

Puget Sound Groundfish Management Plan (Revised)

by

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Executive Summary

Groundfish resources in Puget Sound including bottomfish, Pacific halibut, and non-classified marine fishes are some of the principal clients of the Washington Department of Fish and Wildlife. Recent studies have shown that the majority of key groundfish stocks in Puget Sound are in below average abundance. Some of the species that once dominated the catches of recreational and commercial fisheries are now at depressed or critical abundances, resulting in historic low catches and reduced fisheries. A number of natural and human-induced factors may be responsible for the poor condition of groundfish.

In November, 1996, the Washington Fish and Wildlife Commission adopted the Puget Sound Groundfish Policy to reverse the poor conditions of groundfish and to assure the integrity of the ecosystem and habitat upon which groundfish resources depend. The adopted policy states:

“It is the policy of the Washington Fish and Wildlife Commission to manage Puget Sound groundfish, especially Pacific cod, in a conservative manner in order to minimize the risk of overharvest, and to ensure the long-term health of the resource.”

The proposed Puget Sound Groundfish Management Plan (PSGMP) implements this Commission policy. This is a precautionary approach to groundfish management. It is the intent of the Commission that under conditions of low stock abundance or insufficient information to assess stocks, the Washington Department of Fish and Wildlife (WDFW) should elevate the level of conservation in groundfish management. A precautionary approach to groundfish management shall be utilized in order to minimize the risk of overharvest (overfishing) and to fulfill the agency mandate to “preserve, protect, perpetuate and manage foodfish” as it applies to groundfish in Puget Sound.

By implementing the proposed PSGMP, a process will be established with the goal of maintaining healthy groundfish populations in Puget Sound. This means that groundfish populations will be managed as a diverse and sustainable resource in their ecosystem. Fully meeting this goal will require regular monitoring, stock assessments, establishing a Conservation Plan for each key groundfish species, and managing harvesting and other activities under the provisions of a Use Plan established for each fishery or activity.

Regular fishery and population monitoring will provide critical information needed to assess the status and trend of groundfish stocks. The stock assessments will establish biological reference points to establish stock condition. The stock assessment will also result in an evaluation of the impact of fisheries, bycatch or other activities. The information gathered from the stock assessment will be incorporated into a Conservation Plan. The Conservation Plan will include measures to assure that the long-term condition of the stock does not fall below a sustainable level for reproduction, ecosystem function, or successful fisheries. The Conservation Plan will include an assessment of whether the stock condition and data quality meet reference point criteria for allowing fisheries. Using the

precautionary approach, allowable fisheries will be scaled to the level of information quality and stock condition, assure that overfishing does not occur, and that the population is healthy within natural constraints. The Conservation Plan will also provide for alternative uses of groundfish such as fish watching and scientific collection, meet the mandates of other WDFW policies, and protect critical ecosystem functions.

Use Plans will integrate the results and information from the Conservation Plan for each species into operational plans to conduct fisheries and other directed activities for groundfish. When harvestable groundfish resources are identified, the Use Plans will assure Washington interests receive consideration to utilize the resource. This will be accomplished, in part, by designating certain species, areas, and times for recreational and commercial use to assure orderly fisheries and prevent overfishing. In developing these Use Plans, the effects and interactions of bycatch, competitive fisheries, fishing gear disturbance, transboundary fisheries, and ecosystem functions will be considered.

In implementing the PSGMP, WDFW will affirm its commitment to informing the public regarding the status and use of groundfish in Puget Sound. WDFW will provide opportunity for the public to comment and provide input into planning efforts. Since groundfish have been designated as a treaty right, Conservation and Use Plans will be developed in a cooperative management framework with Puget Sound Treaty Tribes. The result of the outreach process will be increased public confidence in Puget Sound groundfish management.

Table of Contents

Executive Summary	i
List of Tables	iv
List of Figures	iv
Puget Sound Groundfish Policy, Goals and Plan	1
Introduction	2
Puget Sound Groundfish Resources	4
Fisheries	6
Other Clients	10
Other Uses of Groundfish	11
Legislative Authority	12
WDFW Authority and Policies	12
Licensing/Permits	15
Non-Treaty Allocation	18
Transboundary Issues	19
Ecosystem Management	20
Groundfish and Fishery Management	25
Conservation Plans	30
Harvest Rates, Dynamics, and Strategies	32
Use Plans	34
Plan Updating and Modification	38
Acknowledgments	39
Literature Cited	40

List of Tables

Table 1.	Important Species of Bottomfish in Puget Sound	4
Table 2.	The number of commercial licenses for bottomfish issued and active in Puget Sound, 1993-1997	16
Table 3.	Recreational Licenses Issued, 1993-1997	17

List of Figures

Figure 1	North and South Puget Sound	3
Figure 2	Historical Groundfish Catch from Puget Sound (excluding Neah Bay)	6
Figure 3	Marine Fish-Shellfish Management and Catch Reporting Areas	26
Figure 4	Salmon Catch Record Areas of Puget Sound	27

Puget Sound Groundfish Policy, Goals and Plan

Policy

“It is the policy of the Washington Fish and Wildlife Commission to manage Puget Sound groundfish, especially Pacific cod, in a conservative manner in order to minimize the risk of overharvest, and to ensure the long-term health of the resource.”

In November, 1996, the Washington Fish and Wildlife Commission adopted the Puget Sound Groundfish Policy to assure the integrity of the ecosystem and habitat upon which groundfish resources depend. Many stocks of Puget Sound groundfish are in below-average, depressed or critical stock condition, and this condition has resulted in low catches and the reduction or discontinuation of once popular fisheries. It is the intent of the Commission that under conditions of low stock abundance or insufficient information to assess stocks, the Washington Department of Fish and Wildlife (WDFW) should elevate the level of conservation in groundfish management. A precautionary approach to groundfish management shall be utilized in order to minimize the risk of overharvest and to fulfill the agency mandate to “preserve, protect, perpetuate and manage foodfish” as it applies to groundfish in Puget Sound.

Goals

Consistent with the goals established by the Commission for the Department, the following specific goals will guide the management of groundfish resources in Puget Sound:

- Maintain healthy populations of groundfish in Puget Sound.
- Manage groundfish communities in a diverse and sustainable ecosystem.
- Provide Washington interests with consideration for the utilization of harvestable groundfish resources.
- Minimize, reduce, or eliminate bycatch and wastage.
- Promote non-consumptive uses of groundfish.
- Increase public confidence in Puget Sound groundfish management.
- Provide sufficient monitoring to estimate catch, evaluate resource condition, and identify reference points to assure groundfish stocks are not overfished.
- Implement other WDFW policies as they interact or influence groundfish species and their habitats.

Objectives

- Maintaining or rebuilding the majority of groundfish resources at historic average or above average population levels, at levels that do not risk overfishing, or at levels that fulfill natural ecosystem functions.
- Provide fisheries with sufficient monitoring to estimate or record catch, monitor biological and population trends, and evaluate the success of fishers.
- Conduct surveys and other studies to identify stocks, sensitive life stages, and habitat and to estimate population abundance.
- Produce a stock status summary of key species of groundfish every two years.
- Develop a Conservation Plan for key species of groundfish that will assure healthy populations that are not overfished.
- Establish biological reference points to assure a minimum sustainable population is present and, thereafter, reference points to permit fisheries and non-consumptive activities under the principle of precautionary management.
- Develop Use Plans for each groundfish fishery that promotes orderly fisheries and nonconsumptive uses consistent with the principles and information provided in the Conservation Plans.
- Identify significant ecosystem components and where appropriate, strive to minimize population stressors.
- Identify and quantify sources of bycatch and wastage; subsequently, identify measures to reduce, minimize or eliminate bycatch.
- Encourage the growth and development of non-consumptive uses of groundfish.
- Account for transboundary fisheries and foster transboundary efforts to manage shared resources..
- Provide periodic updates of the Puget Sound Groundfish Management Plan.
- Provide regular public outreach regarding groundfish resources and their management.
- Co-manage Puget Sound groundfish resources with Puget Sound Treaty Tribes.
- Assure conformity with significant WDFW policies.

Introduction

Groundfish resources in the inland marine waters of Washington (Figure 1, here defined as Puget Sound including all marine waters east of the Bonilla-Tatoosh Line at Cape Flattery) represent dominant members of the marine and estuarine ecosystem. These resources have provided the basis for enjoyable recreational and valuable commercial fisheries. Recently, several studies have identified significant problems for Puget Sound's groundfish resources. Schmitt et al. (1994) reported the lowest groundfish catches in Puget Sound in fifty years and that there were five fishery collapses due to low fish abundance. The 1995 Status of Stocks Document (Palsson et al. 1996) found the majority of groundfish stocks are at below average abundance. Studies of rockfish and lingcod populations show

these species are overfished in many areas of Puget Sound (Palsson and Pacunski 1995). The results of these and other studies have been reviewed and synthesized into a report identifying resource concerns regarding a spectrum of marine life (West 1997). This report identifies a number of unprioritized factors that have contributed to these declines including overfishing, pollution, marine mammals, hatchery practices, and changes in climate. This report further suggests that a system of Marine Protected Areas (MPAs), changes in hatchery practices, and continued fishery regulation are among key actions that can be taken to improve the condition of marine resources in Puget Sound.

The existing groundfish management plans were developed in 1982 (Pedersen and DiDonato, 1984) and in 1984 (Pedersen and Bargmann 1986). These plans primarily identified and described fisheries for groundfish and determined acceptable biological catches (ABCs) for each species and fishery based on historical fishery performance. The plans inherently assumed that populations were always healthy and could sustain fisheries indefinitely. When catches increased, so did ABCs without regard to fishing mortality rates. In the late 1980s, a special management plan was developed for the midwater trawl fishery for whiting in Port Susan and Saratoga Passage. The whiting plan provided for a series of increasing fishing mortality rates based upon increasing categories of population abundance. The whiting plan also provided for a minimal population abundance to allow for any fishing to proceed. In more recent years, these older plans have not been adhered to because the plans have not prevented the collapse of key groundfish stocks. The population declines prompted more recent management actions to protect weak populations of groundfish, resolve conflicting fisheries, or conform with laws and policies promulgated by the Legislature and WDFW.

In addition to the previous plans, an Environmental Impact Statement (EIS) was developed for the otter trawl fishery (Bargmann et al. 1985). The EIS identified adverse and beneficial aspects of the otter trawl fishery and was a first attempt at relating bycatch, gear conflicts, and habitat alteration into a preferred alternative of environmental impact.

