Use of Domesticated Out-of-Basin Hatchery Stocks to Reintroduce Extirpated Coho Salmon to the Interior Columbia Basin

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Extirpation and Tribal Reintroduction of Coho Salmon to the Interior Columbia River Basin

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ABSTRACT: *Harvest of anadromous salmonids in the Columbia River basin has been fundamental to the nutrition, economy, and cultural and religious beliefs of the regional Native American tribes. Agricultural development, dam construction, urbanization, and overharvest following colonization by European-origin settlers, however, resulted in dramatic reductions in salmon runs and negative impacts to the well-being of tribal peoples. Federal and state fishery agencies attempted to mitigate for the loss and to rebuild some salmonid populations but deemed Coho Salmon of lesser importance for upriver fisheries and allowed them to go functionally extinct. In the mid-1990s, fishery agencies of the Columbia River Treaty tribes spearheaded efforts to reestablish the extirpated Coho Salmon, beginning in the Yakima, Wenatchee, Methow, and Clearwater rivers. The programs were initiated with juveniles from composite lower Columbia River hatchery stocks, acclimated or direct released near potential spawning habitat, then were transitioned to producing juveniles with broodstock collected in-basin. Increasing numbers of fish are now returning to these rivers, a portion of which is the product of natural spawning. Results suggest that the Coho Salmon are adapting to their new environments and founding local naturalized populations.*

Extirpación y reintroducción de salmón plateado por tribus autóctonas en la cuenca del Río Columbia

RESUMEN: *la captura de salmónidos anádromos en la cuenca del Río Columbia ha sido fundamental para la nutrición, economía, cultura y creencias religiosas de las tribus nativas de Norte América. El desarrollo de la agricultura, la construcción de presas, urbanización y sobre pesca que siguieron a la llegada de los colonizadores europeos, dieron como resultado reducciones dramáticas de las corridas de salmón y causaron un impacto negativo en el bienestar de la gente tribal. Las agencias pesqueras federales y estatales trataron de mitigar estas pérdidas y de reconstruir algunas poblaciones de salmónidos, sin embargo clasificaron al salmón plateado como de menor importancia para las pesquerías, permitiendo así que llegara a la extinción funcional. A mediados de la década de 1990, tanto las agencias pesqueras como las tribus oriundas del Río Columbia encabezaron esfuerzos para restablecer el extirpado salmón plateado, comenzando con los ríos Yakima, Wenatchee, Methow y Clearwater. Los programas se iniciaron utilizando individuos juveniles de los stocks cultivados en la parte baja del Río Columbia, mismos que se aclimataban o se liberaban directamente cerca de hábitats potenciales para el desove. Posteriormente, en una etapa transitoria, se produjeron juveniles a partir de reproductores recolectados en las cuencas. En la actualidad, cada vez más peces están regresando a estos ríos, una parte de los cuales es el producto de desoves naturales. Los resultados sugieren que el salmón plateado se está adaptando a sus nuevos ambientes y está creando poblaciones locales naturales.*

Native American Indian tribes long occupied the interior Columbia Basin, and harvest of the abundant salmon was fun-

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Acknowledgements

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- Yakama Nation (Yakima River)
- Yakama Nation – Mid-Columbia (Wenatchee and Methow rivers)
- CRITFC

Pacific Coastal Salmon Recovery Fund

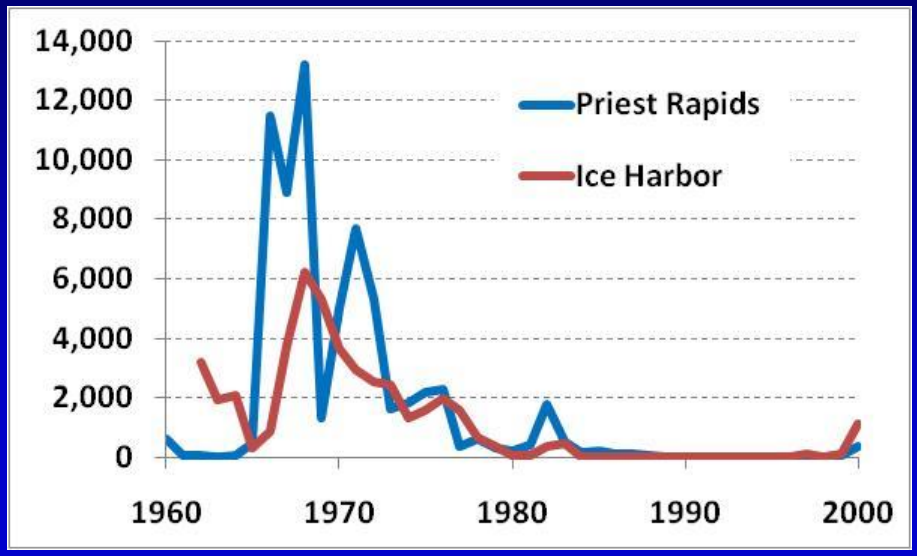
- Nez Perce Tribe (Clearwater River)

Extirpation of Interior Columbia Coho

- Columbia River coho salmon runs dramatically diminished above The Dalles Dam by mid-1900s:
  - over-harvest
  - impassable dams
  - unscreened irrigation diversions
  - freshwater habitat loss and degradation
- 1960s-1970s federal harvest mitigation programs in Mid-Columbia, and eyed-egg outplants by ID (Clearwater R) and OR (Grande Ronde R)
- Eggs and smolts from lower Columbia River (LCR) composite stocks produced in Mitchell Act hatcheries

Extirpation of Interior Columbia Coho

- Programs yielded increase in mainstem dams counts (although Very low escapement for natural spawning)



- 1970s hatchery programs terminated, to switch resources to programs for spring Chinook and to discourage a mainstem tribal coho fishery for fear of impact on steelhead (Chinook and steelhead being preferred sport fish)

