BY THE U.S. GENERAL ACCOUNTING OFFICE

Report To The Honorable Les AuCoin, U.S. House Of Representatives

The Oregon Production Index: A Sound Fishery Management Tool That Can Be Improved

Salmon fishermen and residents of Northwest coastal communities have suffered continuing economic hardships due to a depressed salmon fishing industry. They contend that the Pacific Fishery Management Council's method of setting fishing quotas for coho salmon is unsound and has led to unnecessarily low quotas and short seasons. In particular, fishermen have criticized the Oregon Production Index, the tool the council uses to predict the size of the coming year's coho population.

On the basis of information from independent consultants and other fishery experts, GAO determined that the Oregon Production Index is biologically sound and provides a valid basis for setting fishing quotas and seasons. However, GAO also found ways to improve the Index. GAO is recommending actions which should lead to improved management of the salmon fishery.

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AUGUST 15, 1983

UNITED STATES GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

RESOURCES, COMMUNITY,
AND ECONOMIC DEVELOPMENT
DIVISION

B-207048

The Honorable Les AuCoin
U.S. House of Representatives

Dear Mr. AuCoin:

This report discusses the validity of the Oregon Production Index as a basis for fishery management decisions in the Pacific Northwest. At your request, we have evaluated the biological soundness and record of accuracy of the Index and have made recommendations to the Secretary of Commerce which should lead to improved management of the salmon fishery.

As arranged with your office, unless you publicly announce its contents earlier, we plan no further distribution of this report until five days from the date of the report. At that time we will send copies to the Secretary of Commerce and other interested parties and make copies available to others upon request.

Sincerely yours,

for J. Dexter Peach
Director

REPORT TO THE
HONORABLE LES AUCOIN
HOUSE OF REPRESENTATIVES

THE OREGON PRODUCTION INDEX: A SOUND FISHERY MANAGEMENT TOOL THAT CAN BE IMPROVED

D I G E S T

The 1982 salmon fishing season in the Northwest was plagued by controversy over the Oregon Production Index (OPI), the tool Federal and State agencies use to predict the size of the coho salmon population. Coho are important to the fishing industry because they comprise the largest single salmon species caught off the coast of Oregon. In 1982 many fishermen maintained that coho were more abundant than the OPI had predicted and that fishing quotas based on the OPI were unnecessarily low. The OPI's credibility was further undermined when Federal fishery managers filed regulations on July 30 closing Oregon's salmon fishing season and then retracted the regulations within hours. According to the fishery managers, the regulations had been filed by mistake.

Expressing concern over the controversy surrounding the OPI, Congressman Les AuCoin requested GAO to assess the current method of establishing fishing quotas in the OPI area and determine whether quotas can be set more accurately. Congressman AuCoin was particularly interested in resolving the controversy over whether the OPI provides a sound and accurate basis for setting fishing quotas and seasons. The Congressman was joined in this request by Congressman Neal Smith, Chairman, Subcommittee for Commerce, Justice, State, and the Judiciary, House Committee on Appropriations.

GAO assessed the validity of the OPI as a method of establishing fishing quotas and found that it is biologically sound and has proven to be more accurate than the salmon population predictors used in other States. However, GAO also found ways to improve the OPI.

WHAT IS THE OPI?

The OPI is a fishery management tool which the Oregon Department of Fish and Wildlife

developed in the late 1960s as an indicator of the annual adult coho population in the Columbia River. Oregon refined the OPI over time to predict and measure the annual adult coho population in the OPI area, which extends south from Leadbetter Point, Washington, to southern California. Since 1979 the Pacific Fishery Management Council and Oregon have used the OPI as the basis for setting fishing quotas and seasons.

An accurate OPI is essential to effective management of the coho fishery. If the fishing quotas which are based on the OPI's predictions are unnecessarily low, fishermen lose potential income. Low quotas also affect other sectors of the coastal economy, such as marine suppliers, hotel operators, and restaurant owners. On the other hand, if quotas are set too high, the coho population may become seriously depleted.

THE COHO FISHERY'S PROBLEMS CANNOT BE EASILY SOLVED

The number of adult coho in the OPI area has remained low for six years after dropping in 1977 from about 4,110,000 to 1,127,000 fish. This fact lies at the heart of many of the fishery's problems. In the 1960s and early 1970s, when the coho population was larger, many fishermen joined the fleet. Now that the coho population has declined, the fleet's fishing capacity exceeds the supply of fish. This has resulted in low quotas, short seasons, and other restrictions to help prevent overfishing of the already-reduced coho population.

Fishery biologists have cited numerous reasons for the coho's decline, including overfishing, the degradation of the coho's environment by activities such as dam- and roadbuilding, and environmental fluctuations such as floods, droughts, and changing ocean conditions. Some fishery biologists also believe that the coho released from hatcheries are genetically inferior and more prone to disease than wild coho. Since the number of wild coho has declined in comparison to the number of hatchery coho, the overall coho population shows the effects of this change in stock composition. However, regardless of which of these factors has contributed most to the coho's decline, the solution does not lie

solely--or even primarily--in improving the OPI. Improving the OPI will not by itself increase the coho population, but it will provide fishery managers with more accurate information on which to base fishing quotas and other management actions. (See pp. 5 to 7.)

THE OPI IS BASICALLY SOUND

GAO's analysis indicates that the OPI is a biologically sound concept which provides a valid basis for setting quotas and seasons. This conclusion is buttressed by studies performed for GAO by independent consultants, as well as other reports published by fishery biologists. The biologists GAO contacted agreed that the OPI's method of estimating the size of the coho population and predicting the population for the coming year rests on valid biological assumptions. (See pp. 12 and 13.)

Since the Pacific Fishery Management Council began using the OPI to predict coho abundance in 1979, the OPI has compiled a better record of accuracy than any of the other salmon predictors used in Northwest salmon fisheries. GAO's analysis of 11 Northwest salmon predictors shows that the OPI ranks highest in accurately predicting the size of the coming year's salmon population. (See pp. 13 to 16.)

THE OPI CAN BE IMPROVED

Although the OPI is the best predictor of salmon abundance available, it can be improved. Specifically, studies by independent consultants indicate that OPI area fishery managers need more information on the locations and numbers of Washington coho stocks, private and public hatchery coho stocks, and wild coho stocks. This information would help the Pacific Fishery Management Council and the Oregon Department of Fish and Wildlife improve the OPI's accuracy and target the more abundant hatchery stocks for maximum harvest while protecting the less abundant wild stocks. (See pp. 17 to 21.)

According to council and Oregon Department of Fish and Wildlife officials, the annual cost of gathering this information for Oregon would be roughly $200,000. Oregon Department of Fish and Wildlife officials agreed that the benefits from obtaining the information would

be well worth the cost. The information could be gathered by expanding the Oregon Department of Fish and Wildlife's data collection efforts. Because neighboring States--particularly Washington--contribute coho to the OPI area, any increase in the Oregon Department of Fish and Wildlife's data collection efforts will require additional coordination with the fishery agencies of those States. (See pp. 22 to 23.)

RECOMMENDATIONS

To help improve the OPI's accuracy and provide a better basis for fishery management decisions, GAO recommends that the Secretary of Commerce request the Pacific Fishery Management Council to

--gather additional data on the source and distribution of coho stocks in the OPI area through tagging, scale analysis, or other appropriate methods, and

--obtain more accurate estimates of Oregon coastal wild stock abundance through stream surveys or other counting techniques.

AGENCY COMMENTS AND GAO's EVALUATION

The Department of Commerce, the Pacific Fishery Management Council, and the Oregon Department of Fish and Wildlife agreed that the Oregon Production Index provides a valid basis for fishery management decisions. They also agreed that gathering the data mentioned in GAO's recommendations would provide useful management information and permit better utilization of the coho resource. However, the Department of Commerce and the Pacific Fishery Management Council were uncertain whether improving the accuracy of the OPI's predictions would be worth the cost.

GAO believes that obtaining the information described in the report's recommendations is necessary for the council and the States to effectively manage the coho fishery for maximum harvest of abundant hatchery fish while protecting the less abundant wild stocks. In recognition of the need for gathering the information described in GAO's recommendations, The Oregon Department of Fish and Wildlife has recently requested and received State funds for this purpose.

Contents

ABBREVIATIONS

GAO	General Accounting Office
NOAA	National Oceanic and Atmospheric Administration
NMFS	National Marine Fisheries Service
ODFW	Oregon Department of Fish and Wildlife
OPI	Oregon Production Index

GLOSSARY

Escapement	Salmon which are not caught by ocean fisheries and either remain in the ocean or migrate back to fresh water.
Fishery	One or more stocks of fish which can be managed as a unit, and any fishing for such stocks.
Jack coho	An early-maturing two-year-old male coho that returns to fresh water to spawn.
Off-station releases	Hatchery-raised smolts which are transported to other locations for release.
Scale analysis	A method of determining the origin of a coho by evaluating its scale patterns.
Smolt	A young salmon that migrates seaward.
Spawner	A jack or adult salmon that returns to fresh water to reproduce.
Stock	A type or species of fish capable of being managed as a unit.
Tagging	Various methods of marking fish for later identification.
Wild coho	Coho which are naturally spawned and reared.

