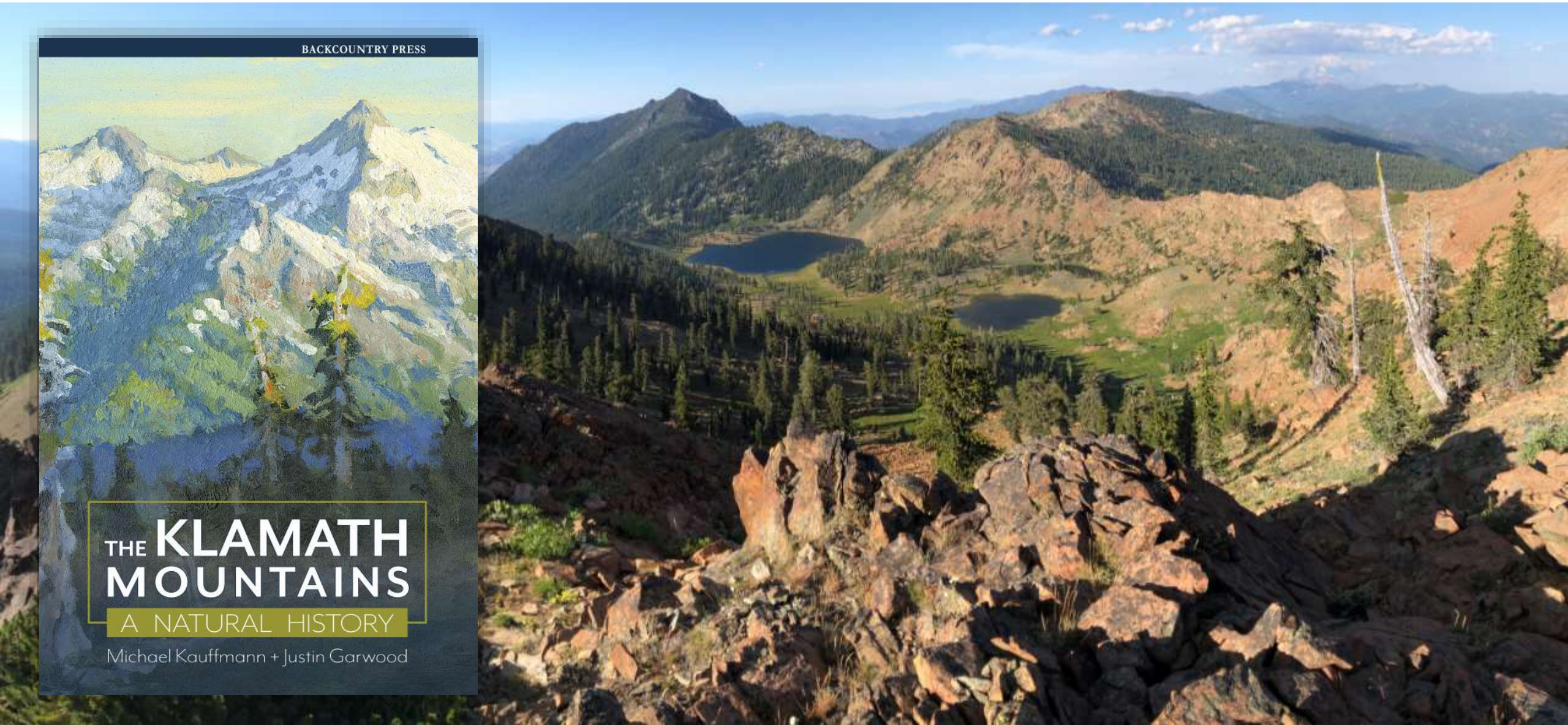
THE KLAMATH MOUNTAINS
A NATURAL HISTORY

THE KLAMATH MOUNTAINS
A LOVE STORY



THE KLAMATH MOUNTAINS ARE A GIFT

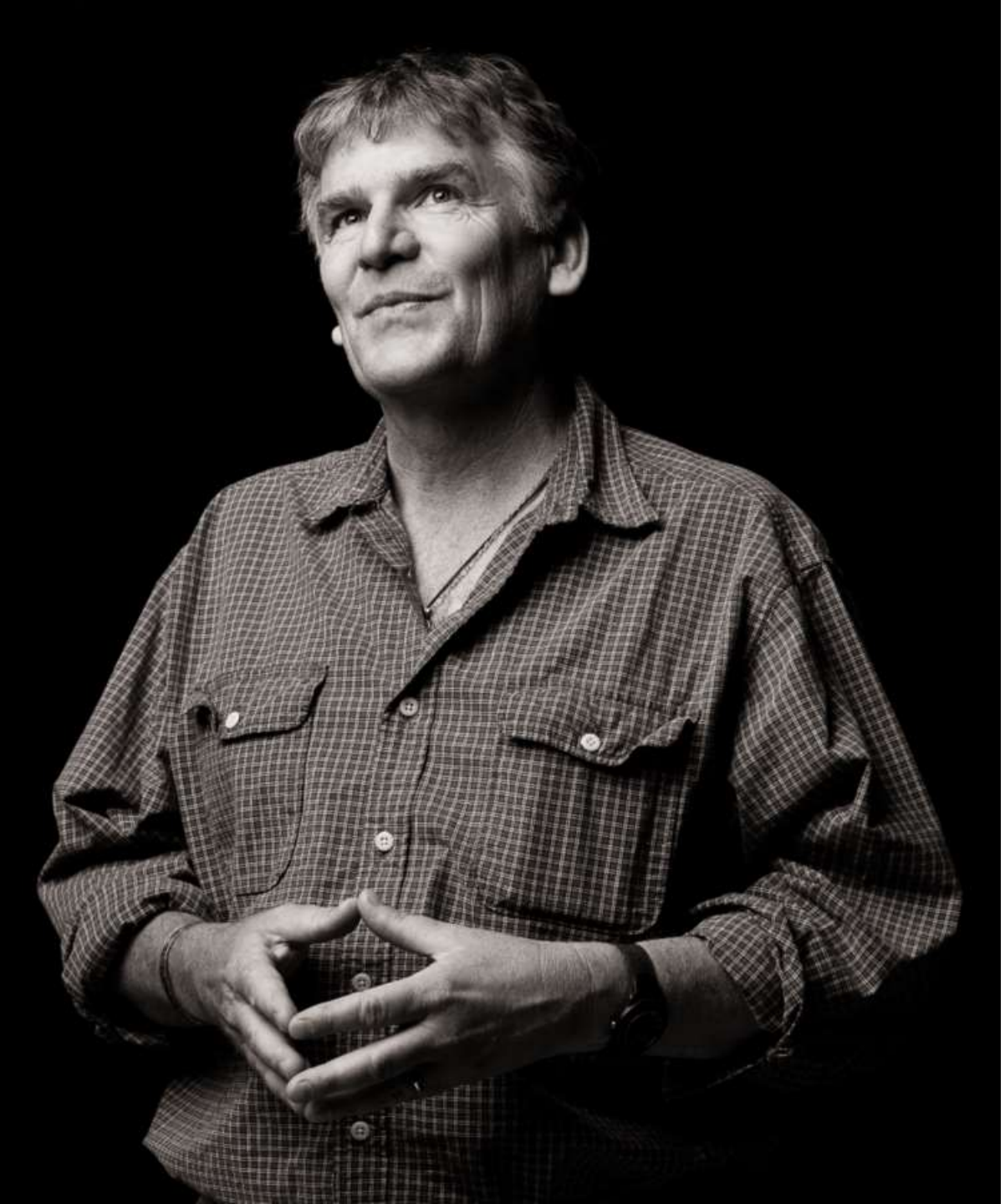
Two Assumptions For Understanding Natural History and Its Importance:

- The Earth is a gift, not a problem
- Loving the Earth is as important as grieving for it

Discussing Love

What fosters passion and love for the Natural World?

Natural History!



"Natural History is the practice of intentional, focused attentiveness and receptivity to the more-than-human world, guided by honesty and accuracy."

- Tom Fleischner, 2003

LOVING THE EARTH LEADS TO CARING, STEWARDSHIP, AND SUSTAINABILITY

Natural History

↓

Love of the Earth

↓

Caring for the Earth

↓

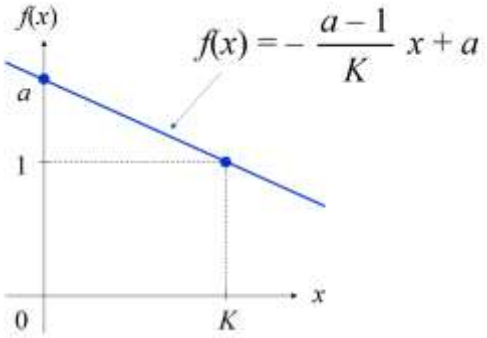
Sustainability

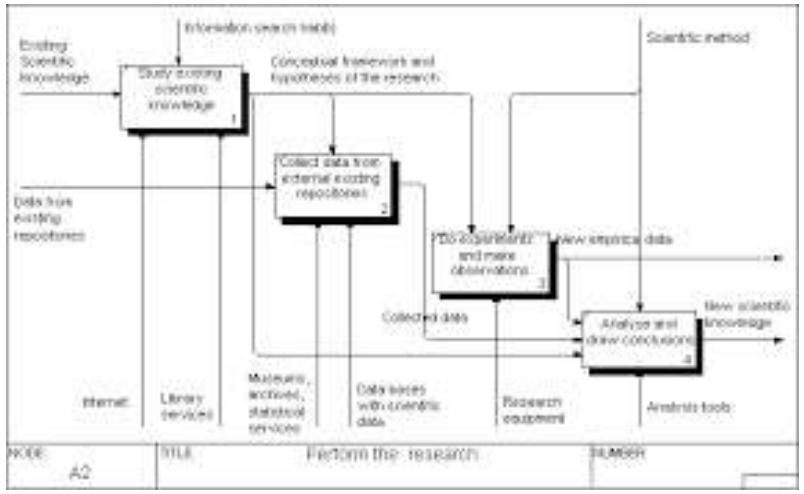
NATURAL HISTORY IS A PRACTICE

AND HUMANS HAVE EVOLVED TO PRACTICE IT

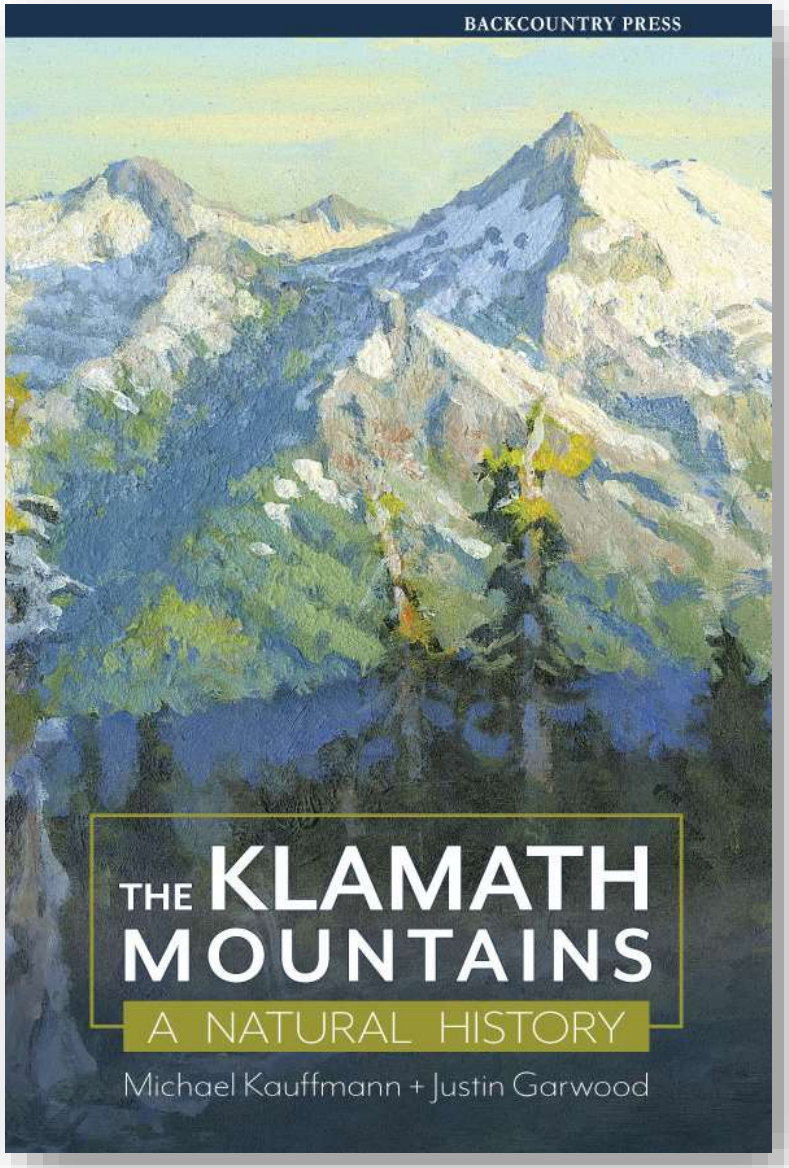
HUMANS UNDERSTAND THE WORLD **THROUGH STORIES**

UNFORTUNATELY, NOT ALL ECOLOGICAL STORIES ARE COMPELLING TO ALL





Our love story for the Klamath Mountains



1) Prologue • David Rains Wallace
2) Klamath as a Teacher • Keith Parker, Matt Johnson, Dawn Blake, & Charley Reed
3) First Peoples • Frank Lake
4) Western Science Arrives • Jim Agee
5) Geology • Mark Bailey
6) Climate • Rosemary Sherriff, Justin Garwood, & Michael Kauffmann
7) Water • Tim Palmer & Justin Garwood
8) Fire Ecology • Jeffrey Kane
9) Cryptogams • Michael Kauffmann, Jordan Mayor, Dana York, Tom Carlberg, Eric Peterson, and Lucy Kerhoulas
10) Plant Communities • Michael Kauffmann, Julie Evens, Julie Kierstead, Michael Murray
11) Forest Insects and Pathogens • Chris Lee
12) Invertebrates • Michael Kauffmann, Justin Garwood, Len Mazur, Brian Dykstra, Rod Crawford, Dana Ross, and Paul Hammond
13) Vertebrates
    1) Fishes • Justin Garwood & Andrew P. Kinziger
    2) Amphibians • Justin Garwood
    3) Reptiles • Chris Feldman & Justin Garwood
    4) Birds • Greg Gray, Michael Kauffmann, Dan Barton, & Tiana Williams-Claussen
    5) Mammals • Karen Reiss, Michael Kauffmann, and Chris Feldman
14) Change and Stewardship

