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RESULTS OF THE CHINOOK ASSESSMENT STUDY CONDUCTED ON THE KLINAKLINI RIVER DURING 1997

by

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ABSTRACT

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In 1997, the Biological Sciences Branch, Pacific Biological Station, conducted a study of chinook salmon (*Oncorhynchus tshawytscha*) productivity in the Klinaklini River. Major components of this study include: i) enumeration and distribution of spawners, ii) collection of biological and environmental information, and iii) evaluation of fishwheel as a stock assessment tool. A counting fence was constructed on Mussel Creek, a live mark-recapture study was conducted by tagging chinook at the fishwheel and recapturing fish at a fence on Mussel Creek, a radio telemetry study was conducted to determine spawner distribution, and a rotary screw trap was used to determine downstream migration of juveniles. Total return of adult chinook to the Klinaklini River was estimated to be 4,906 (95% CL: 3,791 - 6,021) in 1997. Spawner distribution within the watershed was determined to be 79% in Mussel Cr., 12% in Icy Cr., and 9% in Dice Cr. The majority of chinook spawners were aged as three and four year olds and approximately 60% of the chinook caught in the fishwheel were considered to be stream-type.

RÉSUMÉ

Nagtegaal, D. A., E. W. Carter, and D. C. Key. 1998. Results of the chinook assessment study conducted on the Klinaklini River during 1997. Can. Manuscr. Rep. Fish. Aquat. Sci. 2452: 59 p.

Au cours de 1997, la Station de biologie du Pacifique de la Division des sciences biologiques a effectué une étude sur la productivité du saumon quinnat (*Oncorhynchus tshawytscha*) dans la rivière Klinaklini. Les principaux éléments de cette étude étaient : i) dénombrement et répartition des géniteurs, ii) collecte de données biologiques et environnementales et iii) évaluation du filet rotatif comme outil d'évaluation des stocks. On a construit une barrière de dénombrement sur le ruisseau Mussel et on a effectué une étude de marquage-recapture en étiquetant des quinnats passant par le filet rotatif et en les recapturant à une barrière dans le ruisseau Mussel; on a aussi effectué une étude de radiopistage afin de déterminer la répartition des géniteurs. De plus, on a utilisé un piège à vis d'Archimède pour étudier la dévalaison des juvéniles. On a estimé la remonte totale des saumons quinnats adultes à la Klinaklini à 4 906 (95 %, LC 3 791-6 021) en 1997. On a établi que la répartition des géniteurs dans le bassin versant était la suivante : 79 % dans le ruisseau Mussel, 12 % dans le ruisseau Icy et 9 % dans le ruisseau Dice. La majorité des géniteurs étaient âgés de 3 et de 4 ans et on estimait qu'environ 60 % des quinnats capturés par le filet rotatif étaient de type dulcicole.

INTRODUCTION

Four Canadian stock groupings of chinook salmon (*Oncorhynchus tshawytscha*) are recognized in the Strait of Georgia. The differences between stocks are based on run timing of the spawning migration, ocean distribution of catch, and age at maturity of the stocks. Chinook from the Fraser River above Hope, B.C. are spring and summer migration chinook, and are far-north migrating chinook caught primarily in Alaska and northern B.C. The lower Fraser River chinook spawn predominantly in the Harrison River and are fall migrant, white-fleshed chinook. These fish are caught in the Strait of Georgia and off the west coast of Vancouver Island. The upper Strait of Georgia stock is also a fall migrant stock but is a far-north migrating stock and has older ages at maturity than the Harrison or lower Strait stocks. The lower Strait of Georgia stock is a late summer-fall migrant stock, which has a more restricted northward distribution, and is a younger maturing stock.

Considerable interest has been focussed towards the chinook stocks in the Strait of Georgia due to the perceived decline of these stocks and their importance to the local fisheries (Farlinger et al. 1990). In 1985, a chinook rebuilding plan was initiated through the Pacific Salmon Treaty between the United States and Canada (TCCHINOOK 87-4), that required both parties to stop the decline in escapements to naturally-spawning chinook stocks and attain escapement goals in selected lower Strait of Georgia chinook indicator stocks (Cowichan, Nanaimo, Squamish) and upper Strait of Georgia indicator stocks (Klinaklini, Kakweiken, Nimpkish, Wakeman, and Kingcome). Restoration of Pacific chinook salmon stocks to historical levels is one of the primary objectives of the Dept. of Fisheries and Oceans long term management plan. To that end, various "key streams" were also chosen for study (Robertson, Quinsam/Campbell, Kitsumkalem, Harrison, Big Qualicum) in order to represent the overall status of chinook bearing streams along the B. C. coast. These selected streams provide ongoing information to fisheries managers with respect to accurate estimates of escapement as well as estimates of the relative contribution of hatchery and naturally-reared production to these stocks.

DFO Fishery Officers have conducted spawner enumeration on the lower Klinaklini watershed (including Mussel Cr.) using overflights and stream walks since 1949. In recent years however, limited assessment has been done. Since the Klinaklini is glacial, the numbers of spawners were estimated from overflights of a few key clear water indicator sites on Mussel, Icy, Dice, and Jump Cr. tributaries (G. Savard pers com.). The Klinaklini system supports all five salmonids, steelhead and trout populations. It is believed that there are three chinook runs to the Klinaklini system based on migration timing (Berry 1991). As part of environmental impact assessments conducted by Interfor, Mike Berry[2] has collected and documented a considerable amount of anecdotal information concerning salmonid populations within the Klinaklini watershed.

[2] Alby Systems Ltd., P.O. Box 71, Alert Bay, B.C. V0N-1A0

In 1981, The Dept. of Fisheries and Oceans considered implementation of enhancement facilities, on selected watercourses in Knight Inlet, to increase salmonid production. Enhancement plans included a pink spawning channel at Glendale Creek, a chum/pink spawning channel on the Ahnuhati River, a chinook and coho satellite hatchery on Mussel Creek, juvenile chinook and coho outplanting to the Ahnuhati and Klinaklini Rivers, and coho outplanting to Tom Browne and Glendale Creeks. The DFO commissioned Aquatic Resources Ltd. in 1981 (Fielden and Slaney 1982) and E.V.S. Consultants in 1983 (Whelen and Morgan 1984) to conduct spawning studies and collect baseline information for pink, chum, sockeye, coho and chinook from these watercourses. Physical data, including water temperature, relative level and quality, population biological characteristics, and spawning habitat biophysical characteristics were also collected. Preliminary surveys of juvenile salmonid habitat utilization and evaluations of potential rearing area were completed on all study watercourses (Fielden et al. 1985).

A pilot enhancement facility on Mussel Cr. was built and in 1985 chinook and coho broodstock were collected. Approximately 265,000 chinook eggs were incubated of which 63% were released as coded-wire tagged fry and 24% as 4-5 g tagged smolts. For various reasons the facility was dismantled the following year. A total of five coded-wire tagged chinook were recovered from 1987-1989, three from Alaskan fisheries and two from northern sport and troll fisheries.

The purpose of this report is to present the results of the chinook stock assessment study conducted on the Klinaklini system in 1997. The objectives of this study include:

1. evaluate the suitability of using a fishwheel to index the abundance and timing of chinook returns to the Klinaklini system,
2. estimate total chinook escapement and spawner distribution,
3. collect biological data for this stock, and
4. record environmental information.

METHODOLOGY

STUDY AREA

Knight Inlet is a mainland inlet approximately 220 km north of Vancouver indenting the coast for 120 km (Fig. 1). The inlet is up to 530 m deep and averages approximately 3 km in width. It is bounded on both sides by mountains 1200 to 1800 m high.

Mussel Creek (gazetted as Devereux Creek) is one of several tributaries of the Klinaklini River which flows into the head of Knight Inlet (Fig. 2). The Klinaklini is a large glacial river that extends for over 160 km into the Chilcotin area. The confluence of the east and west Klinaklini is approximately 25 km upstream from the estuary; the west Klinaklini being a relatively short watercourse that is directly fed by the Klinaklini glacier, while the east passes through a canyon area and then up into the B.C. interior. Mussel Creek joins the Klinaklini River 8 km from the mouth. The creek drains an area of 74 km^2, is 19 km long and is passable to fish for approximately 17 km. Mussel Cr. is a relatively clear waterway that flows down a shallow valley which lies between the Waddington Range and Klinaklini R., is fed by five lakes and it's gradient is not very steep which makes it a fairly stable system and not prone to flash flooding as is typical of many coastal streams. The lower reaches of the creek are shallow and slow moving with several pools where salmon typically hold before moving upstream to the spawning grounds. Except for this lower section, the creek is quite overgrown and not very visible from overhead.

Much of the lower Klinaklini watershed has been logged but has since overgrown with a mixture of conifers and alder. Gravel roads run the full length of Mussel Creek and the lower Klinaklini R. and are maintained in excellent condition as they are the main lines for a logging operation.

International Forest Products operates a logging camp (Wahkash Contracting) along a side-channel of the Klinaklini River that is situated 2 km upstream from the estuary. The camp has a bunkhouse, several panabode homes, cookhouse, cummunication (satellite phone), and a large workshop repair facility. Access to the camp is by float plane from Campbell River.

FISHWHEEL

Design

The fishwheel design used on the Klinaklini system was similar to the fishwheels that have been used on the Yukon, Taku and Nass rivers in recent years (Milligan et al. 1985; McGregor et al. 1991; Link et al. 1993). There were several modifications made to adapt the standard three basket fishwheel design to meet the specific requirements for the Klinaklini glacial system. Table 1 contains a list of materials used and schematic diagrams of the unit are displayed in Figures 3 and 4.

A rotating three basket welded aluminum fishwheel design was used for the 1997 Klinaklini River chinook assessment. The fishwheel consisted of three basic components; platform, axle/basket assembly and the holding tanks. All welding was preformed with a MIG[3] process, utilizing a root pass and a cover pass procedure. During the survey period there were no failures of welds made by this procedure.

Platform

Resembling a catamaran, (Fig. 3) the two 9.4 m long pontoons each have a 11.8cm wide tread plate surface, supported by a 10.6 cm wide by 5.9 cm deep polystyrene foam floatation encased in 4.9 mm aluminum sheet. The bow (upstream) of the pontoons is tapered 45 degrees to allow water flow to pass easily (Fig. 4). Past experience with rotary screw trap pontoons utilizing

[3] Mixed Inert gas

a simple 45-degree slope proved minimal water resistance while being a cost effective construction method. During operation the fishwheel pontoons are attached to a solid object upstream utilizing 14.7 mm galvanized steel cables. Structural members used to hold the pontoons apart at the bow and stern double as crosswalks joining the port and starboard pontoons. They are each constructed of two 1.2 cm x 1.2 cm aluminum tubes covered with 7.9 cm wide tread plate surface. The crosswalks are bolted to the pontoons with four 1.5 cm x 1.9 cm plated bolts at each corner creating a rigid fishwheel platform.

Axle/Basket assembly

On the inside of each pontoon, near its middle is a 2.8 m tall mast constructed of two 1.2 cm "H" beams to hoist the fishwheel axle/basket assembly (Fig. 4). A 636 kg hand winch is mounted on each mast requiring two people cranking simultaneously to raise or lower the axle/basket assembly. The axle spans from mast to mast, and is made from a 3.5 m, 0.9 cm schedule 40 aluminum pipe. The fishwheel baskets connect to the axle by fitting into sockets made from 0.8 cm tubes 2.4 cm long welded in a row 0.59 m on centre along the length of the axle. As there are three baskets there are also three rows of sockets placed 120 degrees apart. Nylon (UHMW)[4] blocks mounted within each mast are the bearing surface that the axle rotates within. Each block is 4.7 cm square with a 1.2 cm hole in its' center to receive the axle. The fishwheel began operation with the aluminum axle wearing on the bearing block. Within the first month the axle had completely worn through and a field repair replaced the ends of the axle with mild steel pipe. The fishwheel operated smoothly during the remaining two months of the project. The Klinaklini River is extremely silt laden, which likely contributed to accelerated axle wear. Each fishwheel basket is 3.5 m wide and 3.5 m long. They are built with seven evenly spaced 4.9 mm schedule 40 aluminum pipe running the length of the basket. Each basket attaches to seven axle sockets at one end and is curved at the other end to form a scoop. The baskets are framed by a leading edge; intermediate cross member and axle cross member. The baskets are covered with a 0.8 cm knotless fishing net, soaked in water before installation to alleviate stretching and sagging during operation. Taught guy lines (9.8 mm galvanized cable) connected the leading edges of the baskets to each other to achieve rigidity of the three baskets.

Holding tanks

There are two live tanks; each attached to the outside of the port and starboard pontoons at their middle by means of a continuous hinge. Each live tank was originally built 0.6 m wide, 1.2 m deep, and 2.9 m long, made from 4.9 mm aluminum sheet with an expanded metal type grate that would slide vertically at each end. This design proved deficient in two areas. First, the square end of the live tank fell victim to an uprooted tree traveling downstream. The remedy was to fold the walls together forming a doubly thick 45-degree slope that deflected debris. In addition, triangular gussets were installed on the top of the tank to bolster its' lateral strength. Secondly, due to extreme silt conditions, there was considerable silt build up on the floor of the live tank in a short period of time. The solution was to drill a series of 5 cm holes through the

[4] Ultra High Molecular Weight Polyethylene

floor. Minor amounts of silt did build up by settling on the remaining flat surface between the holes but was not considered to be a problem.

Another problem encountered was the expanded metal gates. The expanded metal had a sharp edge that captured fish would cut their snout on as they looked for an escape. While the tanks were being modified in the field, gates 0.6 m by 1.2 m, made from 2.5 cm pipe were installed. One served as a rear gate, sliding vertically, the other was welded horizontally to the outside of the tank with the top of the gate at water level to allow fresh aerated water into the live tank. After the installation of the pipe gates, there were no further snout injuries reported. Recovery tanks were specifically designed and built to hold stressed adult chinook fish until they recovery sufficiently to be released with a radio transmitter. The recovery tanks are 0.6 m wide, 0.9 m deep and 2.3 m long made of 4.9 mm aluminum sheet. They are attached aft of the live tanks by means of a continuous hinge the same as the live tanks so all tanks can be swung from their vertical position to horizontal to facilitate transport of the fishwheel without disassembly. The bottoms of these tanks were also perforated with 5 cm holes.

<u>Safety features</u>

As a safety precaution, aluminum pipe handrails encircle the fishwheel platform on the outside and the inside. Without the handrails, personnel could have a tendency to "cut the corner" when walking around the fishwheel, possibly being injured by rotating baskets. Another dangerous point on the fishwheel is when the baskets pass the mast in a knife-like action. Handrails ensured that both areas were guarded. During this summer's survey there where no personal injuries as a result of the operation of the fishwheel.

<u>Installation</u>

The fishwheel was transported to Knight Inlet via a seine boat, transported 8 km on a logging road to the assembly beach. Once assembled it was easily pulled .5 km upstream with a boat using two 50 hp prop drive outboard motors. Using two 17.7 m x 0.9 cm galvanized cable bridles the fishwheel was attached to a double wrap basket hitch around the bridge pier on the deep side of the river. As the attachment point was near the edge of the river it was necessary to use a "stiff-leg" (a 6.4 cm schedule 40 x 5.9 m aluminum pipe) to position the fishwheel in the flow of the river. The stiff-leg was attached to the bow of the starboard pontoon with a type of ball and socket joint to allow movement. The shore end was jammed into large riprap and tied off for security. The fishwheel fished approximately 5.6 m off the shore in about 4.4 m of water. A 29.4 m fish lead (seine net) was secured from the stern of the starboard pontoon to the near shore to direct any fish travelling inshore towards the fishwheel.

