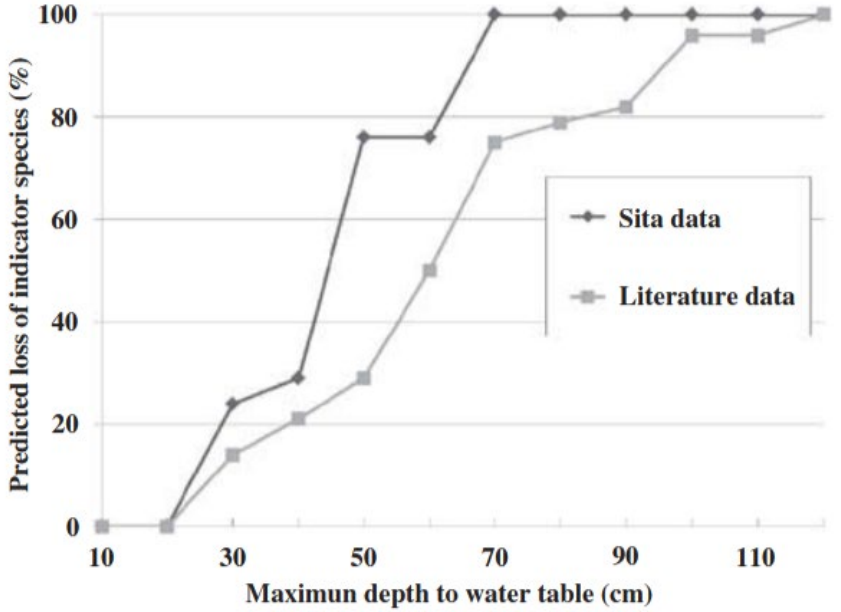
Wetlands and springs:

- **2.3 feet** of drawdown for 100% mortality of indicator species
  (Aldous and Bach 2014)

Rivers and streams:

- **1.6 feet** to fall below 'environmental flow limits' in central Oregon
  (de Graaf et al. 2019)
- **6.6 feet** to transition 10% of gaining reaches to losing reaches in Oregon
  (Jasechko et al. 2021)

Aldous and Bach 2014



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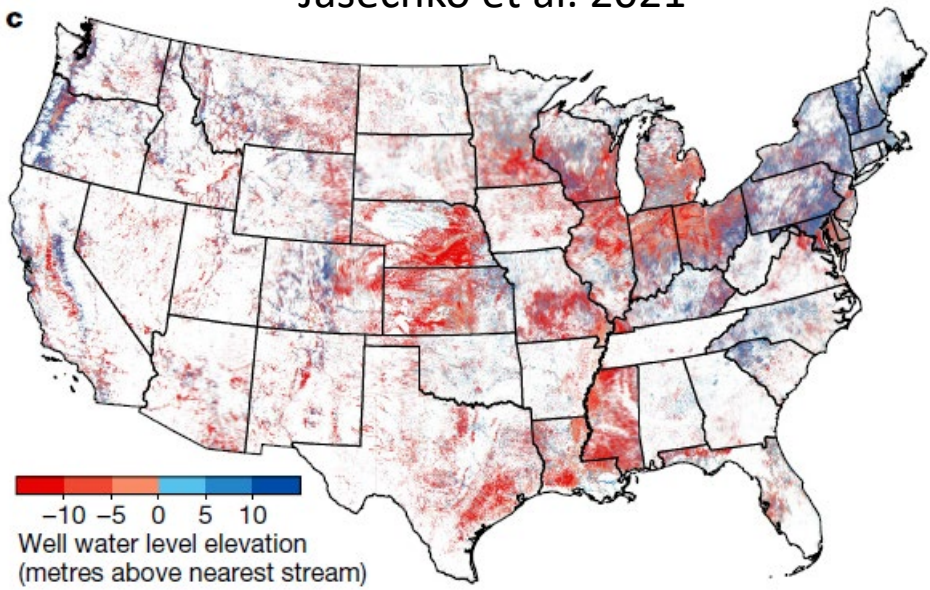

