

THE WILLAPA FISHERIES RECOVERY STRATEGY

**A Cooperatively Developed Plan for Improving the Sustainability of Salmonid Populations
in the Willapa Ecosystem, Washington**

FIRST DISCUSSION DRAFT

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**Developed in Cooperation
by,
THE WILLAPA FISHERIES RECOVERY TEAM
THE WILLAPA ALLIANCE
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STATEMENT OF RESPONSIBILITY

This draft represents the efforts of the Willapa Fisheries Recovery Team to craft a thorough and accurate strategy for improving the sustainability of the Willapa Ecosystem's salmonid populations. It also represents an extensive process to build partnerships between natural resource stakeholders and agencies in the Willapa Basin. However, this document is a first draft of the Willapa Fisheries Recovery Strategy and has been published to elicit discussion and comments from the members of the Willapa Fisheries Recovery Team and other interested parties. It is not a final draft and substantive portions of the document may be changed per the review of the Willapa Fisheries Recovery Team. Additionally, participation in the Willapa Fisheries Recovery Team does not imply endorsement of all portions of this document by any member of the Team. Further review, discussion and revisions by the Fisheries Recovery Team must take place before endorsement may be declared by Team members.

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Mission Statement

The Mission of the Willapa Fisheries Recovery Team is to develop a strategy for increasing and sustaining Willapa fish populations through the following actions; restoring and maintaining key ecosystem functions and processes fundamental to the biological productivity of the system; improving current fish propagation practices to allow the highest level of hatchery production compatible with the maintenance of natural productivity; and by improving methods for utilizing natural resources to secure the health and continued abundance of these resources while developing stability in the economic sectors which depend upon them.

The Willapa Basin [Map 1](#).

INTRODUCTION

Background

The Willapa Bay Basin currently boasts of some of the healthiest salmon populations in Washington state. It is one of the few areas in which fishing for salmon was permitted during the 1993 - 1994 season while the majority of the west coast fishery had been shut down. However, these populations are almost solely dependent upon the production of fish through artificial propagation at the three state operated hatcheries located on the Bay. Naturally spawning populations, are not nearly as robust. The populations of these fish are relatively healthy when compared with the Northwest's other salmon runs, but showing signs of decline.

Additionally, there are significant differences between the conditions of the five species of salmonids which reside in the basin. In particular chum salmon, once the most dominant species in the basin are at only 40 percent of their historic numbers (Suzumoto, 1992). It is also speculated that steelhead and sea run cutthroat trout populations have also shown a serious decline. This is in contrast with overall population sizes of chinook and coho salmon which have actually increased in numbers over historic population sizes. This difference is largely the result of a combination of harvest and habitat related impacts which have affected all of these species, and a disproportional effort to enhance population numbers of chinook and coho salmon with hatcheries without a similar effort to propagate the other species.

The decline in naturally spawning populations of all species of salmonids and the increase in hatchery production has also come with a significant loss in genetic diversity and hence population diversity and resilience. It has also resulted in an increasing dependence upon hatchery production to maintain populations and commercial and recreational fisheries. The decline has also resulted in impacts to ecosystem health. The ecology of Willapa Bay has likely been dramatically influenced by these changes in the fish populations which are manifested in such symptoms as an explosion of burrowing shrimp which inhabit the extensive mudflats of the bay and reduce them to "shrimp barrens" devoid of most other species. It is believed that the once large populations of chum salmon may have been a significant control mechanism for these organisms. Other pieces of the ecosystem have also likely been affected by the loss of energy subsidies once provided by thousands of salmon which were delivered across the landscape to the furthest reaches of the system's numerous streams directly providing nutrients to all levels of the trophic system. The decline has also resulted in reductions of harvest levels on all three salmon in an effort to protect the failing chum runs and also remnant naturally spawning populations of chinook and coho.

The history of Willapa salmon also includes a record of changing and sometimes inconsistent management policies and actions. Fisheries management organizations have instituted and abandoned numerous management strategies for Willapa's salmon as new goals were developed, different understandings of the ecology of the bay and salmon have emerged, and political tides have ebbed and flooded. These shifts in management strategies have resulted in losses to the resource and also the relationship between managers and resource users. It has also resulted in a myriad of uncoordinated projects carried out by both public and private groups which have sought to restore salmonid populations. Lastly, it has resulted in a severely polarized and antagonistic relationship between fisheries managers and user groups and local residents.

Need for the Willapa Fisheries Recovery Strategy

Historically there has been no basin-wide, long-term strategy to coordinate interconnected fisheries management activities throughout the Willapa Basin over time periods of ecological significance. The need for a comprehensive strategy for recovering salmonid populations in the Willapa ecosystem has been demonstrated through the history of salmonid management in the region. It is based upon a concern that remaining naturally spawning populations will be lost and that degraded populations are not currently likely to recover. It is also indicated by downward trends in harvest levels of chum salmon and the predicted decreases in harvest levels of chinook and coho. In short, a fishery which is not sustainable. It is also suggested because management decisions have often been made in with poor information and conjecture because of serious gaps in the information base resulting from the typically limited nature of resources available for decision making and management. A comprehensive strategy is also needed because of a pervasive lack of coordination among fisheries management groups at the federal, state, and local levels which has resulted in incomplete and transitory implementation of fisheries management projects. Lastly, a truly comprehensive process is needed to help bridge the widening gap between management organizations and user groups to establish cooperation in implementing truly effective fisheries management programs.

Another aspect of fisheries management in the Willapa Basin, and many other locations throughout the Northwest, that is currently missing is a mechanism for incorporating local input into management of fisheries resources. There is no avenue for translating a very significant body of information about the Willapa ecosystem and how it functions which is stored in "local knowledge" into management actions. A comprehensive management plan must incorporate this information and perspective. It is similarly important to incorporate local input into the development of management strategies if implementation of a management plan is ever to be achieved. A management plan which relies on forced compliance solely is much less likely to be successful than one which incorporates willing participation..

Basic Principles of the WFRS

Comprehensiveness

There are a series of basic principles on which this fisheries planning process is founded. The first is that such a plan should be a truly comprehensive one, defining its management unit as the Willapa ecosystem (hydrologic boundary of the basin). The plan must consider both ecological and socio-economic factors affecting fisheries management. It should be recognized that economic and social health is intimately tied with environmental health, particularly in natural resource dependent economies like that of the Willapa ecosystem's. The strategy must also consider ecological and socio-economic components of the ecosystem that go beyond the discrete boundary which defines fisheries resources considering in particular other fauna and flora and other natural resource extraction based economic sectors. The Strategy should consider other ecosystem functions and processes outside of the ecological interactions between salmonids and their niche.

A truly comprehensive fisheries management strategy must address all of the significant factors affecting the resource. This means that ecological, artificial production, harvest, economic, and social factors need to be considered. An attempt to address such a broad spectrum of issues can lead to an effort which is so diffuse as to make no forward motion. It can also be daunting from a

professional perspective, with few people being capable of conceptualizing this range of issues. However daunting it is to consider such a wide range of issues, the reality is that the management "problem" or problems which a strategy for Willapa fisheries must address spans this range of issues and must be considered. Fisheries resources are as influenced by social and economic factors as they are by ecological factors. As much as it stretches the cognitive abilities of managers, a truly transdisciplinary approach is absolutely requisite for developing an effective management strategy.

Coordination

The strategy must foster local involvement and coordination and cooperation among resource managers and users. Management nearly completely driven by outside entities has resulted in management strategies which have become to some extent divorced from local priorities and the conditions unique to the Willapa Basin. By maintaining local input in the process, management plans are more likely to be closely tuned to local conditions and be consistent with local priorities while still maintaining priorities which are important to the greater "public" which has a stake in the resource. It is also crucial that the strategy serve as a vehicle for instigating and maintaining coordination and cooperation among groups working to manage fisheries resources in the basin.

Process

It is also recognized that "process" is as important as "outcome" in the development of the Strategy. It is recognized that participants in the development of the Strategy need to be representative of the various stakeholder groups in the basin and be involved throughout the process. The mutual exchange of ideas, information, and perspectives among participants is critical for fostering an improved understanding of management needs. This improved understanding should form the basis of the motivation for implementing the Strategy.

Integration of Local Knowledge and Science

Another central concept of the planning process is the integration of science and "local common sense". Frequently, management plans which are based in the most cutting edge science fall far short of their goals. This is often because the most basic elements of ecosystem management are missed or misunderstood. Even though a sophisticated understanding of ecosystem dynamics may be developed through scientific analysis, some crucial ecological process which can only be assessed through years of observation are overlooked. Also, basic human behavior and needs can be left out of the scientific equation, leading to un-implementable plans. To overcome this, local knowledge and opinions need to be factored into the management equation. The use of this type of information provides a significant challenge to science driven management efforts since it is often un-quantifiable information and frequently difficult to substantiate. There is however no doubt that innovative science plays a central role in developing management strategies. It is equally common to see plans based upon common understandings with a severe absence of quantifiable information. The bottom line is striking a balance between information gained through the use of the scientific method and common sense. Management strategies must be based on information derived through the scientific method, but then evaluated through a filter of common sense and local perspectives. The integration of science and local knowledge in addition to improving the reliability of management plans also serves as an important strategy for disseminating information. Building upon common perceptions with scientifically derived

information is an effective method for explaining and supporting information on complex ecological process to non-scientists.

Adaptive Management

Another central tenant of the WFRS is that it must be an adaptive strategy. Generally, natural systems respond to management activities over periods of decades. Therefore management strategies must also be implemented over comparable periods of time. Initial management strategies must be based upon best available information and the implementation process begun with this basis with an intent to carry management out over an appropriate length of time. It is crucial that an information gathering program be implemented with all management activities. Each management program should be treated as a long-term experiment, an opportunity to learn more about how the ecosystem functions and responds to management activities. The information which is gained through these "experiments" should be added to the available information base and used to update management practices. This is an iterative process which continues over the life of the management plan, in which managers are constantly applying new information to implementation plans, learning from the results of this implementation and revising the management strategy to reflect new information. It is crucial that care is taken that this "adaptive" process is used to "learn" and improve implementation and not used as an excuse for implementation without information. "Adaptive" strategies are easily abused and diligence must be practiced to ensure that scientific rigor forms the basis of the planning process.

Cooperation

Lastly, it is most central to this effort to achieve implementation of the strategy through the development of consensus and cooperative action. With the immense scope of the management problem, the resources needed to manage the fisheries effectively are largely beyond the capacity of any one group or even collection of groups to allocate to the issue. Therefore, to manage such natural resources effectively, the resources of stakeholders and the general public must be leveraged for implementation. The enlistment of stakeholders in implementation is absolutely fundamental to successful management. It is argued that past reliance on regulation and forced compliance in natural resource management has been largely ineffective. Some compulsory management will likely always be necessary, but to effect management at the spatial and temporal scale that is needed, the willing participation of those who affect and are affected by the resource is crucial. It is also asserted that the development of consensus and cooperation is best achieved through stakeholder participation in the planning process. Involvement at this stage fosters "ownership" of or "buy-in" to management plans. It also provides a mechanism for transferring local knowledge to the process. Participation in the planning process provides a significant learning opportunity for all involved. When stakeholders have a hand in shaping management strategies and are participants in making difficult management decisions an improved understanding of why certain actions are necessary is developed. With an understanding of why these actions are necessary a marked increase in cooperation during the implementation of those actions is expected. Some induced compliance will likely be necessary when individual sacrifices must be great, but overall, the resources needed to enforce and police management actions should be greatly reduced.

The Process and Participants

The WFRS process was initiated in 1991 with an initial scoping of fisheries management issues

in the Willapa ecosystem carried out by the Willapa Alliance with the assistance of Ecotrust and The Nature Conservancy. The scoping provided basic information on the condition of Willapa fisheries and identified the need for a process which would develop a comprehensive fisheries management strategy (Suzumoto, 1992). The Willapa Alliance took the lead as chief facilitator for the effort. Relying on fisheries management professionals and local stakeholders a series of initial meetings were held to solidify how the process should be carried out and who the key participants should be. These professional were organized as the Willapa Fisheries Recovery Team and has taken the shape of a flexibly organized team of individuals who represent a wide range of perspectives concerning the management of fisheries resources in the Willapa Bay Basin.

A consensus process was identified as the preferred method for planning and a multilevel team approach, with one large policy level team and a smaller technical team, selected for implementing the process. The team structure was designed to foster consensus building while creating the conditions needed in order to ensure that the work involved in developing a plan would be carried out. All team participants do so voluntarily and without direct compensation for their efforts from the Willapa Alliance. Some participants are paid by their organizations but a number of members are self employed and donate their own time and expertise to the effort.

The larger policy team's membership comprises all of the key affected parties involved in fisheries management in the Willapa ecosystem. Their role is to select the agenda for the process, identify the key problems that the process should identify, and set the goals which the strategy endeavors to meet. The policy team also serves as a consensus building and educational forum for fisheries managers and stakeholders. It is comprised of representatives from all of the primary federal, state, and local management organizations, local user groups, industry, and conservation organizations.. Participating groups include the United States Fish and Wildlife Service, National Marine Fisheries Service, Environmental Protection Agency, Natural Resource Conservation Service, The Shoalwater Bay Indian Tribe, the Washington Departments of Fish and Wildlife, Natural Resources, and Ecology, the Pacific Conservation District, Willapa Bay Water Resources Coordinating Council, Pacific County, a representative from the local ports, Pacific County Economic Development Council, the Pacific County Farm Forestry Association, the Willapa Bay Gillnetters Association, Weyerhaeuser Company, Hancock Timber Resource Group, a representative from the local oyster growers, and representatives from two environmental organizations, The Nature Conservancy and Ecotrust. ([Table 1](#))

A smaller, more strategic technical team was selected by the larger policy team to develop the specifics of the strategy for meeting the goals established by the policy team. This group is responsible for data collection, analysis and interpretation. A transdisciplinary group comprised of some of the policy team members and others was selected to provide professional expertise in riparian ecology and fish biology, geomorphology, forest management, hatchery operations, fish harvest management, and social and economic studies. Team members do not represent specific organizations but rather specific professions and fields of study. Members come from federal and state agencies, the commercial forestry industry, the fishing industry, universities, and conservation organizations. ([Table 2](#))

Table 1. Willapa Fisheries Recovery Team Participants

Mark Ashley	Willapa Fisheries Enhancement Group / Willapa Gillnetters Association
Pete Bisson	Weyerhaeuser Company
Ralph Boomer	US Fish And Wildlife Service
Rick Brix	Washington Department of Fish and Wildlife
Michelle Brown	The Nature Conservancy
Lonnie Crumley	Washington Department of Fish And Wildlife
Mike Dickerson	ShoreTrust Trading Group
Kent Dimmitt	Washington Department of Fish and Wildlife
Larry Dominguez	US Fish and Wildlife Service
Brett Dumbauld	Washington Department of Fish and Wildlife
Bob Falkner	Pacific County Farm Forestry Association
Chuck Gale	Washington Department of Ecology
Mike Gross	Washington Department of Fish and Wildlife
Jerry Gutzwiler	Weyerhaeuser Company
Jennifer Hagen	Shoalwater Bay Indian Tribe
Pat Hamilton	Pacific County Board of Commissioners
Tom Hedt	Natural Resource Conservation Service / Pacific Conservation District
Chuck Hoskinson	Weyerhaeuser Company
Rex Hutchins	Washington Department of Natural Resources
Joe Krupa	Trout Unlimited
Bob Lake	Willapa Gillnetters Association
Steve Landino	US Fish and Wildlife Service
Jack Listfjeld	Washington Department of Fish and Wildlife
Matt Longenbaugh	National Marine Fisheries Service
Wayne Marion	Hancock Timber Resource Group
Jim Neva	Port of Willapa
Rachel Nugent	Pacific Lutheran University
Marty Peoples	Washington Department of Fish and Wildlife
Norris Petit	Willapa Gillnetters Association / The Willapa Alliance
Dick Stone	Washington Department of Fish and Wildlife
Dennis Tufts	Bendicksons (Oyster Grower) / Willapa Bay Water Resources Coordinating Council
Jim Ward	Weyerhaeuser Company
Miranda Wecker	Willapa Alliance / Willapa Bay Water Resources Coordinating Council
Katharine Wellman	Battelle

Table 2. Willapa Fisheries Recovery Team - Technical Group

- Mark Ashley - harvest management, fish culture, and local knowledge

- Pete Bisson - fish biology and ecology, forest practices
 - Jon Bowers - GIS support and data management
 - Lonnie Crumley - fish ecology and fish culture
 - Mike Dickerson - economic development
 - Kent Dimmitt - fish ecology and fish culture
 - Larry Dominguez - fish ecology and habitat restoration
 - Kari Gardey - GIS applications
 - Jack Listfeld - habitat restoration
 - Rachel Nugent - economics and sociology
 - Marty Peoples - estuarine habitat and local knowledge
 - Norris Petit - harvest management, fish culture, local knowledge
 - Dick Stone - harvest management, fish culture, and fish ecology
 - Jim Ward - geology, forest practices
 - Katharine Wellman - economics and sociology
-

Regular meetings of the policy team were held to establish the agenda and identify the problems and goals for the process. Policy team meetings have also been held to monitor the activities of the technical team and provide direction for their efforts. The technical team has met on a more frequent basis to collect, analyze and interpret data.

The process of consensus building has proven to be a slow and time consuming one. A significant variety of priorities for fisheries management exists among the participating groups as well as an equally diverse number of perspectives on how management goals can be achieved. These differences in perspectives lead to an interesting diversity in assessments of what the primary problems facing fisheries resources in the Willapa Basin are perceived to be.

Problems and Goals Identification

The first task of the WFRT was to identify through a consensus process a complete list of the most important problems believed to be facing the health and sustainability of Willapa fish populations. The next step was to develop from this list a corresponding set of goals for fisheries management for addressing the identified problems. The initial perceptions of the "problems" facing Willapa fish populations were very diverse. The identification of problems and goals was accomplished through a series of meetings where opinions and available information were debated by the policy team. A number of versions of a description of the problems and goals identified by the team were developed and reviewed and rewritten by the team employing a winnowing process to consolidate perspectives and potential problems and to rule out others. A final draft was accepted by the team after approximately three months of work.

The following is the complete Problems and Goals Statement developed by the WFRT.

Problems and Goals Statement

Assumptions

The following assumptions were made to provide a starting point for the identification of problems and goals.

Geographic Scope of the Strategy

The focus area of the strategy is Willapa Bay and its drainage basin. It is recognized that some of the issues which will be addressed by the strategy are influenced by elements which go beyond the boundaries of the basin. Such elements should be given consideration in the strategy but attention focused on efforts to be undertaken within the Willapa Basin.

Terminology

The terminology used by the team and applied in the strategy must be clarified and used consistently. There are differences of opinion regarding the best terminology and definitions, however, the team will use the Washington Department of Fish and Wildlife Salmon and Steelhead Stock Inventory (SASSI) definitions to start since they have been clearly defined and relatively widely distributed. These definitions may be modified by the WFRT as needed as the strategy is developed. When drafted, the terminology used in the strategy should be precisely defined in the document. ([Appendix 4](#))

Historic Conditions

When known, pre-industrialization watershed conditions and fish population sizes provide a useful reference point for establishing current habitat and population size goals. An understanding of historic conditions also provides a useful tool for designing habitat restoration. It is however not desirable to use a return to historic conditions as a management goal because of the following reasons. First, it is unclear what these conditions were. Second, because of the current status of local and regional resource conditions and circumstances, a return to historic conditions may not be biologically practical or desirable. Finally, current social and economic needs may not be served by a return to historic conditions.

Prioritization of Resource Management Activities

Availability of resources and opportunities for improving the status of fisheries in the Willapa Basin are finite. It is therefore imperative that the actions recommended by the strategy be as efficient as possible. To accomplish this the strategy should identify critical opportunities for intervention and prioritize the implementation of efforts which address these opportunities. This includes targeting "problems" which offer an opportunity for being solved, as opposed to "lost causes". Directing management efforts toward points of critical intervention may provide for a greater likelihood that implementation will have the desired effect on the resource, a greater likelihood of successful implementation, and also for increased efficiency from implementation efforts. The strategy needs to establish near-term and longer-term priorities for resource maintenance and restoration activities. It should target key ecological processes that underlay the productivity and health of the natural environment. The strategy will focus on restoring and maintaining ecological functions or processes as opposed to physical characteristics. The strategy will also focus on key opportunities to enhance and maintain the Willapa economy and the effectiveness of organizations working to implement sound resource management in the Willapa Basin.

An ecologically and economically balanced fisheries recovery strategy should include efforts to both restore fish populations and ecosystem health but also seek to prevent further degradation of the resource. Maintenance of existing healthy, functioning watersheds and fish populations is often a more economically and ecologically efficient course of action than allowing degradation

to occur and then implementing restorative activities to recover resource health. To this end, wherever possible (and ecologically and economically feasible) the strategy will seek to develop recommendations for activities which maintain current habitat functions and the health of fish populations in the Willapa Basin.

Endangered Species Act (ESA)

There is a significant likelihood that listing of various salmonid species as threatened or endangered under the ESA will occur in the near term. This bears importance for the WFRS in two ways. First, it will be important that developments which occur under ESA are closely tracked so that recommendations developed under the strategy comply with the Act, reducing the need for Federal intervention in resource management in Willapa. Second, it is unlikely that recommendations aimed at restoring salmonid stocks through habitat improvements will conflict with ESA requirements. It will however be necessary to track ESA developments to ensure that the required federal permits are obtained if activities are to take place in an area inhabited by a listed stock.

Adaptive Management

The team will need to base its recommendations for enhancement and restoration actions on the best available information, both peer-reviewed and anecdotal. The status of fisheries resources and habitat in the Willapa Basin has not been adequately studied and documented to provide the team with a satisfactory base of information. Therefore, the work of the recovery team must take place amidst a great deal of uncertainty. It is unlikely that thorough scientific analysis of the stocks and habitat will be completed in the near term. The team and the Fisheries Recovery Strategy will encourage the development of a greater understanding of all aspects of fishery resources and habitat. In addition to activities aimed solely at data acquisition and analysis this will require that management activities also include scientifically valid data gathering components to monitor the impact of management and improve the current information base. The team will review and analyze this information as it is gathered and refine its resource management recommendations and implementation projects to reflect new understandings which result from the analysis.