CHAPTER 1

INTRODUCTION

The summer of 1982 was a period of turmoil for the Oregon salmon fishery. Regional fishery managers had predicted that the number of adult coho salmon, which had dropped by about 70 percent since 1976, would continue its downward trend in 1982. The fishing quotas based on this prediction resulted in the shortest salmon seasons on record, causing financial hardship for the fishing industry and related sectors of the coastal economy and a loss of fishing opportunities for recreational fishermen. Controversy erupted when many fishermen maintained that coho were more abundant than predicted and that the fishing quotas were unnecessarily low. Confidence in the fishery management process reached a low point when Federal fishery managers closed Oregon's salmon fishery on July 30 and then reopened it within hours. This "mistaken" closure confused fishermen and intensified the controversy concerning the management of the salmon fishery. Much of this controversy was focused on the accuracy of the Oregon Production Index (OPI)--the conceptual tool which Federal and State fishery managers use to predict coho abundance.

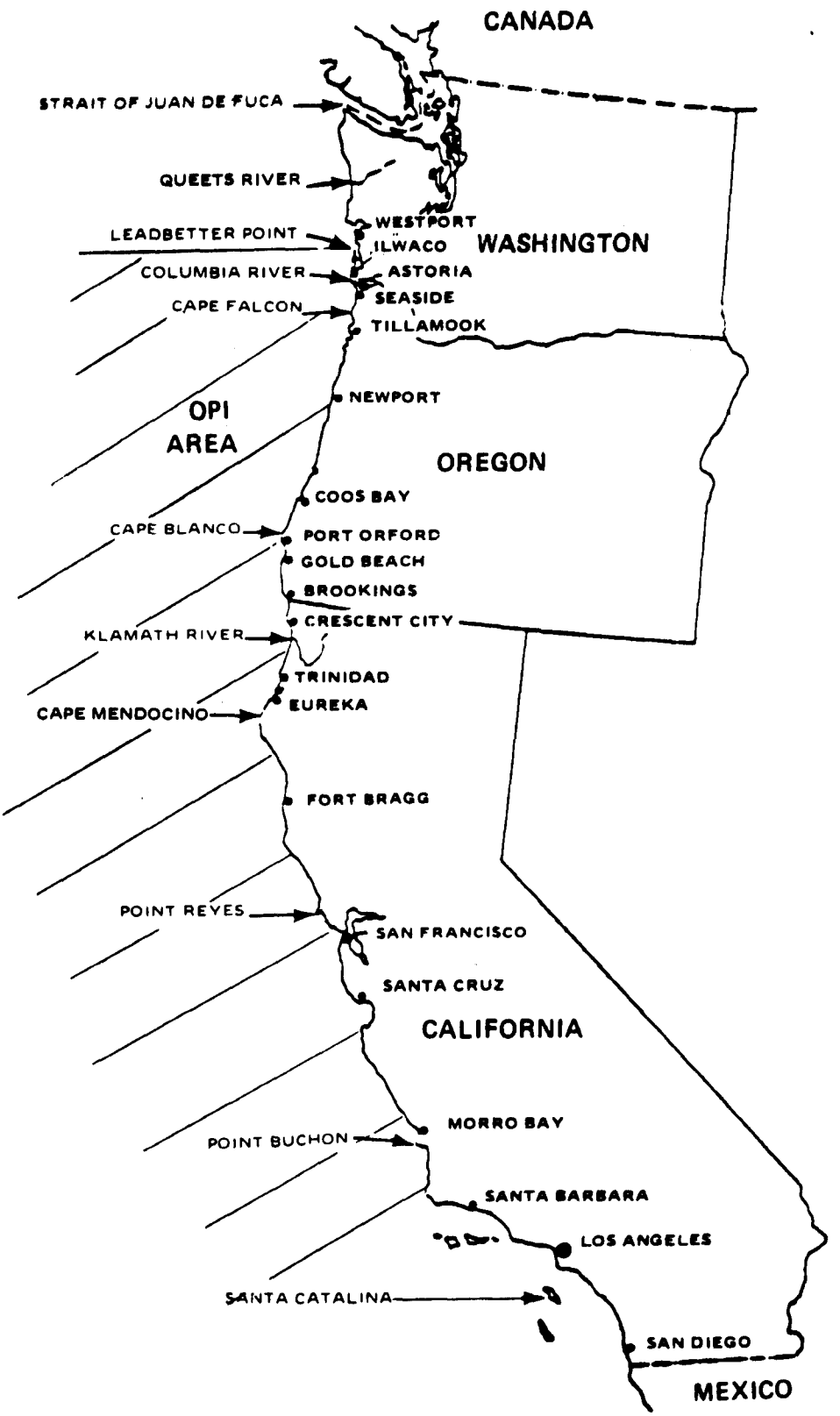
In a July 30, 1982, letter to GAO, Congressman Les AuCoin expressed concern over the financial difficulties facing Oregon's commercial and recreational fisheries. Congressman AuCoin said that OPI estimates of salmon abundance have been repeatedly challenged and that, unless this issue is resolved, the controversy surrounding the Oregon salmon fishery will continue. Accordingly, Congressman AuCoin requested that we assess the current method of establishing fishing quotas in the OPI area and determine whether quotas can be set more accurately. (See fig. 1 for a map of the OPI area.) Congressman AuCoin was joined in this request by Congressman Neal Smith, Chairman, Subcommittee for Commerce, Justice, State, and the Judiciary, House Committee on Appropriations.

THE FISHERY CONSERVATION AND MANAGEMENT ACT HAS SHAPED FEDERAL FISHERY MANAGEMENT PRACTICES

The presence of large, well-equipped foreign fishing fleets off the U.S. coast in the 1960s and early 1970s raised widespread concern that the Nation's coastal fisheries were being depleted. In response to this concern, Congress increased Federal involvement in ocean fishery management by enacting the Magnuson Fishery Conservation and Management Act of 1976 (16 U.S.C. 1801). Among the act's goals were the conservation and management of fishery resources off U.S. coasts. To accomplish these goals the act created a Fishery Conservation Zone generally extending 3 to 200 miles from the U.S. coastline. The act also established eight regional fishery management councils to manage fisheries in conjunction with the States and the Department of Commerce. The Department acts through the National

FIGURE 1

THE OPI AREA



Oceanic and Atmospheric Administration's (NOAA's) National Marine Fisheries Service (NMFS). The councils are composed of representatives of Federal and State fishery management agencies and private citizens appointed by the Secretary of Commerce from nominations made by the State Governors. One of these eight regional fishery management bodies, the Pacific Fishery Management Council (the council), manages the fisheries off the Washington, Oregon, and California coastline. Managing coho in the OPI area is a major portion of the council's responsibility.

Federal and State agencies work together to manage the salmon fishery

The council provides direction for the salmon fishery by preparing, monitoring, and revising salmon management plans. The first salmon plan was adopted in 1977, a new plan was implemented in 1978, and annual amendments to the 1978 plan were issued during 1979-83. All plans and amendments must be reviewed, approved, and implemented by the Secretary of Commerce acting through NMFS. These plans and amendments set forth the conservation, management, and regulatory measures that govern the ocean salmon fisheries, including the quotas that limit the annual coho harvest.

Coho fishing quotas that appear in the annual salmon plan are determined by using the OPI to predict the size of the coho population for the coming season. The size of the coho population is relatively predictable in part because the coho's life cycle is predictable. Coho are hatched in fresh water, migrate to the ocean after a little more than one year, and live there until they are mature. At that point they return again to freshwater to reproduce (spawn) and die. Fishing quotas are set to allow enough coho to return and spawn to maintain the coho population. (See chapter 2 for a description of the OPI's abundance prediction methodology.)

The OPI is developed every year by the Oregon Department of Fish and Wildlife (ODFW) and is submitted to the council in time to set the annual quotas. In setting the coho quotas for the OPI area, the council considers various sources of information, including the OPI and other statistical information supplied by ODFW, the Washington Department of Fisheries, and the California Department of Fish and Game (for 1983); statements from fishermen, fishermen's associations, and other interested parties; and analytical studies from technical groups within the council. Armed with information from sources such as

these, the council allocates the total allowable coho harvest between the commercial and recreational fishermen.[1]

In 1981, when the first coho quotas were implemented, the council adopted an allocation formula for commercial and recreational fishermen that was based on each group's historical harvest level. Under this method of allocation, the commercial fishermen have received a much larger portion of the total coho harvest in the OPI area. For example, in 1982 the total preseason fishing quotas for commercial and recreational fishermen in the OPI area were 577,000 and 214,000 coho, respectively. However, in the 1983 salmon plan, the council adopted a "sliding scale" to determine the allocation for commercial and recreational fishermen. Under this system the percentage of the harvest allocated to each group will change each year according to the number of coho available for harvest. For example, the recreational fishermen's percentage of the harvest would increase in years of decreased coho abundance. This would allow the recreational fishermen the maximum number of fishing days while ensuring that commercial fishermen get a higher percentage of the catch when coho are more abundant.