OPERATION

The fishwheel was operated 24 hours per day for the duration of the study. Catch by species, biological data, water depth, flow rate, water clarity (secchi), temperature, and fishwheel RPM were processed twice a day (7 AM and 7PM) and recorded for each 12 hour period. Water depth was measured from a staff guage mounted on a concrete bridge support structure. Water Survey Canada has a remote discharge recorder at the fishwheel site that electronically monitored the water depth and discharge as well. All fish were counted and sampled by dipnetting the fish from the holding tanks, transferring each fish to a large cooler partially filled with water, processing the fish for biological information, and keeping the fish in a recovery tank for a short time prior to release.

CATCH AND EFFORT

Fishwheel catch per unit effort was measured as the catch per 12 hour period corresponding to a day and night period. Fishwheel rpm and water velocity were also recorded to determine the relationship between catchability and these two variables.

RADIO TELEMETRY

The radio-telemetry component of this study involved catching and radio tagging chinook at the fishwheel and tracking their movement using stationary receivers at remotes sites, on foot, by boat and aerial surveys, and tag recoveries at the fence site on Mussel Cr. (Fig. 2). Radio tags applied were LOTEK[•] model MCFT-3B coded aquatic transmitter. These tags have a continuous operational life of 247 days, are 16 mm in diameter and 51 mm in length, and weigh approximately 16 g. The frequency range of the tags was 149.380 to 149.460 Mhz set at .02 Mhz intervals. The radio tag receiver/datalogger used was a SRX 400 unit with W5 firmware and 135 dB signal sensitivity. Remote sites were powered by a 12 V deep cycle battery.

Radio tags were applied throughout most of the run. Each tag was inserted down the throat of the fish by means of a plastic prod with the antenna protruding from the corner of the mouth. Except for the potential of tag regurgitation, insertion of the transmitter into the stomach appears to be the best method of tag attachment, with minimum effect on swimming performance and behavior (Mellas and Haynes 1985). All tagging and recovery location information was compiled by tag code number, fish condition, size, sex, location and date. Processing of each fish generally took less than 30 seconds and all fish were in excellent condition at the time of release. Handling stress was minimal partially due to the fact that water temperature was only 7 degrees Celsius.

SECONDARY TAGGING

All chinook that were radio tagged at the fishwheel were also tagged with a Ketchum curl-lock sheep ear tag[5] for secondary external identification. In addition, a hole punch was made in the operculum to be used as a tag loss indicator. Fish that were recovered at the Mussel Cr. fence

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[•] LOTEK Engineering Inc., 115 Pony Drive, Newmarket, Ontario, Canada, L3Y-7B5.

[5] Ketchum Manufacturing Ltd., Ottawa, Ontario, Canada

or on the spawning ground could then be readily identified as a radio-tagged fish as well as providing an opportunity to measure the tag loss rate of the Ketchum tag.

TRACKING EFFORT AND TAG RECOVERY

Two stationary remote tracking sites were chosen to monitor upstream movement beyond the workable limits of this study. Remote tracking sites on the East and West Klinaklini were equipped with a receiver/datalogger and power source enclosed within a weatherproof metal box and attached to a mounted YAGI antenna via a coaxial cable. The mobile tracking unit, used to monitor the movement of tagged chinook from the estuary to the East and West Klinaklini confluence, included the same model receiver/datalogger enclosed in a backpack with a handheld 3 element YAGI antenna. This mobile tracking unit was either mounted on the jet boat for tracking along the mainstem Klinaklini or simply carried by hand when walking along access points on the main tributaries (Mussel Cr., Dice Cr., Icy Cr.). Biological sampling at the Mussel Cr. fence monitored all radio-tagged chinook and recorded tag number prior to re-release above the fence.

During all tracking, receivers were set at a gain of 64 which allowed for each of the four frequencies to be scanned for several seconds to record the information. Up to 10 different radio tag codes were recorded on the same frequency. If a signal was received the receiver decoded the signal, reported the tag code and signal strength and stored the data in internal memory. Data recorded from the stationary and mobile tracking units were automatically stored in internal memory. The stationary sites, providing continuous coverage of fish movement, were checked every three days, the information downloaded to a portable computer, and the batteries replaced. After each mobile tracking session, the data were downloaded to the laptop computer as well. The data stored for each signal received included the following information:

1. Julian date
2. Universal time
3. Channel number
4. Power level of signal strength
5. Antenna code
6. Tag code

After downloading, the information was then imported into an Excel spreadsheet, edited for spurious signals, and the location of the signal was then added to the data file. The information was sorted by tag code so that each encounter was recorded by date and location.

EFFICIENCY

A subsample of chinook, coho, chum and pink salmon caught in the fishwheel were tagged using the Ketchum curl-lock sheep ear tag and released approximately 0.5 km below the fishwheel. Recoveries at the fishwheel were recorded and tag recovery proportions used to estimate fishwheel efficiency.

BIOLOGICAL SAMPLING

All chinook salmon at the fishwheel were sampled for post-orbital hypural (POH) length, sex, fish condition, age, and DNA analysis. Fish condition was recorded as good fair or poor depending on external damage and overall health of the fish. Five scales per fish were collected for ageing purposes. DNA samples were collected by taking a hole punch from the operculum and storing it in 70% Ethanol. Samples were stored by week of capture and by collection site (fishwheel or Mussel Cr. fence) to determine whether any differences would be evident between the fish in the mainstem Klinaklini and Mussel Cr.

DNA samples were also collected from a subsample of chum and coho caught in the fishwheel. Post-orbital hypural length, sex, fish condition, and age were recorded for a subsample of coho, sockeye, pink and chum caught in the fishwheel.

MARK-RECAPTURE POPULATION ESTIMATE

A capture-recapture program involving live tagging of chinook at the fishwheel and subsequent recovery at the Mussel Cr. fence or on the spawning grounds was conducted according to techniques described by Schwartz et al. (1986). Adult chinook salmon escapement estimates were generated from the capture-recapture data using the Petersen model (Chapman modification) stratified by sex and river location (Ricker 1975).

MUSSEL CREEK FENCE

Installation and Operation

A resistance board weir similar in design to that described in Nagtegaal et al. (1994) was installed in Mussel Cr. just above the Klinaklini East main logging road (Fig. 2).

All fish that passed through the fence trap box were to be counted by species and tag information recorded.

Biological Sampling

Fish could be sampled by either dipnetting them out of the trap or by beach seining just below the fence. All fish were live sampled and processed prior to re-release above the fence All chinook were biosampled for POH length, sex, and tag number. A random subsample of chinook was sampled for age composition. All coho, pink, chum, and sockeye salmon were sampled for tag number only.

ROTARY SCREW TRAP

Installation and Operation

A 2.4 m rotary screw trap, similar in design to that described in Candy et al. (1996), was installed at a site just upstream of the fishwheel site (Fig. 2). The trap was to be operated continuously for the duration of the study.

Biological Sampling

All juveniles were to be counted by species, measured for fork-length and weight, and a subsample stored for further analysis.

RESULTS

FISHWHEEL

The fishwheel was in operation for the duration of the project between July 2 and Sept. 14, 1997, except for two periods of downtime due to technical difficulties (July 9-11; Aug. 3-4). Since there was virtually no movement of chinook at the beginning or the end of time the fishwheel was in operation, it is believed that the entire chinook run was monitored. A total of 430 chinook, 219 coho, 47 chum, 210 pink, 274 sockeye, and 6 steelhead were captured by the fishwheel (Table 2). In most cases, catch during daylight hours was twice as much as during the night (Table 3). During the early part of the season, there was some evidence of failed fish capture and this was actually observed on two occasions. Due to the rotational speed of the wheel and the height at which the wheel was raised, fish caught in the basket could not slide fast enough down the trough in the basket to the holding pen. Some scale loss was noted on the upright framework of the wheel indicating that fish had rubbed against the framework but had not slid into the holding tank. Some padding was wrapped around the framework and a small padded trough built to catch trapped fish as they slid from the basket to the holding tank. This improved the situation and no further failed fish captures were noted.

In most cases, fish captured were in excellent condition and very little, if any, injury was observed from the trapping process. There were several fish that had sustained injuries from seals, and this was evident due to parts of fins being bitten off. Seals were observed from the Mussel Cr. confluence to the estuary and regularly noted around the fishwheel. The incidence of fin damage on adult chinook at the fishwheel was 5.1%.

A total of 377 live chinook were sampled for age, size (post orbital-hypural length) and sex at the fishwheel. Approximately 49% of the fish sampled were adult males, 45% were females and 6% were jacks. Mean size of adult male chinook was 62.1 cm and female chinook was 67.9 cm (Table 4). Chinook caught in the fishwheel were identified as either 4 or 5 year olds with an age range of 2 to 6 years; four ocean-type and four stream-type age groups were sampled (Table 5). The age mode for females tended to be one year older that for males. Collectively, stream-type age groups comprised 46% of the aged samples and ocean-type accounted for 54%. Of particular note is that about 20% of the fish could only be given a marine age because the center of the scales were regenerate and too difficult to decifer. Fish were not sampled for flesh color, although in a previous study (Whelen and Morgan 1984) red chinook comprised 52% of the population.

Environmental information collected at the fishwheel is contained in Table 6. The discharge of the Klinaklini River was driven by two factors; precipitation and glacier melt. The Klinaklini River is fed by the large Klinaklini glacier located at the head of the west arm of the river. When the air temperature rose and melted the glacier or when a substantial amount of rain fell the water level and discharge increased proportionately. Annually, the highest discharge rates occur during the summer months and 1997 was a fairly typical year compared to the 30 yr. mean flows (Fig. 5). Due to the glacial nature of the mainstem Klinaklini, the water temperature and clarity remained relatively constant throughout the study. The cold water temperatures likely made the sampling and tagging process less stressful for the fish.

Catchability of the fishwheel relative to trap avoidance was considered to be optimal since water clarity was poor, due to the glacial nature of the river, and as a result trap avoidance was likely minimal. The mean secchi depth measured at the fishwheel was 20 cm, indicating how turbid the water was throughout the study. Fishwheel rotational speed was directly related to the flow rate of the river (Fig. 6). In turn, the rotational speed of the fishwheel had a considerable effect on catch and it was observed that the slower speed was more optimal than faster speed (Fig. 7). The rotational speed of the fishwheel could be partially contolled by raising or lowering the baskets within the limits of the upright framework. Optimal speed seemed to be around 1 to 1.5 rpm. During peak flows we had some difficulty slowing down the rotational speed to what was considered more optimal. Improved control could be attained by increasing the lower limits of the framework and lowering the axle below the water line, allowing the baskets to act as a self-braking mechanism.

Fishwheel efficiency was estimated in two ways. Some chinook, coho, pink and sockeye were tagged at the fishwheel, released 0.5 km below the wheel, and recoveries at the fishwheel recorded. A second group of chinook only were tagged and released at the fishwheel and subsequently recovered at the Mussel Cr. fence or other tributaries to the Klinaklini. Although sample size was less than desirable, indications are that efficiency for chinook salmon ranged from approximately 12% to 17% (Table 7). Recapture rate for coho was the lowest at only 1.4%.

RADIO TELEMETRY

Radio tags were placed in 39 chinook salmon in 1997. Tagging was conducted in July and August although 69% of the tags were applied from July 16 to July 29 (Table 8). All tagged fish were caught in the fishwheel and released in good condition. It was assumed that the stress of handling and processing fish was minimal since no tagged fish was recaptured at the fishwheel and no fish were observed to remain in a given area after being tagged.

Radio tracking in the Klinaklini R. was accomplished using jet boat surveys which allowed for good coverage of the mainstem from the estuary to just below the East and West Klinaklini confluence. Depending on water flow and depth, we were able to track the lower Dice Cr. and Icy Cr. sidechannels but were unable to cover more than the first 1 km. Access to the middle and upper reaches of Dice Cr. and Icy Cr. was accomplished from logging road bridge crossings. Tracking these tributaries via helicopter was attempted but with little success. Tracking on the lower Mussel Cr. below the fence was successfully accomplished on foot on a regular basis.

Radio telemetry work was terminated on Sept. 30, 1997, due to budget constraints. Although not all tags were tracked to their presumed final destination, 33 of the tags were recovered and their movement monitored while six fish were never located after initial tagging and release (Table 9). The fate of these six fish was unknown. We observed that fish tended to move considerable distances back and forth in the mainstem Klinaklini and some spent at least a month in the river prior to moving into the tributary in preparation for spawning. Approximately 79% of the tagged chinook ended up in Mussel Cr., 12% in Icy Cr. and 9% in Dice Cr. These spawner distribution estimates are within the range of historical escapement proportions based on visual estimates (Table 10).

There were some indications that chinook may migrate through the East Klinaklini canyon and into the upper river but the tracking receiver could not decipher the tag number. The tracking receiver scans all tag frequencies and deciphers tag codes within each frequency. When the signal cannot be deciphered, due to either noise interference or multiple signal overlap, a signal code of '255' is recorded. Towards the end of the study the remote tracking site on the East Klinaklini recorded several '255' codes. Unfortunately we were unable to determine what was the cause of the '255' signals and whether they represented a tagged fish or simply noise interference.

MUSSEL CR. FENCE

Fish movement through the fence on Mussel Cr. was infrequent. The trap at the fence was not monitored on a 24 hour basis. The fence was opened at various times during the day and night in an attempt to move fish through, but with little success, especially during the first part of the study (Table 11). Salmon tended to hold in the pools below the fence during July and August and showed little signs of wanting to move upstream until September. Towards the end of the study larger schools formed below the fence but still did not move upstream very quickly.

Water depth and temperature in Mussel Cr. fluctuated somewhat but the flow rate remained slow (< 0.2 m/sec) throughout the study (Table 11). Mean temperature was 16 degrees Celcius and the mean depth at the fence site was 0.5 m.

A beach seining operation was conducted in the pools below the fence and fish were sampled prior to re-release above the fence but not included in the daily fence count (Table 12).

In total 1729 adult chinook, 185 adult coho, 4 pink, 4 chum, and 12 sockeye were enumerated at the fence site (sum of fish counted through fence trap and fish sampled at the fence). Mean size of adult male chinook was 65.1 cm and female chinook was 70.9 cm (Table 13). Age composition of fish sampled in Mussel Cr. was comparable to the fishwheel sample (Table 14). The majority (76%) of chinook were aged as 4 and 5 year olds. Stream-type chinook comprised 63% of the sample and 37% were considered to be ocean-type.

ROTARY SCREW TRAP

The trap was operated continuously from July 14 - Sept. 3, 1997. A total of 574 chinook, chum, coho and sockeye fry, 40 chinook and coho smolts, and numerous sticklebacks and lamprey were caught in the trap (Table 15). The majority of downstream movement of juveniles likely occurs in the spring (Fielden and Slaney 1982) prior to the begining of this study. Although samples were limited, the mean length for chinook fry was 52.2 mm.

POPULATION ESTIMATE

Table 16 contains a summary of the live chinook tagging-recapture data by tagging period. A total of 352 adult chinook were tagged and released at the fishwheel site and 68 tagged fish recovered in Mussel Cr. Although some radio-tagged fish were recorded in both Icy and Dice Creeks, no Ketchum tagged fish were recovered since it was very difficult to recover any fish in these smaller tributaries. The Petersen population estimate for the whole system was based on the tag information from the fishwheel and the pooled recovery data from Mussel, Dice and Icy Creeks. The estimate for adult chinook was 4,906 with lower and upper 95% confidence limits of 3,791 and 6,021, respectively (Table 17).

<u>Potential biases</u>:

Some of the typical biases associated with mark-recapture studies (Ricker 1975) are listed below and were examined in some detail for the live mark-recapture data. To minimize bias, fish tagging and recovery occurred concurrently and was stratified by sex.

<u>1. Temporal bias</u>: Temporal bias in the tagging sample was examined by comparing mark incidence between periods in the recovery sample (Table 18). There were no significant differences in the mark incidence between periods ($P>0.05$; chi-square; Zar 1984) although the amount of tags applied had been reduced in the last week.

