

419 pp

BC 068

SALMON STOCK REBUILDING:  
A LONG TERM MANAGEMENT PLAN

VOLUME I

DRAFT - DO NOT COPY

Department of Fisheries and Oceans

13 December 1984

## 7.8 Statistical Area 8

Statistical Area 8 is located on the central coast of British Columbia north of Vancouver Island (Fig. 7.8-1). For fisheries management purposes, Area 8 has been subdivided into six sub-areas, as follows:

1. North Bentinck Arm
2. South Bentinck Arm
3. Upper Dean Channel
4. Dean Channel Closed (Dean Closed)
5. Burke Channel
6. Fisher Channel and Fitz Hugh Sound (Fisher/Fitz)

*perhaps needs a split?*

Each of the sub-areas will be treated independently for the purpose of these discussions. Detailed information with respect to stock attributes and current fishing patterns in Area 8 can be found in Appendix B.

### 7.8.1 Stock Description

#### 7.8.1.1 North Bentinck Arm

##### Sockeye

Atnarko River sockeye is the only active sockeye stock in North Bentinck Arm. There are no passive stocks. The stock is depressed but rebuilding with a target escapement of 75,000. Atnarko sockeye are assumed to migrate up both Burke and Dean Channels.

##### Pink

Atnarko River pinks are the dominant stock in Area 8. The target escapement is 1 million. The even cycle year was reduced to 100,000 following floods in 1980 but has increased to 650,000 in 1984. The odd year cycle is at optimum escapement levels.

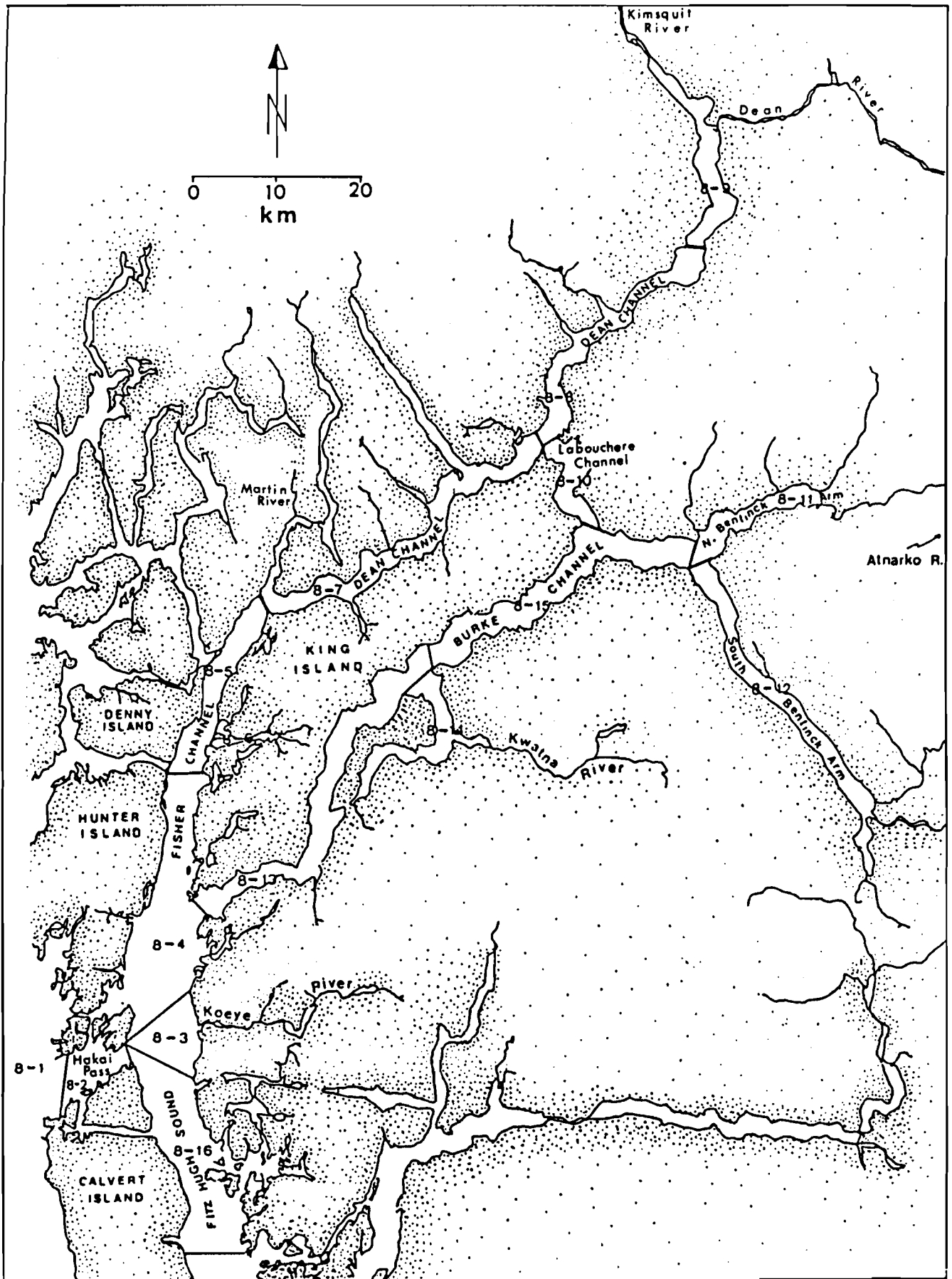


Figure 7.8-1. Statistical Area 8.

Atnarko pinks are fished by seine and gill nets in the Fisher/Fitz and by gill net in the Bella Coola Gillnet Area (Management Units 8-10, 8-15). The Atnarko pink stock migrates through Dean and Labouchere channels as well as through Burke Channel. The proportion of fish that use either route is unknown.

There are three passive pink stocks in North Bentinck Arm. Both cycles are depressed and fluctuate considerably below the combined target of 36,000. Timing and other characteristics are assumed to be similar to those of Atnarko pinks.

#### Chum

There are one active and three passive chum stocks in the North Bentinck Arm sub-area. There are two components of the active stock: the Bella Coola summer chum have an escapement target of 60,000; while the Bella Coola fall chum have a target of 20,000. Summer and fall chum are differentiated not only by timing but by size. Summer fish are larger with an average weight of about 8 kg while fall fish have an average weight of 4.5 kg. The summer chums in the Bella Coola system are enhanced at the Snootli Creek facility.

Collectively, the three passive stocks are depressed but stable at about 30% of the escapement target of 15,500. Timing of the passive stocks is similar to that of Bella Coola summer chums.

#### 7.8.1.2 South Bentinck Arm

There are no actively managed stocks in the South Bentinck Arm sub-area. In general, this is a very isolated area with highly turbid glacial streams, which makes any reasonable assessment of stock strength very difficult.

There are two passive sockeye stocks with a combined target escapement of 50. There are four passive pink stocks of which the even year cycle is severely depressed while the odd year cycle is depressed but stable. Both cycles are far below a combined target escapement of 45,500. Finally, there are four passive chum stocks. They are depressed but stable at less than 10% of the combined target of 21,250.

South Bentinck stocks are thought to have migration timing similar to North Bentinck Arm active stocks.

#### 7.8.1.3 Upper Dean Channel

##### Sockeye

There are two sockeye stocks in Upper Dean Channel. The actively managed Kimsquit sockeye are increasing and approaching the target escapement of 30,000. The passively managed Dean sockeye is a very minor stock and is severely depressed. Kimsquit sockeye are believed to migrate up Burke and Labouchere Channel as well as up Fisher and Dean Channel (i.e., either side of King Island).

##### Pink

There are four passively managed pink stocks in the Upper Dean Channel sub-area. Escapement is depressed and fluctuating far below a collective target of 71,500. As with Kimsquit sockeye, these fish are thought to migrate up both sides of King Island.

##### Chum

The actively managed Kimsquit chum stock is depressed, but seems to be rebuilding towards a target escapement of 60,000. The four passive chum stocks assigned to this sub-area are very depressed and declining. The target is 25,100; however, recent escapements have been below 1,000 for the group. As with pink and sockeye, there is some evidence that Kimsquit chum use both sides of King Island as a migration route.

#### 7.8.1.4 Dean Closed

##### Sockeye

There are only two very small passive stocks of sockeye. Escapements are low but the target for the sub-area is only 200.

Pink

As with sockeye, there are no active pink stocks in this sub-area. The seven passive stocks have a total target escapement of 76,500. The even cycle is depressed and declining while the odd cycle is slightly depressed and fluctuating. These stocks are present in the Fisher/Fitz fishing area during the latter half of July.

Chum

The six early chum stocks in the Dean Closed sub-area are collectively managed as one active group. There are no passive chum stocks. The Martin chum stock, the only late or fall chum stock in this sub-area, is also actively managed. The early group is moderately depressed but stable. The Martin stock is building and a fishable surplus is expected in 1985.

7.8.1.5 Burke ChannelSockeye

The only sockeye stock is the passively managed Kwatna River sockeye, with an escapement of less than 100.

Pink

While there are no actively managed stocks in the sub-area, there are three passive stocks with a relatively large combined escapement target of 115,000 of which the Kwatna accounts for 100,000. The even cycle is depressed as a result of severe flooding in 1980, but the odd cycle exceeded the target in 1983. The timing of these stocks through the Fisher/Fitz fishing area is coincident with Atnarko River pinks (see 7.8.1.1 North Bentinck Arm).

Chum

As with sockeye and pink, there are no active chum stocks in the Burke Channel sub-area. The three passive stocks have a combined escapement target

of 35,000. The current status is depressed and declining. The timing through the Fisher/Fitz fishery is as noted above for Burke Channel sub-area pink stocks.

#### 7.8.1.6 Fisher/Fitz

##### Sockeye

The sub-area contains one active and four passive sockeye stocks. Koeye River, the active stock, is depressed but stable and supports only local Indian food fisheries. Koeye sockeye are present in the Fisher/Fitz fishing area in June, prior to the commencement of commercial fisheries. The only target fishery is a local Indian food fishery. The four passive stocks are also depressed but stable.

##### Pink

As with sockeye, there is only one actively managed pink stock, Koeye River. Koeye pinks are fluctuating near optimum in both cycles. There are six passive pink stocks in the sub-area. The passive stock even cycle is declining, while the odd cycle has been building strongly. Fisher/Fitz pinks are comparatively later than other Area 8 pink stocks.

##### Chum

There are no active chum stocks in Fisher/Fitz. Escapement in the seven passively managed chum stocks in the sub-area are depressed and fluctuating between 10% and 30% of optimum.

#### 7.8.2 Salmon Enhancement Activities

Enhancement activities in Area 8 have a relatively lengthy history. A pilot hatchery was built and operated in 1975 to revitalize the declining odd year Atnarko pink stock. The objective of this pilot project was to increase the escapement of odd pinks to over 100,000. The Atnarko pink stock recovered quickly and, since the facility was in Tweedsmuir Park and the Park Use Permit was due to expire, the hatchery was closed and removed in 1979.

The only notable current enhancement activity in Area 8 is the Snootli hatchery, on the Bella Coola system. The Snootli hatchery is a Japanese style chum hatchery. The original intent of the hatchery was to produce enough summer chum to allow the pink fishery to continue at an efficient exploitation rate without adversely affecting the summer chum population. In addition to chum, the hatchery also produces chinook, coho and steelhead.

The summer chum are taken from all of the major stocks in the Bella Coola area. These include Salloompt, Snootli, Necleetsconnay, Thorsen, Nuhalk, Fish, Klonnick and Airport Slough. In 1983, 35 to 50% of the returns to some spawning areas were attributable to hatchery production. The hatchery capacity is a total of 10 million chum eggs. Actual egg takes ranged from 2 to 3 million in the 1979 to 1981 period; the 1982 to 1984 egg takes are tabulated in Table 7.8-1.

