Update Assessment of Sockeye Salmon Production from Babine Lake, British Columbia

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2012

Canadian Technical Report of Fisheries and Aquatic Sciences 2956

Fisheries and Oceans / Pêches et Océans

Canada

Canadian Technical Report of
Fisheries and Aquatic Sciences

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Cat. No. Fs 97-6/2956E ISSN 0706-6457

Correct citation for this publication:

Cox-Rogers, S., and Spilsted, B. 2012. Update assessment of sockeye salmon production from Babine Lake, British Columbia**.** Can. Tech. Rep. Fish. Aquat. Sci. 2956**: ix** + 65 p.

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ABSTRACT

Cox-Rogers, S., and Spilsted, B. 2012. Update assessment of sockeye salmon production from Babine Lake, British Columbia**.** Can. Tech. Rep. Fish. Aquat. Sci. 2956**:** ix + 65 p.

Wood et al. (1998) provided the last formal assessment of sockeye production from Babine Lake using production data spanning the 1950-1996 return years (1950-1991 brood years). This update adds 14 more years to the data series (1950-2010 return years, 1950-2005 brood years) and provides an overview of the monitoring methods used to assess Babine Lake sockeye production.

Three distinct yet overlapped sockeye “runs” return to Babine Lake each year: early-timed, mid-timed, and late-timed. Babine Lake sockeye were enhanced in the late 1960’s, which saw spawning channels and flow controls established on two of the mid-timed Babine Lake spawning tributaries located at Pinkut Creek and Fulton River. Approximately 90% of all Skeena River sockeye are now from Babine Lake, and of these, an average 75% are enhanced fish from Pinkut Creek and Fulton River.

Skeena River sockeye returns (catch plus escapement) increased substantially after Babine Lake enhancement and continued to do so throughout the 1980’s and through most of the 1990’s as sockeye returns to Babine Lake increased. Since the early 2000’s, Skeena River sockeye returns have declined to lower levels coincident with a recent decline in Babine Lake production. Escapements to enhanced Pinkut Creek and Fulton River continue to exceed spawning requirements, even with the recent declines in total production. Escapements to the unenhanced late-runs exhibit a long-term declining trend which was not evident in the last assessment conducted in the mid 1990’s. Late-timed escapements have been much lower than historic in recent years. Escapements to the early-timed and mid-timed unenhanced runs have also been very low in recent years.

Fry production from Pinkut Creek and Fulton River continues to account for ~90% of fry and smolt recruitment to the Main Arm of Babine Lake; yet total fry recruitment to the Main Arm still appears to be below maximum rearing capacity. North Arm/Nilkitkwa Lake fry and smolt production was on a declining trend prior to cessation of the last brood year assessed, consistent with reduced numbers of late-run spawners.

It is currently unclear how freshwater and/or marine survival variation may be influencing recent Babine Lake brood year recruitment. Reduced adult returns the past decade could be due to fewer smolts leaving Babine Lake, fewer smolts surviving as adults in the ocean, or some combination of both. Several mechanisms affecting freshwater and marine survival have been proposed, but data are lacking to make a proper assessment. Future research may help address some of the concerns.

RÉSUMÉ

Cox-Rogers, S., and Spilsted, B. 2012. Update assessment of sockeye salmon production from Babine Lake, British Columbia. Can. Tech. Rep. Fish. Aquat. Sci. 2956: ix + 65 p.

Wood *et al.* (1998) ont produit la dernière évaluation officielle de la production de saumons rouges dans le lac Babine en se servant des données de production des années de remonte 1950-1996 (années de ponte 1950-1991). La présente mise à jour permet d'ajouter 14 autres années à la série de donnée (années de remonte 1950-2010; années de ponte 1950-2005) et donne un aperçu des méthodes de surveillance utilisées pour l'évaluation de la production de saumons rouges dans le lac Babine.