Problems and Goals

Chinook Salmon

Problem Statement

In general, there is a great deal of uncertainty about the status of naturally-spawning (n-s) chinook salmon stocks in the Willapa Basin. Data on n-s populations is insufficient to derive accurate estimations of population sizes. Wild Fall River chinook are classified by SASSI as being "depressed" and are the only population identified as being in a depressed or critical state. N-s populations are currently believed to be below desired levels. Hatcheries have become the dominant contributor to chinook production in the Willapa Basin. Our current understanding suggests that commercial and recreational harvest levels are dependent upon hatchery production. Genetic features of local chinook stocks have been altered by the introduction of brood stock from other watersheds. Little is known about the success of hatchery strays. It is probable that intra-species diversity is declining. It is probable that the size of adults is declining. The timing of adult returns is more compressed than that prior to the operation of hatcheries.

Goals

- Identify special habitat needs of chinook salmon.
- Quantify the current carrying-capacity of the Willapa ecosystem for chinook salmon.
- Quantify to the greatest extent possible trends in the size, watershed distribution, and life history patterns of chinook populations from pre-industrialization to the present time period.
- Develop a better understanding of life history patterns of Willapa chinook stocks.
- Develop a better understanding of the ecological role of chinook salmon in the Willapa ecosystem.
- Develop a better understanding of the survival rates of n-s chinook and hatchery strays.
- Develop a better understanding of changes in chinook population characteristics due to hatchery influences.
- Increase population sizes of n-s stocks.
- Increase the carrying-capacity of the Willapa Basin to sustain and increase n-s chinook population sizes to ensure the viability of n-s stocks and provide a harvestable surplus.
- Rehabilitate habitat specifically required by chinook salmon.
- Protect and improve current levels of chinook genetic diversity.
- Assure future of commercial fisheries and recreational fishing opportunities.
- Develop and implement propagation measures which do not harm n-s stocks and that employ methods that more closely mimic natural rearing and provide for: a broader distribution of run timing and locations, greater genetic diversity and therefore species resilience, juveniles better adapted to survival in the wild.
- Develop a better understanding of and monitor data collected on the harvest of local chinook.
- Reduce illegal capture.

Coho Salmon

Problem Statement

The level of abundance of Willapa coho stocks is largely unknown and uncertain and additional data is not currently being collected. Data on n-s populations is insufficient to derive accurate estimations of population sizes. A petition for listing under the ESA all coho stocks on the west coast has been submitted and current indications suggest that some form of protective designation is likely. However, enough indicators suggest that there is a harvestable surplus of coho in Willapa and therefore a quota for commercial harvest exists. As with chinook, hatcheries have become the dominant contributor to coho production in the Willapa Basin. Current information suggests that harvest levels are dependent upon hatchery production. Hatcheries have effected the genetic makeup of Willapa coho through years of introducing fish stocks from outside the Basin. Little is known about the success of coho hatchery strays. It is also probable that the size of adults is declining and the timing of adult returns is more compressed than that common prior to the operation of hatcheries.

Goals

- Identify special habitat needs of coho salmon.
- Quantify the current carrying-capacity of the Willapa Basin for coho salmon.

- Quantify to the greatest extent possible trends in the size, watershed distribution, and life history patterns of coho populations from pre-industrialization to the present time period.
- Develop a better understanding of life history patterns of Willapa coho stocks.
- Develop a better understanding of the ecological role of coho salmon in the Willapa ecosystem.
- Develop a better understanding of the survival rates of n-s coho and hatchery strays.
- Develop a better understanding of changes in coho population characteristics due to hatchery influences.
- Increase population sizes of n-s stocks.
- Increase the carrying-capacity of the Willapa Basin to sustain and increase n-s coho population sizes to ensure the viability of n-s stocks and provide a harvestable surplus.
- Rehabilitate habitat specifically required by coho salmon.
- Protect and improve current levels of coho genetic diversity.
- Assure future of commercial fisheries and recreational fishing opportunities.
- Develop and implement propagation measures which do not harm n-s stocks and that employ methods that more closely mimic natural rearing and provide for: a broader distribution of run timing and locations, greater genetic diversity and therefore species resilience, juveniles better adapted to survival in the wild.
- Develop a better understanding of and monitor data collected on the harvest of local coho.
- Reduce illegal capture.

Chum Salmon

Problem Statement

Based on past harvest records, of all the Willapa salmonid species, chum appear to have experienced the greatest documented decline in abundance. There is more data on chum escapement than other salmonid species but more is needed to produce accurate estimations of population sizes. Hatchery production has had a much smaller impact on chum populations than on chinook and coho populations. Most chum enhancement projects were curtailed by 1989 due to budgetary constraints. The limited nature of efforts to enhance chum populations can be attributed to their classification as a low value species in spite of their vital importance in the ecology of Willapa Bay. Most current chum stocks are naturally-spawning runs and therefore average size and timing have not been altered significantly by hatchery influences. Harvest of coho has been limited in order to protect these n-s chum salmon runs. Indicators suggest that there is high quality chum habitat that is currently underutilized. There is no certainty about why the habitat is not being used. In some instances, there may be physical barriers to passage. There also has been a loss of habitat due to road and dike construction.

Goals

- Identify special habitat needs of chum salmon.
- Develop a better understanding of habitat utilization by chum salmon.
- Better quantify declines in chum salmon populations.
- Quantify the current carrying-capacity of the Willapa Basin for chum salmon.
- Quantify to the greatest extent possible trends in the size, watershed distribution, and life history patterns of chum populations from pre-industrialization to the present time period.

- Develop a better understanding of life history patterns of Willapa chum stocks.
- Develop a better understanding of the ecological role of chum salmon in the Willapa ecosystem.
- Develop a better understanding of the survival rates of n-s chum and hatchery strays.
- Develop a better understanding of changes in chum population characteristics due to hatchery influences.
- Increase population sizes of n-s stocks.
- Increase the carrying-capacity of the Willapa Basin to sustain and increase n-s chum population sizes to ensure the viability of n-s stocks and provide a harvestable surplus.
- Rehabilitate habitat specifically required by chum salmon.
- Protect and improve current levels of chum genetic diversity.
- Assure future of commercial fisheries and recreational fishing opportunities.
- Develop and implement propagation measures which do not harm n-s stocks and that employ methods that more closely mimic natural rearing and provide for: a broader distribution of run timing and locations, greater genetic diversity and therefore species resilience, juveniles better adapted to survival in the wild.
- Develop a better understanding of and monitor data collected on the harvest of local chum.
- Reduce illegal capture.

Steelhead

Problem Statement

Local, anecdotal data suggests that steelhead populations have declined significantly in number and in size. Populations are currently below desired levels. A petition for listing under the ESA all west coast steelhead stocks has been submitted and current indications suggest that some form of protective designation is likely. Spawning surveys have been conducted and continue to be conducted in the Willapa Basin but information on population status and trends is inadequate. Willapa steelhead populations have been enhanced using non-native stocks, but the impacts of these introductions are not known. The perceived decline in abundance is thought to be partly attributable to the extremely low rate of ocean survival. Offshore harvest may also be playing a part in the low rate of return.

Goals

- Identify special habitat needs of steelhead.
- Develop better understanding of habitat utilization.
- Quantify to the greatest extent possible trends in the size, watershed distribution, and life history patterns of steelhead populations from pre-industrialization to the present time period.
- Quantify the current carrying-capacity of the Willapa Basin for steelhead.
- Develop a better understanding of life history patterns of Willapa steelhead.
- Develop a better understanding of the ecological role of steelhead in the Willapa ecosystem.
- Increase population sizes of n-s stocks.
- Increase the carrying-capacity of the Willapa Basin to sustain and increase n-s steelhead population sizes to ensure the viability of n-s spawning stocks.

- Rehabilitate habitat specifically required by Steelhead.
- Assure future of recreational fishing opportunities
- Develop and implement propagation measures which protect n-s stocks and that employ methods that more closely mimic natural rearing and provide for: a broader distribution of run timing and locations, greater genetic diversity and therefore species resilience, juveniles better adapted to survival in the wild.
- Develop a better understanding of and monitor data collected on the harvest of local steelhead.
- Reduce illegal capture.

Cutthroat Trout

Problem Statement

The population status and trends of sea-run cutthroat trout have not been documented. Local observations suggest a substantial decline in trout numbers. Habitat requirements of cutthroat trout are not well understood.

Goals

- Identify special habitat needs of cutthroat trout.
- Develop better understanding of habitat utilization.
- Quantify the current carrying-capacity of the Willapa Basin for cutthroat trout.
- Quantify to the greatest extent possible trends in the size, watershed distribution, and life history patterns of cutthroat trout populations from pre-industrialization to the present time period.
- Develop a better understanding of life history patterns of Willapa cutthroat trout.
- Develop a better understanding of the ecological role of cutthroat trout in the Willapa ecosystem.
- Assure future of recreational fishing opportunities

White Sturgeon

Problem Statement

Available data suggests that population levels of white sturgeon are currently sustainable. Information on population status and trends is inadequate. Scientists believe that there is one continuous population of sturgeon inhabiting the coastal region from Grays Harbor to Tillamook Bay and that there is little or no spawning outside the Columbia River. Sport fishing pressure has dramatically increased raising concerns about population resilience.

Goals

- Develop better understanding of sturgeon population status and trends.
- Develop better understanding of habitat utilization.
- Develop a better understanding of life history patterns of Willapa white sturgeon populations.
- Develop a better understanding of the ecological role of white sturgeon in the Willapa ecosystem.
- Assure a harvestable surplus.

- Reduce illegal capture.

Fresh Water Habitat - In-stream, Riparian, and Watershed

Problem Statement

There is a lack of information on current and historic watershed/habitat conditions for most watersheds in the Willapa Basin. Information on watershed/habitat conditions exist but generally is not compiled in a way in which it may be utilized for watershed management. A number of categories of habitat degradation have been identified which include the following: (1) loss of suitable habitat due to land development, sediment inputs, altered hydrologic flow regimes, and lack of currently existing and future inputs of in-stream large organic debris (2) in-stream blockages which prevent salmon from gaining access to habitat (3) non-point pollution problems arising from nutrient loading (4) in-stream temperature problems related to reduced shade cover and low water flows.

Goals

- Collect and synthesize currently available data on watershed/habitat conditions.
- Integrate currently available with newly obtained data.
- Collect and analyze data on pre-industrialization and current watershed/fish habitat conditions and functions throughout the Willapa Basin through appropriately designed and executed research.
- Develop a prioritized list of watershed/habitat data needs and direct data collection, analysis, and synthesis efforts with this list.
- Seek to restore functions and processes when carrying out habitat restoration work. One component of functional restoration is restoring channel/watershed connectivity. This entails restoring the natural pathways for sediment, wood and organic material exchanges between streams, their flood plains, and their watersheds.
- Reduce inputs of fine and coarse sediments to rivers and streams.
- Minimize water withdrawals that contribute to low stream flows.

Saltwater Habitat

Problem Statement

Studies indicate that Willapa Bay receives pollutant inputs from the Columbia River as well as increased fresh water contributions as a result of altered hydrologic processes related to the operation of dams. It is not known whether the effects of these inputs are significant. Some non-point source pollutant inputs to Willapa Bay originate from within the Willapa Basin but it is unclear to what extent these sources result in water quality impairment. Estuarine/shoreline land functions have been altered through a variety of land uses. As a result, fish habitat has been lost and it is likely that the estuary's carrying-capacity for fish populations has been diminished. As human populations have increased in the coastal zone, pressure for development near key saltwater habitat areas has increased. In addition, there has been a substantial increase in recreational uses of marine waters. Sediment input rates into the bay have been altered as a result of land uses. It is uncertain what effect these alterations have had on estuarine functions. Ocean conditions are believed to have important effects on salmonid survival but current information on how ocean conditions affect populations, how these conditions fluctuate over time, and the

mechanisms which control these conditions is very limited. Also, the exotic weed *Spartina* poses a threat to the estuarine rearing and feeding habitat upon which Willapa Bay fish stocks depend.

Goals

- Collect and analyze data on pre-industrialization and current estuarine habitat conditions and functions throughout Willapa Bay through appropriately designed and executed research.
- Develop recommendations for improving estuarine habitat conditions and availability.
- Track and evaluate current and new information as it becomes available on the relationship between ocean conditions and salmonid population sizes.

Predation

Problem Statement

The effect of marine mammal predation on salmonid populations in Willapa is currently unknown. The extent and impacts of hatchery fish predation on n-s is not known. There is also uncertainty about whether other fish act as significant predators on juvenile salmonids.

Goals

- Improve understanding of predator effects on salmonid populations in Willapa through analysis of currently available data on marine mammal populations and improving predator monitoring efforts.

Harvest Management Issues

Problem Statement

Salmonid harvest rates are likely to have a significant effect on the health of Willapa populations. The livelihoods of an important segment of the Willapa community depends on opportunities to commercially harvest salmon. Fishermen have been subjected to a complex series of restrictions that have made their businesses less predictable and reliable as a source of income. There currently are underutilized fisheries resources in the Willapa Basin.

Goals

- Develop a better understanding of harvest management factors such as the offshore fishery and run predictions.
- Develop strategies to make a better future for the commercial fishing industry and the sports fishery.
- Reduce illegal fishing.
- Develop practical strategies to allow escapement of n-s fish and harvest of hatchery fish.
- Explore opportunities for developing alternative fisheries.

Propagation

Problem Statement

There is no policy defining the long-term role of salmonid hatchery contributions to fish populations. Improved techniques for developing a better brood stock still need to be developed

and implemented. Past hatchery practices have led to increased risks to salmonid population health because they did not consider: the conservation of genetic diversity and the role of natural selection, the role of more natural rearing methods in ensuring the fitness of individual fish, the relationship between hatchery releases and the carrying capacity of the systems into which fish were released, and the interaction between hatchery releases and non-hatchery produced fish. It is likely that the reduction of hatchery contributions on a wide scale would lead to a dramatic reduction in run size and a reduction of opportunities for recreational and commercial harvest. There is currently insufficient monitoring and evaluation of propagation activities for their effectiveness and impact on population dynamics and characteristics.

Goals

- Develop improved hatchery practices (BMPs).
- Develop a strategy for local enhancement projects.
- Define the long-term role of salmonid hatchery contributions to fish populations.
- Develop monitoring and evaluation for propagation efforts.

Institutional and Policy Issues

Problem Statement

There is presently no clear direction for managing salmonid populations to achieve the utilization of harvestable surpluses while ensuring that n-s populations are sustained. Inter and intra-agency coordination appears to be inadequate as harvest allocation decisions seem unconnected to both enhancement and habitat-related decision making. Cooperative and trusting relationships between local communities and agency decision makers have been missing in the past. There is a need for more implementation approaches that are non-regulatory and non-adversarial, such as education programs and incentives for best management practices. Regulatory activities rely too heavily on disincentives as opposed to incentives to achieve management objectives.

Goals

- Improve inter and intra-agency coordination on related issues.
- Improve communication, trust and cooperation among communities and regulators.
- Develop an overall strategy for coordinating harvest, enhancement and habitat decision making.
- Develop incentive programs and other non-regulatory approaches to achieve fish harvest and habitat management goals.

Socio-Economic Issues

Problem Statement

Threats to the health and vitality of the fisheries resources within the Willapa Basin create social and economic stress for the commercial and sport fishing sectors. They also create general instability for other resource based economic sectors and ultimately the entire Willapa community. A large percentage of the fish that is landed in Willapa is shipped out of the Basin without processing or adding value resulting in lost economic opportunities. Pressures on the resource are increasing as other areas' resources decline. Government agencies at federal, state, and local levels all currently lack the financial resources to assist small communities through

periods of economic stress. Traditional approaches to harvest and propagation have led to legal obstacles to potential solutions. Current restrictions and laws inhibit the development of solutions to fisheries management problems.

Goals

- Help assure the future viability of the commercial and recreational salmon fishing industries.
- Identify ways to build sustainability into the commercial and recreational fishing industries.
- Explore ways to ease the transition of the fishing sector to the future desired conditions.
- Add value to more fish landed in Willapa area.
- Increase and stabilize sport fishing opportunities.
- Explore new alternatives to the problems addressed above.
- Develop innovative approaches to enhancing both the commercial and sports fishery in Willapa.

Overarching Problems and Goals and A Mission Statement

The overarching goal of the WFRS is to restore the productivity and sustainability of salmonid populations in the Willapa ecosystem. Another central goal is to restore the ecological balance of the system which these populations are an integral part of. Recovery includes the restoration of self sustaining populations of all five salmonid species over a distribution and at numbers similar to historic conditions. It also means the restoration of the historic characteristics and biological diversity of these populations. This recovery serves both ecological and socio-economic priorities.

Another important goal of the WFRS is to secure a sustainable harvestable surplus of salmon for both commercial and sport fisheries. Fishing is an important economic and social component of the Willapa community. It is important that the economic benefits derived from resource use is maintained and ultimately improved. The economic and social benefits from commercial and sport fishing also provide an important impetus for maintaining the health of the ecosystem. In this way the productivity and health of Willapa's fish populations and its ecosystem in general is intimately linked with the economic and social health of Willapa's human communities. It is crucial to recognize this linkage in the development of management strategies.

One of the key fisheries management problems identified is the lack of coordination among management efforts. This lack of coordination occurs between managers and resource users, within and between state and federal management agencies, between local management efforts, and between local management efforts and state and federal programs. It is hoped that through the development of a comprehensive strategy which involves all of the players in fisheries management, greater coordination and cooperation will be achieved. Also a lack of consistency among management efforts implemented by different organizations and also the same organizations has been identified as a significant management problem. It has been recognized that management efforts must be carried out over extended periods of time in order to realize significant ecosystem responses. Frequently management is not carried out over the long term or even simply followed through on. A goal of the WFRS is to institute a greater degree of

consistency among management efforts over long periods of time. This consistency and longevity must however be carefully balanced with the "adaptive" approach. Subscription to an adaptive management approach should not be used to validate inconsistent and unfinished management efforts but more appropriately used in earnest to foster information gathering and learning and the updating of management practices.

Lastly, as discussed in the previous section, the scope of the management problem requires an allocation of significant amounts of resources to implement effective management. It is beyond the ability of any one organization to make all the resources needed available. It is the goal of the WFRTS to promote cooperation among all affected parties to leverage available management resources most efficiently.

From this identification of problems and goals a mission statement was developed by the Team. The following is the final version of the mission statement adopted by the WFRT.. "The Mission of the Willapa Fisheries Recovery Team is to develop a strategy for increasing and sustaining Willapa fish populations through the following actions; restoring and maintaining key ecosystem functions and processes fundamental to the biological productivity of the system; improving current fish propagation practices to allow the highest level of hatchery production compatible with the maintenance of natural productivity; and by improving methods for utilizing natural resources to secure the health and continued abundance of these resources while developing stability in the economic sectors which depend upon them."

The Technical Process

The list of issues and problem and goals statement developed by the Willapa Fisheries Recovery Team established a starting point and boundaries for developing an understanding of the factors which affect the productivity of Willapa's salmonid stocks and a strategy for maintaining and improving their sustainability. The Problems and Goals Statement was used to develop work plan for the Technical Team. The WFRT convened a group of experts, the Technical Team, to define an approach and collect the necessary data, complete the appropriate analysis and interpretation and develop recommendations for a strategy for addressing the problems and goals which they defined at watershed by watershed level. The Technical Team is a transdisciplinary group comprised of some of the policy team members and others selected to provide professional expertise in riparian ecology and fish biology, geomorphology, forest management, hatchery operations, fish harvest management, and social and economic systems. Team members do not represent specific organizations but rather specific professions and fields of study.

The WFRT was kept informed and provided guidance to the Technical Team as it proceeded with the analyses, to assure that the resulting strategy was as responsive as possible to the full range of problems and goals identified by the WFRT.

The technical process was initiated soon after the completion of the problem and goals statement and the development of a work plan. The technical team has met on a regular basis to evaluate available data on ecological processes and conditions, artificial production, harvest, and social and economic conditions and trends. The analysis has been organized using hydrologic watershed boundaries as management units. The available data has largely been compiled from state and federal agency databases and organized, stored and analyzed in a Geographic

Information System operated by the Willapa Alliance. Additionally, GIS models have been developed for carrying out further predictive analysis with the available data. A severe lack of data on both ecological and socio-economic conditions has been discovered through the process. Modeling work with the GIS has helped to overcome some of the ecological data gaps, but many still remain, particularly for socio-economic conditions. A series of recommendations from this analysis focuses on priority data collection activities.

Throughout the technical phase of the process, reports on the emerging analysis methodologies and results have been made by the technical team to the policy team. The purpose of these reports was to provide opportunities keep the policy team abreast of the technical process and to provide opportunities for policy members to comment on technical procedures to ensure that the technical process remains consistent with the direction set by the policy team. The reports also serve as tools for maintaining consensus and participation in the process.

The Technical Team determined that its work could best be performed by breaking into three subgroups, each assigned to address one element of the mission statement: (1) ecological processes, (2) production and harvest; and (3) social and economic factors.

Ecological Process Section

The Ecological Processes Working Group was directed to propose recommendations that would address the first element of the mission statement and problem and goals: *"to restore and maintain key ecosystem functions and processes fundamental to the biological productivity of the system."* More specifically, it was asked to assess the relative significance of key limiting factors that are known to inhibit fish production. They were also instructed to seek information on historic conditions and define opportunities for improving and protecting the productivity of existing habitat

The Ecological Processes Working Group decided to focus on two areas: (1) key limiting factors and (2) status and trends information. With regard to key limiting factors, it was important to work with measurable indices or reasonable surrogates. The group formulated an initial list of the most useful data layers that are available to inventory the basin and watersheds. Members were asked to look for sources of these data. The following information was thought useful: slope, soils, geology, instability; roads; surficial geology; hydrology; riparian forest conditions; canopy data; and fish distribution. The group also decided to divide the Willapa Basin into eight watersheds: the North, Willapa, Palix, Nemah, Naselle, Bear, Long Island; and Long Beach.

The following analysis system was developed by the group to evaluate and compare limiting factors within and between watersheds. The system is presented as a series of matrices which employ a scoring system to compare and rank the indices evaluated for each watershed. Indices were identified to address current salmonid productivity, potential impacts to salmonid productivity, actual impacts to salmonid productivity, and salmonid habitat quality. All feasible parameters for assessing the various indices which could be identified are included in the matrices, but a number of these can not be currently evaluated due to the absence of data for these parameters. These data gaps form the basis for prioritizing future data acquisition activities. The parameters have not been weighted differently and contribute equally to the final evaluation. The results of the analysis were then used by the EPWG to develop management responses

which in turn were adapted as management recommendations upon completion of the analysis of production and harvest and social and economic factors. The following is an explanation of the indices used.

