Species Life Cycle Analysis Modules (SLAM): Investigating Limiting Factors of Lower Columbia River Chinook

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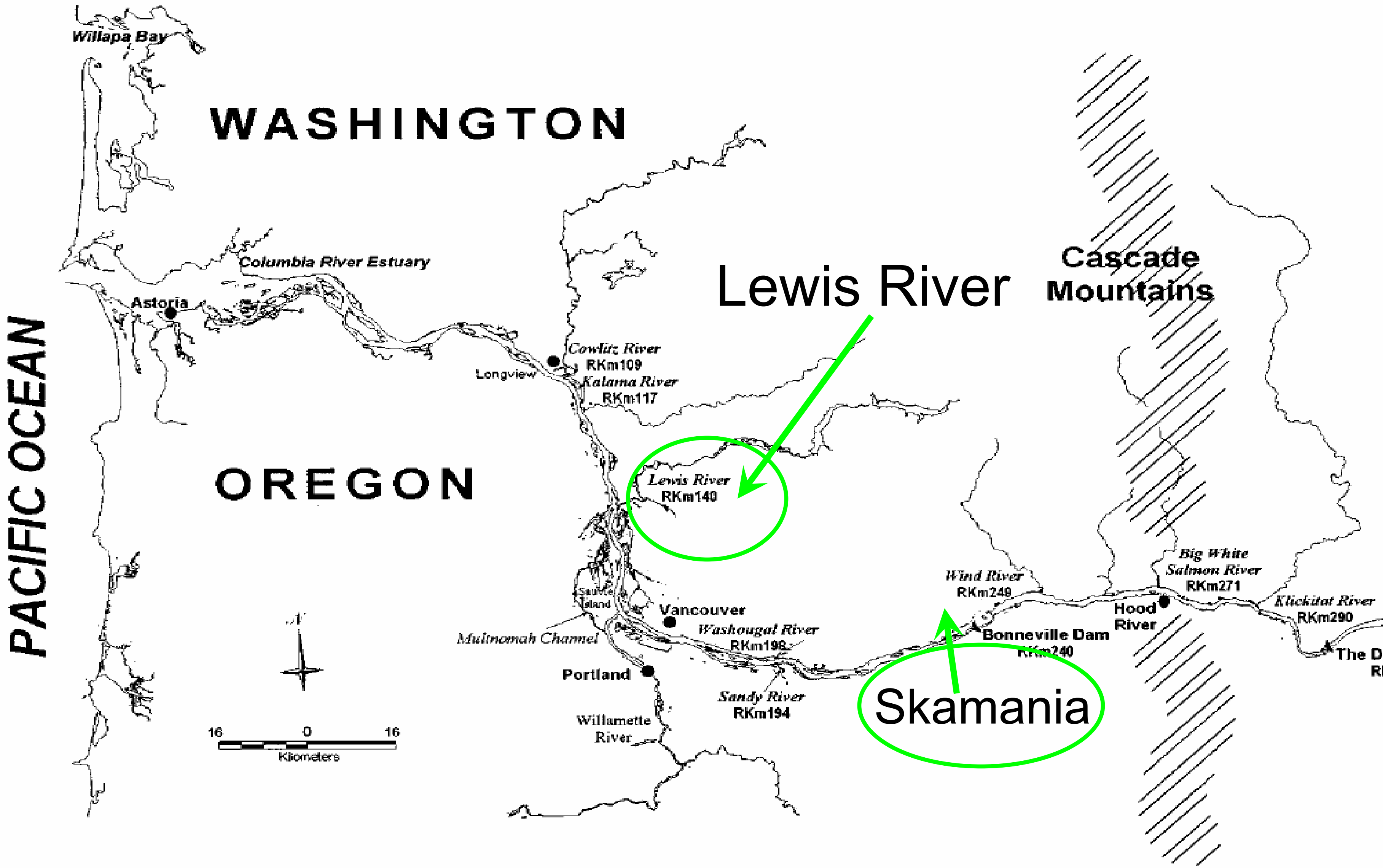

WASHINGTON
OREGON
PACIFIC OCEAN
Willapa Bay
Columbia River Estuary
Astoria
Longview
Cowlitz River
RKm109
Kalama River
RKm117
Lewis River
Lewis River
RKm140
Cascade
Mountains
Sauvie
Island
Vancouver
Multnomah Channel
Washougal River
RKm198
Portland
Sandy River
RKm194
Willamette
River
Wind River
RKm249
Bonneville Dam
RKm240
Skamania
Hood
River
Big White
Salmon River
RKm271
Klickitat River
RKm290
16 0 16
Kilometers

Modeling Limits to Recovery

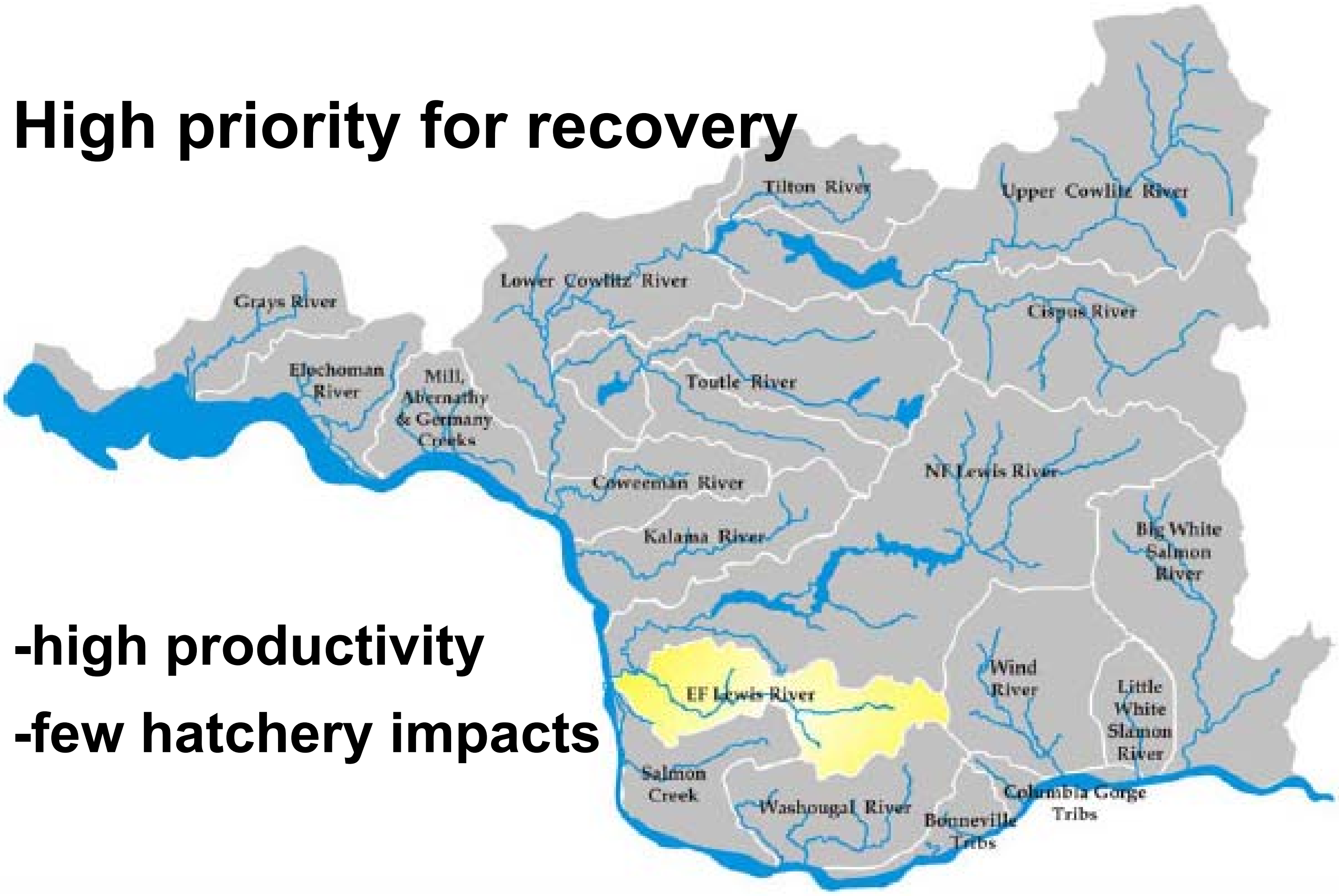
1 East Fork Lewis River
- Limiting Habitat Factors
- Changes needed
- Priority areas, actions, objectives