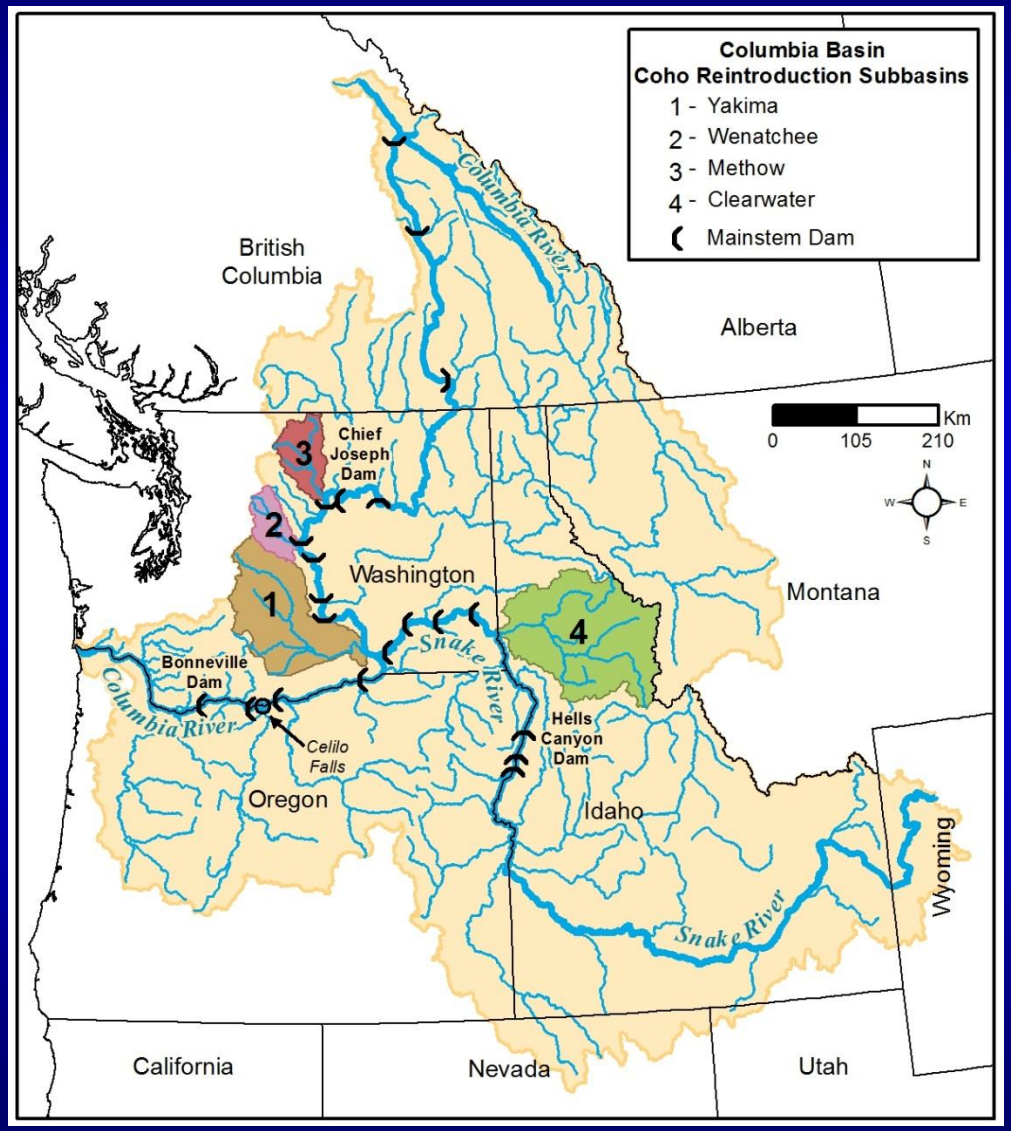
- Interior Columbia coho recognized as functionally extinct by 1980s

Extirpation of Interior Columbia Coho

- legal decisions leading to *US vs. Oregon* (1977):
  - recognition of tribal treaty fishing rights, and
  - status of tribes as co-managers
  - creation of tribal fishery agencies and CRITFC
  - creation of inter-agency forum for negotiation of hatchery production and in-river harvest levels
- 1987 Columbia River Fish Management Plan - tribes obtained annual releases of Mitchell Act hatchery coho smolts in Umatilla R and Yakima R
- However, programs were strictly for harvest mitigation (releases in lower mainstem locations)

Tribal Coho Reintroduction Programs

- Mid-1990s, tribes initiated reintroduction programs designed to reestablish natural coho populations
- Yakama Nation (YN)
  - Yakima R
  - Mid-Columbia
    - Wenatchee R
    - Methow R
- Nez Perce Tribe (NPT)
  - Clearwater R



Tribal Coho Reintroduction Programs

- However, the programs faced:
  - ongoing alterations to in-basin habitat and the Columbia hydrosystem
  - coho available to initiate programs were out-of-basin LCR hatchery stocks
  - stocks from segregated harvest augmentation programs for 15+ generations
- In light of concerns regarding loss of fitness due to hatchery rearing, was it reasonable to believe these domesticated stocks retained the genotypic and phenotypic capacity to reestablish naturally productive populations?

Approach to Reintroduction

- Methodologies generally similar across tribal programs
- Initial years involved transport and releases of LCR smolts produced in Mitchell Act-funded hatcheries
- As adults returned in-basin, they were captured for use as broodstock in increasing proportions to create a localized stock
- Within 5-10 years 100% of broodstock collected in-basin; releases of juveniles from LCR hatcheries eliminated

