Basin Investigations

NORTH COAST BASIN

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OREGON STATE GAME COMMISSION
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PORTLAND, OREGON 97208
THE FISH AND WILDLIFE RESOURCES OF THE
NORTH COAST BASIN, OREGON, AND
THEIR WATER REQUIREMENTS

A Report with Recommendations to the
OREGON STATE WATER RESOURCES BOARD

By
Kenneth E. Thompson
and
John D. Fortune, Jr.
Aquatic Biologists

Oregon State Game Commission
Basin Investigations Section

FEDERAL AID TO FISH RESTORATION
Progress Report
Fisheries Stream Flow Requirements
Project F-69-R-5, Job Number 3

Portland, Oregon
April, 1968
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INTRODUCTION

This report describes the water requirements of fish and wildlife in the North Coast Basin, outlines the procedures used for defining these requirements, and submits minimum perennial flow regimen necessary for maintaining reasonable levels of fish and wildlife production in the basin. Similar reports have been submitted to the State Water Resources Board since 1961 for nine other Oregon drainage basins.

Field studies relevant to this report were initiated in the spring of 1965 and terminated in the fall of 1966. Most of the investigations were conducted during the months of June through September of 1965 and 1966.

Personnel contributing to the study were aquatic biologist, James M. Hutchison, Gregory J. Hattan, and the authors. Consulting and documentary assistance were provided by Oregon State Game Commission district biologists, Wernald H. Christianson, Warren M. Knispel, and William E. Hosford, and personnel of the Fish Commission of Oregon, United States Geological Survey, and Oregon State Water Resources Board.
FISH RESOURCES OF THE NORTH COAST BASIN

Fish Populations

Salmon and steelhead are the most important game fish in the North Coast Basin. More than three times as much angler effort was expended on salmon and steelhead trout angling in 1965 than on any other group of fish. Four of nine species of anadromous fish found in the North Coast have basin-wide distribution. The four most common species are the winter steelhead trout, coho salmon, fall chinook salmon, and sea-run cutthroat trout. Summer steelhead trout, spring chinook salmon, chum salmon, pink salmon, and sturgeon are less widespread, but are well established in certain stream systems in the basin (Plate 1). Various index counts are regularly made on salmon and steelhead to evaluate their population levels (Tables 1, 2, 3, and 4). Shad and eulechon (smelt) migrate through the Columbia River but do not inhabit tributary streams.

Resident trout are indigenous to nearly all streams in the North Coast Basin. The majority of trout stocked in the lakes and streams of the basin are cutthroat, but plantings of rainbow are common in lakes (Appendix VI). Most cutthroat are anadromous, spending part of their life cycle in saltwater and returning to "cradle" streams as adults, 11 to 19 inches in length.
Table 1. Spring chinook salmon counts in the Wilson, Trask and Nestucca Rivers, 1962 and 1964 through 1967  

<table>
<thead>
<tr>
<th>River</th>
<th>Year</th>
<th>Number of pools examined</th>
<th>Number of chinook counted</th>
</tr>
</thead>
<tbody>
<tr>
<td>Wilson</td>
<td>1962</td>
<td>17</td>
<td>152</td>
</tr>
<tr>
<td></td>
<td>1964</td>
<td>4</td>
<td>110</td>
</tr>
<tr>
<td></td>
<td>1965</td>
<td>10</td>
<td>11</td>
</tr>
<tr>
<td></td>
<td>1966</td>
<td>8</td>
<td>21</td>
</tr>
<tr>
<td></td>
<td>1967</td>
<td>10</td>
<td>8</td>
</tr>
<tr>
<td>Trask</td>
<td>1962</td>
<td>20</td>
<td>526 3/</td>
</tr>
<tr>
<td></td>
<td>1964</td>
<td>10</td>
<td>224</td>
</tr>
<tr>
<td></td>
<td>1965</td>
<td>16</td>
<td>131 4/</td>
</tr>
<tr>
<td></td>
<td>1966</td>
<td>12</td>
<td>40</td>
</tr>
<tr>
<td></td>
<td>1967</td>
<td>19</td>
<td>86</td>
</tr>
<tr>
<td>Nestucca</td>
<td>1964</td>
<td>10</td>
<td>59</td>
</tr>
<tr>
<td></td>
<td>1965</td>
<td>12</td>
<td>62</td>
</tr>
<tr>
<td></td>
<td>1966</td>
<td>8</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td>1967</td>
<td>20</td>
<td>15</td>
</tr>
</tbody>
</table>

1/ Data obtained by skin and SCUBA diving.
2/ Source: Fish Commission of Oregon.
3/ Includes chinook salmon in pool below the F.C.O. Trask River Hatchery.
4/ Does not include the chinook salmon (300+) in the pool below the F.C.O. Trask River Hatchery.
Table 2. Three Rivers trap counts, 1961-64

<table>
<thead>
<tr>
<th>Year</th>
<th>Months</th>
<th>Coho</th>
<th>Chinook</th>
<th>Steelhead</th>
</tr>
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<tbody>
<tr>
<td>1960-61</td>
<td>Nov-Feb.</td>
<td>143</td>
<td>2</td>
<td>117</td>
</tr>
<tr>
<td>1962-63</td>
<td>Oct-Apr.</td>
<td>368</td>
<td>21</td>
<td>90</td>
</tr>
<tr>
<td>1963-64</td>
<td>Oct-Apr.</td>
<td>368</td>
<td>34</td>
<td>22 1/</td>
</tr>
</tbody>
</table>

1/ An unknown number of steelhead passed upstream uncounted when a segment of the trap washed out during high water.

Table 3. Chinook salmon spawning surveys, Nehalem River, 1960-67

<table>
<thead>
<tr>
<th>Species</th>
<th>Year</th>
<th>Miles surveyed</th>
<th>Fish per mile</th>
<th>Total fish 1/</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fall chinook</td>
<td>1961</td>
<td>4</td>
<td>61.8</td>
<td>247 (19)</td>
</tr>
<tr>
<td></td>
<td>1962</td>
<td>4</td>
<td>43.8</td>
<td>175 (27)</td>
</tr>
<tr>
<td></td>
<td>1963</td>
<td>5</td>
<td>51.4</td>
<td>257 (50)</td>
</tr>
<tr>
<td></td>
<td>1964</td>
<td>5</td>
<td>50.0</td>
<td>250 (26)</td>
</tr>
<tr>
<td></td>
<td>1965</td>
<td>5</td>
<td>44.8</td>
<td>224 (56)</td>
</tr>
<tr>
<td></td>
<td>1966</td>
<td>5</td>
<td>38.8</td>
<td>194 (19)</td>
</tr>
<tr>
<td></td>
<td>1967</td>
<td>5</td>
<td>34.8</td>
<td>174 (16)</td>
</tr>
<tr>
<td>Summer chinook</td>
<td>1961</td>
<td>12</td>
<td>5.6</td>
<td>67 (6)</td>
</tr>
<tr>
<td></td>
<td>1963</td>
<td>12</td>
<td>3.4</td>
<td>41 (10)</td>
</tr>
<tr>
<td></td>
<td>1964</td>
<td>12</td>
<td>9.3</td>
<td>111 (7)</td>
</tr>
<tr>
<td></td>
<td>1965</td>
<td>12</td>
<td>8.8</td>
<td>106 (7)</td>
</tr>
<tr>
<td></td>
<td>1966</td>
<td>12</td>
<td>3.3</td>
<td>36 (6)</td>
</tr>
<tr>
<td></td>
<td>1967</td>
<td>No survey made</td>
<td></td>
<td></td>
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</tbody>
</table>

1/ Figures in parenthesis indicate jack salmon which are also included in the total.
Table 4. Coho salmon spawning surveys, 1961-67

<table>
<thead>
<tr>
<th>Stream</th>
<th>Year</th>
<th>Miles surveyed</th>
<th>Fish per mile</th>
<th>Total fish 1/</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nehalem R.</td>
<td>1961</td>
<td>12.5</td>
<td>32.2</td>
<td>403 (23)</td>
</tr>
<tr>
<td></td>
<td>1962</td>
<td>11.5</td>
<td>22.2</td>
<td>265 (34)</td>
</tr>
<tr>
<td></td>
<td>1963</td>
<td>15.0</td>
<td>16.4</td>
<td>246 (10)</td>
</tr>
<tr>
<td></td>
<td>1964</td>
<td>15.0</td>
<td>32.8</td>
<td>493 (34)</td>
</tr>
<tr>
<td></td>
<td>1965</td>
<td>13.8</td>
<td>24.3</td>
<td>336 (19)</td>
</tr>
<tr>
<td></td>
<td>1966</td>
<td>13.8</td>
<td>17.8</td>
<td>245 (26)</td>
</tr>
<tr>
<td></td>
<td>1967</td>
<td>13.8</td>
<td>26.3</td>
<td>364 (37)</td>
</tr>
<tr>
<td>Necanicum</td>
<td>1961</td>
<td>4.75</td>
<td>20.4</td>
<td>97 (6)</td>
</tr>
<tr>
<td></td>
<td>1962</td>
<td>4.25</td>
<td>18.1</td>
<td>77 (8)</td>
</tr>
<tr>
<td></td>
<td>1963</td>
<td>4.25</td>
<td>12.0</td>
<td>51 (3)</td>
</tr>
<tr>
<td></td>
<td>1964</td>
<td>4.25</td>
<td>31.3</td>
<td>133 (14)</td>
</tr>
<tr>
<td></td>
<td>1965</td>
<td>4.25</td>
<td>13.4</td>
<td>57 (9)</td>
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<tr>
<td></td>
<td>1966</td>
<td>4.25</td>
<td>25.6</td>
<td>109 (9)</td>
</tr>
<tr>
<td></td>
<td>1967</td>
<td>4.25</td>
<td>4.0</td>
<td>17</td>
</tr>
</tbody>
</table>

1/ Figures in parenthesis indicate jack salmon which are also included in totals.