Table 7.8-1. Eggs taken for chum production at Snootli hatchery (1982-1984).

Year	Summer Chum Egg Take Totals
1982	4.3 million
1983	7.9 million
1984	8.5 million

Small scale pilot egg takes are being undertaken in the Noetok and Taleomey systems in South Bentinck Arm in order to test the feasibility of outplanting these stocks from the Snootli hatchery.

### 7.8.3 Fisheries Managed

There are three principal commercial fishing areas in Area 8. These are the Fisher Channel/Fitz Hugh Sound seine and gillnet fisheries (M.U. 8-2, 8-3, 8-4 and 8-5), the Dean Channel Gillnet Area (M.U. 8-8) and the Bella Coola Gillnet Area (M.U. 8-10, 8-15). The stock migration timing through the three fishing areas is illustrated in Figure 7.8-2.

N.B. M.U. 8-11 & 8-12 are also part of the BCGMA & are actively managed. They are closed quite often due to stock strength & quality. They remain open early in the season. As Snootli hatchery increase 8-11 may have to be fished harder.

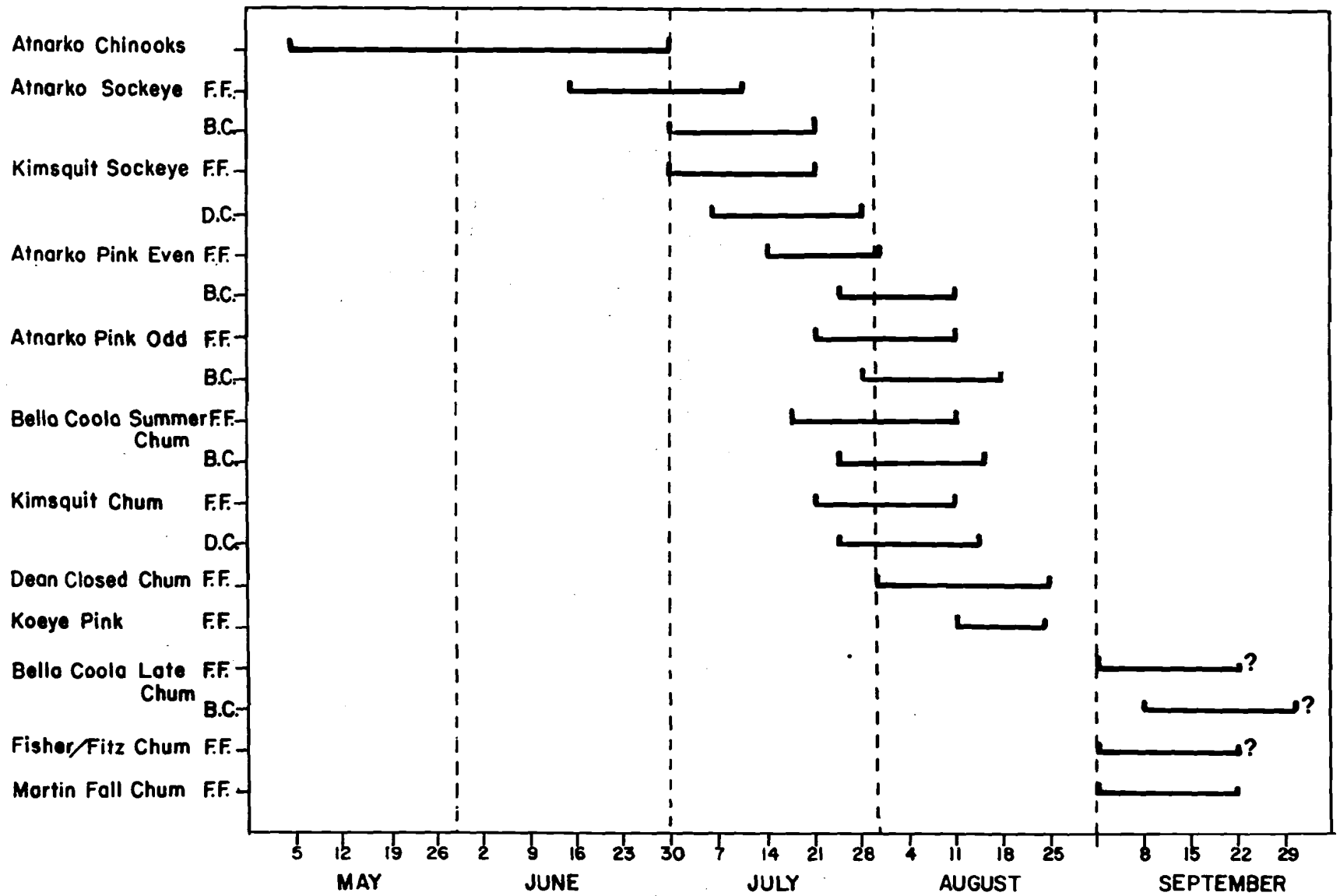


Figure 7.8-2. Stock migration timing through the Area 8 fisheries. (F.F = Fisher/Fitz; D.C = Dean Channel Gillnet; B.C = Bella Coola gillnet).

The earliest fishery typically begins in mid-May and targets on chinook stocks. The fishery uses large mesh gill nets in Fisher/Fitz, Dean Channel and Burke Channel. The chinook fishery in Area 8 has not operated in recent years due to low stock levels; however, a surplus is possible in 1986 and a commercial test fishery is planned.

Fishing for sockeye does not begin until the first week of July, when the area is opened to small mesh gill nets. This fishery is spread over the Bella Coola, Dean Channel and Fisher/Fitz areas. Kimsquit sockeye are usually a week or more behind Atnarko sockeye, which normally peak in the second week of July in ~~Dean Channel~~ Gillnet Area, with Kimsquit sockeye peaking a week later.

*Bella Coola*

Atnarko sockeye are managed principally using catch data that include mean catch per drift in the Bella Coola Indian food fishery and catch data from the Bella Coola and Fitz Hugh fisheries. Kimsquit sockeye are managed similarly, although in 1984 a charter test fishery in Upper Dean Channel was instituted, which should become useful as an in-season measure of escapement.

Atnarko pink and Bella Coola and Kimsquit chum begin to show as incidental catches in the sockeye fishery during the week of July 8 to 14, but July 15 to 21 is generally the first week that pink and chum are targeted. July 15 to 21 is also the first week that seines are permitted to fish in Fisher/Fitz Hugh Sound. Management is initially based primarily on expectations, but as the season progresses emphasis is shifted to catch data and escapement data. Quality also becomes important in late July for chum and in early August for pinks. The Dean Channel charter test fishery will serve as an escapement test fishery once it is calibrated. July 29 to August 4 is the peak week for even cycle Atnarko pinks, as well as for both Kimsquit and Bella Coola chums. August 5 to 11 is the peak week for fishing odd cycle year Atnarko pinks. Dean Channel Closed chum begin to appear during the week of 5 to 11 August. During the week of 12 to 18 August, the inside pink and chum stocks tail off and the fishery shifts to outer Area 8 stocks. This is the peak week for Koeeye pinks and for Dean Closed chum, both of which are managed first to expectations and later to catch and escapement data. By the last week in August

the fishery for pinks and summer chums is over, unless the late summer or early fall chum run is very strong, when there would be a fishery during the week of 25 August to 1 September. By 25 August, the seines are finished in Area 8 for the season.

If a surplus of fall chum is available, the Bella Coola Gillnet Area could be opened ~~the first week~~ <sup>in mid</sup> of September. Fisher Channel, or possibly Cousins Inlet, could also open for Martin River fall chum ~~the first week of~~ <sup>in mid</sup> September. The peak week for both fall chum stocks is believed to be 9 to 15 September. The only time there would be a fishery during the week of 16 to 22 September would be if escapements for fall chums were met, otherwise Area 8 is closed for the balance of the season.

#### 7.8.4 Conflicts in Current Management Approach

##### 7.8.4.1 Management Uncertainties

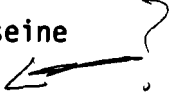
Salmon return to the Dean and Bella Coola area streams by two basic routes, either through Dean or Burke Channel. The Atnarko pink and sockeye, Bella Coola chum and Kimsquit sockeye and chum all migrate in unknown proportions through these two routes. This is further confounded by uncertainties about the migration routes of these stocks in the outside areas. The entry into Fisher Channel can be made either through a variety of routes in Area 7, or through Fitz Hugh Sound. Entry into Fitz Hugh Sound can be made through Hakai Pass through Area 9 or from the North through Fisher Channel.

In summary, the complexity of alternative migration routes compounds the problems of interpreting in-season catch data for all the basic fishing areas.

##### 7.8.4.2 Mixed Stock Harvest

Proceeding chronologically, the Bella Coola River chinooks are targeted first with incidental catches of Dean River chinook. The present enhancement of Bella Coola chinooks increases the problem. There is a minor overlap between Bella Coola chinooks and Bella Coola sockeye but, because of the obvious differences in gillnet mesh size in the fisheries on the two stocks,

the only problem is a very minor interception of chinooks in the early July sockeye fishery.

There is a slight overlap in the timing of Bella Coola at Kimsquit sockeye in mid-July; however, little difficulty is experienced in maintaining a separate harvest of the two stocks. The Kimsquit sockeye, Atnarko even year pinks, Dean chum and Bella Coola chum are in the Fisher/Fitz area in mid to late July. The targeting of any of these stocks in the Fisher/Fitz seine fishery could have a serious impact on the Kimsquit sockeye stock. 

The mixed stock problem is more severe from late July to the third week of August. The mixed stock conflicts are between Atnarko pinks, Bella Coola chum, Kimsquit chum and to a lesser degree the Dean Closed Area chums. The Atnarko pinks are a productive stock and the exploitation rate of stocks in Fisher/Fitz Hugh Sound has (in the past) been dictated by the harvest of Atnarko pinks. The major conflict in the past was with Bella Coola chums; however, these stocks are now enhanced and the stocks should be able to sustain the high exploitation rates directed at Atnarko pinks. Unfortunately, the remaining two stocks (Kimsquit and Dean Closed chums) cannot sustain high exploitation rates.

The interception of Area 8 stocks in Area 7 was a major problem that has been resolved largely by altering the fishing areas and delaying the opening data of the Area 7 fishery. Interceptions still occur in the Seaforth fishery.

#### 7.8.5 Rebuilding Potential

##### 7.8.5.1 North Bentinck Arm

Atnarko sockeye are responding slowly to current management. Rebuilding has been slowed by the escapement losses from commercial test fisheries to assess stock abundance.

*Perfect comment, very appropriate.*

The even year Atnarko pink stocks were devastated by flooding in 1980 (a return of 100,000 from 1,000,000 brood year escapement). Fortunately, the

*What about the  
small spawning chum  
idea*

stock rebounded to 650,000 in 1984. The odd year stock is at optimum. No further actions are necessary to maintain or rebuild Atnarko pinks. There is no potential to actively manage the passive pinks in this sub-area.

The Bella Coola summer run chums are enhanced, with escapements from 1985 onwards expected to be at target levels. The passive stocks are very minor and will continue to be passively managed.

#### 7.8.5.2 South Bentinck Arm

There are only two minor passively managed sockeye stocks in the sub-area, which will continue to be passively managed. The four minor pink stocks are passively managed with no potential options for rebuilding. Enhancement of these stocks is not considered a viable option at present. The chum stocks in South Bentinck are harvested with the North Bentinck chums. Enhancement of these stocks has been recommended to prevent over-exploitation in Bella Coola chum fisheries.

