
Estimating Habitat Quality and Survival Benefits:
Remand Habitat Workgroup Approach

Purpose

- The Habitat Workgroup was charged with estimating survival benefits associated with proposed tributary habitat restoration actions.
- The task was to be completed within a very short time-frame (three months) with readily available information.
- To the extent possible, the approach needed to improve upon the Appendix E Approach used in the 2004 BiOp.

Potential Tools

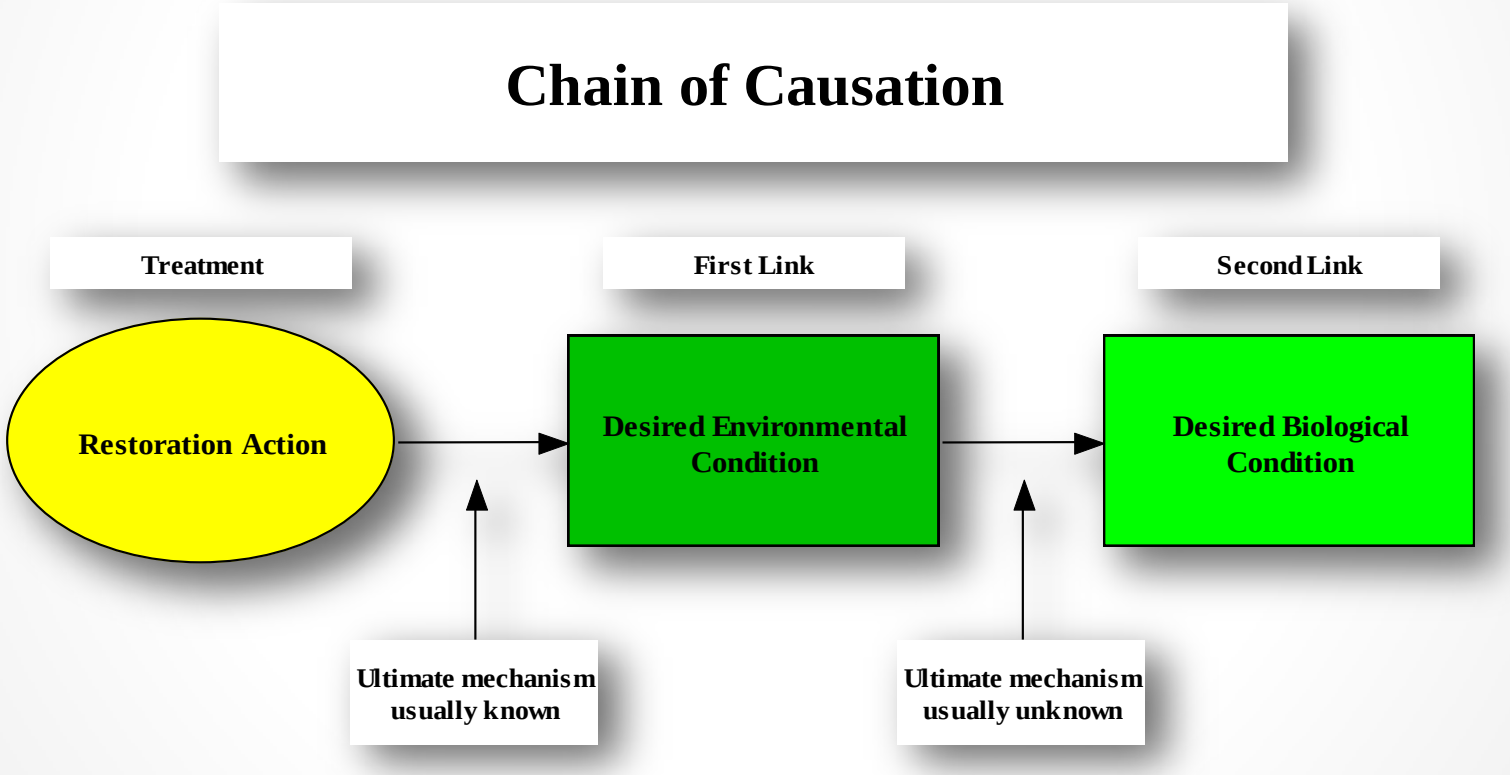
- Fish-Habitat Models (e.g., EDT, HQI, PHABSIM, RIPPLE, Shiraz, Greene and Beechie model, McHugh et al. model, Bioenergetic models, etc.).

