

Overview of the biology and threats to lampreys

Conrad Gowell



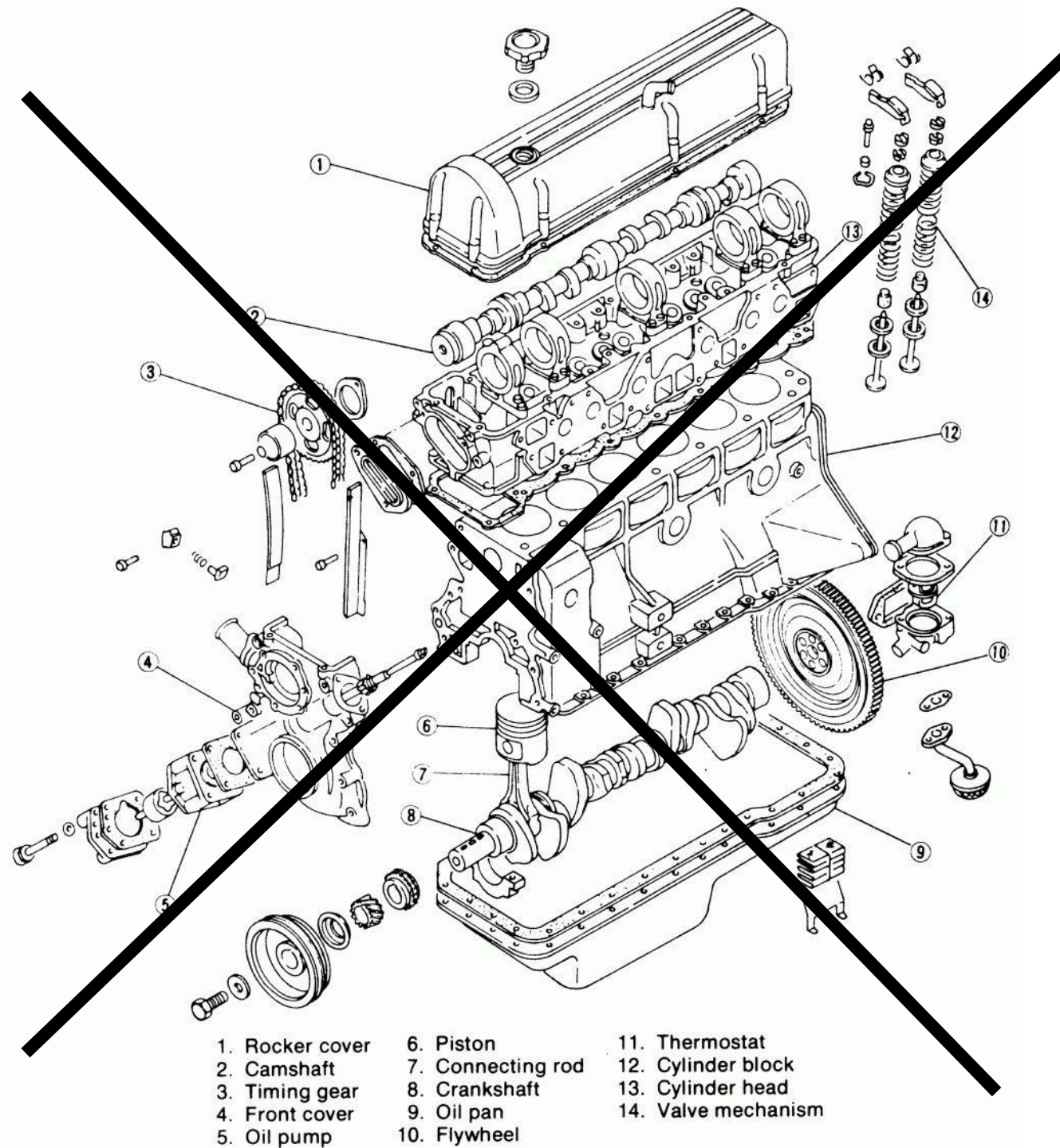
Benjamin Clemens, Ph.D.

Benjamin Clemens
Statewide Lamprey Coordinator
Benjamin.J.Clemens@odfw.Oregon.gov
541-757-5113





Disclaimer



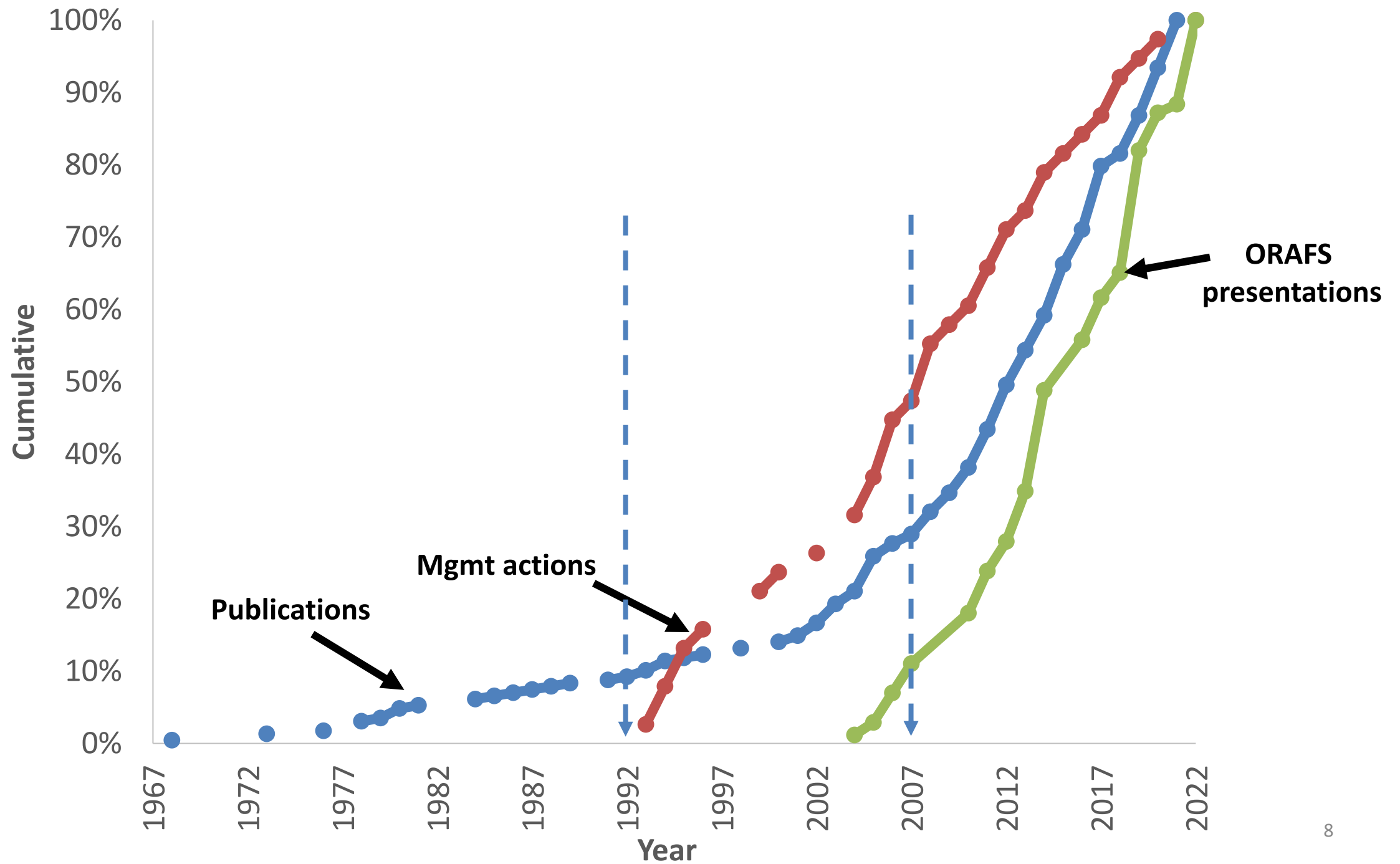






Take-home messages

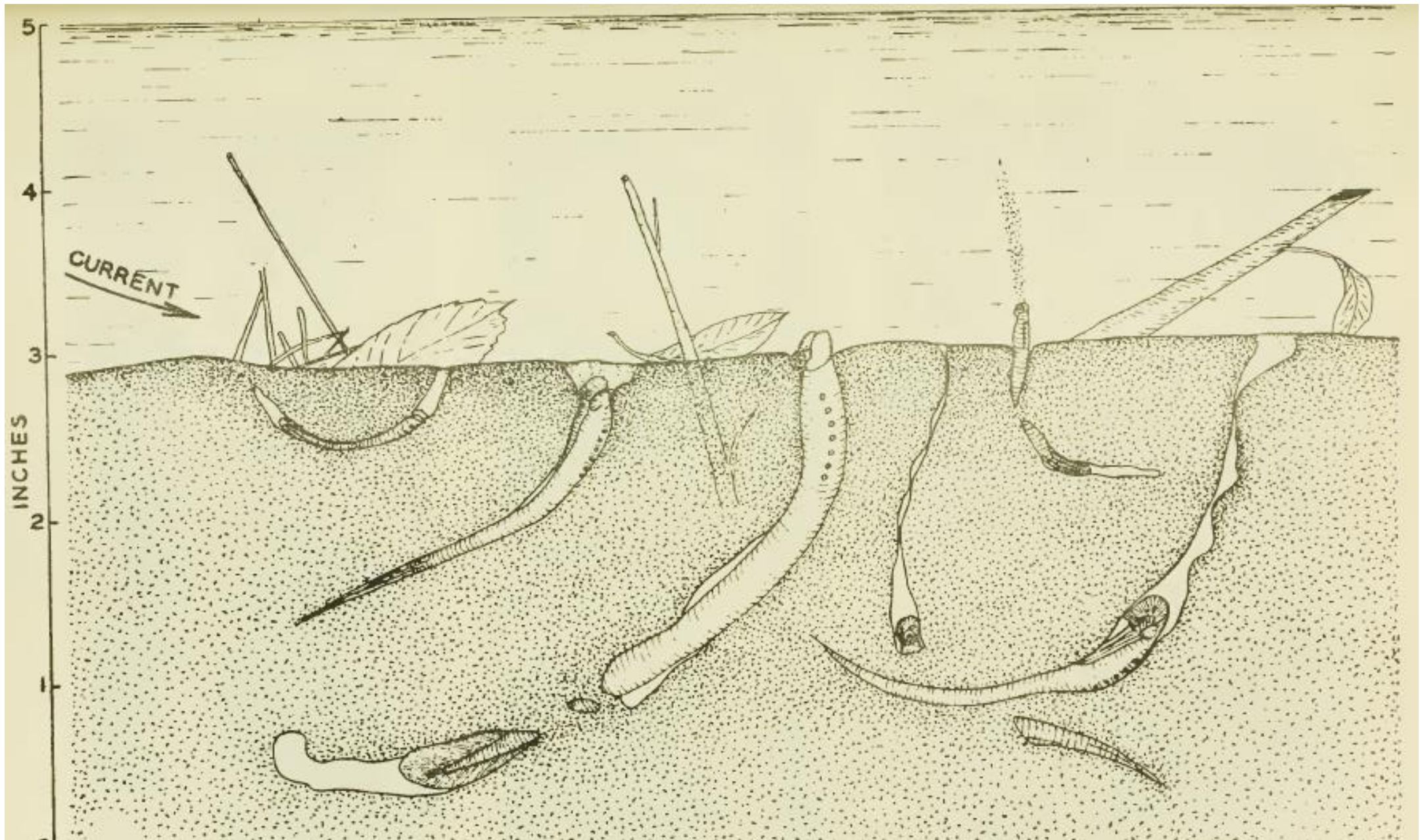
- 1. Many recent developments**
- 2. Periodic strategy' -> habitats w/ large variation**
- 3. Abundant, cold, clean water w/ complex habitat (basin-wide)**
- 4. Threats, conservation plans**
- 5. Process-based functionality & complexity**



***"The recovery of Pacific lamprey may
be linked to salmon recovery"***

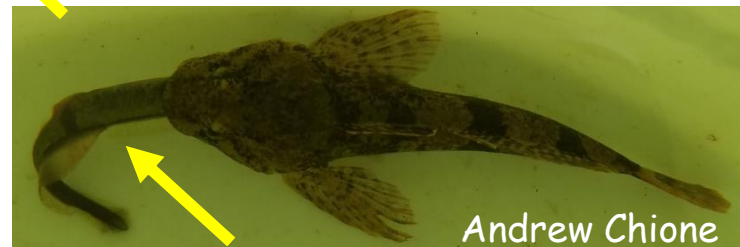
(Close et al. 1995)