Recovery bias was examined by stratifying the application sample by period and comparing proportions recovered (Table 19). No significant differences were observed ($P>0.05$; chi-square) although tag recoveries had tappered off towards the end of the study.

<u>2. Fish size</u>: Size related bias in the application sample was examined by comparing the continuous post orbital-hypural length frequency distributions of tagged and untagged recoveries

at the Mussel Cr. fence site (Table 20). No significant differences were observed in males or females (P>0.05; Kolmogorov-Smirnov two sample test). Size related bias in the recovery sample was examined by comparing the continuous POH length frequency distributions of tagged (fishwheel) and recaptured (Mussel Cr. fence) chinook. Again no significant differences were observed in males or females (P>0.05).

3. Fish sex: Sex related bias in the application sample was examined by comparing the sex ratio of the tagged and untagged recoveries (Table 21). Bias in the recovery sample was examined by partitioning the application sample into recovered and non-recovered components and comparing the sex ratios in each. In both cases, no significant differences were found (P>0.05; chi-square).

4. Tag loss: To monitor tag loss, each chinook tagged with a Ketchum opercular tag was also given a hole punch in the operculum as a secondary tag. At the fishwheel and fence on Mussel Cr., all fish were examined for tags and hole punch. A total of 4 chinook were recaptured with a missing tag accounting for 1.1% of the total number of fish tagged. This tag loss rate was not considered to be significant.

DISCUSSION

USE OF FISHWHEEL AS A STOCK ASSESSMENT TOOL

The fishwheel was successful in capturing sufficient numbers of chinook to be used for tagging studies, biological sampling, and mark-recapture study for a population estimate. Virtually all fish captured were in excellent condition and incurred minimal stress due to the simplicity of the handling procedure and the cold water temperatures.

The success or failure of a fishwheel depends on several key factors. A project, jointly funded by the Ministry of Environment, Lands and Parks and the Fraser River Action Committee of the Department of Fisheries and Oceans, studied various fishwheel designs and attempted to collate available information on optimal working design and environment for fishwheel operation (Mikkelsen 1995a). A wide variety of issues were considered including maneuverability, floatation, safety features, mechanical advantage, efficiency, the site chosen, water depth, clarity and flow, rotational speed of baskets and the optimal number of baskets. Consideration of the following seven aspects were taken into account in this study; physical site, water flow, depth and clarity, number of baskets, basket rotational speed, and the use of a fish lead.

Selection of an appropriate site was integral to the success of the program. The position of the fishwheel had to meet several criteria. These included; a position close to the mouth of the Klinaklini where it could be assumed that all chinook spawning occurred above this point, shoreline topography that was amenable to proper positioning relative to the flow of the river and offered easy accessability, water depth that was slightly deeper than the sampling depth of the fishwheel, water velocity that remained within the range of operational capability of the fishwheel, and a position in the river that would provide some protection from downstream movement of large debris that could damage the fishwheel. Water depth, velocity, and shoreline features were recorded for several sites along the lower reaches of the Klinaklini R. and a suitable site just below the million dollar bridge (Fig. 2) was found that met all the above criteria.

Water clarity must also play a major role in the catching power of a fishwheel. It is understood that avoidance and reaction time to escape the fishwheel decreases as visibility decreases. Secchi depth measurements ranged from 16 to 24 cm indicating that visibility was very poor and as a result likely eliminating the possibility of fish avoidance.

Mikkelsen (1995a) plotted fishwheel efficiency against the number of baskets and determined that the a four basket fishwheel was twice as efficient as a two basket one. It was pointed out the relative gain in overall efficiency becomes less and less as you add more baskets. Our observations indicated that, especially at higher flows, the physical action of these moving baskets and the disturbance that is made churning through the water causes a noise factor that potentially could scare the fish away. In our situation, a three basket wheel provided a balance between optimal efficiency and minimal disturbance.

Fishwheel rotational speed was also compared with efficiency (Mikkelsen 1995a). Results showed that doubling the speed from 2 to 4 rpm does not double the efficiency but, depending on the water depth, may actually decrease efficiency. Indications were that rotational speed in the range of 2 - 3 rpm provided the best efficiency, and it was noted that visibility remained a key factor. The results from this study confirmed that rotational speed is linked to fishwheel efficiency. In our situation, we observed that optimal efficiency was attained at speeds between 0.5 - 1.5 rpm (Fig 7).

In a study designed to test the effect of fish leads on the efficiency of a fishwheel (Mikkelsen 1995b), preliminary results indicated that the addition of a lead increased catch efficiency. The fishwheel operated in the Kitselas Canyon on the Skeena River recorded catches of over 50 sockeye per day compared to 10 - 20 per day when no fish lead was attached. In this study, one lead was installed along the near shore for the entire operation. The assumption was that it would contribute in a positive way to the efficiency of the fishwheel. No comparisons were made without a fish lead.

Many of the aspects of fishwheel design and operation as explained above suggest that it could be a good in-river assessment tool. There are limitations, several as yet undetermined, that have significant impact on the effectiveness and efficiency of this tool, and it will take several more years of information to assess these limitations.

ESCAPEMENT

Chinook escapement for the whole Klinaklini system was estimated in two ways. Live mark-recapture data provided an estimate of 4,906 (95% confidence limits: 3,791-6,021). An examination of some of the common biases that may influence the estimate indicated that no significant problems existed. The results of the radio telemetry study provided an estimate of spawner distribution within the Klinaklini watershed. Based on this information, adult chinook escapement was estimated to be approximately 3,875 for Mussel Cr., 588 for Icy Cr. and 443 for Dice Cr. A second approach to estimating chinook escapement was accomplished by extrapolating fishwheel catch based on catch efficiency. Based on these catch efficiency data, an estimate of 3,440 adult chinook was determined for the whole Klinaklini system. No confidence limits were calculated. Since the estimate extrapolated from efficiency information was based on a limited amount of data, the level of confidence in the mark-recapture estimate was considered to be substantially greater. The Mussel Cr. fence data (1729 adult chinook) was considered to be a minimum estimate since the fence was removed when there were still more chinook holding below the fence.

The above escapement estimates are all greater than estimates in previous years based on aerial counts (Fig. 8). It is often difficult to make comparisons between visual estimation techniques and methods such as a counting fence or mark-recapture approach (Shardlow et al 1987). Based on helicopter flights during this season, the escapement estimate for chinook was considered to be lower than what the results of the fence or fishwheel would indicate. According to a comparison of population assessment methods for sockye salmon (Tschaplinski and Hyatt 1991), live Petersen mark-recapture estimates were considered to be the preferred technique and relatively free from sampling bias. Aerial counts seriously underestimated sockeye populations in all instances despite near-optimum viewing conditions. Viewing conditions on Mussel Cr. were relatively good for the lower section but virtually all the middle to upper sections of the creek were covered with a fairly dense canopy.

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LITERATURE CITED

Berry, M. 1991. Stream narrative of the Klinaklini River. Unpubl. Manuscript.

Candy, J.R., D.A. Nagtegaal, and B. Riddell. 1996. Preliminary report on juvenile chinook production in the Cowichan River during 1993 and 1994. Can. Manuscr. Rep. Fish. Aquat. Sci. 2354: 80 p.

Farlinger, S., N. Bourne, B. Riddell, D. Chalmers, and A. Tyler (Eds). 1990. Pacific stock assessment review committee (PSARC) annual report for 1989. Can. Manuscr. Rep. Fish. Aquat. Sci. 2064: 236 p.

Fielden, R., and T. Slaney. 1982. 1981 survey of salmonids spawning in selected streams of Knight Inlet, British, Columbia. Prepared for Dept. Fish. and Oceans by Aquatic Resources Ltd. 89 p.

Fielden, R., T. Slaney, and G.J. Birch. 1985. Knight Inlet juvenile salmonid reconnaissance. Prepared for Dept. Fish. and Oceans by Aquatic Resources Ltd. 210 p.

Koski, W.R., R.F. Alexander, and K.K. English. 1994. Distribution, timing, fate and numbers of chinook salmon returning to the Nass River watershed in 1993. Nishga'a Fisheries Report NF93-05, New Aiyansh, B.C.

Link, M.R., and K.K. English. 1994. The 1993 fishwheel project on the Nass River and an evaluation of fishwheels as an inseason management and stock assessment tool for the Nass River. Nishga'a Fisheries Report NF93-06, New Aiyansh, B.C.

Link, M.R., English, K.K., and R.C. Bocking. 1993. The 1992 fishwheel project on the NassRiver and an evaluation of fishwheels as an inseason management and stock assessment tool for the Nass River. Nishga'a Fisheries Report NF92-09, New Aiyansh, B.C.

Mellas, E.J., and J.M. Haynes. 1985. Swimming performance and behavior of rainbow trout (*Salmo gairderi*) and white perch (*Morone americana*): effects of attaching telemetry transmitters. J. Fish. Res. Board Can. 29: 1025-1033.

Mikkelsen, J. 1995. Development of fishwheels for use in British Columbia. Dept. of Mech.Eng., UBC, prepared for Ministry of Environment, Land and Parks and Dept. Fisheries and Oceans . 50 p.

Mikkelsen, J. 1995. Design and construction of a fish lead for a Kitselas Canyon fishwheel. Dept. of Mech. Eng., UBC, prepared for Ministry of Environment, Land and Parks and Kitselas Band Council. 13 p.

Milligan, P.A., W.O. Rublee, D.D. Cornett, and R.A.C. Johnston. 1986. The distribution and abundance of chum salmon (*Oncorhynchus keta*) in the upper Yukon River basin as determined by radio-tagging and spaghetti tagging program: 1982-1983. Can. Tech. Rep. Fish. Aquat. Sci. 1351: 89 p.

Nagtegaal, D.A., J. Candy, and B. Riddell. 1994. A preliminary report on the chinook productivity study conducted on the Cowichan River during 1990 and 1991. Can. Manuscr. Rep. Fish. Aquat. Sci. 2315: 84 p.

PSC (Pacific Salmon Commission). 1987. Joint chinook technical committee 1986 annual report. TCHINOOK (87)-4.

Ricker, W.E. 1975. Computation and interpretation of biological statistics of fish populations. Bull. Fish. Res. Board Can. 191: 382 p.

Schwartz, C.J., R.E. Bailey, J.R. Irvine, and F.C. Dalziel. 1993. Estimating salmon escapement using capture-recapture methods. Can. J. Fish. Aquat. Sci. 50: 1181-1197.

Shardlow, T., R. Hilborn, and D. Lightly. 1987. Components analysis of instream escapement methods for Pacific salmon (*Oncorhynchus spp.*). Can. J. Fish. Aquat. Sci. 44: 1031-1037.

Tschaplinski, P.J., and K.D.Hyatt. 1991. A comparison of population assessment methods employed to estimate the abundance of Sockeye salmon (*Oncorhynchus nerka*) returning to Henderson Lake, Vancouver Island during 1989. Can. Tech. Rep. Fish. Aquat. Sci. 1798: 101 p.

Whelen, M.A., and J.D. Morgen. 1984. 1983 spawning salmonid studies in selected watercourses of Knight Inlet, British, Columbia. Prepared for Dept. Fish. and Oceans by EVS Consultants Ltd. 172 p.

Zar, J. 1984. Biostatistical analysis. Prentice-Hall Inc., Englewood Cliffs, New Jersey. 718 p.

Table 1. Materials list for construction of the fishwheel.

Pontoons:
5 – 1/8" x 5' x 12' 5052 aluminum sheet
4 – 1/8" x 5' x 16' 3002 aluminum tread sheet
1 – 3/8" x 3" x 20' aluminum flat bar

Mast:
2 – 3" x 20' I Beam aluminum
¼ sheet - 1/8"x 4' x 8' 5052 aluminum sheet
¼ length – 3/8" x 3' x 20' aluminum flat bar
2 – 1400 lb. boat trailer winches
50' ¼" galvanized cable
2 – 2" double pulleys
1 – 2" single pulleys
4 – ¼" cable clamps
8 – 1 ½" x 6" x 12" Nylon Blocks (UHMW)

Crosswalks:
4 – 1/8" x 3" x 3" x 20' aluminum tubing
1 – 1/8" x 4' x 12' 5052 aluminum sheet

Handrails:
500' – 1 ¼" schedule 40 6063 aluminum pipe
100' – 1 ¼" schedule 40 6061 aluminum pipe

Axle:
1 - 1 - 2" x 20' 6061 aluminum tubing
¼ - 2" x 20' schedule 40 steel pipe
¼ - 2 ½" x 20' schedule 40 steel pipe
4 - 2 15/16" locking collars
1 - 3/8" x 3' x 20' aluminum flat bar
4 - 3/8" x 6" NC plated bolts c/w locking nuts

Baskets:
27 - 1 ¼" schedule 40 6061 aluminum pipe
100' - 3/8" galvanized cable
25 - 3/8" cable clamps
6 - 3/8" x 6" turnbuckles
6 - 5/16" shackles
15 – 3/8" x 4" NC plated bolts c/w locking nuts

Slides:
3 sheets - 1/8"x 4' x 8' 5052 aluminum sheet
30 – ¼" NC plated bolts c/w locking nuts and flat washers

Table 1 (cont.)

Stiff-leg:
1 - 2 ½" x 20' schedule 40 6061 aluminum pipe

Live tanks:
4 - 1/8" x 5' x 10' 5052 aluminum sheet
3 - 1/4" x 2' x 20' aluminum flat bar
5 - ¾" x 20' schedule 40 6061 aluminum pipe
1 - 5/8" x 20' steel rod

Recovery tanks:
4 - 1/8" x 4' x 8' 5052 aluminum sheet
3 - 1/4" x 2' x 20' aluminum flat bar
5 - ¾" x 20' schedule 40 6061 aluminum pipe
1 - 5/8" x 20' steel rod

Table 2. Daily fishwheel counts, Klinaklini River, 1997.

Date (DDMM)	Depth (cm.)	Temp. (Deg.C)	Chinook Adult	Chinook Jack	Coho Adult	Coho Jack	Chum	Pink	Sock
0207	0	7	0	0	0	0	0	0	2
0307	0	7	0	0	0	0	0	1	4
0407	530	7	3	0	0	0	0	0	2
0507	546	7	1	0	0	0	0	0	2
0607	561	7	0	0	0	0	0	0	0
0707	556	7	2	0	0	0	0	0	0
1207	545	7	1	0	0	0	0	0	1
1307	547	7	2	0	0	0	0	0	0
1407	557	7	3	0	0	0	0	0	2
1507	568	7	4	0	0	0	0	0	1
1607	559	7	9	0	0	0	0	0	4
1707	550	7	12	0	0	0	0	0	2
1807	547	7	14	1	0	0	1	0	2
1907	540	7	18	1	0	0	0	0	5
2007	563	7	4	0	0	0	0	1	2
2107	564	6	2	0	0	0	0	0	1
2207	565	6	13	0	0	0	0	0	2
2307	558	6	8	3	0	0	0	0	1
2407	538	5	8	3	0	0	2	0	6
2507	520	5	16	3	1	0	3	0	4
2607	518	5	16	7	0	0	1	1	10
2707	516	5	17	0	2	1	1	4	10
2807	526	5	20	1	4	1	1	2	8
2907	539	6	25	0	1	0	3	0	2
3007	542	6	18	0	0	0	3	2	7
3107	528	6	7	2	0	0	0	3	2
0108	510	5	17	1	1	0	1	1	5
0208	510	6	20	0	2	0	0	5	9
0308	518	6	4	0	0	0	0	0	1
0408	547	6	5	0	0	0	0	1	4
0508	554	6	21	0	4	0	0	1	3
0608	567	6	12	0	1	0	0	0	3
0708	560	6	18	1	3	0	1	0	2
0808	542	6	12	0	4	0	0	1	6
0908	540	5	9	5	3	1	0	2	1
1008	540	5	8	1	5	1	0	1	3
1108	550	6	3	0	0	1	0	0	5
1208	567	7	2	0	1	0	0	0	1
1308	580	7	8	2	4	0	0	2	16
1408	590	6	2	0	1	0	0	0	1

Table 2 (cont.)