After the commercial and recreational coho quotas are determined, the council sets the fishing seasons in each of the subareas of the OPI area. The council then incorporates the quotas and season dates into the annual plan, which is reviewed and approved by the Secretary of Commerce, acting through NMFS, to ensure that the plan is in keeping with the provisions of the Fishery Conservation and Management Act, as amended. NMFS implements the plan after it is approved. The States adopt the same regulations within State waters.

The 1982 salmon season raised concern over the OPI's accuracy

In 1982 many fishermen maintained that the OPI had not yielded an accurate prediction of the size of the adult coho stock, citing large concentrations of coho in Oregon's coastal waters as evidence of the OPI's inaccuracy. If coho population predictions--and the fishing quotas based on these predictions --are unnecessarily low, fishermen lose potential income. Thus,

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[1]In the fishery between Cape Falcon, Oregon, and the U.S./ Canada border, ocean fishery regulations must also ensure that sufficient coho return to Washington to allow treaty Indians to receive their legally mandated share of the salmon harvest. See GAO report entitled "The Pacific Fishery Management Council's Role in Salmon Fisheries" (CED-79-4, 11/09/78) for a discussion of litigation involving the treaty Indians' share of the salmon harvest.

the doubts about the OPI's accuracy that arose during the 1982 season caused considerable concern among the fishermen.

The credibility of the OPI was further damaged during Oregon's 1982 salmon season by disputes between Federal and State fishery managers. According to the salmon management plan, Oregon and NMFS were supposed to act together in closing the coho fishing seasons in predetermined sections of State and Federal waters when the quotas were reached. However, acting on fishermen's reports of greater-than-expected coho abundance, the State on two occasions increased the recreational quotas and extended the seasons within its area of jurisdiction (within three miles of the coast). These adjustments occured on July 20 and 23.

On July 30, NMFS filed emergency regulations which would have temporarily closed the entire salmon fishery in Federal waters in the OPI area in order to compensate for the coho taken during Oregon's extended fishing seasons. However, according to a NOAA Deputy General Counsel, the NOAA Administrator had decided earlier not to close the season. Due to a misunderstanding between the NOAA Deputy General Counsel and the NOAA Administrator, this decision was not communicated to NMFS. As a result, NMFS mistakenly filed the closure regulations. When the mistake was discovered, NMFS attempted to withdraw the regulations before the 3 p.m. deadline for their publication. Unfortunately, Federal Register officials withdrew the wrong set of regulations and published the closure regulations. However, NMFS never implemented the closure, and the fishing seasons in Federal waters were allowed to continue as originally planned.

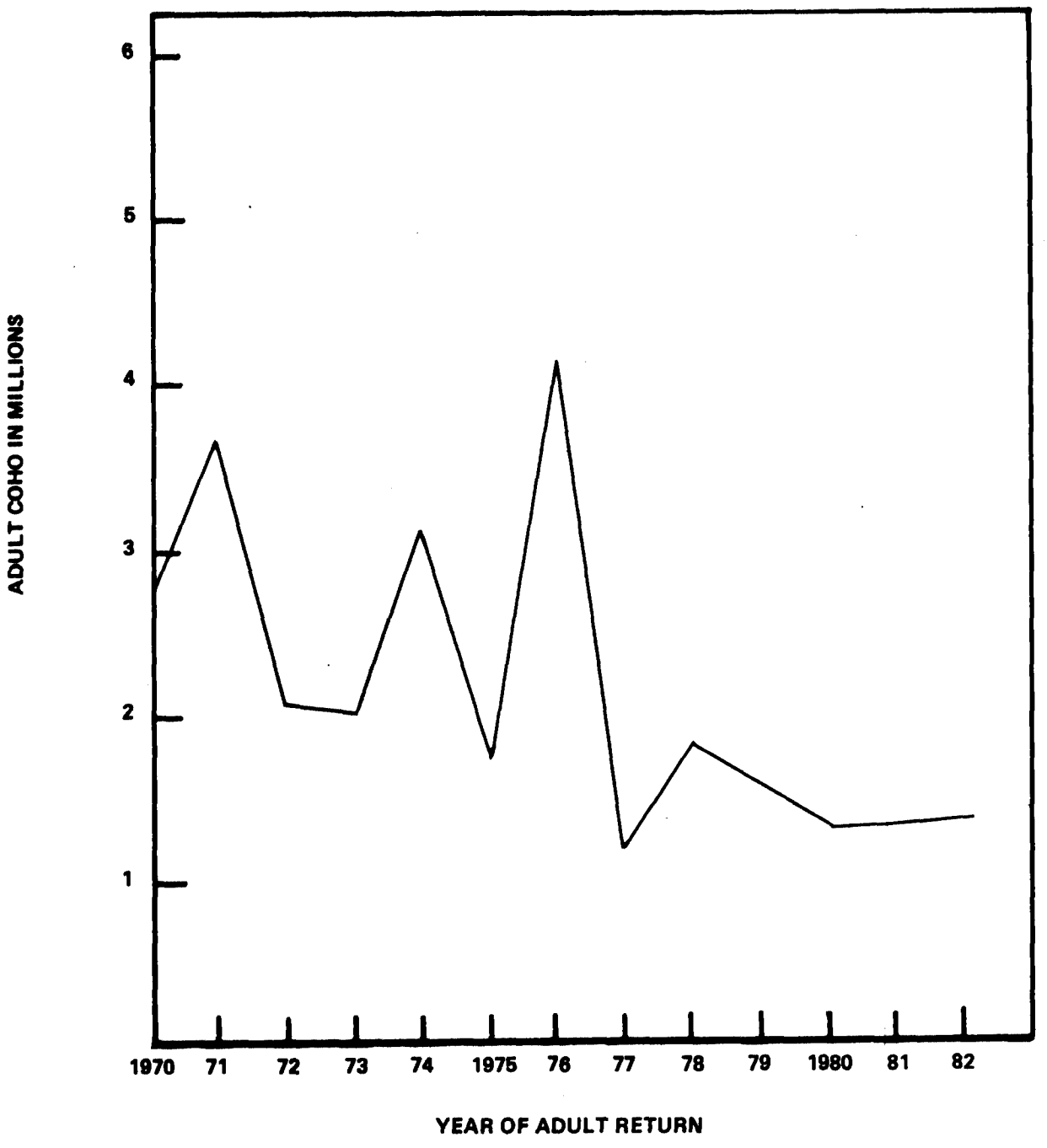
Although the 1982 ocean commercial and recreational coho quotas in the OPI area were 577,000 and 214,000 coho respectively, actual harvest figures were 689,100 and 268,300. According to the council, the commercial quotas were exceeded in large part because the intensive short-duration fishing seasons made it difficult to maintain up-to-date counts of the number of coho harvested. The recreational quotas were exceeded largely because of Oregon's decision to extend its fishing seasons beyond the original quotas.

THE PROBLEMS OF A WEAKENING COHO FISHERY CANNOT BE EASILY SOLVED

Although much of the controversy surrounding the 1982 salmon season was focused on the OPI, the fishery's problems run deeper. The number of adult coho in the OPI area has remained low for 6 consecutive years, after plummeting in 1977 to its lowest level in 15 years. (See fig. 2.) According to the council and ODFW, the fishing capacity of domestic fishermen now far exceeds the number of fish available. This imbalance has created the need for fishing quotas and other means of limiting the number of coho caught. For example, Washington, Oregon, and California have limited the number of commercial salmon

FIGURE 2

COHO ABUNDANCE IN THE OPI AREA
SINCE 1970



DATA SOURCE: OREGON DEPARTMENT OF FISH AND WILDLIFE

fishermen who can enter the fleet by issuing licenses only to previous participants or to replacements for those leaving the fisheries. Government and private fishery biologists told us that these and other means of limiting the coho harvest are essential if the size of the coho stock is to increase significantly. Unless the size of the coho stock increases, even a perfectly accurate OPI will not solve the fishery's problems.

Several factors have contributed to the coho population's decline

According to Federal and State fishery managers, the decline in coho abundance has been caused by a combination of several factors. Over time, human activities such as dam- and roadbuilding, gravel and water removal, logging, and pollution have reduced the coho's freshwater spawning (egg laying) and rearing habitat. Environmental changes such as floods and droughts also may have affected the amount of freshwater salmon habitat available. The coho's ocean environment is subject to fluctuation as well. According to ODFW fishery biologists, changing ocean conditions may be the most important factor in the coho's recent decline. In particular, reduced upwelling levels during the late 1970s may have helped to hold down the coho population's size. Upwelling is the upward flow of the nutrients usually found in deep water. In rising to the surface, the nutrient-rich water increases the ocean's ability to support large numbers of coho. However, the precise relationship between upwelling and coho population swings has not been determined.