Oregon Adult Salmonid Inventory & Sampling Project, ODFW

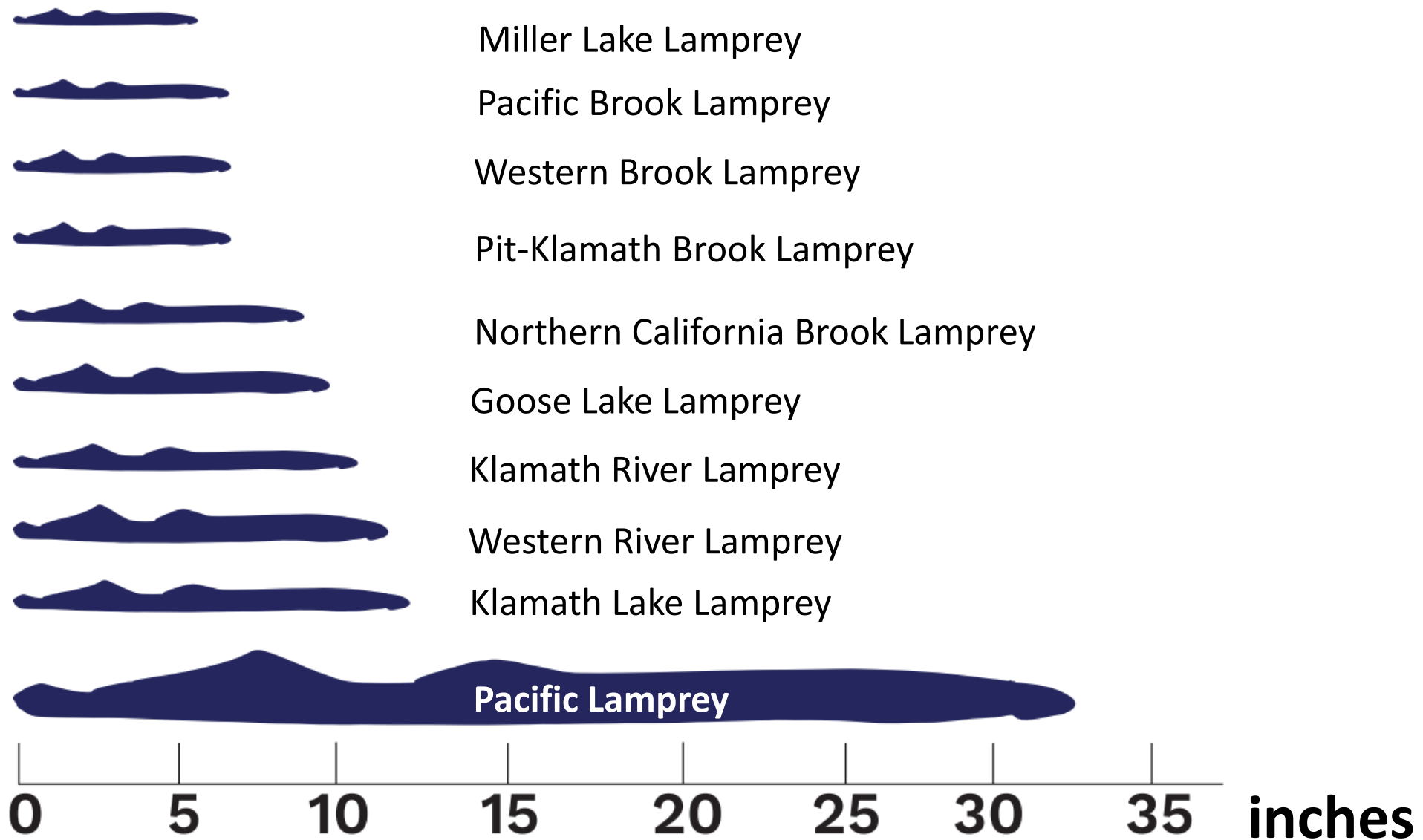


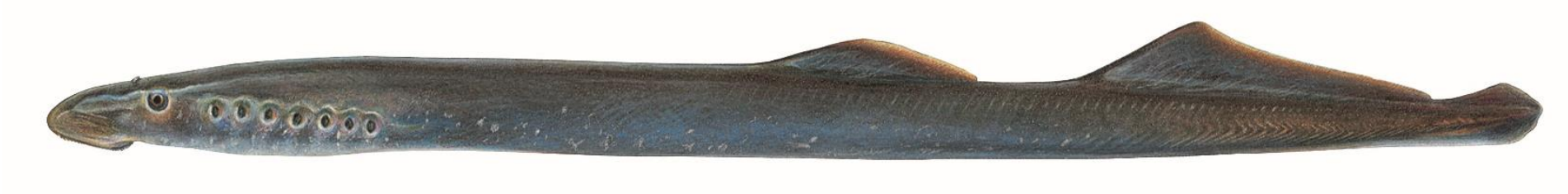
Outline

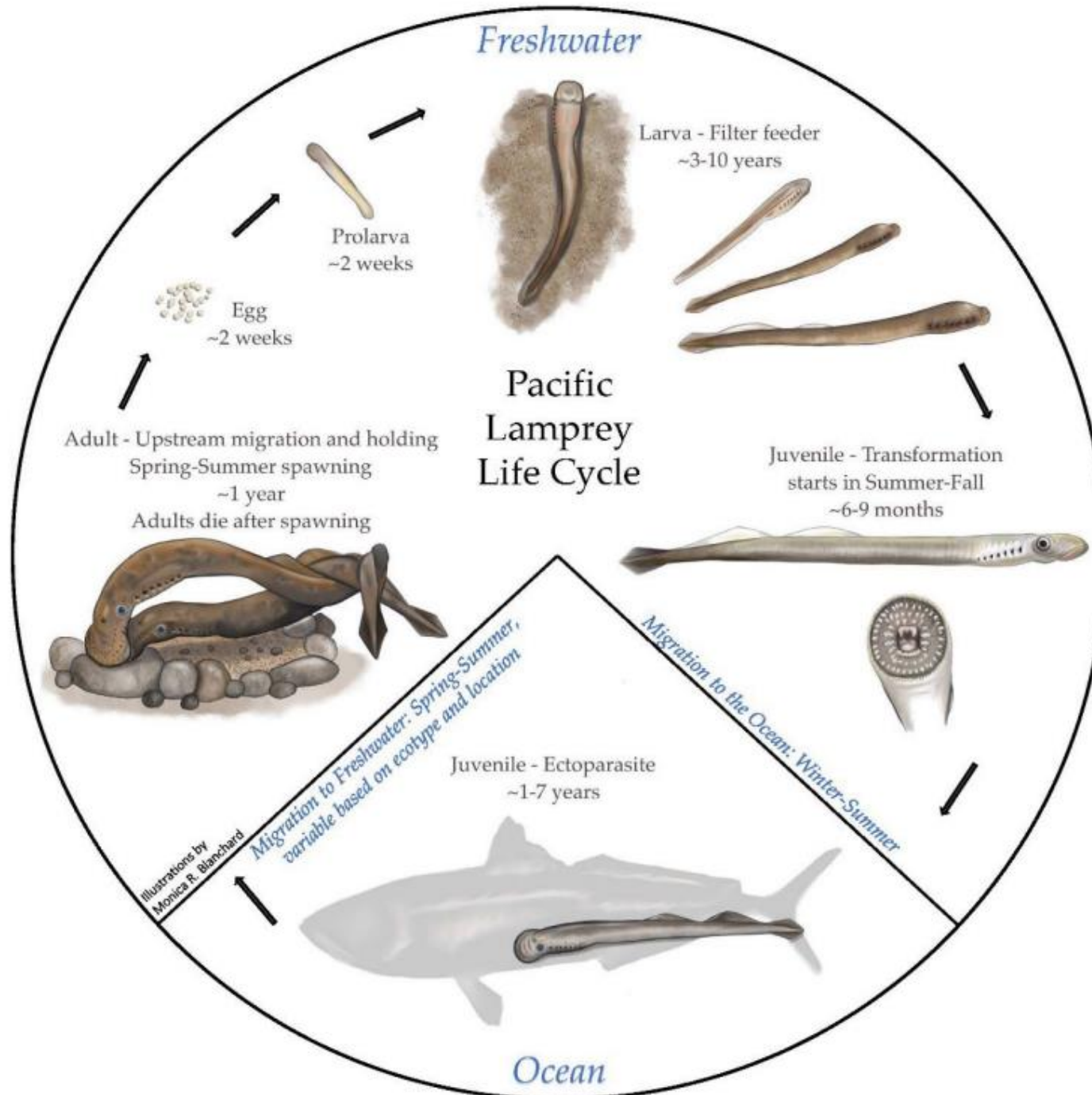
- 1. Lamprey biology**
- 2. Threats/limiting factors**
- 3. Actions (Mgmt & Research)**



Emma Garner





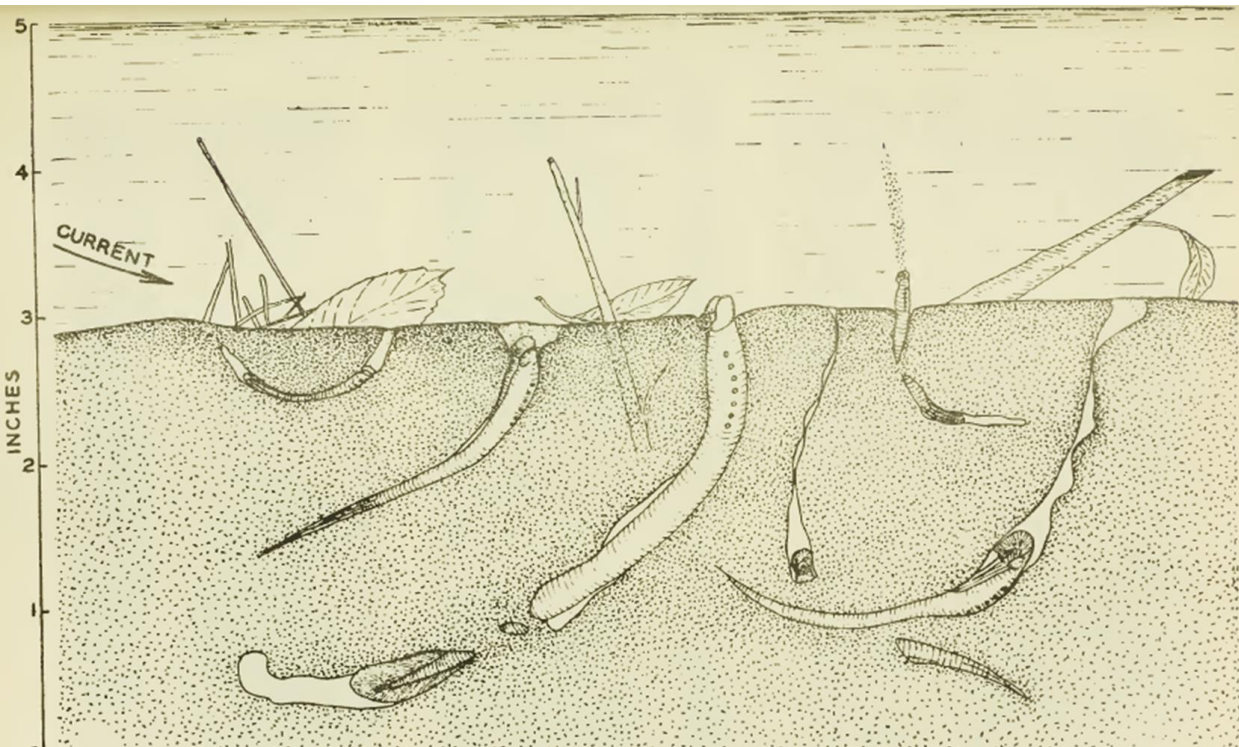


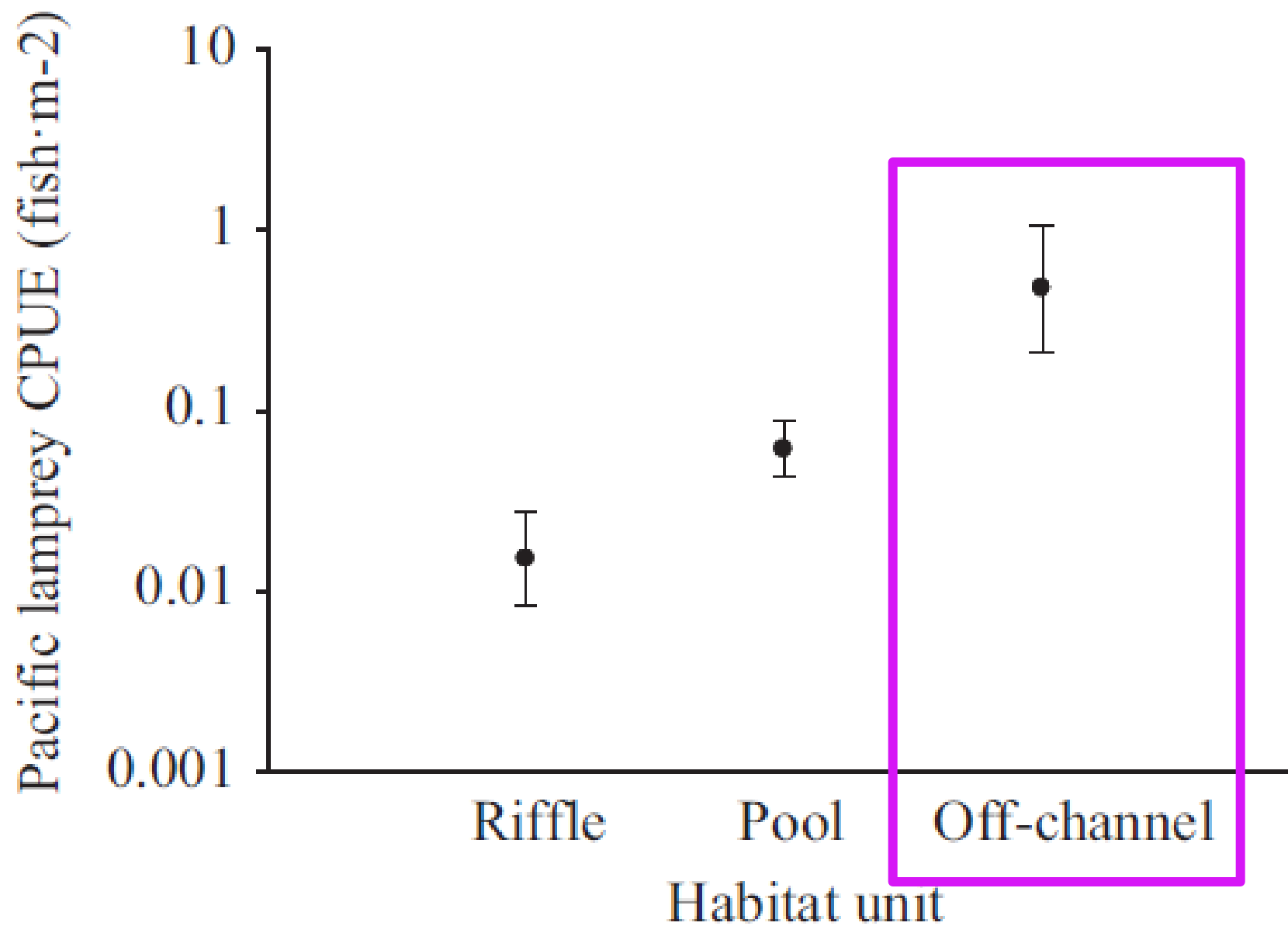


<1"



to ~6"



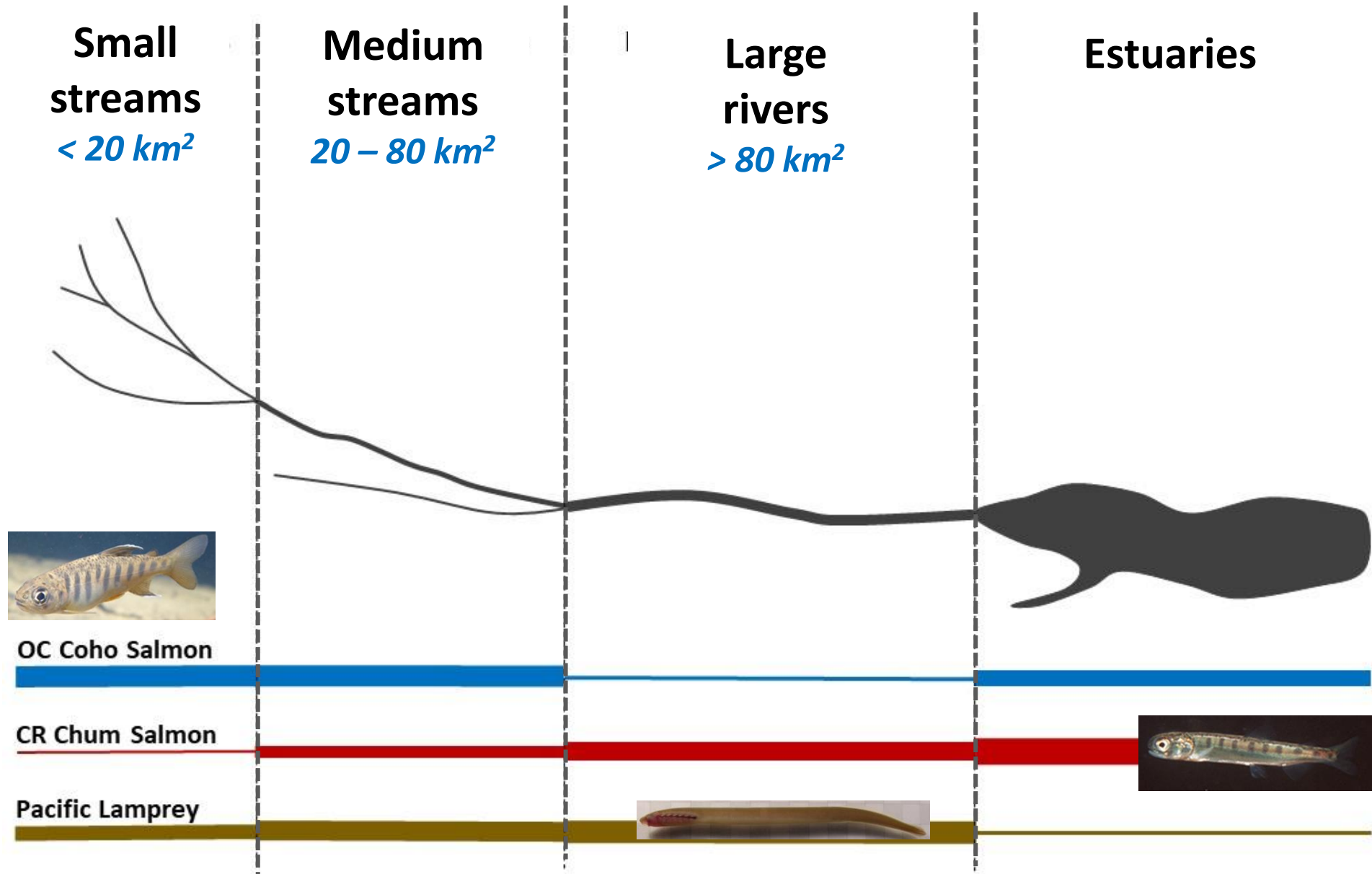




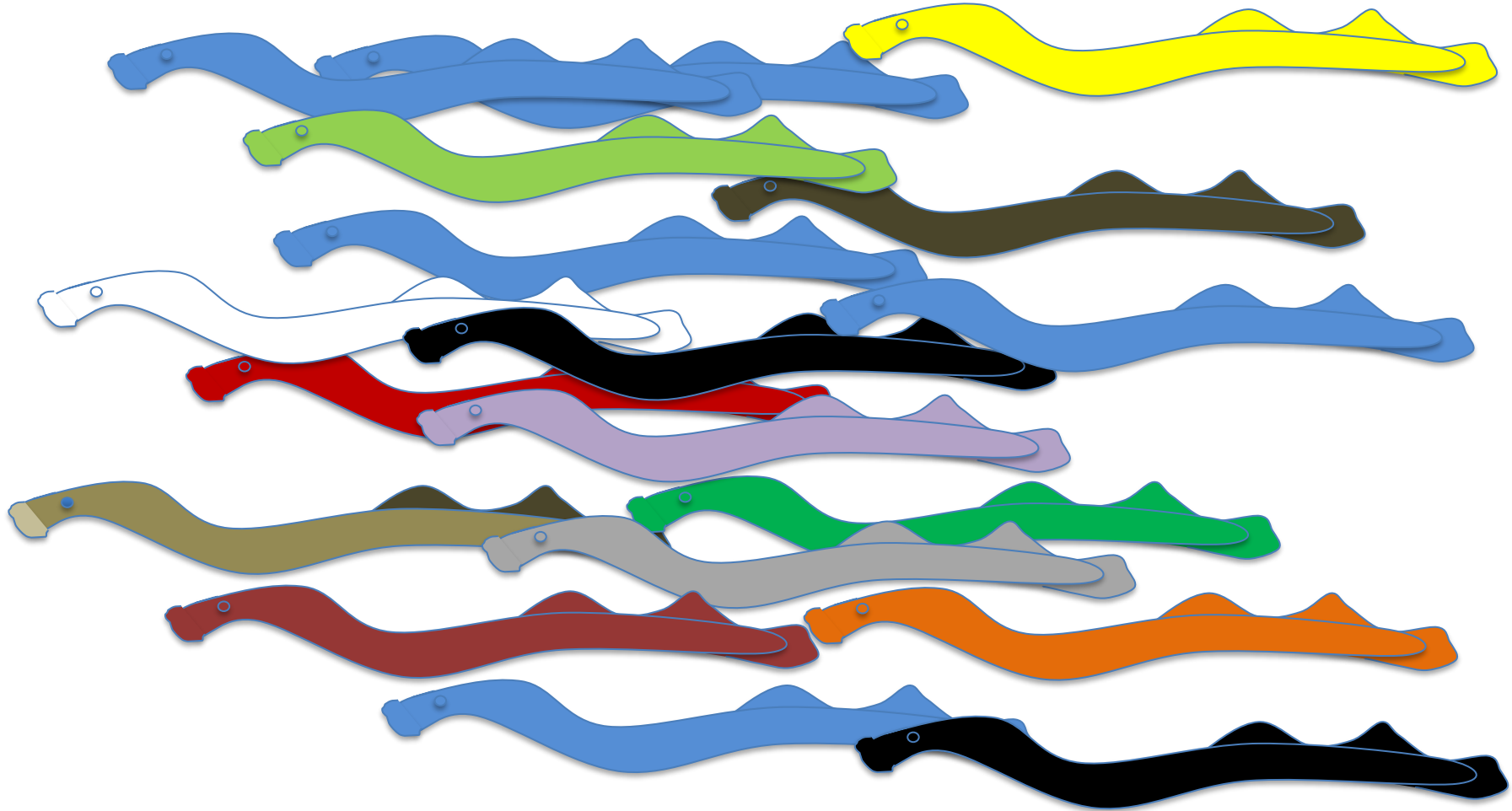


Entering Big Creek, OR Coast

Jason Dunham



Within-species diversity



More standing genetic variation

STREAM MATURING TYPE



OCEAN MATURING TYPE



- **Phenotype**
(morphol. & physiol. Indices)
(Clemens et al. 2013)