THE STORY OF THE KLAMATH MOUNTAINS

Patterns

Relationships

Diversity & Adaptations

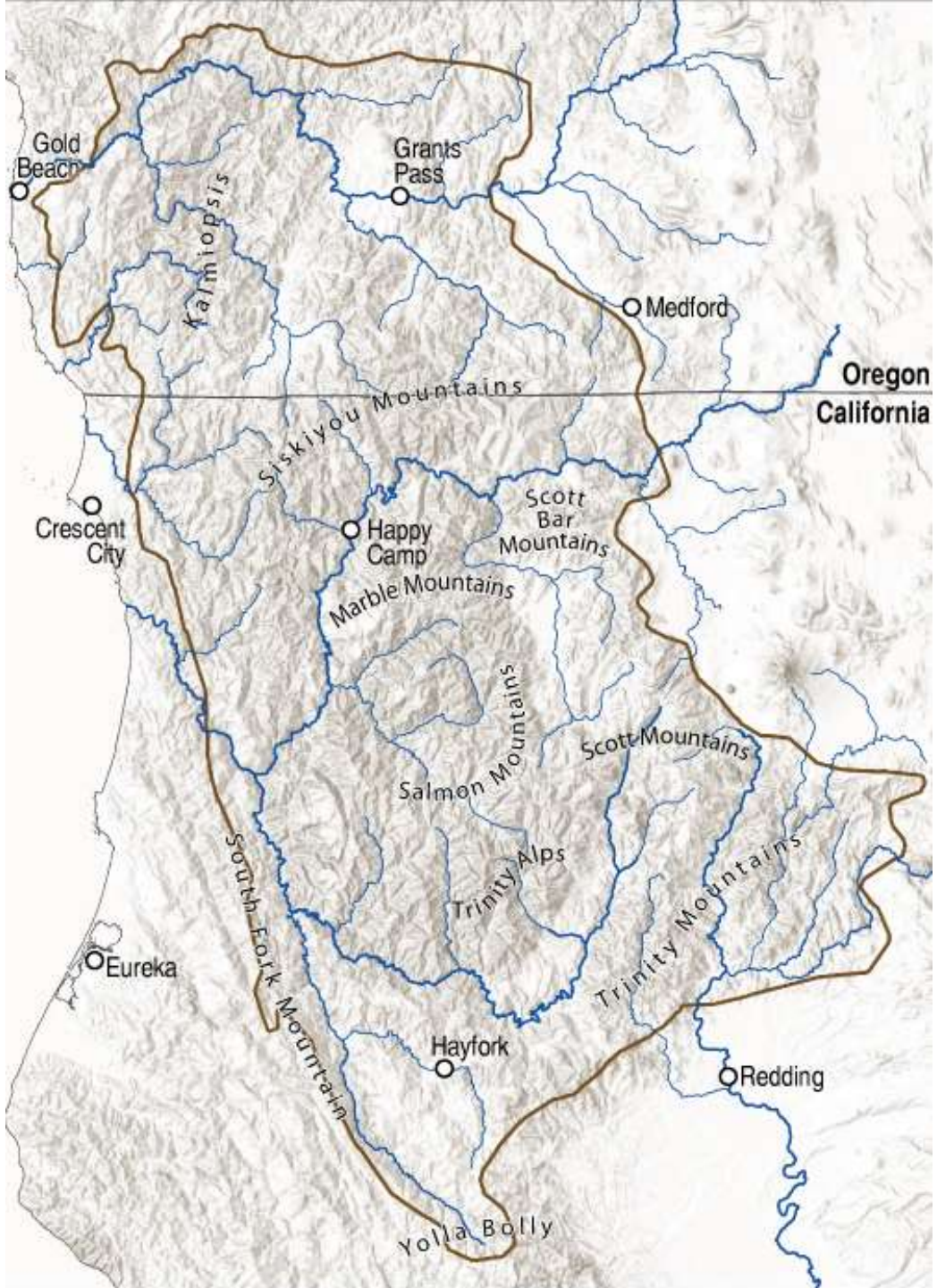
Perseverance

IN FOUR (BRIEF) PARTS

PATTERNS

The Klamath Mountain

Geomorphic Province

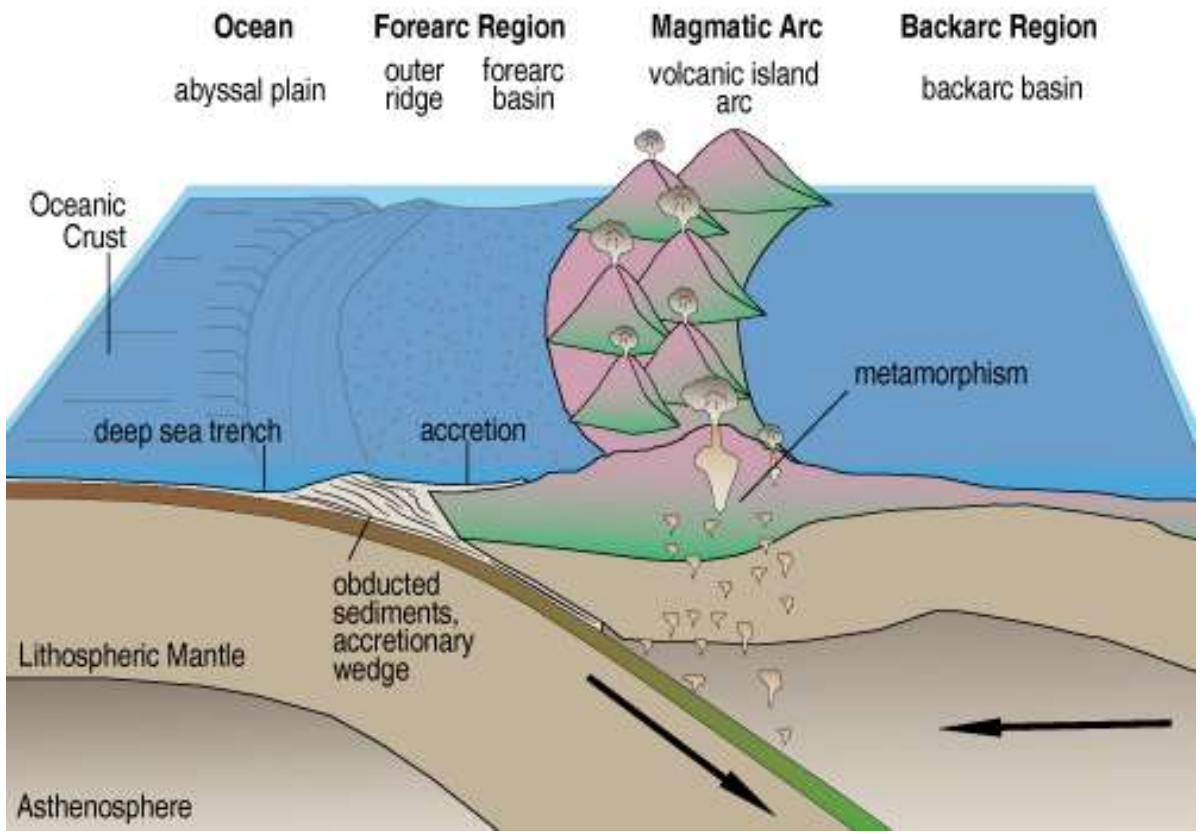


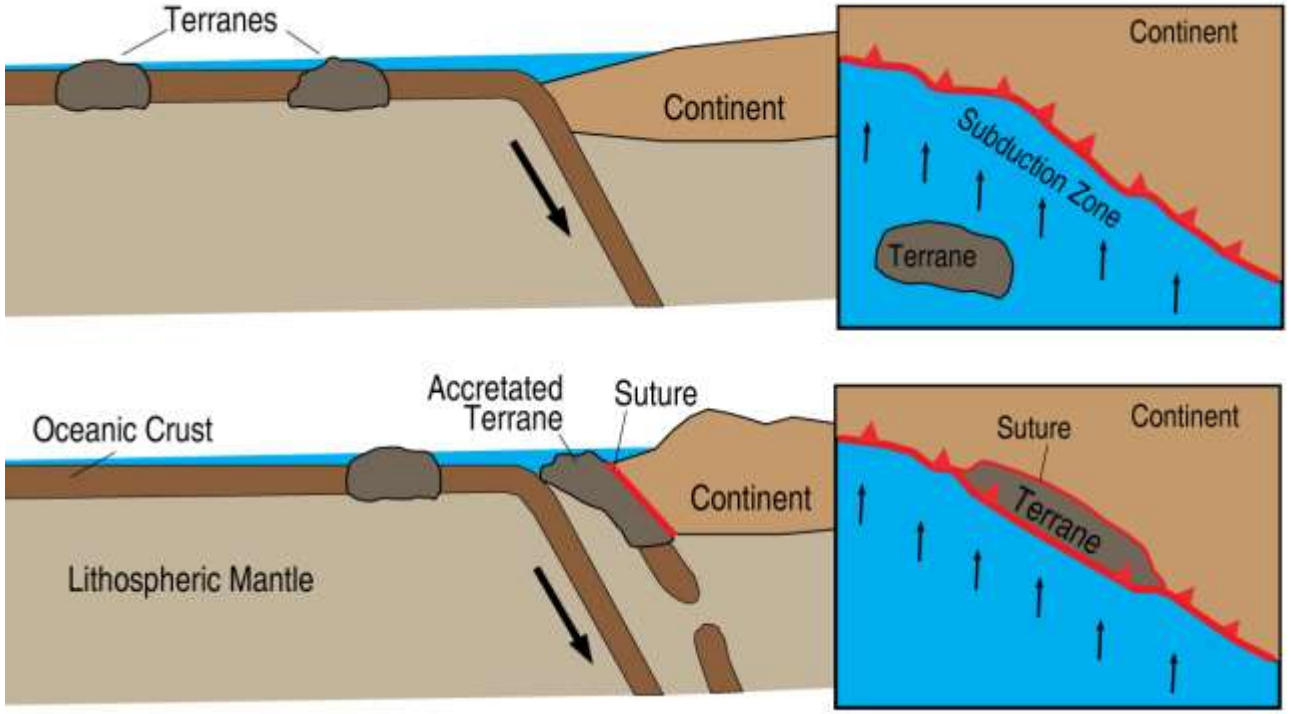
"So overlooked are some of these mountain areas that they have escaped appellation and remain anonymous in the truest sense of the word."

—Bubba Suess

BUT HOW WAS THIS COMPLEX GEOMORPHIC PROVINCE FORMED?

ISLAND ARC TERRANE ACCRETIONS



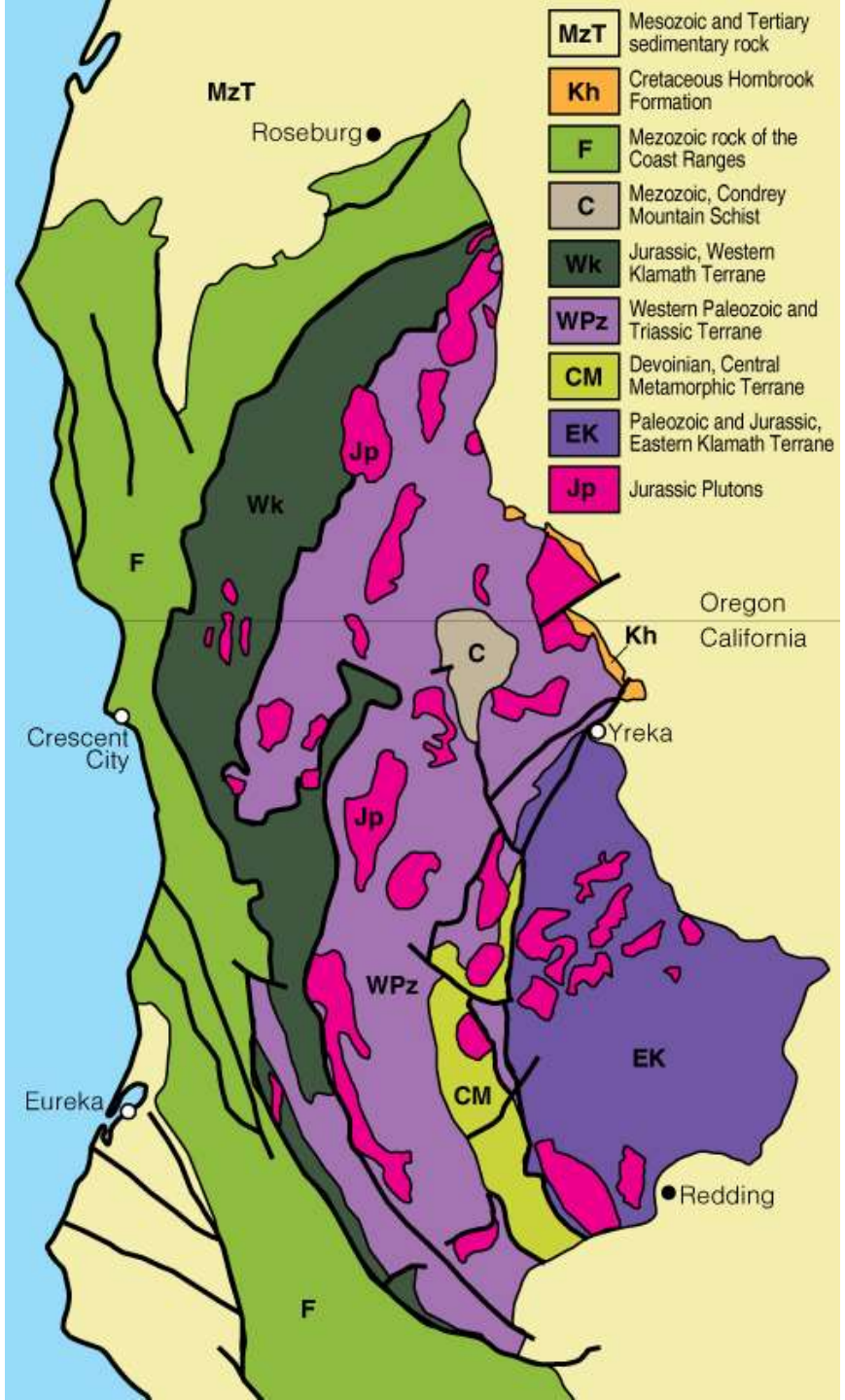


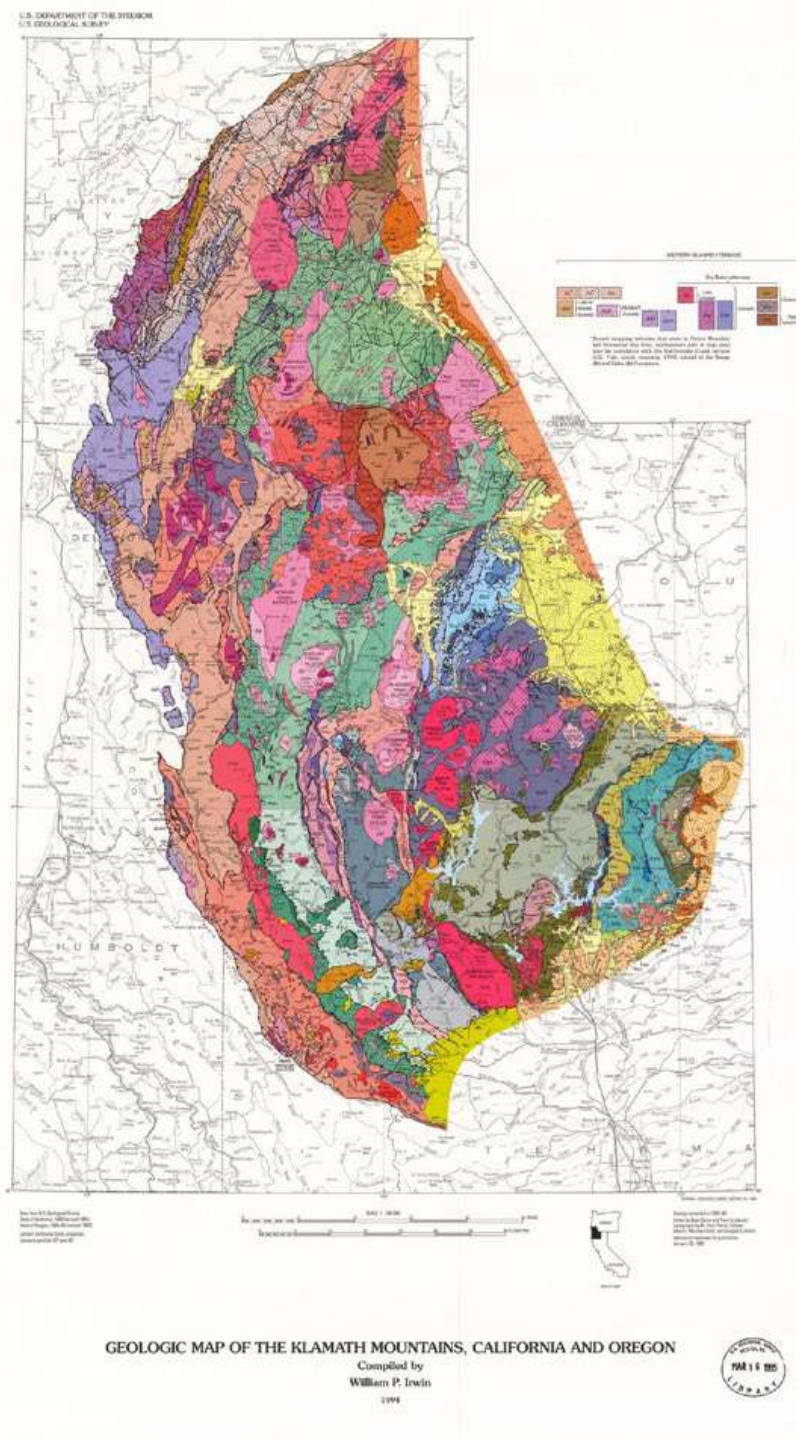
Adapted from Blakey and Ranney (2018)

The Klamath Mountains

Geological Patterns

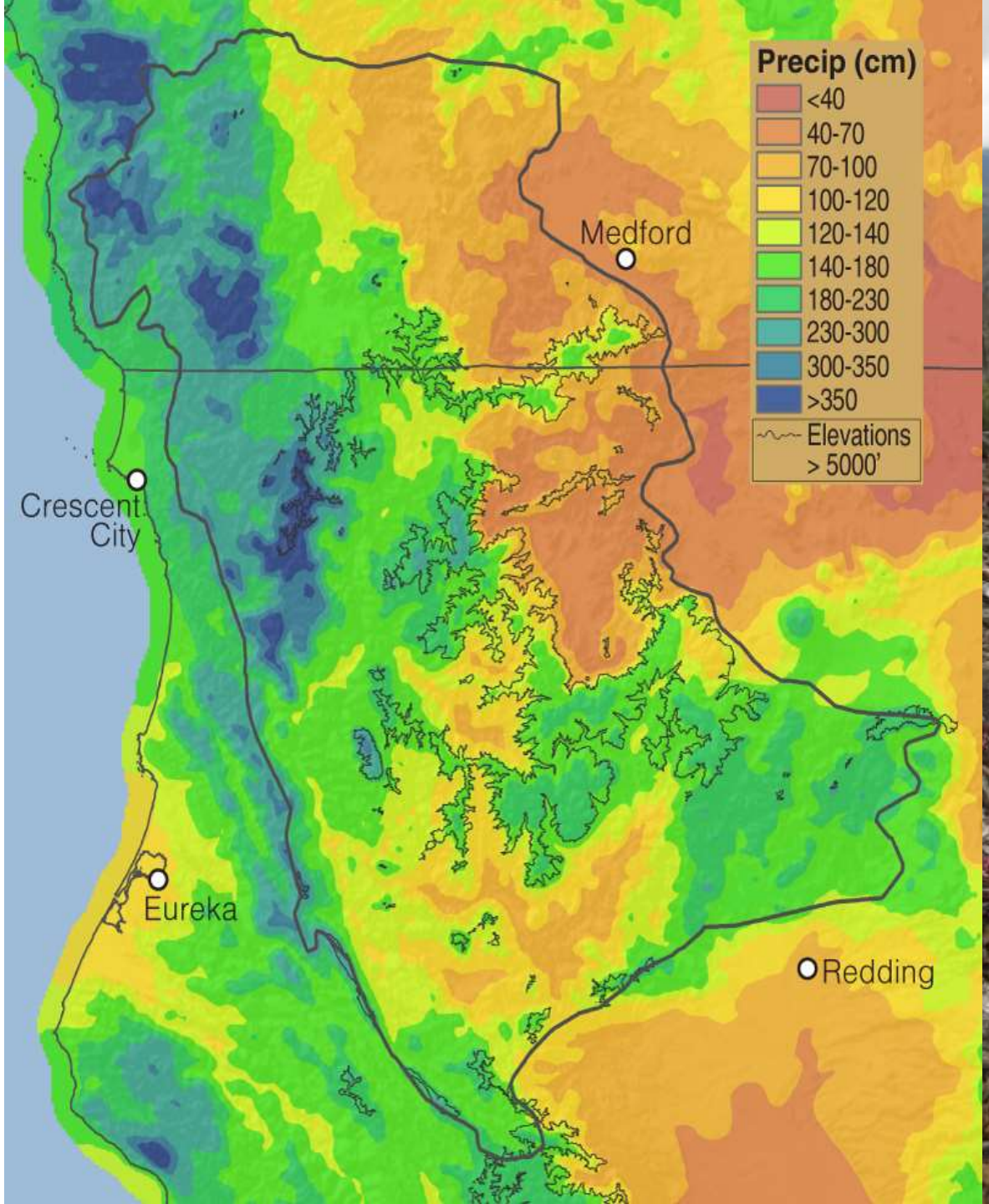
After Irwin (1994)