Trois remontes de saumons rouges distinctes mais se chevauchant retournent dans le lac Babine chaque année : remontes précoces, semi-précoces et tardives. Les saumons rouges du lac Babine ont été mis en valeur à la fin des années 1960, période durant laquelle des chenaux de ponte et des ouvrages de régularisation des débits ont été établis sur deux des affluents de remontes semi-précoces du lac Babine qui servent de frayères et qui sont situés dans le ruisseau Pinkut et la rivière Fulton. Environ 90 % de l'ensemble des saumons rouges de la rivière Skeena proviennent de nos jours du lac Babine et, sur ce nombre, une moyenne de 75 % de ceux-ci sont des poissons mis en valeur du ruisseau Pinkut et de la rivière Fulton.

Les retours de saumons rouges dans la rivière Skeena (prises plus échappées) ont augmenté considérablement après la mise en valeur du lac Babine et ont continué à augmenter durant les années 1980 et la majeure partie des années 1990 puisque les retours des saumons rouges dans le lac Babine ont augmenté. Depuis le début des années 2000, les retours de saumons rouges dans la rivière Skeena ont baissé à de faibles niveaux, ce qui coïncidait avec un déclin récent dans la production du lac Babine. Des échappées vers le ruisseau Pinkut et la rivière Fulton, qui ont été mis en valeur, ont continué à dépasser les besoins en géniteurs, même avec les récentes baisses de la production totale de saumons rouges. Des échappées des remontes tardives non mises en valeur indiquent une tendance au déclin à long terme qui n'était pas évidente dans la dernière évaluation menée au milieu des années 1990. Au cours des dernières années, les échappées tardives des remontes ont été beaucoup plus faibles que les échappées historiques. Les échappées des remontes précoces et semi-précoces non mises en valeur ont aussi été très faibles au cours des dernières années.

La production d'alevins dans le ruisseau Pinkut et la rivière Fulton continue à représenter environ 90 % du recrutement d'alevins et de smolts dans le bras principal du lac Babine; cependant, le recrutement d'alevins totaux dans le bras principal semble toujours inférieur à la capacité de grossissement maximale. La production d'alevins et de smolts dans le bras nord ou lac Nilkitkwa a connu une tendance à la baisse avant la fin de l'évaluation de la dernière année de ponte, ce qui correspondait aux effectifs réduits de géniteurs des remontes tardives.

1.0 Introduction

The Babine/Nilkitkwa Lake system (Fig.1) is the largest natural lake in British Columbia and supports the largest sockeye runs in the Skeena River (Wood et al. 1998). Decade average returns have been 2.6m (1.3m – 2.7m) from 1970-1979, 2.8m (1.5m - 4.9m) from 1980-1989, 3.6m (1m - 7m) from 1990-1999, and 2m (1m - 4m) from 2000-2010. Babine Lake sockeye are harvested in marine commercial fisheries in S.S.E. Alaska and Canadian Statistical Areas 1-5, as well as in First Nation Food, Social, and Ceremonial (FSC) and First Nation Economic and Escapement Surplus to Spawning Requirement (ESSR) fisheries within the Skeena River and within Babine Lake itself.

The Fisheries Research Board of Canada first began investigations of Babine Lake sockeye in the 1940's (Wood et al. 1998). Early investigations revealed that spawning ground capacity, and not lake rearing capacity, was limiting sockeye production from Babine Lake (Johnston 1958). This led to the Babine Lake Development Project (BLDP) in the 1960's, which saw spawning channels and flow controls established on the two major Babine Lake spawning tributaries located at Pinkut Creek and Fulton River (Ginetz 1977). The BLDP became fully operational in 1971 and the first significant returns of enhanced fish to Babine Lake occurred in 1975 (Wood et al. 1998). Approximately 90% of all Skeena sockeye production now comes from Babine Lake, compared to less than 80% before construction of the BLDP began (Wood et al. 1998).

Babine Lake consists of one large sockeye rearing area (the Main Arm or Main "Basin") and three smaller sockeye rearing areas (Hagan, Morrison, and North Arms or "Basins") (Fig. 1 and Fig. 2). Based on tagging studies (Aro and McDonald 1968, Takagi and Smith 1973, Smith and Jordan 1973) three distinct yet overlapped sockeye "runs" return to Babine Lake each year: early-timed, mid-timed, and late-timed. The early- timed sockeye are all un-enhanced and spawn in 18 or so small tributaries to the Main Arm, two tributaries to the North Arm, and a few spawn in the Babine and Nilkitkwa Rivers in some years (Hume and MacLellan 2000). The mid-timed sockeye are mostly enhanced Pinkut Creek and Fulton River (Main Arm) fish which migrate in succession about 1 week apart, but mid-timed un-enhanced sockeye also spawn in the Morrison River and tributaries to Morrison and Tahlo Lake. The late-timed sockeye are all un-enhanced and spawn below Babine Lake in the Upper Babine River above Nilkitkwa Lake, and in the Lower Babine River below Nilkitkwa Lake (Hume and MacLellan 2000).