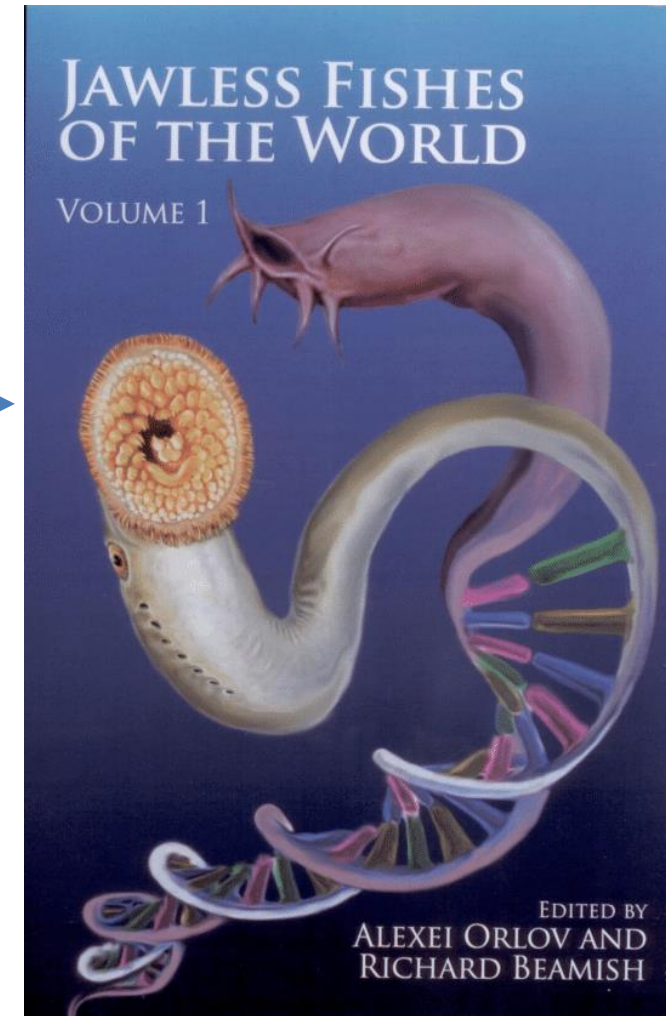
- **Genotype** (Parker et al. 2019; Hess et al. 2020)

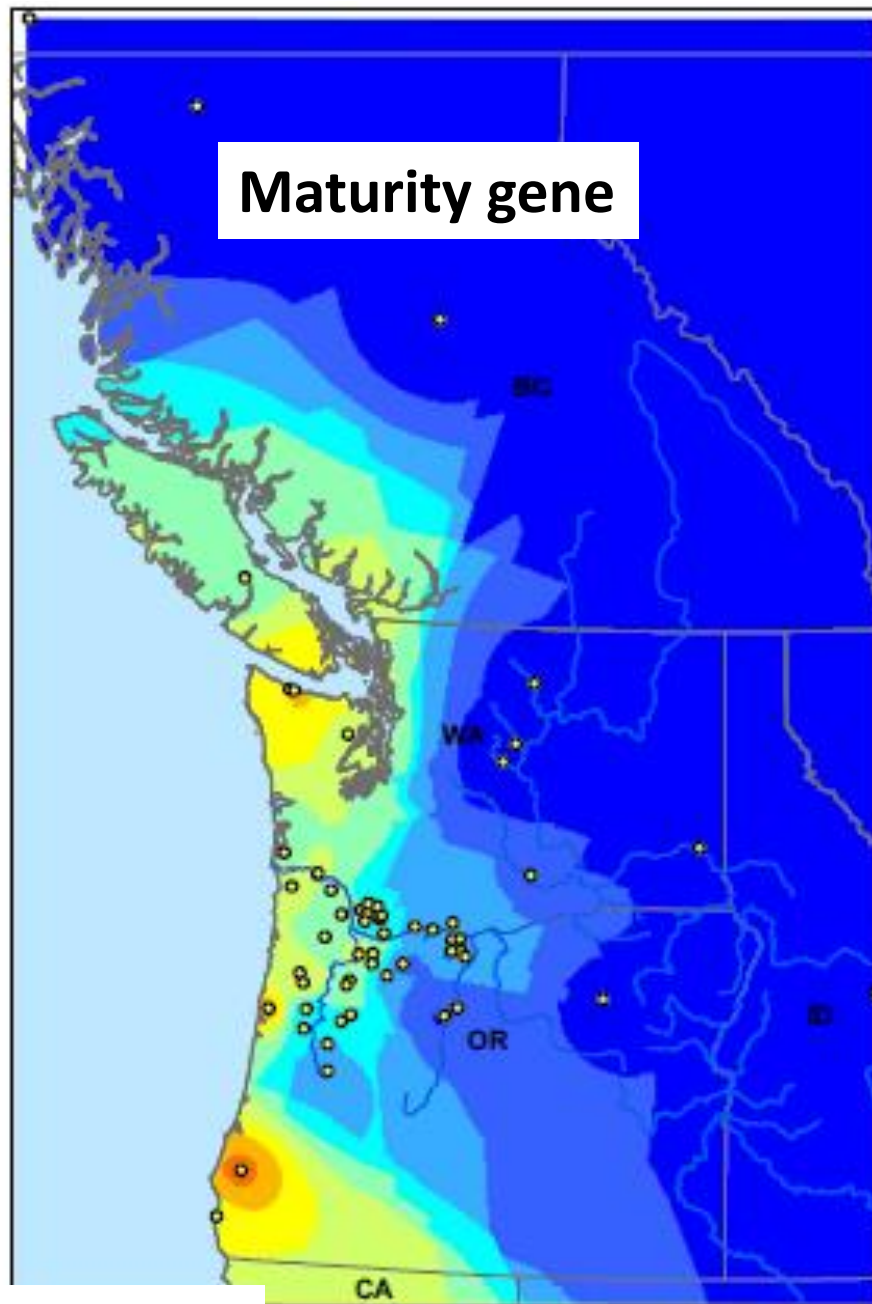
THE POTENTIAL ROLES OF RIVER
ENVIRONMENTS IN SELECTING FOR STREAM-
AND OCEAN-MATURING PACIFIC LAMPREY,
ENTOSPHEUS TRIDENTATUS
(GAIRDNER, 1836)

BENJAMIN CLEMENS, CARL SCHRECK,
STACIA SOWER AND STAN VAN DE WETERING

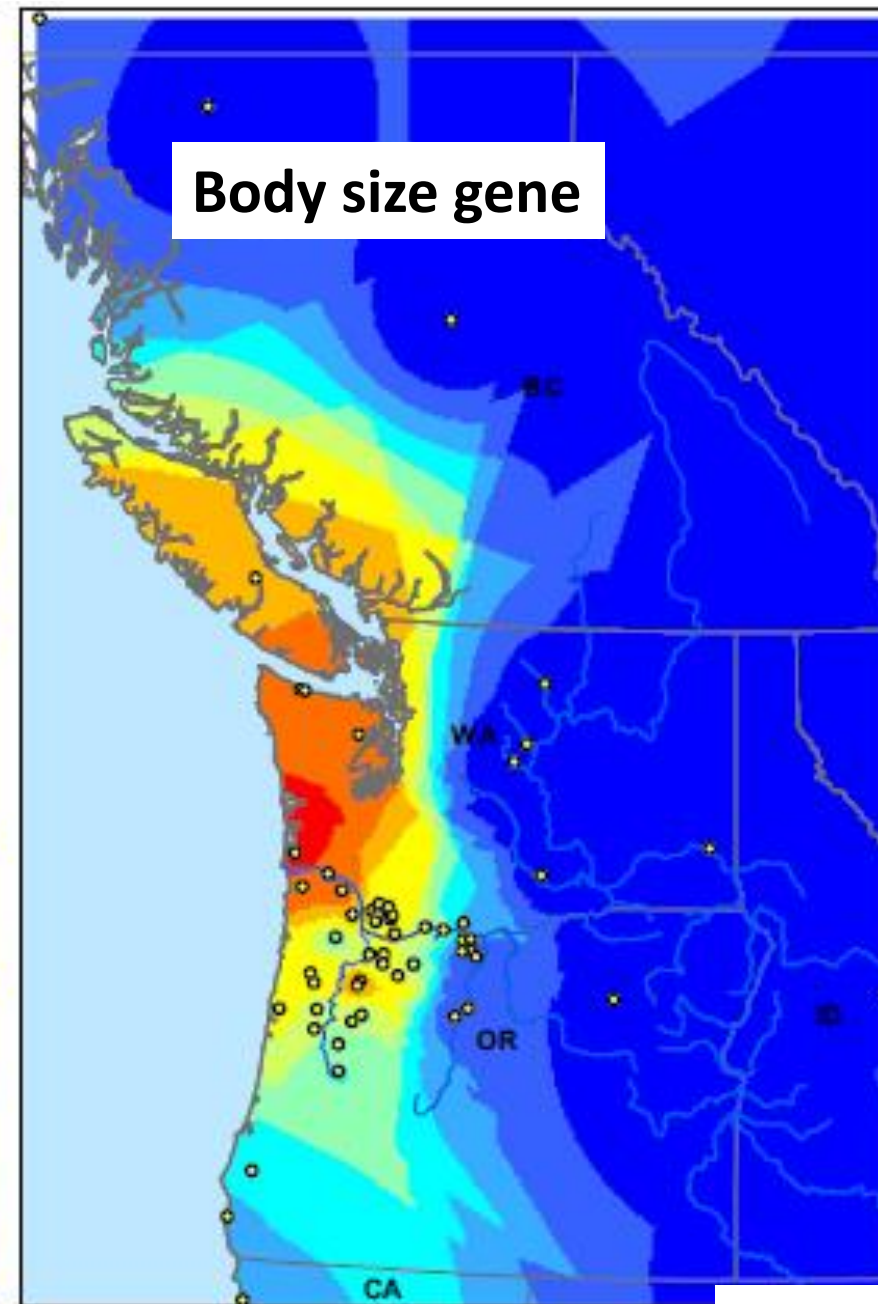
Clemens et al. (2016)

**Simplified, warmwater rivers may
select for ocean maturing ecotype**





Warm = ocean maturing
Cool = stream maturing



Warm = small
Cool = large

Hess et al. 2020





Conrad Gowell

Mason Trinca/High Country News



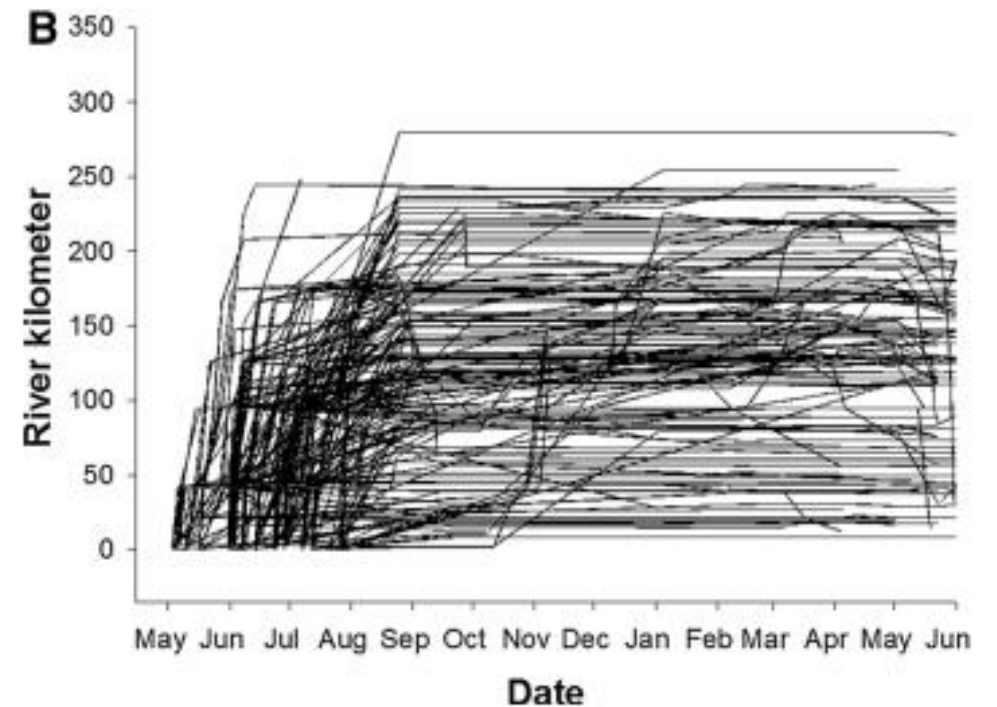




PRIMARY RESEARCH PAPER

Temporal genetic population structure and interannual variation in migration behavior of Pacific Lamprey *Entosphenus tridentatus*

Benjamin J. Clemens · Lance Wyss · Rebecca McCoun · Ian Courter · Lawrence Schwabe · Christopher Peery · Carl B. Schreck · Erin K. Spice · Margaret F. Docker

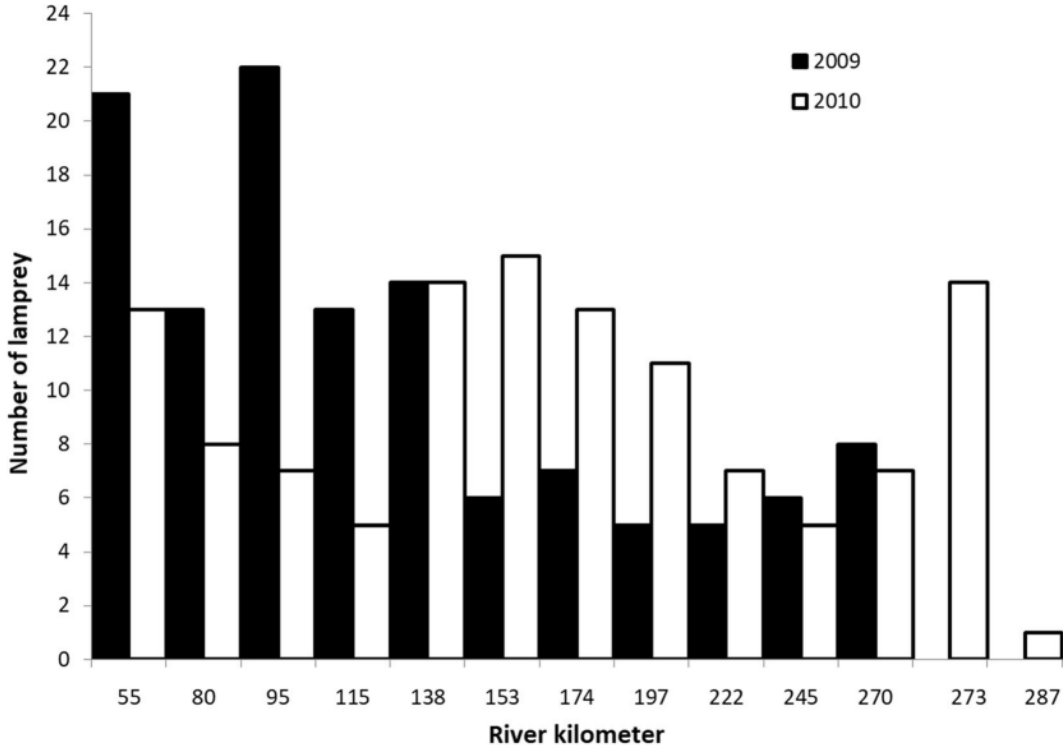
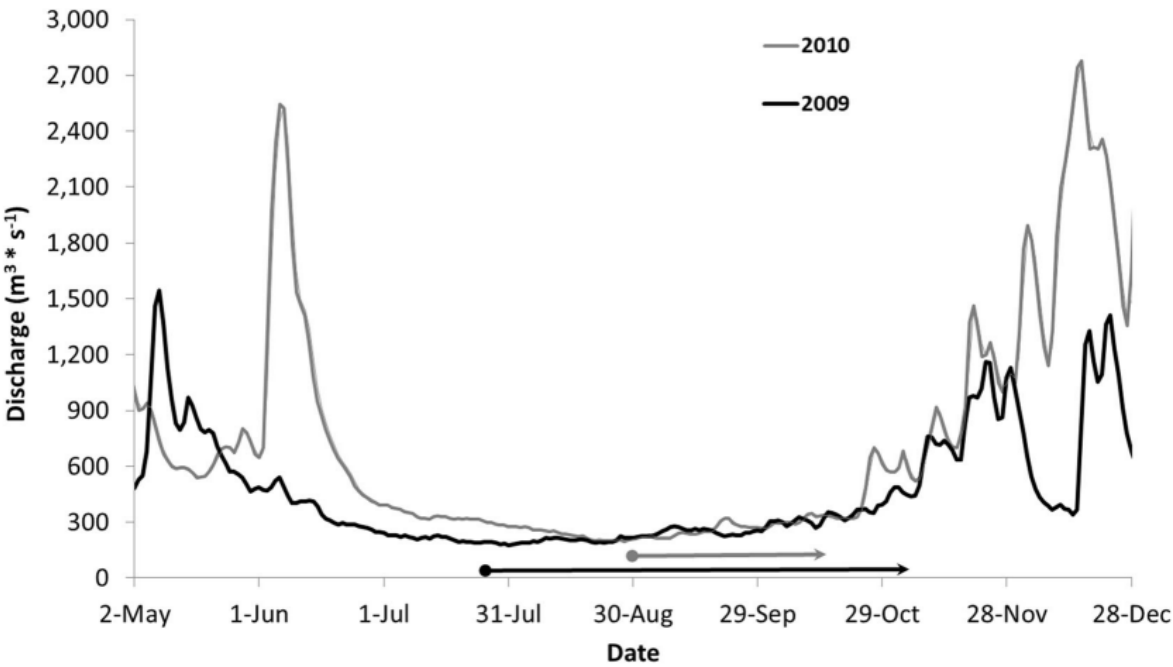