#### 7.8.5.3 Upper Dean Channel

Kimsquit sockeye are strongly affected by the Atnarko pink fisheries.)<sup>?</sup> The potential to rebuild is limited by our present management scheme. The Upper Dean pinks will probably not rebuild unless the exploitation rate in the Atnarko pink fishery in Fisher/Fitz area is reduced.

The Kimsquit chum escapements have benefited from the relatively low exploitation of Atnarko pinks and Bella Coola chums in recent years; however, the anticipated high harvest rates on these stocks in future years may reduce the production from Kimsquit chums. The passive chum stocks in the area will remain as passive stocks and probably will not rebuild.

#### 7.8.5.4 Dean Closed

The two small passively managed sockeye stocks will continue to be passively managed. The passively managed pink stocks may benefit from Area 7 closures. The Dean Closed chum group is actively managed at present and

should slowly increase under current management practices. The achievable production is limited by the problems associated with harvesting the six stocks together. No spatial or temporal separation appears possible.

#### 7.8.5.5 Burke Channel

The Kwatna sockeye stock is essentially extinct. The Kwatna pink stocks are listed as passively managed, since the Kwatna escapement trends tend to mirror Atnarko pinks; thus, conflicts are unusual. No active management appears to be required. The odd year stock is at optimum and the even year is recovering from a 1980 flood. The Burke chums will probably decline from the increased exploitation required to harvest Atnarko pinks and Bella Coola chums.

#### 7.8.5.6 Fisher/Fitz

Koeye sockeye and the sub-area passive sockeye stocks remain severely depressed. The stocks could be rebuilt if the Indian food fishery was reduced. Target escapements for Koeye pinks could be achieved if escapement losses to commercial test fisheries could be reduced. The passively managed pink stocks are severely depressed and will probably remain so.

The passively managed chum stocks are at low levels despite the absence of terminal exploitation. The timing of these stocks is sufficiently late such that few mixed stock problems with local stocks should exist, with the exception of Martinfall chums or Bella Coola late chums.

### 7.8.6 Management Options for Rebuilding

#### 7.8.6.1 Environmental

A spawning channel for Atnarko pinks is being considered at present. It would not be intended as a production facility, but rather as a spawning area shielded from the effects of major floods. The rationale behind the program is to reduce the rebuilding time after major floods by maintaining a moderate return level independent of environmental conditions.

#### 7.8.6.2 Management Uncertainties

##### In-Season Catch Data

An analysis of the in-season use of catch data as an indicator of abundance would be useful for a number of fisheries.

In order of priority, the catch data analysis of the following fishery stock combinations would be desirable:

1. Fisher/Fitz seine nets on pink;
2. Fisher/Fitz gill nets on chum;
3. Bella Coola gill nets on chum;
4. Dean Channel gill nets on chum;
5. Bella Coola gill nets on sockeye;
6. Dean Channel gill nets on sockeye;
7. Fisher/Fitz seine nets on chum;
8. Bella Coola gill nets on pink; and
9. Bella Coola gill nets on chinook.

##### Test Fisheries

In 1984 a charter test fishery was initiated for Kimsquit sockeye and chum salmon. The program was a success and will be continued. Moreover, the usefulness of the information will increase as more data are added each season. In a similar vein, charter test fisheries would be particularly valuable in the Bella Coola gillnet area for chum and also a charter test seine operation in Fitz Hugh Sound for Atnarko pink salmon.

##### Migration and Timing of Kimsquit Sockeye and Chum

Although improved information on migration routes and timing is a universal requirement, the situation in Area 8 deserves special attention, since the proportion of Kimsquit sockeye and chum migrating through Burke Channel is of particular interest.

In order to reduce the exploitation of Kimsquit sockeye and chum from the fisheries targeting upon North Bentinck stocks (Bella Coola chum and Atnarko pinks) in the Fisher/Fitz area, the fishery could be moved into Burke Channel. To evaluate the potential effectiveness of this action, data must be obtained on timing, speed of movement and the proportion of Kimsquit sockeye and chum using the Burke Channel - Labouchere Channel route. Therefore, a tagging study in Burke Channel and the Bella Coola gillnet area is recommended.

#### In-Season Monitoring of Bella Coola Hatchery Chum Marks

A proportion of the chums released from Snootli hatchery on the Bella Coola River are fin-clipped as part of hatchery experiments. The proportion of tags in the commercial fisheries can indicate the relative abundance of hatchery fish in the catch, as well as the timing and pattern of migration of the Bella Coola chums. This information is also pertinent for an evaluation of moving the Fisher/Fitz fishery into Burke Channel (see above).

The data must be recovered in a timely fashion (i.e., in-season); therefore, the ability to initiate a sampling program for marks in the commercial catch and summarize the results in-season should be investigated.

#### 7.8.6.3 Effort Control

A capability to limit the number of vessels allowed to fish during commercial openings would permit more controlled commercial test fisheries. This is a particular problem for potential late chum fisheries, specifically Martin River and Bella Coola fall chums.

Discussions with industry should be initiated which explore options to limit effort in fisheries where only a small harvestable surplus is available.

#### 7.8.6.4 Mixed Stock Harvest

##### Protection of Kimsquit Sockeye and Dean Steelhead

There are no serious mixed stock problems with Atnarko sockeye. They are presently fished in both the Bella Coola gillnet area (M.U. 8-10, 8-15) and Fitz Hugh Sound (M.U. 8-3, 8-4). The exploitation could be restricted to the Bella Coola gillnet area with no significant loss of quality if the interception of Kimsquit sockeye on Dean steelhead in Fitz Hugh Sound was identified as a problem. A more severe restriction would be to move the fishery to the inside portion of M.U. 8-15 and the outer portion of M.U. 8-11. This measure would be considered only if significant interceptions of Kimsquit sockeye or Dean steelhead occurred in Burke or Labouchere Channel. The measure is considered extreme, because the fleet would be cramped into a very small area and there would be a significant loss in quality, particularly in the latter part of the run. The latter portion of the Bella Coola chinook run overlaps with the timing of the fishery for Atnarko sockeye but, because of the small mesh used for sockeye, the incidental catch is considered to be very small.

##### Move Fisher/Fitz Fishery to More Terminal Areas

The harvest of Atnarko pink stock dominates the Area 8 fisheries. The Atnarko pink stock is highly productive (mean return rate since 1950: 3.9 even, 2.5 odd) and the exploitation rate in Fisher/Fitz area is generally dictated by the harvest of the stock. One commonly suggested solution to reduce the mixed stock problem is to move the fishery into Burke Channel or the Bella Coola gillnet area. This option, if proposed, would be controversial because of the problems to industry that would result. These problems include the following:

1. constraining the fleet into a much smaller fishing area;
2. moving seines into a non-traditional area;
3. loss of traditional fishing areas;
4. loss of associated local expertise; and
5. loss of quality.

Obviously, to justify a move with such impacts would require a well documented rationale with the benefits of the change clearly defined. This cannot be done without an elaborate study of stock migration patterns and timing. One cannot simply assume that major benefits would accrue from implementing this option. As an example, if it is assumed that North Bentinck and South Bentinck stocks migrate in equal proportions through Fisher-Dean and Burke channels, and that Dean stocks also migrate equally between these two routes (the simplest case), then there are no benefits from moving the Fisher/Fitz fishery anywhere except to the extreme terminal areas of Upper Dean Channel or North Bentinck Arm. This is simply because the proportion of each stock in all areas is equal (except in the extreme terminal areas); thus, the relative catch of each stock would remain the same, given that the total catch was equivalent. The assumptions outlined above are probably false; however, the option cannot be evaluated in the absence of reliable migration information.

In summary, studies of stock timing and migration patterns are required prior to any drastic changes in the exploitation pattern for Atnarko pink stocks.

#### Harvest Increased Production of Bella Coola Chum in the Bella Coola Gillnet Area

Bella Coola chums are enhanced in the Snootli hatchery. The basic enhancement strategy is to take brood stock from seven discrete areas in the Bella Coola system, and release the fry from the hatchery back into the area from which the brood stock is taken. This strategy assures the optimum spawning population in the Bella Coola system, and increases the overall productivity by adding enhanced production to the natural escapements. The enhancement of any of the seven stocks within the Bella Coola system could be adjusted in response to changes in the abundance of these sub-stocks. Straying studies are being conducted by the Snootli hatchery staff, and adjustments will be made if the information indicates that some of the presently defined substocks are in fact not separate. In summary, the Bella Coola chum stock is considered as one for this

exercise, as no conflicts are expected between stocks in the Bella Coola system.

The harvest of these enhanced Bella Coola chums will require a higher exploitation rate, which will conflict in particular with the South Bentinck Arm chums. The only realistic solution is to enhance the South Bentinck chums through the Snootli hatchery. If the required increased exploitation rate is applied in Fisher/Fitz area, it will impact on the other stocks migrating through the area. In particular, if more Kimsquit chums migrate through Fisher-Dean Channels than through Burke, there would be a reduced exploitation on the Kimsquit chum stock if the required increased exploitation of North Bentinck chums was applied in the Bella Coola gillnet area. This option would not impact on weak Atnarko pink runs if the gear was restricted to large mesh gill nets, and the loss of quality should be minimal. Another consideration that must be addressed, if this option is instituted, is the allocation of the increased production from the Snootli facility to the gillnet fleet.

In summary, any required increase in the rate of exploitation on Bella Coola chum should be applied in the Bella Coola gillnet area (M.U. 8-10, 8-15) rather than in the Fisher/Fitz area (M.U. 8-3, 8-4, 8-5).

#### Protection of Upper Dean Channel Stocks

The option of moving the Atnarko pink and Bella Coola chum fisheries out of the Fisher/Fitz sub-area would benefit all Upper Dean Channel stocks (see above for a full discussion).

#### Protection of Dean Closed Pink Stocks

While there are no actively managed pink stocks in the sub-area, the strategies employed for chum salmon will affect the passive pink stocks. One such option is to restrict the Dean Closed fishery (i.e., management unit 8-5) to gill nets. Seine operations harvest the pink and chum stocks at the same exploitation rate. It should be noted that this

option would require a change in the traditional catch allocation by gear. A similar argument can be made for the Fisher Channel fishery, which intercepts Dean Closed stocks.

While conflicts arising from the harvest of the six actively managed Dean Closed chum stocks cannot be resolved, a reduction in the exploitation rate of Atnarko pinks or Bella Coola chums in the Fisher/Fitz area would benefit the Dean Closed chum stocks (see above).

The Area 7 Seaforth fishery in late July and early to mid-August is believed to intercept Dean Closed chum stocks. The movement of this fishery would benefit the sub-area's chum stocks (see 7.7.6 Management Options).

#### Protection of Burke Channel Stocks

Since the passive Kwatna sockeye stock is essentially extinct, there are no rebuilding plans. On the other hand, the passive pink stocks seem to be productive and no further action is required to assure their recovery.

The Burke chum stocks will probably decline as a result of the anticipated high exploitation rates which will be directed at Bella Coola chum and Atnarko pink stocks. The option of moving the Atnarko pink and Bella Coola chum fisheries out of the Fisher/Fitz sub-area would benefit the Burke Channel chum stocks (see above).

#### Protection of Fisher/Fitz Stocks

The only option in the Fisher/Fitz sub-area is to rebuild Koeve River sockeye through limiting the native food fishery. A mixed stock problem does not exist for pinks and, for chums, the currently minimal terminal harvest will be maintained.

### 7.8.7 Predicted Results

#### 7.8.7.1 Sockeye

Area 8 has two actively managed sockeye stocks. Management actions have been undertaken to reduce the mixed stock fishery impacts on these stocks and it appears that they will be able to rebuild over the twenty year time horizon. Projected long-term catch for Atnarko sockeye is 39,000 pieces and for Kimsquit is 21,000 pieces (Table 7.8-2).