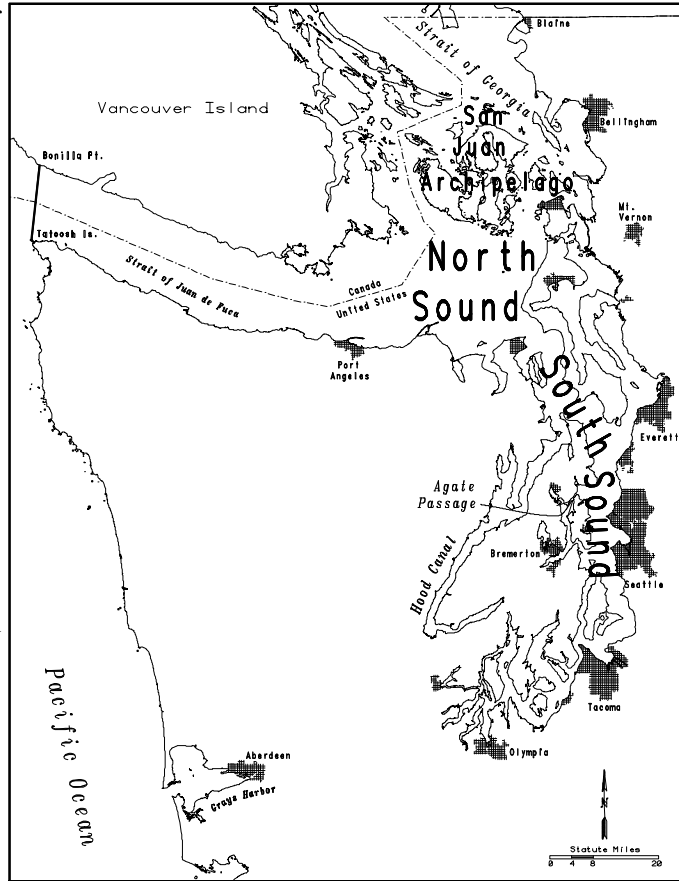


Figure 1. North and South Puget Sound.

Since these attempts at groundfish resource planning in the 1980s, fisheries have drastically changed, population levels have declined, new research and assessment information has become available, and ecosystem management has become an implementation objective. This Puget Sound Groundfish Management Plan (PSGMP) provides a new framework to identify the fisheries, describes information needs, characterizes ecosystem issues, and calls for a system of management plans that incorporates consumptive and non-consumptive uses.

In order to more effectively manage groundfishes in Puget Sound, key factors affecting groundfishes are described in the Puget Sound Groundfish Management Plan . These factors will be systematically and comprehensively assessed in a *Conservation Plan* for each key groundfish species and a *Use Plan* for each fishery or non-consumptive activity. As each topic is presented, action items or preferred actions are identified in bold face.

Puget Sound Groundfish Resources

Groundfishes are the primary clients served by this PSGMP. Groundfishes include those species of bottomfish classified and defined by Washington Administrative Code (WAC 220-16-340). Legally designated foodfish include bottomfish such as Pacific cod, Pacific tomcod, Pacific whiting (hake), walleye pollock, all species of dabs, sole, and flounder, greenling, ratfish, sablefish, cabezon, buffalo sculpin, great sculpin, red Irish lord, Pacific staghorn sculpin, wolf-eel, giant wrymouth, plainfin midshipman, spiny dogfish, six gill shark, soupfin shark, and all other species of sharks, and all species of skates, rockfishes, rattails, and surfperches except shiner perch. There are at least 80 species of bottomfishes that have occurred in Puget Sound, and some of the more prominent ones are listed in Table 1.

Table 1. Important Species of Bottomfish in Puget Sound.

Common Name	Scientific Name
Spiny dogfish	<i>Squalus acanthias</i>
Skates	
Big skate	<i>Raja rhina</i>
Longnose skate	<i>Raja binoculata</i>
Spotted ratfish	<i>Hydrolagus colliei</i>
Pacific cod	<i>Gadus macrocephalus</i>
Walleye pollock	<i>Theragra chalcogramma</i>
Pacific whiting (hake)	<i>Merluccius productus</i>
Plainfin midshipman	<i>Porichthys notatus</i>
Rockfish	<i>Sebastes</i>

Table 1. Important Species of Bottomfish in Puget Sound.

Common Name	Scientific Name
Brown rockfish	<i>Sebastes auriculatus</i>
Copper rockfish	<i>Sebastes caurinus</i>
Greenstriped rockfish	<i>Sebastes elongatus</i>
Widow rockfish	<i>Sebastes entomelas</i>
Yellowtail rockfish	<i>Sebastes flavidus</i>
Quillback rockfish	<i>Sebastes maliger</i>
Black rockfish	<i>Sebastes melanops</i>
Blue rockfish	<i>Sebastes mystinus</i>
China rockfish	<i>Sebastes nebulosus</i>
Tiger rockfish	<i>Sebastes nigrocinctus</i>
Bocaccio	<i>Sebastes paucispinis</i>
Canary rockfish	<i>Sebastes pinniger</i>
Redstripe rockfish	<i>Sebastes proriger</i>
Yelloweye rockfish	<i>Sebastes ruberrimus</i>
Sablefish	<i>Anoplopoma fimbria</i>
Greenlings	
Kelp greenling	<i>Hexagrammos decagrammus</i>
Whitespotted greenling	<i>Hexagrammos stelleri</i>
Lingcod	<i>Ophiodon elongatus</i>
Sculpins	
Cabezon	<i>Scorpaenichthys marmoratus</i>
Great sculpin	<i>Myoxocephalus polyacanthocephalus</i>
Buffalo sculpin	<i>Enophrys bison</i>
Pacific staghorn sculpin	<i>Leptocottus armatus</i>
Wolfeel	<i>Anarrichthys ocellatus</i>
Surfperches	
Striped seaperch	<i>Embiotoca lateralis</i>
Pile perch	<i>Rhacochilus vacca</i>
Flatfishes	
Pacific sanddab	<i>Citharichthys sordidus</i>
Pacific halibut	<i>Hippoglossus stenolepis</i>
Butter sole	<i>Isopsetta isolepis</i>
Rock sole	<i>Lepidopsetta bilineata</i>
Dover sole	<i>Microstomus pacificus</i>
English sole	<i>Parophrys vetulus</i>
Starry flounder	<i>Platichthys stellatus</i>
Sand sole	<i>Psettichthys melanostictus</i>

Pacific halibut are often caught incidentally while fishing for bottomfish. Pacific halibut are not legally included as bottomfish because their principal assessment and management are conducted through the International Pacific Halibut Commission and the Pacific Fishery Management Council. However, WDFW is directly involved with these organizations and participates in the assessment and management of halibut; therefore, halibut are included as a groundfish species.

Besides bottomfish and halibut, there are over one hundred species of marine fishes in Puget Sound that are not classified as foodfish. These can be ubiquitous members of the benthic and near bottom communities in Puget Sound and are included as groundfish species in the PSGMP. At present these unclassified marine fishes are not directly managed but are often caught as bycatch to groundfish fisheries, affected by habitat alteration, and assessed during resource surveys. They are key components to marine ecosystems and the sustainability of other groundfish and marine resources.

Of this groundfish diversity, twenty-one species or groups of species are actively managed by WDFW. These key species and groups are spiny dogfish, skates, spotted ratfish, Pacific cod, walleye pollock, Pacific whiting (hake), rockfish, sablefish, greenlings, lingcod, sculpins, wolf-eel, surfperches, Pacific halibut, Dover sole, English sole, starry flounder, rock sole, sand sole, other bottomfishes, and unclassified marine fishes. These species and groups represent important assemblages for commercial, recreational, and ecological needs and values.

Fisheries

Established groundfish fisheries in Puget Sound are divided into commercial and recreational fisheries. New or emerging fisheries can also occur and a federal court decision has prompted interest in the development of tribal fisheries for groundfish. Puget Sound fisheries once landed over 27 million of pounds in a single year. However, due to declining stocks, market conditions, and area closures, recent groundfish landings have been at the lowest levels in fifty years (Figure 2).

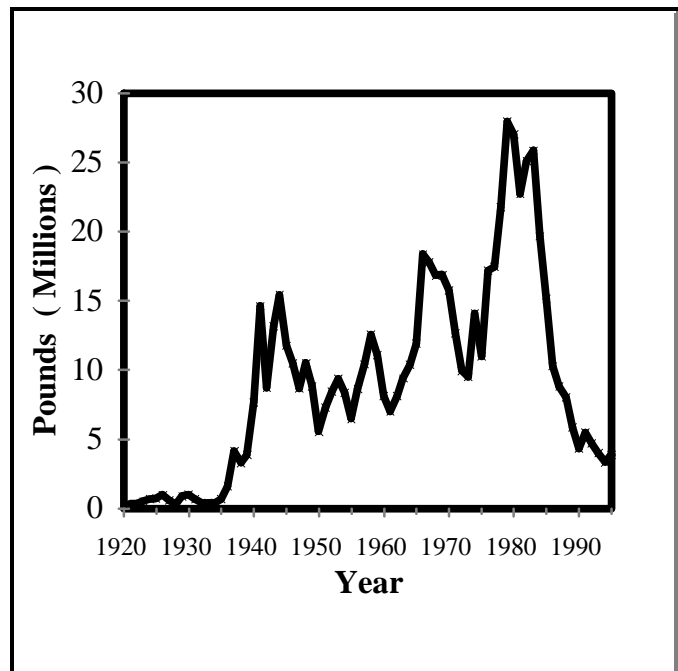


Figure 2. Historical groundfish catch from Puget Sound (excluding Neah Bay), 1921-1996.

Commercial Fisheries

There are six types of commercial gear that WDFW presently allows for harvesting groundfish in Puget Sound. They include bottom trawls, pelagic trawls, dogfish set nets, set lines, drag seines, and bottomfish pots. In addition to these directed gear types, salmon, forage fish, and shellfish fishing gears may capture groundfish as bycatch while fishing for other species.

Bottom or otter trawls are funnel-like nets that are dragged along the bottom and are held open on the sides by “otter” doors. The bottom trawl fishery is the dominant commercial fishery for bottomfish, accounting for 55% of the commercial catch in recent years. Bottom trawlers target several species of flatfish including English sole, starry flounder, rock sole, Dover sole, and sand sole. They also seek spiny dogfish, Pacific cod, and skates. Species that are too small or are not marketable are also captured and typically become discarded as bycatch. Bottom trawls must have a minimum mesh size of four and one half inches.

Pelagic or midwater trawls are similar to bottom trawls but added flotation and lighter doors hold the net open at desired off-bottom depths in the water column. These trawls must have a minimum mesh size of three inches. Pelagic trawls can be used to target midwater fishes and fishes living just above the bottom. In Puget Sound, pelagic trawls are specifically used to catch Pacific whiting in Port Susan and Saratoga Passage. The winter-time whiting fishery once accounted for the greatest landings of any groundfish species and was restricted to about a dozen fishers who held a special whiting endorsement (limited entry fishery). In recent years, this fishery has been suspended due to depressed abundance and small sizes of whiting.

Other commercial gears include set nets, set lines, drag seines, and bottomfish pots. Commercial fishers using set net and set line gear target spiny dogfish and account for 72% of the 2.1 million pounds of dogfish landed in an average year. *Set nets* are anchored gill nets that passively fish on the bottom and are used to target spiny dogfish. Set nets are composed of small diameter line (heavier than salmon gill nets) that is held as a vertical panel above the bottom by a system of floats and weights. Set nets cannot exceed 1000 ft in length and must have a mesh size of at least 5 inches. *Set lines or longlines* consist of a heavy ground line to which are attached many baited hooks on short leaders (gangions). Set lines, like set nets are fished along the bottom and used to target dogfish. *Drag seines* are nets used to fish for surfperches in shallow water. Drag seines are no more than 350 ft in length and must have a minimum mesh size of one half inch. A small boat sets the seine from a point along the shore and encircles a school of fish. Once the net is deployed, the net is drawn to shore and the fish are landed onto the beach. Surfperches are the primary target of drag seine fishers who harvest virtually all of the reported landings of surfperches. Bottomfish pot gear is not typically used in Puget Sound. A *bottomfish pot* is a portable, enclosed cage with one or more entrances into which fish can enter but not escape. The pots are baited and sunk to the bottom where they attract fish. The pots are attached to a buoyed line for retrieval.