Microhabitat use by pre-spawning Pacific lamprey *Entosphenus tridentatus* in a large, regulated river differs by year, river segment, and availability

Benjamin J. Clemens • Carl B. Schreck

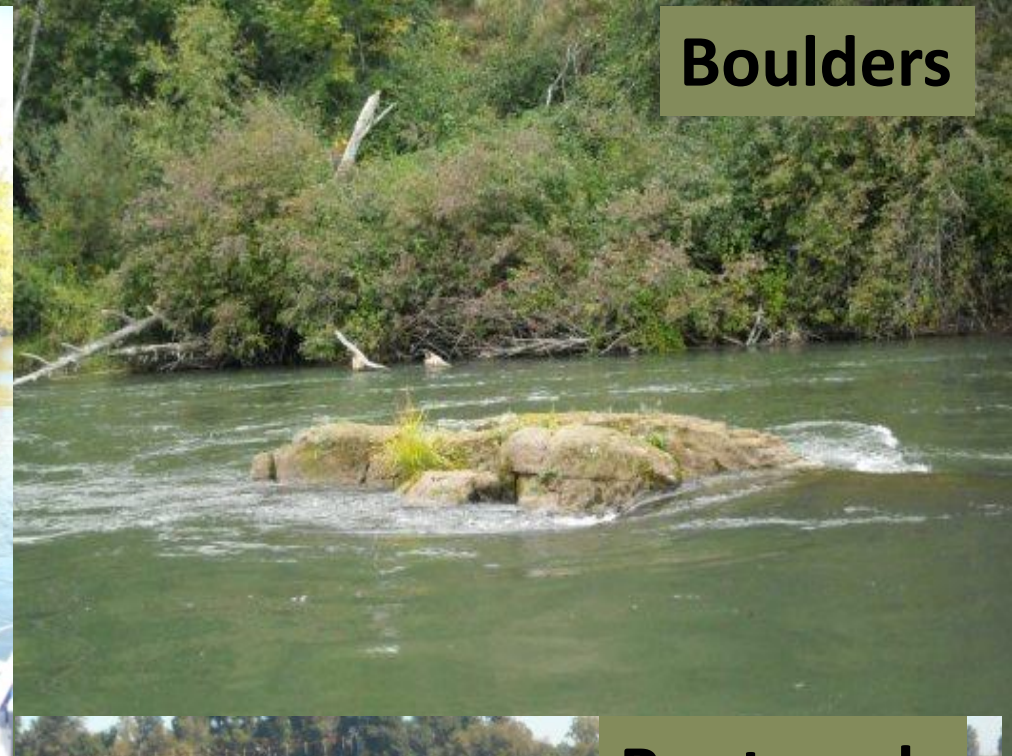
Received: 17 July 2020 / Accepted: 8 March 2021
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Rock revetments



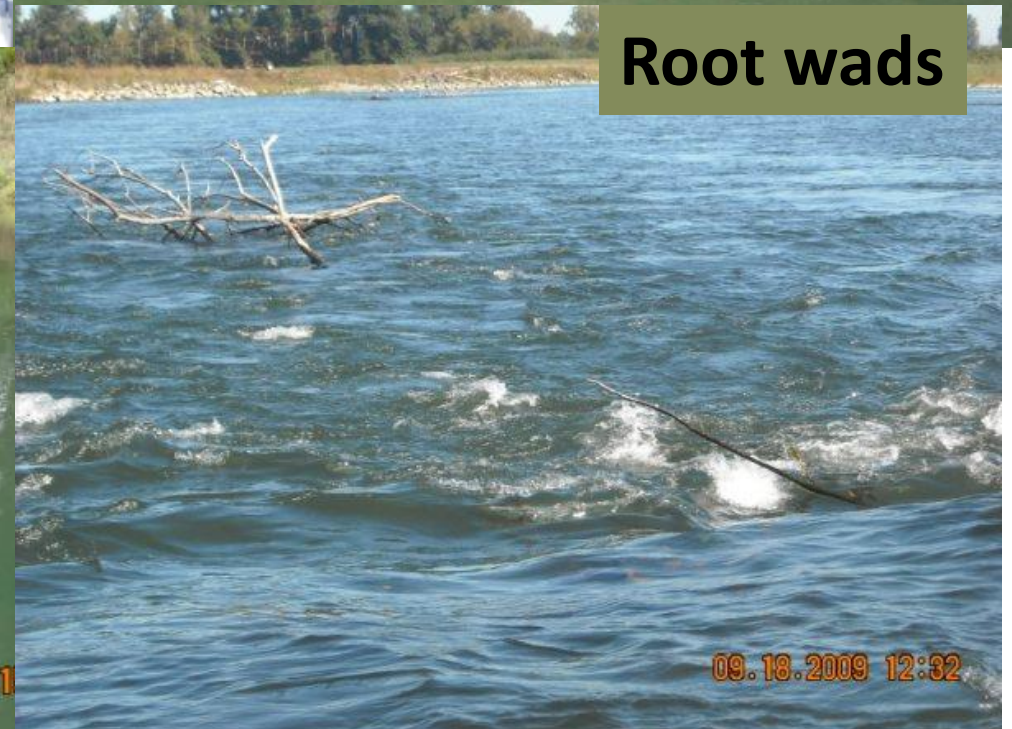
Boulders



Logs



Root wads





Tenmile Lakes Basin Partnership

Eel Creek, OR Coast



Richard Litts




41 predators



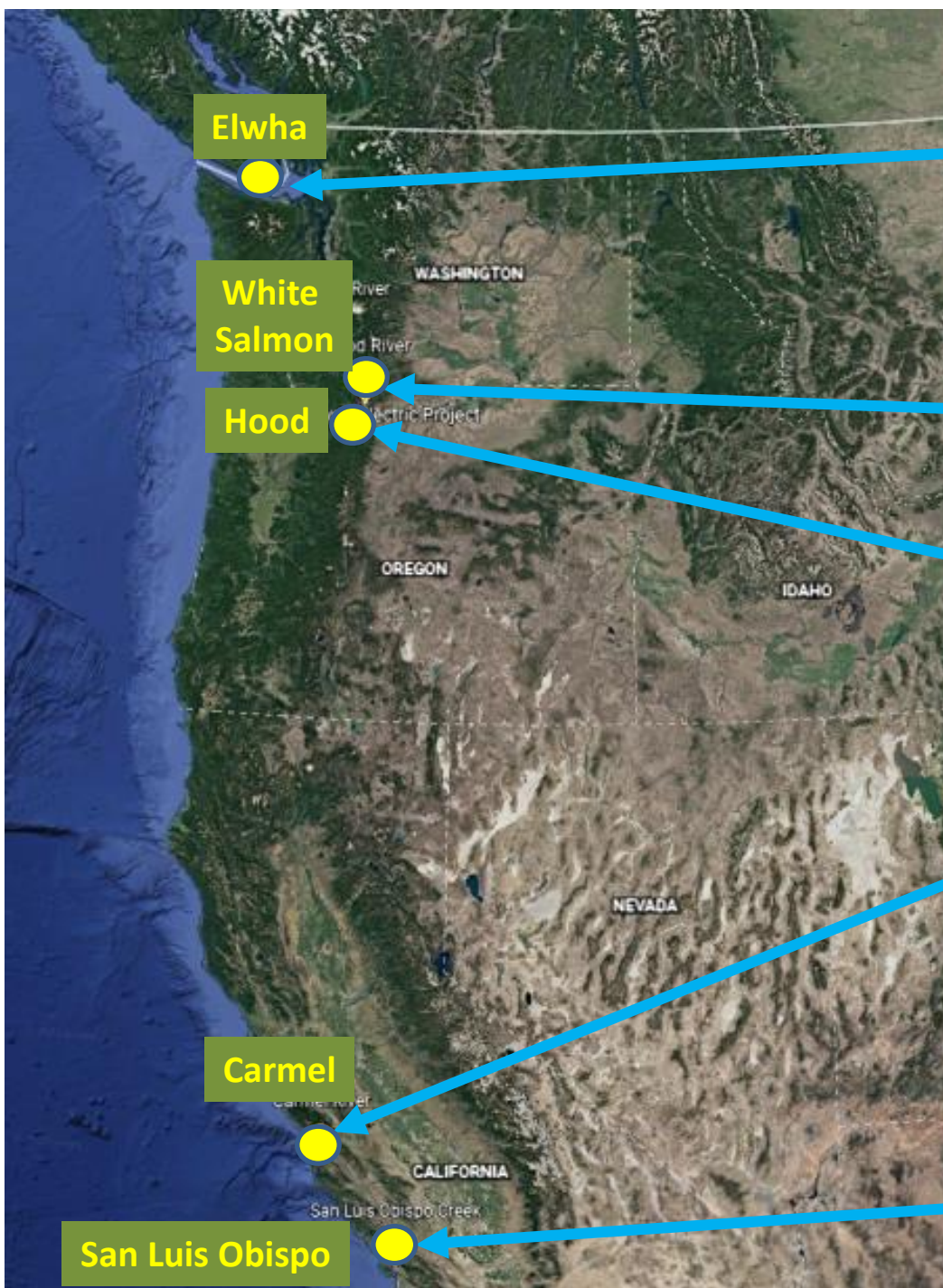
Frank Coster



Bob Hoehne



**Pheromones are
NOT always
needed!**



Elwha

White
Salmon

Hood

Carmel

San Luis Obispo

DAM REMOVALS

Recolonized & effective breeders incr. 12-fold
within 3 yrs

(Moser & Paradis 2017; Hess et al. 2020)

DAM REMOVAL

Recolonized & successfully spawned **within 3 yrs**

(Jolley et al. 2017)

DAM REMOVAL

Recolonized & successfully spawned **within 2 yrs**

(Baker et al. 2015; Hess et al. 2015)

DAM REMOVAL

Recolonized & successfully spawned **within 3 yrs**

(Reid and Goodman 2020)

WEIR MODIFICATION

Recolonized & successfully spawned **within 4 yrs**

(Reid and Goodman 2020)

Received: 6 September 2022

Revised: 13 January 2023

Accepted: 16 January 2023

DOI: 10.1111/eff.12703




ORIGINAL ARTICLE

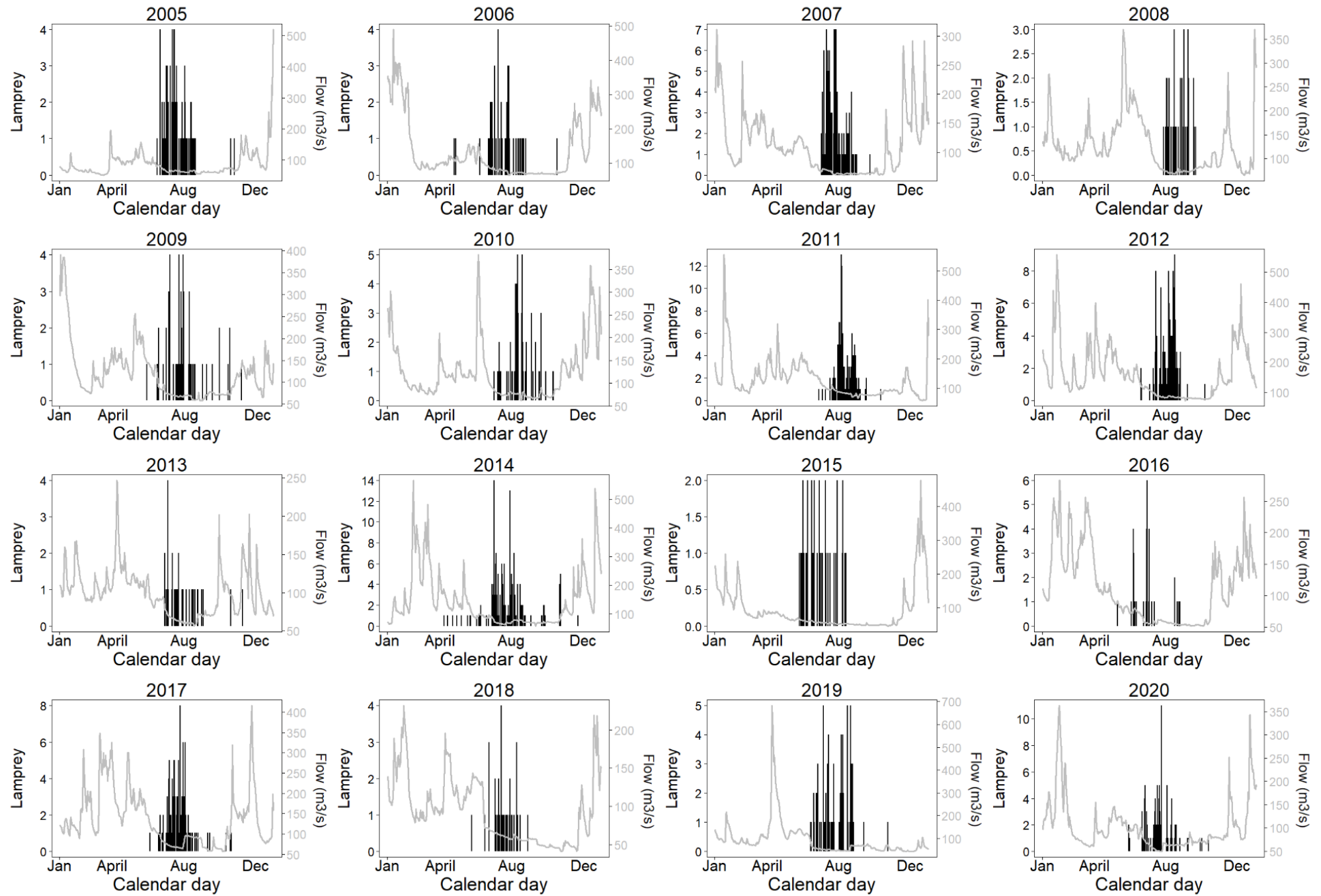
Ecology of

FRESHWATER FISH

WILEY

More flow in a regulated river correlates with more and earlier adult lamprey passage, but peak passage occurs at annual low flows

Benjamin J. Clemens¹  | Jeremy D. Romer²  | Jeffrey S. Ziller²  | Michelle Jones³







