Integration of Habitat, Harvest and Hatchery Strategies and Actions

The purpose of this regional strategy on the integration of habitat, harvest, and hatchery strategies and actions is to address issues that are common to multiple watersheds or that have not been adequately addressed within an individual watershed plan as identified by the Puget Sound Technical Recovery Team (TRT). This strategy does not replace actions or strategies identified within an individual watershed plan.

Each individual watershed chapter identifies factors and conditions necessary to achieve recovery. In some limited cases additional factors or conditions have been identified by the TRT as noted in the watershed profiles contained in this plan. Together these factors and conditions are considered to be based on the best available science for recovery in the individual watershed. This regional strategy does not replace or substitute the conditions or actions necessary in an individual watershed as defined by that watershed chapter in this plan. If there is a conflict between the recommendations of this regional strategy and the individual watershed chapter, the individual watershed chapter shall take precedence.

"Considering the effects of one factor at a time (e.g. harvest, habitat, or hatchery management actions) on salmon population characteristics is more tractable from a technical standpoint, but such estimates of effects are sure to be wrong in most instances. Managers [are asked] to consider suites of habitat, harvest, and hatchery actions together, especially with a view towards how these factors interact..."

Puget Sound Technical Recovery Team (2003)

Salmon recovery faces enormous challenges in tying together actions across all watersheds, jurisdictions and decision-making forums affecting the Puget Sound Chinook Evolutionarily Significant Unit (ESU). The major factors that affect the abundance, productivity, spatial structure and diversity of salmon populations are often lumped into the "H Factors" of harvest, hatcheries and habitat (including hydropower). Each of these factors independently affects the status of salmon populations, but they also have cumulative and synergistic effects throughout the salmon life cycle. The achievement of viability at the population and ESU level depends on the concerted effort of all three factors working together, not canceling each other out, and adjusting over time as population conditions change.

"Integrate:" To make something whole or complete by bringing together the parts….

"Synergy:" The simultaneous action of separate parts which, together, have a greater total result than the sum of their individual effects.

Webster's New World Dictionary

The preparation of the recovery plan has provided an opportunity for all Puget Sound communities, watershed groups and fisheries managers to bring their recovery proposals to the table at one time within respective watersheds and as a region, and take a look at the way

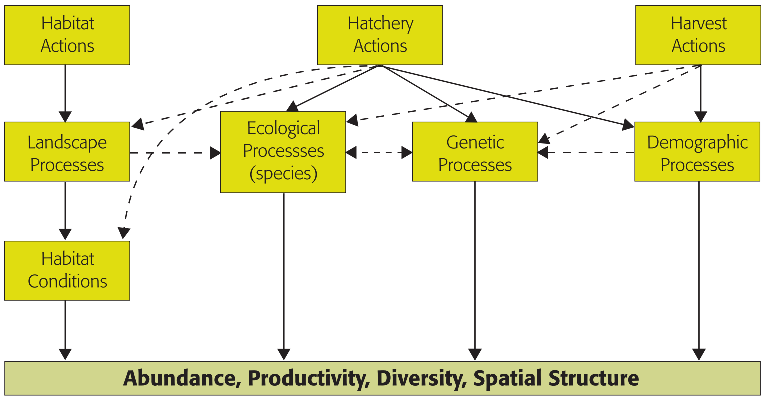

Figure 6.8 Example of the interactions among habitat, hatchery, and harvest management actions and their potential effects on the VSP parameters of a population. (PSTRT, 2003) page 37

these efforts will interact over the coming decades. This broad perspective has highlighted the need for more work in the watershed plans and regional strategies to further develop strategies that integrate the "H Factors" and increase the certainty that the plan outcomes will provide the needed benefits to salmon and the Puget Sound community as a whole.

Definition of an Integrated Salmon Recovery Strategy

An integrated strategy for salmon recovery describes a set of inter-related objectives and actions that have a logical sequence and are predicted to achieve population and ESU viability. Elements of an integrated approach include considerations of temporal and spatial scales, the positive or negative outcomes of actions that are linked across the H factors, and the ability to manage and adapt to uncertainty and change.