Date (DDMM)	Depth (cm.)	Temp. (Deg.C)	Chinook Adult	Chinook Jack	Coho Adult	Coho Jack	Chum	Pink	Sock
1508	595	7	5	0	1	1	0	1	0
1608	580	6	2	0	2	1	0	0	3
1708	560	6	1	3	7	0	0	1	2
1808	548	6	5	1	4	1	0	2	2
1908	542	7	8	1	6	1	1	1	7
2008	539	6	7	0	6	1	2	7	3
2108	545	6	4	0	2	0	0	1	5
2208	540	5	6	2	6	1	1	3	6
2308	539	5	6	0	9	0	0	5	3
2408	540	7	4	0	4	0	0	3	0
2508	547	6	0	0	1	1	0	0	3
2608	550	6	4	0	5	0	0	1	2
2708	561	4	0	0	1	0	0	1	13
2808	535	4	0	1	2	0	0	2	15
2908	517	4	0	2	6	0	0	8	7
3008	500	4	5	1	10	3	0	16	10
3108	499	4	3	0	9	1	4	17	8
0109	500	4	1	0	4	1	0	11	1
0209	508	4	3	0	7	1	4	20	2
0309	500	4	0	0	12	1	3	11	9
0409	503	4	0	0	11	1	3	21	3
0509	510	5	1	0	13	3	7	8	7
0609	490	4	0	0	14	3	1	14	4
0709	477	4	0	0	9	5	0	3	6
0809	480	6	0	0	9	5	0	13	3
0909	500	6	0	0	8	0	0	4	3
1009	490	6	0	0	1	0	3	1	4
1109	480	6	1	0	8	0	0	4	1
1209	470	6	0	0	1	0	0	2	0
1309	457	6	0	0	3	0	1	1	1
1409	460	6	0	0	1	0	0	0	0
Total:			430	42	219	36	47	210	274

Table 3. Daytime and nighttime fishwheel catches by species[1], 1997

Day Catches

Date	Start	Finish	CN	JX	CO	JX	CH	PK	SK	ST
050797	0700	1900	1						2	
220897	0700	1830	3	2	3		1	2	3	
040797	0700	1900	1							
170797	0700	1900	11						1	
180797	0700	1900	14	1					1	1
070797	0700	1900	2							
140897	0700	1830	2		1				1	
250797	0700	1900	15	2			1		3	
160897	0700	1830	2		2	1				
230797	0700	1900	8	3					1	1
030797	0700	1930						1	2	3
310797	0700	1900	5	2				3	2	
260797	0700	1600	9	3			1	1	5	
270797	0700	1630	7		1	1		2	2	1
130897	0700	1830	4	1	2			1	8	
050897	0700	1900	14		2			1	3	
060797	0700	1900	0							
020797	0700	1900							2	1
190797	0700	1900	8	1					2	1
240797	0700	1900	7	3			2		6	
210797	0700	1900	2							
150897	0700	1830	5		1	1		1		
220797	0700	1900	7						2	
300797	0700	1900	14				3	1	6	1
010897	0730	1900	12	1	1			1	3	
150797	0730	1900	3							
100897	0730	2000	5	1	5	1		1	3	
160797	0730	1900	6						3	
200797	0730	1930	2					1	2	
020897	0730	1900	13		2			2	3	
090897	0730	1930	8	4	3	1		2	1	
130797	0730	1900	1							
140797	0730	1900	2							
060897	0800	1900	9						2	
280797	0800	1900	14	1	4	1	1	2	5	1
290797	0800	1900	17		1		1		2	2
080997	0800	1600	0	0	9	5		13	4	
230897	0800	1930	3		8			5	5	
240897	0830	1930	4		4			3	3	
070897	0830	1900	17	1	3				2	
Sum:			257	26	52	11	10	43	90	12
Ave:			6.76	1.7	3.05	1.5	1.42	2.38	2.90	1.33

Table 3 (cont.)

Night Catches

Date	Start	Finish	CN	JX	CO	JX	CH	PK	SK	ST
220897	1600	0700	3		3	1		1	2	
230897	1830	0800	3		1				1	
150797	1900	0730	1						1	
010897	1900	0730	5				1		2	
050897	1900	0700	7		2					
250797	1900	0700	1	1	1		2		1	
070797	1900	0700	0							
300797	1900	0700	4					1	1	
090897	1900	0730	1	1						
180797	1900	0700					1		1	
070897	1900	0830	1				1			
020897	1900	0730	7					3	6	
220797	1900	0700	6							
030797	1900	0700							2	
200797	1900	0730	2							
230797	1900	0700	0							
060897	1900	0800	3		1				1	
210797	1900	0700							1	
040797	1900	0700	2						2	1
240797	1900	0700	1							
030897	1900	0800	4						1	
080897	1900	1030	6						1	
190797	1900	0700	10						3	
160797	1900	0730	3						1	
260797	1900	0700	2	1					3	
310797	1900	0700	2							
290797	1900	0800	8				2			
170797	1900	0700	1						1	
140797	1900	0730	1						2	
050797	1900	0700								
060797	1900	0700	0							
020797	1900	0700								
100897	1930	0730	3							
250897	1930	0730			1	1				
270797	1930	0700	3				1	1	5	
240897	1930	0830	0	0	0	0	0	0	0	
280797	2000	0800	6						3	
130797	2000	0730	1							
Sum:			97	3	9	2	8	6	41	1
Ave:			3.03	0.7	1.28	0.6	1.14	1.2	1.86	1

[1] Species designation:
CN: chinook, JX: jacks, CO: coho, CH: chum, PK: pink, SK: sockeye, ST: steelhead.

Table 4. Length-frequency of chinook sampled at the fishwheel, Klinaklini R., 1997

Length (cm)	Males	Jacks	Females
29	0	2	0
30	0	1	0
31	0	0	0
32	0	3	0
33	0	2	0
34	0	5	0
35	0	2	0
36	0	1	0
37	0	2	0
38	0	2	0
39	0	0	0
40	0	1	0
41	0	1	1
42	0	2	0
43	0	0	0
44	0	0	0
45	3	0	0
46	2	0	0
47	1	0	0
48	2	1	0
49	1	0	1
50	5	0	0
51	7	0	1
52	5	0	2
53	10	0	4
54	6	0	2
55	8	0	4
56	15	0	4
57	3	0	4
58	5	0	2
59	10	0	2
60	7	0	3
61	5	0	3
62	7	0	5
63	4	0	3
64	7	0	6
65	4	0	7
66	13	0	9
67	4	0	10
68	6	0	8
69	2	0	11
70	8	0	13
71	5	0	6
72	5	0	10

Table 4 (cont.)

Length (cm)	Males	Jacks	Females
73	1	0	8
74	4	0	7
75	1	0	5
76	3	0	2
77	3	0	8
78	3	0	2
79	3	0	2
80	2	0	4
81	3	0	3
82	0	0	2
83	1	0	1
84	0	0	1
85	1	0	0
86	0	0	0
87	0	0	0
88	0	0	1
Total:	185	25	167
Mean Length:	62.1	35.6	67.9

Table 5. Age-frequency of chinook sampled at the fishwheel, Klinaklini R., 1997.

Age[6]	Males	Females	Total
0.1	1	0	1
0.2	18	7	25
0.3	16	28	44
0.4	2	7	9
1.1	12	0	12
1.2	26	14	40
1.3	8	27	35
1.4	1	4	5
Total:	84	87	171

Total number of regenerate scales read: 47

[6] European age notation.

Table 6. Environmental data collected at the fishwheel site, Klinaklini R., 1997.

DATE	TIME	DEPTH GUAGE (cm)	SECCHI DEPTH (cm)	FLOW START	FLOW END	FLOW RATE (mps)	TIME FOR 5 REVS (sec)	RPM
03-Jul-97	6:30	535		287820	297704	0.885376659		1.81
04-Jul-97	7:00	530	20.3	953360	962126	0.785229845	171	1.75
05-Jul-97	7:00	546	20.5	963110	973881	0.964831241	146	2.05
06-Jul-97	7:00	561	20.5	317250	328299	0.98973358	131	2.29
07-Jul-97	7:00	556	20.5	984980	993490	0.762298196	142	2.11
08-Jul-97	7:00	581	19.5	906849	918533	1.04661482	130	2.31
13-Jul-97	7:30	547	20.5	364006	373968	0.892363646	157	1.91
14-Jul-97	7:30	557	19.0	373970	384800	0.97011627	149	2.01
15-Jul-97	7:30	568	19.0	384812	395879	0.991345961	140	2.14
16-Jul-97	7:30	559	19.5	404915	415537	0.951484305	144	2.08
17-Jul-97	7:00	550	20.5	425745	435340	0.859488976	155	1.94
18-Jul-97	7:00	547	20.5	443674	453551	0.884749621	160	1.88
19-Jul-97	7:00	540	21.0	463771	472993	0.826076846	163	1.84
20-Jul-97	7:30	563		482853	493402	0.944945202	144	2.08
21-Jul-97	7:30	578	17.0	502990	514855	1.062828213	135	2.22
22-Jul-97	7:00	565	16.0	514878	522958	0.72378019	115	2.61
23-Jul-97	7:00	580	22.0	522757	529336	0.589325479	138	2.17
24-Jul-97	7:00	538	22.0	543268	549855	0.590042093	168	1.79
25-Jul-97	19:00	520		52110	58110	0.537460537	192	1.56
26-Jul-97	7:00	518	18.0	58130	64348	0.55698827	206	1.46
27-Jul-97	7:00	516	22.0	72345	79930	0.679439696	202	1.49
28-Jul-97	8:00	526	22.0	79950	88057	0.726198763	194	1.55
30-Jul-97	7:00	542	23.0	119158	128474	0.834497061	157	1.91
31-Jul-97	7:00	528	26.0	139567	147414	0.702908806	187	1.60
01-Aug-97	7:30	510	25.0	158138	165010	0.615571469	216	1.39
02-Aug-97	7:30	510	23.0	177000	184014	0.628291368	217	1.38
05-Aug-97	7:00	554	20.0	208689	218595	0.887347347	151	1.99
06-Aug-97	8:00	567	24.5	230555	241698	0.998153795	141	2.13
07-Aug-97	8:30	560	19.0	252302	262967	0.955336105	152	1.97
08-Aug-97	10:30	542	24.0	273503	282901	0.841842355	172	1.74
09-Aug-97	7:30	540		297260	306450	0.82321039	180	1.67
10-Aug-97	7:30	542	25.0	320230	329983	0.873642104	180	1.67
11-Aug-97	12:00	550	21.0	343622	353189	0.856980827	164	1.83
12-Aug-97	14:30	567	20.5	365439	375911	0.938047791	150	2.00
13-Aug-97	18:30	580	17.0	381365	394452	1.172291009	136	2.21
14-Aug-97	18:30	590	14.0	407075	419938	1.152225816	119	2.52
15-Aug-97	18:30	595	16.0	459746	472567	1.148463592	117	2.56
16-Aug-97	18:30	580	15.0	522768	535105	1.105108442	139	2.16
17-Aug-97	18:30	560	15.0	546748	557641	0.975759606	157	1.91
18-Aug-97	18:30	548	15.5	580566	591932	1.018129411	168	1.79
19-Aug-97	18:30	542	18.0	592000	603051	0.989912733	170	1.76
20-Aug-97	18:00	539	19.0	603000	613045	0.899798516	169	1.78
21-Aug-97	16:00	545	23.0	626037	635678	0.863609507	163	1.84
22-Aug-97	7:00	540	19.5	647443	656546	0.815417212	173	1.73
23-Aug-97	8:00	539	20.0	668425	676997	0.767851955	181	1.66
24-Aug-97	8:30	540	19.5	689542	698549	0.806817843	174	1.72
25-Aug-97	7:30	547	20.0	711223	720772	0.855368445	165	1.82
26-Aug-97	7:00	550		733096	742858	0.874448294	175	1.71
27-Aug-97	7:30	561		755086	765552	0.937510331	156	1.92
28-Aug-97	7:30	535	21.0	776795	785844	0.810580067	190	1.58
31-Aug-97	7:30	499	21.0	880840	886608	0.51667873	235	1.28
01-Sep-97	7:30	500	22.0	951638	957952	0.565587639	234	1.28
02-Sep-97	7:00	508	22.5	966713	973146	0.576247273	274	1.09
03-Sep-97	8:30	500	21.0	983431	989302	0.525905136	232	1.29

Table 6 (cont.)

DATE	TIME	DEPTH GUAGE (cm)	SECCHI DEPTH (cm)	FLOW START	FLOW END	FLOW RATE (mps)	TIME FOR 5 REVS (sec)	RPM
04-Sep-97	9:00	503	21.0	18003	24531	0.584757065	235	1.28
05-Sep-97	8:30	510	21.5	36466	43284	0.610734324	219	1.37
06-Sep-97	8:00	490	20.0	43302	49110	0.5202618	260	1.15
07-Sep-97	8:00	477		49118	54060	0.442688329	304	0.99
08-Sep-97	16:00	480	20.0	54059	59742	0.509064706	465	0.65
09-Sep-97	19:00	500	22.0	50740	56054	0.476010883	385	0.78
10-Sep-97	16:00	490	22.0	67161	73703	0.586011139	255	1.18
11-Sep-97	16:00	480	19.0	73874	79711	0.522859526	262	1.15
12-Sep-97	13:00	470	28.0	79710	84663	0.443673674	306	0.98
13-Sep-97	15:43	457	32.0	84658	91830	0.642444496	213	1.41
14-Sep-97	14:00	460	32.5	89000	93711	0.421996099	230	1.30

Table 7. Summary of fishwheel mark-recapture efficiency test by species, 1997.

Recoveries at Fishwheel[7]

	Tagged	Recaptured	Recapture Rate (%)
Chinook	24	3	12.5
Coho	74	1	1.4
Sockeye	99	7	7.1
Pink	64	9	14.1

Spawning Ground Recoveries[8]

	Tagged	Recaptured	Recapture Rate (%)
Chinook	398	68	17.1
Coho	0		
Sockeye	0		
Pink	0		

[7] Fish captured at fishwheel, tagged, released 0.5 km below the fishwheel, and again recovered at the fishwheel
[8] Fish captured at fishwheel, tagged, released at the fishwheel and recovered at the Mussel Cr. fence or in other tributaries to the Klinaklini R.

Table 8. Radio tagging information for chinook released at the fishwheel site.