Perch, sunfish, crappie, bass, and bullhead are the warm-water game fish species of the North Coast Basin. All are common in backwater areas along the lower Columbia River, lowland lakes, and ponds along the coast (Table 5). Brown bullhead have been reported in the lower Necanicum River.
Table 5. Distribution of warm-water game fish in North Coast Basin lakes and ponds with public access

<table>
<thead>
<tr>
<th>Lake</th>
<th>Surface acres</th>
<th>Location</th>
<th>Species present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Burkes Lake</td>
<td>6.3</td>
<td>West of Warrenton T.8 N., R.10 W., Sec. 21</td>
<td>Largemouth bass</td>
</tr>
<tr>
<td>Burnham Pond</td>
<td>3</td>
<td>Goble, N.W. of St. Helens, T.5 N. R.1 W., Sec. 8</td>
<td>Largemouth bass, bluegill</td>
</tr>
<tr>
<td>Cemetery Lake</td>
<td>10.3</td>
<td>South of Warrenton T.8N., R.10 W., Sec. 28</td>
<td>Yellow perch, white crappie, largemouth bass, bluegill</td>
</tr>
<tr>
<td>Coffenbury Lake</td>
<td>50</td>
<td>West of Warrenton T.8 N., R.10 W., Sec. 17, 18, 20</td>
<td>Yellow perch, brown bullhead</td>
</tr>
<tr>
<td>Crabapple Lake</td>
<td>22</td>
<td>West of Warrenton T.8 N., R.10 W., Sec. 20</td>
<td>Largemouth bass, yellow perch</td>
</tr>
<tr>
<td>Crescent Lake</td>
<td>7</td>
<td>Manhattan T.2 N., R.10 W., Sec. 29</td>
<td>Largemouth bass</td>
</tr>
<tr>
<td>Cullaby Lake</td>
<td>200</td>
<td>North of Gearhart T.7 N., R.10 W., Sec. 15, 22, 23</td>
<td>White crappie, black crappie, yellow perch, brown bullhead, large-mouth bass</td>
</tr>
<tr>
<td>Lytle Lake</td>
<td>59</td>
<td>North of Rockaway T.2 N., R.10 W., Sec. 29, 32</td>
<td>Largemouth bass</td>
</tr>
<tr>
<td>Marie Lake</td>
<td>0.6</td>
<td>Twin Rocks T.1 N., R.10 W., Sec. 5</td>
<td>Largemouth bass, pumpkinseed sunfish</td>
</tr>
<tr>
<td>Smith Lake</td>
<td>40</td>
<td>North of Garibaldi T.1 N., R.10 W., Sec.18</td>
<td>Largemouth bass, brown bullhead</td>
</tr>
<tr>
<td>Smith Lake</td>
<td>41</td>
<td>South of Warrenton T.8 N., R.10 W., Sec. 28, 33</td>
<td>Largemouth bass, yellow perch, bluegill, white crappie, black crappie, warmouth</td>
</tr>
<tr>
<td>Spring Lake</td>
<td>11</td>
<td>North of Garibaldi T.1 N., R.10 W., Sec. 5, 8</td>
<td>Largemouth bass, black crappie</td>
</tr>
</tbody>
</table>
Table 5 (continued)

<table>
<thead>
<tr>
<th>Lake</th>
<th>Surface acres</th>
<th>Location</th>
<th>Species present</th>
</tr>
</thead>
<tbody>
<tr>
<td>Stanley Lake</td>
<td>7</td>
<td>Gearhart</td>
<td>Brown bullhead</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T.6 N., R.10 W., Sec.15</td>
<td></td>
</tr>
<tr>
<td>Sunset Lake</td>
<td>107</td>
<td>North of Gearhart</td>
<td>Yellow perch, largemouth bass, brown</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T.7 N., R.10 W., Sec. 9, 16, 21</td>
<td>bullhead</td>
</tr>
<tr>
<td>West Lake</td>
<td>32</td>
<td>North of Gearhart</td>
<td>Brown bullhead, yellow</td>
</tr>
<tr>
<td></td>
<td></td>
<td>T.7 N., R.10 W., Sec.22</td>
<td>perch, largemouth bass</td>
</tr>
</tbody>
</table>

Lingcod, greenling, surfperch, rockfish, and flounder are nongame marine fish that support a popular sport fishery in the bays and coastal areas. Dungeness crabs and several species of clams and oysters are also economically important fauna of the North Coast Basin.

Fifteen species of undesirable or "rough" fish are found in the waters of the basin, the majority occurring in the lower Columbia River and its tributaries (Table 6). Ocean tributaries in the basin south to, and including the Nehalem drainage, contain suckers, lamprey, sculpin, and stickleback. Dace, sculpin, and stickleback are the only species of rough fish present in the Tillamook Subbasin. Where rough fish have become well established, they compete with game fish for food and space.
Table 6. Distribution of nongame fish in the North Coast Basin

<table>
<thead>
<tr>
<th>Species</th>
<th>General distribution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Carp</td>
<td>Columbia River and lower reaches of its tributaries</td>
</tr>
<tr>
<td>Chiselmouth</td>
<td>Columbia River and tributaries</td>
</tr>
<tr>
<td>Chub</td>
<td>Columbia River and tributaries</td>
</tr>
<tr>
<td>Sculpin</td>
<td>Common throughout the basin</td>
</tr>
<tr>
<td>Dace</td>
<td>Columbia River and tributaries. Limited distribution in the Nestucca River system</td>
</tr>
<tr>
<td>Goldfish</td>
<td>Columbia River. Suspected in lower reaches of Columbia River tributaries</td>
</tr>
<tr>
<td>Lamprey</td>
<td>Columbia and Nehalem Subbasin streams</td>
</tr>
<tr>
<td>Peamouth</td>
<td>Columbia River and tributaries</td>
</tr>
<tr>
<td>Shiners</td>
<td>Columbia River and tributaries</td>
</tr>
<tr>
<td>Squawfish</td>
<td>Columbia River and tributaries</td>
</tr>
<tr>
<td>Stickleback</td>
<td>Nestucca River. Suspected in tidal areas of other coastal streams. Columbia River and tributaries</td>
</tr>
<tr>
<td>Suckers</td>
<td>In most Columbia and Nehalem Subbasin streams. Absent in Tillamook Subbasin</td>
</tr>
<tr>
<td>Tench</td>
<td>Columbia River. Suspected in lower reaches of Columbia River tributaries</td>
</tr>
<tr>
<td>Troutperch</td>
<td>Columbia River. Suspected in lower reaches of Columbia River tributaries</td>
</tr>
</tbody>
</table>
Economic and Aesthetic Values

Sport fisheries

The sport fisheries of the North Coast Basin are as varied as any other basin in the state (Table 7). The magnitude of the combined effort on these fisheries is indicated in Figure 1. Although not as popular as in some other parts of Oregon, the lake and stream trout fisheries are intensively managed and could withstand considerably more angling pressure than they now receive. Approximately 200,000 trout are stocked annually into 30 streams and 12 lakes by the Oregon State Game Commission (Appendix VI). The basin supports much of the most popular and productive salmon and steelhead angling in the state. More than 40,000 days were spent angling for marine fish such as lingcod, surfperch, rockfish, flounder, and greenling in 1965. Columbia River sloughs and several inland lakes provide a significant fishery on warm-water game fish.

Table 7. Angler trips and catch by species in the North Coast Basin in 1965

<table>
<thead>
<tr>
<th>Species</th>
<th>Angler trips</th>
<th>Catch</th>
</tr>
</thead>
<tbody>
<tr>
<td>Salmon unidentified</td>
<td>276,051</td>
<td>128,345</td>
</tr>
<tr>
<td>Coho</td>
<td>34,374</td>
<td>89,404</td>
</tr>
<tr>
<td>Chinook</td>
<td>4,922</td>
<td>13,709</td>
</tr>
<tr>
<td>Jack salmon</td>
<td>20,275</td>
<td>17,785</td>
</tr>
<tr>
<td>Steelhead</td>
<td>144,804</td>
<td>93,100</td>
</tr>
<tr>
<td>Trout</td>
<td>152,143</td>
<td>267,075</td>
</tr>
<tr>
<td>Warm-water game fish</td>
<td>40,800</td>
<td>108,269</td>
</tr>
<tr>
<td>Nongame marine fish</td>
<td>44,592</td>
<td>173,879</td>
</tr>
<tr>
<td>Totals</td>
<td>717,961</td>
<td>891,566</td>
</tr>
</tbody>
</table>

\[1/\] Source: Calvin, Lyle D. and Thomas D. Burnett, "Survey of Angling Effort in Oregon in 1965".
Figure 1. Angler trips expended on all sport fish in the North Coast Basin in 1965.