2 Species Life Cycle Analysis Modules
- Stages, transitions:
- capacity, productivity

3 Recovery Scenarios:
- Expand key life stages habitat
- Reduce harvest in ocean fisheries

East Fork Lewis: Fall Chinook

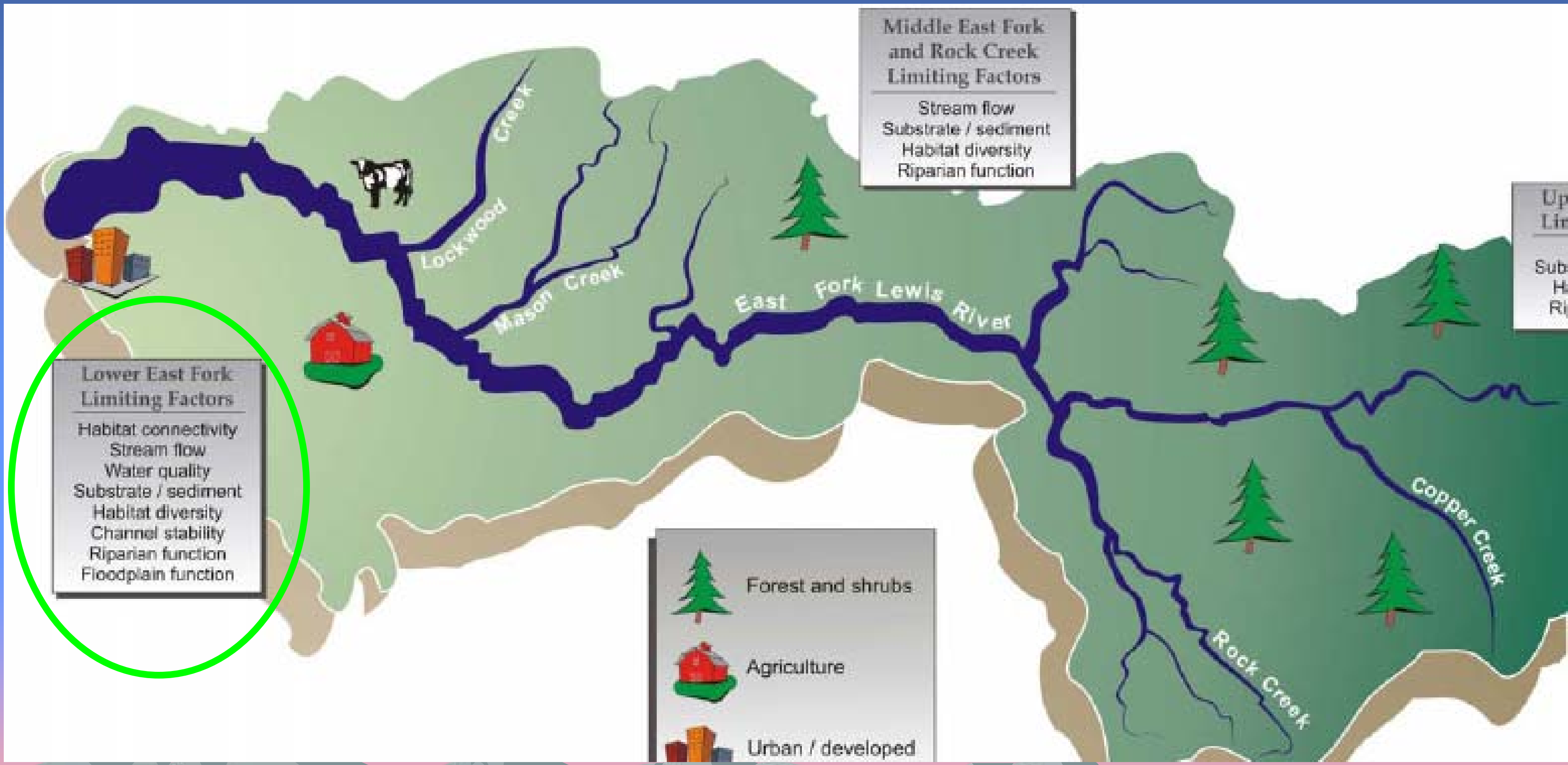
High priority for recovery



-high productivity

-few hatchery impacts

EF Lewis River Limiting Habitat Factors:
connectivity, flow, water quality, substrate, diversity, stability, riparian & floodplain function



Lower EF Lewis River: Changes?