SHEEP EAR TAG	TAG I.D. NUMBER	CODE	CHANNEL	FREQUENCY	ACTIVATED
2316	T9705111F	31	4	149.380	16-Jul-97
2317	T9705112F	32	4	149.380	16-Jul-97
2875	T9705113F	33	4	149.380	17-Jul-97
2876	T9705114F	34	4	149.380	17-Jul-97
2877	T9705115F	35	4	149.380	18-Jul-97
2878	T9705116F	36	4	149.380	18-Jul-97
2879	T9705117F	37	4	149.380	18-Jul-97
2880	T9705118F	38	4	149.380	19-Jul-97
2881	T9705119F	39	4	149.380	19-Jul-97
2882	T9705120F	40	4	149.380	20-Jul-97
2883	T9705121F	41	5	149.400	20-Jul-97
2884	T9705122F	42	5	149.400	21-Jul-97
2887	T9705123F	43	5	149.400	23-Jul-97
2886	T9705124F	44	5	149.400	22-Jul-97
2885	T9705125F	45	5	149.400	22-Jul-97
2888	T9705126F	46	5	149.400	23-Jul-97
2890	T9705127F	47	5	149.400	24-Jul-97
2891	T9705128F	48	5	149.400	24-Jul-97
2893	T9705129F	49	5	149.400	25-Jul-97
2892	T9705130F	50	5	149.400	25-Jul-97
2889	T9705131F	51	5	149.400	24-Jul-97
	T9705132F	52	6	149.420	
2894	T9705133F	53	6	149.420	25-Jul-97
	T9705134F	54	6	149.420	
	T9705135F	55	6	149.420	
	T9705136F	56	6	149.420	
	T9705138F	58	6	149.420	
	T9705139F	59	6	149.420	
	T9705140F	60	6	149.420	
	T9705141F	61	6	149.420	
	T9705142F	62	6	149.420	
2850	T9705143F	63	7	149.440	27-Jul-97
2895	T9705144F	64	7	149.440	27-Jul-97
2896	T9705145F	65	7	149.440	27-Jul-97
2897	T9705146F	66	7	149.440	29-Jul-97
2898	T9705147F	67	7	149.440	29-Jul-97
2899	T9705148F	68	7	149.440	01-Aug-97
2151	T9705149F	69	7	149.440	02-Aug-97
2852	T9705150F	70	7	149.440	05-Aug-97
2853	T9705151F	71	7	149.440	07-Aug-97
2854	T9705152F	72	7	149.440	07-Aug-97
2855	T9705153F	73	7	149.440	09-Aug-97
2856	T9705154F	83	8	149.460	12-Aug-97
2865	T9705155F	84	8	149.460	23-Aug-97
2866	T9705156F	85	8	149.460	23-Aug-97
2867	T9705158F	87	8	149.460	24-Aug-97
2868	T9705160F	89	8	149.460	26-Aug-97
	T9705161F	90	8	149.460	
2869	T9705162F	91	8	149.460	31-Aug-97
	T9705164F	93	8	149.460	

Table 9. Summary of chinook radio telemetry tracking data.

CODE	TIME	CH	PWR	ANT	DATE TRACKED	RCVR	DATE TAGGED	LOCATION FOUND
33	12:17:15	4	230	1	08-Aug-97	3	17-Jul-97	Mussel creek
33		4		1	08-Sep-97	3	17-Jul-97	below Million $ bridge
34					17-Aug-97	3	17-Jul-97	below Million $ bridge
34		4		1	19-Aug-97	3	17-Aug-97	native village
34	13:26:21	4	140	1	24-Aug-97	3	17-Jul-97	Mussel creek
34	10:32:59	4	188	1	29-Aug-97	3	17-Jul-97	Million dollar bridge to Dice confluence
34	9:41:51	4	128	1	06-Sep-97	3	17-Jul-97	lower Dice creek
34		4		1	08-Sep-97	3	17-Jul-97	Dice cr side channel
34		4		1	12-Sep-97	3	17-Jul-97	native village
34		4		1	14-Sep-97	3	17-Jul-97	Mussel creek
35	12:28:35	4	213	1	18-Jul-97	3	18-Jul-97	upper Klinaklini (below main confluence)
35	12:20:44	4	221	1	08-Aug-97	3	18-Jul-97	Mussel creek
35		4		1	20-Aug-97	3	18-Jul-97	Mussel creek
36	9:19:26	4	86	1	24-Aug-97	3	18-Jul-97	Ice bridge
36	10:32:02	4	84	1	01-Sep-97	3	18-Jul-97	Ice creek bridge
38	12:22:28	4	227	1	08-Aug-97	3	19-Jul-97	Mussel creek
38		4		1	14-Aug-97	3	20-Jul-97	Mussel creek
38					17-Aug-97	3	19-Jul-97	below Million $ bridge
38	12:33:27	4	212	1	24-Aug-97	3	19-Jul-97	Mussel creek
38	15:34:42	4	181	1	29-Aug-97	3	19-Jul-97	Mussel creek
38	10:56:55	4	223	1	01-Sep-97	3	19-Jul-97	Mussel creek
38	14:25:17	4	229	1	06-Sep-97	3	19-Jul-97	Mussel creek lower end
38		4		1	09-Sep-97	3	19-Jul-97	Mussel confluence
38		4		1	14-Sep-97	3	19-Jul-97	Mussel creek
39	12:19:51	4	204	1	08-Aug-97	3	19-Jul-97	Mussel creek
39		4		1	14-Aug-97	3	19-Jul-97	Mussel creek
39		4		1	08-Sep-97	3	19-Jul-97	Million $$ bridge
39		4		1	09-Sep-97	3	19-Jul-97	Ice cr sidechannel
39		4		1	14-Sep-97	3	19-Jul-97	Mussel creek
40	14:24:19	4	88	1	24-Jul-97	3	20-Jul-97	Million dollar to Mussel creek confluence
40					17-Aug-97	3	20-Jul-97	log jam #1
40		4		1	19_Aug-97	3	20-Jul-97	native village
40	13:34:04	4	133	1	24-Aug-97	3	20-Jul-97	Mussel creek
40	10:38:18	4	148	1	29-Aug-97	3	20-Jul-97	Dice confluence to native camp
40		4		1	14-Sep-97	3	20-Jul-97	Mussel creek
41		4		1	14-Aug-97	3	20-Jul-97	Mussel creek
41					17-Aug-97	3	20-Jul-97	Mussel creek
41	12:36:13	5	221	1	24-Aug-97	3	20-Jul-97	Mussel creek
41	15:34:01	5	229	1	29-Aug-97	3	20-Jul-97	Mussel creek

Table 9 (cont.)

CODE	TIME	CH	PWR	ANT	DATE TRACKED	RCVR	DATE TAGGED	LOCATION FOUND
41	10:57:06	5	221	1	01-Sep-97	3	20-Jul-97	Mussel creek
41	14:25:28	5	134	1	06-Sep-97	3	20-Jul-97	Mussel creek lower end
41		5		1	09-Sep-97	3	20-Jul-97	Mussel confluence
41		5		1	14-Sep-97	3	20-Jul-97	Mussel creek
43	12:15:43	5	208	1	08-Aug-97	3	23-Jul-97	Mussel creek
43	12:28:29	5	177	1	24-Aug-97	3	23-Jul-97	Mussel creek
43		5		1	08-Sep-97	3	23-Jul-97	Million $$ bridge
43		5		1	14-Sep-97	3	23-Jul-97	Mussel creek
44		5		1	14-Aug-97	3	22-Jul-97	Mussel creek
45					17-Aug-97	3	22-Jul-97	Dice sidechannel
45		5		1	20-Aug-97	3	22-Jul-97	near Ice confluence
45		5		1	08-Sep-97	3	22-Jul-97	native village
46	12:57:05	5	6	1	28-Jul-97	3	23-Jul-97	Million dollar to Mussel creek confluence
46					17-Aug-97	3	23-Jul-97	Mussel Cr. confluence
46		5		1	19-Aug-97	3	23-Jul-97	native village
46	13:33:24	5	153	1	24-Aug-97	3	23-Jul-97	Mussel creek
46	10:38:28	5	167	1	29-Aug-97	3	23-Jul-97	Dice confluence to native camp
46		5		1	08-Sep-97	3	23-Jul-97	Million $$ bridge
46		5		1	12-Sep-97	3	23-Jul-97	native village
47	13:10:54	5	65	1	28-Jul-97	3	24-Jul-97	Mussel creek
47		5		1	14-Aug-97	3	24-Jul-97	Mussel creek
47	12:20:02	5	232	1	08-Aug-97	3	24-Jul-97	Mussel creek
47	12:36:13	5	232	1	24-Aug-97	3	24-Jul-97	Mussel creek
47		5		1	14-Sep-97	3	24-Jul-97	Mussel creek
48					17-Aug-97	3	24-Jul-97	Mussel Cr. confluence
48		5		1	08-Sep-97	3	24-Jul-97	Dice side channel
49		5		1	19-Aug-97	3	25-Jul-97	native village
49		5		1	14-Sep-97	3	25-Jul-97	Mussel creek
50	14:29:52	5	149	1	08-Aug-97	3	25-Jul-97	Mussel creek
50		5		1	09-Aug-97	3	25-Jul-97	Ice cr sidechannel
51	14:11:10	5	160	1	24-Jul-97	3	24-Jul-97	Million dollar to Mussel creek confluence
51	13:42:06	5	231	1	28-Jul-97	3	24-Jul-97	Mussel creek
51	12:20:02	5	230	1	08-Aug-97	3	24-Jul-97	Mussel creek
51					17-Aug-97	3	24-Jul-97	Mussel Cr. confluence
51	12:36:13	5	230	1	24-Aug-97	3	24-Jul-97	Mussel creek
51	15:30:35	5	223	1	29-Aug-97	3	24-Jul-97	Mussel creek
51	10:59:40	5	229	1	01-Sep-97	3	24-Jul-97	Mussel creek
51	14:25:28	5	200	1	06-Sep-97	3	24-Jul-97	Mussel creek lower end

Table 9 (cont.)

CODE	TIME	CH	PWR	ANT	DATE TRACKED	RCVR	DATE TAGGED	LOCATION FOUND
51		5		1	08-Sep-97	3	24-Jul-97	Million $$ bridge
51		5		1	09-Sep-97	3	24-Jul-97	Mussel confluence
51		5		1	14-Sep-97	3	24-Jul-97	Mussel creek
63	13:07:26	7	89	1	28-Jul-97	3	27-Jul-97	Mussel creek
63	13:47:49	7	99	1	28-Jul-97	3	27-Jul-97	Mussel creek
63	12:20:23	7	223	1	08-Aug-97	3	27-Jul-97	Mussel creek
63					17-Aug-97	3	27-Jul-97	Mussel Cr. confluence
63	12:36:34	7	209	1	24-Aug-97	3	27-Jul-97	Mussel creek
63		7		1	08-Sep-97	3	27-Jul-97	Million $$ bridge
63		7		1	09-Sep-97	3	27-Jul-97	Ice cr sidechannel
64		7		1	08-Sep-97	3	27-Jul-97	Million $$ bridge
64		7		1	09-Sep-97	3	27-Jul-97	Ice cr sidechannel
65		7		1	14-Aug-97	3	28-Jul-97	Mussel creek
65	13:13:38	7	79	1	28-Jul-97	3	27-Jul-97	Mussel creek
65	12:18:38	7	177	1	08-Aug-97	3	27-Jul-97	Mussel creek
65					17-Aug-97	3	27-Jul-97	Mussel Cr. confluence
65	12:33:58	7	208	1	24-Aug-97	3	27-Jul-97	bridge to Dice confl
65	15:30:56	7	223	1	29-Aug-97	3	27-Jul-97	Mussel creek
65	10:58:17	7	202	1	01-Sep-97	3	27-Jul-97	Mussel creek
65		7		1	14-Sep-97	3	27-Jul-97	Mussel creek
66				1	08-Sep-97	3	29-Jul-97	below Million $$ bridge
66		7		1	14-Sep-97	3	29-Jul-97	Mussel creek
67					17-Aug-97	3	29-Jul-97	Mussel Cr. confluence
67					20-Aug-97	3	29-Jul-97	Mussel Cr. confluence
67		7		1	08-Sep-97	3	29-Jul-97	below Million $$ bridge
68		7		1	24-Jul-97	3	01-Aug-97	logjam below Million $$ bridge
68					17-Aug-97	3	01-Aug-97	Mussel Cr. confluence
68	15:30:56	7	230	1	29-Aug-97	3	01-Aug-97	Mussel creek
68		7		1	08-Sep-97	3	01-Aug-97	below Million $$ bridge
69					17-Aug-97	3	02-Aug-97	Mussel Cr. confluence
69	12:28:50	7	232	1	24-Aug-97	3	02-Aug-97	Dice confluence to native camp
69		7		1	08-Sep-97	3	02-Aug-97	Million $$ bridge
69		7		1	12-Sep-97	3	02-Aug-97	native village
70		7		1	14-Aug-97	3	05-Aug-97	above Mussel confluence
70		7		1	08-Sep-97	3	05-Aug-97	Million $$ bridge
71	9:06:30	7	222	1	24-Aug-97	3	07-Aug-97	Dice bridge
71	10:48:27	7	183	1	01-Sep-97	3	07-Aug-97	Dice creek
72	10:56:35	7	222	1	01-Sep-97	3	07-Aug-97	Mussel creek
72		7		1	08-Sep-97	3	07-Aug-97	native village

Table 9 (cont.)

CODE	TIME	CH	PWR	ANT	DATE TRACKED	RCVR	DATE TAGGED	LOCATION FOUND
73		7		1	20-Aug-97	3	09-Aug-97	near Ice confluence
83		8		1	14-Aug-97	3	12-Aug-97	Mussel creek
83					17-Aug-97	3	12-Aug-97	Mussel confluence
83					20-Aug-97	3	12-Aug-97	Mussel confluence
83	12:35:52	8	203	1	24-Aug-97	3	12-Aug-97	Dice confluence to native camp
85	11:00:11	8	232	1	01-Sep-97	3	23-Aug-97	Mussel creek
87	10:17:42	8	107	1	06-Sep-97	3	24-Aug-97	between Dice conf. and native camp
87		8		1	08-Sep-97	3	24-Aug-97	native village
87		8		1	12-Sep-97	3	24-Aug-97	above native village
89		8		1	08-Sep=97	3	26-Aug-97	below Million $$ bridge
89		8		1	09-Sep-97	3	26-Aug-97	Mussel confluence
89		8		1	14-Sep-97	3	14-Sep-97	Mussel confluence
91	13:54:16	8	190	1	06-Sep-97	3	31-Aug-97	near Ice confluence
91		8		1	08-Sep-97	3	31-Aug-97	below Million $$ bridge

Table 10. Visual survey data collected for the Klinaklini system by Fishery 0fficers stationed in the Campbell R. subdistrict.

	Method[1]	Date	Chinook Jacks Count	Chinook Jacks Estimate	Chinook Adults Count	Chinook Adults Estimate	River Segment[2]
1979	H	Sept. 15					Mussel
Estimate for Season3						7500	
1980	F	Aug. 29					Mussel
Estimate for Season						7500	
1981	F	July 26				120	Mussel
	F	Aug. 29				900	Mussel
	F	Sept. 22				630	Mussel
	F	Oct. 5				295	Mussel
Estimate for Season						1000	
1982	No observation						
Estimate for Season						2500	
1983	H	July 23					Mussel
	H	Oct. 28					Mussel
Estimate for Season						1220	
1984	H					1000	Mussel[9]
Estimate for Season[3]						1000	
1985	H	June 25					Mussel
	H	Aug. 7					Mussel
	H	15					Mussel
	H	Sept. 15				650	Mussel
Estimate for Season						650	
1986	H	Oct. 15				500	Mussel
Estimate for Season						500	

[9] In November a 200 m slide into Mussel Cr. likely destroyed most of the chinook spawn.

Table 10. (cont.)

	Method[1]	Date	Chinook Jacks Count	Chinook Jacks Estimate	Chinook Adults Count	Chinook Adults Estimate	River Segment[2]
1987	H	June 25				1	Mussel
	H	Aug. 7				5	Mussel
	H	15				50	Mussel
	H	Sept. 15				600	Mussel
Estimate for Season						???	
1988	H	Sept. 12				1000	Mussel
Estimate for Season						1000	
1989	H	Oct. 2				250	Mussel
Estimate for Season						250	
1990	No observations						
Estimate for Season						1200	
1991	H	July 12				45	Mussel
	H	22				110	Mussel
	H	Aug. 16				57	Mussel
	H	Sept. 21				114	Mussel
	H	Oct. 9				8	Mussel
Estimate for Season						500	
1992	H	Aug. 13				650	Mussel
	H	Sept. 18				700	Mussel
Estimate for Season						700	
1993	H	Aug. 29				585	Mussel
	H	Sept. 29				99	Mussel
	H	29				60	Icey
	H	Oct. 26				65	Mussel
Estimate for Season						809	

Table 10. (cont.)