Another possible factor in the decline of the coho population is increased fishing capacity. As coho abundance increased in the 1960s and early 1970s, more fishermen were attracted to the fishery. Advances in fishing equipment and techniques made the fishermen more efficient and increased pressure on the coho stock. As harvest rates increased, the number of coho returning to spawn in their natural habitat decreased, thereby reducing the size of future coho runs.

Many other factors have been cited as contributing to the decline of the coho population. Some biologists suggest the possibility that disease has affected the stock. Possible physical weaknesses of the young coho released from hatcheries have also been described as a problem. Finally, some biologists maintain that the capacity of the ocean to support coho was reached in the mid-1970s and that the following decline in population was part of a natural adjustment to a limited habitat.

Low quotas are set to protect wild coho

The council gives special attention to protecting the wild coho stock when setting quotas. Wild coho are fish which are naturally spawned and reared. According to Federal and State

fishery biologists, wild coho are hardier and better adapted to the natural environment than coho spawned and reared in hatcheries. However, since young wild coho face numerous predators and do not have a controlled habitat and an assured source of food, they have less chance of surviving their first year than hatchery coho. Because of the lower early survival rates for wild coho, quotas and harvest rates set to protect the wild stock are lower than they would need to be to protect the hatchery coho population.

Some fishermen have protested that setting quotas to protect wild stock is unnecessary, since it is uncertain whether "untainted" wild stock still exist. However, Federal and State fishery managers maintain that a significant wild stock exists and must be protected.

Federal agencies fund programs to protect and increase the salmon stock

The Federal Government, in conjunction with the States, has tried to increase the size of the salmon stock and reduce the pressure on the fishery by funding activities such as the salmon hatchery program and the salmon-vessel buyback program. The hatcheries, which are funded by the Departments of Commerce and the Interior as well as the States, were designed in large part to help mitigate the effects of dam construction on the Columbia River. The salmon-vessel buyback program, which is funded by the Department of Commerce and the States, was initiated in response to the 1974 Federal court decision that allocated Northwest treaty Indians a 50-percent share of the salmon that would normally reach certain off-reservation Indian fishing areas.[2] This program's goal was to reduce pressure on the salmon stock by encouraging non-Indian fishermen to sell their boats, gear, and licenses to the Federal Government.

The Reagan administration sought eventual elimination of Federal support for the hatchery program and the salmon-vessel buyback program in its 1984 budget proposal. Federal funding for hatcheries would have been reduced from $10.5 million to $3.5 million in 1984, while the $2.5 million salmon-vessel buyback program would have been terminated after 1983. However, on March 7, 1983, the House Merchant Marine and Fisheries Committee voted to maintain full funding for both.

The coho's decline has affected many sectors of the coastal economy

The decline of the coho population and the resulting limited fishing quotas have had widespread effects. Commercial

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[2] United States v. Washington, 384 F. Supp. 312 (W.D. Wash. 1974).

fishermen have noted that low quotas not only reduce their income, but also encourage them to fish in hazardous weather to ensure that they catch as many fish as possible before the quota is met and the season closes. Recreational fishermen and charterboat operators have stated that short seasons or seasons of uncertain length discourage customers and make long-range planning difficult.

Other sectors of the coastal economy, including marine suppliers, hotel operators, and restaurateurs, depend heavily on both the commercial and recreational fisheries and have been severely affected by the recession in the fishing industry. For example, a motel owner in the coastal town of Astoria, Oregon, told us that closure of the August 1982 recreational salmon season resulted in a 34-percent drop in his August income as compared to his average August gross of the last 14 years. Other merchants from Oregon's coastal towns cited similar losses resulting from the short salmon seasons.

OBJECTIVES, SCOPE, AND METHODOLOGY

As requested by Congressman AuCoin and Chairman Smith, we reviewed the current method of establishing fishing quotas for coho in the OPI area. The objectives of our review were to

--determine whether the OPI is a valid basis for fishery management decisions and

--identify possible improvements in the method used to set quotas.

Our review was performed in accordance with generally accepted Government audit standards. Most of the fieldwork on this assignment was performed between September 5, 1982, and April 29, 1983, in Portland, Oregon; Seattle, Washington; Washington, D.C.; and several coastal cities in Oregon. During our review we considered our previous reports on fishery management issues. (See app. II for a list of pertinent GAO reports.) The data on fishing quotas and harvest levels used in this report is the latest available.

We identified the most common criticisms of the OPI in several ways. We began by holding public meetings at three cities on the Oregon coast: Astoria, Newport, and Coos Bay. These meetings were widely publicized and attracted fishermen, State and local Government representatives, and coastal residents whose livelihoods were affected by problems in the fishing industry. We invited attendees to participate through oral statements, informal remarks, or the submission of written statements. The meetings provided an open forum for discussing problems with the OPI, suggestions for improving it, and related issues.

After holding the open meetings, we interviewed Federal and State fishery managers, representatives of trade and industry groups, and individual fishermen. This approach allowed for more indepth discussions with the involved groups and individuals and enabled us to ensure that we had heard all sides of the issues. To enhance our understanding of the problems involved in managing the salmon fishery, we attended meetings of the council, ODFW, and an ad hoc interstate coordinating committee comprised of representatives from Oregon and Washington fishery management agencies.

After identifying criticisms and potential problems of the OPI, we used a variety of approaches to evaluate the OPI's statistical and biological soundness and to determine whether improvements were needed. First, we reviewed past salmon management plans, salmon prediction figures, and Government and private evaluative studies to assess the historical accuracy of the OPI and to determine the principal factors affecting this accuracy. Through onsite visits in Oregon and Washington we evaluated the methods used to collect data on salmon abundance. We also analyzed the soundness of the statistical model that is used to predict the size of the adult coho population for the coming year.

To help resolve the technical questions concerning the OPI's statistical and biological soundness, we contracted for assistance from individuals and organizations with expertise in the appropriate disciplines. A variety of statistical and biological issues affecting Oregon's coho fishery were analyzed by Dr. Saul B. Saila, Dr. Douglas Chapman, and Battelle-Pacific Northwest Laboratory. Dr. Lee Anderson and Kramer, Chin & Mayo, Inc., analyzed specific fishery management issues from an economic perspective. Finally, a technical comparison of the methods of predicting salmon abundance in Alaska, Oregon, and Washington was provided by Dr. Stephen Mathews. (See app. I for a description of the consultants' titles and professional affiliations.)

CHAPTER 2

THE OPI IS A VALID BASIS FOR FISHERY MANAGEMENT DECISIONS

During the 1982 fishing season, fishermen and residents of coastal communities raised questions about the OPI's biological soundness and its accuracy for setting coho salmon quotas and seasons. Our analysis of the OPI shows that it is a biologically sound concept which has proven to be an accurate basis for setting quotas and seasons. Independent consultants' studies have supported this analysis. However, we have identified several factors that limit the accuracy of the OPI's abundance predictions and measurements. These limitations and our recommended improvements are discussed in chapter 3.

WHAT IS THE OPI?

The OPI is a fishery management tool which ODFW developed in the late 1960s. Originally developed as an indicator of the annual abundance of coho, ODFW used it to predict the size of the Columbia River run. This was important in managing the Columbia River commercial fishery. Over time, ODFW refined the OPI to predict and measure the annual abundance of adult coho south of Leadbetter Point, Washington, and off the coasts of Oregon and California (see fig. 1). Since 1979 the council and ODFW have used the OPI to set quotas and seasons in the OPI area.

The OPI abundance predictor

The OPI consists of two parts. The first part is the abundance predictor, which the council and ODFW use to forecast the number of OPI area adult coho for the next season. The predictor is based on the coho's life cycle, which is normally 3 years from egg to returning adult. However, a considerable number of male coho salmon mature early. These fish, known as jack salmon, return as 2-year-olds to spawn. Jacks are distinguished from the 3-year-old adults because they are smaller (usually less than 21 inches long).

ODFW biologists believe the number of returning jacks counted at selected counting stations in Washington, Oregon, and California has a measurable relationship to the number of coho that will return the next year as adults. Their assumption is that the 2-year-old jacks and the 3-year-old adults, being born in the same year, have been exposed to the same fresh water and ocean conditions up to the time the jacks return to fresh water. Therefore, the adult coho will return the following year in the same proportion as the jacks. Although several other factors are involved, in simple terms, ODFW and the council use this ratio of jacks to adults as a basis to predict the next season's coho population. For example, in 1981, the ratio of jacks to adults was almost 1:23; that is, each returning jack represented about 23 adults that would be potentially available

to ocean fisheries in 1982. Some of these adults would be caught during the fishing season while others would return to spawn.