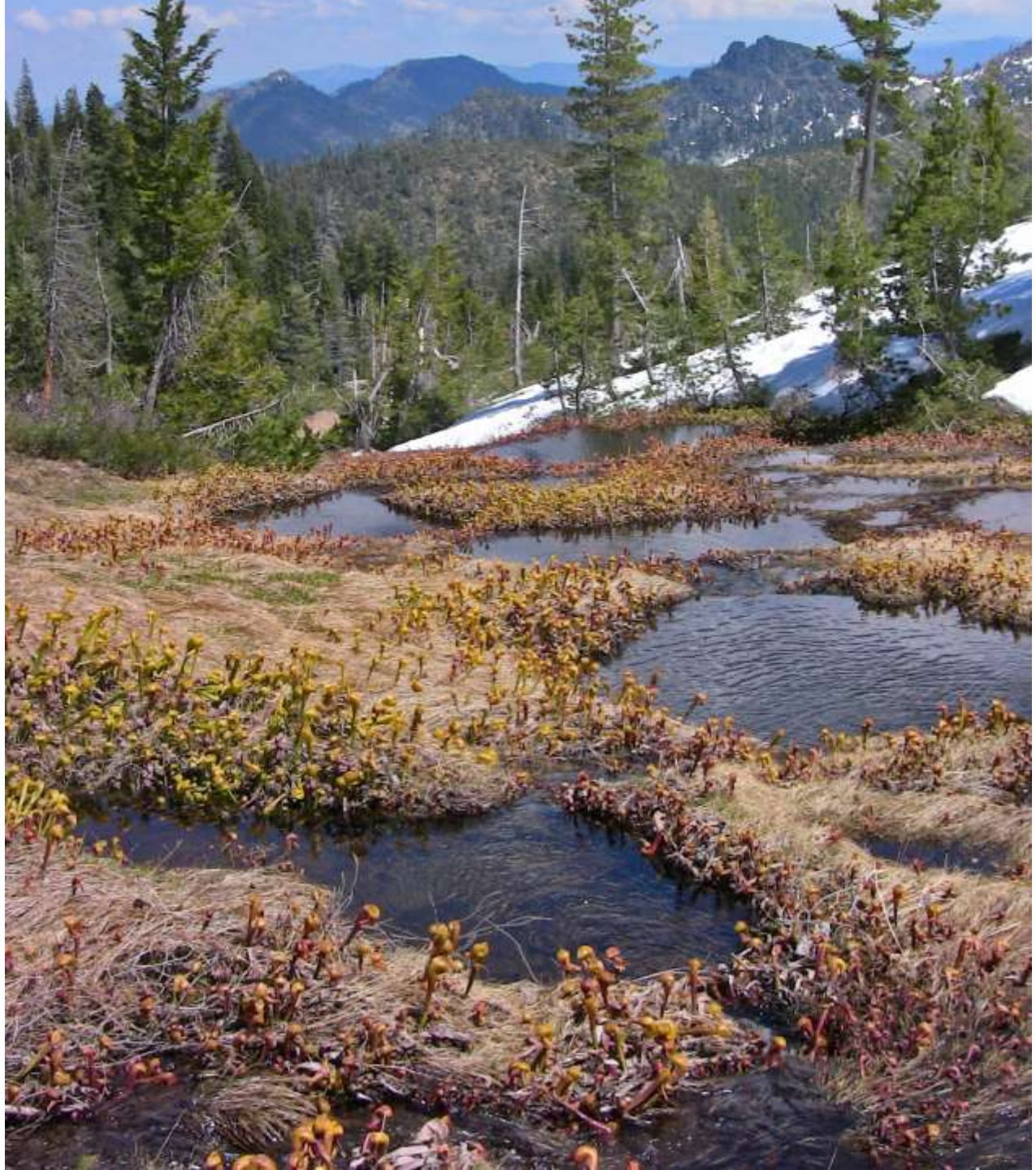




The Klamath Mountains

Climate Regimes





Plant Communities

- Michael Kauffmann
- Julie Evens
- Julie Kierstead
- Michael Murray
- John Sawyer

Coastal Lowland Forests

Serpentines

BIODIVERSITY & ADAPTATIONS

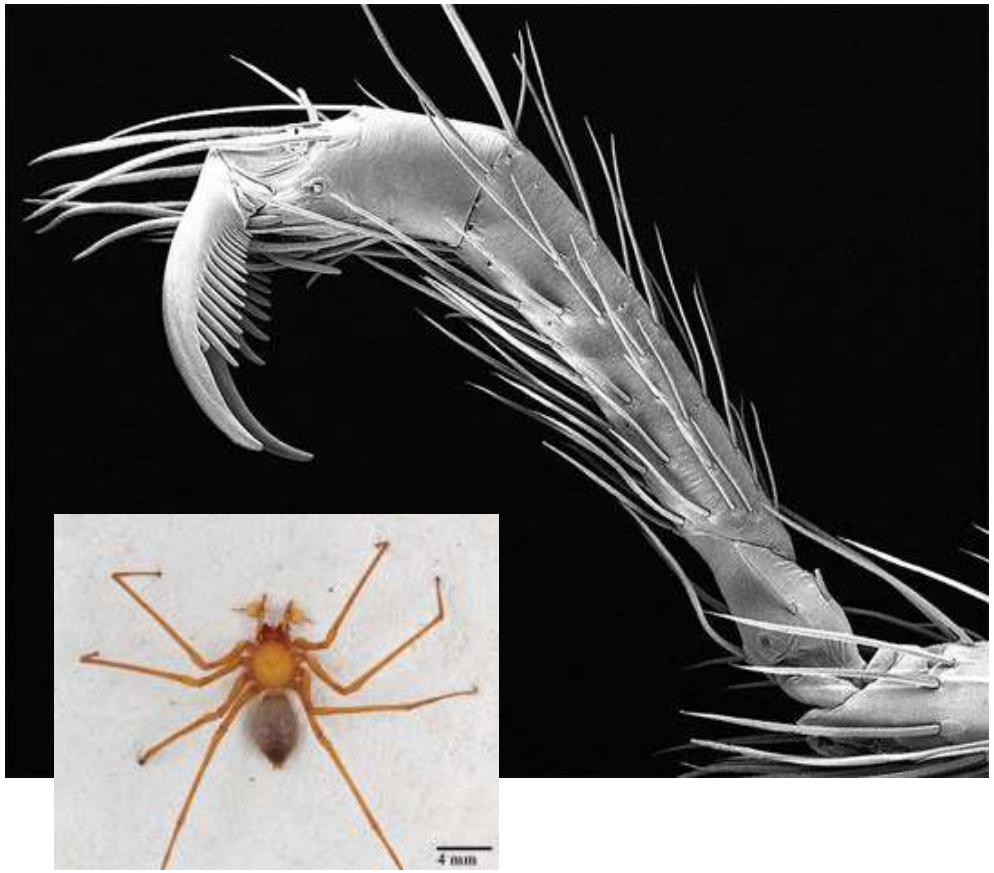

Charles Griswold


Spencer Riffle

OBLIGATE SUBTERRANEAN INVERTEBRATES

Graham's Cave Scorpion (*Uroctonus grahami*).
Photo by Warren E Savary.

The unique hooked claw of *Trogloraptor marchingtoni*.
Photo by Charles E. Griswold.