- *Salmonid Productivity*: Current salmonid productivity assesses each watershed's current capacity to produce salmonids by assessing various parameters that measure actual salmonid production over time in the watershed.
- *Potential Impacts to Salmonid Productivity*: This index evaluates parameters which measure factors which are likely to reduce the current and future salmonid productivity in each watershed. These parameters are not direct measurements of habitat conditions or other factors, but rather measure factors which may affect productivity in a specific manner.
- *Actual Impacts To Salmonid Productivity*: In contrast, actual impacts to salmonid productivity assess existing features of the watershed that reduce the productivity of salmonid populations.
- *Salmonid Habitat Quality*: Is essentially the inverse of the potential and actual impacts indices, measuring the potential and actual productive capacity of a watershed. This index is somewhat similar to both indices, but evaluates parameters which potentially and actually increase salmonid productivity instead of those which reduce it. This index is specifically used to identify habitat areas of high value.

These matrices are presented on the following images.

[Table 3. Ecological Processes Analysis - Salmonid Population Status](#)

[Table 4. Ecological Processes Analysis - Potential Impacts](#)

[Table 5. Ecological Processes Analysis - Impacts](#)

[Table 6. Ecological Processes Analysis - Quality](#)

Production and Harvest Section

The Production and Harvest Working Group was instructed to address the second element of the mission statement and problems and goals: "*to allow the highest compatible level of hatchery production.*" In order to fulfill this task, the group was asked to define and address the key concerns raised by artificial enhancement techniques, and develop a strategy to both strengthen naturally-spawning runs and provide a harvestable surplus for recreational and commercial fishing interests.

The PHWG first developed a discussion of relevant harvest and production issues. A series of "opinions" based on the review of available scientific literature, professional experience, and local knowledge were then developed to address these issues. This discussion and opinion (as a white paper) was presented to the WFRT for review and comment and revised. It is presented as

[Appendix 1](#) for reference to the Production and Harvest Recommendations. The Production and Harvest White Paper was then used to develop a methodology for evaluating production and harvest conditions watershed by watershed throughout the Willapa Basin. The methodology developed was similar to that used in the Ecological Process analysis and employed a series of matrices for measuring and comparing a variety of parameters. The analysis evaluated genetic resources, production balance, current harvest, and artificial production. The PHWG then reviewed the data already collected by the Willapa Alliance (Suzumoto, 1992) and gathered additional information on escapement; artificial production and harvest. A method similar to the one used in the ecological analysis was developed to evaluate conditions. The results of the analysis were then used by the PHWG to develop management responses which in turn were adapted as management recommendations upon completion of the other analysis. The following indices were used.

- *Genetic Resources*: This indices evaluates the genetic characteristics of salmonid populations in each watershed through an evaluation of propagation and other influences. This evaluation provides an assessment of the potential genetic integrity of salmonid stocks in each watershed.
- *Production Balance*: The production balance indices considers the current production goals and influencing factors of each watershed. It provides an assessment of the current production orientation, natural or artificial, of each watershed.
- *Current Harvest*: Similar to the production balance parameter indices, the harvest indices evaluates the current harvest goals and factors of each watershed. It provides ad assessment of the current harvest priorities and goals of each watershed.
- *Artificial Production*: This indices evaluates parameters which influence the suitability of each watershed for artificial production.

This matrix is presented in the following image.

[Table 7. Ecological Processes Analysis - Salmonid Population Status](#)

Social and Economic Factors Section

The Socio-Economics Group was directed to propose a strategy "to improve methods for utilizing natural resources to secure the health and continued abundance of these resources while developing stability in the economic sectors which depend on them." That is, this group was asked to evaluate local attitudes and preferences, explore the impacts of alternative scenarios on the fishing industry and economy of the Willapa Basin, and seek opportunities for new enterprises that add value to fisheries products or improve operations that impact on fish productivity.

This group collected all available data on the following: community preferences; investment opportunities particularly for value-added products; local economic impacts of the fishing industry; and the economic consequences of new policies. It was found that most of the data could not be broken down into the same watershed units used by the other groups. Much of the

demographic and commercial information was gathered in connection with the US Census and thus corresponded to political jurisdictions. However, a watershed-based approach was used in devising the Growth Management Act (GMA) plans and would provide current indications of community needs and preferences. The team also gathered information on: the fisheries sector of the Willapa economy; recent professional evaluations of economic development opportunities; available sectoral economic impact modeling techniques.

Currently an effort is underway to address these data needs. It is designed to evaluate what people feel is important about salmon in the Willapa ecosystem, and what they believe is an appropriate process for protecting and maintaining it. This process utilizes a study which is entitled "A Survey of Community Preferences for Salmon," and began by conducting focused small-group interviews of people in the Willapa Bay watershed who could be identified as representing a certain perspective. These groups have been called "stakeholders" and eight different groups were identified and interviewed: commercial fishers, sports fishers, farmers, local government officials, state and federal government officials, timber companies, farm foresters, and other resource users. We recognize that other stakeholder groups exist within the watershed and their input is also important to development of the recovery plan; however, time and budget necessitated an initial effort limited to eight groups.

The study is being conducted by two members of the EPWG and a third researcher with considerable prior experience doing such studies. The project is currently in the middle of its initial phase. The initial phase is intended to provide a broad overview of values held by different stakeholder groups, as well as an in-depth understanding of the values held by commercial fishers for salmon, the trade-offs they consider to be possible and impossible for the industry to make as part of a salmon recovery plan, and the implications of those trade-offs for negotiation and compromise with other stakeholder groups affected by salmon restoration.

It is hoped that in future stages of the Community Preferences Survey the researchers will be able to conduct the same in-depth assessment of the values and trade-offs of the other affected stakeholder groups. The results of that process can be used to create a detailed map of the feasible policy options for salmon recovery and restoration. Absent the knowledge of values and trade-off possibilities, there is no assurance that a *scientifically* feasible plan will be feasible under the social or economic constraints within the community. Thus, this study is a critical component of plan development, implementation, and success.

Preliminary results show several interesting things about stakeholder values for salmon restoration and recovery in Willapa Bay. Two types of information were considered to be important to the invited stakeholder representatives: that related to the *content* of the Strategy, and that related to the *process* of constructing, disseminating, and finalizing a Strategy. It has also been possible to discern through initial focus group sessions that stakeholders have objectives designed to achieve a certain *end*, and other objectives about the *means* of achieving it. The distinction is important to the construction of a salmon recovery plan because it provides an understanding of why stakeholders express certain values. Finally, the preliminary focus groups demonstrated that most of the groups hold many values in common, particularly as respects the *end* objectives.

A list of combined stakeholder values-without weights or trade-off information-can be presented as illustrative of the issues that will have to be taken into account as the Strategy is developed. Five major types of values were identified among the groups relating to salmon recovery:

- fishery (with sub-headings)
- other environmental issues
- process of plan development
- economic effects
- quality of life

No attempt is made at this stage to define clear lines separating these categories of values; the definitions will take shape as trade-offs and explicit monetary valuation are discussed. It will be possible in the next stages of this research to consider specific restoration actions and their implications for each of those categories of value, and the sub-categories that comprise them. Such information might tell us, for example, that certain stakeholders believe maintaining a certain run of Chum salmon in the Naselle River is of relatively higher priority (value) than achieving a full fleet of commercial boats in Ilwaco.

Final results of this analysis process will be incorporated into the creation of the Willapa Fisheries Recovery Strategy. An analysis matrix has been designed to conduct a comparable assessment of these parameters which can be used in conjunction with the analysis' of ecological process and production and harvest conditions. However, given the current absence of data for running the analysis, the matrix has not been employed, but will be used once the required information has been developed. In the mean time, the information gathered through the Pacific County Comprehensive Planning process is used as a surrogate for the desired information. It is recognized that this data source may be somewhat flawed, but does still represent the best available data of its kind for the county. The analysis and recommendations presented below employ this information.

The GIS Database, Sources, & Data Collection

Among the assumptions clarified during the development of the Technical Team was the commitment to scientific objectivity as the basis for the Team's proposed plan. At the same time, it was acknowledged that there is little data to provide a sound basis of information on a number of key factors. Some of the data that is available is probably flawed. In addition, the careful observations of those who use the Bay and watersheds may be as accurate and reliable as scientifically-derived information. Management decisions must be made before data can be collected on all relevant and important factors. Therefore, the best approach is to treat each plan and each project as an experiment that forms a part of a larger evolution towards more understanding and better management

WATERSHED LEVEL ANALYSIS AND RECOMMENDATIONS

Willapa Basin Priority Watersheds for Restoration - [Map 2](#)
Willapa Basin Priority Watersheds for Conservation - [Map 3](#)
Willapa Basin Salmonid Population Status - [Map 4](#)

Table 8. Ecological Processes Analysis Watershed Ranking

Willapa Basin Potential Ecological Impacts - [Map 5](#)
Willapa Basin Actual Ecological Impacts - [Map 6](#)
Willapa Basin Ecological Quality - [Map 7](#)
Willapa Basin Production and Harvest Prioritization - [Map 8](#)

Table 9. Production and Harvest Analysis Watershed Prioritization

Willapa Basin Genetic Resources - [Map 9](#)
Willapa Basin Current Harvest - [Map 10](#)
Willapa Basin Production Balance - [Map 11](#)
Willapa Basin Artificial Production - [Map 12](#)

THE NORTH WATERSHED

[North Watershed Map 1](#)

[North Watershed Map 2](#)

[North Watershed Map 3](#)

The North Watershed Description

The North Watershed includes the North, Smith and Cedar River drainages and their tributaries. It is 228,953 acres in size and comprises the most northern section of the Willapa Basin. It is bordered to the north by the Grays Harbor Basin and to the south by the Willapa Watershed.

Ecological Processes

Analysis

The North Watershed ranked near the bottom of the salmonid status evaluation of the eight watersheds, above only Long Island and Long Beach. This is primarily because of the low current productivity of chinook and chum and intermediate relative productivity of these species compared to other watersheds.

The analysis of limiting factors which identified potential impacts to natural salmonid productive capacity identified the North Watershed as having an intermediate to low level of potential impacts, ranking 6th out of the 8 watersheds. Significant area and mileage of roads in high mass wasting prone areas presents a significant source of potential impacts.

The analysis of ecological impacts completed for the North Watershed identified it as being the most highly degraded watershed of the 8, tied with the Willapa Watershed. Of particular concern to natural salmonid productive capacity is the prevalence of stream temperature excursions,

access to available habitat, loss of off channel habitat, and particularly the loss of estuarine wetland habitat.

The results of the analysis of ecological quality are consistent with the outcome of the impacts analysis and indicates that the condition of salmonid supporting ecological factors in the North Watershed are poor. The North Watershed ranked 7th out of the 8 watersheds, providing higher quality ecological conditions than only Long Island. Lower average stream temperature, adequate average dissolved oxygen levels, and the absence of toxins and pathogens are the factors which contribute most significantly to ecological quality.

- *Management Response*
 - Restoration Priority: 6
 - Conservation Priority: 6
-
- Given the low salmonid population status, low level of potential impacts, high level of ecological impacts, and low salmonid productive capacity of the watershed, and as compared with the other 8 watersheds, it is recommended the North Watershed be given low priority for the conservation or restoration of salmonid productive capacity. Current conditions do not support significant productive capacity and would require extensive resources to effect significant improvements. Future management practices should apply reasonable care to conserve and improve watershed health, but the limited resources available for improving and conserving watershed conditions should not be allocated to this watershed before others.
 - If resources are available for improving watershed conditions, emphasis should be placed on activities which reduce mass wasting potential such as side cast and fill removal in mass wasting prone areas. Resources should also be focused on reducing water temperatures through improving riparian canopies. Salmonid passage problems related to roads and culverts should be addressed. Lastly, estuarine wetland restoration should be focused on.
 - If resources are available for conservation activities priority should be placed on conserving the existing mature forest stands in riparian areas. Forest stands on high mass wasting potential slopes should also be conserved in locations with the potential for delivering material to streams.

Production and Harvest

Analysis

The production and harvest analysis completed for the North Watershed identified it as a watershed with generally low priority salmonid genetic resources. Populations of North Watershed salmonids ranked relatively low priority as compared to the other watersheds. Chinook populations ranked the lowest of all three species in the watershed and also of all three species in the basin, tied only with Naselle coho. This is primarily attributable to the extremely high proportion of fish introductions from outside of the Willapa Basin and the high level of artificial manipulation of genetic characteristics through propagation and habitat alterations. Coho stocks also ranked very low priority, a result of intermediate proportions of introductions of fish from outside the Willapa Basin and a high level of artificial manipulation from propagation and habitat modifications. North chum however were identified as of intermediate

priority, with all genetic sources coming from within the Willapa Basin and moderate to high levels of manipulation from propagation and habitat alteration.

The current production balance analysis identified the North Watershed as being intermediately suited for management oriented to both harvest with artificial supplementation and ecosystem benefits maintained by natural production. Reduced natural productive capacity as a result of habitat alterations is the primary factor influencing this evaluation for all three species.

The current harvest analysis prioritized the watershed as being of moderately high priority for producing harvestable surpluses. Chinook and coho populations are ranked as high priority and chum are of intermediate priority. Harvest effects and priority and suitability for selective harvest influence this result the most for all three populations.

The analysis of suitability for supplementing production with artificial propagation identified the North Watershed as of intermediate to high priority for all three populations. This outcome is influenced by most of the parameters evaluated.

Overall, the analysis of harvest and production priorities in the North Watershed indicates that conditions in the watershed make it suitable for carrying out programs to artificially enhance salmonid populations and sport and commercial harvests. The analysis also indicates that these activities should be balanced with the maintenance of the natural productive capacity of salmonid populations in the watershed.

Management Response

Production and Harvest Priority: 4

The production and harvest analysis results for the North Watershed suggest that management strategies should strike a balance between the application of artificial propagation practices and the maintenance of natural production. It also suggests managing for a similar balance between sport and commercial harvest opportunities for all three salmonid species and the conservation of existing populations. Specific recommendations are:

- Apply innovative artificial production practices to enhance salmonid productivity to provide harvestable surpluses and to reestablish or restore naturally spawning populations with methods consistent with those defined in the section on production and harvest compatibility in [Appendix 1](#).
- Implement innovative propagation techniques which utilize outplanting practices, in particular remote site egg incubation systems, where appropriate for establishing or supplementing naturally spawning populations. All propagation projects should include a monitoring component to evaluate project effects.
- Complete a stream by stream analysis of current salmonid population characteristics and habitat carrying capacities. Use the results in conjunction with [Appendix 1](#) to establish a prioritized list of potential supplementation projects for the watershed.
- Evaluate the feasibility of operating a selective hatchery release program utilizing off station releases in estuarine locations to provide harvestable surpluses for commercial and sport fisheries.

- Implement innovative commercial harvest practices to efficiently utilize salmonid fisheries produced in the watershed while ensuring escapement levels adequate to sustain natural production. Specifically, evaluate the feasibility of implementing a selective harvest program in conjunction with the selective hatchery release program.
- Promote sport fishing opportunities in the watershed.

Social and Economic Factors

Analysis

The communities of Grayland and North Cove identify the following priorities: remain predominantly residential with clusters of commerce along SR 105, encourage agricultural activities (cranberries) east of the highway, and encourage recreational and open space areas and service activities. It is desired that Tokeland also remain a mixed residential/commercial community with industrial activities at the port area, recreational and open space facilities are encouraged.

Land Use

The protection of water quality and quantity, review of drainage, and flood control are identified as important issues.

Existing uses are identified including: (1) forest land (generally located outside area but provide employment for residents) (2) agricultural lands (cranberry cultivation); (3) rural residential uses (most along highway & in beach plats); (4) commercial land (this area is primarily a bedroom community for Grays Harbor commercial centers but it plans to encourage more convenience retail shops in the area); (5) recreational land (beaches and a state park); and (6) education and public facilities (generally supplied by Grays Harbor communities).

Identified Needs

The following are identified as priority community needs:

- a surface water management plan for the dune area
- public services in Tokeland
- more affordable housing
- housing density that promotes rural atmosphere and long term use of septic systems
- compatible commercial uses in residential areas serving local needs
- public water systems
- concentration of industrial development in port
- low impact industrial uses
- improved docks in Tokeland

Agricultural Lands

The following farming activities are carried out in this planning unit: cranberry farming, cattle ranching, hay production, and fishing. The farming and light industrial activities associated with farming are encouraged by the community as is the protection of cranberry farming from incompatible uses. The conversion of farm land into non-farm land is discouraged.

Forest Lands

The protection of existing forest lands is recommended. Conversion to residential development is particularly discouraged. Also unwanted by the community are harmful forest or road construction practices. A minimum forest lot size of 10 acres is suggested by the community.

Recreational Open Space

The improvement of existing facilities is encouraged. Public access to the Bay needs to be upgraded by improving the port's docks. Parking facilities along the beach are inadequate. Signs need to be improved to provide adequate protection of the privacy rights of beachfront owners.

Public Facilities

The need to improve the quality of the public water supply is also identified by the community. Public services may need to be combined in order to increase efficiency. Public sewer and water services are not felt to be adequate. Wellheads need additional protection. Water conservation needs to be pursued more effectively. Studies need to be done to assess the area's water quality. Coordination of the area's drainage system needs to be improved so that well contamination, road flooding, and submersion of septic tanks and drainfields are avoided.

Transportation

The area has one arterial corridor (SR 105) and several minor collector lines. Cars are the primary mode of transportation with no alternative mass transit option on the horizon. The Port of Willapa airport near Raymond will likely remain for private aviation purposes only.

Housing

Residential development should be based on the availability of water. The community encourages density only where public services are available. Specific priority needs identified through the process were: (1) the establishment of a sewer district; (2) improvement of the public water supply; (3) continued blending of appropriate commercial uses with residential uses; (4) a community sewage treatment facility; and (5) an assessment of the aquifer capacity for future growth planning purposes.

Management Response

- Pursue economic development projects involving fisheries harvest and processing. Locate these activities in the Port region.
- Develop tourist/recreational opportunities in conjunction with fisheries projects at the port.
- Develop educational opportunities in conjunction with fisheries projects at the port.
- Carry out forest road decommissioning and improvement projects to benefit water quality and fish habitat.
- Look for opportunities to address road flooding and fish restoration projects in stream/road crossings, and tide gates particularly in estuarine locations.

Summary

The analysis of *ecological processes* completed for the North Watershed has identified it as a relatively low priority watershed for ecological conservation and restoration given its currently

degraded state and potential for restoration success. Innovative land use practices and restoration work can only improve the condition of the watershed, but given the limited nature of resources available for encouraging such activities, priority should not be placed on implementing them in this watershed before others rated at higher priority. The *production and harvest* analysis evaluated the conditions and priorities for the watershed as being intermediately prioritized for emphasizing natural production to support ecosystem benefits and artificial production to provide economic and recreational benefits. Lastly, the *social and economic factors* analysis prioritized the watershed for economic development activities involving fisheries resources.

There is consistency between the three parts of the analysis and the management responses from each section should be implemented in compatible ways.

Recommended Management Actions

- Given the low salmonid population status, low level of potential impacts, high level of ecological impacts, and low salmonid productive capacity of the watershed, and as compared with the other 8 watersheds, it is recommended the North Watershed be given low priority for the conservation or restoration of salmonid productive capacity. Current conditions do not support significant productive capacity and would require extensive resources to effect significant improvements. Future management practices should apply reasonable care to conserve and improve watershed health, but the limited resources available for improving and conserving watershed conditions should not be allocated to this watershed before others.
- If resources are available for improving watershed conditions, emphasis should be placed on activities which reduce mass wasting potential such as side cast and fill removal in mass wasting prone areas. Resources should also be focused on reducing water temperatures through improving riparian canopies. Salmonid passage problems related to roads and culverts should be addressed. Lastly, estuarine wetland restoration should be focused on.
- If resources are available for conservation activities priority should be placed on conserving the significant existing mature forest stands in riparian areas. Forest stands on high mass wasting potential slopes should also be conserved in locations with the potential for delivering material to streams.
- Apply innovative artificial production practices to enhance salmonid productivity to provide harvestable surpluses and to reestablish or restore naturally spawning populations with methods consistent with those defined in the section on production and harvest compatibility in [Appendix 1](#).
- Implement innovative propagation techniques which utilize outplanting practices, in particular remote site egg incubation systems, where appropriate for establishing or supplementing naturally spawning populations. All propagation projects should include a monitoring component to evaluate project effects.
- Complete a stream by stream analysis of current salmonid population characteristics and habitat carrying capacities. Use the results in conjunction with [Appendix 1](#) to establish a prioritized list of potential supplementation projects for the watershed.

- Evaluate the feasibility of operating a selective hatchery release program utilizing off station releases in estuarine locations to provide harvestable surpluses for commercial and sport fisheries.
- Implement innovative commercial harvest practices to efficiently utilize salmonid fisheries produced in the watershed while ensuring escapement levels adequate to sustain natural production. Specifically, evaluate the feasibility of implementing a selective harvest program in conjunction with the selective hatchery release program.
- Promote sport fishing opportunities in the watershed.
- Pursue economic development projects involving fisheries harvest and processing. Locate these activities in the Port region.
- Develop tourist/recreational opportunities in conjunction with fisheries projects at the port.
- Develop educational opportunities in conjunction with fisheries projects at the port.
- Carry out forest road decommissioning and improvement projects to benefit water quality and fish habitat.
- Look for opportunities to address road flooding and fish restoration projects in stream/road crossings, and tide gates particularly in estuarine locations.

THE WILLAPA WATERSHED

[Willapa Watershed Map 1](#)

[Willapa Watershed Map 2](#)

[Willapa Watershed Map 3](#)

The Willapa Watershed

Description

The Willapa Watershed includes the Willapa River drainage and its tributaries. It is 167,740 acres in size and is located between the North and Palix Watersheds.

Ecological Processes

Analysis

The Willapa Watershed also ranked near the bottom of the 8 watersheds evaluated for salmonid productivity primarily because of data indicating a significantly declining production of chinook and intermediate levels of production for the other two species currently and relatively among the other watersheds.