The regional distribution of commercial fisheries has been substantially reduced in recent years. While bottom trawlers once fished throughout most waters of Puget Sound, their activities are now restricted to the Strait of Georgia, San Juan Islands, Bellingham Bay, and Strait of Juan de Fuca. With these increased restrictions, there has been a reduction in bottom trawling. In the mid-1970s, over one hundred trawl licenses were sold each year. In recent years, only 30 to 40 licenses have been sold. Other commercial gears can operate in most Puget Sound areas with various season and area restrictions.

The PSGMP shall serve as a mechanism to maintain healthy groundfish populations and promote stable and orderly commercial fisheries when sufficient populations levels are present.

Recreational Fisheries

Recreational fishing is conducted by several methods: angling from charter or private boats, angling from piers and docks, angling from the shore, using bow-and-arrow, and spearfishing. Angling from boats is the most popular method of fishing for groundfish and has the largest recreational impact on the groundfish resources of Puget Sound. Groundfish are targeted during 100,000 to 200,000 boat-based angling trips taken annually. Groundfish are also taken incidentally during the 1 million to 2 million boat-based angling trips taken for salmon each year. In recent years, these boat-based fisheries have resulted in harvest of approximately 200,000 individual groundfish.

WDFW surveys only estimate catch and effort statistics for the boat-based fisheries using hook-and-line gear, but shore-based fisheries can account for a substantial portion of total angling effort and catch (Bargmann 1982). Recreational angling from docks, piers, and the shore occurs throughout the year, but more fishing occurs during the fair weather months. Catch rates of bottomfish from shore fishers are generally much less than for anglers fishing from boats. WDFW surveys also do not regularly estimate effort and catch by spearfishers. Diver harvests can account for a significant portion the total harvest of targeted species such as lingcod and rockfish (Bargmann 1984).

The distribution of recreational fisheries varies with region, habitat type, and the nature of salmon fisheries. The Strait of Juan de Fuca and San Juan Islands have many rocky reefs which support rockfish and lingcod populations. Sandy bottoms in these areas are productive grounds for Pacific halibut and other flatfish. The halibut and lingcod resources provide for intense spring season fisheries. Other regions of Puget Sound have lesser amounts of reef habitat and, therefore, the fisheries for rockfish, lingcod, and other reef dwelling species are limited to artificial reefs and the few natural reefs in these regions. In Central and South Sound, recreational fisheries for walleye pollock and Pacific cod once drew thousands of anglers, but with the decline of these populations, these fisheries have become extinct. In contrast to the 1970s and 1980s, almost half of the bottomfish are now caught incidentally to salmon fishing rather than by targeted trips. Large-scale closures to salmon fishing and

special area fisheries for salmon have drastically altered the pattern of bottomfish harvest by season and area.

The PSGMP shall serve as a mechanism to maintain healthy groundfish populations and promote stable and orderly recreational fisheries when sufficient populations levels are present.

Bycatch

Bycatch is the incidental and unintentional catch of a species or a size of individual that is not intended as the target species. These incidental catches can include sea birds, marine mammals, small fishes, invertebrates and other marine organisms. Unwanted bycatch is typically discarded at sea. Discarded species may be the result of regulatory prohibitions, economic constraints, or because the species may have no economic, social, or food value. Bycatch mortalities include species that are contacted and damaged by the fishing process and include the landed and unlanded encounters. Bycatch mortalities may also result from derelict fishing gear. Derelict gear including pots, line, and nets is gear that is accidentally lost during the fishing process or intentionally discarded. Derelict gears can continue to attract, entangle, and kill marine organisms (“ghost fishing”) for long periods of time until the gear decays, becomes entangled in bottom substrates, or is encrusted by sessile organisms to the point of losing its catching capability. Fishery bycatch has been identified as a wasteful and undesirable practice by many segments of the environmental and fishing community. All fisheries, recreational and commercial have bycatch. The magnitude and impact vary considerably dependent on the gear and the fishery.

Bycatch has an ecological impact of killing or impairing those individuals harmed by the fishing process and subsequently removed from the ecosystem. Bycatch has economic costs such as increased catch processing time, increased gear costs, and lost opportunity when fisheries are discontinued to protect sensitive species. The bycatch problem can sometimes be resolved by finding new markets or creating new products for species that are presently undesirable. Bycatch reduction devices, such as grates used in shrimp fishing gear, escapement panels for crabs, halibut, and codfishes are under development, and have been shown to significantly reduce bycatch of non-target species.

In planning fisheries, WDFW staff shall strive to find acceptable harvesting methods that reduce or minimize bycatch levels. These alternative methods may include changing mesh size and dimension, restricting fishing times and areas where and when sensitive species are found, altering other parts of the fishing gear, and changing fishing methods. The development and use of bycatch reduction devices are encouraged and may be required in future fisheries. Bycatch monitoring programs shall be established using direct observations and fishery monitoring. Bycatch may be managed on a quota basis as a control or incentive to improve fishing practices. Department activities will include identification of derelict gear,

collecting observations of locations, and facilitating gear removal as practical. Regulations to facilitate reduction of derelict fishing gear may be implemented.

Treaty Indian Fisheries

The federal court has ruled that Indian tribes who signed treaties with the federal government in the 1850s have treaty fishing rights to harvest a share of surplus groundfish resources in Puget Sound. Several tribes have been asserting this right by promulgating groundfish tribal regulations for commercial and ceremonial and subsistence uses. Most of these regulations have been similar to existing WDFW groundfish regulations for Puget Sound and have been limited to each tribe's usual and accustomed fishing areas. At present, tribal fisheries for Puget Sound groundfish have had limited participation.

The treaty Indian tribes are not parties to the PSGMP. Because of the federal court decisions have only been recently affirmed, implementation plans have not been established with any treaty tribe, and no specific harvest agreements currently exist among treaty tribes or with the WDFW. Tribes are not bound by the provisions of the groundfish policy or the plan except as when agreed to in joint management documents.

WDFW will seek fishery management plans for groundfish with Puget Sound Treaty Tribes, and allocation strategies aimed at assuring healthy fish populations will be sought.

Other Clients

Local, state, and federal agencies are important to the management of groundfish resources in Puget Sound. Significant state agencies include the Department of Natural Resources (DNR), Puget Sound Action Team (PSAT), and the Department of Ecology (DOE). DNR manages state aquatic bedlands upon which groundfish live and depend. PSAT coordinates monitoring, restoration, and management of marine waters and watersheds of Puget Sound. PSAT also oversees the Puget Sound Ambient Monitoring Program (PSAMP) which funds some groundfish monitoring activities. DOE monitors and manages water quality through surveys, discharge permits, and enforcement.

Key federal agencies that affect Puget Sound groundfish resources include the National Marine Fisheries Service (NMFS), the U.S. Environmental Protection Agency (EPA), and the U.S. Army Corps of Engineers (COE). NMFS manages groundfish in federal waters and oversees many programs that affect marine sanctuaries, recreational fishery monitoring, essential fish habitat, and endangered species. EPA oversees the clean up of polluted waterways, facilitates pollution research, and interacts with WDFW on transboundary and ecosystem issues. COE maintains navigable

waterways, controls dredging, and dumping of dredge spoils. COE must evaluate and approve projects affecting navigable waterways.

Other interested parties include individual fishers and citizens, students and academic staff, environmental organizations, fisher associations, and dive clubs.

Consistent with Commission Goals and the Groundfish Management Policy, the public will be involved and informed on a periodic basis regarding the results of stock assessment, fishery monitoring, usage planning, and regulation development. This involvement will be solicited through public notices, mailings, and individual contacts, especially to those interested individuals, groups, tribes, and agencies. Information will be disseminated through a variety of media and forums which can include the following mechanisms: public meetings, scientific meetings, public hearings, workshops, lectures to user groups, agency reports, news media, e-mail, Internet, letters, and telephone contacts.

Other Uses of Groundfish

Groundfishes are taken by researchers, public aquaria, and consultants under the scientific permit system of WDFW. Research is principally conducted by the National Marine Fisheries Service, the University of Washington, other universities, and consulting firms. The results of research activities are often directly applicable to stock assessment and management issues. The magnitude and take of groundfishes by researchers and aquarium collectors is usually of little significance to most groundfish populations. These uses are justified by their inherent educational and research values. Permit holders are required to provide annual reports describing their research collections and activities.

Non-consumptive uses of groundfishes are primarily achieved by recreational divers who visit shallow water habitats, especially rocky reef and artificial habitats, throughout Puget Sound. Although the historical attraction of scuba diving has been spearfishing, the majority of current diving appears to be for nonconsumptive purposes that focus on groundfish and shellfish resources. These nonconsumptive uses are primarily fish watching and photography. Marine protected areas, in particular, attract many divers where they can experience seeing diverse species, large specimens and numerous individuals. Other non-consumptive uses include the existence value of groundfishes and their role in a healthy Puget Sound ecosystem. The main proponents of the use of groundfish in this manner are the various environmental groups and organized recreational fishing groups.

In developing Conservation and Use Plans, staff shall identify, incorporate, and include nonconsumptive and other uses of groundfish species.

Legislative Authority

The Department adopts regulations for the management of groundfish resources under authority granted to it by the Legislature. These authorities are detailed in the Revised Code of Washington (RCW). Detailed rules are adopted by WDFW in the Washington Administrative Code (WAC).

The overall mandate of WDFW is specified in RCW 75.08.012:

“The department shall preserve, protect, perpetuate and manage the food fish and shellfish in state waters and offshore waters.

The department shall conserve the food fish and shellfish resources in a manner that does not impair the resource. In a manner consistent with this goal, the department shall seek to maintain the economic well-being and stability of the fishing industry in the state. The department shall promote orderly fisheries and shall enhance and improve recreational and commercial fishing in the state.”

Puget Sound treaty tribes are not bound by the Legislature’s laws, policies, or initiatives.

WDFW Authority and Policies

Management responsibility for groundfish resources are assigned to the Marine Resources Division of the Fish Management Program. Headquarters and regional staff conduct fishery monitoring, stock assessment, and other management studies to establish catch, fishery trends, stock status, and recommend management actions. Through the Commission, permanent regulations are promulgated, particularly those for commercial Puget Sound groundfish fisheries in WAC 220-48 and for personal use in WAC 220-56. The Commission has empowered the Director to enact emergency regulations.

Groundfish management also depends upon other segments of the Department. The Habitat Program is responsible for assuring that the productive capacity of the marine habitat is not impaired. The Resource Assessment Division of the Fish Management Program focuses research efforts on marine ecosystems and habitat function. Groundfish management depends upon recreational fishery data collected by other Department programs and upon the Enforcement Program to assure laws are implemented. In addition, departmental policies and programs affect groundfish resources and their management. Significant policies are as follows:

Priority Habitats and Species

The Department has established the “Priority Habitats and Species List” which is intended to identify species and habitats of special concern in Washington (Washington Department of Fish and Wildlife, 1996). Priority species are those that require protective measures for their perpetuation due to their population status, sensitivity to habitat alteration, and/or recreational, commercial or tribal importance. Ten species of groundfish are included on this list and include: Pacific cod, walleye pollock, Pacific whiting, black rockfish, copper rockfish, quillback rockfish, yelloweye rockfish, lingcod, English sole, and rock sole.

