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Plenary Session

36th Annual Salmonid Restoration Conference held in Fortuna, California from April 11 – 14, 2018.

Session Overview

- Master of Ceremonies:
  - Thomas Williams, PhD, NOAA Fisheries, Southwest Fisheries Science Center

Presentations

Video Recording of Complete Plenary Session Located at
https://vimeo.com/salmonidrestoration

(Slide 4) Thinking Outside the Channel — Learning from History and Working with Nature to Restore Riverine-Floodplain Connectivity
Colin Thorne, PhD, Nottingham University, UK

(Slide 38) Evolutionary Enlightened Management Strategies for Conserving and Restoring Pacific Salmon and Trout
Stephanie Carlson, PhD, University of California, Berkeley, Carlson Lab

(Slide 80) Fish and Fires — Integrating Traditional and Western Knowledge Systems with Landscape Restoration Strategies to Address, Adapt to, and Confront Large-scale Wildfires in an Era of Climate Change
Frank Kanawha Lake, PhD, US Forest Service, Pacific Southwest Fire and Fuels Program

(Slide 108) Revitalization in Native Country
Wendy Poppy Ferris-George Hupa/Karuk/Yurok/Chameriko, Klamath River Renewal Corporation

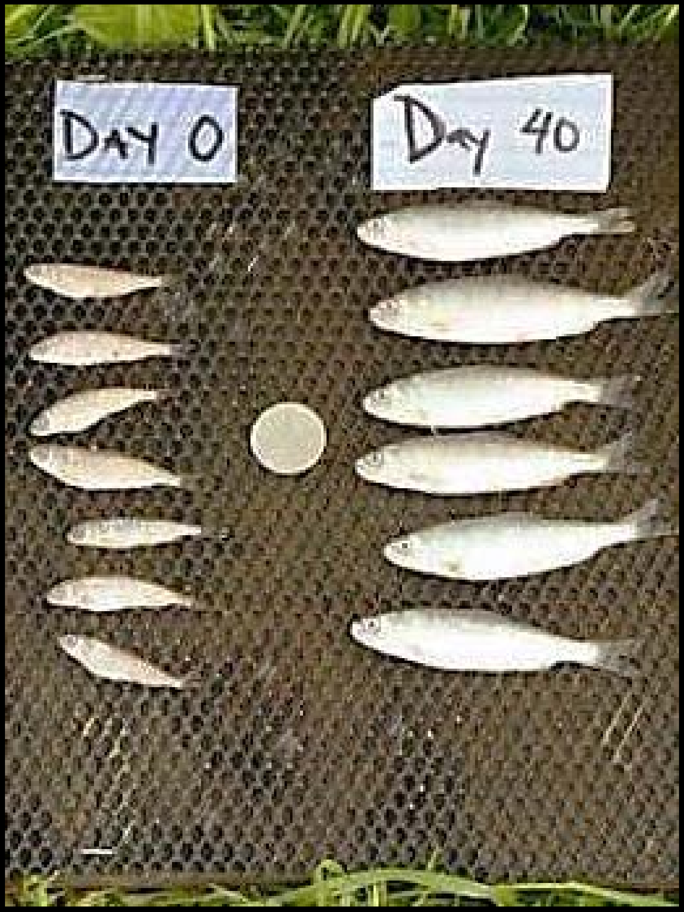
Thinking Outside the Channel

Colin Thorne University of Nottingham UK

Brian Cluer NOAA-NMFS, Santa Rosa CA

Janine Castro USFWS, Vancouver WA

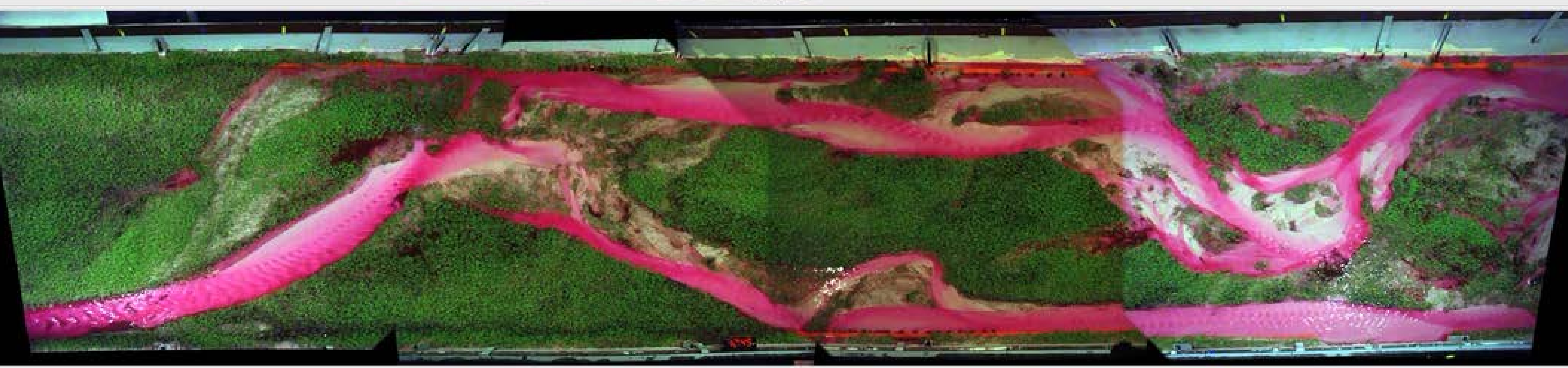
"Advancing the Art and Science of Watershed Restoration"



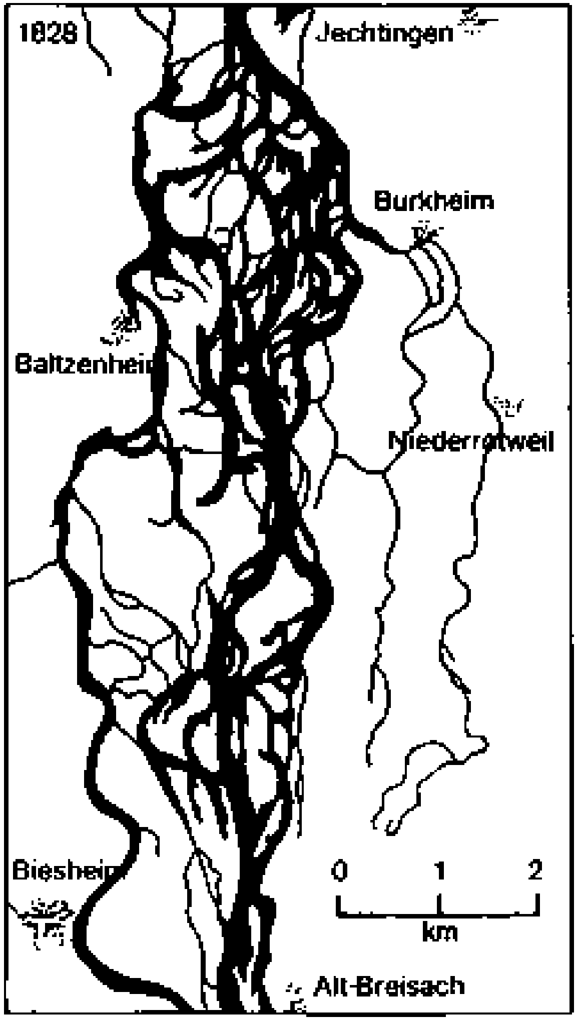
Parana Japura Brahmaputra Orinoco

“Fight the enemy where he isn’t”

General Sun Tzu - ‘The Art of War’ (512 BC)

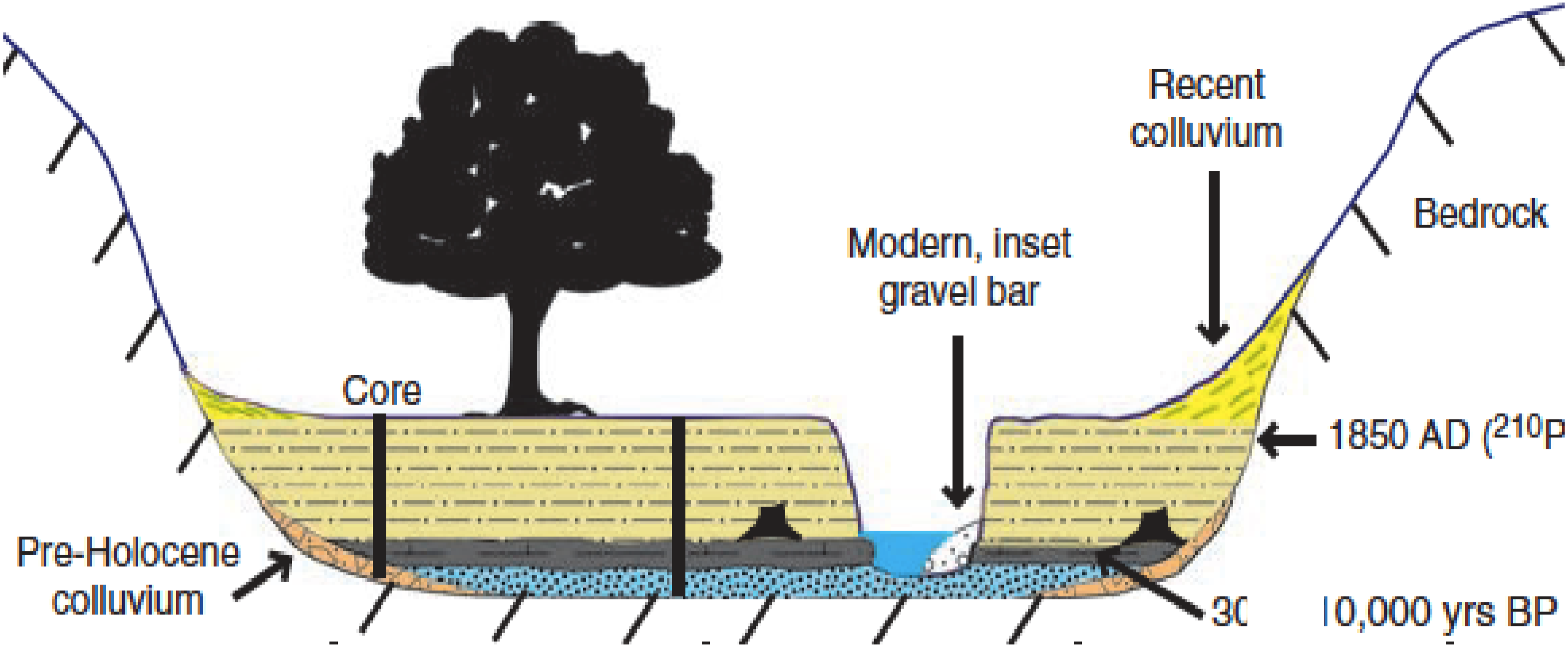


Mical Tal: Interactions between vegetation and braiding leading to an anastomosed channel



1828

Historical evidence - River Rhine



"…before European settlement, the streams were small, anabranching channels within extensive, vegetated wetlands"

Plant Evolution

Fluvial Style

Mya

Permian

> *"…expansion of tree habitats led to the crossing of a threshold in vegetative control of floodplain and river morphology."*

Davies, N.S. and Gibling, M.R., 2011. *Nature Geoscience*, *4*(9), pp.629-633

500

Cambrian

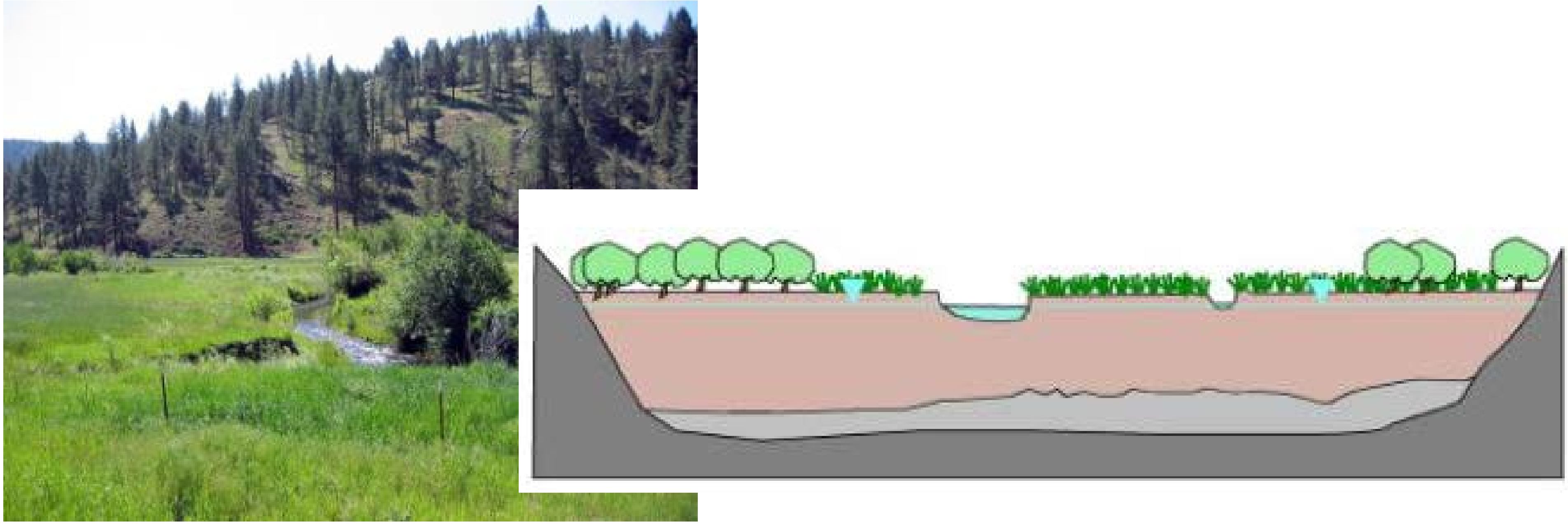
Braided

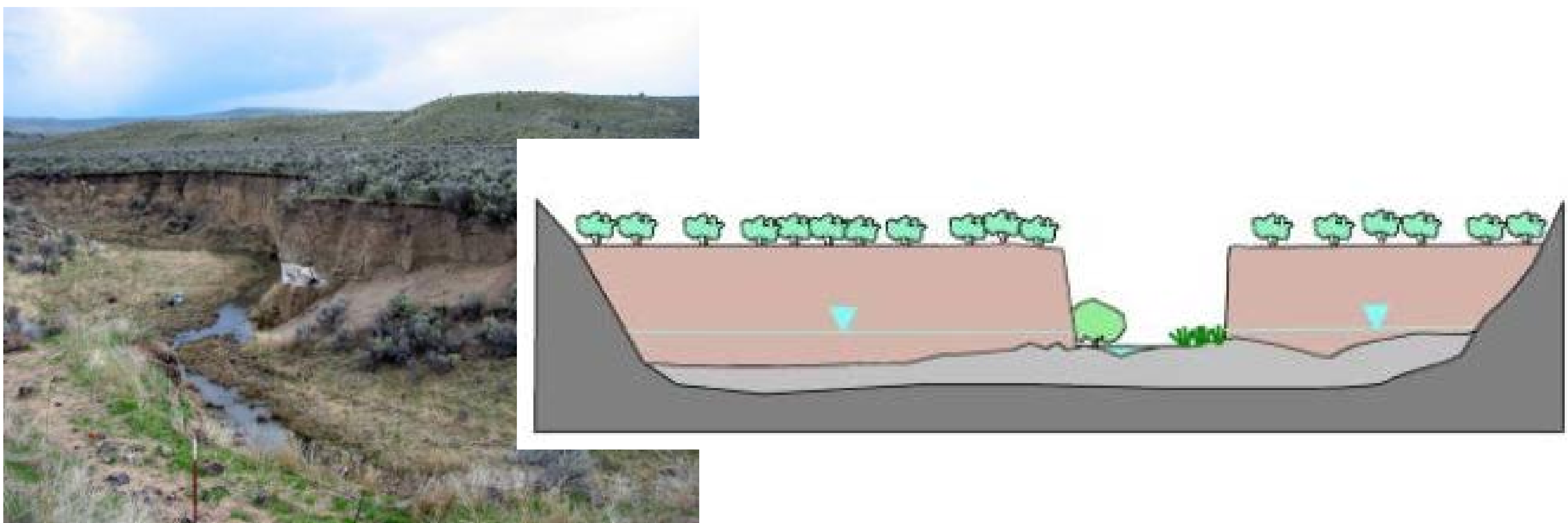
550

Geological Evidence

Gibling, M.R. and Davies, N.S. 2012. Palaeozoic landscapes shaped by plant evolution. *Nature Geoscience*, *5*(2), p.99.

Wider recognition of anastomosing streams in the Western USA





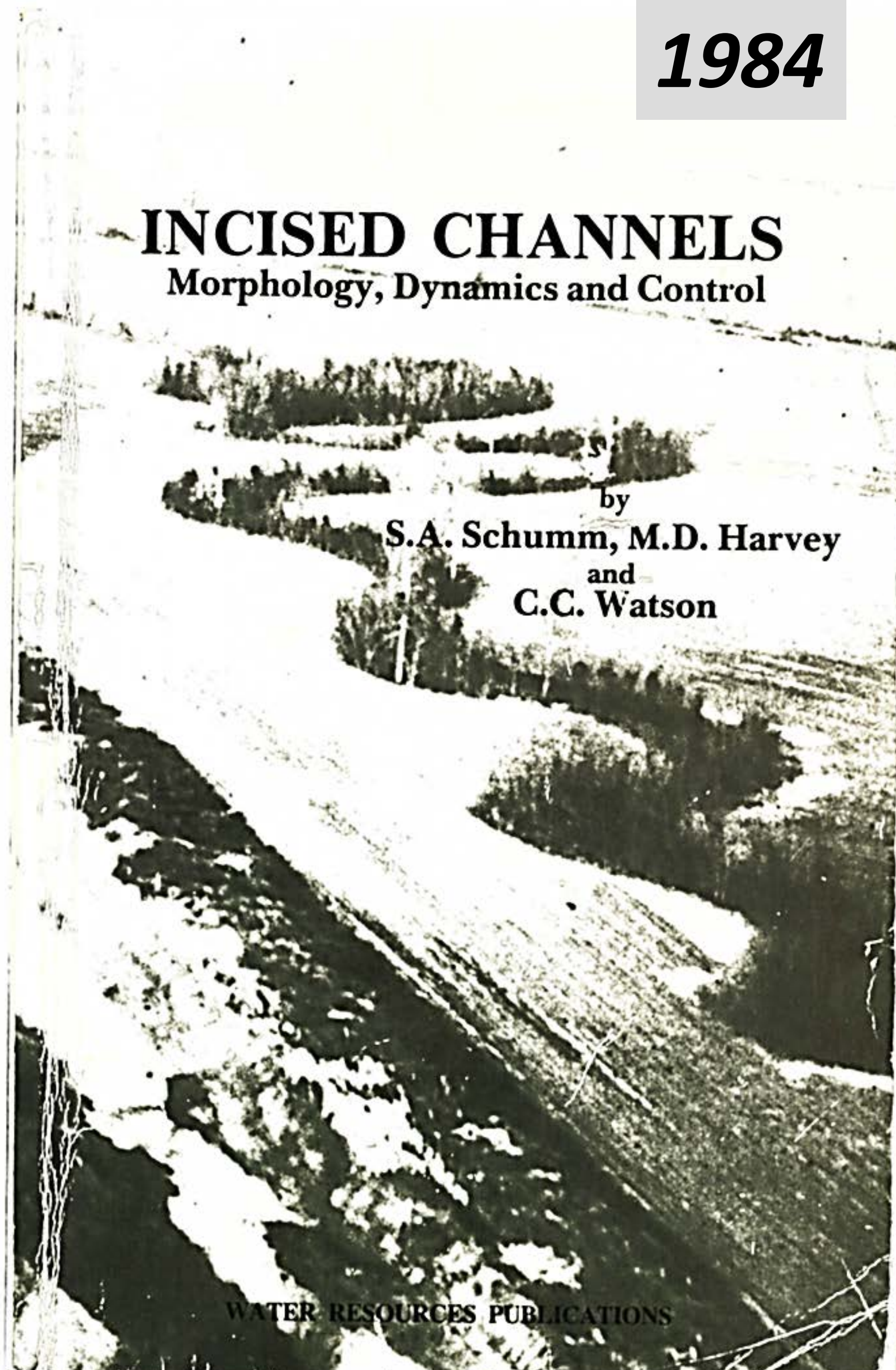
Channel Evolution Models…

INCISED CHANNELS
Morphology, Dynamics, and Control

Schumm, Harvey & Watson

Water Resources Publications, Littleton, Colorado

1984



RIVER RESEARCH AND APPLICATIONS

River Res. Applic. (2013)

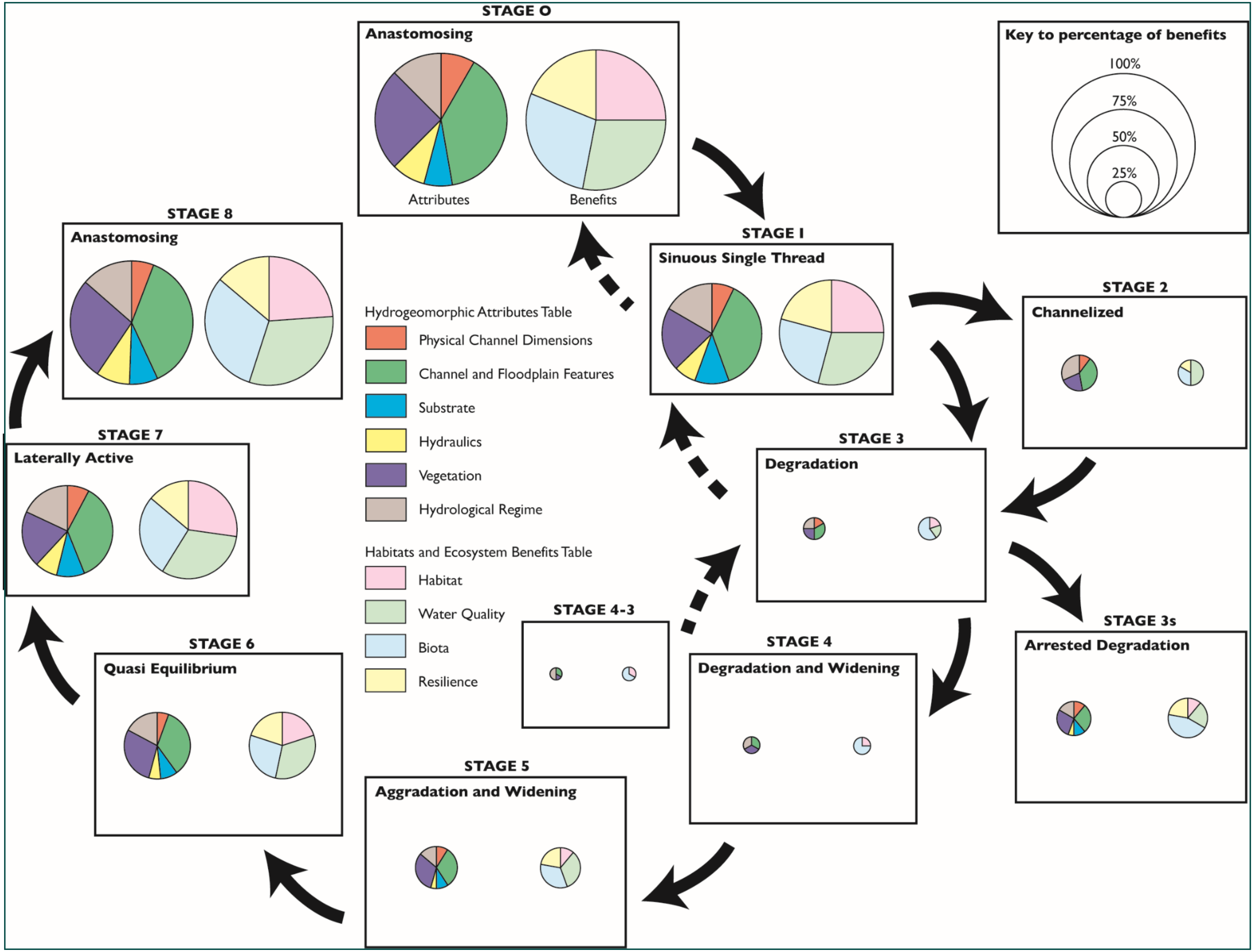
Published online in Wiley Online Library
(wileyonlinelibrary.com) DOI: 10.1002/rra.2631

2013

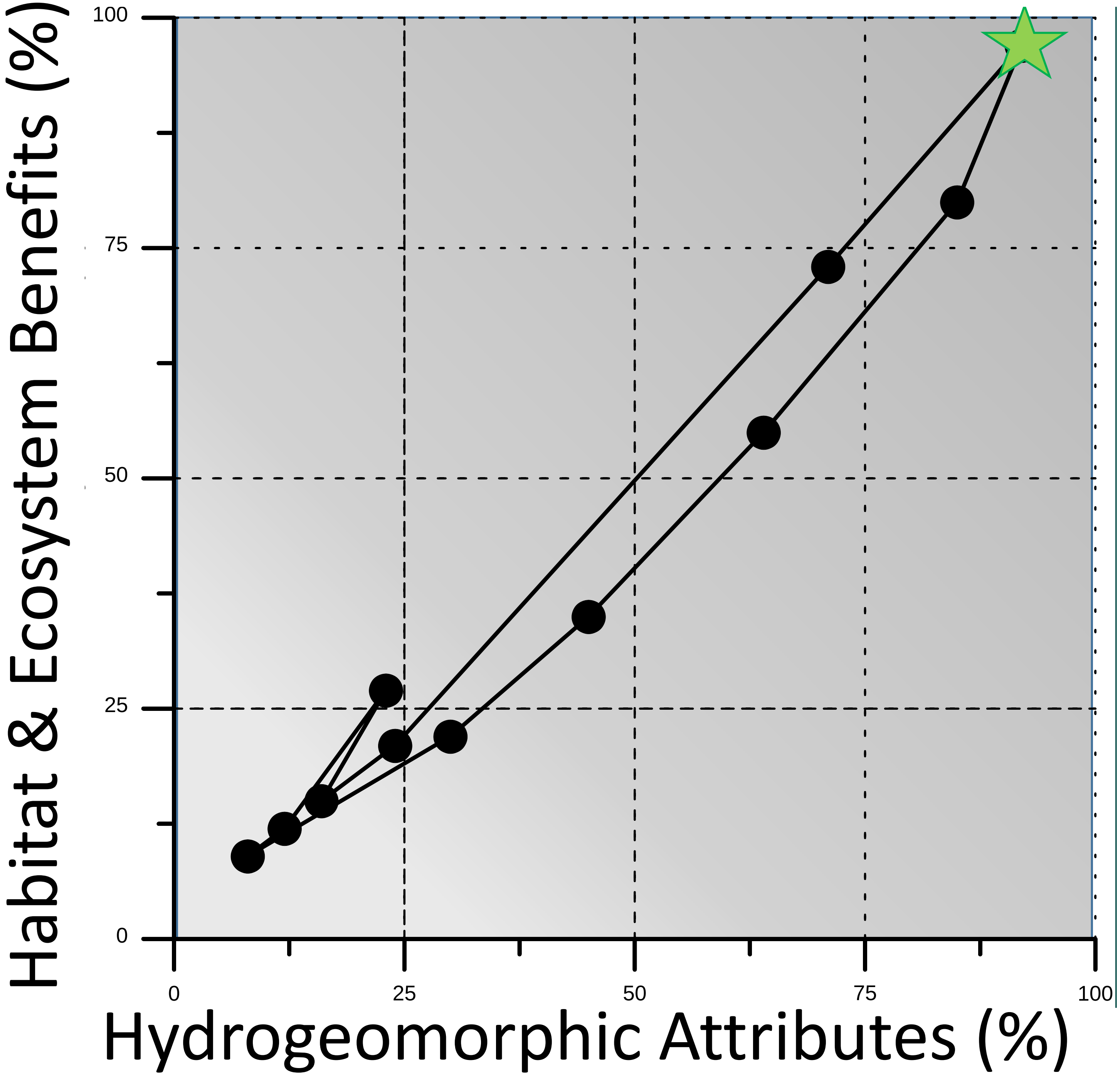
A STREAM EVOLUTION MODEL INTEGRATING HABITAT AND ECOSYSTEM BENEFITS

B. CLUER[a]* and C. THORNE[b]

[a] *Fluvial Geomorphologist, Southwest Region, NOAA's National Marine Fisheries Service, Santa Rosa, California, USA*
[b] *Chair of Physical Geography, University of Nottingham, Nottingham, UK*