- Heavily impacted by agriculture, rural residential development, and gravel mining.
- Improvements needed:
  - riparian restoration
  - reductions in streambank erosion
  - re-connection of floodplains
  - restoration of mining impairments and future avulsion
- Land-use planning/growth management critical
  - expanding development
  - land-use conversions [that] impair habitat conditions or habitat-forming processes

EF Lewis River Impacts

EAST FORK LEWIS RIVER SUBBASIN PLAN

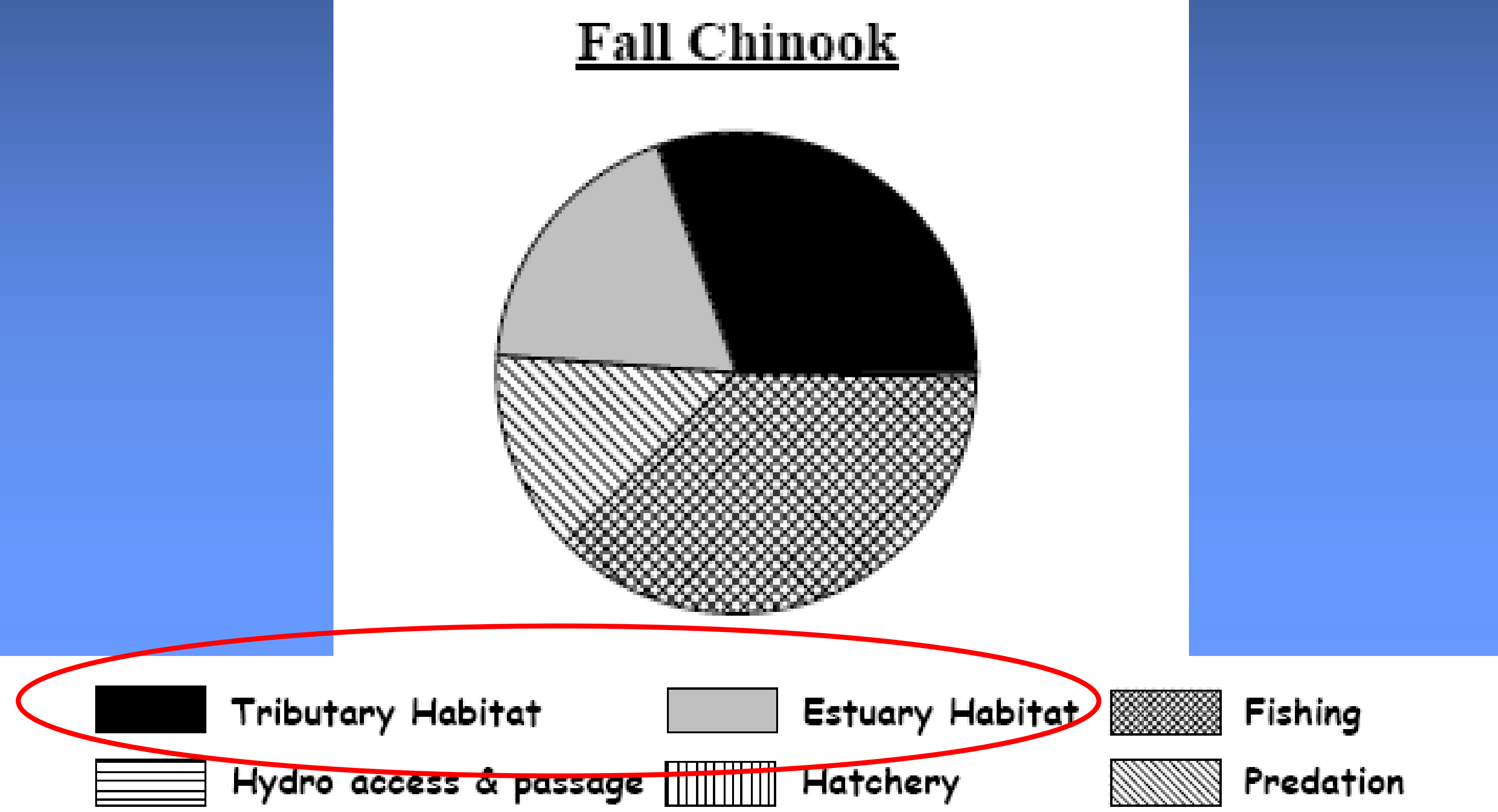
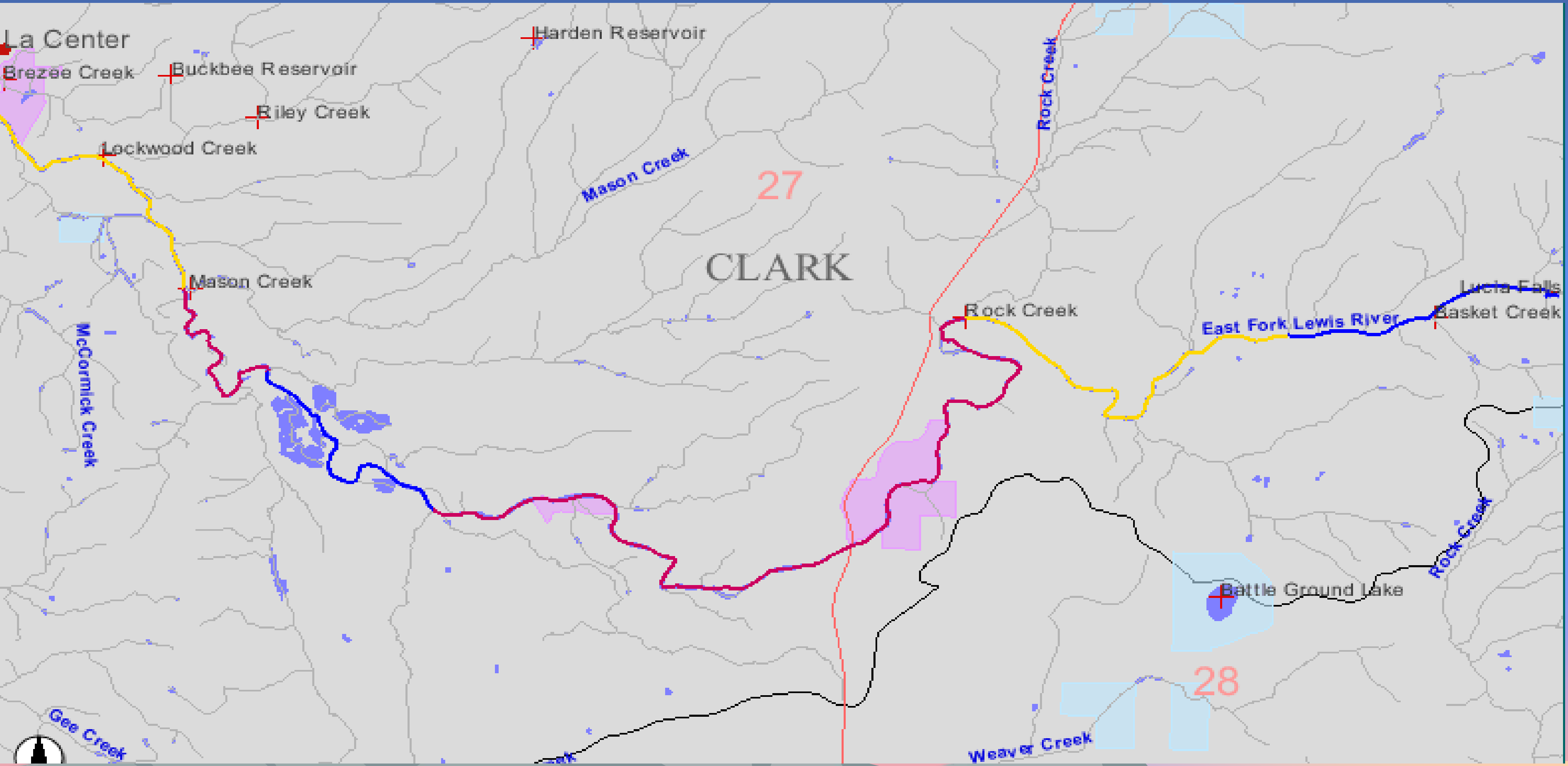


