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# PROCEEDINGS OF THE 1985 NORTHEAST PACIFIC PINK AND CHUM SALMON WORKSHOP

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Rapporteur:

Bruce G. Shepherd
Department of Fisheries and Oceans
1090 West Pender Street
Vancouver, British Columbia V6E 2P1

# DEVELOPMENT AND ASSESSMENT OF GROUNDWATER-FED SIDE CHANNELS

David E. Marshall

Fishery Biologist, Canada Department of Fisheries and Oceans

## Program To Date

Since 1978 our Small Projects Unit of the Salmonid Enhancement Program has undertaken a program to develop new spawning areas and upgrade existing spawning areas in groundwater-fed side channels. A total of approximately 42,000 $m^2$ of new and improved spawning habitat has been created at 11 project sites: 7 in the lower Fraser Valley, 3 on the Squamish River system and 1 on Vancouver Island. A conservative estimate of the potential annual adult production from these projects is 85,000 chum and an additional, but as yet unknown, number of coho. A list of projects is given in the following table:

| Project | River system | Year constructed | Estimated spawning area ($m^2$) Pre-development | Post-devel. |
|---|---|---|---|---|
| Hopedale Slough | Chilliwack/Vedder R. | 1978 | - | 1,120 |
| Barrett Creek | " " | 1978 | | 3,340 |
| Peach Creek | " " | 1982 | 1,320 | 2,600 |
| Worth Creek | Norrish Creek | 1979 | - | 850 |
| Railroad Creek | " " | 1979 | - | 770 |
| Billy Harris Slough | Harrison River | 1979 | - | 7,490 |
| Little Mountain Slough | " " | 1981 | - | 5,800 |
| Lower Paradise Channel | Squamish River | 1979 | - | 1,940 |
| Upper Paradise Channel | " " | 1982 | 1,350 | 2,625 |
| Judd Slough | " " | 1979 | Undetermined | 12,100 |
| Westholme Channel | Chemainus River | 1978 | - | 2,930 |

## Site Selection

Opportunities for carrying out side channel development projects are present on many medium-to-large sized rivers provided that river bench land where suitable site conditions prevail are comprised of porous gravel-type soils and there is an adequate supply of groundwater near the ground surface. Other basic site requirements are sufficient gradient in order to provide the necessary flow characteristics for the channel, reasonable protection from flooding, and some abundance of chum and coho that spawn in the vicinity of the proposed development site to ensure that the channel is well utilized from the start. Usually old fluvial channels that

have cut through bench land are selected for development sites rather than the adjacent bench land itself, perched at a higher elevation. This is a cost-saving factor aimed at reducing the quantity of material that must be excavated.

Channel Design

The work involved in developing a channel typically includes grading down the existing channel in order to intercept a larger portion of the subsurface groundwater flow, and lengthening and widening the channel to increase spawning area. This is followed by scarification of the native gravel or, alternatively, the addition of screened and washed spawning gravel. Large cobbles are sometimes recovered from the excavated material and used to armour the channel banks to prevent undermining by spawning fish. Quarry rock or rip-rap may be used in place of cobbles if a suitable rock source can be found nearby. At a number of sites low weirs, usually of timber construction, are installed at intervals along the length of the channel. The weirs serve to control the channel gradient and create the required minimum spawning depth of 10 - 12 inches. Finally, at projects where flood portection measures are needed, a spur dyke or dam is installed at the head of the channel. flood protection needs vary considerably between projects. Usually sites are selected for development that require a minimum of flood protection work.

Channel Assessment

Assessment of groundwater-fed side channel development projects from adult chum spawning through fry emergence is being carried out annually at Worth Creek and Upper Paradise channels. Results of the 1982-brood spawning, which are considered to represent near optimum spawning densities for chum salmon in these channels, are the following:

| Channel (Area) | No. Adults (No. Females) | Females per $m^2$ | Potential egg dep. | Fry Output | Fry per $m^2$ | Survival Rate |
|---|---|---|---|---|---|---|
| Worth Creek (850 $m^2$) | 1616 (615) | 0.7 | 1.8M | 0.39M | 458 | 21.6% |
| Upper Paradise (2625 $m^2$) | 5099 (1965) | 0.7 | 6.7M | 2.04M | 778 | 30.3% |

Capital Costs

Capital costs for developing Worth Creek and Upper Paradise channels were approximately $8,000 ($9.40 per $m^2$) and $22,000 ($8.40 per $m^2$) respectively. Screened and washed spawning gravel, rock armouring of the banks and timber weirs were provided at both sites.

Benefit Cost Analysis

A benefit/cost analysis of groundwater-fed side channel development projects was recently carried out as part of an overall assessment of the Small Projects Unit program by a team of consultants with expertise in biology, engineering and economics (Anon. 1983). The analysis covered all 11 channels completed to date

which are listed in the introductory table. The study team used the existing SEP Production Model which is the conventional tool used by SEP planners to evaluate potential SEP projects. Estimates of salmon production were based on an earlier study of production in groundwater-fed side channels (Lister et al, 1980) and other data and reports in SPU files. Estimates of costs were based on computerized records of SPU expenditures.

The approach used to quantify benefits and costs in the analysis included the following:

- Fish production levels resulting from the various channels were compared with those which would have occurred in the absence of the projects (i.e., only incremental production was considered).
- Costs were expanded to include the initial reconnaissance and feasibility studies, capital and administration costs (including wages) associated with developing the projects, and finally, maintenance, assessment and administration costs associated with future operations.
- For each channel, a life expectancy was determined based on estimated frequency of occurrence of damaging floods.

The main findings of the study team with regard to the groundwater-fed side channel development program included the following:

- "Economic analyses of spawning area developments indicates a favourable benefit/cost ratio of 1.7:1 overall, with individual projects ranging from 0.3:1 to 2.4:1."
- "Considering the (small) scale of spawning area developments and their comparability to natural areas in terms of spawner productivity, it is concluded that these projects will not add to stock manageability problems, i.e., adversely impact naturally-producing stocks. In this respect they must be considered superior to hatcheries as an enhancement technique for chum salmon."
- "The groundwater-fed spawning areas for chum salmon are a widely applicable technique which will find use not only for enhancement but also for mitigation of impacts from industrial development. The technique appears to be one of the few stream improvement approaches which can provide reasonable long-term benefits at a favourable benefit/cost ratio."

References

Anon. 1983. Evaluation of the Small Projects Unit Program - a component of the Salmonid Enhancement Program. Prepared for Department of Fisheries and Oceans, Vancouver, B. C. by D. B. Lister and Associates Ltd., D.P.A. Economic Consultants Ltd., Kerr Wood Leidal Associates Ltd. 88 p.

Lister, D. B., D.E. Marshall and D.G. Hickey. 1980. Chum salmon survival and production at seven improved groundwater-fed spawning areas. Fish. Mar. Serv. MS Rep. 1595: 58 p.