Derek Wiley, ODFW



Freshwaters Illustrated



ODFW



Periodic strategists

Use seasonal environments

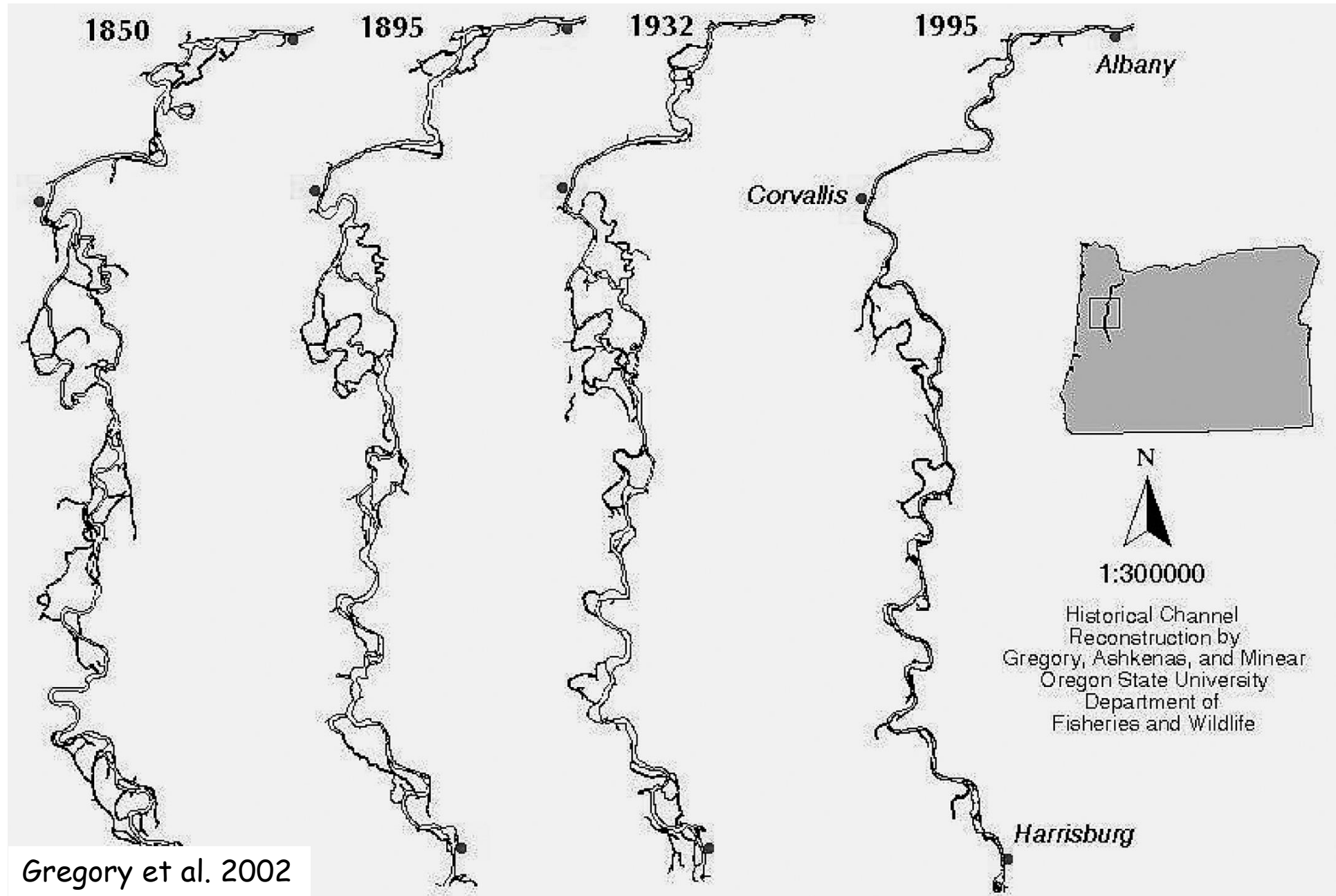
- **Long-lived**
- **Many, small young**
- **High variation in recruitment**
- **Large seasonal/spatial habitat variation**

Clemens et al. (2013)

Winemiller (2005)

Winemiller & Rose (1992)

Channelization of Willamette

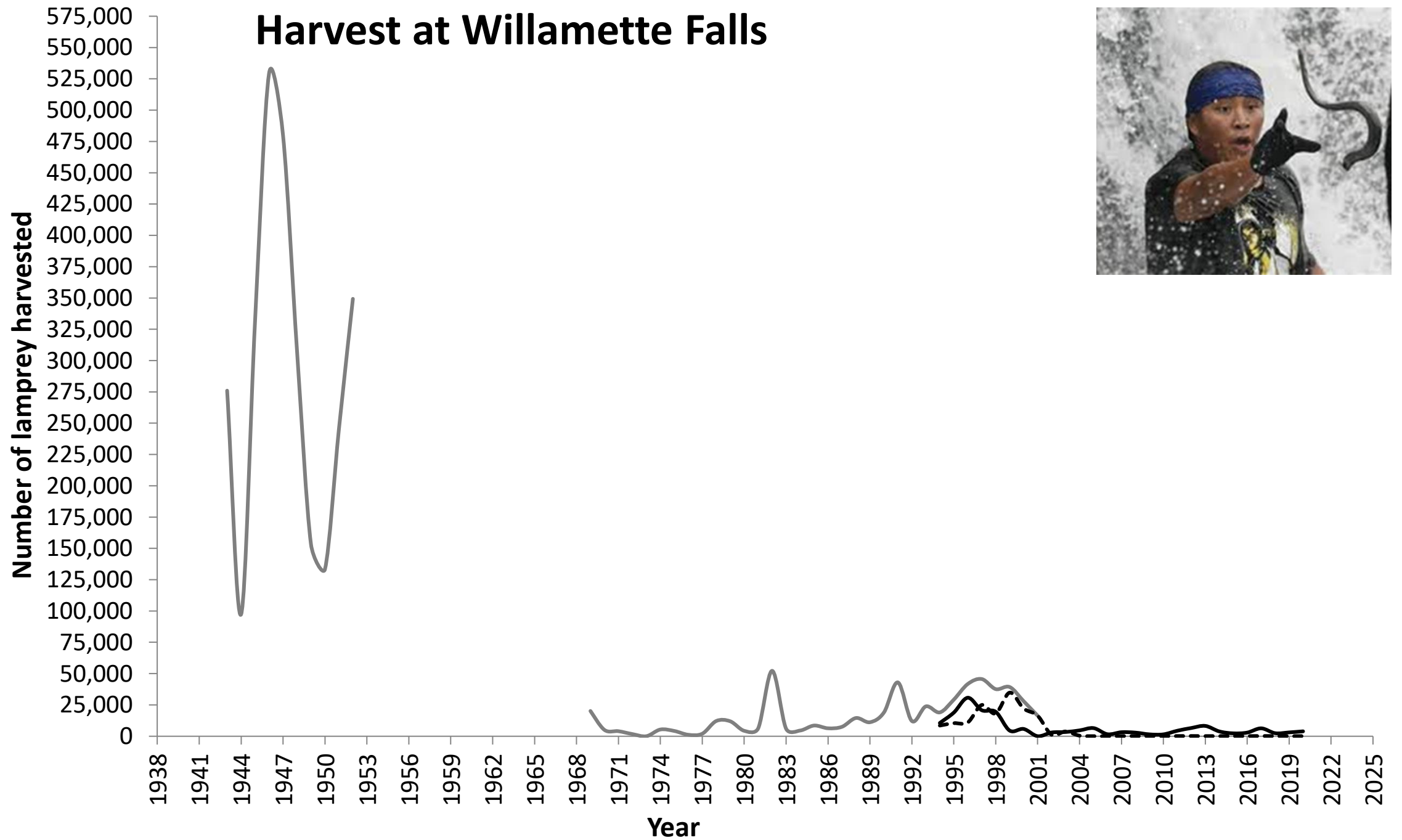


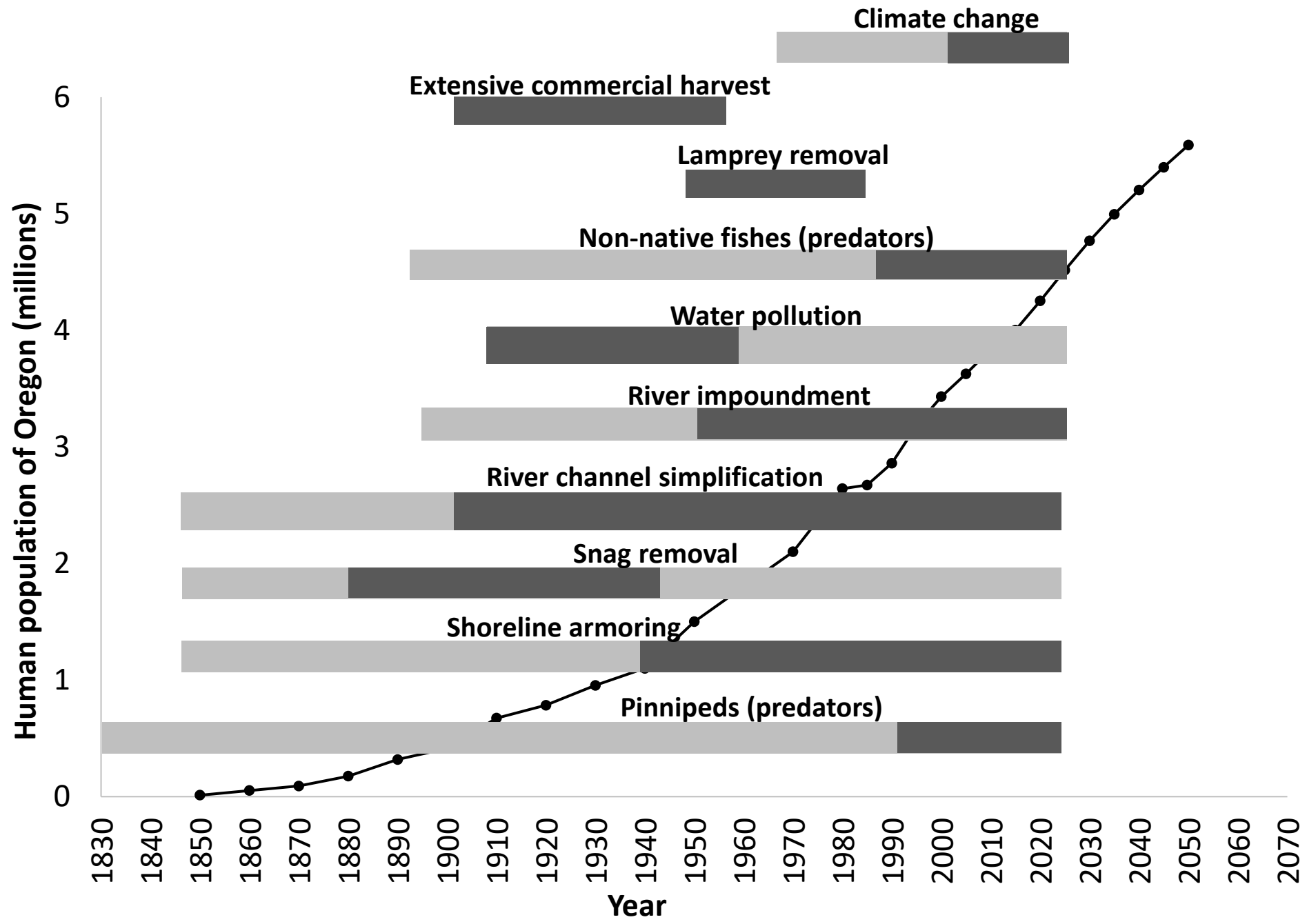
Gregory et al. 2002

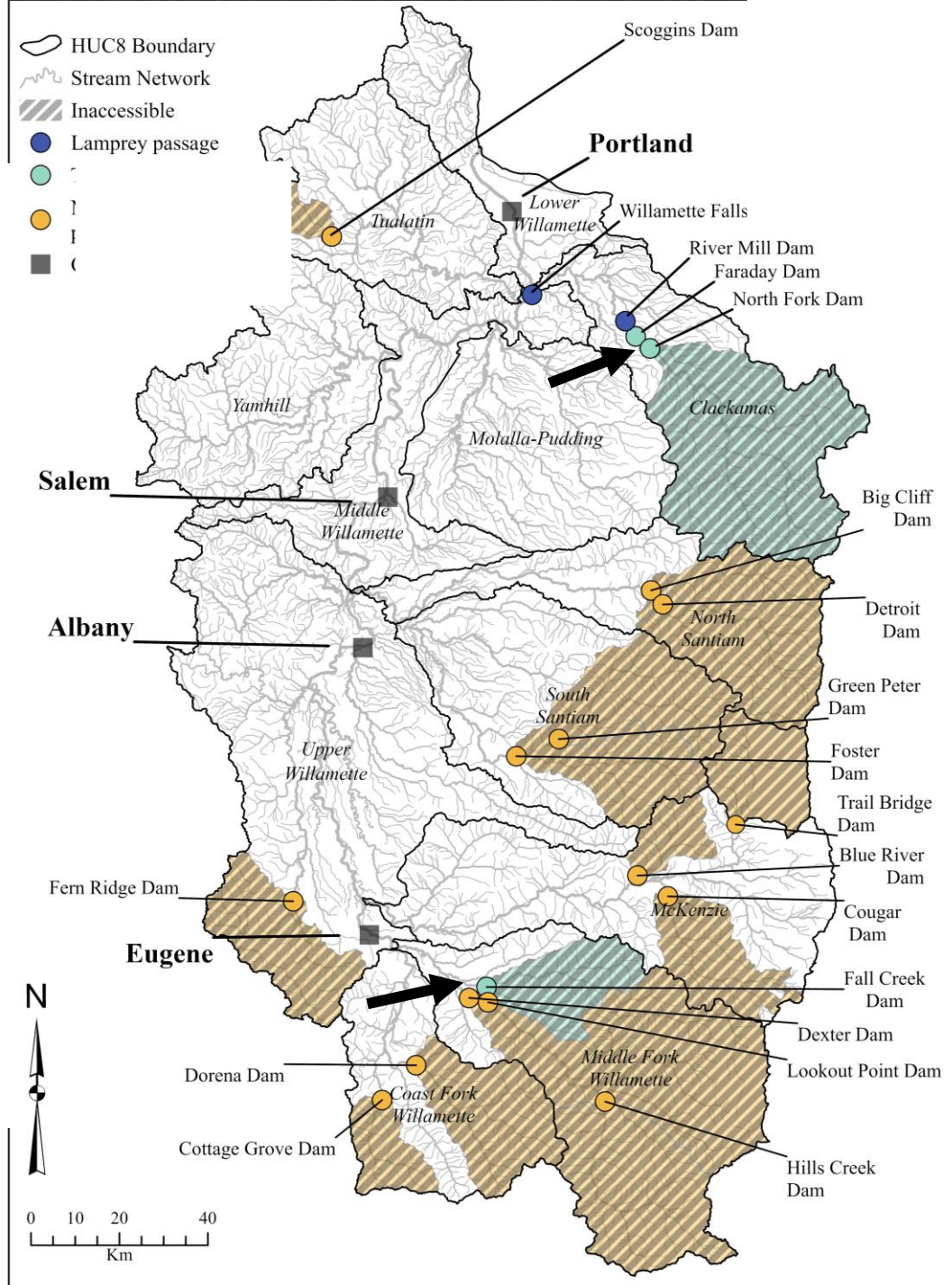
**Willamette Falls
1913**



Harvest at Willamette Falls







- No lamprey passage
- Trap & haul
- Lamprey passage

Special Section |  Full Access

The Case for Basin-Wide Passage and Habitat Restoration for Pacific Lamprey in the Willamette River Basin (Oregon, USA)

Benjamin J. Clemens , Thomas A. Friesen, Stanley V. Gregory, Courtney L. Zambory

First published: 18 March 2023 | <https://doi.org/10.1002/nafm.10891>



“Actions to protect and enhance nationally or internationally important stocks must be implemented from at least a catchment perspective, because many of the issues affecting such species are not localized”

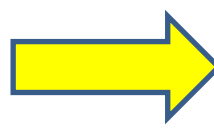
(Nunn et al. 2008)