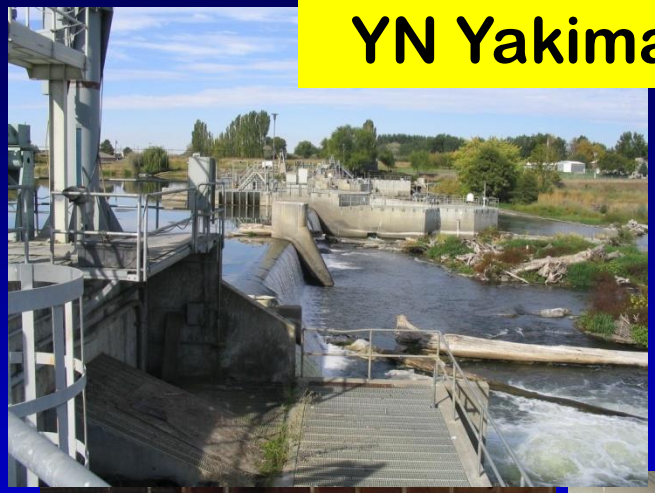
Approach to Reintroduction

- Smolt release locations have generally been from acclimation ponds or hatcheries located on river mainstem
- With returns sufficient for broodstock needs, some testing of alternative release strategies to increase distribution through the subbasin
  - mobile acclimation units
  - adult out-planting
  - direct releases (smolts or parr)

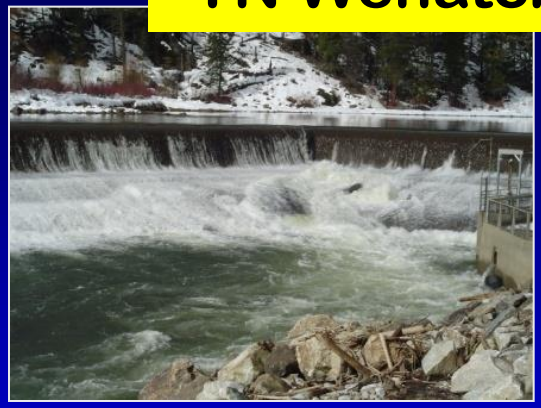
Approach to Reintroduction

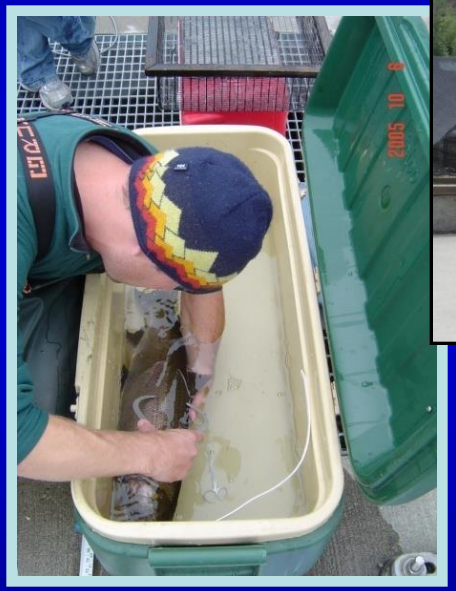
- Monitoring efforts variable among programs, dependent largely on magnitude of financial support
- Monitoring (when feasible):
  - escapement – total (in-basin dam, or mainstem dam counts), and hatchery-origin versus natural origin proportions (scale analysis)
  - natural spawning distribution and redd counts
  - smolt out-migration survival, and smolt-to-adult (SAR) survival
  - evaluation of predation on ESA listed Chinook juveniles, and other effects on non-target taxa of concern (NTTOC)

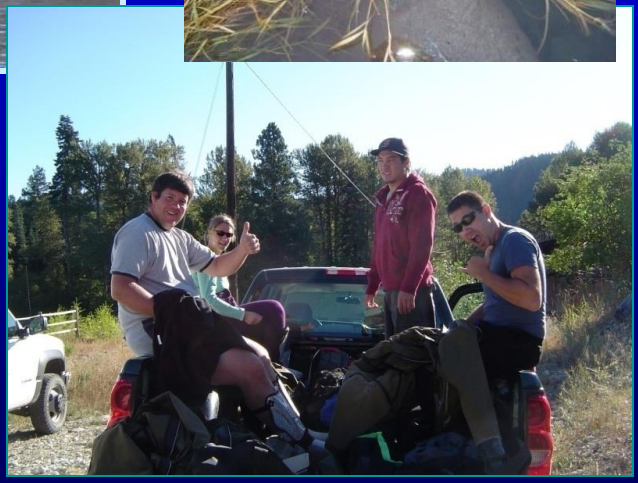
YN Yakima River coho reintroduction



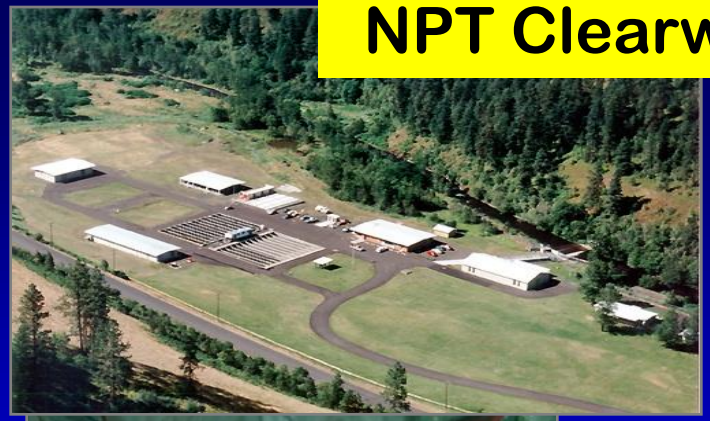
YN Wenatchee & Methow River coho reintroduction