Tagging studies have shown that fry from the Upper and Lower Babine Rivers (progeny from late-timing spawners) and a few small tributaries to Nilkitkwa Lake and the North Arm of Babine Lake, rear primarily in Nilkitkwa Lake and the North Arm of Babine Lake; the smolts migrate early in the spring and are termed "early migrants" (Wood et al. 1998). Fry from other tributaries to the Main Arm, including Fulton River and Pinkut Creek, rear primarily in the Main Arm. These smolts migrate one to two weeks later and are termed "late migrants" (Wood et al. 1998). Interestingly, the majority of late-run sockeye fry must migrate upstream against the current of the Lower Babine River to rear in Nilkitkwa Lake, and against the current of the Upper Babine River to rear in the North Arm. Other Babine Lake sockeye fry migrate downstream to rear in the same Arm as their natal stream (McDonald and Hume 1984).

Wood et al. (1998) provided the last formal assessment of sockeye production from Babine Lake using production data spanning the 1950-1996 return years (1950-1991 brood years). This update adds 14 more years to the data series (1950-2010 return years, 1950-2005 brood years) and provides an overview of the monitoring methods used to assess Babine Lake sockeye production. Trends in spawning escapements by run-timing group, fry recruitment, adult returns, exploitation rates, surplus production from enhanced sites, and enhanced contributions to annual returns are presented.

1.1 Previous Assessments

Babine Lake sockeye have been intensively studied and a rich legacy of biological evaluations exists in numerous technical reports and primary publications. Sockeye production dynamics in Babine Lake are complex and many of the following works contain thoughtful background useful for assessing current trends.

Brett (1952) examined Babine Lake spawning populations in his wider review of Skeena River sockeye. Withler (1952) conducted some of the first biological smolt assessments in Babine Lake. Pritchard (1953) conducted some of the first tagging and adult movement studies of sockeye in Babine Lake. Johnson (1958) studied juvenile sockeye migration patterns and spawning habitat limitation within Babine Lake. Aro (1961) reviewed early escapement estimates for Babine Lake, and Aro and McDonald (1968) conducted marine tagging studies to determine Babine Lake and other Skeena River sockeye timing through the commercial fishing area. Narver (1970), McDonald (1973), Stockner and Shortreed (1975) and Rankin (1977) all examined various juvenile sockeye feeding and trophic structure relationships in Babine lake. Takagi and Smith (1973) and Smith and Jordan (1973) determined run-timing for the various spawning components in Babine Lake, based on tagging studies conducted in the ocean and at the Babine River fence. The first reviews of BLDP fry and adult production were by Ginetz (1977) and West (1978). Beacham and McDonald (1982) examined food and growth dynamics of Babine Lake fish species, while Peterman (1982) examined density-dependent production relationships between sockeye fry, smolts and adults from Babine Lake.

McDonald and Hume (1984) conducted the first intensive biological evaluation of the BLDP, testing results against assumptions that enhancement would increase Babine Lake sockeye production. Levy and Hall (1985) provided a detailed overview of Babine Lake sockeye and assessment history, focusing on limnology and sockeye ecology. Macdonald et al. (1987) examined the utility of using Babine Lake smolt production for fisheries management, while Sprout and Kadowaki (1987) discussed management of Skeena River fisheries targeting the enhanced Babine Lake stocks. West and Mason (1987) updated and reviewed sockeye production from the BLDP, while Hilborn (1992) evaluated “institutional learning” comparing the success of the BLDP relative to sockeye spawning channels in other areas.

