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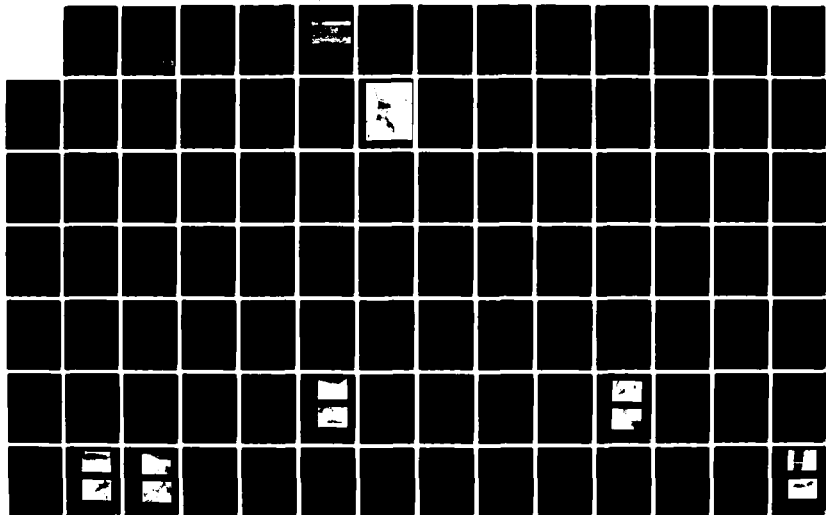
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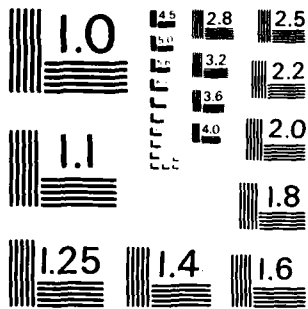
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THE STATUS OF THE ANADROMOUS FISHES OF
THE WHITE-PUYALLUP RIVER SYSTEM

by
Ernest O. Salo
and
Thomas H. Jagielo

Report Submitted to The Seattle District
United States Army Corps of Engineers

September 1983

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Moving cedar bolts down a river in Western Washington,
probably the White

PREFACE

In May of 1983 a draft report on the status of the White River and its anadromous fish resources was circulated among interested parties. Written reviews were received from the Puyallup and Muckleshoot Tribes, the Northwest Salmon and Steelhead Council of Trout Unlimited, and the United States Fish and Wildlife Service. Correspondence from these agencies is included in Appendix V. Oral comments were received from others including Puget Sound Power and Light, Washington Department of Fisheries and The U.S. Department of Agriculture, Forest Service.

Realizing that a report of this nature is never complete, we thank those that responded. Hopefully, this report will be corrected and updated periodically, if not routinely.

Many of the suggestions were incorporated; however, we were unable to comply with all, particularly those calling for ranking of the factors most responsible for the decline of the White River spring chinook. The available data are not sufficient to allow individual ranking and we have not attempted to quantify the impacts--particularly those that occurred concurrently. Effects were additive, cumulative and even synergistic.

The problem of the harvesting of wild stocks in mixed stock fisheries is still unresolved; however rational management concepts have been forthcoming and hopefully they will allow managers to place other perturbations in perspective.

As the stream habitat is a biological continuum of interaction from its estuary to its headwaters, so is the interaction of abuses which threaten to undo it. Only through cooperative efforts by all parties and the spirit

of "Fisheries Conservation through Cooperation" (Tom Cropp, Chairman, White River Cooperative Fisheries Advisory Group) will efforts of restoration of the White River salmon runs be rewarded with visible and sustained success.

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ACKNOWLEDGMENTS

This review of the White River and its fisheries was sponsored by the Seattle District United States Army Corps of Engineers (USACE), which operates Mud Mountain Dam on the White River. We wish to thank Mr. Jack Thompson of the USACE for his support and assistance with administrative details and Mr. Dan Fryberger for his informative tour of Mud Mountain Dam.

Organizations and agencies which contributed records, data and other information include: the United States Army Corps of Engineers, the United States Fish and Wildlife Service, the United States Forest Service, the Washington Departments of Fisheries, Game, Natural Resources and Ecology, the Puget Sound Power and Light Co., the Muckleshoot and Puyallup Indian Tribes, the Port of Tacoma, and the (Ad Hoc) White River Cooperative Fisheries Advisory Group. Color photographs in this report were duplicated from slides provided by Larry Burnstad, USFS. We wish especially to thank Dr. Bob Clubb and Mr. Barry Lombard of the Puget Sound Power and Light Company for making documentation of historical environmental impacts in the White River drainage available for this report.

We also extend thanks to Ms. Carol Sisley and Ms. Karen Fisher for their assistance in preparing the final manuscript.

Abbreviations of Agencies and Organizations
Used in This Report

DNR	Washington Department of Natural Resources
ICRI	Inter-County River Improvement Agency
PCRI	Pierce County River Improvement Agency
PSP&L	Puget Sound Power and Light Company
USACE	United States Army Corps of Engineers
USFS	United States Forest Service
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
WDE	Washington State Dept. of Ecology
WDF	Washington State Dept. of Fisheries
WDG	Washington State Dept. of Game
WRFEC	White River Fisheries Enhancement Committee
WRFIC	White River Fishery Improvement Committee

ADDENDUM

Data revisions and updates, received from the Washington Department of Fisheries subsequent to the final printing, are:

Page 101, Table 3:

Muckleshoot catch of pink salmon:

Year	Number
1965	4
1967	254
1975	64

Changes:

Chinook
1977 reads 23; should be 0.

Chum
1981 reads 0; should be 4.

Coho
1981 reads 0; should be 1.

Total
1977 reads 237; should be 214.
1981 reads 0; should be 5.

Page 106, Table 7:

Changes:

Chinook
1977 reads 353; should be 376.
1981 reads 554; should be 546.

Chum
1981 reads 0; should be 66.

Coho
1979 reads 0; should be 22,729.
1981 reads 10,345; should be 9,684.

Pink
1977 reads 463; should be 472.
1981 reads 0; should be 3,327.

Total
1977 reads 40,761; should be 40,793.
1979 reads 9,707; should be 32,436.
1981 reads 10,899; should be 13,623.

Page 115, Table 15:

Change:

1980 peak reads 148; should be 63.

Page 118, Table 18:

Changes:

Stillaguamish	1973 reads	3,628; should be	3,638.
L. Washington	1982 reads	5,308; should be	4,956.
Green	1982 reads	1,680; should be	1,840.
Puyallup	1980 reads	2,552; should be	2,553.
Nisqually	1979 reads	89; should be	134.

Page 123; Table 20:

Change:

Skagit, 1982, should be 9,000.

These changes would also apply to data graphed in Figures 7 and 8 of the text, and Figures 2, 3, 4, 6, and 8 of Appendix I.

We thank Mssrs. Tim Flint and Richard Geist for the above revisions.

"All the explanations were convincing,
and all of them accounted for something,
but none of them accounted for everything."

- Phenomena: A Book of Wonders

I. INTRODUCTION

Since before recorded time, the White River has been a dynamic and troubled river. Formed and fed by glaciers, altered by volcanoes, mudflows and floods, the river has never "settled in." The scene of Indian-settler disputes, logging and log drives, the river was permanently diverted by man into an estuary that, in time, was completely destroyed.

A list of significant perturbations exceeds fifty. But still there is more than hope--actually promise--for partial restoration, overdue mitigation and even enhancement. This report surveys the history of the river, its anadromous fishes, and hopefully will contribute to their return. One of the changes the river has experienced is the construction of Mud Mountain Dam and our focus is on this dam and its role in river management. Like many other dams, it serves as a reference for it is there that the fish are counted.

The Seattle District United States Army Corps of Engineers (USACE) operates Mud Mountain Dam, a single purpose flood control facility located at r.m. 29.6 on the White River. Construction of the facility began in August 1939, but was halted in 1942 shortly after the beginning of World War II. Work was resumed in 1947 and completed in 1948 (USACE 1971).

Mud Mountain Dam is an earth-core and rockfill structure with a maximum height of 425 feet above bedrock and 350 feet above streambed. The dam provides 106,000 acre-feet of flood storage with the reservoir at the spilling crest. Flows from the reservoir are discharged through two tunnels approximately 2000 feet long - a 9-foot diameter tunnel, and a 23-foot diameter tunnel that contains three penstocks. Flows through the penstocks are controlled by Howell Bunger valves at the downstream end. Discharge through the 9-foot tunnel is controlled with a radial gate. In the past, the 9-foot tunnel has been operated in the full open position to pass river

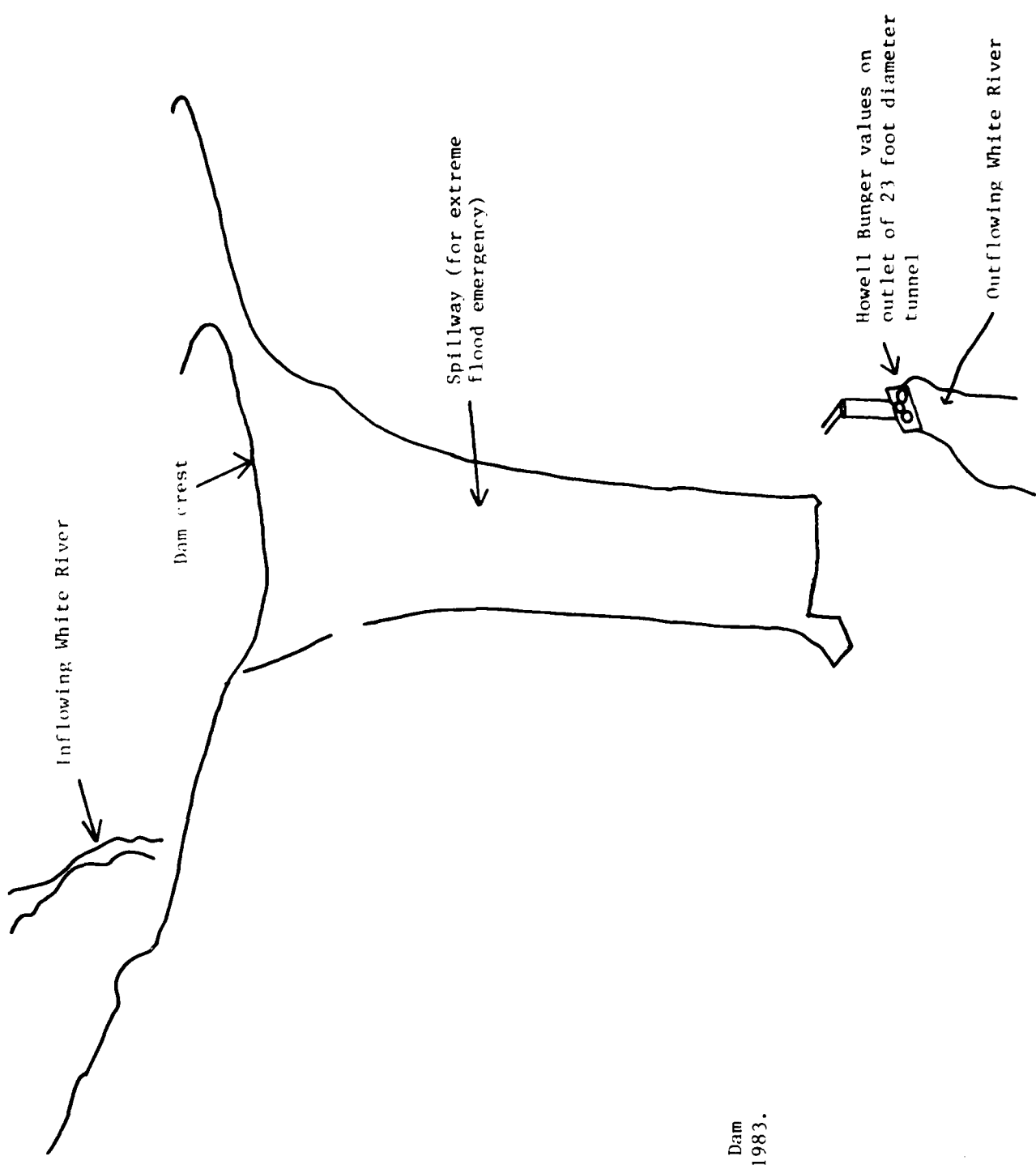
bedload and maintain flood storage space (USACE 1971). At present, due to turbidity control measures requested by the state, the 9-foot tunnel is no longer operational in the full open position.

Mud Mountain Dam is a complete barrier to upstream fish migration; however, a trap and haul operation has transported fish upstream of the dam returning to the upper watershed. A declining trend in these counts and other available data reveal that the White River fisheries are in a state of depletion and the spring chinook stock is approaching extinction. This decline, caused by habitat alterations and over-exploitation of the resource, has been a more-or-less chronic concern of state and federal management agencies, the Indian Tribes, the sportsmen, and other interested parties.

As mentioned above, this report describes the status of the habitat and the fisheries resources of the White River. Included are: the physical characteristics of the river, trends and current status of the anadromous fish runs and their fisheries, man-related environmental impacts, and current efforts at mitigation and enhancement. Fisheries and hydraulic data are summarized in the body of this report and detailed in Appendices I - III.

An in-depth analysis of each perturbation affecting the fisheries is beyond the scope of this report; however, major impacts are identified. Documentation utilized includes published and unpublished reports, memoranda, and conversations with knowledgeable persons. An annotated bibliography of literature pertaining to the White River-Puyallup System fisheries is included in Appendix IV.

Once again it is hoped that this report will prove useful to agencies and organizations concerned with the White River habitat and the rivers fisheries, and will serve as a base for accumulating detailed data for the establishment of an overall management plan for the seriously depleted White River fish runs.



Mud Mountain Dam
aerial view 1983.



II. PHYSICAL CHARACTERISTICS OF THE WHITE RIVER

A. Geological History and The Ancestral White River

The geological history of the area now encompassing the Puyallup Basin is dramatic - involving intense periods of mountain building, volcanic activity, and glaciation. Dunne and Dietrich (1978) described the sequence of events which shaped the Puget Sound region in their report on the geology and hydrology of the neighboring Green River.

Approximately 50 million years ago (MYA) the lowlands of Western Washington consisted of an extensive coastal plain upon which large rivers draining areas as distant as Wyoming flowed to the sea. By 36 MYA (oligocene) intermittent volcanic activity had intensified to major mountain range building with the uplift of a volcanic range - predecessor to the modern Cascade Range. About 25 MYA old deposits were uplifted and deformed into northwest trending folds, imposing north-westerly courses on rivers draining the uplands at this time.

Heavy erosion of the early volcanic range was followed by renewed volcanic activity and uplift of the ancestral Cascade mountains, about 8 MYA (miocene). In the next 2 million years (pliocene) uplift and deformation of underlying rocks steepened the area further, thrusting the Cascade Range to a height probably comparable to that of today.

In the past million years (Pleistocene) land features of the Puget Sound area have been greatly modified by glacial activity. A finger of the massive Cordilleran ice sheet referred to as the Puget Lobe repeatedly advanced and retreated through the Puget trough from the north. This process scoured elongated hills and valleys in a north-south orientation. Two large troughs excavated by this action formed major physiographic features of the Puget Sound lowland evident today - the Duwamish and Puyallup valleys. In early

times these troughs were marine embayments of Puget Sound; subsequently they have become filled with lake and river deposits and now rise above sea level.

The northwest trending folds, volcanic activity, and glacial scouring described above have greatly influenced the historical drainage patterns of the Puyallup Basin. Crandall (1963) reported that the ancestral Mowich Valley trended northward prior to the birth of Mount Rainier, approximately along the modern valley of Voight Creek - a tributary of the Carbon River today (Fig. 1). Lava flows from Mount Rainier later diverted the ancestral Mowich into the Puyallup Valley. Crandell speculated that the valleys of South Prairie Creek and the Puyallup River also drained the Cascade foothills prior to Mount Rainier, but the Carbon River valley was probably formed later.

Though subsequent glaciation has obscured the path of the White River between each advance of the Puget Lobe, evidence indicates that the White River flowed via the South Prairie Creek Valley to the Puyallup River after the last major period of glaciation, the Vashon advance, which occurred about 18,000 years ago (Crandell 1963). Mullineaux (1970) observed that most of the present drainage patterns of the Renton, Auburn, and Black Diamond quadrangles were developed as the Vashon glacier retreated; the White River, however, has since undergone dramatic change.

About 5000 years ago, the White River channel was altered radically by the Osceola mud flow. Pouring down Mount Rainier in both the West Fork and mainstem White River, this mass of "bouldery, sandy clay" spread over at least 65 square miles of the Puget Sound lowland (Mullineaux 1970). Mud flowed heavily into the South Prairie Creek valley to the south, and nearly reached Auburn and the Green River to the north and west. As the mud flow entered the narrow gorge in the vicinity of Mud Mountain Dam, ponding of mud upstream formed a wide natural spillway - the top of Mud Mountain (Crandell 1963).

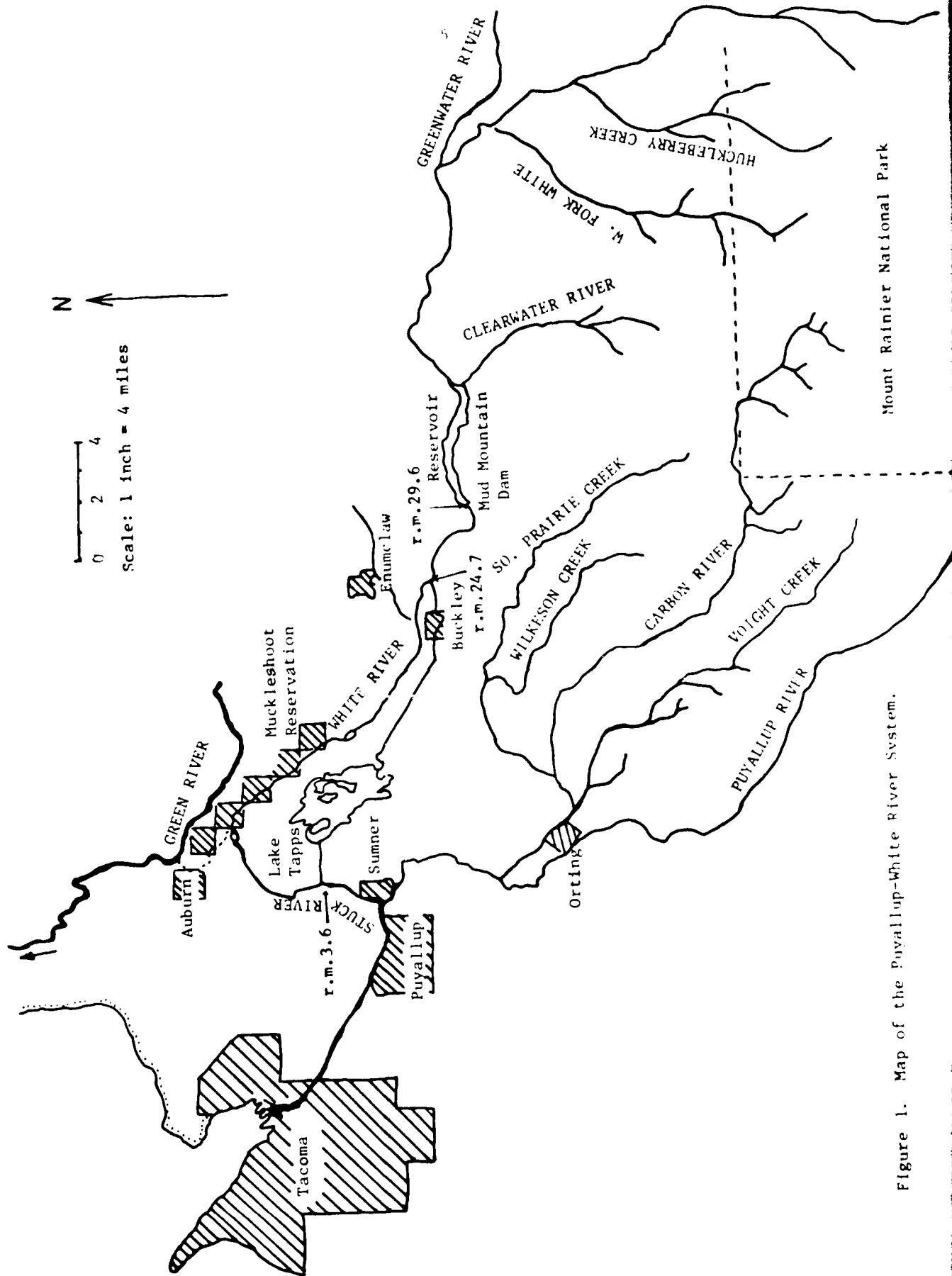


Figure 1. Map of the Puyallup-White River System.

As a result of the Osceola mud flow, the White River left its southerly course through the South Prairie Creek valley and cut a new path northward to the Duwamish, to enter the Green River at Auburn. This diversion greatly influenced the development of the Duwamish Valley because of the large sediment load carried by the White River. Geologists attribute the majority of sediment filling the lower Green-Duwamish Valley to the White River. In fact, Dunne and Dietrich (1978) speculated that the Duwamish Valley might still be an arm of Puget Sound today had the White River not cut into the valley after the Osceola mud flow.

B. Recent Events: Changes in White River Channel Location

The early shift of the White River into the Duwamish Valley was far from permanent. Stetson (1980) has documented movements of the White River in the vicinity of the Muckleshoot Indian Reservation since 1874 (see Table 1 of Appendix II), citing floods, drift jams, landslides, and artificial interference by man as factors which caused changes in channel location during this period. Early survey maps indicate that by 1874, two branches of the White River existed in the Auburn area - the mainstem, which flowed northward to Elliott Bay, and a tributary named the Stuck River, which flowed south and westward from the White to join the Puyallup River. This division of flow took place near the northerly portion of the Muckleshoot Reservation, in Sec. 27, T.21N., R.5E (Fig. 1).

Though the majority of flow typically discharged northward via the mainstem White to Elliott Bay, periods of high water and floods often resulted in significant discharge via the Stuck River to the South. During periods of low flow more than two-thirds of the White River water flowed into what is now referred to as the Duwamish River and the remainder flowed into the Stuck

River. During periods of high flow, about one-half of the flow went into the Duwamish River and the other half into the Stuck and then the Puyallup River.

In his 1907 report on the flooding problems of the Duwamish-Puyallup valleys, Major H. M. Chittenden of the Army Corps of Engineers discussed this peculiarity of the White River, and the involvement of local citizens in altering the river's course. He wrote:

"From 1887 to 1892 there was a good deal of interference by citizens of both counties with natural conditions near the point of separation of the two streams, which resulted in a large part of the flood of 1892 going down the Stuck valley. Due mainly to artificial causes, the channel shifted back and forth several times in the next six years. In the process of these changes it impinged upon a high bluff on the north bank, and undermined it to such an extent that in 1898 it slid into the river, filling the channel completely and turning the entire flow down the Stuck Valley."

By 1900 the river had returned to the North channel, and for the most part remained there until the spectacular events of the November 1906 flood again reshaped the White River. Describing this event, Chittenden (1907) wrote:

"In the early stages of the late flood most of the White River water came down the north channel and the worst effects in the valley from Auburn north were felt at this time. But just before the flood reached its crest a drift jam formed where the river turned sharply north away from the Stuck, almost entirely blocked the channel, threw the whole volume of the river across the neck of land and swept it out completely, including a heavy growth of timber, and turned the entire stream down the Stuck Valley. The lower White Valley felt immediate relief from the flood and the channel of the river down to the Green went practically dry. On the other hand the river worked great havoc down the Stuck Valley..."

Chittenden's report goes on to recommend that the most feasible means of solving the flooding problem would be to permanently divert the White River via the Stuck River valley to discharge into the Puyallup.

Recognizing the need to solve the flood control problem jointly, King and Pierce counties formed the Inter-County River Improvement Agency (ICRI) in 1914. Chittenden's suggestion was subsequently realized in 1915, when ICRI constructed a concrete diversion dam which permanently diverted the White

River into the Stuck River valley. Since its inception and continuing to the present, ICRI has modified the White River channel as far upstream as Buckley by removing drift, straightening and lining the main channel, blocking secondary channels, and confining the main channel to the northern part of the flood plain (Roberts 1920) (Thomas 1939) (Stetson 1980).

C. Streamflow Characteristics

The White River is the largest tributary of the Puyallup River and drains about 468 square miles - an area larger than the remainder of the Puyallup and its other tributaries.

MacDonald (unpublished) described the seasonal runoff pattern of the White River, noting that the key difference between the White and other western Washington rivers is that during spring and summer due to snow and glacial melt Mount Rainier tends to maintain stream runoff at levels higher than in other basins. High runoffs due to precipitation in winter typically fall off in late February and March, followed by a secondary rise in flow beginning in April from melting snow and glaciers, typically resulting in flows averaging 3000 to 5000 cfs. When most of the snow has melted, flows drop off and low flow conditions prevail in late summer and early fall until the rains pick up, resulting in increased runoff from winter precipitation.

Records of stream discharge are available for several different locations on the White River. The best documented site is located one mile south of Mud Mountain Dam (USGS Guage No. 0985) where data have been collected since 1924. The mean annual discharge at this station for 46 years of record was 1455 cfs, with a maximum of 17,000 recorded in February of 1932. An unrecorded maximum

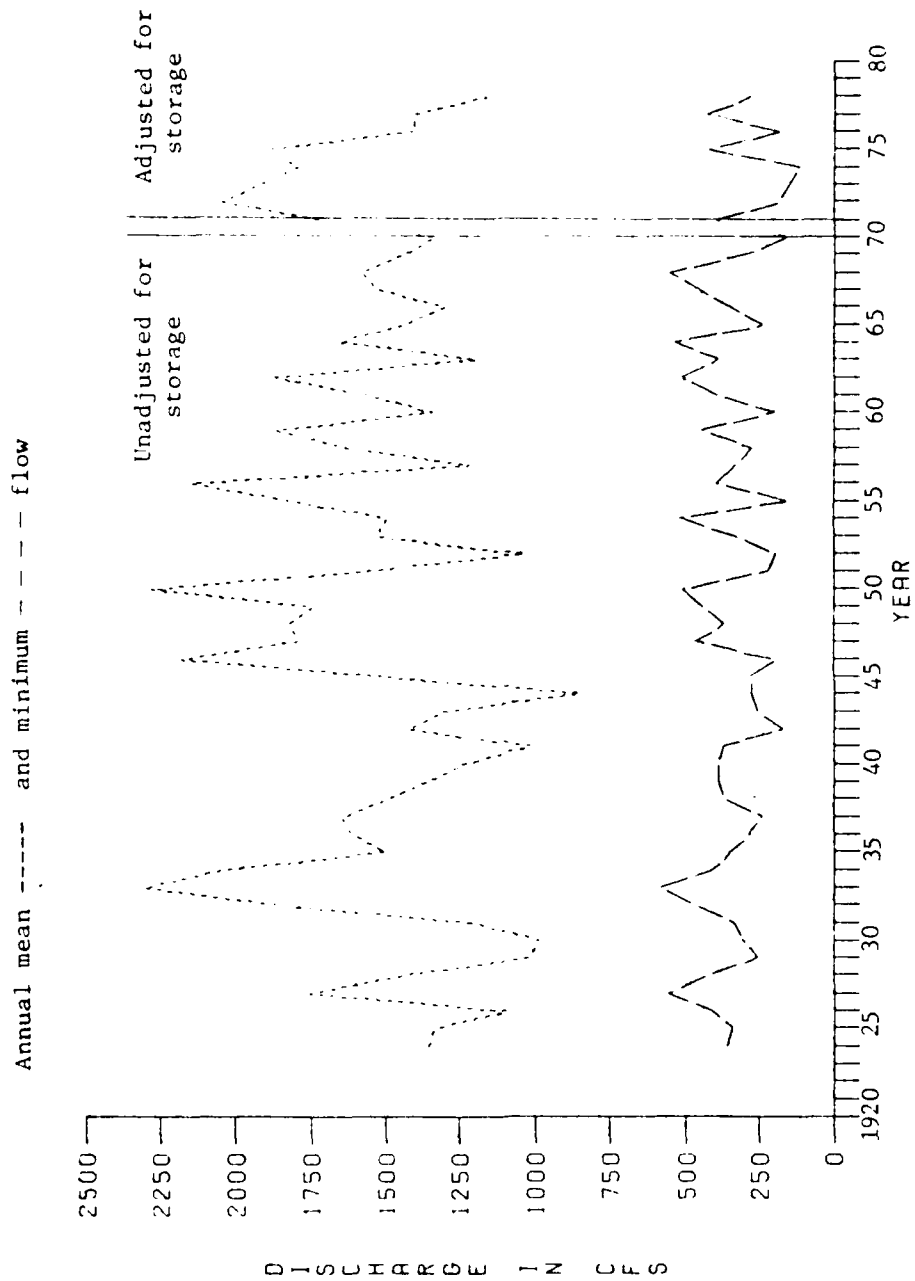
of 28,000 cfs was estimated during a flood in December 1933 (USGS Wat. Sup. Pap. No. 1736). Annual minimum, maximum, and mean flows since 1924 (unadjusted for Mud Mountain Dam storage) are illustrated in Figures 2 and 3.

White River discharge is regulated at r.m. 29.6 by Mud Mountain Dam (Fig. 1), a single purpose flood control facility for the Puyallup Basin operated by USACE. Though construction of the dam began in 1939, was halted in 1942 due to World War II, and was completed in 1947, regulation for flood control began in 1943. Typically, periods of reservoir storage are minimal and are limited to periods of high runoff or when repairs are made on the 9-foot tunnel (USACE, Pers. Comm.).

White River flows are also modified by Puget Sound Power and Light Co. (PSP&L), which operates a low-level diversion dam at Buckley (r.m. 24.7). Water diverted by this dam ultimately enters Lake Tapps and is used for power generation and returned to the river at Dieringer (r.m. 36), bypassing 21 miles of the White River (Fig. 1). Stetson (1980) reports that Puget Power diverts, on the average, about two-thirds of the annual mean flow of the White River near Buckley; during periods of low flow, such as when flows are 1800 cfs or less, the diversion takes virtually all of the flow except for about 30 cfs.

Annual minimum, maximum, and mean flows at the USGS Gauging Station No. 1005 (White River near Sumner) are presented for 1945-1970 in Figures 4 and 5. This station is located downstream of the Buckley diversion (r.m. 4.9) and reflects the discharge history of the reach bypassed by the PSP&L flume. The average discharge at this location for the 25-year period 1945 to 1970 was 615 cfs, with a maximum of 15,100 cfs (Dec. 1955) and a minimum of 28 cfs (Nov. 1958) recorded.

Figure 2. White River flow data--White River near Buckley (USGS Guage 0985)

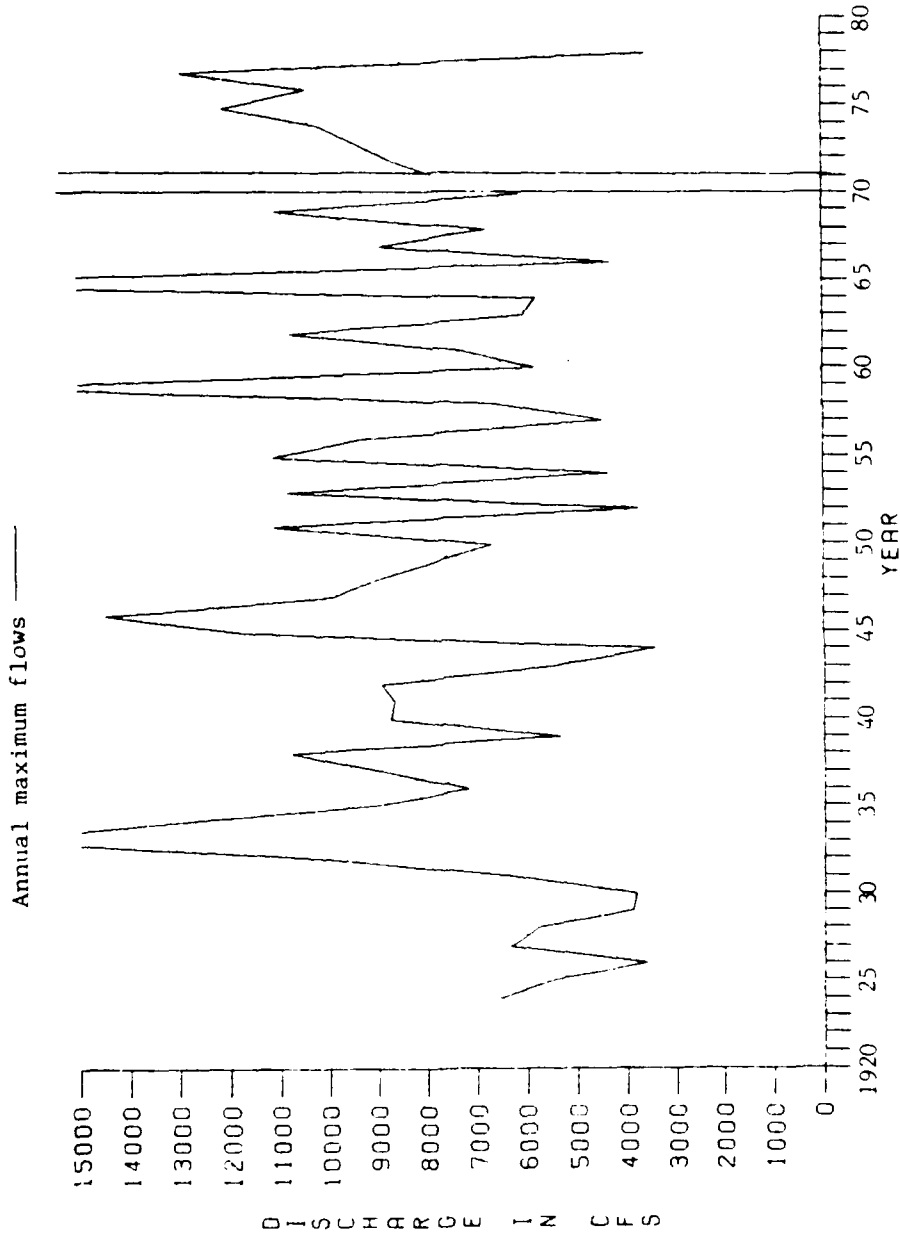


Source: 1924-1970: Data provided by Puget Sound Power and Light Co., unadjusted for Mud Mountain Dam storage-natural flow unlimited.

1971-1978: USGS, unpublished records.

Note: This data is tabulated in Table 2 of Appendix II.

Figure 3. White River flow data--White River near Buckley (USGS Guage 0985).

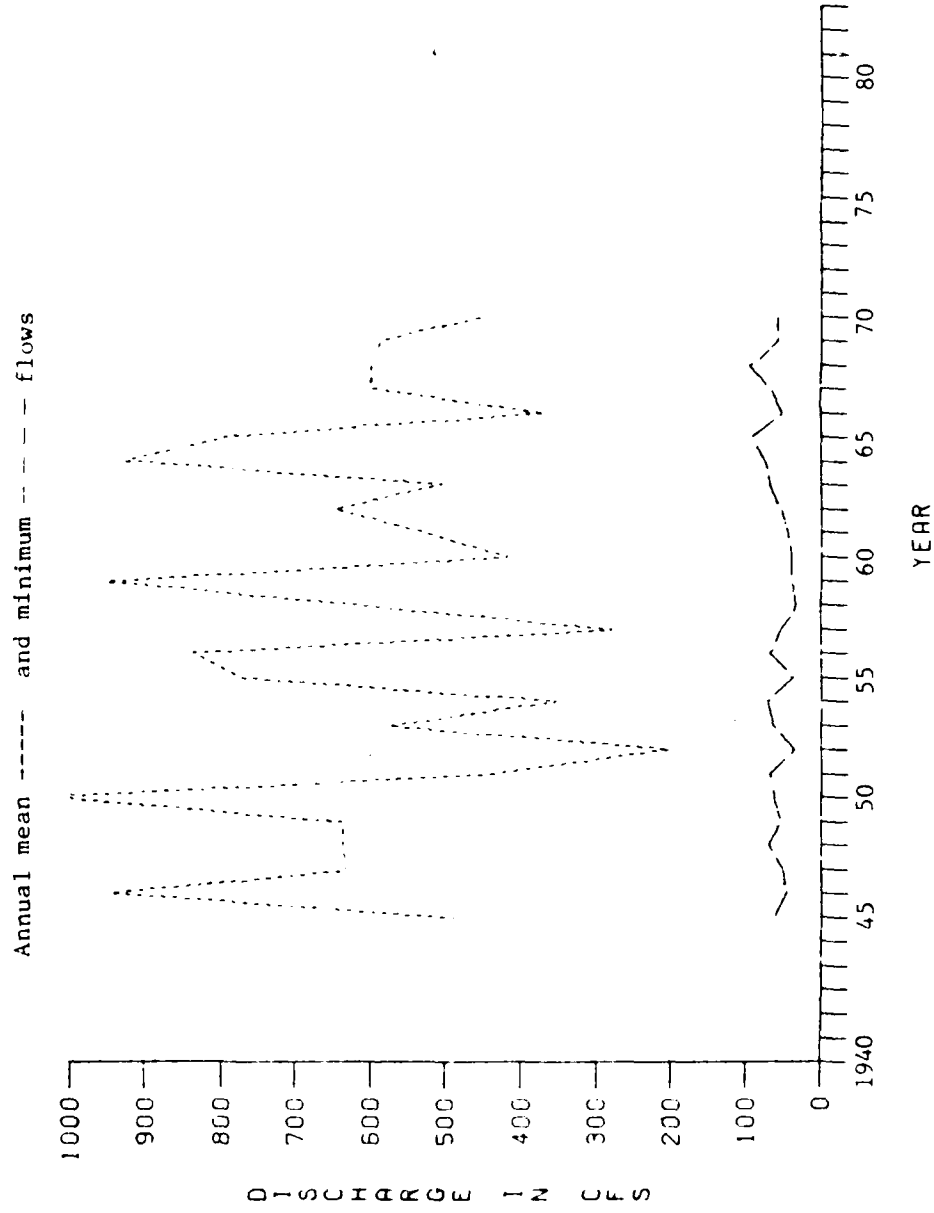


Source: 1924-1970: Data provided by Puget Sound Power and Light Co., unadjusted for Mud Mountain Dam storage - natural flow unlimited.

1971-1978: USGS, unpublished records.

Note: This data is tabulated in Table 2 of Appendix II.

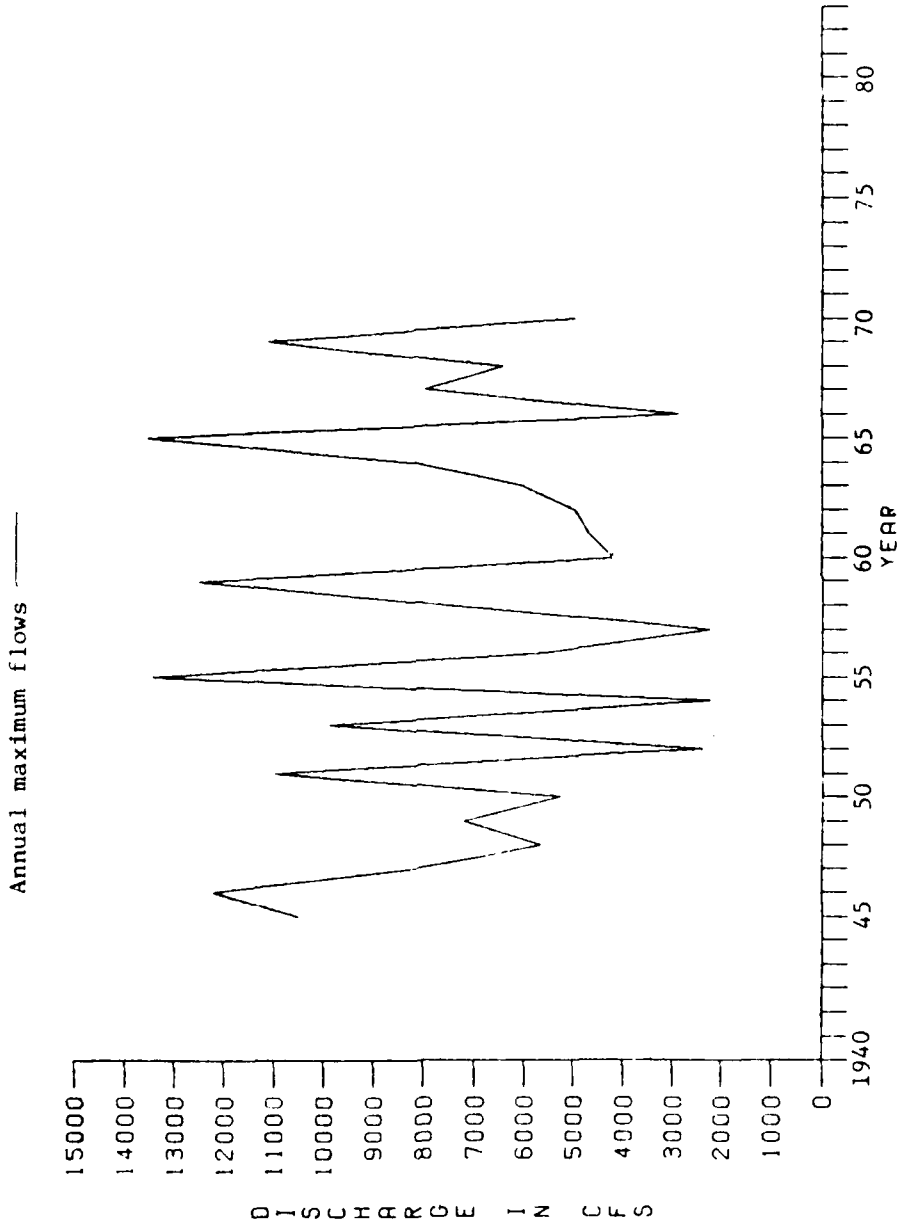
Figure 4. White River flow data--White River near Summer (USGS Guage 1005).



Source: USGS Water Supply Paper 1736.

Note: This data is tabulated in Table 4 of Appendix II.

Figure 5. White River flow data--White River near Sumner (USGS Guage 1005).



Source: USGS Water Supply Paper 1736.

Note: This data is tabulated in Table 4 of Appendix II.

D. Sediment Load

Because of its steep gradient and glacial origins on Mount Rainier, the White River carries significant quantities of suspended sediment (Dunne and Dietrich 1977). In fact, Mills (1976) reported that erosion rates on Mount Rainier rank among the highest of glacial basins on record. Using data of Fahnestock (1963) Mills estimated total sediment discharges in the White River of 256,000 and 118,000 tonnes during the summers of 1958 and 1959 respectively (one tonne equals .9072 tons).

The USGS (1976) conducted a study of sediment transport into Mud Mountain Reservoir for the two-year period June 1974 - June 1976. It was estimated that 430,000 tons of sediment were transported the first year, and 1,400,000 tons were carried the second year. Bedload was considered to be approximately four percent of the total sediment transported; an estimated 20,000 tons were carried during the first year, and roughly 50,000 tons were transported during the second year of the study.

E. Channel Characteristics

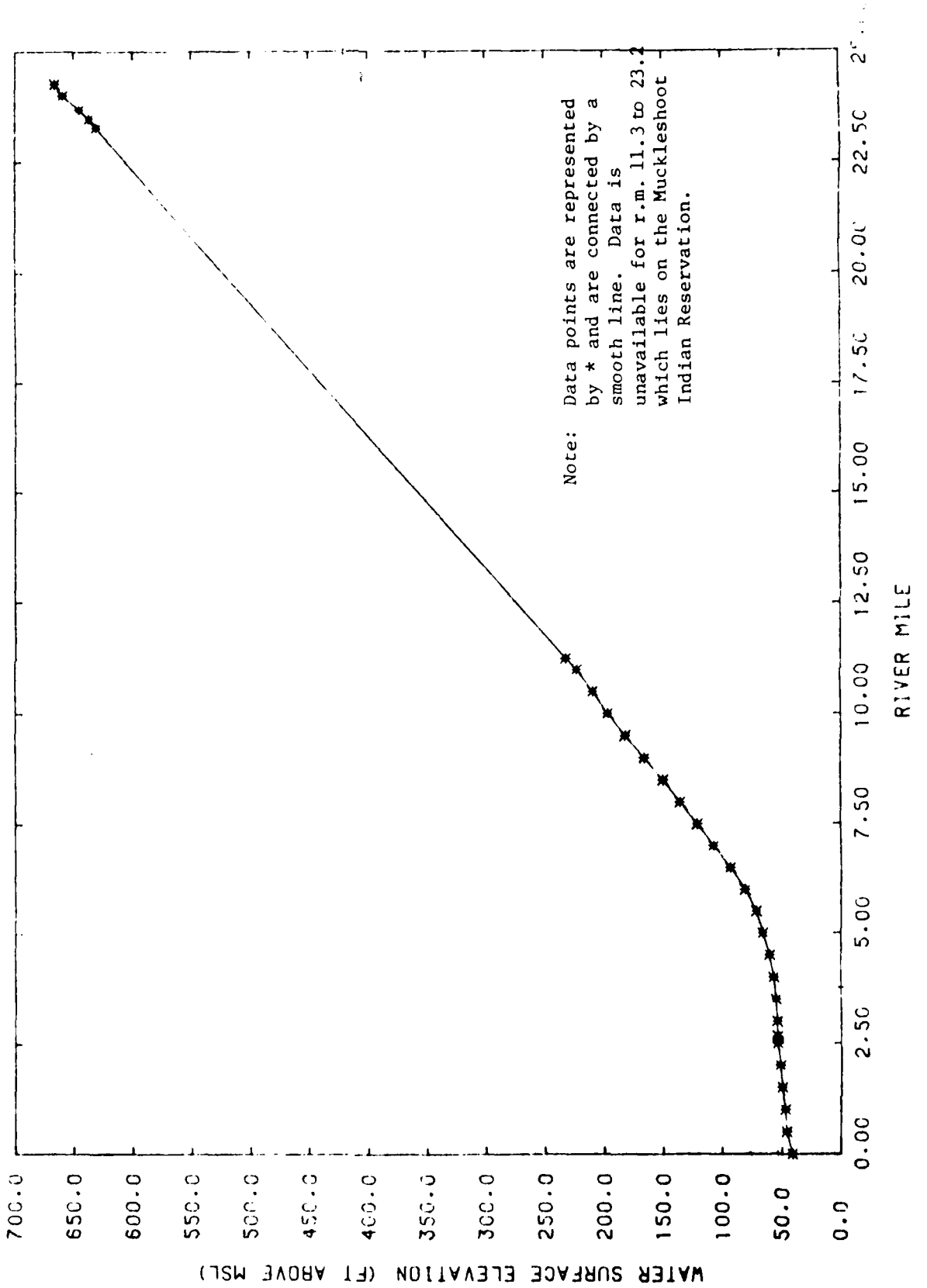
Mullineaux (1970) noted that the channel and flood plain characteristics of the White River differ notably from those of the adjacent Green River. Although both rivers have similar volumes of discharge, above Auburn they differ considerably in bedload transport, gradient, channel patterns, migration habits, and flood plain characteristics.