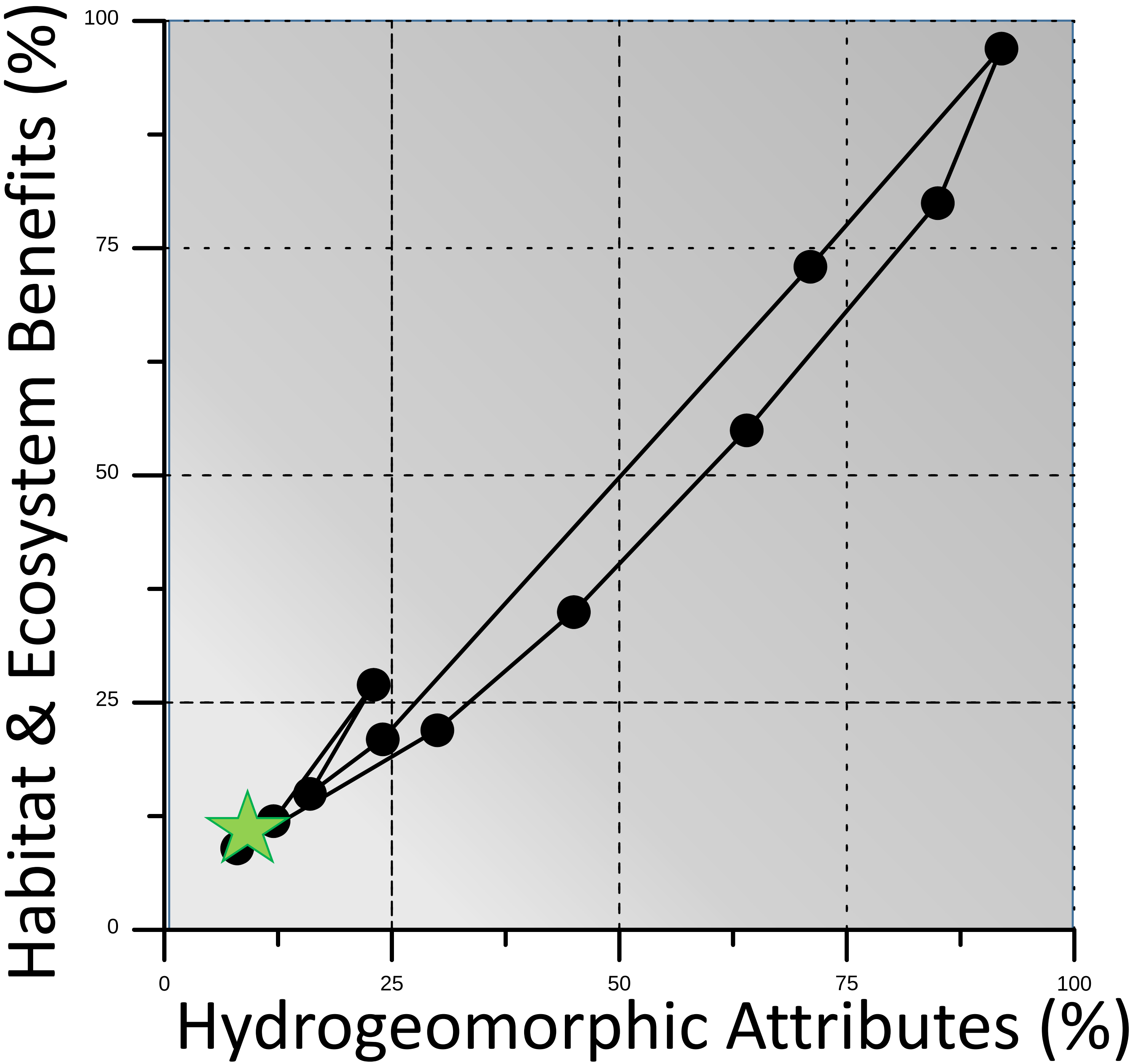


Cluer and Thorne, RRA, 2013

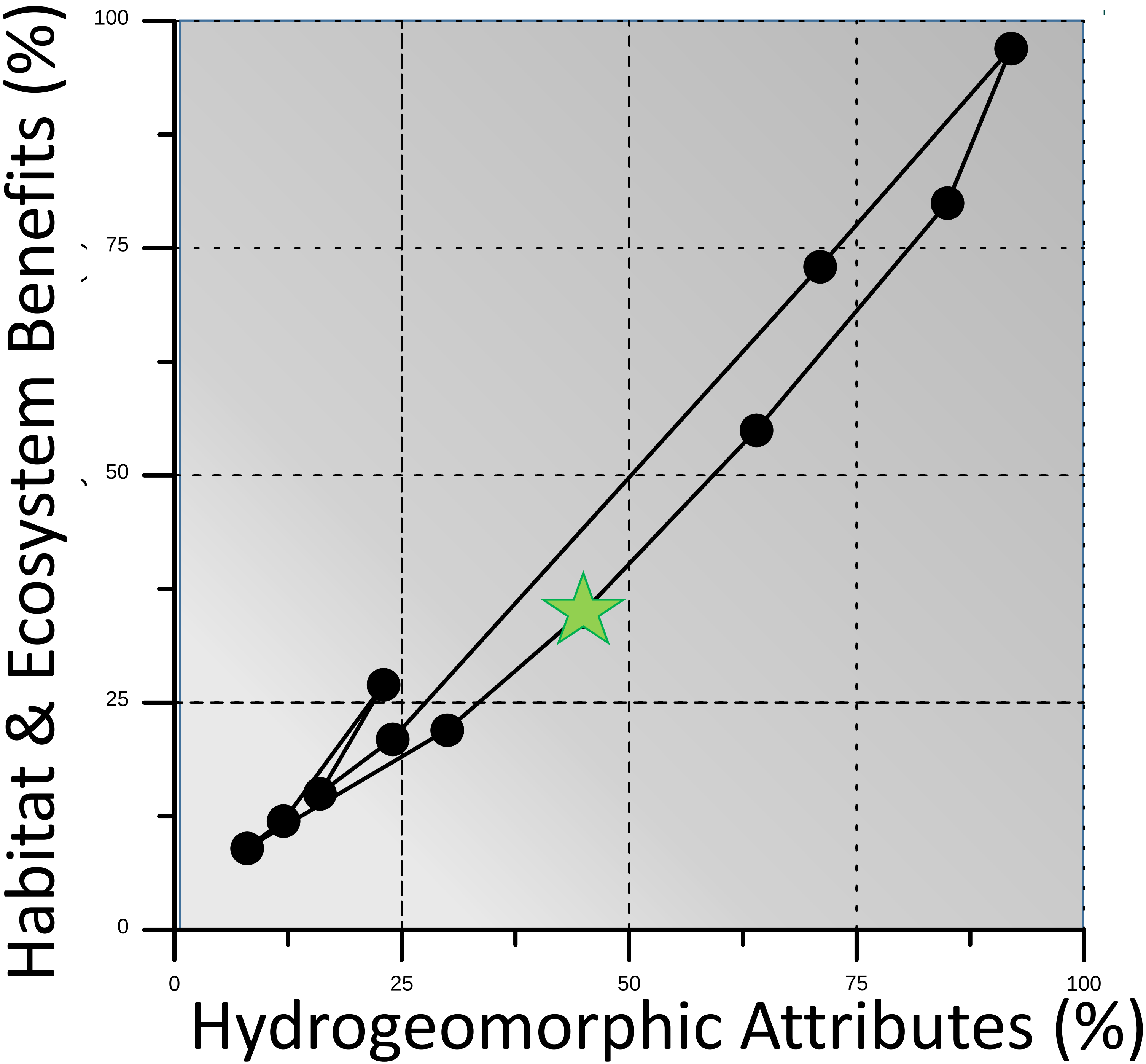


100
75
50
25
0
0
25
50
75
100
Habitat & Ecosystem Benefits (%)
Hydrogeomorphic Attributes (%)


Johnson Creek, Portland, OR



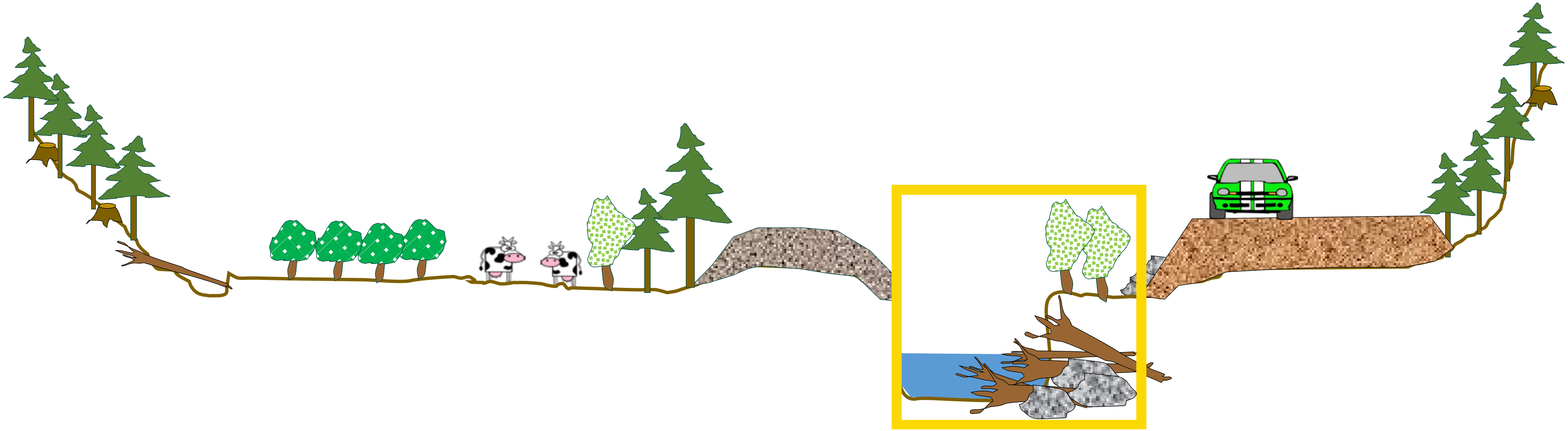
Habitat & Ecosystem Benefits (%)
100
75
50
25
0
0
25
50
75
100
Hydrogeomorphic Attributes (%)

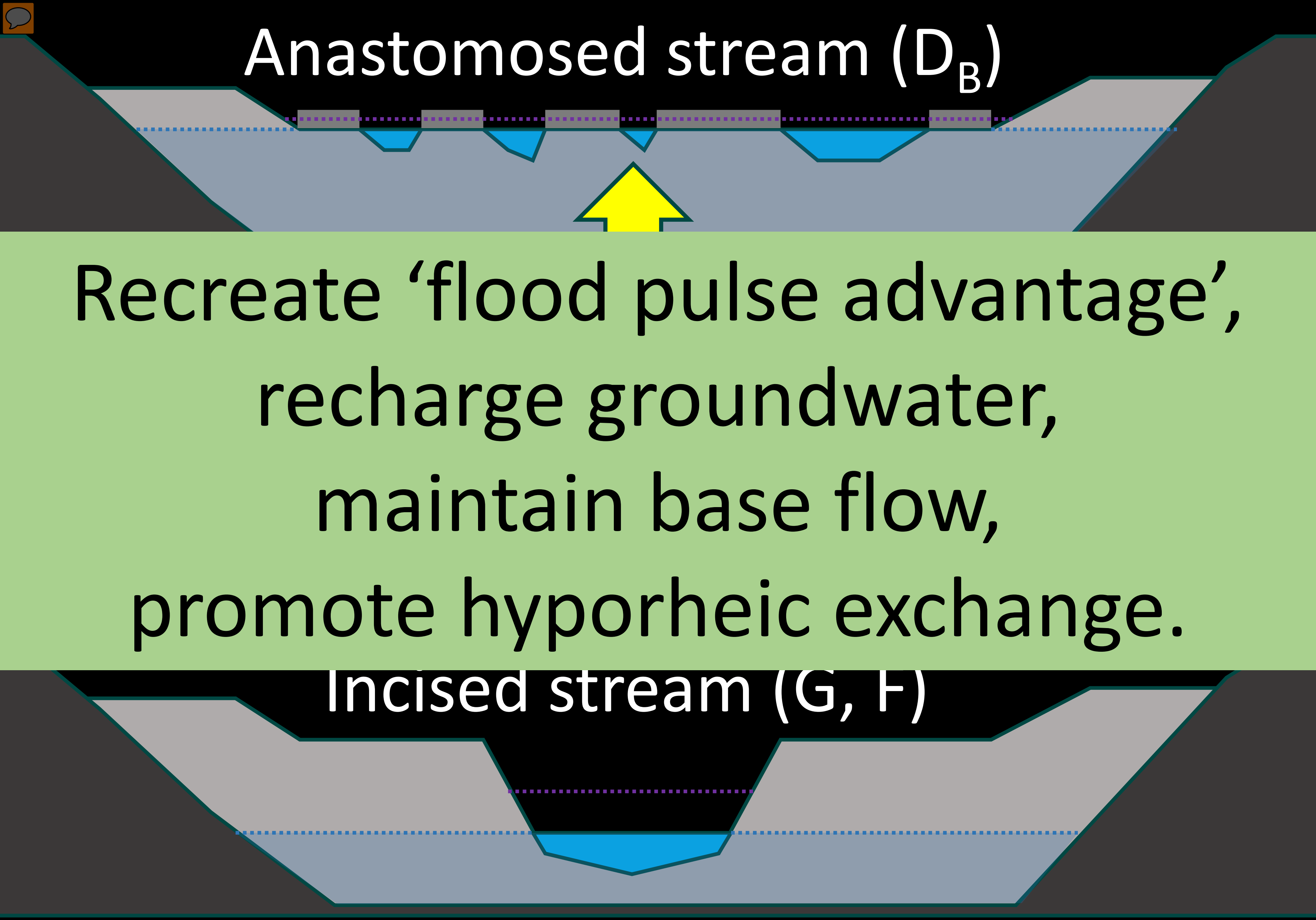


Habitat & Ecosystem Benefits (%)
100
75
50
25
0
0
25
50
75
100
Hydrogeomorphic Attributes (%)

Benefits of Reconnecting River-Floodplain wetland Systems

This and next slide courtesy of Mark Beardsley – EcoMetrics, Colorado

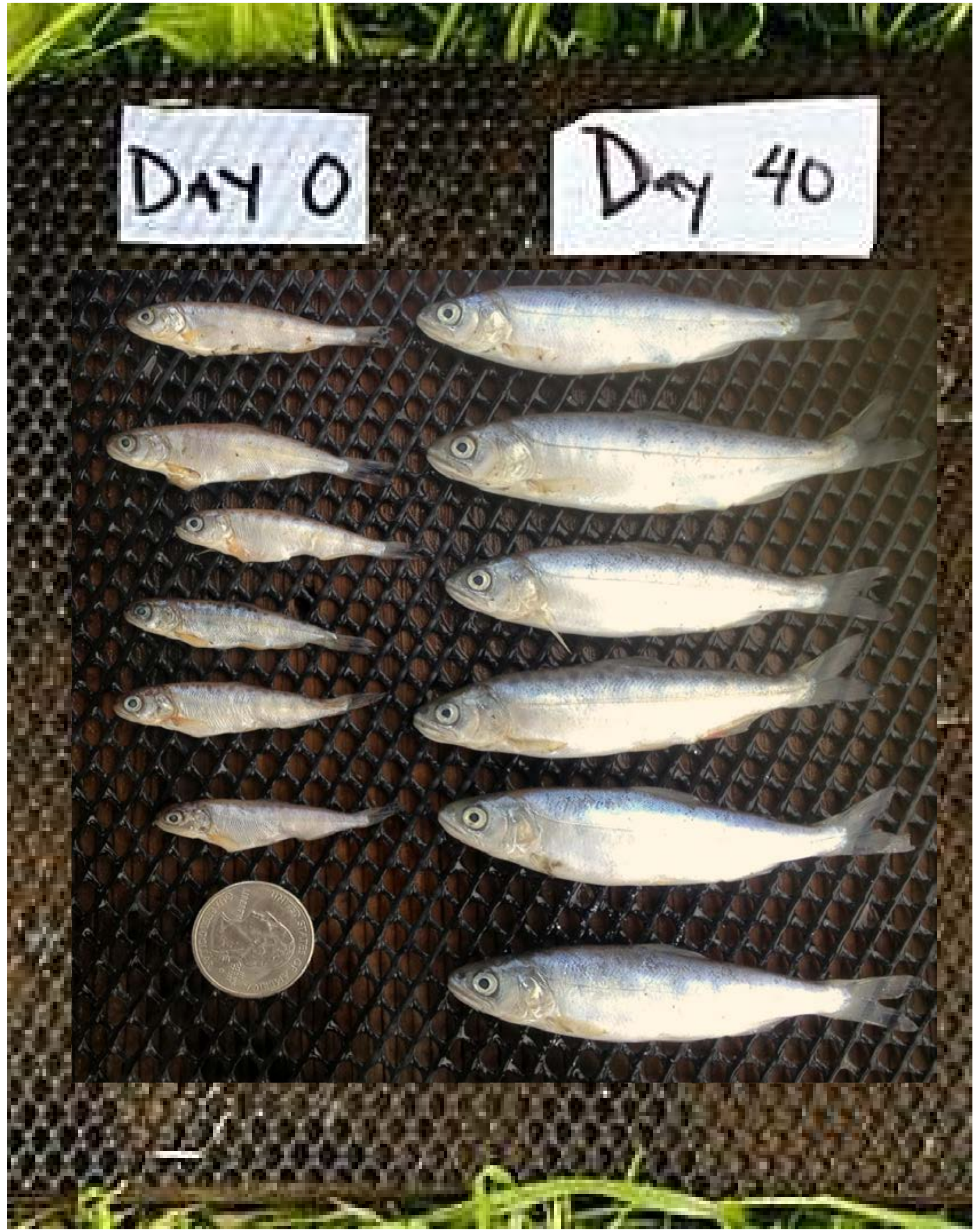



Anastomosed stream (D_B)
Recreate 'flood pulse advantage',
recharge groundwater,
maintain base flow,
promote hyporheic exchange.
Incised stream (G, F)

Fish on Floodplains

"juvenile salmon on day zero are tiny compared to fish that have spent 40 days on the Knaggs Ranch rice fields"

Jacob Katz, 2013



Slide courtesy of Paul Powers, Deschutes NF Regional Restoration Team

Slide courtesy of Paul Powers, Deschutes NF Regional Restoration Team


Methow Beaver Project photo

Flood plain Reconnection

Born to manage wood in streams

2014

Using Beaver Dams to Restore Incised Stream Ecosystems

MICHAEL M. POLLOCK, TIMOTHY J. BEECHIE, JOSEPH M. WHEATON, CHRIS E. JORDAN, NICK BOUWES, NICHOLAS WEBER, AND CAROL VOLK

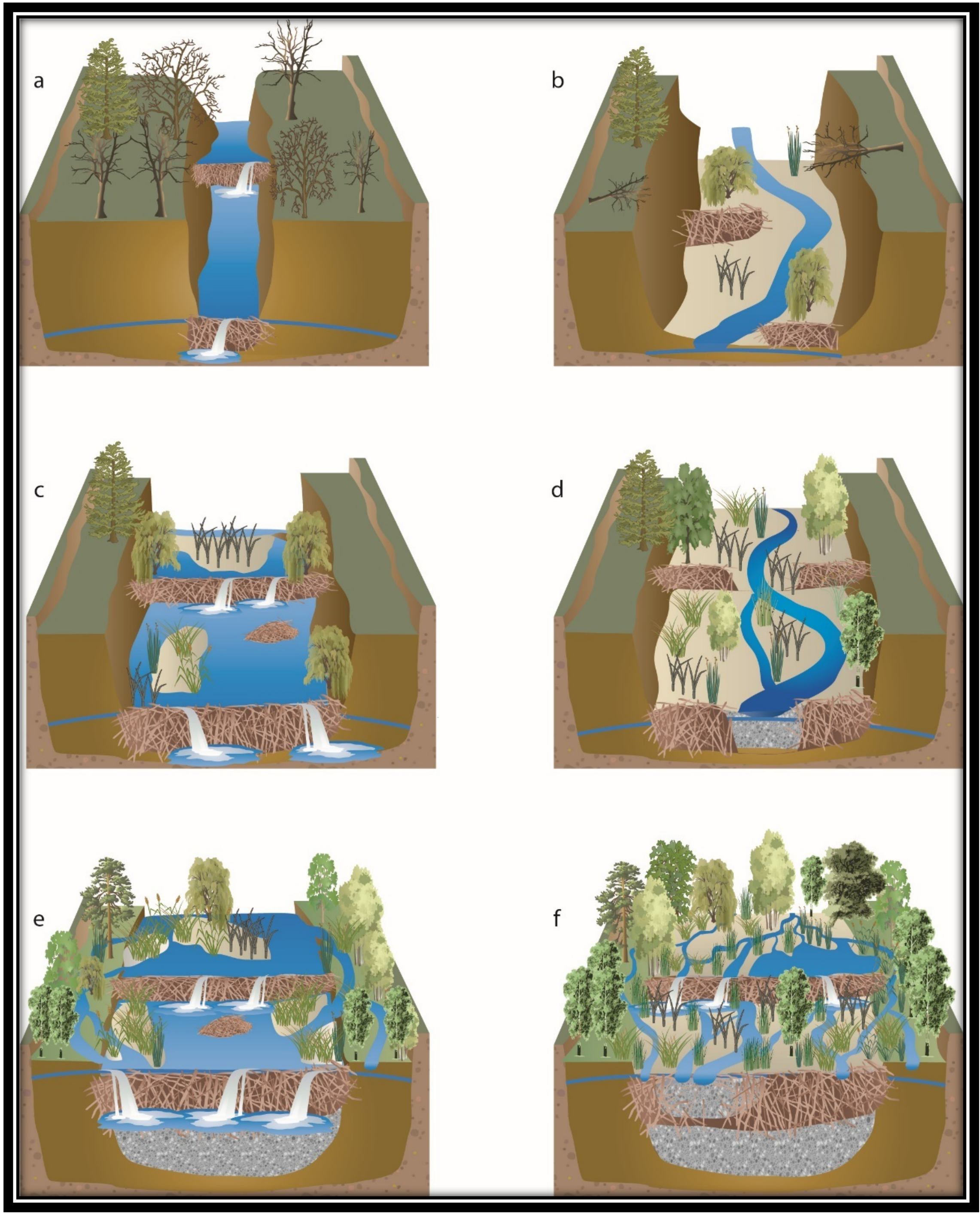
April 2014 / Vol. 64 No. 4 • **BioScience**

Biogenic features such as beaver dams, large wood, and live vegetation are essential to the maintenance of complex stream ecosystems, but these features are largely absent from models of how streams change over time. Many streams have incised because of changing climate or land-use practices. Because incised streams provide limited benefits to biota, they are a common focus of restoration efforts. Contemporary models of long-term change in streams are focused primarily on physical characteristics, and most restoration efforts are also focused on manipulating physical rather than ecological processes. We present an alternative view, that stream restoration is an ecosystem process, and suggest that the recovery of incised streams is largely dependent on the interaction of biogenic structures with physical fluvial processes. In particular, we propose that live vegetation and beaver dams or beaver dam analogues can substantially accelerate the recovery of incised streams and can help create and maintain complex fluvial ecosystems.

Keywords: ecosystem restoration, stream restoration, conservation, beaver, Castor canadensis

Beaver in incised streams

"Recovery possible in years to decades instead of decades to centuries"



Pollock et al., 2014. using beaver dams to restore incised stream ecosystems. *Bioscience*, 64(4).

Restoration to ‘Stage 0’ of a Coastal/Estuarine Stream System

Five Mile Bell

Incised channel prior to restoration

This and next 2 slides courtesy of Paul Burns – US Forest Service, Oregon

Reconnected channel-floodplain system following restoration

“Monitoring shows 2,300 adult coho per mile, compared to mainstem systems like Siuslaw and Alsea which have 40-60 adults per mile in good years and 10-20 adults per mile in most years”

Achieving Future Resilience

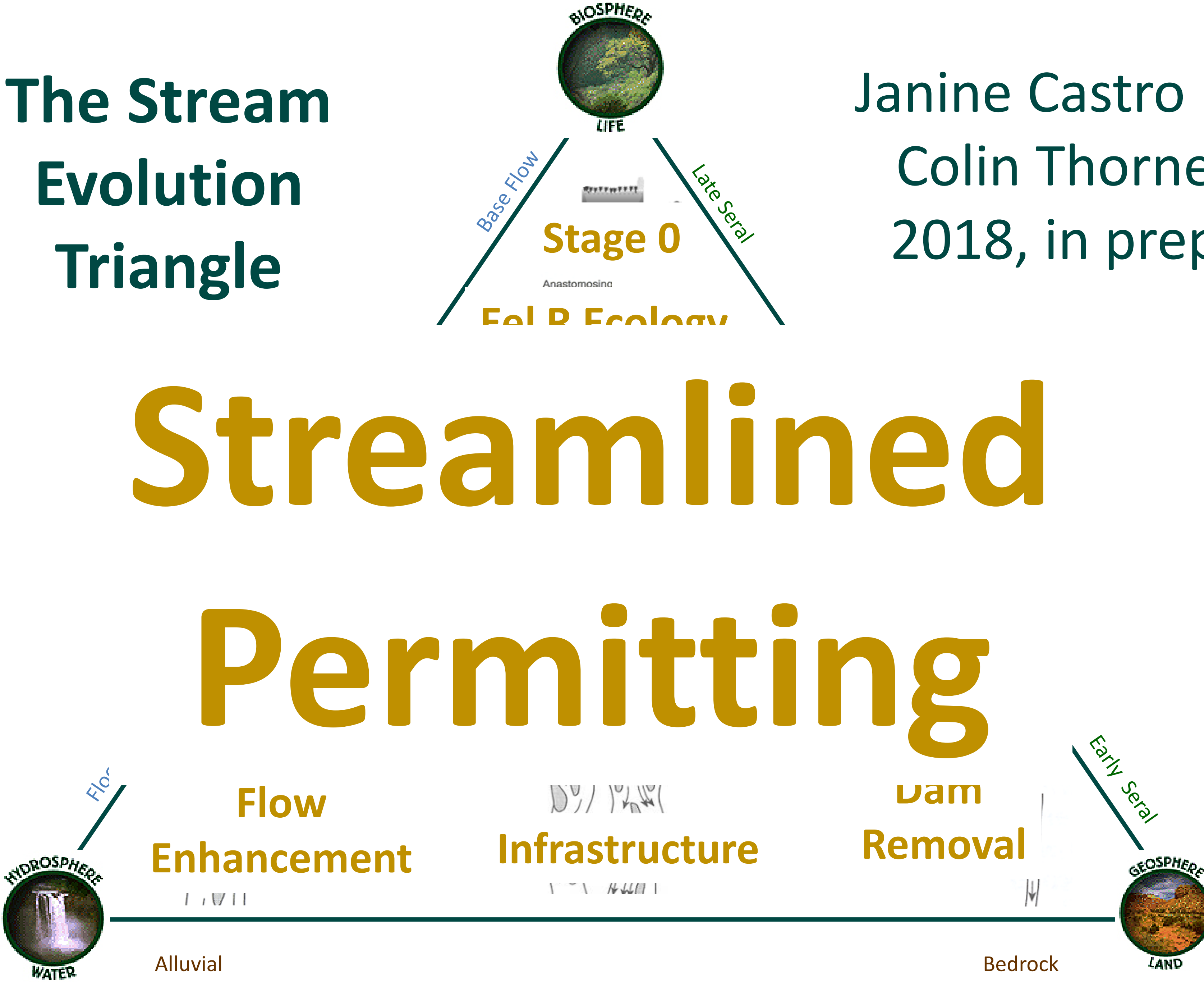
*Alluvial channels have 9 Degrees of Freedom**

1. Width
2. Mean depth
3. Maximum depth
4. Bed grain size
5. Bed gradation
6. Bedform wavelength
7. Bedform amplitude
8. Meander wavelength
9. Meander bend arc angle

* Richard Hey (1997) Stable River Morphology, in 'Applied Fluvial Geomorphology for River Engineering and Management' Thorne, Hey and Newson (eds), Wiley, UK, pp 223-236.