AMPHIBIANS

PHOTOS BY SPENCER RIFFLE

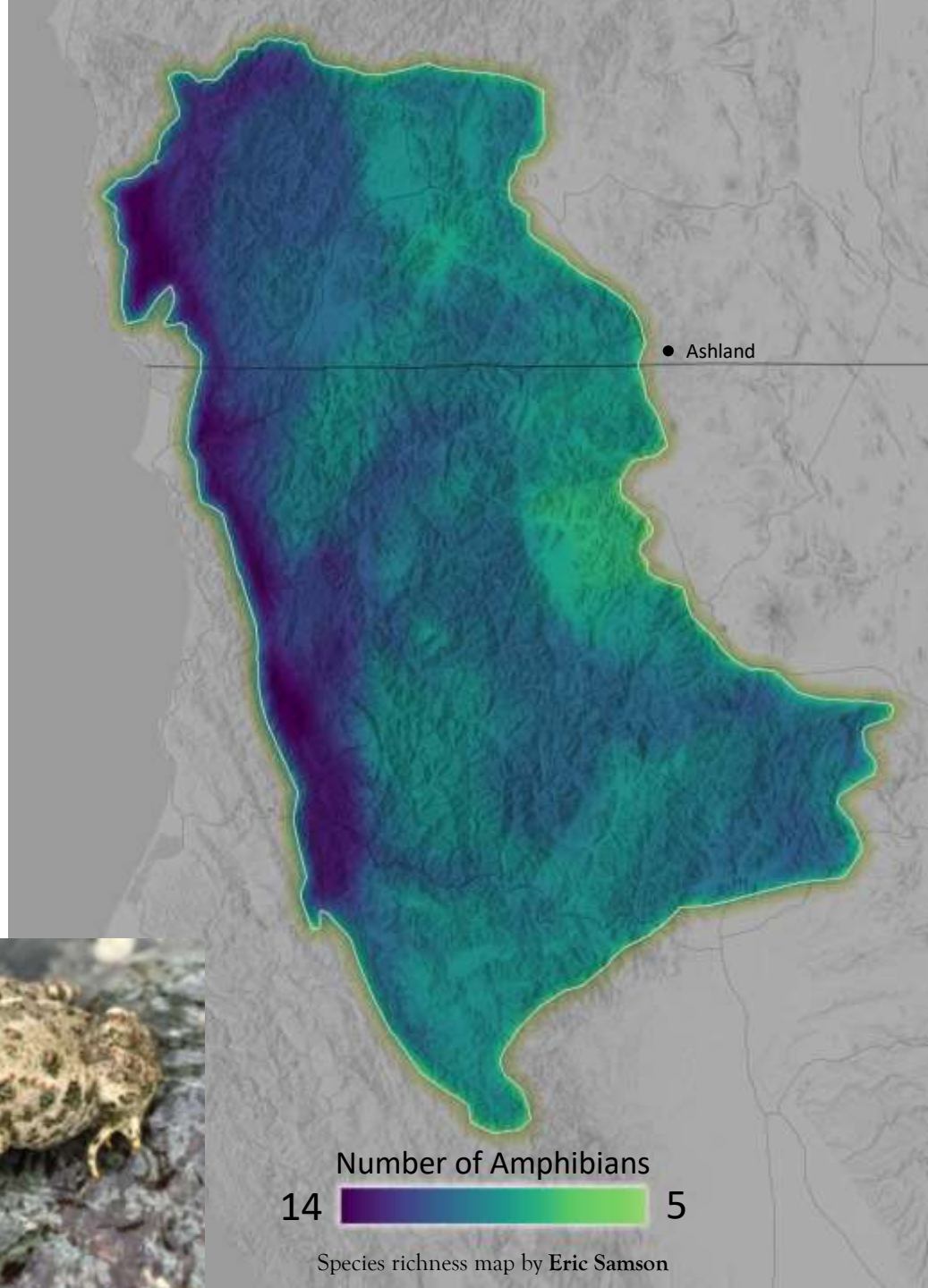
AMPHIBIANS

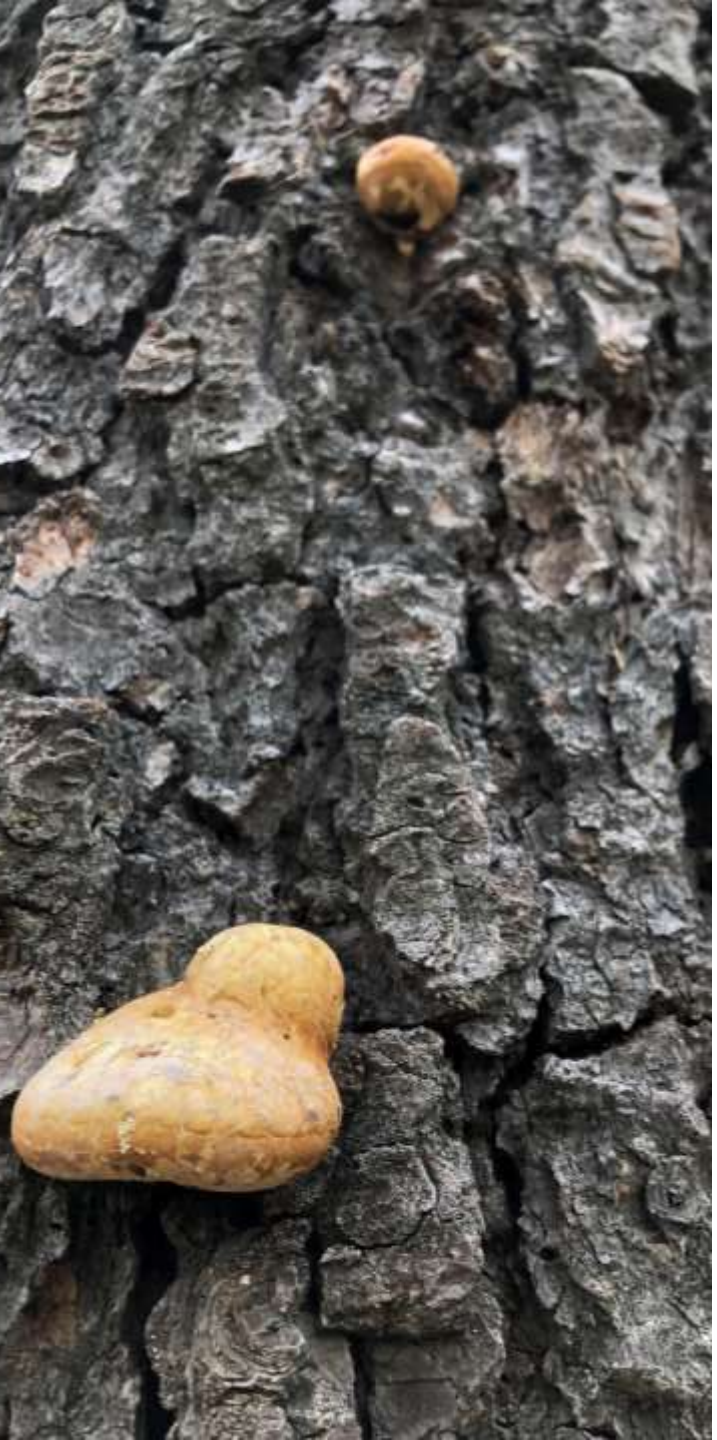
9 Families

26 Species (6 frogs, 20 Salamanders)

32% Regionally Endemic

48% Aquatic

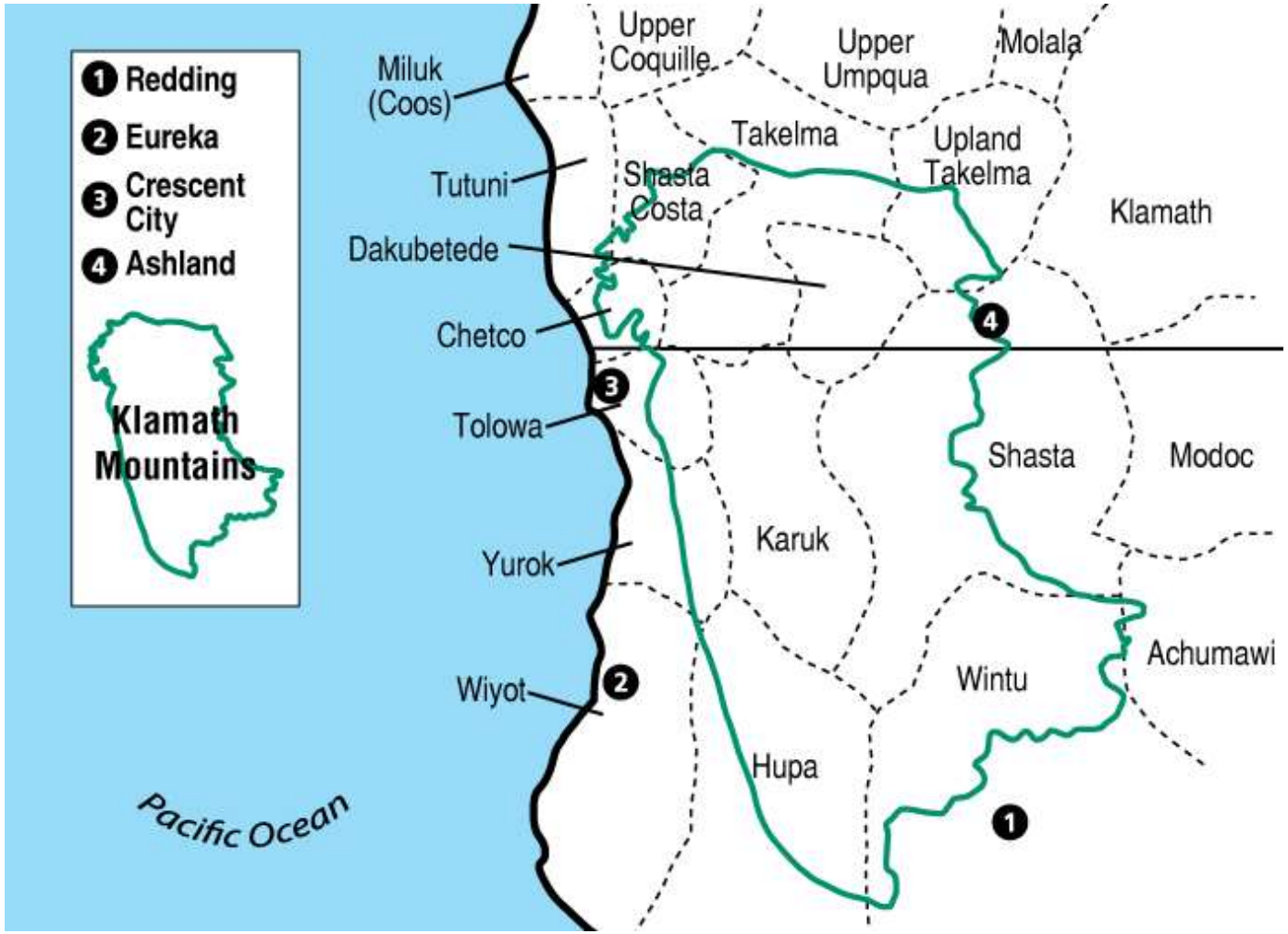




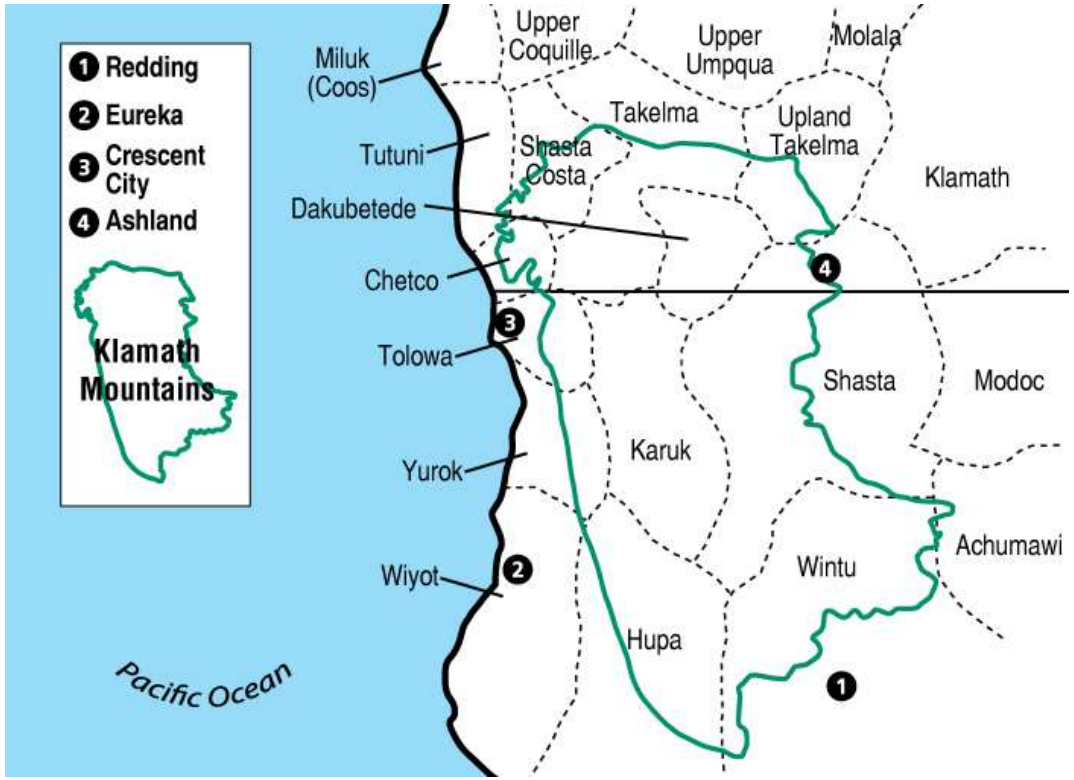
RELATIONSHIPS

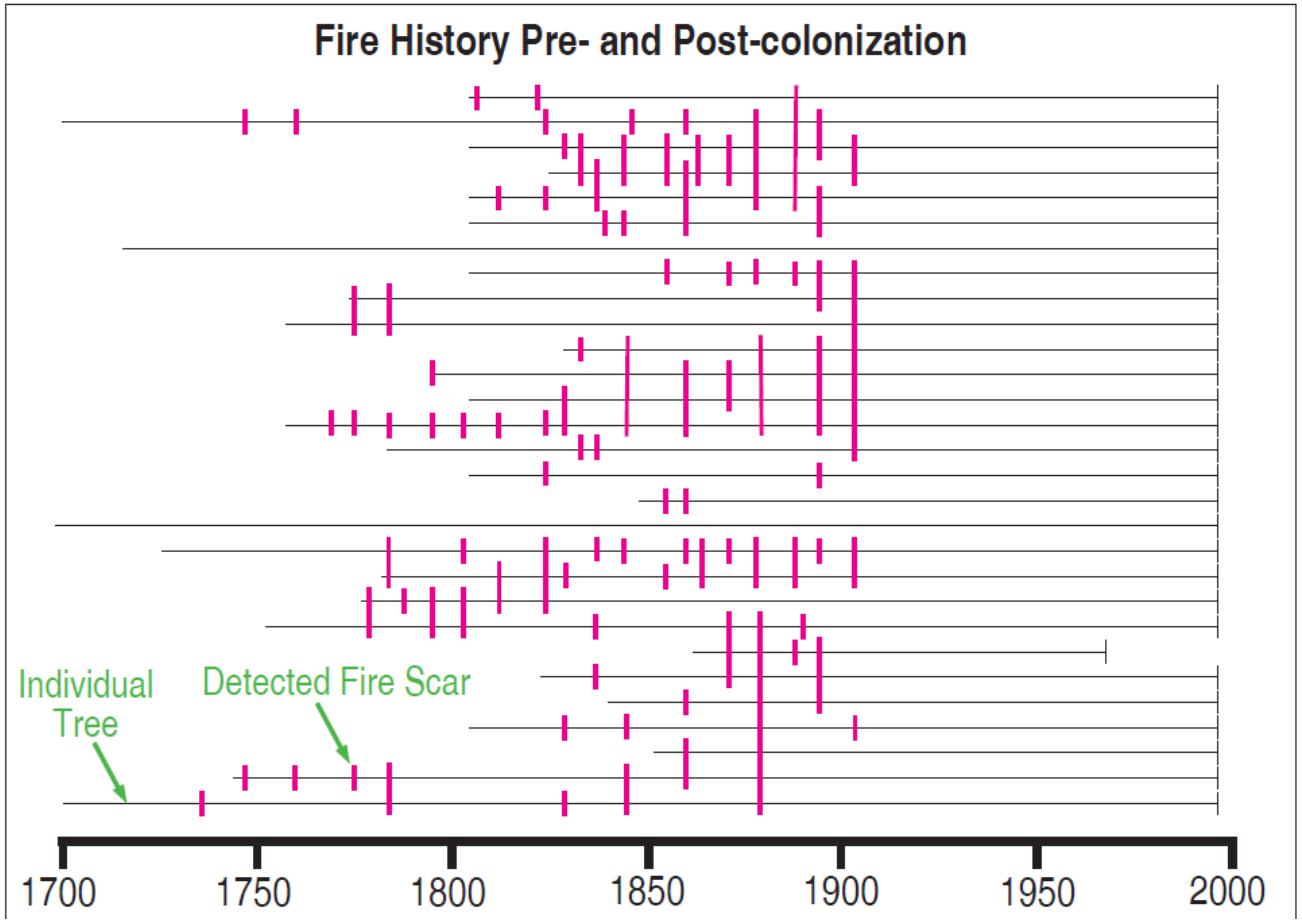
The Klamath Mountains

First People



INDIGENOUS FIRE





Adapted from Carl Skinner, unpublished reports.

PERSEVERANCE

Samwell Cave

- In the early 1900s, John C. Merriam and Annie Alexander began documenting the caves of the eastern Klamath Mountains.
- They unearthed late Triassic marine reptiles and Pleistocene fossils.
- Collections are stored in the University of California Museum of Paleontology in Berkeley.
- Specimens continue to be used to refine our understanding of how California today relates to the Pleistocene.

Window into the past

Euceratherium collinum (shrub-ox)

Table 2: Select Mammalian fossils deposits in Samwell and Potter Creek Caves, Klamath Mountains. Based on Feranec 2007 & 2009.
Symbols: †, extinct; ‡ recent regional extirpation, extant

Artiodactyla (deer, sheep, etc.)
†*Euceratherium collinum* (shrub-ox)
‡*Odocoileus hemionus* (pronghorn)
†*Oreamnos americanus* (mtn. goat)
‡*Ovis* sp.(bighorn sheep)

Carnivora (cats, dogs, etc.)
†*Arctodus pristinus* (short-faced bear)
†*Canis dirus* (dire wolf)
‡*Canis lupus* (grey wolf)
Lutra canadensis (river otter)
†*Panthera leo atrox* (American lion)
Spilogale gracilis (spotted skunk)
‡*Ursus arctos* (grizzly bear)

Chiroptera (bats)
Antrozous pallidus (pallid bat)
†*Desmodus stocki* (vampire bat)

Insectivora (shrews and moles)
Scapanus latimanus (broad-footed mole)

Lagamorpha (rabbits)
Lepus americanus (snowshoe hare)
Lepus californicus (jackrabbit)
‡*Sylvilagus auduboni* (desert cottontail)
Sylvilagus bachmani (brush rabbit)

Perissodactyla (horses)
†*Equus occidentalis* (western horse)

Primata
Homo sapiens (human)

Rodentia (rodents)
‡*Aplodontia rufa* (mountain beaver)
Castor canadensis (American beaver)
‡*Erethizon dorsatum* (porcupine)
Peromyscus maniculatus (deer mouse)
Thomomys bottae (Botta's pocket gopher)
†*Thomomys microdon* (pocket gopher)

Proboscidea (elephants)
†*Mammut americanum* (American Mastodon)
†*Mammuthus primigenius* (woolly mammoth)

Xenarthra (anteaters, tree sloths)
†*Nothrotheriops shastensis* (ground sloth)

Feranec 2007 & 20

WE NEED TO CONTINUE TO TELL THE STORY OF **THE KLAMATH MOUNTAINS**

LOVING THE KLAMATH MOUNTAINS LEADS TO CARING, STEWARDSHIP, AND SUSTAINABILITY

Natural History

↓

Love of the Earth

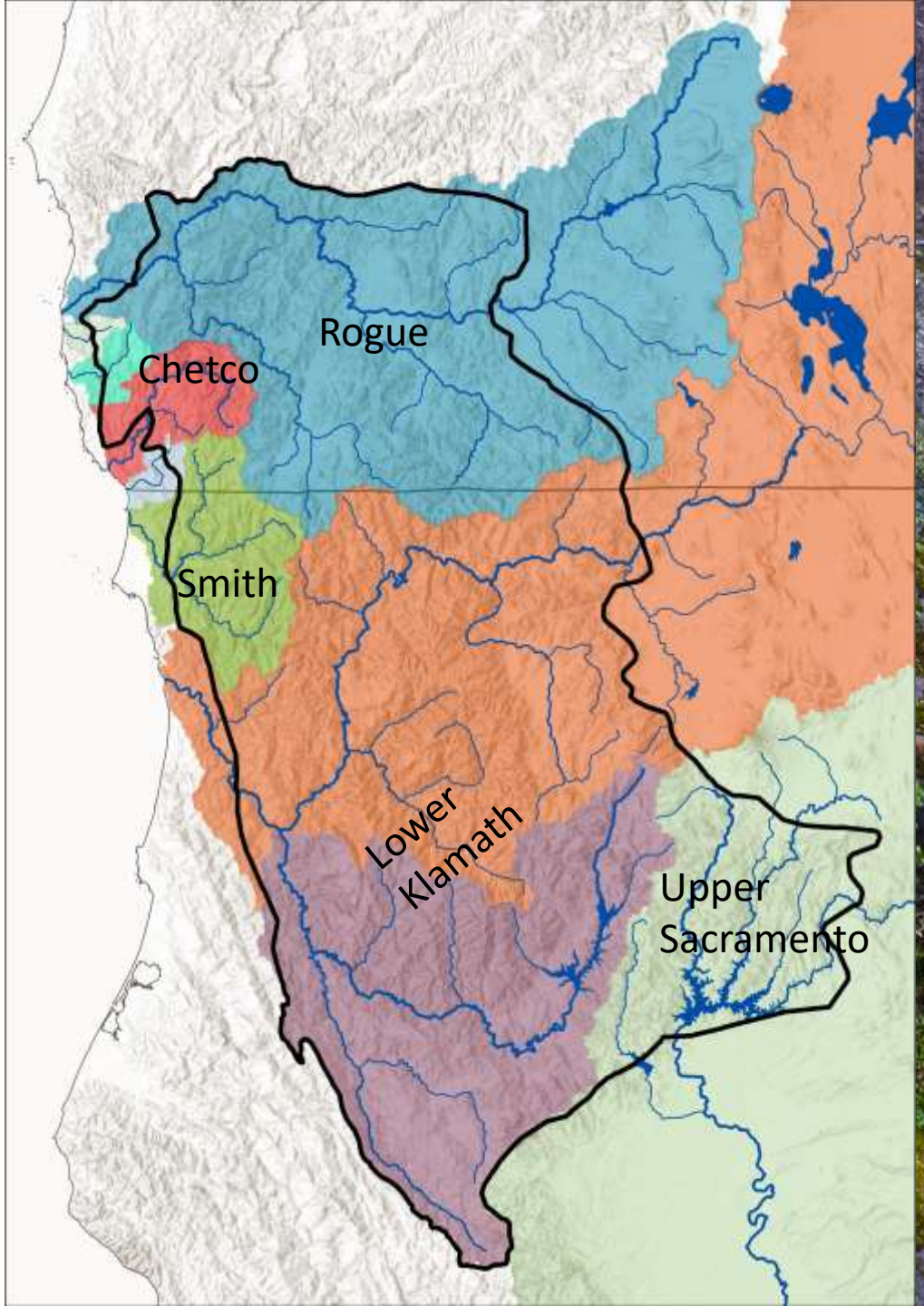
↓

Caring for the Earth

↓

Sustainability

Mountains of Water

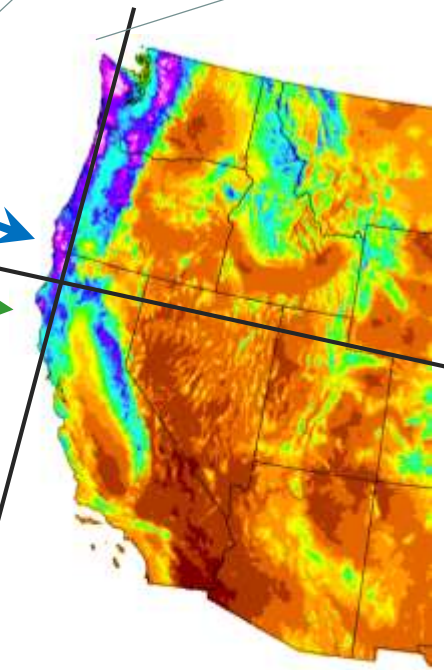


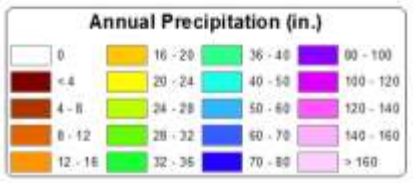
The Klamath Mountains are a Special Landscape for Salmonids

Latitude — Coastal Proximity —Tall Mountains — Geology

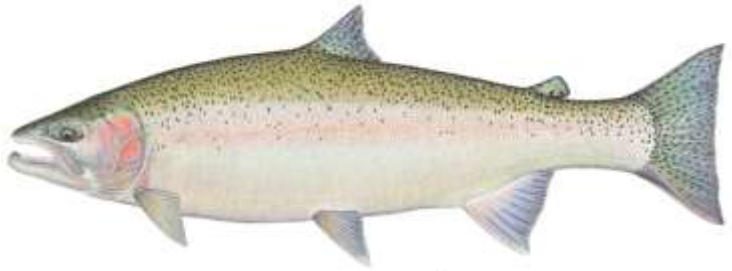
North Pacific Storm Track

Subtropical Subsidence Zone





Salmonid Life Histories of the Klamath Mountains



Drawings by **Michael Zontos**

Rainbow Trout/ Steelhead

- Freshwater
- Winter Run
- Summer Run

+ ½ Pounders

Coastal Cutthroat Trout

- Freshwater
- Potamodromous
- Anadromous

Coho Salmon

- Fall/ Winter

+ Jacks

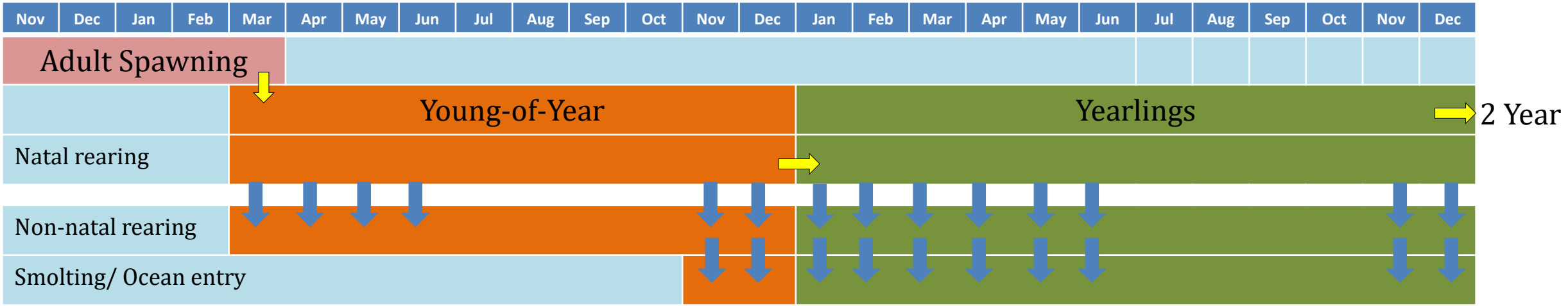
Chinook Salmon

- Spring Run
- Fall Run
- Winter Run
- Historic Summer run?