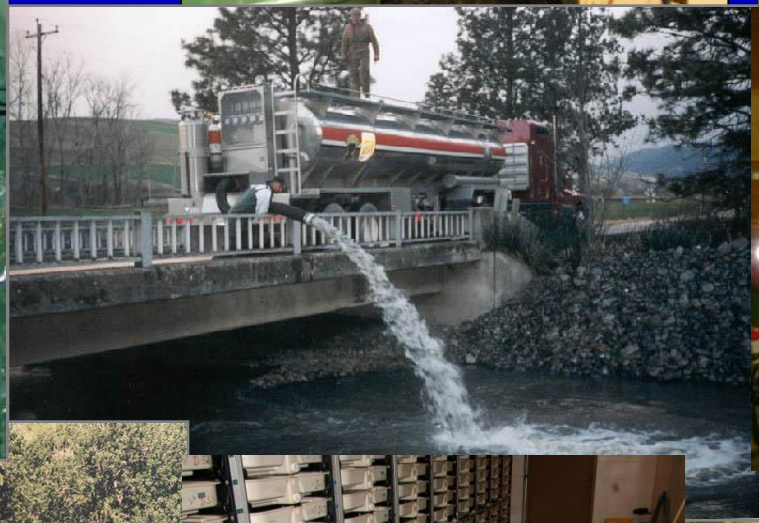


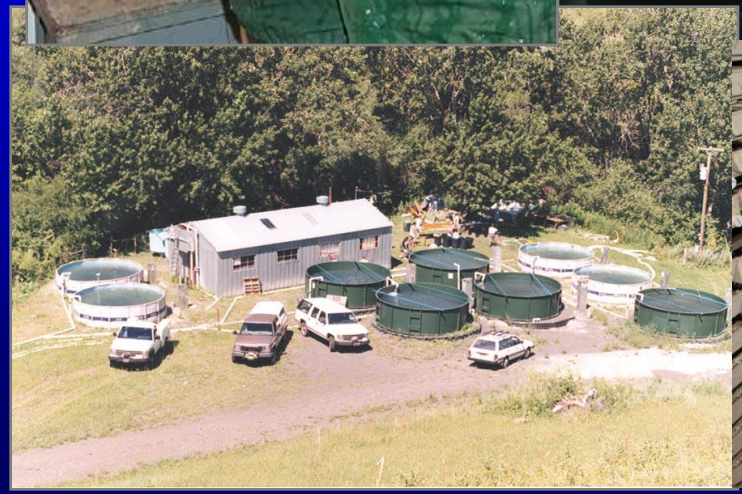




NPT Clearwater River coho reintroduction



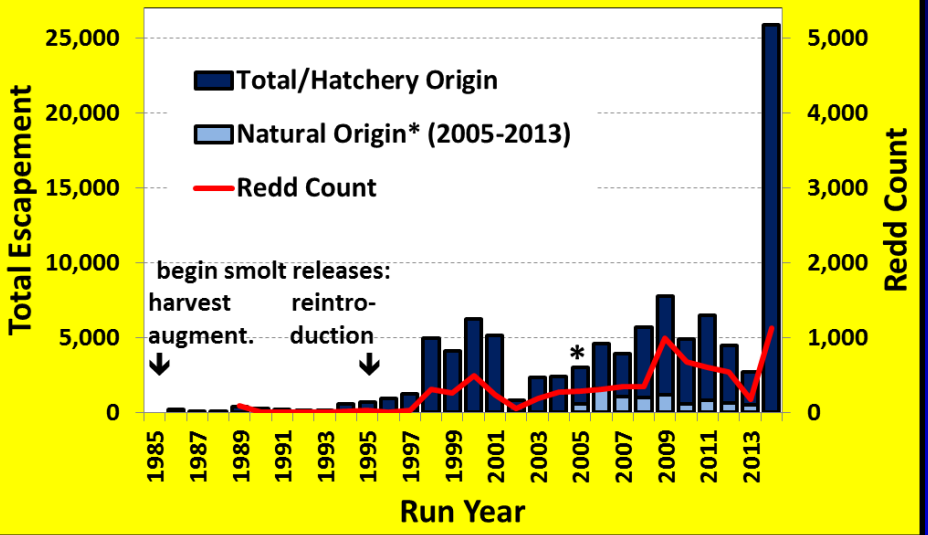




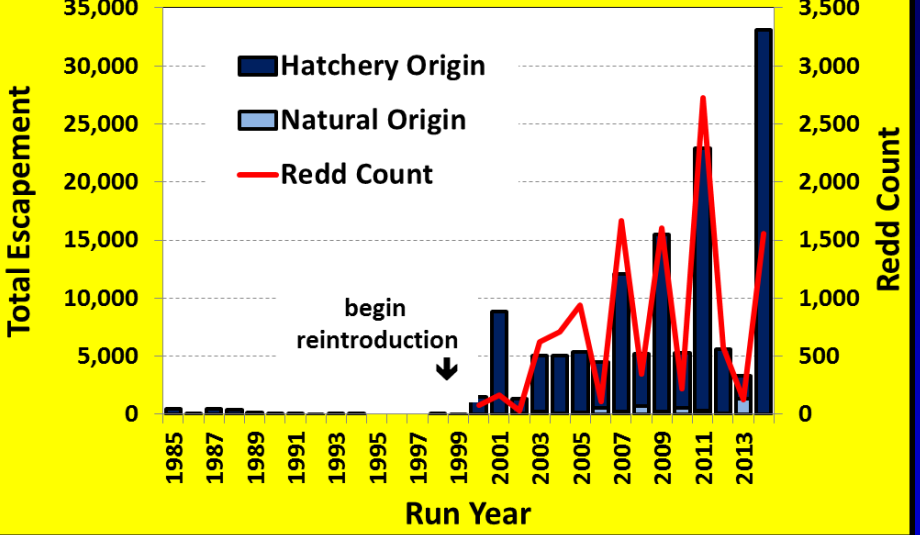
Monitoring Results

- Dramatic increase in escapement across programs
- Returns are contributing to ocean and to tribal Zone 6 Columbia mainstem harvest
- Recently, returns sufficient for limited in-basin tribal harvest - the first in-basin fisheries for coho in 50+ years
- Dramatic increase redd counts
- Escapement now includes natural origin fish (in increasing proportions)
- Smolt survival
  - local stock ≥ LCR
  - natural origin ≥ hatchery origin (local + LCR)