The Stream Evolution Triangle

Janine Castro & Colin Thorne
2018, in prep



Streamlined Permitting


Think Outside the Channel

Evolutionary enlightened management strategies for conserving and restoring Pacific salmon & trout

Stephanie M. Carlson
Environmental Science, Policy & Management
UC Berkeley
@fishteph

Photo credit: Zeke Lunder

“Humans may be the world’s dominant evolutionary force” – Palumbi (2001)

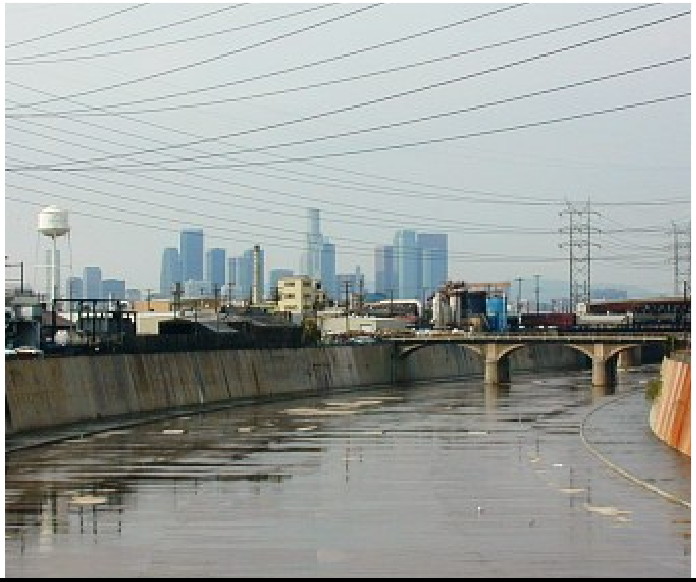


Photo credits: sockeye salmon (N. Kendall); Shasta Dam (usbr.gov); L.A. River (http://you-are-here.com/location/la_river7.jpg); trout stocking (P. Pister)

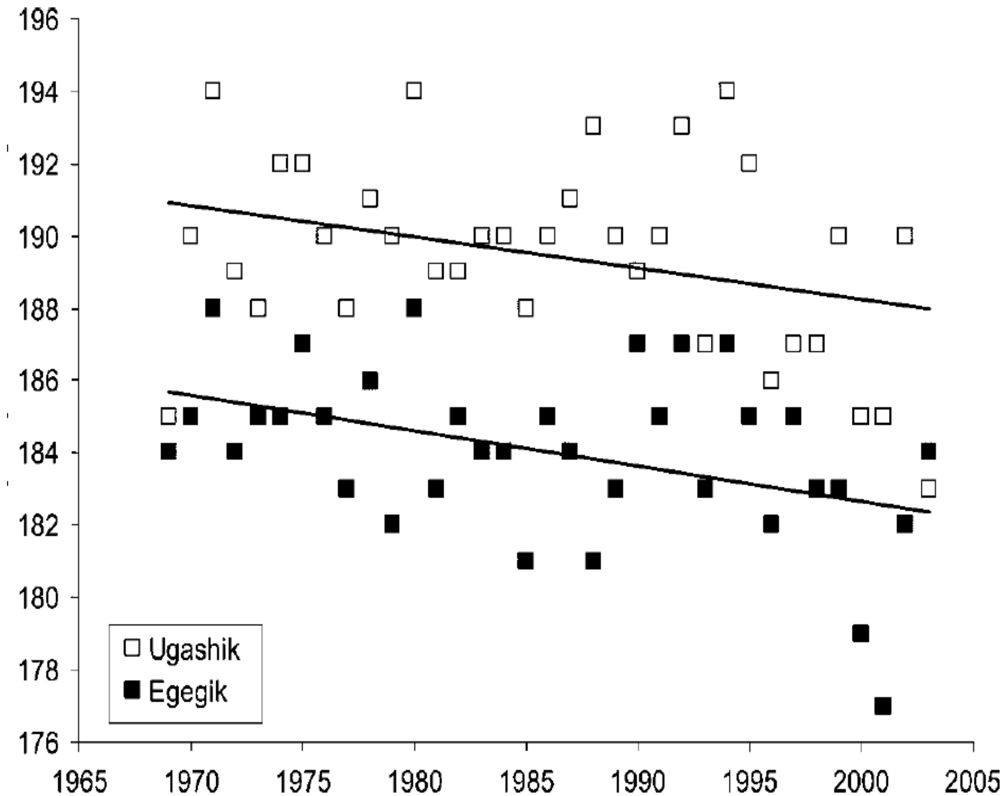
Ecological Applications, 17(3), 2007, pp. 731–739

DIRECTIONAL SELECTION BY FISHERIES AND THE TIMING OF SOCKEYE SALMON (*ONCORHYNCHUS NERKA*) MIGRATIONS

Thomas P. Quinn,[1] Sayre Hodgson,[2] Lucy Flynn, Ray Hilborn, and Donald E. Rogers

Fisheries Research Institute, School of Aquatic and Fishery Sciences, Box 355020, University of Washington, Seattle, Washington 98195 USA

Median Arrival Date



Contributed Paper

Estimates of Natural Selection in a Salmon Population in Captive and Natural Environments

MICHAEL J. FORD,*§ JEFFREY J. HARD,* BRANT BOELTS,† ERIC LaHOOD,* AND JASON MILLER*

*Conservation Biology Division, Northwest Fisheries Science Center, 2725 Montlake Boulevard E. Seattle, WA 98112, U.S.A.

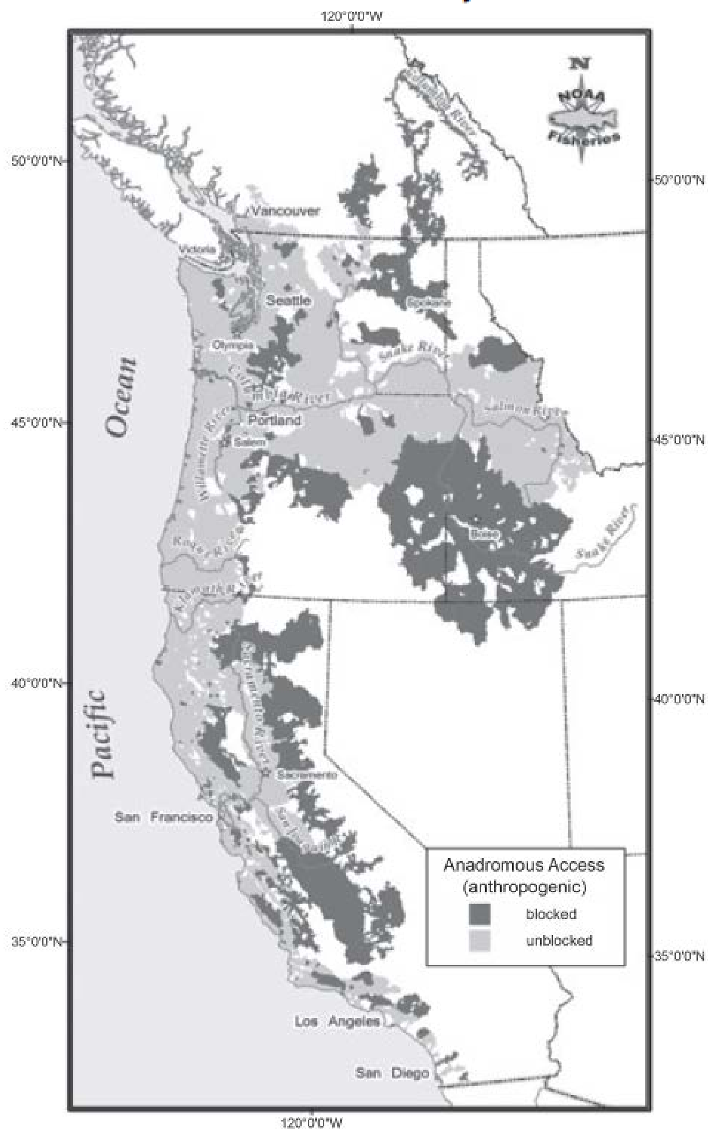
†Washington Department of Fish and Wildlife, 600 Capital Way N, Olympia, WA 98501-1091, U.S.A.

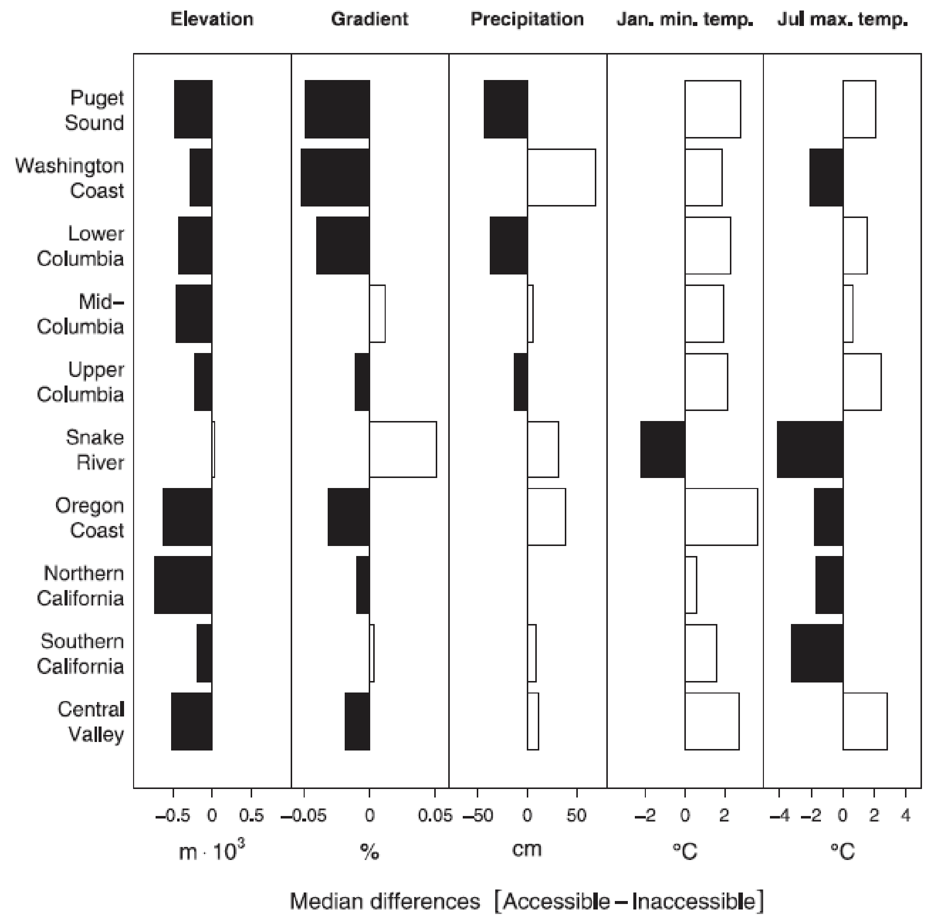
Conservation Biology, Volume 22, No. 3, 783–794

DOI: 10.1111/j.1523-1739.2008.00965.x

Evolutionary consequences of habitat loss for Pacific anadromous salmonids

Michelle M. McClure,[1] Stephanie M. Carlson,[2] Timothy J. Beechie,[1] George R. Pess,[1] Jeffrey C. Jorgensen,[1] Susan M. Sogard,[3] Sonia E. Sultan,[4] Damon M. Holzer,[1] Joseph Travis,[5] Beth L. Sanderson,[1] Mary E. Power[6] and Richard W. Carmichael[7]





2008. Evolutionary Applications 1: 300-318.

Review

Evolutionarily enlightened management

Mary V. Ashley[a,*], Mary F. Willson[b], Oliver R.W. Pergams[a], Dennis J. O'Dowd[c], Scott M. Gende[d], Joel S. Brown[a]

[a] *Department of Biological Sciences, 845 West Taylor Street, University of Illinois at Chicago, Chicago, IL 60608, USA*
[b] *25230 Terrace Place, Juneau, AK 99801, USA*
[c] *School of Biological Sciences, PO Box 18, Monash University, Victoria 3800, Australia*
[d] *Pacific Northwest Research Station, Forestry Sciences lab, 2770 Sherwood Lane, Suite 2A, Juneau, AK 99801, USA*

Received 27 September 2001; received in revised form 15 July 2002; accepted 30 August 2002

Abstract

Here we review growing evidence that microevolutionary changes may often be rapid and, in many cases, occur on time frames comparable to human disturbance and anthropogenic change. Contemporary evolutionary change has been documented in relatively pristine habitats, in disturbed populations, under captive management, and in association with both intentional and inadvertent introductions. We argue that evolutionary thinking is thus relevant to conservation biology and resource management but has received insufficient consideration. Ignoring evolution may have a variety of consequences, including unpredicted evolutionary responses to disturbance and naive or inappropriate management decisions. Philosophically, we must also grapple with the issue of whether the evolution of adaptations to disturbance and degraded habitats is sometimes beneficial or something to be rigorously avoided. We advocate promoting *evolutionarily enlightened management* [Lecture Notes in Biomathematics 99 (1994) 248], in which both the ecological and evolutionary consequences of resource management decisions are considered.

Biological Conservation 111 (2003) 115–123

Intraspecific diversity

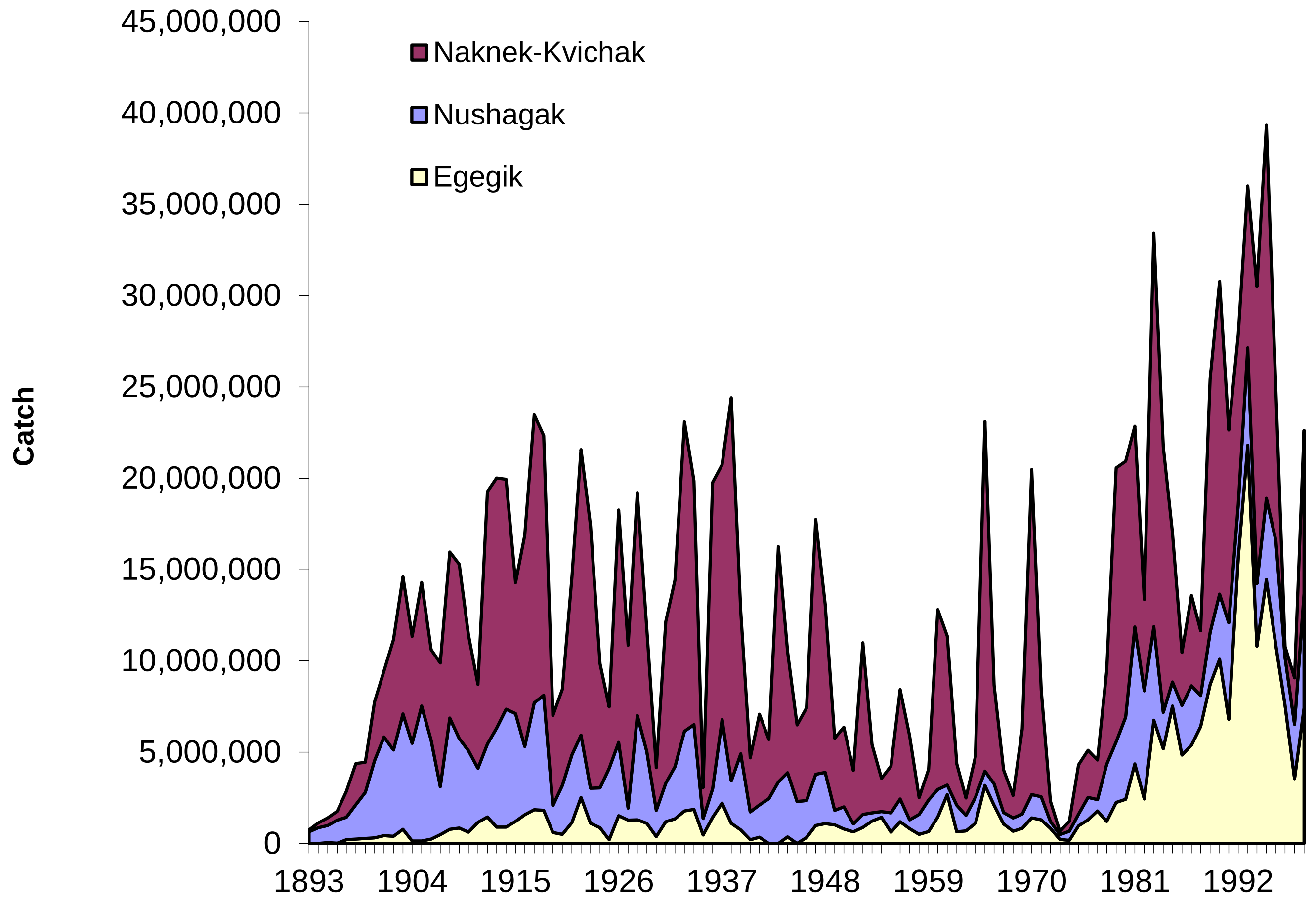
Trait diversity

↑

Habitat diversity

Photo credits: N. Kendall, T. Quinn, A. Hendry

Population diversity gives rise to a "portfolio effect"



Aggregate returns to Bristol Bay were 41-77% more stable than individual stocks

Hilborn et al. 2003. PNAS 100: 6564-6568.

Schindler et al. 2010. Nature 465: 609-612.

To keep every cog and wheel is the first precaution of intelligent tinkering.

—Aldo Leopold (1953:146)

FISH and FISHERIES, 2007, **8**, 297–314

A metapopulation perspective for salmon and other anadromous fish

Nicolas Schtickzelle[1,2] & Thomas P. Quinn[2]

Three main criteria necessary for meta-population dynamics to emerge are satisfied in salmonids:

- Breeding habitat is discrete and populations are separated by unsuitable habitat;
- Straying (i.e., dispersal) links populations
- Some asynchrony is present in the dynamics of populations;

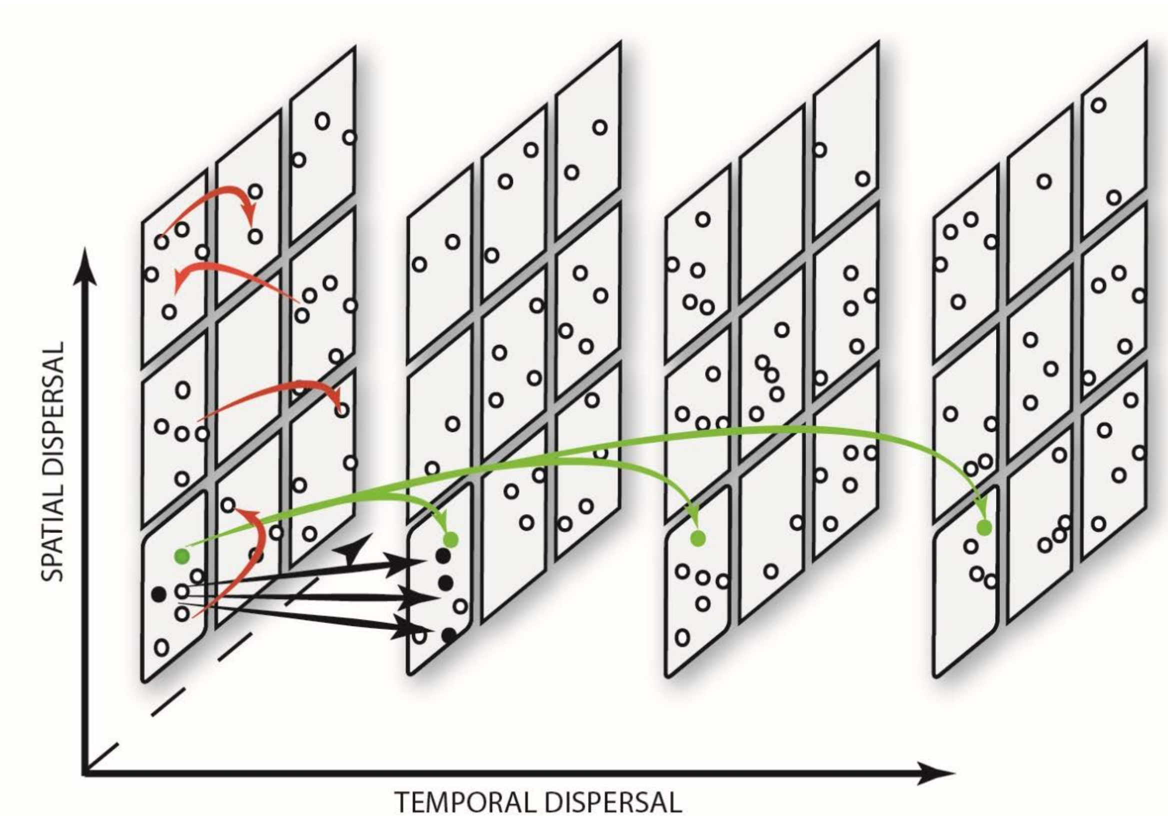
ECOLOGY LETTERS

Ecology Letters, (2014) **17**: 756–767 doi: 10.1111/ele.12275

REVIEW AND SYNTHESIS

Life-history syndromes: Integrating dispersal through space and time

Mathieu Buoro* and Stephanie M. Carlson



Bakshtansky, E.L. 1980. The introduction of pink salmon into the Kola Peninsula. In Salmon Ranching. Edited by J.E. Thorpe. Academic Press, London. pp. 245-259.

- *"Almost all pink salmon become mature at age 1+. If the whole population of eggs or young in a river dies, as has been observed in the Pacific, the area of pink salmon habitation would be reduced and the species would disappear. In such a situation other salmons are protected by a complex age structure and repeated spawning. As opposed to char, trout and several other salmons which may be characterised as having "protection in time", pink salmon has "protection in space", through an enormous abundance of small downstream migrants, large spawning and feeding areas, and an imprecise homing instinct, allowing it to reoccupy lost spawning areas." -page 257*

Dispersal through space or time?

Shapovalov and Taft 1954

- Semelparous coho salmon dispersed at a higher rate than iteroparous steelhead

Westley et al. 2013. CJFAS 70: 735-746.