Thank you

Reach out: zach.freed@tnc.org

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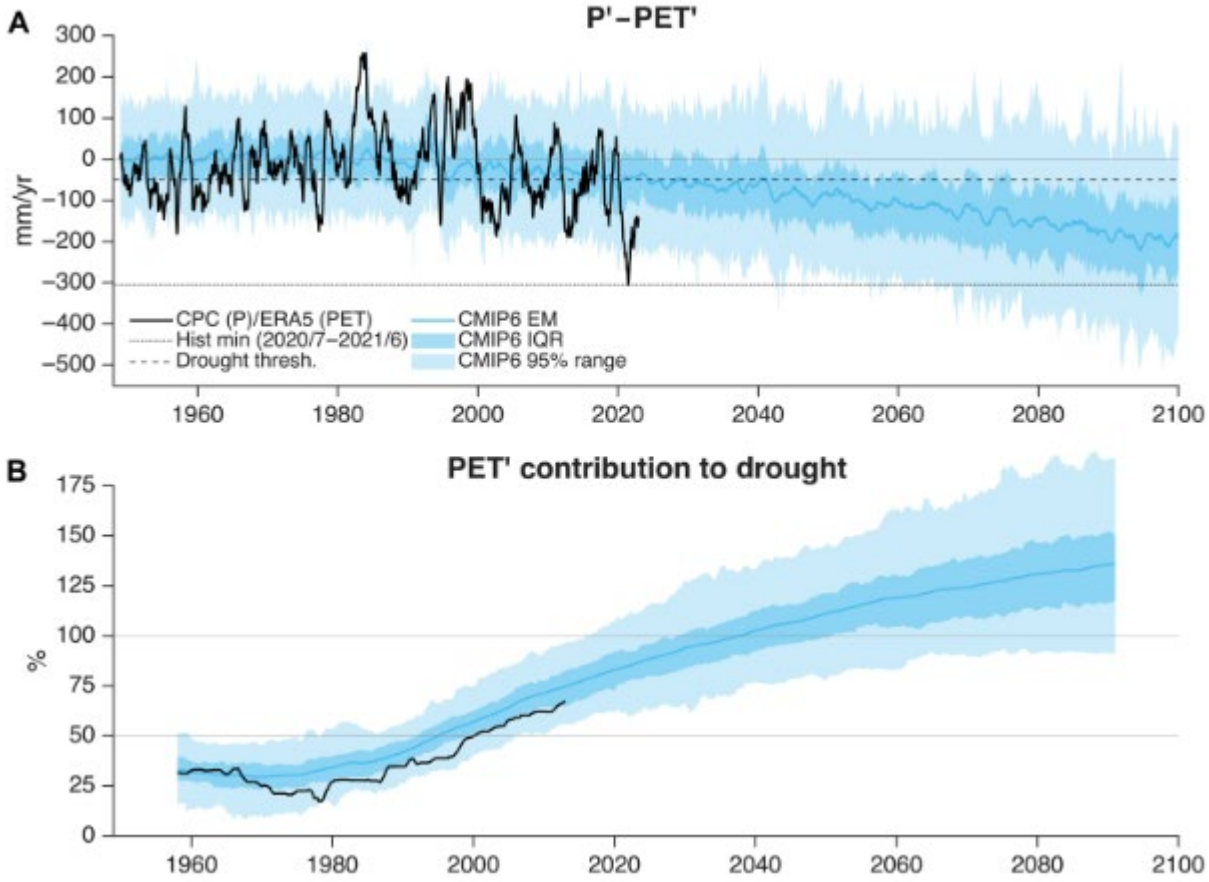
Changes to Supply



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Oregon GDE Atlas 2022

Threats to GDEs - Change in Snow Water Equivalent (RCP 8.5)

- 98 - 100% Decline
- 93 - 97% Decline
- 88 - 92% Decline
- 69 - 87% Decline
- 26 - 68% Decline

Orienting Features

- Highways
- Counties
- Lakes

The slow melt of snowpack is the most effective way to recharge aquifers and provide late-season streamflow. Changes to snowpack will affect the amount of recharge for groundwater-dependent ecosystems, but will also emphasize the ecological importance of GDEs for providing late-season flows and perennially-available water. Snow water equivalent (SWE) is the amount of water found within the snowpack. SWE is projected to decrease significantly across Oregon by the 2070 – 2099 timeframe under the high-emission RCP 8.5 climate scenario, in some cases decreasing by up to 98% relative to historical means.