The catch and angler effort expended on salmon and steelhead in the North Coast Basin is impressive (Tables 7, 8, and 9). Nearly one-half million fisherman days were spent in the basin on salmon and steelhead in 1965 (Figure 2).

Table 8. Salmon and steelhead sport catch in certain North Coast Basin streams in 1965 and 1966 1/

<table>
<thead>
<tr>
<th>Stream</th>
<th>1965 salmon</th>
<th>1965 steelhead</th>
<th>1966 salmon</th>
<th>1966 steelhead</th>
</tr>
</thead>
<tbody>
<tr>
<td>Columbia River 2/</td>
<td>42,728</td>
<td>14,400</td>
<td>40,057</td>
<td>22,199</td>
</tr>
<tr>
<td>Big Creek</td>
<td>445</td>
<td>1,993</td>
<td>983</td>
<td>5,082</td>
</tr>
<tr>
<td>Clatskanie</td>
<td>81</td>
<td>257</td>
<td>200</td>
<td>375</td>
</tr>
<tr>
<td>Gnat Creek</td>
<td>3/</td>
<td>219</td>
<td>4</td>
<td>502</td>
</tr>
<tr>
<td>Lewis &amp; Clark R.</td>
<td>42</td>
<td>242</td>
<td>30</td>
<td>285</td>
</tr>
<tr>
<td>Youngs River</td>
<td>15</td>
<td>16</td>
<td>51</td>
<td>21</td>
</tr>
<tr>
<td>Klaskanie</td>
<td>591</td>
<td>273</td>
<td>886</td>
<td>912</td>
</tr>
<tr>
<td>Kilchis River</td>
<td>169</td>
<td>300</td>
<td>592</td>
<td>703</td>
</tr>
<tr>
<td>Miami River</td>
<td>73</td>
<td>180</td>
<td>85</td>
<td>226</td>
</tr>
<tr>
<td>Necanicum River</td>
<td>257</td>
<td>703</td>
<td>196</td>
<td>821</td>
</tr>
<tr>
<td>Nehalem River</td>
<td>6,597</td>
<td>3,279</td>
<td>4,818</td>
<td>4,724</td>
</tr>
<tr>
<td>Salmonberry R.</td>
<td>34</td>
<td>85</td>
<td>12</td>
<td>174</td>
</tr>
<tr>
<td>Neskowin Creek</td>
<td>19</td>
<td>73</td>
<td>77</td>
<td>230</td>
</tr>
<tr>
<td>Nestucca River</td>
<td>3,825</td>
<td>7,058</td>
<td>4,218</td>
<td>12,507</td>
</tr>
<tr>
<td>Tillamook River</td>
<td>142</td>
<td>38</td>
<td>68</td>
<td>166</td>
</tr>
<tr>
<td>Trask River</td>
<td>2,769</td>
<td>2,665</td>
<td>3,232</td>
<td>4,230</td>
</tr>
<tr>
<td>Wilson River</td>
<td>1,306</td>
<td>11,128</td>
<td>1,781</td>
<td>17,887</td>
</tr>
<tr>
<td>Totals</td>
<td>59,093</td>
<td>42,909</td>
<td>57,290</td>
<td>71,044</td>
</tr>
<tr>
<td>Combined totals</td>
<td>102,002</td>
<td></td>
<td>128,334</td>
<td></td>
</tr>
</tbody>
</table>

1/ From Oregon State Game Commission salmon and steelhead punchcard records.
2/ Includes all river below Bonneville Dam.
3/ No catch reported.
<table>
<thead>
<tr>
<th>Year</th>
<th>Boat trips</th>
<th>Number of anglers</th>
<th>Number of chinook</th>
<th>Number of coho</th>
<th>Total salmon</th>
<th>Catch per angler trip</th>
<th>Period for which catch was estimated</th>
</tr>
</thead>
<tbody>
<tr>
<td>1946</td>
<td>14,900</td>
<td>40,400</td>
<td>23,400</td>
<td>2,600</td>
<td>26,000</td>
<td>0.64</td>
<td>8/24 - 9/7</td>
</tr>
<tr>
<td>1947</td>
<td>13,600</td>
<td>39,000</td>
<td>12,800</td>
<td>3,200</td>
<td>16,000</td>
<td>0.41</td>
<td>8/24 - 9/1</td>
</tr>
<tr>
<td>1948</td>
<td>15,600</td>
<td>47,500</td>
<td>12,000</td>
<td>3,000</td>
<td>15,000</td>
<td>0.32</td>
<td>8/24 - 9/5</td>
</tr>
<tr>
<td>1949</td>
<td>13,900</td>
<td>40,500</td>
<td>11,200</td>
<td>2,800</td>
<td>14,000</td>
<td>0.35</td>
<td>8/24 - 9/4</td>
</tr>
<tr>
<td>1950</td>
<td>15,000</td>
<td>40,000</td>
<td>16,600</td>
<td>2,300</td>
<td>18,900</td>
<td>0.47</td>
<td>8/24 - 9/2</td>
</tr>
<tr>
<td>1951</td>
<td>17,200</td>
<td>48,500</td>
<td>7,200</td>
<td>1,900</td>
<td>9,100</td>
<td>0.19</td>
<td>8/24 - 9/3</td>
</tr>
<tr>
<td>1952</td>
<td>11,800</td>
<td>34,000</td>
<td>11,000</td>
<td>4,000</td>
<td>15,000</td>
<td>0.44</td>
<td>8/24 - 9/1</td>
</tr>
<tr>
<td>1953</td>
<td>18,500</td>
<td>50,700</td>
<td>14,700</td>
<td>8,000</td>
<td>22,700</td>
<td>0.45</td>
<td>8/10 - 9/15</td>
</tr>
<tr>
<td>1954</td>
<td>15,700</td>
<td>55,000</td>
<td>12,500</td>
<td>16,000</td>
<td>28,500</td>
<td>0.52</td>
<td>8/1 - 9/15</td>
</tr>
<tr>
<td>1955</td>
<td>20,000</td>
<td>64,300</td>
<td>12,500</td>
<td>15,200</td>
<td>27,700</td>
<td>0.43</td>
<td>8/1 - 9/15</td>
</tr>
<tr>
<td>1956</td>
<td>20,000</td>
<td>78,000</td>
<td>34,000</td>
<td>50,000</td>
<td>84,000</td>
<td>1.08</td>
<td>8/1 - 9/15</td>
</tr>
<tr>
<td>1957</td>
<td>14,600</td>
<td>54,000</td>
<td>18,500</td>
<td>38,700</td>
<td>57,200</td>
<td>1.06</td>
<td>7/3 - 9/15</td>
</tr>
<tr>
<td>1958</td>
<td>19,000</td>
<td>66,000</td>
<td>25,000</td>
<td>39,600</td>
<td>64,600</td>
<td>0.98</td>
<td>6/1 - 9/15</td>
</tr>
<tr>
<td>1959</td>
<td>19,200</td>
<td>75,000</td>
<td>23,400</td>
<td>50,000</td>
<td>73,400</td>
<td>0.98</td>
<td>6/1 - 9/30</td>
</tr>
<tr>
<td>1960</td>
<td>21,000</td>
<td>78,000</td>
<td>37,700</td>
<td>34,600</td>
<td>72,300</td>
<td>0.93</td>
<td>6/30 - 9/30</td>
</tr>
<tr>
<td>1961</td>
<td>29,600</td>
<td>89,800</td>
<td>20,500</td>
<td>85,500</td>
<td>106,000</td>
<td>1.18</td>
<td>6/11 - 9/30</td>
</tr>
<tr>
<td>1962</td>
<td>30,500</td>
<td>116,400</td>
<td>29,900</td>
<td>118,900</td>
<td>148,800</td>
<td>1.28</td>
<td>6/7 - 9/15</td>
</tr>
<tr>
<td>1963</td>
<td>30,600</td>
<td>117,800</td>
<td>32,600</td>
<td>116,200</td>
<td>148,800</td>
<td>1.26</td>
<td>6/10 - 9/22</td>
</tr>
<tr>
<td>1964</td>
<td>27,800</td>
<td>113,100</td>
<td>28,100</td>
<td>134,100</td>
<td>162,200</td>
<td>1.43</td>
<td>6/15 - 9/20</td>
</tr>
<tr>
<td>1965</td>
<td>36,500</td>
<td>152,600</td>
<td>53,200</td>
<td>251,800</td>
<td>305,000</td>
<td>2.00</td>
<td>6/21 - 9/26</td>
</tr>
<tr>
<td>1966</td>
<td>41,400</td>
<td>163,900</td>
<td>71,400</td>
<td>187,800</td>
<td>259,200</td>
<td>1.58</td>
<td>6/1 - 9/30</td>
</tr>
</tbody>
</table>

1/ Fishery includes Columbia River downstream from Bonneville Dam and ocean fishery off the mouth of the Columbia River.