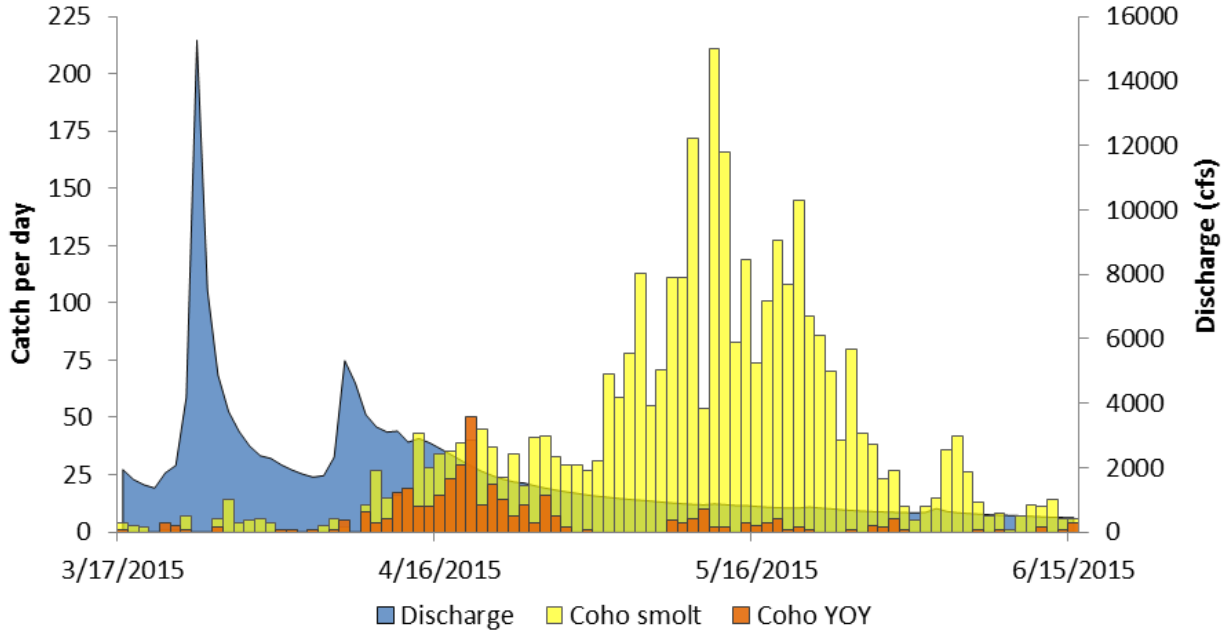
+ Jacks

Female Chinook Salmon guarding a completed redd

Generalized Coho Salmon Life History: It Takes a Basin to Raise A Fish

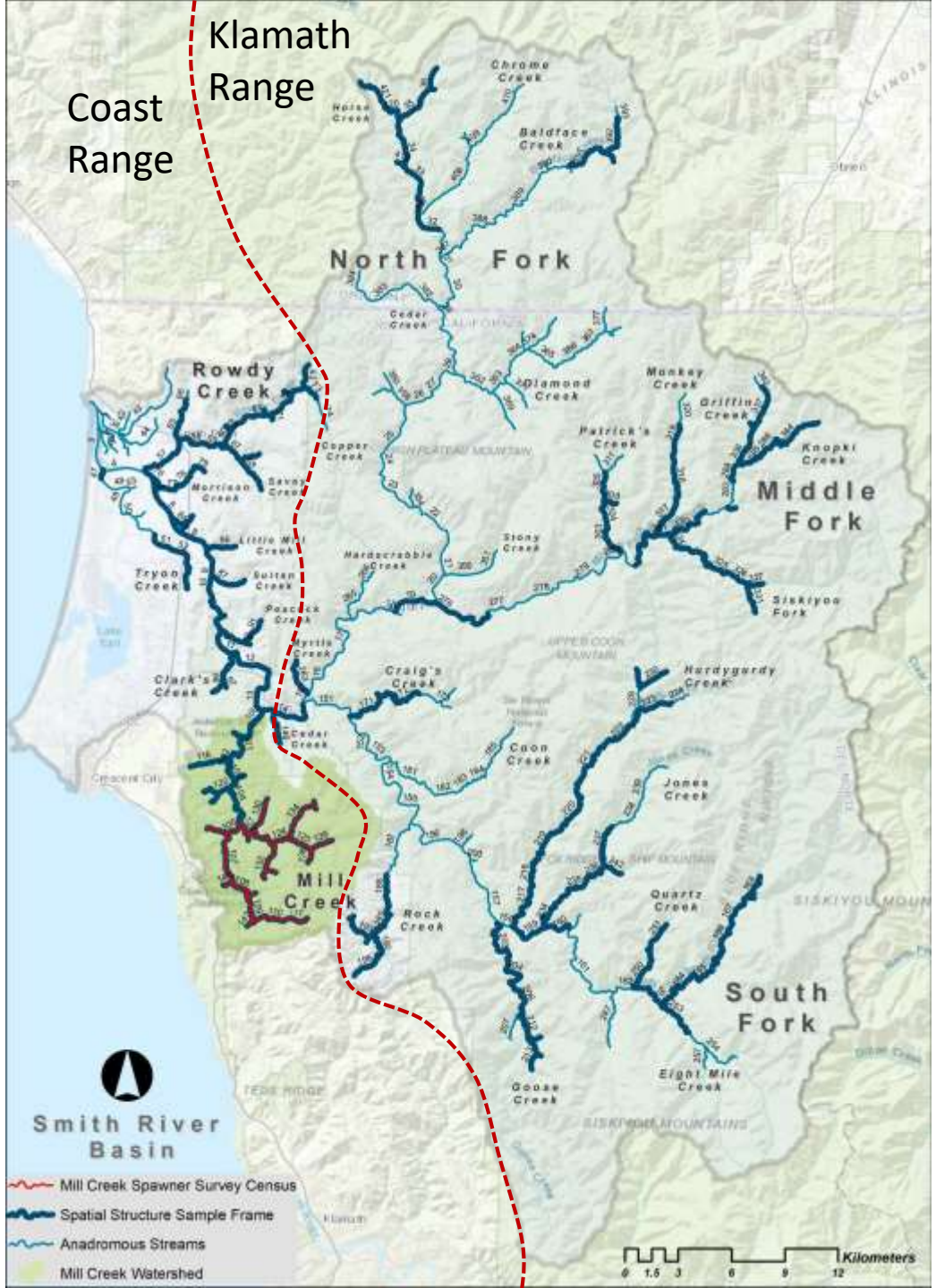


= Migration period



In 2011 a Smith River Coho Salmon Sample Frame is Born

…So is Jolyon and the Little Smith River Band

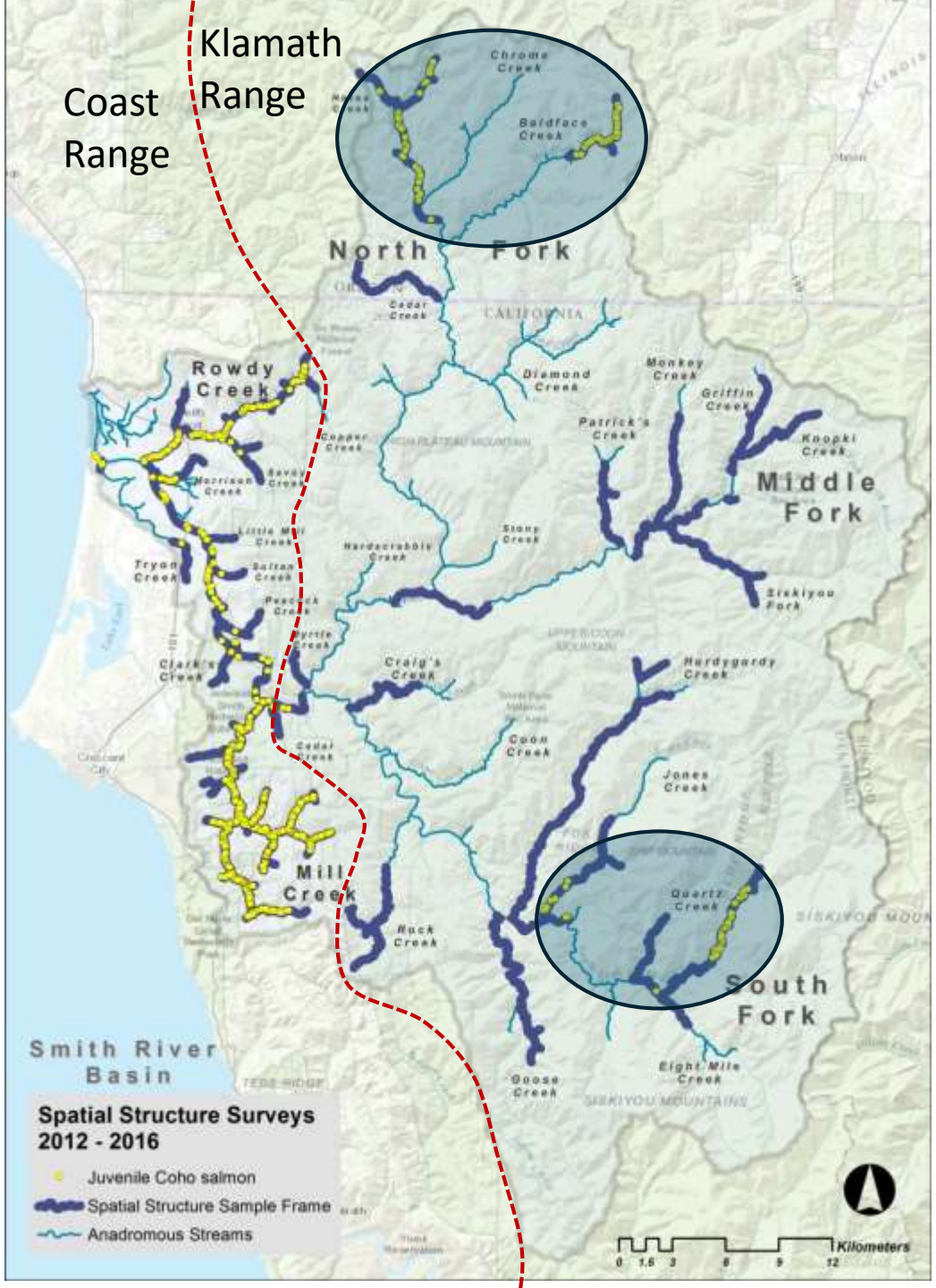



AQUA-LUNG

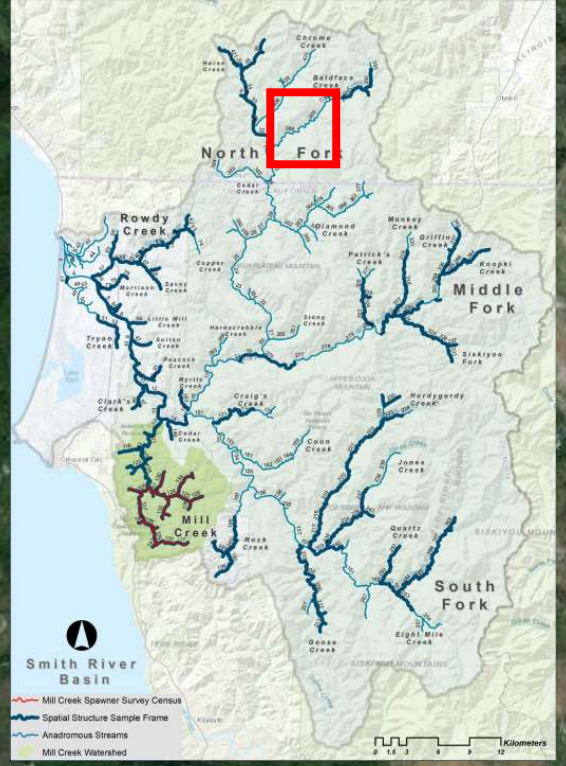
Smith River Coho Population Structure in a Nutshell From 5 Years of Observational Studies

Smith River Coho Population Structure in a Nutshell From 5 Years of Observational Studies

Klamath Mtn Spawning/ Natal Regions

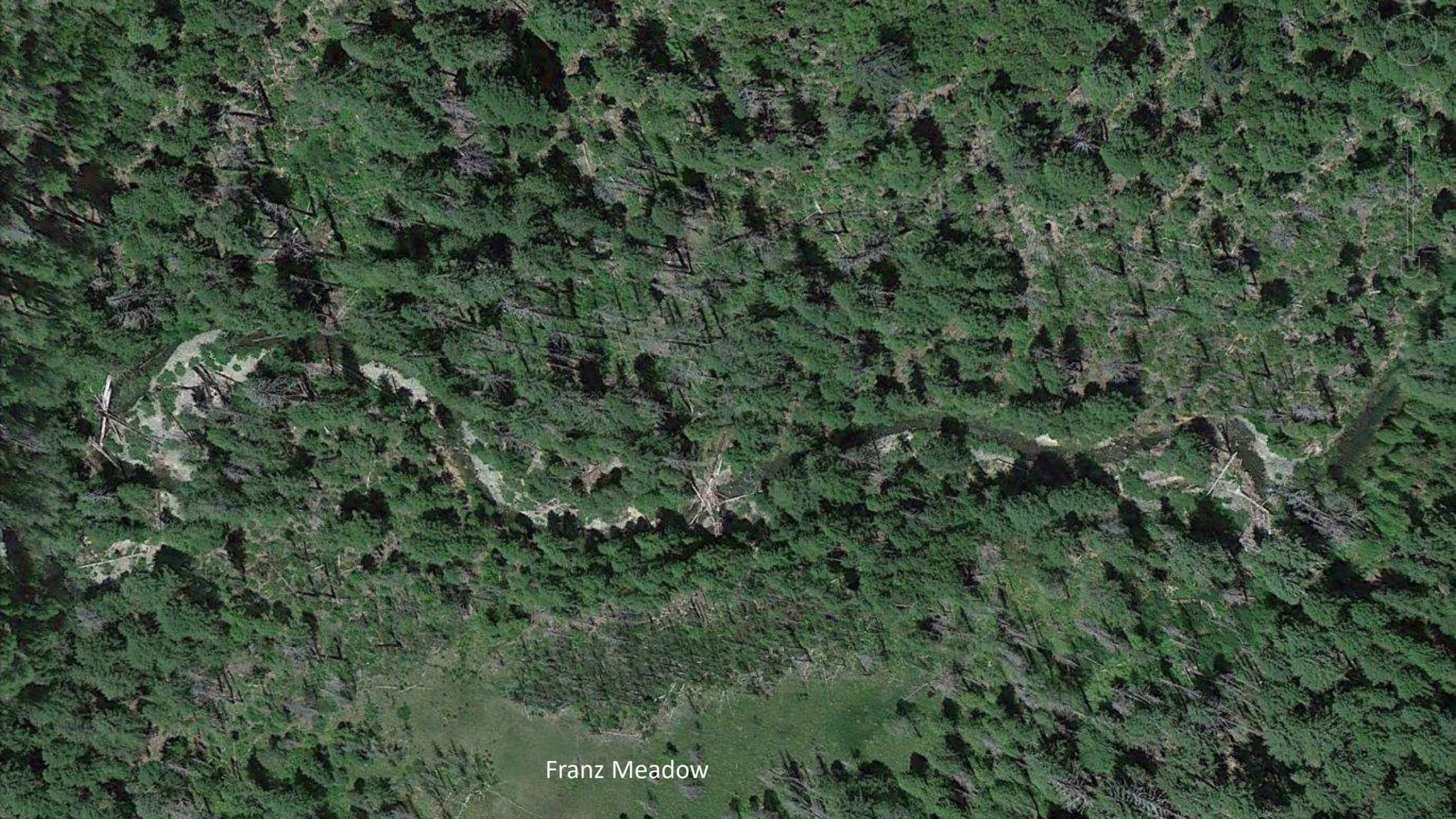


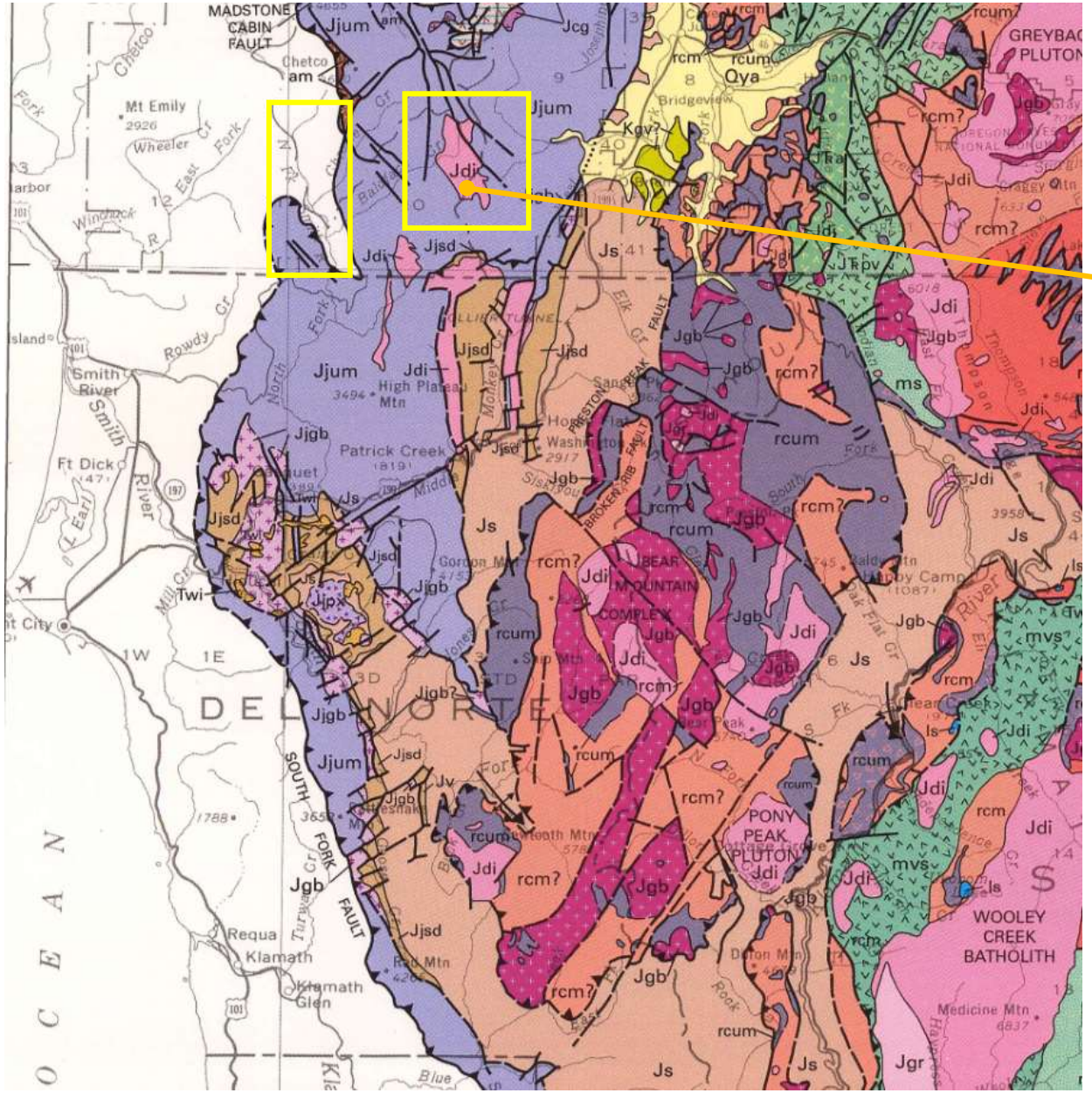
North Fork Smith River


Chrome Creek
Baldface Creek
North Fork
Rowdy Creek
Middle Fork
Mill Creek
South Fork
Smith River Basin
Mill Creek Spawner Survey Census
Spatial Structure Sample Frame
Anadromous Streams
Mill Creek Watershed
Kilometers

15 km


In Kayaking Units: Class IV to V
Gnar gnar!