Figure 21. Relative contribution of potentially manageable impacts on East Fork Lewis River salmonid populations.

Restoration by EDT priority reaches
pink=high, yellow=med, blue=low



wdfw.wa.gov/mapping/salmonscape

High priority actions for key stages:

Egg incubation, Fry colonization, 0-age active rearing

1 Protect stream corridor structure/function

2 Protect hillslope processes

3 Restore floodplain function and channel migration (breaching, side channel link)

4 Restore degraded hillslope processes (forest cover, impervious surfaces)

(cont’d)

Prioritized measures: cont'd

5 Restore basin riparian conditions

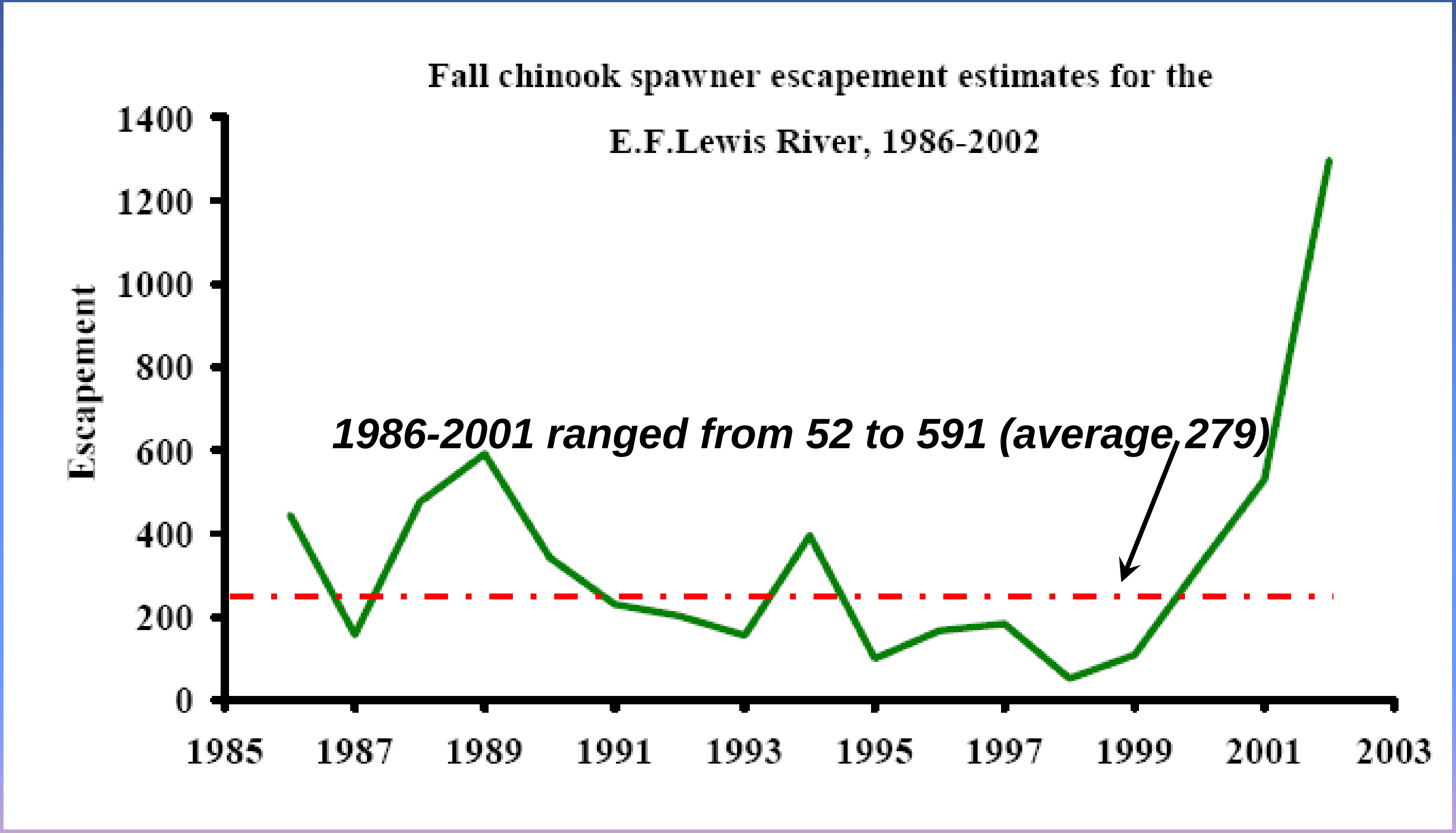
6 Restore degraded water quality particularly temperature

7 Provide for adequate instream flows

8 Restore access to blocked habitat

9 Restore channel structure / stability

Spawner Escapement Objective high viability with 1900-3900 adults



Species Life-Cycle Analysis Module (SLAM)