Wild Salmonid Policy

On December 5, 1997, the Commission adopted the “Wild Salmonid Policy.” The goal of this policy is to protect, restore and enhance wild salmonids and their ecosystems in Washington (Washington Department of Fish and Wildlife 1997). Two sections of this policy directly affect groundfish management: the ecological interactions policy and the marine area policy.

The ecological interactions policy is as follows:

- Maintain healthy populations of indigenous animal and plant species within levels that sustain or promote abundant wild salmonid populations and their habitats. A healthy balanced ecosystem requires that all the parts be available in the right amounts. Where there is a lack of species diversity it may be necessary to increase populations by providing the proper habitat characteristics.

The marine area policy is as follows:

- Provide nearshore marine, estuarine, and tidally-influenced marine ecosystems that contain productive, balanced, integrated communities of organisms having species composition, abundance, diversity, structure, and organization comparable to that of natural ecosystems of the region.
- Ensure that functions and values of the following habitat types are maintained or increased: eelgrass habitats, herring spawning habitats, intertidal forage fish spawning, intertidal wetlands, intertidal mudflats, and safe and timely migratory pathways for salmonids in marine waters.
- Allow natural rates of erosion and transport of sediments, nutrients, and large woody debris that affect habitat quality in tidally influenced estuarine and marine shorelines.

Groundfish activities will conform to the directives of the Wild Salmonid Policy, particularly in maintaining marine habitats and striving to maintain healthy and diverse groundfish populations.

Threatened and Endangered Species

Groundfish may be subject to listing as threatened or endangered species under state or federal jurisdictions. In addition, groundfishes and groundfish fisheries may interact with threatened and endangered species by competing with prey resources, serving as prey or predator, or by fisheries injuring or killing listed species or by creating habitat disruption.

Conservative measures will be taken to rebuild depressed and critical groundfish populations when possible. Groundfish staff will identify threatened or endangered species when necessary, gather and disseminate key information regarding species proposed for listing, and minimize the chance of disturbing, injuring, or killing threatened or endangered species or disrupting the habitats upon which they depend.

Artificial Reef Policy

A significant policy that affects groundfish and has been in place since 1989 is the Artificial Reef Policy that establishes the process to enhance natural fish habitat with artificial habitat (Policy No. 401). Artificial reefs are permanent alterations of the bottom habitat designed to enhance finfish and shellfish production and to contribute to the management of these resources. Potential uses for artificial reefs can include the enhancement of fishery opportunities; increased fish habitat and populations; and the mitigation for the loss of natural reef habitat.

Artificial reefs for enhancement of marine fish populations is a controversial subject. Fisheries scientists and reef developers have not been able to effectively answer the question: Do artificial reefs add to the productive capacity of reef fishes or merely act as fish attraction devices? It is certain that many reef structures attract several life stages of fish, but do the reefs contribute to an increase in overall fish productivity? The consensus of marine scientists is that few, if any, artificial reef programs clearly show that fish production has increased. Grossmann et al. (1997) has found that most studies of artificial reefs found deleterious effects on reef fish populations. The primary deleterious effect is increased fishing effort and catch rates that result in a higher potential for overexploitation as previously unexploited stocks or stock segments are aggregated to the artificial structures and are fished. As a local example of the unknown functions of artificial reefs, research has found artificial reefs are less suitable habitat for rockfish than natural rocky reefs in Puget Sound (Matthews 1990a, b).

Until the benefits of artificial reefs in Puget Sound can clearly be demonstrated, artificial reefs should not be used in the context of the current Artificial Reef Policy to enhance fisheries for groundfish. Artificial reefs may act as a population and habitat enhancement technique when used in the context of permanent no-take refuges, but only if their benefits do not negatively affect other marine organisms.

Licensing/Permits

A number of license types and categories exist for non-treaty fishing of groundfish and bottomfish. Commercial fishers must possess one of several types of commercial fishing licenses in order to commercially fish for any species of bottomfish. Recreational fishers must possess a personal use license to harvest salmon and bottomfish in Washington's marine waters. Charter boat operators must also possess a Salmon or Nonsalmon license. The collection of any groundfish species for scientific or educational purposes requires a Scientific Collecting Permit issued by the Department.

Tribal fishers are subject to the licensing requirements of their own tribal governments. The treaty Indian bottomfish fishery is not restricted by state license requirements, nor is it under any state growth restrictions.

Commercial

Non-treaty fishers may purchase commercial bottomfish licenses from the Licensing Program of WDFW. There are eight possible types of licenses, although three license types do not have open access fisheries. The license type depends upon the type of gear used and the intended target species or fishery. Commercial licenses include bottom trawl, Puget Sound whiting, set net, set line, drag seine, bottomfish pot, bottomfish troll, and bottomfish jig. Except for Puget Sound whiting, the numbers of Puget Sound bottomfish licenses issued are not limited at present. Set net and set line licenses are sold to fishers who exclusively target spiny dogfish, and drag seine licenses are issued to fishers targeting surfperch. Puget Sound whiting seasons are closed at present. The number of whiting licenses has been limited since 1986 under the provisions of RCW 75.30 and WAC 220-87. There are no open bottomfish troll or bottomfish jig fisheries in Puget Sound. Table 2 summarizes the numbers of licenses sold in each license category during the last five years.

Table 2. The number of commercial licenses for bottomfish issued and active in Puget Sound, 1993-1997.¹

YEAR	1993		1994		1995		1996		1997	
GEAR	Licenses	Active	Licenses	Active	License	Active	Licenses	Active	Licenses	Active
Drag seine	26	13	19	15	20	13	15	14	18	11
Set net	25	15	27	21	26	16	23	11	18	8
Pot	5	0	7	2	1	0	3	0	0	0
Bottom-fish trawl ²	87	28	49(10)	23	32(9)	22	34(4)	23	32(3)	20
Set line	182	54	106	42	95	41	65	35	53	14
Salmon charter	265	---	260	---	231	---	210	---	209	---
Non-salmon charter	26	---	31	---	35	---	23	---	18	---

¹ Most of these gear licenses, except Puget Sound trawl, can also be used outside of Puget Sound. The fisher indicates what district he plans to fish on his application, but he is not bound by that choice.

² Numbers in parentheses indicate the number of Puget Sound whiting licenses.

Charter boat licenses are separated into two categories. Salmon charter licenses are a limited entry license, which means no new licenses are being issued. Salmon charters must also possess a Salmon angler permit which designates how many anglers may fish from the boat. Salmon charter anglers may fish for salmon or bottomfish. Nonsalmon Charter licenses permit anglers to only fish for bottomfish. The numbers of this license is not limited.

On occasion, new gears, markets, or conditions arise that create new or altered commercial fisheries. Such emerging commercial fisheries may be permitted by the Director under the provisions of RCW 75.28 and 75.30 and WAC 220-88. The Director has the authority to issue “experimental fishery permits” or “trial commercial fishery permits.” An experimental fishery is defined as a fishery for a newly classified species for which the department has determined that there is a need to limit participation, or a fishery exploiting a previously classified species in a new area, method, or change in participation level. A trial commercial fishery permit is issued for similar new or changed fisheries but when limited participation is not necessary. Permits have been issued for harvesting bottomfish in the past, especially when bottomfishing was being pioneered in Puget Sound.

As technology changes, new markets are developed, or changes in fishing effort occur, provisions of the emerging commercial fisheries act may be invoked for commercial fisheries for bottomfish in Puget Sound. Department staff shall advise the Director on the likely stock assessment, fishery monitoring, and usage issues as circumstances warrant or as Experimental Fishery Permits are requested. Recommendations for approval shall only be given when stocks are not in jeopardy, the fishery can be monitored, the ecosystem will not be adversely impacted, and public comment has been received.

Recreational

Recreational fishers who possess a personal use foodfish license can legally use hook-and-line, bow and arrow, or spears to harvest bottomfish in Washington State. This license also allows anglers to harvest salmon in marine waters during open seasons and areas. All other gears are prohibited for harvesting bottomfish for personal use. Anglers may fish for a variety of bottomfish under various daily bag limits for species, seasons, and areas. When fishing in Puget Sound (except Neah Bay), fishers must also possess a Puget Sound Enhancement Stamp. Recreational fishers seeking Pacific halibut must also possess a halibut catch record card in Puget Sound. The halibut card is free and must be returned to the Department at the end of the season. Table 3 identifies how many personal use license and halibut catch record cards have been issued during the past five years.

Table 3. Recreational Licenses Issued, 1993-1997.

License	1993	1994	1995	1996	1997
Personal use	438,395	271,904	341,190	358,954	not available
Puget Sound Enhancement Stamp	not issued	108,313	137,161	142,345	not available
Halibut catch record card	18,375	11,884	11,857	10,648	18,212

Scientific Collecting Permits

Individuals, groups, or other entities who conduct any scientific study that handles or collects food fish must obtain a scientific collecting permit from the Department (WAC 220-50-045). In addition, unclassified marine fishes are defined as wildlife and as such, a scientific permit is required to collect these species for research or display under the provisions of WAC 232-12-276.

WDFW groundfish staff shall review scientific collection permits when they apply to groundfish species. In most cases, these permits shall be endorsed when the research, display, or educational requirements are met through the application process. However, when conservation concerns exist regarding a particular species or a collection method, certain

restrictions may be required on the permit which include reducing the intended number to be collected and prohibiting the taking of certain species in time, place, and manner.

Non-Treaty Allocation

No specific allocation exists between non-treaty commercial and recreational groundfish fisheries. There are also no agreements between Washington and Canada regarding shared groundfish resources in transboundary waters (See Transboundary Issues). The early groundfish management plans designated certain fisheries and areas to be managed for recreational or commercial uses in Puget Sound. In addition, specific regulations have been promulgated to effect orderly fisheries and promote a recreational or commercial emphasis for designated species. In the 1982 and 1984 Groundfish Management plans, flatfishes, spiny dogfish, Pacific whiting, Pacific cod, walleye pollock, and surfperches were to be managed as commercial species. Lingcod and rockfish were to be primarily managed as recreational species. Several exceptions were allowed to promote recreational fishing for cod in Agate Passage and Tacoma Narrows and walleye pollock in Tacoma Narrows. Commercial fishing for lingcod was also provided for in a special zone in the Strait of Juan de Fuca, and fisheries for yellowtail rockfish were allowed in the western portion of the Strait of Juan de Fuca, Strait of Georgia, and Bellingham Bay. Subsequent regulatory actions were adopted to further these goals.

Over time, several of these guidelines have been modified to provide increased recreational opportunity and reduce commercial fisheries when conservation actions were needed. Commercial fisheries using jig and bottomfish troll gears were completely eliminated in 1994, allowing for lingcod and rockfish to be almost exclusively fished by recreational fishers. Similarly, roller gear was banned as a type of bottom trawl gear and the eastern Strait of Juan de Fuca was closed to prevent commercial rockfish and lingcod harvest as well as meeting some needs for Pacific cod stocks of central sound origin.