Franz Meadow



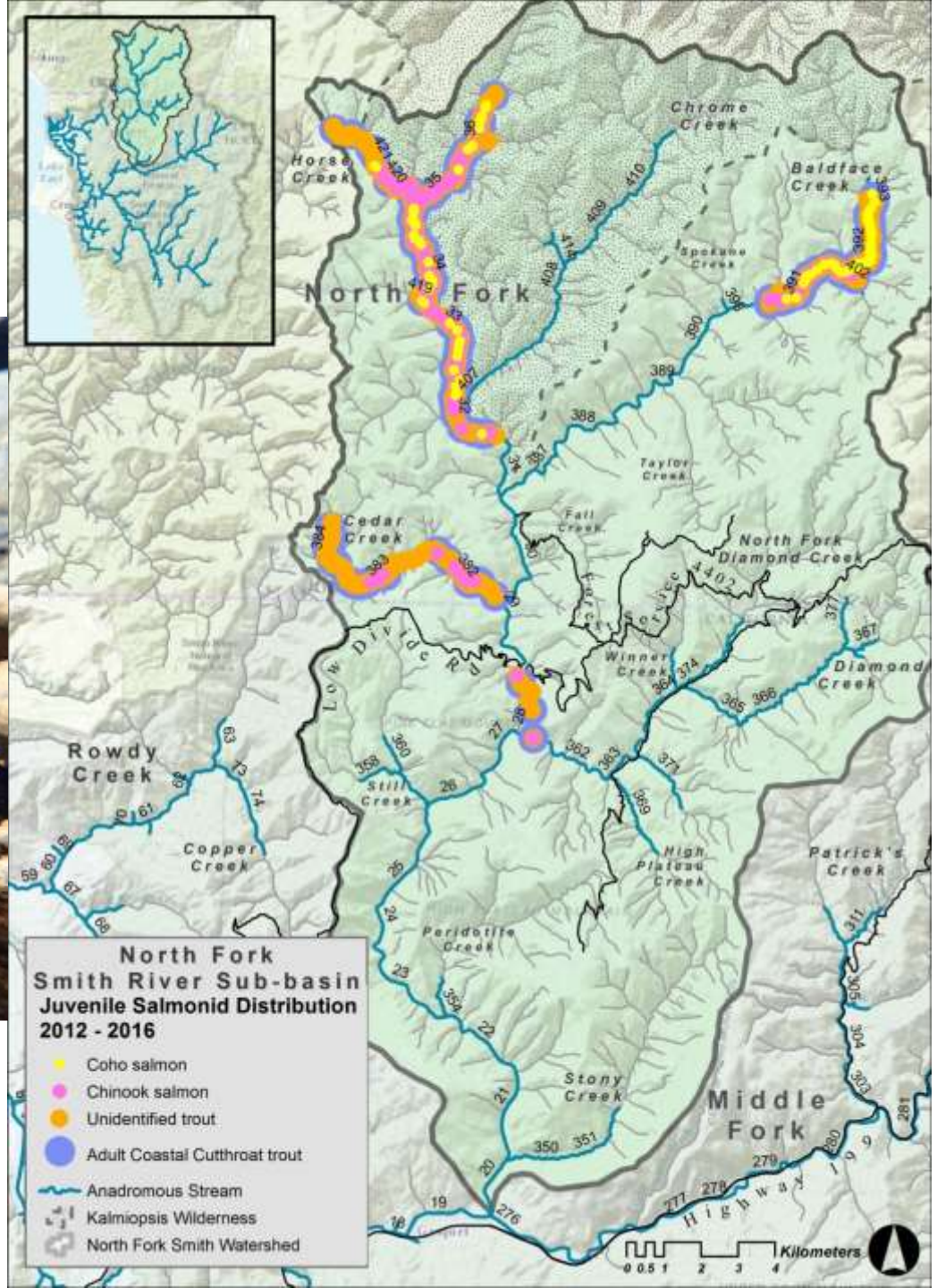
POSTAMALGAMATION PLUTONIC ROCKS

[Includes some plutons of uncertain affiliation]

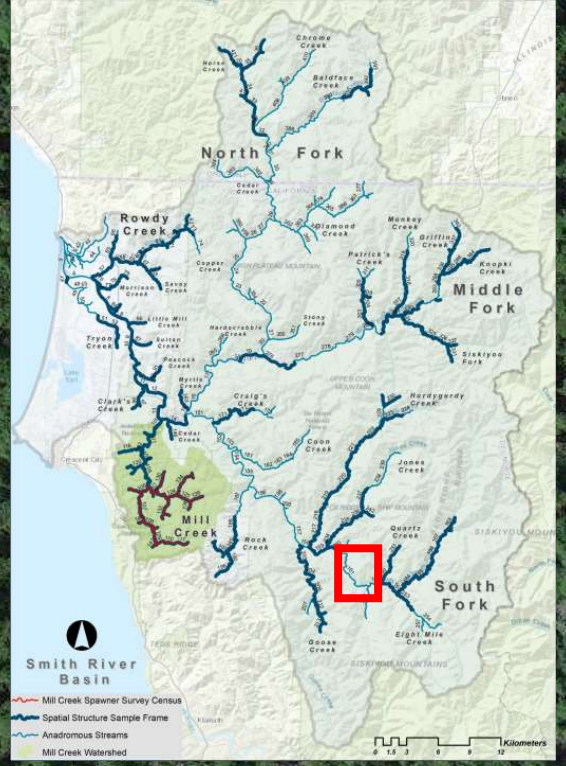
Ksb	**Plutons of Shasta Bally belt (Early Cretaceous)**—Mostly quartz diorite, trondhjemite, and granodiorite in composition; 133 to 136 Ma in isotopic age; probably postaccretion (see Irwin, 1985a). Also includes several small Cretaceous plutons in easternmost part of the Redding subterrane (fig. 1)
KJgp	**Plutons of Grants Pass belt (Early Cretaceous? and Jurassic)**—Mostly quartz diorite
Jgr	**Granitoid rocks (Jurassic)**—Plutonic rocks ranging from quartz diorite to granite in composition
Jdi	**Diorite (Jurassic)**—Mostly diorite, but locally includes gabbro and quartz diorite. Includes weakly foliated hornblende-diorite gneiss in Willow Creek quadrangle
Jgb	**Gabbro (Jurassic)**—Includes minor pyroxenite

Geology is Destiny!

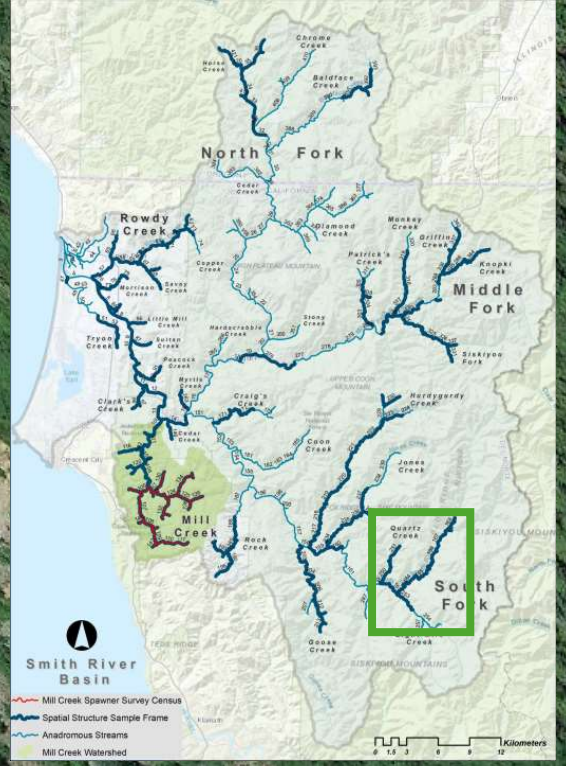
YOY Coho Salmon-Baldface Creek

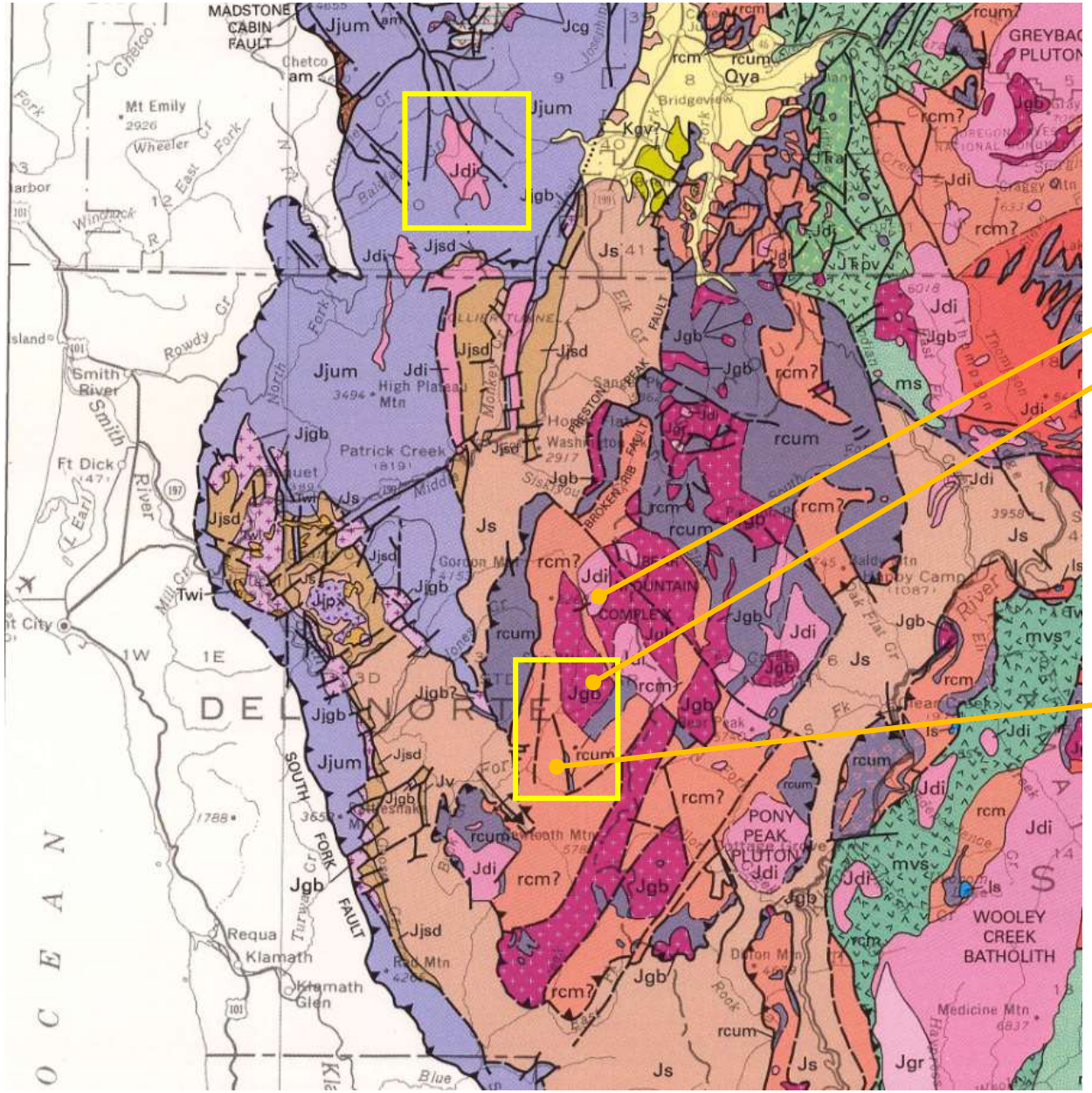



South Fork Smith River



In Kayaking Units: Class IV to V
Gnar gnar!


North Fork
Rowdy Creek
Middle Fork
Mill Creek
South Fork
Smith River Basin
Mill Creek Spawner Survey Census
Spatial Structure Sample Frame
Anadromous Streams
Mill Creek Watershed
Kilometers



POSTAMALGAMATION PLUTONIC ROCKS

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KJgp — **Plutons of Grants Pass belt (Early Cretaceous? and Jurassic)**—Mostly quartz diorite

Jgr — **Granitoid rocks (Jurassic)**—Plutonic rocks ranging from quartz diorite to granite in composition

Jdi — **Diorite (Jurassic)**—Mostly diorite, but locally includes gabbro and quartz diorite. Includes weakly foliated hornblende-diorite gneiss in Willow Creek quadrangle

Jgb — **Gabbro (Jurassic)**—Includes minor pyroxenite

RATTLESNAKE CREEK TERRANE

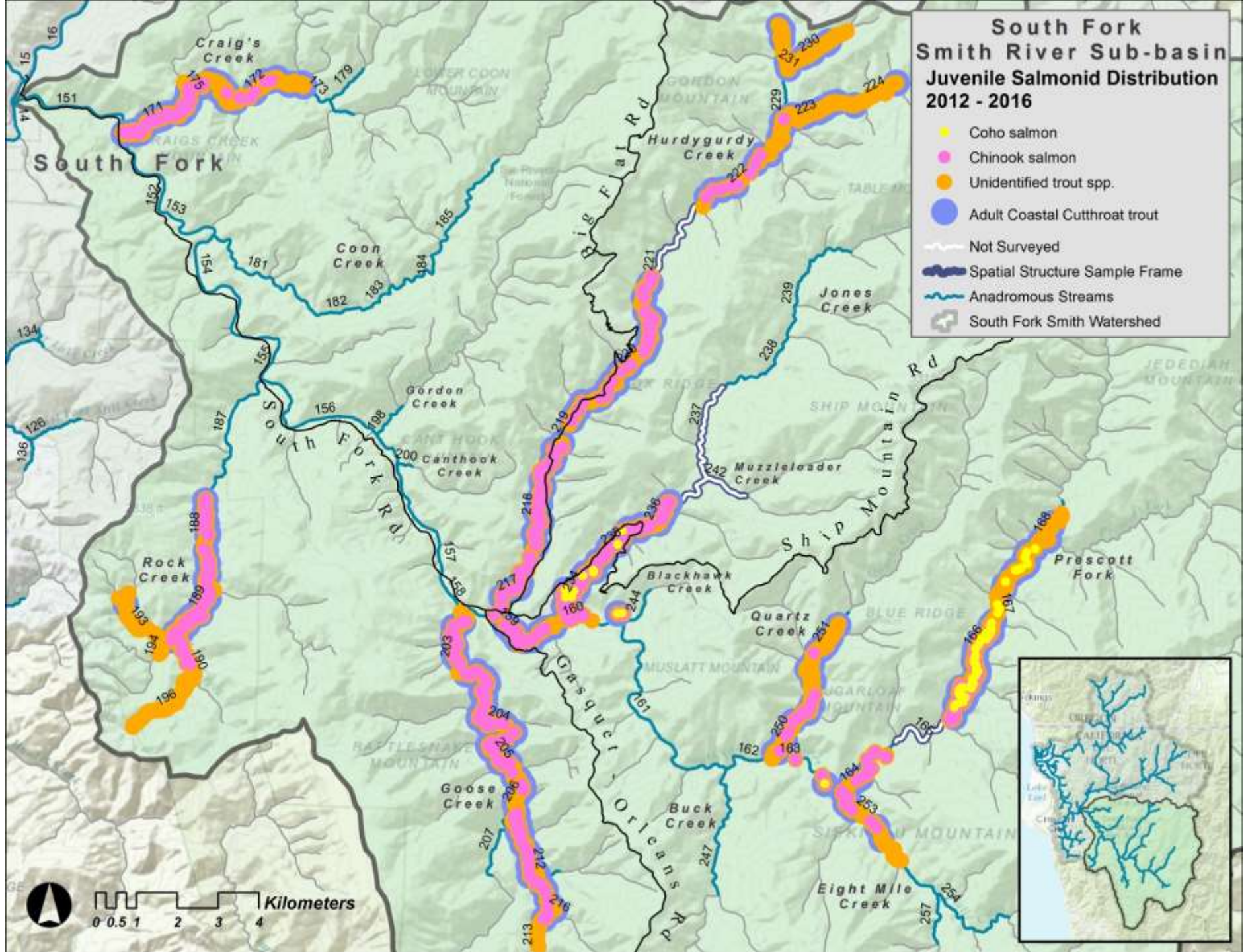
[Includes type area in southern part of Klamath Mountains province (Irwin, 1972), questionably correlative rocks of Preston Peak area, melange of Takilma area, ophiolite of Sexton Mountain area, and metamorphosed melange of Marble Mountains, Seiad Valley, Condrey Mountain, and Dutchman Peak areas]

rcp — **Plutonic rocks (Jurassic and Triassic?)**—Medium- to coarse-grained rock ranging from diorite to granite. Includes Star Mountain pluton that has a U-Pb isotopic age of approximately 200 Ma (Wright, 1981)

rcm — **Melange (Jurassic and older)**—Consists of sheared and dislocated bodies of serpentinized peridotite, pillow basalt and other mafic volcanic flows and tuff, thin-bedded chert, argillite, intermediate-composition to silicic volcanic rocks, dikes and irregular intrusive bodies ranging from gabbro to granite, weakly slaty mudstone, sandstone, and conglomerate, and minor limestone (ls) and blocks of amphibolite (a). Chert contains Late Triassic to Middle Jurassic radiolarians; limestone contains Devonian(?) and younger corals, late Paleozoic fusulinids, and Late Triassic ammonites and conodonts (Irwin, 1985b; Irwin and others, 1985)