- Semelparous Chinook salmon dispersed at a higher rate than iteroparous steelhead

Management strategy

- Identify, conserve, and restore natural risk spreading mechanisms
  - Life history diversity
  - Dispersal and spatial structure

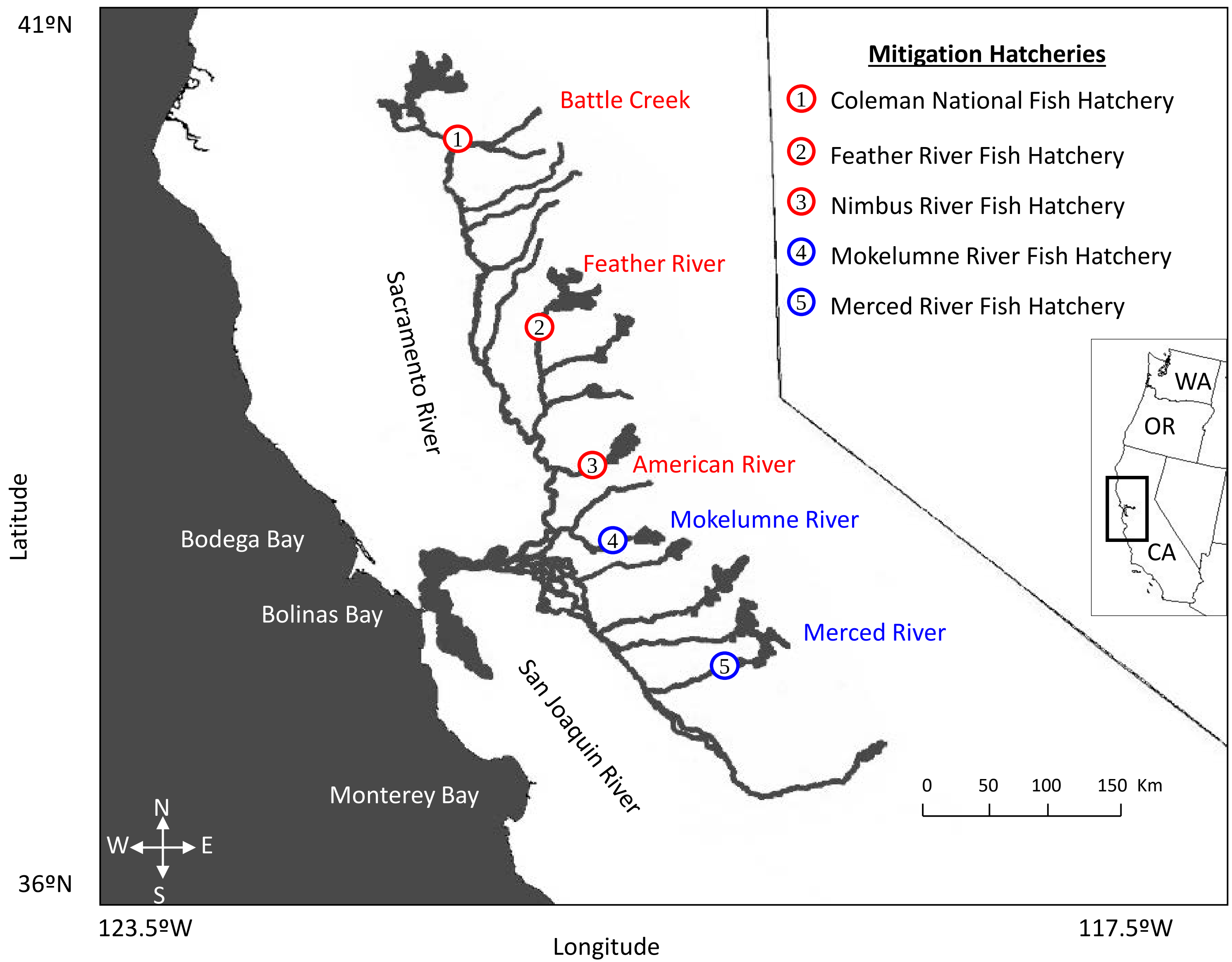
Management contexts

- Hatchery management
- Flow management
- Habitat restoration

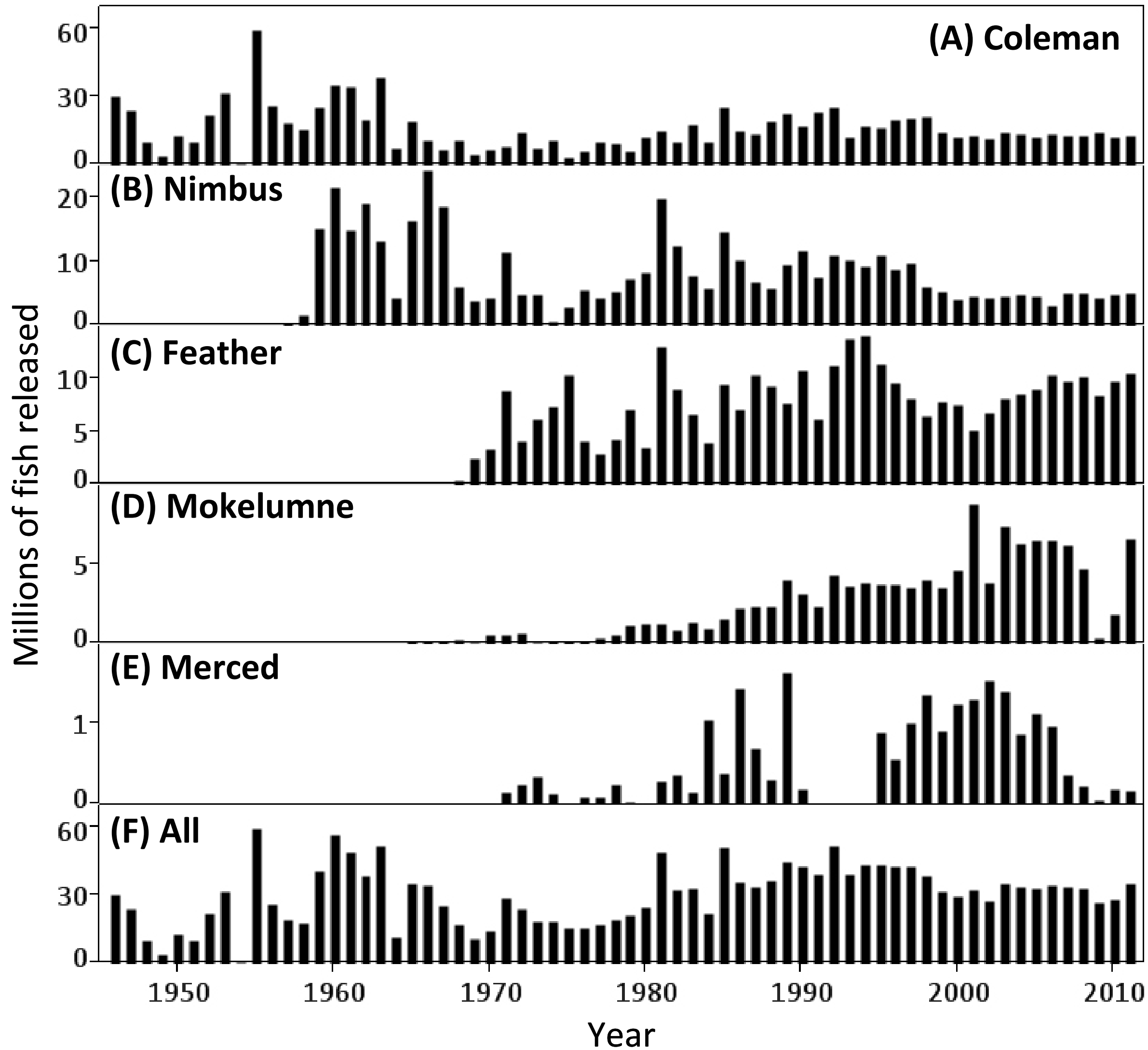
Management contexts

- Hatchery management
- Flow management
- Habitat restoration

Hatcheries on the Central Valley Rivers

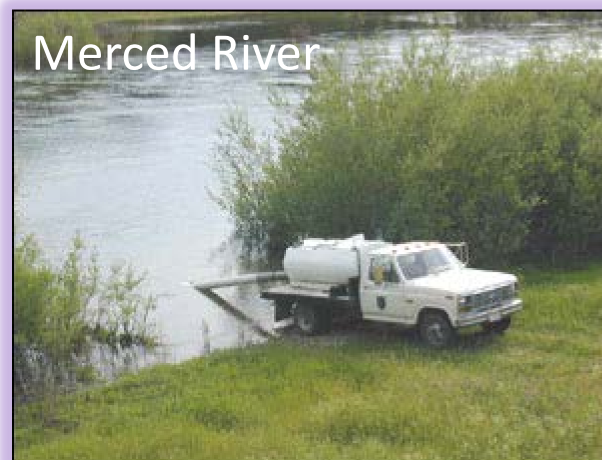


> 2 billion hatchery fish released between 1946-2012



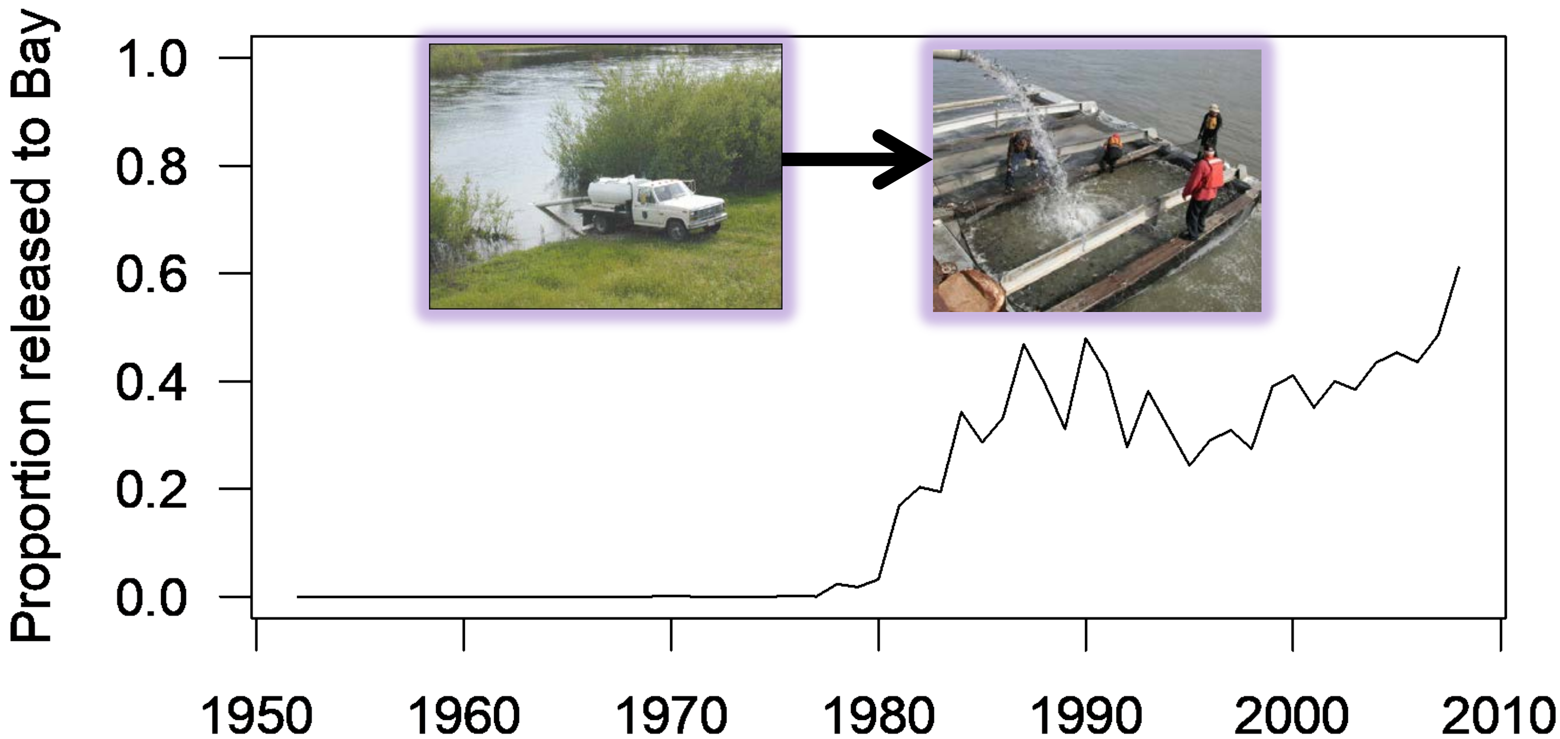
Huber and Carlson, 2015. San Francisco Estuary and Watershed Science.

Trend towards off-site releases of hatchery fish

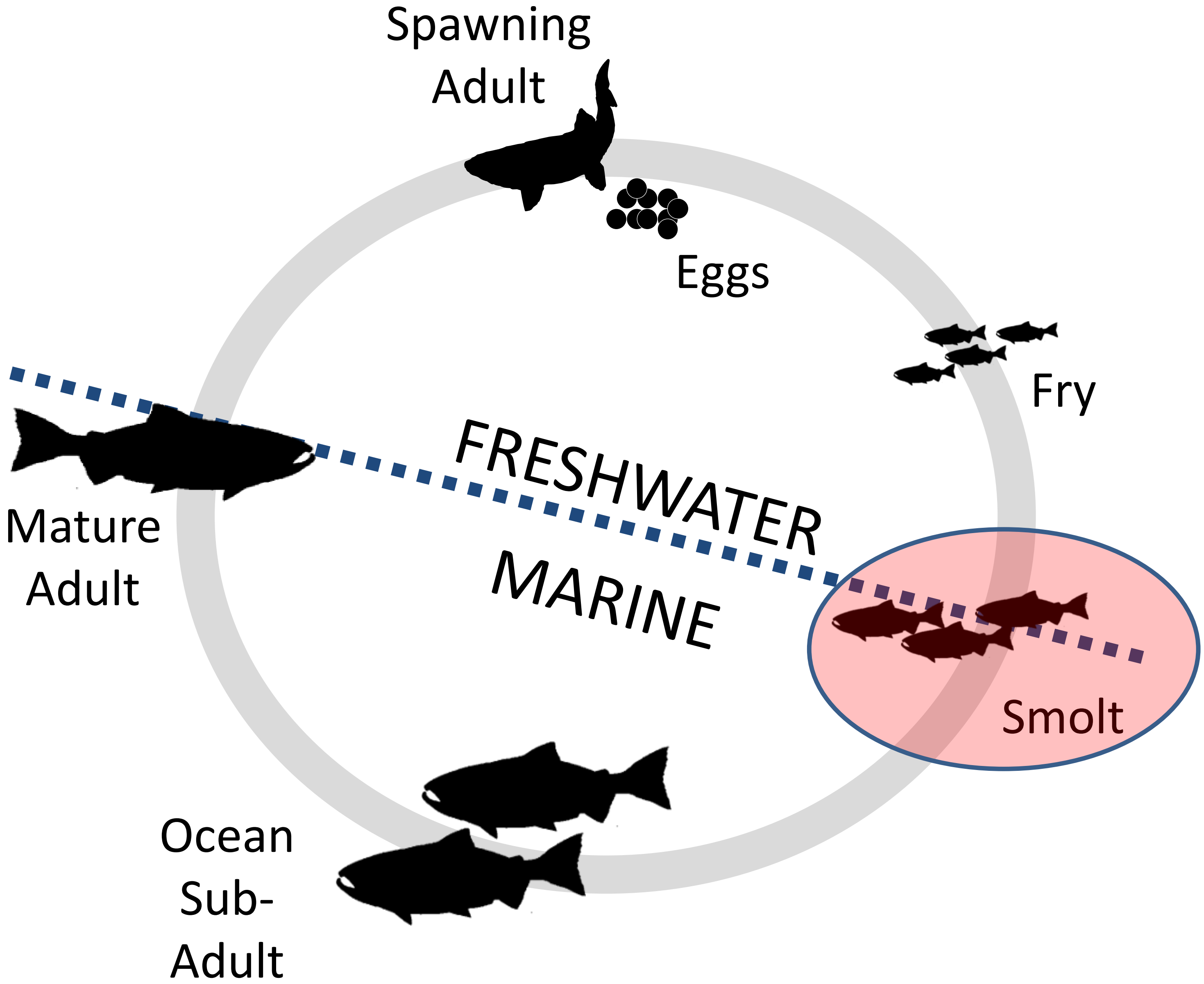


http://www.fisheryfoundation.org/

Trend towards off-site releases of hatchery fish



Huber and Carlson, 2015
Satterthwaite and Carlson, 2015



Slide courtesy of C. Phyllis, artwork by J. Moore

Ocean conditions vary among years

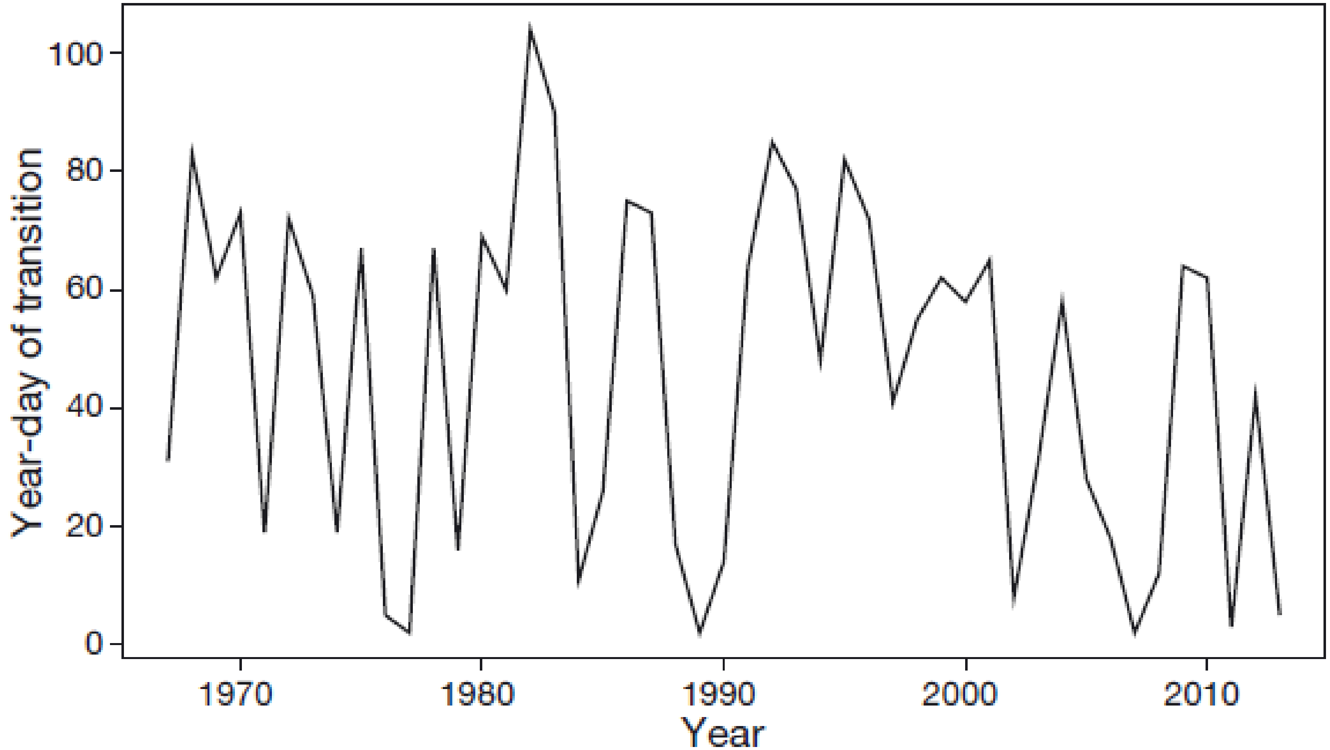
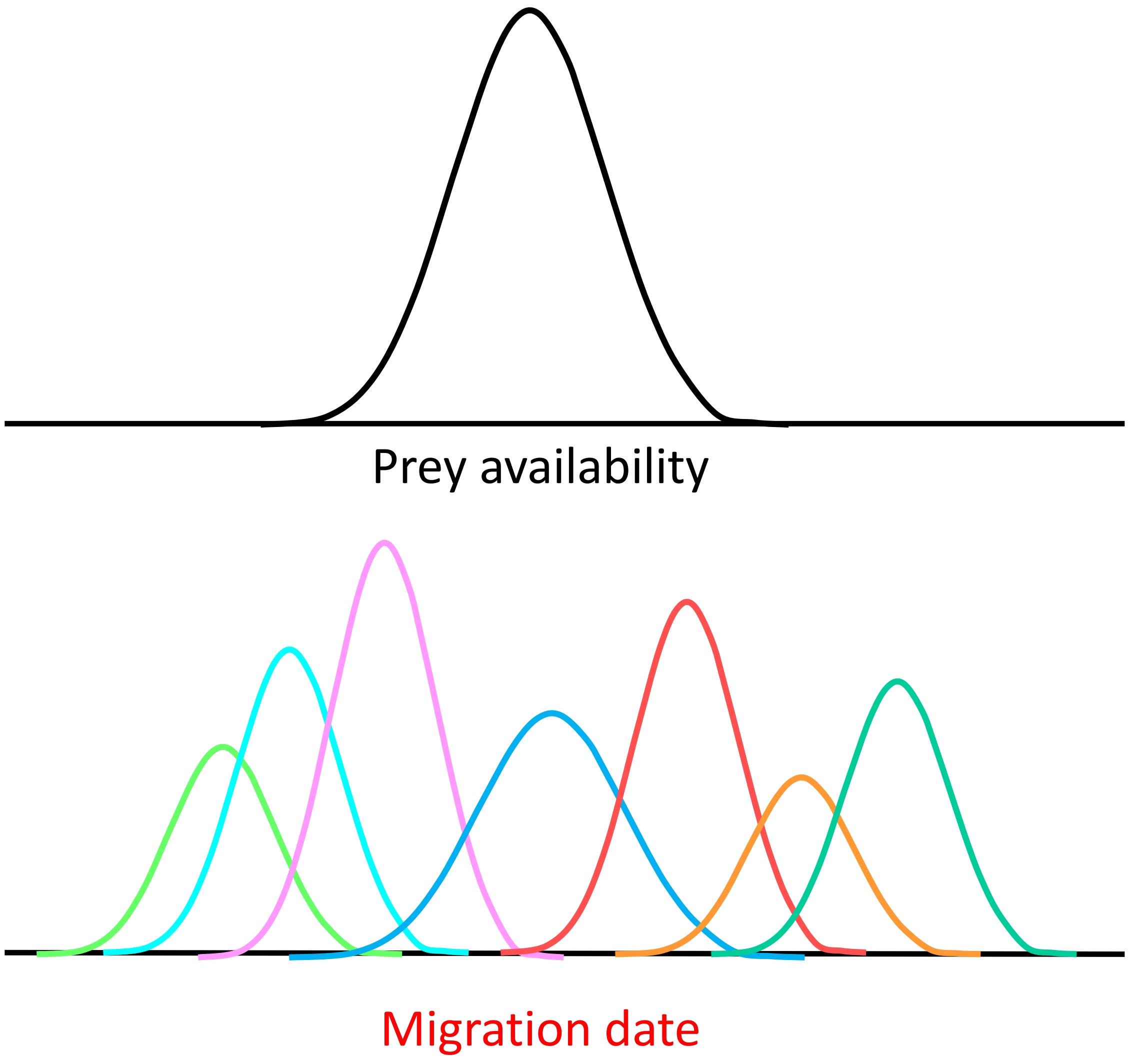


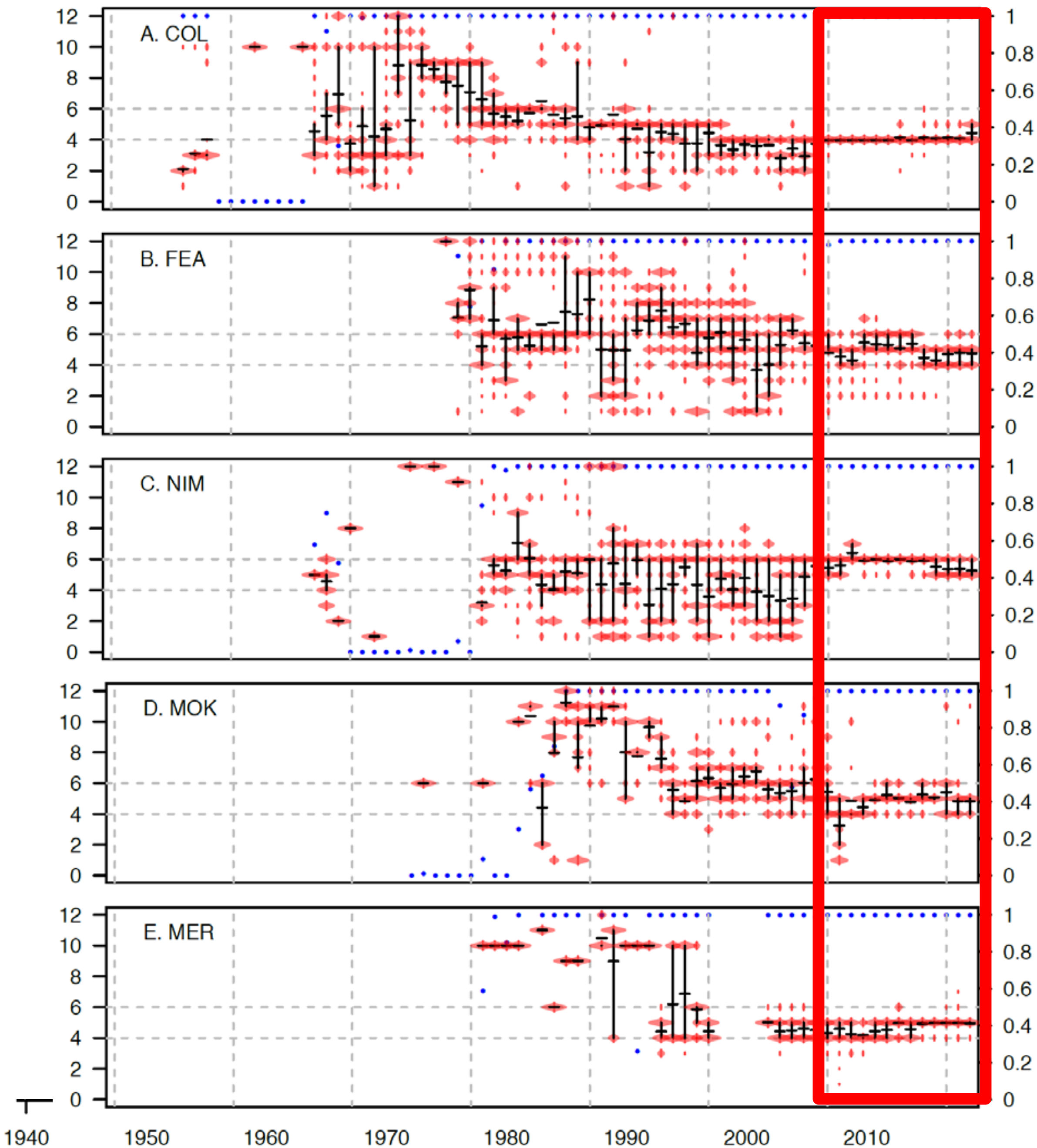
Fig. 1. Annual variation in spring transition date measured at 39° N, 125° W (see 'Materials and methods: Covariates and confounding issues' for methodological details); 'year-day' = day of year

Satterthwaite, Carlson et al. 2014. Marine Ecology Progress Series.

Timing of ocean entry: Match-mismatch dynamics



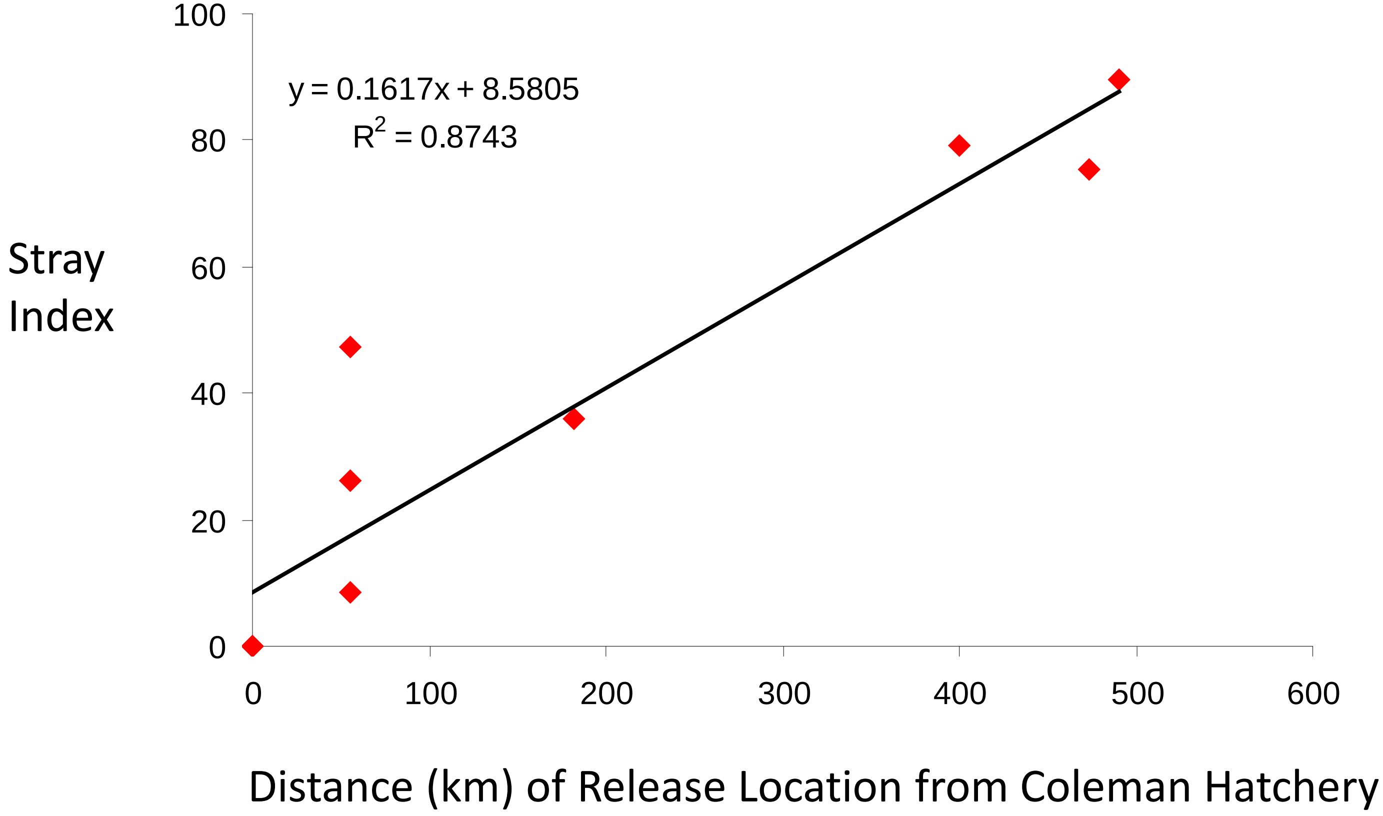
Release month



Proportion of total release

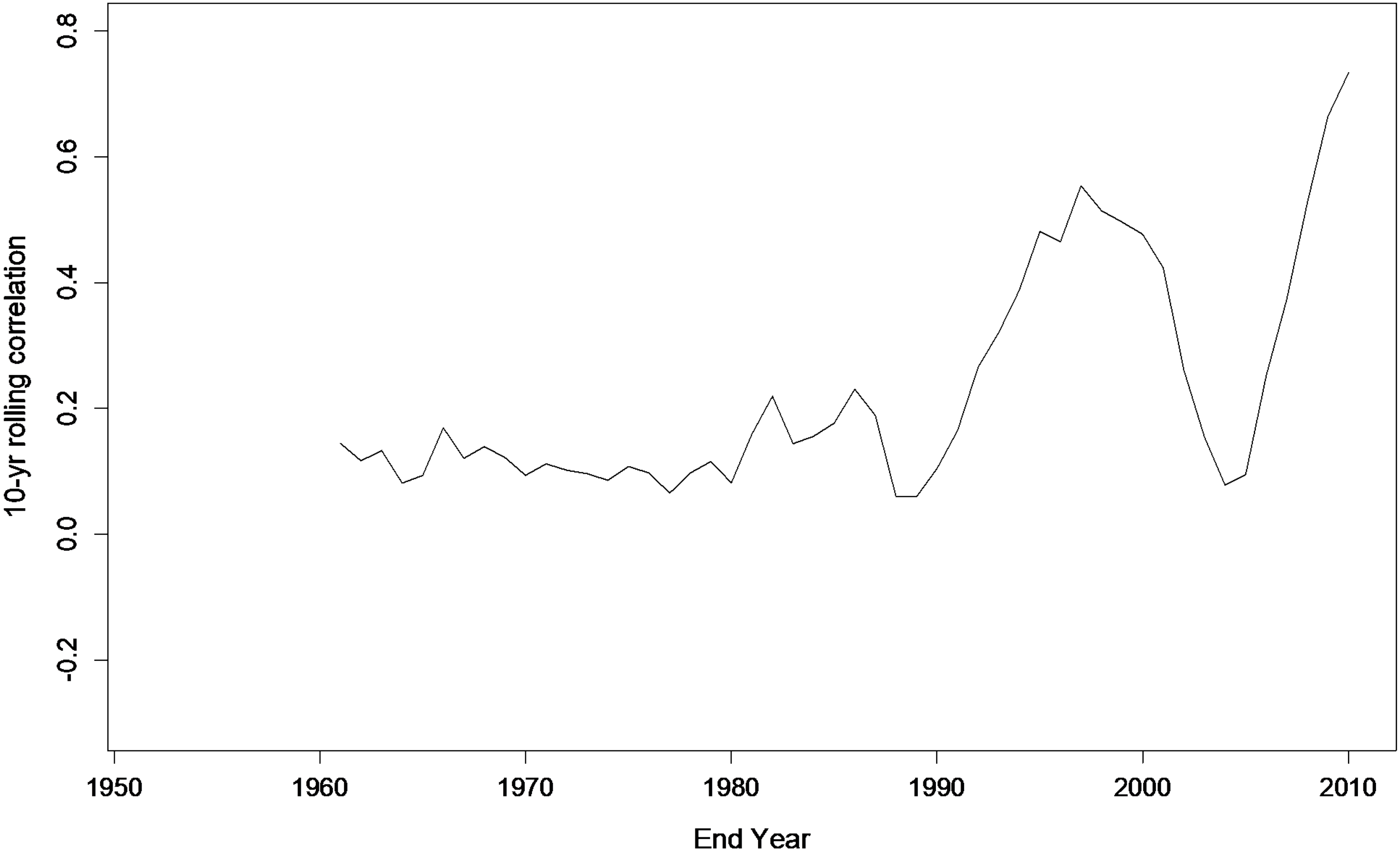
Huber and Carlson. 2015. San Francisco Estuary and Watershed Science.