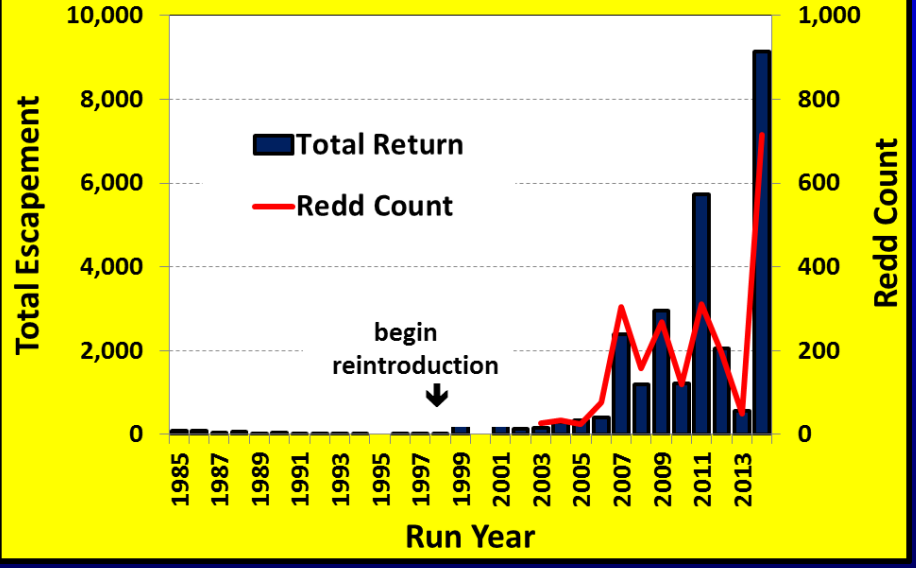
Yakima River Coho



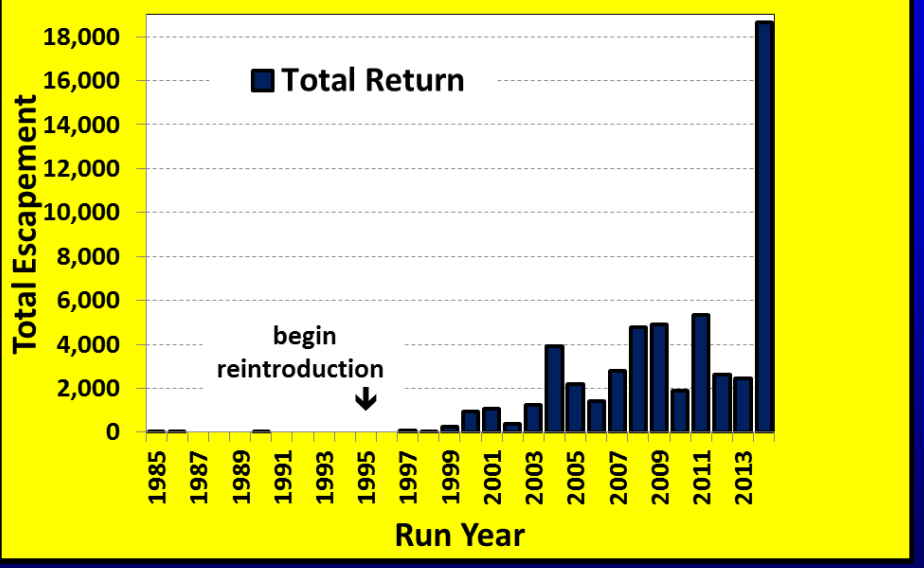
Wenatchee River Coho



Methow River Coho



Clearwater River Coho



Future Plans

- Increase local adaptation of stocks by incorporation of increasing number of natural-origin adults into hatchery broodstocks
- Transition away from just mainstem acclimation releases to additional upper tributary releases – to expand range through subbasin
- Increase monitoring for improved survival and SAR estimates, as funding permits
- Consider reintroduction programs for other subbasins

Summary

- While fish-per-redd levels are still high and % natural-origin values are still at low levels, results nonetheless demonstrate that within 3+ generations, the reintroduced coho salmon are indeed creating new local natural populations.

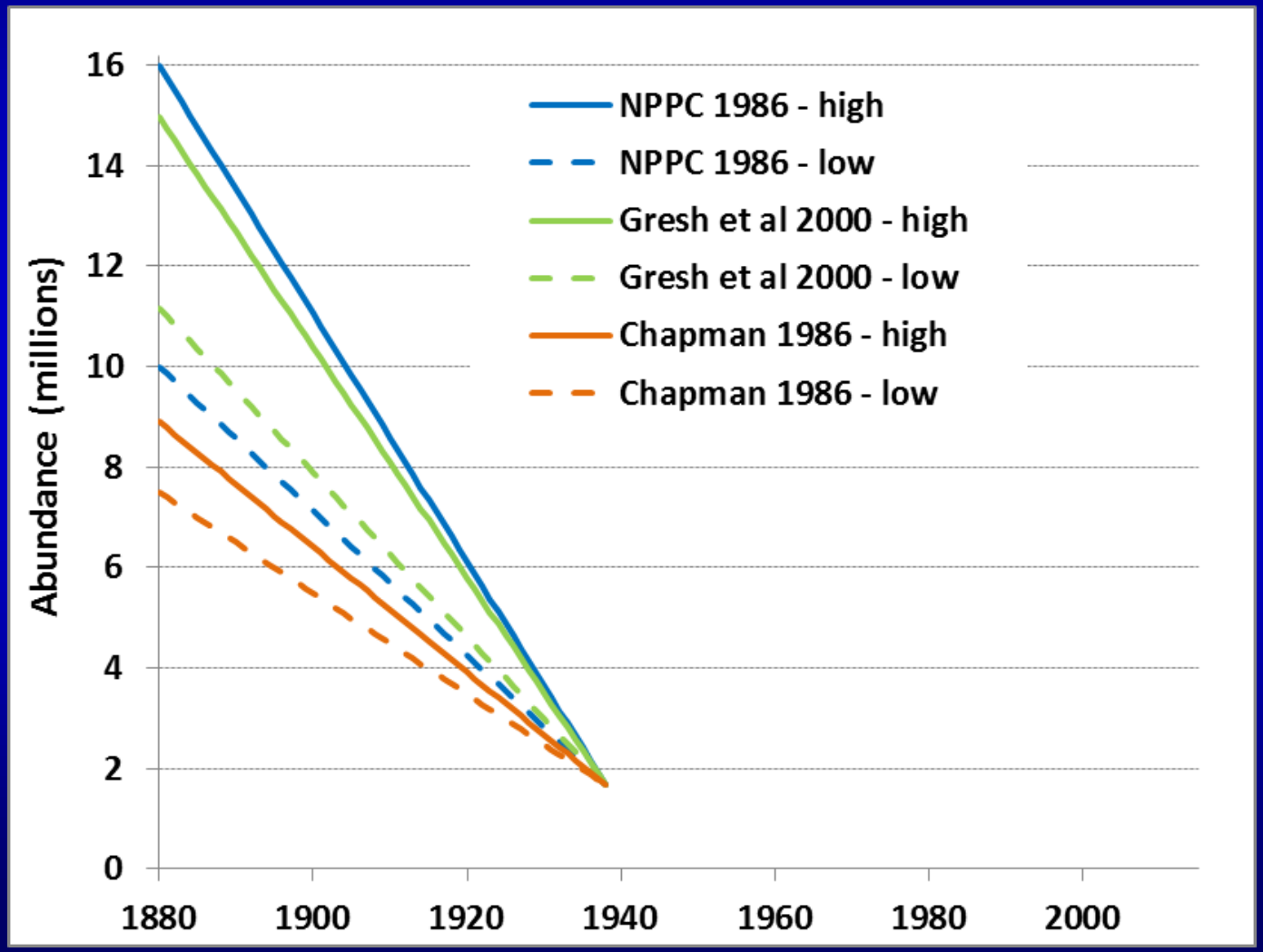
- Despite extensive "domestication" resulting from many (15+) generations of segregated hatchery rearing, the LCR stocks apparently retained sufficient phenotypic and genotypic characters/diversity, such that hatchery broodstock management and natural selective forces can work to rebuild natural fitness.