The channel of the White River east of Auburn is conspicuously braided, and the flood plain, prior to artificial channel control, moved rapidly across the channel floor, shifting as much as 1000 feet in several places within 10 years. Channel shifts have occurred by migrating meanders, as well as by braiding (Mullineaux 1970).

Citing coarse load and high velocity as factors that lead to rapid lateral migration, Mullineaux (1970) speculated that the more rapid migration of the White River (as compared to the Green) may be a result of the coarse load supplied just upstream of the Auburn Quadrangle.

High velocity and a coarser bedload have also resulted in a comparatively steep gradient in the lower reaches of the White River; the river gradient near Buckley, for example, is steeper than it is 10 to 20 miles farther upstream (Mullineaux 1970). Based on thalweg elevations taken from a USACE River Profile Map (USACE 1976) a mean drop of approximately 30 feet per mile occurs between the diversion dam at Buckley (r.m. 24.7 elev. 669 ft.) and the Dieringer Powerhouse discharge flume (r.m. 3.6 elev. 36 ft.) (Fig. 6).

Figure 6. Profile of the White River below Mud Mountain Dam.
Source: Data from USACE (1982).



III. HISTORICAL TRENDS AND CURRENT STATUS OF

WHITE RIVER ANADROMOUS FISH RUNS

A. Documentation of Run Size Prior to The Buckley Trap
and Haul Operation

Unfortunately, little documentation of run sizes is available for the period prior to the trap and haul operation at Buckley which began in 1940. Early Washington Department of Fisheries (WDF) records are limited to essentially qualitative reports based on foot surveys by field personnel. For example, on June 10, 1928 Emerson Hart investigated fish stranding and poaching below the White River diversion dam near Buckley, and wrote:

"I find that there is a good run of chinook salmon in this river and there are about two hundred of these salmon in holes at the foot of the dam that are unable to go farther up river on account of not being able to make the fishway when water is too low."

In another report dated July 15, 1929, Hart wrote:

"I saw no salmon in the pools below the dam while I was there, but I understand that quite a few have been caught by hook and line a few days ago."

Somewhat more helpful is a letter dated January 3, 1938 from B. M. Brennan, Director of WDF, to Colonel Thomas M. Robins, USACE, which provided then available information relating to the size of anadromous fish runs in the White River. In discussing the magnitude of White River runs, Brennan noted "...our present information is based on a watershed badly depleted in fish life..." but wrote, "It has been the opinion of this state that the fish runs in the White River are of such magnitude to warrant the installation of a \$50,000 screening project in the (Puget Power) diversion."

In the same letter Brennan (1938) explained that counts at the Buckley diversion dam were unreliable as estimates of run size because washouts of the dam enabled fish to bypass the fish ladder, and turbid water conditions often precluded complete counts of fish passage at the dam. However, Brennan wrote:

"...we have records showing where in the period of one hour ten to fifteen fish have been seen ascending the fish ladder. More generally indicative is the number of jumps per minute in which we have records indicating there have been as high as three to five jumps per minute."

Brennan (1938) continued his assessment by noting that information from residents and fishermen indicated the magnitude of White River runs. He observed that a poll revealed that some 2000 sportsmen fished the White River for salmon and steelhead and considered the area to be their chief recreational spot. An Auburn sportsmans group reported that throughout the three-month steelhead season it was quite customary to find 25 to 40 fishermen taking at least one fish daily per man from the reach of the Stuck River downstream of the Muckleshoot Indian Reservation (this would indicate a run in excess of 2250-3600 steelhead). Brennan also wrote: "The immediate vicinity of Buckley affords considerable salmon fishing both legal and illegal...in this small area...it was not uncommon to find as many as 150 people along the stream." In the upper White, Brennan reported, a check of 158 fishermen showed a total of 575 steelhead, 277 cutthroat, 5 whitefish, and 69 dolly varden; and in August of 1930 a group of fishermen reported that 600 to 700 salmon were observed in a five-mile stretch of the Clearwater River.

Additionally, Brennan (1938) commented that the runs of the previous year (1937) "were the shortest that have been encountered in many years." Despite poor visibility conditions, spawning surveys conducted that year on the Clearwater, Greenwater, and Huckleberry Creek counted a total of 102 chinook in eight miles of streams. Brennan wrote that "a considerable number of unoccupied spawning nests were observed, indicating more spawning salmon than were observed," and also noted that in this area "silvers have been reported spawning in some numbers in past years."

B. Documentation of Run Size Since Initiation of The
Buckley Trap and Haul Operation in 1940.

1. Chinook

Historically the White River has supported both spring and fall chinook; spring runs spawned mostly in the upper reaches of the river, while fall runs spawned primarily downstream of Mud Mountain Dam (Smoker et al. 1952). Buckley trap counts summarized by month for 1966-1981 (Table 2a of Appendix I) indicate run timing to the upper watershed. Spring chinook typically arrived at the Buckley trap from May through early August and peaked in late June or early July. Summer-fall runs arrived from August through October and peaked in late August or early September.

As indicated by Brennan (1938), there were no reliable counts or other forms of fish census prior to the construction of Mud Mountain Dam. Although the counts in the early years of fish hauling at Mud Mountain Dam were probably incomplete and thus conservative, they provide an indication of the condition of chinook stocks spawning in the upper watershed just prior to the construction of Mud Mountain Dam.

Construction of the dam began in 1939 and the hauling of fish around the construction site began in 1940; however, work was halted due to World War II from 1942 to 1947 (USACE 1971). During this period water was allowed to flow freely through the 23-foot diameter tunnel, without gates (Dan Fryberger, Pers. Comm.). If one assumes that downstream migrants passed unimpeded during this period, the trap counts of chinook between 1942 and 1949-50 should reflect run strength in the period just prior to the operation of Mud Mountain Dam (counts of 1940 and 1941 are not considered representative because of incomplete hauls, the possible affects of initial construction activities, and reports of poaching at the trap).

Counts of chinook returning to the Buckley trap from 1942 through 1950 represent fish which migrated downstream from 1938 through 1946--a period when Mud Mountain Dam impacts were presumably minimal. The mean trap counts of chinook for this period (1942-1950) was 2953 (Table 1 of Appendix I). Indian harvests on the White River averaged 506 chinook annually for the period 1942-1950, with a maximum of 1289 reported for 1945 (Table 3 of Appendix I and Figure 7).

These figures are not unreasonable, especially when one considers the perturbations which impacted runs in the White River prior to 1938, which included man-induced diversions and landslides, severe floods, clearcut logging in the upper watershed, construction and operation of the Puget Power diversion flume (without a downstream migrant screening device until 1938), ICRI channel straightening and clearing activities, and documented poaching (see "Impacts," Section VI, and Figure 8).

Trap counts for the following nine year period (1951-1959) reveal a severe decline to a mean of 743 chinook. Indian harvests on the White River (1951-1959) averaged 779 annually, with a maximum of 1619 reported in 1956.

Fish which returned to the White River during this period experienced the additional impacts of Mud Mountain Dam operation (as downstream migrants), ICRI channel dredging and riprap dike construction in the Muckleshoot Reservation section and an intensified Indian fishery on the White and lower Puyallup rivers (Tables 3 and 7 of Appendix I, and Figure 7).

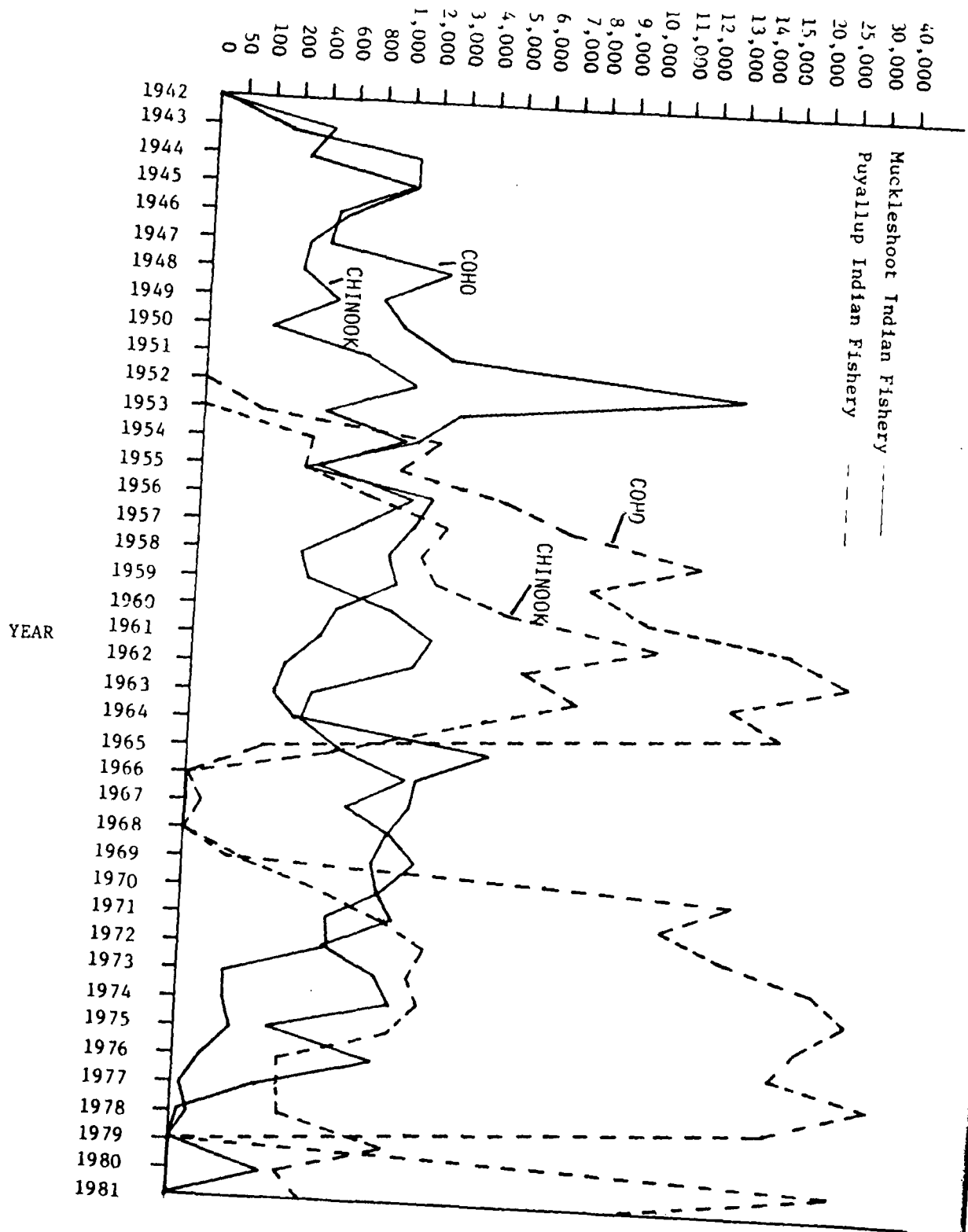


Figure 7. Historical Indian harvests of coho and chinook salmon in the White and Puyallup river system.

22
White River Trap Counts (moving average of 3)

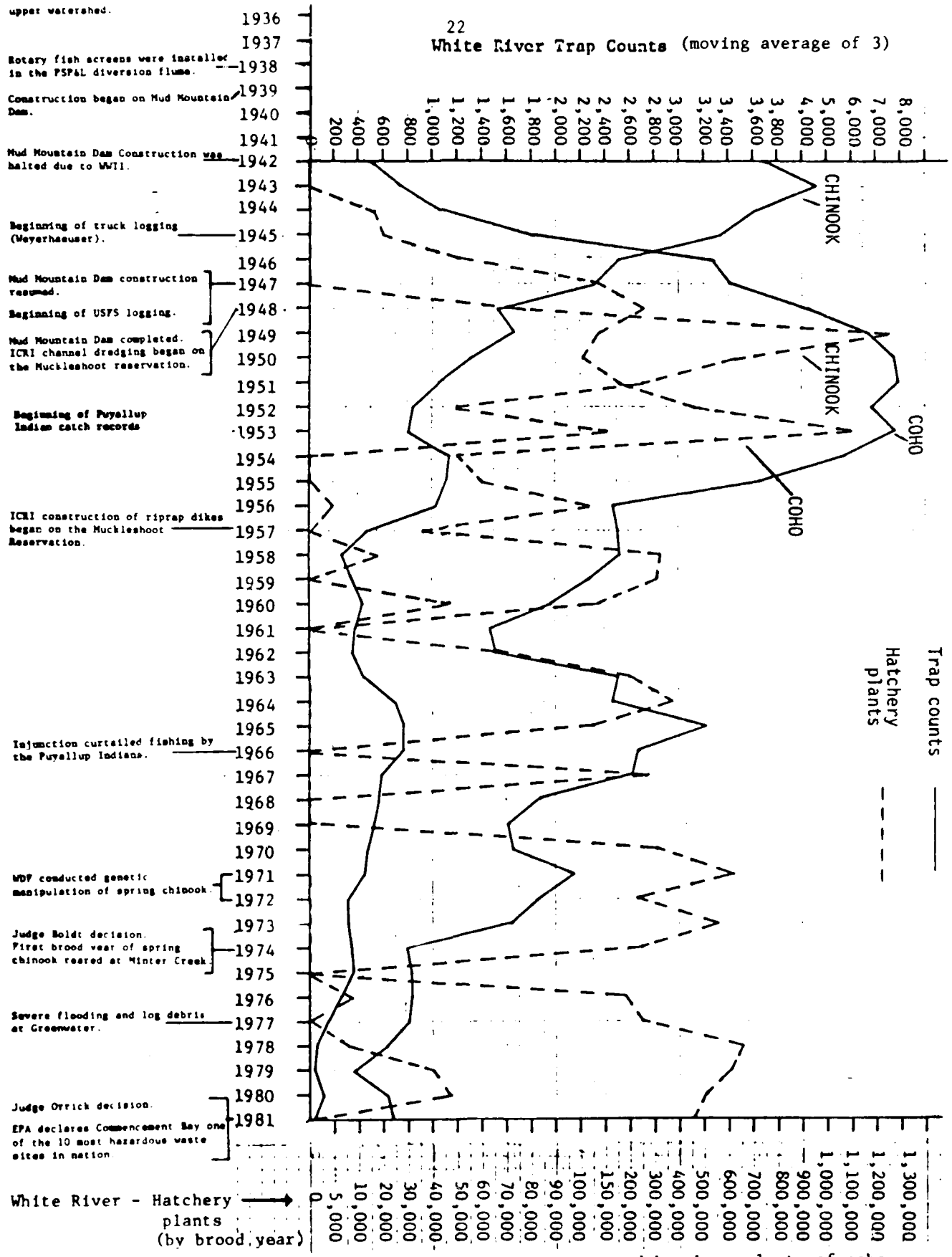


Figure 9. Historical impacts and White River trap counts and hatchery plants of coho and chinook salmon

	1885
	1886
	1887
	1888
Frequent White River channel shifts between the Green and Stuck river valleys.	1889
	1890
	1891
First lumber mill built in Enumclaw.	1892
	1893
	1894
	1895
The White River Lumber Co. acquired lumber mills at Enumclaw and Ellison on Boise Creek.	1896
	1897
A landslide diverted the entire White River flow into the Stuck River.	1898
	1899
	1900
	1901
	1902
	1903
	1904
	1905
Severe flooding caused a log jam which diverted the White River into the Stuck River.	1906
	1907
	1908
	1909
	1910
PSP&L constructed a diversion dam at Buckley.	1911
	1912
	1913
The ICRI began flood control activities on the White River.	1914
	1915
The White River was permanently diverted into the Stuck River valley.	1916
	1917
	1918
	1919
	1920
	1921
	1922
	1923
	1924
	1925
	1926
	1927
	1928
	1929
	1930
	1931
	1932
The longest recorded flood on the White River washed out much of ICRI's work.	1933
	1934
Clearcut logging commenced in the	1935

Trap counts continued to decline through the 1960's to a mean of 559 (1960-1969); Indian harvests on the White for this period averaged 1499 (1960-1969). Impacts incurred during this period include the ongoing environmental perturbations noted above, unquantified (White River stocks), but probably significant, high seas and Puget Sound fishing pressure, and documented overfishing on the lower Puyallup River (WDF 1961), where a record landing of 10,659 chinook was reported for 1961 (see "Historical Fisheries," Section IV-B).

The decline in the trap counts of chinook continued in the 1970's. The mean for 1970-1974 was 373, falling to 199 for 1975-1979. Landings of chinook by the Indians also declined substantially from a mean of 523 (1970-1974) from the White River to an average of 43 (1975-1979) (Table 3 of Appendix I). Indian catches of chinook on the lower Puyallup also dropped; however, they still averaged 1876 fish for the period 1970-1974, before dropping to a mean of 884 (1975-1979) (Table 7 of Appendix I).

Counts in recent years are at record low levels pointing out that White River spring chinook are an endangered race. USACE records show a return of only 20 chinook in 1982, partially a reflection of the hauling of spawners to Minter Creek since 1974. Enhancement efforts are discussed in Section VII.

Plantings of hatchery chinook from 1939 to 1981 have not been constant for the White River drainage. However, between 1945 and 1950, substantial numbers of fall chinook were released periodically in the Clearwater, Greenwater, and mainstem White rivers (Table 11 of Appendix I and Figure 8). Also, plants of 1972, 1974, 1975, and 1976 brood spring chinook were made in 1974, 1976, 1977, and 1978 respectively (Table 12 of Appendix I).

Estimates of naturally spawning chinook reported for the Puyallup Basin indicate sporadic but gradually declining escapements since 1965 (Table 1).

Table 1. Puyallup System coho and chinook escapements. These are estimates of those naturally spawned (wildfish) only.

<u>Year</u>	<u>Coho</u>	<u>Chinook</u>
1965	14,000	4,110
1966	10,000	6,250
1967	17,000	2,290
1968	9,000	890
1969	2,000	850
1970	4,000	5,110
1971	10,000	2,220
1972	3,000	925
1973	3,000	630
1974	5,000	1,480
1975	2,000	1,396
1976	4,000	1,120
1977	8,000	703
1978	3,000	962
1979	2,000	2,359
1980	4,000	2,553
1981	5,000	518
1982*		851*

* Preliminary

Source: (1965-1976) WDF Technical Reports Nos. 28 and 29.

(1977-1982) WDF data provided by Tim Flint (coho) and Dick Geist (chinook).

Note: This data is subject to revision and updating by WDF. Estimates of 1965-1974 were based on a limited number of spawning ground counts and are not considered as accurate as those since 1975 (WDF, Pers. Comm.).

The glacial nature of many streams within the Puyallup Basin has precluded effective spawning ground surveys (Ames and Phinney 1977; however, a section of South Prairie Creek (Fig. 1) has been used as an index area for fall chinook counts since 1952 (Egan 1978, 1980). Estimates of past fall chinook escapement to the Puyallup system have been determined by relating these counts to a tagging study (Puyallup Tribe and USFWS 1977) conducted in 1975 and 1976 (Ames and Phinney 1977). Reported declines for the Puyallup System, therefore, are in part a reflection of the counts on South Prairie Creek - a tributary of the Carbon River, which drains independently of the White River. Comparison of the counts available for this index area (Egan 1978, 1980) in the 1960's with those available for the 1970's indicates a decline of approximately 45 percent from a mean of 70 (1960-1969) to 39 (1970-1979) (Table 15 of Appendix I).

A broader perspective on the White River chinook runs is obtained by comparing them with the escapement of wild salmon in other Puget Sound streams. Ames and Phinney (1977) reported that hatchery runs comprised approximately 70 percent of the 1976 Puget Sound catch, and noted that wild runs were predicted to be below escapement goals for five of nine streams in the Strait of Juan de Fuca, all Hood Canal stocks, and the Puyallup and Nisqually river systems in South Puget Sound.

Recently updated estimates of Puget Sound wild fall chinook escapements (Table 18 of Appendix I) indicate declines in many Puget Sound streams since 1968. When these estimates are smoothed using a moving average of three (Figures 4, 5, and 6 of Appendix I) declining trends are particularly evident in the South Sound and Hood Canal stocks. Puyallup River escapements fell from a mean of 1688 (1968-1975) to 1295 (1976-1982), a decline of 23 percent (Table 19 of Appendix I). A similar trend, however, was noted in the

neighboring Nisqually River, where escapements fell 68 percent from a mean of 631 (1968-1975) to 204 (1976-1982).

2. Coho

Historically, coho are reported to have spawned "in all accessible streams and tributaries" of the White River (Wilson 1973). Coho runs typically arrive in early September and continue through December, with a peak in November (Table 2b of Appendix I).

It is difficult to assess the condition of coho stocks in the upper White River prior to the construction of Mud Mountain Dam by using the early trap count records. Apparently, dam construction activities and other factors had a devastating impact on coho runs in the White River. This was discussed by Smoker et al. (1952) and is evident from the trap counts of 1940, 1941 and 1942 which totaled 112, 14, and 18 coho, respectively (Table 1 of Appendix I).

Hatchery plants of 1941, 1942, and 1943 brood silvers (coho) reportedly "re-established" spawning populations in 1944, 1945, and 1946 (Heg 1953b). Trap counts for 1944, 1945, and 1946 thus included returns of hatchery plants, and totaled 717, 1003, and 3811, respectively. Because hatchery plants obscured wild coho escapement trends for 1944-1946, the trap counts and in-river Indian harvests of 1943 (which totaled 1467 and 426 coho, respectively) are the only indication of wild coho runs which migrated downstream between 1938 and 1946, when Mud Mountain Dam impacts were presumably minimal.

Hatchery plants of coho have been made virtually every year since the early 1940's to enhance naturally spawning populations and thus have obscured the trends in escapements of wild stocks. Hatchery plantings are summarized in Tables 11 and 12 of Appendix I. Streams planted in the upper watershed include the Clearwater, Greenwater, and West Fork White rivers, and Pyramid,

Whistler, Midnight, and Huckleberry creeks. In the lower watershed, Strawberry, Bowman, and Boise creeks have been planted in addition to the mainstem White downstream of the diversion dam at Buckley. Plants made between 1956 and 1977 were primarily released in areas below Mud Mountain Dam. In the late 1970's, however, substantial numbers of fish were also released in areas upstream of Mud Mountain Dam.

Probably consisting largely of returns of hatchery plants, coho trap counts averaged 3122 for 1944-1949. Muckleshoot in-river coho harvests for 1944-1949 averaged 964 annually with a peak of 2540 in 1948 (Table 3 of Appendix I and Figures 7 and 8).

A record 12,484 coho were hauled at the Buckley trap in 1950. During this same year, 1054 coho were landed by the Muckleshoot net fishery in the White River. Subsequently, trap counts averaged 6623 for 1951-1954 but declined substantially in the late 1950's to a mean of 2587 (1955-1959). In-river Indian harvests of the early 1950's declined from a mean of 5233 (1951-1954), with a record peak of 13,333 in 1952, to an average of 1344 in the late 1950's (1955-1959). Harvests by the Puyallup Indian fishery on the lower Puyallup River were first recorded in 1953 with 104 coho; the numbers increased rapidly with an average of 5180 between 1953 and 1959. The largest harvest for this period was 12,044 in 1958 (Figure 7).

In the early 1960's (1960-1963), trap counts declined to a mean of 1479 and Muckleshoot Indian harvests fell to an average of 420. During this period, Indian harvests on the Puyallup River reached 27,283 coho in 1962 and averaged 16,893 annually (1960-1963). By the late 1960's (1964-1969) trap counts of coho rose to an average of 2556 and Muckleshoot landings averaged 1957 annually. Catches on the lower Puyallup River of 15,799 in 1964 declined to a mean of 55 (for 1965-1969) as an injunction curtailed fishing by the

Puyallup Indians (see "Historical Fisheries," Section IV-B).

Trap counts declined through the 1970's to 320 coho in 1979, averaging 1164 annually for 1970-1979. Muckleshoot in-river landings of coho also declined over this period, to a mean of 747 (1970-1979). Indian landings of coho on the Puyallup River, however, increased in the 1970's; an average of 18,534 were landed for the period 1970-1979, with a maximum of 39,930 taken in 1977.

Since 1980 coho have continued to return to the Buckley trap in depressed numbers; counts totaled 335 in 1980, reached 1237 in 1981, but fell to 522 in 1982 (Table 1 of Appendix I).

WDF estimates of wild coho escapements for the Puyallup (Table 1) have a declining trend since 1965. Surveys conducted on Clear, Kelley, and Kings creeks (tributaries independent of the White River drainage) are used to establish these estimates, suggesting that declines have also occurred in other areas of the Puyallup Basin.

WDF estimates of wild coho escapements for Puget Sound streams for 1965-1982 are presented in Table 20 of Appendix I and are plotted using a moving average of 3 in Figures 7, 8, and 9 of Appendix I. These figures indicate that escapements to North Sound streams have been sustained at higher levels than in Central and South Sound streams which have generally declined since 1965.

Comparison of the mean escapements for the period 1965-1973 with the mean escapements for 1974-1982 (Table 21 of Appendix I) also illustrates this trend, and highlights in particular the declines in the Puyallup and Green rivers. Puyallup escapements, which fell 54 percent from a mean of 7222 (1965-1973) to 3333 (1974-1982), are commensurate with declines in Green River escapements which fell 39 percent from a mean of 5700 (1965-1973) to 3500

(1974-1982). By comparison, for the same periods White River trap counts (Table 1 of Appendix I) declined 65 percent from a mean of 2047 (1965-1973) to 717 (1974-1982); however, the relative proportion of hatchery fish in these counts is unknown and obscures knowledge of the wild stock escapements.

3. Steelhead

Wilson (1973) reported that steelhead have spawned throughout the entire White River system, wherever suitable conditions were available.

Historically, runs to the upper White River typically peaked during April and May; the Indian fishery (conducted by the Muckleshoot Tribe in the lower reaches of the White) has been most successful during December and January (Hahn and Leland 1979) (Tables 2 and 4 of Appendix I, respectively).

Discussing information indicative of run sizes prior to 1938, Brennan (1938) noted that typically 25-40 sport fishermen took at least one fish daily per man (from the lower White River) during the three-month fishing season. If this remark is taken literally, runs in excess of 3500 steelhead frequented the White River prior to the Buckley trap and haul operation.

Also suggestive of early run sizes are trap counts of steelhead for 1942-1948, which represent the return of the downstream migrants of 1940-1946 (period of minimal Mud Mountain Dam impact). Counts peaked at 2166 (in 1946) and averaged 1474 (for the period 1942-1948) (Table 1 of Appendix I).

Trap counts averaged above 1000 but generally declined through 1954, before falling sharply to low levels in the mid 1950's - early 1960's. In spite of peaks reaching 906 in 1966 and 726 in 1971, counts have averaged below 500 since 1954.

Peak harvests of winter-run steelhead occurred during the season of 1949-1950, when Indian landings of 2176 (Table 4 of Appendix I) and sport catches

of 885 fish (Table 6 of Appendix I) were reported. Substantial landings were also reported for the 1953-1954 season, when Indian harvests totaled 2123, and sport catches reached 1378 steelhead. Indian harvests subsequently averaged 1440 between the seasons of 1954-1955 and 1958-1959. Sport catches peaked at 1044 during the 1955-1956 season but declined to 272 during the 1958-1959 season.

Indian harvest data are not available from 1961 to 1972, but data available for the 1970's indicate that harvests fell to low levels, averaging 193 between the seasons of 1973-1974 and 1978-1979. Sport catch statistics for the 1960's and 1970's (Table 6 of Appendix I) averaged 365 between the seasons of 1961-1962 and 1969-1970, which fell to a mean of 194 between the seasons of 1970-1971 and 1978-1979.

Washington Department of Game biologists studied steelhead escapements to the Buckley trap during the spring of 1979 and concluded that hatchery steelhead comprise a minor portion, at best, of the upriver escapement (Hahn and Leland 1979). Trap counts for 1979 totaled 249 steelhead. By comparison, spawning ground surveys conducted on South Prairie Creek in 1979 resulted in a run size estimate of 406 steelhead, also predominantly wild stocks (Hahn and Leland 1979).

Based on aerial spawning surveys between March and May of 1979, Muckleshoot tribal biologists (Pers. comm. 1983) reported steelhead spawning in the Buckley to Dieringer reach of the White River; a count of 20 redds was recorded on April 25, 1979. Surveys conducted by foot in April and May of 1983 by the Muckleshoot Tribe in the upper watershed resulted in a total count of 35 redds between the mouth of the Clearwater River and r.m. 5.5 (appendix V).

Historical plants of steelhead in the White River and in the entire

Puyallup System are presented in Tables 11 and 14 of Appendix I, respectively.

4. Chum

Historically, chum salmon have utilized the lower reaches of the White and Puyallup Rivers (Wilson 1973). Because spawning has not occurred above Mud Mountain Dam, trap count data do not provide an indication of past trends in chum escapement. However, landings by chum by the Indian net fishery on the White River indicate historical trends (Table 3 of Appendix I).

Smoker et al. (1952) reported that chum salmon were landed primarily in December and January. Catches in excess of 3000 fish occurred in the mid 1940's, when 3622 and 3185 fish were landed in 1944 and 1945, respectively. Lower annual catches averaging 994 from 1946 to 1951 preceeded a record harvest of 5441 in 1952. Subsequently, catches declined substantially and only exceeded 500 fish per year in 1958 (502), 1961 (723), and 1966 (733). Since 1970, with the exception of incidental catches in 1973 (5), 1975 (1) and 1976 (20), no chum have been reported in the White River Indian fishery.

Indian landings of chum on the lower Puyallup River since 1953 are summarized in Table 7 of Appendix I. Catches averaged 381 between 1957 and 1964, were nominal between 1965 and 1972, but subsequently reached peaks of 1495 in 1974, 759 in 1976, and 1600 in 1980.

5. Pink

Although Wilson (1973) reported that pink salmon have historically utilized the lower White River for spawning, Indian catch statistics (WDF 1962) suggest that this species was not present in commercially harvestable numbers. In 1980 Director of Fisheries Gordon Sandison noted that pink salmon redds were observed in 1973 below the Buckley diversion and wrote: "While

conditions drastically limit salmonid production, pink and chum salmon, as well as fall chinook still spawn in limited numbers in this area," (WDF 1980).

By contrast, the Puyallup River has historically sustained a substantial run of pink salmon; a maximum Indian harvest of 53,425 pink salmon was reported for 1963 on the lower river. Indian harvests of pink salmon on the lower Puyallup since 1953 are presented in Table 7 of Appendix I.

IV. HISTORICAL AND CURRENT FISHERIES IMPACTING WHITE RIVER STOCKS

A. White River Fisheries

1. Indian Fisheries

Various accounts document Indian subsistence fishing in the White River drainage since early times. Discussing the traditional fisheries of the Muckleshoot Indians, anthropologist Barbara Lane (undated) reported that weir fishing sites located on the Green, White, and Stuck rivers (and associated tributaries) accounted for the bulk of fish taken, though fish traps and other means were also utilized where appropriate. Arthur Ballard (1957), while describing the use of Indian weirs in the Auburn area, also mentioned the use of a funnel snare for steelhead near the southeast corner of the Muckleshoot Reservation, and salmon spearing on the Stuck River.

Apparently, Indians in the vicinity of the White River were somewhat opportunistic fishermen and frequently would move to areas where fishing success could be optimized (Lane, undated). Historical records suggest that fishing on the White River was often abandoned in favor of the Green River on this basis. For instance, the Tulalip Agency Records (1941) note that the White River was not used so much "...because it was too dirty and swift." Also, a U.S. Senate Document (1920) noted that the Muckleshoot Indians "...always prefer Green River to the White River, which runs through their reservation, because the latter is always cloudy from silt and for that reason has never been frequented by fish like the Green has."

In more recent times, the Washington State Department of Fisheries has recorded landings of salmon by Indians on the White River since 1939 (Table 3 and Figure 2 of Appendix I). In 1952, WDF presented an analysis of this fishery (Smoker et al. 1952), which at that time harvested spring and fall chinook, coho, and chum - primarily by set gill nets. It was reported that

the number of nets fished had risen from 4 in 1943 to 17 in 1951. Through an examination of harvest intensity and the Buckley trap counts, biologists concluded that of the four stocks fished only coho runs were improving, and this increase was largely due to "the heavy sustained hatchery plants of this species by the State Department of Fisheries." While declines of spring chinook were not attributed to the Muckleshoot fishery, heavy harvests of fall chinook were observed and increased protection was recommended to ensure adequate spawning escapements.

Heckman (1964) discussed the status of White River fisheries in the early 1960's. He reported that about fifty Indians fished on the White River, approximately half commercially and the remainder on a subsistence basis. Set gill nets continued to be the major gear type employed. Statistics revealed that the catch per unit effort (or gear) had been reduced in the past decade. Reductions in spawning escapement and Muckleshoot Indian fish landings were reported to be coincident with an increased downstream fishery conducted by the Puyallup Indians (see Puyallup River Fisheries, below).

More recently, Hahn and Leland (1979) reviewed the status of steelhead in the White River and presented Indian catch statistics available since 1949 (Table 4 of Appendix I) noting that "The Indian fishery has declined substantially in the 1970's compared to the 1950's."

Historical trends in Indian harvests of salmon and steelhead on the White River are discussed by species in Section III, "Historical Trends in Fish Runs."

It has been suggested that overfishing has occurred on the White River below the Puget Power diversion dam, where at times low flow conditions have rendered salmon more vulnerable to the Muckleshoot Indian fishery. Ralph H. Imler of the USFWS wrote:

"At one time White River runs of salmon and steelhead trout numbered several thousand fish. With the project, and in spite of present fish facilities, these runs have decreased to only a few hundred fish. According to Washington State conservation agencies, this reduction is not due to inadequate fish facilities, but rather to an intensive Indian fishery in White River below Buckley, Washington. This area has an adequate minimum flow of 30 c.f.s. for fish transportation water, but this small flow provides excellent conditions for fishing by Indians." (Imler 1960).

More recently, however, the USFWS (1974) has recommended flows of 250 c.f.s. (for coho) and 500 c.f.s. (for chinook) during periods of upstream migration. These recommendations pertained to habitat and passage improvement and were not associated with the Indian fisheries (see Appendix IV).

In a 1952 analysis of the Muckleshoot Indian fishery (Smoker et al. 1952) biologists noted, "In 1945, 1948 and 1951, the Indian fishermen took a higher percentage of the run than in other years" and suggested low flows might have been responsible for the increased catches. This phenomenon was also documented in the minutes of a White River Fishery Improvement Committee meeting (Sept. 13, 1968) which noted: "Under existing minimum flow conditions salmon often hole up in the stream area within the Muckleshoot Indian Reservation. An increase in minimum flow may eliminate this phenomenon and make the fish less available to Indian fishermen."

2. Sport fisheries

Speaking of the White River in the late 1930's, Brennan (1938) wrote: "The river affords a fishing spot for some 2000 sportsmen of the communities...the sportsmen of this area consider this area their chief recreational spot." Salmon sport catch data are not available for this period, but catch statistics from punch card returns (Table 5 of Appendix I) indicate relatively few landings in the White River since 1964.

As discussed in Section III, Part 3, substantial numbers of sport-caught

steelhead have been landed from the White River. Regarding steelhead fishing of the late 1930's, Brennan (1938) wrote: "...from the mouth of the Stuck River to the Indian Reservation, which is approximately ten miles, it is quite customary to find twenty-five to forty fishermen taking at least one fish daily per man throughout the three months steelhead season, and when the river is in the right condition the catch is even better." Historical sport catches of steelhead based on punchcard records are presented in Table 6 of Appendix I; trends in this fishery are discussed in Section III-B, Part 3.

B. Puyallup River Fisheries

Because the White River is a tributary of the Puyallup River, harvests on the lower Puyallup and Commencement Bay directly impact White River stocks.

1. Indian Fisheries

The development of the Indian fishery on the lower Puyallup was discussed in a document entitled, "Indian Fisheries of Washington State" (WDF 1961). In 1953, the Indian fishery on the lower Puyallup consisted of 3 set nets below the Highway 99 bridge which yielded a total catch of 104 coho and 2 chum. By 1961 the fishing effort had expanded to include 35 gill nets, 10 set nets, and 4 traps between the Highway 99 bridge and Commencement Bay, which yielded a total catch of 10,659 chinook, 490 chum, and 16,532 coho. At that time, state fisheries managers reported that the total Puyallup and Muckleshoot Indian catch accounted for 80 percent of the total silver (coho) run and 85 percent of the total chinook run (WDF 1961). An injunction curtailed fishing by the Puyallup Indians on the lower river in the late 1960's, but harvest levels reached new peaks in the 1970's and 1980's - a total of 39,930 coho were landed in 1977 (Table 7 and Figure 3 of Appendix I).

Reports indicate that the fishery on the lower Puyallup has impacted

stocks returning to the White River (WDF 1961) (Heckman 1964, 1967). Comparison of White River trap counts and Muckleshoot Indian fish landings on the White River with Puyallup River catch statistics (Figures 1, 2 and 3 of Appendix I) for the late 1950's through the early 1960's reveals a declining trend in White River stocks coincident with increased landings on the Puyallup River.

Historical Indian catch statistics of chinook, coho, chum, and pink salmon landed in this fishery through 1981 are presented in Table 7 of Appendix I; Indian landings of steelhead on the mainstem Puyallup since the 1952-1953 season are presented in Table 8 of Appendix I.

2. Sport Fisheries

Puyallup River sport catches of salmon and steelhead are presented in Tables 9 and 10 of Appendix I; however, these statistics include landings for the entire Puyallup system and as such do not exclusively reflect harvest trends in the lower river which would directly impact White River stocks.

Heckman (1964) regarded the Puyallup River is one of the leading steelhead sport fishing streams in Washington, consistently ranking in the top ten streams in the number of fish caught annually. Heckman (1964) noted that the number of sport-caught fish on the Puyallup showed a downward trend since the mid 1950's. Winter-run landings since 1961-1962 (Table 10 of Appendix I) reflect a continued downward trend through the 1980-1981 season. The relative contributions of hatchery produced fish and wild steelhead are not clear.

C. Elliott Bay - Duwamish River Fisheries

Historical records of the early commercial salmon fisheries in Puget Sound describe an intense fishery at the mouth of the Duwamish River.

Fisheries at this site are of relevance to White River stocks because prior to 1906 the White River flowed into this drainage.

Bagley (1929), describing the development of this early fishery, recalled that in the winter of 1853 Dr. David S. Maynard, a Seattle entrepreneur, asked Chief Sealth to show him the best local fishing ground and Sealth took him to the mouth of the Duwamish. By summer, Maynard employed as many as one hundred Indian fishermen and had established facilities for processing fish oil and curing fish, which he packed in barrels and marketed in San Francisco. Activities of this type continued over the next twenty-five years, with Indians doing the fishing while settlers packed and marketed the fish oil and salted fish. Bagley notes that it was not uncommon to see sixty canoes at any one time fishing at the mouth of the Duwamish. Also, since early times, weirs were employed for commercial fishing at this location. One built by Victor E. Tull in 1877 took as many as eight hundred fish in one night. The Elliott Bay fishing industry developed further as canneries moved into the area. The first was Jackson, Meyers and Company, which moved their operations from Mukilteo to Elliott Bay in 1880.

Early reports of the State Fish Commissioner (1912) documented heavy fishing downstream of the "White River" hatchery (now known as the Green River Hatchery). Diminished returns to the hatchery were attributed to abuses of a law passed in 1911 "which gave anyone a right to fish for his own family use at any time or place." The same report notes that catches of salmon-trout (juvenile salmon) for several years past "has cut down the amount of mature fish that would have returned." This reportedly reduced returns to the White River Hatchery.

D. Puget Sound and High Seas Fisheries

Though the actual harvest rates are imprecisely known, Puget Sound and High Seas fisheries annually take a percentage of the White River - Puyallup System fish stocks. These fisheries have historically included recreational fisheries, the commercial troll fisheries, and the commercial net fisheries.

Henry (1977) reported dramatic increases in fishing effort for both sport and commercial marine fisheries. Since the mid 1960's, chinook and coho catches in the Puget Sound net fisheries, Washington troll fisheries, and the Washington ocean sport fisheries have been increasing. In addition to Washington user groups, Canadian fisheries - which include the troll fishery off the West Coast of Canada and the net fisheries in the Strait of Juan de Fuca, have grown to take over one-half of the Puget Sound coho and chinook that are caught by any commercial fisheries (Henry 1977).

Thus, these fisheries which are less conspicuous than the highly visible Indian river fisheries, have significant impacts on the Puyallup fish stocks. Recent attempts at negotiating a treaty involving Oregon, Washington, Alaska and Canada have been discouraging.

Data provided by WDF showing contribution rates of Puyallup System coho releases are presented in Table 17 of Appendix I. These data represent the results of studies conducted on tagged groups of coho released from the Puyallup Hatchery and White River which indicate the proportions of Puyallup System coho caught by the various marine fisheries. These data indicate that for all release groups combined, the percentage harvested by Canadian fisheries (32.4%) averaged about one-half the percentage landed by all Washington fisheries (63.8%). Of the Washington fisheries, the ocean troll fishery harvested variable portions, which were comparable to those taken by the Puget Sound net fisheries. Washington sport user groups followed next in

order of the proportion of fish harvested. Other fisheries which harvested a minor portion of the tagged fish included the Washington coastal net fishery, the Alaska net fishery, and the California troll fishery.

E. Illegal Fisheries and Poaching Activities

In addition to the legal harvest of White River stocks, numerous instances of poaching have been documented over the years.

The early field notes of Emerson Hart (1928), for instance, refer to poaching below the diversion dam at Buckley in 1928:

"These salmon that are in holes below the dam are at the mercy of anyone who wants to take them. There have been several men and boys arrested within the last three days for gaffing these salmon."

In a letter discussing White River fish runs, Brennan (1938) wrote:

"...the area in the immediate vicinity of Buckley affords considerable salmon fishing both legal and illegal. In order to break up the depredations the department in the year 1930 spent over \$1000 in patrolling this small area in which it was not uncommon to find as many as 150 people along the stream. Each year a number of arrests are made in this area for illegal fishing."

Additionally, WDF correspondence dated July 1, 1932 reports a complaint of gaffing and netting chinook salmon at the diversion dam and a letter dated July 14, 1932 from Joseph Enicok to B. M. Brennan describes the arrest of persons in this area for gaffing fish.

Regarding incidents of poaching at the Buckley fish trap in the 1940's, a letter from Milo Moore (Director of Fisheries) to Frank J. McLaughlin (President of PSP&L) dated July 22, 1946 states:

"The Department of Fisheries has just completed an investigation into illegal fish violations occurring at the Buckley Dam. A number of these violations involved Army Engineers employed, especially those directly related to hauling fish from the Buckley trap."

In more recent times, agents from the Department of Fisheries (WDF) and the Department of Game (WDG) have annually arrested individuals engaged in

illegal fishing along the White and Puyallup rivers. Bruce Richards (1982), Game Department enforcement agent, reported that over a five-year period approximately 12 arrests were made per year involving illegal steelhead sport fishing and about five arrests per year were related to illegal net fishing. Richards (1982) also noted that in the White River steelhead Indian subsistence fishery, Game Department agents typically pull three times the number of nets that are actually involved in arrests, because of problems in jurisdiction and courts.

Regarding illegal salmon fishing activities, Larry Johnson (1982), WDF Enforcement Sergeant, reported that arrests in 1981 included one person on the Puyallup for failing to report his catch of salmon, five commercial gill netters arrested in conjunction with a federal court order, and one arrest on the White River for fishing in closed waters. Johnson (1982) also noted that in years past (since 1968) more illegal activity occurred on the White River, but recent declines in the numbers of fish reaching this area has resulted in fewer hours of patrolling.

V. RECENT TRENDS IN SALMON HARVEST MANAGEMENT

A. Background

In 1979 WDF first proposed a management plan to protect the wild salmon runs of Puget Sound, noting: "Virtually all parties have agreed that a definite long-range salmon enhancement and management plan is needed for Puget Sound" (WDF 1979a). This proposal is part of what is sometimes referred to as the "Magnuson Bill."

At the time of this proposal, a significant portion of the remaining natural Puget Sound runs consisted of stocks returning to the Skagit, Stillaguamish, and Snohomish systems. It was estimated that these three rivers accounted for 42 percent, 48 percent and 67 percent of Puget Sound fall chinook, coho, and pink salmon potentials, respectively. The basic thrust of the plan was to manage these three rivers for natural production, while emphasizing artificial production in regions having the best past record of survival and contribution to Washington fisheries: the Hood Canal for chum, Bellingham Bay for commercial chinook, and South Puget Sound for coho and chinook. WDF estimated that the overall plan could at best achieve 50 percent mitigation of the natural run potential of Puget Sound asserting "Utilization of full potential is, however, an unrealistic goal." (WDF 1979a).

With few modifications, this management approach is in effect today (WDF, Pers. comm.). Thus, for streams in the South Puget Sound area (e.g. the Puyallup System) management emphasis is on hatchery production of chinook and coho stocks and streams in the Puyallup system are not managed by escapement of wild stocks. WDF estimated that the natural production potentials affected by this plan total 57,000 coho in South Puget Sound (WDF 1979b).

It has generally not been the policy of WDF to manage the White River salmon stocks independently of the Puyallup system as a whole (WDF, Pers.

comm.). Thus, because Puyallup system harvests are no longer managed by the escapement of wild stocks, and White River wild stocks are harvested while mixed with Puyallup Voight Creek hatchery fish targeted at a high harvest rate, White River stocks have suffered the adverse effects of a mixed stock fishery. Recently, there has been a general re-emphasis on wild fish (Wildfish Conference, Peninsula College, J. Walton ed. 1983).

B. Harvest Management Trends Since 1975

1. Coho

Coho management methodology is described in WDF Technical Report No. 28. Pre-season predictions of the coho run size destined for the South Puget Sound management area are made for each run year ($X + 2$) based on river flows in year X . Though forecasts are not made for each river system of South Puget Sound, the area wide estimate is apportioned to specific river systems (e.g. the Puyallup) based on production potential for naturally spawning runs, and contribution rates of micro-tagged salmon for hatchery runs. In-season estimates of run size are updated as catch data are received from area 10 (Zillges 1977).

The harvest rate for Puyallup coho stocks depends on the fishery in areas 10, 11 and 11A (Figure 9). In recent years, high relative harvest rates have been recommended for these stocks (which include White River stocks) to ensure full harvest of the hatchery run (WDF 1979b). This objective is consistent with the WDF proposal (WDF 1979a) to manage South Puget Sound primarily on the basis of artificial coho production; however, this approach does not protect the naturally spawning runs of the system, which cannot sustain such high rates of harvest.