2/ Not included are an estimated 420 pink salmon in 1963, and 660 in 1965.
FIGURE 2. ANGLER TRIPS EXPENDED ON SALMON AND STEELHEAD IN THE NORTH COAST BASIN IN 1965. EXCLUDES NONRESIDENT ANGLING ON THE COLUMBIA RIVER.

The trout fishery of the North Coast Basin supported more than 150,000 angler days (Tables 7 and 10). Although not comparable to the basin's large salmon and steelhead fishery, there is potential for a sizable increase in the trout fishery if stream discharges are not excessively depleted and streamside habitat is left undisturbed.

Angling for warm-water game fish in the basin is relatively localized, but accounted for more than 40,000 angler days and 108,000 fish in the creel in 1965 (Tables 7 and 11). Most of the angler effort and catch takes place in the lower Columbia River sloughs.

Because of the variety and availability of nongame marine fish, they make an important contribution to the North Coast sport fisheries. These marine fish are caught by anglers in the bays and along the jetties and beaches. A survey of 1965 angler use tabulated nearly 45,000 angler trips expended to catch approximately 174,000 marine fish (Tables 7 and 12). In addition, many hours are spent in pursuit of Dungeness crabs and several species of clams. The Fish Commission of Oregon manages and regulates the harvest of these popular animals.
Table 10. Angler trips by month for trout in the North Coast Basin in 1965 

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>0</td>
<td>0</td>
<td>3,431</td>
<td>3,594</td>
<td>34,399</td>
<td>25,419</td>
<td>27,487</td>
<td>31,702</td>
<td>16,379</td>
<td>2,195</td>
<td>7,092</td>
<td>445</td>
<td>152,143</td>
</tr>
<tr>
<td>Percent</td>
<td>0</td>
<td>0</td>
<td>2</td>
<td>2</td>
<td>23</td>
<td>17</td>
<td>18</td>
<td>21</td>
<td>11</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

1/ Trout classification includes anadromous or sea-run cutthroat trout.


Table 11. Angler trips by month for warm-water game fish in the North Coast Basin in 1965 

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>0</td>
<td>0</td>
<td>1,345</td>
<td>886</td>
<td>5,807</td>
<td>9,909</td>
<td>7,256</td>
<td>546</td>
<td>15,051</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>40,800</td>
</tr>
<tr>
<td>Percent</td>
<td>0</td>
<td>0</td>
<td>3</td>
<td>2</td>
<td>14</td>
<td>25</td>
<td>18</td>
<td>1</td>
<td>37</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

1/ Source: Calvin, Lyle D. and Thomas D. Burnett, "Survey of Angling Effort in Oregon in 1965."
### Table 12. Angler trips by month for marine nongame fish in the North Coast Basin in 1965

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Number</td>
<td>879</td>
<td>0</td>
<td>6,864</td>
<td>1,352</td>
<td>14,298</td>
<td>4,052</td>
<td>6,784</td>
<td>7,140</td>
<td>3,193</td>
<td>30</td>
<td>0</td>
<td>0</td>
<td>44,592</td>
</tr>
<tr>
<td>Percent</td>
<td>2</td>
<td>0</td>
<td>16</td>
<td>3</td>
<td>32</td>
<td>9</td>
<td>15</td>
<td>16</td>
<td>7</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>100</td>
</tr>
</tbody>
</table>

1/ Lingcod, greenling, surfperch, rockfish, flounder and some other fish are considered as marine nongame fish.

2/ Source: Calvin, Lyle D. and Thomas D. Burnett, "Survey of Angling Effort in Oregon in 1965".
From a philosophical viewpoint, sportsmen and other conservationists place special emphasis on the aesthetic values relative to the fish resources of a region. Although little is probably known of the psychological benefits imparted to people by the presence of unspoiled streams and thriving fish populations, they do exist. Fishermen comprise a minority of the people who enjoy these psychological benefits; therefore, the pollution of a stream or the destruction of a fish population concerns not only anglers but a large segment of the public. In short, the annual three million dollar price estimated for the North Coast Basin steelhead and salmon fisheries might be conservative if they had to be replaced by resources of equal recreational and therapeutic value. If these fisheries were permitted to depreciate through the influence of pollution, stream flow depletions and careless watershed destruction, the cost of restoring the resource would exceed the cost of preventing the loss of stream habitat through proper management of water and watershed.

Commercial Fisheries

Commercial fish landings at Astoria, Nehalem, Tillamook, Netarts and Pacific City annually exceed 20,000,000 pounds (Table 13). Chinook and coho salmon landings in the North Coast between 1960 and 1964 annually averaged 651,000 pounds. Lesser catches of chum, pink and sockeye salmon and steelhead are also taken. The most significant fishery, that on bottom fish, harvests principally rockfish, flatfish and sablefish.

Salmon, steelhead, shad, smelt and sturgeon are caught with gill nets in the Columbia River. Salmon are also taken on troll in the ocean. Bottom fish are harvested the entire year, principally by otter trawl along the continental shelf and other coastal areas. Several techniques are employed to harvest the various species of shellfish.
Other than the lower Columbia River, Tillamook Bay is the only Oregon bay not closed to commercial fishing by legislative action. It is presently closed to commercial fishing by regulation, but may be opened at any time at the discretion of the Fish Commission.

Mainly because of the expanded fishery on bottom fish, made possible by new markets for these fish and modernized processing methods, commercial fisheries of the North Coast Basin have increased by about 17 percent during a recent 10-year period.

Table 13. Commercial fish landings of the North Coast Basin, 1960-64 1/

<table>
<thead>
<tr>
<th>Average landings, pounds</th>
<th>Bottom fish</th>
<th>Tuna</th>
<th>Crab</th>
<th>Shrimp</th>
<th>Coho</th>
<th>Chinook</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>17,985,000</td>
<td>4,639,000</td>
<td>1,657,000</td>
<td>649,000</td>
<td>523,000</td>
<td>128,000</td>
<td>25,581,000</td>
</tr>
<tr>
<td>Percent of average landings</td>
<td>70</td>
<td>18</td>
<td>6.5</td>
<td>3</td>
<td>2</td>
<td>0.5</td>
<td>100</td>
</tr>
<tr>
<td>Percent of average annual Oregon catch landed in North Coast Basin</td>
<td>62</td>
<td>72</td>
<td>29</td>
<td>24</td>
<td>22</td>
<td>12</td>
<td>--</td>
</tr>
</tbody>
</table>

1/ Substantial commercial landings of shad, smelt and sturgeon are also made. The 1964 Oregon landings of these species totaled 1,317,000 pounds.
Characteristics of North Coast Basin Streams

Water availability

Water supplies in the North Coast Basin are generally adequate for current fish and wildlife populations. Water shortages are typically limited to three months of the year (July, August, September). For more than six months each year flows in most streams exceed the level required for optimum utilization of spawning and rearing areas for fish production. Peak flows occur in December, January, and February.

Of the four principal river systems in the North Coast Basin, (Nehalem, Wilson, Trask, and Nestucca) the Nehalem drainage experiences the most critical water shortages during the summer (Figure 3). A comparison of mean summer (July-September) discharges per unit of drainage area reveals this point. For the summer period of 1965 the values were 0.16 cfs per square mile drainage area for the Nehalem River system, 0.58 for the Trask, 0.52 for the Wilson and 0.43 cfs per square mile for the Nestucca (Table 14). It was also the Nehalem River system where the adverse effects of low stream flows on fish life (See Appendix IV-Biological Requirements) were most evident. Conversely, the fish life in streams which discharge into Tillamook Bay are least troubled by inadequate summer minimum flows which may also partly explain why the spring chinook salmon are more successfully established in the Trask and Wilson River systems.
Figure 3. Nehalem River at river mile 91.0, discharge 1.7 cfs, August 9, 1966.
Table 14. Comparison of summer mean discharges of the Nehalem, Nestucca, Trask, and Wilson Rivers in 1965 with those of a prior duration 1/

<table>
<thead>
<tr>
<th>River</th>
<th>Gage location (river mile)</th>
<th>Drainage area (square miles)</th>
<th>Mean discharge (July-Sept) 1965</th>
<th>Mean discharge (July-Sept)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nehalem</td>
<td>13.5</td>
<td>667</td>
<td>108 cfs</td>
<td>197 cfs (1946-65)</td>
</tr>
<tr>
<td>Nestucca</td>
<td>13.5</td>
<td>180</td>
<td>76</td>
<td>2/</td>
</tr>
<tr>
<td>Trask</td>
<td>10.4</td>
<td>145</td>
<td>84</td>
<td>122 (1951-55)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td>(1961-65)</td>
</tr>
<tr>
<td>Wilson</td>
<td>9.4</td>
<td>161</td>
<td>84</td>
<td>141 (1946-65)</td>
</tr>
</tbody>
</table>

1/ Source: U.S. Geological Survey.
2/ Gage installed in 1964.