The analysis of limiting factors which identified potential impacts to natural salmonid productive capacity identified the Willapa Watershed as having the highest potential for ecological impacts of the 8 watersheds. The Willapa ranked as highly at risk for all of the parameters measured. Essentially all parameters of potential impacts measure at high levels with significant amounts of the watershed in mass wasting prone areas, a preponderance of immature forests in riparian zones and throughout the watershed, an extremely high ratio of roads to watershed area, and potentially reduced nutrient levels due to salmonid carcass removal.

Similarly, the analysis of ecological impacts identified the Willapa Watershed as being the most impacted watersheds of the 8, tied with the North Watershed. Of greatest concern is the frequency of elevated stream temperatures, loss of access to available habitat, loss of off channel habitat, and the loss of estuarine wetlands.

The evaluation of ecological quality identified the Willapa Watershed's ecological condition as being in low to intermediate status, ranking 6th out of the 8 watersheds. The lack of pathogens, and toxins, contribute to the ecological quality of the watershed.

- *Management Response*
 - Restoration Priority: 5
 - Conservation Priority: 5
-
- The conditions present in the Willapa Watershed suggest a low priority for restoration and conservation activities. A low salmonid productivity, high ecological impact rating and high level of potential impacts suggest that the watershed should be given low priority for restoration and conservation of salmonid productivity given the significant investments required to realize an improvement in productivity and limited opportunities to conserve important habitat functions.
 - Resources available for restoration activities should be focused on reducing the road to area ratio through decommissioning, with emphasis placed on roads in high mass wasting prone areas. Sediment production and delivery from roads should also be given priority. Conifer recruitment in riparian zones should be prioritized through forest conversion practices as well temporary measures to improve instream wood availability with the artificial delivery of wood to streams. Improvement of nutrient delivery and retainment should be focused on through improving the distribution of salmonid carcasses artificially and naturally and with the placement of large woody debris. Restoration of off-channel habitat and estuarine wetland habitat should also be prioritized. Lastly, instream temperatures should be mitigated by increasing riparian cover and also reducing soil exposure levels.
 - Conservation resources should be focused on conserving the remaining mature riparian forest stands in the watershed. Forest stands on high mass wasting potential slopes should also be conserved in locations with the potential for delivering material to streams.

Production and Harvest

Analysis

The production and harvest analysis carried out on the Willapa Watershed identified it as a watershed with intermediate to low priority salmonid genetic resources. Populations of Willapa Watershed salmonids ranked as intermediate to low priority as compared to the other watersheds. Coho populations ranked the lowest of all populations in the watershed and very low as compared to the rest of the basin's populations. This is primarily attributable to the high proportion of introductions of fish from outside of the Willapa Basin and the high level of artificial manipulation of genetic characteristics through propagation influences. Chinook stocks ranked moderately low as well, primarily a result of extremely high proportion of plantings with fish from outside the Willapa Basin and a high level of artificial manipulation from propagation activities. Willapa chum however were identified as of intermediate priority, with all genetic

sources coming from within the Willapa Basin and only moderate to low levels of manipulation from habitat and propagation effects.

The current production balance analysis identified the Willapa Watershed as being highly rated for management employing artificial supplementation except for chum populations. The ranking for chinook and coho is influenced by a number of factors including significant limits to natural production, high suitability of conditions needed for artificial production, and higher levels of economic sustainability for artificial production. The rating for chum populations is kept low by factors such as the poor economic sustainability of artificial production of this species, and the effects of the low potential for political support for artificial production of chum.

The current harvest analysis prioritized the watershed as being of high priority for producing harvestable surpluses. Chinook and coho populations are ranked as extremely high priority and chum are of high priority. Harvest effects and priority and suitability for selective harvest influence this result the most for all three populations.

The analysis of suitability for supplementing production with artificial propagation identified the North Watershed as of generally high priority for all three populations, but particularly for coho. This outcome is influenced most substantially by opportunities for improving existing facilities, separating run timing, and utilizing currently unutilized habitat.

The general outcome of the analysis of harvest and production priorities in the Willapa Watershed indicates that conditions in the watershed make it highly suitable for carrying out programs to artificially enhance salmonid populations and sport and commercial harvests. The Willapa Watershed is ranked the highest for artificial production and harvest priority of all of the watersheds evaluated.

Management Response

Production and Harvest Priority: 6

The production and harvest analysis results for the Willapa Watershed suggest that opportunities to maximize production and harvest should be pursued in this watershed. The Willapa Watershed is identified as being of high priority for providing harvestable surpluses. Specific recommendations are:

- Apply innovative artificial production practices to enhance salmonid productivity to provide harvestable surpluses. Priority should not be placed on using artificial propagation to reestablish or restore naturally spawning populations.
- Evaluate the feasibility of operating a selective hatchery release program utilizing off station releases in estuarine locations to provide harvestable surpluses for commercial and sport fisheries.
- Implement innovative commercial harvest practices to efficiently utilize salmonid fisheries produced in the watershed while ensuring escapement levels adequate to sustain natural production. Specifically, evaluate the feasibility of implementing a selective harvest program in conjunction with the selective hatchery release program.
- Promote sport fishing opportunities in the watershed.

Social and Economic Factors

Analysis

The communities of the Willapa Watershed have identified general goals for natural resource management which include: (1) conservation of forest and agricultural lands; (2) improvement of public services & housing; (3) improvement of transportation routes; (4) increased consistency of government regulations; (5) more equitable distribution of the area's infrastructure; and (6) support for the transition from family farms to family industries compatible with adjacent uses.

Residential uses

South Bend and Raymond are classified as urban areas in the watershed and the smaller communities of Willapa, Old Willapa, Menlo, Frances, and Lebam are classified as community growth areas because they do not have (and probably will not in the near future have) all the public services typically available in urban areas. The accommodation of residential development where water is available, and the slope and soils are appropriate is recommended by the community. The community desires a range of population densities and economic income levels in their watershed. There is also a call for improvement of various social services for the old and young in the area. The community also recommends a balance of development of compatible uses with protection of the environment. Education is seen as an important vehicle for achieving such a goal.

Commercial Uses

The communities want to maintain the existing small clusters of retail centers. They also seek to promote small cottage and home based enterprises and industries. Heavier industry should be directed towards existing industrial cores.

Industrial Uses

Community members desire the development of a heavy industrial park, preferably at the Port of Willapa. They also would like to encourage light industries to locate in their area, but want to avoid incompatible uses. Existing uses are to be protected from new uses that may challenge the rights of existing uses. To attract new development, the communities recognize the need to improve transportation corridors.

Agro-forestry Uses

Dairy, stock, hay and forestry are the major forms of agriculture in this watershed. The community identifies the following goals and policies as important:

- the conservation of prime agricultural land;
- placement of buffers by new users between existing and new uses if non-compatible;
- support for family farms;
- maintenance of the quality of life and the environment; and
- provision of options for conversion from farm to residential uses.

Recreational Uses

Improvement of day use parks and the addition of parking for hunters and fishermen is desired. Another priority is the protection of private property from trespass by visitors.

Public Facilities

Residents want to maintain and improve existing public facilities including the water system and emergency services.

Utilities

A need to upgrade electrical service, water lines, and telecommunications systems is identified by the community.

Housing Element

Single family residences in the watershed's rural areas is desired. Manufactured housing is also deemed acceptable. It is recommended that multi-family buildings are located where urban services are available. The community asserts that water services and social services need to be upgraded.

Transportation

There is one arterial (SR6) in this watershed. In addition to automobiles, bus transportation is available between Raymond and South Bend. Dial-a-ride mass transit is available in the Willapa Valley. The airport in Raymond can serve private aviation only. There is no longer rail service in the watershed.

Management Response

- Pursue economic development projects to build light industrial fisheries processing industries in the currently urbanized areas particularly in the port region. Also seek to develop industrial opportunities involving fisheries harvest activities.
- Emphasize the development of education opportunities in conjunction with fisheries projects on site and also in cooperation with existing educational centers.
- Pursue opportunities to enhance the economic and environmental sustainability of dairy, stock, and hay enterprises in areas important for providing salmonid habitat functions.
- Develop recreational fisheries opportunities on public lands and waters.

Summary

Similar to the North Watershed, the analysis of *ecological processes* completed for the Willapa Watershed has identified it as a lower priority watershed for ecological conservation or restoration given its currently degraded state and potential for restoration success. The Willapa Watershed does offer opportunities for improving ecological processes which affect salmonid productivity through innovative land use practices and restoration work, particularly relating to agricultural uses. However, like the North Watershed, priority should not be placed on implementing conservation and restoration activities in this watershed before others rated at higher priority. The *production and harvest* analysis evaluated the conditions and priorities for the basin as being highly prioritized for emphasizing artificial production to provide economic and recreational benefits. Lower priority should be placed on artificial production activities to enhance naturally spawning populations of fish. Lastly, the *social and economic factors* analysis prioritized the watershed for economic development activities involving fisheries resources and also sustainable agriculture in areas which effect fisheries resources.

There is consistency between the three parts of the analysis and the management responses from each section should be implemented in compatible ways.

Recommended Management Actions

- The conditions present in the Willapa Watershed suggest a low priority for restoration and conservation activities. A low salmonid productivity, high ecological impact rating and high level of potential impacts suggest that the watershed should be given low priority for restoration and conservation of salmonid productivity given the significant investments required to realize an improvement in productivity and limited opportunities to conserve important habitat functions.
 - Resources available for restoration activities should be focused on reducing the road to area ratio through decommissioning, with emphasis placed on roads in high mass wasting prone areas. Sediment production and delivery from roads should also be given priority. Conifer recruitment in riparian zones should be prioritized through forest conversion practices as well temporary measures to improve instream wood availability with the artificial delivery of wood to streams. Improvement of nutrient delivery and retainment should be focused on through improving the distribution of salmonid carcasses artificially and naturally and with the placement of large woody debris. Restoration of off-channel habitat and estuarine wetland habitat should also be prioritized. Lastly, instream temperatures should be mitigated by increasing riparian cover and also reducing soil exposure levels.
 - Conservation resources should be focused on conserving the remaining mature riparian forest stands in the watershed. Forest stands on high mass wasting potential slopes should also be conserved in locations with the potential for delivering material to streams.
 - Apply innovative artificial production practices to enhance salmonid productivity to provide harvestable surpluses. Priority should not be placed on using artificial propagation to reestablish or restore naturally spawning populations.
 - Evaluate the feasibility of operating a selective hatchery release program utilizing off station releases in estuarine locations to provide harvestable surpluses for commercial and sport fisheries.
 - Implement innovative commercial harvest practices to efficiently utilize salmonid fisheries produced in the watershed while ensuring escapement levels adequate to sustain natural production. Specifically, evaluate the feasibility of implementing a selective harvest program in conjunction with the selective hatchery release program.
 - Promote sport fishing opportunities in the watershed.
 - Pursue economic development projects to build light industrial fisheries processing industries in the currently urbanized areas particularly in the port region. Also seek to develop industrial opportunities involving fisheries harvest activities.
 - Emphasize the development of education opportunities in conjunction with fisheries projects on site and also in cooperation with existing educational centers.
 - Pursue opportunities to enhance the economic and environmental sustainability of dairy, stock, and hay enterprises in areas important for providing salmonid habitat functions.
 - Develop recreational fisheries opportunities on public lands and waters.
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THE PALIX WATERSHED

[Palix Watershed Map 1](#)

[Palix Watershed Map 2](#)

[Palix Watershed Map 3](#)

The Palix Watershed

Description

The Palix Watershed includes the Palix, Bone, and Niawiakum drainages and their tributaries. The Palix Watershed's northern border is with the Willapa Watershed and it is bordered to the south by the Nemah Watershed. It encompasses a total of 38,453 acres.

Ecological Processes

Analysis

The Palix Watershed ranked at the top of the salmonid productivity analysis because of its significant production of chum salmon. This productivity is however balanced by the apparently low productivity of chinook. The analysis of Palix system productivity is biased by the lack of data on other populations.

The Palix Watershed was evaluated as having a low potential for ecological impacts and comparatively was only more at risk than the North, Long Beach and Long Island Watersheds. This ranking is largely attributable to the lack of mass wasting prone geology, a consistent supply of salmonid carcass derived nutrients, and somewhat more mature forests in riparian zones. Road sediments pose a potentially significant source of potential impacts.

The analysis of ecological impacts identified the Palix Watershed as showing intermediate to more significant levels of impacts to natural salmonid productive capacity. Of particular concern is the loss of estuarine wetland habitat, loss of off channel habitat.

The ecological quality of the Palix Watershed was evaluated as also being of intermediate condition. The availability of parent material for gravel production, limited reductions in access to available habitat, and the absence of marine pathogens and toxins contribute most greatly to watershed quality.

- *Management Response*
- Restoration Priority: 2
- Conservation Priority: 3

- The high current salmonid productivity ranking coupled with the intermediate to high ratings for potential ecological impacts and current ecological impacts and moderate ecological quality assessment suggest that the Palix Watershed be given high priority for restoration and intermediate priority for conservation. Given the importance of its salmonid productive capacity and intermediate level of ecological degradation, investments in restoration activities will likely yield significant returns in improved

salmonid productivity. Existing ecological functions should be maintained given their excellent current ability to provide for salmonid productivity.

- Restoration activities should focus on reductions in road produced sediments through road improvements and decommissioning roads in riparian areas. They should also focus on the restoration of off channel habitat and estuarine wetlands. Lastly, potential for future large woody debris recruitment appears good, but current recruitment levels are poor and should be augmented temporarily with the delivery of wood to the system.
- Conservation activities should focus on the conservation of the most mature riparian forests.

Production and Harvest

Analysis

The production and harvest analysis completed for the Palix Watershed produced results substantially different than those for the North and Willapa. The Palix is identified as having salmonid populations with high to moderate priority salmonid genetic resources. Populations of Palix Watershed salmonids ranked as relatively high priority as compared to the other watersheds in the basin. Chum populations ranked the highest of all populations in the watershed and high as well compared to the rest of the basin's populations. This rating is attributable to the low proportion of introductions of fish from outside of the Willapa Basin and the low level of artificial manipulation of genetic characteristics as a result of propagation influences. Coho stocks rated moderately high priority as well, primarily a result of the low level of artificial manipulation from propagation activities. Palix chinook were identified as of intermediate to low priority, with a very high proportion of fish introductions coming from outside the Willapa Basin but low levels of manipulation from habitat and propagation activities.

The production balance analysis identified the Palix Watershed as being rated as low to intermediate for management employing artificial supplementation. The chinook and coho ratings are influenced by most of the parameters evaluated, all being scored as low to intermediate for artificial supplementation. The rating for chum populations is generally low except for limits to natural productivity.

The current harvest analysis prioritized the watershed as being of intermediate to low priority for producing harvestable surpluses. Chinook and coho populations are ranked as moderately high priority but chum populations are rated as extremely low. Low harvest effects and priority and low suitability for selective harvest influence this result for all three populations.

The analysis of suitability for supplementing production with artificial propagation identified the Palix Watershed as of low priority for all three populations and particularly for chum. This outcome is influenced primarily by the high potential for impacts to naturally producing stocks, no opportunities for capitalizing on existing propagation infrastructure and generally full utilization of available habitat.

The outcome of the analysis of harvest and production priorities in the Palix Watershed indicates that the watershed is not suitable for carrying out programs to artificially enhance salmonid populations or to provide harvestable surpluses. The Palix Watershed is ranked as extremely low priority for artificial production and harvest as compared to the other watersheds evaluated.

Management Response

Production and Harvest Priority: 2

The production and harvest analysis results for the Palix Watershed suggest that natural production and protection of genetic resources should be focused on in the watershed. Artificial production activities should not be carried out in the watershed and commercial harvest should be limited. Limited sport harvests may be acceptable. Specific recommendations are:

- No artificial propagation activities should be carried out in the watershed and significant efforts should be employed to prevent the inflow of artificially propagated fish.
- Commercial harvests of stocks produced in the Palix Watershed should not occur. Some sport harvest may be permitted in a manner which does not significantly impact natural productivity.
- Monitoring of natural production should be prioritized in this watershed.

Social and Economic Factors

Analysis

The communities of the Palix Watershed identify their watershed as one which has a thriving fishing and oyster industry. They identify the following general natural resource management goals: (1) prevent development sprawl; (2) encourage adequate transportation; (3) provide affordable housing; (4) promote economic development where appropriate services exist; (5) upgrade and maintain recreational facilities; (6) protect natural resources; (7) protect the environment; and (8) preserve historic sites.

Land Use Element

The Palix community expresses a desire to preserve its traditional mix of residential and commercial uses. Among the primary economic sectors in Bay Center are cattle ranching, timber production, tourism, and the fishing and shellfish industries. It is desired that residential growth be directed toward existing population concentrations in Bay Center and Wilson point. The community desires to improve Bay Center's infrastructure to encourage this mixed use of residential and light commercial or cottage industries. There is some consensus among community members that residential density goals be set at 1 residence per 2.5 acres. Single family housing is desired in rural areas, while multiple family housing limited to areas with high levels of population concentrations. An upgrade of water services and the installation of a central sewer system in Bay Center is foreseen as needed.

Commercial

Bay Center contains a neighborhood retail zone and port activities. Residents would like this central core maintained and mixed uses encouraged while commercial development along Highway 101 limited. It is believed by watershed residents however that the commercial infrastructure should be upgraded to support continued growth.

Industrial

Residents want to encourage light, environmentally-clean industries which are water dependent in nature. They see the need for better coordination of dock activities.

Agro-forestry

The area supports livestock, timber, and hay businesses. Residents desire the conservation of these agricultural uses of the watershed's lands. They express the desire to allow conversion of land only for compatible uses. They also assert the need to minimize deleterious impacts on shellfish. The community asserts that stormwater runoff impacts should be controlled to protect aquatic uses. There is community support for diverse uses of tidelands. The community also desires greater public access to public shellfish beds. The community supports the right to farm, log and harvest shellfish. They also assert the need for compensation of private property rights when uses are limited. A concern has also been expressed by the community in regards to trespass or intrusion onto private property by government officials or volunteer groups gathering information. Many community members desire written permission for access to private land to gather information. Lastly, the right to notification and hearings before the government can impose regulations is asserted by the community.

Recreational/Open Space

The residents of this watershed believe that community parks and open spaces are important to their quality of life. To that end they desire that existing recreational facilities be improved and better maintained. Specific interests include a new facility for youth, expanded parking for fishermen and hunters, and improved public beach access.

Public Facilities and Utilities

The community asserts that the water system in Bay Center needs to be upgraded. They also desire the improvement of the public boat launch. A recycling program is also identified as a need by the community. A health clinic is also desired by the community. Community members suggest that these services might in part be financed by the imposition of impact fees on new development.

Housing

The Palix community asserts that more housing in all price ranges is needed in the watershed. Residents support the use of manufactured housing to fill this need, similarly, the rehabilitation of the area's rundown housing is seen as a potential method.

Transportation

Most transportation needs in the watershed are met by autos. A mass transit bus stops in Bay Center twice a day. The Raymond airport serves private planes. Residents desire better maintenance of Highway 101 and bike lanes.

Management Response

- Encourage the development of recreational fishing opportunities through the improvement of recreational facilities and access.
- Seek the development of industrial fisheries harvest activities in the port area and improve the infrastructure needed to do this.
- Pursue opportunities to enhance the economic and environmental sustainability of livestock, hay, and timber industries in areas important for providing salmonid habitat functions.

- Pursue restoration activities which improve environmental health.
- Prioritize fisheries restoration opportunities which also benefit shellfish populations.
- Pursue fisheries restoration activities which focus on improving water quality.
- Actively seek to involve private land owners in restoration planning.

Summary

The Palix Watershed was identified by the *ecological processes* analysis as of high priority for watershed restoration and moderately high priority for conservation activities because of its current condition and the potential for maintaining and improving salmonid productivity. The watershed was also identified through the *production and harvest analysis* as having conditions which suggest that it be highly prioritized for emphasizing natural production to provide ecosystem benefits. Artificial enhancement should not be carried out in the watershed and the maintenance of naturally sustained stocks emphasized. Lastly, the *social and economic factors* analysis identifies priorities for the watershed for developing both recreational and commercial fishing opportunities. It also prioritizes fostering sustainable agriculture and forestry in areas which effect fisheries resources and involving private land owners in restoration and conservation planning.

The results of the analysis are generally compatible with the exception of activities related to commercial salmon harvests. Given the significant information from the *ecological processes* and *production and harvest* analysis and somewhat weaker recommendations from the *social and economic* analysis regarding commercial harvest activities, it is recommended that commercial harvest be limited in the watershed. Economic opportunities involving commercial fisheries harvest might still be encouraged, but it likely does not make sense to focus on citing activities dependent on the proximity of fishing opportunities in the watershed.

Recommended Management Actions

- The high current salmonid productivity ranking coupled with the intermediate to high ratings for potential ecological impacts and current ecological impacts and moderate ecological quality assessment suggest that the Palix Watershed be given high priority for restoration and intermediate priority for conservation. Given the importance of its salmonid productive capacity and intermediate level of ecological degradation, investments in restoration activities will likely yield significant returns in improved salmonid productivity. Existing ecological functions should be maintained given their excellent current ability to provide for salmonid productivity.
- Restoration activities should focus on reductions in road produced sediments through road improvements and decommissioning roads in riparian areas. They should also focus on the restoration of off channel habitat and estuarine wetlands. Lastly, potential for future large woody debris recruitment appears good, but current recruitment levels are poor and should be augmented temporarily with the delivery of wood to the system.
- Conservation activities should focus on the conservation of the most mature riparian forests.
- No artificial propagation activities should be carried out in the watershed and significant efforts should be employed to prevent the inflow of artificially propagated fish.

- Commercial harvests of stocks produced in the Palix Watershed should not occur. Some sport harvest may be permitted in a manner which does not significantly impact natural productivity.
- Monitoring of natural production should be prioritized in this watershed. An emphasis should be placed on obtaining land owner permission to collect this data when there is a need to access private property. Similarly, emphasis should be placed on involving land owners in data collection, analysis and interpretation. All information collected should be actively distributed to all interested parties in the watershed.
- Carefully encourage the development of recreational fishing opportunities through the improvement of recreational facilities and access.
- Seek the development industrial opportunities relating to commercial salmonid fisheries which are not dependent on proximity to harvest locations and can be implemented through decentralized industrial facilities (cottage industries), such as the production of harvest gear. Also encourage industrial opportunities related to fisheries other than salmonid harvests.
- Prioritize pursuing opportunities to enhance the economic and environmental sustainability of livestock, hay, and timber industries in areas important for providing salmonid habitat functions.
- Pursue restoration activities which improve environmental health.
- Prioritize fisheries restoration opportunities which also benefit shellfish populations.
- Pursue fisheries restoration activities which focus on improving water quality.
- Actively seek to involve private land owners in restoration planning.