Putting the Red Back in Redfish Lake, 20 Years of Progress Toward Saving the Pacific Northwest's Most Endangered Salmon Population

Paul A. Kline & Thomas A. Flagg
Fisheries 39(11), 2014

"Many authors have suggested that reversal of hatchery-based reductions in fitness would take at best many generations to resolve (Lynch and O'Healy 2001; Ford 2002). Similar to findings developed by Galbreath et al. (2014) for Coho Salmon (O. kisutch), our data suggest that fitness recovery could be much more immediate."

With that in mind, recall: Historic Columbia River Salmon and Steelhead Abundance



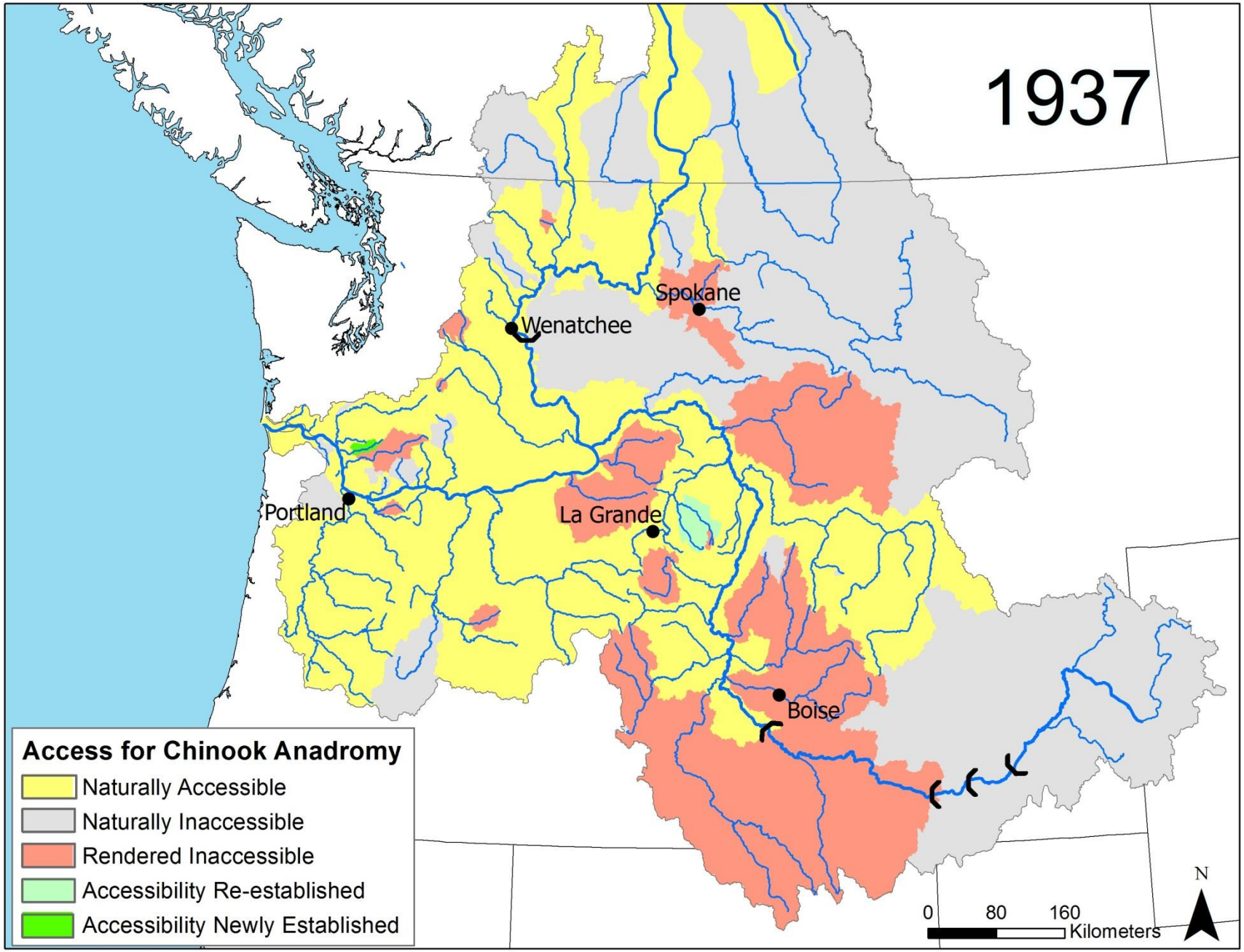
Historic Columbia River Salmon and Steelhead Abundance

Northwest Power Planning Council (NPPC). 1986. Compilation of information on salmon and steelhead losses in the Columbia River basin. Portland, OR.