Anadromous fish in the Lower Columbia tributaries spawn about a month earlier than fish elsewhere in the basin and therefore encounter more difficulty in their early fall migrations. The 1949 legislative withdrawal of the Clatskanie River and its tributaries, Klaskanine River and its tributaries, Lewis and Clark River, and Big Creek from any future legal appropriations other than for fish life, was a significant step toward perpetuating runs in these streams. The protection of all existing unappropriated water during the late summer and early fall in the remaining Columbia Subbasin streams is likewise needed to maintain the present resource.

Withdrawals which create significant flow deficiencies during the natural low flow period include: A municipal diversion on the Upper South Fork Necanicum River, an industrial diversion on Coal Creek (Kilchis River tributary), municipal withdrawals on Youngs River and Lewis and Clark River, miscellaneous withdrawals on Beaver Creek (Columbia River tributary), and irrigation and municipal withdrawals in the Tillamook River system.
Figure 4. Nehalem River at river mile 20.0, typical low gradient, bedrock pool area where water temperatures frequently become excessive for fish life during the summer, August 1966.
Water quality

In general, the quality of water in North Coast Basin streams is excellent for fish production. Most water quality problems associated with fish life relate to domestic and industrial pollution, siltation, or temperature. Few incidences have been reported of fish kills resulting from either domestic or industrial effluents.

Silt in the streams results from either natural erosion or man-caused disturbances such as road construction and gravel removal. The addition of silt is most critical during periods of low flow because much of it may be deposited on gravel bars important for spawning and rearing of fish. The blanket of silt and sand has a smothering effect on fish eggs which incubate in the gravel. It is also harmful to aquatic insects which provide food for fish.

High water temperatures add another burden to fish life. Temperatures exceeding 65 F begin to have certain critical effects on fish. Foremost of these is an increase in the metabolic rate resulting in an increased need for dissolved oxygen. This condition is compounded by the decreased ability of water to hold dissolved oxygen as the temperature increases. Another significant effect is the more frequent occurrence of disease at higher temperatures. Under natural low flow conditions during the summer, many of the streams in the North Coast Basin exceed 65 F. In most streams, these high temperatures are only temporary and many fish can seek relief in the cooler tributaries; but in some, excessive water temperatures persist throughout much of the summer. Because of the proportionately lower summer flows in the Nehalem River system, water temperatures attain levels more critical to fish than in most other North Coast drainage systems (Figure 4). Water temperatures approaching 80 F have
been recorded in the Nehalem River (Appendix 3). Here and in most streams in the basin, any further flow depletions during the months of July, August, and September may result in increasingly higher stream temperatures with greater impacts on fish life.

**Barriers**

Barriers to fish passage, in the form of log jams, water falls, cascades and dams, preclude the use of large sections of many streams for fish production. The most common type of barrier is the log jam. The Oregon State Game Commission and Fish Commission of Oregon, with the financial assistance of certain other land management agencies, expend considerable time and revenue annually for removing jams. Most impassable log jams occur in the headwaters of a stream system where logging is most extensive. The combination of careless stream-side logging and high winter flows are responsible for the formation of most jams.

There are several falls in the basin which block anadromous fish from potentially productive stream areas (Table 15 and Figure 5). A few falls have been laddered or made passable where economically feasible.
Table 15. Status of falls and dams affecting anadromous fish

<table>
<thead>
<tr>
<th>Stream</th>
<th>Type of barrier</th>
<th>Location</th>
<th>Passage status</th>
</tr>
</thead>
<tbody>
<tr>
<td>Beaver Creek</td>
<td>Falls</td>
<td>River mile 4.8</td>
<td>Impassable</td>
</tr>
<tr>
<td>Lewis &amp; Clark River</td>
<td>&quot;</td>
<td>&quot; 21.5</td>
<td>&quot;</td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot; 16.5</td>
<td>Marginal</td>
</tr>
<tr>
<td>Carcuss Cr. (Clatskanie R) Falls</td>
<td></td>
<td>1-2 mi. above mouth</td>
<td>Impassable</td>
</tr>
<tr>
<td>Youngs River</td>
<td>&quot;</td>
<td>River mile 9.2</td>
<td>&quot;</td>
</tr>
<tr>
<td>S. Fk. Necanicum R.</td>
<td>Dam</td>
<td>&quot; 1.2</td>
<td>Marginal</td>
</tr>
<tr>
<td>N. Fk. Necanicum R.</td>
<td>&quot;</td>
<td>0.2 mi. above mouth</td>
<td>&quot;</td>
</tr>
<tr>
<td>W. Fk. Elk Cr. (Pacific) Falls</td>
<td></td>
<td>Approx. 1.0 mi above mouth</td>
<td>Impassable</td>
</tr>
<tr>
<td>W. Fk. Elk Cr. (Pacific)</td>
<td>&quot;</td>
<td>Approx. 0.5 mi. above mouth</td>
<td>&quot;</td>
</tr>
<tr>
<td>Miami River</td>
<td>&quot;</td>
<td>River mile 12.2</td>
<td>Marginal</td>
</tr>
<tr>
<td>Little N. Fk. Wilson R.</td>
<td>Steep gradient</td>
<td>&quot; 6.5</td>
<td>&quot;</td>
</tr>
<tr>
<td>Jordan Cr. (Wilson R.) Falls</td>
<td>&quot;</td>
<td>&quot; 6.0 (Approx)</td>
<td>Impassable</td>
</tr>
<tr>
<td>S. Fk. Wilson River</td>
<td>&quot;</td>
<td>&quot; 2.0</td>
<td>Marginal</td>
</tr>
<tr>
<td>Drift Cr. (Wilson R.)</td>
<td>&quot;</td>
<td>&quot; 0.3</td>
<td>Impassable</td>
</tr>
<tr>
<td>Trask R., Middle Fk.</td>
<td>&quot;</td>
<td>&quot; 2.0</td>
<td>&quot;</td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot; 3.0</td>
<td>&quot;</td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot; 3.8</td>
<td>&quot;</td>
</tr>
<tr>
<td>Bark Shanty Cr. (Trask R.)</td>
<td>&quot;</td>
<td>&quot; 1.2</td>
<td>&quot;</td>
</tr>
<tr>
<td>&quot;</td>
<td>&quot;</td>
<td>&quot; 2.7</td>
<td>Unknown</td>
</tr>
<tr>
<td>Munson Cr. (Tillamook R.)</td>
<td>&quot;</td>
<td>&quot; 2.3</td>
<td>Impassable</td>
</tr>
<tr>
<td>Three Rivers (Nestucca R.)</td>
<td>&quot;</td>
<td>&quot; 9.0</td>
<td>&quot;</td>
</tr>
<tr>
<td>Stream</td>
<td>Type of barrier</td>
<td>Location</td>
<td>Passage status</td>
</tr>
<tr>
<td>------------------------</td>
<td>-----------------</td>
<td>---------------------</td>
<td>------------------</td>
</tr>
<tr>
<td>Cedar Cr. (Nestucca R.)</td>
<td>Dam</td>
<td>River mile 0.3</td>
<td>Impassable 1/</td>
</tr>
<tr>
<td>Clarence Cr.</td>
<td>Falls</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Slick Rock Cr.</td>
<td></td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>(Nestucca R.)</td>
<td></td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Bible Cr. (Nestucca R.)</td>
<td></td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Testament Cr.</td>
<td></td>
<td>Unknown</td>
<td>&quot;</td>
</tr>
<tr>
<td>Elk Cr. (Nestucca R.)</td>
<td></td>
<td>River mile 2.8</td>
<td>Marginal</td>
</tr>
<tr>
<td>Nestucca R.</td>
<td></td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Steep gradient</td>
<td>Impassable</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Little Nestucca R.</td>
<td>Falls</td>
<td>&quot;</td>
<td>&quot;</td>
</tr>
<tr>
<td>Louie Cr. (L. Nestucca R.)</td>
<td></td>
<td>Unknown</td>
<td>Marginal</td>
</tr>
<tr>
<td>Sand Cr.</td>
<td></td>
<td>2.0 mi. above Andy Cr.</td>
<td>Impassable</td>
</tr>
<tr>
<td>Jackson Cr.</td>
<td>Steep gradient</td>
<td>River mile 1.3</td>
<td>&quot;</td>
</tr>
</tbody>
</table>

1/ The dam was made impassable to reduce the incidence of disease in water used at the fish hatchery downstream.
Fig. 5 Beaver Creek Falls at river mile 4.8 on Beaver Creek, tributary to Clatskanie Slough near Clatskanie, Oregon, August, 1966.
Fig. 6  Diversion dam and poorly constructed fish ladder near mouth of North Fork Necanicum River, August 1966. Approximately three quarters of flow was being diverted from stream.
Existing man-made dams in the basin are relatively minor (Figure 6); although some proposed structures would have a serious effect on fish and wildlife, if constructed. Some beaver dams create barriers to fish movement during medium and low flow periods, but most are removed by high water or are otherwise made passable.