THE NEMAH WATERSHED

[Nemah Watershed Map 1](#)

[Nemah Watershed Map 2](#)

[Nemah Watershed Map 3](#)

The Nemah Watershed Description

The Nemah Watershed includes the North, Middle and South Nemah drainages and their tributaries. The northern border of the Watershed is with the Palix Watershed and it is bordered to the south by the Naselle. The Nemah Watershed encompasses 41,385 acres.

Ecological Processes

Analysis

The Nemah Watershed salmonid productivity analysis ranks this watershed near the middle of the watersheds evaluated. The Nemah has consistently intermediate levels of productivity of all species except chinook which are showing a decline in productivity.

The analysis of potential impacts identified the Nemah as one of the more at risk watersheds in the basin ranking 2nd at risk of the 8. This ranking is primarily influenced by the large amount of mass wasting prone slopes and significant mileage of roads present in the watershed. Also, an extensive portion of the watershed is in an early seral stage which, in spite of the large stand of

mature forest which is also present, may effect large woody debris recruitment, instream temperature and nutrient availability.

The analysis of impacts to the natural salmonid productive capacity of the Nemah Watershed identified it as being the least impacted watershed of the 8. None of the parameters evaluated are of concern.

Consistent with the evaluation of watershed impacts, the analysis of ecological quality indicates that ecological conditions present in the watershed are in the best shape of the 8 watersheds evaluated. Spawning gravel production potential, lower average stream temperatures, higher dissolved oxygen levels, the lack of pathogens or toxins, limited reductions in access to available habitat, and the moderate availability of off channel habitat and estuarine wetlands contribute most greatly to watershed quality.

- *Management Response*
 - Restoration Priority: 4
 - Conservation Priority: 1
-
- High priority should be placed on conservation and moderately high priority on restoration of ecological processes. Current watershed conditions are superior to any other watershed in the basin and represent some of the best existing ecological conditions remaining and should be maintained in this condition through conservation. Intermediate to higher levels of salmonid productivity also support this recommendation. Ecological restoration activities are also given high priority because of intermediate to high levels of potential ecological impacts. Investments in restoration should realize significant returns in improved salmonid productivity.
 - Restoration activities should focus on reductions in road related impacts specifically chronic sediment through road improvements and through a significant reduction in the high road to area ratio and significant numbers of stream crossings by decommissioning. It should also focus on mass wasting related road problems through decommissioning activities in high mass wasting prone areas. Additionally, the conversion of riparian forests dominated by early seral stage stands to more mature stands and providing temporary measures to improve instream wood availability with the artificial delivery of wood to streams should be emphasized.
 - Conservation activities should emphasize maintaining mature forest stands in riparian zones. Forest stands on high mass wasting potential slopes should also be conserved in locations with the potential for delivering material to streams.

Production and Harvest

Analysis

In spite of the presence of the Nemah hatchery, the production and harvest analysis completed for the Nemah Watershed identified the watershed as having salmonid populations with high to moderate priority salmonid genetic resources, similar to those of the Palix. Populations of Nemah Watershed salmonids ranked as relatively high priority as compared to the other watersheds in the basin. Chum populations ranked the highest of all populations in the watershed and high as well compared to the rest of the basin's populations. This evaluation is largely in part

due to the low proportion of introductions of fish from outside of the Willapa Basin and the low level of artificial manipulation of genetic characteristics through habitat alterations. Coho stocks rated as moderately high priority as well, primarily a result of the low level of artificial manipulation of genetic characteristics from habitat modifications. Nemah chinook were identified as of intermediate to low priority, with a very high proportion of plantings coming from outside the Willapa Basin but low levels of manipulation from habitat and propagation effects.

The production balance analysis indicates that there is a significant variation between species concerning prioritization for using artificial production. Nemah chinook and coho are given high priority for management employing artificial supplementation. The chinook and coho ratings are influenced most by the current production goal identified for the watershed and the economic and political sustainability of artificial supplementation. The rating for chum populations is very low because of the identification of the production goal as non-harvest oriented and the low economic and political sustainability of supplementation programs for this species.

The current harvest analysis prioritized the Nemah Watershed as being of intermediate to high priority for producing harvestable surpluses. Chinook and coho populations are ranked as high priority but chum populations are rated as moderately low. High harvest effects and priority and intermediate suitability for selective harvest influence the chinook and coho rating. Lower harvest effects and priority influence the rating for chum.

The analysis of suitability for supplementing production with artificial propagation identified the Nemah Watershed as of relatively high priority for all three populations. This outcome is influenced primarily by the low potential for impacts to naturally producing stocks, and the significant opportunity for capitalizing on the existing propagation infrastructure.

The analysis of harvest and production priorities for the Nemah Watershed indicates that the watershed is moderately suitable for carrying out programs to artificially enhance salmonid populations or to provide harvestable surpluses. The Nemah Watershed is ranked as of intermediate priority for artificial production and harvest as compared to the other watersheds evaluated. Propagation and harvest activities should be balanced with the maintenance of the natural productive capacity of salmonid populations in the watershed.

Management Response

Production and Harvest Priority: 3

The production and harvest analysis results for the Nemah Watershed suggest that management strategies should emphasize natural production. Artificial production and harvest practices should be geared to enhance natural production, maintain and improve genetic adaptedness of Nemah populations and ensure escapements to provide for strong natural reproduction. Specific recommendations are:

- Carefully apply innovative artificial production practices to reestablish or restore naturally spawning populations with methods consistent with those defined in the section on production and harvest compatibility in [Appendix 1](#).

- Prioritize reducing the inflow of genetic material from outside the Nemah Watershed for propagation activities. Implement innovative propagation techniques which prioritize maintaining and improving local adaptedness of Nemah stocks.
- Gradually reduce and phase out on-station hatchery releases of propagated fish. A transition to remotely taken fish for propagation activities should be implemented simultaneously. Out-planting techniques should be implemented where appropriate for establishing or supplementing naturally spawning populations. All propagation projects should include a monitoring component to evaluate project effects.
- Prioritize the completion of a stream by stream analysis of current salmonid population characteristics and habitat carrying capacities. Use the results in conjunction with [Appendix 1](#) to establish a prioritized list of potential supplementation projects for the watershed.
- Monitoring of natural production should be prioritized in this watershed.
- Gradually reduce commercial harvest pressures on Nemah stocks in conjunction with the reduction of on-station releases and the increased availability of target populations in other watersheds.
- Sport harvests should be carefully monitored to avoid impacts to naturally maintained populations.

Social and Economic Factors

Analysis

The communities of the Nemah Watershed identify the following general natural resource management goals: (1) prevent development sprawl; (2) encourage adequate transportation; (3) provide affordable housing; (4) promote economic development where appropriate services exist; (5) upgrade and maintain recreational facilities; (6) protect natural resources; (7) protect the environment; and (8) preserve historic sites.

Land Use Element

The Nemah community expresses a desire to preserve its traditional mix of residential and commercial uses. Timber production is the primary industry in the watershed. It is desired that residential growth be directed toward existing population concentrations in Lynn point. Single family housing is desired.

Commercial

Residents would like commercial development along Highway 101 limited.

Agro-forestry

The area supports timber related enterprises. Residents desire the conservation of this use of the watershed's lands. They express the desire to allow conversion of land only for compatible uses. They also assert the need to minimize deleterious impacts on shellfish. The community also desires greater public access to public shellfish beds. The community supports the right to farm, log and harvest shellfish. They also assert the need for compensation of private property rights when uses are limited. A concern has also been expressed by the community in regards to trespass or intrusion onto private property by government officials or volunteer groups gathering information. Many community members desire written permission for access to private land to

gather information. Lastly, the right to notification and hearings before the government can impose regulations is asserted by the community.

Recreational/Open Space

The residents of this watershed believe that community parks and open spaces are important to their quality of life. To that end they desire that existing recreational facilities be improved and better maintained. Specific interests include a new facility for youth, expanded parking for fishermen and hunters, and improved public beach access.

- Public Facilities and Utilities
- A health clinic is desired by the community.

Housing

The Nemah community asserts that more housing in all price ranges is needed in the watershed. Residents support the use of manufactured housing to fill this need, similarly, the rehabilitation of the area's rundown housing is seen as a potential method for improving the availability of housing.

Transportation

Most transportation needs in the watershed are met by autos. Residents desire that a mass transit stop be added. The Raymond airport serves private planes. Residents desire better maintenance of Highway 101 and bike lanes.

Management Response

- Encourage the development of recreational fishing opportunities through the improvement of recreational facilities and access.
- Pursue opportunities to enhance the economic and environmental sustainability the timber industry in areas important for providing salmonid habitat functions.
- Pursue restoration activities which improve environmental health.
- Prioritize fisheries restoration opportunities which also benefit shellfish populations.
- Actively seek to involve private land owners in restoration planning.

Summary

The Nemah Watershed was identified by the *ecological processes* analysis as of highest priority for watershed conservation and moderately high priority for restoration activities because of its current condition and the potential for maintaining and improving salmonid productivity. The watershed was also identified through the *production and harvest analysis* as having conditions which suggest that it be prioritized for emphasizing natural production to provide ecosystem benefits. It is recommended that artificial enhancement should be carried out with extreme care and only to aid in the enhancement of natural production. Lastly, the *social and economic factors* analysis identifies priorities for the watershed for developing recreational fishing opportunities. It also prioritizes fostering sustainable forestry in areas which effect fisheries resources and involving private land owners in conservation and restoration planning.

The results of all three components of the analyze are generally consistent and the management responses from each section should be implemented in compatible ways.

Recommended Management Actions

- High priority should be placed on conservation and moderately high priority on restoration of ecological processes. Current watershed conditions are superior to any other watershed in the basin and represent some of the best existing ecological conditions remaining and should be maintained in this condition through conservation. Intermediate to higher levels of salmonid productivity also support this recommendation. Ecological restoration activities are also given high priority because of intermediate to high levels of potential ecological impacts. Investments in restoration should realize significant returns in improved salmonid productivity.
- Restoration activities should focus on reductions in road related impacts specifically chronic sediment through road improvements and through a significant reduction in the high road to area ratio and significant numbers of stream crossings by decommissioning. It should also focus on mass wasting related road problems through decommissioning activities in high mass wasting prone areas. Additionally, the conversion of riparian forests dominated by early seral stage stands to more mature stands and providing temporary measures to improve instream wood availability with the artificial delivery of wood to streams should be emphasized.
- Conservation activities should emphasize maintaining mature forest stands in riparian zones. Forest stands on high mass wasting potential slopes should also be conserved in locations with the potential for delivering material to streams.
- Carefully apply innovative artificial production practices to reestablish or restore naturally spawning populations with methods consistent with those defined in the section on production and harvest compatibility in [Appendix 1](#).
- Prioritize reducing the inflow of genetic material from outside the Nemah Watershed for propagation activities. Implement innovative propagation techniques which prioritize maintaining and improving local adaptedness of Nemah stocks.
- Gradually reduce and phase out on-station hatchery releases of propagated fish. A transition to remotely taken fish for propagation activities should be implemented simultaneously. Out-planting techniques should be implemented where appropriate for establishing or supplementing naturally spawning populations. All propagation projects should include a monitoring component to evaluate project effects.
- Prioritize the completion of a stream by stream analysis of current salmonid population characteristics and habitat carrying capacities. Use the results in conjunction with [Appendix 1](#) to establish a prioritized list of potential supplementation projects for the watershed.
- Monitoring of natural production should be prioritized in this watershed. An emphasis should be placed on obtaining land owner permission to collect this data when there is a need to access private property. Similarly, emphasis should be placed on involving land owners in data collection, analysis and interpretation. All information collected should be actively distributed to all interested parties in the watershed.

- Gradually reduce commercial harvest pressures on Nemah stocks in conjunction with the reduction of on-station releases and the increased availability of target populations in other watersheds.
- Sport harvests should be carefully monitored to avoid impacts to naturally maintained populations.
- Encourage the development of recreational fishing opportunities through the improvement of recreational facilities and access.
- Pursue opportunities to enhance the economic and environmental sustainability the timber industry in areas important for providing salmonid habitat functions.
- Pursue restoration activities which improve environmental health.
- Prioritize fisheries restoration opportunities which also benefit shellfish populations.
- Actively seek to involve private land owners in restoration planning.

THE NASELLE WATERSHED

[Naselle Watershed Map 1](#)

[Naselle Watershed Map 2](#)

[Naselle Watershed Map 3](#)

The Naselle Watershed Description

The Naselle Watershed includes the Naselle drainage and its tributaries. The Naselle is bordered to the north by the Nemah Watershed and is bordered to the south by the Bear Watershed. It encompasses a total of 87,433 acres.

Ecological Processes

Analysis

The analysis of salmonid productivity in the Naselle indicates an intermediate level of productivity, similar to that of the Nemah Watershed. High relative productivity in chinook populations and as compared to other watersheds are balanced by the declining productivity trends in chinook and chum.

The evaluation of potential ecological impacts ranks the Naselle Watershed as one of the most at risk watersheds. The level of risk is effected by high amounts of mass wasting prone land, an extremely high ratio of roads to watershed acreage, and a likely reduction in carcass derived nutrients. An exception to this high level of risk is the potential for large woody debris recruitment which appears to be higher than most of the other watersheds.

The analysis of ecological impacts assessed the Naselle Watershed as having low level of impacts to natural salmonid productive capacity. It ranked 6th out of the 8 watersheds. Of concern are the occurrence of elevated stream temperatures and access to available habitat.

The evaluation of ecological quality ranks the Naselle Watershed as 3rd out of the 8 watersheds in capacity to support salmonid productivity. Ecological quality is supported most by higher

dissolved oxygen levels, the absence of pathogens and toxins, and the availability of off channel and estuarine wetland habitat.

- *Management Response*
 - Restoration Priority: 3
 - Conservation Priority: 4
-
- Moderate to high priority for restoration and conservation activities should be afforded for the Naselle Watershed. A high level of potential impacts and low level of actual impacts combined with an intermediate level of salmonid productivity suggest designating the watershed moderately high priority for restoration. Intermediate to high levels of ecological quality suggest intermediate priority for conservation.
 - Restoration activities should focus on reducing road densities, particularly in high mass wasting prone areas and removing side cast and fill material. Stream temperatures should also be mitigated through restoration of riparian canopies. Removal of salmonid migration barriers related to roads and culverts should be focused on. Lastly, nutrient sources should be enhanced through improving the distribution of salmonid carcasses artificially and naturally.
 - Conservation activities should focus primarily on maintaining intact riparian zones. Forest stands on high mass wasting potential slopes should also be conserved in locations with the potential for delivering material to streams.

Production and Harvest

Analysis

The analysis of production and harvest priorities carried out on the Naselle Watershed identified it as a watershed with low to intermediate priority salmonid genetic resources. Populations of Naselle Watershed salmonids ranked as relatively low priority as compared to the other watersheds. Coho populations ranked the lowest of all populations in the watershed and the basin. This is primarily attributable to the high proportion of introductions of fish from outside of the Willapa Basin and the high level of artificial manipulation of genetic characteristics through propagation alterations. Chinook stocks ranked as low as well, also a result of the high proportion of plantings with fish from outside the Willapa Basin and a high level of artificial manipulation from propagation activities. Naselle chum however were identified as of intermediate priority, primarily because of lower manipulation of genetic characteristics through propagation and limited loss of habitat.

The current production balance analysis identified a range of ratings for the Naselle Watershed's populations of salmonids. Chinook and coho are highly rated for management employing artificial supplementation. The rating for chinook and coho is influenced by a mix of factors including a production goal oriented toward harvest, significant limits to natural production, high suitability of conditions needed for artificial production, and higher levels of economic sustainability for artificial production. The rating for chum populations is however very low. This rating is influenced by a non-harvest oriented goal, the poor economic sustainability of artificial production of this species, and a lack of political support for artificial production.

The current harvest analysis prioritized the Naselle Watershed as being of extremely high priority for producing harvestable surpluses for chinook and coho, but of very low priority for chum. Harvest effects and priority influence this result the most.

The analysis of suitability for supplementing production with artificial propagation identified the watershed as of generally high priority for all three populations, but particularly for coho. This outcome is influenced most substantially by opportunities for improving existing facilities, separating run timing, and the potential for utilizing currently unutilized habitat.

The cumulative outcome of the analysis of harvest and production priorities in the Naselle Watershed indicates that conditions in the watershed make it generally suitable for carrying out programs to artificially enhance salmonid populations and sport and commercial harvests. The Naselle Watershed is ranked as the second highest for artificial production and harvest priority of all of the watersheds evaluated.

Management Response

Production and Harvest Priority: 5

The production and harvest analysis results for the Naselle Watershed suggest that opportunities to maximize production and harvest should be pursued in this watershed. It does however also indicate that care be exercised to protect the natural production of chum. The production and harvest analysis results for the Naselle Watershed suggest that management strategies should strike a balance between the application of artificial propagation practices and the maintenance of natural production. It also suggests managing for a similar balance between sport and commercial harvest opportunities for all three salmonid species and the conservation of existing populations. Specific recommendations are:

- Apply innovative artificial production practices to enhance salmonid productivity to provide harvestable surpluses and to reestablish or restore naturally spawning populations with methods consistent with those defined in the section on production and harvest compatibility in [Appendix 1](#).
- Implement innovative propagation techniques which utilize outplanting practices, in particular remote site egg incubation systems, where appropriate for establishing or supplementing naturally spawning populations. All propagation projects should include a monitoring component to evaluate project effects.
- All propagation projects and harvest activities should be structured to actively protect existing chum populations.
- Complete a stream by stream analysis of current salmonid population characteristics and habitat carrying capacities. Use the results in conjunction with [Appendix 1](#) to establish a prioritized list of potential supplementation projects for the watershed.
- Evaluate the feasibility of operating a selective hatchery release program utilizing off station releases in estuarine locations to provide harvestable surpluses for commercial and sport fisheries.
- Implement innovative commercial harvest practices to efficiently utilize salmonid fisheries produced in the watershed while ensuring escapement levels adequate to sustain natural production. Specifically, evaluate the feasibility of implementing a selective harvest program in conjunction with the selective hatchery release program.

- Promote sport fishing opportunities in the watershed.

Social and Economic Factors

Analysis

General Goals

The Naselle community identifies the following goals for natural resource management in the watershed: encourage development in urban areas where adequate public facilities and services exist or can be provided, reduce inappropriate conversion of undeveloped land, and decrease residential sprawl. Fostering a balance of economic development goals and maintenance of the quality of rural life has also been identified by the Naselle community.

Members of the community assert concern over infringements of property rights but also concerns about timber companies closing their lands to public access. Community members also desire minimal interference from regulatory agencies and more government efficiency and equity in the processing of permits. Similarly, the Naselle community asserts a strong desire for the government to avoid uncompensated takings and a need for the government to provide sufficient notice for land use decisions, and improve opportunities for public participation.

The community recognizes the central role of natural resource-based industries including timber, agriculture, and fisheries in their watershed. The community desires conservation of productive lands and measures to discourage incompatible uses. But, they also specifically want to allow the division of forest lands to allow estate planning. Large-scale conversion of forest lands into residential or recreational development is not desired.

The Naselle community would like to encourage high wage commercial and industrial enterprises in the watershed, without causing significant impacts to environmental health. It is desired that development of commercial activities not connected to natural resources be located in urban growth areas.

Residents have expressed interest in an empirical survey to determine the preferences and needs of local residents.

Public Facilities

Naselle residents identify the need for a long-term solid waste management strategy for residences, businesses, and industrial waste generators. Recycling, toxic waste disposal, waste reduction, waste collection and transportation, and residential waste disposal are believed to be needed.

Forestland Development Rules

The Naselle community recognizes special problems associated with potential conflicts between residential interests and logging operations on adjacent industrial forest lands. Community members believe that standard forestry practices are sufficient on lands adjacent to residences.

Housing

Residents feel that the area is in need of more affordable housing. Substandard housing is seen as a problem.

Transportation

Residents identify a need for a lane on local bridges to accommodate pedestrians and bicyclists.

Rural Lands

Currently most residences are located within the Naselle urban growth area. Naselle residents assert that the potential for residential development outside of urban areas should be constrained by the following factors: limits on the soil's suitability for wastewater treatment, the availability of paved roads, and water supply constraints. *Management Response*

- Pursue the development of fisheries processing opportunities in the watershed. Site such potential development in the currently urbanized areas of the watershed.
- Pursue opportunities to enhance the economic and environmental sustainability the timber industry in areas important for providing salmonid habitat functions.
- Actively seek to involve private land owners in restoration planning.
- Consider the need to provide public access to forest lands when designing habitat restoration and conservation projects.

Summary

The *ecological processes* analysis completed for the Naselle Watershed identified it as of moderately high priority for restoration activities and of intermediate priority for conservation. The watershed has sustained significant impacts to its ability to provide for salmonid productivity and there is a likelihood that more may occur given watershed conditions, however the watershed has a high potential productive capacity and there are significant opportunities for remedying past problems. The *production and harvest* analysis identifies the Naselle Watershed as being of relatively high priority for emphasizing artificial production activities to provide economic and recreational benefits and also to enhance naturally spawning populations of salmonids to provide ecosystem benefits. The *social and economic factors* analysis prioritizes fostering sustainable forestry in areas which effect fisheries resources and involving private land owners in conservation and restoration planning. It also stresses the importance of factoring in community preferences in restoration and conservation activities and securing community support before implementing them.

There is concurrence between many of the results of all three analysis. However, there is a discrepancy between some of the results relating to habitat restoration and production and harvest. Given the potential for providing significant levels of natural production of salmonids in the watershed, emphasis should be placed on management oriented toward natural production and providing ecosystem benefits. Opportunities should be provided for providing some commercial harvests and sport harvests. The following management recommendations should be implemented in compatible ways.

Recommended Management Actions

- Moderate to high priority for restoration and conservation activities should be afforded for the Naselle Watershed. A high level of potential impacts and low level of actual impacts combined with an intermediate level of salmonid productivity suggest

designating the watershed moderately high priority for restoration. Intermediate to high levels of ecological quality suggest intermediate priority for conservation.