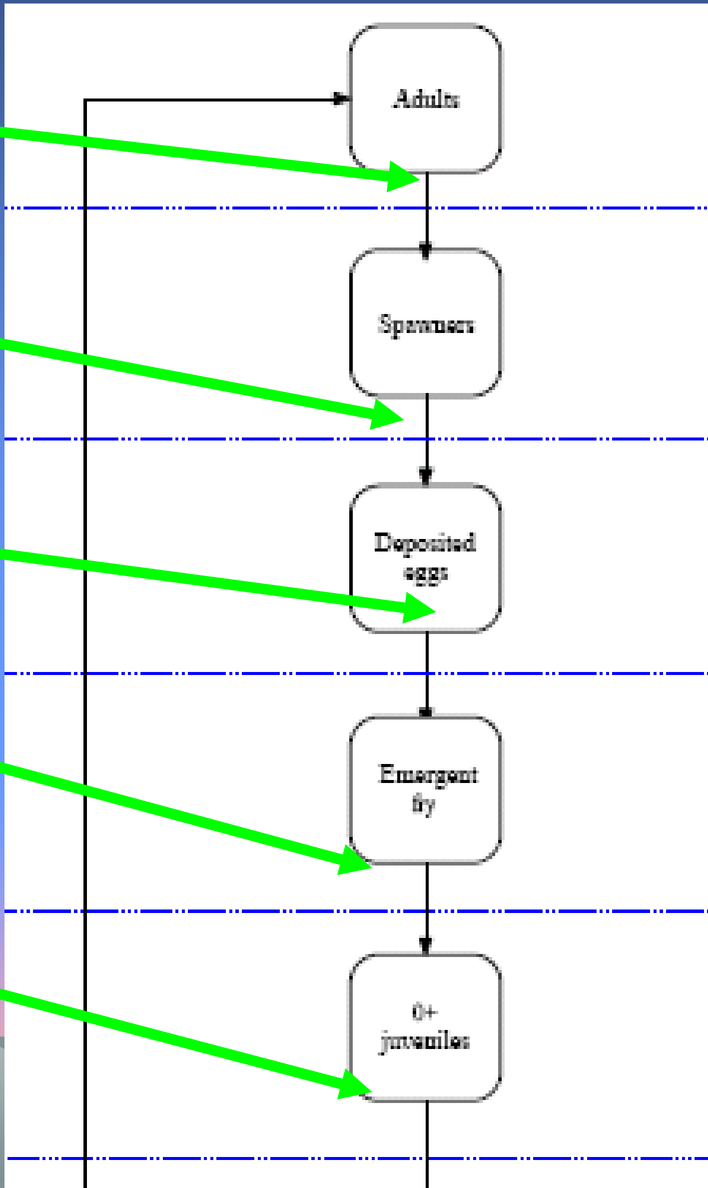
- Parameterized for population stages
  - **fecundity**
  - **egg-to-fry fry-to-juvenile survival**
  - **age-specific marine survival, harvest**, and **maturation rates**
- Each stage “recruits” to next
  - density dependence, annual variability

Habitat Parameters

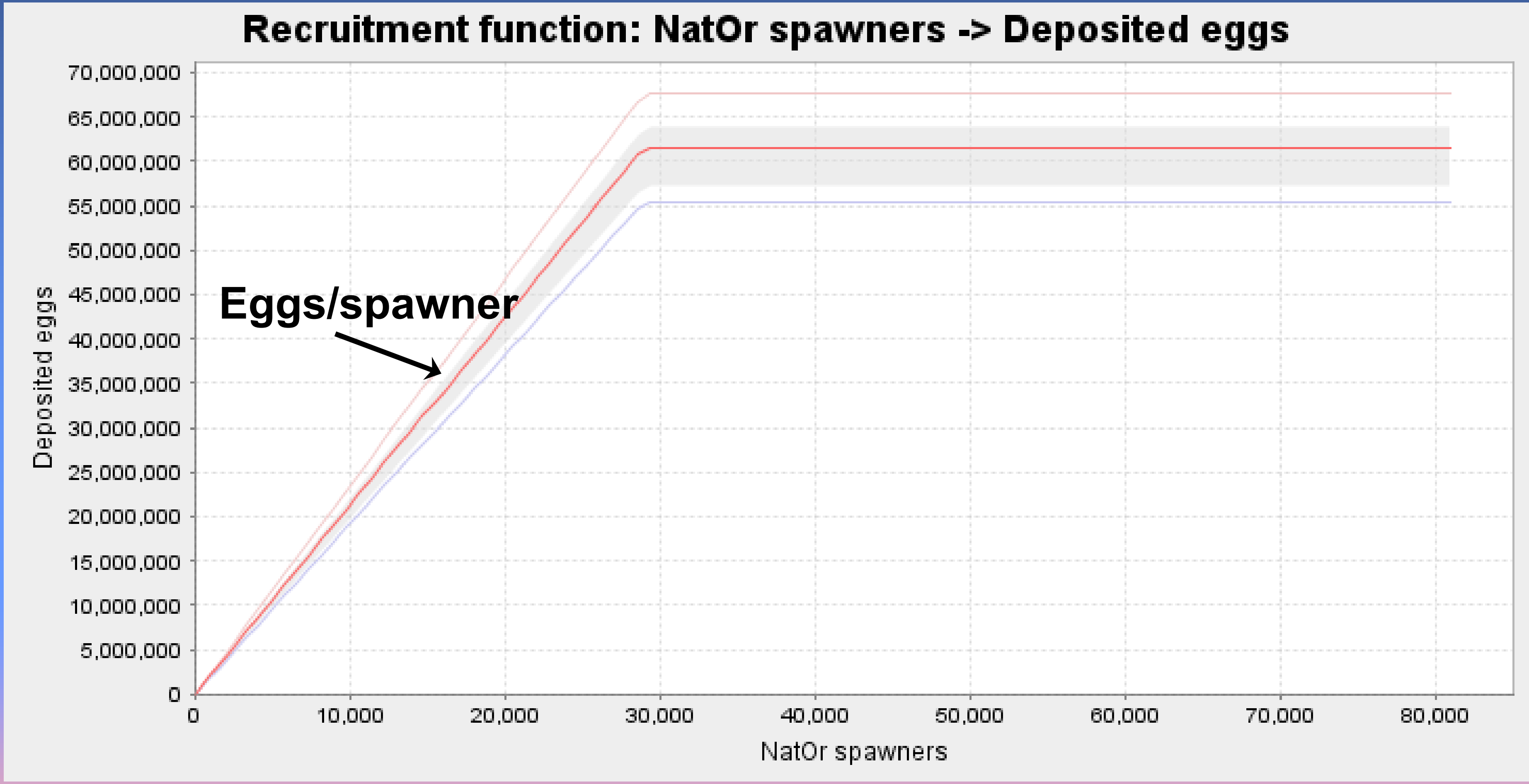
- Area * Density = Total Fish
  - Width, slope, passage => habitat area
  - pool, riffle, glide, backwater => fish density
  - Other variables: substrate, vegetation, flow
- Habitat, Density data from:
  - Upper Puget Sound Lunetta et al 1997; Bartz et al 2006
  - Lewis case study Steele et al, 2007 Fullerton et al 2008
    - stream gradient, bankfull width, riparian seral stage
  - Local input specificity, e.g. EDT Mobrand et al. 2000