Outline

1. Lamprey biology
- 2. Threats/limiting factors**
3. Actions (Mgmt & Research)



**Road back
Hero's return**



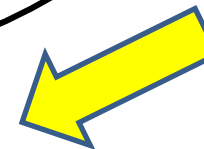
Call to adventure



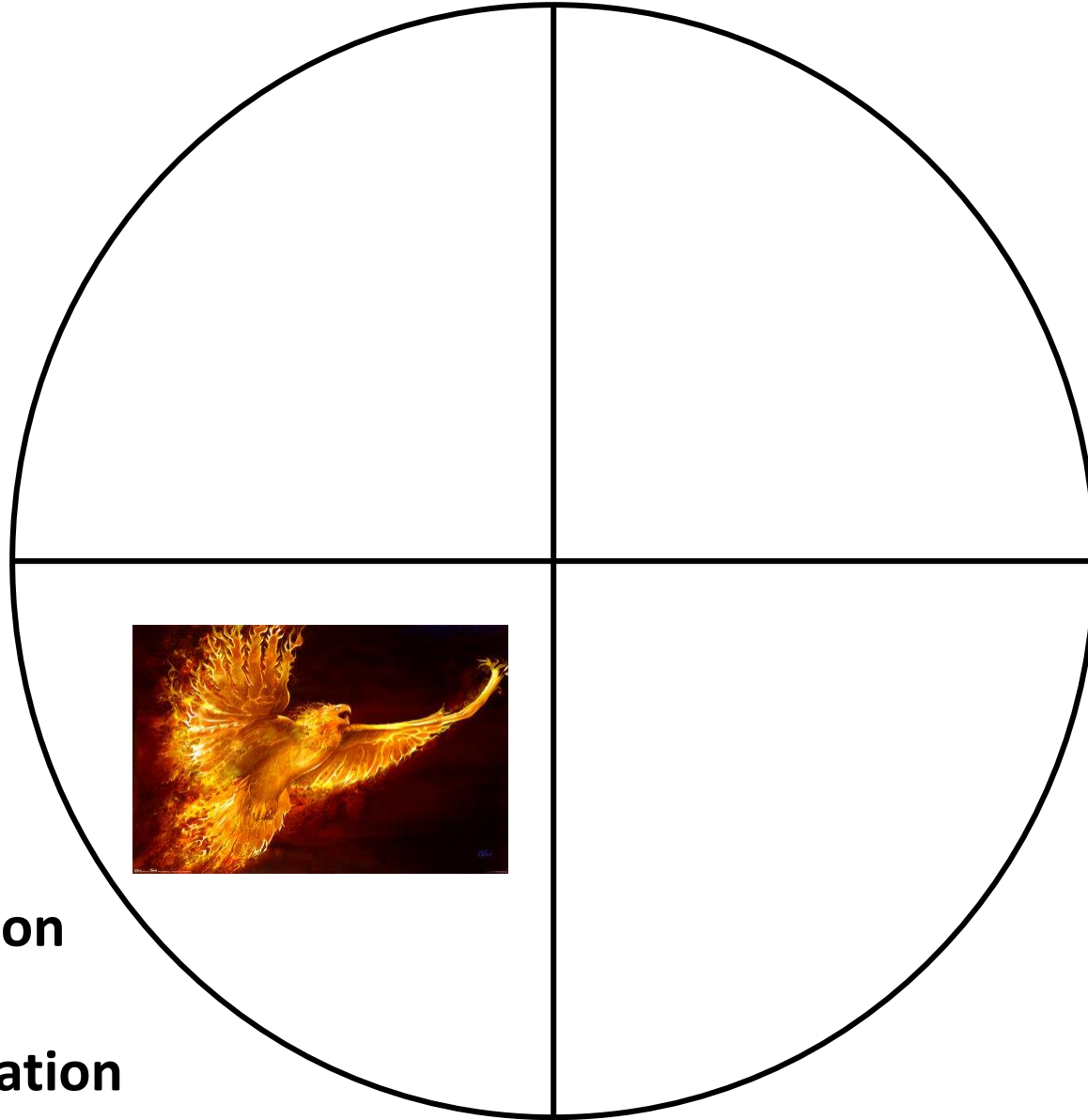
**Unification
&
transformation
(2000 – 2020)**



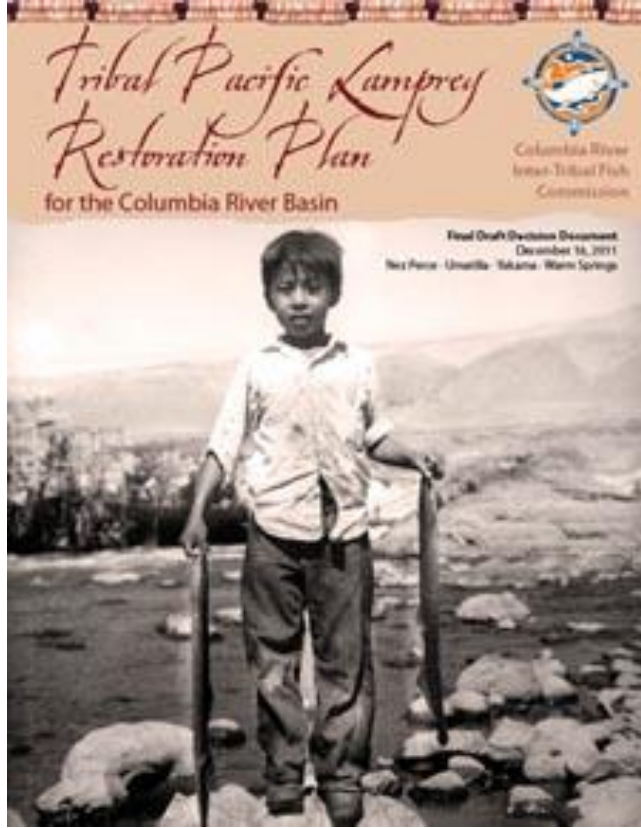
**Supreme ordeal
(1880 - 1999)**







**Unification
&
transformation
(2000 – 2020)**



Conservation Plan for Lampreys



Conservation Plan for Lampreys



Status: Sensitive



Pacific Lamprey (13-33")



Lamprey (4-12")



Western Brook Lamprey



Pacific Brook Lamprey (4-7")

Outline

1. Lamprey biology
2. Threats/limiting factors
3. **Actions (Mgmt & Research)**



Education & outreach



THE MOST **Disgusting** ANIMALS ON THE PLANET

BY JOHN PERRITANO



The cuteness is coming

LAMPREY
SUMMER 2019



June 2021, Volume 3, Number 6

Conservation Science and Practice

Open Access

A journal of the Society for Conservation Biology

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DOI: 10.1111/csp2.402

PERSPECTIVES AND NOTES

Conservation Science and Practice
A Journal of the Society for Conservation Biology

WILEY

Dispelling misperceptions of native lampreys (*Entosphenus* and *Lampetra* spp.) in the Pacific northwest (USA)

Benjamin J. Clemens¹  | Christina J. Wang²

Native Lampreys of Oregon



Miller Lake lamprey: Oregon's smallest lamprey species.



Oregon Department of Fish and Wildlife

4034 Fairview Industrial Drive SE
Salem, Oregon 97302

503-947-6000 | ODFW.com

www.dfw.state.or.us/fish/species/lampreys.asp



2/2021

image courtesy of
Michael Durham/Oregon Zoo



Pacific LAMPREY

(parasitic) is culturally significant to several Native American tribes that harvest them for use in ceremonies and for food, medicine and other purposes. For more information on the Pacific lamprey, go to https://www.dfw.state.or.us/fish/species/docs/lamprey/pacific_lamprey.pdf



Western river LAMPREY

(parasitic) rear to adult size in the nearshore ocean and large estuaries before returning to freshwater to spawn and die. For more information on the western river lamprey, go to https://www.dfw.state.or.us/fish/species/docs/lamprey/western_river_lamprey.pdf



Western brook LAMPREY

(non-parasitic) spend their entire lives in freshwater and do not feed as adults. For more information on the western brook lamprey, go to https://www.dfw.state.or.us/fish/species/docs/lamprey/western_brook_lamprey.pdf



Miller Lake LAMPREY

(parasitic) is the smallest landlocked parasitic lamprey in the world, existing only in Miller Lake and its sub-drainage, and in the upper Williamson and Sycan rivers east of the Cascades. For more information on the Miller Lake lamprey, go to https://www.dfw.state.or.us/fish/species/docs/lamprey/miller_lake_lamprey.pdf

Large species illustrations are not shown to scale.

PIT-KLAMATH BROOK lamprey
7 Inches | Non-parasitic



KLAMATH RIVER lamprey
11 Inches | Parasitic



PACIFIC BROOK lamprey
7 Inches | Non-parasitic



GOOSE LAKE lamprey
10 Inches | Parasitic



NORTHERN CALIFORNIA BROOK lamprey
9 Inches | Non-parasitic



KLAMATH LAKE lamprey
13 Inches | Parasitic



At this time, little information
is available for these six species.



Season 32, Episode 3



Episode 73: Lamprey



2018 Lamprey ID workshop



2020 River Restoration Northwest Lamprey Short Course



2019 PSU Lamprey Short Course



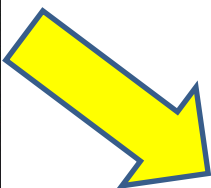
2021-2022 Community Science



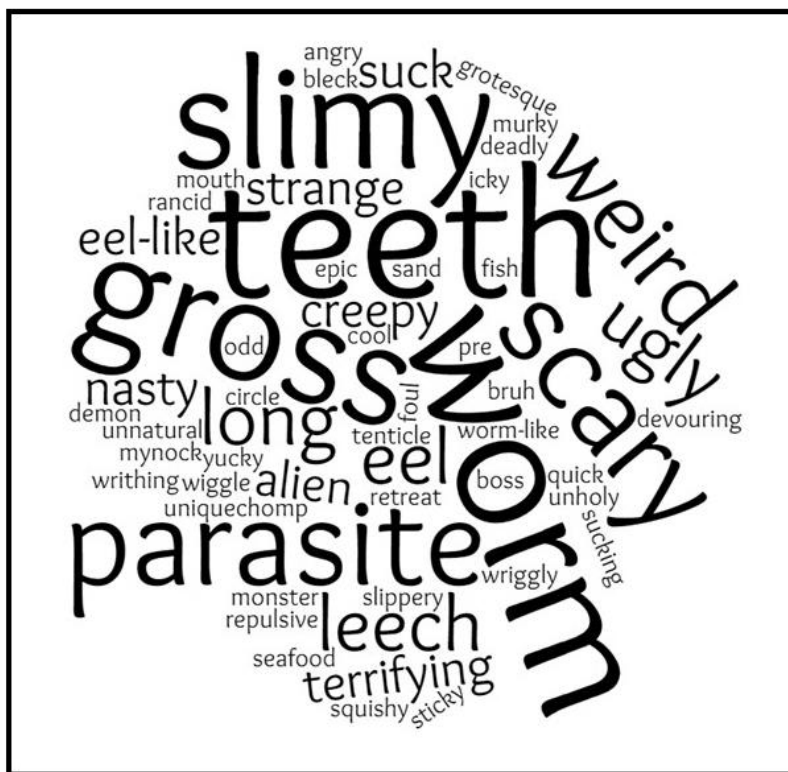
2022 Lamprey Biology & Identification Workshop



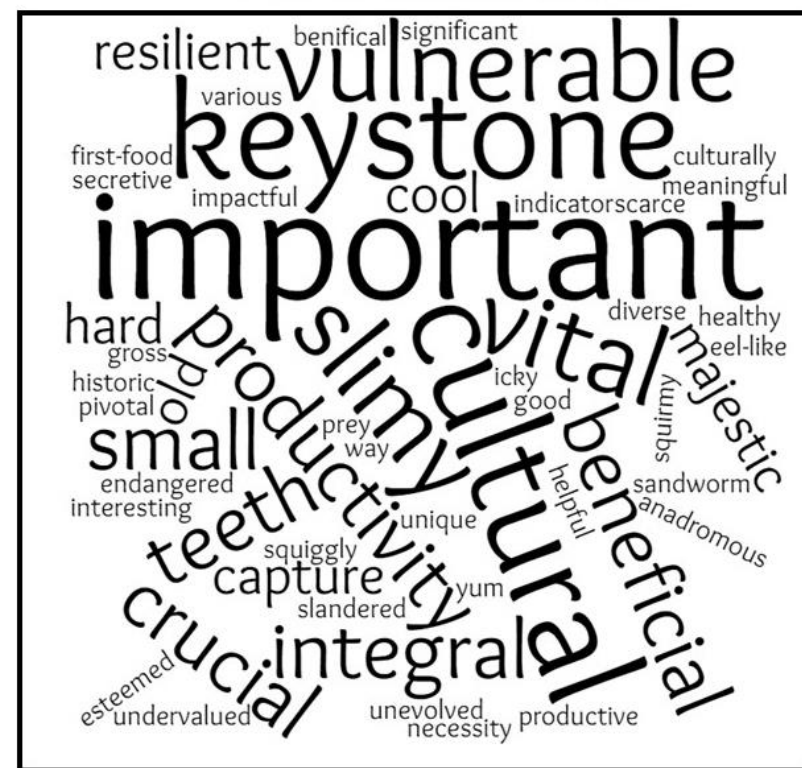
2021-2022 Community Science



Pre Assessment



Post Assessment



Welcome to the Eel Lake Fish Passage and Trap Facility

Pacific lamprey

Pacific lamprey of Tenmile & Eel Creek basins

Lampreys arose 400-500 million years ago, making them older than dinosaurs! They remain primitive with boneless bodies and sucking disk mouths.

Lampreys are not eels. Eels are a much newer and different species and do not exist in Oregon.

Oregon has 10 native species of lampreys, and Pacific lamprey occur right here. They play an important role as indicators of healthy streams and are culturally significant to Pacific Northwest tribes.

Lampreys need passage

Pacific lamprey migrating upstream to spawn usually find traditional "jump-pool" fish ladders difficult to navigate because they cannot jump like salmon and steelhead.

Instead, they use their sucker mouths to attach to vertical, smooth, wet surfaces and inch upward. The climbing surface must remain wet and have a rounded edge at the top for lamprey to successfully pass upstream.

The jump-pool fish ladder at Eel Lake Dam was designed to pass adult coho salmon, winter steelhead, and sea-run cutthroat trout, but not Pacific lamprey. Seasonally, the fish trap is used to capture adult winter steelhead for hatchery broodstock needs.

The solution: a lamprey passage ramp

Pacific lamprey use their sucker mouths to attach to and climb the wet metal surface.

To help Pacific lamprey pass over the dam, a lamprey passage ramp was designed and installed in 2018.

For the first time in several decades, adult Pacific lamprey can now be seen climbing the passage ramp during their spring spawning migration!

This ramp was funded and installed through a multi-agency partnership: the Oregon Department of Fish and Wildlife, Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians, Tenmile Lakes Basin Partnership, Oregon Watershed Enhancement Board, and the U.S. Fish and Wildlife Service.

Pacific Lamprey at the Eel Lake Fish Passage and Trap Facility

Pacific lamprey

Pacific lamprey lifecycle

Pacific lamprey lifecycle

Pacific lamprey have four life stages: larva, juvenile, parasitic juvenile, and spawning adult.

Adults spawn and their eggs hatch in fresh water. The hatched larvae live and grow in soft, silty river bottoms for up to 10 years.

Juveniles emerging from the silt have eyes and teeth. They migrate to the ocean where they become parasitic and attach to and feed on a variety of fishes and marine mammals.

Adults return to fresh water to spawn and die, completing the life cycle.

Traditional Native American uses of Pacific lamprey

For millennia, adult Pacific lamprey have been a key food, medicine, and cultural resource for several Native American tribes in the Pacific Northwest.

Once bountiful, Pacific lamprey were gathered in this area by Quuich and Hanis Coos peoples.

Today, these tribal peoples are now confederated with their northern kin, the Sha'yuushtl'a, and their southern cousins, the Miluk Coos and known as the Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians.

Pacific lamprey are known as *lq'asii* (pronounced *hl-q' aw-sii*) in Quuich and *sinkwit* in Hanis Coos. *lq'asii* were harvested in May and June and dried on platforms made from Douglas fir trees.

To avoid antagonizing the *lq'asii* and causing them to vanish, the only tool used to process *lq'asii* was a freshwater mussel shell. If any other tool was used, a storm would swell the river, ruining the *lq'asii* hunters' *wap* (traps) and making it impossible to hunt them for the rest of the season.

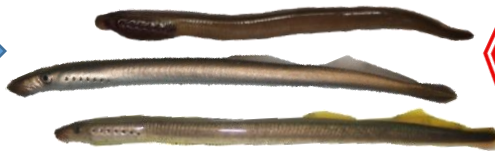
Chief Doc Slyter (Hanis Coos) of the Confederated Tribes of the Coos, Lower Umpqua and Siuslaw Indians (left) and Tribal Councilman Doug Barrett (Sha'yuushtl'a) Quuich) process a Pacific lamprey with a freshwater mussel shell.

Photo: Robby Russell (Miluk Coos)

Scan with a QR code reader on your mobile device (or take a photo for a link)

Do You Use Lampreys as Bait?