No formal allocation is proposed among non-treaty user groups fishing for groundfish in Puget Sound. However, rockfish, lingcod, greenlings, sculpins, and Pacific halibut will be managed as recreational species. Spiny dogfish, flatfish except halibut, and skates will be managed as commercial species. Other species will be considered for mixed uses including Pacific cod, walleye pollock, and surfperches. Harvest rates and strategies and consumptive and nonconsumptive uses will be identified in Conservation and Use Plans.

Transboundary Issues

The marine waters of Puget Sound share a border with Canada's Province of British Columbia. Groundfish populations, especially in the basins adjacent to the international border move freely between the political boundaries and are in essence shared between the two countries. Fish populations straddling the border may be subject to fisheries and environmental stressors originates within either country. In 1992 the Premier of British Columbia and the Governor of Washington signed the Environmental Cooperation Agreement to address common concerns about declining environmental conditions and depressed populations of biota in shared marine waters. A Symposium on the Marine Environment held in 1994 was the first comprehensive review of resource status on both sides of the International Border. One paper by Schmitt et al. (1994) identified similar declining trends in a number of groundfish resources shared between the state and province.

The agreement resulted in an Environmental Cooperation Council which assembled a Marine Science Panel (MSP). The MSP established a number of work groups to investigate specific issues and recommend solutions to identified problems. These work groups include Protect Marine Life, Habitat Loss, Exotic Species, Toxics, Marine Protected Areas, Research and Monitoring, Strategic Opportunities, and Communications and Outreach. Many of these work groups continue to focus on groundfish resources and their status in the transboundary ecosystem. One report by West (1997) reviewed groundfish stock status and linked depressed groundfish populations to environmental stressors. WDFW staff have participated in many of these transboundary committees and in recent years have instigated joint surveys of marine resources in the transboundary waters.

Other transboundary processes exist. A Technical Subcommittee (TSC) formed under the authority of the International North Pacific Fisheries Commission meets every year to discuss groundfish populations and research in each West Coast state and British Columbia. At times, the TSC may form subcommittees to work on special issues or problems identified at the annual meeting.

Cooperative transboundary activities shall be continued and every effort will be made to include information obtained from adjacent waters in stock assessment, fishery analysis, and conservation plans. When transboundary fisheries endanger the status of groundfish stocks, agreements and actions will be sought from both Washington and British Columbia authorities to minimize any chance of overfishing or other activities that diminish groundfish populations or their ecosystem.

Ecosystem Management

Groundfishes occupy most habitats of the Puget Sound ecosystem including shallow and deepwater habitats which are linked to freshwater and oceanic ecosystems. Puget Sound is an estuary with significant freshwater flows from the Fraser, Nooksack, Skagit, Stillaguamish, Snohomish, Duwamish, Puyallup, Nisqually, Skokomish, Elwha, and Dungeness Rivers, as well as smaller rivers and streams throughout the inland basin. Because of the estuarine flow, significant amounts of oceanic waters flow along the bottom to replace the water entrained in the outflow of surface waters. The stability and sustainability of Puget Sound groundfish resources are linked to an interdependence with other groundfish species as well as nutrients, plankton, benthic fauna, forage fishes, anadromous fishes, seabirds, marine mammals, and humans. The health and stability of this complex matrix can also be influenced by global, regional, and local natural and anthropogenic factors.

Good information and informed decisions are necessary to prevent the disruption of the Puget Sound ecosystem either through direct fishery interaction or by other activities that will diminish the system. The following items below identify issues to be addressed in each Conservation and Use Plan where they apply. These are not necessarily exhaustive of all the ecosystem issues involving a particular resource.

Ecosystem management shall be enacted for groundfish resources in Puget Sound. This includes identifying significant ecosystem components and stressors. When possible, population stressors will be minimized or eliminated, especially when the source of stress results from an existing management activity.

Biodiversity

Biological diversity or biodiversity refers to the number of species and numbers of individuals of a species within an ecosystem. Ecosystem health is often characterized by the number and complexity of species and their populations.

Conservation and Use Plans shall contain measures to prevent human-induced reductions in biodiversity.

Habitat

Each groundfish species requires specific types and amounts of habitat to maintain a healthy population. This essential habitat is not just limited to the area occupied by adults, but includes those habitats that are required by all life history phases. Typically, groundfishes occupy three or four habitats during their

life history including where they spawn, incubate, disperse, rear, and feed. Particular areas may be important to each stock or subpopulation of a groundfish species.

Habitat loss or degradation can be caused either naturally or by human disruption. Natural disruption should not be controlled, but human disruption affecting the productivity of Puget Sound groundfishes must be minimized. Human-induced habitat loss includes production loss due to poor water quality (see pollution); excessive nutrient and sediment loads; elimination of marine, estuarine, and intertidal habitats by filling, dredging, mining, dumping, and bulkheading; removal of aquatic vegetation, and the disruption of habitat by fishing, diving, vessel traffic, and aquaculture practices. In some cases, the disturbance of one habitat type can lead to the creation of habitats of another type. The plowing of benthic habitats by fishing gear may increase the productivity of target species. Changes in sediment flow by bulkheading or jetty construction may create or destroy sand and mud habitats.

WDFW enforces the Hydraulic Code (RCW 75.20, WAC 220-110, WAC 232-14) which requires the Department to protect aquatic habitat and which requires that a permit be obtained from the Department for any activities that use, divert, obstruct, or change the natural flow or bed of waters of the state. In addition, a number of policies govern how the agency issues permits and protects aquatic habitat on the long term. One policy is a no net loss of habitat policy and a new policy is being developed specifically for marine habitats.

The Department's policy of no net loss of habitat requires continuing oversight of human activities to ensure the productive capacity of Puget Sound groundfish and ecosystem. Unless proposed habitat altering activities are fully understood and can guarantee that the no net loss of habitat or stock productivity occurs, the Department's influence and control will act to limit such activities.

Watershed/Estuary Links

The Puget Sound marine ecosystem is linked to freshwater watersheds and the river mouths either directly as habitat or through many biological and physical processes. In particular, estuaries and rivers may be the habitat of starry flounder and other euryhaline groundfish species. Estuaries often attract early life phases of groundfish, and are the sources of nutrients, sediments, and pollutants found in Puget Sound. Activities occurring in watersheds and riverine areas can directly and indirectly affect groundfishes through habitat disruption and alteration, flow and current modification, eutrophication, nutrient deprivation, and chemical contamination. These effects may be exacerbated by the effects of flooding and the intrusion of sediments into the marine environment that affect water quality and existing bottom habitats.

Fishing Gear Impacts

Bottomfishing gear including trawls can cause physical impacts to the habitats they contact. In 1985, the WDFW issued an environmental impact statement regarding the effects of otter (bottom) trawls in Puget Sound. This document concluded that although the doors and foot rope of the trawl may alter the bottom, the positive effects of the fishery (employment, economic activity) were overall more beneficial. Recently, new techniques and studies have compared the impact of trawling to areas that are trawled and areas that are pristine. Most of these studies have concluded that bottomfishing disrupts benthic organisms in many habitats and reduces the vertical structure of the biological and physical environment.

Conservation and Use Plans will identify fishing gear impacts caused by groundfish fisheries. Impacts will include the type and nature of the fishing gear, the likely impact on the physical environment, and the impact on benthic organisms. Areas may be designated as disruption free (as in the case of marine protected areas) or as areas of intense fishing and habitat disturbance.

Vulnerable Life History Stages

Groundfishes typically transition through several metamorphic phases during their life history. These often include existence as eggs, larvae, juveniles, sub-adults, and adults. While fishes are sensitive to ecosystem perturbations during any of these phases, there are several stages that are more sensitive because of their fragile physiology or poor ability to swim that may require special consideration and protection. These life history stages include the early part of life including the egg, larval, and juvenile phases. In addition, spawning adults are vulnerable to disturbance because most of their energy has been devoted to reproduction increasing their vulnerability to predation, starvation, and disease. Reproductive behavior may also be disrupted during harvesting or observation.

Conservation and Use Plans shall identify sensitive life history stages and factors that may enhance or inhibit survival. When possible, harmful factors will be controlled or eliminated. Staff shall identify the types and locations of essential life history stages and habitat to the Priority Habitats and Species Program.

Climatic Effects

The survivorship, recruitment, and productivity of fish populations varies naturally with biological and physical factors. Physical factors are usually induced by changes in climate, and the changes in climate may occur naturally or be caused by humans. Natural cycles in the earth's climate have been recently identified that are correlated to the productivity of a wide array of groundfishes on the West Coast of North America. Some species do well during warm periods while other perform poorly. Some

groundfishes, especially Pacific cod and walleye pollock which are on the southern limits of their natural ranges and are sensitive to changes from cold to warm climates. These and other species may be sensitive to *El Nino* and warm-water events that occur frequently along the coast. Fish populations are particularly sensitive during periods of low stock productivity, and even conservative fishing rates may not reverse the rate of decline, or worse, may drive the population below a critical threshold from which it cannot recover.

Conservation and fishery plans will strive to identify those species that are sensitive to the effects of climatic change and include harvest and usage options that mitigate the effects of harvest during periods of low productivity. Fisheries may be curtailed during these sensitive periods to protect the affected weak stocks.

Predator-Prey and Competitive Interactions

Puget Sound groundfishes can be significant predators on other organisms in the Puget Sound ecosystem. In turn, groundfish populations may be limited by other predators. Changes induced naturally, or by harvest and management activities, may affect the productivity and populations of all organisms within their complex food webs. Puget Sound groundfishes may compete with each other, salmon, and other animals for space, food, and other limiting resources. The nature of competitive interactions is poorly understood for Puget Sound groundfishes, but the effects of resource fluctuation is to be expected for groundfish, salmon, or other species as brought about by natural or anthropogenic sources.

Groundfish conservation plans shall identify the known key predators, prey, and competitors of groundfish resources. Staff shall determine whether harvest, enhancement, or other management activities may negatively affect groundfish resources through unintended changes in food webs and competitive interactions. Consultations and agreements will be sought with agency staff and other relevant entities to assure the persistence of healthy groundfish populations and ecosystems.

Marine Mammal Interactions

Marine mammals are key predators on groundfishes in Puget Sound (Schmitt et al. 1995) and may also compete with groundfish populations and fisheries for limited food and other resources. Because of their special status of protection, marine mammals present a difficult management problem and are likely limiting some fish populations and fisheries in Puget Sound. In particular, marine mammals appear to be limiting the population of Pacific whiting in Port Susan and may be affecting lingcod, walleye pollock, and Pacific cod resources throughout Puget Sound. Fisheries may also cause a taking of marine mammals either by capture or entanglement in fishing gear or by fisheries removing the prey resources needed for marine mammals.

Conservation plans will identify the interactions and needs of marine mammals when considering potential fisheries so that groundfish populations, marine mammals, and the stability of fisheries are duly protected. WDFW Marine Resources staff will seek consultations and agreements with other program staff and federal authorities to assure the persistence of healthy marine mammal and groundfish populations.

Pollution

Chemical contamination and the human-induced diminishment of water quality may lead to the reduction of species and ecosystem productivity. Focused research has been conducted in Puget Sound by the National Marine Fisheries Service and by the Fish Task of the Puget Sound Ambient Monitoring Program. Both entities have found the ambient levels of chemical contamination from industrial and non-point sources have resulted in health effects in groundfishes that cause reduced reproductive capacities and survivorship. The results from these studies have led to human health risk advisories by county and state health agencies.