Lifecycle Transitions linear or with density dependence

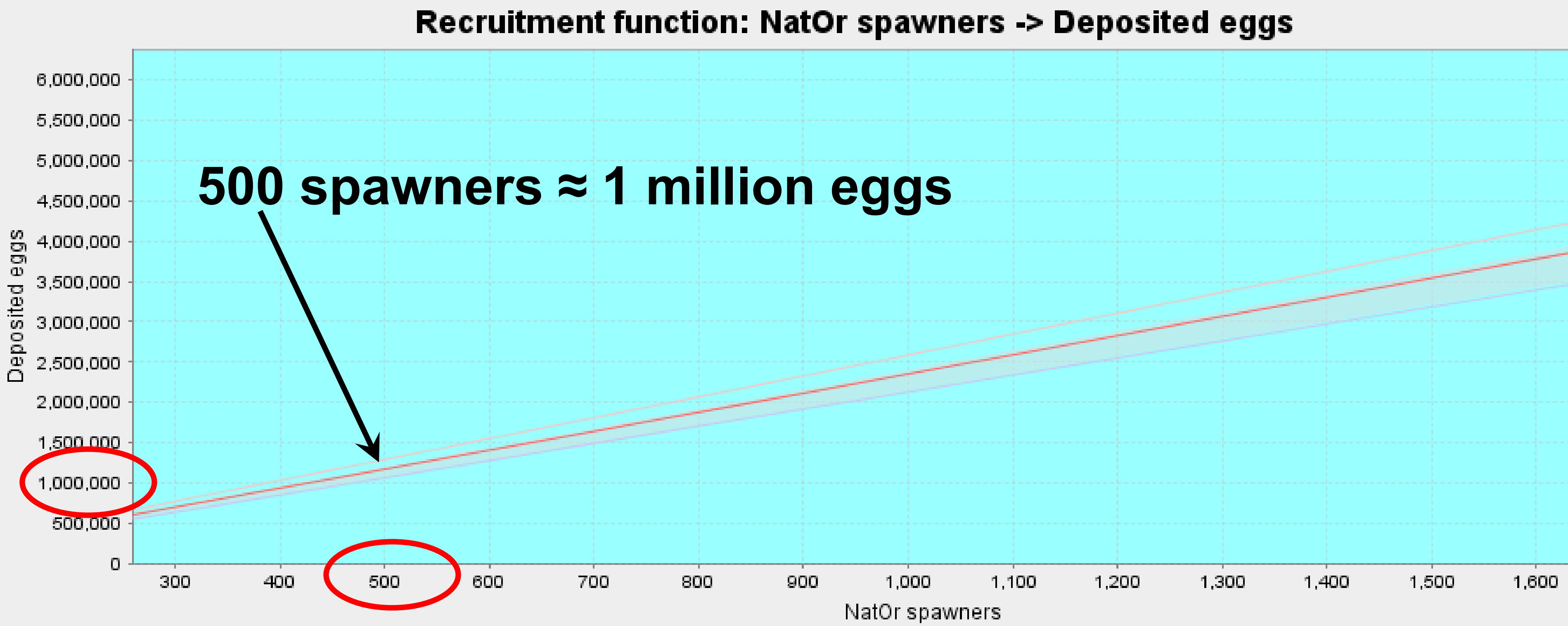
- – Linear: river adults to spawners
- – Hockey Stick: spawners to eggs
- – Linear:eggs to emergent fry
- – Hockey Stick: fry to 0+juvenile
- – Linear:0+ juvenile to age 1 ocean



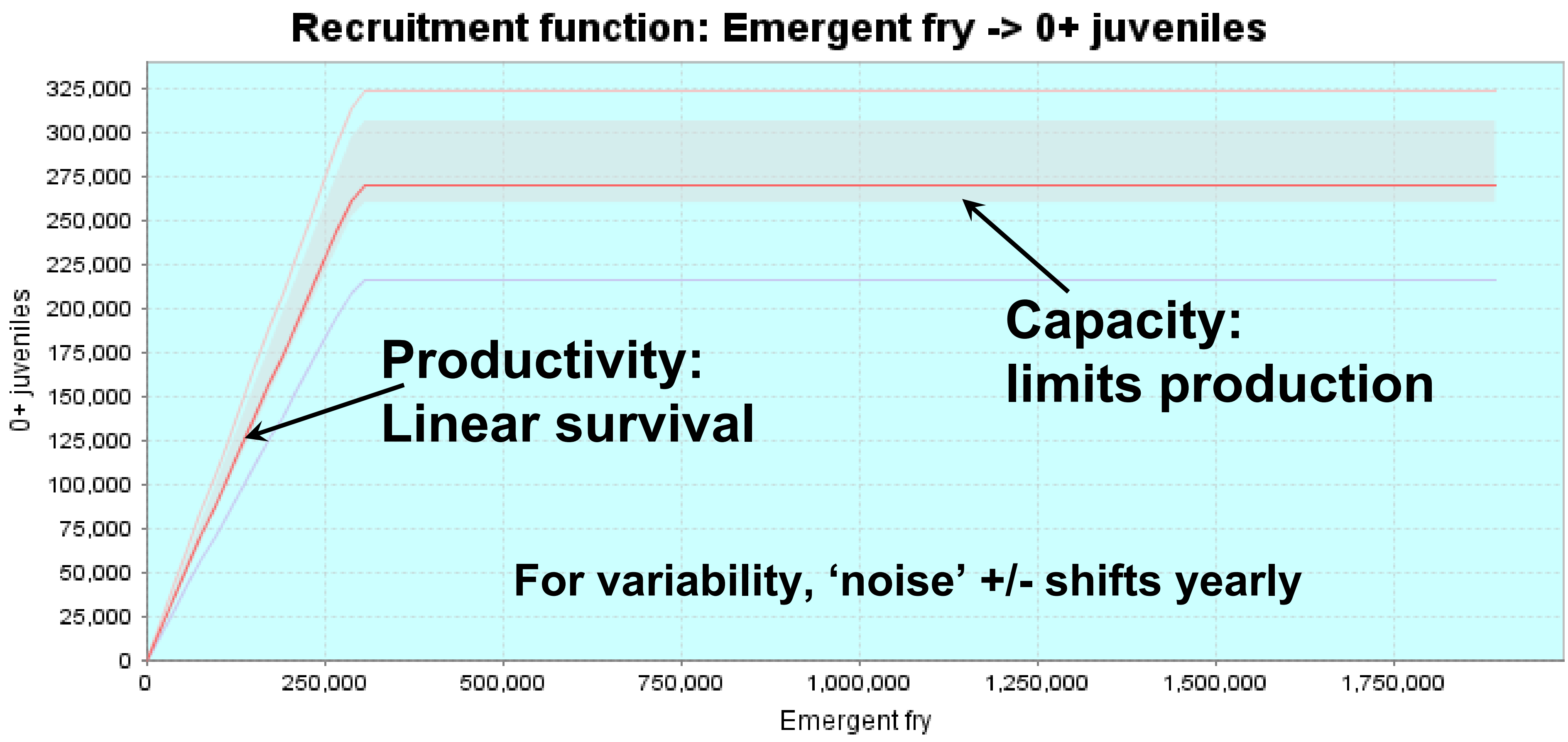
Density Dependent Recruitment: Hockey Stick ‘ceiling’