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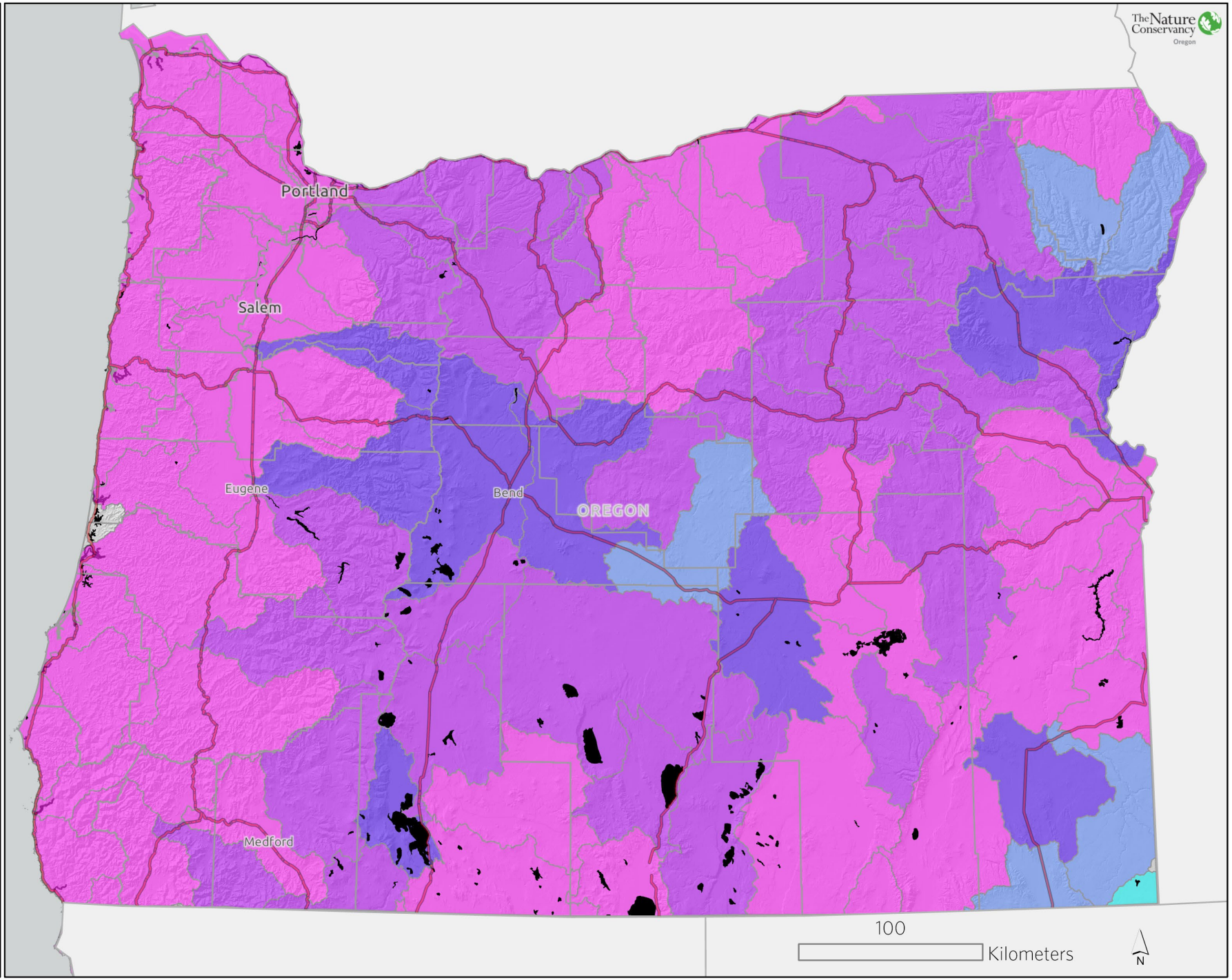