Studies have indicated that, due to higher survival rates, hatchery coho

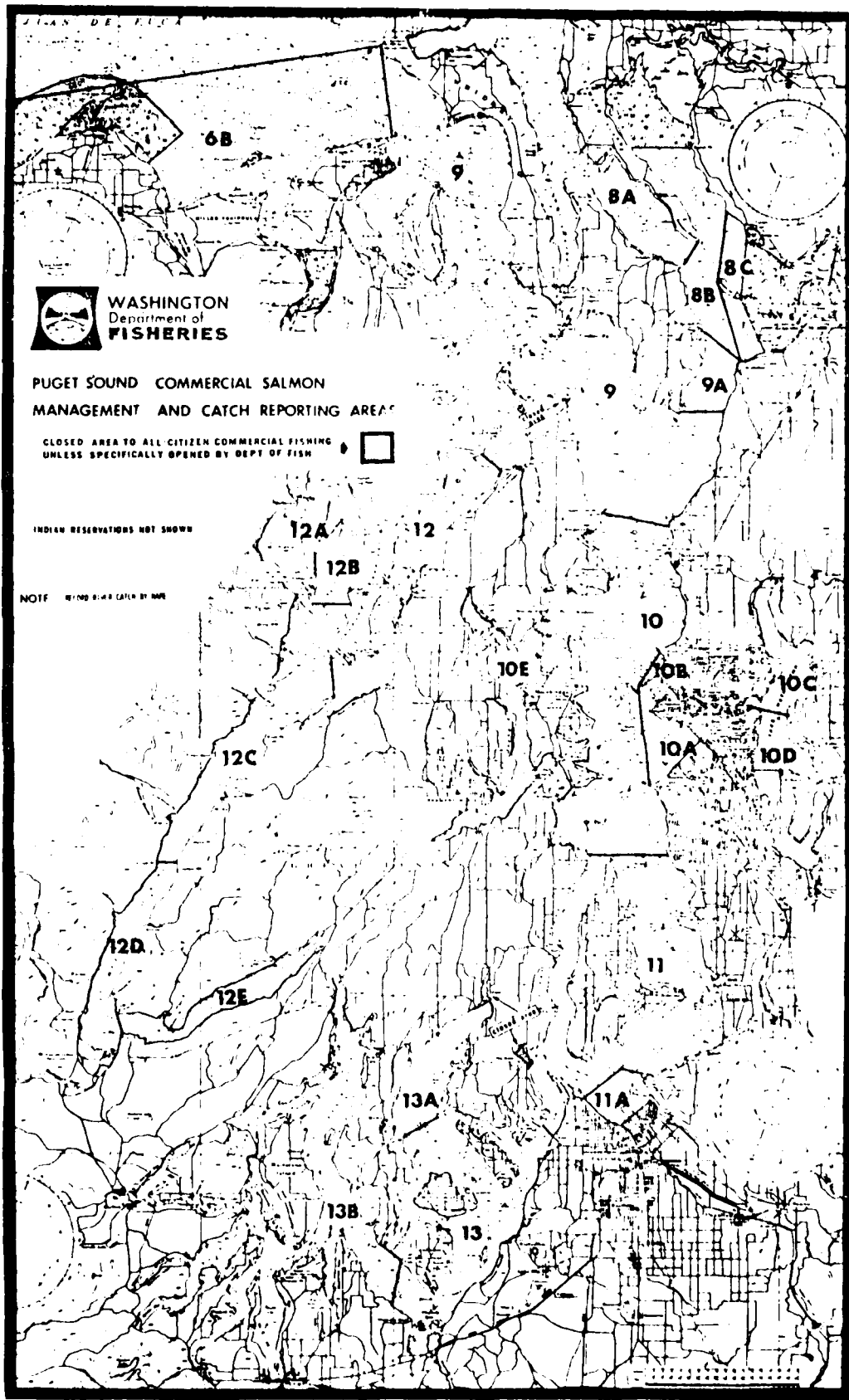


Figure 9. WDF Puget Sound commercial salmon management areas.

can sustain total fishing rates as high as 97 percent (a catch: escapement ratio of over 32:1), while at best natural coho populations can be maintained with fishing rates of 75 percent (a catch:escapement ratio of 3:1) (WDF 1979a). As a result, when natural and artificially produced stocks are fully harvested while they are mixed, the only possible results are underfishing hatchery runs if natural runs are protected, or overfishing natural stocks if full harvest of hatchery runs is desired. This phenomenon, often referred to as the mixed stock fishery concept, is recognized as one of the most serious problems facing Washington salmon managers today (Henry 1977).

Evidence suggests that this principle has operated in the Puyallup System, where management objectives have centered on full harvest of the Voight Creek hatchery runs. A WDF management report (WDF 1978) states, "The escapement expected in 1978 is less than the biologically determined level in some areas (e.g. Puyallup and Nooksack) because the natural run overlaps a hatchery run that should be harvested at a high rate."

Table 2 summarizes WDF coho management recommendations for the Puyallup System since 1975. It is noteworthy that expected escapements in recent years have repeatedly fallen below the natural escapement goals (based on river production potentials) of 14,455 set for 1975 and 11,000 set for 1977. WDF data presented by Finney et al. (1982) (Table 16 of Appendix I) indicates that catch:escapement ratios for five groups of Puyallup stock coho, considered representative of hatchery and native stocks, averaged 13.5:1. Harvest intensity of this order is not compatible with preservation of wild spawning coho (as noted above), which can at best sustain a catch:escapement ratio of 3:1 (WDF 1979a). These trends indicate that management emphasis on full harvest of artificial coho production has compromised natural spawning escapement levels in the Puyallup system.

Table 2. Status of Puyallup system coho and recommendations for management^{1/}

Year	Predicted total return		Expected harvest		Expected escapement		Natural escapement goals		Comments
	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	
1975 ^{2/}	14,460	42,000	5	37,000	14,455	5,000	14,455		
1976									
1977								11,000 ^{3/}	Hatchery strays will augment natural escapement
1978	14,000	89,200	13,400	86,300	600	2,900			
1979	10,000	50,800	9,100	46,300	900	4,500			
1980									
1981									
1982	30,900	77,200	29,500	73,700	1,400	3,500			

^{1/} From WDF Progress Reports, Nos. 57, 90, 158.

^{2/} From (WDF 1975).

^{3/} From WDF Technical Report No. 28.

2. Fall Chinook

Fall chinook management methodology is detailed in WDF Technical Report No. 29. Similar to the process described for coho, a forecast of run size to South Puget Sound is determined and then apportioned to individual rivers. Run size forecasts are based on historical escapement levels and the distribution of the predicted run by river system is determined by the contribution rate in previous years. In contrast to the methodology used for coho, fall chinook escapement goals are not based on the amount of spawning habitat available. As a WDF report notes, "The spawning area available to chinook greatly exceeds the amount needed to support rational spawning escapements" (Ames and Phinney 1977). Escapement goals have therefore been based primarily on historical escapement levels.

Typically, fall chinook escapement estimates are based on spawning ground counts in index areas. The glacial nature of the Puyallup system, however, precludes effective spawning ground counts. As a result, fall chinook escapement to the Puyallup is among the most difficult to estimate in Puget Sound (Ames and Phinney 1977). The most recent (and reliable) estimates of escapement to the Puyallup have been produced by relating 1975 and 1976 tag study results (Puyallup Tribe and USFWS 1977) to spawning ground counts on South Prairie Creek. Re-calculation of escapements for 1965-1976 by this method revealed a declining trend, coincident with the resumption of chinook fishing by treaty Indian tribes and thus were not felt to represent the needs of the basin (Ames and Phinney 1977). Because in-river harvests were at a minimum from 1965-1970, the mean escapement for this period (3250) was established as the escapement goal for the naturally spawning fall chinook stocks of the Puyallup system.

WDF Puyallup System summer/fall chinook management recommendations for

1975-1982 are summarized in Table 3. Since 1979, recommended harvest rates have been based on full harvest of the hatchery run. Thus, as with coho, naturally spawning escapements of fall chinook to the Puyallup system (which includes White River runs) have been compromised.

3. Spring Chinook

The spring chinook stocks of the Puyallup-White system are in a state of depletion (Table 4) and have had no scheduled harvests since 1975. Native stock rehabilitation projects have aimed at saving the stocks of the Carbon River, and more recently those of the White River (see "Enhancement activities," Section VII).

4. Chum and Pink Salmon

In response to recommendations from treaty Indian tribes, chum and pink stocks of the Puyallup System continue to be managed on the basis of natural escapements (WDF, Pers. comm.). WDF status reports of Puyallup system chum and pink stocks and recommendations for management since 1975 are summarized in Tables 5 and 6, respectively.

Table 3. Status of Puyallup system summer/fall chinook and recommendations for management^{1/}

Year	Predicted total return		Expected harvest		Expected escapement		Escapement goals		Comments
	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	
1975 ^{2/}	3,124	3,120	0	244			4,500	1,500	A portion of natural escapement should be supplied from hatchery return.
1976									
1977	2,150	4,800	0	0	2,150	4,800	3,250	4,800	
1978	2,900	1,300	0	0	2,900	1,300	3,250	1,300	
1979	2,000	1,500	1,000	750	1,000	750	-	-	Hatchery will take all available eggs ⁴
1980	3,200	2,900	1,000	900	2,200	2,000	-	-	
1981	3,100	4,000	1,700	2,200	1,400	1,800	-	-	
1982	2,900	4,100	1,300	1,900	1,600	2,200	1,600	-	Harvest rate based on either hatchery needs or mean natural escapement

^{1/} From WDF Progress Reports, Nos. 19, 70, 89, 107, 130, 163.

^{2/} From (WDF 1975).

Table 4. Status of Puyallup system spring chinook and recommendations for management--^{1/}

Year	Predicted total return		Expected harvest		Expected escapement		Escapement goal	
	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery
1975 ^{2/}	300-500	Few	0	0	800	See comment (1)		
1976								
1977								
1978	250	Few	0	0	250	Few	800	See comment (2)
1979	50	100	0	0	50	100	Undetermined	0
1980	Few	150	0	0	Few	150	800	See comment (3)
1981	Few	-	0	0	Few	-	See comment (4)	See comment (5)
1982	Few	-	0	0	Few	-	See comment (4)	See comment (5)

^{1/}From WDF Progress Reports, Nos. 41, 81, 98, 129, 155.

^{2/}From (WDF 1975).

Comments: 1. Carbon River native stock rehabilitation project.

2. Primarily White River stock. Run requires complete protection. Adults to be used for artificial propagation. All juveniles will be planted in White River.

3. Run requires complete protection. Local native stock rehabilitation project. Success not yet evaluated. All adults needed for artificial propagation.

4. All adult returns are needed for enhancement efforts to perpetuate the run through development of an egg-bank source.

5. All adult returns to Minter Creek will be required for enhancement. Return rate is uncertain for this program.

Table 5. Status of Puyallup system chum salmon and recommendations for management.^{1/}

Year	Predicted total return		Expected harvest		Expected escapement		Escapement goals		Comments
	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery	
1975 ^{2/}	8,750	-	0	-	8,350	-	10,000	-	
1976									
1977	11,700	-	7,000	-	4,700	-			
1978									
1979	3,900	1,000	2,400	600	1,500	400			Puyallup Tribal program
1980	4,300	8,500	2,400	4,800	1,900	3,700			Puyallup Tribal program. Escapement represents harvest rate appropriate for natural chum.
1981	2,100	700	600	200	1,500	500			
1982									

^{1/} From WDF Progress Reports, Nos. 31, 92, 115, 140.

^{2/} From (WDF 1975).

Table 6. Status of Puyallup system pink salmon and recommendations for management^{1/}

Year	Predicted total return		Expected harvest		Expected escapement		Spawning ground esc. goal	Comments
	Natural	Hatchery	Natural	Hatchery	Natural	Hatchery		
1975 ^{2/}	9,200	-	0	-	9,200	-	25,000	
1976								
1977	10,800	-	0	-	18,000	-		
1978								
1979	36,900	-	17,400	-	19,500	-		500 fish escape- ment needed for eggs for egg boxes.
1980								
1981	95,000	1,800	76,000	1,400	19,000	400		Harvest rate appropriate for natural stocks
1982								

^{1/} From Progress Reports, Nos. 19, 89, 130.

^{2/} From (WDF 1975).

Ten thousand and one (10,001)
walked across the stream on
the backs of the salmon...
the one was the problem.

VI. MAN-RELATED IMPACTS AFFECTING WHITE RIVER ANADROMOUS FISH RUNS

A. Introduction

In a statement by the Washington Department of Fisheries, Johnson (1980) acknowledged: "The White River probably presents more problems to salmon resource production than any other individual stream in Puget Sound." Various committees of concerned parties have met to discuss White River fishery problems over the years; notably the White River Fishery Improvement committee (1968-1972) and more recently the White River Fisheries Enhancement Committee (see Section VII, "Enhancement Activities").

A timetable of events in the history of the White River is given in Table 1 of Appendix III and in Figure 7. A list of problems recently compiled by the White River Fisheries Enhancement Committee (1982) (Figure 1 of Appendix III) also emphasizes the extent of man's impact on the White River today. Some of the major perturbations having impacts on the White River are discussed below.

B. Perturbations Which Have Impact White River and Its Anadromous Fish Runs.

1. Logging Activities

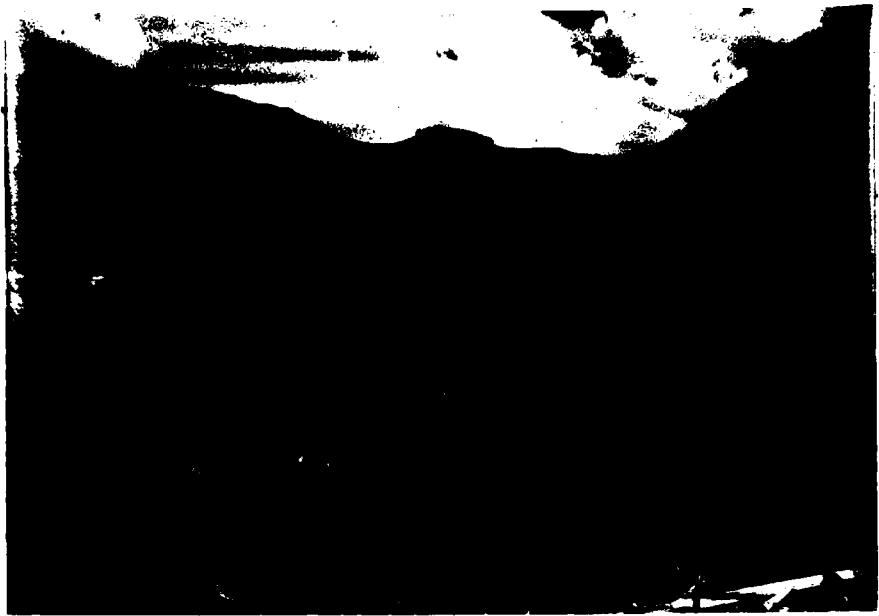
Logging began in the White River drainage near the turn of the century with the formation of the White River Lumber Company (Weyerhaeuser Co. 1979). In 1897 the White River Lumber Company acquired a mill at Ellison on Boise Creek and a planing mill at Enumclaw. The two mills were connected by a three mile long flume which used water from Boise Creek. The mill at Enumclaw was used until 1928 and had a capacity of 100,000 board feet per day. In 1931 a new mill was built at Ellison which had a capacity of 600,000 board feet per day. The White River Lumber Co. affiliated with Weyerhaeuser Co. in 1929 and

operated jointly until 1949, when the two companies merged (Weyerhaeuser 1979). The magnitude of clearcut areas in the upper watershed is illustrated by the White River District Fireman's Map (USFS 1979).

Weyerhaeuser Co. owns 68,000 acres in the White River drainage, most of which is now in second growth timber (Beyerman 1983). Since 1947, an additional 13,699 acres of United States Forest Service lands drained by the White River have been cut (Wolfson 1982). The Washington Department of Natural Resources noted that logging on state lands in the White River drainage began in the early 1960's and since that time approximately 7,000 acres have been cut (Ben Cleveland, pers. comm.).

The adverse effects of clearcut logging in the upper watershed has frequently been cited as a factor limiting White River fish production (WRFIC 1968b), (PSTF 1970), (Wilson 1973), (Williams et al. 1975), (WDE 1980), (Johnson 1980), (WRFEC 1982). Williams et al. (1975) reported that extensive clearcut logging, removal of natural stream cover, and logging road construction not coordinated with fish production requirements have reduced the quality of available fish production habitat in the Greenwater, West Fork, and Clearwater drainages.

In the past, impacts from clearcutting included: 1) altered runoff patterns (changed magnitude of low and flood flows), which resulted in increased turbidity and stream siltation (PSTF 1970), 2) improperly constructed logging roads, which led to road failures with adverse impacts to stream habitat (WDE 1980) (Finney et al. 1982), (WRFEC 1982) and 3) log jams and debris blockages which impeded fish migration (Williams et al. 1975) (WRFEC 1982). Poor and illegal logging practices (Forest Practices Act violations) have damaged the streams used by salmon (WRFIC 1968b) (WDE 1980) (WRFEC 1982). Modern silvicultural practices, including the use of herbicides



Section of typical clearcutting in the upper watershed.



Culvert on logging road in upper watershed limiting salmon access to spawning area.

and fertilizers are also reported to have degraded the natural habitat (WRFEC 1982).

Finney et al. (1982) recently reported evidence of fish habitat degradation resulting from logging activities in the upper watershed. Based on stream surveys conducted between May and December of 1980 and 1981, Finney et al. (1982) noted that the effects of logging activities included: 1) increases in stream temperatures due to decreasing the amount of vegetation available for stream shading, 2) increased siltation in tributaries (which covers gravel spawning beds) due to increased road construction, 3) silt loading and/or excessive bedload movement due to culvert "washouts," 4) restriction of fish access to available habitat by improperly designed culverts, 5) decreased instream cover, loss of pool habitat, decreased channel stability, and decreased stream energy dissipation caused by over-cleaning of stream channels, 6) decreased riparian vegetation due to physical destruction and/or streambed erosion resulting in channel instability, loss of shading, and loss of vegetation important to aquatic food chains, and 7) log jams resulting from excessive accumulations of logging debris which decreases access by anadromous fish and, if washed out, can displace bedload and cause channel scouring and channel shifts.

2. Flood Control Activities

a. Mud Mountain Dam

Designed as a single purpose flood control facility, Mud Mountain Dam is located 29 miles upstream from the confluence of the White and Puyallup rivers (Figure 1). Construction of the facility began in August, 1939 and was halted in 1942 as a result of World War II. Work was resumed in 1947 and completed in 1948. The earth and rockfill dam is 700 feet long at the crest, 425 feet high above bedrock (350 feet high above streambed), and approximately 1600

feet thick at the base and provides 106,000 acre-feet of flood storage with the reservoir at the spilling crest (USACE 1971).

Mud Mountain Dam constitutes a complete barrier to upstream fish migration; however, a trap and haul operation at the Buckley diversion has transported fish to a point upstream of Mud Mountain since 1940. The 6 miles of habitat from the dam to the Buckley trap presumably have been lost as potential salmonid spawning area, although at times fish may have gotten into the area. Also, because the fish release site is located upstream of several small tributaries (e.g. Bear and Scatter Creeks), it has been suggested that some relocation of stocks may have resulted from the trap and haul operation (WRFEC 1982).

Adverse impacts to spawning and rearing habitat resulting from the routine operation of Mud Mountain Dam for flood control have been documented. During impoundment, an average of approximately 3 miles of river are converted to a reservoir (USACE, pers. comm.) and thus are lost as potential spawning and rearing habitat. Of significance to the stream habitat below the dam are releases of water heavily laden with silt. An estimated 50,000 - 250,000 cubic yards of sediment and approximately 8,000 - 10,000 cords of drift accumulate each year behind the dam (USACE 1971). As the pool level is drawn down and the trash racks are cleared of debris, large quantities of sediment are sluiced into the river downstream. Newly planted salmon have been flooded from the channel (USACE 1971) (WDF 1970a, 1970b) and silt and debris have caused suffocation of eggs in the gravel by this process (USACE 1971, 1978) (WDG 1971). Destruction of food organism habitat in this reach has also been attributed to siltation from Mud Mountain Dam releases (WDG 1971) (Wilson 1974).

Mortality of adult salmon and delay in upstream migration have also been

associated with releases of sediment from Mud Mountain Dam. Flushing of accumulated silt in autumn coincides with the migration of coho salmon and has resulted in losses of adult fish by smothering (WDF 1970b). Fisheries department personnel estimated a kill of 200 adult salmon as a result of sediment flushing in October, 1965 (Heckman 1967). Though this event was considered an uncommon incident (WRFIC 1968b), delay of adult fish moving upstream was noted as "one of several concerns" which "surfaces each year" as a result of this process (USACE 1978).

Delay and mortality of downstream migrants are also recognized as impacts of Mud Mountain Dam. The Dam is equipped with two outlet structures for discharge of impounded waters - a 9-foot diameter tunnel with an intake elevation of 895 feet m.s.l. (above mean sea level), and a 23-foot diameter tunnel that contains three steel penstocks. The 23-foot diameter tunnel with an intake elevation of 970 feet m.s.l. is controlled by three Howell Bunger valves. Typically, discharge occurs via the 9-foot diameter tunnel, but during floods or periods when the 9-foot tunnel is being inspected or repaired, the 23-foot tunnel is utilized (USACE, pers. comm.). Downstream migrant mortality in the 9-foot diameter tunnel is not believed to be high (Regenthal and Rees 1957), but on occasions when discharges from the 23-foot tunnel coincide with downstream migration, fish losses are substantial (WRFIC 1968b). Fish mortalities result from physical contact with the Howell Bunger valves and impact with the rock canyon wall on the opposing bank (Regenthal and Rees 1957) (WRFIC 1968a, 1968b) (USACE 1974).

Delay of smolts during out-migration has been reported to result from excessive pool elevations behind the dam. A letter dated May 23, 1953 from the Washington Department of Fisheries to the USACE states:

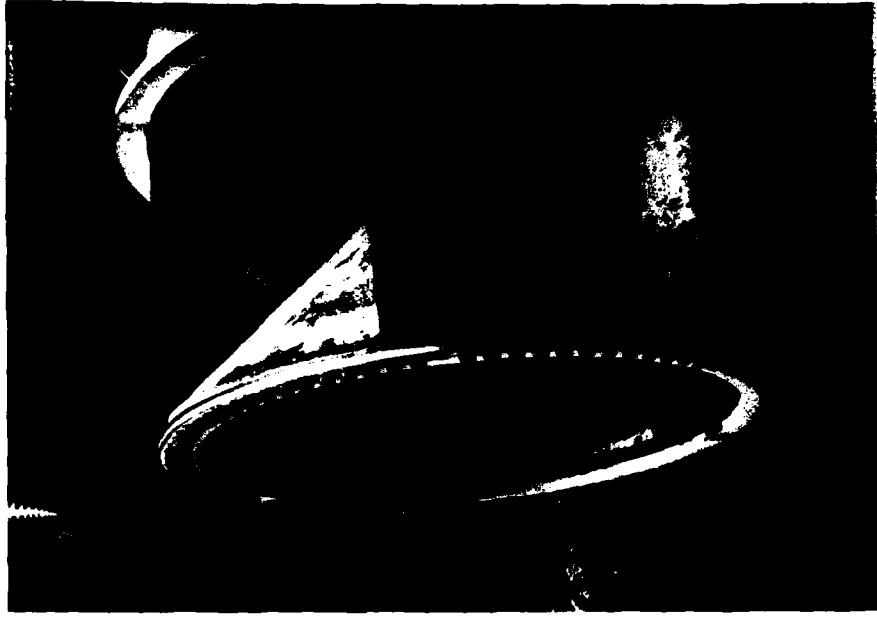
"During the period February 15 to July 1 of each year, there is a constant downstream migration of fish from the river areas above the dam.

The production of migrant fish above the dam can be disastrously depleted if not totally lost by maintaining pool elevations that result from the total blocking for the hazardous passage of these fish through the dam."

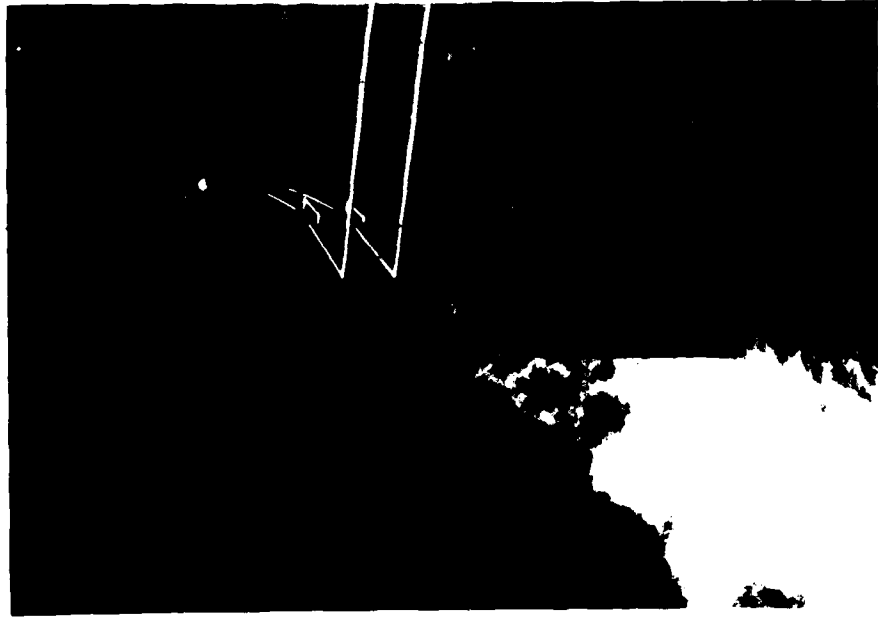
Studies conducted by WDF in 1956 suggested that large numbers of chinook and coho out-migrants were delayed until pool levels fell below 80 feet in depth (Maib and Dunstan 1956). Further investigations by Regenthal and Rees (1957) indicated some period delay at all levels tested; though nearly all silver and chinook migrants would pass through the dam at pool levels of 118 feet or less, only eight percent (or less) of each species would exit at levels of 160 feet (see Table 7).

Current reservoir operational procedures are such that the pool is maintained at as low an elevation as practical. During the flood season (October through March) storage capacity is reserved for flood peak attenuation, but after a high flow event the pool is quickly drafted. Under non-flood conditions the pool is kept low to prevent excessive sediment deposition in the reservoir, thus normal river discharges are passed through the 9-foot diameter tunnel which is throttled for downstream turbidity control. Whenever the elevation reaches 970 feet, discharges pass into the 23-foot diameter tunnel and through the Howell-Bunger valves. The total capacity of both outlets with the pool elevation at 1215 feet is 17,400 cfs (4,800 plus 12,600, 9-foot and 23-foot tunnels, respectively). Pool elevation exceeds 1000 feet (MSL) about 10 percent of the time, and 970 feet about 45 percent of the time (Tudor Eng, 1982). The mean pool elevation for May is above 970 (980) and above 1000 feet in June so undoubtedly a number of the downstream migrants are lost by migration through the 23-foot tunnel in average years.

Some thought has been given to the use of the 23-foot tunnel, and its three penstocks, for power generation and Tudor Eng (1982) estimates that



One of three Howell Bunger valves on
the 23-foot diameter tunnel outlet.



The outlet of the 9-foot diameter tunnel.

Table 7. Calculated percentages of coho and chinook migrants passing through a submerged exit at various forebay levels in a 100-day period, Mud Mountain, 1957.

Reservoir level (feet)		Percentage of coho exiting (approx.)	Percentage of chinook exiting (approx.)
Range	Mean		
109 - 125	118	100%	more than 95%
120 - 140	133	75%	55%
142 - 154	146	60%	48%
158 - 162	160	8%	less than 8%

¹ From: Regenthal, A. F. and W. H. Rees. 1957. The Passage of Fish Through Mud Mountain Dam. Washington Department of Fisheries.

power could be generated on about 80 percent of the days although the pool elevations are "normally" above the 970-foot level (the elevation of the invert 23-foot tunnel) only about 45 percent of the time.

Appropriate screening of the tunnel would be necessary (Tudor Eng 1982). This could be an advantage for the fish over the existing conditions (Eicher, G., pers. comm.). Excessive debris would require unusual protection for the screens and the concept of screening may be formidable.

During the fall, winter and spring, pool elevation fluctuates widely making it unsafe for public use. During the summer, the pool is temporarily elevated to float debris for collection and transport to a debris basin where, after lowering of the pool, the consolidated debris is burned.

Besides the continuous discharge of the sediment, an accumulation must be eroded away as a routine operation procedure. After a major flood in 1977, an estimated 2 million cubic yards of sediment was deposited in the reservoir and it took about four months to erode out the material.

b. ICRI

The Inter-County River Improvement Agency was founded in 1914 to "...perpetually control the waters of White River so that it would continue to flow to the sea through the Puyallup" recalled Thomas (1939) in his review of the first 25 years of ICRI work on the White and Puyallup Rivers. Early activities focused on straightening and clearing the river channels and "cut-offs" were made, resulting in a loss of 1.64 miles of river. This process resulted in "raw banks of open and loose earth," subject to rapid erosion and undercutting. Engineers realized that bank protection was required to prevent the river from deteriorating to a state "far worse than the original." Revetments of various types were employed over the years, which included

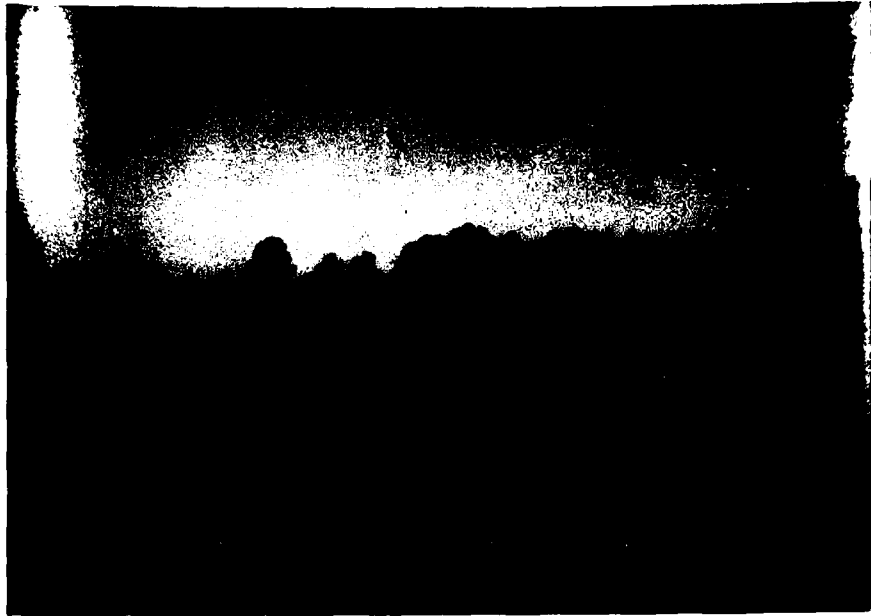
concrete slabs, brush mattresses, log cribs, brush retards, bulkheads, rolled wire, tetrahedrons, and more recently, rock walls (riprap). On-going channel clearing activities during this period included brush cutting on the banks and removal of large logs, trees, and stumps from the river bed - which were then placed on curves and at the mouths of old channels (Thomas 1939).

More recently, Stetson (1980) reviewed ICRI flood control works on the Muckleshoot section of the White River. His report notes that brush clearing and drift removal have been a continuous activity in this vicinity since early times. Gravel and rock dikes have been used for bank protection continuously since the late 1940's until recent years, and channel dredging began in this reach in 1949. Table 2 and Figure 2 of Appendix III summarizes quantities of gravel removed from the White, Carbon and Puyallup Rivers by ICRI (1974-1980).

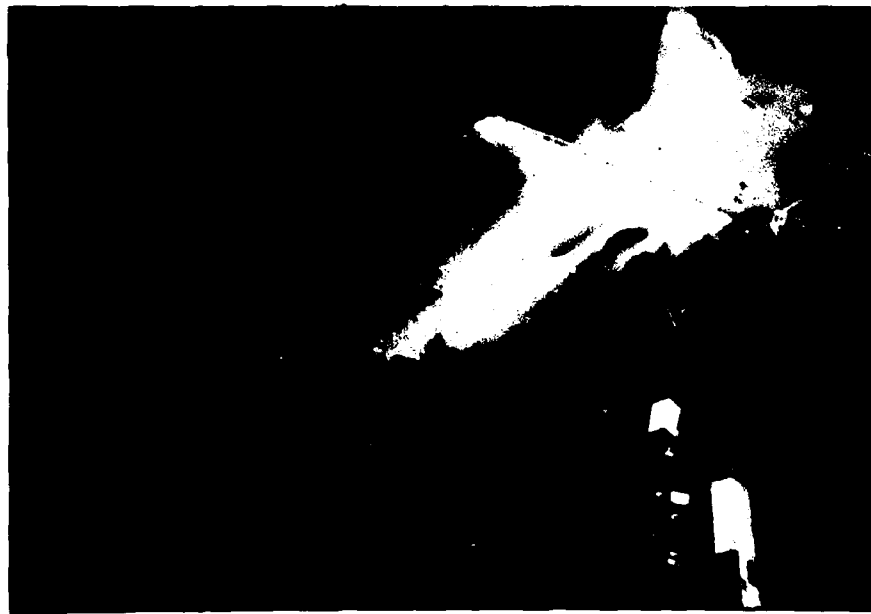
Perturbations such as these have decreased the quantity and quality of salmonid rearing habitat in the lower White and Puyallup Rivers. Transformation of the naturally meandering river into a straightened conduit to hold flood waters and the blocking of side channels has reduced the wetted streambed area available for spawning and rearing (Chapman 1980). Hydrological changes resulting from diking, channelization, and gravel removal have disrupted the natural pool-riffle structure of the streambed (Wilson 1974b), consequently reducing the quality of spawning conditions for salmon. Channel clearing activities can also potentially reduce the quality of salmonid habitat. Removal of large organic debris such as stumps, logs, and trees reduces the amount of pools and sheltered areas used as nursery habitat for young salmonids (Toews et al. 1982). Brush cutting along the banks reduces streamside cover, and can result in elevated summer stream temperatures and reduced input of terrestrial invertebrates - a food source for juvenile salmonids (Simenstad and Buechner 1980).

Over the years, ICRI and PCRI (Pierce County River Improvement Agency) activities have drawn repeated criticism from state and federal fisheries resource managers and the Puyallup and Muckleshoot Indian Tribes. A White River Fisheries Improvement Committee memo (1968b) noted that annual gravel removal and rechannelization activities by ICRI near Auburn and Dieringer "...interfere with fish migration and could directly cause fish losses." Correspondence from the state Legal Services Center to ICRI dated May 14, 1970 states that river rechannelizing work in the vicinity of the Muckleshoot Indian Reservation "is damaging to (the Tribes) rights and interests in the river, especially fishing." A letter from the Muckleshoot Indian Tribe to Mr. William Thornton of PCRI, dated March 2, 1976, is critical of gravel and log removal from the streambed and repair of the dike along the river bank, noting: "...the presence of the dike...must bear a large burden for the loss of fish runs from the White River System." Also, the Puyallup Indian Tribe brought an injunction against Pierce County which halted brush removal from the banks of any stream feeding the Puyallup River Basin (Puyallup Tribe vs. Pierce County Commissioners, District Court No. C79-269-T), claiming that such activity reduced the survival rate of juvenile salmon because streamside vegetation moderates water temperatures, creates shadows along shore, and provides a food source for salmon.

The USACE has also engaged in channel straightening activities for flood control on the Puyallup River; levees and revetments on a 2.2 mile reach in and near Tacoma were completed in 1950 (USACE 1977), (Figure 10).



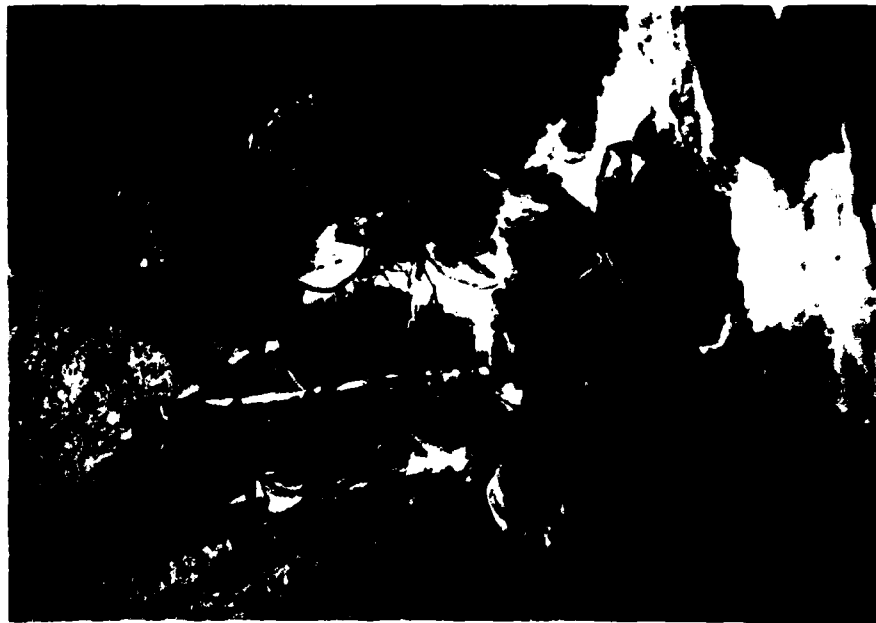
Section of White River downstream of PSP&L diversion dam showing one of the sites where ICRI gravel removal operations occur.



Aerial view of PSP&L diversion dam at Buckley.



Rotary fish screens on PSP&L diversion flume.



Log jam in bypass channel from PSP&L diversion flume.

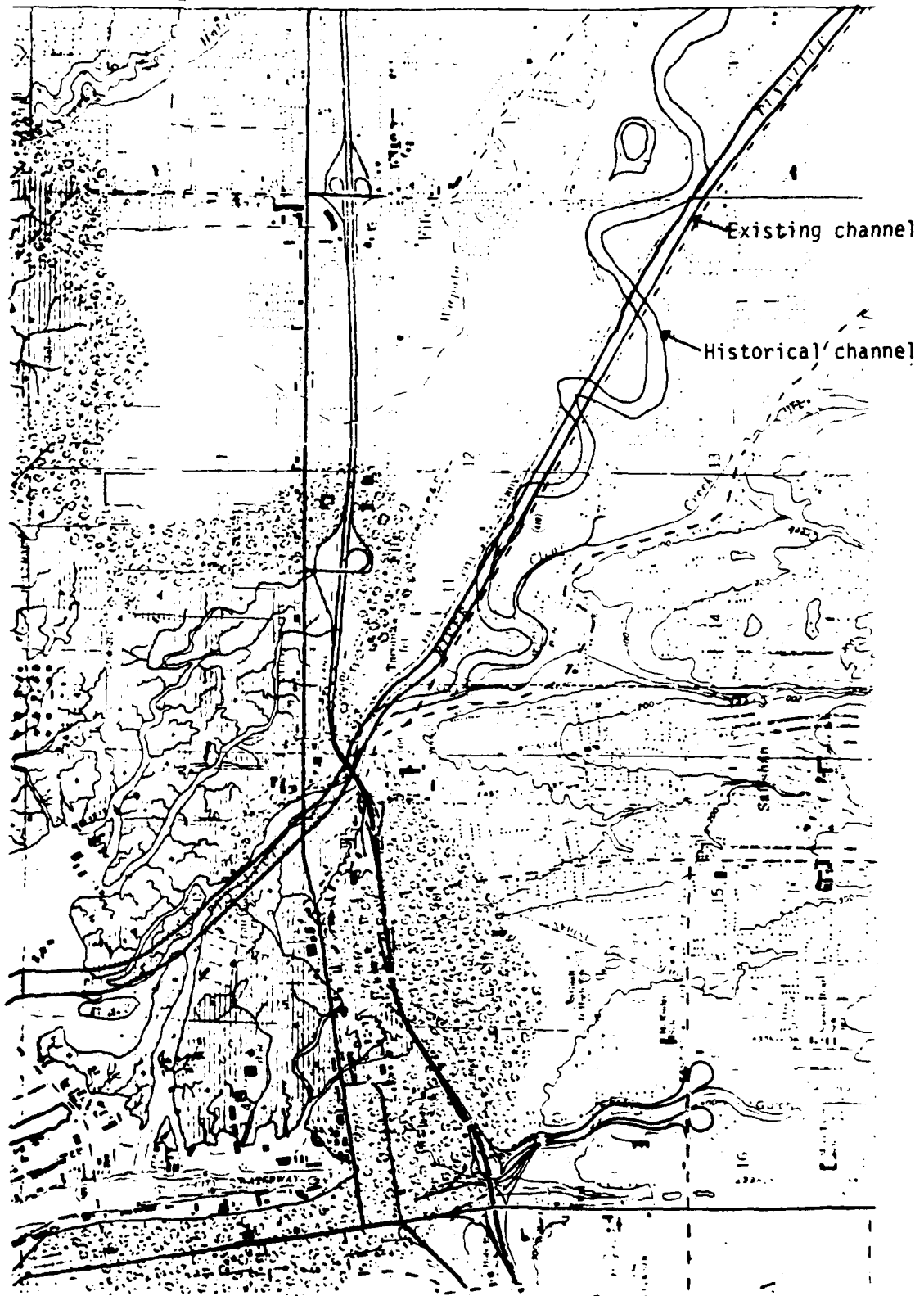


Figure 10. Map showing the historical and existing location of the lower Puyallup River channel.

Source: (Bortleson et al. 1980).

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3. Puget Power Facilities

The Puget Power hydroelectric project on the White River diverts water at Buckley which ultimately enters Lake Tapps and is used for power generation and returned to the river at Dieringer (Figure 7). Water diverted by this route bypasses 21 miles of the White River. Puget's facilities have been reported to limit production in the White River by affecting the upstream and downstream migration of salmon and the spawning and rearing potential of the Buckley to Dieringer reach (Williams 1975, PSTF 1970).

In years past, flushing of accumulated sediment from Dingle Basin, a settling pool in the Puget Power diversion, has been a concern of fisheries biologists. Ambrogetti (1974), a biologist with the United States Fish and Wildlife Service (USFWS), observed the silt flushing operation in November of 1973 and wrote:

"An increase in flow from two hundred cfs to several thousand cfs at this time of year must have affected the eggs incubating in the river gravel. The structural design of the Dieringer Flume requires that it be flushed periodically; but flushing in November when eggs are in the gravel must cause severe losses. Eggs incubating in the lower White River should be considered marginal before flushing, because of the numerous environmental problems in this area. Any extra stress put on these eggs should be a cause for alarm."

Since 1975 sediment discharges from Dingle Basin into the White River have been discontinued as a routine procedure and accumulations of sediment have been removed by truck from the PSP&L diversion (PSP&L, pers. comm.). William Finnigan (PSP&L) informally estimated that 300,000 to 700,000 cubic yards of sediment are removed annually from the area between the diversion dam at Buckley and Lake Tapps (Nece et al. 1982).

Historically, periods of low river flow downstream of the PSP&L diversion dam have been cited as detrimental to salmonid spawning and upstream migration (Muckleshoot Tribe, Appendix V). Early records (Parker and Lee, undated) report an October 1916 mean flow of 9.88 cfs at Buckley. Mean flows for

October and November 1917 were reported as 3.19 and 14.0 cfs, respectively.

Heckman (1964, 1967) and Wilson (1974) reported that low flows resulting from the diversion have impeded the upstream migration of adult salmon. Royce (1969) reviewed a computer analysis of the correlation between flow in the White River and fish counts at Buckley and reported that lack of data precluded an assessment of the relationship between low flows and fish passage.

A more substantial analysis of minimum flows and fish passages in the lower White River was conducted by the USFWS (1974). This study concluded that a release of 250 cfs at the Buckley diversion dam met the desired depth criteria for coho migration and 500 cfs met the depth criteria for chinook migration at all test sites. For adequate salmonid spawning flows between 170 and 230 cfs, approximately 8.5 to 10% of the bankfull area, were needed for fall chinook, while between 160 and 230 cfs, about 2 to 2.5% of the bankfull area, was needed for preferred spawning habitat for coho. The USFWS (1974) also reported observations suggestive of delayed migration due to low flows, and cited attraction to the Dieringer powerhouse outfall as a problem to upstream migration.

Early WDF records have reported downstream migrant losses due to Puget Power prior to the screening of the diversion flume in 1939. Brennen (1938) wrote:

"You must bear in mind in any statements concerning the number of fish that our present information is based on a watershed badly depleted in fish life owing to the fact that the power diversion has run unprotected since 1914. It is not uncommon to go into the settling basin in this ditch during downstream migration periods and see hundreds of migrants. At the occasional shut down of these basins during migration period it is not uncommon to find numbers of people obtaining fish from potholes."

and in the same letter,

"Evaluation of the fish runs should be based upon the size of the runs which existed before the depletion by destruction of downstream migrants."

Upon completion of the screen the loss will stop and the runs will build up to many times the present estimated magnitude and value."

Subsequently, concerns related to downstream migration of salmonids have centered on the efficiency of the rotary screens designed to return fish from the diversion flume via a bypass channel to the White River. Installed in 1939, this facility consists of eight rotating screen drums 14 feet in diameter and 12 feet wide mounted in concrete bays in the diversion canal. Washington Department of Fisheries reports claim that mortalities, delays in migration, and passage into Lake Tapps have resulted from the ineffectual operation of the screens (Regenthal 1953, Heg 1953a, Bostick 1955, Dunstan 1955).

Regenthal (1953) reported that preliminary studies revealed that 25.7 percent of all downstream migrants passed over the screens, including approximately 63.5 percent of the chinook and 17.6 percent of the coho downstream migrants.

Heg (1953) subsequently reported over-screen passage estimates of 47.9 percent for chinook and 6.9 percent for coho downstream migrants. Studies in 1955 revealed that fish passage over the screens was directly related to fish size; smaller fish (both chinook and coho) went over the screens more readily than larger ones (Bostick 1955). The percentage of fish lost over the screens in that year (Bostick 1955) were estimated to be 50 percent for chinook, and 75 percent for coho. Dunstan (1955) noted that of the "zero" chinook which passed over the screens, 73 percent were found to be dead, while the majority of coho which passed over the screens were found to be in good condition.

Reduced spawning and rearing potentials in the Buckley to Dieringer reach have also been attributed to Puget Power (Wilson 1974, USFWS 1974, Johnson 1980), though this stretch of river has not been considered particularly good habitat for spawning and rearing due to a poor river profile and sub-optimum

spawning gravels (Salo et al. 1972).