Influence of release location on tendency to stray



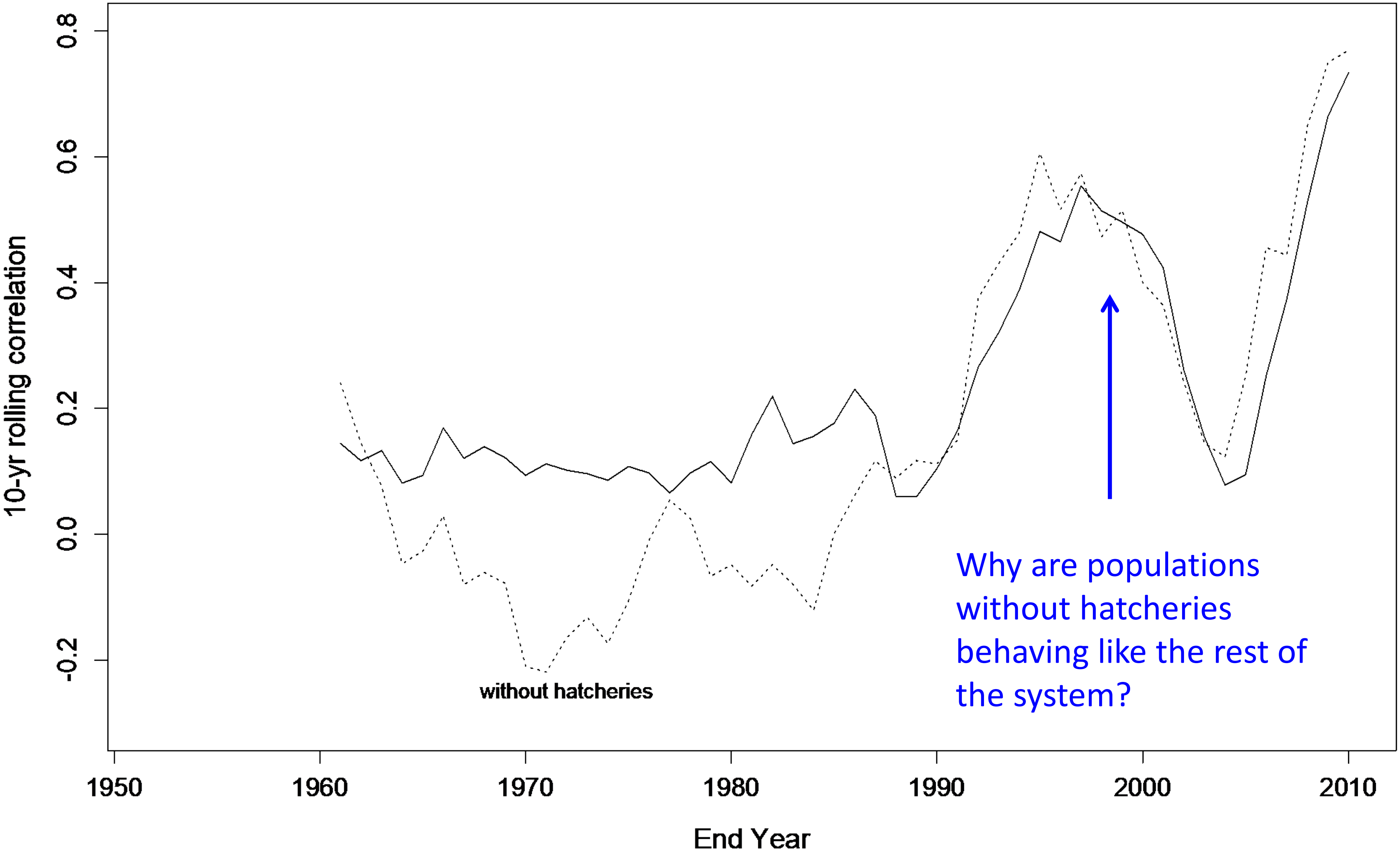
CDFG/NMFS. 2001. Final report on anadromous salmonid fish hatcheries in California.

Trend towards a general increase in mean pairwise correlations



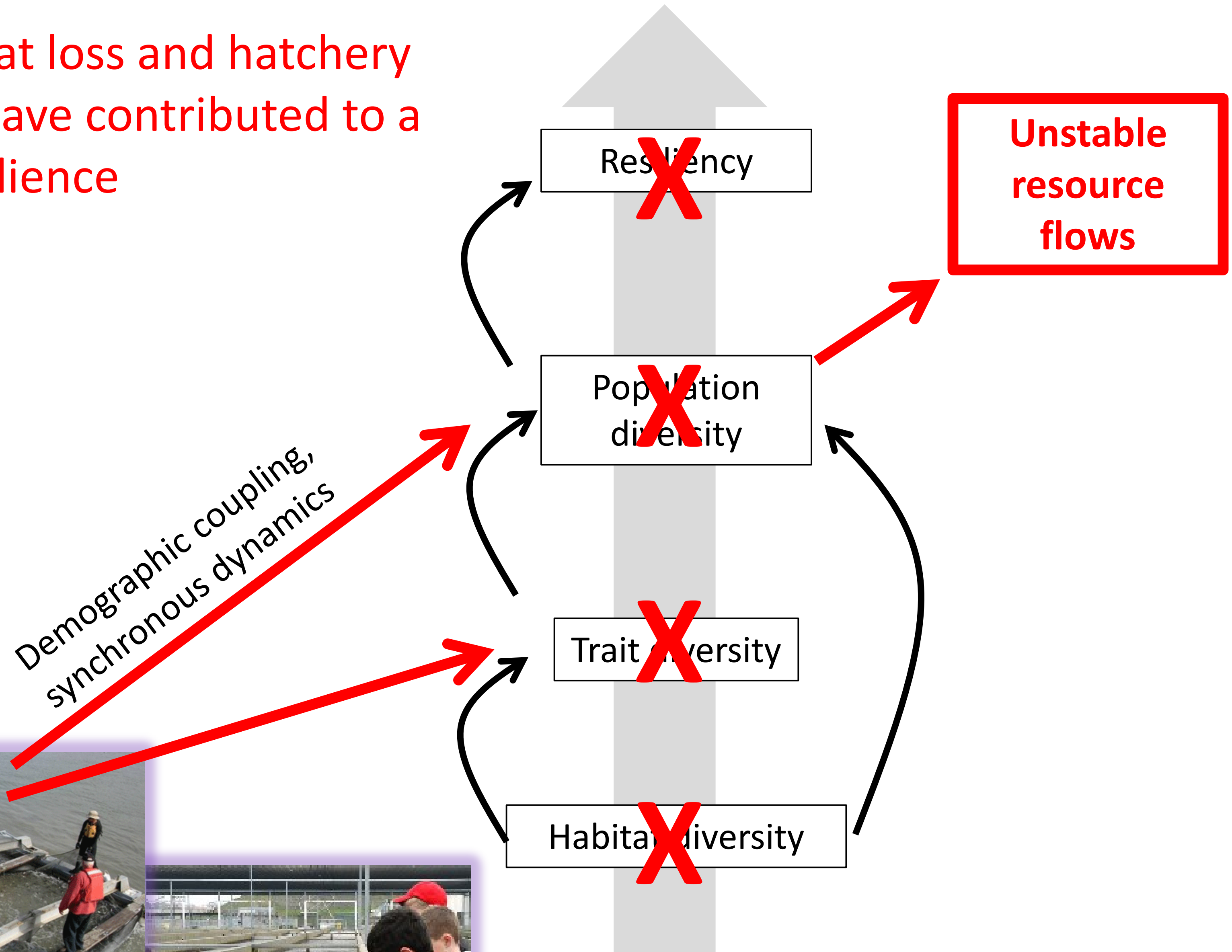
Satterthwaite and Carlson, 2015. Canadian Journal of Fisheries and Aquatic Sciences.

Trend towards a general increase in mean pairwise correlations



Satterthwaite and Carlson. 2015. Canadian Journal of Fisheries and Aquatic Sciences.

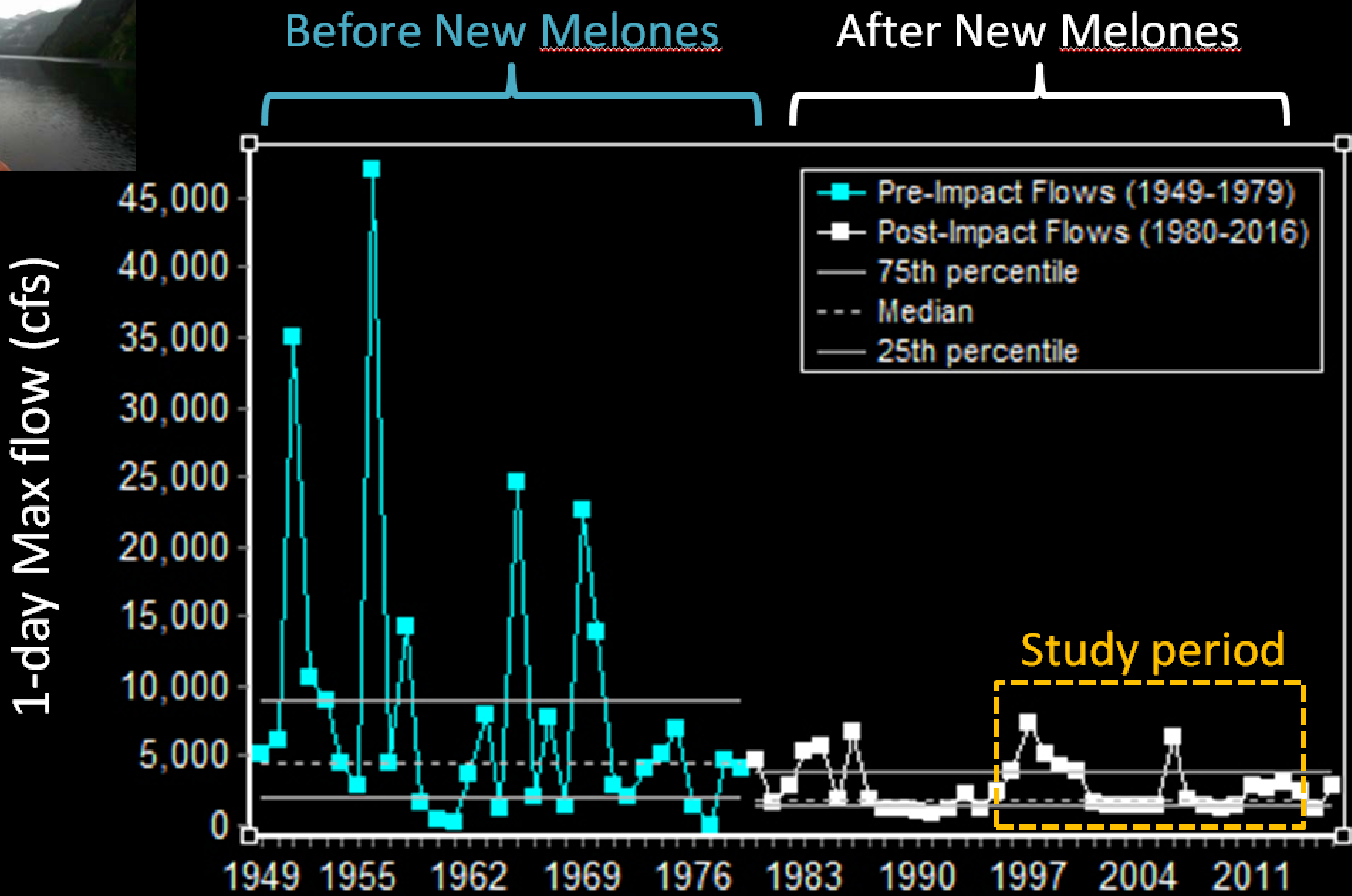
Both habitat loss and hatchery practices have contributed to a loss of resilience



Management contexts

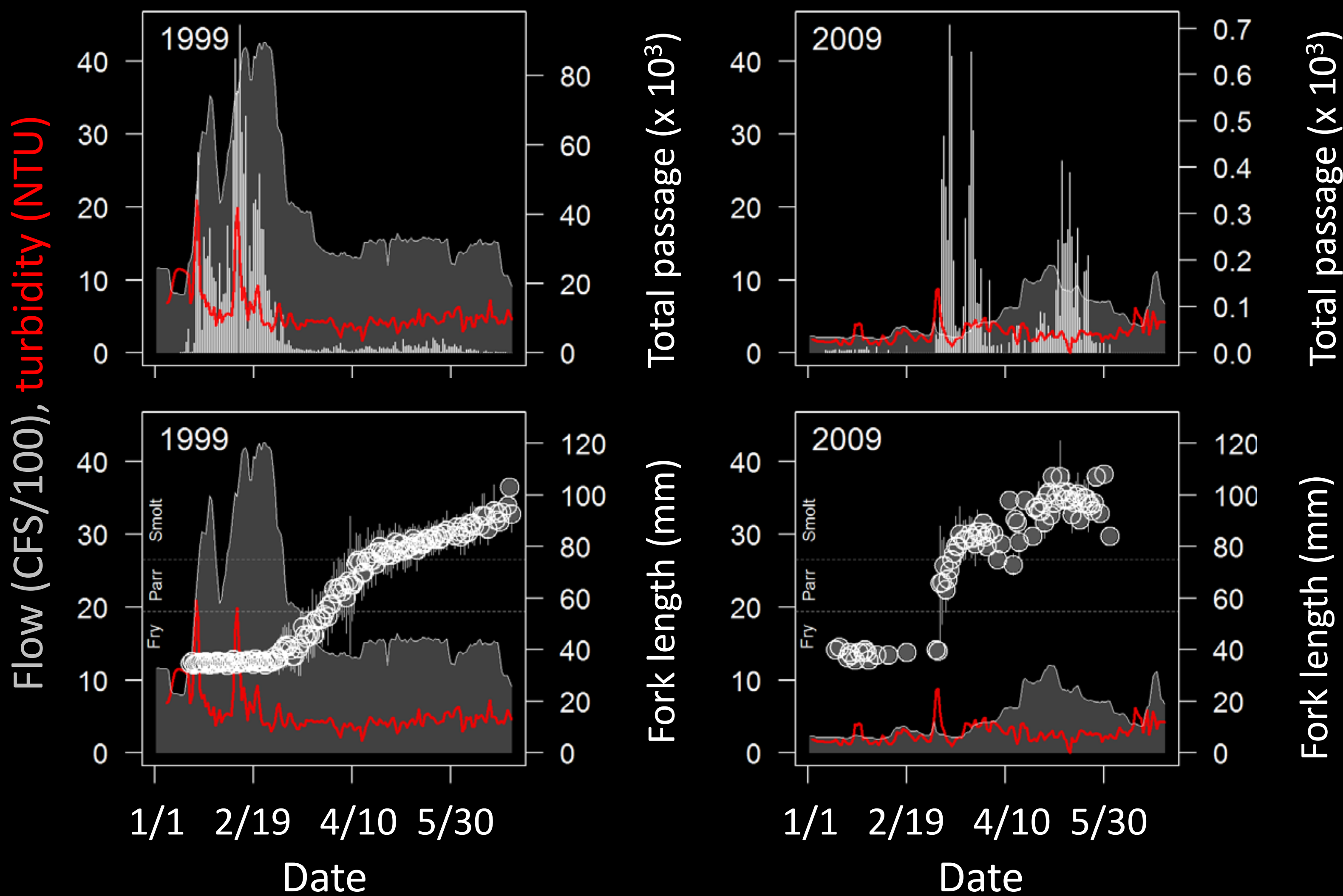
- Hatchery management
- Flow management
- Habitat restoration

Reduced flow magnitude and variance



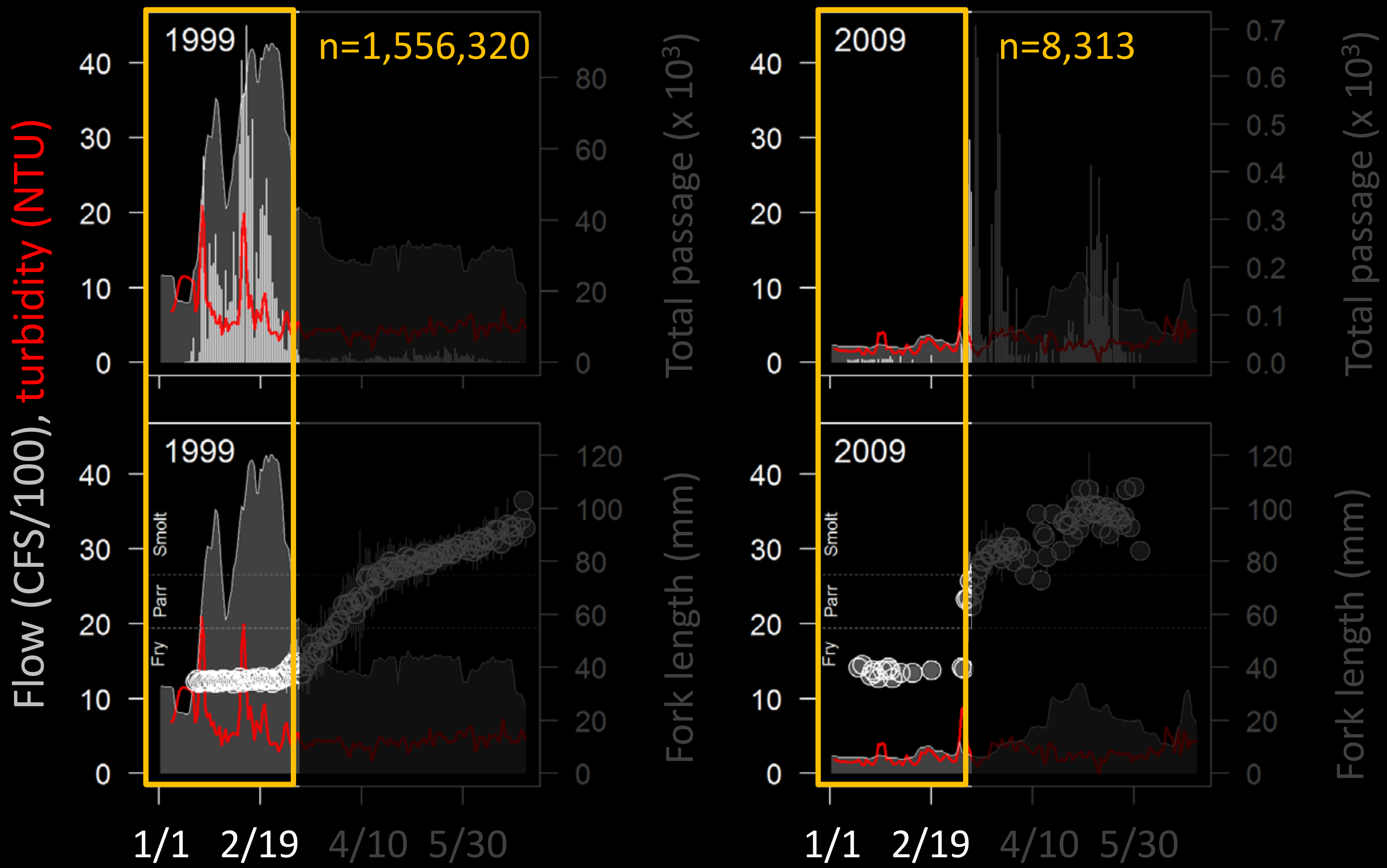
Following slides courtesy of Anna Sturrock

Juvenile outmigration (Jan-Jun)



Sturrock et al. In Prep.

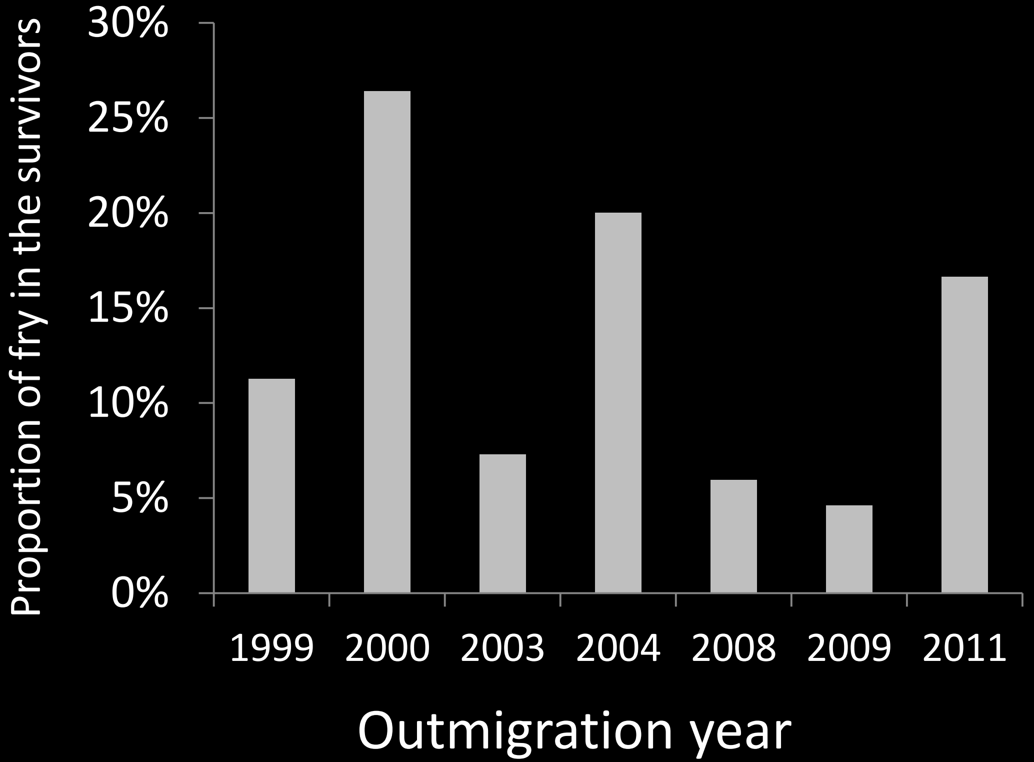
Juvenile outmigration (Jan-Jun)



Sturrock et al. In Prep.

Juvenile salmon express diverse life history strategies. Most typically leave the natal stream as early dispersing fry (Williams 2006), which we know very little about. **Our data shows that all strategies are viable.**

www.science.calwater.ca.gov/images/scinews_0610_tags_04_lg.jpg



Sturrock et al. 2015, Sturrock et al. unpubl

Sturrock et al. In Prep.

Management contexts

- Hatchery management
- Flow management
- Habitat restoration

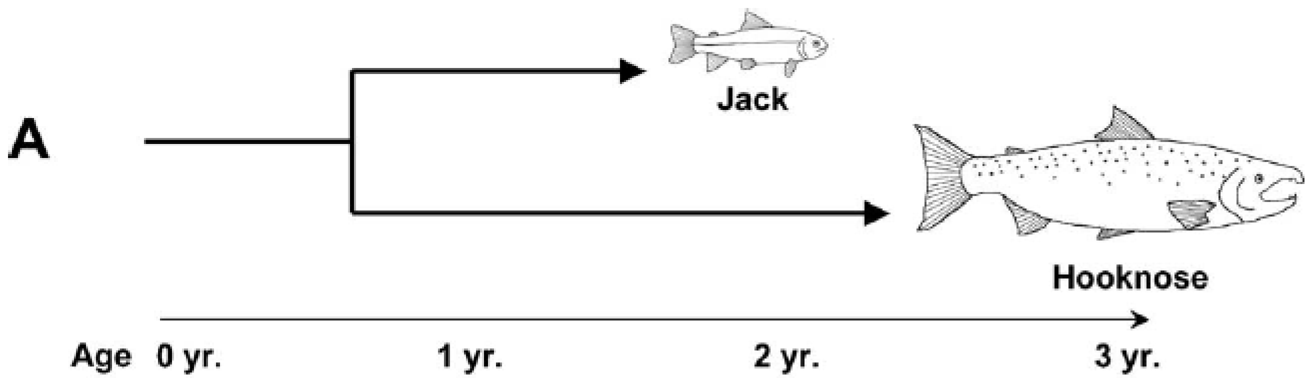
Phenotype management: a new approach to habitat restoration

- Goal of habitat restoration often to maintain or to promote population growth of some focal population
- Allocation of resources to different types of restoration projects has the potential to influence phenotypes of focal population
- *Phenotypic management* entails restoring specific habitats to manage for phenotypic diversity

Watters et al. 2003. Biological Conservation 112: 435-445.