			Chinook				
			Jacks		Adults		
	Method[1]	Date	Count	Estimate	Count	Estimate	River Segment[2]
1994	H	Sept. 17			719	719	Mussel
	H	Nov. 11			30	30	Icy/Dice
	H	Nov. 11			690	690	Mussel
Estimate for Season[6]						720	
1995	H	Aug. 4			69	250	Mussel
	H	Aug. 4			6	10	Icy/Dice
	H	Aug. 25			800	800	Mussel
	H	Sept. 22			1400	1400	Mussel
	H	Sept. 22			450	450	Icy/Dice
	H	Oct. 30			11	11	Icy/Dice
	H	Oct. 30			20	20	Jumper
Estimate for Season						3290	
1996	H	Aug. 22			257	800	Mussel
	H	22			0	0	Icy/Dice
	H	Oct. 18			776	2300	Mussel
Estimate for Season[6]						2600	
1997	H						

[1]S - Swim survey, H - Helicopter survey, F - boat survey
[2]Refer to Fig. 2
[3]Total escapement estimate for adult chinook

Table 11. Daily counts at the Mussel Cr. fence site, 1997.

Date (DDMM)	Depth (cm.)	Temp. (deg. C)	Chinook Adult	Chinook Jack	Coho Adult	Coho Jack	Chum	Unknown
0807	795	14	0	0	0	0	0	0
0907	805	15	0	0	0	0	0	0
1007	777	14	0	0	0	0	0	0
1107	550	14	0	0	0	0	0	0
1207	510	12	0	0	0	0	0	0
1307	510	15	0	0	0	0	0	0
1407	550	14	0	0	0	0	0	0
1507	600	14	0	0	0	0	0	0
1607	540	15	1	0	0	0	0	0
1707	490	15	2	0	0	0	0	0
1807	440	15	0	0	0	0	0	0
1907	430	15	0	0	0	0	0	0
2007	580	16	0	0	0	0	0	0
2107	650	16	1	0	0	0	0	0
2207	600	16	0	0	0	0	0	0
2507	133	17	0	0	0	0	0	0
2607	127	18	3	0	0	0	0	0
2707	129	15	7	0	1	0	0	0
2807	135	18	0	0	0	0	0	0
2907	144	16	1	0	0	0	0	0
3007	144	16	0	0	0	0	0	0
3107	132	16	2	0	0	0	0	0
0108	125	15	1	0	0	0	0	0
0208	29	16	2	0	0	0	0	0
0308	130	15	1	0	0	0	0	0
0408	140	16	3	0	0	1	0	0
0508	152	15	1	1	1	2	0	0
0608	158	16	1	2	0	1	0	0
0708	542	18	1	0	0	0	0	0
0808	434	15	0	0	0	0	0	0
0908	43	16	2	0	1	0	0	0
1008	44	16	2	1	2	1	0	0
1108	50	15	12	1	9	3	0	0
1208	72	16	1	1	2	1	0	0
1308	615	16	2	0	0	0	0	0
1408	755	18	4	1	2	0	0	0
2608	755	18	145	2	5	0	0	0
2708	755	18	186	20	11	0	1	0
2808	755	18	19	2	2	0	0	0
2908	755	18	82	5	14	2	0	0
3008	755	18	62	6	9	1	0	0
3108	755	18	30	4	6	0	2	0
109	755	18	27	0	12	1	1	0
209	755	18	9	2	11	0	0	0
509	755	18	40	3	13	0	0	0
609	755	18	1	0	2	0	0	0
709	755	18	5	2	7	0	0	0
809	755	18	34	3	11	3	0	0
Total:			690	56	121	16	4	0

Table 12. Daily numbers of salmon biosampled at the Mussel Cr. fence site, 1997.

Date (DDMM)	Chinook	Coho	Pink	Chum	Sockeye
1607	1	0	0	0	0
1707	2	0	0	0	0
2207	14	0	0	0	0
2507	1	0	0	0	0
2607	3	0	0	0	0
2707	7	0	0	0	0
2907	1	0	0	0	0
3107	2	0	0	0	0
0108	1	0	0	0	0
0208	16	3	0	0	1
0808	0	0	0	0	2
0908	2	2	0	0	0
1008	5	3	0	0	1
1208	2	3	0	0	1
1308	2	0	0	0	0
1408	5	4	0	0	2
1508	88	0	0	0	0
1608	32	0	0	0	0
1708	59	0	0	0	0
1808	111	3	0	0	1
1908	82	3	0	0	1
2008	8	0	0	0	0
2208	37	7	4	0	0
2308	48	3	0	0	0
2408	18	1	0	0	0
2508	205	4	0	0	2
2608	229	6	0	0	0
2908	0	8	0	0	0
3008	0	7	0	0	0
0509	0	5	0	0	0
0909	50	2	0	0	0
1009	4	0	0	0	0
1109	4	0	0	0	0
1209	0	0	0	0	1
Total:	1039	64	4	0	12

Table 13. Length-frequency of chinook sampled at the fence, Mussel Cr., 1997.

POH Length (cm)	Males	Jacks	Females
25	0	2	0
26	0	3	0
27	0	6	0
28	0	4	0
29	0	2	1
30	0	4	0
31	0	4	0
32	0	3	0
33	0	11	0
34	0	9	0
35	0	1	0
36	0	3	0
37	0	2	1
38	0	2	1
39	0	4	1
40	0	3	0
41	0	4	2
42	0	2	1
43	0	5	0
44	0	11	1
45	12	2	7
46	4	0	2
47	3	0	1
48	6	0	2
49	6	0	0
50	10	0	4
51	10	0	0
52	10	0	2
53	9	0	1
54	8	0	3
55	40	0	5
56	69	0	9
57	5	0	5
58	12	0	2
59	6	0	4
60	13	0	7
61	6	0	1
62	7	0	5
63	3	0	2
64	4	0	2
65	6	0	4
66	33	0	18
67	58	0	37
68	4	0	8
69	5	0	9
70	16	0	24

Table 13 (cont.)

POH Length (cm)	Males	Jacks	Females
71	4	0	7
72	10	0	17
73	8	0	11
74	8	0	27
75	8	0	12
76	7	0	15
77	38	0	71
78	36	0	49
79	7	0	10
80	5	0	6
81	1	0	5
82	3	0	3
83	1	0	6
84	3	0	1
85	0	0	1
86	1	0	0
87	2	0	1
88	15	0	6
89	4	0	1
90	3	0	0
91	0	0	2
92	1	0	0
93	1	0	1
94	0	0	0
95	0	0	0
96	0	0	0
97	0	0	0
98	0	0	1
Total:	531	87	425
Mean Length:	65.1	35.3	70.9

Table 14. Age-frequency of chinook sampled at the fence, Mussel Cr., 1997.

Age[10]	Males	Females	Total
0.2	32	9	41
0.3	43	36	79
0.4	5	5	10
1.1	2	6	8
1.2	21	13	34
1.3	15	18	33
1.4	0	1	1
TOTAL	118	88	206

Total number of regenerate scales read: 80

[10] European Age notation.

Table 15. Daily count of juvenile fish caught in the rotary screw trap, Klinaklini R., 1997.

Date	Chinook		Chum	Coho		Pink	Sockeye	Other[11]
	Fry	1 yr smolt		Fry	1 yr smolt			
14-Jul				7			3	
15-Jul				6			2	
16-Jul				5				
17-Jul				7			1	
18-Jul			1	4			1	
19-Jul			1	7			1	
20-Jul	1		3	2			4	1
21-Jul				1				
23-Jul				2				4
24-Jul	2			12				2
25-Jul			1	17				30
26-Jul				16			1	7
27-Jul				19			1	5
28-Jul				8	1		3	7
29-Jul				9	1			3
30-Jul				20	1		1	1
31-Jul				31			1	2
01-Aug				23				6
02-Aug				26	1		1	
03-Aug	1			24	4		1	1
04-Aug				1				
05-Aug				24	3		3	2
06-Aug				8				2
07-Aug				14	2		1	
08-Aug				19	5			6
09-Aug	2			14	1			1
10-Aug				15	3			
11-Aug				8				
12-Aug	4			24				3
13-Aug	1			7				
14-Aug	2		2	5				1
15-Aug	3			2				
16-Aug				2				9
17-Aug	3		3	10				18
18-Aug				6				3
19-Aug	2			3				1
20-Aug				2				
21-Aug				8	1			7
22-Aug				4	1			17
23-Aug				1				
24-Aug				3	1			3
26-Aug				4				7
27-Aug				7				12
28-Aug				13	5			25
29-Aug				18	2			16
30-Aug				15	5			12
31-Aug				13	2			12
01-Sep	2	1		4				
02-Sep	2							
03-Sep	3			10				
04-Sep								
Totals:	28	1	11	510	39	0	25	226

[11] Includes: sculpins, lamprey, stickleback and trout

Table 16. Summary of chinook mark-recapture data, 1997.

Date	No. Tagged[12]		No. Examined[13]		No. Recaptured[14]	
	Males	Females	Males	Females	Males	Females
0507	0	2	0	0	0	0
0707	0	4	0	0	0	0
1207	0	2	0	0	0	0
1307	0	4	0	0	0	0
1407	1	3	0	0	0	0
1507	2	3	0	0	0	0
1607	3	5	1	0	0	0
1707	5	7	1	1	0	0
1807	6	9	0	0	0	0
1907	4	5	0	0	0	0
2007	1	3	0	0	0	0
2107	2	0	0	0	0	0
2207	7	6	5	9	0	0
2307	7	7	0	0	0	0
2407	3	8	0	0	0	0
2507	11	6	1	0	0	0
2607	5	8	2	1	0	1
2707	3	8	5	2	0	0
2807	9	10	0	0	0	0
2907	2	9	0	1	0	0
3007	1	8	0	0	0	0
3107	2	5	2	0	0	0
0108	9	3	1	0	0	0
0208	11	9	8	5	0	0
0408	3	2	0	0	0	0
0508	13	8	0	0	0	0
0608	9	1	0	0	0	0
0708	17	0	0	0	0	0
0808	7	4	0	0	0	0
0908	8	0	0	2	0	0
1008	7	1	2	0	0	0
1108	2	1	0	0	0	0
1208	1	1	1	0	0	0
1308	4	0	2	0	0	0
1408	2	0	4	1	1	0
1508	3	2	39	42	2	3

[12] Tagged at the fishwheel
[13] Fish sampled in Mussel Cr., Dice Cr., and Icey Cr.
[14] Fish recovered with a Ketchum operculum tag (does not include lost tags)

Table 16 (cont.)

Date	No. Tagged[15]		No. Examined[16]		No. Recaptured[17]	
	Males	Females	Males	Females	Males	Females
1608	0	2	12	17	0	0
1708	3	1	28	24	2	1
1808	2	3	47	58	0	4
1908	4	4	40	39	2	5
2008	3	4	2	5	0	0
2108	6	2	0	0	0	0
2208	10	2	28	4	3	0
2308	4	2	35	12	4	2
2408	1	3	14	4	2	0
2508	0	0	127	74	7	5
2608	2	2	110	109	9	11
2708	0	1	0	0	0	0
2808	0	0	0	0	0	0
2908	0	0	0	0	0	0
3008	3	2	0	0	0	0
3108	2	1	0	0	0	0
0109	0	1	0	0	0	0
0209	1	2	0	0	0	0
0509	0	1	0	0	0	0
0909	0	0	28	18	1	0
1009	0	0	3	1	0	0
1109	2	0	3	1	0	0
Total:	213	187	551	430	33	32

[15] Tagged at the fishwheel
[16] Fish sampled in Mussel Cr., Dice Cr., and Icey Cr.
[17] Fish recovered with a Ketchum operculum tag (does not include lost tags)

Table 17. Petersen chinook mark-recapture escapement estimates by sex, Klinaklini River, 1997.

Sex	Escapement estimate	95% Confidence Limit	
		Lower	Upper
Male[18]	2,614	1,813	3,415
Female	2,236	1,491	2,981
Total	4,906	3,791	6,021

[18] Adult males only, jacks not included

Table 18. Incidence of tagged adult chinook recovered[19] at the Mussel Cr. fence site by recovery period, 1997.

Recovery Period	Recovered with tag		Total Recovery		Mark Incidence
	No.	%	No.	%	%
Aug. 14-23	31	45.6	491	49.4	6.1
Aug. 24-30	35	51.5	438	44.1	7.7
Aug. 31-Sept.6	0	0	0	0	-
Sept. 7-13	2	2.9	64	6.5	1.5
Total	68	100.0	993	100.0	6.5

[19] includes adult chinook which had lost the primary Ketchum tag but had the hole punch in the operculum.

Table 19. Proportion of the tag application sample recovered at the Mussel Cr. fence site, by period, 1997.

Application period	Tags applied No.	Tags recovered[20] No.	Recoveries %
July 13-26	111	22	20.0
July 27-Aug. 9	163	28	17.3
Aug. 10-23	56	15	26.8
Aug. 24-Sept. 6	22	1	4.5
Total	352	66	18.8

[20] includes tag recovery of adult chinook recovered with tag intact only

Table 20. Summary statistics for Kolmogorov-Smirnov length-frequency comparison for tagged (fishwheel) and recaptured (Mussel Cr.) chinook.

Length	Cumulative Frequency						Difference		
(cm)	Males Tagged	Males Recaps	Females Tagged	Females Recaps	Total Tagged	Total Recaps	Males	Females	Total
25	0	0	0	0	0	0.002	0	0	0.002
26	0	0	0	0	0	0.005	0	0	0.005
27	0	0.002	0	0	0	0.011	0.002	0	0.011
28	0	0.002	0	0	0	0.014	0.002	0	0.014
29	0.005	0.004	0	0.002	0.006	0.017	0.002	0.002	0.012
30	0.011	0.007	0	0.002	0.008	0.021	0.004	0.002	0.013
31	0.011	0.009	0	0.002	0.008	0.025	0.002	0.002	0.016
32	0.027	0.011	0	0.002	0.017	0.028	0.016	0.002	0.011
33	0.027	0.013	0	0.002	0.02	0.038	0.015	0.002	0.019
34	0.032	0.014	0	0.002	0.025	0.047	0.018	0.002	0.021
35	0.038	0.014	0	0.002	0.028	0.048	0.024	0.002	0.02
36	0.043	0.014	0	0.002	0.031	0.051	0.029	0.002	0.02
37	0.049	0.016	0	0.005	0.037	0.054	0.033	0.005	0.017
38	0.054	0.016	0	0.007	0.042	0.057	0.038	0.007	0.014
39	0.054	0.021	0	0.009	0.042	0.061	0.033	0.009	0.019
40	0.054	0.027	0	0.009	0.045	0.064	0.027	0.009	0.019
41	0.054	0.032	0.006	0.014	0.051	0.07	0.022	0.008	0.019
42	0.054	0.034	0.006	0.016	0.057	0.073	0.02	0.01	0.016
43	0.054	0.041	0.006	0.016	0.057	0.078	0.013	0.01	0.021
44	0.054	0.057	0.006	0.019	0.057	0.089	0.003	0.012	0.033
45	0.065	0.079	0.006	0.035	0.062	0.109	0.014	0.029	0.047
46	0.076	0.086	0.006	0.04	0.068	0.115	0.01	0.034	0.047
47	0.081	0.091	0.006	0.042	0.071	0.119	0.01	0.036	0.048
48	0.092	0.102	0.006	0.047	0.079	0.127	0.01	0.041	0.047
49	0.097	0.112	0.013	0.047	0.085	0.132	0.015	0.034	0.047
50	0.124	0.129	0.013	0.056	0.099	0.146	0.004	0.044	0.047
51	0.162	0.146	0.019	0.056	0.122	0.155	0.016	0.037	0.034
52	0.189	0.164	0.032	0.061	0.142	0.167	0.025	0.03	0.025
53	0.238	0.179	0.051	0.064	0.176	0.176	0.059	0.013	0.001
54	0.27	0.193	0.063	0.071	0.198	0.187	0.077	0.007	0.011
55	0.308	0.264	0.082	0.082	0.227	0.23	0.044	0	0.003
56	0.389	0.387	0.108	0.104	0.28	0.305	0.002	0.004	0.024
57	0.405	0.396	0.133	0.115	0.3	0.314	0.009	0.018	0.014
58	0.432	0.418	0.146	0.12	0.32	0.328	0.015	0.026	0.008
59	0.486	0.429	0.158	0.129	0.354	0.337	0.058	0.029	0.017
60	0.524	0.452	0.177	0.146	0.382	0.357	0.073	0.031	0.026
61	0.546	0.463	0.196	0.148	0.402	0.363	0.083	0.048	0.039
62	0.584	0.475	0.228	0.16	0.436	0.375	0.109	0.068	0.061
63	0.605	0.48	0.241	0.165	0.453	0.38	0.125	0.076	0.074
64	0.643	0.488	0.272	0.169	0.487	0.385	0.156	0.103	0.102
65	0.665	0.498	0.316	0.179	0.518	0.395	0.167	0.138	0.123
66	0.719	0.557	0.373	0.221	0.572	0.444	0.162	0.152	0.128
67	0.735	0.661	0.437	0.308	0.609	0.535	0.074	0.128	0.074
68	0.768	0.668	0.481	0.327	0.646	0.547	0.1	0.154	0.099
69	0.778	0.677	0.544	0.348	0.68	0.56	0.102	0.196	0.12
70	0.816	0.705	0.627	0.405	0.737	0.598	0.111	0.222	0.138
71	0.843	0.712	0.665	0.421	0.768	0.609	0.131	0.243	0.159
72	0.87	0.73	0.722	0.461	0.807	0.635	0.14	0.26	0.173
73	0.876	0.745	0.772	0.487	0.833	0.653	0.131	0.285	0.18
74	0.897	0.759	0.816	0.551	0.864	0.686	0.138	0.266	0.178

Table 20 (cont.)