4. Industrialization and Urbanization

a. White River

Numerous pollution-caused fish kills on the White River have been documented in Washington Department of Ecology files. For instance, on Strawberry (Salmon) Creek, the discharge of 39,000 gallons of chlorinated water (used to clean a City of Sumner water holding tank) resulted in a fish kill of 150 coho and 10 searun cutthroat trout on January 27, 1981. An event years earlier on Salmon Creek led to a count of 135 dead fish, including 96 salmonids, in silty water of 13°C (WDE 1972a). The same area was observed to be affected by a toxic agent a week later; investigators reported: "The fish were nearly all coho salmon, which had apparently moved into the affected area to fill vacancies left by fish killed the previous week" (WDF 1972b). Department of Ecology records have also documented fish kills on Lake Tapps in 1971 (WDF 1971) and on an unnamed tributary of White River in 1970, where an estimated 500 game fish died in a three-day fish kill resulting from chrome pollution from the Boeing Air Company (WDE 1970).

Miller (1965) conducted a study on Boise Creek, a tributary in the lower reaches of the White River, to assess the effects of Weyerhaeuser lumber milling facilities and agricultural activities on the capacity of the stream to support salmonid embryos and fry. He noted that in contrast to upstream control sites, conditions in the industrial-agricultural areas sampled were inadequate or marginal for immature salmonids. High water temperature and intragravel DO was believed responsible for the degradation of these areas. In 1974, Kramer, Chin and Mayo (1975) also observed greatly degraded water quality in Boise Creek, attributed to discharges of Weyerhaeuser waste water.

Weyerhaeuser has subsequently upgraded their treatment facilities to meet state water quality standards.

Domestic sewage in various levels of treatment has been discharged into the White river over the years. Kramer, Chin and Mayo (1975) reported that Enumclaw operated a secondary treatment plant which discharged effluent through an outfall on Boise Creek, approximately 1.5 miles upstream from the confluence with the White River. Buckley operates a primary sewage treatment plant and discharges effluent into the White River. Also, the Rainier State School discharges effluent from a secondary treatment facility into the White River above the Puget Power diversion dam. Water quality has been degraded as a result of these discharges and is aggravated by low flow conditions below the diversion dam, which reduces the dilution factor of the effluent in the stream. Water quality violations have resulted from high fecal coliform counts in the White River, largely as a result of raw sewage overflows and insufficient chlorination capacity at the existing sewage treatment plants (Kramer, Chin and Mayo 1975). Fecal coliform counts of 240,000 mpn (most probable number) on Boise Creek were the highest reported within the Puyallup Basin (WL 1980). Enumclaw has recently upgraded their sewage treatment plant and Buckley has installed a new sewage treatment facility; discharges from these plants are 100 feet, and 1/2 mile downstream of the highway 410 bridge, respectively (Muckleshoot Tribe, Appendix V).

A problem particularly confounding to flood control engineers has been the increased residential development activity in the White and Puyallup River flood plain in recent years. Such development has resulted from poor land zoning practices and hampers the optimum operation of Mud Mountain Dam for flood control. During periods of high runoff, discharges reaching 11,000 - 12,000 cfs occur; while some residences downstream of Mud Mountain Dam are

flooded at discharges as low as 6000 cfs (USACE, pers. comm.). In addition to many single family residences, multi-unit developments have proliferated on the White River flood plain in recent years. For instance, Cedardowns (a residential mobile home community) and Lakeland Hills (a residential community) are two developments proposed with White River frontage. Increased human activity along the river and modified runoff patterns result from developments of this kind (Auburn 1980, 1981).

Urbanization and industrialization has also led to competing water uses in the White River. The city of Auburn diverts Coal Creek for the city water supply, which has been reported to result in a loss of salmonid spawning and rearing habitat. An expert retained by the Muckleshoot Indian Tribe estimates the number of harvestable fish annually lost due to this diversion to be 83 chinook, 451 coho, 6037 chum, 1580 pink, and 31 steelhead (Muckleshoot Tribe 1982). Also, the White River Lumber Company diverts about 4 cfs from Boise Creek near Enumclaw, and irrigation uses divert an estimated 8,700 acre-feet of water in the lower reaches of the White and Puyallup Rivers (WDE 1980).

b. Commencement Bay

After the White River joins the Puyallup, the combined waters continue on for 10 river miles before emptying into Commencement Bay. This final stretch of river and its ending in Commencement Bay does not offer much relief to the river's water quality problems. That the river has been abused from its beginning to its very end draws no argument. The terminus, however, is receiving attention and fairly intensive biological scrutiny...this attention appears to be migrating upstream and hopefully will continue and bear fruit.

Commencement Bay is a rectangular bay approximately four miles (6.4 kilometers) long and two miles wide running in a northwesterly-southeasterly

direction with Brown's Point being the western end of the northern shoreline and Pt. Defiance, in the vicinity of Ruston, forming the western end of the southern shoreline. The eastern end is the "closed end" formed by the Port of Tacoma with its waterways and the Puyallup River and its estuary. Ruston Way runs along the southern shoreline of the bay from an area known as Old Tacoma to the town of Ruston, a distance of approximately two miles.

The Puyallup River has a significant affect on the circulation patterns of Commencement Bay. At almost all times of the year the Puyallup River plume swings to the north after entering the bay, thus affecting the entrances to Milwaukee, Sitcum, Blair and Hylebos waterways (Barnes and Ebbesmeyer 1978). These waterways and the shoreline northwest to Brown's Point are characterized by lower surface salinities, and aluvial sedimentation, including glacial flour in the summer and fall months and bedload from the Puyallup River during winter and spring flooding. At times a layer of fine sediments appears on the surface while a layer of denser sediments is flowing along the bottom with a layer of clear water between the two. The deposition of sediments is affected by tides, density configuration of the water columns and winds (Salo et al. 1980).

The Ruston Way shoreline has been subjected to significant abuses. Tacoma's earliest industrial area extended from today's City Waterway to Pt. Defiance. This four-mile strip of land was at the turn of the century an unbroken linear industrial complex representing lumber, boat building, grain and shipping firms (Sias, Patricia, undated). Between 1900 and 1977 at least six lumber mills, one shingle mill and three boat building firms operated on either the shoreline or on pier-supported docks along Ruston Way between McCarver Street and the Tacoma smelter. In order to accommodate these businesses, and the railway that serviced them, the shoreline was filled as

needed with sand, soil and rock from the steep bluffs on the west and with whatever fill was available, including possibly ship ballast and in some cases slag from the smelter. Ruston Way, which now has minimal industrial development, has remained an urban shoreline (Salo et al. 1980).

The north shore of Commencement Bay remains relatively unchanged after logging in the late 19th and early 20th centuries. The east end, once a combination of broad tide flats, estuarine inlets and upper wetlands (Figure 11) comprising the Puyallup River delta and other smaller deltas, was dredged and filled between 1920 and the late 1960's...and some of this activity still continues (COBS report 1981). The lower Puyallup River has been channelized and the river mouth has been relocated and about 7.4 square kilometers of intertidal and 10 square kilometers of subaerial wetlands have been lost (Tables 8 and 9).

The marine environment although affected significantly by man still supports a variety of resident marine fish, anadromous salmonids, marine invertebrates and aquatic and shoreline birds.

From the early days of the sawmills industrial wastes have been discharged into the marine environment. This undoubtedly has affected the diversity and abundance of marine organisms and wastes classified as toxins have become of concern. The extent and significance of the public health aspects related to the consumption of afflicted fishes are not agreed upon fully by members of the scientific community; however, everyone agrees that much cleaning up is needed and that toxic wastes, many in the form of leachates, do exist.

In the past two decades the water quality and waste discharge practices have improved and a number of studies have been centered on Commencement Bay problems (see COBS 1981 for review). Field studies on the abundance and

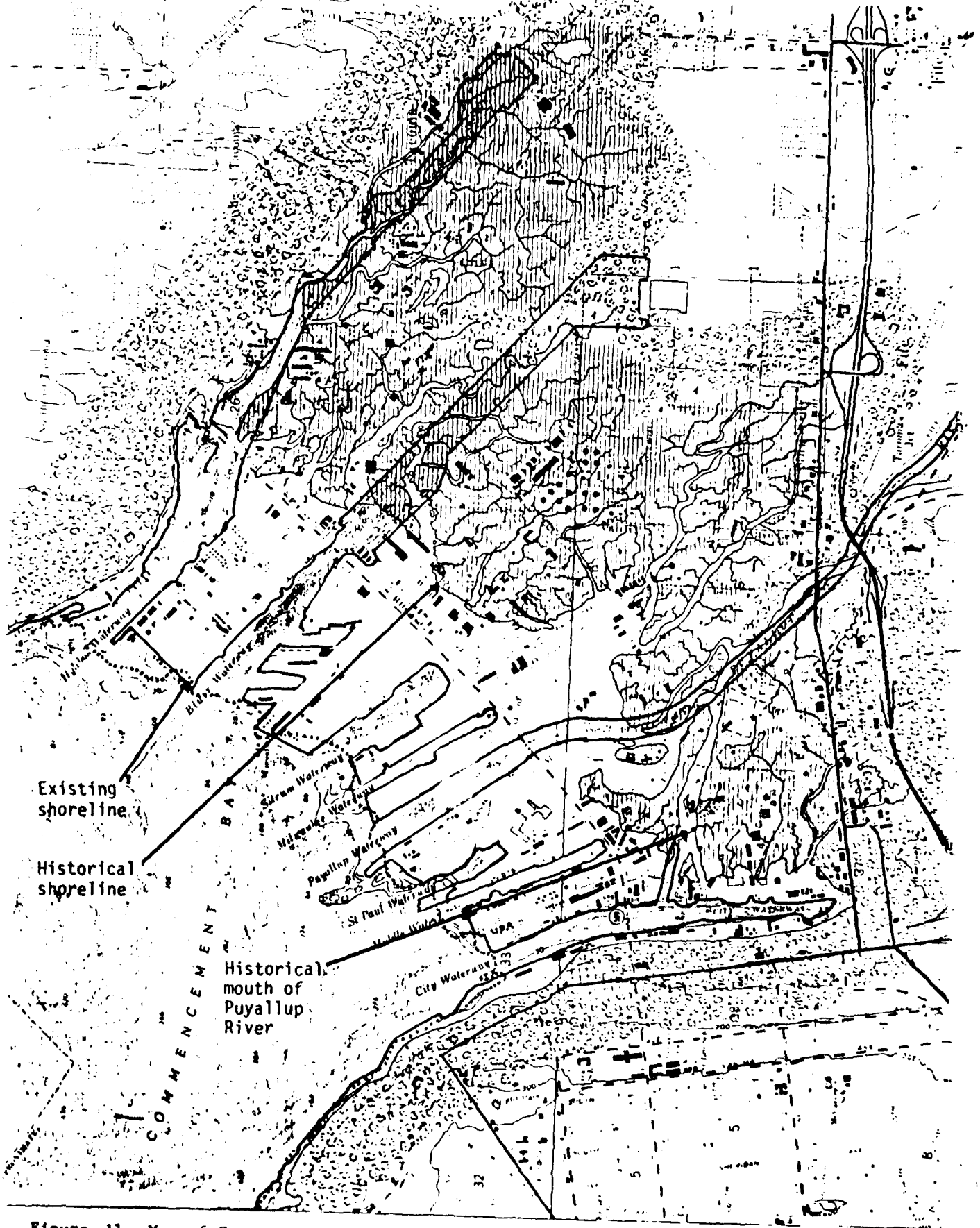
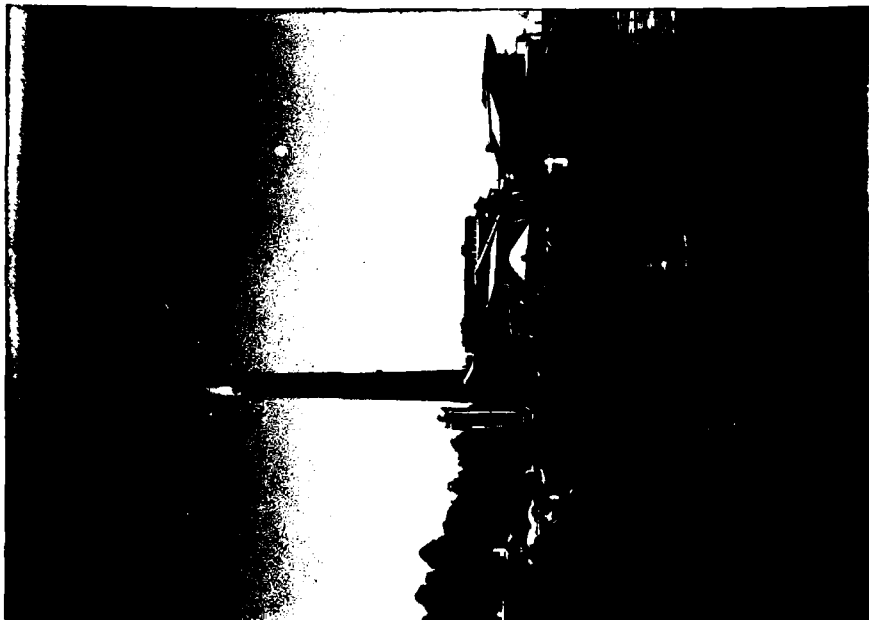
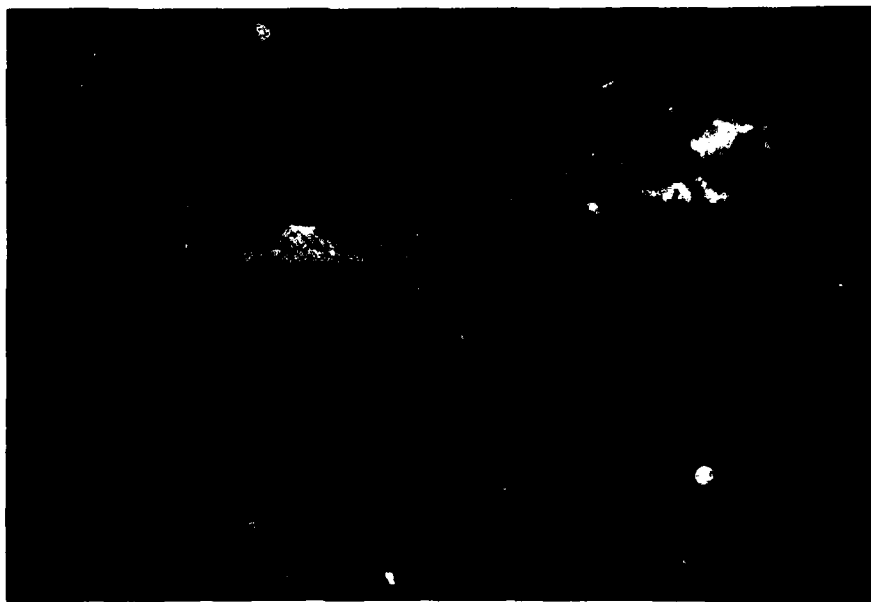


Figure 11. Map of Commencemen Bay showing historical shoreline and wetland changes.
 Source: USGS Hydrologic Investigations Atlas HA-617 (sheet 8) (Bortleson et al. 1980).



Industrial development and typical riprapping
along Commencement Bay.



Pulp mill and industrial facilities near entrance
of Puyallup River on Commencement Bay.

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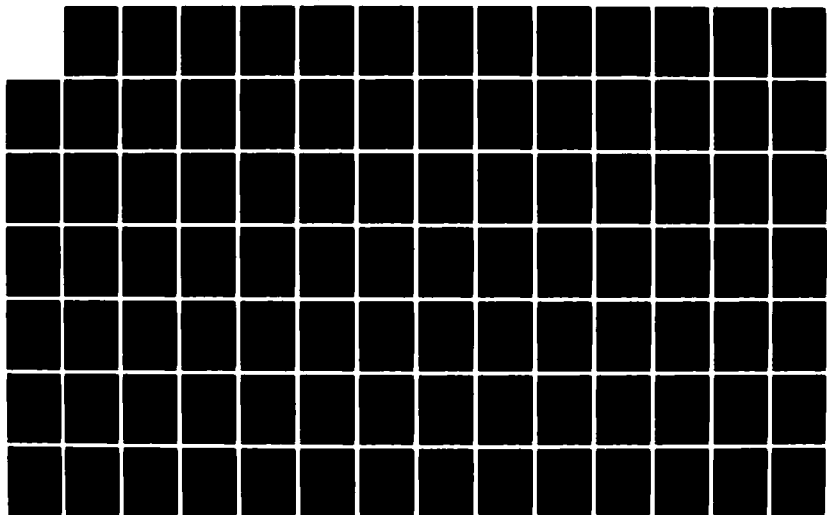
THE STATUS OF THE ANADROMOUS FISHES OF THE
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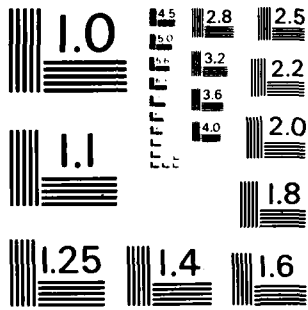
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TABLE 8.—Comparison of historical and present-day subaerial wetland areas

Estimated area of subaerial wetland (in square kilometers)				
River delta	Historical	Present-day	Increase or (decrease)	Source
Nooksack	4.5	4.6	0.1	Topographic maps and aerial photographs
Lummi	5.8	.3	(5.5)	Topographic maps
Samish	1.9 (11) ^a	.4	(1.5)	Do
Skagit	16 (29) ^a	12	(4)	Do
Stullaguamish	3.0 (10) ^a	3.6	0.6	Do
Snohomish	39	10	(29)	Topographic maps and aerial photographs
Duwamish	2.6	.03	(2.6)	Topographic maps
Puyallup	10	virtually none	(10)	Do
Nisqually	5.7	4.1 ^b	(1.6)	Do
Skokomish	2.1	1.4	(0.7)	Topographic maps and aerial photographs
Dungeness	.5	.5	0	Do
Totals for mapped areas	91	37	(55)	

^a Number in parentheses is an estimate based on vegetation and landforms of wetland area present prior to its conversion and before the initial C&GS topographic survey, under natural conditions.

^b Includes about 1.6 sq km that were wet meadow and fresh-water marsh landward of present dikes prior to December 1975 dike break (Klotz and others, 1978) in addition to about 2.5 sq km of salt marsh.

Source: Bortleson et al. 1980.

TABLE 9.—Comparison of historical and present-day intertidal wetland areas.

Estimated area of intertidal wetland (in square kilometers)				
River delta	Historical	Present-day ^a	Increase or (decrease)	Remarks
Nooksack	6.7	8.5 ^b	1.8	Intertidal areas measured from lat 48°45'00", near Fish Point, to long 122°32'30"
Lummi	14	13	(1.0)	Intertidal areas measured from long 122°42'30", near Sandy Point, to lat 48°45'00", near Cagey Road
Samish	not available	15	?	Present-day intertidal area measured from long 122°30'00" near Fish Point, to lat 48°37'30" near Pigeon Point
Skagit	Do	55	?	Present-day intertidal area measured from lat 48°16'12", Browns Point, to lat 48°34'24", near Deadman Island (off map)
Stillaguamish	Do	20	?	Present-day intertidal area measured from long 122°27'35", near Lona Beach, to lat 48°10'00", near Warm Beach
Snohomish	13	8.8	(4.2)	Present-day intertidal area measured from lat 48°02'48", near Mission Bay (off map), to lat 47°59'00", near Port Gardner
Duwamish	8.5	virtually none	(8.5)	Historical intertidal area measured from long 122°23'00", Duwamish Head, counter-clockwise around Elliott Bay, to long 122°23'30", near Smith Cove
Puyallup	7.4	0.1	(7.3)	Historical intertidal area measured from lat 47°15'48", near City Waterway, to lat 47°17'12", near Hylebos Waterway
Nisqually	7.4	5.8	(1.6)	Intertidal areas measured from long 122°45'00", near DeWolf Bight, to long 122°40'00", near Sequelitchew Creek
Skokomish	5.0	4.5	(0.5)	Intertidal areas measured from lat 47°21'36" to long 123°06'00", near Union City
Dungeness	5.9	6.0	0.1	Intertidal areas measured from lat 48°11'00", near Dungeness Lighthouse, counter-clockwise around Dungeness Bay, to long 123°05'00", near Jamestown

^aFrom U.S. Geological Survey topographic maps, except Nooksack River delta (see below)

^bFrom NOAA hydrographic survey, H-3320, H-3321, 1:10,000 scale, dated 1956

^cHistorical intertidal area calculated from 1966 hydrographic chart but mean lower low water line is not correct, shown in sheet 5 because base map does not extend far enough in seaward direction

Source: Bortleson et al. 1980.

distribution of juvenile salmon in relation to the waterways and the open bay are continuing by Dames and Moore, the Puyallup Nation, and the University of Washington. Recent court decisions (Boltdt 1974 and Orrick 1981) also gave the Indian Tribes a strong voice and authority in the approval process of projects that may affect aquatic resource. In many respects the tide has turned and it is hoped that the impetus for cleaner waterways carries forward into the next decades; also, it is hoped that mitigation, as far as possible, will be local and "in kind."

If you wait for the answer,
you won't need it.

VII. ENHANCEMENT ACTIVITIES AND PLANS OF CONCERNED AGENCIES AND ORGANIZATIONS

A. Background

From the foregoing discussion, it is evident that the White River presents a plethora of habitat and harvest management problems to fisheries resource managers. For any substantial improvement in fisheries resources to occur, a combined effort by each of the involved parties is essential. Environmental perturbations which have accumulated gradually over the years have placed a cumulative strain on fisheries resources and have created an inertia among responsible parties - each of which requires the cooperation of the others for enhancement efforts to work. The following discussion, based on telephone and in-person interviews, reflects the current "holding pattern" position of many of the organizations and agencies, which realize the need for cooperation and joint action among all parties involved.

B. White River Fisheries Enhancement Committee (also Known as the The White River Cooperative Fisheries Management Committee). Contact: Tom Cropp, chairperson

Formed as the result of a meeting convened by Larry Burnstad (White River District, USFS) on June 29, 1982, this ad-hoc committee has consisted of individuals from various state and federal agencies, Indian Tribes, and other organizations concerned with the status of the White River fisheries. Primary objectives of this group have been: 1) to identify existing fisheries problems, 2) to identify further research needs, and 3) to prioritize problem solutions and develop a cooperative management plan.

From a list of 53 problems, 46 were identified as pertinent (Figure 1 of Appendix III). Committee members divided the river into three management areas (upper, middle, and lower river) and subcommittees defined and

prioritized the problems of each river section. Attempts were then made to determine the feasibility of solving the problems in each river section.

Though not vested with the authority to take direct action in problem solving, the committee intends to foster awareness and send letters requesting action to persons who are in positions to make changes occur.

C. Washington Department of Fisheries (WDF)

1. Coho Contact: Tim Flint

At the present time, coho enhancement activities in the White River are limited to fry plant in the upper watershed. When some of the White River problems are corrected (e.g. PSP&L screens an upper watershed habitat destruction from logging activities) WDF plans to make regular plants of yearling coho in the White River drainage. Increased utilization of the White River spawning and rearing habitat for coho production is a future goal of WDF.

2. Fall Chinook Contact: Bob Gerke

Currently, fall chinook plants are not made in the White River drainage. Pending the outcome of Federal Energy Regulatory Commission (FERC) licensing of the PSP&L facility, which could result in increased lower river flows, planting of fall chinook below the diversion dam is considered a possibility. A problem encountered with establishing a naturally spawning population, however, is that it would conflict with the current management objective of fully harvesting the hatchery produced fall chinook of the Puyallup System. Meetings are planned to discuss the feasibility of natural production enhancement under the existing management philosophy. One possibility would be to make annual fry plants to supplement the population so that harvest

rates could remain at levels targeted for hatchery fish.

3. Spring Chinook Contact: Dick Geist (WDF),
Ralph Boomer (USFWS),
Conrad Mahnken (NMFS)

White River spring chinook, an endangered race, are currently taken to the Minter Creek Hatchery as part of a native stock rehabilitation program. Plans are to establish an "egg bank" run of White River spring chinook stocks to Minter Creek; all adults which return to the White River will be taken for propagation and no off-station plants will be made until the run is well established. Off-station smolt plants into the White River will be made when sufficient numbers of smolts are available.

The success of this program has not yet been evaluated. The first good return of White River stock to Minter Creek is expected in 1983; however, there were no jack returns in 1982.

In addition to enhancement efforts at Minter Creek, a small portion of the 1977 and 1980 broodstock was taken to the National Marine Fisheries Service facilities at Manchester to explore the possibility of rearing offspring to maturity in marine pens. Potentially, some of the 1981 and 1982 broodstock will be taken to Manchester as part of this program.

Although experiments in hybridization were conducted in the past (the 1971 brood year for example: White River males x females from Green River into Soos Creek; WRm x Issaquah females into Hoko; WRm x Cowlitz females into Whidbey Island pens; WRm x Cowlitze females into Sultan River), and all were marked and tagged, the returns are not known to us. Other experiments were conducted on the 1974, 1975, 1976, and 1977 broods. To date we have not

documented any returns.

The cooperative program between the WDF and USFWS started in earnest with the 1978 and 1979 brood years.

Disposition of the stocks since 1976 is given as:

<u>Year</u>	<u>Above dam{1}</u>		<u>To hatchery</u>	
	<u>Adults</u>	<u>Jacks</u>	<u>Adults</u>	<u>Jacks</u>
1982	0	0		
1981	0	0	22	2
1980	2	1	42	1
1979	20	10	35	5
1978	0	0	23	2
1977	19	13	25	1
1976	124	5	9 ²	0

¹Assumed spring run - late May to early August.

²WDF records show 44; COE records show 9.

Disposition of eggs from Hupp Springs - Minter Creek and smolts planted into Minter Creek are:

<u>Brood</u>	<u>Eggs</u>	<u>Smolts</u>	<u>Date released</u>
1978	12,300	4,220 (20/lb)	31 March 1980
1979	81,500	48,575	March 1981
1980	85,000	19,615 (Garrison to Hupp)	March 82
1981	81,118		
1982	23,500		

At present, this program appears to be the only option available; although it is not accepted without trepidation. The possible changes in behavior and phenotypic characteristics, when reared in a foreign environment, are not known. Changes in timing of return are very possible and returns of "spring chinook" as falls has been reported (Eicher, pers. comm. and others). Therefore, it is suggested that the fish be returned to the White river as soon as reasonably safe downstream passage can be assured. The next recommended step is to establish rearing areas on the White. All of the programs, including the existing one, are possible only with the complete dedication and sincerity of the personnel involved (we were impressed with the dedication of hatchery manager Bill Young at Minter Creek).

D. Washington Department of Game (WGF)

1. Steelhead Contact: Tom Cropp

WDG plans to emphasize native stock production of White River steelhead, by using fry plants in the upper watershed tributaries to restore naturally spawning runs. For this reason, hatchery plants of steelhead smolts will not be made in the White River to sustain a steelhead fishery. In 1982, WDG and the Muckleshoot Tribe participated in a cooperative enhancement project in which 24,600 White River native steelhead fingerlings were stocked in the upper White River drainage. A similar program is projected for 1983. Also, WDG plans to work in conjunction with USFS to restore steelhead rearing habitat in the upper watershed, which has been devastated by flooding and logging debris removal.

E. United States Forest Service (USFS)

Contact: Larry Burnstad

The USFS has been active in efforts aimed at enhancing anadromous fish habitat in the upper reaches of the White River drainage. Finney et al. (1982) listed stream enhancement projects completed on National forest lands, which included: 1) stream debris cleanout and streambank revegetation on Lost, Huckleberry, Pyramid, Pinocle, Whistler, and Midnight Creeks, in addition to the West Fork White and Greenwater Rivers, 2) side channel cleanout and rearing pond enhancement on Sec. 20 of the Greenwater River, 3) fish habitat improvement structures on Pyramid Creek, and 4) fish habitat surveys on 35 streams, totaling 67 miles of the White River drainage.

Planned enhancement activities reported by Finney et al. (1982) include continued fish habitat and stream stability surveys on the remaining tributaries through 1986, and surveys of specific areas under consideration for enhancement projects.

F. Muckleshoot Indian Tribe

Contacts: Steve Elle, Don Finney

Steve Elle notes that, pending the outcome of a lawsuit with PSP&L, the Tribe could soon be engaged in various projects to enhance White River stocks. A possible out-of-court settlement, for instance, could involve an incubation and spawning channel facility at the Dieringer outfall. Additionally, the Tribe is currently engaged in a chum rearing program in the Green River. When these stocks are built up, plans are to use chum egg boxes in tributaries of the lower White River, including First, Second, and Boise Creeks.

Regarding Coal Creek, a tributary now diverted entirely by the City of Auburn, the possibility of tapping ground wells to secure 5 cfs of water for

fisheries enhancement is being explored. Pending agreements with PSP&L (which regulates flows in the lower river), the City of Auburn (which diverts Coal Creek), and the Puyallup Tribe which intercepts White River fish runs), possible plans could be made for a hatchery on Coal Creek in the future.

Don Finney noted that the Tribe has been active with USFS and WDG enhancement activities in the upper watershed, and is vitally interested in the restoration of fish habitat in the White River.

G. Puyallup Indian Tribe

Contact: Dan Thayer

The Puyallup Indian Tribe has been quite active in fishery enhancement activities in the Puyallup System, maintaining a hatchery in which steelhead, coho, and chinook are raised. Since 1975, the Tribe has planted coho (smolts) and chum (fed fry) into the Puyallup System. Since 1980, chinook (fed fry) and steelhead (smolts) have also been planted. Coho and chum are primarily planted in the lower reaches of the system, while chinook are planted in the upper drainage tributaries. Steelhead are planted in the mainstem White, mainstem Puyallup, and Clarks Creek. Combined per year plants average approximately 500,000 chinook, 500,000 chum, 250,000 coho, and 50,000 to 100,000 steelhead.

Enhancement plans for the future include a proposal for hatchery expansion which, based on funding, could result in the doubling of present facilities or the acquisition of another hatchery.

VIII. CONCLUSIONS AND RECOMMENDATIONS

1. A decision needs to be made as to whether or not the river's natural resources can be restored and maintained at a level commensurate with the investment of effort and conservation (conservation = wise use, in this case, perhaps more limited use for some user groups, i.e., timber harvesters, power generators, gravel movers and fishermen). The decisions will not be made by "treading-water" postures.
2. Any White River Conservation Council (Commission)* must have commitments from all user groups to integrate the plans of Federal, State, County, Tribal and Private agencies.
3. The decision must be made as to whether a mix of wild and hatchery stocks of salmon and steelhead can be maintained at levels that are commensurate with a reasonable harvest.
4. The application of federal and state rules and regulations pertaining to logging, such as the Forest Practices Act, must be strictly adhered to...so that sedimentation will be minimized, proper buffer strips will be left and changes in run-off patterns attenuated. Along this line, an analysis should be made of the historical run-off patterns to document any changes in intensity and timing of peaks of the White and its tributaries. Also, an analysis should be made to see if there have been any changes in sedimentation levels.
5. The operation of the Mud Mountain Dam facilities should be re-analyzed to reaffirm that the procedures of storage, drawdown, and sediment passage are the most efficient for passage of juvenile salmonids (also see 12).
6. The experiments assessing the behavior of juvenile salmonids in the reservoir should be repeated including the use of spray-marked wildfish,

captured and released in the tributaries, and hatchery fish known to be true smolts. These experiments are essential if power generation is to be considered at Mud Mountain.

7. If power generation is contemplated (at Mud Mountain), the best screening systems must be used for by-passing the migrants into a capture and haul system. This system should be operated in conjunction with any new screening and bypass facilities proposed at the Puget Sound Power and Light facilities.
8. The methods of trapping and hauling of adults should be re-assessed. Stream surveys should be made to estimate spawning success.
9. The FERC licensing of the Puget Power facilities should result in optimum screening, handling of juveniles and adults, and disposition of sediments. Coordination with management of Mud Mountain Dam (flood control) should be ensured.

It is assumed that the FERC licensing processes will result in proper screening in the proper locations and adequate flows for transportation and spawning of adults, and rearing flows for juveniles.

10. The feasibility of a hatchery at Dieringer has been brought up on occasion, and although not in the province of this report, the idea should not be abandoned; however, any proposed facility should be operated as a part of a total enhancement scheme.
11. The policies and activities of the Inter-County River Improvement Association need to be evaluated and once again the program must be coordinated with the management of the total river as an objective. Gravel is a renewable resource and a continuing problem. Enhancement may be possible, but not assured, by judicious deployment of large organic

debris (LOD = logs, rootwads and trees). The operation of Mud Mountain Dam deprives the river and Puget Sound of 10,000 cords of wood a year. This loss of recruitment of wood affects river erosion, shoreline erosion, maintenance of beaches, wetlands, organic input, and habitat of shoreline fauna.

12. The proper maintenance of levees and streambeds in relation to riparian vegetation, channelization, riprap and wetlands needs to be assessed and documented for reference.
13. It appears as if the fisheries management agencies (WDF, WDG, USFWS, NMFS and Tribal Management) are "settling in" and the speed at which allocation is being brought about is commendable. Improvement, of course, is possible and any and all enhancement schemes should be assessed and approved before implementation. Harvest management requires continuous evaluation. Of particular concern are the spring chinook. We recommend the enhancement efforts be returned to the river, including on-site rearing, as soon as possible.
14. It appears as if the degradation, without mitigation, of the environment of Commencement Bay has bottomed out. Now the policies call for consideration of the priorities of (a) on-site and in-kind mitigation, (b) off-site and in-kind and (c) not-in-kind enhancement such as hatcheries and floating pens. Recent negotiations among the Port of Tacoma, the Puyallup Nation and Management Agencies promise to assure appropriate mitigation whenever possible.

*No such council or commission exists at the present time.

REFERENCES CITED

- Ames, J. and D. E. Phinney. 1977. 1977 Puget Sound Summer-Fall Chinook Methodology: Escapement Estimates and Goals, Run Size Forecasts, and In-season Run Size Updates. Tech. Rept. No. 29. Washington Dept. of Fisheries.
- Ambrogetti, Walter J. 1974. Memo from fishery management biologist, Northwest Fisheries Program - Tumwater, to Muckleshoot Indian Reservation Files. February 19, 1974.
- Auburn, City of. 1980. Final Environmental Impact Statement for Cedardowns - A residential mobile home community. Planning Department, Auburn, WA.
- Auburn, City of. 1981. Lakeland Hills Proposed Residential Community. Final Environmental Impact Statement. Dept. of Planning and Community Development. Auburn, WA.
- Bagley, Clarence B. 1929. History of King County, Washington. Vol. 1. The S. J. Clarke Publishing Co., Seattle-Chicago. pp. 653-659.
- Ballard, Arthur C. 1957. The salmon weir on Green River in western Washington. Davidson Journal of Anthropology, 3:37-53.
- Barnes, C. A. and C. C. Ebbesmeyer. 1978. Some aspects of Puget Sound's circulation and water properties. From Estuarine Transport Processes (Kjerfve, B., Ed.), 1978. The Belle W. Baruch Library in Marine Science No. 7., Univ. of South Carolina Press.
- Beyerman, G. 1983. Letter from Gary Beyerman (Weyerhaeuser Co.) to Barry Lombard (PSP&L). February 3, 1983.
- Bortleson, G. C., M. J. Chrzastowski, and A. K. Helgerson. 1980. Historical changes of shoreline and wetland at eleven major deltas in the Puget Sound region, Washington. Hydrologic Investigations Atlas HA-617, U.S. Geological Survey.
- Bostick, W. E. 1955. Downstream migrant passage over White River screens. Puget Sound Stream Studies. (1953-1956) p. 22. Washington Dept. of Fisheries.
- Brennan, B. M. 1938. Letter from B. M. Brennan (WDF) to Colonel Thomas M. Robins (USACE). January 3, 1938.
- Chapman, Donald. 1980. Personal Testimony in Muckleshoot Tribe vs. Trans-Canada Ltd. No. C77-909R. R.S. District Court, Seattle, WA.
- Chittenden, Hiram M. 1907. Report of an Investigation by a Board of Engineers of Means of Controlling Floods in the Duwamish-Puyallup Valleys and Their Tributaries. United States Army Corps of Engineers. Special pamphlet.

- Commencement Bay Study, 1981. Prepared by Dames and Moore for U.S. Army Corps of Engineers, Seattle District. 7 volumes (COBS Report).
- Crandell, Dwight R. 1963. Surficial Geology and Geomorphology of the Lake Tapps Quadrangle, Washington.
- Cummins, Kenneth W. 1979. The National Stream Ecosystem. Pp. 7-24 in The Ecology of Regulated Streams. James V. Ward and Jack A. Stanford, eds. Phenum Press, New York.
- Dunne, Thomas, and William Dietrich. 1978. Geology and hydrology of the Green River. Technical Appendix A In A River of Green. King County Division of Planning.
- Dunstan, William A. 1955. White River downstream migration. Puget Sound Stream Studies (1953-1956). Washington Dept. of Fisheries.
- Egan, Ron. 1978 and 1980. Puget Sound Salmon Spawning Ground Data Report. Prog. Repts. No. 109 and No. 146. Washington Dept. of Fisheries.
- Fahnestock, Robert K. 1963. Morphology and hydrology of a glacial stream - White River, Mount Rainier, Washington. Geological Survey. Prof. Paper 422-A. Physiographic and Hydraulic Studies of Rivers. (USGS).
- Finney, D. E., L. Burnstad, and J. Doyle. 1982. Status Report: Current Fisheries Resource and Management of the White River Drainage. 2630. USDA Forest Service, Supervisor's Office, Mt. Baker Snoqualmie National Forest.
- Hahn, Peter and Bob Leland. 1979. Steelhead in the White River, Washington. Steelhead Program Quarterly Progress Report. Washington Dept. of Game.
- Hart, Emerson. 1928 and 1929. Field Survey Notes, June 10, 1928 and July 15, 1929. Unpublished WDF records.
- Heckman, James L. 1964. Special Report - Status of the White River Washington Fisheries. Fishery Management Program. Bureau of Sport Fisheries and Wildlife. U.S. Dept. of the Interior. Portland, Oregon (mimeo).
- Heckman, James L. 1967. Muckleshoot Indian Reservation Progress Report, Fishery Management Program. Bureau of Sport Fisheries and Wildlife. U.S. Dept. of Interior, Olympia, WA. (mimeo).
- Heg, Robert T. 1953a. White River Downstream Migrant Trap. Progress Report. Puget Sound Stream Studies (1953-1956). Washington Dept. of Fisheries.
- Heg, Robert T. 1953b. The role of hatchery plants in rebuilding the White River silver salmon population. Progress Report. Puget Sound Stream Studies (1953-1956), p. 122. Washington Dept. Fisheries.

- Henry, Kenneth A. 1977. Background document on Northwest salmon fisheries. NMFS, NOAA. Northwest and Alaska Fisheries Center, Seattle, WA. 25 pp (unpublished manuscript).
- Imler, Ralph H. 1960. Letter from U.S. Fish and Wildlife Service to Colonel R. P. Young, Seattle District Corps of Engineers.
- Johnson, Larry. 1982. Letter from Larry Johnson (WDF) to Barry Lombard (PSP&L). December 20, 1982.
- Johnson, Ray. 1980. Statement of Washington Dept. of Fisheries. Letter to Washington Dept. of Ecology, January 25, 1980.
- Kramer, Chin, and Mayo. 1975. Enumclaw, Buckley, and the Rainier State School receiving water quality objectives.
- Lane, Barbara. Undated. Anthropological Report on the Traditional Fisheries of the Muckleshoot Indians. Exhibit 38C.
- Maib, C. W., and W. A. Dunstan. 1956. The Passage of Fish Through Mud Mountain Dam. Washington Dept. of Fisheries.
- Miller, Denny M. 1965. Evaluation of the Suitability for Salmonid Production of a Stream with Multiple Water Uses. Masters Thesis, College of Fisheries, Univ. of Washington, Seattle, WA.
- Muckleshoot Tribe. 1982. Supplemental Responses to Interrogatories Nos. 16-31. Muckleshoot Tribe vs. Puget Power.
- Mullineaux, Donal R. 1970. Geology of the Renton, Auburn, and Black Diamond Quadrangles, King County, Washington. Geological Survey Professional Paper 672.
- Nece, R. E., D. P. Lettenmaier, and K. Kiernan. 1982. Puyallup River Basin Flood Management Study. Phase 1 Report. Department of Civil Engineering, Univ. of Washington. Submitted to Pierce County Dept. of Public Works.
- Parker, G. L. and L. Lee. Undated. Summary of hydrometric data in Washington, 1878-1919.
- Puget Sound Task Force - Pacific Northwest River Basins Commission. 1970. Comprehensive Study of Water and Related Land Resources, Puget Sound and Adjacent Waters. Appendix XI: Fish and Wildlife.
- Puyallup Tribe and U.S. Fish and Wildlife Service. 1977. Population estimation of the 1976 Puyallup River fall chinook run. Preliminary Report. 6 pp.
- Regenthal, A. F. 1953. Passage of Downstream Migrants Over White River Screens. Puget Sound Stream Studies (153-1956). p. 102. Washington Dept. of Fisheries.

- Regenthal, A. F., and W. H. Rees. 1957. The Passage of Fish Through Mud Mountain Dam. Washington Dept. Fisheries.
- Richards, Bruce. 1982. Letter from Bruce Richards (WDG) to Barry Lombard (PSP&L). Undated.
- Roberts, W. J. 1920. Report on flood control of White-Stuck and Puyallup rivers. Inter-county River Improvement Agency. King and Pierce Counties, Washington.
- Royce, William F. 1969. Comments on White River Flow and Delayed Migration. Unpublished (mimeo.).
- Salo, Ernest O., B. P. Snyder, and J. M. Silver. 1972. The fishery potential of the White River between the Buckley diversion and the Dieringer powerhouse discharge. Preliminary Rept. Submitted to the American Native Rights Fund.
- Salo, E. O., R. L. McComas, and S. Ralph. 1980. Aquatic survey and assessment of Ruston Way shoreline. Report submitted to City of Tacoma, Washington.
- Sias, Patricia (undated manuscript). The Old Tacoma waterfront; A developmental profile. Historic Preserv. Officer, Community Development, City of Tacoma.
- Simenstad, C. and H. Buechner. 1980. Food Habits Analysis of Juvenile Chinook (*Oncorhynchus tshawytscha*) and Coho Salmon (*O. kisutch*) from the Quillayute River and Estuary. Fisheries Research Institute, University of Washington. Seattle, Washington.
- Smoker, W. A., R. T. Heg, D. Johnson, and R. Robison. 1952. The Muckleshoot Indian Fishery on the White River. Washington Dept. Fisheries.
- Stetson Engineers, Inc. 1980. Report on Movements of the White River with Emphasis on Sec. 28, T. 21N, R. 5E. Muckleshoot Indian Reservation, Plaintiff Exhibit No. 237, Muckleshoot vs. Trans-Canada Enterprises Ltd.
- Stetson, Thomas M. 1975. Water Resources and Requirements of the Muckleshoot Indian Reservation, King and Pierce Counties, Washington.
- Thomas, B. P. 1939. Annual Report of the Chief Engineer for the Year Ending 1938. Intercounty River Improvement Agency. King and Pierce Counties, Wash.
- Toews, D. and M. K. Moore. 1982. The Effects of Streamside Logging on Large Organic Debris in Carnation Creek. Land Use Unit, Habitat Protection Division. Dept. of Fisheries and Oceans. Vancouver, B.C.

- Tudor Engineering. 1982. Reconnaissance report on the potential hydroelectric development, Mud Mountain Dam Power Project. Report submitted to City of Tacoma Dept. of Public Utilities.
- Tulalip Agency Records 1941. Discussion of accustomed fishing places. Muckleshoot Tribal Council Minutes. May 21, 1941.
- United States Army Corps of Engineers. 1971. Environmental Statement: Mud Mountain Dam and Reservoir, White River, Washington.
- United States Army Corps of Engineers. 1974. Mud Mountain Master Plan Phase III. Design Memorandum 20B. Prepared by Miles Yanick and Co.
- United States Army Corps of Engineers. 1977. Water Resources Development in Washington. North Pacific Division, Oregon.
- United States Army Corps of Engineers. 1978. Memo for Record. February 27, 1978.
- United States Army Corps of Engineers. 1982. Backwater Channel Capacity Study, White River near Auburn and Buckley, Washington.
- United States Fish and Wildlife Service. 1974. Anadromous fish migration, spawning and rearing flow study on White River. Special Report for the Muckleshoot Indian Tribe, Washington. Tumwater, WA.
- United States Forest Service. 1979. Fireman Map - White River Ranger District. Map B. Transportation Plan, USDA. Enumclaw, WA.
- United States Senate. 1920. Letter from the Acting Secretary of the Interior. Allotted Nisqually Indian Lands. Doc. No. 243. 66th Congress, 2nd Session.
- Washington Department of Ecology. 1970. Reported Pollution Caused Fish Kills in Washington State: January 1 through June 30, 1970.
- Washington Department of Ecology. 1971. Reported Pollution Caused Fish Kills in Washington State: January 1 through July 1, 1971.
- Washington Department of Ecology. 1972a. Memo from Bob Bottman to Mike, Ron, and Files. April 5, 1972.
- Washington Department of Ecology. 1972b. Memo from John Bernhart to Harry Tracy. April 17, 1972.
- Washington Department of Ecology. 1980. Puyallup River Basin Instream Resources Protection Program, Water Resources Management Program. WWIRPP Series No. 6. State of Washington, Olympia, WA.

- Washington Department of Fisheries. 1961. Presentation of the Indian fisheries problem in the management of salmon in the State of Washington. Statement by Washington Dept. of Fisheries to Congressional Subcommittee on Merchant Marine and Fisheries. Tacoma, WA, October 13, 1961.
- Washington Department of Fisheries. 1962. Fisheries Statistical Report.
- Washington Department of Fisheries. 1970a. Letter from Thor C. Tollefson to Mr. Frank G. Homan. May 4, 1970.
- Washington Department of Fisheries. 1970b. Letter from Washington Dept. of Fisheries to U.S. Army Corps of Engineers. June 2, 1970.
- Washington Department of Fisheries. 1975. Status of the Salmon Resource of the Puget Sound and Coastal Regions, Washington. Mgmt. and Research Div.
- Washington Department of Fisheries. 1977. 1977 Status of Puget Sound Summer-Fall Chinook and Pink Salmon and Recommendations for Management. Prog. Rept. No. 19. Harvest Mgmt. Div.
- Washington Department of Fisheries. 1978. Status of Puget Sound Coho and Recommendations for Management. Harvest Mgmt. Div., Olympia, WA.
- Washington Department of Fisheries. 1979a. A Proposal for Long-Range Puget Sound Salmon Resource Management. WDF 9-12-79. Olympia, WA.
- Washington Department of Fisheries. 1979b. 1979 Status of Puget Sound Coho and Recommendations for Management. Prog. Rept. No. 90. Harvest Mgmt. Div.
- Washington Department of Fisheries. 1981. Status of Puget Sound Spring Chinook Salmon and Recommendations for Management. Prog. Rept. No. 129. Harvest Mgmt. Div.
- Washington Department of Game. 1971. Letter from Wash. Dept. of Game to U.S. Army Corps of Engineers. July 6, 1971.
- Washington State Fish Commissioner. 1912. Annual Report for 1911-1912 Season.
- Weyerhaeuser Co. 1979. A History: The White River Lumber Co., Enumclaw, Washington. Weyerhaeuser Co. Archives and Creative Services. December 1979.
- White River Fishery Improvement Committee. 1968. Minutes of committee meeting, September 13, 1968.