#### 7.8.7.2 Pink

The Area 8 pink fishery is dominated by Atnarko pink salmon populations. This mixed fishery affects other pink and chum salmon populations in the North Bentinck Arm, Upper Dean, South Bentinck Arm and Burke Channel management subunits. The effect of this management approach is projected in Table 7.8-3. Pink salmon catch, if optimum escapement can be maintained, should average 2,273,000 pieces. Chum catches should average 248,000 pieces. Escapement levels for the other stocks in this fishery are less than target escapements but appear to be stable.

In management subunit Dean Closed, the active chum stock aggregation drives the fishery. However, this factor causes a mixed stock conflict with passive pinks. Longer term catch projection for chum aggregation is 45,000 pieces, while the passive pink long-term projection is 68,000 (Table 7.8-4). Both stock aggregations appear to be building in escapement; therefore, no significant changes are anticipated.

The Fisher/Fitz management subunit is dominated by Koeve River pinks during the 12 to 19 August time period, which causes a mixed stock conflict with passive pink and chum stocks in the subunit. The catch projection for these stocks under this scenario is a long-term catch of 26,000 pink pieces and 10,000 chum pieces (Table 7.8-5). Escapement for passive stocks remain relatively constant but below target escapement levels. Any improvement in the catch of passive stocks will require forgoing a catch of Koeve pinks. Long-term catch for Koeve pinks under this approach is 180,000 pieces (Table 7.8-5).

Table 7.8-2. Projected catch trends for sockeye stocks in Area 8.

YEAR	RIVER	
	KIMSQUIT	ATNARKD
1	3259	6140
2	2857	6619
3	3176	22724
4	12922	9728
5	29232	11539
6	8370	11382
7	8389	23528
8	9633	39516
9	26497	25725
10	31808	29193
11	19026	34580
12	19997	55375
13	24962	56145
14	27106	47077
15	34515	54385
16	25759	56226
17	28008	68603
18	35549	79764
19	30564	69864
20	31077	72038
MEAN	20635	39007
PARAMETER VALUES		
PRODUCTIVITY/ VARIANCE	2.19/1.09	
AGE COMPOSITION	30% 4'S; 70% 5'S	
HARVEST COST		
MIXED	10%	
TEST	10%	

TABLE 7.8-3 PROJECTED CATCHES FOR MIXED FISHERIES WITH ATNARKO PINK STOCK AS THE TARGET.

YEAR	CATCH				
	ATNARKO PINK	ENHANCED CHUM	KINSQUIT CHUM	PASSIVE PINK	PASSIVE CHUM
1	115616	94808	14059	16814	10170
2	3081246	73263	23204	616230	27126
3	733272	152294	54943	62801	12332
4	2404730	160107	33961	344566	26821
5	1464540	153601	18821	168816	38899
6	2085892	219181	49315	360565	18513
7	1712986	183904	50814	217301	27694
8	1826320	178327	39914	379203	26672
9	2291232	192604	25961	256974	49831
10	2053910	208813	48662	348444	18352
11	2154772	203300	46033	266967	31797
12	2266442	198172	48912	387888	30633
13	2197850	187147	33011	329688	42187
14	1979956	182017	57048	320636	16958
15	2013919	197978	53811	312807	26575
16	2199672	188338	42602	324591	39230
17	2345150	198985	35723	236208	39728
18	2603956	212233	43259	293365	18112
19	2283965	172882	41613	191264	29667
20	1945484	175108	32782	267968	27465
MEAN	1988046	180538	39642	285155	27938
PARAMETER VALUES					
PRODUCTIVITY/ VARIANCE	3.25/4.46	4.72/1.84	2.36/1.84	3.25/4.46	2.36/1.84
AGE COMPOSITION	100% 2'S	10% 3'S; 90% 4'S	10% 3'S; 90% 4'S	100% 2'S	10% 3'S; 90% 4'S
HARVEST COST					
MIXED	10%	0%	0%	0%	0%
TEST	10%	0%	0%	0%	0%

Table 7.8-4. Catch projections for Dean Closed management sub-unit.

YEAR	CATCH	
	ACTIVE CHUM	PASSIVE PINK
1	52071	12305
2	27478	41389
3	16359	13763
4	22239	60666
5	53764	42717
6	43528	89563
7	33632	47298
8	38390	84386
9	53897	63751
10	44586	93500
11	47836	61019
12	57521	100587
13	56048	75210
14	43464	79105
15	49587	72064
16	48068	97113
17	48603	68546
18	51362	86882
19	58640	84460
20	54120	92137
MEAN	45060	68323
PARAMETER VALUES		
PRODUCTIVITY/ VARIANCE	2.36/1.84	3.25/4.46
AGE COMPOSITION	10% 3'S; 90% 4'S	100% 2'S
HARVEST COST		
MIXED	20%	0%
TEST	10%	0%

Table 7.8-5. Catch projections for Fisher/Fitz Hugh management sub-unit.

YEAR	CATCH		
	KOEYE ACTIVE PINK	PASSIVE PINK	PASSIVE CHUM
1	24125	4194	2271
2	59740	9528	11307
3	84192	11798	5798
4	151041	20810	5553
5	159505	21224	6753
6	187107	37359	20115
7	195253	27210	13982
8	207834	36387	5564
9	222817	31882	11613
10	203681	33856	18455
11	222128	27909	12150
12	232127	31705	5724
13	199308	24108	9815
14	197553	29652	16832
15	190594	26273	11682
16	213326	32794	4705
17	210236	23923	11467
18	251321	33581	14618
19	212112	26518	8777
20	199377	21746	5419
MEAN	181169	25623	10140
PARAMETER VALUES			
PRODUCTIVITY/ VARIANCE	3.25/4.46	3.25/4.46	2.36/1.84
AGE COMPOSITION	100% 2'S	100% 2'S	10% 3'S; 90% 4'S
HARVEST COST			
MIXED	10%	0%	0%
TEST	20%	0%	0%

## 7.9 Statistical Area 9

The major geographical components of Statistical Area 9 are Fitz Hugh Sound, Rivers Inlet and Owikeno Lake (Figure 7.9-1). Detailed stock attributes and current fishing patterns in Area 9 can be found in Appendix B.

### 7.9.1 Stock Description

The Owikeno sockeye stocks are considered as one actively managed group, with one small passively managed stock. There are four actively managed pink stocks in both even and odd years, as well as 15 passively managed pink stocks in both cycles. Finally, there are five actively and ten passively managed chum stocks.

#### 7.9.1.1 Sockeye

The Owikeno Lake sockeye stock is made up of those sockeye that spawn in the ten spawning areas in tributaries to Owikeno Lake. Owikeno sockeye are in the Rivers Inlet area from late June until early August. Peak weeks for the commercial fishery are the weeks 8 - 14 July and 15 - 21 July. The Owikeno sockeye target escapement was increased in 1980 from 500,000 to 1,000,000, which has reduced the surplus available for harvest. The five year average catch for 1971-75 was 450,000 compared to only 40,000 for 1979-83. Escapements in the 1970's averaged 380,000 while the average escapement for 1980-83 inclusive was 610,000. Beaver Creek in outer Rivers Inlet supports the only other sockeye stock in Area 9. This is a small, passively managed stock of only 100 fish.

#### 7.9.1.2 Pink

The four actively managed pink stocks in Area 9 are Clyak River, Chuckwalla River, Kilbella River and Johnston Creek. For the purposes of this discussion, Chuckwalla and Kilbella\* stocks have been combined, since their timing through the fishery is similar and the rivers have a common estuary.

The timing of pink migration through the fisheries in Area 9 is presented in Figure 7.9-2. Pink catches have been poor in recent years (1979-1983) after a period (1960's and 1970's) of relative stability. The recent poor catches reflect the stricter management of the resource coupled with extreme environmental problems (floods) in 1980 and 1982.

Clyak pinks were strong on the even year cycle until the extreme flood problems in 1980 and 1982. With a target escapement of 50,000 and no further environmental problems, there should be a surplus available to fisheries by 1986. The odd year cycle, however, is depressed but stable near 1,000. Chuckwalla pink stocks are depressed and both cycles appear to be declining. The even cycle is currently at about 10% of the target of 100,000 while the odd is near 20% of the target. Kilbella pinks have also been at very low levels in both cycles. Although the 1983 escapement was 20,000, escapements have been less than 5,000 in recent years, far below the target of 50,000. Johnston Creek pink stocks are slightly depressed but seem to be rebuilding toward the target of 90,000. Escapements in 1982 and 1983 were 70,000. Historically, the odd cycle seems to have been weaker, but this is no longer the case. The 15 passive pink stocks have a collective target escapement of 57,000. There were fairly good escapements in 1980 (41,000 total) but in general escapements have been depressed and fluctuating below 10,000.

#### 7.9.1.3 Chum

The five active chum stocks in Area 9 are Clyak River, Draney Inlet, Chuckwalla River, Kilbella River and Wannock River. As with pinks, the Chuckwalla and Kilbella stocks are combined because of coincidental timing and proximity of the river systems.

Timing of chum migrations through the fisheries is presented in Figure 7.9-2. Timing of the passively managed group is coincident with the Draney Inlet and Chuckwalla/Kilbella stocks.

Clyak chum stocks are depressed and fluctuating. The target escapement of 40,000 was achieved in 1982, but escapements before and since have been poor. Draney Inlet chum stocks are also depressed and fluctuating. The tar-

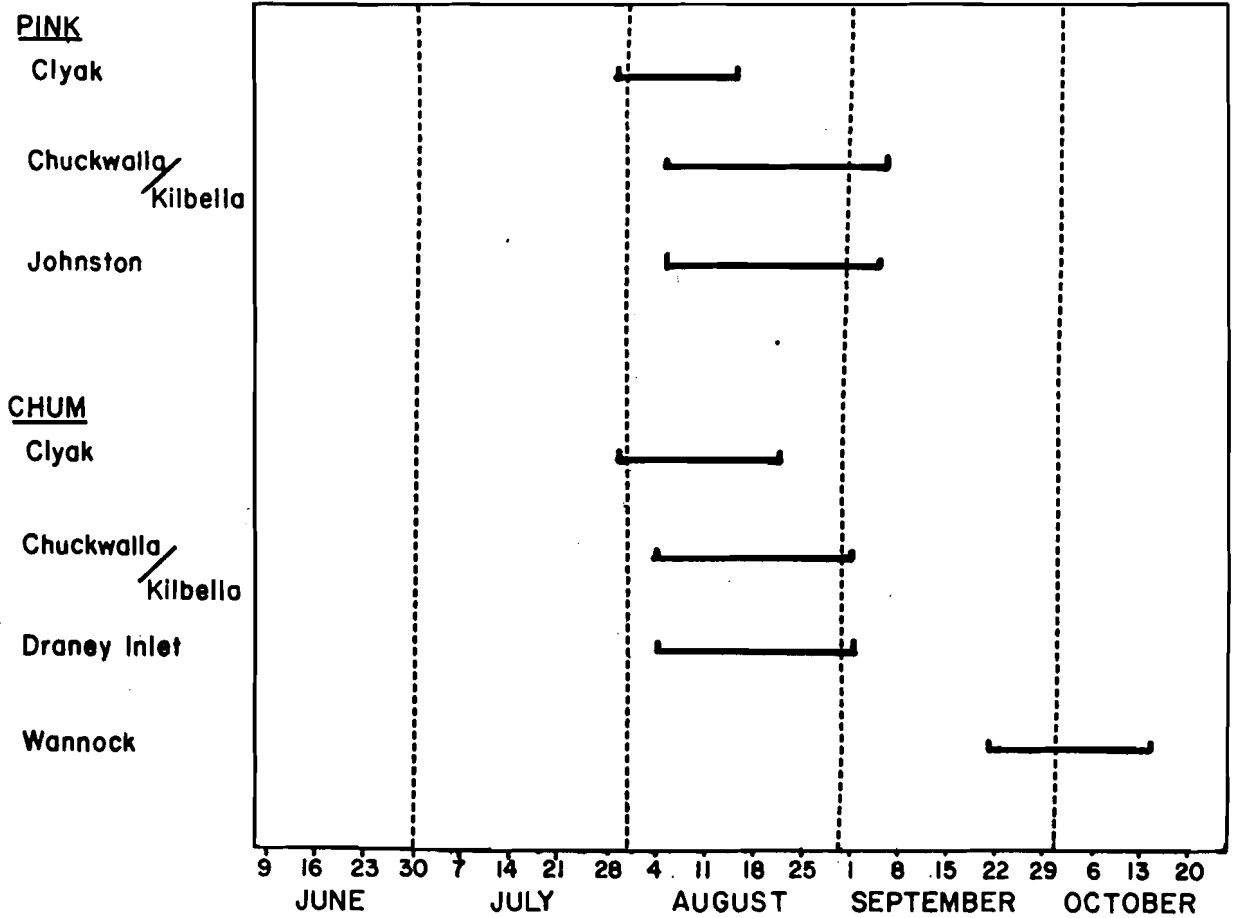


Figure 7.9-2. Stock migration timing through the fisheries in Area 9.