Oil spills are another source of pollution that is usually from identifiable sources and may be catastrophic. Damage penalties are also levied against polluters and funds may be used to mitigate for the loss of marine species and habitats.

Groundfish staff shall cooperate with research, health, and oil spill response entities to identify the effects of chemical contamination on groundfish populations and minimize the threat to human health.

Competitive Fisheries

The effects of fisheries that compete with groundfish populations or fisheries is poorly understood. Shellfish fisheries that remove prey items such as shrimp may limit groundfish production and affect population stability. Groundfish may also be caught in other fisheries, or other fisheries may remove keystone predators that could change population stability. In turn, groundfish fisheries may remove species targeted in other fisheries or that affect other marine resources. The bycatch of crabs during trawling is an example which has led to regulatory change to mitigate the interaction.

Fisheries that compete with groundfish resources will be identified and evaluated. Competing fisheries that introduce significant risk to either resource or the economic viabilities of the fisheries will be examined for possible adjustments to reduce conflicts and risks.

Exotic Species

Exotic species are a continual threat to the stability of marine ecosystems on the West Coast of North America. Species introduced from ballast water, the importation of aquatic organisms for mariculture, and other sources threaten to invade critical marine habitats and the ecosystem upon which Washington marine life depends. These invasions may decrease habitat quality, introduce diseases, or alter trophic relationships which may affect population stability.

Groundfish staff will strive to identify the occurrence of exotic species that may affect groundfish populations and the ecosystem. Conservation plans and activities will strive to minimize the negative impacts of invasive species.

Groundfish and Fishery Management

Groundfish populations and their affected ecosystem shall be managed through a series of *Conservation and Use Plans*. A Conservation Plan (CP) will be developed for each key groundfish species or species group including non-classified marine fishes. CP's will contain stock assessment information, identified ecosystem issues, recommended harvest levels, and non-consumptive uses. Using recommendations from the CP, the Use Plans (UP) will contain comprehensive harvest strategies and fishery plans for the various groundfish fisheries as well as providing for non-consumptive uses. The approaches and guidelines used to develop these plans are presented below.

Precautionary Approach

The Fish and Wildlife Commission has established a precautionary approach to groundfish management in Puget Sound. The Commission policy is to manage Puget Sound groundfish, especially Pacific cod, in a conservative manner in order to minimize the risk of overharvest and to ensure the long-term health of the resource. Similar precautionary approaches have been adopted internationally (FAO 1995) and nationally as stipulated in the Sustainable Fisheries Act of 1996. The FAO Code of Conduct states:

“States should apply the precautionary approach widely to conservation, management and exploitation of living aquatic resources in order to protect them and preserve the aquatic environment. The absence of adequate scientific information should not be used as a reason for postponing or failing to take conservation and management measures. ... In implementing the precautionary approach, States should take into account, *inter alia*, uncertainties relating to the size and productivity of the stocks, reference points, stock condition in relation to such reference points, levels and distribution of fishing mortality and the impact of fishing activities, including

discards, on non-target and associated and dependent species as well as environmental and socio-economic conditions.”

In order to implement the precautionary approach, fisheries agencies have been developing implementation plans and guidelines that interpret the precautionary approach into their management frameworks. Some of these guidelines include:

1. Obtaining and sharing the best scientific information and implementing improved techniques for dealing with risk and uncertainty;
2. Developing stock specific reference points and actions to be taken if they are exceeded;
3. Accounting for uncertainty in stock parameters, estimates, environmental conditions, and socio-economic factors; and
4. Developing data collection and research programs to assess the impact of fishing on non-target and associated species.

In applying the PSGMP, staff will develop similar precautionary guidelines, reference points, information systems, and measures of data quality and risk.

Information Needs

The Department has a number of information systems to track fishing effort and harvest, monitor biological trends, and assess stocks.

Several data collection systems exist to record or estimate catch and effort, and the systems differ by fishery. For commercial fisheries, a fish receiving ticket is required each time a fisher sells catch to a processor. These tickets include information on species, price, date, and Marine Fish-Shellfish Catch Reporting and Management Area (Figure 3). A copy is sent to WDFW and the data are entered into computer databases. For the trawl fishery, fishers are also required to log the date, time, position, duration, and catch estimates for each time they set and retrieve their net. This mandatory logbook is

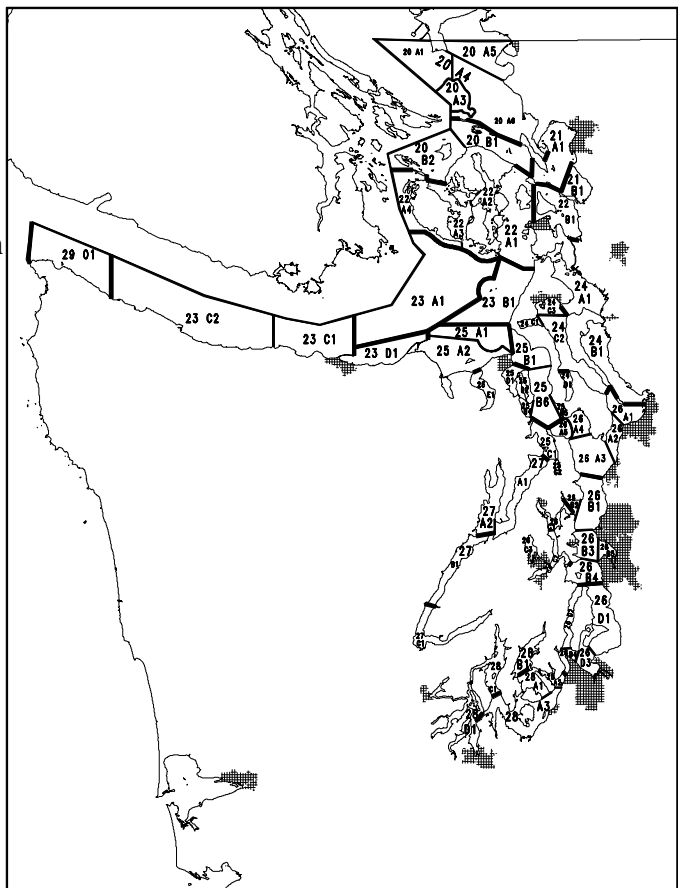


Figure 3. Marine Fish-Shellfish Management and Catch Reporting Areas.

returned to WDFW and the data are entered into a computer database called the Coastal Trawl Logbook System (Clark 1986a, b). These commercial fishery data form the basis of management and stock assessment of many Puget Sound groundfish stocks.

Recreational catch and effort are not completely recorded as they are for commercial fisheries. Instead, catch and effort are estimated by the Department's Salmon Catch Record Card System and Puget Sound Baseline Program. The Baseline Program is a creel survey focusing on boat anglers who fish in Puget Sound. Catch rates are estimated and multiplied by the catch of salmon estimated from the Salmon Catch Record System (Palsson 1988) and estimates of catch and effort are made for the ten catch record areas in Puget Sound (Figure 4). Recent regional closures of the recreational salmon fishery have diminished data quality for groundfish, because the catch estimation system depends upon open salmon seasons. A second recreational catch estimation system has been instituted by the National Marine Fisheries Service in Washington State. The federal Marine Recreational Fisheries Statistical Survey (MRFSS) also uses a creel survey of marine fishers in Puget Sound to estimate catch rates. However, the effort multiplier for total catch is a bimonthly telephone survey of coastal residents (Witzig et al. 1992). The MRFSS has lower sample sizes which result in estimates of catch and effort with low precision. However, the MRFSS does not depend upon open salmon seasons for catch estimates and also includes shore-based fishers and divers who spearfish. These modes of fishing are not comprehensively included in the WDFW catch estimation system.

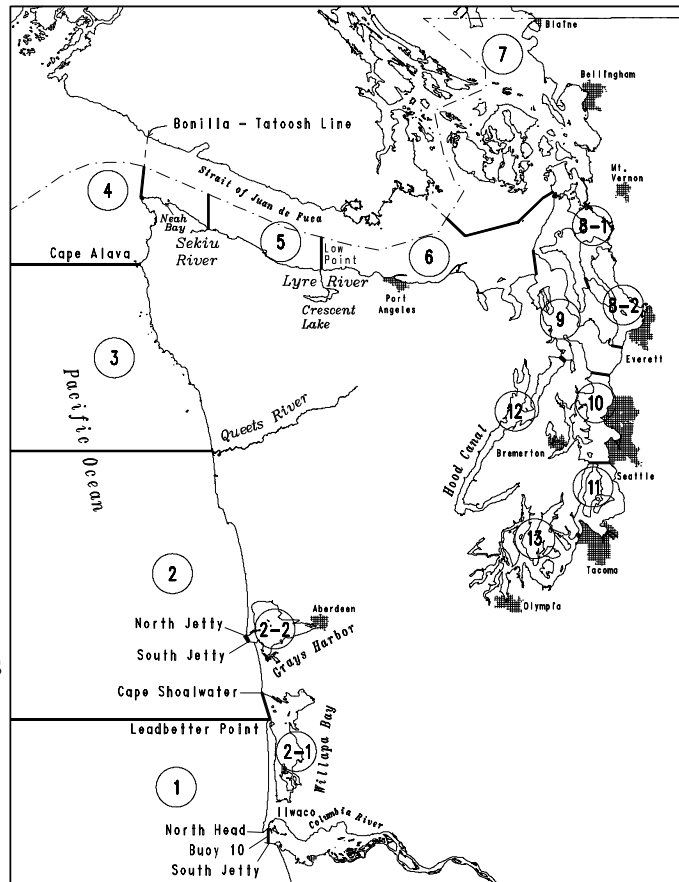


Figure 4. Salmon Catch Record Areas of Puget Sound.

WDFW samplers collect information on the size, species composition, and ages of harvested fish. Population information is collected during regional surveys using trawls, scuba transects, underwater television cameras and other techniques. Groundfish staff have also conducted independent catch estimation and creel surveys for the Pacific cod harvested from Agate Passage and lingcod caught in the Tacoma Narrows (Palsson 1991), the LaConner smelt fishery (Hoffmann and Palsson 1990), dive charter fisheries (Palsson et al. 1991), and the Puget Sound charter fishery (Lippert et al. 1991).

Fishery monitoring, survey, and stock assessment activities have been recently scrutinized by the Department's biometrical staff (Tagart et al. 1996). In particular, they identified the need to improve recreational catch estimates, verify television surveys of rockfish populations, and improve biological monitoring to gain regular catch-at-age, species composition, and direct fishery observations. Other information deficiencies included quantifying bycatch, especially species that are not harvested but are killed or damaged during the recreational and commercial fishing process.

The Department shall continue to collect fishery, biological and population information. Staff will strive to improve data quality, conduct comprehensive surveys and catch estimation, and implement the recommendations of biometrician reviews.

Stock Assessment

Stock assessment forms the technical basis for groundfish management. Stock assessment refers to the determination of the abundance of a fish population, whether the abundance is stable over time and the estimation of natural and fishing-related mortality. A status of stocks document was published in 1996 for Puget Sound bottomfish (Palsson et al. 1996) and represents the first comprehensive review of groundfish status. This report found that the majority of stocks were at below average levels and the quality of most information was rated as only fair.