Temporal considerations evaluate whether actions are working in the right order, and how differing time scales are incorporated into recovery. For example, habitat restoration activities may take over a century to be effective, while hatchery actions will have an impact on the next generation, and harvest management affects the current year's return. If hatchery rebuilding programs are to be effective in restoring naturally spawning populations, they need to be linked to the quantity and quality of available habitat. As habitat improvements begin to be effective, hatchery supplementation programs need to change to allow improvement of salmon productivity, diversity, spatial structure and abundance. Projects and activities in an integrated strategy should reflect the progressive improvement in VSP parameters over time.

Spatial elements of H-integration consider how habitat, hatchery or harvest actions interact in particular locations. For example, are habitat restoration projects aimed at bolstering capacity of wild juvenile Chinook in a lower watershed coordinated with hatchery release locations so that those habitats are used primarily by wild (instead of hatchery-origin) juveniles?

An integrated salmon recovery strategy should have the following elements:

- Consistency among the recovery goals for the population, the hypotheses about what is limiting the population, and the recovery actions that are proposed.
- Strategies and actions are interrelated in their predicted effects on VSP parameters.
- Strategies and actions produce no long lasting damaging or contrary effects in the population parameters.
- The strategies are designed to be biologically efficient - they can achieve VSP outcomes before irreversible harm is done to the population.
- The strategy contains actions across all three H sectors.
- The timing and sequence of projects and activities reflect changing long-term improvements in VSP parameters.

Contradictory	Non-aligned	Integrated
Actions across the Hs are inconsistent and mutually detrimental.	Actions across the Hs do not conflict, nor do they enhance each other.	H Actions work in concert and are progressively sequenced in time and space.
C-1: A new area of habitat is restored before the population is sufficiently large to make use of it. In very small populations, the distribution could become so thin that productivity actually declines due to low reproductive success.	**N-1:** Habitat actions are mainly focused on a single activity, such as placement of large woody debris. This may improve overall habitat quality, but if the population is very low in abundance, initial negative population responses to this activity may drive the population close to extinction unless appropriate harvest and/or hatchery actions are undertaken concurrently.	**I-1:** Habitat restoration is phased and sequenced in parallel with expected population growth due to harvest rate reductions and hatchery supplementation (where applicable).
C-2: Harvest may negatively impact diversity by selectively harvesting larger spawners. The remaining smaller females cannot dig redds in areas of larger rocks that were the preferred habitat when average size was higher.	**N-2:** Harvest management includes measures to assure that mortality is evenly distributed across the size and timing characteristics of the run, thus not selectively impacting any one component.	**I-2:** Harvest management and hatchery supplementation (where applicable) is specifically designed to produce a diversity pattern of spawning and rearing life histories that will fit in with current and restored habitat conditions.
C-3: Harvest management guidelines are based on the escapement needs of hatchery fish. Commingled wild fish may or may not achieve escapement numbers appropriate for available habitat.	**N-3:** Harvest management guidelines are set to provide sufficient natural spawners for current habitat conditions. However, spawner numbers may not increase when habitat improves due to plan actions or when marine survival conditions are favorable.	**I-3:** Harvest rates are established that allow spawner numbers to increase to take advantage of favorable marine survival conditions and improving habitat. Carcasses from increasing escapements provide additional marine-derived nutrients to the upper watershed, which in turn enhances natural productivity.
C-4: The size of hatchery releases overwhelms a habitat that has recently been restored, increasing competition and negating the benefit to wild fish.	**N-4:** Hatchery supplementation programs are underway, but the watershed lacks protection strategies for the limited amount of productive habitat that remains.	**I-4:** Monitoring programs look at escapement estimates, proportions of natural and hatchery origin spawners, genetic profiles and juvenile distribution and abundance. Information feeds back into management actions for adjusting harvest rates, hatchery production and release timing, and locations for habitat restoration focus.

Figure 6.9 Continuum of H-Integration Strategies — examples

Contradictory and Integrated Salmon Recovery Strategies

Management actions in one H sector may have positive or negative effects on salmon depending on actions in the other H areas. The intent of an integrated recovery strategy is to ensure that actions have no permanent or long-lasting contrary effects, and to advance the ability of these actions to work together. Figure 6.9 is a conceptual diagram of the continuum of H integration strategies from a dysfunctional situation where the factors work against each other, to the development of an effective and progressive set of actions where the actions in the Hs work synergistically.