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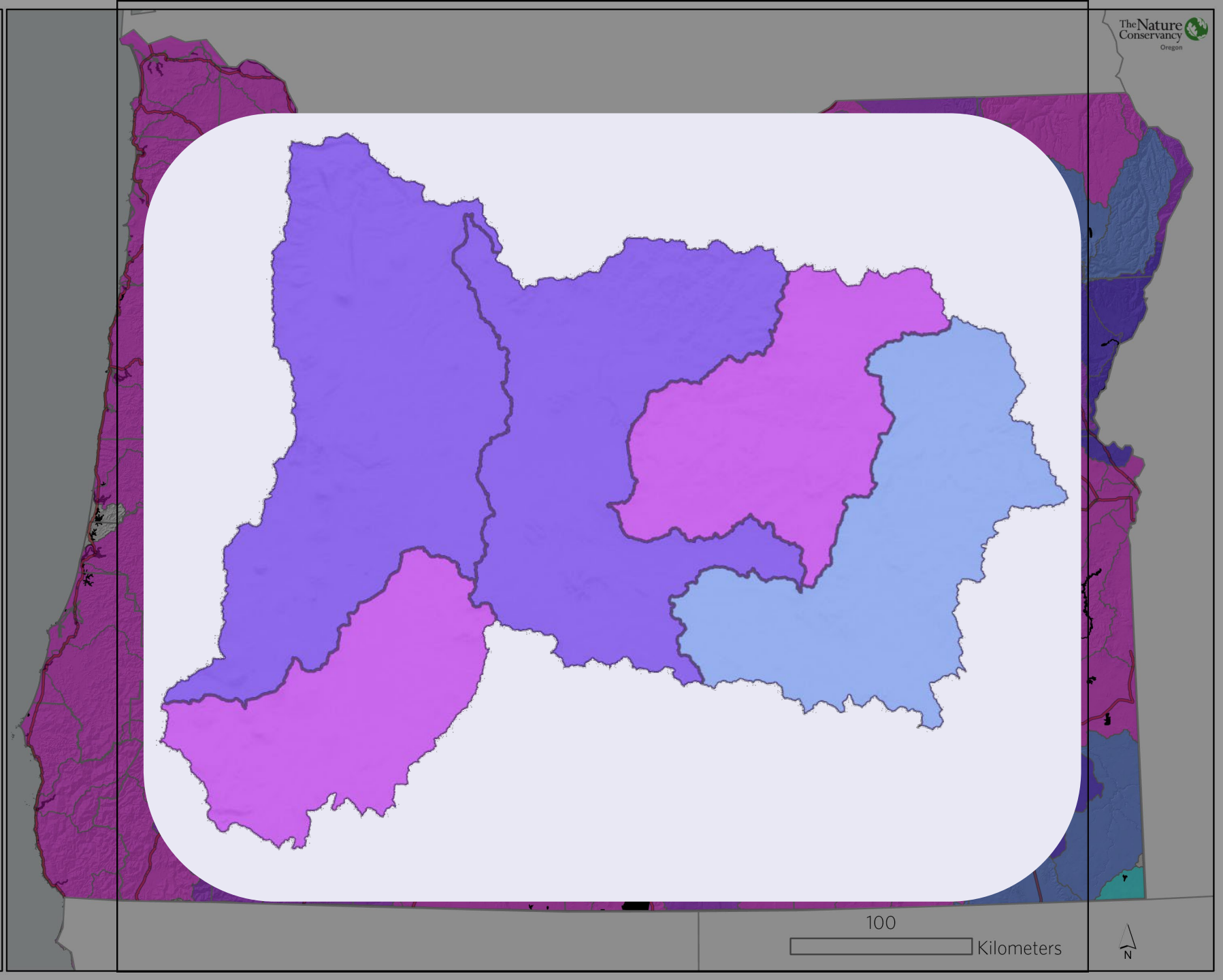

Freed et al. 2022

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Threats to GDEs - Change in Evapo-transpiration (RCP 8.5)

- 17.4 - 24.5% Increase
- 12.2 - 17.3% Increase
- 8.7 - 12.1% Increase
- 6.0 - 8.6% Increase
- 3.1 - 5.9% Increase

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Actual evapotranspiration has direct and indirect impacts to GDEs. Evapotranspiration demand for water from plants and open-water evaporation will influence water availability and community composition for all GDEs, but especially wetlands and phreatophytes. Evapotranspiration will also result in increased human water demand, exacerbating existing stressors to all GDEs. Future projected actual evapotranspiration for the years 2070 – 2099 will substantially increase throughout the state under the high-emission RCP 8.5 climate scenario relative to historical means.