- Restoration activities should focus on reducing road densities, particularly in high mass wasting prone areas and removing side cast and fill material. Stream temperatures should also be mitigated through restoration of riparian canopies. Removal of salmonid migration barriers related to roads and culverts should be focused on. Lastly, nutrient sources should be enhanced through improving the distribution of salmonid carcasses artificially and naturally.
- Conservation activities should focus primarily on maintaining intact riparian zones. Forest stands on high mass wasting potential slopes should also be conserved in locations with the potential for delivering material to streams.
- Apply innovative artificial production practices to enhance salmonid productivity to reestablish or restore naturally spawning populations with methods consistent with those defined in the section on production and harvest compatibility in [Appendix 1](#).
- Implement innovative propagation techniques which utilize outplanting practices, in particular remote site egg incubation systems, where appropriate for establishing or supplementing naturally spawning populations. All propagation projects should include a monitoring component to evaluate project effects.
- All propagation projects and harvest activities should be structured to actively protect existing chum populations.
- Promote sport fishing opportunities in the watershed.
- Gradually reduce and phase out on-station hatchery releases of propagated fish. A transition to remotely taken fish for propagation activities should be implemented simultaneously. Out-planting techniques should be implemented where appropriate for establishing or supplementing naturally spawning populations. All propagation projects should include a monitoring component to evaluate project effects.
- Prioritize the completion of a stream by stream analysis of current salmonid population characteristics and habitat carrying capacities. Use the results in conjunction with [Appendix 1](#) to establish a prioritized list of potential supplementation projects for the watershed.
- Monitoring of natural production should be prioritized in this watershed. An emphasis should be placed on obtaining land owner permission to collect this data when there is a need to access private property. Similarly, emphasis should be placed on involving land owners in data collection, analysis and interpretation. All information collected should be actively distributed to all interested parties in the watershed.
- Gradually reduce commercial harvest pressures on Naselle stocks in conjunction with the reduction of on-station releases and the increased availability of target populations in other watersheds.
- Pursue opportunities to enhance the economic and environmental sustainability the timber industry in areas important for providing salmonid habitat functions.
- Seek the development industrial opportunities relating to commercial salmonid fisheries which are not dependent on proximity to harvest locations and can be implemented through decentralized industrial facilities (cottage industries), such as the production of harvest gear. Also encourage industrial opportunities related to fisheries other than salmonid harvests. Locate this development in currently urbanized areas.

- Aggressively seek to involve private land owners in restoration planning and implementation.
- Consider the need to provide public access to forest lands when designing habitat restoration and conservation projects.

THE BEAR WATERSHED

[Bear Watershed Map 1](#)

[Bear Watershed Map 2](#)

[Bear Watershed Map 3](#)

The Bear Watershed Description

The Bear Watershed includes the Bear drainage and its tributaries. The watershed comprises the most southern end of the Willapa Basin. The northern border of the Watershed meets the Naselle Watershed and it is bordered to the south by the Columbia River Basin. The Bear Watershed encompasses 18,217 acres.

Ecological Processes

Analysis

The Bear Watershed was ranked at the top of the salmonid productivity analysis primarily because of its high current productivity and relative productivity of chum. The current and relative productivity of chinook in this watershed is low however.

The Bear Watershed was analyzed as being of an intermediate degree of potential ecological impacts, falling in the middle of the 8 watersheds. Producing significant risks to natural salmonid productive capacity are the prevalence of potentially sediment producing roads, the prevalence of high mass wasting prone geology, predominately immature forests, and temperature and large woody debris recruitment limitations. The high potential sources of fine sediments are somewhat mitigated by the low levels of sediment response reaches.

The analysis of ecological impacts evaluated the Bear Watershed as having an intermediate level of impacts to natural salmonid productive capacity. Of concern are stream temperatures and dissolved oxygen levels and the loss of estuarine wetland habitat.

In spite of significant impacts to the natural productive capacity of the Bear Watershed, the evaluation of ecological quality indicates that significant watershed capacity to provide salmonid productivity exists. Specifically, the intermediate prevalence of parent material for spawning gravel, adequate dissolved oxygen levels, the lack of pathogens and toxins, and the availability of off channel habitat supports the productive capacity of the watershed.

- *Management Response*
- Restoration Priority: 1

- Conservation Priority: 2
- The Bear Watershed should be given high priority for restoration priority and conservation. The watershed maintains significant salmonid productivity and has incurred intermediate levels of ecological impacts and risk. It also possesses significant attributes which support ecological quality. Resources allocated to restoration in this watershed should realize significant responses in production and conservation resources will help maintain the significant natural salmonid production capacity of the watershed.
- Restoration resources should be focused on reductions in chronic sediment production from roads and also mass wasting through road repair and side cast and fill removal in mass wasting prone areas. Restoration should also focus on the conversion of riparian forests dominated by early seral stage stands to more mature stands and providing temporary measures to improve instream wood availability with the artificial delivery of wood to streams. Lastly, the restoration of estuarine wetland functions should also be concentrated on.
- Conservation activities should be focused on protecting remaining mature riparian forests. Forest stands on high mass wasting potential slopes should also be conserved in locations with the potential for delivering material to streams.

Production and Harvest

Analysis

The production and harvest analysis completed for the Bear Watershed produced results similar to those for the Palix. The Bear is identified as having salmonid populations with generally high priority salmonid genetic resources. Populations of Bear Watershed salmonids ranked as very high priority as compared to the other watersheds in the basin. Chum and chinook populations ranked the highest of all populations in the watershed and in the Willapa Basin. This rating is attributable to the lack of introductions of fish from outside of the Willapa Basin and the low level of artificial manipulation of genetic characteristics through propagation alterations. It appears that chum propagation activities primarily used stocks indigenous to the Bear Watershed. Coho stocks rated moderately high priority as well, primarily because of the low level of artificial manipulation from propagation activities and habitat alteration.

The production balance analysis identified the Bear Watershed as being rated as low to intermediate for management employing artificial supplementation. The chinook and chum ratings are influenced equally by most of the parameters evaluated, all being scored as low to intermediate for artificial supplementation. The factors influencing the coho rating are similar, except that political sustainability of artificial production is higher.

The current harvest analysis prioritized the watershed as being of low to intermediate priority for producing harvestable surpluses. Coho populations are ranked as moderately high priority but chum and chinook populations are rated as low. Low harvest effects and priority and low suitability for selective harvest influence this result for all three populations.

The analysis of suitability for supplementing production with artificial propagation identified the Bear Watershed as of generally low priority for all three populations. This outcome is influenced primarily by the high potential for impacts to naturally producing stocks, limited opportunities

for capitalizing on existing propagation infrastructure and generally good current utilization of available habitat.

The outcome of the analysis of harvest and production priorities in the Bear Watershed indicates that the watershed is not suitable for carrying out programs to artificially enhance salmonid populations or to provide harvestable surpluses. The Bear Watershed is ranked the lowest of all watersheds for artificial production and harvest.

Management Response

Production and Harvest Priority: 1

The production and harvest analysis results for the Bear Watershed suggest that natural production and protection of genetic resources should be focused on in the watershed. Artificial production activities should not be carried out in the watershed and commercial harvest should be limited. Some sport harvest may be permitted. Specific recommendations are:

- No artificial propagation activities should be carried out in the watershed and significant efforts should be employed to prevent the inflow of artificially propagated fish.
- Commercial harvests of stocks produced in the Bear Watershed should not occur. Some sport harvest may be permitted in a manner which does not significantly impact natural productivity.
- Monitoring of natural production should be prioritized in this watershed.

Social and Economic Factors

Analysis

There is no social or economic data available for the Bear Watershed. The watershed was included in the Naselle planning unit in the Comprehensive Plan development process, the source of the data for this analysis. There are very few residents in this watershed and opportunities for economic development are limited.

Management Response

- There are no responses recommended at this time.

Summary

The Bear Watershed was identified by the *ecological processes* analysis as of highest priority for watershed restoration and high priority for conservation activities because of its current condition and the potential for maintaining and improving salmonid productivity. The watershed was also identified through the *production and harvest analysis* as being of the highest priority for emphasizing natural production to provide ecosystem benefits. It is recommended that no artificial production be carried out in the watershed.

The results of the analyze are very consistent and the management responses from each section should be implemented in compatible ways.

Recommended Management Actions

- The Bear Watershed should be given high priority for restoration priority and conservation. The watershed maintains significant salmonid productivity and has incurred intermediate levels of ecological impacts and risk. It also possesses significant attributes which support ecological quality. Resources allocated to restoration in this watershed should realize significant responses in production and conservation resources will help maintain the significant natural salmonid production capacity of the watershed.
- Restoration resources should be focused on reductions in chronic sediment production from roads and also mass wasting through road repair and side cast and fill removal in mass wasting prone areas. Restoration should also focus on the conversion of riparian forests dominated by early seral stage stands to more mature stands and providing temporary measures to improve instream wood availability with the artificial delivery of wood to streams. Lastly, the restoration of estuarine wetland functions should also be concentrated on.
- Conservation activities should be focused on protecting remaining mature riparian forests. Forest stands on high mass wasting potential slopes should also be conserved in locations with the potential for delivering material to streams.
- No artificial propagation activities should be carried out in the watershed and significant efforts should be employed to prevent the inflow of artificially propagated fish.
- Commercial harvests of stocks produced in the Bear Watershed should not take place. Some sport harvest may be permitted in a manner which does not significantly impact natural productivity.
- Monitoring of natural production should be prioritized in this watershed.

THE LONG ISLAND WATERSHED

[Long Island and Long Beach Watersheds Map 1](#)

[Long Island and Long Beach Watersheds Map 2](#)

[Long Island and Long Beach Watersheds Map 3](#)

The Long Island Watershed

Description

The Long Island Watershed includes Long Island. This watershed has no major drainages, but does have a number of small streams and large sloughs. It encompasses 5,403 acres.

Ecological Processes

Analysis

No populations of salmonids have been identified as residing in the Long Island Watershed and therefore a population score of 0 was given.

The analysis of risk completed on the Long Island Watershed identified it as being of extremely low risk of potential impacts to salmonid productivity. Of concern is primarily the immature seral stage of the majority of the watershed's forests.

The ecological impacts analysis completed on the Long Island Watershed indicates that the watershed has experienced minimal impacts to the natural salmonid productive capacity. Of particular concern is the loss of off-channel habitat.

The evaluation of ecological quality identifies the Long Island Watershed as possessing limited natural productive capacity for salmonids. The availability estuarine wetlands and the lack of pathogens and toxins in marine areas provides the watershed's most significant features for salmonid productivity.

- *Management Response*
 - Restoration Priority: 7
 - Conservation Priority: 7
-
- No restoration or conservation actions are recommended currently.

Production and Harvest

Analysis

No naturally or artificially maintained populations of salmonids were identified in this watershed and therefore a full analysis was not completed.

Management Response

- Artificial propagation should not be carried out to establish naturally spawning populations of salmonids due to lack of suitable habitat to support natural production.
- Evaluate the potential for establishing selective propagation and harvesting programs in the watershed.

Social and Economic Factors

Analysis

There is no social or economic data available for the Long Island Watershed. There are no residents in this watershed and opportunities for economic development are limited.

Management Response

- There are no responses identified.

Summary

There are no self sustaining populations of salmonids present in this watershed however, the watershed may provide some significant habitat for juvenile salmonid rearing for populations from other watersheds. No restoration or conservation activities are suggested at this time. The watershed is potentially suitable for locating artificial production activities solely to produce economic benefits. Propagation to enhance naturally producing populations is not recommended.

Recommended Management Actions

- Artificial propagation should not be carried out to establish naturally spawning populations of salmonids due to lack of suitable habitat to support natural production.
- Evaluate the potential for establishing selective propagation and harvesting programs in the watershed.

THE LONG BEACH WATERSHED

[Long Island and Longbeach Watershed - Map 1](#)
[Long Island and Longbeach Watershed - Map 2](#)
[Long Island and Longbeach Watershed - Map 3](#)

The Long Beach Watershed

Description

The Long Beach Watershed includes Long Beach Peninsula. This watershed has no major drainages, but does have a number of streams and large sloughs. It encompasses 33,109 acres. ([See Willapa Basin Map](#))

Ecological Processes

Analysis

No populations of salmonids have been identified as residing in the Long Beach Watershed and therefore a population score of 0 was given.

Similar to the Long Island Watershed, low risk factors were identified in this watershed.

The analysis of ecological impacts ranked the Long Beach Watershed as having a high level of impacts to natural salmonid productive capacity. Of particular concern in this watershed are water quality problems including pathogens, dissolved oxygen, and temperature.

The evaluation of ecological quality identifies a low capacity to support salmonid productivity in the Long Beach Watershed.

- *Management Response*
 - Restoration Priority: 8
 - Conservation Priority: 8
- No restoration or conservation actions are recommended.

Production and Harvest

Analysis

No naturally or artificially maintained populations of salmonids were identified in this watershed and therefore a full analysis was not completed.

Management Response

- Artificial propagation should not be carried out to establish naturally spawning populations of salmonids due to lack of suitable habitat to support natural production.
- Evaluate the potential for establishing selective propagation and harvesting programs in the watershed.

Social and Economic Factors

Analysis

Residents of the Long Beach Watershed identify the watershed's water as its most vital resource. Residents assert a need for stronger monitoring of water quality, public education efforts, and conservation measures. The use of impact fees to fund these measures is supported by the community. A need for coordination of various rules and regulations regarding growth and development is identified by residents. Open space is identified as a valuable resource. Finally, community members assert that the area's infrastructure will need to be expanded, improved, and maintained to keep pace with growth.

The following goals and objectives are identified by Long Beach community members for their watershed:

- encourage affordable housing
- retain open space,
- develop recreational opportunities,
- conserve wildlife and habitat,
- adequately fund county departments,
- assure water quality,
- impose impact fees on new developments,
- streamline permitting,
- improve dune management policies,
- maintain a clean beautiful peninsula,
- ensure local input in land use planning,
- protect agricultural uses and timber industry uses,
- support water management plan,
- support sustainable agriculture,
- avoid conflicts,
- regulate sand removal,
- avoid filling of wetlands,
- achieve mitigation where called for, and
- enforce setback rules,

Land Use

Community members assert the need for higher density and affordable housing in growth areas. They believe that development in the ocean offshore of the area should not be allowed. Community members identify a need for a light industrial park in the watershed and it is asserted that the ports should be brought into a cooperative effort to create it. Residents are also concerned about the maintenance of aesthetic qualities of the watershed. They assert that rural

development is constrained by: wetlands, water availability, fire protection, wastewater disposal considerations, and the limited transportation system.

Commercial and Industrial Lands

Community members assert that that most commercial uses should be located within currently urbanized or growth areas.

Resource Lands and Critical Areas

Agricultural lands in the watershed are identified by community members as prime, unique, and farmlands of local importance as defined by NRCS. Cranberry agriculture is recognized as the most significant component of the Watershed's terrestrial agriculture and of exceptional economic importance. Community members identify support for development of new, alternative crops, additional nursery operations and other forms of agricultural enterprises.

Commercial shellfish beds are also identified by watershed residents as a critical resource in the area. Community members anticipate that new aquaculture operations may be proposed in the future such as sea vegetable farming and net pen development and assert that these uses should not be considered compatible with oyster farming unless shown to have no or little impacts on oyster farming operations. The community expresses a preference for oyster farming as an environmentally compatible industry. Residents acknowledged that in order to assure the future of the oyster industry, the Bay must be kept clean. Increased population density and residential development with attending increases in sewage effluent pose the greatest threats to maintenance of water quality. To this end, the community asserts the need for limiting development to appropriate places, adequate runoff controls, and sufficient monitoring and enforcement.

Management Response

- Pursue economic development opportunities involving fisheries harvest and processing. Locate these activities in the Port regions of the watershed. Great attention must be paid to ensuring that such development activities do not present any negative impacts to water quality.
- Involve community members in planning process for development projects.

Summary

There are no self sustaining populations of salmonids present in this watershed and therefore restoration and conservation activities are not recommended. The watershed is potentially suitable for locating artificial production activities solely to produce economic benefits. Propagation to enhance naturally producing populations is not recommended.

Recommended Management Actions

- Artificial propagation should not be carried out to establish naturally spawning populations of salmonids due to lack of suitable habitat to support natural production.
- Evaluate the potential for establishing selective propagation and harvesting programs in the watershed. Great attention must be paid to ensuring that such development activities do not present any negative impacts to water quality.

- Pursue economic development opportunities involving fisheries harvest and processing. Locate these activities in the Port regions of the watershed. Great attention must be paid to ensuring that such development activities do not present any negative impacts to water quality.
 - Involve community members in planning process for development projects.
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ADDITIONAL RECOMMENDATIONS

- Employ a more selective commercial harvest licensing program which identifies individual watersheds as specific fishing zones and requires a permit to fish in each zone. This will allow for more careful control of exploitation rates on stocks produced in each watershed.
 - Conduct a feasibility analysis for the development of a selective rearing and harvest program to be implemented in the Willapa Basin. The feasibility analysis should consider citing such a project in the watersheds identified in this plan as being suitable for artificial production and harvest programs.
 - In addition to the information on social and economic conditions being collected through the Community Preferences survey, the completion of an evaluation of potential economic impacts of the various management options suggested in this Strategy is recommended.
 - The proceeds from fish and eggs produced in the Willapa Basin and harvested at local hatcheries should be applied to fishery management operations in the Willapa Basin. Sufficient supplies of eggs should be collected at propagation facilities to support propagation projects which are consistent with management identified in this strategy. Once egg quotas are met, over escapements of hatchery produced fish should be collected and sold to produce revenues. These revenues should be employed solely to support fisheries management activities in the Willapa Basin.
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DATA COLLECTION AND MONITORING NEEDS

During the coming years, the WFRT will track the impacts of projects undertaken as a result of the planning process. In particular, a coordinated monitoring effort will be directed specific parameters of ecological health, fish productivity, and economic vitality as identified by the Technical Team. The Team will oversee the further development of the Willapa GIS system through the assimilation of new data and refinement of existing information. Additional sources of the information will be sought. A blending of information sources will improve the understanding of the watershed by bringing into focus gaps and areas of inconsistent or conflicting information. It also can highlight where there is a greater need for regularity in the collection of data and the parameters studied. This effort will build a means to provide feedback for future iterations of the policy planning process. Priority data collection and monitoring foci are identified below.

Specific Data Collection Foci

- Instream habitat conditions identified in the ecological processes limiting factors matrices.
- Juvenile salmonid habitat utilization and general distribution in the Willapa estuary.
- Salmonid distribution in fresh water habitat.
- Salmonid population abundance by stock in priority watersheds as identified above.
- Natural production rates of salmonids in priority watersheds as identified above.
- Delineation of individual stocks of salmonids.
- Determination of genetic lineage of individual stocks of salmonids.
- The efficacy of all propagation tools and projects used in the Willapa Basin.
- Potential economic impacts of management options.

IMPLEMENTATION OF THE PLAN

The plan cannot succeed without the ongoing commitment of all the relevant stakeholders in the watershed. The value and power of the WFRS comes from the voluntary participation of stakeholders and management agencies. Coordination between the Strategy and the policies of the natural resource management agencies must be achieved. Similar coordination must also be achieved with Pacific County's Growth Management Plan, comprehensive land use plans, and the Water Resources Management Plan. The WFRS will need to maintain this coordination as local, state, and federal policies evolve.

Implementation of projects must take place in and opportunistic manner, exploiting opportunities as they become available, but also through directed efforts to "make" opportunities. As feasible, members of WFRT should take advantage of their respective responsibilities to help achieve the priority actions identified in the WFRS. Future WFRT meetings will seek to maintain existing and develop new partnerships that allow for collaboration, that lead to synergistic policies, and achieve economies of scale in carrying out Strategy priorities. The WFRT will serve as a clearinghouse for up-to-date information on the activities of members as they work to implement the Strategy.

The WFRT should also contribute to efforts to secure funding for implementation projects. National and state government interest in supporting "grass roots" watershed restoration projects has never been greater. Major grant programs can be sought through the combination of skills available under partnerships. In soliciting funding, the carefully-drawn comprehensive Strategy will assure funders that proposed projects are the product of a deliberative, rational and inclusive consultative process. Recommendations from the WFRS suggest projects that are aimed at the root causes of management problems and are justified by detailed scientific analysis. The WFRS will provide confidence that funding is applied to the most effective and constructive activities.

Priorities are established for restoration, conservation, hatchery management, and harvest management and data collection activities throughout the Willapa Basin. Allocation of resources for these activities should be allocated according to these priorities to the greatest extent

possible. However, specific opportunities to implement projects which are not consistent with this prioritization but are not in conflict with management recommendations should be facilitated where possible, but should not be the focus of discretionary resources. Where possible, ways in which to leverage such resources to compliment the priority activities should be developed.

Lastly, the WFRS process has been developed as an adaptive one. Best available information has been used to complete the analysis and corresponding recommendations presented above. Priorities for improving and updating the current database have been suggested. Similarly, recommendations for evaluating the efficacy of the implementation steps have also been presented. This "learning" process must be given high priority in the implementation phase. A mechanism for applying new information to the planning process has also been developed in the analytical process and through the establishment and continued maintenance of the WFRT. The WFRT will be used to help update the WFRS as new information becomes available. Additionally, the principles of adaptive management are generally applied in the context of integrating new information concerning the natural environment. In the WFRS they should also be applied to the policy landscape surrounding fisheries and natural resource management in tracking and adapting to changes in and increased understanding of local, state, and national policy.

APPENDIX ONE

An assessment of Fundamental Production and Harvest Issues in the Willapa Basin

INTRODUCTION

This section address the management of artificial production and harvest and the second component of the WFRT's mission statement. *The Mission of the Willapa Fisheries Recovery Team is to develop a strategy for increasing and sustaining Willapa fish populations through the following actions; restoring and maintaining key ecosystem functions and processes fundamental to the biological productivity of the system; improving current fish propagation practices to allow the highest level of hatchery production compatible with the maintenance of natural productivity; and by improving methods for utilizing natural resources to secure the health and continued abundance of these resources while developing stability in the economic sectors which depend upon them.* In this section we ask the question " what is the highest compatible level of hatchery production? To answer this question we develop a definition for "compatibility" between artificial production, natural production and harvest. This section also seeks to describe how "compatibility" can be reached and sustained. The goal of "maximize" and make "compatible" defines a desired condition in the Willapa ecosystem in which both the natural productivity of fish populations is maximized and artificial production is managed at a level which provides for the maximum level of harvestable surpluses while not diminishing natural productivity. The overarching goal is to achieve the highest sustainable overall level of salmonid productivity from the Willapa basin.