As already noted, Wood et al. (1998) provided the last production assessment for Babine Lake sockeye. Wood (2001) also provided a thoughtful historical overview of the Skeena River sockeye fishery and the biodiversity issues involved when harvesting productive and less productive stocks in mixed-stock fisheries. A recent comparative review by Shortreed and Morton (2000) examined limnological status and productive capacity for Babine Lake "25" years after the BLDP was established. Hume and MacLellan (2000) reviewed and updated juvenile sockeye population dynamics of Babine Lake sockeye. Gottesfeld and Rabnett (2008) provide an updated overview of Babine Lake salmon resources, human impacts, and First Nations utilization. Peterman, in Walters et al. (2008), re-examined trends in density-dependent smolt outputs and smolt - adult marine survival for Babine Lake brood production years 1970-2000. Walters et al. (2008) conducted an independent science review of Skeena River fisheries and assessment methods, commenting extensively on Babine Lake sockeye production.

2.0 Methods

2.1 Adult Returns and Exploitation Rates

Annual return (catch plus escapement) and brood year production (recruitment) data for Skeena River sockeye are maintained in an Excel database (Contact Steve Cox-Rogers, DFO, Prince Rupert). The source data in the production file comes from a variety of assessments, both published and un-published. The most complete evaluation of total Skeena River sockeye return and annual exploitation rates comes from the joint Canada-U.S. run-reconstruction evaluations (Gazey and English 2000) now updated from 1982-2008; 2009 and 2010 are currently preliminary. Analyses for these years incorporate marine stock composition data evolved from the 1982-83 joint U.S.-Canada marine tagging studies, S.S.E Alaskan scale pattern analyses, and more recently, Canadian genetic (DNA) analyses. Catches of Skeena River sockeye from 1970-1981 are more approximate as they use fixed tagging proportions from 1982 and 1983 North Coast tagging studies (English et al. 1995) to assign marine catch by stock. Skeena River sockeye catches from 1950-1969 are even less certain and come from the analyses conducted by Wood et al. (1998) who cites McDonald et al. (1987) for their derivation.

Following McKinnel and Rutherford (1994), Wood et al. (1998) assumed 90% of the annual Skeena River sockeye return (age 1.2 and 1.3) was of Babine Lake origin and they used this fixed proportion to examine temporal trends in Babine Lake sockeye production from 1950-1991. Wood et al. (1998) note this assumption "probably overestimates Babine returns prior to 1970; it may also underestimate Babine returns in some years after 1970". Since 2000, genetic stock composition data from the lower Skeena River Tyee Test Fishery (source Terry Beacham, DFO, Nanaimo) indicates an average 87% (80% - 93%) of the sockeye entering the Skeena River are from Babine Lake, very close to the 90% assumption of Wood et al. (1998). As an update to Wood et al. (1998), the annual Tyee Test Fishery (DNA) Babine Lake percentages from 2000-2010 have now been applied to the Skeena River sockeye returns for those years, with the average for the mDNA series (87%) applied to the years 1970-1999. No changes have been made to other years.

As the Skeena River sockeye fishery targets Babine Lake sockeye, exploitation rates for the Skeena River aggregate stock should generally approximate those for the Babine Lake aggregate stock. Exploitation rates for the individual early, mid, and late timed Babine Lake runs (sub-stocks) cannot be directly calculated as run-specific catch records for each component do not exist. An alternative approach is to model Babine Lake sub-stock exploitation rates using assumed run-timing distributions for each and applying reconstructed sockeye harvest rates (weekly) for the aggregate Skeena River stock in Canadian marine fisheries to estimate exploitation rates. Additional exploitation rate estimates for the Skeena River aggregate stock in Alaskan and in-river Skeena FSC fisheries can be added to approximate exploitation on each of the sub-stocks (Cox-Rogers 1994, Cox-Rogers et al. 2010). A more comprehensive application of this methodology has been developed by Gazey (2008) and is currently undergoing calibration. Reconstruction approaches are appealing for modeling Skeena River and Babine Lake sub-stock impacts as they can be “reversed” to run as predictive fishery management tools (Cox-Rogers et al. 2010).