Once ODFW biologists determine the predicted number of adult coho available in the OPI area (the OPI estimate), they must make another computation to include private hatchery fish.[1] The biologists add their estimate of the number of private hatchery coho which will be caught in the OPI area to the OPI estimate. This revised prediction then becomes the basis for deciding how many coho can be harvested without depleting the stock.

The OPI abundance measurement

The second part of the OPI, the abundance measurement, is an accounting of the season's harvest and escapement of adult coho. This measurement is the sum of (1) ocean recreational and commercial catches in the OPI area; (2) hatchery returns to the Columbia River below Bonneville Dam; (3) Bonneville Dam and Willamette Falls counts; (4) returns to Oregon coastal hatcheries and Ten Mile Lakes,[2] including estimated returns from off-station releases;[3] and (5) the Columbia River in-river commercial catch.

According to ODFW, the abundance measurement represents about 90 percent of the actual adult coho population. The remaining 10 percent is largely wild coho returning to coastal streams.

THE OPI IS BIOLOGICALLY SOUND

Our analysis of consultants' reports and information from scientists contacted during our review indicates that the OPI is a biologically sound concept. For example, one consultant, Dr. Stephen Mathews, compared the OPI with prediction methods used for 10 other major west coast salmon stocks and concluded that "The OPI predictor is probably the simplest and most biologically sound predictor of any salmon stock."

Coho abundance is relatively easy to predict for two principal reasons. First, a large majority of OPI area coho

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[1]Private hatchery coho produce few jacks, so their abundance cannot be estimated by the method described above. The method of estimating private hatchery coho is discussed in chapter 3.

[2]For 1983, counts at Ten Mile Lakes were discontinued and counts from two California hatcheries and two Oregon dams were added to the abundance measurements.

[3]Off-station releases are hatchery-raised smolts that are transported to other locations for release.

are produced in hatcheries. This helps fishery managers estimate the coho population because the number of coho returning to hatcheries can be recorded more easily than the number of wild coho returning to coastal streams. Second, the relationship between the numbers of OPI area adults and jacks is generally consistent from year to year. This is true in large part because a relatively insignificant number of adult coho die during their last year in the ocean. As a result, the number of jacks usually maintains a predictable ratio to the number of adults that return one year later.

Dr. Douglas Chapman, another consultant, concurred that it is biologically sound to use jack counts to predict coho population levels: "It is biologically reasonable that the large runs should have large early returns of precocious males, i.e., jacks; conversely for small runs." According to Dr. Chapman, the OPI is also cost-effective:

> "The method based on the jack index used by ODFW has the advantage that jack counts can be obtained in most instances with adult counts at little or no additional cost. It therefore represents a minimal cost prediction procedure."

In a report prepared for the Port of Ilwaco, Washington, Natural Resources Consultants stated that

> "We have encountered no scientist concerned with salmon management who does not consider the OPI predictor to be the best available empirical method of estimating the stock of coho in the area from Leadbetter Point south five to six months in advance. [Natural Resources Consultants] concurs in that view."[4]

Judging from the analysis performed by biologists such as these, it can be concluded that the OPI is a biologically sound management tool. If this is so, then predictions made by using the OPI concept of jack salmon counts as a predictor should be reasonably accurate. In the next section we look at the historical record of the OPI abundance predictor as compared to other Northwest salmon prediction methods.

THE OPI HAS BEEN AN ACCURATE PREDICTOR

As a predictor of salmon abundance, the OPI has compiled a better record than other salmon predictors we evaluated during this study. Dr. Mathews, who analyzed and evaluated 11 salmon forecasting methods, including the OPI, observed that "We are quite sure that there are no other salmon runs in the Pacific Northwest with as accurate a history of prediction as OPI coho." This observation was echoed by other fishery biologists.

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[4]"Management and Regulation of the Coastal Fishery for Salmon in 1982 and 1983," Natural Resources Consultants, 1983.

The relative error

Dr. Mathews evaluated the accuracy of the 11 forecasting methods by computing their relative errors and comparing them to one another. The relative error is a concept used by scientists to measure the accuracy of predictions. It is computed by subtracting the abundance prediction from the abundance measurement and dividing the difference by the abundance measurement. For example, in 1982, the predicted abundance was 1,090,800 and the observed abundance was 1,411,800--a difference of 321,000. Thus, the relative error is 22.74 percent (321,000 divided by 1,411,800).

Dr. Mathews found the average relative error for the OPI predictor was lower, and hence better, than the average relative error for any of the other 10 predictors. Table 1 compares the average relative errors for the 4-year period 1979-82 for the 11 Northwest salmon predictors studied by Dr. Mathews. During this period the OPI's average relative error, which includes the prediction error for private hatchery contribution, was 16.67 percent. The largest relative error for the period, 22.74 percent, occurred in 1982. Only two of the predictors have average relative error rates closely approaching the error rate of the OPI: the predictors for Puget Sound coho and Puget Sound chum salmon.

Table 1

Average and Range of Relative Prediction Error
For a Number of Northwest Salmon Stocks
For 1979-82

Area and species	Average relative error (percent)	Range of relative error (percent) Range	Difference
OPI coho	16.67	(-22.74 to -7.36)	= 15.38
Puget Sound coho	18.17	(-32.96 to +5.25)	= 38.21
Puget Sound chum	20.95	(-37.53 to +13.76)	= 51.29
Puget Sound chinook	23.04	(-24.90 to +27.07)	= 51.97
Southeastern Alaska pinks	26.11	(-39.23 to +28.94)	= 68.17
Kodiak pinks	28.73	(-53.03 to +33.97)	= 87.00
Bristol Bay sockeye	33.61	(-43.06 to +55.93)	= 98.99
Prince William Sound chum	34.71	(-59.22 to +68.19)	= 127.41
Prince William Sound pinks	42.97	(-64.51 to +8.93)	= 73.44
Cook Inlet pinks	54.63	(-57.23 to +97.74)	= 154.97
Nushagak pinks (note a)	147.93	(-76.81 to +217.24)	= 294.05

a/Computed only for years 1976, 1978, 1980, and 1982 because these salmon return only in even-numbered years.

Source: Dr. Stephen Mathews and GAO.

The range of relative error

Table 1 shows another factor that illustrates the forecasting capabilities of the various salmon predictors--the range of relative error. The range is determined by computing the difference between the greatest relative errors in overprediction and underprediction.

In our opinion, determining the range of relative error is at least as important as calculating the average relative error, because opposite-but-equal errors can offset each other when they are averaged together. For instance, if the relative error of prediction for one year were (+) 50 percent and for another year (-) 50 percent, the average relative error would be zero, and the predictor would appear to be perfect. However, in the example cited, the range of error in fact would be 100 percent. Therefore, considering the range of error in conjunction with the average error discloses the magnitude of error that averaging may hide.

It seems logical that a predictor with a relatively small range of fluctuation over time will be a more dependable management tool that can be more easily adjusted than one with a widely ranging error rate. For example, the Puget Sound coho predictor underestimated the run by (-) 32.96 percent in 1979 and overestimated the run by (+) 5.25 percent in 1982, a range of 38.21 percent. Similarly, the range of error for Puget Sound chum is 51.29 percent. The OPI abundance predictor, on the other hand, has underestimated the abundance each of the 4 years--from (-) 7.36 percent in 1981 to (-) 22.74 percent in 1982. Thus, the range of relative error over the 4 years was only 15.38 percent.

A bias may exist in the OPI predictor, as it has consistently underpredicted coho abundance. ODFW biologists have tried to adjust the OPI to avoid this underprediction, but they acknowledge that their predictions tend to be conservative, partly because of the information needs discussed in chapter 3 and partly because they are concerned about the danger overprediction would pose to depressed stocks. However, even with this tendency toward underprediction, the range of fluctuation for the OPI is less than the range for the Puget Sound coho predictor or, for that matter, any of the other nine forecasting tools (see table 1). The combination of the OPI's relatively small error rate and range of error shows that the OPI is a more dependable management tool than the other predictors considered in this study.

CONCLUSIONS

Much of the criticism leveled at the OPI during the 1982 fishing season questioned its biological soundness and its accuracy as a fishery management tool. We determined that these criticisms were largely unfounded. Our analysis, which several independent fishery management experts have supported, has shown the OPI to be biologically sound and a relatively accurate basis for setting coho fishing quotas and seasons. Comparison between the OPI and other methods of measuring and predicting salmon abundance shows the OPI to have a better accuracy record than any other management tool used in Northwest salmon fisheries.

Although we believe the OPI is the best salmon fishery management tool available, it is not perfect. In Chapter 3 we identify some factors which limit the OPI's usefulness and recommend changes that should further improve its accuracy and increase its credibility as a basis for setting coho quotas and seasons.