Larvae, Juveniles,
Resident Adults
(< 8 inches long)



Pacific Lamprey Adults
(up to ~3 ft long)



OAR 635-004-0225
OAR 635-011-0071
WAC 220-310-070

Lampreys (often called “eels”) are used as bait by sport anglers in some states. However, using any lamprey species as baits for recreational fishing or shellfish harvest in **Oregon** and **Washington** is

Against the Law

Lampreys are native to the Pacific Northwest and contribute to healthy streams. To learn more about the native lampreys of Oregon and Washington and to check local fishing rules visit:

OR Fishing
Regulations



Oregon's Native
Lamprey Brochure



Pacific Lamprey
Conservation Initiative



WA Fishing
Regulations



For information on this topic, please contact your local state biologist:

Benjamin Clemens (Oregon Dept. of Fish & Wildlife):

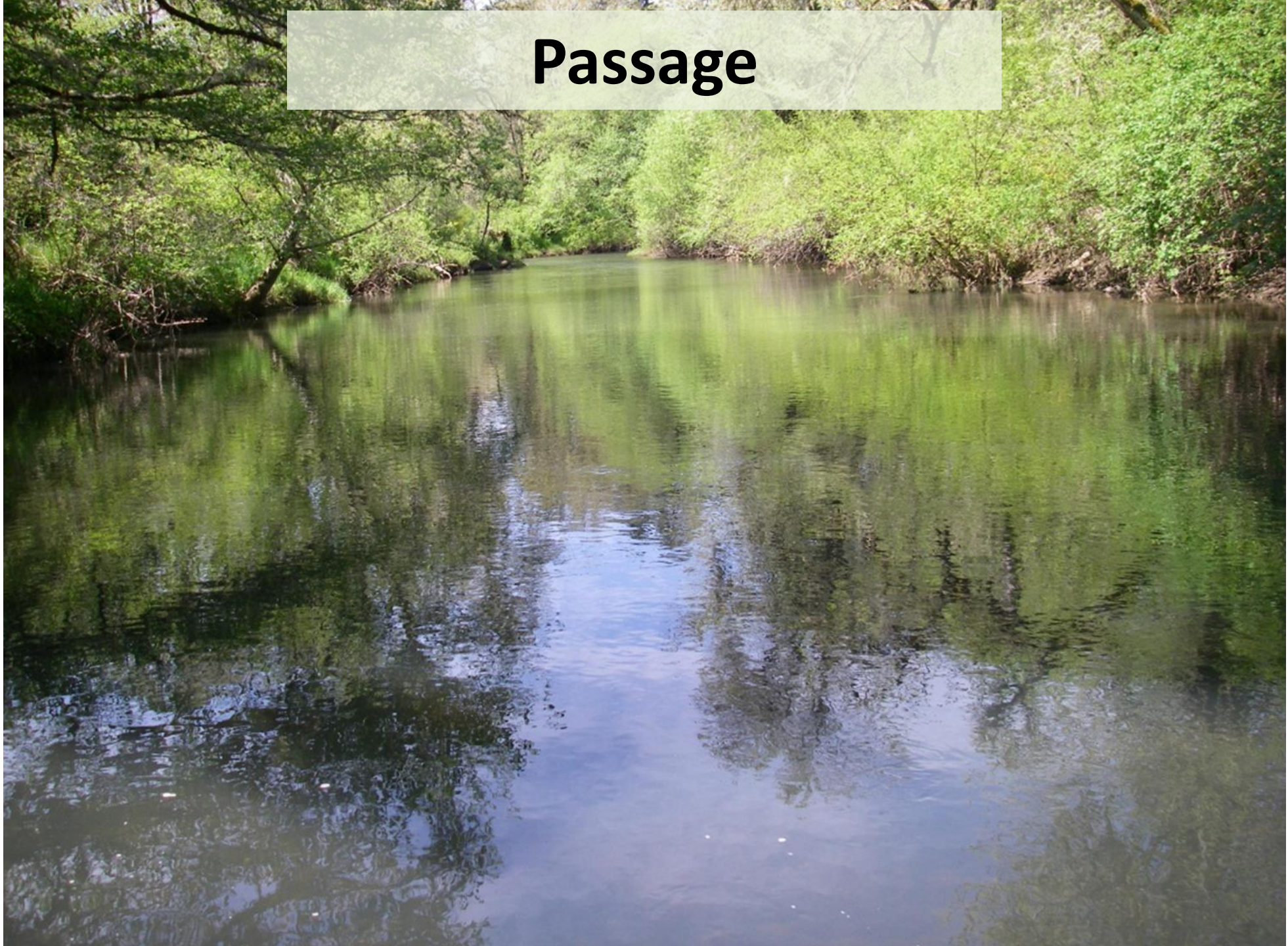
Benjamin.J.CLEMENS@odfw.oregon.gov

Monica Blanchard (Washington Dept. of Fish & Wildlife):

Monica.Blanchard@dfw.wa.gov



Passage



Winchester Dam

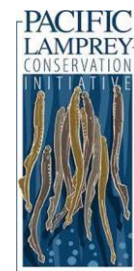


ODFW





2019-20: Leaburg Dam adult passage study



*Best Management Guidelines for
Native Lampreys
During In-water Work
Living Document, Original Version 1.0
May 4, 2020*

Lamprey Technical Workgroup

Comparison of Pacific Lamprey and Pacific Salmon Life Histories, Habitat and Ecology

Living Document, Original Version 1.0
March 8, 2023



Habitat restoration



South Fork McKenzie River



Jeremy Romer, ODFW

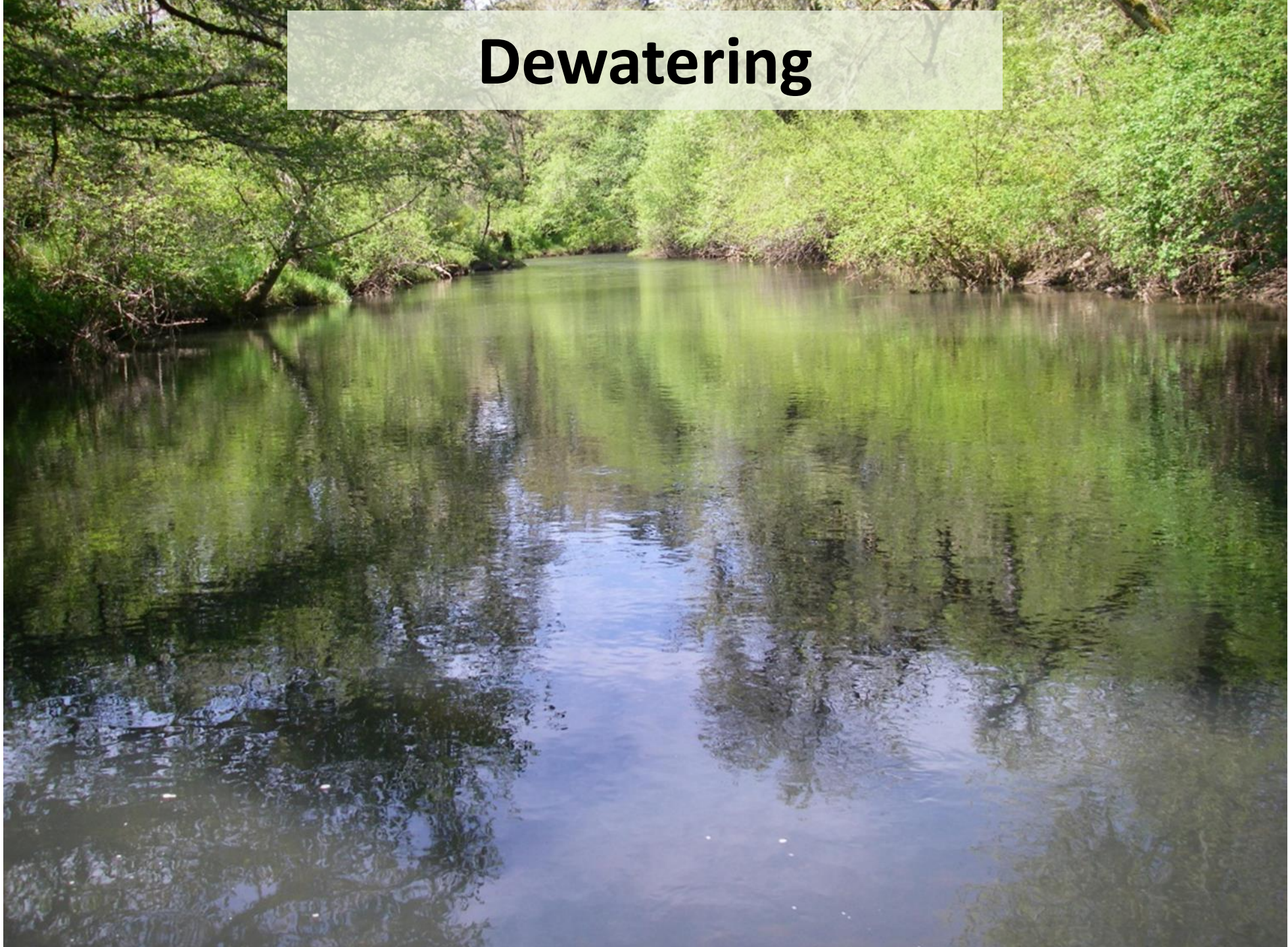
Fivemile & Bell creeks



Joe Skalicky, USFWS



Dewatering





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Revised: 25 August 2020

Accepted: 27 August 2020






DOI: 10.1002/rra.3730



RESEARCH ARTICLE

WILEY

Effects of dewatering on behavior, distribution, and abundance of larval lampreys

Julianne E. Harris¹  | Joseph J. Skalicky¹  | Theresa L. Liedtke²  |
Lisa K. Weiland²  | Benjamin J. Clemens³  | Ann E. Gray⁴

Monitoring abundance



Transactions of the American Fisheries Society

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ISSN: 0002-8487 print / 1548-8659 online

DOI: 10.1002/tafs.10326

ARTICLE

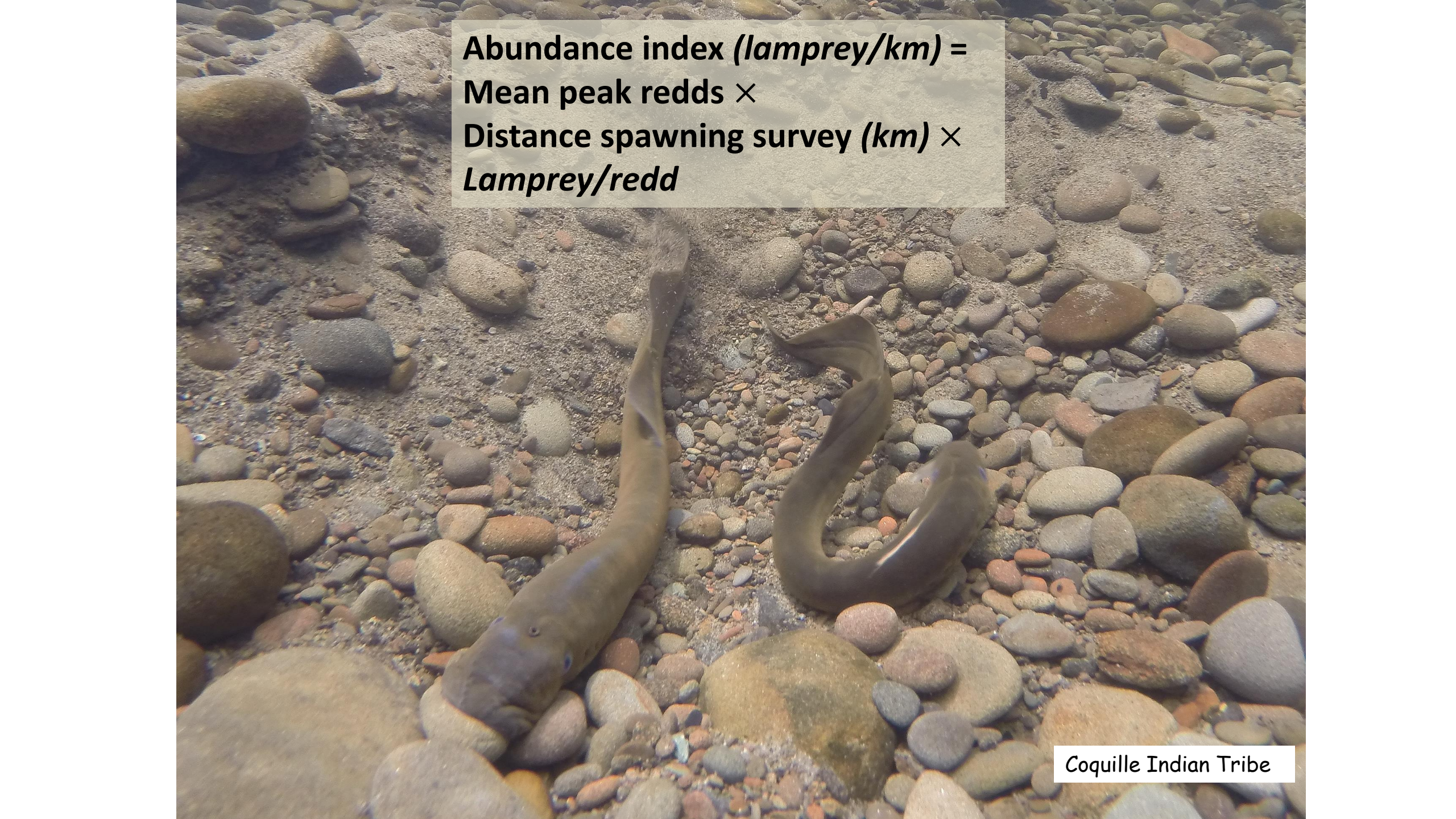
Abundance Trends for Adult Pacific Lamprey in Western Oregon (USA): Historic Declines, Recent Increases, and Relative Contributions from Coastal Rivers

Benjamin J. Clemens,*  Matthew A. Weeber, and Mark Lewis

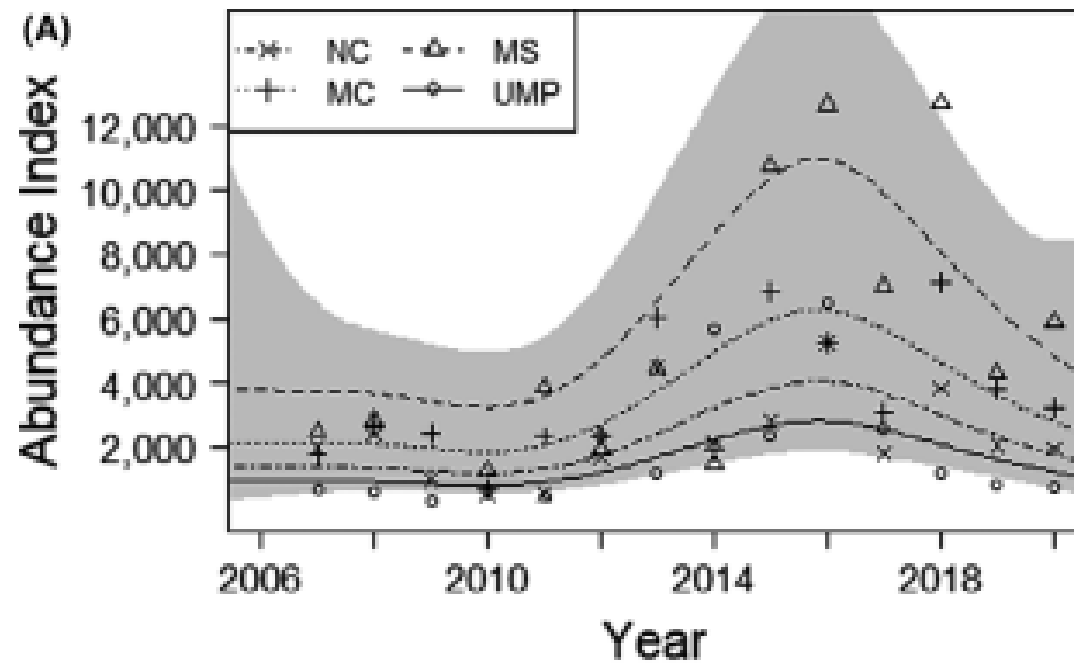
Oregon Department of Fish and Wildlife, 28655 Highway 34, Corvallis, Oregon 97333, USA

Michelle Jones

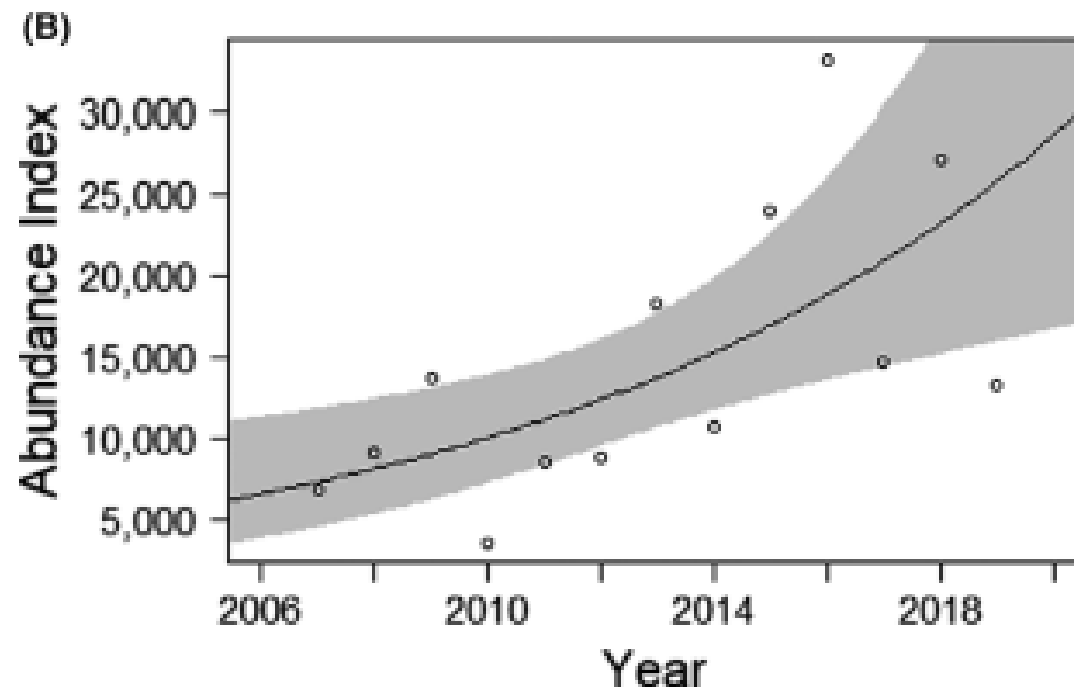
Oregon Department of Fish and Wildlife, 4034 Fairview Industrial Drive Southeast, Salem, Oregon 97302, USA

A photograph of two lampreys on a riverbed covered with smooth, rounded stones of various colors (brown, grey, tan). The lampreys are elongated, eel-like fish with a mottled brown and tan pattern. One lamprey is in the foreground, facing the viewer, while the other is slightly behind and to the right, facing away. The water is clear, and the lighting is natural, suggesting a daytime scene.