There are a number of ways to increase the production or productivity of salmonids in the Willapa basin. Each method is most suited for achieving specific management outcomes such as increased harvestable surpluses, other ecosystem benefits, more diverse run timing, or more locally adapted stocks. This chapter will identify what we believe are the most effective strategies and methods for achieving the goals we have defined.

The Technical Team has identified a series of issues which are most central for defining "compatibility" in the Willapa basin. These issues include:

- Genetic conservation.
- Maintenance of natural and artificial production.
- The relationship between harvest and artificial production.
- Risks associated with management strategies.
- Information needs.

There are three specific management questions which will be discussed in the context of these issues:

- 1. What is the relationship between hatchery, natural production, and harvest in the Willapa basin.
- 2. What is the role or effects of alternative propagation strategies on natural productivity.
- 3. Which types of production are most likely to lead to which management outcomes.

The discussion of these issues and questions will provide a check list to be applied when developing production strategies for the basin. By applying this checklist to conditions in the Willapa ecosystem the Technical Team can define production and harvest goals in each watershed.

Various management techniques will also be discussed in the context of these issues, building a "tool box" which holds tools for implementing strategies to increase and sustain salmonid productivity. The purpose and efficacy of a variety of techniques will be reviewed. Each technique will be examined in relation to circumstances and conditions in which they may be applied. Finally, the potential failures of each technique will be assessed.

The final component of this chapter will be the application of our checklist and box of tools to the specific conditions present in the eight watersheds in the Willapa basin. Specific goals and implementation activities will be identified in each watershed and throughout the basin. The strategies and techniques best suited for meeting these goals in each watershed will then be identified.

ISSUES

Genetic Conservation

Genetic conservation is concerned with the protection of the inherent productive capacity of fish populations. Fish populations have a series of physical and behavioral traits that interact with environmental conditions to control the potential of a population to survive and provide benefits. These traits are passed genetically from one generation to the next so conserving this basic genetic material is a key part of meeting the objectives of maximizing the productivity of both artificially and naturally reproducing fish.

What is Genetic Material?

Genetic material is the biological blueprint stored in the cells which determines the basic characteristics of all living organisms. Genetic material is passed on from both parents to their offspring in a variety of combinations which produce an equally varied combination of traits in the next generation. Specific physical and behavioral traits or some combination may be passed on directly from parent to offspring. Salmonids exhibit an extremely wide variety of physical and behavioral traits between species, runs and stocks. These differences such as size, growth rate, reproductive capacity, return timing, and habitat preference are determined largely by their genetic blueprints.

Why is Genetic Material Important?

Genetic material is important for the following reasons:

- 1. Genetic makeup is one of the primary determiners of salmonid fitness.
- 2. The local adaptedness of salmonid stocks is important for populations to be successful in their specific environments.
- 3. Genetic diversity is crucial for maintaining both species and population resilience.

There are two key genetic issues which should be considered in salmonid management.

- 1. The selection and transference of genetic information provides fish populations with the ability to adapt to their environments so that they are successful in their unique local areas. This process is referred to as local adaptation.
- 2. The maintenance of genetic diversity, a variety of genetic information that produces different characteristics in a population of fish, is crucial for ensuring that populations can deal with changing environments and adverse conditions. This is referred to as species or population resilience.

Certain characteristics in individuals and populations of salmonids help them to be more successful under some conditions and less successful under others. When successful, salmonids reproduce and pass on their traits to their offspring. When unsuccessful, parents do not produce as many young and therefore fewer of the future generation of salmonids carry the traits of these less successful parents. The measure of success is frequently termed fitness. The process which selects for the most fit individuals is called natural selection. This process selects traits which are most suited for the specific environment in which the fish resides. This makes the fish best suited for a specific environment and the conditions which it meets there, or locally adapted.

All of the processes involved in local adaptation are not completely understood. It is speculated that adaptation may take place given the right conditions. It is also not known if there are factors

which make local adaptation more likely to occur under some circumstances than others. It is believed that the rate of adaptation may vary significantly as a function of the following conditions:

- The difference between the characteristics of the native location and the new environment.
- The general characteristics of each location.
- The occurrence of random events.
- The genetic diversity of the stock, more diverse stocks being more likely to adapt to their new environment.
- The number of individuals in the stock.

As conditions vary, by both chance and design, some of the different traits expressed by populations and individuals help them be more successful while some are less successful. A range of traits within individuals in a population which result from a range of shared genetic blueprints is therefore crucial for population survival. This range of traits is referred to as genetic diversity and makes it possible for stocks to survive as conditions change in their environment. This species or population resilience. Environmental conditions vary considerably both temporally and spatially throughout the Willapa basin. They vary greatly from stream to stream and from year to year. Conditions vary from one location to another in the basin and are also very dynamic, changing with weather, landslides, timber harvest rotations, outbreaks of disease, and other factors. This variation in conditions is met with an equally varied set of physical and behavioral traits in the basin's populations of salmonids.

There are two types of genetic diversity in fish populations, diversity between stocks and diversity within stocks among individual fish. Diversity between separate stocks of fish develops as separate breeding populations evolve different genetically controlled traits in response to the different conditions under which they live. It is important to have a number of locally adapted populations for a region for a species (or regional populations) to be resilient. Diversity within stocks is also important. Even though individual stocks of salmonids are locally adapted to the specific conditions in the streams in which they reside, each individual within these populations is slightly different as a result of the many combination of traits which can occur. It is important to have individuals with a variety of genetic traits within a population for the population as a whole to be resilient.

Genetic diversity is also important for providing sources of new genetic material. As is the case with livestock, dogs and other animals, breeding in populations in which all the members possess very similar genetic material can result in the development of abnormal traits in individuals, or inbreeding depression.

In summary, the following points must be given consideration during any effort to increase production in naturally spawning populations of salmonids or when providing increased system productivity from artificial production. The genetic makeup of salmonid individuals and populations is one of the primary determiners of fitness. The local adaptedness of salmonid stocks is important for populations to be successful in their specific environments. Lastly, genetic diversity is crucial for maintaining both species and population resilience.

How Genetic Material Can be Conserved

Genetic material can be conserved through the following steps:

- 1. Maintain adequate population sizes to reduce the chance of random loss and avoid inbreeding.
- 2. Limit unnatural levels of gene flow between genetically distinct populations through propagation practices.
- 3. Avoid artificial selection of specific traits through propagation, harvest, or habitat management. Some selection may be useful in propagation programs under specific circumstances but should be used judiciously.

There are basically two levels of genetic information that need to be conserved, population and individual. Both types of material can be conserved by ensuring that adequate population sizes are maintained. Maintaining an adequate population size serves two functions in conserving genetic information. First, it helps to ensure that populations do not become extinct. Second, it helps to provide an adequate pool of genetic material within populations to allow for healthy genetic exchanges between parent and offspring, avoiding the problems associated with inbreeding.

Another way in which genetic information is conserved is by avoiding the artificial mixing of genetic material by allowing populations which are typically separated to interbreed. Short-circuiting the natural selection process by artificially combining genetic material can result in traits which are not compatible with environmental conditions. Ensuring that individuals from separate populations are not interbred in propagation efforts helps protect against this problem.

The process of natural selection chooses specific traits within individuals and populations which help these fish be more successful under specific environmental conditions. The artificial selection of these traits can often disrupt the local adaptation process. Specific traits can sometimes be selected for in artificial propagation programs. Artificial selection of traits should be carefully controlled and used judiciously. When appropriate, natural selection processes should be used to determine which genetic material should be propagated in artificial production projects.

Harvest strategies may also select specific population traits, particularly involving size and return timing. Harvest may select against specific traits by targeting individuals which possess them, removing the genetic information which produces these traits from the population. Distributing harvest among the range of traits present may help to avoid this problem.

Lastly, some habitat management strategies can favor specific traits. Creating one or two specific, static habitat types can favor specific traits and discourage others. Allowing habitat fragmentation to occur may also reduce genetic diversity by separating breeding populations and reducing their effective gene pools. To avoid these problems the full range of habitat types should be managed for and the connectivity of habitat protected.

To summarize, the following steps should be taken to conserve genetic material. Adequate population sizes should be maintained to reduce the chance of random loss and avoid inbreeding.

Unnatural levels of gene flow between genetically distinct populations through propagation practices should be limited. Lastly, artificial selection of specific traits through propagation, harvest, or habitat management should be avoided. Some selection may be useful in propagation programs under specific circumstances but should be used judiciously.

How the Genetic Diversity of Willapa Salmonid Populations Can Be Conserved

The genetic diversity of Willapa salmonid populations may be conserved through the following steps:

- 1. The degree of local adaptedness of populations in each watershed should be evaluated. The evaluation should consider the following:
 - number of propagated fish introduced
 - length of period of introductions
 - length of time since the last introduction
 - source of genetic material introduced
 - method of propagation
 - further sampling and analysis of genetic material
- 2. Local adaptedness should be facilitated in all populations throughout the basin regardless of their origins or condition.
- 3. More protection should be afforded to the populations which exhibit the most local adaptedness and genetic uniqueness.
- 4. Less protection should be afforded to populations which are the least adapted to local conditions.

In any ecosystem, the more genetic diversity that is present the more resilient the populations will be. To protect and improve genetic diversity, local adaptation should be encouraged in all salmonid populations. In the Willapa basin, our best information suggest that most populations have been influenced by artificial manipulation to some degree. As a result of significant levels of genetic manipulation, some populations may be very poorly adapted to their environments. To improve local adaptation and protect and increase genetic diversity, the most locally adapted salmonid populations should be provided the greatest management protection. The process of local adaptation should be encouraged in other stocks as well, but more flexibility in management should be exercised.

In order to effectively improve local adaptation and genetic diversity through the conservation of the most locally adapted genetic material, the degree to which populations in each watershed have been affected by artificial propagation activities should be evaluated. This can be accomplished by examining records (both official and unofficial) which document propagation activities in each location. The following information should be evaluated when assessing degree of local adaptedness:

- number of propagated fish introduced
- the length of time over which introductions were made
- the length of time since the last introduction

- source of the genetic material propagated
- and type of propagation activity

This can also be accomplished by further sampling and analysis of genetic material in local populations to determine genetic origin, relationship with other populations and ultimately degree of local adaptedness.

Whatever the genetic condition of stocks, the adaptation process should be facilitated in all populations throughout the basin to improve the overall productivity of the basin's artificially and naturally reproducing salmonid populations.

To summarize, the following steps should be taken to conserve genetic diversity. The local adaptedness of Willapa stocks should be evaluated. Local adaptedness should be facilitated in all Willapa stocks. The greatest amount of protection should be afforded to the most locally adapted stocks.

Balancing Natural and Artificial Production

The WFRT identified the goal of balancing artificial and natural production within the Willapa basin to provide for both ecosystem and economic benefits. The natural production of salmonids is crucial for maintaining a healthy and productive ecosystem and can provide harvestable surpluses. Artificial production is best geared for providing significant harvestable surpluses for commercial and sport fisheries, but can limit natural productivity if not appropriately operated. We believe that it is possible to "have our cake and eat it too", ensuring that healthy, diverse naturally spawning populations of salmonids are increased and sustained throughout the Willapa basin while artificial production is carried out in innovative and sustainable ways to provide significant harvestable surpluses for the fisheries. There are a number of factors which influence how well natural and artificial production are balanced to meet the goals of a healthy ecosystem and a healthy harvest rate. This section will address these factors, the roles which artificial and natural production can play in the Willapa basin, and ultimately how this balance can be defined and achieved.

The Role of Natural Production in the Willapa Basin

The maintenance of naturally spawning populations is important for providing the following functions and benefits:

- 1. Naturally spawning populations can provide harvestable surpluses.
- 2. The existence of naturally spawning stocks sustains the genetic diversity and adaptedness of a region's salmonid populations.
- 3. Naturally spawning populations play a crucial role in ecosystem function.
- 4. Salmon spawning in the wild is an important part of the Willapa community's heritage.

Natural production serves a number of functions in the Willapa basin. First, natural production can produce a surplus of fish beyond what is required to sustain populations. Surpluses can be harvested by both commercial and sport fisheries. Given the size and productivity of the Willapa basin, surpluses of some species have the potential for being very significant.

Second, natural production generates the diversity of genetic information necessary for maintaining the resilience of salmonid populations. As discussed above, genetic diversity and adaptedness can not be created artificially.

Third, naturally spawning populations play critical roles in the overall function of the Willapa basin's ecosystem. Salmonid populations are a critical component of the ecosystem's nutrient cycles. They play important roles in many food chains, both providing food and consuming it, transferring it into other forms, and helping to maintain the balance between the populations of many species. Recent information also suggests that anadromous species like salmonids provide a nutrient subsidy to freshwater and terrestrial environments from the marine environment. Salmonids grow and store energy while at sea maturing and when they return to their natal streams to spawn and die, they release this stored energy which is absorbed and utilized in the freshwater ecosystem.

Lastly, the presence of salmon spawning throughout the basin's rivers and streams is an important part of the Willapa community's heritage. It is important to members of the community to be able to walk along a stream and watch or fish for salmon. Salmon have long been a defining element of the local environment fundamental to the esthetic and spiritual experience and lifestyle of Willapa residents.

In summary, it is recognized that maintenance of naturally spawning populations is important for providing harvestable surpluses, genetic diversity and local adaptations, significant ecosystem benefits, and plays an important role in maintaining the local communities way of life.

The Role of Artificial Production in the Willapa Basin

Artificial production of salmonids can serve the following roles in the Willapa basin:

- 1. It can provide a harvestable surplus of fish which can be harvested by both the commercial and sport fisheries to provide economic and social gains.
- 2. Artificial production can also be used to restore naturally spawning populations through supplementation strategies.

The WFRT has identified two functions which artificial production may serve in fisheries management in Willapa . First, various forms of propagation may be used to provide harvestable surpluses for both commercial and recreational fisheries. Propagation can be used to increase the production of fish from specific systems to provide a surplus of fish which can be harvested. To maintain propagation efforts a constant supply of inputs including labor, food, energy, water and ultimately money, is required. In order for these types of systems to be successful, inputs must be balanced with outcomes to provide a net benefit. Benefits include harvestable surpluses, recreational opportunities, and ultimately economic gain. Harvest driven propagation programs can sometimes reduce the productivity of naturally spawning populations. There may be situations where these types of impacts are unavoidable and warranted, but they should be carefully controlled and impacts kept to a minimum.

Second, some forms of propagation may be used to provide increases in fish production for the purpose of restoring naturally spawning stocks. Careful application of artificial propagation may

be used to increase fish production in locations in which there are seriously depleted stocks in order to reestablish sufficient population sizes to allow the populations to be self maintaining. This is accomplished by using propagation to overcome limiting factors or to provide the initial individuals needed to establish a population.

With both applications of artificial propagation, the conservation of genetic diversity and adaptedness should be practiced. The desired outcome of any propagation program is to increase production. If genetic diversity is depleted, production will not be sustainable.

In summary, artificial production of salmonids provide an increased harvestable surplus of fish which can be harvested by both the commercial and sport fisheries to provide economic and social gains. Artificial production can also be used to restore naturally spawning populations through appropriately designed supplementation strategies.

Natural Factors Influencing Productivity

Natural factors assert a significant influence on the productivity of both naturally spawning and artificially produced fish through:

- 1. Variations in the availability and condition of habitat.
- 2. Fluctuations in environmental conditions such as precipitation and temperature.
- 3. The effects of predation and competition for food and space.

There is an extensive number of naturally occurring factors which influence fish productivity in the Willapa basin. These factors may fall into three broad categories, habitat, environmental conditions, and competition and predation. Each of these factors may have a significant influence on the productivity of both naturally spawning and artificially propagated fish. The affects of these factors may vary from species to species and from one population to another. This variation results from the temporal and spatial variability of the factors. It also results from the differences between species and populations of fish. Different species and populations may be affected differently because of their own characteristics and responses. The chapter on ecological processes will enumerate these natural factors more completely and relate their affects on fish productivity more precisely in each watershed.

In summary, natural factors assert a significant influence on the productivity of both naturally spawning and artificially produced fish through variations in habitat conditions and availability, fluctuations in environmental conditions, and the effects of competition and predation.

Effects of Harvest on Productivity

Harvest can influence naturally and artificially maintained productivity in the following ways:

- 1. Escapement is one of the most important factors determining hatchery and natural salmonid productivity.
- 2. Harvest can be the most important factor influencing escapement to both hatcheries and natural rearing areas in the Willapa basin.
- 3. Artificially maintained salmonid populations can generally sustain higher harvest levels than naturally spawning populations in the Willapa basin.

- 4. Elevated harvest rates on hatchery populations can harvest naturally spawning populations at levels which reduce their escapement below population replacement requirements.
- 5. Escapement levels required to maintain naturally spawning populations can be much more difficult to predict than escapements needed to maintain hatchery populations.

The other primary factor affecting productivity in the Willapa basin is human harvest. Harvest can affect productivity by influencing population dynamics, distribution, and timing. Harvest in the Willapa basin is done by both commercial and recreational fishing. It is closely linked with hatchery production but both artificially and naturally maintained populations can be harvested.

Harvest affects population dynamics by its regulation of escapement. Escapement of fish is a crucial factor determining the rate of production from both hatcheries and naturally functioning systems. Different levels of escapement are required to meet different productivity goals. A certain level of escapement given variable environmental, physical, biological, and other conditions and factors is required to replace the individuals within a population which die each year. This level of escapement is extremely difficult to predict accurately given the immense number and high variability of the factors which determine survival. There is also a level of escapement which allows populations to reach their maximum possible productivity given the other determiners of productivity.

The effect of escapement is somewhat easier to predict with hatchery production. The production capacity of the hatchery is determined by the availability of rearing space and required inputs such as water. Escapement of adults past the fishery determines the availability of eggs and sperm needed to meet this capacity. When escapement provides fewer parents than is required to fill the rearing capacity of the hatchery, productivity declines. When escapement provides the number of parents needed to meet the rearing capacity, productivity reaches maximum levels. Barring operational problems with the rearing facility, productivity is determined by the escapement to the hatchery by in large in the Willapa system. Water levels, predators, and disease may influence actual escapement to the hatchery once fish are past areas of harvest, but harvest tends to be the most important factor determining escapement to the hatchery. Once the young are released from the hatchery numerous other factors influence the systems production of fish.

In naturally producing systems, escapement is an equally important factor in determining productivity. There are a variety of other factors however which complicate the estimation of productivity. Yearly (and more frequent) variations in habitat availability and condition determine the production potential of the system, influencing the amount of escapement required to fill its capacity. Variability in environmental conditions is also highly significant and dramatically influences the amount of escapement needed to maximize productivity.

Artificially maintained populations in the Willapa basin are typically capable of producing harvestable surpluses which may sustain much higher harvest rates than naturally spawning populations. Harvest rates on hatchery populations are generally set at levels which are designed to harvest these higher surpluses and exploit the increased production capabilities of hatchery facilities. These harvest rates can not be sustained on naturally spawning populations. When

naturally spawning populations are intercepted in a fishery which harvests at a rate designed to exploit hatchery level production, the naturally spawning population is likely to be harvested at a rate which will reduce escapement to levels below the population replacement level. In other words, if a naturally spawning population is harvested at a hatchery rate, the resulting escapement rate will be below what is required for the population to be sustained. The following examples illustrate how harvest rates effect naturally spawning and artificially propagated populations differently.

Harvest Management Examples

Harvest management issues primarily revolve around escapement policy. How many fish do we need to allow to spawn in either the wild or in a hatchery to sustain the types of runs we want for the future? Hatchery and wild salmon can have very different management needs. Hatchery fish are protected from many of the sources of mortality that affect wild fish. They are less exposed to floods that can wash eggs out of the gravel, fine silts that clog the gravel and suffocate the eggs, predators, low flows, and the many other factors that can kill wild fish. Because of this protection the overall survival of hatchery fish is greater and they can withstand higher harvest rates than can wild fish. In these examples we will demonstrate how this difference in survival can lead to different management strategies, and some of the implications of this to long term survival and production. We will then compare these strategies with current approaches.

Choosing the proper escapement level requires a balance between the risk to long term stock health and the opportunity to harvest. The safest way to protect long-term stock health is to not fish at all. In this way spawners will be available to use all the available habitat. If fish die from a fish kill or other source of loss, more fish will be there to take their place. However, complete protection does not meet any of our needs for fishing opportunity. Salmon can be safely fished and still provide for long-term survival. However at some point we can fish stocks to the point where the risk of stock loss is too great. There is no one best level for escapement. We can select from a range of escapement levels that have different levels of stock protection and harvest opportunity. In the following discussion you will see how these interact with choosing different harvest strategies.

Chum salmon provide the simplest example for comparing the different harvest strategies for hatchery and wild stocks. The major hatchery program for chum ended in 1990 and currently the chum run in Willapa Bay is primarily wild fish. However this historical data is still a good example. For this example we need some basic background information:

- The average adult return for each wild spawning chum from 1982-91 was 2.47 fish. If we started with 1,000 spawners 2,470 fish would return over the next three to five years. We can harvest 1,470 of these fish and still have the 1,000 spawners needed to keep the cycle going. This is a harvest rate of 59.5%.
- Over the same period hatchery chum salmon had an average return rate of 10.0 fish per spawner. If we started with 1,000 hatchery spawners they would produce 10,000 adult fish back to Willapa Bay. We can catch 9,000 of these and still have the 1,000 fish that we started with. This is a harvest rate of 90%.
- If we harvest the combined wild and hatchery runs at 59.5% we can sustain the wild run at current levels, but we will only catch 5,950 of the 9,000 possible hatchery fish. This

leaves 3,050 fish to return to the hatchery. Since only 1,000 are needed for spawning there are 2,050 extra, or "surplus", fish at the hatchery.

- Alternatively, if we fish the combined runs at 90% we will sustain the hatchery run, but we will catch 2,223 of the 2,470 wild fish. This leaves only 247 fish to spawn. Since 1,000 fish are needed to sustain the run at current levels the wild run will decline.