Stocks - Stock assessment depends upon clearly defining the stock or stocks of fish upon which a fishery is operating. The stock concept has a number of definitions: A group of animals forming a distinct genetic unit, an aggregation of animals in a consistent place and time, or a unit of animals which a fishery exploits are common connotations. Pacific whiting in Port Susan near Everett has been identified as a distinct genetic unit in Puget Sound (Utter and Hodgins 1971), and lingcod in Puget Sound have been shown to be genetically distinct from coastal populations (Jagiello et al. 1996). Although several other genetic investigations have been conducted on other species of groundfish, conventional genetic techniques have generally not been useful in determining genetic uniqueness (Utter and Ryman 1993). New genetic techniques may have more promise at identifying populations, but the wide dispersal of marine fish larvae may reveal low genetic discreteness among geographic areas due to gene flow.

Other stock identification work has occurred using differences in growth rates, discrete spawning aggregations, and tagging studies. Palsson (1990) identified three stocks of Pacific cod in Puget Sound, and unpublished data on growth rates suggest some rockfish and walleye pollock differ within Puget Sound. Palsson et al. (1997) used the fishery stock concept and assessed eighteen key groundfish species by two broad geographical regions. North Sound stocks were those fish occurring in Puget Sound north of a line between Port Townsend and Whibey Island and South Sound stocks were those fish south of that line.

Stocks will be assessed on the finest genetic, regional, or fishery specific scale as practicable. The precautionary approach should assume that stocks differ on fine scale until it is demonstrated otherwise. Partnerships will be encouraged with departmental, tribal, university, and federal scientists to resolve stock definition on a genetic basis.

Stock Assessment - A variety of stock assessment techniques are available to fishery scientists, and the one chosen is usually dependent upon the available data, the management criteria, and the acceptable levels of risk and uncertainty. The precautionary approach suggests that reference points be established to manage fisheries before any danger of overfishing occurs. Stock assessment, therefore, requires the establishment of reference points and corresponding actions for fishery managers to take to prevent overfishing or deleterious ecosystem effects. Without reference points such as fishing mortality rates, maximum sustainable yield estimates, minimal population levels, or past fishing success, fisheries should not be allowed. Preferred scientific information includes historical estimates of spawning stock biomass, recruitment, fishing and natural mortality rates, critical population thresholds, yield analyses and evaluations of risk and precision. With increasing levels of reliable information, fisheries could be managed at correspondingly higher yields to the fullest possible maximum sustained yield.

There are no stock assessments for Puget Sound groundfish which present enough information to allow for the harvest of stocks at maximum sustainable yields. Only the historical performance of commercial and recreational catch rates have been used to evaluate stock status and trends for most of the principal groundfish species. The comparison of recent catch history, catch rates, or population abundance to long term averages are used as reference points for management but in most cases do not reflect the effect fisheries have on populations or the capability of populations to sustain harvest. Catch and catch rate reference points only offer an indication of relative abundance over time and are subject to bias, often overestimating the actual population. Recently, trawl, acoustic, and underwater television surveys have been used to estimate population abundance, and these survey estimates can be used as additional reference points for fisheries management.

Until more detailed stock assessment techniques can be developed, recent and historical comparisons population indicators will be used for Puget Sound groundfish stocks. Stock status is categorized into six levels or reference points including unknown, critical, depressed, below average, average and above average. To determine status, the average of the most recent two years of the catch, catch rate, or population abundance is calculated. This recent average is then divided by the 20 year, long-term mean of the stock indicator. This ratio expressed as a percentage is categorized into one of the following:

Above Average	The two-year mean exceeds the long-term mean by more than 5%.
Average	The two-year mean is within 5% of the long-term mean.
Below Average	The two-year mean is below the long-term mean by 6% to 35%.
Depressed	The two-year mean is below the long-term mean by 36% to 75%.

- Critical** The two-year mean is below the long-term mean by more than 76%, or the fishery or population is not detectable.
- Unknown** A lack of recent data for the primary stock indicator prevents a determination.

Because of the lack of catch-at-age and mortality rate estimates, this categorization scheme does not account for the historical or theoretical yield of the stock and reflects only an index of change from the mean. Critical population or overfishing thresholds cannot be quantified from this type of analysis.

Stock assessments for Puget Sound stocks can include an evaluation of fishery impact. For this determination, estimates of the absolute population abundance from surveys are compared to the total annual harvest by the fisheries for the same survey year. Trawl survey, acoustic, and video surveys are frequently used to estimate groundfish resources. Tagging studies and modeling can also be used to estimate fishing mortality rates and thus fishery impact. Fishery impact is characterized into three categories as follows:

- Overutilized** When the percentage of the annual catch exceeds 15% (5% for rockfish) of the survey population biomass, averaged over comparable survey years.
- Fully utilized** When the percentage of the annual catch ranges between 5% and 15% (1% and 5% for rockfish) of the average survey population biomass.
- Under-utilized** When the percentage of the annual catch is less than 5% (1% for rockfish) of the average survey population biomass.

A status of stocks document presenting the results of stock assessments will be published on a regular basis. This document will present the rationale and methods for stock assessments of the principal groundfish species or other species of interest. Stock assessments will consist of a determination of stock status and trend of catch, catch rate, population, or survey data. The data series that is considered most reflective of stock abundance will be designated the primary stock indicator with additional data series designated as secondary stock indicators. Staff will strive to improve assessments to include additional reference points such as estimates of catch-at-age, spawning stock biomass, recruitment, maximum sustained yield, fishing and natural mortality, and unfished spawning biomass.

Conservation Plans

The precautionary approach defines the general strategy for conserving groundfish species and deciding when to allow any harvest. A Conservation Plan (CP) will be developed for each key groundfish species and updated on a periodic basis. The CP shall contain the most recent information on stock status and trend, reference points to assure a healthy stock, a harvest strategy for recreational and commercial fisheries in terms of the reference points, the available or needed tools to manage the fishery

and population, a review of relevant ecosystem issues, and needs for nonconsumptive users. All CPs will be reviewed by the Commission prior to implementation.

The goal of the CP is to maintain stocks at levels that do not endanger the natural sustainability of the population, impede ecosystem function, or diminish fishery and nonconsumptive uses.

Critical Threshold and Overfishing

All species and populations must have a sufficient number of individuals for successful, continued reproduction. Ecologists identify the concept of a critical threshold, a population level below which reproduction and survival is impaired, limiting the ability of a population to sustain itself. A population may have multiple thresholds or stable levels, each representing a different level of productive capacity. Fishery scientists only recently have incorporated this concept into fisheries management and it has become an important reference point in the precautionary approach (Clark 1991, 1993; Mace and Sissenwine 1993, Rosenberg et al. 1994).

The critical threshold concept has become important in the definition of overfishing. Overfishing can be described in many ways including but not limited to economic, growth, and recruitment overfishing. Economic overfishing occurs when fishing has reduced population abundance below a point which the value of the catch or attraction to recreational fishers is too low to maintain profitability. Growth overfishing occurs when fishing has reduced the size of individuals being caught as to render the catch unmarketable or undesirable to recreational fishers. Recruitment overfishing occurs when fishing has reduced population abundance to a level that reproduction cannot occur or is too meager to rebuild or sustain to a population. This last form is comparable to reducing the population below the critical threshold and has been adopted as the operative definition of overfishing by many management organizations.

In many management forums, overfishing has been defined as fishing rates which cause the spawning biomass to decline below a level which achieves the largest level of maximum sustained yield. These levels have been suggested as "F20%", "F30%", and "F40%" which represent fishing mortality rates to achieve respective preservation of 20%, 30%, and 40% of the unfished spawning stock biomass. These are increasingly more conservative population thresholds and overfishing levels. This prevents low spawning stock biomass and related variability in recruitment. Many fishery management organizations have adopted F30% or more conservative guidelines, including the Pacific Fishery Management Council and the North Pacific Fishery Management Council.

Fisheries shall only be allowed when there is a sufficient number of spawning fish to assure a healthy population (critical threshold). A precautionary approach shall be used to assure that harvest strategies prevent overfishing below a critical threshold and that the harvest

strategies do not cause low spawning biomass, recruitment, and yield. Other forms of overfishing will be avoided to assure the continued economic and recreational value of groundfish resources.

Harvest Rates, Dynamics, and Strategies

A harvest rate is the annual exploitation rate expressed in terms of a percentage of annual catch divided by the total population abundance. Populations of fish have different dynamics that control their innate capacity to grow, reproduce, and survive. These characteristics affect the ability of fishers to catch and harvest species and stocks on a sustained basis. Some species, such as most flatfish grow fast and produce many eggs, resulting in productive fisheries. Other species, such as rockfish, grow slowly, have low mortality rates, and do not repopulate their habitats quickly. Once overfished, rockfish populations may take decades to recover.

The combination of population dynamics, current population levels, the types and effectiveness of fisheries, ecosystem attributes, and management goals all contribute to development of the harvest strategy. These factors will be identified in the Conservation and Use Plans.

The precautionary approach will be the overriding principle in developing a harvest strategy for a groundfish species. Fisheries will only be allowed when stock assessment information demonstrates a sufficient population exists to maintain successful reproduction, ecosystem function, and long-term sustainability. The precautionary approach shall be used to establish reference points from stock assessments that result in conservative levels of fishing. The harvest strategy will define a level of overfishing and identify steps to prevent overfishing. Harvest strategies shall take into account all sources of fishing mortality including directed harvest, harvest from transboundary, salmon, and shellfish fisheries, and all forms of bycatch. A harvest strategy shall also consider ecosystem issues and values, multispecies fisheries, and non-consumptive uses. Species-specific harvest strategies will be developed with stock assessment results into a Conservation Plan (CP). The results from all species CP's will be integrated into a Use Plan for each major groundfish fishery.

Harvest guidelines and fishing rates are types of precautionary reference points and may be developed from a number of data sources and models of ecosystems and exploitation dynamics. Data sources and models that estimate levels of maximum sustained yield are preferred but are generally lacking for Puget Sound groundfish stocks. When catch or population information is lacking, fisheries shall not be allowed. At a minimum level of information, harvest guidelines using the six stock status reference points may be related to a tiered harvest rate scheme based upon resource surveys or catch history. The guidelines are based upon the observation that maximum sustainable yields are often reached for groundfish populations when fishing mortality (F) equals natural mortality (M) or when fishing mortality

is one third to one half the total mortality (Z) (Gulland 1983). More recently, equilibrium models have been better able to incorporate stock specific estimates of mortality, growth, and other biological information to estimate conservative fishing mortality rates. Even when exploitation models and information are available, other ecosystem issues may require that harvest guidelines do not achieve maximum sustained yield.

Based upon Gulland’s (1983) or other suitable estimates of equilibrium or maximum sustainable yield, survey estimates and stock assessments will serve as minimal reference points for conducting fisheries with the precautionary approach. When survey data, stock specific estimates, or advance stock assessments are not available, stock status information will be referenced to alternative and conservative catch guidelines to control fisheries. As more detailed information advanced modelling become available, increased fishing rates approaching maximum sustained yield may be achieved with improved reference points and knowledge of ecosystem function.