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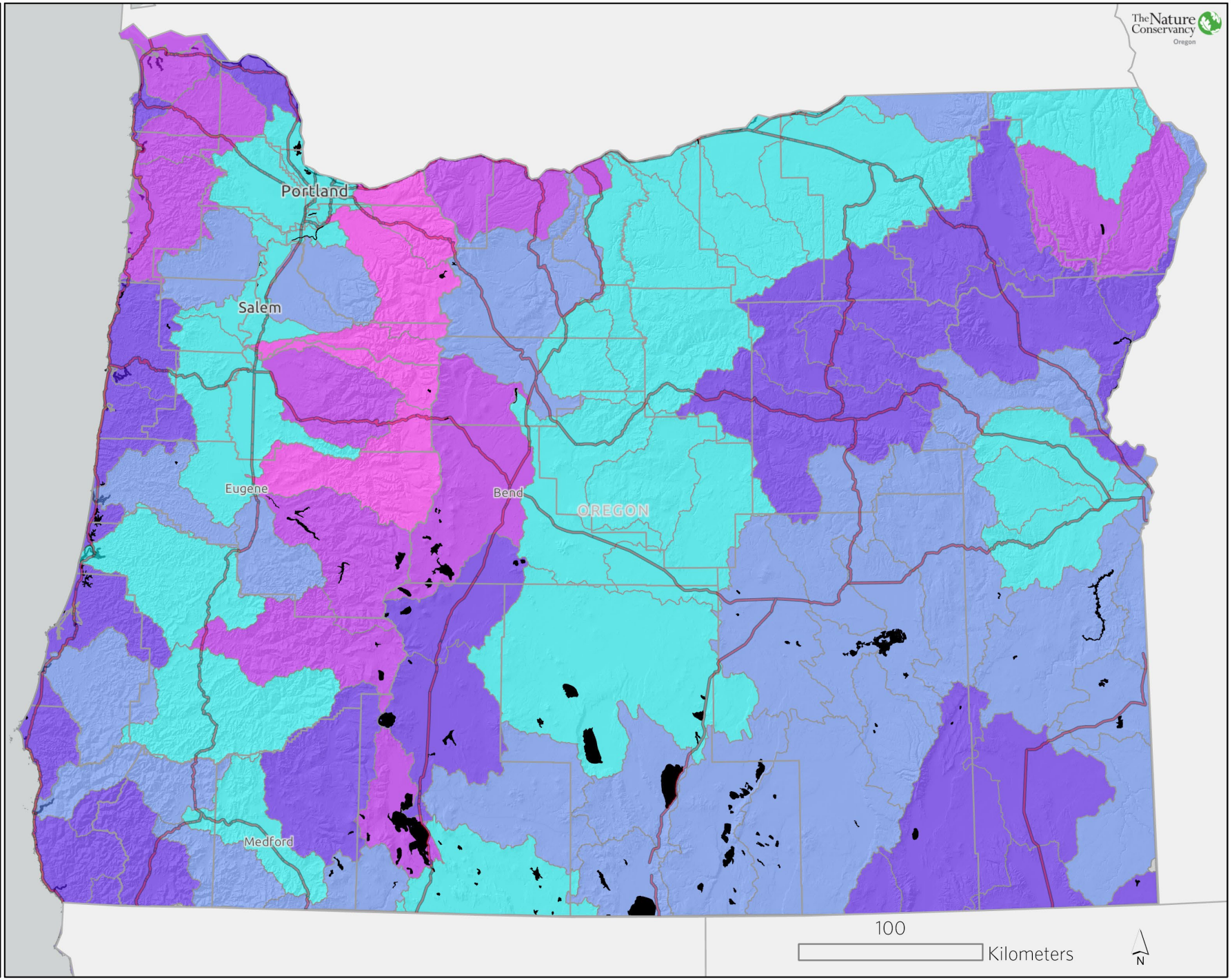