Directing Phenotypes: Habitat Restoration

Habitat restoration may influence growth rates and life history expression

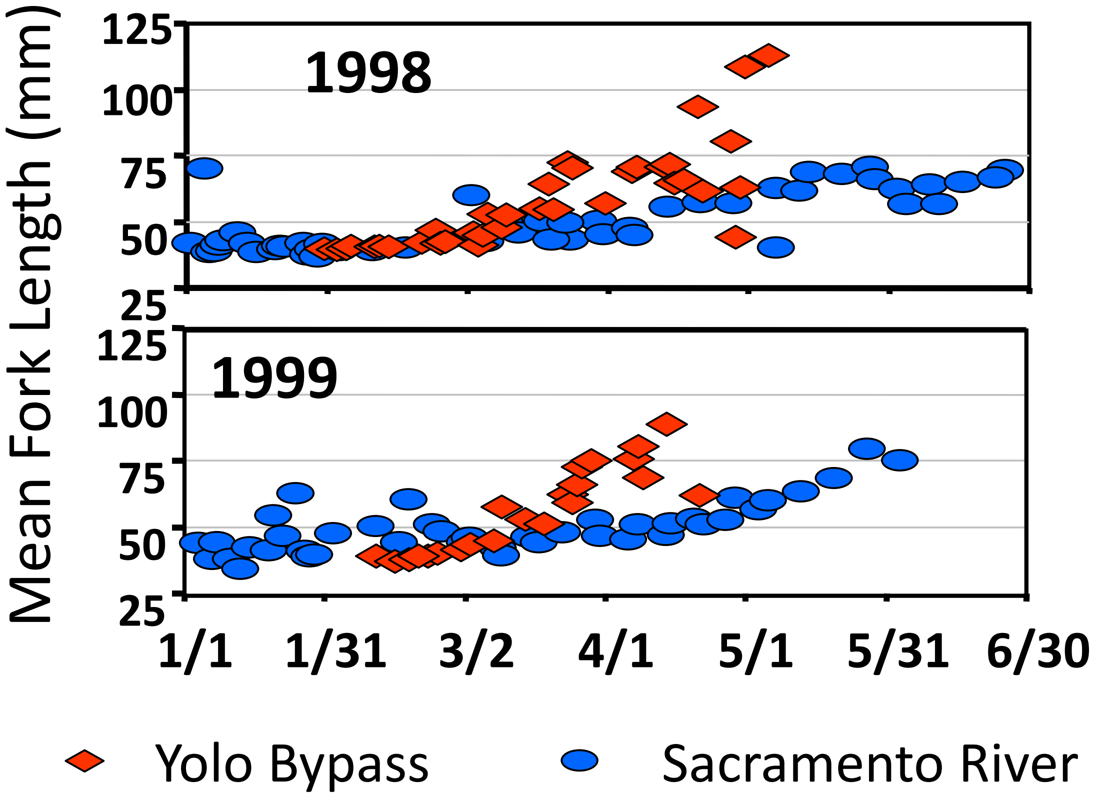


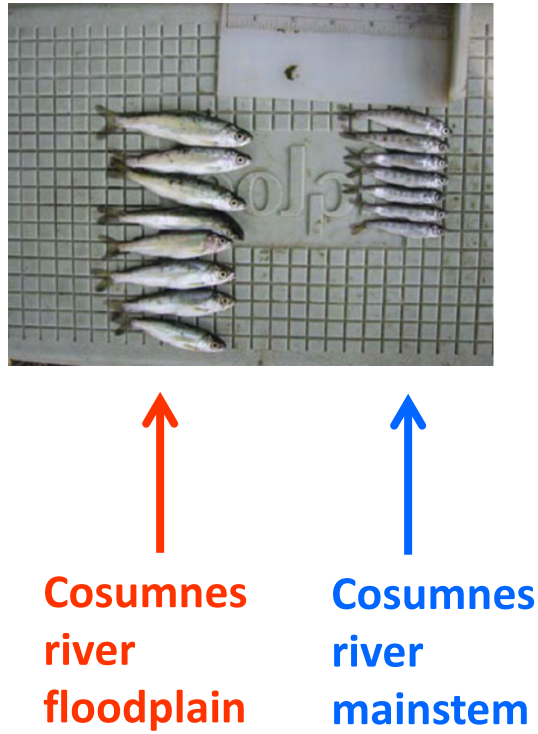
- In an experimental stream setting, a riffle treatment promoted greater variation in growth rates and age at maturity than the pool treatment
- This result supports the idea that streams with higher riffle:pool ratio produce more fast growing individuals

Watters et al. 2003. Biological Conservation 112: 435-445.

Directing Phenotypes: Habitat Restoration

Salmon grow faster in floodplain habitat





Plot courtesy of T. Sommer, DWR

Picture from Jeffres et al. 2008.
Environ Biol Fish 83: 449-458.

“Humans may be the world’s dominant evolutionary force” – Palumbi (2001)

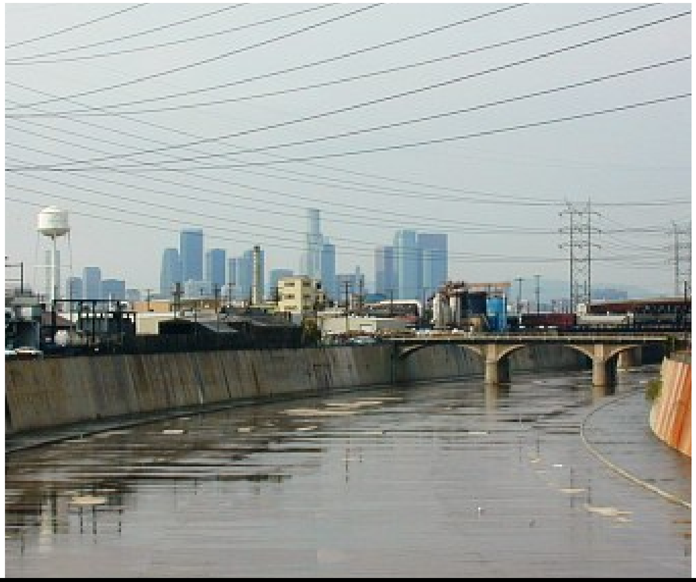


Photo credits: sockeye salmon (N. Kendall); Shasta Dam (usbr.gov); L.A. River (http://you-are-here.com/location/la_river7.jpg); trout stocking (P. Pister)

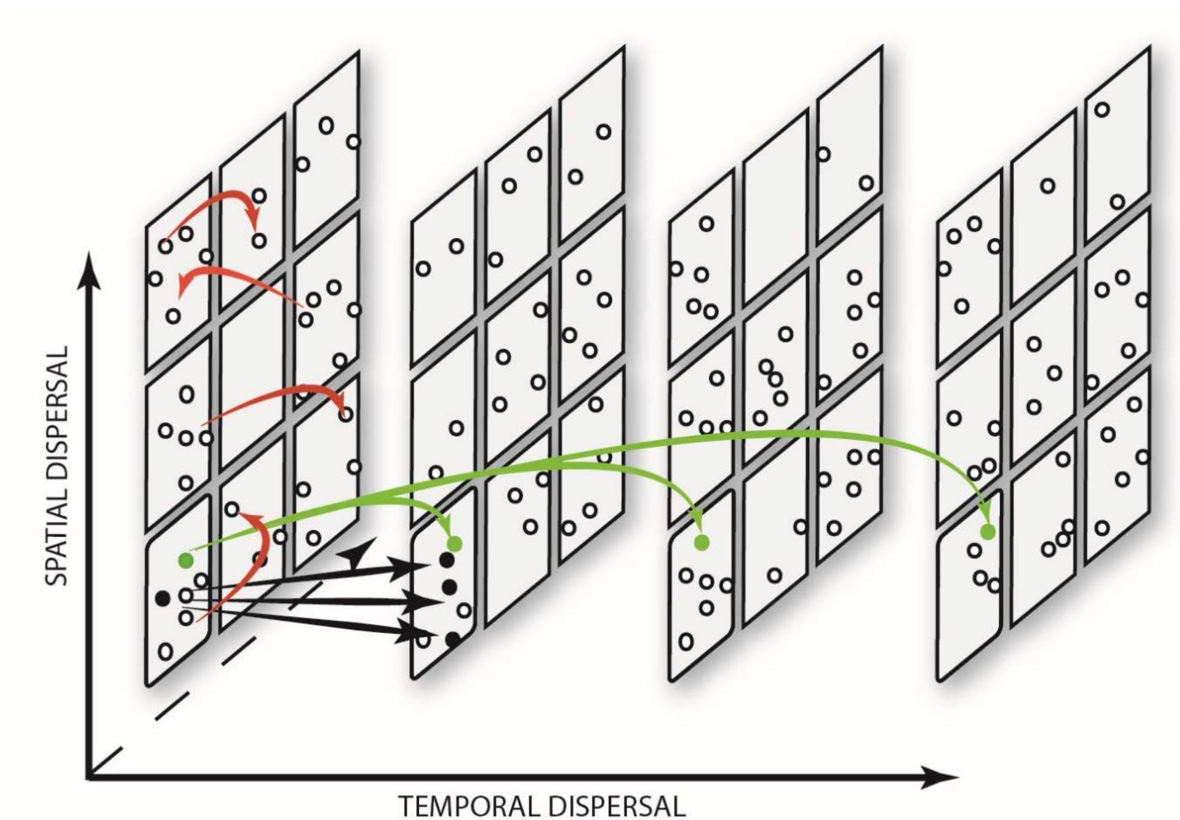
ECOLOGY LETTERS

Ecology Letters, (2014) **17**: 756–767 doi: 10.1111/ele.12275

REVIEW AND SYNTHESIS

Life-history syndromes: Integrating dispersal through space and time

Mathieu Buoro* and Stephanie M. Carlson



Directing Phenotypes: Habitat Restoration

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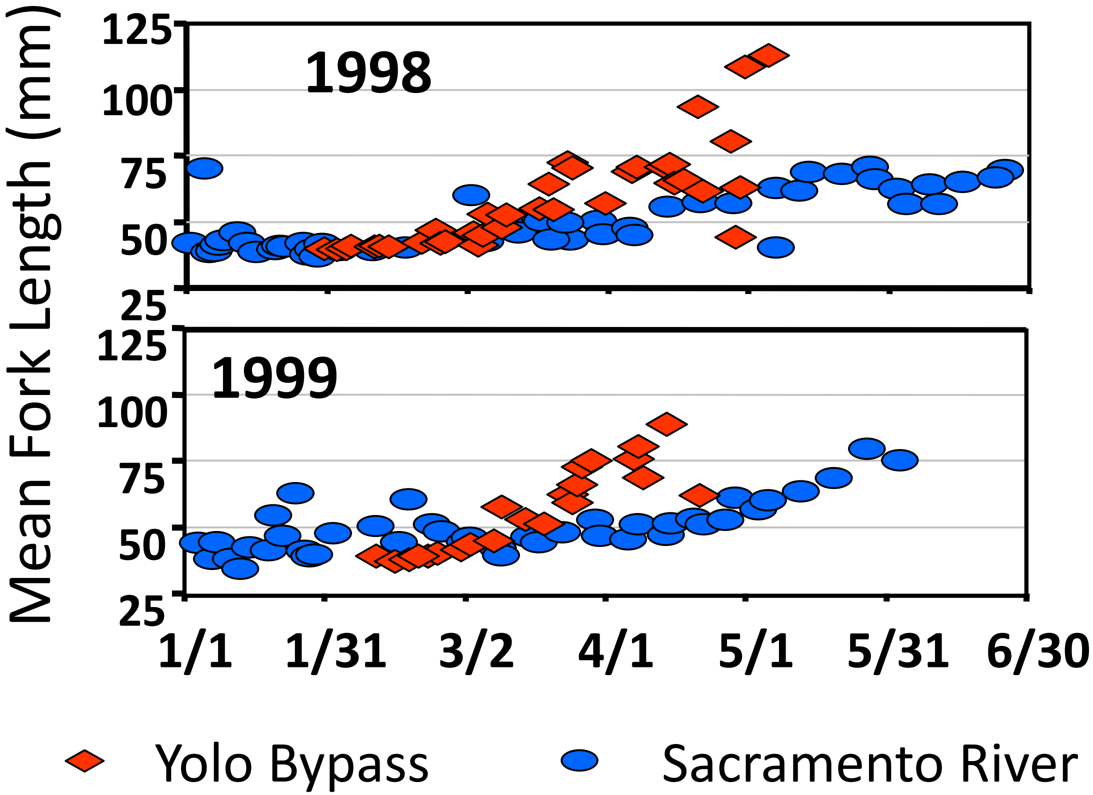
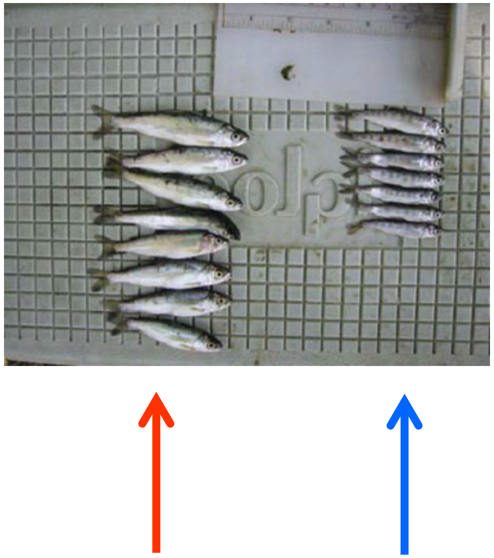




Cosumnes river floodplain

Cosumnes river mainstem

Plot courtesy of T. Sommer, DWR

Picture from Jeffres et al. 2008.
Environ Biol Fish 83: 449-458.

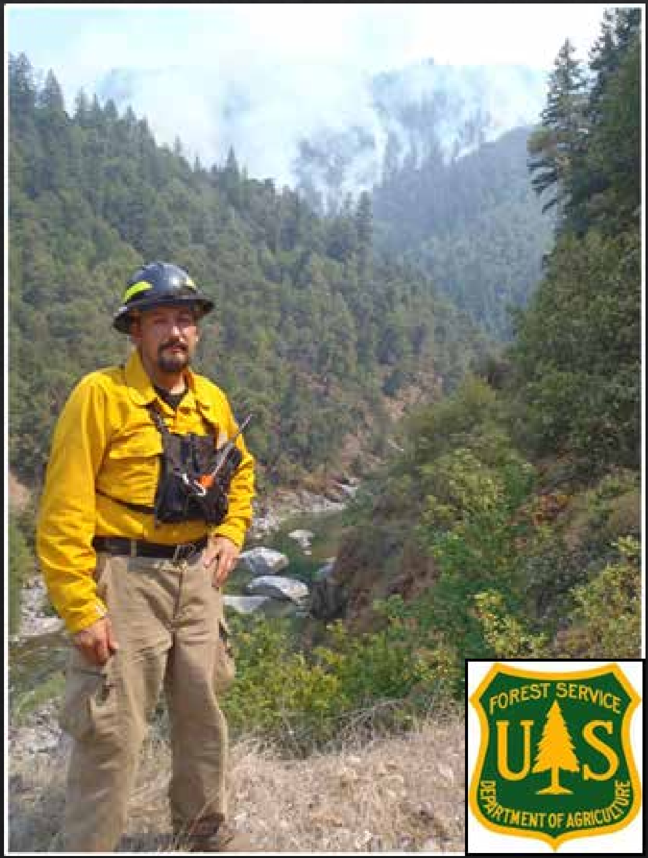
Take home messages

- Recognize that different species spread-risk in different ways (e.g., “protection in time” vs “protection in space”)
- Proactive management strategy is to identify and conserve natural risk spreading mechanisms

Acknowledgements

- Michael Kinnison, collaborator on "applied evolution in fisheries" working group
- Will Satterthwaite, collaborator on Central Valley salmon portfolio work
- Postdocs and students
  - Dr. Mathieu Bouro – risk spreading in space and time
  - Dr. Anna Sturrock – flow management and life history expression (Delta Science Fellow)
  - Eric Huber – patterns in hatchery releases

Fish and Fires-Integrating Traditional and Western Knowledge Systems with landscape restoration strategies to address, adapt to, and confront large-scale wildfires in an era of Climate Change



Frank K. Lake

- Education
  - 1995 B.S. University of California, Davis.
  - 2007 Ph.D Oregon State University
- USDA Forest Service-PSW Orleans/Redding, Ca.
  - Fire and Fuels Program
  - Former fish habitat biologist USFS & Hoopa Valley Indian Reservation.
- Research
  - Traditional Ecological Knowledge and Ethnobiology
  - Fire Effects and Climate Change Impacts to Tribally Valued Habitats and Resources
- Management
  - Resource Advisor on Wildfires
  - Interdisciplinary team assignments

WESTERN KLAMATH RESTORATION PARTNERSHIP

Understanding Climate-Fire-Forests-Hydrology-Fish Relationships

- **Issues and Question:**

Knowledge about fire effects (scale, severity, location on the landscape…) from both pre-historical/historical managed fires and lightning fire (especially at the watershed scale) on fisheries habitat.

Climate change projections, landscape fuels and we will have more frequent fires.

<u>Q: How can we manage wildfires to reduce or mitigate negative impacts and potentially improve fisheries habitat so more fish are hatched and survive to make it to the ocean and thus, return?</u>

Confronting Challenges: Threats and Stressors

- In an era of increasing environmental disturbances and climate change, many entities are planning strategies and implementing landscape restoration treatments.
- Addressing Challenges at an appropriate scale
- Identify Climate and Non-Climate Threats and Stressors to Fisheries stocks & populations
- Formulating applicable solutions or mitigation actions
- Integration of Tribal Traditional Knowledge and Western Science Knowledge systems.
- **Anthropogenic Threats Analysis**:
  "A fish species rated high for fire is one in which most of its streams are affected by fire, through increased erosion, increases in temperature, spills of fire-fighting chemicals, and effects of ash and other materials."
  - Katz, J., Moyle, P.B., Quiñones, R.M., Israel, J. and Purdy, S., 2013. Impending extinction of salmon, steelhead, and trout (Salmonidae) in California. Environmental Biology of Fishes, 96(10-11), pp.1169-1186.

Traditional and Western Knowledges: An Integrated Systems Approach

- Inform and guide restoration at various scales of the landscape
- What historical and current tribal fisheries management and harvesting practices are applicable?
- What Western science methods and management practices can learn from Traditional Knowledge?
- What are some of the applications of these approaches to wildland fire management?

Karuk subsistence fishing and monitoring

Tribal & Western Knowledge: Local and Regional Perspectives

- Tribal Traditional Ecological Knowledge
  - Long-term observations of fire effects and fisheries
    - "*Living with Fire*"
  - Subsistence and Ceremonial activities
    - Traditional burning as a form of Human Services to Ecosystems [Bill Tripp]
- Scientific Synthesis of Various Studies
  - Wildfire severity
  - Forestry management
  - Landscape vulnerability to wildfire

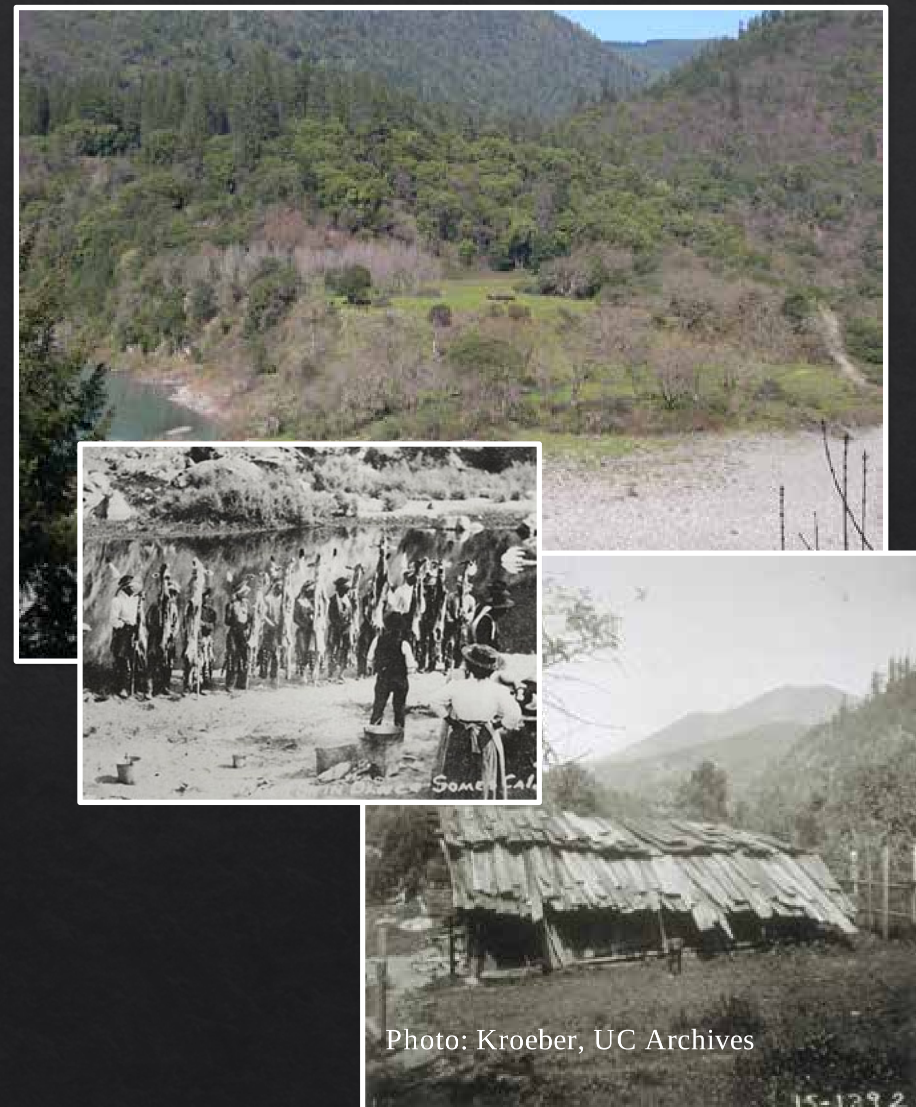


Photo: Kroeber, UC Archives

Tribal & Western Knowledge: Local and Regional Perspectives

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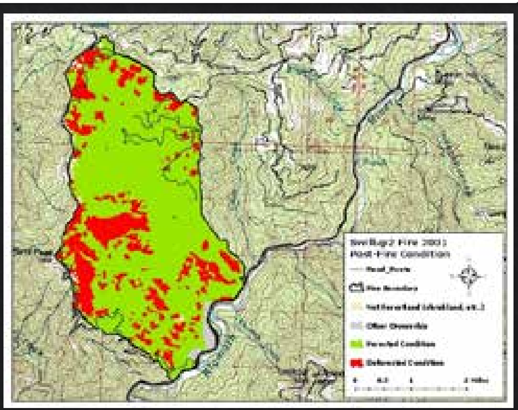
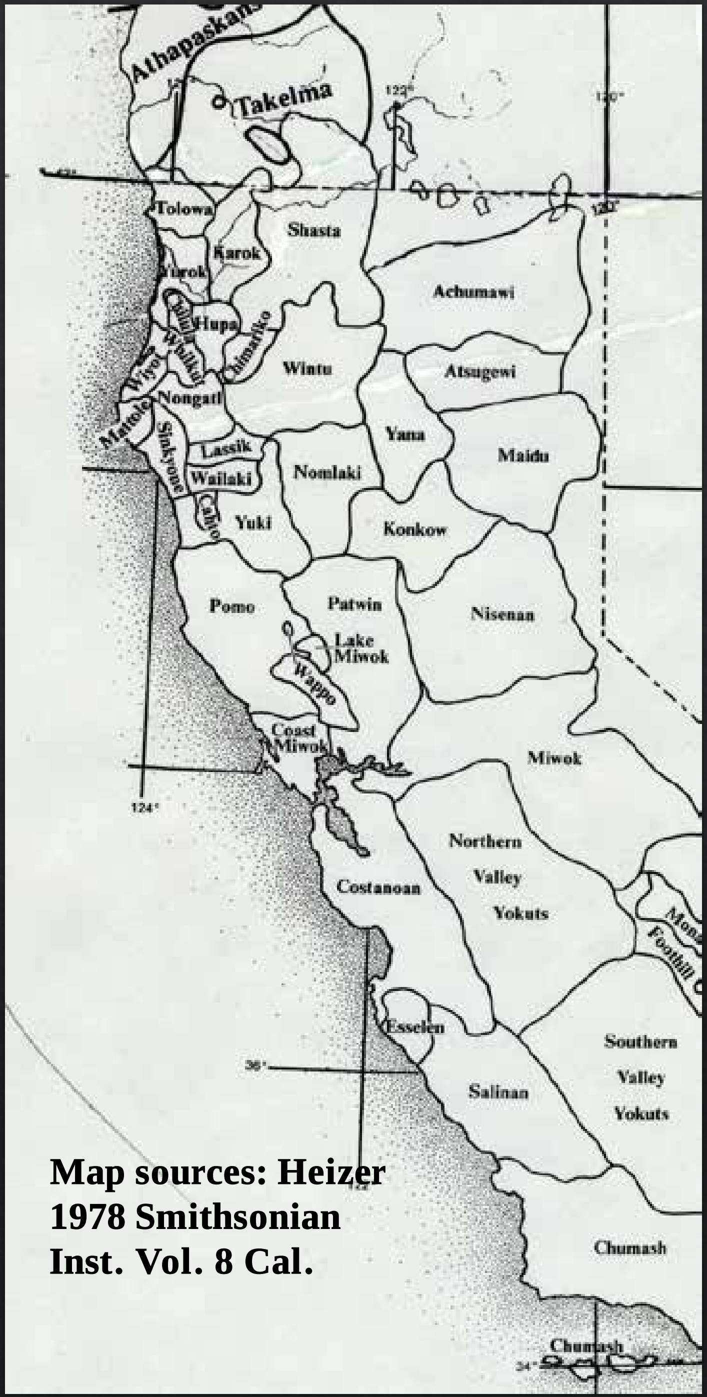
    - Vaillant, N.M., Kolden, C.A. and Smith, A.M., 2016. Assessing landscape vulnerability to wildfire in the USA. Current Forestry Reports, 2(3), pp.201-213.



Co-evolution: Fire Regimes, Tribal Cultures and Salmonid Populations

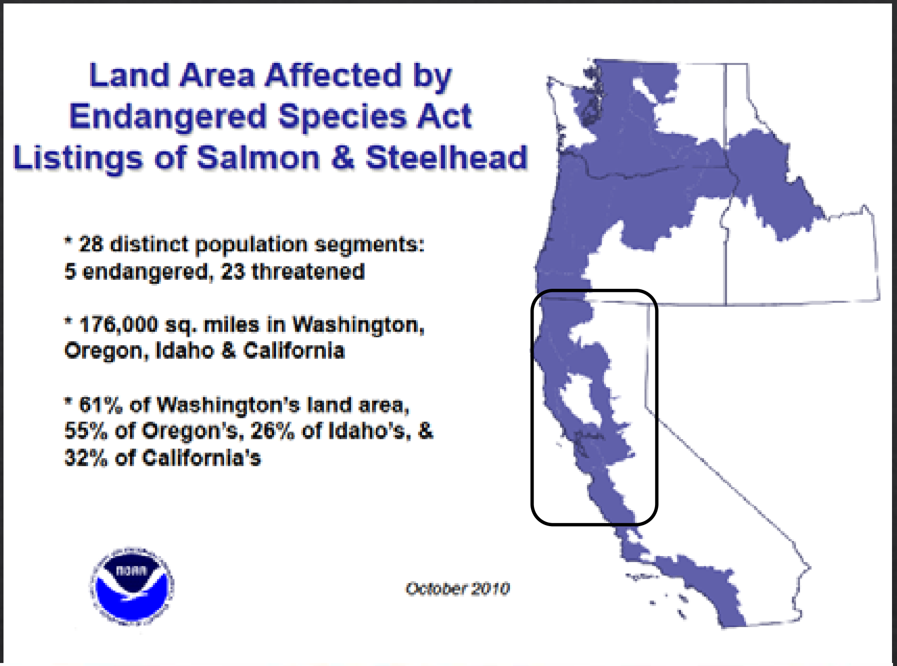
- Fire has been an important ecological and cultural process in western landscapes for millennia.
- Many American Indian tribes and salmon species inhabiting watersheds in northern California and the Pacific Northwest adapted to living with wildland fires.
- Cultural Fire Regimes and Watershed Processes-
  - Implications for Salmon?