2.2 Babine Lake Escapement Monitoring

Since 1949, all sockeye returning to Babine Lake have been counted through a permanent counting fence located on the Babine River 1 km below the outlet of Nilkitkwa Lake (Aro 1961, West and Mason 1987). After passing the counting fence and after all in-lake harvests have occurred, the fish are enumerated again on the various tributary spawning grounds within Babine Lake. Thirty wild sockeye spawning locations, plus the enhanced Pinkut and Fulton sites, have been variably monitored by DFO, and more recently the Lake Babine First Nation, since 1950. These sites represent most of the early, mid, and late timing spawning sites within Babine Lake, although others do exist (Wood et al. 1998). The fence counts and spawning ground counts are maintained in an Excel “Escapement Table Database” maintained by DFO in Prince Rupert (Spilsted and Spencer 2009). The data are verified each fall and subsequently transferred to the regional DFO NuSEDS escapement database each year. The Babine Lake Escapement Table Database is complete for the years 1950-2010 and is available in digital format (Contact Barb Spencer; DFO, Prince Rupert).

The tributary escapement counts for the wild (un-enhanced) early and mid-timed sockeye runs come from visual stream walks and/or air surveys. The visual escapement surveys have been conducted in similar ways over the years, but the number of sites visited annually and the consistency of the coverage can vary depending on weather conditions, water levels, and crew availability. The tributary spawning counts are recorded in the database without any adjustments or expansions. These records report cells as an actual number, an A/P indicating adults present, an N/O indicating none observed, or an N/I indicating not inspected. Of importance for data interpretation is the treatment of A/P and N/O records as the former suggests some number of spawners present with no estimate of magnitude, while the latter suggests no spawners present at the time the survey was conducted. The distinction is important because an N/O entry could indicate a) truly zero spawners for a tributary that year, *or* b) spawners present in the tributary but in a different area or holding in the lake at the time the survey was conducted. As there is often no additional information suggesting what the interpretation of N/O records for a tributary should be, this update follows Wood et al. (1998) in that N/O records are treated the same as A/P records and are simply left blank for data assessments (e.g. not filled as zeroes).

Escapement counts for the wild late-timed sockeye come from mark-recapture programs (1976-1992) and from air surveys for other years. Escapement counts for Pinkut Creek and Fulton River come from counting fences (weirs) located on each tributary just upstream of Babine Lake. The counting fences separate the spawning channels from the natural streams and allow sockeye to be diverted into both. Once channel spawning targets are met, the fences are closed and "surplus" spawners are locked out below the fences. Fulton River and Pinkut Creek can be loaded to *maximum* spawning capacities of 381,000 and 128,000 sockeye respectively (West 1978, Brad Thompson, DFO, pers. Comm.):

	Spawners	Fry (million)	Fry/Spawner
Fulton Channel #1	20,000	15	750
Fulton Channel #2	116,000	87	750
Fulton R. Above Weir	200,000	45	225
Fulton R. below Weir	45,000	10	225
Total	381,000	157	
Pinkut Channel #1	58,000	44	750
Upper Pinkut Creek	40,000	9	225
Pinkut Creek Above Weir	25,000	6	225
Pinkut Creek Below Weir	5,000	1	225
Total	128,000	60	
Total BLDP	509,000	217	

The BLDP fences can be re-opened and the facilities "reloaded" with previously locked out fish holding below the fences in Babine Lake if and when pre-spawning mortality occurs. The number of spawners finally locked out below the fences is estimated each year by systematic visual surveys but an unknown proportion also remains along the Babine Lake shorelines bordering the BLDP sites (Wood et al. 1998).

2.2.1 Escapement Adjustments

The majority of the tributary escapement counts for wild Babine Lake sockeye are simple abundance indices subject to visual count underestimation bias and/or missing or variable tributary survey coverage. Spilsted and Spencer (2009) discuss many of the issues and cautions one must be aware of when interpreting DFO escapement data records. Wood et al. (1995, 1998) used a simple procedure to adjust the Babine Lake escapement records for underestimation bias but they did not adjust the data series for missing annual surveys. While both adjustments are considered in this paper, some background to the escapement counts themselves might be useful.