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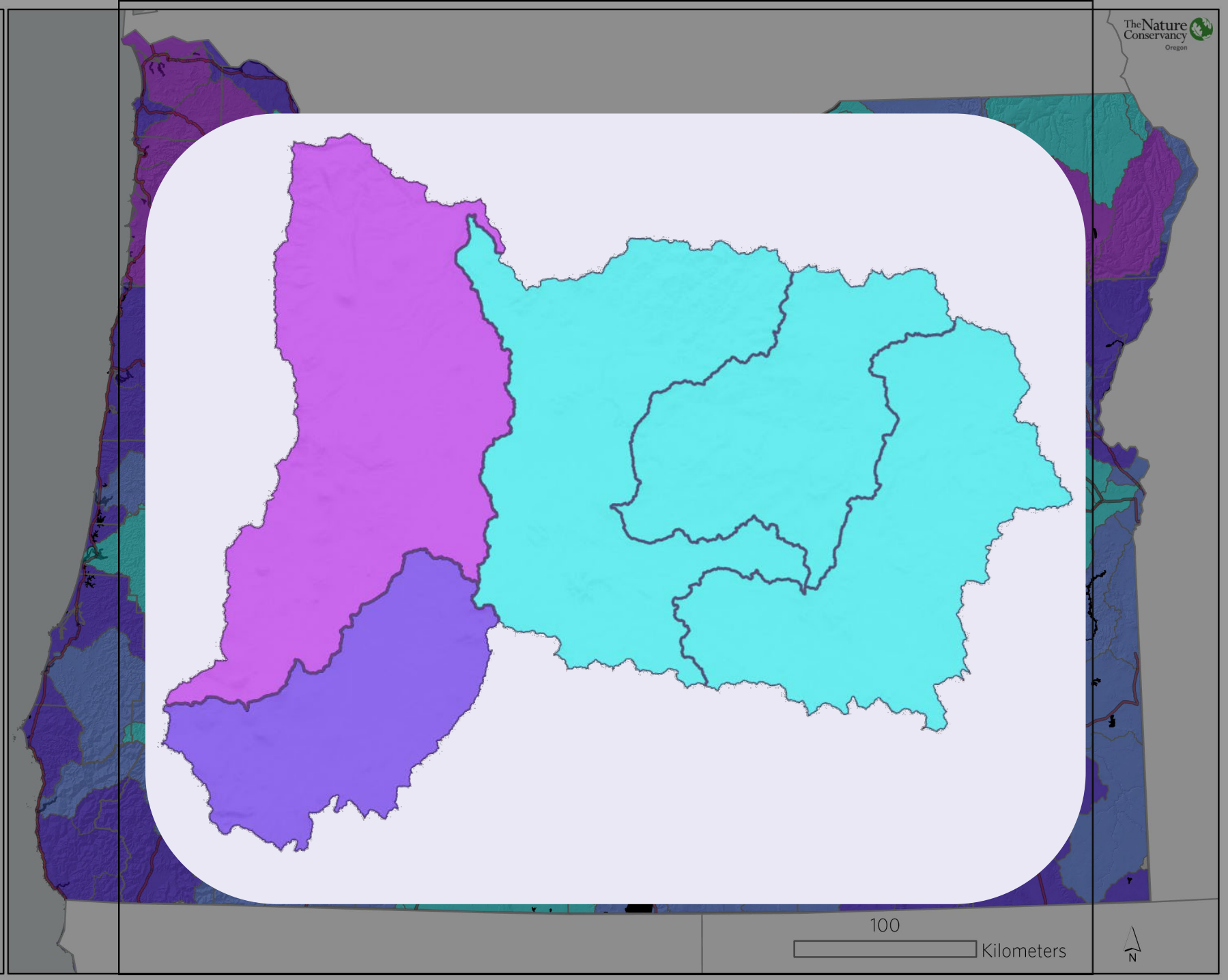

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