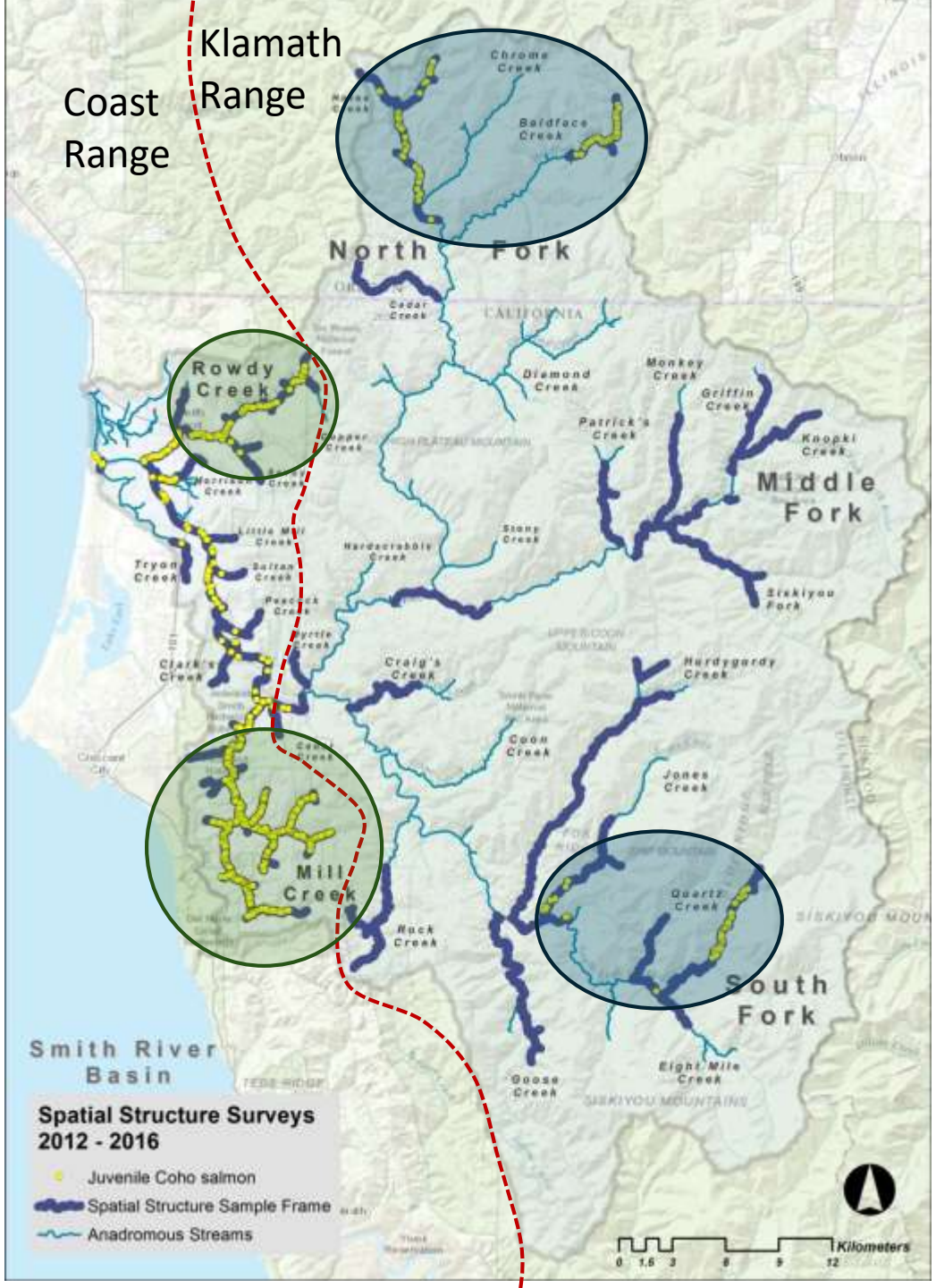
rcmm — **Metamorphosed melange (Jurassic and older)**—Tectonically disrupted metasedimentary and metavolcanic rocks in Marble Mountains Wilderness area (Donato and others, 1982), in Condrey Mountain quadrangle (Hotz, 1967), and in Dutchmans Peak area (Smith and others, 1982). Consists of quartz-biotite-muscovite schist and other quartzose metasedimentary rocks that include metaquartzite (metachert?), lenses of micaceous and quartzitic marble (m), and of amphibolitic metavolcanic rocks, metadiabase, metagabbro, and metamorphosed ultramafic rocks. Probably metamorphosed equivalent of unit rcm

rcum — **Serpentinized ultramafic rocks (age uncertain)**—Mainly sheared serpentinized peridotite. Locally is blocky tectonitic harzburgite and minor dunite. Includes metaperidotite (pattern), consisting mainly of olivine and variable amounts of actinolite, anthophyllite, and chlorite, in areas adjacent to unit rcmm (Coleman and others, 1988)


South Fork
Smith River Sub-basin
Juvenile Salmonid Distribution
2012 - 2016
Coho salmon
Chinook salmon
Unidentified trout spp.
Adult Coastal Cutthroat trout
Not Surveyed
Spatial Structure Sample Frame
Anadromous Streams
South Fork Smith Watershed
Craig's Creek
South Fork
Coon Creek
Big Flat Rd
Hurdygurdy Creek
Jones Creek
Gordon Creek
South Fork Rd
Canthook Creek
Muzzleloader Creek
Ship Mountain Rd
Rock Creek
Blackhawk Creek
Quartz Creek
Prescott Fork
Goose Creek
Grasshopper Creek
Buck Creek
Eight Mile Creek
Kilometers
0 0.5 1 2 3 4

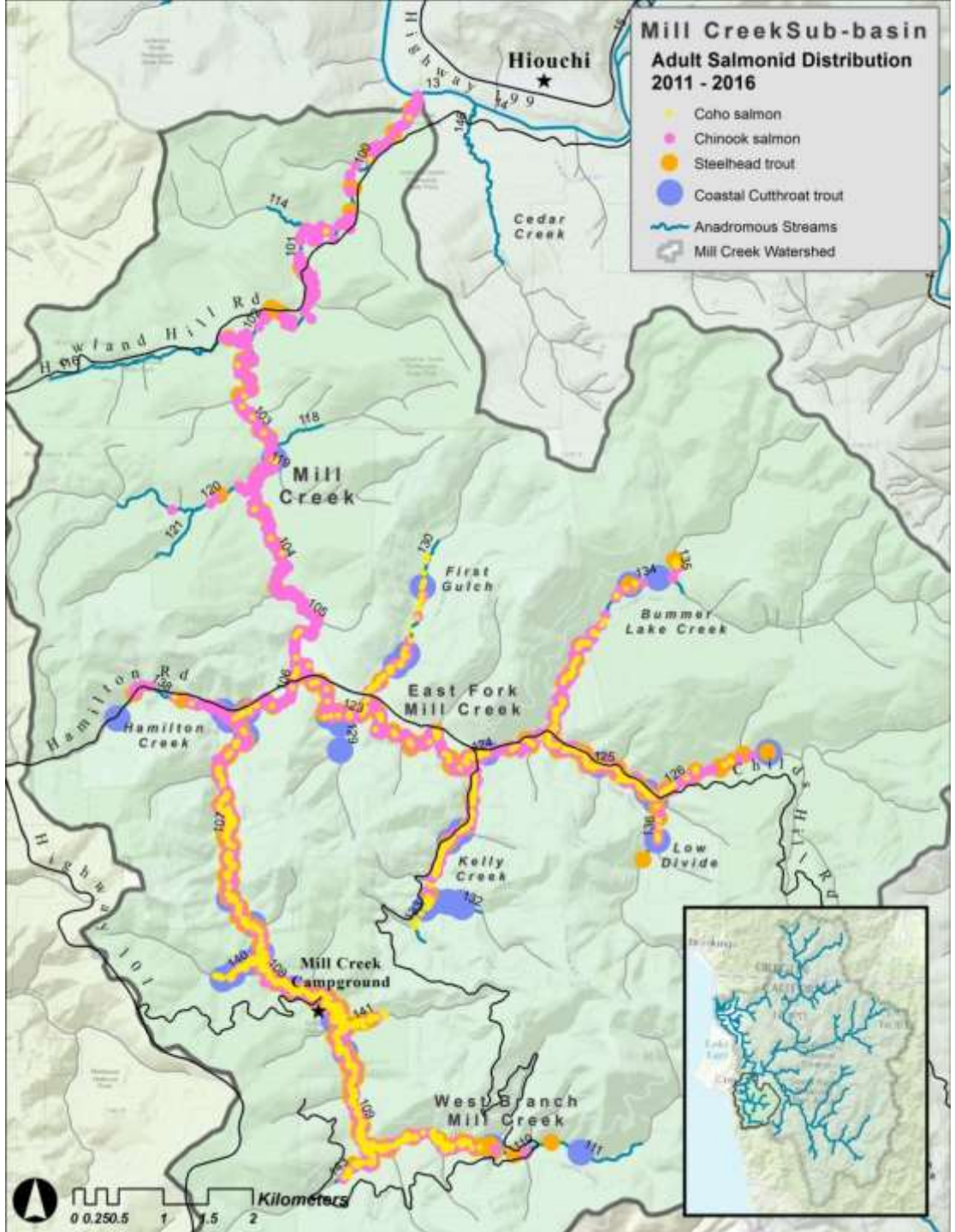
Smith River Coho Population Structure in a Nutshell From 5 Years of Observational Studies

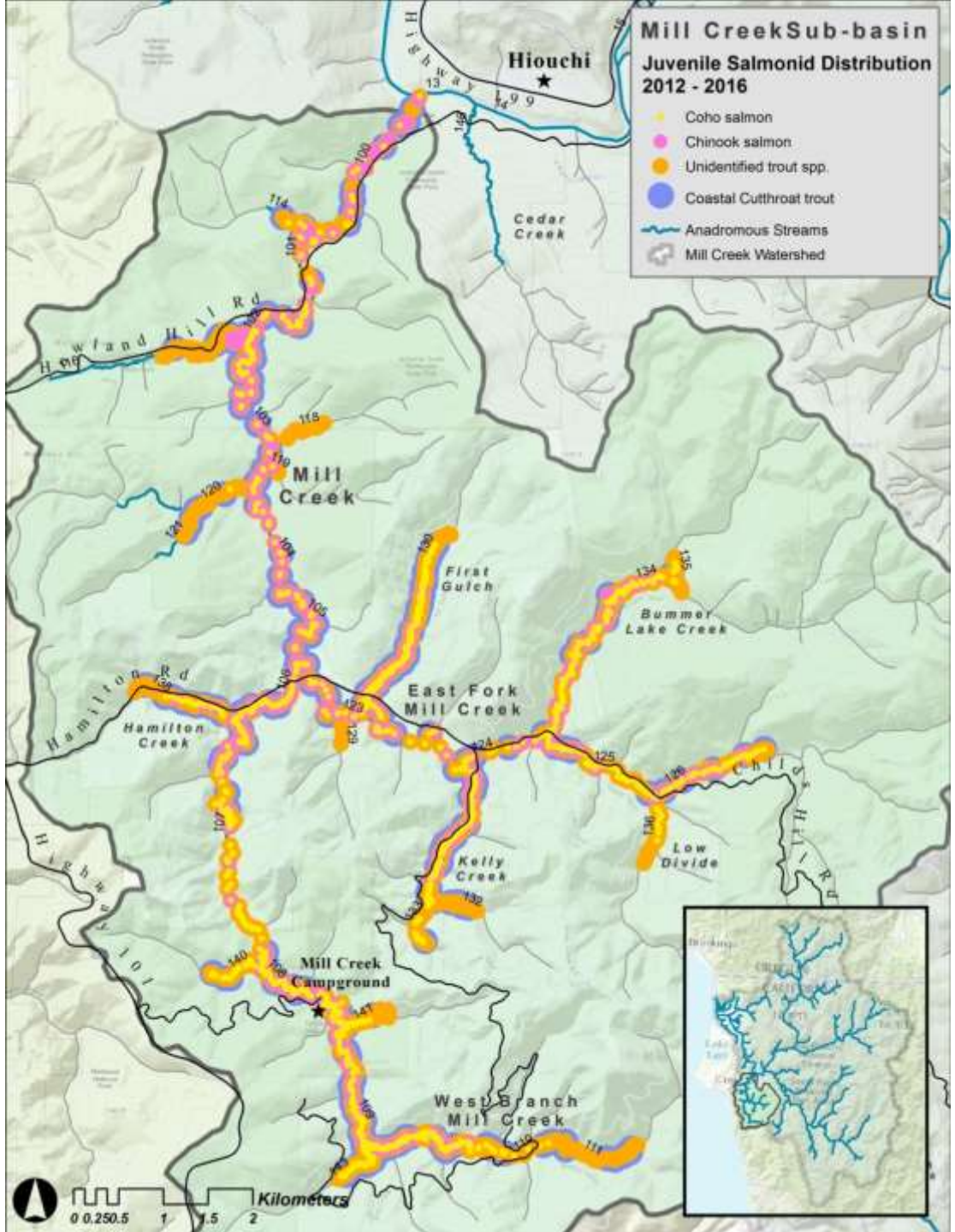
- Klamath Mtn Spawning/ Natal Regions
- Coastal Mtn Spawning/ Natal Regions




Lower Mill Creek


Upper Mill Creek


Mill CreekSub-basin
Adult Salmonid Distribution
2011 - 2016
Coho salmon
Chinook salmon
Steelhead trout
Coastal Cutthroat trout
Anadromous Streams
Mill Creek Watershed
Hiouchi
Highway 199
Howland Hill Rd
Cedar Creek
Mill Creek
First Gulch
Bummer Lake Creek
East Fork Mill Creek
Hamilton Rd
Hamilton Creek
Kelly Creek
Low Divide
Chili's Hill Rd
Highway 101
Mill Creek Campground
West Branch Mill Creek
Kilometers
0 0.250.5 1 1.5 2