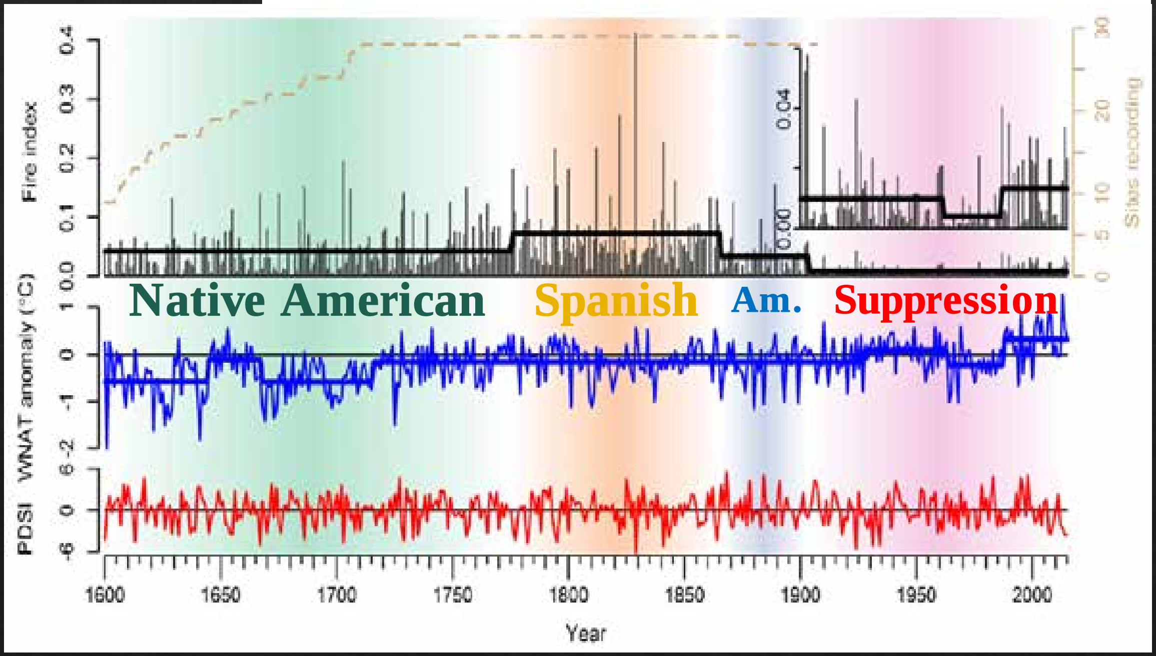


Map sources: Heizer 1978 Smithsonian Inst. Vol. 8 Cal.

Changing Fire Regimes, Land Use Practices, and Fisheries Stocks

- Following Euro-American settlement: Changes in
  - Fire regimes
  - Water and resource management practices
  - Fire suppression and exclusion activities
  - Other impacts to watersheds have negatively affected many wild salmon populations.





Map: NOAA 2010, Graph: Taylor et al. 2016

Tribal Knowledge of the Effects of Fires on Fisheries

- "Indians complain about modern [fire] restrictions. Fishing in small streams possible formerly; now completely choked by brush". Lassik-Eel River/SF Trinity Essenes' field notes

- "He told me that they were sure that the burning made the springs run better… Gianella 1933 in Stewart, eds. Lewis and Anderson 2002, -Forgotten Fires: Native Americans and the Transient Wilderness

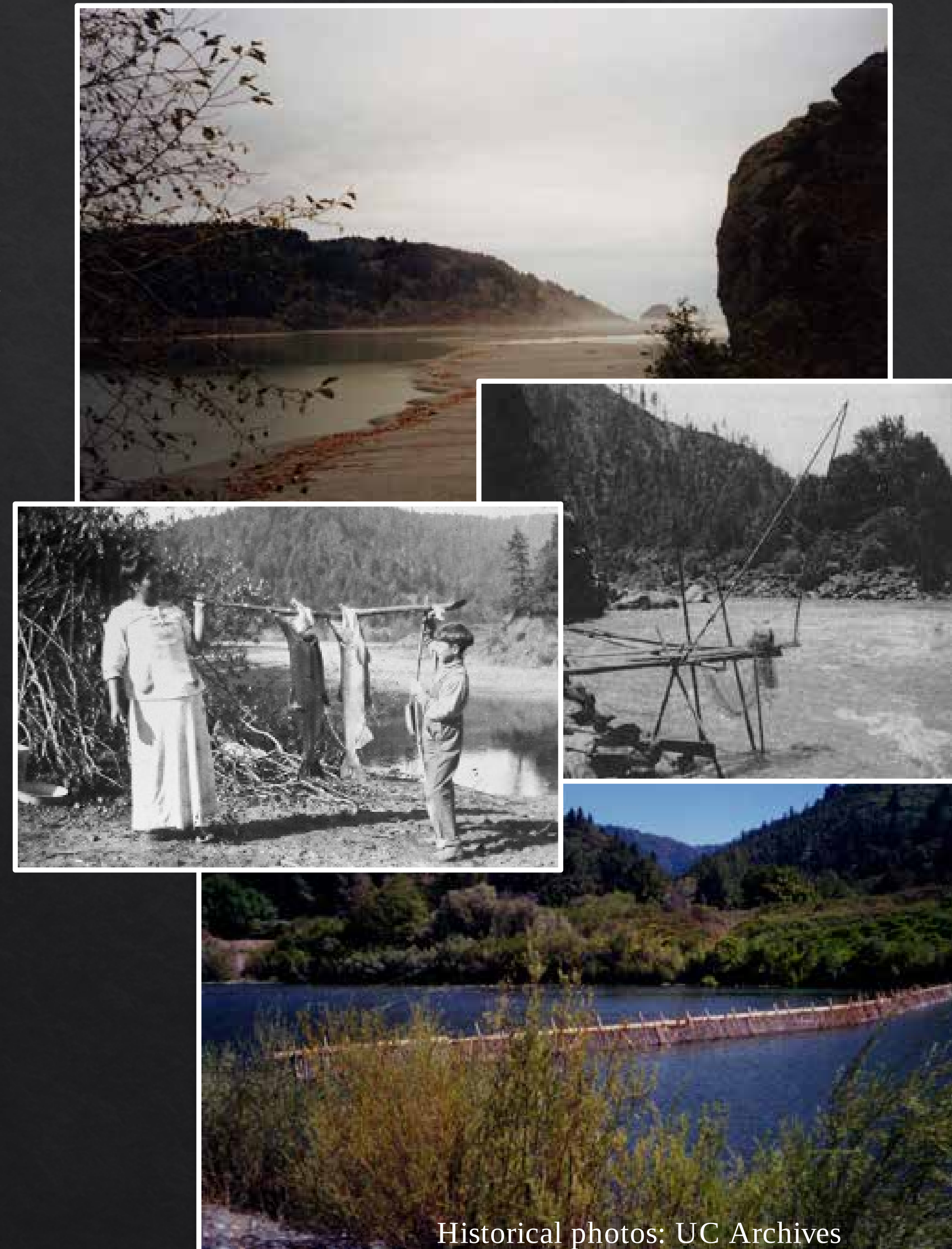
Fires, Vegetation response, Transpiration, Hydrology, Aquatic Habitat

Rogue River-Tututni

- **"They practice a sort of superstitious rite every spring and fall, by burning over the hills for the purpose, as they say, of inviting the salmon to enter the river. They think that if this offering is not made, the great spirit will prevent the salmon from appearing.** (Hubbard 1861, Bancroft Library Manuscripts Collection) in Pullen (1996).

Tribal knowledge of Ecological Processes and Fisheries

- Indigenous fisheries management
  - Ocean, Estuary, Riverine, and Tributaries
- Tribal harvesting practices
  - Species- Stocks/Runs
  - Hydro-Geomorphic adaptations and manipulations
- Fish habitat requirements
  - Species: Adults and Juveniles
  - Runs and seasonal uses
  - Regulations, Protection, and Conservation practices



Historical photos: UC Archives

Factors influencing Fire and Fish

- Climate/weather
- Fire frequency, vegetation response, and landscape condition
- Direct/Indirect Effects
- Spatial and temporal scales

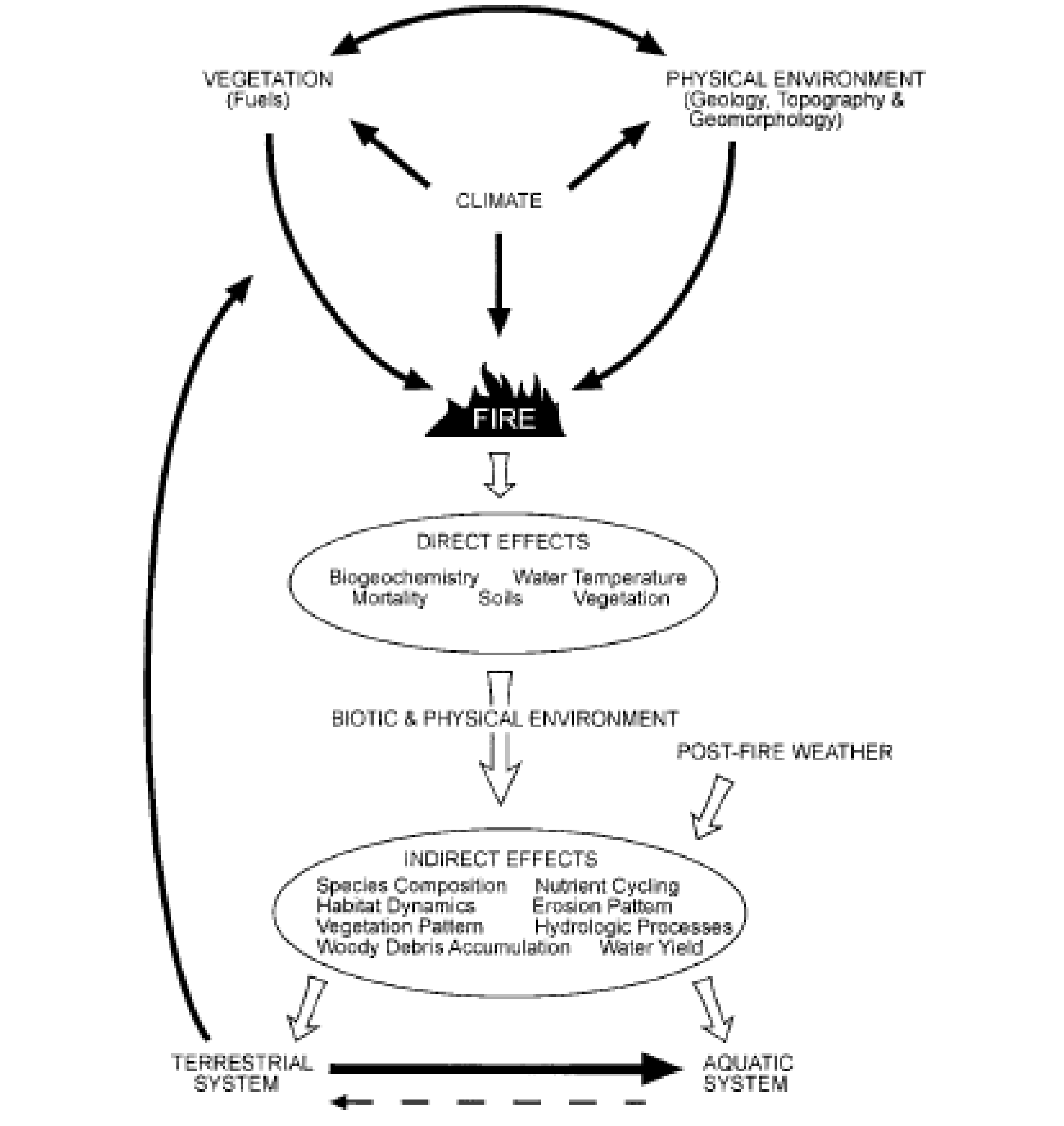
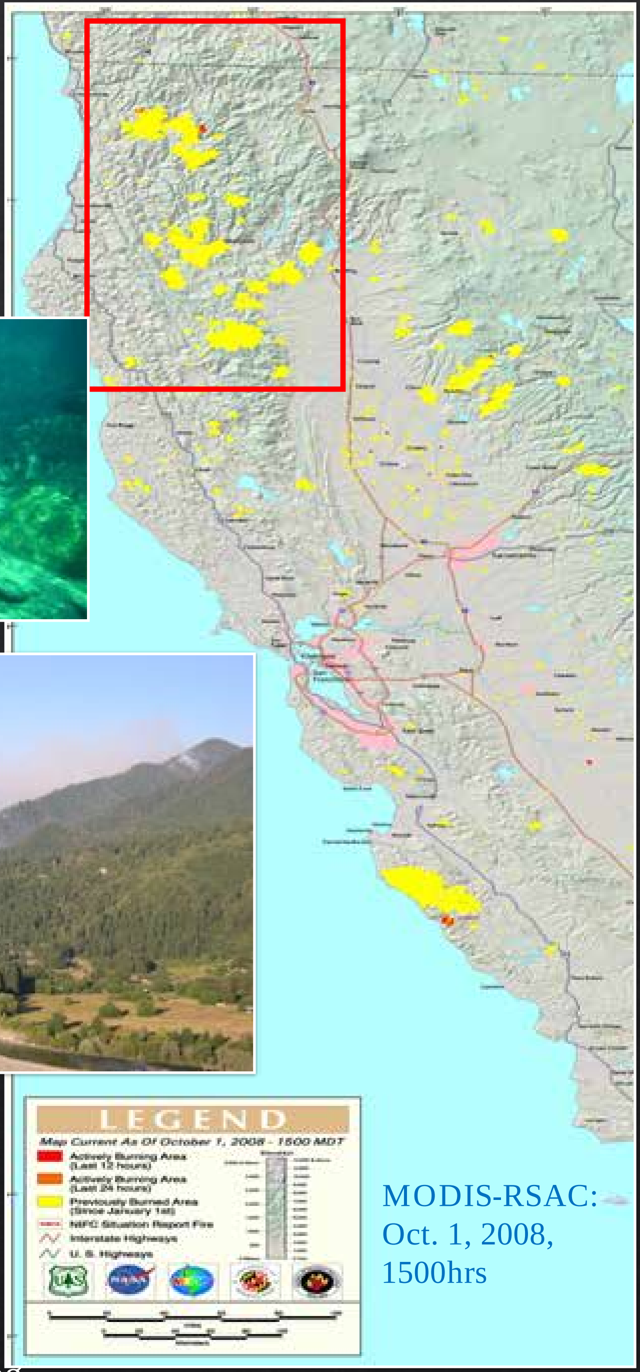


FIGURE 1.—Factors influencing fire and the effects of fire on terrestrial and aquatic ecosystems.

Figure Source: Gresswell 1999, Vol. 128, No. 2, Fire and Aquatic Ecosystems in Forested Biomes of North America, Transactions of the American Fisheries Society.

Climate and Wildfires:
Threats to Salmonids

- Climate change
  - Precipitation delivery: Less snow pack- hydrologic regime change
  - Winter mean temperature to increase
  - Forest species composition
  - Longer wildfire season affected by fuel moisture content
- Wildfires: Short and long term effects/impacts?
  - Extent and severity to increase
  - Direct and indirect effects to salmonid habitat quality
  - Fire suppression/repair activities
  - Need for sub-basin planning
  - Research to link direct and in-direct effects to habitat or species populations.



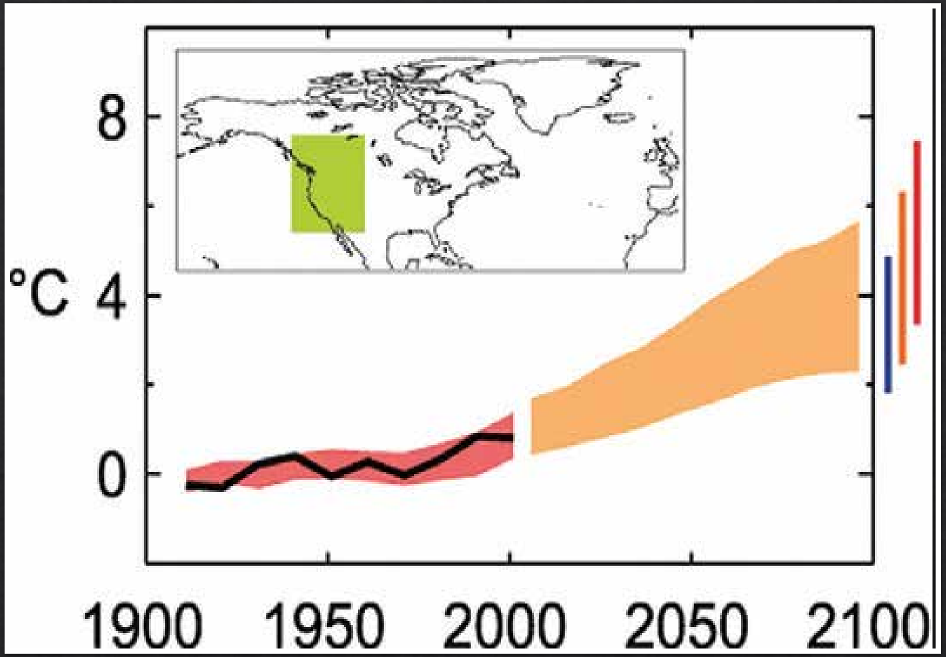
MODIS-RSAC: Oct. 1, 2008, 1500hrs

MODIS Image: http://activefiremaps.fs.fed.us/fireplots/cgb2008275_1500.jpg

Climate Predictions for Western North America-Temperature and Forests

- Among models temperature is expected to increase.
- Figure 4 [top-right]: Temperature increases relative to 1901-1950 average temperature in western North America (from Figure 11.11 in Solomon and others 2007). Bars on right show ranges for B1 blue, A1B orange, and A2 red.

Source: Luce et al. 2012: Climate Change, Forests, Fire, Water, and Fish, RMRS-GTR-290



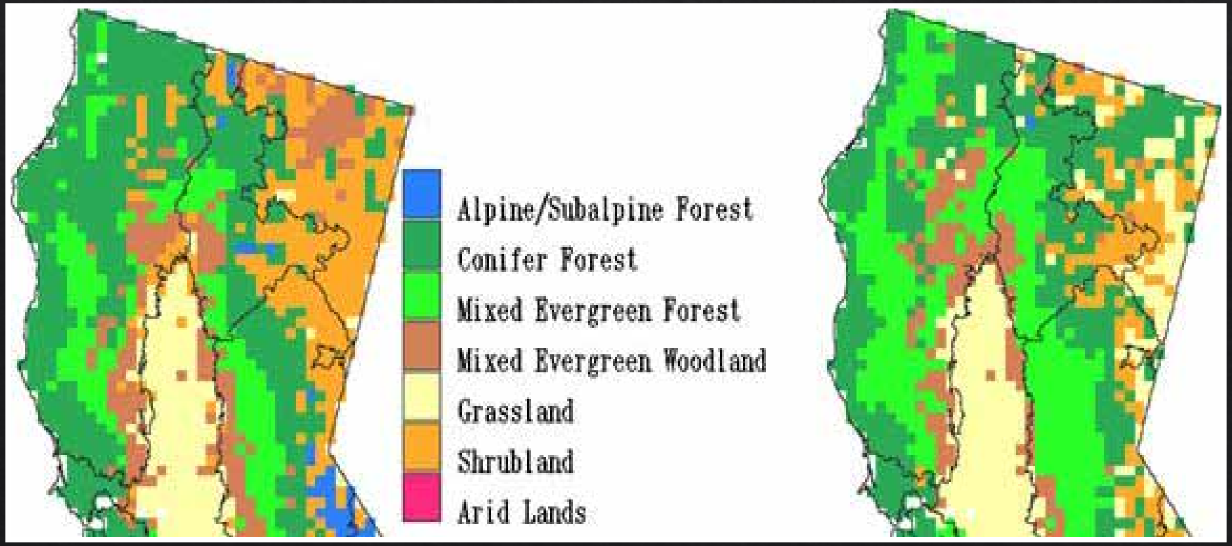
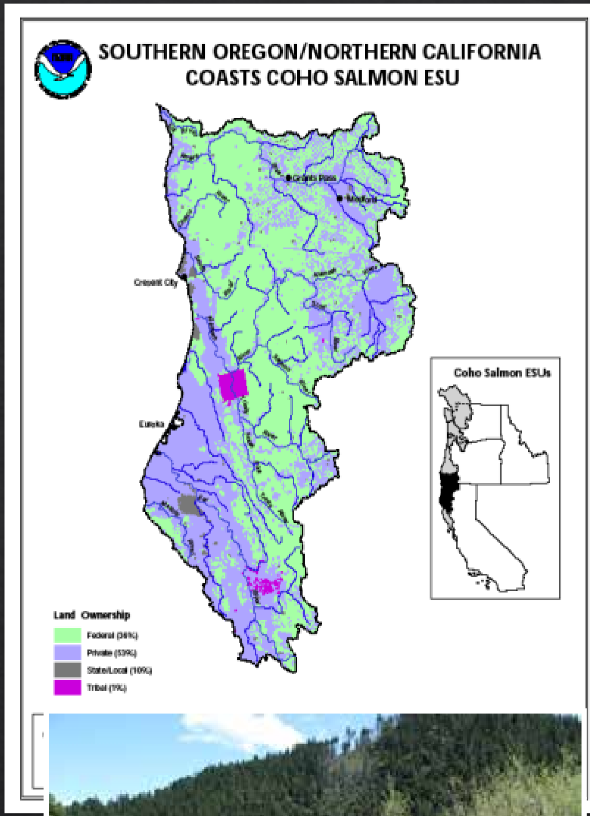


Figure [bottom-left]: Distribution of the vegetation classes simulated for the Historical (1961-1990) [left] and PCM1-A2 [right] future period (2070-2099). The vegetation class mapped at each grid cell is the most frequent class simulated during the time period. Source: Lenihan et al. 2008. Climate Change Journal

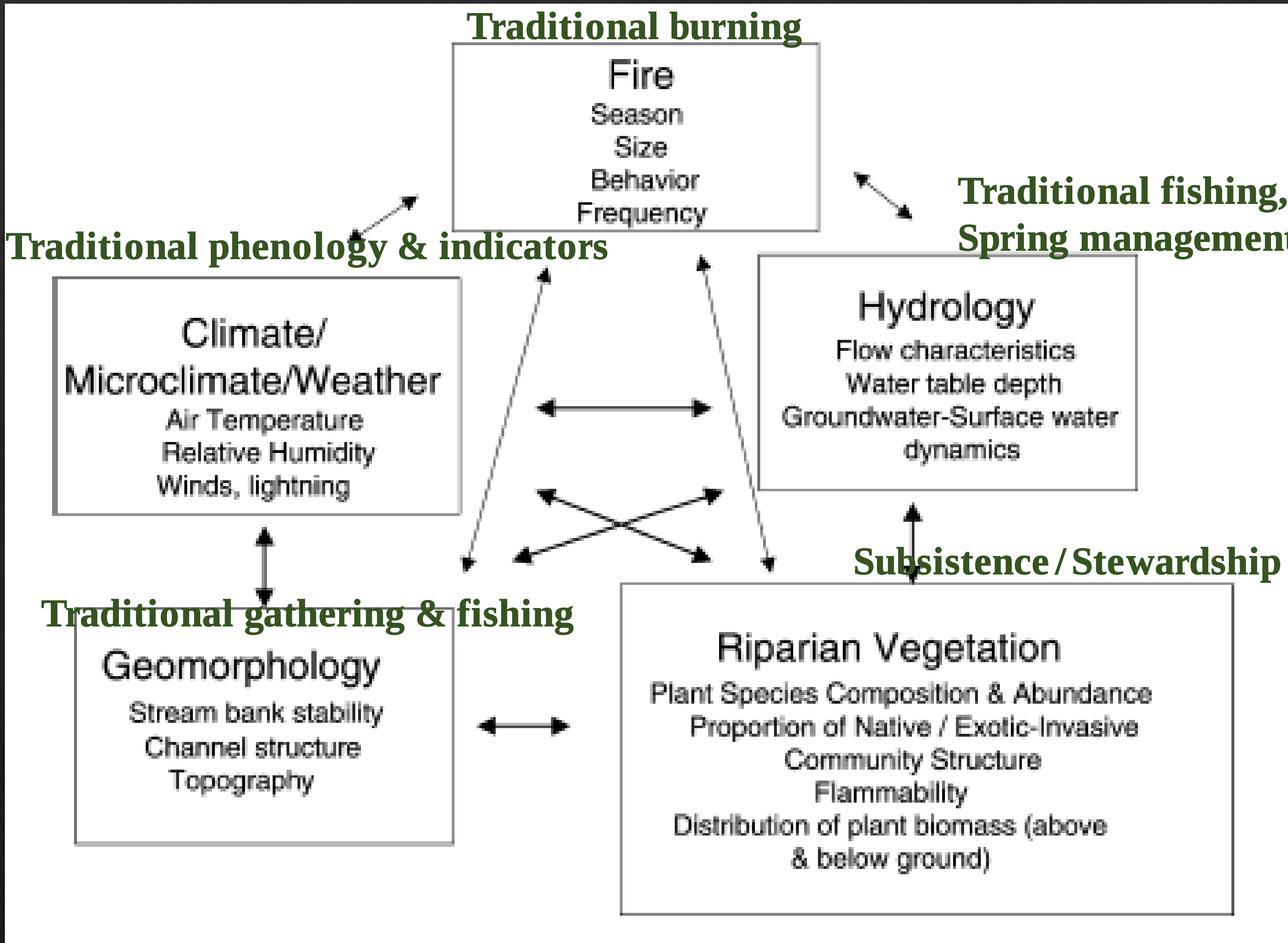
Managing fisheries: Climate and Fire

- Climate's influence on different life history stages for species of concern
  - Ocean and In-land environmental conditions
  - Ecological processes
  - Disturbance thresholds and species resilience
- Fire's influence on different life history stages of species
  - Existing factors "threatening" population viability
  - Spatial and temporal magnitude of disturbances synergistic with fire effects: Stream or population?
  - Projected magnitude of change, where and how much is too much?
  - What factors do managers have influence over or can respond to (mitigation?).



Suggested Reference: Kirkland, J., Flitcroft, R., Reeves, G. and Hessburg, P., 2017. Adaptation to wildfire: A fish story. Science Findings 198. Portland, OR: US Department of Agriculture, Forest Service, Pacific Northwest Research Station. 5 p., 198, pp.1-5.