- White River Fisheries Improvement Committee. 1968a. Office memo, October 9, 1968.
- White River Fisheries Improvement Committee. 1968b. Progress Report Memorandum. October 21, 1968.
- White River Fisheries Enhancement Committee. 1982. Proceedings of September 14, 1982 meeting. USFS Technical Center, Enumclaw.
- Williams, R. W., R. M. Laramie, and J. J. Ames. 1975. A catalog of Washington streams and salmon utilization. Vol. I: Puget Sound region. Washington Dept. of Fisheries.
- Wilson, S. M. 1973. An Evaluation of The White River and Its Tributaries as a Fishery Resource. First Progress Report. Submitted to Muckleshoot Indian Tribe.
- Wilson, S. M. 1974b. An Evaluation of The White River and Its Tributaries as a Fishery Resource. Final Report. Submitted to Muckleshoot Indian Tribe.
- Wolfson, Alan W. 1982. Letter from Alan W. Wolfson (USFS) to Barry Lombard (PSP&L). December 21, 1982.
- Zillges, G. 1977. Methodology for Determining Puget Sound Coho Escapement Goals, Escapement Estimates, 1977 Pre-season Run Size Prediction and In-season Run Assessment. Tech. Rept. No. 28.

APPENDIX I

White River Fisheries Data

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Table 1. WHITE RIVER TRAP COUNTS

YEAR	CHINOOK	COHO	STEELHEAD
1940	0	112	0
1941	1101	14	437
1942	5431	18	1902
1943	4603	1467	1155
1944	3736	717	1021
1945	2584	1003	1662
1946	3692	3811	2166
1947	1470	4992	1031
1948	1841	1469	1381
1949	1370	6739	1364
1950	1849	12484	1298
1951	719	3623	1122
1952	842	7500	822
1953	931	9698	1304
1954	633	5671	1211
1955	1893	1961	205
1956	794	3403	535
1957	374	2094	368
1958	245	2031	156
1959	261	3448	162
1960	528	1398	280
1961	505	1098	203
1962	164	1992	458
1963	447	1429	264
1964	658	4090	347
1965	969	1810	683
1966	639	3756	906
1967	684	2506	828
1968	465	1639	447
1969	534	1537	476
1970	557	1688	482
1971	393	1818	726
1972	392	2972	477
1973	137	796	228
1974	388	1081	351
1975	488	546	260
1976	229	833	192
1977	66	1090	220
1978	140	493	381
1979	72	320	249
1980	61	335	279
1981	175	1237	16
1982	20	522	326*

Source: Data provided by Kevin Bauersfeld, Washington Dept. of Fisheries.

* Preliminary.

Note: Data in this table include Jacks; also, miscellaneous fish collected at the trap (including sockeye, pink, searun cutthroat, dolly varden and other species) are not tabulated here.

Figure 1. WHITE RIVER TRAP COUNTS

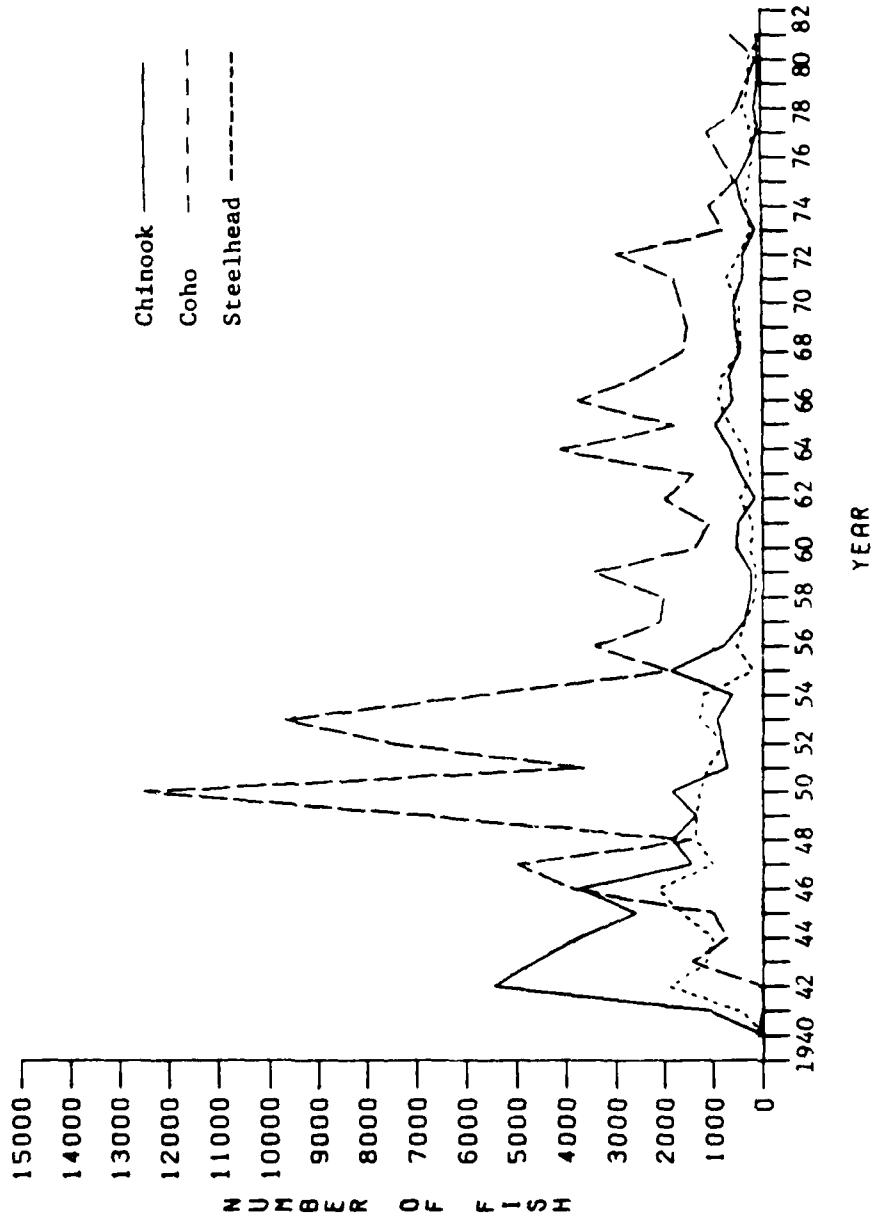


Table 2a. Number of Chinook Salmon Hauled Each Month
at the White River Fish Facility

Month	Year												1979		1980		1981			
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	Adults	Jacks	Adults	Jacks	Adults	Jacks	
January	0	0	0	0	0	0	0	0	0	0	0	0	0							
February	0	0	0	0	0	0	0	0	0	0	0	0	0							
March	0	0	0	0	0	0	0	0	0	0	0	0	0							1
April	0	0	0	0	0	0	0	0	0	0	0	0	0							
May	15	52	0	20	68	6	2	3	51	6	11	0	0	6						4
June	230	282	260	379	299	88	123	14	50	80	98	38	18	22	32					17
July	369	287	109	92	162	269	198	34	154	203	77	16	7	14	7	2				1
August	9	10	15	26	18	21	52	4	106	113	39	12	24	10	8	1	1			
September	16	19	28	17	9	8	2	48	17	86	4	0	88	2		13	1			39
October	0	4	0	0	1	1	4	23	10	0	0	0	3	2						51
November	0	0	0	0	0	0	0	0	0	0	0	0	0							65
December	0	0	0	0	0	0	0	0	0	0	0	0	0							
TOTAL	639	654	412	534	557	393	381	126	398	488	229	66	140	56	15	57	4	178	21	

Table 2b. Number of Coho Salmon Hauled Each Month at the White River Fish Facility

Month	Year																		
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979		1980		1981	
														Adults	Jacks	Adults	Jacks	Adults	Jacks
January	5	2	19	0	59	34	74	3	2	3	3	0	6						
February	0	4	0	0	12	0	0	0	0	0	0	0	0						
March	0	0	0	0	0	0	0	0	0	0	0	0	0						
April	0	0	0	0	0	0	0	0	0	0	0	0	0						
May	0	0	0	0	0	0	2	0	0	0	0	0	0						
June	0	0	19	0	0	0	0	0	0	0	0	0	0						
July	0	0	0	0	0	0	0	0	0	0	0	0	0						
August	0	0	0	0	0	0	0	0	0	0	2	0	0					26	2
September	757	238	376	232	70	63	740	43	132	121	309	215	132	37	20	9		344	8
October	2267	1593	698	526	609	414	754	139	43	254	153	328	171	82	26	104	25	418	24
November	598	296	473	572	844	1018	626	317	790	117	307	418	0	59	4	152	41	337	3
December	134	36	7	205	94	284	783	294	114	54	62	119	0	91		10	3	75	15
TOTAL	3761	2169	1592	1535	1688	1818	2977	796	1081	549	833	1080	309	269	50	275	69	1200	52

Table 2c. Number of Steelhead Trout Hauled Each Month
at the White River Fish Facility

Month	Year															
	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981
January	1	44	66	0	59	27	12	42	21	5	12	6	0			31
February	3	38	63	7	40	168	31	12	64	16	4	3	4		5	11
March	23	10	92	8	14	33	122	24	46	26	10	13	117	11	20	94
April	289	102	55	126	61	230	178	63	111	79	59	57	143	96	179	49
May	483	428	58	280	193	258	118	63	61	123	103	63	89	38	52	44
June	54	164	54	54	162	7	9	26	43	10	1	72	24	78	7	41
July	1	2	1	0	0	0	0	3	3	0	1	1	1	9		16
August	0	1	0	0	0	0	1	0	0	0	0	4	0		1	
September	0	0	0	0	0	0	0	0	0	0	0	0	3	15		
October	0	0	0	0	0	0	0	0	0	0	0	0	0			
November	0	0	0	0	0	0	0	0	0	0	2	2	135		1	
December	1	39	17	0	0	3	6	3	2	1	0	3	49		2	
TOTAL	855	828	406	475	529	726	477	236	351	260	192	232	565	247	267	286

Table 3. WHITE RIVER INDIAN CATCH STATISTICS (MUCKLESHOOT)

YEAR	CHINOOK	CHUM	COHO	TOTAL
1939	150	0	4	154
1940	0	0	0	0
1941	2	0	0	2
1942	0	0	0	0
1943	162	2866	426	3454
1944	1281	3622	271	5174
1945	1289	3185	1159	5633
1946	595	917	512	2024
1947	317	1439	458	2214
1948	261	319	2540	3120
1949	521	1261	844	2626
1950	132	961	1054	2147
1951	750	1066	2723	4539
1952	1106	5441	13333	19880
1953	471	336	3250	4057
1954	1271	0	1627	2898
1955	445	6	375	826
1956	1619	32	2390	4041
1957	778	11	1834	2623
1958	351	502	985	1838
1959	403	93	1137	1633
1960	1026	38	656	1720
1961	2553	723	535	3811
1962	1952	168	274	2394
1963	491	20	213	724
1964	426	53	386	865
1965	697	479	4624	6000
1966	1772	733	2304	4809
1967	745	80	2003	2828
1968	1450	113	1266	2829
1969	2384	59	961	3404
1970	1096	0	1029	2125
1971	666	0	1531	2197
1972	678	0	646	1324
1973	86	5	1055	1146
1974	67	0	1670	1737
1975	104	1	243	348
1976	59	20	1061	1140
1977	23	0	214	237
1978	27	0	17	44
1979	0	0	0	0
1980	0	0	277	277
1981*	0	0	0	0

Sources: Salmon catch data: Fisheries Statistical Report (1975, 1978)
 Washington Dept. of Fisheries. Data for recent years provided
 by Loren Stern, WDF.

* Preliminary.

Figure 2. WHITE RIVER INDIAN CATCH STATISTICS (MUCKLESHOOT)

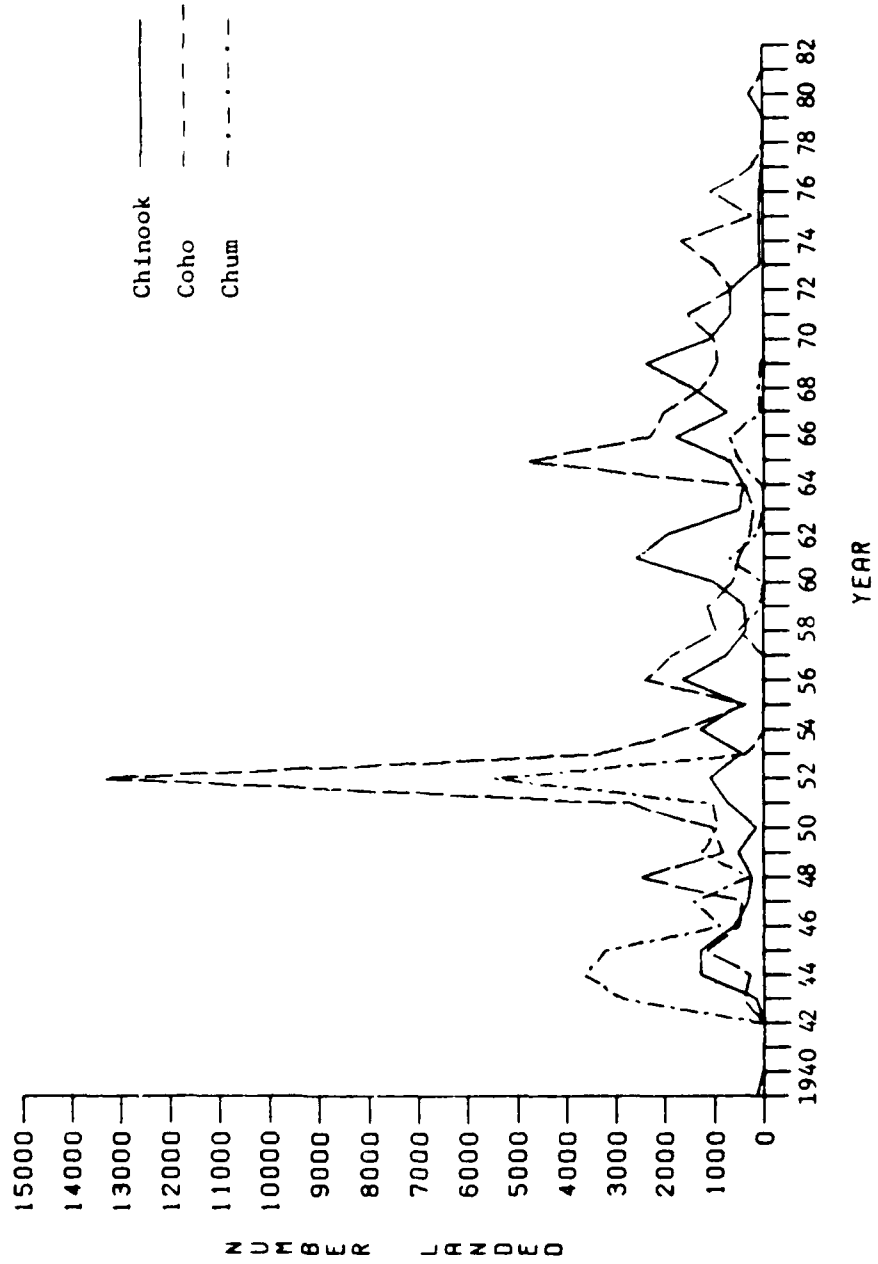


Table 4. Historical Treaty Indian harvests of steelhead on the White River, Washington. Data prior to 1975 was not verifiable and was unknown for some years. After 1975, commercial fish sales tickets were required and improved documentation occurred. Ceremonial and subsistence catches of steelhead have not been included (200 winter steelhead were estimated caught for 1978-79, estimates for previous years are unknown).

Year	Month												Total	
	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	Winter-run	Summer-run
1949-50	--	--	--	--	--	--	--	--	1,040	1,136	--	--	2,176	--
1951	No data available.													
1952-53	--	--	--	--	--	--	--	--	419	181	--	--	600	--
1953-54	--	--	--	--	61	89	1,304	628	102	--	--	--	2,123	61
1954-55	--	--	--	--	--	45	992	366	174	--	--	--	1,577	--
1955-56	--	--	--	--	--	--	360	500	173	75	--	--	1,108	--
1956-57	--	--	--	--	--	--	631	436	278	98	--	--	1,494	--
1957-58	--	--	--	--	--	--	680	512	152	293	11	--	1,743	--
1958-59	--	--	--	--	--	--	642	403	106	73	--	--	1,279	--
1959-60	--	--	--	--	--	--	516	--	--	--	--	--	516	--
1960-61	--	--	--	--	--	--	954	--	--	--	--	--	954	--
1961 to 1972	No data available.													
1973-74	--	--	--	--	--	--	17	--	61	--	--	--	78	--
1974-75	--	--	--	--	--	--	--	122	214	36	--	--	372	--
1975-76	48	18	--	--	--	--	--	--	--	--	--	--	66	--
1976-77	--	--	--	--	--	--	5	311	4	--	--	--	320	--
1977-78	--	--	--	--	--	--	60	--	--	--	--	--	60	--
1978-79	--	--	--	--	--	--	31	28	--	--	--	--	59 ^{a/}	--
1980-81	--	--	--	--	--	--	--	--	--	--	--	--	143	--

^{a/} Plus 200 ceremonial and subsistence winter steelhead. Source: Hahn and Leland (1979).

Table 5. White (Stuck) River Salmon Sport Catch Statistics

Year	Species			Total	
	Chinook	Coho	Jacks		
1964				-	
1965				-	
1966				-	
1967				-	
1968				41	Source: Washington Salmon Sport Catch Report from punch card returns
1969				7	
1970				24	Annual reports 1964-1980 State of Washington Dept. of Fisheries
1971				12	
1972				-	
1973				5	
1974	3	10	2	15	
1975		41	12	53	
1976				-	
1977				-	
1978	11	3	3	17	
1979		4		4	
1980	11	13	9	33	

Note: Earlier statistics are considered biased because punch card returns were voluntary; they are considered to overestimate by 15%.

Table 6. Sport Catch of steelhead by month from the White River, Washington, 1961-62 to 1978-79. Harvests were projected from voluntarily returned punchcards and were corrected for non-response bias. Annual punchcards were first issued for the 1961-62 season. Steelhead caught during November 1 to April 31 were defined as winter-run, all others were summer-run.

Year	Winter-Run					Summer-Run					Total			
	Nov.	Dec.	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Winter	Summer
1961-62	--	106	68	73	--	--	--	--	--	--	--	--	247	--
1962-63	--	33	102	61	51	--	--	--	--	--	--	--	247	--
1963-64	--	196	209	113	61	--	--	4	--	--	4	--	579	8
1964-65	--	70	40	41	28	--	--	4	--	--	--	--	179	4
1965-66	--	13	113	55	32	--	--	--	--	--	--	--	213	--
1966-67	--	103	159	115	46	--	--	--	--	--	--	--	423	--
1967-68	2	90	393	145	100	7	7	--	--	15	4	--	737	26
1968-69	4	176	73	41	47	4	7	--	13	32	15	--	345	67
1969-70	4	120	67	65	62	--	--	2	2	--	4	--	318	8
1970-71	2	155	141	127	88	5	--	--	--	4	2	2	518	8
1971-72	7	115	81	52	--	--	--	--	2	2	--	--	255	4
1972-73	2	38	50	32	46	8	--	--	--	--	--	--	176	--
1973-74	4	58	10	20	20	--	--	--	--	--	--	--	112	--
1975-76	5	76	50	60	--	--	--	--	2	--	--	--	191	2
1975-76	--	41	41	21	9	--	--	--	--	--	--	4	112	4
1976-77	--	16	--	--	--	--	--	--	3	3	3	--	16	9
1977-78	--	70	182	6	--	--	--	--	4	--	--	--	261	4
1978-79	--	79	20	4	--	--	--	--	--	--	--	--	103	--
1979-80														

Source: Hahn and Leland 1979.

Table 7. PUYALLUP RIVER INDIAN CATCH STATISTICS^{1/}

YEAR	CHINGOK	CHUM	COHO	PINK	TOTAL
1953	0	2	104	0	106
1954	439	262	2509	0	3210
1955	372	7	1116	143	1638
1956	824	8	5072	0	5904
1957	2965	141	7310	2001	12417
1958	2058	799	12044	0	14901
1959	2562	311	8103	6028	17004
1960	5229	217	10294	0	15740
1961	10659	490	16532	19097	46778
1962	5813	580	27283	0	33676
1963	7985	347	13461	53425	75218
1964	3746	159	15799	0	19704
1965	675	0	161	47	863
1966	0	0	0	0	0
1967	1	0	28	2	31
1968	0	0	0	0	0
1969	136	0	87	43	266
1970	493	22	13001	0	14516
1971	1233	92	11154	6173	18652
1972	2794	78	13472	0	16344
1973	2211	481	23395	8089	34176
1974	2649	1495	29735	0	33879
1975	1699	375	22308	10357	34739
1976	345	759	15821	0	16925
1977	353	15	39930	463	40761
1978	392	136	15728	0	16256
1979	1626	29	0	8052	9707
1980	396	1600	27186	0	29182
1981*	554	0	10345	0	10899

Source: Fisheries Statistical Report (1975, 1978). Washington Dept. of Fisheries. Data for recent years provided by Loren Stern, WDF.

^{1/} Prior to 1975, the Puyallup Indian Tribe was the only Indian fishery on the Puyallup River.

* Preliminary data.

Figure 3. PUYALLUP RIVER INDIAN CATCH STATISTICS

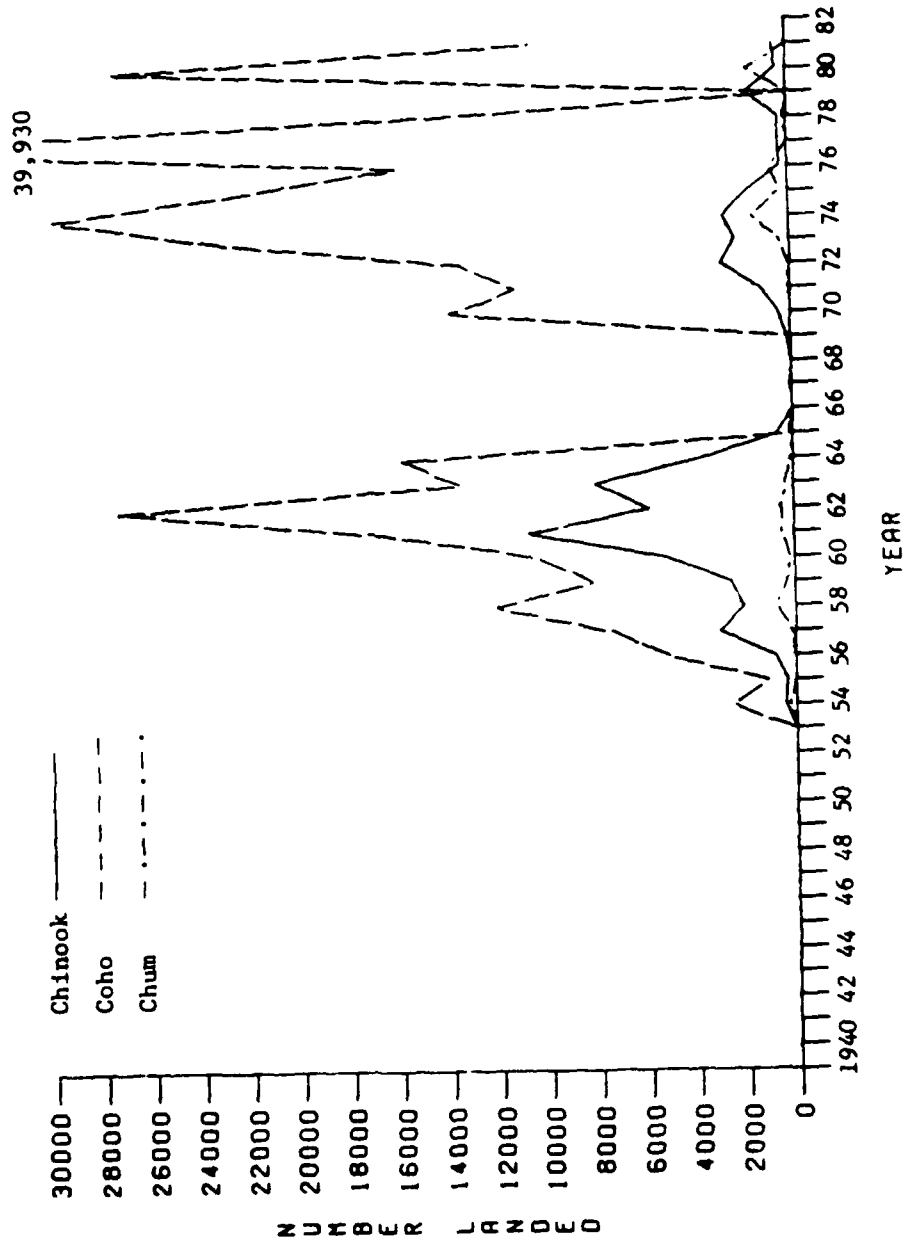


Table 8. Puyallup River (Mainstem) Indian harvests of winter-run steelhead.

<u>Season</u>	<u>Number caught</u>
1952-53	104
1953-54	207
1954-55	480
1955-56	577
1956-57	1196
1957-58	1086
1958-59	1246
1959-60	4741
1960-61	2310
1961-62	1840
1962-63	1126
1963-64	1200
1964-65	1000
1965-66	
1966-67	160
1967-68	100
1968-69	
1969-70	500
1970-71	1500
1971-72	1480
1972-73	317
1973-74	1649
1974-75	1906
1975-76	2898
1976-77	992
1977-78	62
1978-79	197
1979-80	
1980-81	889

Source: Records provided by Washington Department of Game.

Table 9. Puyallup River Salmon Sport Catch Statistics

Year	Species				Total salmon
	Chinook	Coho	Jacks	Other	
1964					374
1965					722
1966					1360
1967					4901
1968					2586
1969					1865
1970					1946
1971					1733
1972					1674
1973	43	486	2153	29	2711
1974	71	1660	430	23	2184
1975	12	344	360	28	744
1976	88	2245	1466	40	3839
1977	120	1438	584	26	2168
1978	123	1014	1310	69	2516
1979	42	818	841	27	1728
1980	50	721	729	22	1522

Source:

Washington Salmon Sport
Catch Report from
punch card returns
Annual reports 1964-1980
State of Washington
Dept. of Fisheries

Note: Earlier statistics are considered biased because punch card returns were voluntary; they are considered to overestimate by 15%.

Table 10. Puyallup River System winter-run steelhead sport catch statistics^{1/}

<u>Season</u>	<u>Number caught</u>
1961-62	6250
1962-63	7018
1963-64	9674
1964-65	4144
1965-66	11256
1966-67	9188
1967-68	10177
1968-69	6968
1969-70	4042
1970-71	7257
1971-72	5868
1972-73	2967
1973-74	2735
1974-75	2335
1975-76	1352
1976-77	1884
1977-78	5493
1978-79	3054
1979-80	2168
1980-81	2042

^{1/} From Washington Dept. of Game, corrected and updated 11/19/82.
Calculated from punchcards and corrected for non response bias.

Table 11. White River hatchery plants.

YEAR PLANTED	CHINOOK	CORO	STEELHEAD
1939	0	0	10497
1940	0	0	0
1941	0	0	0
1942	0	0	0
1943	0	16734	0
1944	0	20611	0
1945	273532	153816	0
1946	1254000	187205	0
1947	636498	142195	0
1948	251674	165822	0
1949	54250	141000	47816
1950	150000	475000	0
1951	0	1091970	0
1952	0	25753	2745
1953	5000	65400	0
1954	0	62088	0
1955	17279	110986	0
1956	0	37926	11000
1957	471498	571933	11750
1958	0	64112	0
1959	0	147125	0
1960	0	0	0
1961	0	266769	0
1962	0	381680	0
1963	0	0	0
1964	0	125441	0
1965	0	186120	0
1966	0	96964	17999
1967	0	0	0
1968	0	300824	12081
1969	0	329460	19667
1970	0	307881	30138
1971	0	550734	20615
1972	0	255000	18127
1973	0	250800	15015
1974	8942	0	9860
1975	0	195953	10088
1976	8340	646895	11676
1977	40580	670476	22596
1978	47525	511852	7300
1979	0	460713	13000
1980	0	531720	0
1981	0	0	6105
1982			24600
1983		550161	

Source: Unpublished records provided by Tony Rasch, WDF.

Steelhead data provided by WDG.

Table 12. White River hatchery plants of salmon
(White River and tributaries)

Brood year planted	Chinook	Coho
1941	-	16,734
1942	-	20,611
1943	-	53,816
1944	75,000	137,973
1945	1,254,000	252,195
1946	636,498	145,822
1947	251,674	116,000
1948	50,000	180,000
1949	(spring) 4,250 plus 150,000	461,678
1950	-	1,101,245
1951	-	50,100
1952	5,000	61,314
1953	-	126,962
1954	17,279	37,926
1955	-	323,977
1956	471,798	312,068
1957	-	147,125
1958	-	-
1959	-	66,568
1960	-	200,200
1961	-	381,680
1962	-	125,441
1963	-	-
1964	-	283,084
1965	-	-
1966	-	-
1967	-	300,824
1968	-	637,341
1969	-	243,700
1970	-	562,034
1971	-	250,800
1972	(spring) 8,942	-
1973	-	195,953
1974	(spring) 8,340	250,000
1975	(spring) 40,580	650,580
1976	(spring) 47,525	618,793
1977	-	511,852
1978	-	460,713
1979	-	70,268
1980	-	1,007,752

Source: WDF records provided by Tony Rasch.

Table 13. Puyallup System hatchery plants of salmon
(Puyallup, White, and tributaries).

Brood year	Number planted	
	Chinook	Coho
1941	-	118,508
1942	573,575	709,031
1943	603,960	624,359
1944	818,597	979,217
1945	2,059,589	830,788
1946	1,965,172	519,190
1947	678,933	839,844
1948	500,809	960,536
1949	469,686	1,043,904
1950	641,469	1,692,775
1951	-	311,151
1952	1,038,310	1,153,913
1953	1,154,093	393,851
1954	1,473,302	346,543
1955	965,041	821,309
1956	2,434,176	806,911
1957	1,713,165	638,467
1958	1,381,189	488,997
1959	1,725,329	368,958
1960	715,600	590,773
1961	1,549,510	768,519
1962	507,465	547,870
1963	364,466	378,240
1964	1,495,651	934,312
1965	1,123,556	522,362
1966	1,302,949	563,720
1967	1,715,505	865,700
1968	2,880,601	1,973,656
1969	1,215,296	1,352,536
1970	1,569,116	2,948,643
1971	1,494,996	1,271,774
1972	1,679,557	1,338,022
1973	3,160,140	1,644,168
1974	1,391,765	1,991,700
1975	3,493,430	2,799,563
1976	2,593,830	2,964,851
1977	4,250,532	2,273,914
1978	2,802,073	1,090,136
1979	-	1,995,054
1980	6,721,522	6,702,648

Source: WDF records provided by Tony Rasch.

Table 14. Winter run steelhead smolts planted in the Puyallup River system.

<u>Year planted</u>	<u>Number</u>
1960	79,700
1961	57,200
1962	55,900
1963	63,000
1964	93,800
1965	65,100
1966	99,800
1967	66,500
1968	99,600
1969	123,700
1970	122,600
1971	122,100
1972	107,400
1973	90,400
1974	81,400
1975	94,900
1976	96,800
1977	98,400
1978	94,100
1979	81,300
1980	106,300
1981	
1982	

Table 15. Fall chinook spawning ground counts, South Prairie Creek, index area (river mile 1.1 - 2.6).^{1/}

Year	Total count	
	Peak	(No. of surveys)
1946	23	(1)
1952	108	(3)
1953	62	(2)
1954	47	(1)
1955	54	(2)
1956	88	(2)
1957	38	(1)
1958	46	(1)
1960	42	(1)
1963	5	(1)
1964	126	(1)
1965	111	(1)
1966	169	(1)
1967	62	(1)
1968	24	(1)
1969	33	(2)
1970	138	(2)
1971	60	(1)
1972	25	(1)
1973	17	(2)
1974	40	(4)
1975	40	(2)
1976	28	(8)
1977	19	(3)
1978	26	(1)
1979	112	(6)
1980	148	(7)

^{1/} From Egan 1978 and 1980.

Table 16. Catch/Escapement ratios for tagged groups of Puyallup stock coho.

<u>Tag code</u>			
1/1/15	'72 Puyallup	20/1b.	4/30/74
	NOTE: Representative of hatch and native coho Catch/ESC = 20.78		
1/4/4	'72 Puyallup	12/1b.	7/20/74
	NOTE: Delayed release - not representative of norm hatch or native coho Catch/ESC = 9.22		
1/14/2	'73 Puyallup	29/1b.	5/8/75
	NOTE: Representative of hatch and native coho Catch/ESC = 7.83		
1/15/4	'73 Puyallup	23/1b.	6/4/75
	NOTE: Representative of hatch and native coho Catch/ESC = 8.40		
1/15/12	'73 Puyallup	14/1b.	5/15/75
	NOTE: Except for large size at release, probably representative of normal hatch and native coho Catch/ESC = 13.50		
13/8/11	'74 Puyallup	21/1b.	4/5/76
	NOTE: Except for some disease problems, representative of normal hatch and native coho Catch/ESC = 16.95		

Source: Finney et al. (1982).

Note: Catch to escapement ratios should be used with caution, as escapement estimates are probably conservative. Present catch:escapement ratios probably do not exceed 15:1 (WDF, Pers. Comm.).

Table 17. Fishery contribution rates, estimated escapement, and total survival of Puyallup Hatchery and White River Coho releases - adults only. (Data presented as contributions per fish released. Values in () indicate percent harvested by each fishery).

Release group	Brood year	Washington		Puget Sound		Washington		Canada		Total fishery contribution	Escapement ^{1/}	Total survival (including escapement)
		Sport	Troll	Sport	Net	Total	Total	Total				
Puyallup Hatchery:												
1-1-15	1972	0.52 (5.9%)	1.32 (14.9%)	0.25 (2.8%)	4.30 (48.5%)	6.39 (72.1%)	0.09 (1.0%)	2.38 (26.9%)	8.86 (100%)	0.42	9.28	
1-14-2	1973	0.84 (6.8%)	2.87 (23.4%)	0.69 (5.6%)	2.77 (22.6%)	7.19 ^{2/} (58.6%)	0.69 (5.6%)	4.39 (35.8%)	12.27 (100%)	1.58	13.85	
1-15-4	1973	0.84 (7.9%)	2.66 (25.0%)	0.57 (5.3%)	2.02 (18.9%)	6.11 ^{2/} (57.3%)	0.75 (7.0%)	3.79 (35.6%)	10.66 ^{3/} (100%)	1.28	11.94	
1-15-12	1973	1.55 (9.9%)	3.96 (25.3%)	0.52 (3.3%)	2.95 (18.8%)	8.98 (57.3%)	0.83 (5.3%)	5.82 (37.1%)	15.68 ^{4/} (100%)	0.98	16.66	
13-8-11	1974	1.22 (5.7%)	3.21 (15.1%)	0.44 (2.1%)	8.25 (38.8%)	13.12 (61.8%)	0.79 (3.7%)	7.33 (34.5%)	21.24 (100%)	1.21	22.45	
13-6-13	1974	1.48 (6.2%)	3.45 (14.5%)	0.79 (3.3%)	10.36 (43.8%)	16.08 (67.8%)	0.70 (3.0%)	6.94 (29.2%)	23.72 (100%)	1.38	25.10	
White River:												
13-11-7	1975	0.64 ^{5/} (16.5%)		0.29 (7.5%)	1.85 (47.8%)	2.78 (71.8%)	0.01 (0.3%)	1.08 (27.9%)	3.87 (100%)	0.32 ^{6/}	4.19	

^{1/} Escapement estimates may be somewhat conservative. Present catch:escapement rates probably do not exceed 15:1.

^{2/} Includes .02 for Washington coastal net fishery.

^{3/} Includes .01 for Alaska net fishery.

^{4/} Includes .05 for California troll fishery.

^{5/} Combined Washington ocean fisheries.

^{6/} Estimated escapement estimates are weak for off station stream plants but are probably ball park estimates.

Source: Data provided by Tim Flint, WDF.

Table 18. Puget Sound fall chinook escapement estimates (1968-1982). Wild fish only.

River	Year															
	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	
Nooksack	2,700	1,600	3,200	4,600	3,000	3,500	2,000	3,030	2,200	1,480	2,061	2,122	3,174	1,352	1,628	
Samish	844	500	1,000	1,400	800	1,200	1,200	950	1,500	610	644	1,263	1,765 ^{1/}	2,200	4,000	
Skagit	12,330	9,613	18,872	18,760	23,234	17,809	12,901	11,555	14,479	9,497	13,209	13,605	20,345	8,670	10,439	
Stillaguamish	1,108	382	432	362	322	3,628	1,013	1,198	2,140	1,475	1,232	1,042	821	630	773	
Snohomish	5,214	3,700	5,724	7,822	3,128	4,841	6,030	4,485	5,315	5,565	7,753	5,370	6,460	3,368	4,379	
L. Washington	-	1,381	14,267	8,424	3,811	7,940	3,264	4,143	3,600	5,790	4,658	4,060	8,314	3,716	5,308 ^{2/}	
Green	3,110	4,035	11,171	5,832	4,343	3,180	5,095	3,394	3,140	3,804	3,304	9,704	7,743	3,606	1,680	
Puyallup	890	850	5,110	2,220	925	630	1,480	1,396	1,120	703	962	2,359	2,552	518	851	
Nisqually ^{3/}	600	300	900	800	700	700	500	550	450	220	178	89	207	195	88	
Skokomish	2,400	1,700	2,100	2,666	1,066	1,572	674	1,673	1,134	1,427	164	1,251	479	117	248	
Hamma Hamma	400	300	300	425	171	252	108	268	252	317	36	278	106	26	55	
Duckabush	227	174	227	125	115	170	73	181	73	91	11	80	31	18	16	
Dosewallips	200	300	600	654	262	386	165	410	20	260	5	280	107	102	56	

^{1/} Plus 167 above dam - 1932.

^{2/} Will definitely be modified.

^{3/} Since 1979, these are minimum escapements (conservative) because of problems with counting fish in turbid water.

Note: Deschutes River fish are all essentially of hatchery origin.

For all Strait of Juan de Fuca streams east of the Sall River a constant escapement of 1550 fish is assumed.

Source: Data provided by Dick Geist, WDF.

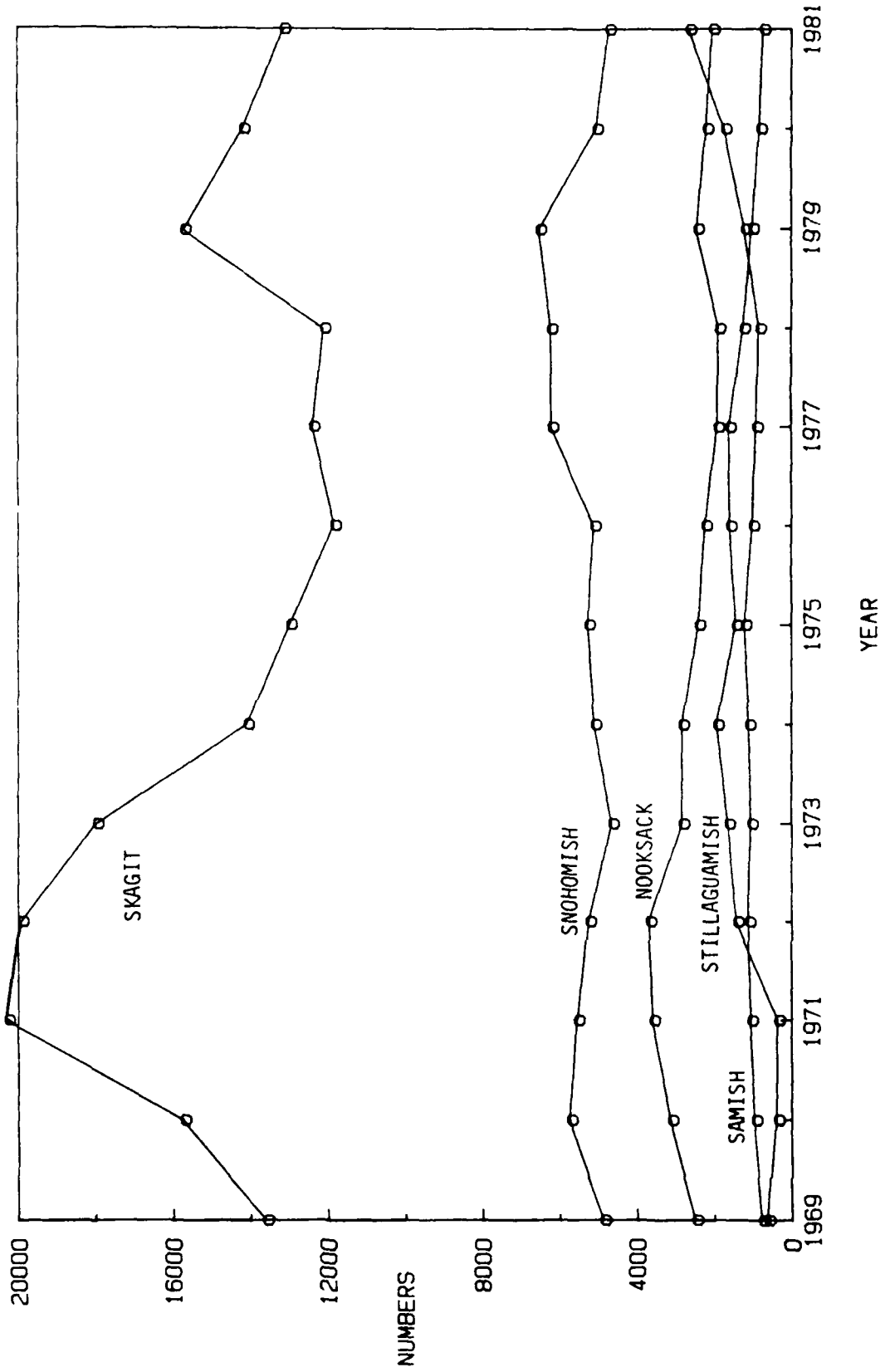


Figure 4. Escapements of wild chinook for northern Puget Sound rivers (smoothed by moving average of 3's) 1969-1982.

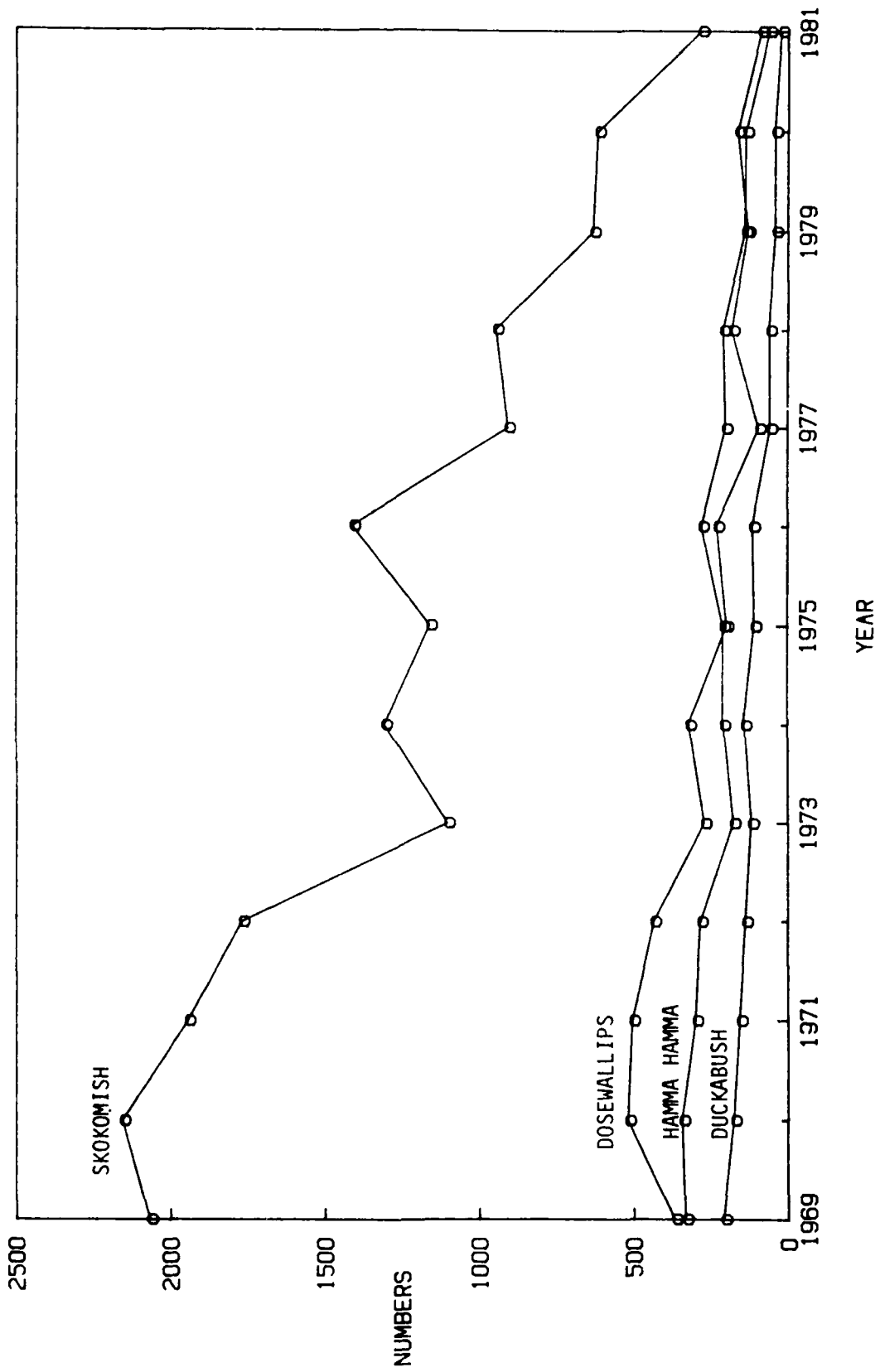


Figure 5. Escapements of wild chinook for central and southern Puget Sound rivers (smoothed by moving average of 3's) 1969-1982.