Improperly installed road culverts or culverts altered by high water often create impassable or marginal passage conditions (Figures 7 and 8). After prolonged effort on the part of the fish and game departments, road construction agencies have become more cognizant of the importance of properly designed culverts suitable for fish passage, this problem is becoming less common.
Fig. 7 Culvert at the mouth of Killam Creek on the Tillamook River is poorly designed and impassable to fish at low flows, August 1966.
Fig. 8 Culvert at the mouth of Fawcet Creek on the Tillamook River, August 1966. High flows have eroded under bottom step making it impassable to fish at low flows.
Management and Research

To help maintain and perpetuate fishery resource of the North Coast Basin, conservation agencies have employed several professional fishery management and research biologists who devote all or part of their time to this effort. The Oregon State Game Commission maintains three full-time biologists, stationed at Tillamook, Seaside and Deer Island, whose responsibilities are to gather factual information concerning the area's game fish resources and their recreational uses.

The Fish Commission of Oregon conducts similar investigations on the basin's salmon, shellfish, and nongame marine fish.

The Research Division of the Oregon State Game Commission has been using the Wilson River as one of the key streams in its investigations of winter steelhead. An intensified program was performed to determine the size, age, and condition of fish and time of stocking that produce the best returns of hatchery reared stocks. These efforts have resulted in larger runs of steelhead and led to liberalized bag limits and extension of open waters available to the angler.

The Fish and Game Commissions operate six fish hatcheries in the basin. The Fish Commission manages four, which are located on Big Creek, North Fork Nehalem River, and Klaskanine River, each rearing salmon and steelhead, and one on Trask River, which rears salmon exclusively. The two Game Commission hatcheries on Gnat Creek and Cedar Creek raise salmon, steelhead, and trout. Fish reared at these facilities are stocked principally in the North Coast Basin.
STREAM FLOW STUDY

Studies designed to ascertain minimum stream flow requirements of fish in North Coast Basin streams were conducted during the summers of 1965 and 1966. The product of these studies are submitted in the form of minimum discharge recommendations by semi-monthly periods in Appendix I. The primary intent of the recommendations is to serve as a guide for protecting stream flows from excessive appropriation. These are designed to maintain and perpetuate native fish populations presently in the basin. Enhancement is not a consideration in these recommendations. If flows greater than the recommended minimums can be provided in any stream, such provision should be encouraged since it will benefit fish life.

Discharge measurements were used as one of the guides for determining flow regimens submitted in Appendix I. Discharge information was compiled during the study by Oregon State Game Commission's Basin Investigations personnel (Appendix II) and by U. S. Geological Survey stream gaging stations. A tabulation of the mean summer flows during the past 10 to 20 years indicates that 1965 summer stream flows were 60 to 70 percent of average (Table 14). U. S. Geological Survey gaging records for the summer of 1966 and the periodical measurements of the Oregon State Game Commission Survey Crew (Appendix II) indicate that the 1966 runoff was slightly higher than in 1965, though less than average.

Methods for determining the rates recommended in Appendix I were the same as those used in the nine basins studied previously. The recommended flows are based on the biological requirements of fish (Appendix V) and water availability or existing flows. Each recommended flow provides an average condition
over gravel bars that meets the minimum depth and velocity requirements of
fish.

Spring and fall chinook salmon are the largest salmonids in the basin, and thus have the greatest transportation and spawning flow requirements. Because summer steelhead and spring chinook salmon reside in streams during the summer prior to spawning, their dependency on minimum summer flows exceeds that of any of the other game fish in the basin. Stream flow requirements for spawning and passage of coho, chum, and pink salmon, and steelhead and sea-run cutthroat trout are similar (Appendix V). Seasonal stream flow requirements for all anadromous fish in the basin were developed from Figure 9 on spawning periodicity. Because natural selection has adjusted the life histories of fish to natural stream discharge patterns, recommendations developed in Appendix I are necessarily keyed to these patterns. Although nothing conclusive can be said of the relationship of the recommended flows with angling, the minimums submitted here are believed to be considerably below optimum for this purpose.
FIGURE 9. PERIODICITY CHART SHOWING WHEN ADULT ANADROMOUS FISH ARE PRESENT OR SPAWNING IN NORTH COAST BASIN STREAMS. DOTTED LINES INDICATE PRESENCE OF ADULTS IN THE STREAMS AND SOLID LINES INDICATE PERIODS OF HEAVIEST SPAWNING. SPAWNING BEGINS APPROXIMATELY ONE MONTH EARLIER IN COLUMBIA RIVER TRIBUTARIES.

<table>
<thead>
<tr>
<th></th>
<th>JULY</th>
<th>AUG.</th>
<th>SEPT.</th>
<th>OCT.</th>
<th>NOV.</th>
<th>DEC.</th>
<th>JAN.</th>
<th>FEB.</th>
<th>MAR.</th>
<th>APR.</th>
<th>MAY</th>
<th>JUNE</th>
</tr>
</thead>
<tbody>
<tr>
<td>PINK SALMON</td>
<td></td>
<td></td>
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<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>SPRING CHINOOK SALMON</td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
</tr>
<tr>
<td>FALL CHINOOK SALMON</td>
<td></td>
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<td></td>
<td></td>
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<tr>
<td>CHUM SALMON</td>
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<td></td>
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<td></td>
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<td></td>
</tr>
<tr>
<td>COHO SALMON</td>
<td></td>
<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CUTTHROAT TROUT</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>WINTER STEELHEAD</td>
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<td></td>
<td></td>
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<td></td>
<td></td>
<td></td>
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<td></td>
</tr>
<tr>
<td>SUMMER STEELHEAD</td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
GAME RESOURCES OF THE NORTH COAST BASIN

General

Because of the availability, distribution, and quality of Oregon's coastal fresh water supplies, wildlife numbers and distribution are not limited by water shortages as in some other parts of the state. Diversions, impoundments, and excessive consumptive use could cause local water shortages, particularly during late summer. Flooding of habitat by reservoirs and water pollution by domestic and industrial effluents are potential hazards to wildlife.

Among many management techniques regular index counts are made on most of the basin's game animals to evaluate population status and determine surpluses for hunting (Tables 17, 19, 20 and 21).

Big Game

More hunter-days are expended on black-tailed deer than any other game animal in the North Coast Basin (Table 16). The Tillamook Burn and extensive logging have made vast areas of the basin more productive for deer by removing the overstory and allowing the growth of forage plants. This has made the North Coast Basin one of the best areas in the state for black-tailed deer.

Table 16. Deer harvest, North Coast Basin

<table>
<thead>
<tr>
<th></th>
<th>1964</th>
<th>1965</th>
<th>1966</th>
<th>1967</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated no. of hunters</td>
<td>19,116</td>
<td>19,325</td>
<td>17,021</td>
<td>16,700</td>
</tr>
<tr>
<td>Estimated total deer kill</td>
<td>9,198</td>
<td>6,946</td>
<td>6,626</td>
<td>6,210</td>
</tr>
<tr>
<td>Estimated total hunter-days</td>
<td>110,130</td>
<td>104,139</td>
<td>97,203</td>
<td>87,730</td>
</tr>
</tbody>
</table>
Table 17. Black-tailed deer population trends

<table>
<thead>
<tr>
<th>Big game mgmt. unit</th>
<th>Sample route miles traveled</th>
<th>Deer observed per mile traveled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clatsop</td>
<td>106</td>
<td>2.4</td>
</tr>
<tr>
<td>Nestucca</td>
<td>92</td>
<td>1.5</td>
</tr>
<tr>
<td>Trask</td>
<td>111</td>
<td>3.4</td>
</tr>
<tr>
<td>Wilson</td>
<td>39</td>
<td>2.3</td>
</tr>
<tr>
<td>Weighted means</td>
<td>2.5</td>
<td>2.7</td>
</tr>
</tbody>
</table>

Roosevelt elk are relatively plentiful in the basin. The 1964 harvest exceeded 2,700 animals (Table 18), when 12,000 sportsmen, expending several times that many hunter-days, hunted elk in the basin. The habitat preference of elk is similar to deer, thus they too have benefited from the removal of dense forest canopy. Like the other important game species, their population dynamics are under constant surveillance by the biologists. Among other measures, population trend counts (Table 19) are made annually on elk. These indices of animal numbers are used to adjust the regulations governing their harvest.