Gresh, T., J. Lichatowich and P. Schoonmaker. 2000. An estimation of historic and current levels of salmon production in the Pacific Northeast Pacific ecosystem. Fisheries 25(1):15-21.

Chapman, D. W. 1986. Salmon and steelhead abundance in the Columbia River in the nineteenth century. Transactions of the American Fisheries Society 115:662-670.

WDFW and ODFW. 2002. Status Report - Columbia River Fish Runs and Fisheries, 1938-2000, July 2002 (Table 1, p.97-98).


1937
Spokane
Wenatchee
Portland
La Grande
Boise
Access for Chinook Anadromy
Naturally Accessible
Naturally Inaccessible
Rendered Inaccessible
Accessibility Re-established
Accessibility Newly Established
0
80
160
Kilometers
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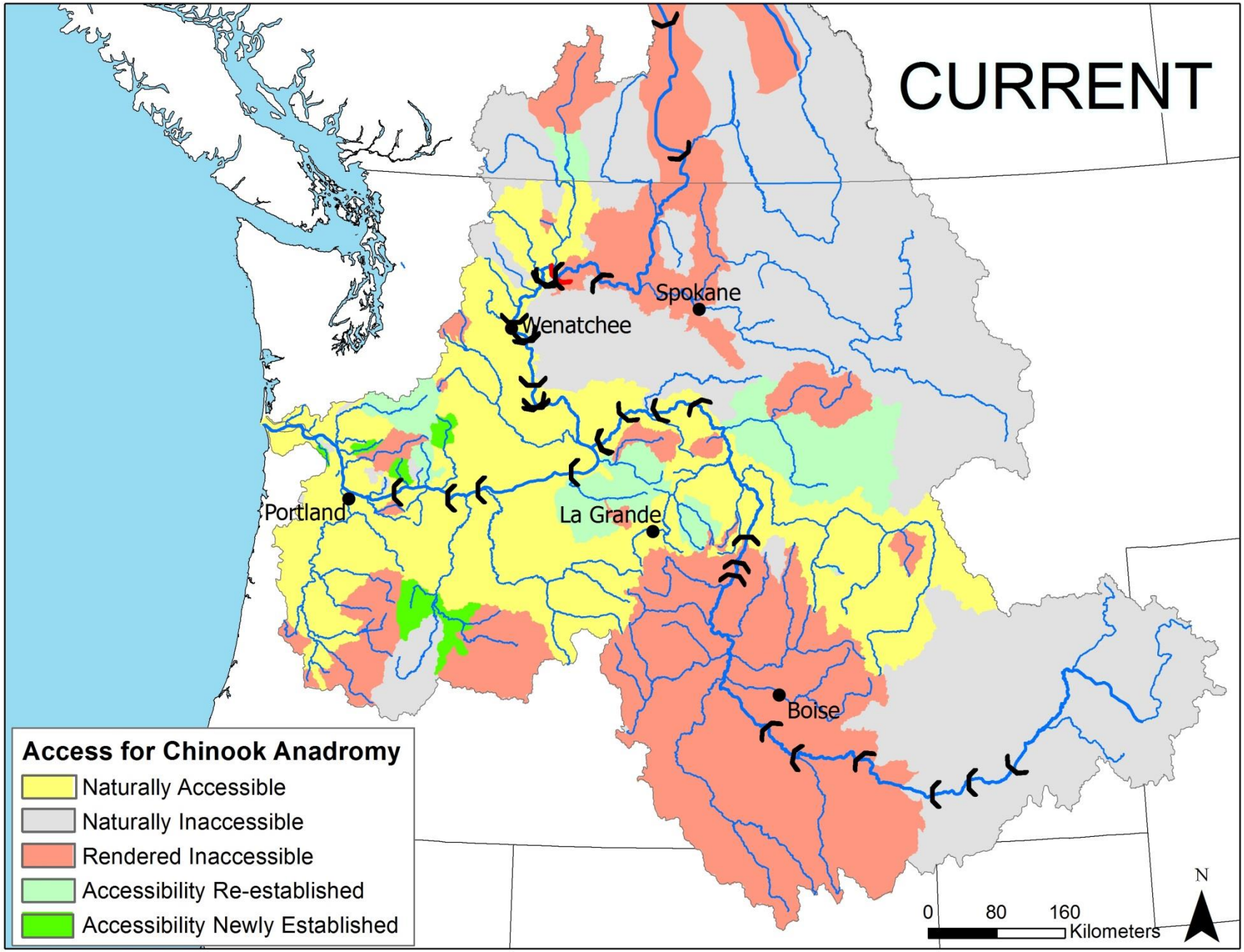
Returns to the Columbia River