- Professional Judgment (Delphi) Approach (similar to the Appendix E approach).

Limitations

- Very short time period to complete the work for salmon and steelhead populations throughout the Columbia Basin.
- Must use existing information that is readily available.
- Cannot accurately estimate the effects of tributary habitat actions on survival at all life stages.

Survival benefits will only be estimated for egg-smolt and pre-spawn life stages.



Logic Path

Habitat Action → Limiting Habitat Factors → Local Habitat Conditions → Overall Habitat Quality → Freshwater Survival

Assumptions

- Limiting habitat factors are known for each population.
- Habitat actions directly affect habitat variables that limit the population.
- Habitat variables can be combined to describe local habitat conditions.
- Local habitat conditions can be combined to describe overall habitat quality for the entire population.
- Changes in overall habitat quality are directly linked to changes in freshwater survival.

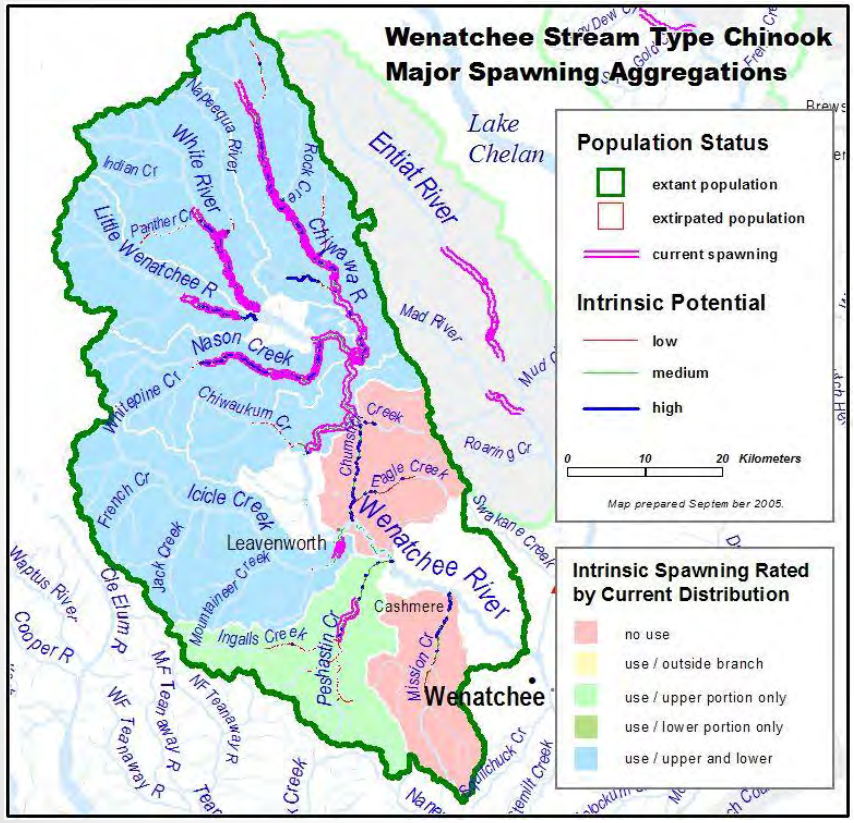

1-30-2002

Process

- Requires Local Biologist Input
  - Identify limiting habitat factors for each assessment unit or population.
  - Estimate the "current" status or condition of each limiting habitat factor.
  - Identify habitat actions that would address the limiting habitat factors.
  - Estimate the "potential" status or condition of limiting habitat factors if the habitat action is implemented.