get escapement of 20,000 was exceeded in 1982; however, escapements have generally been between 25% and 50% of the target escapement. Chuckwalla and Kilbella chum stocks are also depressed and fluctuating below 20% of the target escapements of 25,000 and 5,000, respectively. Wannock chum stocks are depressed but appear to be rebuilding slightly. Recent escapements have been less than half of the target of 40,000. The ten passively managed chum stocks are very depressed and fluctuating around 10% of the combined target of 51,000 for the area.

#### 7.9.2 Fisheries Managed

Fisheries management for salmon in Area 9 normally commences during the week 24 - 30 June. The target stock is Owikeno sockeye. Sockeye continues as the only target stock until the week of 29 July to 4 August when Clyak pink and chum begin to appear in the fishery. Management for sockeye is very discrete in Rivers Inlet as the only incidental catches of note are Chuckwalla/Kilbella chinook in the first two weeks, and Clyak pink and chum in the final week. The fishery is managed to escapement using an echo-sounding program to estimate escapement past the fishery. The only boats operating in Area 9 are gillnetters.

During August the Rivers Inlet fishery is managed as a mixed pink and chum fishery. This is considerably more complex than the sockeye fishery because there are eight active stocks involved (for pink: Clyak, Chuckwalla, Kilbella and Johnston; for chum: Clyak, Chuckwalla, Kilbella and Draney Inlet). In addition, the incidental catch includes Owikeno sockeye, all of the pink passive stocks, all of the chum passive stocks and Wannock chinook. The pink/chum fishery is managed to escapement using catch data and then escapement data as the season progresses.

After the mixed pink/chum fishery, there is no commercial fishing activity in Rivers Inlet until the last week in September, when there may be a fishery for late chums heading to the Wannock River. As with the previously described fisheries, this fishery is also managed to escapement. Wannock chum may contribute to a commercial fishery up to the week 7-13 October. The only incidental catches may be some local coho.

After 13 October the Rivers Inlet commercial salmon fishery is closed for the balance of the season.

### 7.9.3 Salmon Enhancement Activities

During the first phase of the Salmonid Enhancement Program (SEP), enhancement activities in Area 9 were extremely limited, and included no large scale projects. Some small projects were undertaken by the Owikeno Band under a Job Creation Project in 1982, but none of these projects will affect the stocks of fisheries management to any noticeable extent. For the past two years (1983, 1984), staff from the Snootli hatchery have worked with the local band to take eggs from Wannock chinook for incubation at Snootli. This is part of a concerted effort to halt the decline of a unique chinook stock.

### 7.9.4 Conflicts in Current Management Approach

#### 7.9.4.1 Management Uncertainties

In Area 9, the buildup of sockeye at the head of Rivers Inlet is estimated by echo-sounding, which thus provides an estimate of the sockeye escapement through the fishing area. The program is most appropriate and useful for small run sizes in which catch information is not available to confirm stock abundance. Without the echo-sounding program, more commercial test fisheries would have to be operated. Predicting stock abundance in-season in Area 9 is a problem for all species, especially sockeye because of its prominence.

#### 7.9.4.2 Mixed Stock Harvest

There is essentially no mixed stock problem for Rivers Inlet sockeye. There are only minor interceptions of southerly migrating stocks to Smith Inlet, and also to sockeye coming through Hakai-Fitz Hugh Sound from the north. A mixed stock problem occurs in one common area (Management Units 9-2, 9-3, 9-4 and 9-11). The current management plan is to exploit any pink or chum surplus while attempting to minimize the effect on other stocks. This tactic will create problems in the future, since catch reductions in recent years have resulted in a rebuilding of these stocks, and some major surpluses are expected.

The Wannock chum stock returns much later than the other stocks in Area 9, and interact only with Area 9 coho.

#### 7.9.5 Rebuilding Potential

Since 1979, when the target escapement for sockeye was increased to 1,000,000, there has been essentially no harvest of Rivers Inlet sockeye. Escapements in 1981, 1982 and 1983 were high (600,000 - 800,000) and are expected to reach the target escapement in the near future, thus yielding a large harvestable surplus. The present policy of fishing only if a surplus is available has rebuilt the sockeye stocks.

For pinks, target fisheries are held only on stocks surplus to estimated escapement. Stocks are responding, but severe floods in 1980 and 1982, management uncertainties, and the mixed stock problem have slowed the potential rebuilding rate. The stocks presently identified as passive have little potential to be actively managed.

For chums, stocks are responding to current management practices which have reduced exploitation. All of the chum stocks had one strong cycle year (1982), with all other cycles severely depressed. The harvest of surplus pinks from presumably more productive stocks is a major deterrent to rebuilding chum stocks. If separation of stocks cannot be achieved through time, area or gear manipulation, forgoing some pink surpluses may have to be considered. The present passive stocks, have no potential to be actively managed with the exception of MacNair Creek which has potential, although it has not yet responded to presently low exploitation rates.

#### 7.9.6 Management Options for Rebuilding

##### 7.9.6.1 Management Uncertainties

##### Conduct a charter gillnet sockeye test fishery in the outer portion of Rivers Inlet

A pilot gillnet sockeye test fishery was attempted in 1981 in the outside area of Rivers Inlet. The initial results indicated that the test fish-

ery would be a useful indicator of the abundance of the incoming run. A problem is that the most appropriate test fishing sites are within the commercial fishing boundaries; thus, the program is disrupted during commercial fisheries. Since the returning sockeye stocks are anticipated to be very strong in the foreseeable future a large number of fishing days are expected. Although charter test fisheries are more controlled, they become redundant if a large regular commercial fishery is conducted. Charter test fisheries for pink or chum stocks are a much lower priority, but would be an asset. The migration patterns and timing for pinks and chums are more variable and overlap, which makes the information from a test fishery difficult to interpret. A commercial test fishery may be more appropriate, as it provides information over a wider geographical area, which may enable catch analysis by stocks.

#### Effort limitations during commercial test fisheries

An ability to limit the number of vessels during commercial test fisheries would reduce escapement losses. This is more pertinent to the smaller pink and chum stocks than to sockeye.

#### Special project to fully analyse Area 9 sockeye catch data for in-season management

An analysis of in-season use of sockeye catch data as an indicator of abundance must be done prior to the large returns expected in 1985 and 1986.

#### Review Wannock chum catch data

Although it does exist, the problem for pink and chum stocks is related more to stock separation than to interpretation of catch data. The Wannock chum stock is an exception, and the meagre historical data will have to be reviewed prior to the proposed 1986 fishery.

### Install fence on the Quap River

The Owikeno sockeye escapements are presently estimated from stream surveys. A fence on the Quap River would be useful as a standard index to compare with the estimate made by stream-walking. The Quap is a large producer and is an appropriate site for a fence.

### 7.9.6.2 Mixed Stock Harvest

7.9.6.2.1 Sockeye There are only very minor mixed stock harvests of Owikeno sockeye within Rivers Inlet. Only the early pink or chum fisheries could intercept sockeye, which can be a problem if sockeye stocks are low; given the high value of sockeye, fishermen tend to ignore pink or chum targets in favour of sockeye. If chums are the target, a mesh restriction (to larger mesh) could be used to protect sockeye and pinks; however, sockeye and pinks are too similar and variable in size to be separated from each other by a mesh restriction.

Interceptions in Area 8 are limited by shifting management control of the pertinent areas (M.U.'s 8-2, 8-3) to Area 9 during the sockeye migration period through these areas. Interception in the Smith Inlet fishery is discussed in the following section on Smith Inlet. There are no other confirmed sockeye interceptions, although more information is required on troll catch of sockeye.

7.9.6.2.2 Pink and Chum Of the nine actively managed pink and chum stocks, only Wannock chums can be harvested separately at present. The other 8 stocks are subject to a mixed stock harvest.

Options for the eight pink and chum stocks are presented one stock at a time, assuming there is a surplus to harvest. The simple intent is to outline time, area and gear restrictions to maximize the exploitation of the target stock while minimizing the interception of others. An exhaustive discussion of all permutations of weak stock-strong stock possibilities is not attempted because of the complexity (there are 28 possible combinations). The size of the target escapements is also not considered. The stock locations (see Figure 7.9-1) considered are as follows:

	<u>Stock</u>	<u>Location</u>
Pink	Clyak River	Head of Moses Inlet
	Chuckwalla River	North side - Head of Rivers Inlet
	Kilbella River	North side - Head of Rivers Inlet
	Johnston Creek	Mid Inlet - East side - In management unit 9-3
Chum	Clyak River	Head of Moses Inlet
	Chuckwalla River	North side - Head of Rivers Inlet
	Kilbella River	North side - Head of Rivers Inlet
	Draney Inlet	Head of Draney Inlet
	Wannock River	Head of Rivers Inlet

Move Clyak pink harvest to more terminal areas

Several options are available for geographical separation of Clyak pinks. The most severe move would be to limit the fishery to Management Unit 9-7, the middle portion of Moses Inlet. This would eliminate all interceptions except Clyak chums and, if required, a mesh restriction (to smaller mesh) would reduce the exploitation rate of chums. This option presents two problems. First, M.U. 9-7 is small and would crowd the fleet and, second, quality would be poor in this more terminal area. The quality problem can be reduced by fishing earlier, but this increases in-season management uncertainty with regards to run size. Management Units 9-5 and 9-4 can be added, which would improve quality, and the enlarged fishing area would accommodate more gear. On the other hand, Kilbella - Chuck-wallla pinks and chums and Wannock chinooks would be intercepted in these management units. Management Units 9-3, 9-2 and 9-11 could also be opened; however, Johnston Creek pinks and Draney Inlet chums would be added to the interception lists. In summary, although the Clyak stocks return earlier, the overlap with other stocks is too great to permit separate management.

Move Clyak chum harvests to more terminal areas

The same arguments apply as for Clyak pinks except that, with a mesh restriction, pink stocks would not be intercepted. Quality problems would likely be more severe for chums.

Move Chuckwalla-Kilbella harvest to more terminal areas

The Chuckwalla and Kilbella rivers share the same estuary, and timing of the pink and chum stocks is similar. Since separation of these two stocks is not possible, they are considered as one. Although the Chuckwalla stock is larger, the escapements tend to fluctuate together; thus, conflicts may be minimal.