Abundance index (*lamprey/km*) =
Mean peak redds ×
Distance spawning survey (*km*) ×
Lamprey/redd



**Recent modest
increase in abundance**




Monitoring distribution





ARTICLE

Sampling Methods and Survey Designs for Larval Lampreys

Benjamin J. Clemens* 

Oregon Department of Fish and Wildlife, Corvallis Research Lab, 28655 Highway 34, Corvallis, Oregon 97333, USA

Julianne E. Harris 


U.S. Fish and Wildlife Service, Columbia River Fish and Wildlife Conservation Office, 1211 Southeast Cardinal Court, Suite 100, Vancouver, Washington 98683, USA

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Department of Natural Resources and the Environment, Cornell University, Ithaca, New York 14853, USA

Joseph J. Skalicky 

U.S. Fish and Wildlife Service, Columbia River Fish and Wildlife Conservation Office, 1211 Southeast Cardinal Court, Suite 100, Vancouver, Washington 98683, USA

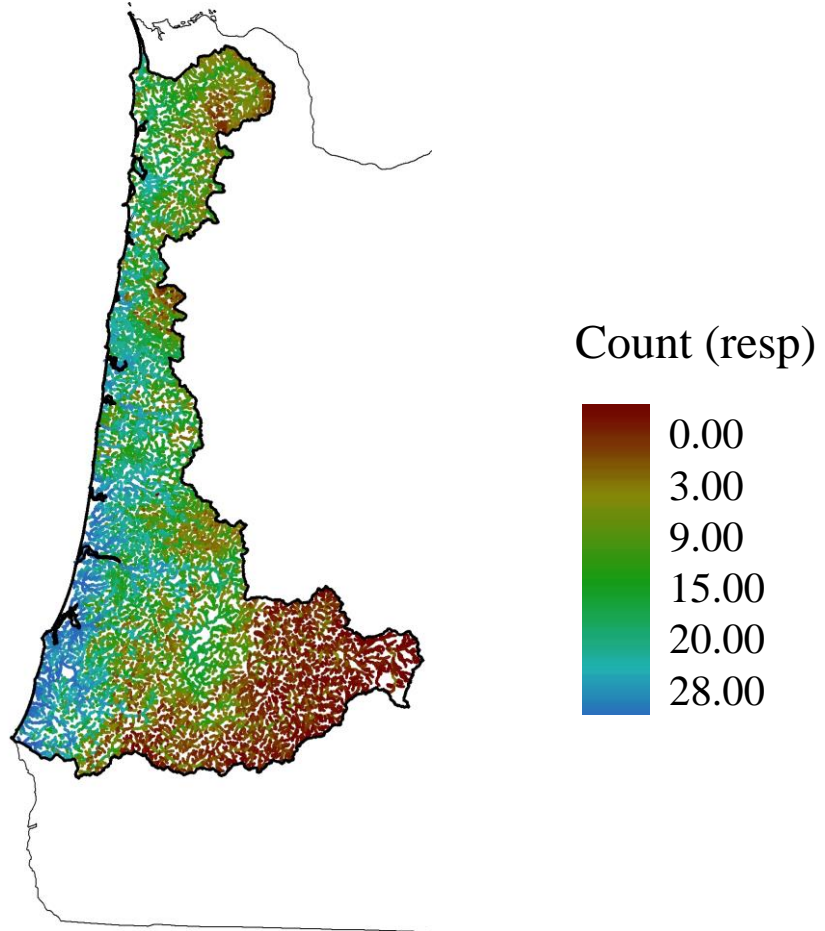
Fraser Neave

Fisheries and Oceans Canada, Sea Lamprey Control Centre, 1219 Queen Street East, Sault Ste. Marie, Ontario P6A 2E5, Canada

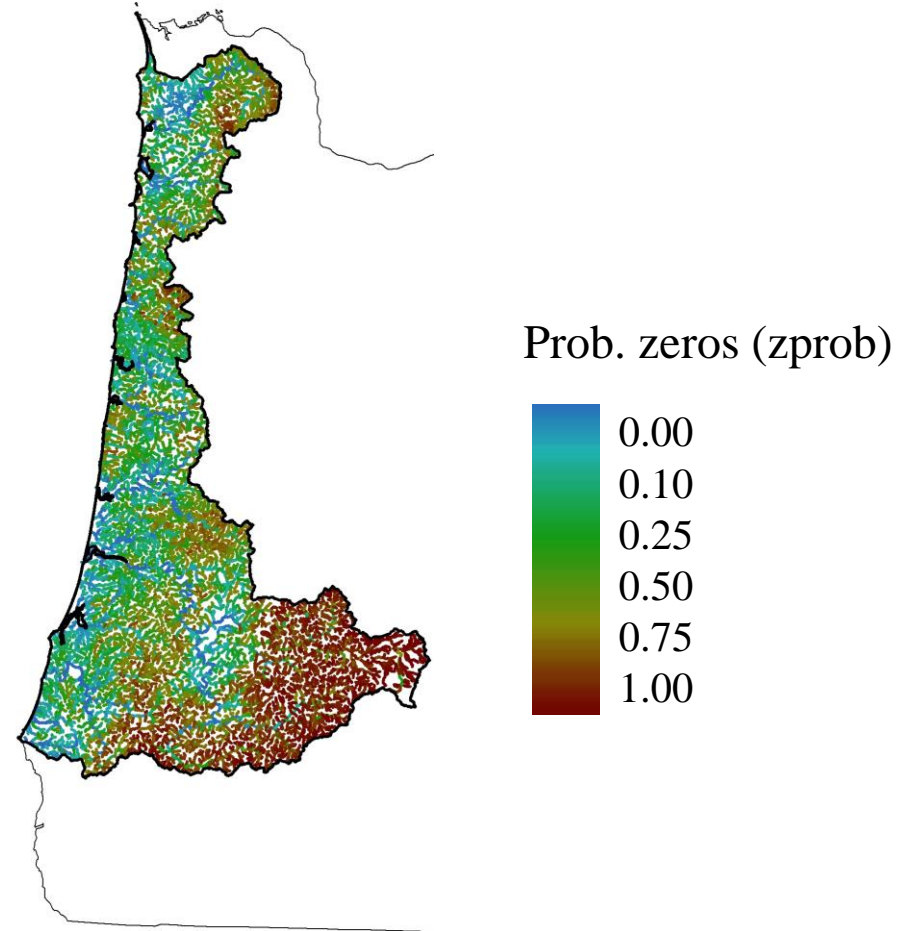
Ralph T. Lampman 

Yakama Nation, Department of Natural Resources, Fisheries Resource Management Program, Toppenish, Washington 98948, USA

Final Model 21 RESP Continuous



Final Model 21 ZPROB Continuous



Water quality





Karie Wiltshire

Issues and Perspectives

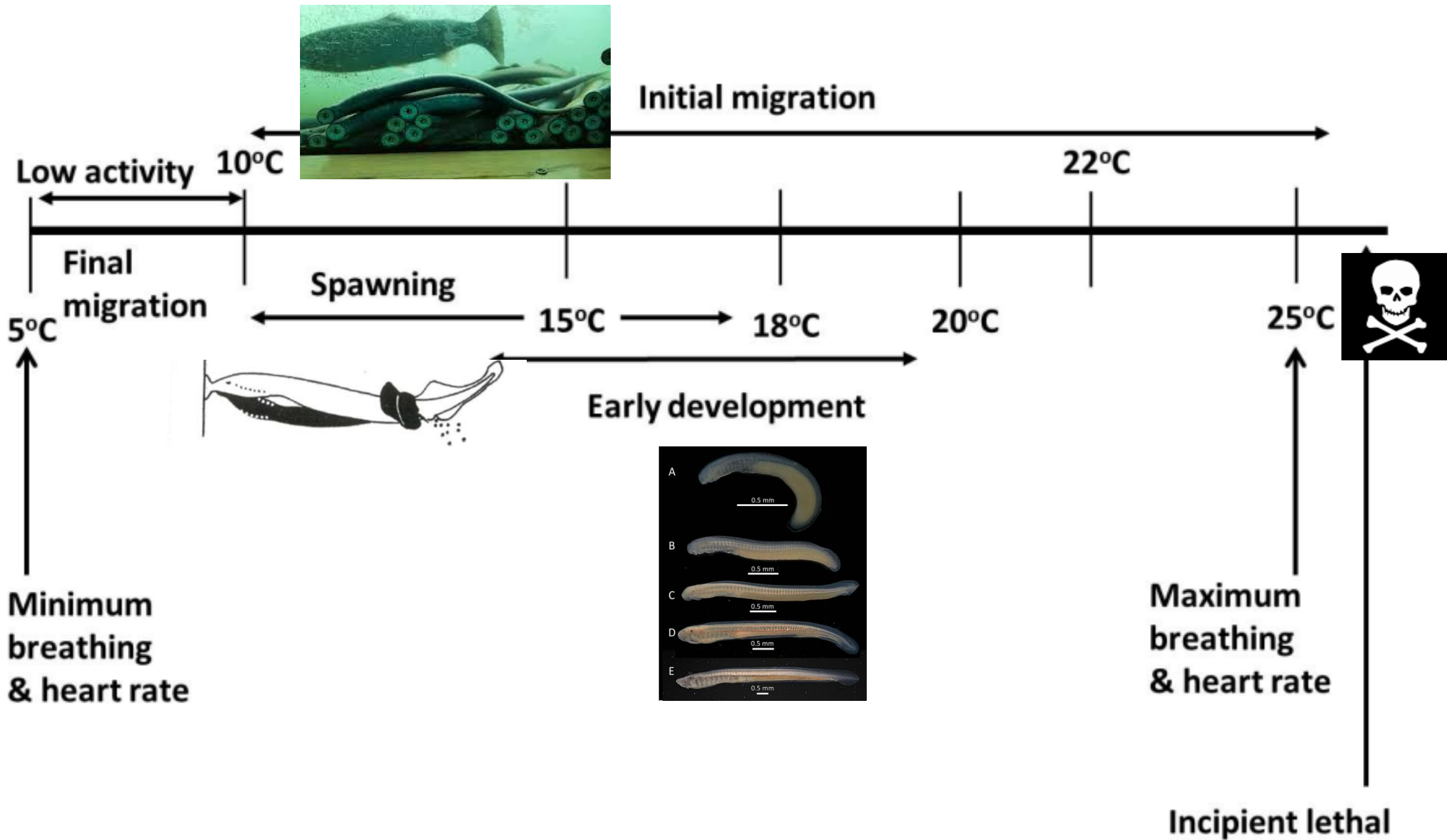
Warmwater Temperatures ($\geq 20^{\circ}\text{C}$) as a Threat to Pacific Lamprey: Implications of Climate Change

Benjamin J. Clemens*

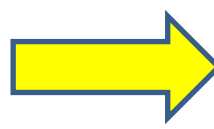
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Abstract

Interest in the effects of warmwater temperatures ($\geq 20^{\circ}\text{C}$) on fishes has grown as biologists attempt to understand the impacts of climate change on native species. Previous research hypothesized that rivers displaying warmwater temperatures and low river flows, such as may become more common with climate change in North America, may select against Pacific Lamprey *Entosphenus tridentatus* migrating and spawning in the upper reaches of some watersheds. I provide new information from different locations that supports this hypothesis, including observations of prespawn mortalities of Pacific Lamprey during a recent heat wave, when daily water temperatures averaged 26.6°C (range: $20.8\text{--}30.6^{\circ}\text{C}$), and additional data from the literature. These observations and data suggest that the continued warming and slowing of rivers pose a threat to Pacific Lamprey in some Oregon (USA) rivers, which appears to agree with other research that suggests that lampreys will lose habitats in lower latitudes as climate change progresses.



**Road back
Hero's return**



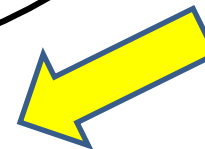
Call to adventure



**Unification
&
transformation
(2000 – 2020)**



**Supreme ordeal
(1880 - 1999)**



Predictions over next 50 yrs

1. **PASSAGE & WATER QTY & QLTY increasingly important**
2. **Loss of lampreys in some highly altered/blocked rivers**
3. **Resident lampreys lose habitat (difficult mgmt. decisions)**
4. **Anadromous lampreys (& their hosts) are moving poleward**
5. **Some populations benefit, whereas others decrease**
6. **More acknowledgment of lamprey importance**
7. **More acknowledgment that lamprey status is indication of healthy rivers**
8. **More interest among Oregonians in non-game, native species**
9. **More opportunities for collaboration**
10. **More focus on “other” lampreys (i.e., NOT Pacific Lamprey), but data still lacking**
11. **Push for more monitoring & restoration**
12. **Habitat restorers seek magic formula; however, recommend gestalt of process-based functionality & complexity**





University
of Manitoba

Bonneville
POWER ADMINISTRATION



PACIFIC
LAMPREY
CONSERVATION
INITIATIVE



NOAA
FISHERIES



Tenmile Lakes Basin Partnership



Portland State
UNIVERSITY



Fisheries and Oceans
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WESTERN FISHES

Specializing in the Biology and Stewardship of Native Western Fishes



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River
Restoration
Northwest



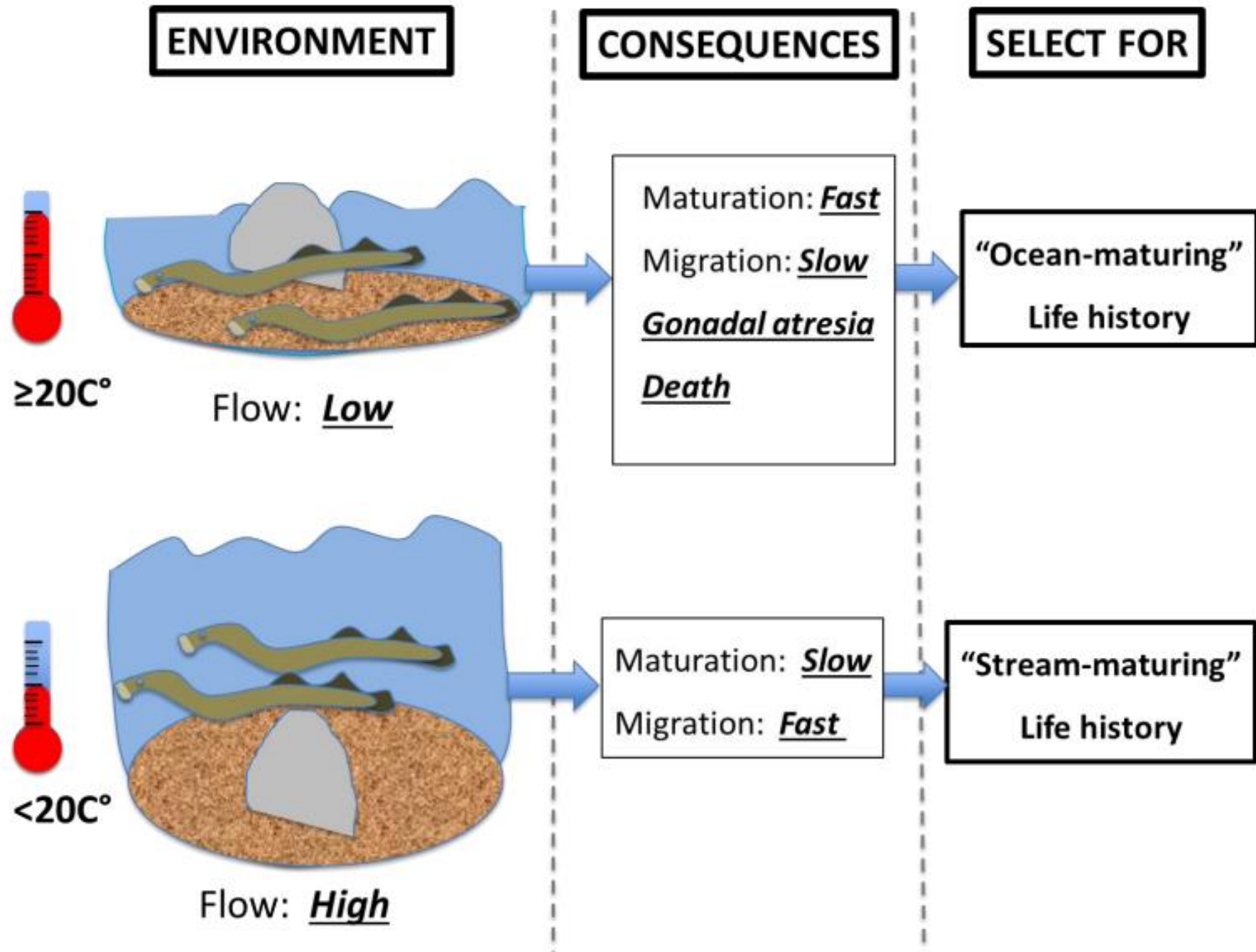
Cornell University







Take-home messages

- 1. Many recent developments**
- 2. Periodic strategy' -> habitats w/ large variation**
- 3. Abundant, cold, clean water w/ complex habitat (basin-wide)**
- 4. Threats, conservation plans**
- 5. Process-based functionality & complexity**





Trait		
Home to natal streams?	Y	N
Climb?	N	Y
Jump?	Y	N
Swimming mode	Burst & endurance	Burst & attach