- Requires Remand Habitat Workgroup Input
  - Combine limiting habitat factor scores into a single local habitat condition score.
  - Combine local habitat condition scores into a single overall habitat quality score for the population.
  - Translate habitat quality change into survival change.

Identification of Limiting Habitat Factors



- Identify site-specific limiting habitat factors.
  - From Recovery Plans, Draft Recovery Plans, Subbasin Plans, and Limiting Factors Analysis Reports.

Estimate "Current" Status of Limiting Habitat Factors

- Estimate the "current" status of limiting habitat factors as a percent of optimal condition (0-100%).
  - Optimal condition was based on properly functioning condition (PFC) (NMFS 1996).
- Weight the importance of each limiting habitat factor (scaled from 0.00-1.00 with sum = 1.00).
  - Lethal factors or factors < 20% of optimum were automatically given a weight of 1.00.
- Assign weights to each assessment unit (scaled from 0.00-1.00 with sum = 1.00).
  - Weights were based on proportion of the total population area that each AU made up.

Identify Tributary Habitat Actions

- Identify specific habitat actions that will address the limiting habitat factor.
- The habitat action must directly or indirectly address the limiting factor and/or threat.

Estimate "Potential" Status of Limiting Habitat Factors

- Estimate the "potential" status of limiting habitat factors as a percent of optimal condition (0-100%).
  - Condition that should result if the habitat action is implemented.
  - Estimate the potential status of each limiting habitat factor in 10 and 25 years.
- If necessary, re-weight the importance of each limiting habitat factor (scaled from 0.00-1.00 with sum = 1.00).

Derivation of Current and Potential Local Habitat Conditions

- Step 1: Calculate the weighted status of each limiting habitat factor. This equals the status of the habitat factor (as a % of optimal condition) times its associated weight (relative weight of the factor on fish survival).

- Step 2: Combine the weighted status scores into a composite local habitat condition score for each assessment unit. Calculated by adding together the weighted habitat status scores.

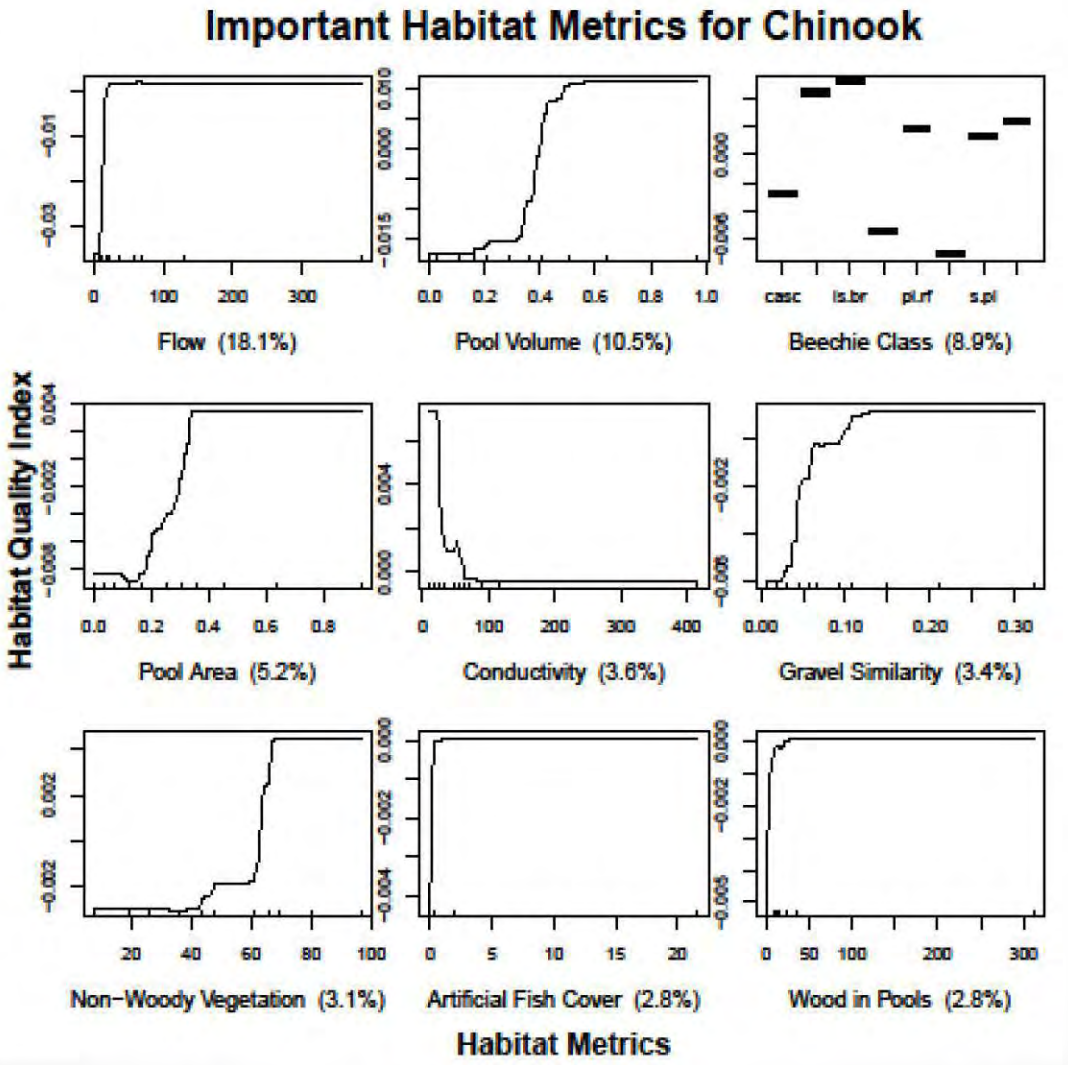
Derivation of Current and Potential Overall Habitat Quality