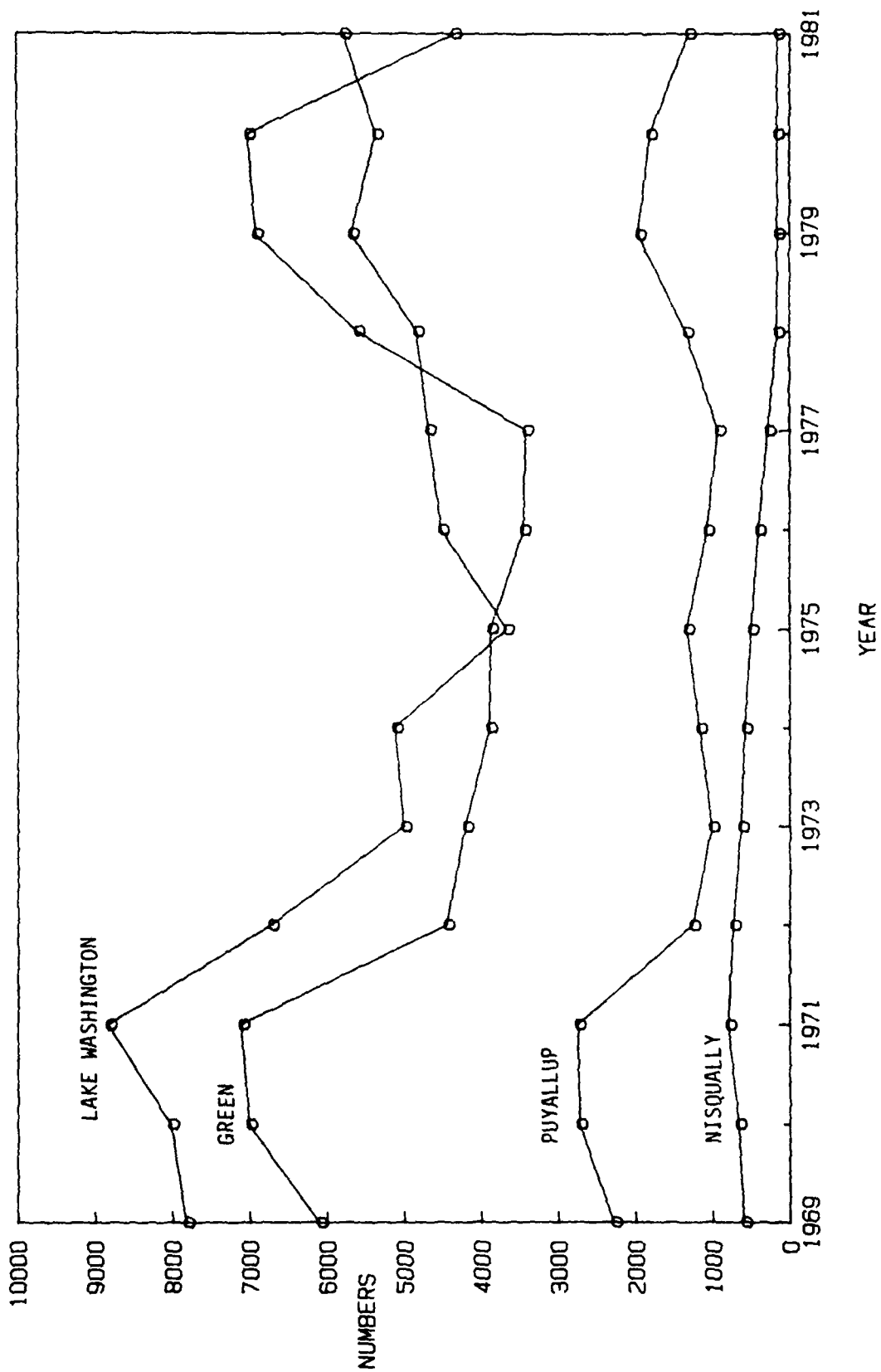


Figure 6. Escapements of wild chinook for southern Puget Sound rivers (smoothed by moving average of 3's) 1969-1982.

Table 19. Means of Puget Sound natural fall chinook escapement estimates (wild fish only) for 1968-1975 and 1976-1982.^{1/}

River	Mean escapement 1968-1975	Mean escapement 1976-1982	Percent change
Nooksack	2954	2002	- 32
Skagit	15634	12892	- 18
Samish	987	1712	+ 74
Stillaguamish	1057	1159	+ 10
Snohomish	5118	5459	+ 7
Skokomish	1731	689	- 60
Hamma Hamma	278	153	- 45
Duckabush	162	46	- 72
Dosewallips	372	119	- 68
Lake Washington	6176 ^{2/}	5064	- 18
Green	5020	4712	- 6
Puyallup	1688	1295	- 23
Nisqually	631	204	- 68

^{1/} Source: Calculated from data provided by Dick Geist, WDF.

^{2/} Mean for 1969-1975.

Table 20. Puget Sound coho escapement estimates (1965-1982), wild fish only.

River	Year																		
	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	1980	1981	1982	
Nooksack	5,000	3,000	2,500	500	1,000	3,000	2,000	1,000	2,000	3,000	2,000	1,000	1,000	1,000	1,000	2,000	5,000	1,000	500
Sauish	4,000	2,000	2,000	500	1,000	2,000	1,000	1,000	1,000	2,000	1,000	1,000	2,000	1,000	1,000	5,700	6,400	6,500	3,900
Skagit	28,000	23,000	15,000	21,000	10,000	21,000	14,000	14,000	15,000	31,000	10,000	16,000	30,000	30,000	9,000	33,000	25,000	15,000	
Stillaguamish	13,000	16,000	12,000	24,000	9,000	26,000	18,000	8,000	14,000	22,000	18,000	23,000	25,000	25,000	16,000	36,000	24,000	9,000	9,000
Snohomish	49,000	63,000	46,000	93,000	33,000	99,000	69,000	31,000	55,000	83,000	68,000	90,000	113,000	61,000	122,000	94,000	37,000	56,000	
L. Washington	7,000	24,000	6,000	10,000	7,000	30,000	17,000	7,000	8,000	18,000	7,000	16,000	15,000	8,000	11,000	11,000	8,000	7,000	
Green	4,600	8,000	4,600	12,500	3,400	9,100	5,700	2,300	1,100	5,600	1,900	3,700	5,100	1,700	4,000	5,000	2,500	2,000	
Puyallup	12,000	9,000	15,000	8,000	2,000	4,000	9,000	3,000	3,000	5,000	2,000	3,000	5,000	2,000	2,000	4,000	5,000	2,000	
Nisqually	3,000	7,000	3,000	2,000	2,000	5,000	600	2,000	2,000	1,000	2,000	1,000	6,000	6,000	2,000	2,000	6,000	5,000	1,300
Deschutes	2,500	3,300	600	1,300	1,800	1,300	2,000	500	1,600	4,500	3,200	1,600	4,800	4,800	1,900	6,300	2,800	3,500	7,900
Skokomish	3,100	8,500	4,000	4,600	1,800	8,500	2,000	800	3,000	4,700	1,400	3,100	3,300	3,600	6,600	8,100	5,300	6,300	

Source: Data provided by Tim Flint, WDF.

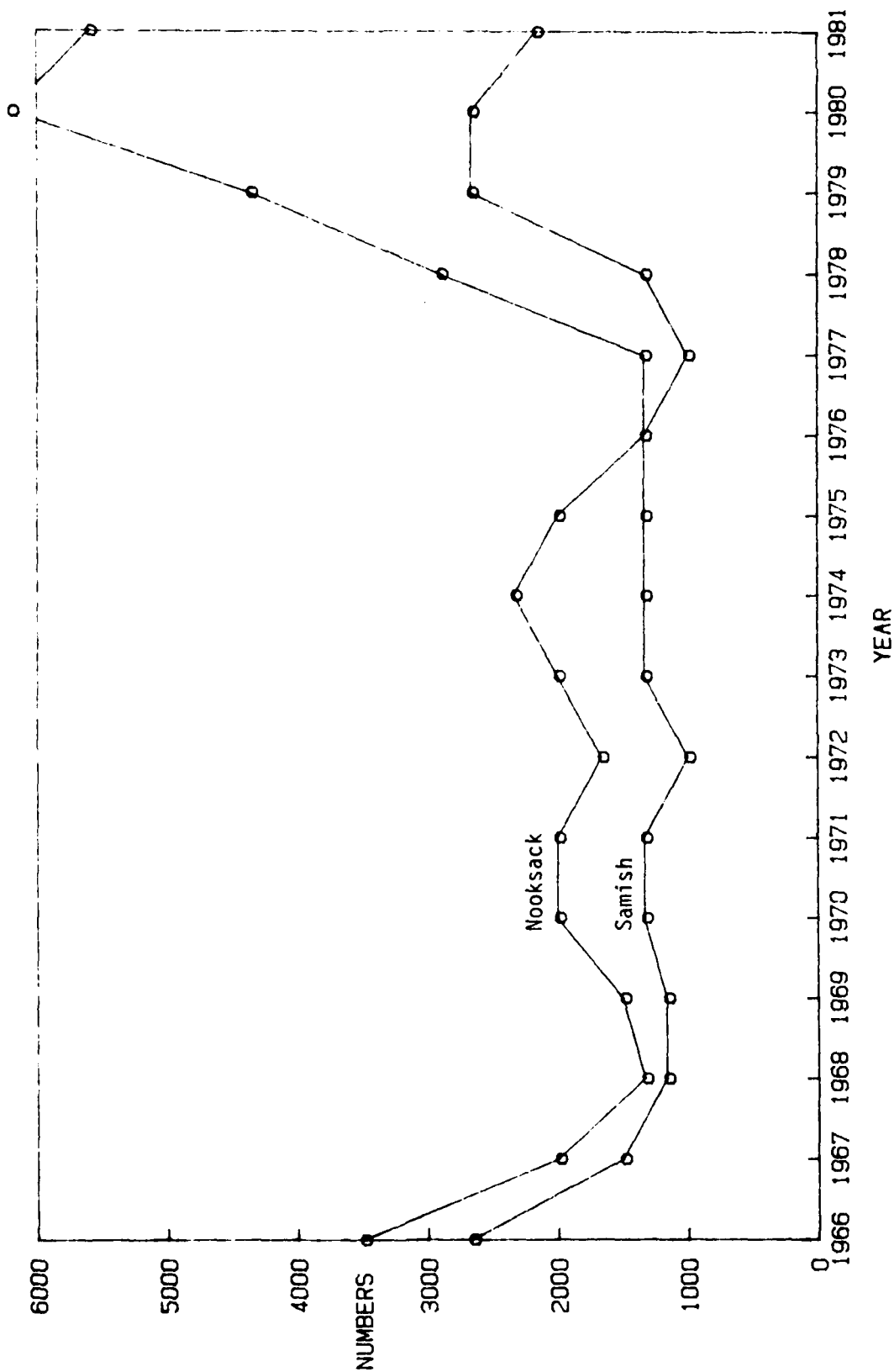


Figure 7. Escapements of wild coho for northern Puget Sound rivers (smoothed by moving average of 3's) 1966 - 1981.

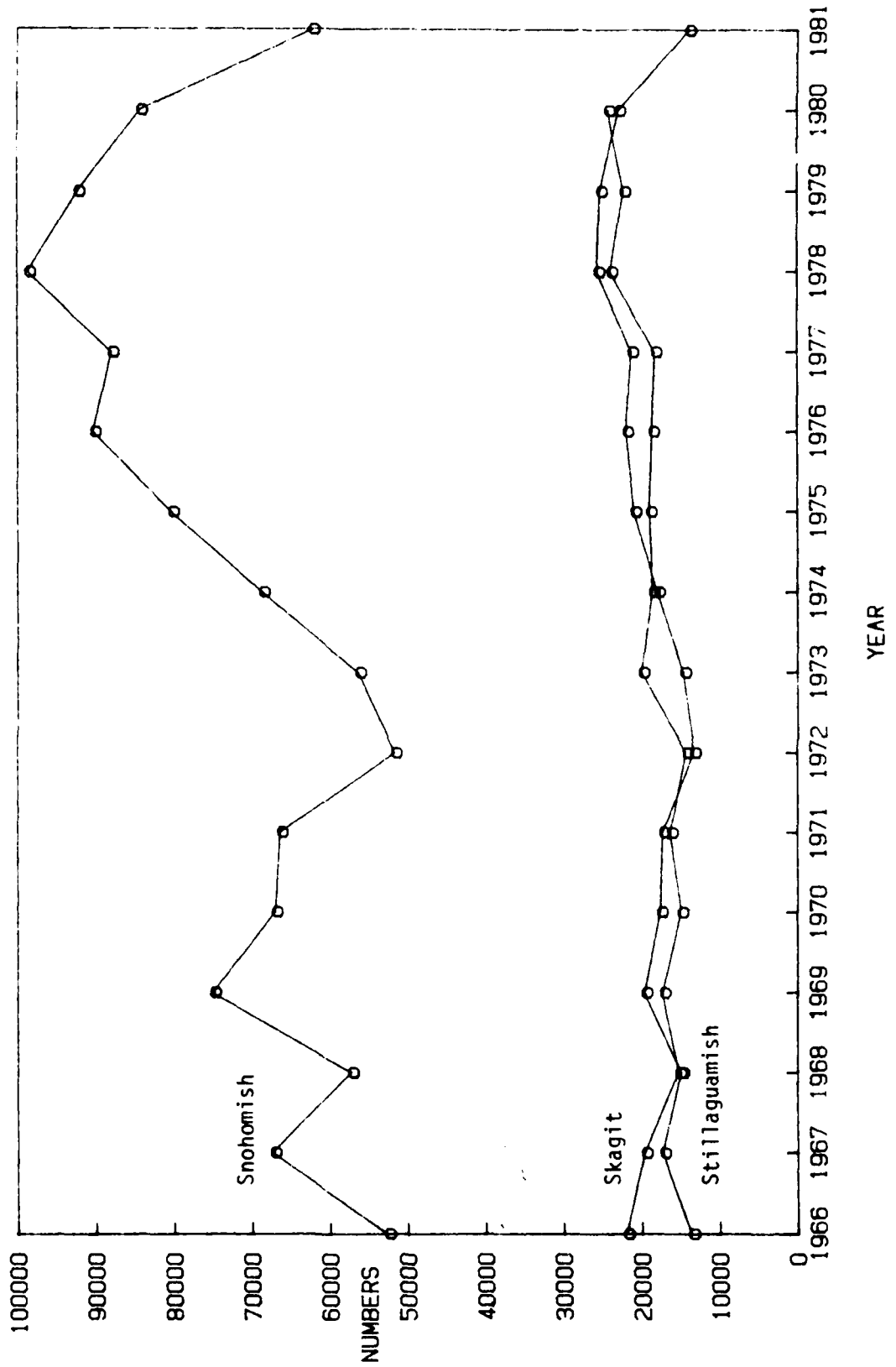


Figure 8. Escapements of wild coho for northern Puget Sound rivers (smoothed by moving average of 3's) 1966 - 1981.

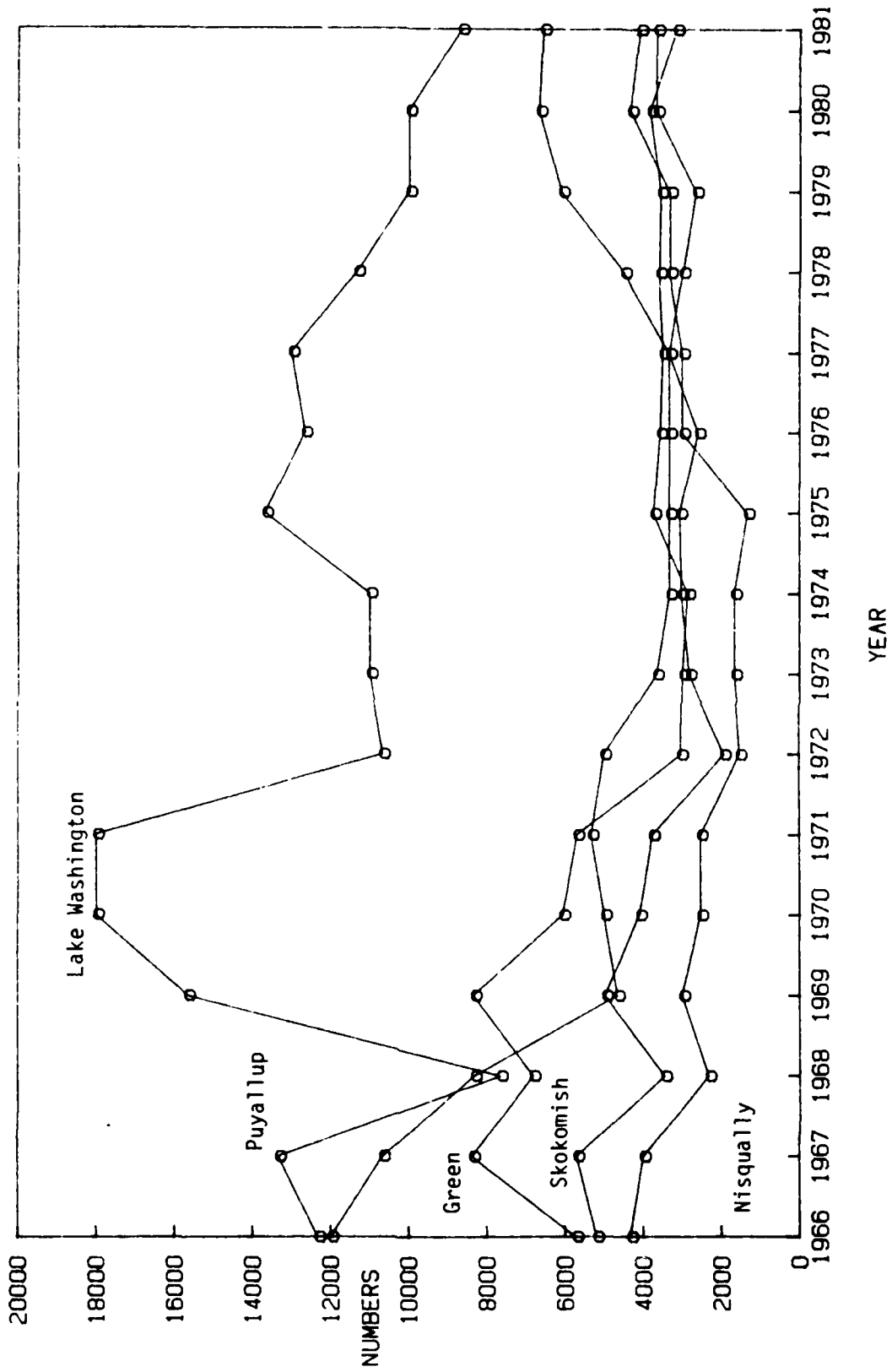


Figure 9. Escapements of wild coho for central and southern Puget Sound rivers (smoothed by moving average of 3's) 1966 - 1981.

Table 21. Means of Puget Sound natural coho escapement estimates (wild fish only) for 1965-1973 and 1974-1982.^{1/}

River	Mean escapement 1965-1973	Mean escapement 1974-1982	Percent change
Nooksack	2222	1833	- 18
Samish	1611	3278	+104
Skagit	17889	21125 ^{2/}	+ 18
Stillaguamish	15556	20222	+ 30
Snohomish	59778	80444	+ 35
Skokomish	4033	4711	+ 17
Lake Washington	12889	11222	- 13
Green	5700	3500	- 39
Puyallup	7222	3333	- 54
Nisqually	2956	2922	- 1
Deschutes	1656	4056	+ 14.5

^{1/} Source: Calculated from data provided by Tim Flint, WDF.

^{2/} Mean for 1974-1981.

APPENDIX II
White River Physical Data

APPENDIX II CONTENTS

- 1 Table 1. Potential causes of movements of the White River - Muckleshoot Indian reservation.
- 2 Figure 1. Schematic of stream gaging sites on the White River.
- 3 Table 2. White River flow data - White River near Buckley.
- 4 Table 3. White River flow data - White River at Buckley.
- 5 Table 4. White River flow data - White River near Sumner.

Table 1. Potential causes of Movements of the White River Muckleshoot Indian Reservation.

<u>Date</u>	<u>Event</u>
1887-1892	Interference by citizens with natural conditions near the point of separation of north and south channels
1892	Flood ^{1/} According to Chittenden, interference by citizens from 1887 to 1892 caused a large portion of this flood to flow to the south down the Stuck Valley
1897 or 1898	Landslide, northwest quarter of Section 28
July 4, 1899	Explosion and landslide, north bank of White River near east boundary of Section 28
1899 or 1900	King County placed logs, brush and sand bags in White River to continue effects of slide
Aug. 1900	King County commenced construction of ditch and embankment in Section 29
Nov. 14, 1906	Flood - White River broke through to Stuck River and began flowing south to the Puyallup River ^{1/}
1907	King County built a barrier and constructed a concrete bulkhead on the north side of the White River
July 20, 1911	Diversion of White River to Lake Tapps from near Buckley began

Source: Stetson (1980).

Table 1, Cont. Potential causes of movements of the White River Muckleshoot Indian Reservation.

<u>Date</u>	<u>Event</u>
Jan. 23, 1914 to present	Inter-County River Improvement works-- construction of Auburn Diversion Dam and drift barrier, bank protection, dikes, dredg- ing, channel clearing of drift, trees and brush.
Nov. 19, 1915	High water--3,510 cfs $\frac{2}{4}$, $\frac{5}{5}$
Dec. 22, 1915	High water--6,070 cfs $\frac{2}{2}$, $\frac{5}{5}$
Mar. 10, 1916	High water--7,690 cfs $\frac{2}{4}$, $\frac{5}{5}$
Dec. 18 & 19, 1917	Flood--23,100 cfs $\frac{2}{2}$, $\frac{4}{4}$ (Dec. 18)
Dec. 31, 1917	High water--8,380 cfs $\frac{2}{2}$, $\frac{5}{5}$
Jan. 22 & 23, 1919	Flood--19,000 cfs $\frac{2}{2}$, $\frac{4}{4}$ (Jan. 22)
Dec. 30, 1920	High water--12,400 cfs $\frac{2}{2}$, $\frac{4}{4}$
Dec. 1, 1921	High water--8,220 cfs $\frac{2}{2}$, $\frac{5}{5}$
Dec. 13, 1921	Flood--16,600 cfs $\frac{2}{2}$, $\frac{4}{4}$.
Jan. 6, 1923	High water--13,300 cfs $\frac{2}{2}$, $\frac{4}{4}$
Oct. 3, 1927	High water $\frac{1}{1}$
Nov. 11, 1927	High water $\frac{1}{1}$
Feb. 26, 1932	Flood--17,000 cfs $\frac{3}{3}$, $\frac{4}{4}$
Nov. 13, 1932	Flood--16,500 cfs $\frac{3}{3}$, $\frac{4}{4}$
Jan. 8, 1933	Flood--12,300 cfs $\frac{3}{3}$, $\frac{5}{5}$

Source: Stetson (1980).

Table 1, Cont. Potential causes of movements of the
White River Muckleshoot Indian Reservation.

<u>Date</u>	<u>Event</u>
Dec. 9 & 10, 1933	Flood--28,000 cfs ^{<u>2/</u>} , ^{<u>4/</u>}
Dec. 22, 1933	High water ^{<u>1/</u>}
Jan. 23, 1934	High water ^{<u>1/</u>}
Oct. 25, 1934	Flood--14,300 cfs ^{<u>2/</u>} , ^{<u>4/</u>}
Nov. 6, 1934	Flood ^{<u>1/</u>}
Jan. 23, 1935	High water ^{<u>1/</u>}
Apr. 18, 1938	Flood--12,400 cfs ^{<u>2/</u>} , ^{<u>4/</u>}
Dec. 19, 1941	High water--7,550 cfs ^{<u>3/</u>} , ^{<u>4/</u>}
1939-1948 1942	Construction of Mud Mountain Dam Regulation for flood control com- menced at Mud Mountain Dam
Dec. 14, 1946	Flood--12,300 cfs ^{<u>3/</u>} , ^{<u>4/</u>}
Nov. 23, 1959	Flood--13,000 cfs ^{<u>3/</u>} , ^{<u>4/</u>}
Dec. 2, 1975	Flood--12,100 cfs ^{<u>3/</u>} , ^{<u>5/</u>}
Dec. 2, 1977	Flood--10,600 cfs ^{<u>2/</u>} , ^{<u>5/</u>}

-
- 1/ No flow measurement available.
2/ USGS Station No. 1000, White River at Buckley, downstream
of Puget's diversion to Lake Tapps.
3/ USGS Station No. 985, White River near Buckley, upstream
of Puget's diversion to Lake Tapps.
4/ Peak flow.
5/ Average daily flow.

Source: Stetson (1980).

Figure 1. Schematic of stream gaging sites on the White River (not drawn to scale).

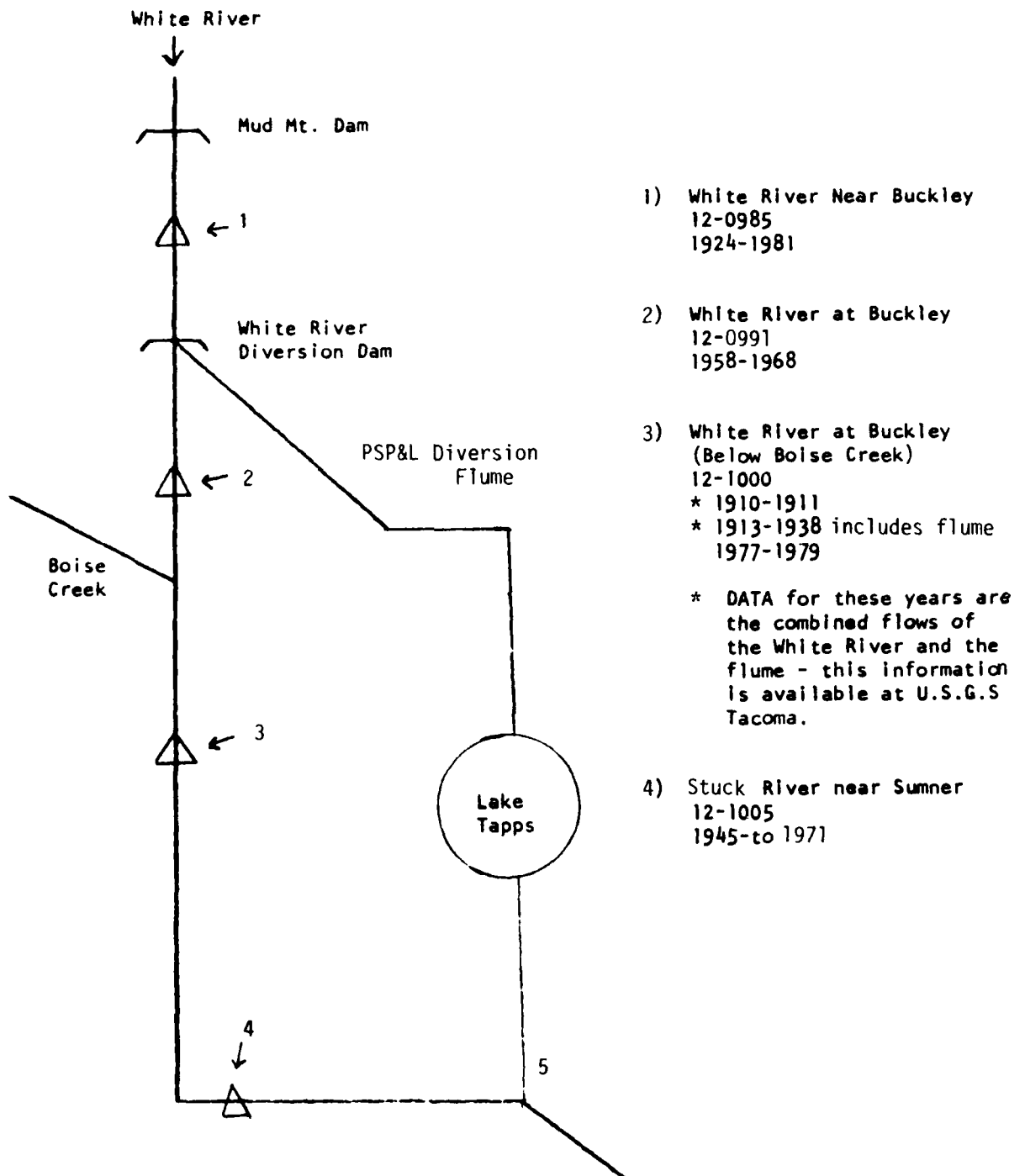


Table 2. WHITE RIVER FLOW DATA--WHITE RIVER NEAR BUCKLEY (USGS Guage 0985)

ANNUAL DISCHARGE IN CFS

YEAR	MAX	MIN	MEAN
1924	6527	358	1351
1925	5430	342	1336
1926	3600	410	1093
1927	6310	560	1759
1928	5740	418	1437
1929	3900	253	1019
1930	3820	301	987
1931	6260	335	1200
1932	10256	472	1860
1933	16585	583	2309
1934	13637	409	2049
1935	9093	346	1502
1936	7170	285	1615
1937	8866	238	1648
1938	10753	370	1496
1939	5320	388	1358
1940	8740	391	1240
1941	8656	370	1015
1942	8918	172	1419
1943	5527	57	1304
1944	3453	275	852
1945	11742	278	1510
1946	14470	195	2179
1947	9919	467	1797
1948	8965	369	1826
1949	7811	445	1746
1950	6677	508	2282
1951	11131	217	1561
1952	3740	193	1034
1953	10806	329	1530
1954	4351	511	1491
1955	11100	146	1823
1956	9322	392	2141
1957	4466	331	1216
1958	6640	273	1637
1959	16809	445	1867
1960	5807	197	1340
1961	7284	396	1574
1962	10760	508	1866
1963	6021	388	1193
1964	5768	537	1658
1965	20844	235	1436
1966	4317	354	1295
1967	8915	453	1535
1968	6773	554	1585
1969	11068	291	1434
1970	6130	150	1330
1971	7690	393	1735
1972	8680	188	2043
1974	10200	111	1792
1975	12100	422	1902
1976	10400	179	1400
1977	12900	426	1397
1978	3590	280	1161

Table 3. WHITE RIVER FLOW DATA--WHITE RIVER AT BUCKLEY (USGS Guage 1000)
ANNUAL MEAN DISCHARGE IN CFS

YEAR	STREAM AND		
	DIVERSION	DIVERSION	STREAM
1914	1280	595	685
1915	1000	595	405
1916	1940	638	1302
1917	1630	588	1042
1918	1770	667	1103
1919	1620	805	915
1920	1330	718	612
1921	1860	605	1255
1922	1400	686	714
1923	1460	785	675
1924	1290	838	452
1925	1430	918	512
1926	1030	774	256
1927	1470	853	617
1928	1870	922	948
1934	2267	868	1399
1935	2051	859	1192
1936	1584	887	697
1937	1244	870	374
1938	1917	931	886

Table 4. WHITE RIVER FLOW DATA--WHITE RIVER NEAR SUMNER (USGS Guage 1005)

ANNUAL DISCHARGE IN CFS

YEAR	MAX	MIN	MEAN
1945	10500	62	488
1946	12200	46	947
1947	8160	52	633
1948	5630	70	636
1949	7190	54	638
1950	5250	62	1024
1951	11000	68	445
1952	2410	36	202
1953	9880	64	577
1954	2210	72	356
1955	13400	37	774
1956	5540	68	838
1957	2240	53	280
1958	7530	32	615
1959	12500	40	954
1960	4180	41	417
1961	4670	45	531
1962	4930	55	649
1963	6020	68	505
1964	8200	74	927
1965	13500	92	787
1966	2830	52	370
1967	7940	67	600
1968	6400	95	602
1969	11100	58	589
1970	4940	58	453

APPENDIX III
White River Impacts

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- 1 Table 1. Timetable of events on the White River.
- 2 Figure 1. White River Fisheries Enhancement Committee, Proceedings of September 14, 1982.
- 3 Table 2. Annual Gravel Removal Volumes 1974-1980.
- 4 Figure 2. Location and magnitude of gravel removal operations, 1974-1980.

Table 1. Timetable of events on the White River.

<u>Year</u>	<u>Event</u>	<u>Source</u>
~18,000 years ago	The last glacial stage, the Vashon advance.	Crandell (1963)
~5,000 years ago	The Osceola mudflow.	Mullineaux (1970)
1856	Formation of the Muckleshoot Indian Reservation.	Curtis (1913)
1887-1892	The White River channel shifted back and forth between the Green and Stuck river valleys, mainly due to "artificial" causes. "...Interference by citizens of both counties with natural conditions."	Chittenden (1907)
1892	The majority of this years' flood went down the Stuck River valley. First lumber mill built in Enumclaw (planing mill).	Chittenden (1907) A History - The White River Lumber Co. (Weyerhaeuser pamphlet)
1897	White River Lumber Co. acquired the Enumclaw lumber mill and another at Ellison (Boise Creek). A 3-mile flume floated logs from Ellison to Enumclaw.	Ibid.
1898	A landslide diverted the entire White River flow into the Stuck River.	Chittenden (1907)
1900	By this year the White River again flowed into the Green River.	Dunne (1978) River of Green report.
1901	The White River Hatchery (located on Soo's Creek, now known as the Green River Hatchery) was completed.	State Fish Commissioner's 10th-11th annual reports
1902-1928	Enumclaw Mill rebuilt after fire; capacity: 100,000 board feet per day.	A History - The White River Lumber Co. (Weyerhaeuser pamphlet)

Table 1, continued.

<u>Year</u>	<u>Event</u>	<u>Source</u>
1903	The egg-take at the White River Hatchery was 369,500 chinook, 528,000 coho, 328,000 pink, and 96,800 steelhead.	Ibid. 14th-15th annual reports
1905-1906	The White River Hatchery was considered "...undoubtedly one of the best plants in the state..."	Ibid. 16th-17th annual reports
1906	Severe flooding in November caused a log jam which diverted the White River into the Stuck River.	Chittenden (1907)
1907	A sizeable increase in chinook egg take was reported at the White River Hatchery.	State Fish Commissioner's 18th & 19th annual reports
1908	Expansion of the White River Hatchery (new building and pond construction) was underway.	Ibid. 18th and 19th annual reports
1909	The hatchery expansion was completed and a record chinook egg-take was reported; "The season of 1909 was a banner year for this plant."	Ibid. 20th and 21st annual reports
	An Appropriation of \$50,000 was made by the State for improvement of the Puyallup and Stuck rivers.	Session Laws 1909, ch. 241
1910-1911	Puget Sound Power and Light constructed a diversion dam at Buckley.	PSP&L
1914	The Inter-County River Improvement Agency (ICRI) began flood control activities-channel straightening, clearing, etc.	Muckleshoots papers in Trans-Canada case.
1915	The White River was permanently diverted into the Stuck River Valley by the construction of a diversion dam at Auburn.	Ibid.
1917 & 1919	Major flooding occurred on the White River.	Ibid.

Table 1, continued.

<u>Year</u>	<u>Event</u>	<u>Source</u>
1922	By this year the river channel in section 28 (the Auburn to Buckley reach) was meandering again.	Ibid.
1929-1949	White River Lumber Co. becomes affiliated with Weyerhaeuser; the two companies merged in 1949.	A History - The White River Lumber Co. (Weyerhaeuser pamphlet)
1933	The longest recorded flood on the White River washed out much of ICRI's work all along the river.	Muckleshoots papers in Trans-Canada case.
Mid 1930's	Clearcut logging commenced in the upper watershed.	Wilson (1973)
1931	New lumber mill constructed at Ellison; capacity: 600,000 board feet per day.	A History - The White River Lumber Co. (Weyerhaeuser pamphlet)
1938	Rotary fish screens were installed in the PSP&L diversion flume.	WDF Annual Bulletin No. 39 (1939)
1939	In August of this year, construction began on Mud Mountain Dam.	USACE (1971)
1940	A part of this years' fish runs were hauled above Mud Mountain Dam.	WDF, USACE records
1941	The first full year that fish runs were hauled above Mud Mountain Dam.	Ibid.
1942	Mud Mountain Dam construction was halted due to WWII.	USACE (1971)
1945	Beginning of truck logging in the White River drainage (Weyerhaeuser)	A History - The White River Lumber Co. (Weyerhaeuser pamphlet)
1947	Mud Mountain Dam construction was resumed.	USACE (1971)
1947	USFS logging began in the White River drainage.	White River District USFS
1948	Mud Mountain Dam was completed	USACE (1971)

Table 1, continued.

<u>Year</u>	<u>Event</u>	<u>Source</u>
1948	Dredging of the river channel in the Muckleshoot work section began.	Muckleshoots papers in Trans-Canada case
1953	The Indian net fishery began on the lower Puyallup River.	WDF 1961
1957	The construction of riprap dikes in the Muckleshoot section began.	Muckleshoots papers in Trans-Canada case.
1966	An Injunction curtailed fishing by the Puyallup Indians.	
1970	Washington Dept. of Ecology began documentation of fish kills on the White River.	WDE (1970)
1971-1972	WDF conducted genetic manipulation of White River spring chinook stock.	Baranski (1978)
1974	First brood of White River spring chinook reared at Minter Creek.	Baranski (1978)
1974	Boldt decision	
1977	Flooding resulting in log debris jams caused much destruction in the town of Greenwater and the upper White River drainage.	The Weekly, Vol. 2, No. 38, Dec. 14-20, 1977
1981	EPA declares Commencement Bay one of the 10 worst hazardous waste sites in the nation.	Seattle Times Nov. 1, 1981

Figure 1. WHITE RIVER FISHERIES ENHANCEMENT COMMITTEE
 PROCEEDINGS OF SEPTEMBER 14, 1982

IN ATTENDANCE:

Tom Cropp - WDG
 Dan Thayer - Puyallup Tribe
 Cary Feldman, Barry Lombard, Larry Tornberg - Puget Power
 Walt Pachico, Don Finney - Muckleshoot Tribe
 Dan Fryberger, Jack Thompson, Tom Bonde - Corps of Eng.
 Art Tasker - D.N.R.
 Rick Trosper - WDF
 Tom Jagielo, Ernie Salo, U.W.
 Jim Doyle - U.S.F.S.
 Larry Roberts - N.W.S.S.C.
 Bob Wunderlich - U.S.F.W.S.

The primary goal of this meeting was the creation of a comprehensive list of problems affecting the anadromous fish stocks of the White River. No attempt was made to classify problems according to significance, solvability, or any other criteria at this meeting.

After several hours of input from all participants the following problem list was compiled.

1. High Seas Interception - Toll, Trawl, and Sport Fishing
2. Lack of Tagging Data
3. Estuary Lacks Rearing Capacity - Dredging & Filling
4. Industrial and Agricultural Pollution
5. Indian Net Fishery
6. Sport and Non-Indian Commercial Fishery
7. Gravel Removal and Diking (channelization)-Lack of Data on Effects
8. Man-Made Migration Obstacles in Tribs.
9. Flood Control - Changes in Historical Flood Flows (to Green River)
10. Tributary Diversion and Water Use
11. Domestic Sewage Outfalls
12. Mainstem Diversion - Low Flows Below Buckley for Spawning, Rearing, Transporting
13. City of Tacoma Waterline Crossing (Laddered)
14. Muckleshoot Net Fishery
15. Up-Migrant Adults Attracted to Dieringer Outlet (dead-end)
16. Fish Screen Inefficient (Diversion Canal)
17. Fish Screen By-Pass Channel Maintenance
18. Lake Tapps Water Quality
19. Loss of 6 Miles Utilization from Buckley Trap to Mud Mt. Dam
20. Heavy Sediment Load
21. Adult Loss or Escapement From Trap or in Transport
22. Out-Migrant Loss at Mud Mt. Dam
23. Modified Run-Off Pattern Due to Peak-Flow Containment
24. Migration Delay in Impoundment
25. Removal of Large Organic Debris at Dam
26. Habitat Change in Impounded Area
27. Mud Mt. Dam - No Ladder
28. Lack of Land Use Planning and Zoning
29. Relocation of Tributary Stocks Through Transport
30. Poaching (illegal fishing)

Figure 1, continued

31. Questionable Management - Relocation of Stocks (Chinook)
32. Predators
33. Sport Fishing in Tribes - Sub Migrants
34. Questions and Conflicts in Regulations and Management
35. Road Failures
36. Road Construction and Maintenance
37. Excessive Roading
38. Log Jam and Debris Blockages
39. Canopy Loss
40. Debris Removal
41. Boise Cr. Water Quality - Weyco. Pond
42. Logging - Related Run-Off Pattern Changes
43. Water Quality Degradation
44. Natural Barriers to Migration
45. FPA, HPA Violations
46. Low Productivity - Both Natural and Man-Caused
47. Interruption of Natural Plant Succession (tree planting, spraying, fire control, etc)
48. Lack of Comprehensive River Planning (biological and physical)
49. Small Hydro Projects - Potential
50. Mining - Toxic Waste and Dredging
51. 4WD Use in Spawning Areas
52. Lack of Sanitary Facilities for Recreation
53. Acid Rain?

As you can see from this list, we have a great number of problems ranging from very simple to very complex. Our next job is to identify those problems which we feel can be solved using presently - available technology.

Our next meeting is scheduled for Tuesday, November 9 at 9:00 a.m. at the White River Ranger District Office in Enumlcaw. We will plan to adjourn by noon after covering as many problems as we can. Subsequent meetings will be necessary in January and possibly March to complete this phase of listing problems and potential solutions.

Your continued interest and participation in this important work is vital to our success.

Table 2. Annual gravel removal volumes (CY) 1974-80.

<u>Year</u>	<u>White River</u>	<u>Carbon River</u>	<u>Puyallup River</u>
1974	71,000	137,000	128,000
1975	51,000	57,000	88,000
1976	247,000	31,000	134,000
1977	56,000	18,000	81,000
1978	153,000	19,000	42,000
1979	33,000	28,000	123,000
1980	<u>---</u>	<u>95,000</u>	<u>40,000</u>
AVERAGE	87,000	55,000	91,000

Source: Table taken from Nece et al. (1982).

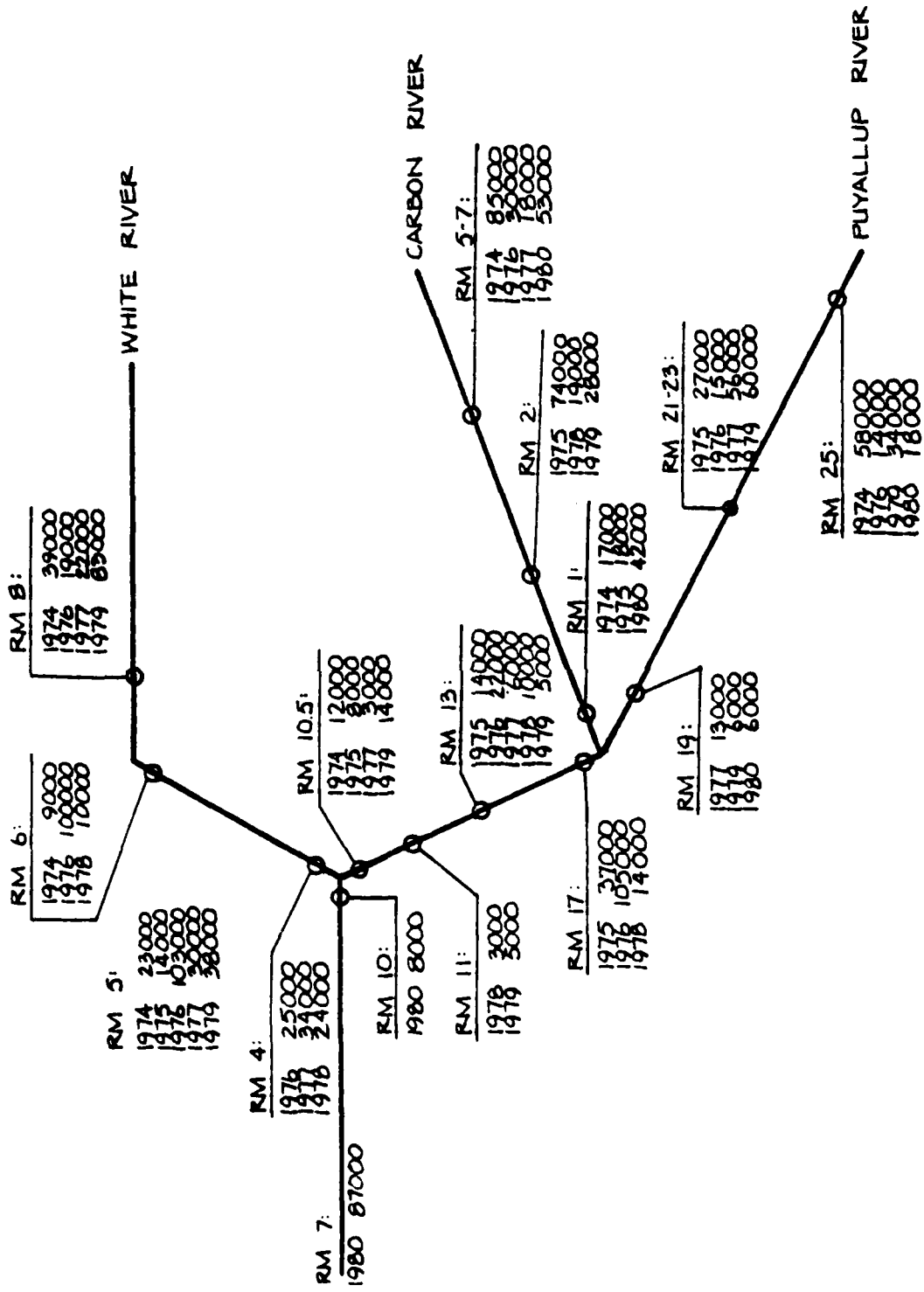


Figure 2. Location and Magnitude of Gravel Removal Operations in Puyallup Basin, 1974-80.

Source: Figure taken from Nece et al. (1982).

APPENDIX IV

An Annotated Bibliography on White River -
Puyallup System Fisheries

An Annotated Bibliography on
White River-Puyallup System Fisheries

1. Ajwani, Santo. 1956. A review of Lake Washington watershed, historical, biological and limnological. Masters Thesis, University of Washington.

A compilation of historical and scientific data of relevance to the fisheries of the Lake Washington watershed. The Cedar, Sammamish, and other rivers, as well as Lake Washington limnology, are discussed.

2. Allee, Brian J., K, V. Koski and E. O. Salo. 1971. Clearwater River Project . Final Report. Submitted to Small Tribes Organization of Western Washington.

An evaluation of the fishery resource potential of the Clearwater River was conducted to determine the feasibility of salmonid enhancement in this part of the upper White River drainage. Available temperature, water quality, and fisheries data are presented for the Clearwater River. A combination spawning, incubation, and rearing channel facility was suggested to enhance natural runs of chinook salmon. An oxbow located on the lower Clearwater River was recommended as a feasible site for the channel facility.