A terminal fishery in M.U. 9-6 with added boundaries which exclude Kilbella Bay would be the most extreme harvest strategy. Reduced quality would be expected in this more terminal area, especially in chums, although exploitation in the early portion of the run would reduce this problem. Management Units 9-5 and 9-4 could be added, but then Clyak pink and chum would be intercepted. Fisheries further out in the inlet would impact on Johnston pinks and Draney Inlet chums.

Restrict Johnston pink harvest to more terminal areas

Johnston pinks could be exploited by opening M.U. 9-3 alone. This action would, however, intercept all the other stocks except perhaps Draney Inlet chums. Management Units 9-2 and 9-11 could be added to expand the fishing area and exploitation. A lack of information on timing or migration patterns does not permit intelligent redesigning of the present M.U. boundaries; however, more restrictive boundaries which would limit the fishery to areas closer to Johnston Creek could reduce the interception of other species. Obviously, the quality of fish caught would be reduced.

### Restrict Draney Inlet chum to more terminal areas

At present, if a surplus of Draney Inlet chum were available, the fishery would be directed to M.U. 9-2. However, Clyak and Chuckwalla-Kilbella chums would also be intercepted in this area. An alternative would be to move the fishery to a portion of Draney Inlet (M.U. 9-10) with the major advantage that there would be no interceptions of other stocks. On the negative side, this area is highly tidal and uncharted; moreover, the quality of the fish would be poor. A compromise may be to create a new more restrictive Management Unit adjacent to the entrance of Draney Inlet, thus reducing the incidental catch of non-target stocks and minimizing the loss in quality. However, the relatively small area would crowd the fleet and restrict fishery operations.

7.9.6.2.3 Passive Stocks It is assumed that all the passive stocks in Area 9 will decline if they cannot withstand the exploitation rates required to harvest the actively managed stocks. The MacNair Creek chums are an interesting case, in which escapements at present are nowhere near the optimum of 45,000. If the stock has low productivity, there will be problems increasing the escapement; however, if the stock responds to present reduced exploitation, it could well move into the ranks of the actively managed stocks.

## 7.9.7 Predicted Results

### 7.9.7.1 Sockeye

The sockeye rebuilding plan described earlier will be successful in rebuilding sockeye stocks for Owikeno Lake. Based on management to the new escapement target of 1,000,000 pieces, sockeye long-term mean catch projection is 1,240,000 pieces annually (Table 7.9-1).

### 7.9.7.2 Pink and Chum

Considerable conflict exists with regard to management of mixed stocks of pink and chum salmon. This involves both conflicts between individual stocks of one species and between stocks of pink and chum. Many options were

Table 7.9-1. Catch projections for sockeye stocks in Area 9.

Year	Total Catch
1	387,545
2	989,023
3	910,079
4	911,828
5	1,188,673
6	1,408,120
7	1,095,724
8	1,238,124
9	1,602,827
10	1,338,270
11	1,191,225
12	1,119,274
13	1,488,760
14	1,393,976
15	1,501,637
16	1,430,356
17	1,301,426
18	1,456,942
19	1,373,725
20	1,462,887
Mean	1,239,521
Parameter Values	
Productivity/Variance	2.55/2.55
Age Composition	30% 3's; 70% 4's
Harvest Codes	
Mixed	5%
Test	1%

described for management of pink and chum stocks (7.9.6 Management Options). A complete analysis of all options has not been attempted.

The present management approach involves harvesting all the stocks in a mixed stock fishery. The result is less than optimum production potential. Catch projections for the current management approach yield long-term averages for pink salmon of 508,000 pieces and for chum salmon of 72,000 pieces (Tables 7.9-2 and -3).

Options to reduce the impact of the mixed fishery involve moving to more terminal fisheries. In order to demonstrate the possible yield from such actions, the analysis has concentrated on the Clyak, Chuckwalla and Kilbella River stocks. It was assumed that the Clyak and the Chuckwalla/Kilbella fisheries harvest both pinks and chums. One option involves managing the fisheries for pink escapement only (pink driven), while the other manages the fishery for chum escapement only (chum driven). The results for Clyak pink and chum and Chuckwalla/Kilbella pink and chum salmon are presented in Tables 7.9-4 to 7.9-7.

If one were to manage Clyak pink and chum stocks terminally for pinks (pink driven), the long-term catch average for pinks would be 76,000 pieces and for chums would be 20,000 pieces (Table 7.9-4). Similarly Chuckwalla/Kilbella stocks managed terminally for pinks would have long term average catch projections of 275,000 pieces for pink and 8,000 pieces for chum (Table 7.9-5). On the other hand, the fishery could be managed for chum stocks (chum driven) and forgo some pink salmon catch in the terminal fishery. Catch projections for such an option for Clyak pink and chum would be 31,000 chums and 34,000 pinks (Table 7.9-6)). This would reduce the pink catch by 42,000 pieces and would increase the chum catch by 11,000 pieces, relative to the pink driven scenario (Table 7.9-4). Similarly for Chuckwalla/Kilbella combined stocks the chum management system would result in a long-term catch of 20,000 chums and 84,000 pinks (Table 7.9-7). This would reduce the pink catch by 191,000 while chums would increase by 11,000 relative to the pink driven scenario (Table 7.9-5).

Late running Wannock chum stocks can be rebuilt and will provide a long-term catch projection of 27,000 pieces (Table 7.9-3).

Table 7.9-2. Catch projections for pink stocks in Area 9.

Year	Johnston	Clyak	Chuckwalla	Kilbella	Passive	Total
1	141,185	11,606	9,462	3,145	11,430	
2	136,586	1,225	19,084	28,902	20	
3	161,564	33,399	22,138	5,706	26,812	
4	179,451	2,736	63,225	54,254	43	
5	197,330	75,672	66,351	12,546	57,499	
6	182,823	7,883	117,168	92,533	82	
7	210,978	80,604	131,586	27,526	73,052	
8	181,571	16,992	136,540	92,209	143	
9	186,449	95,069	148,253	56,423	101,131	
10	191,554	25,848	184,110	115,199	295	
11	193,462	96,491	192,724	63,473	98,836	
12	203,143	47,483	195,642	87,675	555	
13	190,355	96,545	221,664	103,741	102,605	
14	203,202	45,734	191,198	95,922	1,199	
15	207,004	80,600	176,443	94,190	100,285	
16	192,583	66,383	207,782	104,314	2,772	
17	189,902	119,767	196,386	100,586	119,158	
18	215,975	69,809	215,037	118,737	7,579	
19	193,864	109,383	228,565	95,824	112,680	
20	193,558	91,028	209,042	107,182	20,782	
Mean	187,627	58,713	146,620	73,004	41,848	507,812
Parameter Values						
Productivity/ Variance	3.25/4.46					
Age Com- position	100% 2's					
Harvest Cost						
Mixed	25%	25%	25%	25%	4%	
Test	10%	10%	10%	10%	0%	

Table 7.9-3. Catch projections for chum stocks in Area 9.

Year	Clyak	Draney	Chuck- walla	Kil- bella	Pas- sive	Wannock	Total
1	3,221	14,916	2,634	520	6,581	872	
2	5,958	7,463	6,687	476	3,864	2,769	
3	54,868	37,421	5,164	1,239	8,637	24,102	
4	13,284	7,610	1,211	564	2,213	9,631	
5	4,179	16,111	3,468	595	5,937	2,265	
6	10,620	11,309	7,761	570	4,337	10,293	
7	36,946	20,382	5,328	1,439	7,208	40,518	
8	14,400	8,662	1,615	624	2,525	22,066	
9	6,691	14,941	4,614	648	6,448	8,049	
10	14,696	13,376	10,292	743	4,647	19,785	
11	31,353	19,218	5,514	1,619	5,978	48,423	
12	13,172	12,209	2,011	722	2,550	35,313	
13	8,141	13,414	7,049	794	6,986	17,010	
14	18,118	13,030	10,111	872	4,502	36,556	
15	30,044	18,996	6,082	2,000	5,340	52,632	
16	16,424	12,667	2,968	829	3,133	38,958	
17	9,699	12,866	8,378	1,019	5,224	28,522	
18	21,308	14,767	11,967	1,149	3,874	45,096	
19	28,017	16,056	6,665	2,053	4,403	58,785	
20	15,790	12,598	3,917	1,005	3,201	48,335	
Mean	17,846	14,901	5,672	974	4,879	27,499	71,771
Parameter Values							
Productivity/Variance	2.36/1.84						
Age Composition	10% 3's; 90% 4's for all stocks						
Harvest Cost							
Mixed	40%	40%	40%	40%	60%	0%	
Test	10%	10%	10%	10%	0%	20%	

Table 7.9-4. Catch projections for terminally managed Clyak pink and chum stocks (pink driven).

Year	Catch	
	Pink	Chum
1	7,478	1,141
2	430	1,226
3	40,096	34,428
4	1,049	2,715
5	98,002	7,476
6	11,974	4,286
7	118,460	46,479
8	38,081	18,006
9	121,169	12,404
10	72,889	19,493
11	91,375	33,331
12	90,372	33,111
13	133,271	13,034
14	75,232	21,203
15	113,530	29,270
16	107,219	33,273
17	97,547	14,967
18	104,513	28,729
19	111,871	23,665
20	94,780	22,866
Mean	76,467	20,055
Parameter Values		
Productivity/Variance	3.25/4.46	2.36/1.84
Age Composition	100% 2's	10% 3's; 90% 4's
Harvest Cost		
Mixed	0%	0%
Test	10%	0%

Table 7.9-5. Catch projections for terminally managed Chuckwalla/Kilbella stocks (pink driven).

Year	Catch	
	Pink	Chum
1	24,039	1,757
2	28,001	1,546
3	144,456	1,777
4	153,981	5,043
5	214,287	10,047
6	276,536	8,742
7	326,675	4,848
8	259,079	12,352
9	284,351	13,043
10	317,372	9,723
11	377,353	5,938
12	391,610	15,816
13	337,943	19,070
14	302,645	9,367
15	349,651	5,857
16	245,118	12,366
17	338,585	14,891
18	331,044	11,616
19	344,548	5,437
20	405,797	14,395
Mean	275,039	8,432
Parameter Values		
Productivity/Variance	3.25/4.46	2.36/1.84
Age Composition	100% 2's	10% 3's; 90% 4's
Harvest Cost		
Mixed	0%	0%
Test	10%	0%

Table 7.9-6. Catch projections for Clyak pink and chum stocks terminally managed (chum driven).

Year	Catch	
	Pink	Chum
1	3,346	725
2	413	1,218
3	34,041	46,085
4	1,417	4,393
5	12,179	1,978
6	4,233	6,186
7	59,389	51,089
8	23,176	28,177
9	20,408	6,959
10	25,876	16,745
11	65,968	43,083
12	40,901	43,221
13	45,701	23,297
14	48,123	50,358
15	51,172	48,862
16	44,614	41,840
17	43,311	31,626
18	57,150	60,595
19	54,693	62,476
20	49,204	53,354
Mean	34,266	31,113
Parameter Values		
Productivity/Variance	3.25/4.46	2.36/1.84
Age Composition	100% 2's	10% 3's; 90% 4's
Harvest Cost		
Mixed	0%	0%
Test	0%	10%

Table 7.9-7. Catch projections for Chuckwalla/Kilbella pink and chum stocks (chum driven).