CHAPTER 3

THE OPI CAN BE IMPROVED

Although the OPI provides a valid basis for fishery management decisions, it can be improved. The council and ODFW need more complete and accurate information on the source and distribution of coho within the OPI area. (See fig. 1.) This information would contribute to a more accurate OPI and more effective management of the coho fishery. Other possibilities for improving the OPI's accuracy are also available. However, our consultants and ODFW fishery biologists cautioned that the potential benefits from these additional improvements could be small.

MORE INFORMATION ON THE SOURCE AND DISTRIBUTION OF OPI AREA COHO IS NEEDED

The council and ODFW lack sufficient information on where and in what numbers the different coho stocks are present in the OPI area. Specifically, fishery managers need additional information on the numbers and locations of

--coho which migrate to the OPI area from the north,

--coho from private hatcheries in Oregon,

--coho from public hatcheries on the Columbia River, and

--wild coho from Oregon's coastal streams.

This information would help fishery managers to more accurately estimate coho abundance and set seasons and quotas to allow a maximum harvest of the more abundant hatchery stocks while at the same time protecting the less abundant wild stocks. Council and ODFW officials estimated that the annual cost of gathering this information for Oregon would be roughly $200,000. ODFW officials stated that the benefits from obtaining the information would be well worth the cost. The information could be gathered by expanding ODFW's data collection efforts. Because neighboring States--particularly Washington--contribute coho to the OPI area, any increase in ODFW's data collection efforts will require additional coordination with the fishery agencies of those States.

More data is needed on coho entering the OPI from the north

In recent years, increasing numbers of coho have been entering the OPI area from Washington sources outside the OPI area. This has, of course, increased the number of coho available for harvest by OPI area fishermen. However, because these fish originate in rivers, streams, and hatcheries which do

not feed directly into the OPI area, the increase in their numbers is not accounted for in the OPI abundance predictions. This has contributed to the consistent underprediction of OPI area coho abundance mentioned in chapter 2. Data on the number of coho which enter the OPI area from Washington is needed to further improve OPI abundance estimates.

A major source of coho entering the OPI from the north is Washington's Willapa Bay hatchery system. According to Washington Department of Fisheries biologists, the hatcheries in the Willapa Bay system have released over 2 million coho annually for the last five years. A large portion of these coho migrate south into the OPI area. However, Washington and Oregon fishery biologists have little information on the numbers of these southern-migrating coho. As a result, Willapa Bay coho are not included in OPI abundance predictions.

Dr. Stephen Mathews noted that the number of coho entering the OPI area from the north is probably increasing and that the "building influx of coho from the north" is a major reason for the OPI's record of low abundance predictions. An ODFW fishery biologist concurred with Dr. Mathews' analysis and added that Washington's short 1982 ocean coho season probably compounded the problem of low abundance predictions by allowing an unusually large number of northern coho to migrate to the OPI area. The biologist said that because the influx of northern coho was not included in OPI abundance predictions, the error in the OPI's 1982 prediction was greater than usual.

According to Dr. Mathews, information on coho entering the OPI area from the north could be developed through expanding existing fish tagging programs. However, council and State officials noted that this step had not been taken because of a lack of the necessary staff and equipment.

Data is needed on private hatchery coho

Private hatchery releases have increased dramatically, from less than 1 percent of the total coho released in the OPI area in 1974 to 42 percent in 1982. However, because private hatcheries use different rearing practices than public hatcheries, private hatchery coho produce few jacks. Because jack counts are the major factor used in predicting coho abundance, ODFW biologists cannot predict private hatchery abundance with the same degree of accuracy as they predict public hatchery abundance.

To account for private hatchery coho, ODFW biologists estimate the private hatchery coho's probable contribution to the ocean catch and add this estimate to the OPI abundance prediction. However, Dr. Douglas Chapman cautioned that the estimates contain a high potential for error. For example, in 1982, ODFW overestimated the private hatchery contribution to the total ocean harvest by 58 percent. ODFW predicted a contribution of 193,300 coho, while the actual number was only 122,100. Consequently, the additional 71,200 coho that was harvested came

from public hatchery or wild stocks. An ODFW fishery biologist told us that because public hatchery, private hatchery, and wild stocks occupy the same general area of the ocean, a portion of the over-harvest was probably taken from the depressed wild stocks. The biologist said this was evidenced by the low return of wild stocks to their spawning areas in 1982.

To better manage the harvest of private hatchery stocks, the council and ODFW need more information on where and in what numbers these stocks are present in the OPI area. This information would help the council and ODFW set seasons so that the more abundant hatchery stocks could be targeted for maximum harvest. ODFW officials said that information on the size and location of private hatchery stocks could be gathered through additional fish tagging or scale analysis.

More data is needed on the distribution of public hatchery coho

Most of the coho caught in the OPI area come from public hatcheries on the Columbia River. Because these hatchery stocks are reared in a protected environment and wild stocks are not, hatchery stocks need fewer returning spawners to perpetuate their population. As a result, a higher percentage of hatchery coho can be harvested without the risk of depleting the stock to dangerously low levels. In recognition of this, the council and ODFW have adopted a management objective of setting fishing seasons and quotas to allow for a maximum harvest of public hatchery coho while protecting wild stocks. However, information on the number and distribution of public hatchery coho is essential to achieve this objective.

Although fishery managers have accurate estimates of the size of the OPI area public hatchery coho population, they lack adequate data on where hatchery coho are concentrated in the ocean. Because council and ODFW fishery managers do not have adequate data on the distribution of public hatchery coho, they are unable to accurately target the fishery on these abundant stocks. While seasons associated with coho quotas are designed to allow maximum harvest of hatchery coho, fishermen may actually be harvesting less plentiful stocks. For example, in 1982 coho returned to Columbia River hatcheries in surplus numbers while depressed wild coho stocks were overfished. According to council and ODFW fishery managers, more tagging and scale analysis is needed to better identify the location of public hatchery stocks so fishermen can concerntrate on harvesting them.

More accurate estimates of wild stocks are needed

A management objective adoped by the Council and ODFW calls for the protection and rebuilding of depressed wild coho stocks. To achieve this goal, the council and ODFW need precise

information on both the size the location of the wild coho population in the ocean. Little reliable information is available on these subjects. Without this information, the council and ODFW cannot reliably set seasons and quotas to protect and rebuild the wild stocks.

According to ODFW fishery biologists, wild coho should be preserved because they are genetically hardier than coho spawned and reared in hatcheries. Through the process of natural selection, wild stocks have become better adapted for survival, growth, and reproduction than hatchery stocks. Because wild stocks are hardier, they are used to start new hatchery stocks and replenish depressed wild stocks. Although stocks of wild coho are essential to the OPI area fishery, ODFW officials estimate that wild stock escapement goals are not being met and stocks are at or near record low levels. A 1982 ODFW report stated that

> "The escapement of coho salmon was extremely poor in 1981 despite severe restrictions imposed on ocean troll and sport fisheries * * *. The escapement indices equaled the record low indices established in 1977-78 and continued the downward trend in the spawning stocks evident in the 1970s."

This trend continued into 1982 when coastal wild stock escapement was estimated to be 137,500--34,500 below the council's preseason goal of 172,000.

Although ODFW provides the council with some estimates of the size of the wild coho population, these estimates are unreliable. Battelle-Pacific Northwest Laboratories and Dr. Douglas Chapman found a high probability for error in ODFW's procedures for estimating the number of wild coho that return to spawn each year. Battelle stated that "In the present situation, it appears that the number of spawners is estimated with unknown and probably large error." Dr. Chapman confirmed Battelle's conclusion and added that the estimates ODFW uses to expand its sample to an estimate of the total population of wild coho contain high potential for error.

ODFW's estimates of wild spawners are based on counts from selected coastal streams and are expressed as a "standard spawning index." From 1975 through 1980, the index was based on a sample of only 14.8 miles, or less than 1 percent of the estimated 4,764 miles of spawning habitat in Oregon's coastal watersheds. ODFW reports that its attempts to expand the index to 52.7 miles in 1981 were curtailed by bad weather and had only limited success in improving the accuracy of wild stock estimates.

ODFW does not include wild stock estimates in OPI abundance calculations because they recognize the high potential for error in the estimates. Consequently, any change in the abundance of wild stocks introduces error into the OPI's abundance predictions and measurements. Without some improvements in wild stock

estimates, we doubt the council and ODFW can adequately protect or restore the stocks as planned. More accurate wild stock estimates would also contribute to more accurate OPI abundance predictions and measurements.

In addition to gathering accurate information on wild stock abundance, fishery managers also need to know the distribution of these stocks in the OPI area. Data on where and in what numbers wild stocks are concentrated will allow fishery managers to direct fishing effort away from these depressed stocks. Because the council and ODFW currently lack such data, the depressed wild stocks are subject to the same intensity of fishing effort as the more abundant hatchery coho. However, as discussed previously, wild stocks cannot support the same level of harvest as hatchery stocks. As a result, wild stocks are being overfished.