Length (cm)	Cumulative Frequency Males Tagged	Males Recaps	Females Tagged	Females Recaps	Total Tagged	Total Recaps	Difference Males	Females	Total
75	0.903	0.773	0.848	0.579	0.881	0.706	0.129	0.269	0.175
76	0.919	0.786	0.861	0.614	0.895	0.727	0.133	0.247	0.168
77	0.93	0.854	0.911	0.781	0.924	0.831	0.076	0.13	0.092
78	0.946	0.918	0.924	0.896	0.938	0.913	0.028	0.028	0.025
79	0.962	0.929	0.937	0.92	0.952	0.929	0.034	0.017	0.023
80	0.973	0.938	0.962	0.934	0.969	0.94	0.035	0.028	0.029
81	0.989	0.939	0.975	0.946	0.983	0.945	0.05	0.029	0.038
82	0.989	0.945	0.987	0.953	0.989	0.951	0.045	0.034	0.038
83	0.995	0.946	0.994	0.967	0.994	0.958	0.048	0.027	0.037
84	0.995	0.952	1	0.969	0.997	0.962	0.043	0.031	0.036
85	1	0.952	1	0.972	1	0.963	0.048	0.028	0.037
86	1	0.954	1	0.972	1	0.964	0.046	0.028	0.036
87	1	0.957	1	0.974	1	0.966	0.043	0.026	0.034
88	1	0.984	1	0.988	1	0.987	0.016	0.012	0.013
89	1	0.991	1	0.991	1	0.991	0.009	0.009	0.009
90	1	0.996	1	0.991	1	0.994	0.004	0.009	0.006
91	1	0.996	1	0.995	1	0.996	0.004	0.005	0.004
92	1	0.998	1	0.995	1	0.997	0.002	0.005	0.003
93	1	1	1	0.998	1	0.999	0	0.002	0.001
94	1	1	1	0.998	1	0.999	0	0.002	0.001
95	1	1	1	0.998	1	0.999	0	0.002	0.001
96	1	1	1	0.998	1	0.999	0	0.002	0.001
97	1	1	1	0.998	1	0.999	0	0.002	0.001
98	1	1	1	1	1	1	0	0	0
						D_{obs} =	0.167	0.285	0.18

$D_{.05,64} = .1669$

Table 21. Sex composition of application and recovery samples of adult tagged chinook, 1997.

Sex		Application sample			Recovery sample		
		Recovered	Not Recovered	Total	Tagged	Not Tagged	Total
Male	Percent	54.4	53.1	53.4	54.4	56.7	56.6
	No.	37	153	190	37	528	565
Female	Percent	45.6	46.9	46.6	45.6	43.3	43.4
	No.	31	135	166	31	402	433
Total	No.	68	288	356	68	930	998

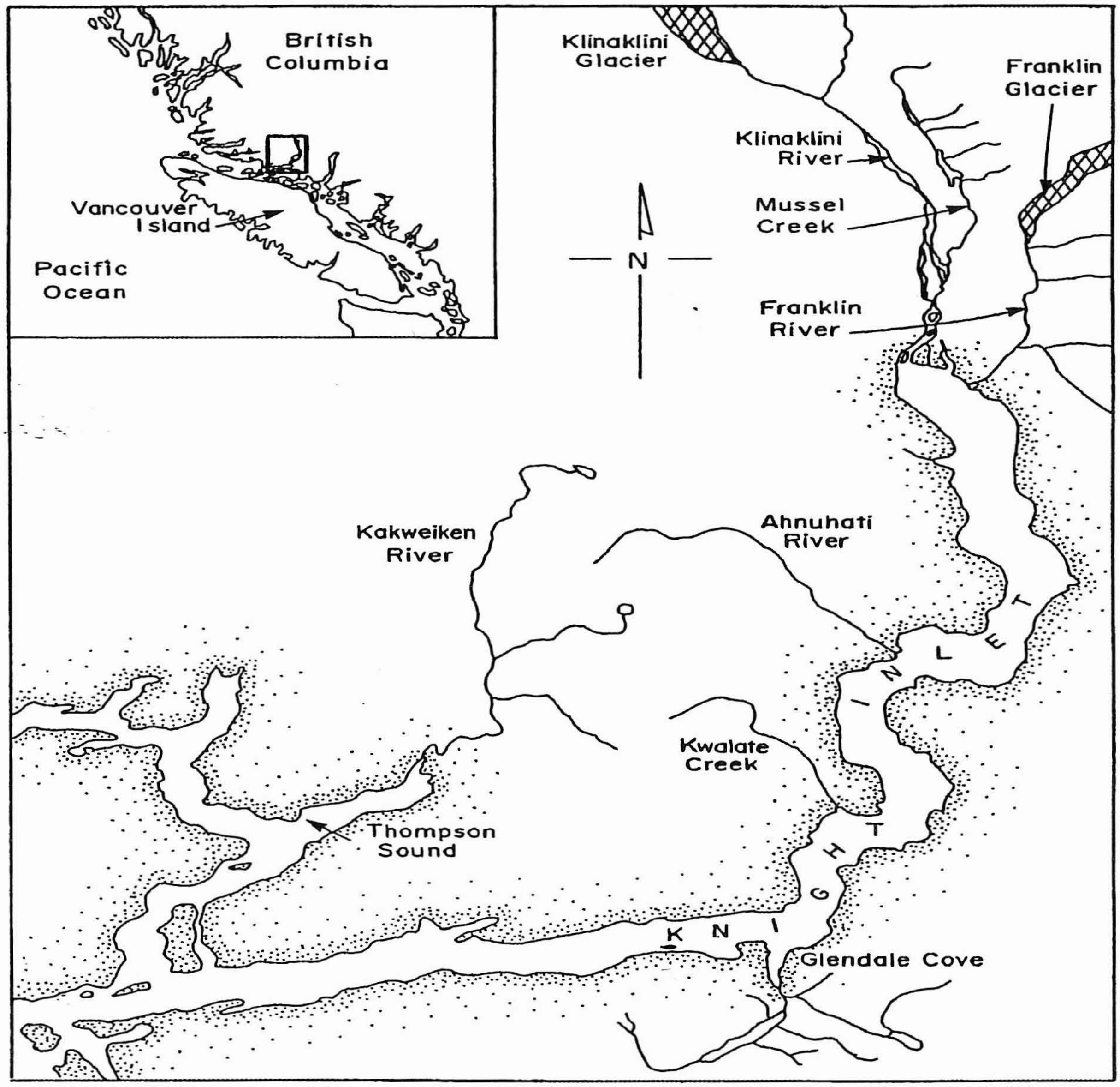

Fig. 1 Knight Inlet study area.

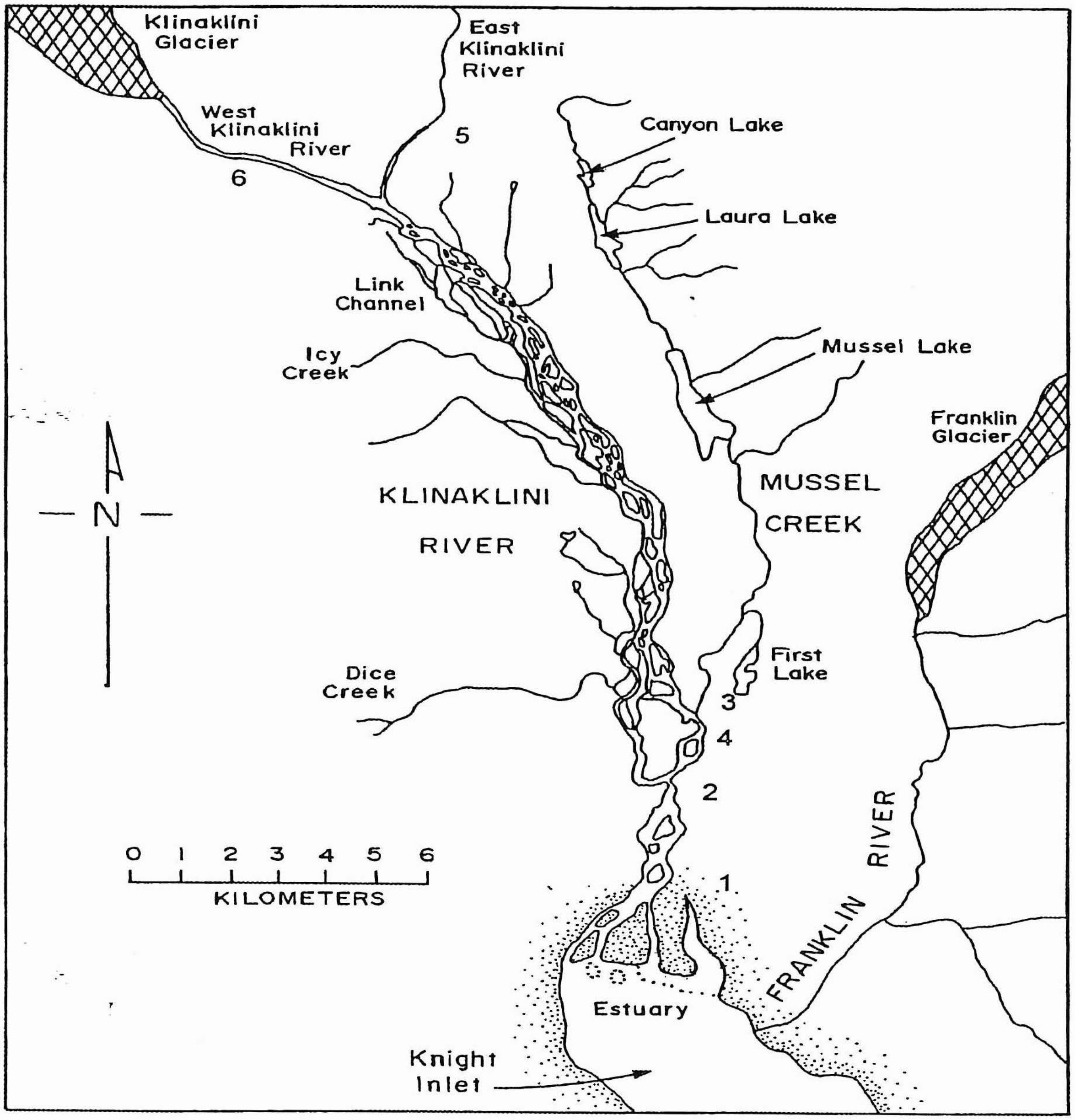

Fig. 2. Location of 1)Interfor camp, 2)fishwheel, 3)counting fence, 4)rotary screw trap, 5)East and 6)West remote tracking sites.

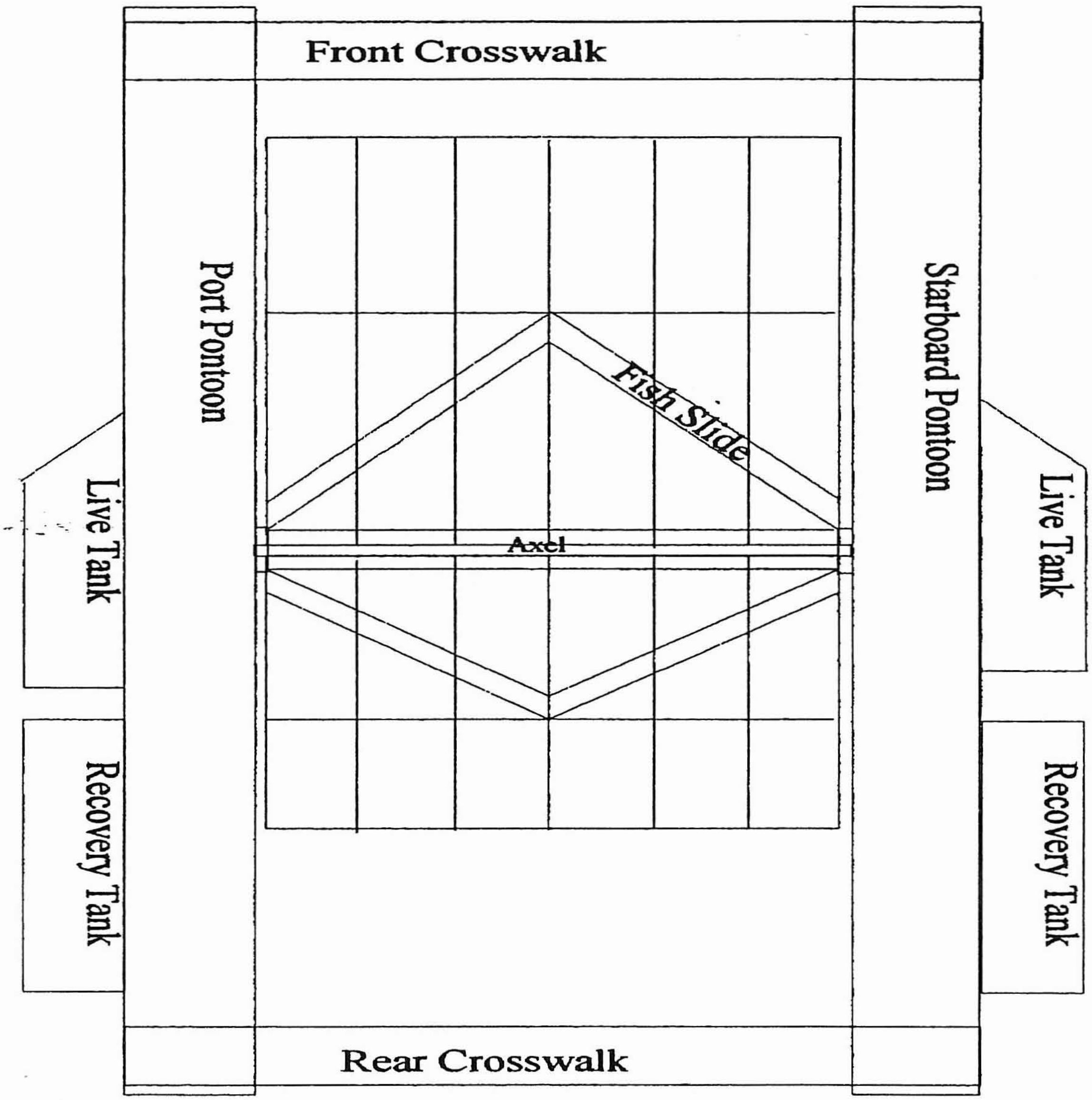

Fig. 3. Schematic diagram of fishwheel (aerial view).