Year	Catch	
	Pink	Chum
1	3,949	802
2	10,724	1,565
3	13,718	1,449
4	35,680	528
5	32,491	2,400
6	65,067	9,293
7	46,963	4,443
8	57,094	1,482
9	73,399	10,986
10	142,868	31,482
11	70,295	11,433
12	59,805	5,051
13	122,838	30,320
14	138,727	40,413
15	133,664	25,244
16	87,415	28,745
17	158,366	55,737
18	183,409	64,004
19	129,856	37,591
20	115,270	34,350
Mean	84,080	19,866
Parameter Values		
Productivity/Variance	3.25/4.46	2.36/1.84
Age Composition	100% 2's	10% 3's; 90% 4's
Harvest Cost		
Mixed	0%	0%
Test	0%	10%

## 7.10 Statistical Area 10

Statistical Area 10 is located on the central coast of British Columbia north of Vancouver Island (Fig. 7.10-1). The area includes Smith Sound, Boswell Inlet, Naysash Inlet, Smith Inlet and Wyclees Lagoon. The major salmon producing streams are Canoe Creek, Docee River, Nekite River, Smokehouse Creek, Takush River and Walkum Creek.

Detailed information of stock attributes and current fishing patterns in Area 10 can be found in Appendix B.

### 7.10.1 Stock Description

Six stocks, which consist of one sockeye, two pink and three chum, are actively managed in Statistical Area 10. In addition, there are several small pink and chum stocks which are passively managed. The largest and most important stock in Area 10 is the sockeye stock.

#### 7.10.1.1 Sockeye

The Area 10 sockeye stock originates from Canoe and Smokehouse creeks; the latter, which is the larger of the two systems, supports 75% of the spawning sockeye. The largest component of the stock appears to approach Smith Sound from a westerly direction. Smaller components however, are thought to migrate south through Statistical Areas 7 and 8 as well as north from Statistical Area 27. Normally, sockeye enter Smith Inlet in late June and the run continues through July until early August. The fish appear on the spawning grounds in early September and spawn through the month of October.

Escapement of Area 10 sockeye has increased from an average of approximately 71,000 between 1950 and 1959 to 90,000 between 1970 and 1977. In 1980 the escapement target was increased from 120,000 to 200,000 and recent escapements have reflected this increase, averaging near 200,000 for the period 1980-83.

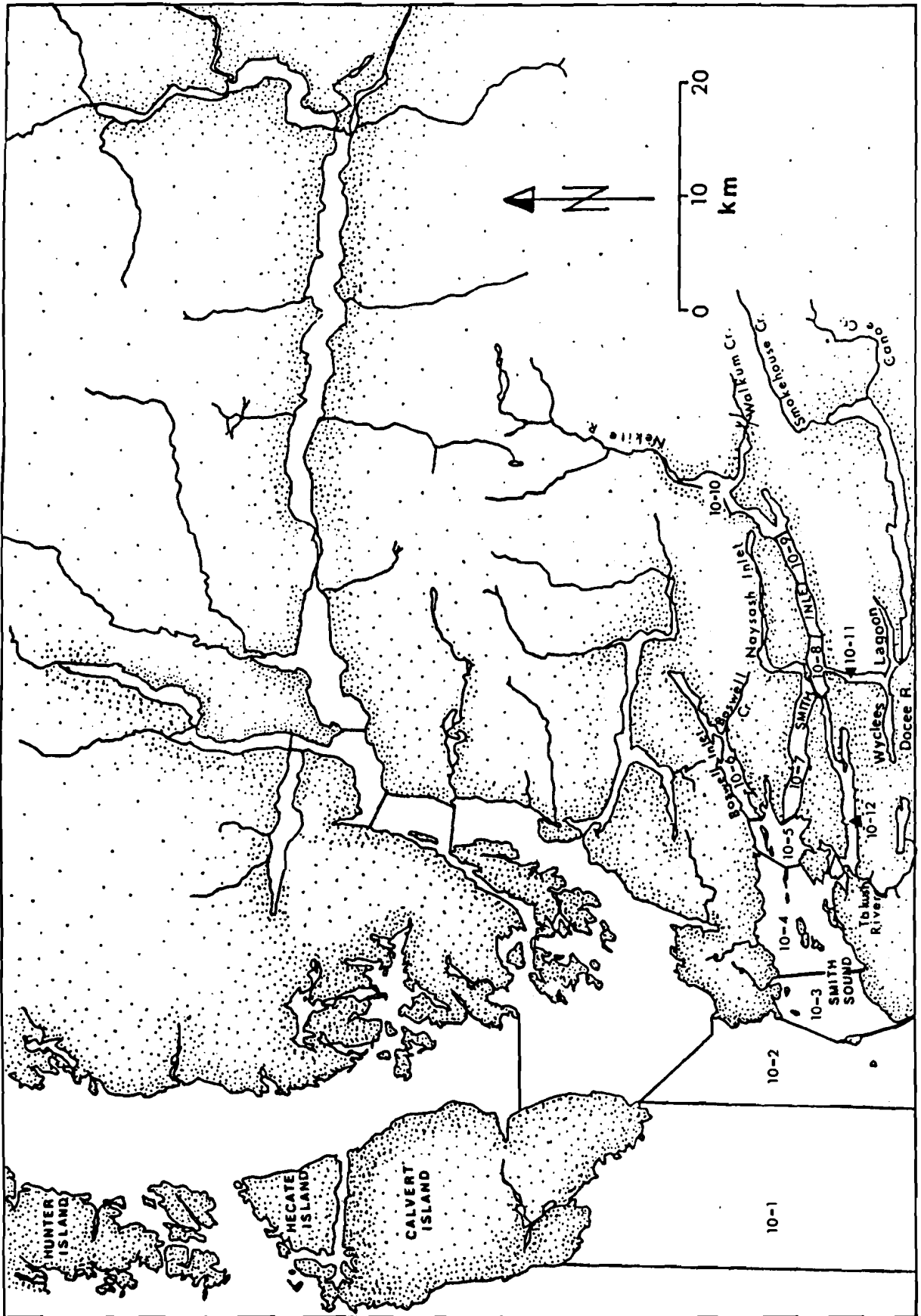


Figure 7.10-1. Statistical Area 10.

#### 7.10.1.2 Pink

The two actively managed pink stocks in Statistical Area 10, the Nekite even year stock and the Nekite odd year stock, account for approximately 95% of the total escapement. In addition, there are several smaller passively managed pink stocks originating in Walkum Creek, Boswell Creek and Takush Creek. Little is known about the migration pattern of Area 10 pink stocks prior to their presence in the Area 10 terminal fishery from mid-July to early September. Both Nekite River stocks enter the Nekite River in August and complete spawning by late September. Spawning in Walkum Creek occurs somewhat later; fish enter the stream in September and spawn until late October.

Escapements for the even and odd year Nekite stocks averaged approximately 16,000 and 10,000, respectively, between 1950 and 1979. More recently, escapement of the even year stock has declined to approximately 5,000 while odd year escapement has increased dramatically to approximately 55,000. The escapement target for both odd and even stocks is 60,000.

#### 7.10.1.3 Chum

Statistical Area 10 chum are concentrated in the Nekite River, Takush River and Walkum Creek. Nekite chum, currently the largest chum stock in Area 10, and Takush chum are actively managed. Walkum chum are subject to a passive management regime. Little is known about the migration pattern of Area 10 chum. Chum are present in the Area 10 fishery between late July and early November. Nekite chums are found in the fishery during August and early September followed by the Takush chums during the remainder of September. These two actively managed stocks do not overlap in timing during the fishery.

Chum escapements to Area 10 ranged from 15,000 to 30,000 between 1950 and 1979. However, beginning in 1980, escapement to the Nekite system increased rapidly resulting in an average escapement to Area 10 between 1980 and 1983 of 60,000. Escapement targets to the Nekite, Takush and Walkum systems are 60,000, 15,000 and 7,500, respectively.

### 7.10.2 Fisheries Managed

Area 10 salmon stocks are generally managed to escapement. There is no fishery opening when run size is expected to be below optimum escapement. In addition, the early part of each fishery is monitored carefully to quickly establish any deviation from the pre-season forecasts of run size. The timing of stocks found in the fishery is presented in Figure 7.10-2.

Gillnets are the only gear employed in the Area 10 fishery, which opens for sockeye as early as the last week of June and may continue as late as early August. The fishery shifts in late July from one dominated by sockeye to one dominated by pinks and chums. The majority of the pink catch is taken by mid-August. Nekite and Walkum chums are normally through the fishery by early September while the Takush chum run does not usually peak in the fishery until the third week of September. Mesh size restrictions (to larger mesh) are used to protect pink during those periods when both pink and chum are in the vicinity of the fishery.

### 7.10.3 Salmon Enhancement Activities

The fertilization of Long Lake (Fig. 7.10-1) is the only salmon enhancement activity in Statistical Area 10. The lake was initially fertilized in 1976, 1977 and 1978 in an attempt to increase the production of Area 10 sockeye. The program was interrupted for two years in 1979 and 1980 because of an increase in stickleback populations which adversely affected salmon production. Fertilization began again in 1981 and has continued to date, apparently without a similar increase in the stickleback population. The returns from recent years have been good, with an average return rate of 3.9 fish per spawner.

There is some doubt as to whether this increase can be attributed to the enrichment program, because unfertilized Owikeno sockeye stocks in Area 9 also returned at an exceptionally high rate during the same period. The smolt abundance surveys taken by the Lake Enrichment Group (Table 7.10-1) indicate that the broods from 1981 to the present were very productive.

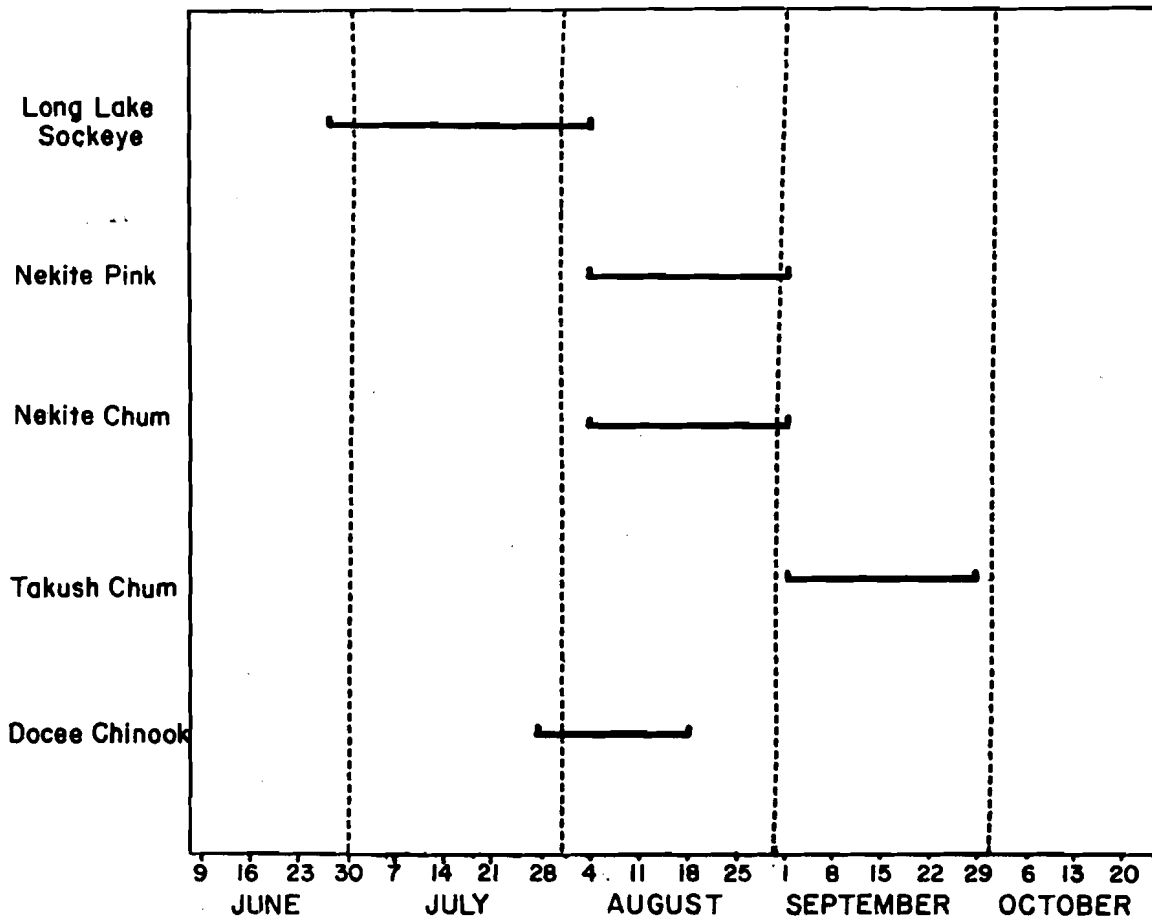


Figure 7.10-2. Stock migration timing through the fisheries in Area 10.