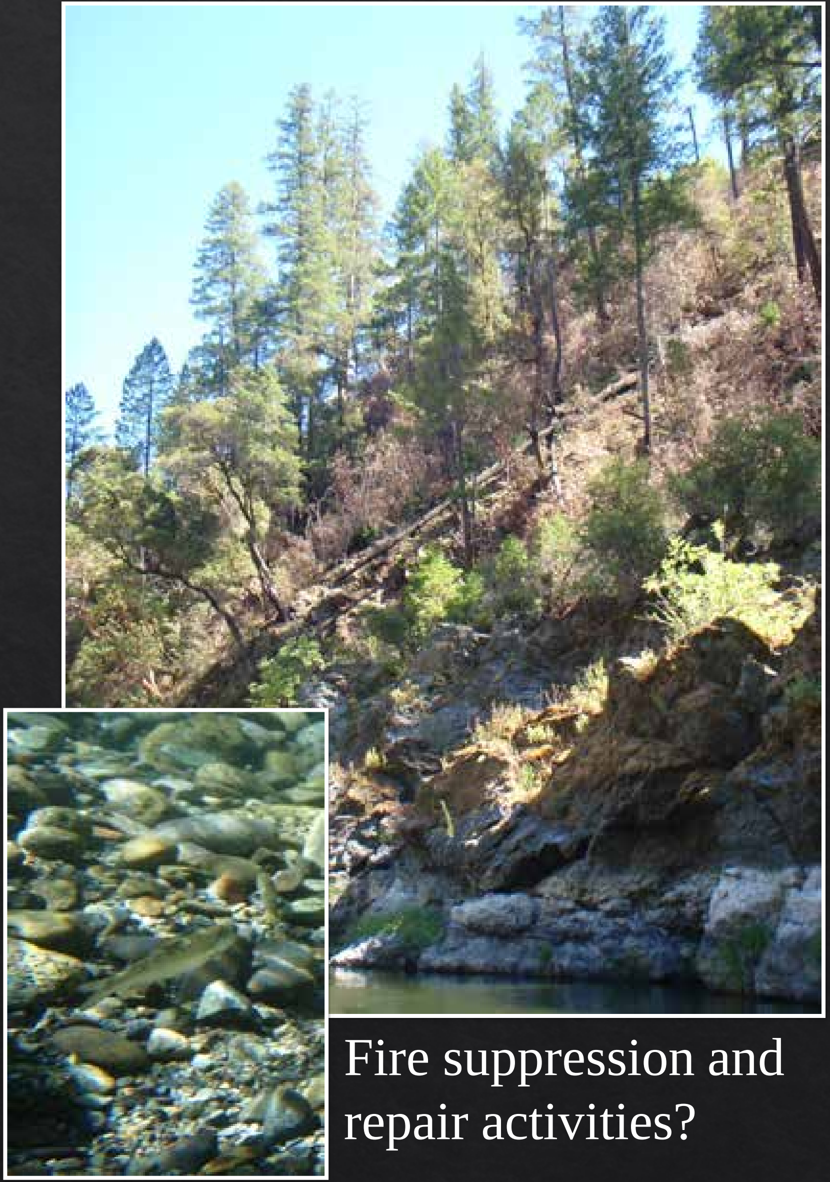
Synergistic Interactions: Climate-Forest-Fire-Hydrology-Fish



Dwire and Kauffman 2003. Fire and Riparian Ecosystems in Landscapes of the Western USA. Vol. 178. Forest Ecology and Management

Fisheries and Aquatic Conditions Influenced by Wildfire

- **Direct**
  - Heating/Vegetation removal
  - Smoke/Temperature
  - Nutrient, sediment, and woody material inputs
- **Indirect**
  - Erosion: Nutrients, sediment and woody material inputs
  - Hydrology: Increased or modified water yield
  - Population changes linked to fire severity and extent
  - Species and runs influenced differently due to life histories and disturbance adaptations



Fire suppression and repair activities?

Extent of High Severity: Slope Failure-Habitat Degradation or Replenishment?

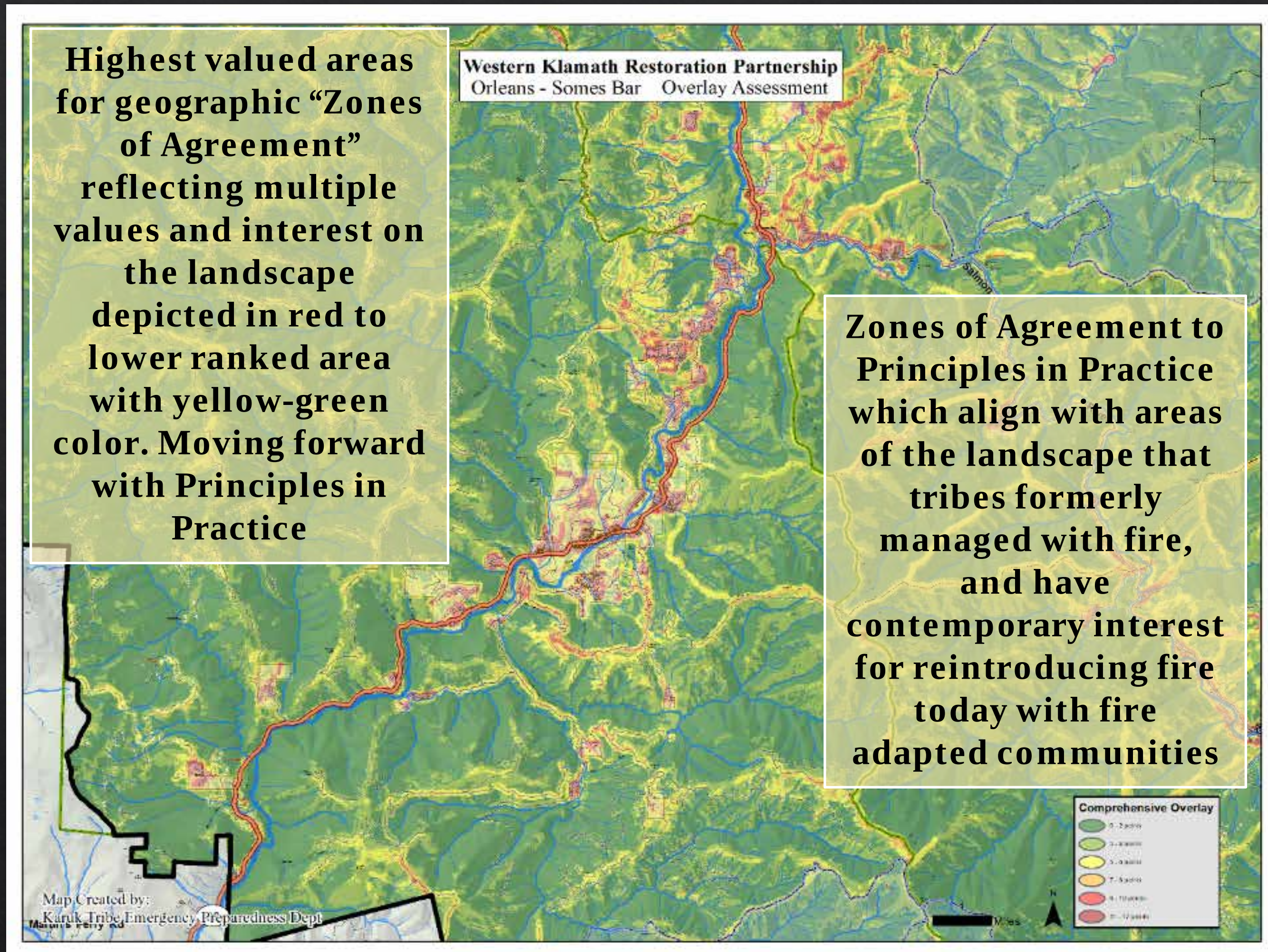
- Ecological debate over “acceptable” extent of high severity fires in watersheds
  - Proportion of watershed burned
- Disturbance pulse theory and applications for watershed processes considering current and projected increases wildfires
  - Temporal and Spatial scales of consideration
  - Landscape ecological fire debit = reduced inputs to riparian and aquatic systems?
- Hydrologic, Sediment and Woody Material delivery and connectivity.
- How can fisheries and watershed science inform pre- and post-fire recovery activities?

Riparian Restoration Approaches: Pre- and Post-Wildland Fire

- Effects of climate change on riparian systems will vary dramatically among river systems
  - Ecologists, climate modelers, and restoration practitioners need to anticipate consequences of climate change within the context of local ecosystems.
- Similar to restoring ecosystems in areas where people have disrupted natural fire regimes—a one-size-fits-all solution is impractical.
- Practitioners will need to draw upon local knowledge of ecosystems and guiding ecological principles to develop appropriate restoration strategies and prescriptions (Seavy et al. 2009:334)
- Challenges: Fire suppression felling of trees in riparian areas. "Bucked Chunks Fuel"

Seavy, N.E., Gardali, T., Golet, G.H., Griggs, F.T., Howell, C.A., Kelsey, R., Small, S.L., Viers, J.H. and Weigand, J.F., 2009. Why climate change makes riparian restoration more important than ever: recommendations for practice and research. Ecological Restoration, 27(3), pp.330-338.

Integrating landscape scale fuels, wildland fire, and fisheries restoration approaches



*Western Klamath Restoration Partnership collaborative fisheries restoration work with the MidKlamath Watershed Council, Karuk Tribe USFS, and others.

Aligning Communities Values with Landscape Restoration, Climate Change, and Wildland Fire Research and Management Strategies

- Landscape Restoration Strategies
  - Heterogeneity and Resilience considerations
  - SPLATs [Strategically Placed Landscape Area Treatments] Targeting *20-30% of the landscape planning area
- Climate Change Vulnerability Assessments and Adaptation Planning Efforts
  - Threats and Stressors to environment and community practices
  - Planning considerations for Ecosystem Services
- The National Cohesive Strategy for Wildland Fire Management Implementation
  - Resilient landscapes
  - Fire Adapted Communities
  - Wildland Fire Management Responses
- Linking to Tribal and Rural Community Values
  - Alignment of multiple resource objectives with community values for the reintroduction of fire
    - *Eco-cultural Restoration
  - Adaptive research & management-Metrics and Indicators

Key science papers:
Hessburg et al. 2015: Restoring Fire Prone…Seven Core Principles
Hessburg et al. 2016: Tamm Review: Mix Severity Fire Regime Forests…

Tribal Traditional Knowledge and Focal Species as Indicators

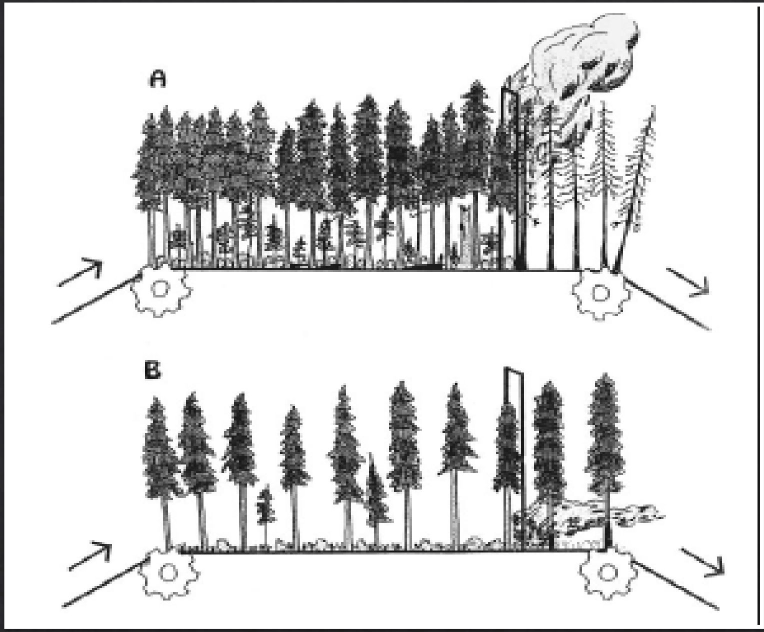
- Use of Focal species to represent different habitat requirements across the landscape
- Each species has components of a life history phase that links different habitat conditions and vulnerability to or benefits from wildland fire
- Western Klamath Restoration Partnership Indicators [Karuk]
  - Pacific Giant Salamander
  - Sandbar Willow
  - Roosevelt Elk
  - Pacific Fisher
  - Northern Spotted Owl

Fuels and Wildland Fire Management: Implications for Fisheries?

- Fuels Reduction Treatments
  - Reduction of surface and ladder fuels in the Wildland Urban Interface, Roads, and Ridges, or other high value resources.
  - Manual and Mechanical approaches: Extent and Scale
  - Considerations for portions of the critical fisheries watershed (strategic areas), riparian
- Wildland fire
  - Prescribed Fire
  - Managing wildfire to achieve resource objectives or Suppression

Fuels Treatments: Shaded fuelbreaks that benefit fish?

- Strategic placement in watershed to protect life, property and resources
- Removal or manipulation of fuel continuity, structure, and composition to influence fire behavior
- Increase resilience of forests by promoting drought tolerant/fire adapted species [Vaillant et al. 2016]
- How necessary or applicable to riparian zones?



Agee et al. 2000. The use of shaded fuelbreaks in landscape fire management. Forest Ecology and Management Vol. 127.

Haypress Fire Aug. 2017, Upper Rogers Creek-Trib. To Klamath River

Monitoring, Research, and Restoration Efforts: Agencies, Tribes, Community Organizations

- Road decommissioning [Post-Fire]
  - Geologically unstable watersheds
- Fish passage enhancement
  - Roads and irrigation diversions
- Stream flow management and conservation. Fish centric
- Entrapment prevention
  - Fish screens and flow management
- Riparian Improvements
  - Creek mouth modification, plantings, and thinning.
- Post-fire repair work
  - Soil stabilization and fuel treatments

Photos: USFS, MKWC, Yurok Tribe

Collaboration and Coordination Among Interested Parties

- Forming of coalitions and alliances between tribes, agencies, industry, and organizations.

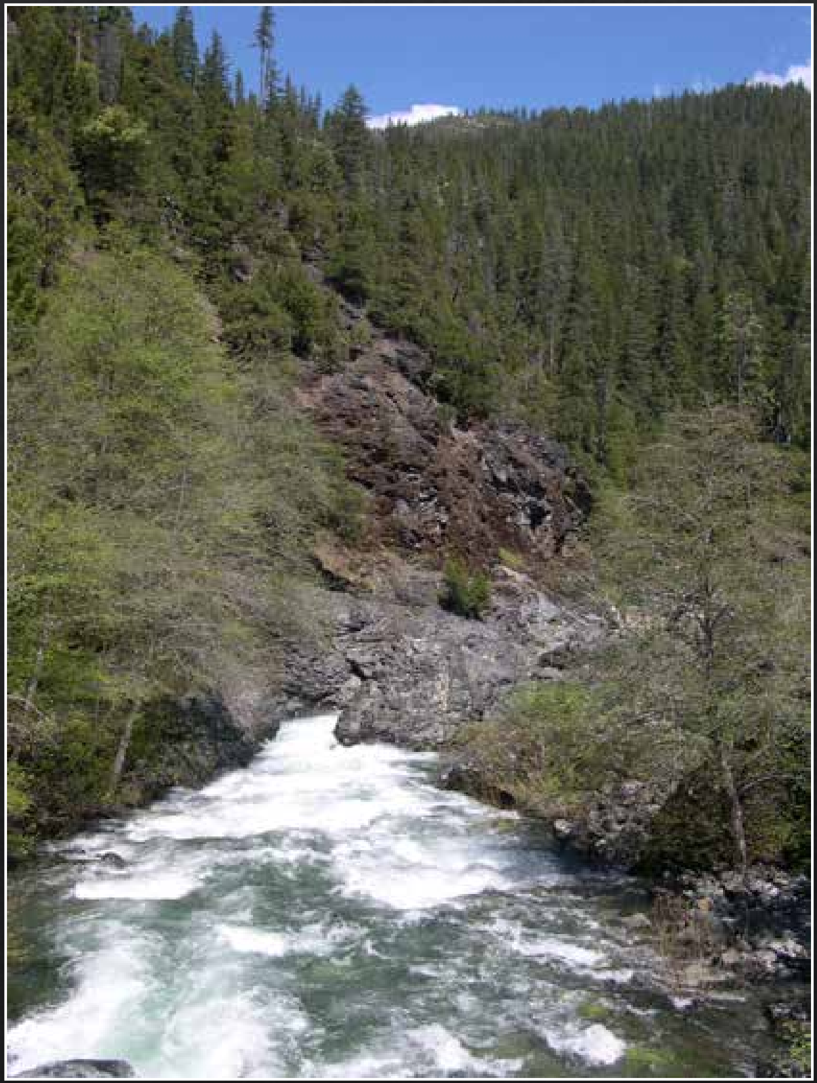
- Education and outreach in communities-
  - A shared message and efforts.

- Main Parties are Agencies (Federal, State), Tribes, Non-Profit Organizations, Industry/Private, Universities, and landowners.
- Tribes have been proactive leading efforts for Tribal trust and public resources

Photos: Mid Klamath Watershed Council

Fisheries Conservation and Restoration Efforts: Considering Wildland fire and Forest management

- Prioritized fisheries refugia: Considerations and Tradeoffs for species or runs?
- Watershed Condition Assessment:
  - Resiliency to Wildfires
- Upslope forestry/fuel treatments to be implemented?
- Riparian/In-stream restoration projects to be implemented?
- Wildfire rehabilitation/repair practices that improve water quality and fisheries habitat?



Questions?

Thanks to Salmonid Restoration Conference Organizers and Volunteers

DAM REMOVAL

NATIVE AMERICAN TRIBES IN NORTHWESTERN CALIFORNIA

Wendy Poppy George
Cultural Resources Specialist

ROOVERVIEW

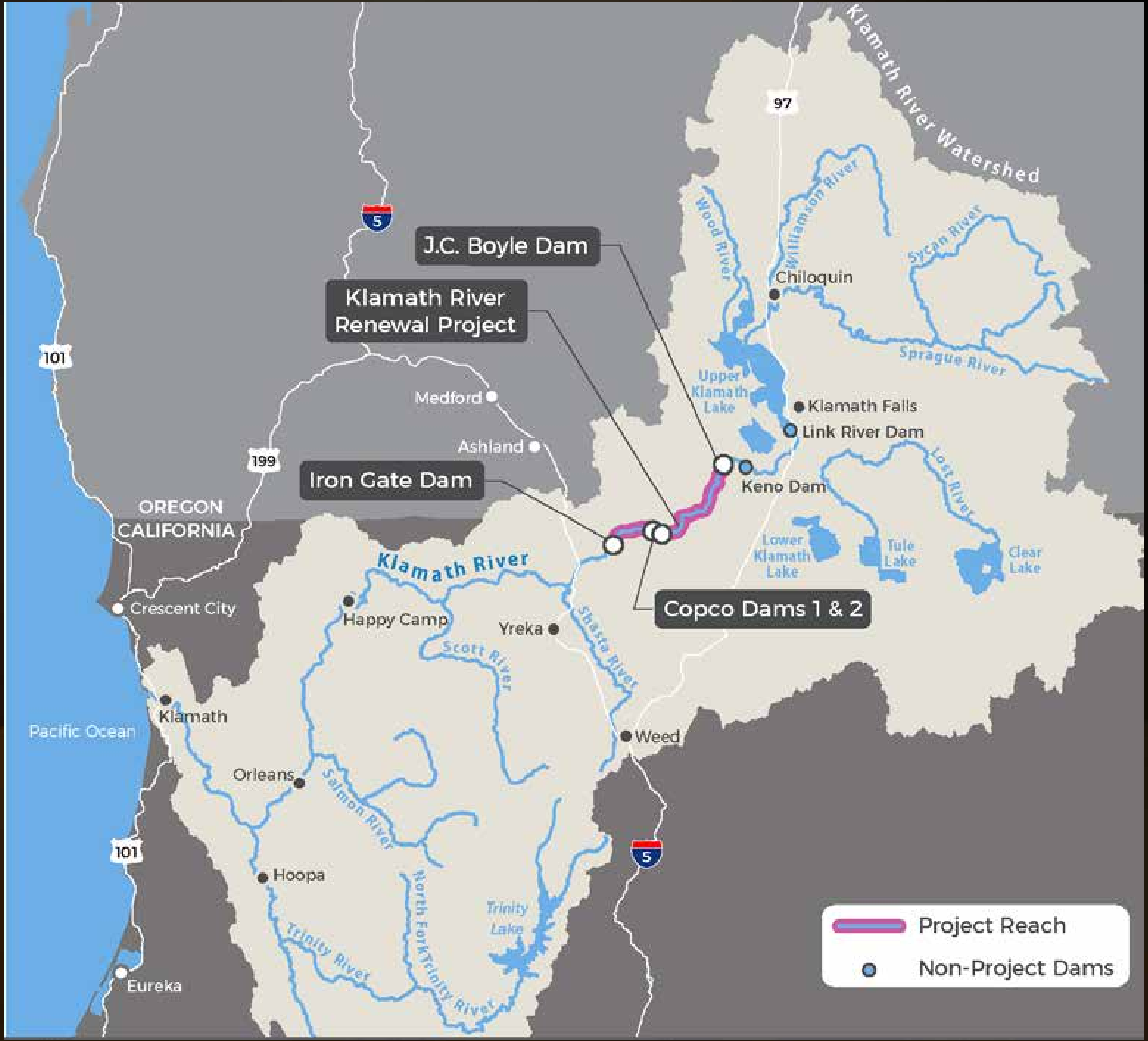
- INTRODUCTION
- PRE-CONTACT
- TRIBES IMPACTED BY DAMS
- SOCIAL STRUCTURES
- IMPORTANCE OF A HEALTHY ENVIRONMENT
- TRIBES JOIN TOGETHER AND TAKE A POSITION TO REMOVE DAMS
- TRIBES WORK TO REBUILD

- KARUK
- YUROK
- HUPA
- CHALULA
- WYOT
- BIG LAGOON RANCHERIA
- BLUE LAKE RANCHERIA
- TSUNUGWE
- CHAMERIKO

- TRINIDAD RANCHERIA
- KLAMATH MODOC YAHOOSKIN
- REDWOOD CREEK
- SHASTA
- RESIGINI
- ELK VALLEY
- BEAR RIVER

THE KLAMATH BASIN

HOW MANY NATIVE AMERICAN LIVES DOES IT TOUCH?



NATIVE AMERICANS WORK TOWARDS THE LARGEST DAM REMOVAL PROJECT IN THE WORLD

- Block access to over 350 miles of historic spawning habitat
- Degrade water quality
- Host algae blooms
- Create opportunities for fish disease causing parasites to flourish
- Dams cause decline in salmon & other species

LAND AND WATER MANAGEMENT

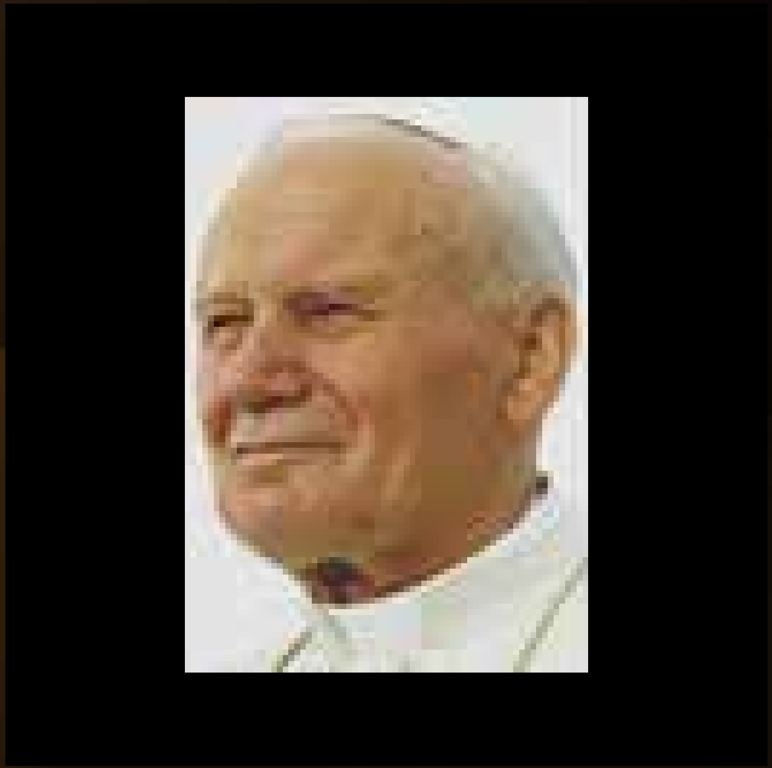
SOCIAL CONSTRUCTION

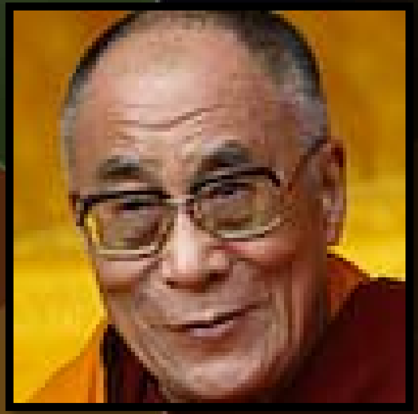
CULTURE

Culture *is defined as an integrated system of beliefs, traditions, and customs that govern or influence a person's behavior. Culture is learned, shared by members of a group, and based on the ability to think in terms of symbols.*

RELIGION

A specific set of beliefs about one's relation to the supernatural; a society's mechanism for relating supernatural phenomena to the everyday world.





SOCIETY

SOCIETIES ARE POPULATIONS OF PEOPLE LIVING IN ORGANIZED GROUPS WITH SOCIAL INSTITUTIONS AND EXPECTATIONS OF BEHAVIOR.

NATIVE AMARICANS

SYMBOLIC LIVING

Repetitious lifestyle - Living in Balance

WINTER

SUMMER

FALL

SPRING

SUBSISTENCE GATHERING

WINTER

ELDER BERRIES

PINE NUTS

MUSSELS

ACORNS

MANZANITA BERRIES

ELK

DEER

WILD GRAPE

FALL SALMON

FALL

MAIDENHAIR FERN

HUCKLEBERRIES

BEAR GRASS

CEDAR BERRIES

JUNIPER BERRIES

FIR BOW

ALDER/ALDER BERRIES

WOODWARDIA FERN

SUMMER

MEDICINAL PLANTS OF ALL KINDS

NATIVE TEA AND HERBS

MAPLE BARK

SEAWEED

STURGEON

WILLOW STICKS

HAZEL STICKS

ABALONE

SPRING

SPRING SALMON

EEL

WILLOW ROOTS

SPRUCE/DIFFENT SEASONAL GATHERING

QUILLS

BIRDS HARVESTED FOR CEREMONIAL PURPOSES

WOODPECKER

CALIFORNIA NATIVE AMERICANS STRIVE TO PRESERVE THEIR TRADITIONAL WAYS

TIME AWAY FROM HOME
PROTESTS BEGIN & EDUCATING THE PUBLIC BECOMES OUR NEW CULTURE

REBUILDING WHAT WE'VE LOST

RESTORING OUR SACRED LAND

“Every generation of Tribal People on the Klamath River, since European contact, has experienced dramatic declines in our fisheries over the course of their lifetime. What removing dams on the Klamath River means to Tribal People is that, WE will be breaking that cycle of passing down our most treasured resource (Salmon) to future generations in worse shape than we received it. I am confident that we will be the first generation since contact to change that reality.”

Leaf Hillman

Karuk Tribe Spiritual Leader

REFERENCES

PHOTOGRAPHS COURTESY OF LEAF HILLMAN, WENDY POPPY GEORGE, CRAIG TUCKER, KLAMATH RIVER RENEWAL CORPORATION (KRRC), DWAYNE & PATRICIAL FERRIS

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