3. American Friends Service Committee. 1970. Uncommon controversy: Fishing rights of the Muckleshoot, Puyallup and Nisqually Indians. University of Washington Press.

A report prepared for the American Friends Service Committee attempting to present the Indian point of view in the controversy over the fishing rights of Muckleshoot, Puyallup and Nisqually Indians. Numerous references are made to historical fishing activities and treaties of these tribes. A discussion of legal aspects, the controversy today, and fish and their environment are included.

4. Ames, Jim and Duane E. Phinney. 1977. 1977 Puget Sound Summer-Fall Chinook Methodology: Escapement Estimates and Goals, Run Size Forecasts, and In-Season Run Size Updates. Technical Report No. 29. Washington Department of Fisheries.

Harvest management methodology for Puget Sound stocks of summer-fall chinook is presented. Chinook escapement estimates for the Puyallup River System from 1965-1976 are also included.

5. Auburn, City of. 1980. Final Environmental Impact Statement for Cedardowns - A residential mobile home community. Planning Department, Auburn, WA.

This proposed development includes Stuck River frontage. Plans are included to preserve the Shoreline Zone as a natural, open space with a pocket park and trails to provide access points to the river.

6. Auburn, City of. 1981. Lakeland Hills Proposed Residential Community. Final Environmental Impact Statement. Department of Planning and

Community Development.

The Lakeland Hills proposal encompasses 1266 acres of land on a portion of the uplands south of the White River and East of the Kent-Auburn valley. A 200 foot strip of land adjacent to the White River lies within the Auburn Shoreline Master Program "conservancy environment." The Lakeland Hills development would be inconsistent with the Master Program.

7. Bagley, Clarence B. 1929. History of King County, Washington Vol. 1. The S. J. Clarke Publishing Co., Seattle-Chicago.

Chapters on "Fish and Fisheries," "White River Valley," "Auburn," "Kent," "Renton," and "Enumclaw" are of relevance to the history of the White River fishery.

8. Ballard, Arthur C. 1957. The Salmon Weir on Green River in Western Washington. Davidson Journal of Anthropology 3:37-53.

This paper describes, in some detail, the construction and historical use of salmon weirs by Indians on the Green River. Mention is made of aboriginal fishing sites on the Green, White, and Stuck rivers.

9. Becker, C. D. 1966. An annotated bibliography on the ecology of salmonids in Puget Sound estuaries. Circular No. 66-17, Fisheries Research Institute, University of Washington.

Among the items reviewed are a number of relevance to Green and White River salmonid ecology. Items of potential interest are numbers 12, 18, 35, 40, 44, 55, 57, 58, 59, 60, 87, 98, 101, 102, 109 and 135.

10. Becker, C. D. 1967. The Green River Hatchery, Washington: A Historical and Statistical Review. Circular No. 67-1, Fisheries Research Institute, University of Washington.

Geographical changes in the Green-Duwamish watershed and the history of the Green River Hatchery are described. Chinook and coho releases and returns from the Green River Hatchery from 1944-1965 are tabulated.

11. Bostick, W. E. et al. 1955. Pink, chinook and silver escapement (1955). Puget Sound Stream Studies (1953-1956), Washington Dept. of Fisheries.

Escapement counts for index areas (including the Duwamish and Puyallup systems) are presented for 1951-1955.

12. Bostick, W. E. 1955. Downstream migrant passage over White River Screens. Puget Sound Stream Studies (1953-1956) p. 22.

A second determination was made to access the percentage of fish passing over the screens vs. entering the by-pass system of the White River power diversion (cf. Regenthal 1953). It was concluded that approximately 50% of the zero chinook, and 75% of the zero silver salmon are lost over the screens.

13. Burges, Stephen J. 1972. Spawning and Rearing Hydraulic Characteristics--White River Washington, Buckley to Dieringer. Attachment to: Anadromous Fish Migration, Spawning and Rearing flow study on White River. USFWS.
14. Burley, Curtis L. Direct testimony of Curtis L. Burley on behalf of the United States Dept. of the Interior and the Muckleshoot Indian Tribe.
- Curtis L. Burley was the assistant manager of the Northwest Fisheries Program (USFWS), and participated in the 1974 USFWS study of the White River. Data from that report are included in his testimony. His testimony concurs with James Heckman's testimony, stating that Puget Power's White River Project adversely affects both upstream and downstream fish migration and spawning and rearing habitat of the reach between the Buckley diversion and Dieringer.
15. Chittenden, Hiram M. 1907. Report of an Investigation by a Board of Engineers of Means of Controlling Floods in the Duwamish-Puyallup Valleys and their tributaries. United States Army Corps of Engineers. Special Pamphlet.
- This early report assessed flood control options available to King and Pierce counties subsequent to the destructive flooding of the White River in 1906. Conditions leading to the great flood of 1906 and historical shifts of the White River between the Duwamish and Puyallup valleys are described. It was recommended that the White River be permanently diverted through the Stuck River Valley to discharge into the Puyallup River.
16. Crandell, Dwight R. 1963. Surficial Geology and Geomorphology of the Lake Tapps Quadrangle, Washington.
- This report deals with the geology of portions of Pierce and King Counties within the Puyallup Basin. The geologic history and rivers ancestral to the modern White, Carbon, Mowich, and Puyallup Rivers is discussed.
17. Cross, Lorriane. 1975. History of Puget Sound with a Viewpoint Towards Understanding What Has Happened to the Indians of the Muckleshoot Indian Reservation. B.A. Degree, General Studies, University of Washington.
- Historical information on the Muckleshoot Indian Tribe and a discussion of "current issues" including fishing, religion, and education. Some early maps of the Muckleshoot and Puyallup Indian reservations are included.
18. Donworth, George. 1909. Memorandum concerning General History of White River-Lake Tapps Power Enterprise. (Unpublished mimeo.)
- A discussion of early rights and activities relating to water diversion for power generation on the White River is presented. Topics covered include the organization of the Pacific Coast Power

Company, the Muckleshoot reservation, the natural outlet of Lake Tapps, and the use of the White and Stuck rivers for floating logs and shingle bolts.

19. Dunn Bar file. Northwest Collection, University of Washington.

This file contains items of interest relating to early logging activities in the White River drainage.

20. Dunstan, William A. 1954. Preliminary Report of the Light Guidance and Inverted Weir Structures as Aids in Migration Through the White River Screening System. Washington Department of Fisheries.

During 1953, 7% of the downstream migrating silver salmon and 49% of the chinook in the White River were lost. Impingement of fish on the White River screens, and passage into Lake Tapps during periods of high diversion canal flows is reported. Methods for velocity reduction and light guidance around trouble spots is discussed.

21. Dunstan, William A. 1955. White River downstream migration. Puget Sound Stream Studies (1953-1956), Washington Department of Fisheries.

Further use of the diversion trap was made in 1955 to gather data on the downstream migration of silver and chinook salmon in the White River. (Similar experiments were conducted in 1953 and 1954 also.) Contrary to pre-1954 findings, it was noted that the number of fish diverted into the by-pass flume was not directly proportional to the total amount of water diverted. The percent of fish diverted into the flume decreased markedly as the total flow increased.

22. Egan, Ron. 1978. Salmon spawning ground data report - 1978. Progress Report No. 51, Washington Department of Fisheries.

Spawning ground surveys are tabulated by stream and year for the index areas studied. Data are presented for the White (Stuck) River obtained by both aerial and foot surveys through 1977. Note: The aerial surveys made on the White River were considered ineffective often, due to turbid water conditions. (Personal communication, Kevin Bauersfeld, WDF.)

23. Egan, Ron. 1980. Puget Sound Salmon Spawning Ground Data Report. Progress Report No. 109, Washington Dept. Fisheries.

This report contains spawning ground counts of chinook, chum, pink, coho, and sockeye salmon in Puget Sound streams for escapement years 1978 and 1979.

24. Egan, Ron. 1981. Puget Sound Salmon Spawning Ground Data Report. Progress Report No. 146. Washington Dept. Fisheries.

This report contains spawning ground counts of chinook, chum, pink, coho, and sockeye salmon in Puget Sound streams for the escapement year 1980.

25. Engstrom-Heg, B. and A.F. Regenthal. 1954. Spawning ground survey counts In Puget Sound Stream Studies (1953-1956), p. 5, Washington Department of Fisheries.

The 1951-1954 chinook, silver and chum salmon escapement counts for the Puget Sound streams surveyed, including the Duwamish and Puyallup systems, are presented.

26. Fahnestock, Robert K. 1963. Morphology and hydrology of a glacial stream - White River, Mount Rainier, Washington. Geological Survey Prof. Paper 422-A. Physiographic and Hydraulic Studies of Rivers (USGS).

The morphological and hydrological characteristics of the White River were investigated. It was found that the slope of the valley terrain was related to particle size and discharge. It was noted that a marked change from a meandering pattern to a braided pattern took place with the onset of the high summer flows and the pattern returned to meanders with the low flows of fall.

27. Finney, Donald E., Larry D. Burnstad, and James A. Doyle. 1982. Status Report: Current Fisheries Resource and Management of the White River Drainage. USDA Forest Service, Supervisor's Office, Mt. Baker-Snoqualmie National Forest.

This report discusses the history and current status of anadromous fish resources in the White River, the current management situation, and management concerns affecting USFS fish habitat improvement plans. A discussion of current trends, run size estimates, fisheries below Mud Mountain Dam, and enhancement efforts for steelhead, coho, and chinook stocks is presented.

28. Hahn, Peter and Bob Leland. 1979. Steelhead in the White River, Washington. Steelhead Program Quarterly Progress Report. Washington Department of Game.

Steelhead escapements to the Buckley trap were studied during the spring of 1979. It was concluded that hatchery steelhead comprise a minor portion, at best, of the upriver escapement. Historical trapping and harvest records are summarized. A decreasing trend in steelhead escapements to the upper White River are noted for 1940-1978. Also, the Indian fishery has evidently declined substantially in the 1970's compared to the 1950's.

29. Heckman, James L. 1964. Special Report - Status of the White River Washington Fisheries. Fishery Management Program. Bureau of Sport Fisheries and Wildlife. U.S. Dept. of the Interior. Portland, Oregon. (mimeo).

The decline of anadromous fish runs in the White River is discussed. An intensified Puyallup Indian fishery, low minimum flows below the Buckley diversion, and channel maintenance for flood control are cited as contributing factors. The author states that improvement of fish passage conditions would be of little benefit except in conjunction

with the regulation of the downstream Indian fishery.

30. Heckman, James L. 1967. Muckleshoot Indian Reservation. Progress Report, Fishery Management Program. Bureau of Sport Fisheries and Wildlife. U.S. Dept. of the Interior. Olympia, Washington. (mimeo.)

Cooperation between the Muckleshoot Indians and the Bureau of Sport Fisheries and Wildlife is reported; a plant of 10,000 coho was made in Second Creek. It is noted that increased fish landings by the Puyallup Indians near the mouth of the Puyallup River has resulted in decreased Muckleshoot catches on the White River. A 1965 fish kill resulting from silt flushing from Mud Mountain Dam is discussed - WDF estimated 200 adult salmon mortalities.

31. Heckman, James L. Direct testimony of James L. Heckman on behalf of the U. S. Department of Interior and the Muckleshoot Indian Tribe.

James Heckman was the manager of the Northwest Fisheries Program - USFWS. Speaking of the White River between the Buckley diversion and Dieringer, he states that the primary cause for low fish production in that portion of the White River is lack of adequate stream-flow for a significant portion of the year below Puget Power's diversion dam. He states that this low flow adversely affects both upstream and downstream fish migrations and substantially reduces the spawning and rearing potential of the river. The inadequacy of the fish screens is also mentioned.

32. Heg, Robert T. 1953. The Role of Hatchery Plants in Rebuilding the White River Silver Salmon Population. Progress Report. Puget Sound Stream Studies (1953-1956), p. 122. Washington Department of Fisheries.

The approximate contribution of hatchery fish to silver salmon escapement above Mud Mountain Dam was calculated for each year from 1940 to 1951. It was concluded that hatchery releases subsequent to 1946 played a minor role in the rapid buildup of White River silver salmon stocks compared to natural production.

33. Heg, Robert T. 1953. White River Studies. Puget Sound Investigations (1951-1953) p. 98-101a.

An inclined plane downstream migrant trap was operated in the return bypass below the fish screens in the Puget Sound Power and Light diversion flume on the White River. Efforts to determine the number of fish entering the diversion at various water levels yielded inconclusive results; however, data indicated heavy losses of marked fish between the diversion dam and the trap. It is indicated that fish collection at the screens is inadequate in that fish pass over the screens, and delays occur immediately above the screens. Catches of coho and chinook salmon are low in April, May and early June - an indication that the fish were being delayed above Mud Mountain Dam. Counts of all fish captured at time of reporting are tabulated.

34. Heg, Robert T. 1953. White River downstream migrant trap. Progress

Report. Puget Sound Stream Studies (1953-1956), Washington Dept. of Fisheries.

The 1953 downstream migration of coho and chinook salmon in the White River was studied. Groups of fin-nipped fish were planted above Mud Mountain Dam, between the two dams, and in the upper and lower portions of the diversion flume. Estimates of 1) the percentage of downstream migrants entering the diversion flume vs. the main White River channel, 2) fish mortality in the diversion flume, and 3) the percentage of fish passing over the fish screens into Lake Tapps vs those that returned to the White River via the bypass were made for coho and chinook salmon.

It was concluded that:

1. The reservoir above Mud Mountain Dam constitutes a complete barrier to migration during periods of high storage.
2. Little delay occurs between Mud Mountain Dam and the Puget Sound Power and Light diversion dam.
3. Significant delay and variable but usually high mortality occurs in the diversion flume and basin.
4. When the diversion dam is topping, the proportion of fish going down the main White River channel is at least as great as the proportion of water remaining in this channel.
5. When the flume is full, considerable numbers of fish ride over the screens into Lake Tapps.

The calculated downstream migration of coho and chinook salmon for 1953 is tabulated by week.

35. Heg, Robert T. et al. 1953. Progress Report. Puget Sound Investigations (1951-1953) Washington Dept. of Fisheries.

Spawning ground counts made from 1945 to 1952 are tabulated for various rivers including the Green, White and Puyallup rivers. Silver salmon index areas were set up on Clearwater Creek and Greenwater River above Mud Mountain Dam.

Also, salt water investigations were conducted. Marked chinook salmon recoveries in the saltwater fisheries are tabulated by stream of origin for the 1948 and 1949 year classes. Included are listing of recoveries for the Green and Puyallup River systems.

36. Heg, Robert T. 1953. South Prairie Creek Fall Chinook Study. Puget Sound Investigations (1951-1953), p. 104. Washington Department of Fisheries.

This study on South Prairie Creek, a medium-sized stream in the Puyallup River system, was performed to obtain early life history information on this stream in the fall of 1952. A maximum count of 108 spawning and dead fish was obtained on October 7 in one mile of stream.

37. Heg, Robert T. 1954. White River Studies. Progress Report. Puget Sound Stream Studies (1953-1956). Washington Department of Fisheries.

The downstream migration of coho and chinook salmon for 1954 were estimated based on trap counts at the diversion bypass for 1954 and

the results of 1953 fin-nipping experiments. Passage of fish through Mud Mountain Dam, with respect to the reservoir's pool level was analyzed. The results indicated that the tunnel becomes partially available to chinook at 96 feet, and fully available at about 50-60 feet. Delay of the 1952 silver salmon escapement is described.

38. Henry, Kenneth A. 1977. Background Document on Northwest Salmon Fisheries. NMFS, NOAA. Northwest and Alaska Fisheries Center, Seattle, WA. Unpublished manuscript.

A review of the historical development of salmon fisheries in the Columbia River, Washington Coast, and Puget Sound areas, with a discussion of problems confronting management and maintenance of Washington salmon and steelhead stocks. Data on the current status of the various fisheries, fishing gear, and stocks is included.

39. Herring, W. E. 1915. A compilation of Data and Reports. Water Powers of the Pacific Northwest. Vol. 2.

These memoranda concern the proposed development of the "Hebb Power Site," located just upstream of the Puget Power diversion dam site. Early White River flow data for the period 1899-1914 are presented. The site was recommended as feasible for power development.

40. Hidaka, F. T. 1973. Low Flow Characteristics of Streams in the Puget Sound Region, Washington. United States Geological Survey. Open-File Report.

Low-flow frequency curves, indexes of low-flow characteristics, and factors affecting low flows by basins are presented. Melt water from glaciers on Mount Rainier contributes to the Puyallup, White, and Carbon Rivers and is responsible for large low-flow-yield indexes in these streams. Greenwater River and South Prairie Creek drain areas about the same sizes as that of Carbon River, but because they do not have glacial sources, their low-flow-yield indexes are much smaller.

41. Inter-County River Improvement. 1936. Annual Report of the Engineers. King and Pierce Counties, Washington.

ICRI flood control works are reviewed. The failure of concrete revetments, particularly in the lower Puyallup River, and the subsequent use of brush retards, rip rap, and tetrahedrons for bank stabilization is described. The problem of gravel deposition and gravel dredging are discussed. Drift removal in the White River channel from the County line to Buckley is reported. The desirability of constructing Mud Mountain Dam is noted.

42. Isely, Mary B. 1969. A look at the Washington State Indian fisheries as shown in State Dept. of Fisheries statistics. (Mimeographed) American Friends Service Committee, Seattle, WA, 1969.

43. King County Division of Planning. 1978. Technical Appendices to A River of Green.

Appendix A - Geology and hydrology of the Green River by Dr. Thomas Dunne and William Dietrich.

- Reviews geologic history of the Green River Valley. Flow changes in the Green, White, Black, and Cedar rivers are documented.

Appendix B - Aquatic resources of the Green-Duwamish River with enhancement possibilities, by Dr. Ernest O. Salo and Lynn McComas.

(See: Salo, E. O. and R. Lynn McComas, 1978. Report Submitted to Jones and Jones Consultants.)

44. Kramer, Chin and Mayo, Inc. 1973. A Regionalization Study for the Sewage Systems of Enumclaw, Buckley, and the Rainier State School. Prepared for the town of Buckley, the City of Enumclaw, and the Rainier State School.

The sewer treatment facilities of Buckley, Enumclaw, and the Rainier School are considered to be point sources of wasteload discharged into the White River. Non-point source pollution from agricultural activities in the area was determined to be negligible. Analysis of water quality parameters of the White River is presented. Water quality violations have occurred with coliform count, largely as a result of raw sewage overflows and insufficient chlorination capacity at the existing sewage treatment plants.

45. Kramer, Chin, and Mayo. 1975. Enumclaw, Buckley, and the Rainier State School Receiving Water Quality Objectives. Complex Facilities Planning Study.

Water quality objectives for the White River are summarized. An analysis of water quality conditions in the White River is presented. At the present time, water quality violations have occurred with coliform count and turbidity. It is concluded that sewage overflows from all sources should be eliminated and that expansion and upgrading of treatment facilities is necessary.

46. Kramer, Chin and Mayo, Inc. 1980. Draft Environmental Impact Statement for City of Auburn Proposed Groundwater Withdrawals.

The City of Auburn's proposed water supply expansion is assessed. It is noted that (1) withdrawal of groundwater could have a slight impact on the flows of the White/Stuck and/or Green Rivers and (2) the fisheries of the White and Green Rivers will be little affected by this proposal.

47. Lane, Barbara. 1973. Political and Economic Aspects of Indian-White Culture Contact in Western Washington in the mid-19th century. Anthropological report in U.S. vs. Washington.

This report concerns Indian life at the time of the Treaties, regulation and execution of the Treaties, current successors to Treaty Tribes, and Post Treaty actions. Background information on the function of fishing in Indian life, non-Indians understanding of Indian fishing, Indians fishing "rights" among themselves, controls over Indian fishing, and location of Indian fisheries are discussed.

48. Lane, Barbara. 1974. Report on the Navigability of the Duwamish-White and Puyallup-Stuck River systems: Anthropological and Historical Evidence. Prepared for NARF.

Early Indian and Pioneer use of the Duamish, White, Stuck, and Puyallup rivers is documented, with emphasis on upstream navigability.

49. Lane, Barbara. 1980. The Muckleshoot Indians and the White River. A report prepared for the Muckleshoot Indian Tribe.

This report concerns the traditional and current Indian use of the White River, Indian concepts of ownership of the White River, the establishment and enlargement of the Muckleshoot reservation, and the navigability of the White River in the area of the reservation.

50. Lane, Barbara. Undated. Anthropological Report on the Traditional Fisheries of the Muckleshoot Indians. Exhibit 38C.

This report seeks to document the salmon and steelhead fisheries used by ancestors of the muckleshoot Indians through the use of archeological evidence, historical records, and ethnographic studies. The principal source cited on Muckleshoot fishery locations is an unpublished manuscript by T. T. Waterman (Appendix I). Indian fishing during treaty times and fishing at present are discussed.

51. Macy, Paul T. 1982. Aboriginal Fisheries, Early Explorations, and Development of Fisheries. Unpublished Manuscript.

This paper discusses aboriginal use of fish resources, fishing gear, and historical catches in the Pacific Northwest. A review of early explorations and the development of fisheries is included.

52. Maib, C. W. and W. A. Dunstan. 1956. The Passage of Fish Through Mud Mountain Dam. Washington Department of Fisheries.

Studies were conducted to investigate the downstream migration of silver and chinook salmon through Mud Mountain Dam at various pool levels. Though results of this study were observed by unscheduled high pool levels which resulted in fish passage through the 23 foot diameter tunnel, it was revealed that some silvers sounded to a depth of 143 feet, and large numbers of chinook sounded to a depth of 139 feet to exit the reservoir. Delays in downstream migration were observed for both species until pool levels were reduced below 80 feet in depth.

53. Matsuda, Robert I., R. S. Domenowske and L. L. Peterson. 1969. A preliminary water quality and ecological survey of the Big Soos system. Municipality of Metropolitan Seattle, Water Quality Ser. No. 5. 47 pp.
54. Matsuda, Robert I., G. W. Issac and R. D. Dalseg. 1968. Fishes of the Green Duwamish River. Municipality of Metropolitan Seattle Water Quality Ser., No. 4. 38 pp.
55. Miller, Denny Marvin. 1965. Evaluation of the Suitability for Salmonid Production of a Stream with Multiple Water Uses. Masters Thesis, University of Washington.

A study was conducted on Boise Creek, a tributary to the White River, to assess the effects of industrial (lumber milling) and agricultural activities on the capacity of the stream to support salmonid embryos and fry. Intragravel DO, streambed permeability, gravel composition, streambed shift, resident fish populations, and benthic organisms were studied. In contrast to upstream control sites, conditions at sites sampled in the industrial-agricultural areas were inadequate or marginal for immature salmonids. Low intragravel DO is suggested as responsible for the degradation of these areas.

56. Muckleshoot Indians, Pamphlet file. Northwest Collection, University of Washington. Indians of North America Tribes, Oregon and Washington.

This file contains newspaper clippings and other items of interest concerning the Muckleshoot Indians' fishing rights, and incidents over the years related to the fishing activities of the tribe.

57. Mullineaux, Donal R. 1970. Geology of the Renton, Auburn, and Black Diamond Quadrangles, King County, Washington. Geological Survey Professional Paper 672.

This report deals with the geology of the Puget Sound lowland southeast and adjacent to Seattle and discusses in part, the geologic history of the Green (White) River valley.

58. Nece, Ronald E., Dennis P. Lettenmaier, and Kevin E. Kiernan. 1982. Puyallup River Basin Flood Management Study. Phase I Report. Department of Civil Engineering, Univ. of Washington. Report submitted to Pierce County Dept. of Public Works.

This report reviews the problem of maintaining channel capacity for flood control by gravel removal in the Puyallup Basin, with consideration of the potential impacts to fisheries resources. Previous estimates of gravel movement and historic records of channel cross sections were reviewed. A detailed Phase II study is proposed to identify specific long-term management plan options.

59. Noel, Patricia Slettvet. 1980. Muckleshoot Indian History. Auburn School District No. 408, Auburn, Washington.

A history of the Muckleshoot Indian Tribe with a summary of relevant dates, population figures, maps, and related articles. Items included of relevance to the tribe fishery are: a description of fishing techniques, a picture of a weir on the Muckelshoot Reservation taken in 1902, correspondence with the U.S. Dept. of the Interior regarding fishing rights, and a map of "usual and accustomed" fishing places.

60. Northwest Indian Fisheries Commission. 1979. Annual Report. Olympia, Washington.

This publication describes the Northwest Indian Fisheries Commission's origin, objectives, and activities. Policy coordination, fishery management services, and other functions of the organization are discussed.

61. Olson, Forrest W. 1978. An Evaluation of Factors Affecting the Survival of Puget Sound Hatchery - Reared Coho Salmon (Onchorhynchus kisutch). Masters Thesis, University of Washington.

Stepwise regression analysis of factors affecting coho survival for Puget Sound models revealed that streamflow during the summer rearing period correlated most significantly with survival of hatchery coho. Analysis of factors affecting coho survival for each Puget Sound hatchery for 1960-1974 is presented.

62. Parametrix, Inc. 1980. Preliminary Cultural Resources Survey - Burlington Northern Black Diamond Geothermal Prospect Study. Parametrix, Inc., Bellevue, Washington.

A brief report containing a description of the geographic setting of a proposed Geothermal Prospect Study in the vicinity of Enumclaw. Past and present land use and ethnographic and ethnohistoric information obtained through a registry search, literature search, and field reconnaissance are presented.

63. Percival, S. M. 1917. The Inter-County River Improvement. Pacific Builder and Engineer, July 1917.

This article is a narrative description of the early contention between Pierce and King counties regarding the course of the White River, the subsequent creation of the Inter-County River Improvement Agency (ICRI), and the early works of ICRI. The utility of the drift barrier, dredging, channel straightening, and bank protection are discussed.

64. Phinney, Lloyd A. Direct testimony before the Federal Power Commission.

Lloyd Phinney was employed as a Biologist III (aquatic) for WDF. In his testimony he described the life cycle of salmon and steelhead in the Puyallup watershed and the high seas migration pattern. Also discussed was coordination between the operation of Mud Mountain Dam and the PSP&L Company's facilities on the White River. Phinney stated that salmon runs of the White River are adversely affected by Puget's facilities. Streamflow and sedimentation effects on salmon in the Buckley to Dieringer Reach, and the inadequacy of the fish screens were noted.

65. Puget Sound Task Force - Pacific Northwest River Basins Commission. 1970.

Puget Sound and adjacent waters. Appendix XII, Flood Control. A description of flood control measures taken in the Puyallup Basin is presented. Monthly discharges for the Puyallup River (at Puyallup) and the White River (at Buckley) are summarized for 1931-1960.

66. Puyallup Tribe and United States Fish and Wildlife Service. 1977. Population estimation of the 1976 Puyallup River fall chinook run. Preliminary Report. 6 p.

Tagging studies were conducted on Puyallup River chinook during 1975 and 1976. The Washington Department of Fisheries has used the results of these studies to derive estimates of escapement for the years 1965-1974 by relating spawning ground counts (from an index area on South Prairie Creek, RM 1.1 to 2.6) to the tag study results.

67. Rees, William H. and R. T. Heg. 1953. Spawning Ground Surveys. Puget Sound Stream Studies (1953-1956), p. 127. Washington Department of Fisheries.

Chinook, silver and pink salmon spawning ground counts are tabulated for surveys made from 1943 to 1953 in various streams, including the Green, White and Puyallup rivers.

68. Rees, William H. 1956. Chinook, Silver, and Chum Escapements. Puget Sound Stream Studies (1953-1956) p. 41. Washington Department of Fisheries.

Escapement counts are presented for 1951-1956 surveys of the index areas, including the Green, Puyallup, and White Rivers.

69. Regenthal, A. F. 1953. Passage of Downstream Migrants over White River Screens. Puget Sound Stream Studies (1953-1956) p. 102. Washington Department of Fisheries.

It was observed that 25.7 percent of all downstream migrants passed over the screens and into Lake Tapps; chinook salmon passed over the screens with higher frequency than silver salmon.

70. Regenthal, A. F. and W. H. Rees. 1957. The Passage of Fish Through Mud

Mountain Dam. Washington Department of Fisheries.

Similar to experiments conducted in 1955 (c.f. Maib and Dunstan 1956), fish released upstream of Mud Mountain Dam were recaptured downstream to assess the affect of reservoir level on downstream migration through the dam. Test pools utilized for the experiment included average forebay depths of 118, 113, 146, and 160 feet. Some period of delay in downstream migration was observed at all levels tested. Results indicated that at forebay depths of 118 feet or less nearly all silver an chinook passed unimpeded through the dam. At a reservoir level of 133 feet approximately 75 percent of the silvers and 55 percent of the chinooks successfully passed through the dam, while at depths of 146 feet only 60 percent and 48 percent, respectively, would exit. At a reservoir level of 160 feet, eight percent or less of either species would successfully sound to the outlet and exit.

71. Roberts, W. J. 1915. Address before the Puyallup Commercial Club, November 18, 1915. Chief Engineer. Inter-County River Improvement, King and Pierce Counties, Washington.

The White-Stuck-Puyallup flood problem is outlined. Early appropriations for flood control work and the creation of the Inter-County River Improvement Agency (ICRI) are noted. Construction of the Auburn Dam and drift barrier are discussed. Early drift removal, channel straightening, dredging, and bank protection activities of ICRI are described.

72. Roberts, W. J. 1920. Report on Flood Control of White-Stuck and Puyallup Rivers. Inter-County River Improvement Agency. King and Pierce Counties, Washington.

This report covers the activities of the Inter-County River Improvement Agency (ICRI) from its inception in January 1914 to December 31, 1919. Construction of the Auburn Dam in 1915, which permanently diverted the entire White River into the Stuck River, and a drift barrier three miles upstream of this dam are discussed. River clearing, channel straightening and dredging, and bank protection in the various river sections are described.

73. Robison, Robert S. 1958. The Indian Fisheries. Washington Department of Fisheries. Unpublished mimeo 5 p.

The Indian Fisheries of Washington State, including the Puyallup and Muckleshoot fisheries are described. Intensive exploitation by the Puyallup Indians in 1958 adversely impacted spawning escapements to the Puyallup watershed, while the Muckleshoot Indians catch was severely reduced.

74. Rogers, D. E. and Ernest O. Salo. 1982. Trends in Natural and Hatchery Production of Chinook Salmon. Fisheries Research Institute, School of Fisheries, University of Washington.

Recent trends in chinook salmon abundance are examined for the North

Pacific, largely on the basis of catch statistics. The sustained catches of chinook salmon in the southern region of the North Pacific can be largely attributed to hatchery production that has replaced the declining production from natural stocks. Problems of allocation of the catch among the fisheries along the west coast of North America are identified. Increases in catches since 1977 are attributed to increased marine survival associated with mild weather.

75. Royal, Lloyd A. 1947. Report on the low flow conditions of Cedar River affecting salmon runs. Copy in central files of the WDF dated Sept. 15, 1947. Unpublished (mimeo.).
76. Royce, William F. 1968. Report on Examinations of White River Near Auburn to Estimate Difficulty of Fish Passage. Unpublished (mimeo.). 14 p.

Photographs taken of three "critical" fish passage sections in the White River near Auburn are presented. Measurements of velocity and stream cross section were used to determine a discharge of 127 ccs for the day of picture taking. In the author's opinion, at each cross section measured and photographed, at least three points provided conditions adequate for easy passage by salmon.

77. Royce, William F. 1969. Comments on White River Flow and Delayed Migration. Unpublished (mimeo.).

Comments are presented based on a computer analysis of the correlation between low flow and trap counts in the White River at Buckley. No correlation between low flows and fish passage was found due to lack of data. Direct observations of fish passage were recommended.

78. Salo, Ernest O., Bruce P. Snyder, and Jan M. Silver. 1972. The Fishery Potential of the White River Between the Buckley Diversion and the Dieringer Powerhouse Discharge. Preliminary Report. Submitted to the American Native Rights Fund.

The feasibility of enhancing or modifying the stretch of the White River between the Buckley diversion and Dieringer to improve fisheries resources was assessed. It was concluded that neither improvements of this section of the stream nor the development of a viable fishery for resident fishes were feasible alternatives. The construction of a hatchery at Dieringer was considered a reasonable alternative and a preliminary evaluation of the site was made.

79. Salo, E. O. and R. Lynn McComas. 1978. Aquatic Resources of the Green-Duwamish River with Enhancement Possibilities. Report submitted to Jones & Jones Consultants, Seattle, WA.

A survey of the ichthyofauna and fisheries of the Green-Duwamish River. The authors identify six anadromous species of sufficient recreational and aesthetic value to warrant consideration: steelhead, cutthroat, dilly vardon, chinook, coho and chum. Natural and artificially propagated runs of each are described. The river fisheries include a sport steelhead, chinook and coho fishery. Also,

an Indian fishery (Muckleshoot) exists in both the river and Elliot Bay for steelhead, chinook and coho. Plans for the Indian enhancement program, to include a new hatchery for spring and fall chinook, coho, and chum salmon on Spaight Creek are described.

80. Shackelford, Elisabeth. 1918. A History of the Puyallup Indian Reservation. Bachelor of Arts Thesis. College of Puget Sound. Tacoma, WA.

An anthropological look at the Puyallup Indian Tribe based on personal interviews and government documents. Historical changes in the boundaries of the Puyallup Indian Reservation are discussed.

81. Simenstad, C., K. Fresh, and E. Salo. 1982. The Role of Puget Sound and Washington Coastal Estuaries in the Life History of Pacific Salmon: An Unappreciated Function. Contribution No. 574, School of Fisheries, University of Washington, Seattle, WA.

Of the five Pacific salmon species, chum and chinook use estuaries most extensively. Salmon use estuaries for: 1) productive foraging, 2) physiological transition, 3) refuge from predators, and 4) migration and staging. These functions have probably changed due to salmon culture practices and alterations of estuarine habitat, resulting in reduced salmon growth and survival.

82. Smoker, William A., Robert T. Heg, Donald R. Johnson, and Robert Robison. 1952 (revised 1961). The Muckleshoot Indian Fishery on the White River. Washington Department of Fisheries.

This report was prepared as a guide to assist the Muckleshoot Indians in managing their fisheries to insure the best utilization of the White River. The condition of White River chinook, chum, and silver salmon stocks is assessed. Muckleshoot catch statistics and Buckley trap counts indicate that spring and fall chinook runs are in a condition of serious decline; however, silver salmon production has increased - largely as a result of heavy sustained hatchery plants by WDF. Catch statistics reveal that chum stocks are also in a state of decline. Monthly catches of chinook, chum, and silver salmon are presented for 1943-1951. Hatchery plants of spring and fall chinook and silvers for 1944-1950 are tabulated. Also, "catch per net" data for the Muckleshoot set net fishery are presented for 1943-1952.

83. Stauffer, G. D. 1969. Estimates of population parameters of the 1965 and 1966 adult chinook salmon runs in the Green-Duwamish River. Univ. of Washington. M.S. thesis. 155 pp.

84. Stetson Engineers, Inc. 1980. Report on Movements of the White River with emphasis on Sec. 28, T.21N, R.5E. Muckleshoot Indian Reservation. Plaintiff exhibit no. 237 Muckleshoot vs. Trans-Canada Enterprises Ltd.

This thorough report documents historical channel movements of the White River. The impacts of large floods, log jams, landslides, channel control works, and alterations by man are discussed. The

influence of ICRI works, the Puget Power diversion, and Mud Mountain Dam are noted.

85. Stetson, Thomas M. 1975. Water Resources and Requirements of the Muckleshoot Indian Reservation, King and Pierce Counties, Washington.

Surface and groundwater resources for the Muckleshoot Indian Reservation on the White River are inventoried. The influence of Puget Power's White River Project and Mud Mountain Dam is discussed. Land use and water requirements, including the water requirement for fisheries, are reported. Additional topics covered are, (1) the contribution of White River Project to Puget's power supply, (2) water rights, and (3) water resources management. A substantial amount of water quality, temperature, suspended sediment, discharge, and other scientific data pertaining to the White River are included in Appendices A through M.

86. Svoboda, Paul. 1977. Population Assessment of Juvenile Salmonids and Physical Surveys in Four Selected Streams within the Puyallup and Hylebos Watersheds. Tribal Biologist. Puyallup Tribe of Indians.

Baseline data is presented for Swan, Strawberry, and Hylebos Creeks, and an unnamed tributary of Hylebos Creek (Stream No. 0013). Each of these streams was easily accessible, had a past history of environmental pollution, and had little or no record of biological data. Physical parameters measured included water quality and streambed composition. Population estimates of juvenile coho, trout, and total salmonids were determined by the removal method. It was noted that Strawberry Creek habitat was degraded by heavy streambed siltation.

87. Thomas, B. P. 1939. Annual Report of the Chief Engineer for the year ending 1938. Inter-County River Improvement Agency King and Pierce Counties, Washington.

The accomplishments of the first 25 years of the Inter-County River Improvement Agency (ICRI) on the White and Puyallup Rivers are reviewed. Early activities included channel straightening, bank stabilization, and drift removal. Cut-offs and the blocking of side channels resulted in a loss of 1.64 miles of river length. Revetments of various types included concrete slabs, brush mattress, log cribs, brush retards, bulkheads, rolled wire, tetrahedrons, and riprap. Channel clearing activities included brush cutting on the banks and removal of large logs, trees, and stumps from the river bed which were then placed on curves and at the mouths of old channels.

88. United States Army Corp of Engineers. 1971. Environmental Statement: Mud Mountain Dam and Reservoir, White River, Washington.

This environmental statement was prepared in conjunction with the Army Corp's plans to modify Mud Mountain Dam to reduce the frequency of repairs needed on the 9-foot tunnel. Lateral bracing and the installation of a steel liner were proposed. Construction of a conservation pool was considered unfeasible.

Release of accumulated sediment after cleaning the trash racks or repairing the 9-foot tunnel can cause sediment loads downstream which exceed water quality standards and adversely affect food organisms and eggs in the gravel. Injury to juvenile fish using the stream as a nursery can also result from high sediment discharges. Operation of Mud Mountain Dam is described, and comments on this environmental statement by concerned parties (PSP&L), Muckleshoot Tribe, WDF, etc. are included.

89. United States Army Corps of Engineers. 1974. Mud Mountain Master Plan Phase III. Design Memorandum 20B. Prepared by Miles Yanick and Company.

Existing resources on project lands are assessed and a plan for management is provided. A description of facilities, physical characteristics of project lands, and environmental restrictions to development are discussed. The decline of fish runs in the White River is noted and is attributed to (1) increased industrial pollution, (2) increased Indian net fishing at the mouth of the Puyallup River, (3) low flows below the Puget Power diversion, (4) high turbidity, and (5) siltation. It is noted that high sediment loads released as a result of Mud Mountain Dam operation for flood control cause high downstream turbidity and adversely impact fish migration. Also, Howell Bunker values in the 23 foot diameter tunnel cause mortality of downstream migrant fingerlings.

90. United States Army Corps of Engineers. 1976. Mud Mountain Master Plan. White River Basin, Washington. Dept. of the Army. Seattle District, Corps of Engineers.

This report updates the Mud Mountain Master Plan Phase III (1974). Problems relevant to fisheries include flooding of newly planted salmon, Howell Bunker valves, and high sediment load downstream during pool drawdown.

91. United States Army Corps of Engineers. 1977. Water Resources Development in Washington. North Pacific Division, Oregon.

A catalog of projects underway or completed by the U.S. Army Corps of Engineers in Washington. Projects in the Puyallup River Basin, which include Mud Mountain Dam, Puyallup River Flood Control, and Tacoma Harbor, are described.

92. United States Army Corp of Engineers. 1982. Backwater Channel Capacity Study, White River near Auburn and Buckley, Washington.

This hydraulic study was conducted to determine channel capacities of the White River, in view of a river bed aggrading problem occurring near Auburn. White River hydraulic parameters and past, present, and future channel capacities are determined.

93. United States Dept. of the Interior. 1974. Anadromous fish migration, spawning and rearing flow study on White River. Special Report for the Muckleshoot Indian Tribe, Washington. (Fish and Wildlife Service Northwest Fisheries Program, Tumwater, Washington.)

A study performed by USFWS (in coordination with WDF personnel and Dr. Stephen J. Burges, U.W. Dept. of Civil Engineering) of the White River between Buckley and Dieringer to determine minimum flow requirements for effective upstream passage of adult salmon and steelhead, and for rehabilitation of spawning and rearing conditions.

At all test sites a release of 250 cfs at the Buckley diversion dam met the desired depth criteria for coho migration. A discharge of 500 cfs met the depth criteria for fall chinook at all test sites. A definite attraction of fish into the Dieringer flume was noted; it is assumed that these fish are lost to production of the White River. At flows between 170 and 230 cfs, approximately 8.5% to 10% of the bankfull area is considered spawning habitat for fall chinook. At flows between 160 and 230 about 2% to 2.5% of the bankfull area is preferred spawning habitat for coho.

It is concluded that minimum stream flows resulting from Puget Sound Power and Light diversion of water are far too low to provide migration flows and maintain spawning and rearing habitat for salmonids in the White River.

Critical problems for the anadromous fish resources of the White River are identified as 1) the lack of adequate water for passage of adult fish to their spawning grounds both above and below Mud Mountain Dam and Puget Sound Power and Light's diversion dam; 2) the loss of downstream migrants through the screening facilities in Puget Sound Power and Light's diversion canal.

Preliminary flow recommendations are made and it is further recommended that 1) a fish barrier be constructed at the mouth of the Dieringer flume and 2) additional studies be conducted to refine rearing flow recommendations and to develop incubation flow recommendations.

94. United States Geological Survey. 1976. Sediment transport by the White River into Mud Mountain Reservoir, Washington, June 1974 - June 1976. Water Resource Invest. 78-133.

This study, conducted by the U.S. Geological Survey in cooperation with the Army Corps of Engineers, evaluated sediment transport by the White River into Mud Mountain Reservoir during the period June 1974 - June 1976. The river transported 430,000 tons of suspended sediment into the reservoir during the first year of the study and 1,400,000 tons in the second year. Potential deposition in the reservoir was estimated at 750 acre-feet during the 2-year study.

95. Ward, James V. and Jack A. Stanford, eds. 1979. The Ecology of Regulated Streams. Plenum Press, New York.

This book reviews the ecology of stream regulation. Focusing specifically on downstream effects, the biological and ecological impacts of dams are emphasized. Contributions by specialists in various areas cover topics such as Effects of Stream Regulation on Channel Morphology, The Regulated Stream and Salmon Management, and The Use of Habitat Structure Preferenda for Establishing Flow Regimes Necessary for Maintenance of Fish Habitat.

96. Washington Department of Ecology. 1976. White River Investigation and Analysis of other controlled rivers.

Undertaken in response to the accidental drowning of two young girls following a sharp increase in the flow of the Stuck River, this report examines the factors and circumstances involved in the accident. The potential for similar happenings on other streams in the state is considered. The combined effect of increased discharge at Mud Mountain Dam and cessation of diversion into Lake Tapps by Puget Power contributed directly to the tragedy. A review of historical records indicates that fluctuations of greater than one foot per hour have occurred frequently on the White River; a total of 18 such surges occurred during the sample 1972 water year alone.

97. Washington Department of Ecology. 1980. Puyallup River Basin Instream Resources Protection Program. Water Resources Management Program. WWIRPP Series-No. 6. State of Washington, Olympia, Washington.

An assessment of the instream resources of the Puyallup River basin with a synopsis of natural and man-caused factors adversely affecting those resources. Instream flow, water quality, and fisheries resources are discussed for the Puyallup River and tributaries, including the White River.

This report outlines the proposed closure of White River and other streams to further out-of-stream consumptive use. Minimum flows are established for both the Carbon and Puyallup Rivers.

98. Washington Department of Fisheries. Annual Reports.
A number of these reports feature articles of direct concern to the White River Fisheries. Most notable are the reports for the following years:

1939 - Discusses fish screens on the White River.

1948 - Reports construction of fishway at Buckley Dam.

1949 - Discusses fish screens on the White River. Describes trapping and hauling operations and the success in increasing silver salmon escapements.

1950 - Further discussion on the success of the trap and haul operation in increasing silver salmon escapements, from 12 in 1941 to 11,419 in 1950. A 50% decline in the chinook run is discussed.

1954 - Discussion of Mud Mountain Dam causing a delay in silver and chinook downstream migrants. Estimates are given for downstream silver escapements. "The escapements have been steadily increasing as a result of the Department's rehabilitation program, started when installation of Mud Mountain Dam reduced the silver runs to a few

adults in the early 1940's."

1956 - Describe the 1955 study of on downstream migrants, to determine how deep chinook and silver salmon would sound to pass through Mud Mountain Dam.

1958 - Discussion of the downward trend of chinook and chum salmon escapements in the White River. Chum escapement trends are described as "probably a reflection of the Indian catch, in view of good escapements elsewhere."

1959 - The Muckleshoot Indian catch of salmon on the White River is tabulated for 1939-1959. Mud Mountain trap counts for 1940-1959 are presented.

99. Washington Department of Fisheries. Progress Reports.

Annual reports on the Status of Puget Sound Salmon and Recommendations for Management are presented by species in the following WDF Progress Reports:

Coho - Nos. 57, 90, 158.

Pink - Nos. 19, 89, 130.

Spring Chinook - Nos. 41, 81, 98, 129, 155.

Summer/Fall Chinook - Nos. 19, 70, 89, 107, 130, 163.

100. Washington Department of Fisheries. 1961. Presentation of the Indian Fisheries Problem in the Management of Salmon in the State of Washington. Statements by Washington Department of Fisheries to Congressional Subcommittee on Merchant Marine and Fisheries. Tacoma, WA, October 13, 1981.

This document discusses how the Indian Fisheries for salmon are part of a total management picture, and as such must be managed as part of the entire complex. Overfishing by the Puyallup River Indian Fishery is included among the examples of the various problems facing salmon resource managers of Washington State.

101. Washington Department of Fisheries. 1962. Fisheries statistical report (1962).

Indian fishery statistics are presented for the Muckleshoot and Puyallup Indian Tribes on page 192. Tabulated are the reported catches of salmon, by species, from 1939 to 1962 for the Muckleshoots, and from 1953 to 1962 for the Puyallups.

102. Washington Dept. of Fisheries. 1975. Status of the Salmon Resource of the Puget Sound and Coastal Regions, Washington. Prepared by Management and Research Division.

This report was prepared to facilitate the management and subsequent "fair share" treaty entitled division of catch of the salmon resource within the Case Area of U.S. versus Washington (civil no. 9213). Predicted total adult return, allowable catch level, and spawning ground escapement goals (interim) are presented by production area for stocks of spring and fall chinook, coho, chum, sockeye, and pink salmon.