Mill CreekSub-basin
Juvenile Salmonid Distribution
2012 - 2016
Coho salmon
Chinook salmon
Unidentified trout spp.
Coastal Cutthroat trout
Anadromous Streams
Mill Creek Watershed
Hiouchi
Highway 199
Howland Hill Rd
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Hamilton Rd
Hamilton Creek
Kelly Creek
Low Divide
Chili's Hill Rd
Highway 101
Mill Creek Campground
West Branch Mill Creek
Kilometers
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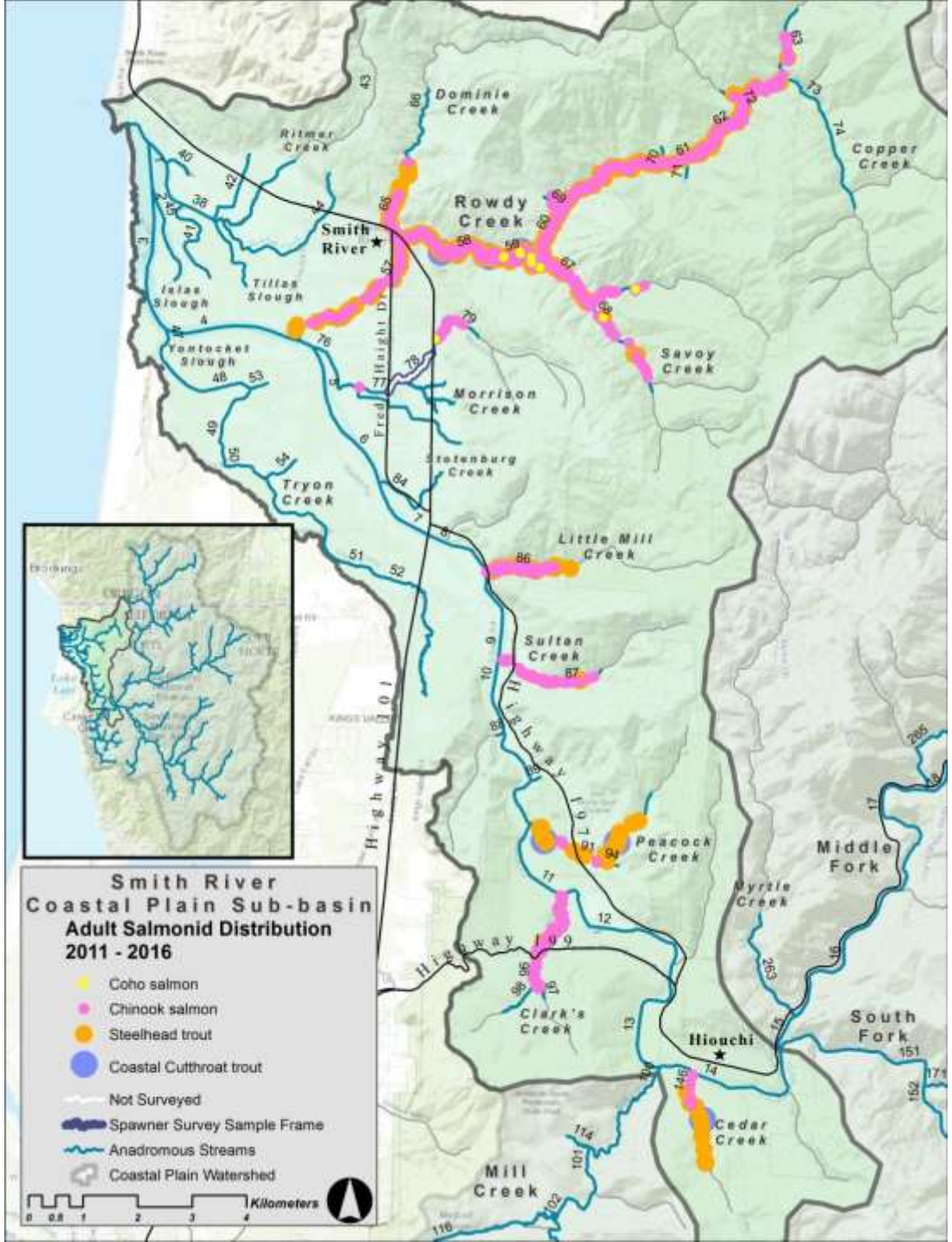
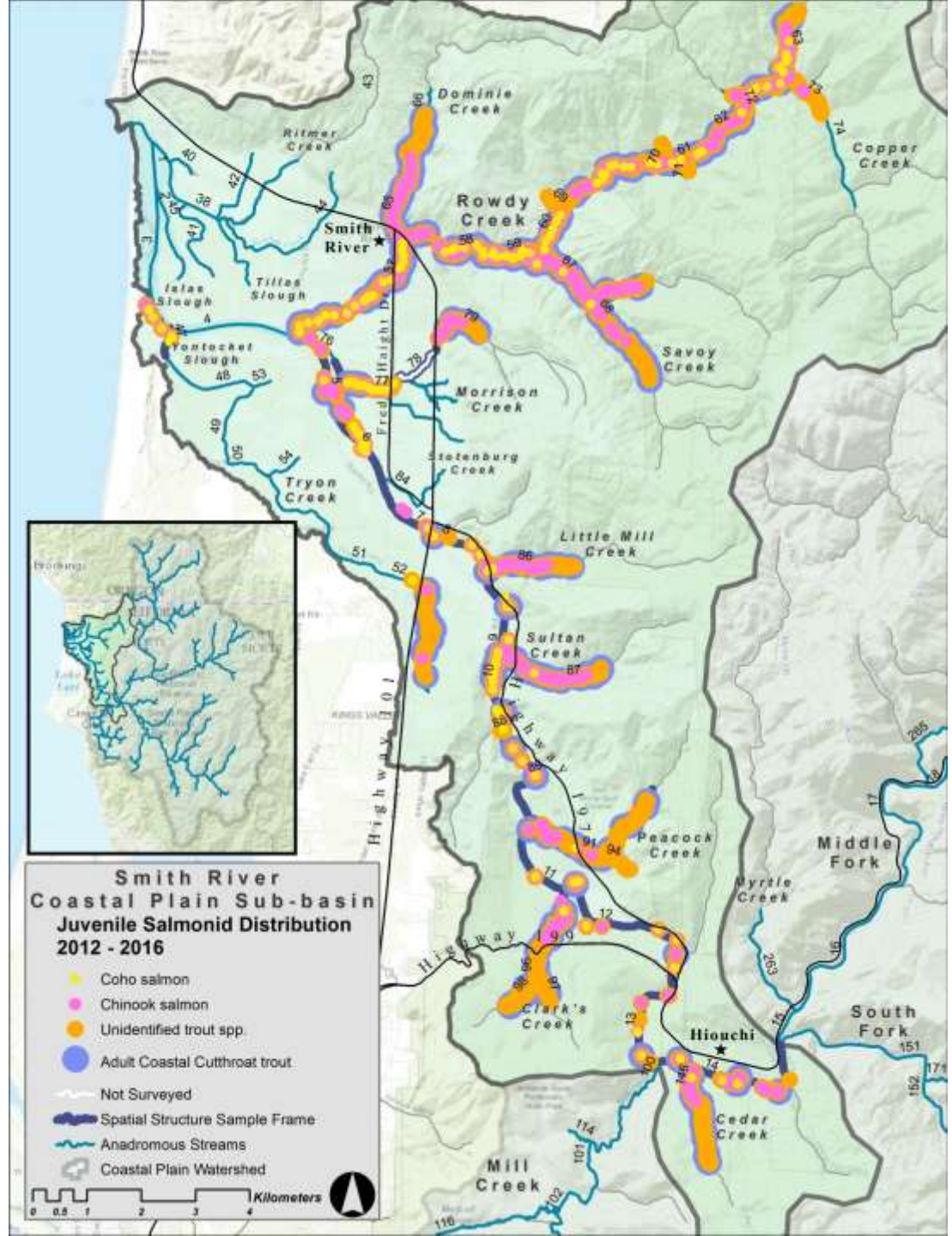
Rowdy Creek


Dominie Creek
Ritmer Creek
Copper Creek
Rowdy Creek
Smith River
Tillas Slough
Ialas Slough
Yontocket Slough
Savoy Creek
Morrison Creek
Fred Haight Dr
Stotenburg Creek
Tryon Creek
Little Mill Creek
Sultan Creek
Highway 101
Peacock Creek
Myrtle Creek
Middle Fork
Clark's Creek
Hiouchi
South Fork
Cedar Creek
Mill Creek
Smith River
Coastal Plain Sub-basin
Adult Salmonid Distribution
2011 - 2016
Coho salmon
Chinook salmon
Steelhead trout
Coastal Cutthroat trout
Not Surveyed
Spawner Survey Sample Frame
Anadromous Streams
Coastal Plain Watershed
Kilometers
0 0.5 1 2 3 4


Dominie Creek
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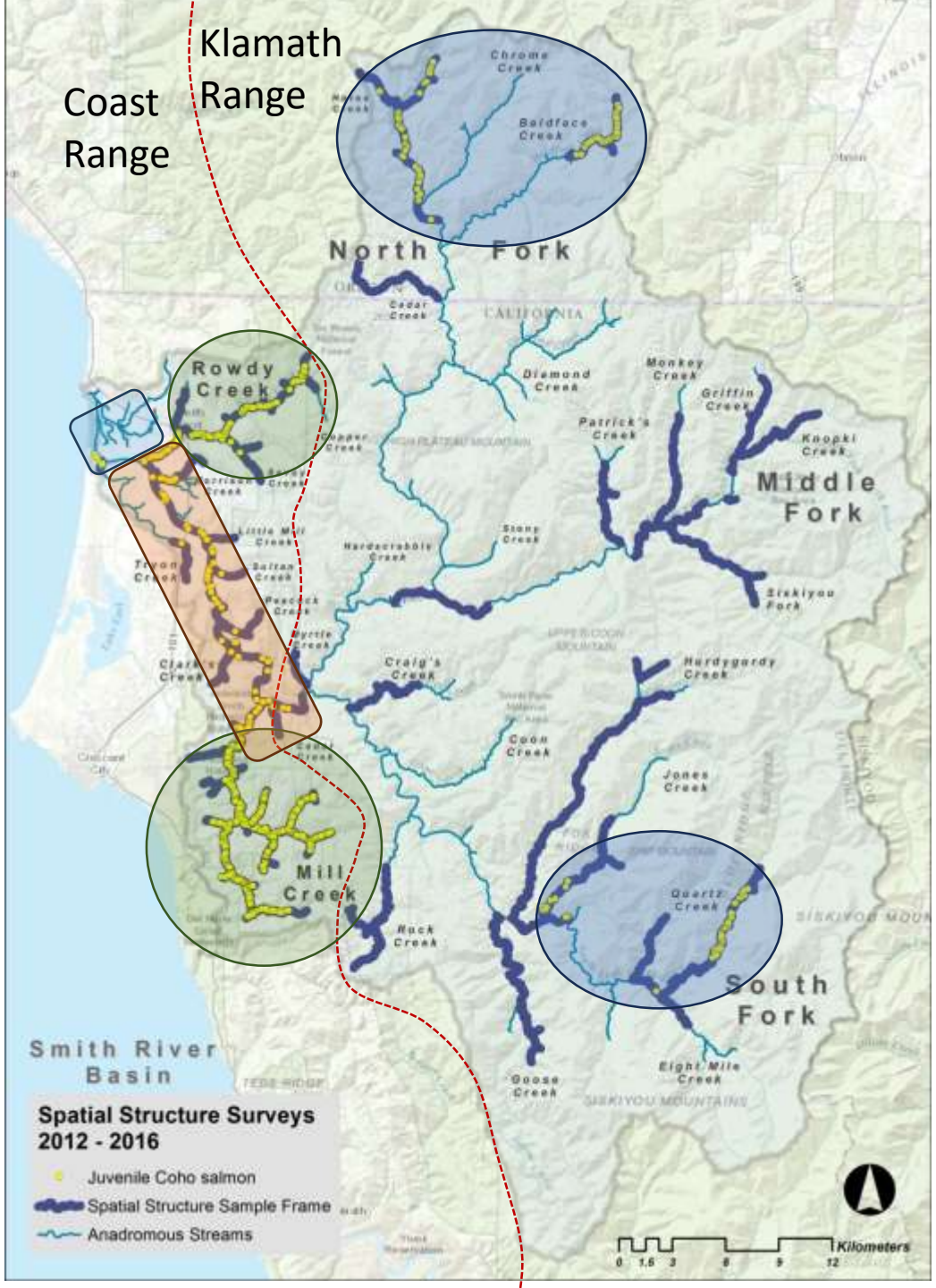
Smith River
Coastal Plain Sub-basin
Juvenile Salmonid Distribution
2012 - 2016
Coho salmon
Chinook salmon
Unidentified trout spp
Adult Coastal Cutthroat trout
Not Surveyed
Spatial Structure Sample Frame
Anadromous Streams
Coastal Plain Watershed
Kilometers
0 0.5 1 2 3 4

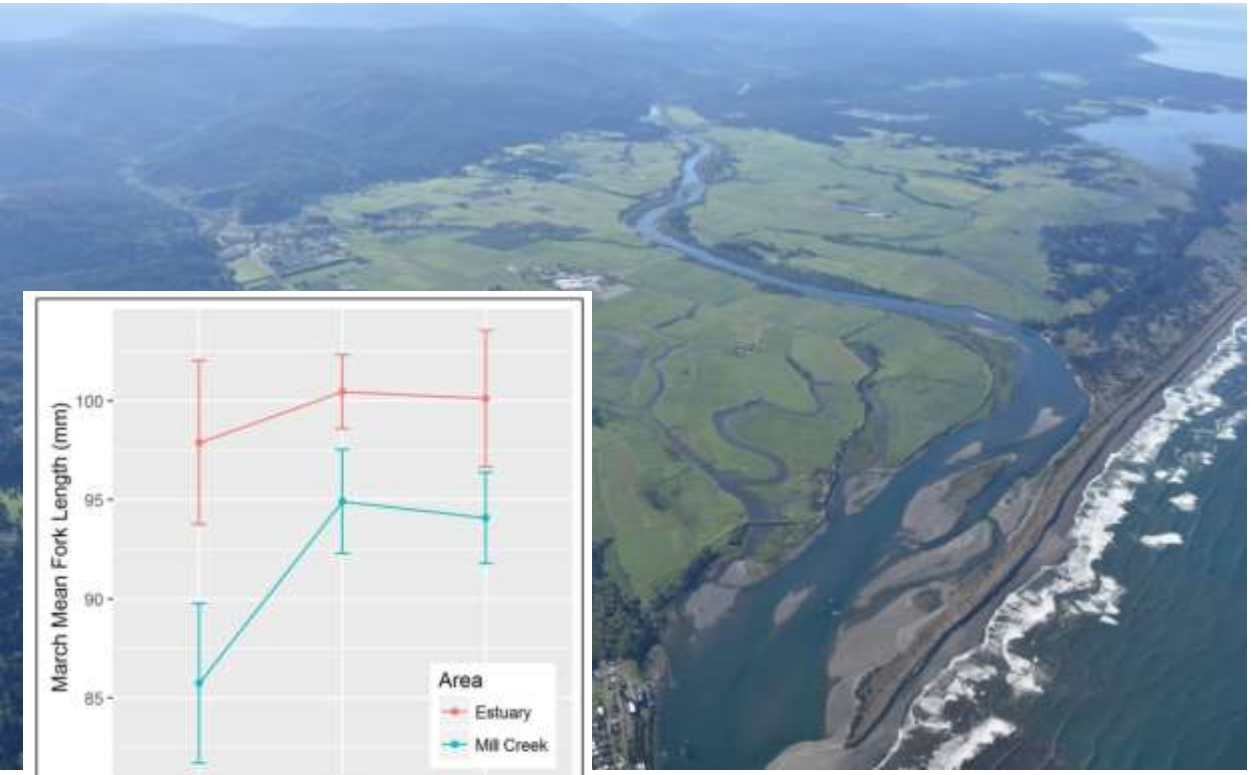
Smith River Coho Population Structure in a Nutshell From 5 Years of Observational Studies

- Klamath Mtn Spawning/ Natal Regions
- Coastal Mtn Spawning/ Natal Regions
- Mainstem Non-natal Rearing
- Estuary Winter Non-natal Rearing

It takes a basin to raise a Coho Salmon….

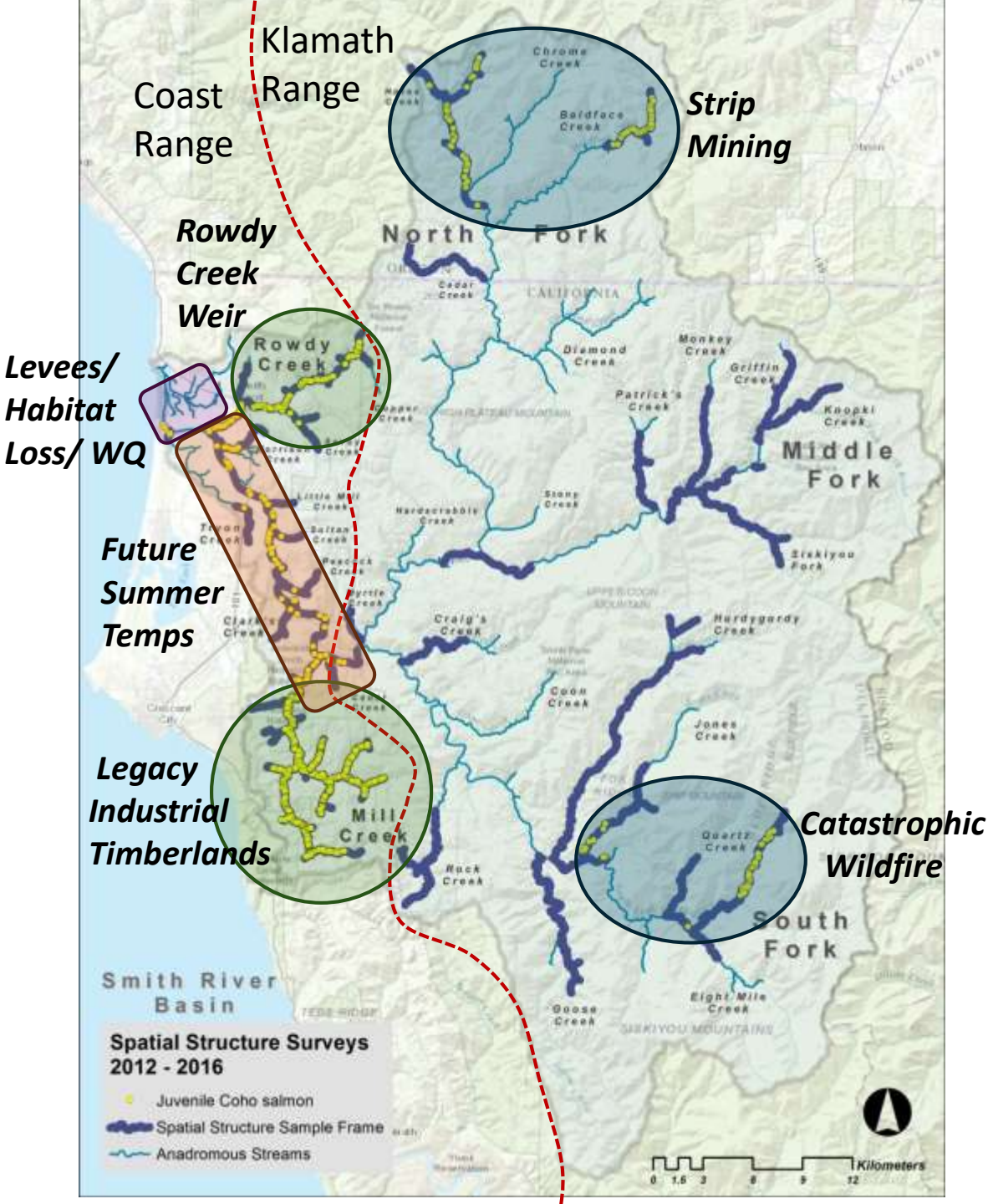


Non-natal Rearing in the Lower River and Estuary



Perhaps the 6 most pressing coho salmon environmental issues by sub-region

- Klamath Mtn Spawning/ Natal Regions
- Coastal Mtn Spawning/ Natal Regions
- Lower Mainstem Non-natal Rearing
- Estuary Winter Non-natal Rearing



“The Rowdy Creek Fish Hatchery weir is a complete barrier to juvenile salmonids and partial barrier to adult salmonids. A total of 18.4 kilometers of spawning and rearing habitat exists above the barrier.“ *Garwood and Larson (2013)*

Honesty, Accuracy, and Receptivity Guide Us to Better Stewardship of Definable Landscapes

- Spatial scales are important
- Be aware of bias-every population is unique
- Personally connect with landscapes
- Share what you have learned with others early and often
- Baselines are shifting. Be guided by the past but also the best information we have is often now
- Update goals often through regularly updating restoration plans