Actions should not move population parameters away from viability unless the effects of such actions can be shown to be of short duration and necessary to the long-term achievement of population viability. Even then, such actions should not cause irreversible declines in any VSP attribute. Moreover, it may be necessary to implement actions from one H before actions are taken under any of the others. Example N-1 from the table illustrates the need to undertake an immediate rescue of an imperiled population through harvest or hatchery actions, since habitat actions will not be effective for a longer time period. Long-term viability still requires habitat actions to be undertaken, but the timing and proper sequence of such actions must be well-conceived.

Key Questions to Identify Issues for Harvest, Habitat and Hatchery Interactions

Members of the Puget Sound Technical Recovery Team have identified a set of example questions to help illustrate how cross-H issues in a watershed or region can be considered.

1. Given the VSP attributes of a population, what role has each H played in the condition of the population?
2. Has any VSP attribute been irretrievably altered? (Generally applies more to diversity and spatial structure)
3. Is the population imperiled by changes in any particular VSP attribute or combination of attributes in the short or long term?
4. What H strategies have the greatest probability for addressing this change?
5. Given the strategies, what actions are necessary to implement them successfully?
6. How do the actions interact and complement one another towards achieving objectives for the population?
7. What is the effect of each action and the cumulative effects of all actions on the VSP attributes?

Puget Sound watershed groups and local co-managers have identified examples of cross-H issues for watershed level evaluation such as:

- Harvest and habitat: Are harvest rates consistent with population productivity and spatial structure? How do different fishing regimes differentially affect VSP parameters in a given population? Is the productivity of the habitat consistent with maintaining VSP levels and sustainable harvest levels?
- Hatcheries and habitat: Are hatcheries used effectively to reintroduce and maintain populations where habitat is degraded? Are hatchery structures blocking access to important habitat? Are hatchery programs designed to ensure that the use of habitat by hatchery-reared fish is consistent with the achievement of VSP levels in naturally-spawning populations?
- Harvest and hatcheries: Are those hatchery programs that are intended to produce fish to augment harvest operated consistently with the recovery of the ESU? Can the production from these programs be harvested without increasing the harvest rate on natural populations as they rebuild? Is the harvest management plan designed to allow sufficient escapement so that supplementation programs assist the watershed's ability to meet population recovery goals?

Steps in the Development of an Integrated Salmon Recovery Strategy

In order to achieve integration of salmon recovery strategies, it is necessary to meld scientific analysis with decision-making by the appropriate management entities in order to:

- Understand or predict the combined effects of the individual H actions on VSP parameters over the life of the actions
- Compare the effects of the H actions on VSP parameters for their directionality (+ or -), magnitude, time lag and persistence
- Choose actions that are complementary in their effects
- Time the actions appropriately keeping in mind the state of the VSP attributes and salmon population goals
- Sequence the actions appropriately to achieve the desired VSP effects in time to avoid the loss of VSP integrity (the "first things first" principle)
- Utilize monitoring and adaptive management to address probabilities and uncertainties

The end result of the development of an integrated strategy should be to identify a suite of actions that are consistent and predicted to move salmon populations towards short, moderate, and long-term recovery goals. An integrated strategy should describe the relative uncertainty of the suite of actions, and how uncertainties will be reduced through an adaptive management and monitoring program.

Communication

Participation and communication must occur on a technical, policy and implementation/action level. Each viewpoint must be considered along with participants' ability to implement change. It is essential that managers and participants in one H sector communicate and understand the relationship of their actions to those in the other sectors.

"In a well-run fishery, all of the key players (fishermen, biologists, and managers) should be able to state in unambiguous terms what harvest strategy is used for the fishery." (Hilborn and Walters, 1992)

An integrated structure for salmon recovery applies within and across the habitat and hatchery sectors as well, and is characterized by informed groups who understand how each other's activities are arranged to maintain and restore the salmon populations. Additionally, management must occur in coordination, so that decision-making in one of the H sectors is not usurped or preempted by decisions occurring in another sector.