- 1880s to 1937 – dramatic decrease in returns:
  - overharvest by commercial fishing industry
  - habitat degradation – mining , timber harvest, irrigation, agriculture development
  - tributary dams and upper Snake dams (Swan Falls 1901)
- Several lower basin hatcheries, however:
  - many involved releases of eyed eggs or unfed fry
  - difficulties for juvenile rearing due to low quality feeds (based on ground meat & fish offal) and disease problems
  - low SARs
- despite hatchery releases, returns to Columbia River as of 1937 still dominated by natural origin fish
- run declines largely unrelated to hatchery effects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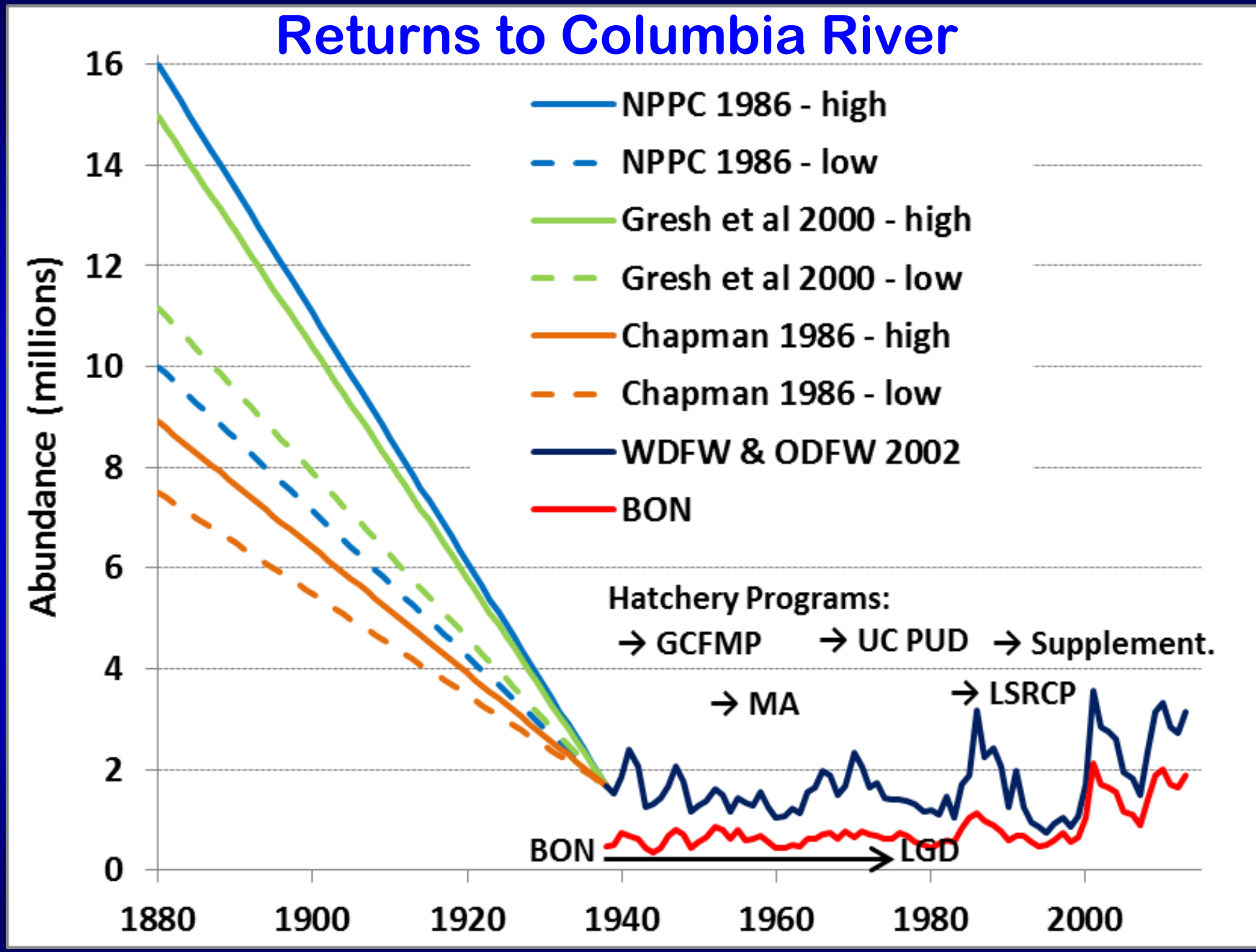
Returns to Columbia River



Returns to the Columbia River

- beginning 1938 – hydrosystem development
  - impassable dams – Grand Coulee/Chief Joseph complex (1938), and Hells Canyon comnplex (1958-1967)
  - passable mainstem dams – BON (1938) to LGD (1975) – but changed system from free-flowing to series of reservoirs
- Mitigation hatchery programs:
  - Grand Coulee Fish Management Project - 1940 - Leavenworth , Entiat & Winthrop NFHs
  - Mitchell Act - initiated in 1949 with Klickitat Hatchery; currently 25 hatcheries constructed and/or operated with MA funds; some facilities in BON pool, but all others (with exception of Ringold facilities) are below BON – despite mandate to mitigate for lost production in the basin above the mainstem dams

Returns to the Columbia River

(early 1960s – development of Oregon Moist Pellet – greatly improved smolt production and increased SARs)

- mitigation hatchery programs (cont.):
  - mid-Columbia PUD facilities – initiated in 1960s with Priest Rapids and Wells hatcheries
  - Lower Snake River Compensation Plan – initiated 1979 with McCall Hatchery; first of 11 hatcheries
- Mitigation hatchery programs - harvest augmentation objective; segregated broodstock management; smolts released from mainstem locations, without intention of adult escapement to spawning grounds

Returns to the Columbia River

- Supplementation – alternative management objective – increase returns for harvest and increase returns to spawning grounds to rebuild natural production; integrated broodstock management , smolts released upstream in proximity to spawning areas
- Supplementation programs beginning in 1980s
- Currently, returns to the Columbia River are dominated by hatchery origin fish from harvest augmentation (mitigation) programs, with limited numbers returning to spawning grounds; supplementation fish returning to the spawning grounds represent only a minority of total return

Conclusions

1) Eventual natural self-sustainability of reintroduced populations – and of extant depressed populations undergoing supplementation – continues to be primarily constrained, not by negative hatchery effects, but by the problems that originally caused the populations to decline:

- habitat loss and degradation (freshwater, estuary)
- hydrosystem mortality

(harvest now generally "well" managed)

These are the problems that most urgently need to be addressed, and the extent to which we do <u>not</u> address them will dictate what we must accept for natural population abundance.

Conclusions

2) Negative fitness effects on natural population fitness associated with interbreeding of hatchery origin fish are susceptible to reversal through judicious ("reformed") hatchery management and natural selective processes (as witnessed by results of the coho, and other reintroduction programs) - this should diminish apprehension re. supplementation hatchery programs.

3) Recommendations for when/how to use hatchery production requires consideration not just of the biological issues, but also of the legal mandates and social expectations for mitigation, and the willingness to invest, or not, in restoration actions.