In most years, the sum of the escapement counts to the individual spawning sites within Babine Lake are significantly less than the Babine Lake fence count (Wood et al. 1998). The difference between the two is termed “un-accounted” in the data records and for many years un-accounted fish were thought to be non-censused lake spawners. However, dive surveys conducted by Wood et al. (1995) showed that lake spawning represents a negligible fraction of un-accounted fish and contribute little to fry recruitment. The number of enhanced fish (surplus) locked out of the BLDP sites each year accounts for most but not all of the un-accounted fish. More importantly, unaccounted fish existed before the first significant returns to the BLDP sites in 1975, indicating that spawning escapements to the various Babine Lake tributaries were (and still are) generally underestimated by visual or mark-recapture surveys (Wood et al. 1998).

Wood et al. (1995) developed a simple but parsimonious algorithm to estimate the uncensored (surplus) production returning to the enhancement facilities after correcting visual escapement estimates to the early, mid, and late timing runs for underestimate bias. The Babine Lake fence counts were regressed against summed spawning escapement estimates for the pre-enhancement period (1950-1969), and the regression relationship was used to adjust the un-enhanced escapement time series upwards by about 20%. Any remaining unaccounted fish were assumed to be surplus enhanced fish. Wood et al.’s (1995) methodology has been followed in this paper to update the adjusted escapement series through 2010.

2.3 Enhanced Surplus

The number of sockeye surplus to BLDP spawning requirements can be calculated as *apparent* surplus as the fish pass the Babine River fence and enter Babine Lake (e.g. total BLDP fish entering Babine Lake minus the maximum BLDP spawning capacity of 509,000), or as *biological* surplus once BLDP loadings are finalized (e.g. total BLDP fish entering Babine Lake minus BLDP catch minus final BLDP loadings). Calculating surplus after all Babine Lake fisheries and final spawner loading takes place is the more accurate biological assessment of enhanced surplus as used by Wood et al. (1998) and in this paper. In many years, the BLDP spawner loadings can be below or above the maximum capacities, and successive re-loading of the channels can occur using fish holding below the fences. For accounting purposes, the number of effective spawners in the BLDP facilities each year is defined as the number of sockeye actually spawning above the fences plus the minimum of either the below-fence spawning capacities (45,000 Fulton, 5,000 Pinkut) or the number of spawners locked out below the fences, whichever is less. All other sockeye become part of the enhanced surplus calculation.

2.4 Fry Production

Fry production from the BLDP facilities is monitored each spring using fixed-position, converging throat or fan traps (West and Mason 1987). The number of fry produced by the early, mid, and late-timed wild runs is not monitored but is estimated on the basis of the number of parent spawners and the assumption that fry output per spawner is equal to the average estimated from natural spawning in the Fulton River and Pinkut Creek (233 fry per spawner, MacDonald and Hume 1984, Wood et al. 1998). This approach may underestimate or overestimate actual fry production among sites or among years because density-dependent variation in fry/spawner production at different spawner levels is not being incorporated. Data tabled in West (1978) indicates natural fry per spawner can vary among years and has generally been lower for Pinkut Creek compared to Fulton River. The different natural sites within Babine Lake probably exhibit similar variations in average fry per spawner production. For sockeye rearing in the Main Arm, MacDonald and Hume (1984) considered their wild fry estimates to be gross approximations, but when added to the much larger outputs from the BLDP sites, still useful for estimating the total number of fry production.

2.5 Lake Rearing Capacity

The juvenile rearing capacity of the Main Arm has been estimated with a photosynthetic rate model at 219m fry producing 92m smolts (Shortreed and Morton 2000). Additional fry-rearing capacity in the North Arm, Morrison Arm, and Hagan Arm likely raises the rearing capacity of all Babine Lake to >300m fry, due, in part, to increased phytoplankton biomass and photosynthetic rates attributable to carcasses from the BLDP sites which have increased phosphorous loading by 38% compared to the pre-enhancement period. (Shortreed and Morton 2000, Jeremy Hume, DFO, pers comm.). Additional rearing capacity exists in Nilkitkwa Lake but has yet to be estimated.