- Step 3: Multiply the local habitat condition scores for each assessment unit by their respective assessment unit weights.

- Step 4: Add together the products (weighted habitat condition scores) to estimate the overall habitat quality score for the population.

Derivation of Survival Benefits

Fish-Habitat Relationships



Derivation of Survival Benefits

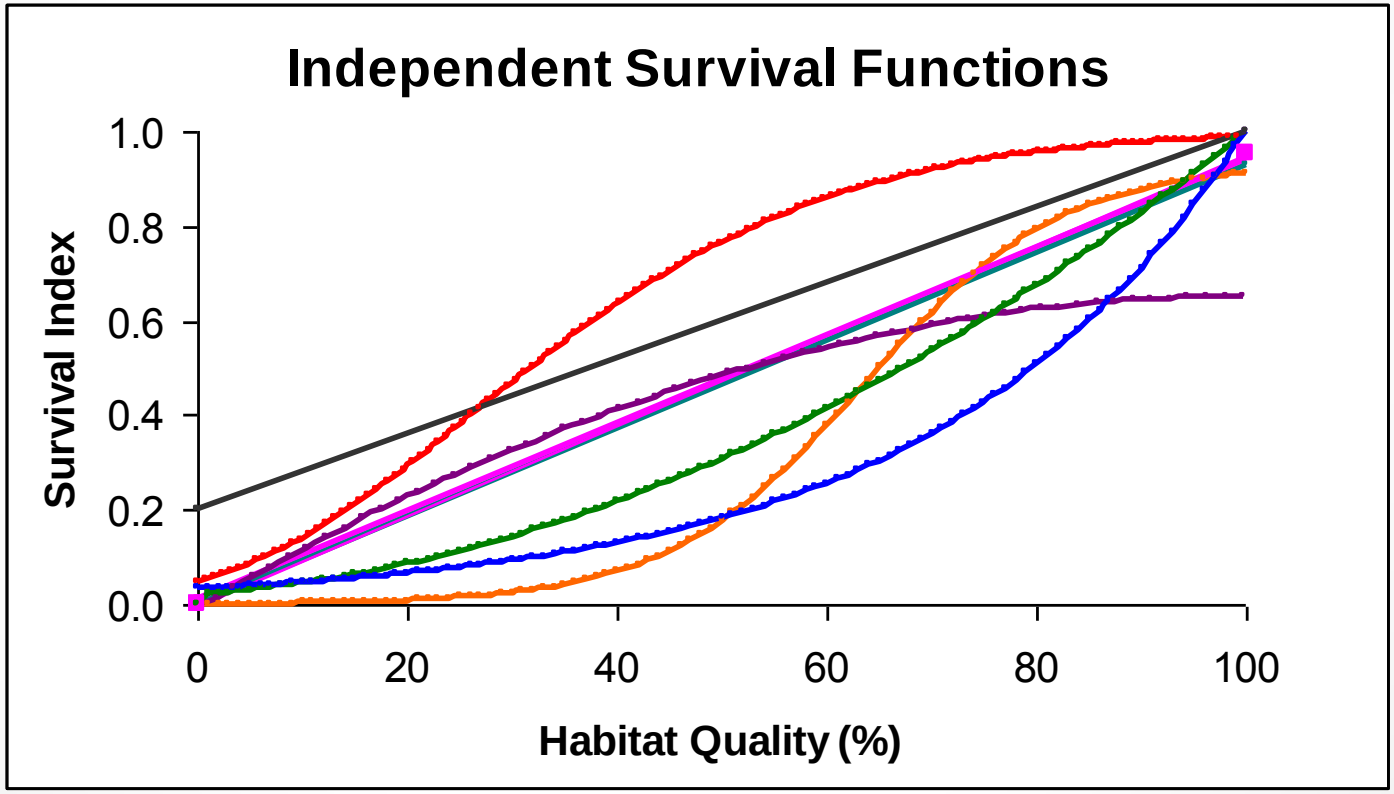
- There are published relationships between habitat variables and survival.

$$p_{1,2} = \begin{cases} 0.95 & \text{if } f < 0.268 \\ -3.32f + 1.81 & \text{if } 0.268 \le f < 0.544 \\ 0.06 & \text{if } f \ge 0.544 \end{cases}$$

$$p_{2,1} = \begin{cases} 0.273T_{inc} - 0.342 & \text{if } 1.3 \le T_{inc} < 4.7 \\ 0.94 & \text{if } 4.7 \le T_{inc} < 14.3 \\ -0.245T_{inc} + 4.44 & \text{if } 14.3 \le T_{inc} < 18.1 \\ 0.01 & \text{if } T_{inc} \ge 18.1 \end{cases}$$

$$p_{2,2} = \begin{cases} 0.58 - 0.844Q^{*} & \text{if } Q^{*} < 0.675 \\ \\ 0.01 & \text{if } Q^{*} \ge 0.675 \end{cases}$$

Functional Relationships between Habitat Quality and Survival Index



Functional Relationships

Chinook egg-smolt survival = 0.0018(HQI)

Steelhead egg-smolt survival = 0.0004(HQI)

Chum egg-fry survival = 0.0035(HQI)

Adult pre-spawn survival = 1.00(HQI)