Technical Assessment

Models may provide managers with an opportunity to work together to document goals, identify important variables and data sources, and discuss what assumptions are unknown or untested. Several watersheds have utilized computer models to begin evaluating the relationship of proposed habitat, harvest and hatchery actions together. Each of these tools is designed to address specific questions, and no one tool is perfectly suited to answer all of the questions associated with developing an H-integration strategy. A number of modeling tools for this purpose are described in the *"Technical Guidance for Watershed Groups in Puget Sound"* (PSTRT, 2003). Two of the commonly used models in the Puget Sound region are the Ecosystem Diagnostic Treatment (EDT) model (Mobrand Biometrics) and the SHIRAZ model (Sharma et al. 2002). While both models were originally developed to predict the effectiveness of habitat conditions and processes on salmon throughout a watershed, they can also be used to explore interactions among hatchery, harvest and habitat management on salmon populations.

Recently another integrative modeling tool known as "AHA" (All H Analyzer) was developed by the Hatchery Scientific Review Group based on theoretical work from scientists from WDFW, NOAA, USFWS and tribes. An overview of AHA is available at the hatchery reform website (www.hatcheryreform.org) and in the HSRG's 2005 Report to Congress (HSRG 2005). Under AHA, actual or theoretical data about habitat productivity and capacity, harvest rates, and hatchery operations in a watershed are entered. AHA allows managers to consider some of the effects of habitat, harvest and hatchery management choices together as the factors are changed in a series of model runs. These runs inform management decisions by describing current conditions, goals for the long-term future of a salmonid population, and one or more scenarios for achieving or moving toward those goals in the short-term. AHA is a good illustration of the potential value that models can provide in demonstrating how management among the H's can be coordinated. Additional factors important for designing integrated all-H strategies, such as the spatial locations in which habitat, hatchery and harvest actions are implemented, cannot be explored with this tool, and should be included in strategy development.

Status of H Integration at the Regional and Watershed Level

On the continuum of H Integration Strategies (figure 6.9), some of the watersheds in Puget Sound have eliminated actions that are contradictory and have achieved at least "non-aligned" status in that the proposed sets of actions do no harm to each other. A few have moved further down the continuum toward an integrated approach. The Puget Sound Technical Recovery Team has identified questions and uncertainties about the interaction of "H Factors" in some cases and offered suggestions for furthering this work to these watershed area groups.

The development of a recovery plan for the entire Puget Sound Chinook Evolutionarily Significant Unit has necessitated a comprehensive review of the relationship between habitat, harvest and hatchery programs. The Comprehensive Resource Management Plans for Chinook (harvest and hatchery components) incorporate provisions to integrate their activities with improvement to VSP parameters at the watershed and regional level, such as:

- The Co-managers have established rates of harvest and thresholds that are directly tied to abundance and rebuilding in each watershed. Population levels that fall below low abundance thresholds trigger severe restrictions in the fisheries that potentially intercept these populations before they return to their spawning ground.
- Hatchery programs that are directed toward the recovery of threatened populations of Chinook, such as captive broodstock programs, are being evaluated in the development of local and regional harvest regimes at the Pacific Fisheries Management Council and North of Falcon forums.
- Harvest management forums, such as the Pacific Fishery management Council, have established habitat committees because they recognize that habitat quality affects the performance of the salmon stocks they manage.
- Hatchery reform initiatives have reviewed the relationship of hatchery facilities to habitat conditions, both to evaluate the impacts of the facilities themselves, and to determine whether hatchery programs have looked at habitat capacity in their operational planning.

Additional issues that have been identified for further work on H Integration at the regional level include, but are not limited to:

- Substantial uncertainties exist regarding the interaction of hatchery and wild populations in habitats throughout their life cycle, and how those interactions affect VSP parameters over the long term. These hatchery-wild fish interactions that could affect a population's progress towards recovery include hatchery fish of all salmonid species. This is an important question to address because of the need to ensure that hatchery management is consistent with the habitat protection and restoration strategy towards achieving recovery objectives.
- The capacity of the nearshore to sustain natural- and hatchery-origin populations of all salmonids in Puget Sound requires further evaluation. Local studies of the competition and predation in nearshore areas, such as those underway in the Skagit system, will contribute to regional understanding of this issue.
- More information is needed to analyze the effect of harvest on diversity and spatial structure.
- Resources for monitoring and data analysis are limited, thus the development of regional monitoring and adaptive management plans and the establishment of research and monitoring priorities at a regional scale are important to developing and tracking the effects of H integration actions.

WDFW has indicated their commitment to use their resources, working with tribes as co-managers and local watershed recovery groups, to further the work on H integration strategies in 2005-2006.

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