Council and ODFW fishery managers told us that more tagging and scale analysis could provide the needed data. However, current data collection efforts have not been increased due to staff and equipment limitations.

ADDITIONAL OPPORTUNITIES FOR INCREASING THE OPI's ACCURACY

In addition to obtaining more data on the source and distribution of coho in the OPI area, ODFW has other opportunities for increasing the OPI's accuracy. However, the consultants and certain agency officials said that, because of the OPI's current level of accuracy, the benefits from these additional improvements could be small. The areas where these improvements could be made are discussed below.

--Estimates of returns from public hatchery coho released off-station (away from the hatchery) are questionable. These estimates are based on the assumption that the survival rate for off-station releases is the same as for coho released directly from hatcheries. Dr. Chapman and ODFW biologists question the validity of this assumption. According to ODFW biologists, the survival rate for off-station releases is probably lower because they are trucked to their release sites and released in unfamilar waters. Consequently, the OPI could contain inflated off-station return estimates.

--Estimates of the recreational catch in the Columbia River and its tributaries are incomplete. ODFW and Washington Department of Fisheries biologists told us that a significant number of coho are taken from these locations by recreational fishermen each year. However, neither ODFW nor the Washington Department of Fisheries has a sampling program to help develop more accurate estimates of the recreational in-river catch.

--A change in the type of coho stocks being released by southern Washington State hatcheries which feed into

the OPI area has reduced the accuracy of OPI abundance predictions. Of the two major coho stock types used in OPI area hatcheries, the Cowlitz and the Toutle, Cowlitz stocks produce a higher percentage of jacks and migrate in a more northerly direction off the Washington coast. To benefit the Washington fishery, the Washington Department of Fisheries has increased production of Cowlitz stocks in recent years. However, the OPI is not adjusted to reflect the effects of the additional Cowlitz stocks on jack counts. Consequently, coho abundance could be overpredicted.

--OPI data is less precise than abundance predictions indicate. ODFW currently expresses abundance predictions as specific figures. However, Dr. Lee Anderson and Dr. Saul Saila cautioned that the data and calculations used to predict abundance should be expressed as a range of predicted abundance rather than a specific figure. Expressing the OPI prediction as a range of abundance would give a more accurate impression of the OPI's level of precision and allow fishery managers more flexibility in setting quotas and seasons.

Although certain improvements can be made in each of these areas, further analysis and study would be needed by ODFW and the council to determine whether the potential benefits from these additional improvements would warrant the expenditures necessary to implement them. However, based on our consultants' analysis and our own evaluation, we believe that greater benefits could be derived from gathering more source and distribution data as discussed in the previous section.

CONCLUSIONS

Although the OPI has proven to be a valid basis for fishery management decisions, several factors outside of the OPI's predictive capability affect the coho fishery. As discussed in chapter 1, the problems of a weakening coho fishery cannot be solved by better abundance predictions and measurements alone. However, more complete and accurate information on the source and distribution of coho throughout the OPI area would be a major step toward improving the management of the coho fishery.

More information is needed on where and in what numbers Washington stocks, private and public hatchery stocks, and wild stocks are present in the OPI area. This information can be gathered through tagging, scale analysis, stream surveys, or other methods of counting and identifying coho. Council and ODFW officials estimate that the annual cost of gathering this information for Oregon would be roughly $200,000. ODFW officials agree that the benefits from obtaining the information would be well worth the cost, but maintain that limited staff and equipment have thus far prevented them from taking the necessary steps. The information could be gathered by expanding ODFW's data collection efforts. Because neighboring States--particularly Washington--contribute coho to the OPI area, any

increase in ODFW's data collection efforts will require additional coordination with the fishery agencies of those States.

RECOMMENDATIONS TO THE SECRETARY OF COMMERCE

To help improve the OPI's accuracy and provide a better basis for fishery management decisions, we recommend that the Secretary of Commerce request the Pacific Fishery Management Council to

--gather additional data on the source and distribution of coho stocks in the OPI area through tagging, scale analysis, or other appropriate methods, and

--obtain more accurate estimates of Oregon coastal wild stock abundance through stream surveys or other counting techniques.

AGENCY COMMENTS AND OUR EVALUATION

The Pacific Fishery Management Council characterized our review as "thorough" and "accurate" and agreed that the OPI provides a valid basis for managing the ocean salmon fisheries. The council also agreed that the OPI's accuracy can be improved and that the data collection activities described in our recommendations would provide "much useful management information" for managers and users of the resource. The only concern the council raised was whether increasing the OPI's accuracy would be worth the cost.

ODFW stated that the results of our report were complete and that our recommendations were valuable, not only for improving the OPI's accuracy, but for developing better harvest strategies as well. ODFW also expressed the hope that our report would be a positive step toward improving fishery managers' credibility with fishermen and coastal fishing communities.

The Department of Commerce agreed with our general conclusion that the OPI is a sound and useful fishery management tool. In addition, the Department agreed that gathering the information cited in our recommendations would permit better utilization of the coho resource by targeting fishing efforts on hatchery stocks while protecting wild stocks. However, the Department questioned whether improving the accuracy of the OPI predictor would be worth the cost.

Our recommendations go beyond improving the overall accuracy of the OPI's predictions. As discussed above, the primary value of our recommendations is that they would enable the council and the States to more effectively manage the coho fishery to achieve maximum harvest of abundant hatchery fish while protecting the less abundant wild stocks. The value of these recommendations is recognized in ODFW's comments on our report. The cost of implementing our recommendations must be weighed in relation to their

value in improving the utilization of the resource, not solely in relation to their value in improving the overall accuracy of the OPI predictor. In recognition of the need for gathering the information described in our recommendations, ODFW has recently requested and received State funds for this purpose.

APPENDIX I

Consultants Contracted by GAO

Dr. Lee G. Anderson, Associate Professor, College of Marine Studies, University of Delaware

Battelle Memorial Institute-Pacific Northwest Laboratories, Richland, Washington

Dr. Douglas G. Chapman, Director; Center for Quantitative Science in Forestry, Fisheries, and Wildlife; University of Washington

Kramer, Chin & Mayo, Inc.; Consulting Engineers, Architects, Applied Scientists; Seattle, Washington

Dr. Stephen B. Mathews, Professor, School of Fisheries, University of Washington

Dr. Saul B. Saila, Professor of Oceanography, Chief Scientist, Division of Marine Resources, University of Rhode Island

GAO STUDIES PERTINENT TO PACIFIC SALMON MANAGMENT ISSUES

"The Pacific Fishery Management Council's Role in Salmon Fisheries" (CED-79-4, 11/09/78)

"Progress and Problems of Fisheries Management Under the Fishery Conservation and Management Act" (CED-79-23, 01/09/79)

"Activities of the Interstate Marine Fisheries Commissions Under the Fishery Conservation and Management Act of 1976" (CED-79-46, 02/26/79)

"The Fishery Conservation and Management Act's Impact on Selected Fisheries" (CED-79-57, 04/03/79)

"Need to Improve Fisheries Management Plan Process" (RCED-83-72, 01/07/83)

APPENDIX III

LES AuCOIN
1ST DISTRICT, OREGON

CONGRESS OF THE UNITED STATES
HOUSE OF REPRESENTATIVES
WASHINGTON, D.C. 20515

July 30, 1982

The Honorable Charles Bowsher
U.S. General Accounting Office
Room 7000
441 G Street NW
Washington, D.C. 20548

Dear Mr. Bowsher:

Since the Magnuson Fishery Conservation and Management Act became law in 1976, fishing has been under the close scrutiny of the federal government. The MFCMA established the Fishery Conservation Zone and set up Fishery Management Councils which have the responsibility of writing a management plan governing the Fishery Conservation Zone.

The goals of a fishery management plan include preventing overfishing and allowing a certain amount of salmon to survive the ocean season. The Councils not only assess the availability of the resource but they also determine the number of fish which can be harvested without depleting the resource. Almost from the beginning, however, there has been raging controversy over the reliability of government estimates which lead to the management of seasons and fish harvests.

This controversy reached new heights in the Pacific Fisheries Management Council area this year when the National Marine Fisheries Service, at the direction of the Secretary of Commerce, announced the closure of all commercial and sports salmon fishing in federal waters and hours later reversed that decision. Such rapid alternations of policy do nothing to enhance the credibility of the management process.

Meanwhile, the economic stakes for both commercial and recreational fishing are enormous. The commercial and sports fishing seasons have been drastically cut-back on a yearly basis. In the last year, a cut of approximately fifty percent occurred, leading more fishermen to give up the only livelihood they know. Their families' futures are being determined by government estimates which may, or may not be accurate. No one knows for sure.

Such economic stakes put a premium on the accuracy of the data base and estimates which management agencies use to govern the fish harvests. It is necessary, therefore, to get to the bottom of the controversy so that Congress can be confident that management of the

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APPENDIX III

Fishery Conservation Zone is scientifically and biologically sound.