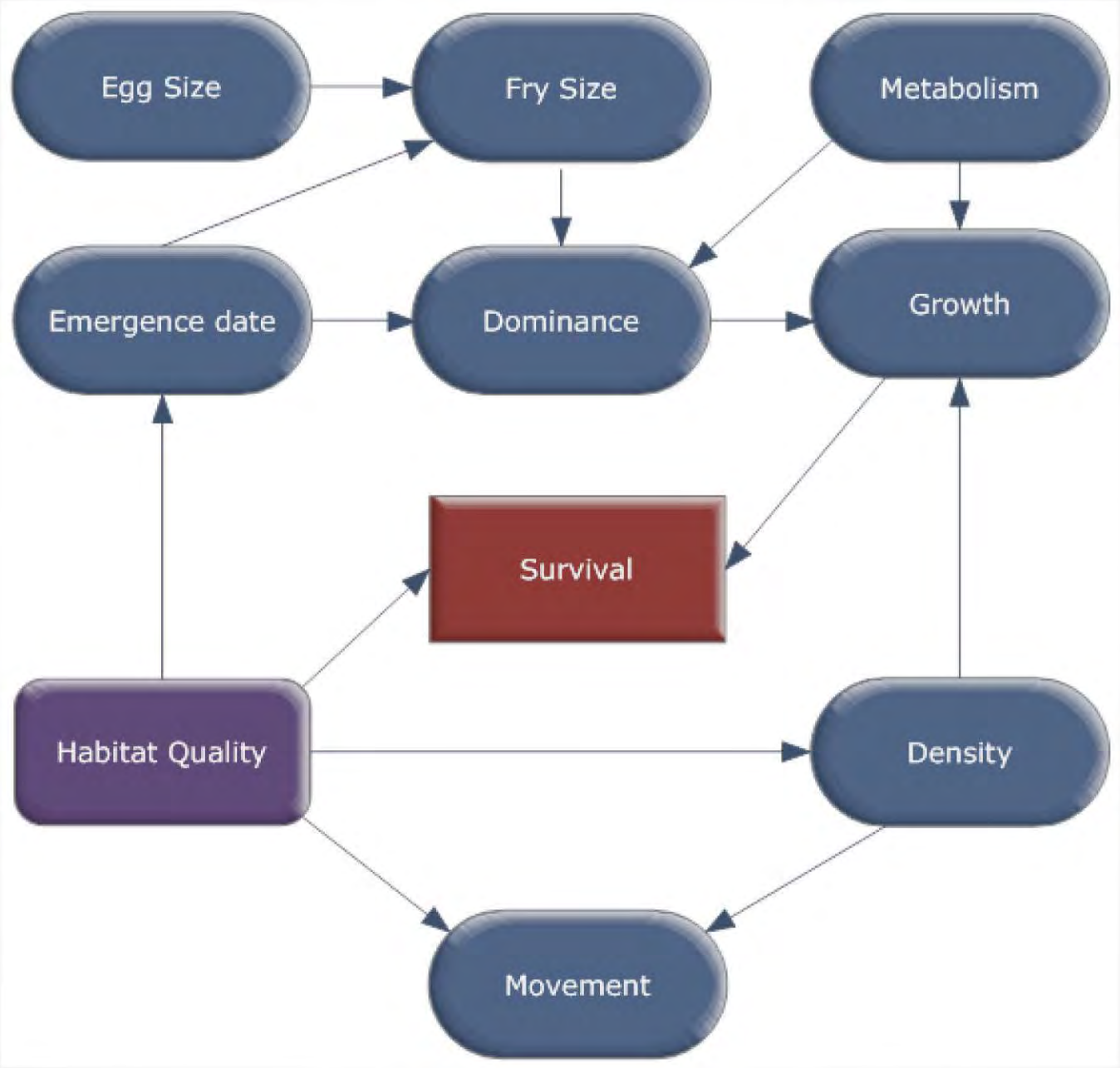
Assumptions

- Egg-smolt survival is the lowest when habitat quality is the lowest and survival is the highest when habitat quality is the highest.
- Egg-smolt survival is directly proportional to habitat quality.
- Mortality is density independent.
- Hatcheries have no effect on survival of naturally produced fish.

Estimation of Benefits

$$\text{Habitat Change} = HQI_{potential} / HQI_{current}$$

$$\text{Survival Change} = S_{potential} / S_{current}$$


Egg Size
Fry Size
Metabolism
Emergence date
Dominance
Growth
Survival
Habitat Quality
Density
Movement

Considerations

- Use empirical data to the extent possible.
- Remember the River Continuum Concept (RCC).
- Assess habitat quality upstream from fish barriers.
- Consider the timing of restoration effects.
- Consider life-stage habitat requirements and the limiting factors associated with each life stage.