A suggested harvest scheme is as follows:

<u>Stock Status</u>	<u>Harvest Guideline</u>
Above Average	Annual catch not to exceed the survey biomass times the natural mortality rate, one half the total mortality rate, or the F40% fishing rate, which ever is the most conservative. When data are lacking, catches not to exceed two times the recent average catch.
Average	Annual catch not to exceed the survey biomass times the natural mortality rate, one half the total mortality rate, or the F40% fishing rate, which ever is the most conservative. When data are lacking, catches not to exceed the recent average catch.
Below Average	Annual catch not to exceed the survey biomass times 75% of the natural mortality rate, 37.5% of the total mortality rate, or the F40% fishing rate, which ever is the most conservative. When data are lacking, catches not to exceed 75% of the recent average catch.
Depressed	Annual catch not to exceed the survey biomass times 25% of the natural mortality rate, 12.5% of the total mortality rate, or the F40% fishing rate, which ever is the most conservative. When data are lacking, catches not to exceed 25% of the recent average catch.
Critical	No harvest allowed.
Unknown	No harvest allowed.

Further caution must be taken in considering how fish populations react to fishing. Most population models assume that populations are stable and at equilibrium. Peterman (1977) states that populations with two or more “domains of stability” must be managed accordingly. In these cases, two or more mortality processes combine in a series to create a stock-recruitment relationship with more stable points than the single point of stability exhibited by the standard Ricker model (Ricker 1975). In one case, an unfished population would be stable at one point and could be continuously exploited without permanent harm as long as it never dropped down to a lower point of stability. Below this lower point (the critical threshold), the population would move toward extinction, even if harvesting was completely stopped. In a second case, a critical spawning adult abundance also exists, but a population falling below the lower point would not go toward extinction but toward a lower stable equilibrium. Such low population levels would remain unproductive for harvesting, and the elimination of all harvest would still not permit the population to return to the higher abundance near the upper point of stability. Populations at the lower points of stability or in low abundance face the greatest percent mortality from fisheries. Populations at low abundance are more susceptible to disease, predation, or other population stressors which may put the population at risk of extinction. All of these characteristics underscore the need for a precautionary approach to harvest strategies and management.

Use Plans

Use plans may be developed on a regional basis to facilitate Department deployment objectives or better coordinate tribal and non-treaty fisheries. Use Plans integrate the key recommendations on harvest rates, guidelines, and strategies, from the CP’s of each key groundfish species into specific plans, recommended regulations, and management tools to conduct fisheries and non-consumptive activities. Use Plans will also consider ecosystem issues, major population stressors, and the impacts of directed, mixed, and bycatch fisheries. Use Plans will be updated on a periodic basis. Consumptive harvest shall only be allowed on a precautionary basis consistent with the Groundfish Management Policy. Fisheries shall only occur when a current use plan is in place which includes reference points and corresponding management actions to prevent overfishing and assure healthy groundfish populations. All Use Plans will be reviewed by the Commission prior to implementation.

Use plans will be developed on a periodic basis for each commercial bottom trawl, Pacific whiting, set net, set line, drag seine, and bottomfish pot fishery. A Use Plan will also be developed for recreational fisheries including private boat, charter boats, shore-based, spearfishing, and Pacific halibut. Use Plans will also be developed for unclassified groundfishes and groundfishes caught or affected by other fisheries. The Use Plan will identify whether the fishery is targeted on one species group or is a mixed species fishery, and whether the fishery has significant bycatch. Use Plans will be developed for non-consumptive uses.

Targeted Fisheries

Targeted fisheries are those that seek one principal species with a specific gear that results in catches primarily of the targeted species. The gears may be fished in a time and place to accomplish their goal. These fisheries include commercial drag seine fisheries for surfperch, midwater trawling for Pacific whiting, set net and set line fisheries for spiny dogfish, the recreational hook-and-line fishery for Pacific halibut and spearfishing, especially for lingcod.

Targeted fisheries will be encouraged along with the development of gears that reduce unwanted species or species that are in poor stock conditions. Targeted fisheries must be continually monitored to assure that the only the targeted species is caught. Since targeted fisheries are often highly efficient, the management framework must assure that stocks are not overharvested.

Mixed-Species Fisheries

Gears and fisheries that regularly capture or target more than one species are mixed-species fisheries. In Puget Sound, these groundfish fisheries include bottom trawl fisheries and recreational hook-and-line fisheries. Since many stocks are harvested at once, stocks that are in weak condition may be at higher risk of overfishing.

Mixed fisheries shall be managed on a weak stock basis whereby the fishery is limited by the strength of the weakest stock. Mixed species fisheries shall only occur when observers can directly monitor the unsorted catch for species composition, size, and other biological information. Use Plans shall encourage the development of bycatch reduction devices and fishing practices to minimize harvest of unwanted species.

Management Tools

A variety of management tools can be used to achieve harvest guidelines. The following are tools for managing groundfish fisheries and their possible benefits or drawbacks:

Daily bag limits	The primary management tool for recreational groundfish. Anglers can only catch a specified number of fish per day. Bag limits are simple to understand and enforce but ineffective when the average catch is far less than the bag limit. They can encourage high-grading, wastage, and bycatch.
Annual bag limits	Fishers can only catch a specified number of fish per year. This has not been implemented for groundfish but would likely be applied to trophy fish like lingcod and halibut. Annual limits can encourage high-grading, wastage, and bycatch.

Trip limits	Limits placed on the pounds of certain species landed by commercial fishers each day. Trip limits have recently been instituted in Puget Sound for lingcod, rockfish, and sablefish, and are designed to discourage targeting on depressed stocks or species designated for recreational emphasis.
Size limits	Usually a minimum size of a fish that can be retained by a fisher. Size limits can also be applied as a maximum size limit--fish over a certain size can not be retained or used in combination with a minimum size limits is termed a slot limit. Size limits are not effective for groundfish with swim bladders--most die from pressure changes when brought to the surface. Minimum limits have been used for English sole and starry flounder, and a slot limit is used for sturgeon, lingcod, and other groundfish. Size limits can encourage high grading, wastage, and bycatch.
Area closures	Areas that are temporarily closed to protect spawning fish, molting crabs or other sensitive species or their environments from physical disturbance.
Marine Protected Areas (MPAs)	Areas that are closed or restricted permanently to harvest activities. See below.
Rotating area closures	Areas that are closed for long time periods (years, decades) and reopened to allow fishing. Areas may be rotated to offer a mixture of long-term protection of sensitive species and fisheries.
Seasonal closures	Closures to fishing based upon a defined time period. They have been used to protect spawning Pacific cod and lingcod and have recently been implemented for cabezon. Seasonal closures also have been successful for reducing crab bycatch in trawl fisheries.
Mesh & hook size	Hook size and spacing and the sizes of net meshes can be used to control the size and in some cases the species of fish target by recreational and commercial fishers. Mesh regulations have been used to reduce bycatch in trawl fisheries and hook size requirements have been used to target larger commercial species such as dogfish in set line fisheries.
Bycatch reduction devices (BRDs)	A device or gear modification used to reduce bycatch, often of specific species or groups of species. BRDs have been used in shrimp trawl fisheries in Puget Sound to reduce the bycatch of groundfish.
Catch and release	Allows for the catch but not harvest of a species. Catch and release has not been widely used for groundfish, and like size limits, is not effective for fish with swim bladders. However, lingcod and Pacific halibut are frequently caught and released successfully incidental to salmon fishing and other groundfish fisheries.
Quotas	A maximum catch allowed for an entire area and season. Quotas have been used to limit fishing mortality on Pacific cod. They can encourage discarding at sea and wastage.
Limited entry	Limiting the total amount of fishing effort by restricting the number of licenses sold. Qualification is usually based upon historical fishing patterns. Charter salmon and whiting fisheries, for example, are limited entry. Limited entry fisheries are difficult to implement and, in the case of whiting, have not been successful in preventing stock collapse.
Individual transferable quotas (ITQs)	ITQs are rights to a share the harvestable portion of a stock. ITQs are sold to fishers on a permanent or long-term basis. They have been successful for Pacific halibut and sablefish fisheries but difficult and expensive to implement. ITQs prevent <u>free</u> entry into the fishery.

Conservation and Use Plans shall strive to use the most effective management tools to meet the harvest guidelines and strategies established for Puget Sound groundfish.

Marine Protected Areas

Marine Protected Areas are areas which designate some level of protection in time and place for marine organisms. The levels of protection may range from temporary bans on development to permanent restrictions on all forms of harvest, development, and intrusion. The science of marine protected areas is developing but may be used as a management tool to restore fish populations, maintain biodiversity, and reduce the effects of habitat loss and impairment.

The Department recognizes that substantial expanses of all habitats may need to be designated as no-take harvest refuges. Twenty percent or more of each habitat type in each region may be needed as no-take refuges to ensure critical thresholds of populations, habitat values and functions, and species diversity are maintained.

Aquaculture

The artificial propagation of aquatic organisms (aquaculture) for commercial or enhancement purposes has been focused in Puget Sound on shellfish and salmonids. The culture of salmonids can affect groundfish resources in many indirect manners. Poorly understood predator-prey and competitive interactions may enhance or interfere with egg, larval, juvenile, and subadult stages of groundfish. Unnatural or poorly timed releases of smolts, the year round presence of resident hatchery reared salmonids, or the returning runs of adult salmonids may interfere with natural cycles of groundfish life history and stock productivity.

The net pen culture of salmonids in Puget Sound produces localized effects on groundfish resources. Excessive feces, shading, lighting, and other effects may detrimentally affect the local habitat upon which many species of groundfish depend. Intensive salmonid culture may also introduce diseases and antibiotics into the environment which may negatively affect the productivity of groundfish species.

A conservative approach to undertaking new enhancement projects will be exercised until more reliable information is available. Groundfish staff will work with hatchery staff to account for and minimize negative ecosystem effects on groundfish.

The culture of marine fishes to enhance depleted stocks is receiving interest by several agencies throughout Puget Sound. The culture of any species brings about the problems of genetic introgression, alteration of behavior, competitive and predator-prey interactions, and the ability to evaluate the

success of the enhancement program. Start up and production of mariculture can be great, outstripping the limited funds provided for basic management support.

Persons who release fish into Washington waters are also required to have a permit for such activities (WAC 220-20-040). WDFW shall not issue permits when the planting of fish presents an important conflict or competition to the established stocks, conflicts with the Department's overall management plan, cause a decrease in established stocks, or would inhibit the ability to harvest existing stocks.

The PSGMP recommends a conservative approach to the culture of marine fishes for enhancing stocks. Mariculture should proceed cautiously to determine the following: the objectives in an enhancement program, the need for species enhancement, the likelihood of culturing candidate species, the genetic structure of populations of the species, habitat effects, predator-prey and competitive interactions, the effect of poor climatic conditions on released fishes, the ability to mark released individuals to determine success and contributions, and criteria for success.

Permanent Regulations

The harvest rates, guidelines, and strategies along with the reference points and management tools to invoke permanent or emergency regulations will be identified in the Use Plan. Preferred management tools will be presented to accomplish the management of the fishery and populations. These management tools will be developed into permanent regulation proposals to be heard in public fora and considered for adoption by the Commission.

Plan Updating and Modification

The PSGMP shall be updated on a periodic basis or when directed by the Commission, Director, or Senior Fish Management staff. Updates shall be conducted at least every five years.

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