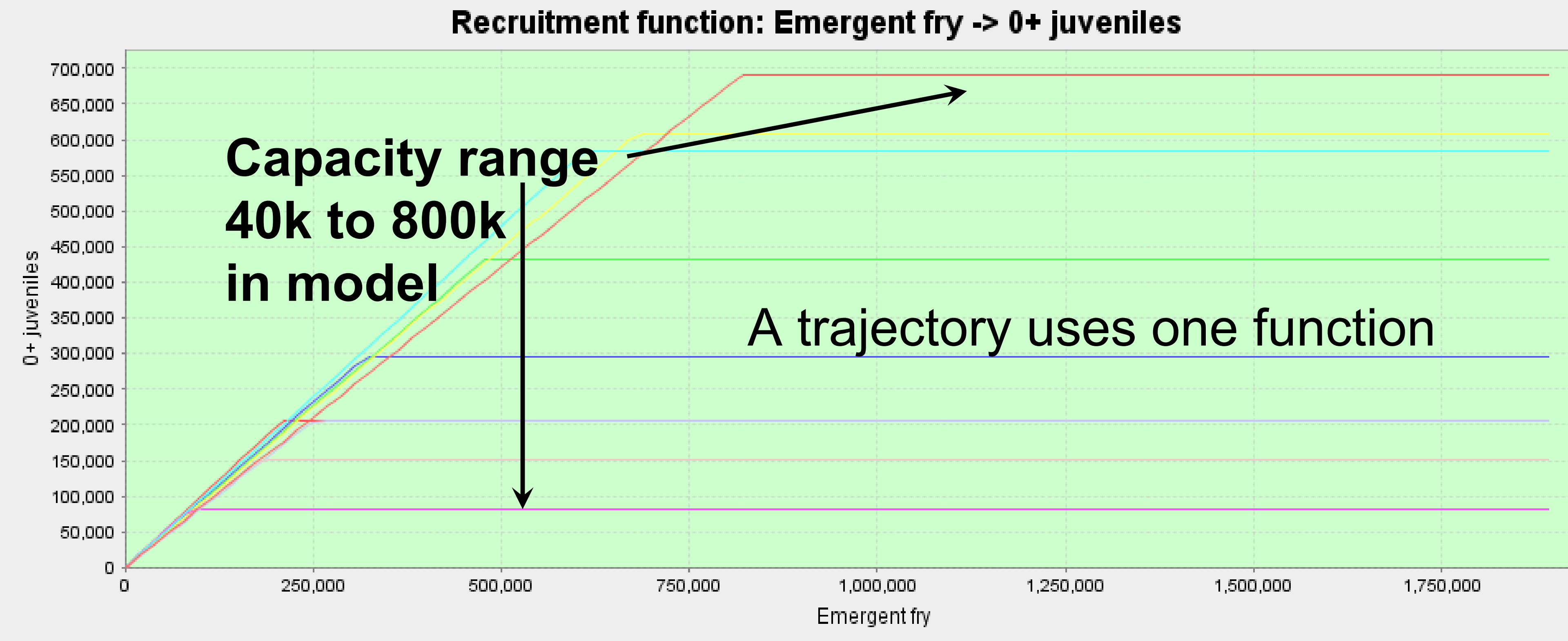
Spawner to Egg Productivty



Density-dependent fry to juvenile



Uncertainty =Range of functions



Juvenile Capacity Limiting

- More fry doesn't always mean more adults
- With 500 spawners ≈ +/- 400,000 juveniles
- How much improvement needed?

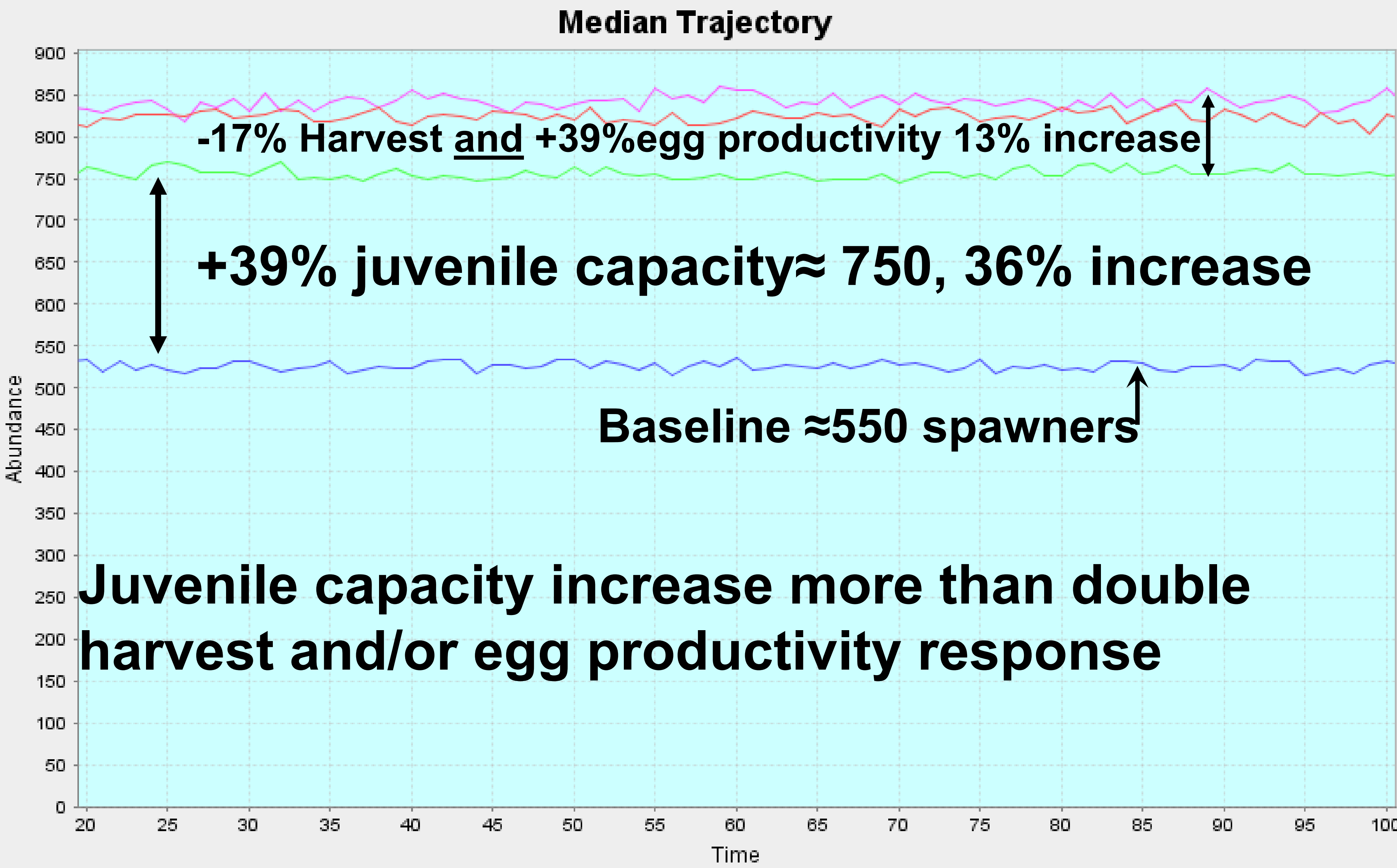
"Impacts must decrease … to achieve the <u>required 39% increase in tributary habitat potential</u>"