Table 18. Elk harvest, North Coast Basin

<table>
<thead>
<tr>
<th>Estimated number of hunters</th>
<th>1964</th>
<th>1965</th>
<th>1966</th>
<th>1967</th>
</tr>
</thead>
<tbody>
<tr>
<td>Estimated total elk kill</td>
<td>2,728</td>
<td>1,806</td>
<td>1,456</td>
<td>1,493</td>
</tr>
</tbody>
</table>
Table 19. Roosevelt elk population trends

<table>
<thead>
<tr>
<th>Big game mgmt. unit</th>
<th>Sample route miles traveled</th>
<th>Elk observed per mile traveled</th>
</tr>
</thead>
<tbody>
<tr>
<td>Clatsop</td>
<td>47</td>
<td>10.6</td>
</tr>
<tr>
<td>Nestucca</td>
<td>20</td>
<td>0.5</td>
</tr>
<tr>
<td>Trask</td>
<td>27</td>
<td>2.3</td>
</tr>
<tr>
<td>Wilson</td>
<td>29</td>
<td>8.2</td>
</tr>
<tr>
<td>Weighted mean</td>
<td></td>
<td>6.6</td>
</tr>
</tbody>
</table>

Upland Game

Five species of upland game birds occupy the North Coast Basin. Two species, the band-tailed pigeon and mourning dove, are migratory. Resident game birds include the blue grouse, ruffed grouse, and mountain quail; all utilize forest habitat primarily. Production and population trend counts are taken each year on grouse and quail to help ascertain proper harvest regulations (Table 20). More hunting pressure is exerted on doves and pigeons than on grouse and quail.

Table 20. Grouse and mountain quail population trends, North Coast Basin

<table>
<thead>
<tr>
<th>Species</th>
<th>Miles traveled</th>
<th>Birds per mile</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue grouse</td>
<td>124</td>
<td>0.22</td>
</tr>
<tr>
<td>Ruffed grouse</td>
<td>124</td>
<td>0.06</td>
</tr>
<tr>
<td>Mountain quail</td>
<td>124</td>
<td>0.35</td>
</tr>
</tbody>
</table>

Waterfowl

Of the basin's wildlife, the 19 species of waterfowl which spend all or part of each year in this area are most dependent on water supplies. Water
shortages and pollution are the most important water related limitations affecting waterfowl. These are especially important to the birds, particularly ducks, during their fall and winter concentration (Table 21). Most water developments, unless for consumptive uses, do not create problems for waterfowl. Contrary to the interests of most wildlife, shallow impoundments, where they complement or enhance existing habitat, are beneficial to ducks, geese and certain other water birds. A few species, such as the wood duck, commonly nest in the basin. Major winter waterfowl concentration and hunting areas are on the lower Columbia River, Sand Lake, and Youngs, Nehalem, Tillamook and Netarts Bays.

Table 21. Annual winter waterfowl inventory, North Coast Basin

<table>
<thead>
<tr>
<th>Species</th>
<th>1963</th>
<th>1964</th>
<th>1965</th>
<th>1966</th>
<th>1967</th>
<th>Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mallard</td>
<td>350</td>
<td>593</td>
<td>2,781</td>
<td>528</td>
<td>1,131</td>
<td>1,077</td>
</tr>
<tr>
<td>American widgeon</td>
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<td>994</td>
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<td>820</td>
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<td>738</td>
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</table>

**Furbearers**

Beaver, muskrat, mink and otter are the four most valuable furbearers in the basin. Eight other species are commonly trapped (Table 22). Total annual revenue from the harvest of the basin's furbearers, based on green pelt value, ranges from nearly $16,000 to more than $23,000. Furbearers rely extensively on water for their existence. Proper water quantities, as well as quality, are important. Probably the most destructive water problems are floods and pollution, each condition capable of causing losses or driving the animals from a stream.
Table 22. Fur trapping, Clatsop, Columbia and Tillamook Counties 1/

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<th>1963-64</th>
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<td>2,263</td>
<td>2,512</td>
<td>1,727</td>
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<tr>
<td>Mink</td>
<td>320</td>
<td>2,659</td>
<td>269</td>
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<tr>
<td>Otter</td>
<td>57</td>
<td>1,191</td>
<td>59</td>
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<td>Raccoon</td>
<td>291</td>
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<td>Nutria</td>
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<td>Bobcat</td>
<td>26</td>
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<td>Oppossum</td>
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<td>70</td>
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<td>Fox</td>
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<td>7</td>
<td>0</td>
</tr>
<tr>
<td>Weasel</td>
<td>10</td>
<td>3</td>
<td>11</td>
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<td>Skunk</td>
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</table>

Totals    | 4,481   | $18,635 | 3,672   | $15,862 | 5,104   | $23,302 |

1/ These figures represent more than 90 percent of all licensed trapping in Clatsop, Columbia and Tillamook Counties. Some additional trapping took place by children under 14 years of age who were not required to obtain a license or file a report of their catch.
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  1961     North Coast Basin
APPENDIX
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* Part of recommended discharge regimen were extrapolated by correlating known discharge volumes with flow requirements of neighboring streams of similar size.
Appendix II. Miscellaneous flow and temperature measurements, North Coast Basin streams, 1965-1966

<table>
<thead>
<tr>
<th>Stream</th>
<th>Date</th>
<th>Time</th>
<th>Temp. °F.</th>
<th>Flow cfs</th>
<th>Location</th>
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<tr>
<td>Bear Cr.</td>
<td>6-10-65</td>
<td>11:30 AM</td>
<td>54</td>
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<td>11.1* 0.7 mi. above mouth</td>
<td></td>
</tr>
<tr>
<td></td>
<td>7-16-65</td>
<td>12:00 Noon</td>
<td>59</td>
<td>62</td>
<td>26*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>9-16-65</td>
<td>12:35 PM</td>
<td>53</td>
<td>63</td>
<td>2.5*</td>
<td></td>
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<tr>
<td></td>
<td>4-28-66</td>
<td>7:15 PM</td>
<td>53</td>
<td>52</td>
<td>13*</td>
<td></td>
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<tr>
<td></td>
<td>6-7-66</td>
<td>4:25 PM</td>
<td>57</td>
<td>61</td>
<td>9.3*</td>
<td></td>
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<tr>
<td></td>
<td>7-6-66</td>
<td>12:10 PM</td>
<td>57</td>
<td>59</td>
<td>6.8*</td>
<td></td>
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<tr>
<td></td>
<td>8-8-66</td>
<td>2:45 PM</td>
<td>64</td>
<td>70</td>
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<td>57</td>
<td>60</td>
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<tr>
<td></td>
<td>11-7-66</td>
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<td>45</td>
<td>-</td>
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<td>6-7-66</td>
<td>1:10 PM</td>
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<td>55</td>
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<td>11-7-66</td>
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<td>44</td>
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<td>32.0*</td>
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* Measured flow, others are estimated.
### Appendix II (continued)

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<th>Time</th>
<th>Temp. °F.</th>
<th>Flow cfs</th>
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<td>6-7-66</td>
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<td>0.3 mi. above mouth</td>
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<td>56</td>
<td>58</td>
<td>25*</td>
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<td>56</td>
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<td>7-16-65</td>
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<td>47</td>
<td>54</td>
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<td>58</td>
<td>59</td>
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<td>56</td>
<td>61</td>
<td>12.7*</td>
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<td>8-8-66</td>
<td>3:35 PM</td>
<td>66</td>
<td>73</td>
<td>5.2*</td>
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<td>58</td>
<td>64</td>
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### Appendix II (continued)

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<th>Flow cfs</th>
<th>Location</th>
<th>Remarks</th>
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<td>River mile 10.8</td>
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<td>58</td>
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<td>29*</td>
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<td>8-8-66</td>
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<td>70</td>
<td>72</td>
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<td>9-14-66</td>
<td>4:15 PM</td>
<td>61</td>
<td>64</td>
<td>6.5*</td>
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</tbody>
</table>

| Plympton Cr. | 6-10-65    | 12:30 PM  | 53              | 64            | 17.4*    | 0.3 mi. above mouth | Recent rain |
|              | 7-16-65    | 1:00 PM   | 61              | 64            | 6.4*     |                  |                 |
|              | 9-16-65    | 11:45 AM  | 51              | 61            | 6.3*     |                  |                 |
|              | 4-28-66    | 5:30 PM   | 49              | 54            | 17.6*    |                  |                 |
|              | 6-7-66     | 2:40 PM   | 54              | 58            | 14.6*    |                  |                 |
|              | 7-6-66     | 11:25 AM  | 53              | 60            | 10.6*    |                  |                 |
|              | 8-8-66     | 2:00 PM   | 59              | 70            | 4.6*     |                  |                 |
|              | 9-14-66    | 1:15 PM   | 54              | 60            | 4.7*     |                  |                 |
|              | 11-7-66    | 11:30 AM  | 44              | -             | 8.5*     |                  |                 |

| Young's R.   | 6-10-65    | 9:30 AM   | 57              | 60            | 35       | Mile 8.9, 0.1 mi. below Young's Falls | Recent rain |
|              | 7-16-65    | 10:45 AM  | 62              | 59            | 9.0*     |                  |                 |
|              | 8-26-65    | 6:00 AM   | 65              | 68            | 6.5*     |                  |                 |
|              | 9-16-65    | 2:20 PM   | 56              | 64            | 14.5*    |                  |                 |
|              | 4-29-66    | 9:30 AM   | 48              | 54            | 40*      |                  |                 |
|              | 6-7-66     | 5:55 PM   | 59              | 58            | 20.4*    |                  |                 |
|              | 7-6-66     | 1:20 PM   | 58              | 60            | 19.7*    |                  |                 |
|              | 8-8-66     | 4:00 PM   | 67              | 74            | 6.8*     |                  |                 |
|              | 9-14-66    | 3:50 PM   | 59              | 65            | 4.3*     |                  |                 |
### Appendix II (continued)