This basic relationship between hatchery and wild chum holds for all the salmon in Willapa Bay. Different stocks of fish have different survival rates and different ideal harvest rates. In this case if you want to catch all the hatchery fish you will overharvest the wild fish and reduce their population. If you manage to meet the wild stock escapement needs you will not be able to fully harvest all the hatchery fish. As a result you may give up some harvest opportunity and there will be hatchery surpluses.

How do we decide what approach to use? The best approach will be a function of the relative size and productivities of the hatchery and wild stocks, and each person's own view of the balance of stock risk and the need for fishing opportunity. The following two examples using actual run data for Willapa Bay chum and chinook will illustrate two different outcomes:

Chum - Table 1 provides harvest and escapement outcomes from three different management strategies for chum. These outcomes include wild escapement, hatchery escapement (including the availability of fish to place above the hatchery weir), total initial catch the first year, and the predicted yearly future run size and catches. The hatchery fish available for upstream release is included because there is spawning area above some of the hatcheries that can contribute to future run sizes and because of the interest in these fish in the Willapa Bay region. The analysis is based on the 1982-1992 average run size of 103,400 fish (82,400 wild and 21,000 hatchery).

Table 1. Predicted outcomes of three harvest strategies for Willapa Bay chum salmon.

	Hatchery Fishing Rate Average (90%)	Wild Fishing Rate (59.5%)	Recent Actual (49.3%)
Wild Escapement (Goal = 35,400)	8,240	33,372	41,777
Total Hatchery Escapement	2,100	8,526	10,647
Hatchery Escapement Available for Upstream release	0	6,426	8,547
Total Initial Catch	93,060	64,420	50,976
Predicted Future Run	41,320	119,344	129,277
Predicted Future Harvest	37,188	70,890	63,734

- In this case the wild run is much larger than the hatchery run, and has the capacity to generate significant catches. Hatchery fish make up only about 22% of the total chum run.
- Managing at the rate to catch all the hatchery fish provides the largest initial catch. It meets the escapement goal for hatchery chum, but provides less than 25% of the wild escapement goal. There are also no fish to put upstream to use the spawning area above the hatcheries. Because of the low wild escapement, the predicted future run size is less than 40% of the current run size, and expected future catches are much lower.
- Managing at the rate at the wild fish rate gives an intermediate initial catch. It basically meets the escapement goal for both wild and hatchery fish, and provides some fish to pass above the hatchery. These fish are then part of the wild escapement and are part of the prediction for future runs. The future run size from this approach is intermediate, but it provides the highest future catch.
- Recent actual management has been somewhat more conservative than is needed to meet wild fish needs. This has not been by design, but is due to the imprecision of management. Current management provides the highest hatchery and wild escapement levels, and places the highest number of fish above the hatchery. It provides the highest long term run size, but due to the low harvest rate it has the lowest immediate and long-term catch expectations.
- In this example it appears that the best balance of low risk and high fishing opportunity comes from fishing at the rate that protects wild fish.

Chinook - Table 2 provides harvest and escapement outcomes for three different management strategies for Willapa Bay chinook salmon. Allowable harvest rates for chinook are generally lower than for chum, but the relationship between wild and hatchery harvest rates is very similar. A harvest rate of 45.7% is needed to meet the wild escapement goal at current run sizes. This is lower than we see for chum because of the large catches of Willapa chinook in ocean fisheries. This means that the Willapa Bay fishery is fishing on a smaller percentage of the total chinook run than is the case for chum.

The allowable harvest rate for hatchery chinook is 78.4%. A total of 37% of the hatchery chinook do not return to the hatchery, and spawn in the wild. This has the effect of lowering the return rate of the hatchery fish so that the hatchery harvest rate must be lower. It also has the effect of supplementing the wild escapement, though the fish are concentrated in a few areas around the hatchery. They are expected to be much less productive than if they were spread out evenly over a larger area.

This analysis is based on recent average run sizes of 46,400 chinook (38,300 hatchery and 8,100 wild).

- Fishing at the hatchery fishing rate meets the hatchery escapement goal, but provides the lowest wild escapement and hatchery strays. The wild escapement is less than 40% of the escapement goal. The total of hatchery strays and wild escapement barely exceeds the escapement goal, and most of the escapement would be concentrated in limited areas near the hatcheries. Meeting the hatchery goal provides only for the basic hatchery program. It

Table 2. Predicted outcomes from three harvest strategies for Willapa Bay chinook.

	Hatchery Fishing Rate Average (78.4%)	Wild Fishing Rate (45.7%)	Recent Actual (60%)
Wild Escapement (Goal = 4,400)	1,750	4,400	3,240
Hatchery Escapement at the Hatcheries	5,187	13,040	9,606
Hatchery Strays	3,086	7,757	5,714
Total Catch	36,377	21,205	27,840
Hatchery Surplus	0	7,853	4,419
Predicted Future Run	48,939	65,045	57,998
Predicted Future Harvest	38,368	29,726	34,799

provides no surplus fish to release above the hatchery, or eggs for any enhancement beyond the hatchery. This approach does provide the largest initial harvest and the largest predicted future harvest.

- Fishing at the wild fish rate meets the escapement goal for both hatchery and wild fish. It also provides 7,757 hatchery strays so the combined wild escapement is well above the goal. Again, much of the escapement is concentrated into a limited area where competition for space and food will be higher, and overall survival is expected to be lower. This approach has a hatchery surplus of 7,853 so that some fish would be available for placement above the hatcheries and eggs would be available for suitable enhancement work. This approach provides the lowest initial and long term catches because of the lower harvest rate, but provides the largest long-term run size.
- The current harvest rate is intermediate to the other two examples. Under this approach 74% of the wild escapement goal is met. The hatchery goal is met and there are 5,714 hatchery strays. The hatchery surplus of 4,419 provides for both above the hatchery releases and some enhancement. It provides an intermediate level of initial and long-term harvest.

Chinook are an example of where hatchery and wild management goals provide conflicting outcomes for stock risk and fishing opportunity. With chinook the hatchery run is much larger and has a greater capacity than the wild run so the results are very different than with chum. In this case the most fishing opportunity is provided by fishing at the hatchery rate, but this also provides the lowest wild escapement and the greatest stock risk. The most stock protection is provided using the wild management approach, but this also provides the lowest catch rates. The current management approach is an example of one of many possible intermediate management approaches that could be used.

Coho - the same detailed level of information is not available for coho in Willapa Bay. No estimates of wild coho escapements are available, and no wild escapement goal has been set.

Wild coho spawn in many areas of the watershed, and given the large number of hatchery fish it is certain that some straying of hatchery fish occurs.

Work from Puget Sound suggests that total harvest rates for wild coho of 60-65% are optimal. This includes harvests in all fisheries, including ocean fisheries. Coastal coho stocks survive at a lower rate than Puget Sound stocks so that the optimal rate is more likely to be in the 50% -60% range. Estimated actual total harvest rates for 1979-92 were 80.7%. Allowable harvest rates on hatchery coho are greater than 98%. It is unlikely that we can ever achieve the high fishing rates allowed under the hatchery management approach, but it is certain that the population is below the optimum level for wild production.

Coho are very similar to chinook. Hatchery fish dominate the production in the system, and management for hatchery fish will likely produce the highest immediate and long term catch opportunities. However, managing for hatchery fish creates high risks to wild stock health and productivity. More work is necessary to determine if the current approach is a reasonable alternative.

In Summary, it is clear from these examples that hatchery and wild fish have very different management needs and that if we are to meet the needs of either wild or hatchery fish it will have significant impacts on the harvest and production of the other group. If we want to harvest all the hatchery fish using current methods, we will overharvest wild stocks. If we want to have abundant wild fish on the spawning grounds utilizing the available habitat, we will not be able to harvest all the hatchery fish using current techniques, and we will have surpluses. There is no clear way to choose the "right" approach. The approach will depend on the species, the relative abundance of hatchery and wild fish, and how important stock health risks and catch are.

Differential Harvest on Natural and Artificial Populations

Harvest is used to regulate the number of hatchery produced fish which are allowed to spawn both at the hatcheries and naturally. Hatchery production and harvest method, location, timing, and duration can be closely linked to provide harvestable surpluses for the fisheries while regulating the interaction between hatchery and naturally spawning populations of fish. The effectiveness of this strategy can be influenced by a wide range of factors including the following:

- 1. Location and physical characteristics of the hatchery area.
- 2. Location and physical characteristics of the fishery area.
- 3. Proximity of the spawning areas of naturally spawning populations.
- 4. Migrational characteristics of naturally spawning populations in the vicinity of the fishery and the hatchery such as return timing and migrational route.
- 5. Migrational characteristics of the hatchery population targeted by the fishery.
- 6. Survival of hatchery fish.
- 7. Accuracy of predictions for hatchery fish returns.

Risk Management

All natural resource management options pose some risk that the outcome of the management actions will not result in the desired or predicted condition. This is at least in part because:

- There are many variables which must be accounted for.
- There are many variables which can not be controlled or even influenced.
- The information needed to make management decisions is imperfect, at best.
- Preferred management options are not always implemented successfully.

Six general reasons why a strategy for managing fisheries resources may not result in the desired outcome can be identified:

- 1. The strategy employed was based upon theories which were incorrect.
- 2. Inaccurate information was used to select the strategy.
- 3. Information needed to make management decisions was not available.
- 4. Variables which can not be controlled acted in ways which were not predictable given the best available information.
- 5. The current condition or characteristics of the resource limit management options and success.
- 6. The strategy was not implemented correctly.

In addition to considering the likelihood of management failure, the potential cost of the failure should also be considered when assessing risk. If the management strategy fails and the desired outcome is not reached, what will be lost? How costly is the loss? Finally, when assessing the potential likelihood and cost of failure of a management option, the potential cost of not implementing a management option must also be considered. What will likely happen if nothing is done and what might it cost?

The following section address specific factors which should be considered when evaluating risks associated with management options.

Sources of Risk

There are a number of specific sources of risk which fall into the six categories of reasons that a management strategy may fail. The following lists the sources of risks which should be considered when designing management plans for Willapa fisheries.

1. Management Theory

- Methods of estimating the productivity of freshwater systems exhibit a significant margin of error.
- Models for predicting ocean productivity are extremely inaccurate.
- Models for predicting escapement are only marginally accurate.

2. Inaccurate Information Base

- Data used to estimate escapement can be inaccurate.

- at hatcheries
 - on spawning grounds
- Data used to estimate harvest rates can be inaccurate.

3. Inadequate Information Base

- Data used to estimate the productive capacity of habitat is outdated.
- Data needed to evaluate hatchery productivity is not available.
- Data needed to estimate escapement is not available.

4. Independent and Unpredictable Variables

- Variability of weather can not be predicted.
- Variations in climate can not be predicted.
- Changes in habitat condition can only be predicted with limited resolution and reliability.
- Ocean conditions can not be predicted.

5. Resource Condition and Characteristics

- Small population sizes are more vulnerable to degradation.
- Less genetically diverse populations are more vulnerable to degradation.
- Reduced numbers of separate populations increases vulnerability to degradation.
- Reduced distances between populations increases vulnerability to degradation.
- Reduced diversity in the timing of population life cycles increases vulnerability to degradation.

6. Poor Implementation

- Harvests may take more fish from naturally spawning populations than desired.
- Harvest may not take as many hatchery fish as desired.
- Operational errors at hatcheries and at other propagation facilities may reduce production below desired targets.

What are Acceptable Levels of Risk

Since some level of risk is an unavoidable condition in fisheries management, managers and the public must decide how much risk they willing to incur with respect to the possible management options. One way this decision can be made is by assessing four considerations concerning the range of possible management options, recognizing that no management action is also an option. The four considerations include:

- 1. What is the level of confidence in the information and predictions we are relying on to make our management decisions?
- 2. What is the level of confidence that the management strategy can be successfully implemented?
- 3. What may be lost if the management strategy fails?

- 4. Can we recover what is lost if management fails?

Information needs

One of the more significant barriers to implementing more successful propagation and harvest strategies in the Willapa basin is the lack of availability and reliability of data crucial for designing and implementing management. This situation is not uncommon to most management areas. Four primary data needs categories for the basin have been identified which include:

- 1. Genetic characteristics of local populations.
- 2. Current distribution and abundance of salmonids in the basin.
- 3. Current natural production capacity of the individual watersheds and streams within the basin.
- 4. Survival rates and behavior of artificially propagated fish.

Genetic Characteristics of Willapa Salmonid Populations

Current understanding of the genetic characteristics of salmonid populations in the basin is limited. Given the significant amount of artificial propagation which has occurred in the basin, genetic characteristics have been greatly changed in many populations. It is not well documented which populations have been impacted by artificial propagation. There is more information on which systems have been affected but more is needed and a cumulative report of this information is not currently available. It is not well defined to what extent genetic material in affected populations has been artificially manipulated. The source and general traits associated with much of the genetic material found in local, naturally spawning populations is not well documented. Some information on genetic lineages and characteristics from limited genetic sampling is available but the quality of this information may be limited due to relative sparseness of the data sets. The degree of local adaptedness of individual populations is therefore not well understood.

An analysis and compilation of known propagation measures would provide some of the information which is needed for understanding sources of genetic material, traits associated with the material, and likely degree of genetic manipulation of specific populations. More extensive sampling of genetic material may also help to answer these questions.

Current Distribution and Abundance of Fish

Data on the distribution of all of the salmonid species is outdated for much of the basin. Data is particularly lacking for steelhead and cutthroat trout. Current data on abundance throughout the basin is even more sparse. Very little is known about population sizes in a majority of the basin. Even less is known about the distribution and abundance of the various salmonid species with respect to their life cycles. This is true for both the freshwater and marine environments.

Information on distribution is currently being collected through stream typing surveys. Additional surveys of juveniles and adults are needed to provide data on distribution and abundance.

Current Capacity of the System to Produce Fish

Data on the availability of habitat types in both freshwater and marine environments is limited.

The data that exists is outdated in most cases which reduces its reliability significantly. The productive capacity of available habitat throughout the system is poorly quantified as well.

Habitat surveys coupled with productivity studies are needed throughout the basin.

Survival and Behavior of Artificially Propagated Fish in the Wild

The survival of artificially propagated fish in the basin is not well quantified. It is unclear which types of propagation provide the greatest survival rates and why. The behavior, particularly relating to returning to and straying from natal spawning areas, is not well quantified for in the Willapa basin, particularly with respect to propagation methods.

General Considerations for Information Needs

Important questions to ask with respect to these four information needs include:

- How much is currently known about the topic-how much data is available?
- How was the information or data obtained?
- How reliable is the information or data?
- How much do we currently need to know about the topic?
- What resolution of data is needed?
- How can the information be obtained?

In summary, the following data needs have been identified for improving the management of artificial propagation programs and harvest:

- 1. Develop a more complete understanding of genetic characteristics of local populations of salmonids.
- 2. Improve the information base on the current distribution and abundance of salmonids in the basin.
- 3. Quantify the current natural production capacity of the individual watersheds and streams within the basin.
- 4. Develop a better understanding of the survival rates of artificially propagated fish in the basin.

PRODUCTION ISSUES CHECK LIST

This section summarizes the primary issues that should be considered in relation to the use of artificial production measures and strategies. The sections above provide a discussion of these issues and why these conclusions were reached. This "check list" is designed to be applied when identifying appropriate management strategies for maximizing salmonid productivity for individual watersheds throughout the Willapa basin.

Protection of Genetic Resources

- 1. Is the population too small to assure a sufficiently large gene pool? Can it be increased? How?
- 2. Will policies avoid excessive mixing of distinct stocks?

- 3. Will policies avoid harmful skewing of the overall population caused by:
 - propagation policies?[egg take policies, escapement, release, feeding]
 - harvest policies?[timing, size, etc.]
 - habitat policies?[diversity and connectedness of habitat]
- 4. Can we identify high priority existing genetic resources?
- 5. Are these high priority stocks well protected? Are they at risk?
- 6. Are artificial stocks likely to interbreed with, compete with, or prey upon high priority natural stocks?
- 7. Can we identify locally-adapted stocks? Are they well protected?
- 8. Are policies toward artificial stocks leading towards better adaptedness?
- 9. Can we modify current practices to better promote stock adaptedness?
- 10. Are polices leading towards improving the diversity of the gene pool?

Proper Balance of Natural and Artificial Production

- 1. What is the proper balance of natural and non-natural production in this watershed? Should this watershed emphasize natural or artificial production?
- 2. Do we want more natural fish to support:
 - sports and commercial harvest?
 - the species' genetic resources?
 - ecosystem function?
 - the quality of life within local communities?
- 3. Do we want more artificial fish to support:
 - sports and commercial harvest?
 - the species' genetic resources?
 - ecosystem function?
 - the quality of life within local communities?
- 4. Are there other major limiting factors limiting natural productivity?
- 5. Would other limiting factors override efforts to promote artificial production?
- 6. How economically sustainable is the technique for enhancement?
- 7. How politically sustainable is the enhancement technique?
- 8. How effective is the technique for increasing production?
- 9. What is the time-frame for seeing an improvement?
- 10. How does the technique affect the balance of natural and non-natural production?
- 11. What level of risk is acceptable in assigning priority to artificial or natural production?

Harvest and Artificial Production

- 1. Do harvest policies in this watershed support or reduce natural stock production?
- 2. How important are harvestable surpluses to local communities?
- 3. Will raising levels of escapement to utilize natural habitat necessitate reductions in harvest levels.
- 4. How are artificial spawning populations selected?
- 5. Is there underutilized or unutilized habitat available for natural production?
- 6. Can the characteristics of existing enhancement facilities be modified to promote better adaptation to the wild?
- 7. Are the enhancement facilities located in the optimal place for avoiding damage to natural production and encouraging local adaptedness?
- 8. Are the harvest areas suitable for selective harvest?
- 9. Are the migrational characteristics of the natural and non-natural stocks conducive to selective harvest?
- 10. Do techniques to modify return timing and migrational routes to permit selective harvest present an undue risk to natural stocks?
- 11. Do proposed techniques improve the non-natural fish's survival in the wild?

Risk Management

- 1. What will happen if nothing is done?
- 2. What are the costs of doing nothing?
- 3. How much confidence do we have in the basic theories underlying our policies?
- 4. How much confidence do we have in the information we used to develop the plan?
- 5. Did we lack important information needed to make decisions?
- 6. Are there overriding factors that can not be controlled?
- 7. Are we sure that the plan is workable?
- 8. Is it likely the strategy be implemented correctly?
- 9. What may be lost if the management strategy fails?
- 10. Can we recover what we lost if management fails?

Information Needs

- 1. Do we know what information is most needed to improve management?
- 2. Do we know the reliability of the most important information we are using?
- 3. Do we have confidence regarding information on:
 - genetic characteristics of local populations?
 - current distribution and abundance of stocks?
 - current natural production capacity of the individual watersheds and streams?
 - survival rates of artificially propagated fish?
 - straying rates of artificially propagated fish?
- 4. Do we have confidence regarding information on:
 - genetic characteristics of local populations?

- current distribution and abundance of stocks?
 - current natural production capacity of the individual watersheds and streams?
 - survival rates of artificially propagated fish?
 - straying rates of artificially propagated fish?
- 5. How was information obtained?
 - 6. How much do we need to know about each issue?
 - 7. Is the resolution of information adequate?
 - 8. Can the missing information be obtained and how?

APPENDIX TWO

Supplementary Data Tables

[Table 10. Ecological Process Analysis - Data Summary](#)

[Table 11. Salmonid Populations Status - Watershed Comparisons](#)

[Table 12. Potential Ecological Impacts - Watershed Comparisons](#)

[Table 13. Ecological Impacts - Watershed Comparisons](#)

[Table 14. Ecological Quality - Watershed Comparisons](#)

[Table 15. Basin Wide Salmonid Propagation Statistics](#)

[Table 16. Production and Harvest Analysis Data Summary](#)

APPENDIX THREE

Completed Ecological Processes and Production and Harvest Matrices

Matrices

Salmonid Populations - By Watershed

North
Willapa
Palix
Nemah
Naselle
Bear
Long Island
Long Beach

Potential Impacts - By Watershed

[North](#)
[Willapa](#)
[Palix](#)
[Nemah](#)
[Naselle](#)
[Bear](#)
[Long Island](#)
[Long Beach](#)

Impacts - By Watershed

[North](#)
[Willapa](#)
[Palix](#)
[Nemah](#)
[Naselle](#)
[Bear](#)
[Long Island](#)
[Long Beach](#)

Quality - By Watershed

North
Willapa
Palix
Nemah
Naselle
Bear
Long Island
Long Beach

Chinook/Coho/Chum - By Watershed

North
Willapa
Palix
Nemah
Naselle
Bear

APPENDIX FOUR
Glossary of Terms Used in the WFRS

Basin, Willapa: The boundary which defines the Willapa Ecosystem which is delineated based on topographic features that control the direction of the drainage of surface waters into Willapa Bay.

Endangered Species Act (ESA): A 1973 Act of Congress that mandated that endangered and threatened species of fish, wildlife, and plants be protected and restored.

Harvestable Surplus: The portion of the total production remaining after meeting escapement needs.

Local Adaptation: The degree of congruence between a fish's genetically and behaviorally produced characteristics and the environment in which it lives.

Native Stock: An indigenous stock of fish that has not been substantially affected by genetic interactions with non-native stocks or by other factors.

Naturally Spawning Stock: A stock that is sustained by naturally spawning and rearing in natural habitat, regardless of parentage.

Population: Synonymous with stock.

Riparian: The area adjacent to a stream which is both influenced by and influences the stream.

Resilience: The ability of a stock to withstand adverse environmental and other impacts and still remain healthy and productive.

Run: The sum of stocks of a single salmonid species which migrates to a particular region, river, or stream of origin at a particular season.

Salmonid: Any member of the taxonomic family Salmonidae, which includes all species of salmon, trout, and char.

Stock: The fish spawning in a particular lake or stream or portion of them at a particular season, which to a substantial degree do not interbreed with any group spawning in a different place or in the same place at a different time.

Supplementation: The release and management of artificially propagated fish in streams with the intent to increase or establish wild fish populations while minimizing associated genetic and ecological risks.

WDFW: Washington Department of Fish and Wildlife

WFRS: Willapa Fisheries Recovery Strategy

WFRT: Willapa Fisheries Recovery Team

Watershed: The geographic boundary assigned to management units within the Willapa Basin which are delineated based on topographic features that control the direction of the drainage of surface waters.

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