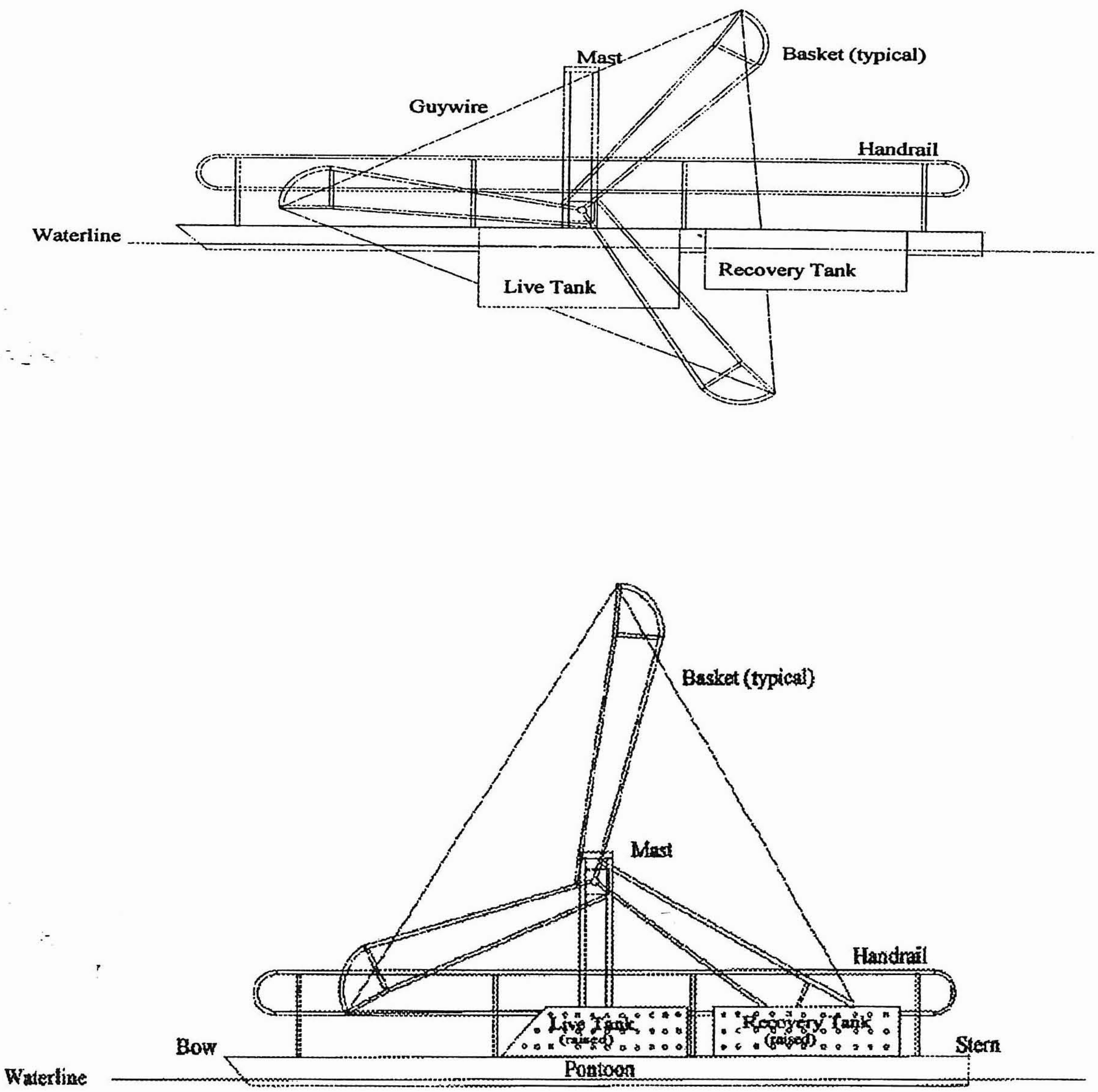

Fig 4. Schematic diagram of fishwheel in the lowered (top) and raised (bottom) position.

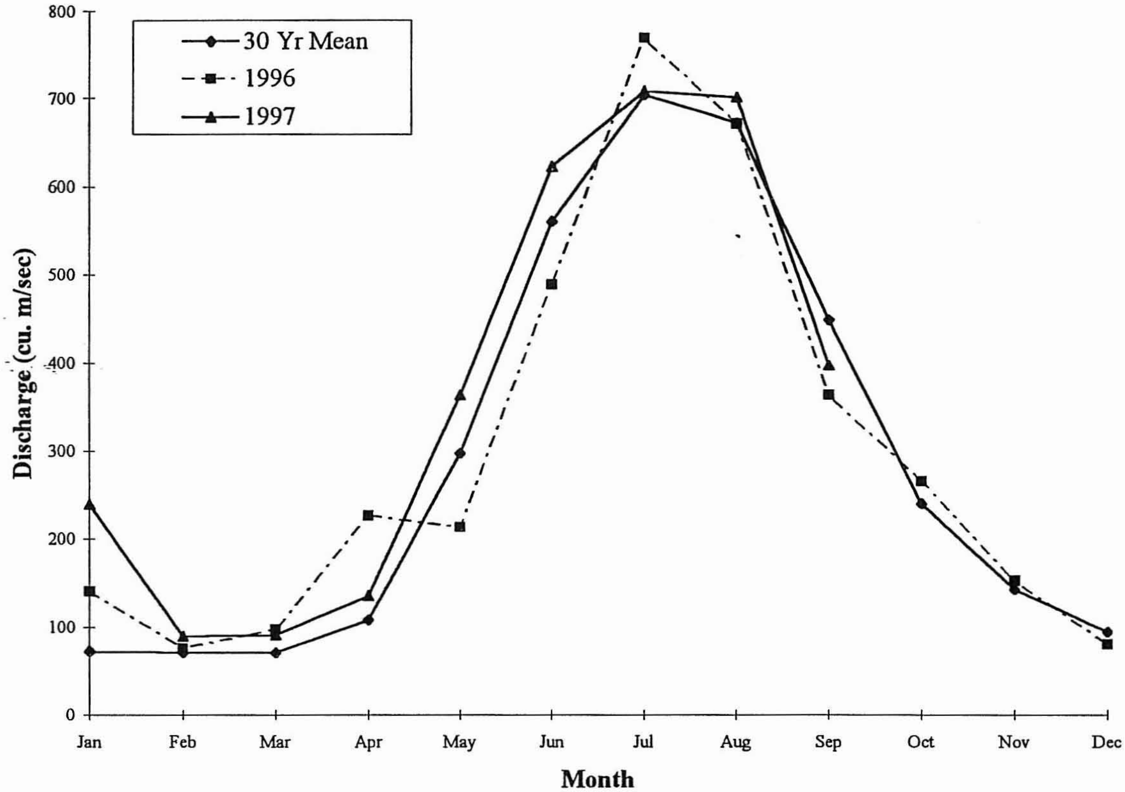

Fig. 5 Klinaklini River discharge.

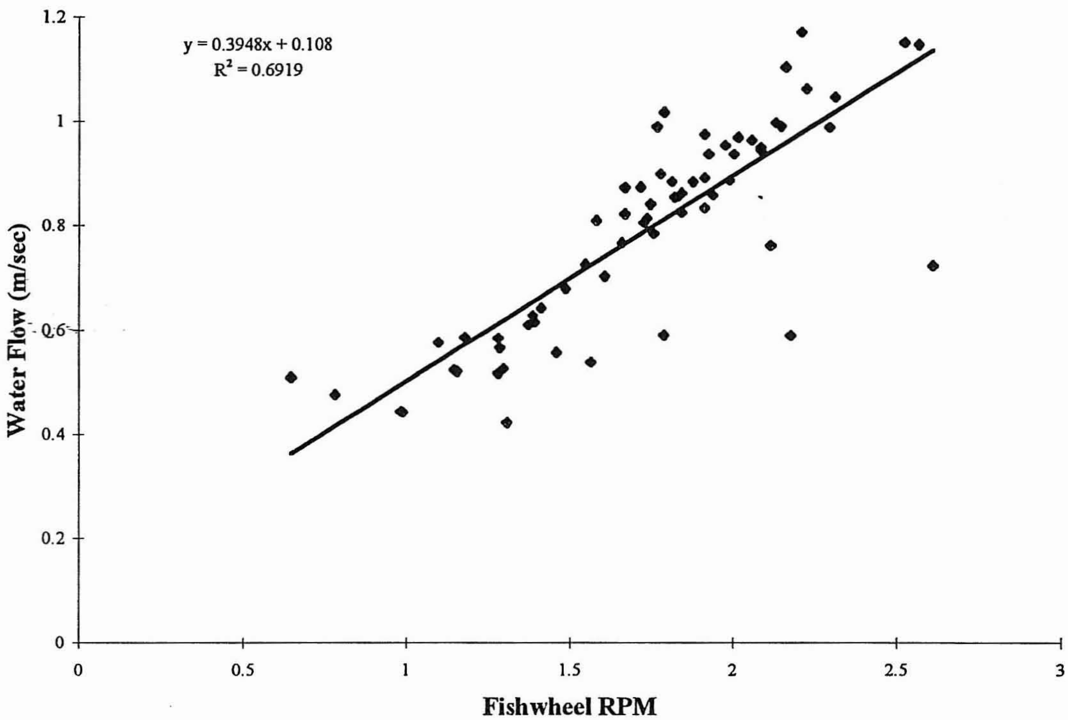

Fig. 6. Fishwheel rotational speed related to water flow, Klinaklini R., 1997.

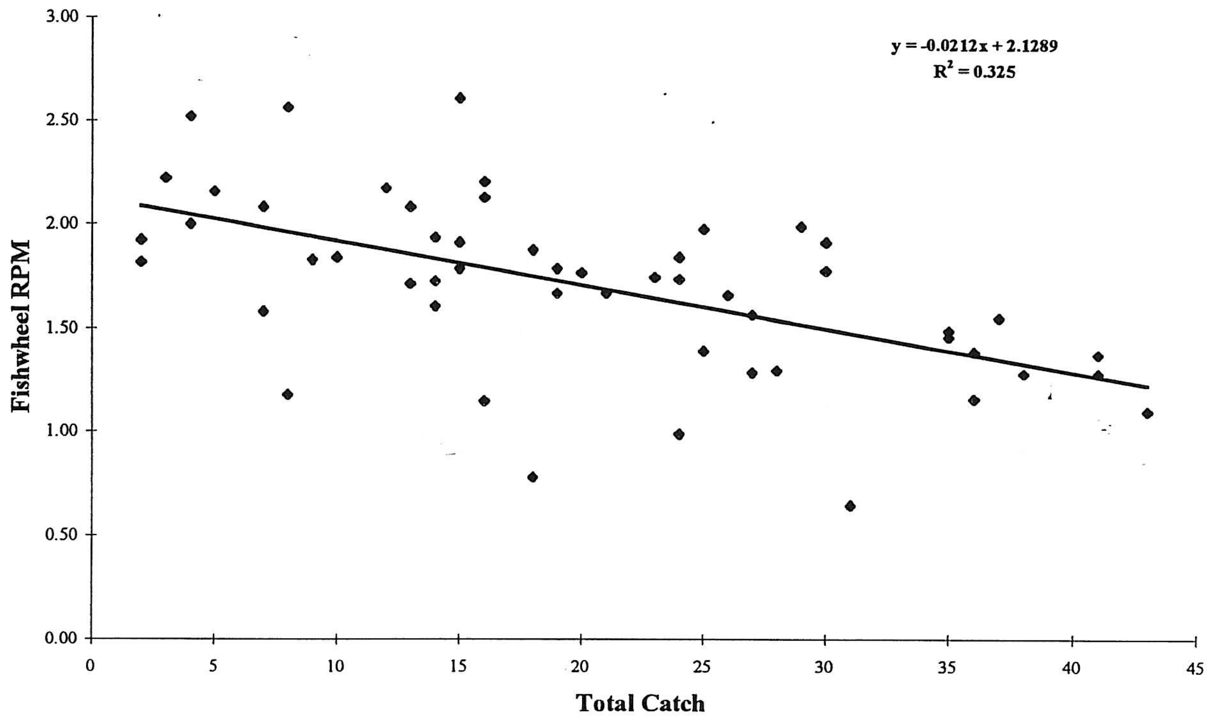

Fig. 7. Fishwheel rotational speed related to catch, Klinaklini R., 1997.

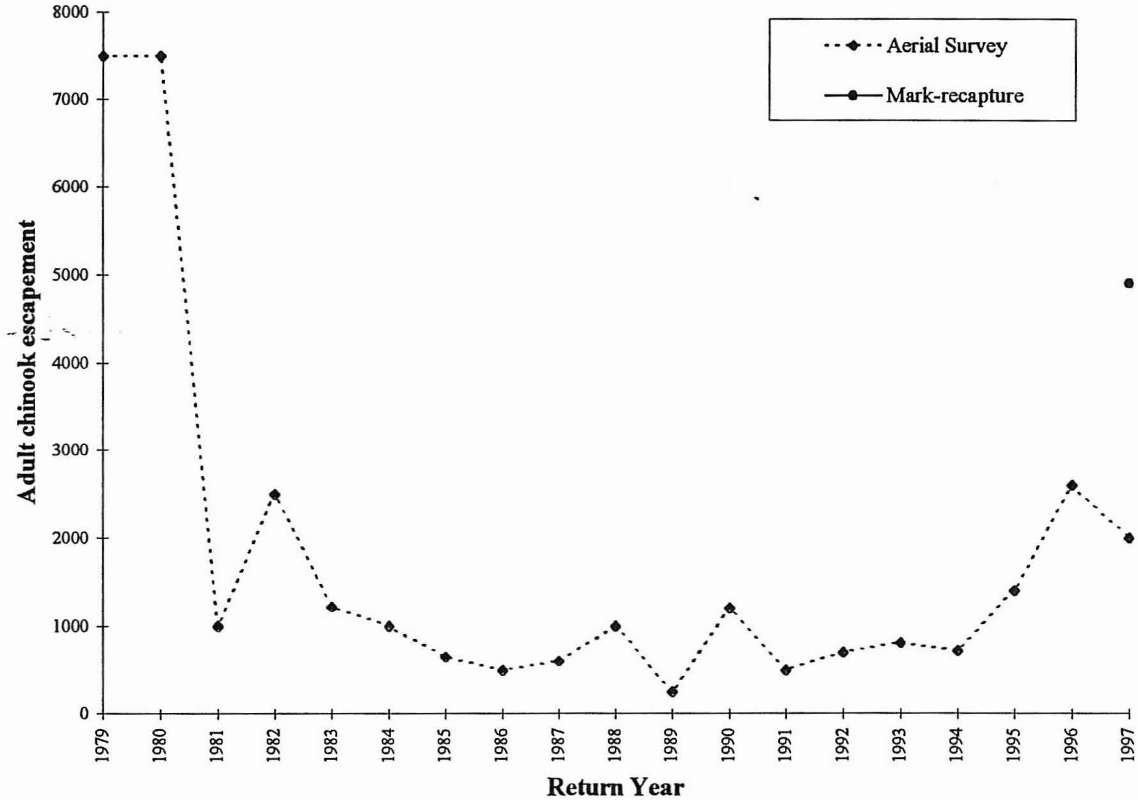

Fig. 8. Chinook escapement estimates, Klinaklini system, 1979-97.