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<thead>
<tr>
<th>Stream</th>
<th>Date</th>
<th>Time</th>
<th>Temp. Water</th>
<th>Temp. Air</th>
<th>Flow cfs</th>
<th>Location</th>
<th>Remarks</th>
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<td>58</td>
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<td>1/4 mi. downstream from</td>
<td>1/4 mi. downstream from</td>
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<td>Mapes Creek</td>
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<td>6-17-65</td>
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<td>9-17-65</td>
<td>9:35 AM</td>
<td>51</td>
<td>46</td>
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<td>26.7*</td>
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<td>Mouth</td>
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Appendix II (continued)

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Recent rain

Intermittent flow in sections of lower 1.0 - 2.0 miles.
Dry in lower 1.1 mi.

Dry in lower 0.8 mi.
Coho juveniles seen at mile 1.0.
0.5 cfs between mouth & mile 0.4.
Dry in lower 1.0 mi.
many coho zeros seen.
Lowermost flow at mi. 1.0, estimated at 0.5 cfs.

Numerous coho salmon juveniles observed at mile 0.2.
Appendix II (continued)

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Recent rain
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Type of instrument: Recording thermometers.

Stream or impoundment: Necanicum River.

Dates covered: May 18-65 through October 26-65.

Location: One-half mile above tidewater at Necanicum Park on right bank.

Source: OSGC.
Appendix III (continued)

Type of instrument  Recording thermometers  Stream or impoundment  Necanicum River  Location  One-half mile above

tidewater at Necanicum Park on right bank  Dates covered  5-18-65 through 10-26-65  Source  OSGC

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Appendix III (continued)

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Remarks: Readings of the instrument were somewhat inconsistent with hand thermometer readings. Compensations were made but extreme accuracy is questionable (probably always within two degrees.)
Appendix III (continued)

Type of instrument: Minimum-maximum thermometer  Stream or impoundment: Nestucca River  Location: Two hundred yards above  Niagara Creek on left bank, river mile 29.7  Dates covered: 5-19-65 through 9-13-65  Source: OSGC

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Appendix III (continued)

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### Appendix III (continued)

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Note: Temp. inlet out of water or nearly out of water June 24-30, July 14-28, August 21 to September 30.

## Appendix IV. Monthly maximum, mean, and minimum water temperatures for years of record on some streams in the North Coast Basin

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1/ Temperature records furnished by spot observations and temperature correlation adjustments by U.S. Geological Survey and miscellaneous records of the Oregon State Game Commission. Data was compiled by the U.S. Department of the Interior, Geological Survey and recorded in their publication entitled "Compilation of Water-Temperature Data for Oregon Streams", 1964.
Appendix V. Biological requirements of fish

A stream must present certain physical characteristics and provide water of adequate quantity and quality in order to support a population of fish. The requirements for salmon and steelhead are reviewed in this appendix. Conditions suitable for these anadromous fish will also accommodate resident trout.

Habitat preferences

Species of fish differ in their requirements or preferences for habitat. Some are best adapted to riffles, while others use pools extensively. Since production of food organisms is highest in riffles, best production of fish is achieved with a balanced combination of riffles and pools. The gradient of a stream in combination with the flow governs the ratio between riffles and pools. In a reach of a given gradient, a discharge that creates a strong flowing riffle situation would not be suitable for a quiet-water fish. On the other hand, a small flow that reduces the stream to a series of pools, virtually eliminates habitat for the riffle dwellers. Therefore, consideration must be taken in each particular reach of stream so that stream flows will be maintained that provide habitat best suited for the species in question.

Spawning

Salmon and trout must have gravel for spawning. For salmon and steelhead, gravel should range between 1/4 inch and 6 inches in diameter with extremes in sizes being least desirable. Chinook salmon normally select slightly larger gravel than do coho and steelhead, while anadromous cutthroat and resident trout choose the smaller gravels. Gravel must be relatively free of sand and silt, and must not be seriously compacted. Excessive sand and silt create adverse conditions for eggs and fry in the gravel by causing low intragravel
flows which in turn result in decreased supplies of dissolved oxygen for respiration. Large amounts of fine material can also reduce survival of fry because it fills the gravel interstices thus blocking their emergence route out of the spawning bed. Adequate depth of gravel is necessary for construction of a redd or nest by the female fish. Chinook salmon dig slightly deeper reds than do the coho salmon and steelhead. Redd depths may vary from approximately 6 to 15 inches.

Salmon and steelhead require about two months to hatch and another month to emerge from the gravel after hatching. This is primarily controlled by the prevailing water temperatures. Suitable water temperatures for spawning range from about 42 to 55 F.

The dissolved oxygen requirement for egg survival in the gravel is higher (8 ppm) than for fish after hatching (5 ppm). To meet the greater demand of eggs, clean permeable gravel is required to insure adequate flow of intra-gravel water.

Biologists have made measurements at numerous reds of the three species concerned. From the results of these studies, water depth and velocity criteria have been determined for proper spawning conditions. Minimum water depth for chinook salmon spawning is 0.8 foot, while coho salmon and steelhead require at least 0.6 foot. Proper velocities for spawning by all three species range between 1.0 and 2.5 feet per second as measured 0.4 foot from the bottom.

Rearing

The most critical time in the fresh water life of young salmonids is the period of low flow during the summer. Depending on the species, up to 3 years is spent in fresh water before migrating to the ocean. To support the young
fish during this period, the stream must contain sufficient flow to provide food, shelter, and a suitable medium in which to live.

Food: Juvenile salmon and steelhead feed primarily on immature aquatic insects. Production of these organisms is confined almost entirely to riffle areas. The best producing riffles are those composed of large gravel or rubble. Clean, well-aerated water flowing over these areas is necessary for proper maintenance of these food forms.

Shelter: Shelter has been described as any place a fish will seek when frightened or disturbed. Such places may be found within riffles, but are usually associated with deeper pool areas. Shelter is necessary not only for fish to escape their enemies, but to avoid psychological stress.

Suitable medium: A suitable medium in which to live refers primarily to water quality requirements. Good rearing water is high in dissolved oxygen (above 5 ppm), with temperatures not exceeding 65 F for extended periods, low in turbidity, and not greatly acid or alkaline.

High water temperatures contribute to mortalities by simply exceeding the tolerances of salmonids. Water loses its capacity to hold dissolved oxygen as its temperature increases, yet the metabolic rate and resultant oxygen requirement of cold-blooded animals is greater at higher temperatures. In addition, water temperatures above the optimum for salmonids are often ideal for competing species of undesirable fish. The incidence of disease frequently increases with rising temperatures. Turbid waters generally cause greater damage to fish habitat than to fish themselves, primarily from the siltation of food-producing and spawning areas. Heavy silt loads, however, can injure the gills and other tender structures and
result in mortality. Water that is far from neutral, either acid or alkaline, interferes with the physiology of fish.

Adequate summer stream flows play a vital part in meeting each of the three basic rearing requirements. Without an adequate flow, any or all of the conditions may be seriously limited and result in a substantially decreased fish production.

**Passage**

By definition, anadromous fish migrate between the ocean and fresh water. To complete this cycle, the fish must have adequate stream flow for passage. As upstream migrants, adult salmon and steelhead require a portion of the stream cross-section to have sufficient depth so passage will not be impeded. Minimum depths of 0.8 foot for chinook, and 0.6 foot for coho and steelhead are recommended as desirable passage conditions. Abrupt reduction in stream flow exceeding 1 cfs may cause some retardation of upstream passage.

The juvenile fish in fresh water must have enough water for intra-stream movement during their rearing period; a minimum stream depth of 0.1 - 0.2 foot is required throughout the year. Flows adequate to insure good survival of juveniles on their seaward migration are greater than those required for intra-stream movement, but this is usually no problem because the downstream migration normally takes place during seasons of higher flows.
### Appendix VI. Oregon State Game Commission fish stocking in the North Coast Basin, 1961-65

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<tr>
<th>Stream system or lake</th>
<th>Species</th>
<th>Size</th>
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1/ Similar stocking rates were applied prior to 1961.

2/ Warm-water game fish liberations and adult salmon and steelhead transplants are not included.

3/ Species abbreviations: Ch, chinook salmon; Co, coho salmon; Ct, cutthroat trout; Rb, rainbow trout; St, steelhead trout.

4/ "F" - fry and/or fingerlings; "L" - yearling or legal sized.