LCFRB December 2004, SUBBASIN PLAN

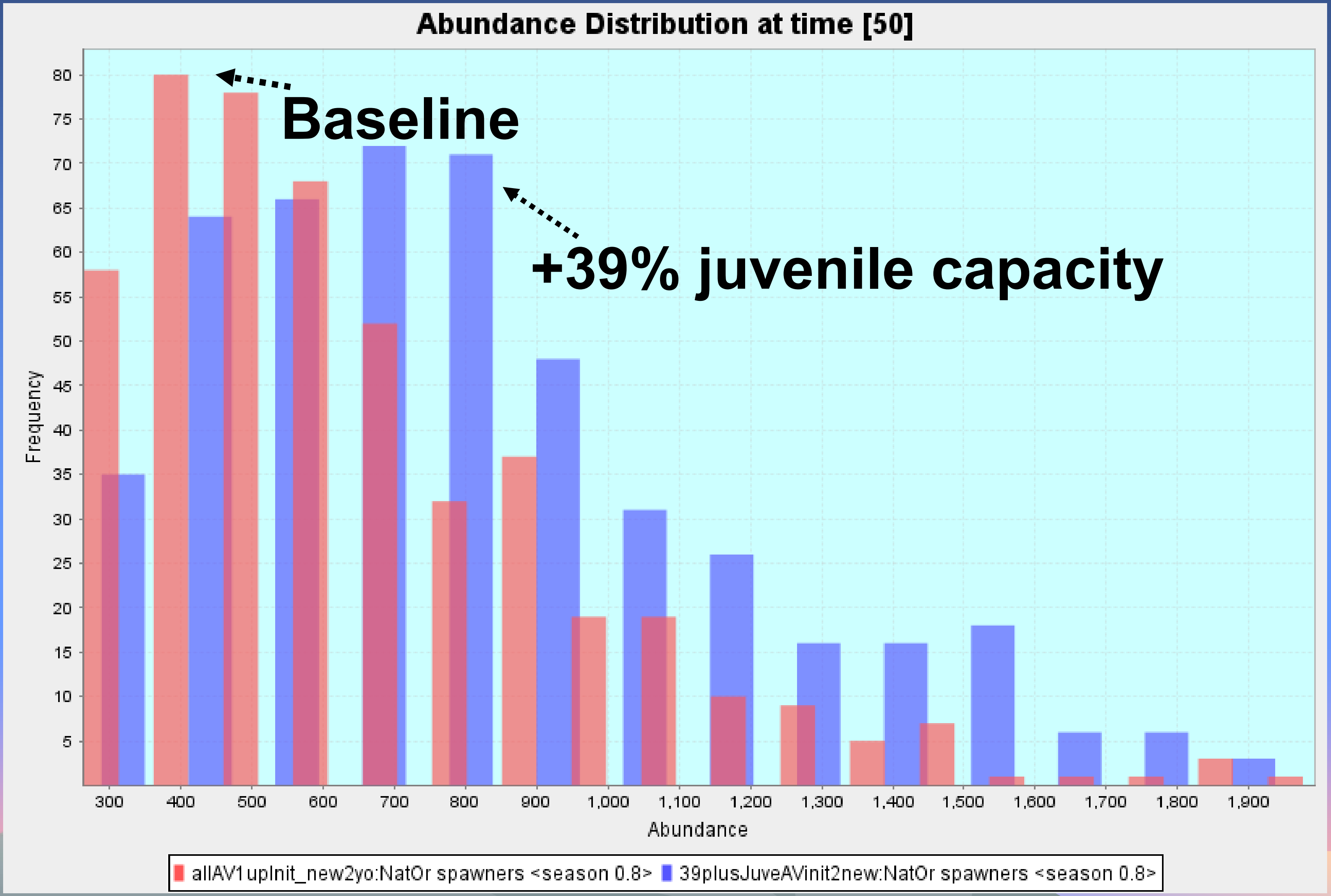
Harvest Changes

- Lower maximum exploitation rate
- Reduce in-river harvest
- Harvest more hatchery fish, reduce indirect mortality of natural origin fish
- Uncertain responses

Abundance change with habitat & harvest



Uncertainty: peak shift



Next steps

- Input data, trend habitat improvement / loss
- Recent age-specific harvest, uncertainty
- Other rivers with hatchery, dams, lower productivity
- Improve uncertainty estimates with sensitivity function, one at a time

"Knowledge is a wonderful thing, but sometimes simply knowing what we don't know is a form of understanding."

Cowen, 1/13/08

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- Mike Ford, Norma Sands, Robert Kope: harvest
- Stillwater: parameterization
- Bartz et al, Scheurell at al 2006: Shiraz
- Funding: National Research Council

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