Table 7.10-1. Effect of the fertilization of Long Lake on the weight and density of sockeye salmon smolts.

Brood Year	Sample Year	Wt(g) Smolts	Treatment	Density Index #/ha	Escapement
1972	1973	2.2	Unfertilized		76,000
1975	1976	2.4	Unfertilized		63,000
1976	1977	4.9	Fertilized	790	61,000
1977	1978	2.3	Fertilized	1,166	129,000
1978	1979	1.2	Fertilized	1,683	84,000
1979	1980	1.9	Unfertilized	378	21,000
1980	1981	3.0	Unfertilized	860	128,500
1981	1982	2.5	Fertilized	2,800	215,000
1982	1983	2.2*	Fertilized	2,900	215,000
1983	1984	1.18*	Fertilized	1,485	200,000

\* Computation method was altered.

#### 7.10.4 Conflicts in Current Management Approach

##### 7.10.4.1 Management Uncertainties

In Area 10, the average migration timing of Long Lake sockeye through the Docee Fence has been compiled into a model that predicts total returning stock from escapement totals to date through the fence. The accuracy of this prediction increases as the season progresses, but there is still enough uncertainty to require that commercial test fisheries measure stock abundance. There is also uncertainty about the level of the Long Lake sockeye target escapement; however, this is a problem common to all stocks in all areas. Smith Inlet is unique in that productivities at various escapement levels can be evaluated.

##### 7.10.4.2 Mixed Stock Harvest

The mixed stock harvest problems in Smith Inlet are relatively minor. Sockeye fishing in the outermost portion of Smith Inlet (M.U. 10-3) intercepts Rivers Inlet sockeye and may bias stock size projections for Smith Inlet sockeye. This increases the uncertainty in projections of total returning stock, and may result in fishery openings that are not warranted.

The Nekite chum and Nekite pink fisheries may conflict, but since the fishery uses only gillnets, restricting the nets to larger mesh sizes will protect pinks when chum are the target; however, the converse is not as effective. A fishery on Nekite chum may intercept Docee River chinooks, and the later Takush chum fishery may intercept Area 10 coho.

#### 7.10.5 Rebuilding Potential

Area 10 sockeye stocks have essentially been "rebuilt". Any additional gains will be made by reducing management uncertainty such that quicker and more precise responses can be made in-season to natural variability of the returning stock size. The Long Lake sockeye stock offers an almost unique opportunity to assess optimum escapement requirements because the catch and escapement data can be measured accurately.

Fisheries on managed pink stocks in Area 10 are not initiated unless a surplus is anticipated. Since there are essentially no losses attributed to mixed stock fishing, increases in production can be achieved only by reducing management uncertainty and increasing the in-season response to environmentally caused variability. A special opportunity may exist to re-establish pinks in the Takush River as there is currently no exploitation of these stocks. Since the causal factor for the reduced even year Nekite pink run was flooding during 1980 and 1982, they should increase quickly from the present depressed levels with no changes in current management, while odd year Nekite pinks should maintain their present high production.

Current management policies have rebuilt Nekite chum stocks, and Takush chums are expected to respond in the next cycle. Future problems may result if Nekite pink stocks are rebuilt, as pink target fisheries would capture Nekite chums incidentally.

To achieve further chum production increases, we would have to reduce losses from environmental variability or management uncertainty sources.

#### 7.10.6 Management Options for Rebuilding

##### Expend more effort on analysis of in-season catch, effort and escapement data

The loss of potential escapements to the commercial fisheries which are held to assess stock abundance would be reduced by refining in-season analysis of catch and escapement data, particularly in-season estimates of abundance from catch per unit effort data. This is a continuing program, not a new option, although it is an option in the sense that greater effort could be expended in this area.

The management uncertainty of Long Lake sockeye is expected to be minimal in future years, as the high return rate and present high escapements should permit regular achievement of target escapement. However, pink and chum management is uncertain because the timing and catch analysis is less refined and the historical data for returns are sparse.

Actively vary Smith sockeye escapements

The circumstances for Long Lake sockeye are special, since the escapement and catch are enumerated with very little error. Long-term production may be increased by changing the present target escapements. This option may be raised with industry with a basic rule that both sides of the present escapement level would be probed.

Effort limitation

An ability to limit the number of vessels allowed to fish during commercial openings would permit more controlled test fisheries, and reduce management uncertainty losses. For example, the Takush chum stock, being small, is more susceptible to overharvesting by excessive effort.

Test fishing charters

Test fishing charters would help to decrease management uncertainty; however, Smith Inlet is a low priority relative to other North Coast areas, since the potential gain is relatively small.

Closure of Management Unit 10-3

The sockeye fishery in M.U. 10-3 intercepts Rivers Inlet sockeye. As noted earlier, the catch of Rivers Inlet sockeye may bias the stock size projections for Smith Inlet. This area (M.U. 10-3) is also a highly desirable (from the commercial viewpoint) fishing area to harvest Smith Inlet sockeye. In some years, it may be difficult to catch sufficient Long Lake sockeye without fishing in this area (presuming a fishery is not opened in Wyclees Lagoon). In 1982-83, industry was consulted and M.U. 10-3 was created as a smaller outside area which could be closed to stop the interception of Rivers Inlet sockeye. Stock identification methods (using parasites as biological indicators) exist to separate Area 10 and 9 sockeye; thus, a study to evaluate the extent of the problem may confirm the necessity for the closure.

Chum versus pinks

In the future, the exploitation rate for Nekite pinks may exceed that required for chums. Restricting nets to small mesh will help to decrease chum catches, but there will still be cases where chum escapements will suffer. Time and area closures may be of some benefit, but this information will have to be acquired during future fisheries. Further analysis of the relative merits of harvesting pinks at the expense of chums is required before the option of foregoing pink production to increase chum stocks can be properly considered.

Further, if both pink and chum surpluses are available, methods would have to be devised to harvest pinks when the primary target is chums. Two possible solutions are as follows:

1. allow only small mesh nets to ensure pink harvest, and increase mesh size if chum exploitation is insufficient; and
2. allow some chum fishing days with large mesh nets before switching to pink harvest days with small mesh requirements.

Nekite Chum/Pink versus Docee Chinook

The extent of chinook interception is not known. Chinook catches will be monitored during future pink or chum fisheries and, if a problem is identified, time or area closures may be instituted to reduce the incidental catch.

Takush Chum versus Area 10 Coho

The extent of the coho interception is not known. If a problem is identified, attempts will be made to reduce conflicts by time or area closures.

### Transplant pinks to the Takush River

If the present Takush pinks, which may not constitute a viable stock, do not respond positively to the present zero exploitation rate, a transplant should be considered, perhaps from the later portion of the Nekite pinks.

#### 7.10.7 Predicted Results

##### 7.10.7.1 Sockeye

Sockeye stocks in Area 10 are at or near optimum escapement levels and no further action is anticipated at this time. Stock projections indicate that if escapement levels are maintained, the long term catch will average 531,000 pieces (Table 7.10-2).

##### 7.10.7.2 Pink versus Chum

Considerable conflict exists with regard to management of mixed pink and chum fisheries in Area 10. It is not possible to achieve optimum escapement for both pink and chum populations if the assumption is made that pink stocks have higher productivity. This is the case with Nekite pink and chum stocks in Area 10. Two basic options are:

1. to manage pink stocks to optimum escapement levels and accept reduced potential of chum stocks; or
2. to manage chum stocks to optimum escapement levels and forgo some production from pink stocks.

With regard to option 1, stock projections indicate that, if active pink stocks are managed to escapement, the long-term catch trend will average 125,000 pieces (Table 7.10-3). However, chum salmon stocks managed incidentally do not rebuild but decline with a long-term average catch level of 35,000 pieces.

Table 7.10-2. Projected catches for Area 10 sockeye.

Year	Total Projected Catch
1	40,089
2	347,954
3	652,402
4	614,873
5	505,693
6	393,636
7	581,543
8	576,879
9	550,487
10	546,696
11	566,831
12	583,444
13	544,228
14	599,623
15	583,417
16	601,276
17	546,507
18	574,730
19	577,674
20	626,520
Mean	530,725
<u>Parameter Values</u>	
Production/Variance	3.89/2.17
Age Composition	25% 4's; 75% 5's
Harvest Costs	
Mixed	0
Test	20%

Table 7.10-3. Catch projections for Area 10 pink and chum for Option 1.

Year	Total Catch Pinks	Total Catch Chums
1	140,221	85,056
2	112,160	66,522
3	125,267	45,610
4	144,282	71,782
5	150,141	59,297
6	149,093	56,055
7	115,060	43,269
8	140,568	42,156
9	137,396	44,800
10	126,443	43,221
11	152,842	35,912
12	153,823	38,938
13	119,346	33,717
14	96,940	26,036
15	121,070	26,730
16	155,141	27,191
17	126,890	31,811
18	116,013	26,294
19	103,706	26,294
20	113,872	17,938
Mean	125,090	34,739
<u>Parameter Values</u>		
Productivity/Variance	3.25/4.46	2.36/1.84
Age Composition	100% 2's	10% 3's 90% 4's
Harvest Costs		
Mixed	0%	0%
Test	20%	20%

With regard to option 2, stock projections indicate that if active chum stocks are managed to optimum escapement the long-term catch average would only increase to 74,000 pieces (Table 7.10-4). This option would also result in an average reduction (approximately 50%) in long-term pink catch to 66,000.

#### 7.10.7.3 Chum

Late running active chum stocks for the Takush can be rebuilt to optimum escapement with a long-term average catch of 13,000 pieces and long-term average escapement of 13,000 (Table 7.10-5).

Table 7.10-4. Catch projections for Area 10 pink and chum stocks for Option 2.

Year	Total Pink Catch	Total Chum Catch
1	83,414	85,528
2	79,814	67,224
3	52,808	36,314
4	78,147	78,376
5	57,100	69,893
6	94,109	88,022
7	57,146	59,442
8	67,515	81,948
9	79,295	83,354
10	58,264	61,110
11	67,582	70,149
12	76,953	82,480
13	70,604	88,649
14	105,025	102,951
15	51,435	75,153
16	79,221	79,982
17	69,221	79,039
18	63,871	65,124
19	74,713	83,961
20	57,477	75,391
Mean	66,042	73,623
<u>Parameter Values</u>		
Productivity/Variance	3.25/2.40	2.36/1.84
Age Composition	100% 2's	10% 3's; 90% 4's
Harvest Costs		
Mixed	0%	0%
Test	20%	20%