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THE STATUS OF THE ANADROMOUS FISHES OF THE
WHITE-PUYALLUP RIVER SYSTEM(U) WASHINGTON UNIV SEATTLE
FISHERIES RESEARCH INST E O SALO ET AL. SEP 83

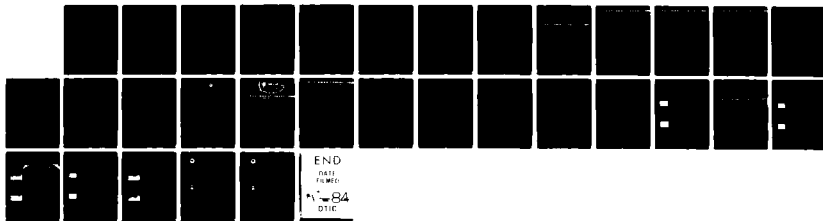
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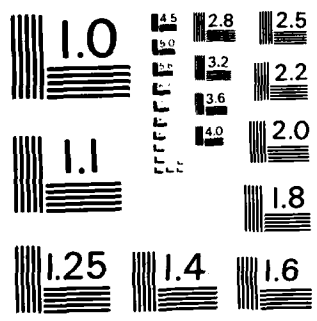
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103. Washington Dept. of Fisheries. 1975. Fisheries statistical report.

This report contains the Indian salmon catch, by species, for the White and Puyallup Rivers from 1939 to 1975 inclusive. Through this period (pre Boldt decision) the Indian fishery was conducted exclusively by the Muckleshoot Indians on the White River, and the Puyallup Indians on the Puyallup River, respectively.

104. Washington Department of Fisheries. 1977. 1977 Status of Puget Sound Summer-Fall Chinook and Pink Salmon and Recommendations for Management Division. Progress Report No. 19.

This report outlines, by stock management area, the predicted return to a specific fishing area, escapement goals for hatchery and wild runs, allowable harvest, net fishery management recommendations, and test fishing needs. Total closure was recommended for protection of the Puyallup River chinook and pink salmon stocks.

105. Washington Department of Fisheries. 1977. Methodology for Determining Puget Sound Coho Escapement Goals, Escapement Estimates, 1977 Pre-Season Run Size Prediction and In Season Run Assessment. Technical Report No. 28.

This report estimates total hatchery vs. wild runs of coho by adding catches and estimated escapement. Estimates of natural production in the Puyallup and other Puget Sound rivers are presented for 1965 to 1976. Potential production for the White River and tributaries above Buckley was assumed to be equal to the average trap count for the 1943-1975 period, with the lowest and highest counts not included in the average. It was estimated that the White River contributed 30% of the Puyallup basin smolt potential.

106. Washington Department of Fisheries. 1978. Fisheries statistical report.

This report contains the Indian salmon catch, by species, for the White and Puyallup Rivers from 1975 to 1978 inclusive. Also tabulated are Indian salmon catches by tribe by species for both on and off reservation fishing. The statistics provided for the Muckleshoot Indian Tribe "on reservation" catch are ambiguous when compared to the Indian catch listed for the White River. This is because the Muckleshoots report catches in the Puyallup River, Lake Washington, etc. as "on reservation" catches.
(Dale Ward - WDF, personal communication.)

107. Washington Department of Fisheries. 1978. Methods for In-Season Estimation of Strength of Salmon Runs Destined for Puget Sound in 1978. Harvest Management Division. Progress Report No. 52.

In-season estimates of summer/fall chinook, coho, and chum stocks are described. The Puyallup Basin is managed as part of "South Sound." In-season estimation of South Sound chinook stocks is determined as a function of updating methods available for Duamish-Green and Capitol Lake-Deschutes fish. Updating of South Sound coho is determined by

using cumulative catch per landing by non-Indian gill nets in area 10.

108. Washington Department of Fisheries. 1979. Highlights of 1977 Management of Puget Sound Salmon Fisheries. Technical Report No. 44.

General problems relative to management of the Indian and non-Indian commercial salmon fishery in Puget Sound are examined. Litigation influencing 1977 salmon management is reviewed. Closures to protect Puyallup River salmon stocks are documented.

109. Washington Department of Fisheries. 1979. A Proposal for Long-range Puget Sound Salmon Resource Management. WDF 9-12-79. Olympia, Washington. (Unpublished).

The need for a long-range management plan to protect the dwindling runs of naturally produced Puget Sound salmon stocks is discussed. A solution to the problem of concurrent management of natural and hatchery stocks is presented. It is proposed that the Skagit, Stillaguamish, and Snohomish rivers be permanently managed for natural production of all salmon species. For South Puget Sound, however, it is recommended that artificial production be emphasized for coho and chinook enhancement.

110. Washington Department of Fisheries. 1979. Highlights of 1978 Management of Puget Sound Salmon Fisheries. Technical Report No. 47.

The 1978 management of Spring chinook, sockeye, summer-fall chinook, and coho destined for Puget Sound rivers is documented. Litigation and associated allocation orders are noted, and the occurrence of conservation closures and abuses of ceremonial fishing is reported. Closures to protect Puyallup and White River chum and chinook salmon were effected.

111. Washington Dept. of Fisheries. 1980. Methods for In-Season Estimation of Strength of Salmon Runs Destined for Puget Sound in 1980. Progress Report No. 117. Harvest Management Division.

Methodology for determination of In-Season estimates of run strength of summer/fall chinook, coho, and chum stocks in Puget Sound are presented by management area. Appendices provide daily cumulative catch/cumulative landings data for each area.

112. Wetherall, Jerry Alan. 1971. Estimation of survival rates for chinook salmon during their downstream migration in the Green River, Washington. Ph.D. Thesis, University of Washington.

A review of the analytical approaches to estimating mortalities occurring in downstream migration of salmon. A new model is developed incorporating temporal dynamics of downstream migration, and estuary sampling parameters. This model is applied to experimental data collected in 1966, 1967 and 1969 by the Fisheries Research Institute on Green River chinook salmon downstream migration.

113. Weyerhaeuser Co. 1979. A History: The White River Lumber Co., Enumclaw, Washington. Weyerhaeuser Co. Archives and Creative Services, December 1979.

This pamphlet discusses the history of the White River Logging Co., which was incorporated in 1897. The company was affiliated with the Weyerhaeuser Timber Company from 1929 until 1949, when the two companies merged. Early logging activities and mills at Enumclaw are discussed.

114. White River Fishery Improvement Committee.
Minutes of Committee Meetings:

September 13, 1968.

Flow below the Puget Power Diversion, fish delays and fish availability to fishermen, fish screening, the bypass channel, Army Corps sluicing, Howell-Bunger valve operation, and ICRI activities were discussed.

September 20, 1968.

Planting of steelhead in the Puyallup System was discussed.

October 9, 1968.

Improved sluicing at Mud Mountain Dam, a conservation pool at Mud Mountain Dam, improved trap attraction at PSP&L diversion, relocation of the trapping facilities, and channelization for flood control downstream from the diversion dam were discussed.

October 21, 1968.

The following factors affecting anadromous fish production were described: 1) the diversion dam at Buckley, 2) Mud Mountain Dam and Reservoir, 3) logging operations, 4) annual flood control channelization, 5) industrial and domestic pollution on the lower Puyallup River.

November 4, 1968.

Participation by the Muckleshoot Indians and problems with flood control work on the lower river were discussed.

April 15, 1970.

Inadequate minimum flows, poorly functioning diversion flume screens, discharge of silt from Mud Mountain Dam, a conservation pool at Mud Mountain Dam, and upper watershed logging problems were discussed.

May 6, 1970.

Silt discharge from Mud Mountain Dam, logging practices in the upper watershed, Puget Power de-silting operations, and stocking of coho on the Muckleshoot Reservation were discussed.

December 9, 1971.

Improvements in Mud Mountain Dam operation, possible use of the six miles of river between the diversion dam and Mud Mountain Dam for fall chinook production, and low flow problems below the diversion dam were discussed.

August 23, 1972.

Operation of Mud Mountain Dam, the feasibility of a conservation pool, a White River flow study, and a lawsuit by the Muckleshoot Indians were discussed.

115. Williams, R. W., R. M. Laramie and J. J. Ames. 1975. A catalog of Washington streams and salmon utilization. Vol. I: Puget Sound region. Washington State Dept. of Fisheries.

This publication gives a capsulated description of each drainage area of the Puget Sound region. Salmon utilization, limiting factors, habitat improvement, and habitat needs are discussed for each drainage area. The Puyallup Basin is cataloged as WRIA 10, which includes the White River. The Green-Duwamish system is WRIA 09. The timing of salmon freshwater life phases in the Puyallup Basin are depicted graphically for each species. Limiting factors noted for the Puyallup basin include seasonal flooding, low summer flows, unstable stream beds, physical barriers (PSP&L facilities are described), poor water quality, and extensive tideland industrialization.

116. Wilson, Stephen M. 1974. An Evaluation of the White River and it's Tributaries as a Fishery Resource. Final Report. Submitted to Muckleshoot Indian Tribe.

Factors limiting salmon production in the White River are considered, including the impact the Mud Mountain Dam and Puget Sound Power and Light facilities. The problems of low streamflow, high sediment load and elevated water temperatures are discussed. Alternative methods of anadromous fish production are examined.

117. Zillges, Gordy. 1977. Methodology for Determining Puget Sound Coho Escapement Goals, Escapement Estimates, 1977 Pre-Season Run Size Prediction and In-Season Run Assessment. Technical Report No. 28. Washington Department of Fisheries.

In addition to discussing WDF harvest management methodology, estimates of coho production potentials in Puget Sound streams are included. Also, estimates of natural coho escapements for 1965-1976 is presented for the Puyallup and other Puget Sound river basins.

Newspaper Articles

- Auburn Globe News, May 3, 1961.
Fishing Controversy Involves Public vs. Private Power Issue.
- Auburn Globe News, April 4, 1962.
Indians Seek Federal Action to Solve Fishing Problems They Face.
- Auburn Globe News, May 3, 1961.
Fishing Controversy Involves Public vs. Private Power Issue.
- Auburn Globe News, July 22, 1964.
Controversy on Indians Fishing Hauls in Many
- Auburn Globe News, December 6, 1970.
Fiorelli innocent; Diversion didn't affect streambed, judge states.
- Auburn Globe News, July 21, 1972.
Water Diversion prompts Indians to file suit against Puget Power.
- Seattle P-I, Thursday, July 6, 1899.
Resort Had to Dynamite - Stuck Valley Farmers Try to Blow up White River Dam.
- Seattle P-I, Friday, July 7, 1899.
To Drain Stuck Valley - The Stuck River Could by a Small Expenditure be Diverted Again to it's Old Channel and Empty Into the Sound Instead of the Puyallup.
- Seattle P-I, October 13, 1903.
Farmers Demand Relief Be Given - Committee From White River Valley Seeking Help - Want Portage Opened - Slide on Muckleshoot Reservation Threatens Greatest Flood in History.
- Seattle Times, Friday, November 16, 1906.
Farmers See Dry Land and are Hopeful.
- Seattle Times, Friday, November 16, 1906.
King County is Benefitted by Flood - Rush of Waters Causes White River to Leave Old Channel and Flow into the Stuck River, a Condition Long Desired.
- Seattle Times, Sunday, November 18, 1906.
State Aid Needed to Save River Counties - Deepening, Widening, and Straightening of Stuck and Puyallup Rivers Would Protect Farming District.
- Seattle Times, Sunday, January 27, 1957.
The White-The River Nobody Wanted.
- Seattle Times, September 23, 1970.
Court Told of Special Indian Fishing Rights.
- Seattle Times, Sunday, November 1, 1981.

Tacoma displeased with pollution crown.

Seattle Times, March 6, 1982.

Study links toxic sediment to diseased fish.

White River Journal, Friday, November 8, 1907.

No Danger of Floods - Work Done Makes Them Almost Impossible.

APPENDIX V

Letters of Comment

11 Dice
15 Aug

MUCKLESHOOT INDIAN TRIBE FISHERIES DEPARTMENT

39015 172ND AVENUE S.E. - AUBURN, WASHINGTON 98002 - (206) 939-3311

August 12, 1983

Steve Dice
U.S. Army Corps of Engineers
Seattle District - Planning Branch
P.O. Box C-3755
Seattle, Washington 98124

RE: Comments on the draft, "Status of the
Anadromous Fishes of the White-Puyallup
River System". Salo, E.O., and T.H.
Jagiello, May 1983.

Mr. Dice;

Thank you for the opportunity to review the above referenced report and for allowing us extra time to complete our review. We are pleased that your agency has shown continued interest in the fisheries resources of the White River by funding this effort.

As you may know, the Muckleshoot Tribe has been in litigation with Puget Sound Power and Light Company since 1972 concerning water rights and fisheries damages caused by the operation of their White River project. Simultaneously, the Tribe has been involved in the almost 20 year drama of Federal Energy Regulatory Commission (FERC) jurisdiction over this same project. As you also may know, Dr. Salo has been retained by Puget Power as an expert in the case and also to write a report that is reportedly very similar to the one produced for the Corp of Engineers. Thus, we are very concerned about the objectivity and content of this report. It is obvious from the citations in the report that Dr. Salo prepared his report, at least in part, based upon unrestricted access to Puget's files and the files of Puget's attorneys. We have noted in our July 6th correspondence to Dr. Salo our grave concerns over the citing of several studies in the draft report to the Corps which were prepared under his direction for the Muckleshoot Tribe in anticipation of litigation and trial. Please refer to a copy of this July 6th correspondence which was provided to Jack Thompson of your agency.

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In general, we find Dr. Salo's report to be very interesting and comprehensive. However, we also find it to be rather selective with respect to which references were included, which were only partially included, or which were left out entirely. We feel Dr. Salo has minimized the fisheries problems caused by Puget Power while maximizing those attributed to all other sources. A prime example is on page 17 paragraph 2 where a sentence from a letter from Brennan (1938) is only partially included. This reads as follows in Dr. Salo's report, "In discussing the magnitude of White River runs, Brennan noted '... our present information is based on a watershed badly depleted of fish life...' ". The whole sentence actually reads, " You must bear in mind in any statements concerning the number of fish that our present information is based on a watershed badly depleted in fish life owing to the fact that the power diversion has run unprotected since 1914." (from Brennan, 1938). This type of intentional omission leads us to openly question Dr. Salo's ability to be unbiased when considering his recent employment by Puget Power and his apparent dependence upon historical and other information supplied by them. We feel this has slanted the report in Puget's favor by downplaying the company's effects on the river and its fish runs, which have been substantiated by federal and state agencies, while at the same time highlighting all other responsible entities often with unsubstantiated statements and evidence - especially the Tribal fisheries, Mud Mt. Dam, logging, and estuary destruction. We note a serious lack of discussion of the impacts of Puget's project prior to 1935 when there were extremely low flows (Source: Summary of Hydrometric Data in Washington, 1878-1919, Parker & Lee) and no screens or other downstream fish migrant protections.

The Muckleshoot Tribe reserves the right to comment further on this report. These comments do not represent our total concerns as much of the comment we could offer is based on information in our possession which is proprietary and was prepared in anticipation of litigation and trial.

Specific comments listed by page and paragraph follow:

<u>Pg.</u>	<u>Para.</u>	
1	1	Please change the first sentence to read, "dynamic" and life-giving river.
17	2	Please include the whole sentence from the Brennan (1938) quote. It should read, "You must bear in mind in any statements concerning the number of fish that our present information is based on a watershed badly depleted in fish life owing to the fact that the power diversion has run unprotected since 1914."
20	1	We disagree that this is a reflection of the chinook run strength prior to the operation of Mud Mt. Dam. It may be directly prior to Mud Mt. Dam, but your statement implies that these may be "pristine" production figures or may represent numbers of fish years before Mud Mt. We feel the numbers of chinook and other species prior to Mud Mt. were already depressed by years of critically low flows and operation of the diversion flume with no screens for 27 years. We recommend that Dr. Salo review flow

MUCKLESHOOT¹⁷⁷ INDIAN TRIBE FISHERIES DEPARTMENT

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Pg. Para.

- 20 1 (cont.) records on the White River below the Buckley diversion for 1914-1919. As he will note, mean White River flows for October of water year 1917-1918 were 3.2 c.f.s. Other monthly mean flows were between 10 and 20 c.f.s. This information is in a document titled, "Summary of Hydrometric Data in Washington, 1878-1919, G.L. Parker and Lasley Lee." Loyd A. Royal (Washington Department of Fisheries) surveyed on foot Puyallup and White River and some of their tributaries during 1930 and 1931 to determine use by salmonid fish. He noted that the White River was dry below the diversion dam many summer and fall days during the fall migration period, and also that the river prior to Puget's Project had large runs of salmon and steelhead and that by 1930 and 1931 these runs were almost decimated, but that remnants remained. Brennan (1938) notes that, "It is not uncommon to find numbers of people obtaining fish from the pools."
- 20 3 The list of impacts prior to 1938 should not include the effects of "clear cut logging in the upper watershed." According to several other parts of the report, this did not begin until the mid 1930's. Unless you have some documentation of the effects, we would not suspect they would have been felt to a significant degree until later.
- 26 3 Once again, Brennan (1938) notes that, "You must bear in mind in any statements concerning the number of fish that our present information is based on a watershed badly depleted in fish life owing to the fact that the power diversion has run unprotected since 1914. It is not uncommon to go into the settling basin in this ditch during downstream migration periods and see hundreds of migrants. At the occasional shut down of these basins during migration period it is not uncommon to find numbers of people obtaining fish from the potholes."
- 27 2 40,000 coho smolts were planted into Boise Creek by WDF in spring of 1983. Also attached please find the 1983 coho planting summary for the upper White River watershed.
- 33 2 The U.S. Senate Document (1920) is obviously not very accurate as it is obvious to anyone who frequents the river that for the majority of the year the river is not "cloudy from silt", but, rather, is in fact clear.

MUCKLESHOOT¹⁷⁸ INDIAN TRIBE FISHERIES DEPARTMENT

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Pg. Para.

- 35 1 It is interesting that this quote from USFWS is used instead of more up to date information such as their 1974 White River flow study which directly contradicts the statement by Imler with respect to minimum flows of 30 c.f.s. being adequate for fish transportation. In fact, in this 1974 report, USFWS recommends 250 c.f.s. for coho adult upstream migration and 500 c.f.s. for chinook upstream migration. We feel this would be a good place to at least mention the flow study of 1974, lest you misrepresent USFWS position.
- 35 3 We find it amazing that Dr. Salo includes no discussion of the current sport fisheries on the White River or its tributaries, or the flume and Lake Tapps. We have noted both lower and illegal (during closed season) steelhead fishing in the lower White (below Buckley), illegal smolt fisheries in the lower river, legal sport smolt fishing (catch composed of steelhead smolts) in the upper White mainstem in spring and fall, and a legal smolt fishery in Puget Sound in May in and near Prinz Basin.
- 48 2 Regarding Puyallup system summer/fall chinook management, escapement goals since 1975 have been revised several times. From 1979 to the present, management has been on the basis of natural escapement goals. WDF's 1982 Puget Sound Summer/Fall Chinook Status Report and Recommendations for Management indicate natural escapement goals as 1600 fish.
- 61 3 The inference has been made in several meetings with City of Tacoma that assuming a very high or total mortality of fish through the Howell-Bunger valves, that going through the power turbines (and by-passing the Howell-Bunger valves) of the proposed project may lower the mortality for fish. Screening the intake is a complex problem and designing in no screens at all seems to be an alternative being proposed by City of Tacoma. This is not an acceptable alternative from our viewpoint.
- 65 67 Somewhere in this section please include a discussion of the 1974 USFWS White River flow study rather than burying it in the annotated bibliography. So far, it is the only comprehensive scientific study on flows to be done and made available. Since minimum flows are such a key issue on the lower White River, we feel a discussion of the study should be included here.
- 66 2 Please add to this paragraph that the diversion flume was completely unscreened for 27 or so years and that there have been many times especially in the early years, in which flows in the Buckley to Dieringer reach have fallen below 30 c.f.s.

MUCKLESHOOT INDIAN TRIBE¹⁷⁹ FISHERIES DEPARTMENT

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Pg. Para.

- 66 2 Also please note that steelhead kelts are diverted down the flume and either shunted down the debris filled bypass channel and back to the river, or on down the flume into Lake Tapps. In the bypass channel they are an easy mark for poachers and are subject to physical injury. In the flume below the screens, steelhead have been reportedly caught by fishermen.
- 67 2 We object to Dr. Salo's use of privileged documents in this paragraph and would also suggest including some mention that the Buckley to Dieringer reach of the White River is utilized for spawning and rearing by steelhead (please find attached aerial spawner survey results), coho, and fall chinook.
- 68 2 Enumclaw has recently upgraded their sewage treatment plant that discharges directly into the White River about 100 feet below the Highway 410 bridge. Buckley has a new sewage treatment plant which discharges into the White River about 1/2 mile below the 410 bridge. Please note that very low flows in this reach can reduce the dilution factor of the effluent discharge and reduce water quality. Also please note in this section that up to a point, the nutrient additions to the White River from these outfalls appears to increase the primary and benthic production. Hopefully, Puget Power will be supplying this baseline information in their FERC application.
- 69 2 We strongly object to the fact that Dr. Salo used privileged documents without Tribal permission to describe Coal Creek fish losses. These were prepared in the context of litigation and were not supplied to Puget Power for release in publications done by their experts. In any event, these figures are preliminary and have not been finalized.
- 76-82 Because Dr. Salo relied heavily on information supplied by Puget Power, and because Puget is clearly and repeatedly referred to as a significant contributor to the White River's fisheries problems, we find it rather stunning that Dr. Salo includes no interview with Puget to enlighten readers of this report on their views, enhancement plans, etc. Because the title of this section is "Enhancement Activities and Plans of Concerned Agencies and Organizations", we can only conclude that the omission of Puget Power means that they are either undertaking no enhancement activities and have no plans to, or they are not a concerned agency or organization.
- 80 2 Please find attached two letters summarizing the 1982 White River Native Steelhead plants into the upper watershed and a description of the initial year of this cooperative enhancement project.

1983 OFF-STATION COHO PLANTS - WHITE RIVER SYSTEM
FROM PUYALLUP HATCHERY (1982 BROOD)

<u>Date</u>	<u>Stream</u>	<u>WRIA No.</u>	<u>Number</u>	<u>lbs.</u>	<u>No/lb</u>	<u>Tank Time</u>	<u>Temperature Differential °F</u>
3/31/83	Clearwater River	10-0080	48,830	38	1,285	:55	1°
3/31/83	Huckleberry Creek	10-0253	51,400	40	1,285	1:55	9°
3/31/83	Greenwater River	10-0122	100,230	78	1,285	2:35	7°
5/5/83	Huckleberry Creek	10-0253	33,984	64	531	2:15	9°
5/5/83	Lost Creek	10-0264	22,833	43	531	2:00	9°
5/5/83	Clearwater River	10-0080	53,100	100	531	3:00	6°
5/12/83	Unnamed (Silver Springs)	10-0332A	12,656	28	452	1:25	7°
5/12/83	White River	10-0031	25,312	56	452	1:25	7°
5/12/83	Minnehaha Creek	10-0300	33,448	74	452	2:15	11°
5/12/83	W. Fork White River	10-0186	26,668	59	452	3:00	11°
5/12/83	Greenwater River	10-0122	101,700	225	452	2:15	12-14°

5/0161

JOHN SPELLMAN
Governor



FRANK LOCKARD
Director

STATE OF WASHINGTON
DEPARTMENT OF GAME

Seattle Regional Office—300 Fairview Avenue N.E., Seattle 98109 Telephone: 464-7764

March 9, 1983

Steve Elle, Biologist
Muckleshoot Indian Tribe
39015 - 172nd Avenue SE
Auburn, WA 98022

Re: Wild Steelhead Project - White River

Dear Steve:

This letter is to inform you of our plans for 1983 regarding White River wild steelhead brood stock capture and fry releases.

Below is a summary of what was accomplished last year. We plan to use a similar number of adult fish this year.

Eleven female and ten male fish were transported from the Buckley trap to the Puyallup Hatchery. This represents approximately 14 percent of the winter-run return to the trap (using June 26 as a cut-off date).

Eight females were spawned (three were stolen from the raceway where they were being held for ripening) giving us a total of 34,017 eggs, or 4,253/female.

From egg to fry, we lost 28 percent of the total, leaving us with 24,600 fry at 450/pound. A portion of this loss (approximately 15 percent) was due to the dry chinook mash diet being fed. Fred Norman feels that we can eliminate this loss in the future by feeding O.M.P. mash exclusively. Similar losses were experienced in Green and Puyallup River wild stock fry.

The 24,600 fry were scatter-planted in September in the following areas:

Viola Creek	- 6,400
Pinochle Creek	- 4,800
Wrong Creek	- 1,200
Cripple Creek	- 600
West Valley Creek	- 1,200
28-Mile Creek	- 9,950
Greenwater River	- 350 (approximately)
Huckleberry Creek tributary	- 100 (approximately)

Steve Elle
March 9, 1983
Page 2

Survival of these fry is expected to be excellent, as all areas planted are known to be underseeded with steelhead. Follow-up electrofishing this summer will give us a good idea of the success or failure of our first year's efforts.

From last summer's electrofishing, I'm quite sure that most of the adults transported by the Corps end up in the Clearwater, leaving nearly all other areas underseeded.

I hope we can again count on your assistance in this program. Follow-up surveys need to be done and new planting sites located. We hope to have about 42,500 fry available this year.

Very truly yours,

THE DEPARTMENT OF GAME

Tom Cropp by td

Tom Cropp
Area Fisheries Biologist

TC:td

cc: Fred Norman
Jim DeShazo
Chuck Phillips
Rich Goenen
Larry Burnstad

WR 12/28/82



JOHN SPELLMAN
Governor

STATE OF WASHINGTON

DEPARTMENT OF GAME

Seattle Regional Office—509 Fairview Avenue North. Seattle 98109. Telephone: 464-7764

December 28, 1982

Don Finney
Muckleshoot Indian Tribe
Fisheries Department
39015 - 172nd Avenue SE
Auburn, Washington 98002

Dear Mr. Finney:

I would like to thank you and the other members of the Muckleshoot Fisheries staff for your invaluable assistance in stocking the White River drainage this fall.

For your records, the 24,600 native steelhead fingerlings we planted were distributed as follows:

- Viola Cr. - 14.2 lbs. @ 450/lb. = 6400
- Pinochle Cr. - 10.6 lbs. @ 450/lb. = 4800
- Wrong Cr. - 2.6 lbs. @ 450/lb. = 1200
- Cripple Cr. - 1.3 lbs. @ 450/lb. = 600
- West Valley Cr. - 2.6 lbs. @ 450/lb. = 1200
- 28-Mile Cr. - 22.1 lbs. @ 450/lb. = 9950
- Greenwater R. - 1.0 lbs. @ 450/lb. = 450

Wick Cr

900

Our program in 1983 will involve similar numbers of fish if they are available at the trap.

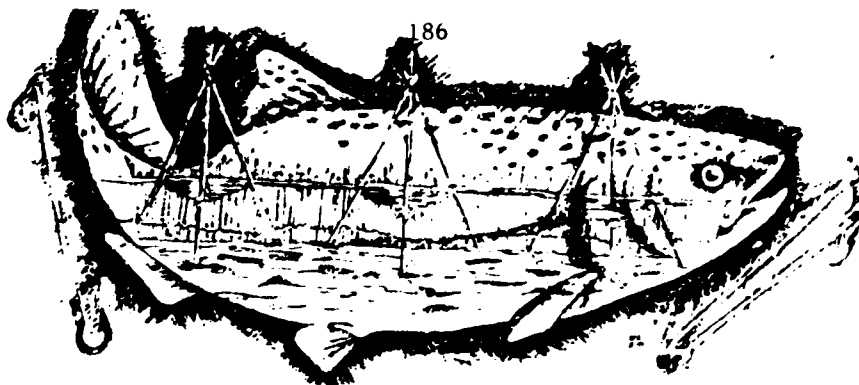
Again, your help is appreciated.

Sincerely,

Tom Cropp by td

Tom Cropp
Area Fisheries Biologist

TC:td



MUCKLESHOOT INDIAN TRIBE FISHERIES DEPARTMENT

39015 172ND AVENUE S.E. - AUBURN, WASHINGTON 98002 - (206) 939-3311

Al Wolfson-District Ranger
White River Ranger District
U.S. Forest Service
857 Roosevelt Ave. E.
Enumclaw, WA 98022

June 29, 1983

RE: Clearwater River Fisheries Information

Dear Al;

As promised in our letter of March 31, 1983, we have conducted steelhead spawner surveys and preliminary fish habitat assessments on the Clearwater River.

On 4/21/83, 4/29/83, and 5/12/83 the River was covered from the mouth to river mile 5.5 (approx. $\frac{1}{2}$ mile north of the USFS boundary). Steelhead spawning redds were noted as follows:

<u>Location</u>	<u>No. Redds</u>
Mouth to 1st Bridge (R.M.0.0-2.2)	18
Between Bridges (R.M.2.2-3.7)	10
Upper Bridge to Clear Cutting (R.M.3.7-5.5)	7
<hr/>	
Total	35

Steelhead research at the Snow Creek facility run by Washington Dept. of Game has revealed that each female steelhead digs 1.28 redds. Changing this to females/redd gives approximately .8, thus by multiplying no. of redds (35) times females/redd (.8) this equals no. of females (28) which spawned. Assuming a 1:1 ratio of females to males gives a total of 56 steelhead.

From the mouth to the second bridge, the river has good spawning and rearing habitat for coho, steelhead, and spring chinook. There appeared to be excess spawning habitat in this reach for steelhead as several suitable gravel beds showed no signs of fish utilization.

MUCKLESHOOT INDIAN TRIBE¹⁸⁷ FISHERIES DEPARTMENT

39015 172ND AVENUE S.E. - AUBURN, WASHINGTON 98002 - (206) 939-3311

Page 2.

Above the second bridge, patches of spawning gravel exist, but this appears to be the limiting factor in the section we covered on foot. Rearing habitat is abundant although less suited to coho due to the steep bouldery character of the river.

Throughout the surveys we noted abundant aquatic insect populations- caddis, mayfly, and stonefly. Also noted extremely abundant coho fry in all side channels and along the edge of the main channel from the lower bridge to the mouth. Many of these fry were likely the result of Washington Dept. of Fisheries' coho fry plants this spring.

The upper extent of anadromous fish passability was not fully determined due to on-going logging operations along the river in section 33 and 34. Steelhead redds were noted up to the base of a large and questionably passable log jam at approximately river mile 5.2. We have since done a field inspection of the jam with Weyerhaeuser officials and they agreed to have their stream clean-out crews remove some of the smaller straining type woody debris to assure anadromous fish passage. This jam has an added benefit in that it had backed up tons of ideal spawning gravel for coho and steelhead which has formed a low gradient pool/riffle complex approximately 1000 feet long. Therefore, we assume the river is or will be passable beyond this jam, but how far is up to question.

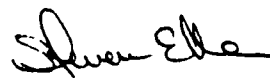
Yet to be done will be fish habitat/access surveys of the Clearwater and tributaries from river mile 5.5 to the headwaters. We assume that your fisheries staff has this scheduled into the 1983 field season, and we would welcome the opportunity to assist your staff in this effort. Please contact Don Finney at 939-3311.

We hope this information is useful in developing your Clearwater E.A. If you have any questions, please do not hesitate to call.

Sincerely;



Don Finney
Fisheries Biologist



Steve Elle
Fisheries Biologist

cc: NWIFC- McDonald
BIA Everett-Roy
WEYCO-Crotts
WDF-Trosper, Gerke
WDG-Cropp, Engman

Aerial Spawner Surveys for Steelhead 1979

DATE	Location	Bedds observed	Remarks
March 2, 1979	White R. : Powerhouse Channel to Auburn Br. Auburn Br. to diversion dam	1 0	River clear & low. Heavy siltation in lower half of river.
March 22, 1979	White R. Powerhouse to Auburn Br. Auburn Br. to Dam	6 4	River low & clear 10 nets in river.
April 25, 1979	White R. Powerhouse to Auburn Br. Auburn Br. to Dam	3 17	River low & clear. Heavy siltation & algae growth. observed
May 23, 1979	White R.	—	River low & very silty runoff 0 visibility

Steve Ste

STEELHEAD SPawning AREA SURVEY

Date of Survey: 2 March 79

Time of Survey: 1300--1500

Weather: Sunny and clear

Survey Team: Oppermann, Dohler (nicknames)

Ground Survey

Aerial Survey Queen City Mill, Johnson

RIVER	SURVEY AREA DESCRIPTION	REDDS	REMARKS (Fish, Water Conditions, etc.)
Pyallup	White River to Carbon River	1	River low & clear
	Carbon river to Orting Dr.	5	
	Orting Dr to Electron Power house	0	
	Electron to barrier dam	0	
	Total	6	
White River	Powerhouse channel to Auburn Dr.	1	River low & clear heavy siltation in lower half of R.
	Auburn Dr. to diversion dam	0	189
Carbon R.	Mouth to So. Prarie Cr.	0	River low & clear
	So. Prarie Cr. to Carbonado	0	
So. Prarie	Mouth to So. Prarie	1	Low and clear
	So. Prarie to Burnott	0	
	Burnott to Beaver Creek	0	
		0	

STEELHEAD SPawning AREA SURVEY

Date of Survey: 25 April 1979

Survey Team: Oppermann, Bruce Dohle (Included hood tribol biologist)

Time of Survey: 1115--1215

Ground Survey

Weather:

Aerial Survey Jack: Johnson, Queen City Falls.

RIVER	SURVEY AREA DESCRIPTION	REDDS	REMARKS (Fish, Water Conditions, etc.)
Dugallup	Mouth to Carbon River	1	River low and clear
	Carbon River to Ortling br.	3	
	Ortling br. to Electrobrn	0	Two deer
	Total	4	
Carbon	Mouth to Highway 162	2	Marked redd still very visible, river low and clear
	Highway 162 to D.P.A. powerlines	3	
	D.P.A. powerlines to Carbonado	2	
	Total	7	
So. Prarie	Mouth to So. Prarie	26	River low and clear, several fish seen also 4 deer
	So. Prarie to Burnett br.	11	
	Burnett br. to Beaver cr.	14	
	Total	51	
White	Powerhouse channel to Auburn br.	3	River low and clear, heavy siltation and algae growth
	Auburn br. to barrier dam	17	marked redd not visible. Removed net with one male Gill
	Total	20	

STBELHEAD SPANNING AREA SURVEY

Date of Survey: 23 May 1979

Time of Survey: 1000--1020

Weather: overcast

Survey Team: Oppermann with Bruce Doble, Buckleclon
tribal biologist

Ground Survey

Aerial Survey Jack Johnson, Queen City, Mo

RIVER	SURVEY AREA DESCRIPTION	REDDS	REMARKS (Fish, Water Conditions, etc.)
Puyallup		—	river very silty from runoff water, no visibility
Carbon		—	same as Puyallup
So. Prarie cr. Mouth to So. Prarie		75	creek low and clear. several fish seen but reds very
So. Prarie to Burnett br.		19	difficult to see because of thick overstory and light
Burnett br. to Spiketon rd.		1	algae growth
Spiketon rd. to Beaver cr.		10	
	Total	111	

192

White

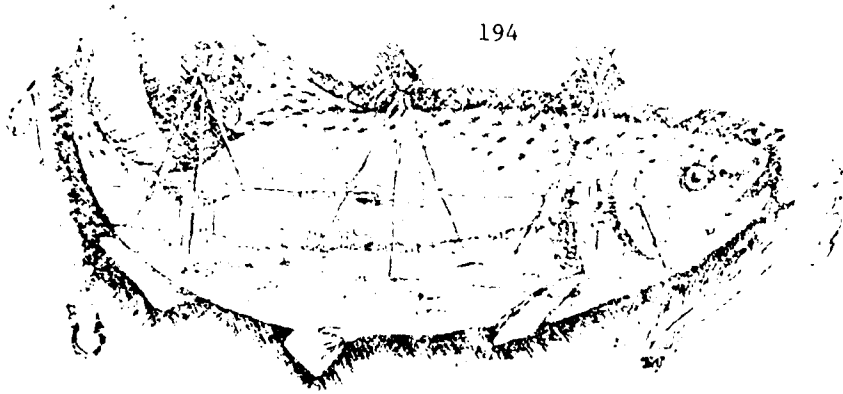
0000409
river low but no visibility due to silty runoff

White River Aerial Survey
 Wright Co Helicopter Service (Mike Williams experienced Pilot)
 Survey Counts by Steven Elle (Muckleshoot Management Bio)
 4-29-83 11:08 to 11:50 AM
 White River Mouth to Buckley Division Dam

Section	New Redds	Old Redds	Total Redd	# Fish
Mouth to Deringer rd	2	0	2	0
Deringer to R St Bridge	3	2	5	1
R St to Northwest Gas Pipeline	6	4	10	0
Gas Pipeline to Shaker Church	3	6	9	0
Church to 410	4	7	11	3
410 to Dam	3	0	3	0
Totals	21	19	<u>40</u>	4

- Observations:
- ① Redds observed on foot 4-19-83 barely visible.
 - ② 4 new reds observed by Walter Pacheco from End of Dike to R St (same as helicopter). Disputed by Puget Power observes.
 - ③ Puget Power surveys down 1 side of River questionable surveys due to non-coverage of entire riffle areas and due to inexperienced. (Subjective analysis Steve Elle & Walter Pacheco Muckleshoot Biologist)
 - ④ Need Puget's total counts to compare to these counts of new redd at least!

Prepared by Steven Elle
 5-3-83

Recd 25 Aug 83
DH

AUG 31 1983

MUCKLESHOOT INDIAN TRIBE FISHERIES DEPARTMENT

39015 172ND AVENUE S.E. - AUBURN, WASHINGTON 98002 - (206) 939-3311

Steve Dice
U.S. Army Corps of Engineers
Seattle District-Planning Branch
P.O. Box C-3755
Seattle, WA 98124

August 25, 1983

RE: Comment corrections on Salo, Jagielo
White River Fisheries Status Report

Mr. Dice;

In our haste to get the comments on the above referenced report in by the August 15th deadline, there were a few typographic omissions made which we would like to correct.

Comment for page 20, paragraph 1 the last four or five lines should read, Brennan (1938) notes that, "It is not uncommon to go into the settling basin in this ditch during downstream migration periods and see hundreds of migrants. At the occasional shutdown of these basins during migration period it is not uncommon to find numbers of people obtaining fish from the potholes."

Comment for page 147 Reference #2 was accidentally left out entirely, and should have read; The date on this reference is off by 10 years and should be 1971.

Sincerely;

Don Finney-Fisheries Biologist

JUL 29 1983

*Rec'd 10/26/83
LH*



United States Department of the Interior

FISH AND WILDLIFE SERVICE

Fisheries Assistance Office
2625 Parkmont Lane, Bldg. A
Olympia, Washington 98502

July 18, 1983

Dr. Steven F. Dice
Chief, Environmental Resources Section
Seattle District, Corps of Engineers
P.O. Box C-3755
Seattle, Washington 98124

Dear Dr. Dice:

We have reviewed the draft report entitled "The Status of Anadromous Fishes in the White-Puyallup River System" by Earnest Salo and Thomas Jagielo. We find the report well written and a good reference. However, because of the high degree of interest in White River spring chinook, we suggest the authors include a summary and ranking, if possible, of the most important factors they believe responsible for the decline of this stock. This would help identify information needs and focus restoration efforts. On a more specific note, the discussion on pages 19-23 suggests that downstream passage through Mud Mountain Dam may have had a large adverse impact on White River spring chinook. It is not clear, however, what additional impact both the Muckleshoot and Puyallup fisheries may have had on the spring component of the chinook run in the post dam period, or whether the existing catch data allows such specific evaluation. We suggest this be included, if possible.

We appreciate the opportunity to review this report.

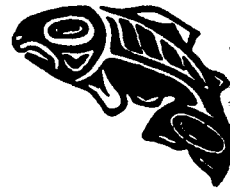
Sincerely,

Ralph S. Boomer
Project Leader

RCWunderlich:dem



20 July 83
 [Signature]



Puyallup Tribe of Indians

MEDICINE CREEK TREATY NATION

TO: Steven Dice, U.S. Army Corps of Engineers
 FROM: Thomas Deming, Puyallup Tribal Fisheries
 DATE: 13 July 83
 SUBJ: Comments on the draft, "Status of the Anadromous
 Fishes of the White Puyallup River System." Salo,
 E.O., and T.H. Jagielo, 1983.

The draft document at hand is in general a well written, well constructed approach to the interrelating items and conditions which effect White River stocks of anadromous fishes. There are, however, some basic concerns about how particular items and conditions are highlighted and how they may be referenced and/or construed in the future. These concerns are listed below:

Figure 8: and several other pages.

In reference to the date of 1953, when an Indian net fishery began along the lower Puyallup; this date may be when current statistical counts were first obtained by WDF but certainly not when the Puyallup Tribe first started fishing within an area they have populated for at least the last few thousand years.

Page 23; The utilization of "documented over fishing" on the lower Puyallup may be supported by records of landings but, no mention is made about records of non-Indian commercial harvest. The implied implication within the first paragraph of the page seems extremely one-sided.

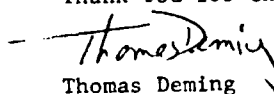
Puyallup Tribal harvest policies have indicated no or only limited target fisheries for Puyallup River fall chinook from 1976 to present. Also, Tribal policy has had no harvest of spring chinook since the late 1970's.

Page 28; Again, mention is made of record Indian harvest but not of "record" non-Indian commercial and sport harvests.

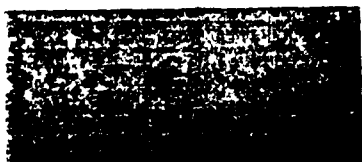
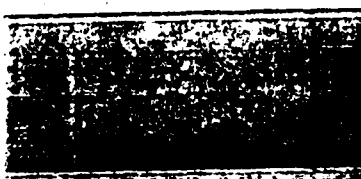
- Page 29; It may be possible also to note the trend of declining wild stocks in relation to non-Indian commercial harvests and WDF harvest programs based on hatchery harvest rates within this section.
- Page 33; Unfortunately, the entire section is rather one-sided by being based solely on historical WDF bias pointing the "evil finger" of overharvest at the Tribes by including such statements by Imler (1960). By noting, "that the fish reduction is not due to inadequate fish facilities, but rather to an intensive Indian fishery...", one could infer that complete blockage of a river, dewatering several miles of river-bed, and killing a great majority of downstream smolts will not harm the fish runs.
- Page 39; It seems rather inconsistent to not use the words "overharvested," "intensive," and "directly impacted", which are so commonly used for discussing Indian fisheries, when discussing non-Indian commercial fisheries. In regards to the 1978 Puyallup River fall chinook harvest; non-Indian (commercial and sport) accounted for 79.7% of the harvest (Washington harvest considered only), while Indian harvest only accounted for 20.3% of the total.
- Harvest exploit rates made beautiful graphs, but there are none within text showing the "intensive, overharvest" of Puyallup River stocks by non-Indian commercial fishermen.
- Page 83; The Puyallup Tribe releases both fall chinook smolts and fall chinook fed fry. The fed fry releases are planted into South Prairie and Kapowsin Creeks and the smolt releases are planted into the mainstem White River and Clarks Creek.
- Page 126; As shown-- Puyallup and Lake Washington are on the same line.
- Page 141; If the 1966 injunction against Indian fishing is shown it may be required to also indicate such things as the 1974 Boldt decision, recent Orrick decisions, Puyallup Phase's I, II, and III, etc.

The strongest portion of this document is a result of the concise notation of several recommendations.

Thank You for the review opportunity.



Thomas Deming
Fisheries/Wildlife Biologist



14907 S. 30th St. E.
 Everett, Wa. 98171



Dr. Solo

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After reading your report I would like to respond to several subjects.

Regarding potential in the 31 mile stretch of the river between Mud Mt. and the buckles dispersion should be utilized to its fullest potential by allowing spawning to occur on flinting grounds and to have used this area full time. We not be suited to spawning in the upper watershed. Hauling these fish above their natural range may not be as beneficial as allowing them to spawn in the lower reaches.

Goodline activity is documented by the information on pp. 104-105 by reporting harvests during periods of closed seasons.

Reports of hatchery operations at the North Creek station. Hatchery would be a big help in comparing fish counts. The Prallur hatchery has been in operation since 1977 and counts of spawned fish have been kept since then.

The harvest rate in the Prallur system based mainly on hatchery exploitation rates causes severe overfishing of native stocks.

NORTHWEST STEELHEAD & SALMON COUNCIL OF TROUT UNLIMITED



The Pacific Fishery Management Council is trying to manage the ocean fisheries to provide 100% of native stock to fully utilize spawning areas. Their example:

THE EFFECT ON POTENTIAL HARVEST OF REGULATING MIXED STOCK FISHERIES TO MEET NATURAL SPAWNING ESCAPEMENT GOALS

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	Hatchery Fish	Natural Fish
Population	100,000	100,000
Required Spawning Escapement	10,000	40,000
Allowable Harvest	90,000	60,000
Harvest @ 0.85 Mixed Stock Catch Rate	85,000	35,000
Realized Spawning Escapement	15,000	15,000
LONG TERM HARVEST POTENTIAL	85,000+	+ 60,000,000
Harvest @ 0.60 Mixed Stock Catch Rate	60,000	60,000
Known Stock Harvest	20,000	0
Realized Spawning Escapement	10,000	40,000
LONG TERM HARVEST POTENTIAL	90,000	+ 60,000 + 150,000

This simplified example illustrates the potential benefits of restricting mixed stock fishing rates to meet natural spawning escapement goals.

At an 0.85 rate the natural component of the population is severely overfished; it probably would not be completely eliminated as in this simplified example, but would certainly cease to make a meaningful contribution to fisheries. When the mixed stock harvest rate is reduced to 0.60 to meet natural spawning escapement goals, total long term harvest is increased by more than 75%.

Importantly, in this example, traditional mixed stock fisheries would catch more fish at the lower fishing rate than the higher fishing rate; i.e., 120,000 fish vs. 100,000.

Regulating mixed stock fisheries to meet natural spawning escapement goals result in significant numbers of hatchery fish for known stock harvest; i.e., harvest in fisheries that can target on hatchery fish. The depressed condition of many major natural stocks of salmon require development of inside known stock fisheries to complement reduced mixed stock fishing rates in ocean fisheries under Pacific Council Jurisdiction.

FROM PERSPECTIVE OF MANAGEMENT OF OCEAN CHINOOK AND COHO SALMON FISHERIES WITHIN THE CONSERVATION ZONE OF CALIFORNIA, OREGON AND WASHINGTON.

Larry M. Roberts
Environmental Protection and
Natural Resources Chairman
Western Washington
Northwest Steelhead & Salmon Council

NORTHWEST STEELHEAD & SALMON COUNCIL OF TROUT UNLIMITED