In the Pacific Fisheries Management Council region, the component of the management plan which seems to cause the most serious difficulty is the method of determining the quota of fish to be harvested by both commercial and recreational fishermen. The quotas are based on the "Oregon Production Index", an indicator of the number of fish available in the Oregon production area. The quotas have come under great criticism this year for being too low.

There is real doubt among the fishermen as to the accuracy of the OPI. A major factor in the OPI is the rate of fish escapement. Placing the greatest importance on the number of immature fish, as the OPI does, disregards many other important impacts upon fish runs. Fishermen strongly believe that many other variables are involved. They often report actual sightings of fish which are larger than the OPI indicates.

A third factor is that not all of the fish are tagged. A tag indicates where the fish comes from, be it Oregon, Washington or Canada. Fishermen simply do not know whose fish they're catching.

Something needs to be done now to determine if there is a more accurate way of determining the Oregon Production Index and the quotas. Fishermen just can't survive much longer if their seasons will be cut short every year and the fishermen and the management people need to stop arguing with each other and start working together.

There has absolutely been enough controversy questionning the accuracy of the methods used in determining the OPI. It is time for a solution. I am sure that no one would object to a shortened fishing season, if indeed, the resource would be as seriously depleted as the OPI indicates.

Commercial fishermen are rapidly going out of business. Last year, over 8400 fishermen held a commercial license in Oregon. This year, 400 of those gave up.

A charterboat businessman in my district is losing over 45% of his total gross income because of the uncertainty in not knowing exactly how long the season will last. This particular business will probably lose 600 bookings in the month of August alone. Last year, he grossed $65,000 during that month. I'm sure his income won't be as high this year.

Because answers must be found now, we are requesting that the General Accounting Office study the current method of establishing fishing quotas and determine if there are any alternative ways to determine a quota more accurately.

APPENDIX III

A review by an independent agency is needed to assess the entire problem. Fishermen, management people, and policymakers need to rely on an impartial study to make their decisions.

Thank you for your cooperation. I look forward to hearing from you.

With warm regards,

Sincerely,

Les AuCoin

LES AuCOIN
Member of Congress

PACIFIC FISHERY MANAGEMENT COUNCIL

526 S. W. Mill Street
Portland, Oregon 97201
Phone: Commercial (503) 221-6352
FTS 8-423-6352

CHAIRMAN
John R. Donaldson

EXECUTIVE DIRECTOR
Joseph C. Greenley

July 22, 1983

Mr. J. Dexter Peach, Director
U.S. General Accounting Office
NBOC #1 Room 039
11420 Rockville Pike
Rockville, MD 20852

Dear Mr. Peach:

The staff of the Pacific Fishery Management Council has reviewed your draft report entitled "The Oregon Production Index: A Sound Fishery Management Tool That Can Be Improved," and through our letter of July 15, 1983 suggested various technical revisions.

We commend your staff for a thorough and accurate review of this complex management tool. We are pleased that they found it valid for use in managing the ocean salmon fisheries. Further, we agree that it's accuracy can be improved.

A study of salmon migrations into and out of the OPI area would provide much useful management information, and would answer questions on this matter raised by both managers and users of the resource. Our only concern is whether the increase in accuracy in predicting the OPI that might result would, in itself, be worth the cost.

[GAO COMMENT: As discussed in chapter 3, the primary value of our recommendations is that they would enable the council and the States to more effectively manage the coho fishery to achieve maximum harvest of abundant hatchery fish while protecting the less abundant wild stocks. The value of these recommendations is recognized in ODFW's comments on our report. The cost of implementing our recommendations must be weighed in relation to their value in improving the utilization of the resource, not solely in relation to their value in improving the overall accuracy of the OPI predictor. In recognition of the need for the information described in our recommendations, ODFW has recently requested and received State funds for this purpose.]

We appreciate the opportunity to comment on your report.

Sincerely,

for Joseph C. Greenley
Executive Director

wd

APPENDIX V

VICTOR ATIYEH
GOVERNOR

Department of Fish and Wildlife
OFFICE OF THE DIRECTOR
506 S.W. MILL STREET, P.O. BOX 3503, PORTLAND, OREGON 97208

July 22, 1983

Mr. J. Dexter Peach, Director
U.S. General Accounting Office
NBOC #1, Room 039
11420 Rockville Pike
Rockville, MD 20852

Dear Mr. Peach:

The Oregon Department of Fish and Wildlife salmon management staff (and administration) is very pleased with the results of the audit of the Oregon Production Index conducted by staff of the General Accounting Office. Since it was the first such audit conducted involving this agency concerning such a controversial and complex management tool we did not know what to expect. What we discovered during the audit process was the professional picture of the GAO staff exhibited in their contact with the user groups at public meetings held on the Oregon coast and also their involvement with the ODFW staff informally and at public and interagency meetings.

The contents of the report are complete and only slight corrections of a technical nature needed to be addressed. The recommendations to the Secretary of Commerce for improving the OPI's accuracy and usefulness are good ones, not only to improve predictive capabilities, but to develop better harvest strategies.

ODFW staff appreciate the opportunity to comment on the draft report and we hope that this report is a positive step to improve communication and creditability with fishermen and coastal fishing communities.

Sincerely,

John R. Donaldson, PhD
Director

kbw

APPENDIX VI

UNITED STATES DEPARTMENT OF COMMERCE
The Inspector General
Washington, D.C. 20230

July 25, 1983

Mr. J. Dexter Peach
Director, Resources, Community
and Economic Development Division
U. S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Peach:

This is in reply to your letter of June 24, 1983, requesting comments on the draft report entitled "The Oregon Production Index: A Sound Fishery Management Tool That Can Be Improved".

We have reviewed the enclosed comments of the Deputy Administrator, National Oceanic and Atmospheric Administration, and believe they are responsive to the matters discussed in the report.

Sincerely,

Sherman M. Funk
Inspector General

Enclosure

GENERAL COMMENTS

We appreciate the opportunity to review and comment on the draft proposed report on the Oregon Production Index (OPI). My fisheries staff in the Pacific Northwest have reviewed the document and agree with the general conclusion that the OPI is a sound and useful fishery management tool.

We have some reservations, however, about the merits of spending $200,000 to improve the accuracy of the OPI predictor. We do not believe that the slight improvement we could obtain would be worth the money, since other factors involved with management also have great variability. For example, inseason management depends on decisions made with very soft data: As a result, inseason salmon catch data (both recreational and commercial) have questionable reliability but must be used. Further, once we have data and are able to predict reaching a quota event, it takes several days to change a regulation (i.e., to close a given area). We cannot be precise enough to manage for the last fish and we have, on occasion, had over-harvests of over 100,000 fish. It makes no sense to increase the accuracy of a predictor beyond the level of management.

[GAO COMMENT: Our recommendations go beyond improving the overall accuracy of the OPI's predictions. As discussed in Chapter 3, the primary value of our recommendations is that they would enable the council and the States to more effectively manage the coho fishery to achieve maximum harvest of abundant hatchery fish while protecting the less abundant wild stocks. The value of these recommendations is recognized in ODFW's comments on our report and in the Department of Commerce's own comments in the next paragraph. The cost of implementing our recommendations must be weighed in relation to their value in improving the utilization of the resource, not solely in relation to their value in improving the overall accuracy of the OPI predictor. In recognition of the need for the information described in our recommendations, ODFW has recently requested and received State funds for this purpose.]

We agree with the report that additional information on ocean distribution of wild stocks, hatchery fish, and Canadian stocks would permit better utilization of the resource. We may be able to fish selectively on some stocks (hatchery fish) and protect others (wild stocks) and thus increase the numbers of fish harvested.

In the final section Recommendations to the Secretary of Commerce, the Secretary lacks the authority to "direct" the Council to collect additional information. The Magnuson Act gives the Secretary the authority to disapprove all or part of a Council's fishery management plan if the Council fails to use the best available scientific information, but it does not authorize the Secretary to direct the Council to obtain better information than that which is already available. The Secretary, however, may recommend that the Council try to obtain better information and may provide the Councils with funds to undertake such endeavors. Although the Councils are aware of the shortcomings of the data, they are barely able to maintain the current data level with the limited funds available. Additional funds would have to be supplied to collect the stock distribution data needed for better management.

APPENDIX VI

[GAO COMMENT: The word "direct" has been changed to "request." However, our recommendations do not imply that funding for the data collection efforts we describe should be solely--or even primarily--a Federal responsibility. In fact, our conclusions note that much of the needed information could be obtained by expanding ODFW's data collection efforts. As mentioned above, ODFW has recently requested and received State funding for this purpose.]

SPECIFIC COMMENTS AND SUGGESTED CHANGES

[GAO COMMENT: The Department of Commerce supplied minor technical and editorial comments in this section. These comments have been incorporated into the report as appropriate.]

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