2.6 Smolt Production

Smolt emigration from Babine Lake has been estimated by mark-recapture programs conducted below the outlet of Nilkitkwa Lake, 1951 to 2002. The smolt program has not operated since 2002 (brood year 2000). Various approaches have been used over the years to generate smolt estimates from the mark-recapture data. Wood et al. (1998) computed “corrected” smolt abundance estimates to account for discrepancies in mark-recapture results following the methods of Macdonald and Smith (1980). Their smolt data are reported here and have been updated through 2002.

3.0 Results

Table 1 reports aggregate annual Skeena River sockeye escapement, catch by fishery, exploitation rate by fishery, and Skeena River stock size (adults only) for the years 1970-2010. Table 2 reports annual Skeena River returns by age and estimated annual Babine Lake stock size. Table 3 reports modeled Marine + FSC exploitation rates for early, mid, and late timing Babine Lake sockeye sub-stocks from 1970-2010. Table 4 reports the Babine Lake fence counts and reconstructed spawning escapements by run-timing group for the years 1950-2010. Table 5 reports estimated fry production by run-timing group for brood years 1950-2010 and smolt production from Babine Lake for the brood year years 1959-2000. Table 6 reports brood year fry, smolt and adult production (recruitment) from Babine Lake for the years 1950-2005.

Table 7 reports brood year fence counts and adult production (recruitment) by age class from Babine Lake for the years 1950-2005.

Appx. Table 1 reports estimated BLDP contributions to the annual Skeena River sockeye return, 1982-2009. Appx. Table 2 outlines the Babine Lake sockeye escapement adjustment process developed by Wood et al. (1995). Appx. Table 3 reports the adjusted Babine Lake fence count and tributary escapement series by run-timing group 1950-2010. Appx. Table 4 reports the unadjusted Babine Lake escapement counts maintained in the DFO "Escapement Table Database" for the years 1950-2010.

3.1 Adult Returns and Exploitation Rates

Skeena River sockeye returns (catch plus escapement) increased substantially after Babine Lake enhancement began in the early 1970's and continued to do so throughout the 1980's and through most of the 1990's (Table 1, Fig. 3) as sockeye returns to Babine Lake increased (Table 2, Fig. 4). Since the early 2000's, Skeena River sockeye returns have declined to lower levels coincident with a recent decline in Babine Lake production. Skeena River sockeye returns averaged 2.1m from 1970-79, 3.1m from 1980-89, 3.9m from 1990-99, and 2.3m 2000-2010. The largest post-enhancement return of Skeena River sockeye was in 1996 (7.5m), while the smallest was in 2009 (860k). Since 1982, an estimated ~75% (53% - 91%) of the sockeye returning to Babine Lake have been from the BLDP, corresponding to ~65% (48% - 80%) of all sockeye returning to the Skeena River (Appx. Table 1).

Total exploitation (total catch/total return) on Skeena River sockeye has averaged just under 60% (22% - 72%) since Babine Lake enhancement began in the 1970's (Table 1, Fig. 3). Total exploitation rates averaged 56% (40% - 68%) through the 1970's, 56% (40% - 70%) through the 1980's, 65% (61% - 72%) through most of the 1990's until 1998, and 43% (22% - 69%) since then. A similar range of exploitation is evident in historical Skeena River sockeye reconstructions stemming back to the early 1900's (see Figure 4 of Wood 2001), although the exploitation shares have shifted as fisheries have developed.

Exploitation rates for the Skeena River aggregate stock should approximate those for the Babine Lake aggregate stock given that ~90% of Skeena River sockeye are from Babine Lake. Model-based exploitation rate estimates (marine + FSC) for the early-timed runs (peaking in marine fisheries in late June-early July) have averaged between 25% - 40% since enhancement began but have dropped to 15% - 25% for most of the 2000's (Table 3, Fig. 5). Model-based exploitation rate estimates for the mid-timed runs (peaking in marine fisheries throughout mid-July) have averaged between 50% - 55% since enhancement began but have dropped to <40% for most of the 2000's. Model-based exploitation rate estimates for the late-timed runs (peaking in marine fisheries in late-July-early August) have ranged between 40% - 50% since enhancement began and have dropped to <35% for most of the 2000's. The significant temporal overlap between the early, mid, and late-timed runs (Smith and Jordan 1973, Takagi and Smith 1973) makes assigning specific exploitation estimates somewhat speculative but the estimates reported in Table 3 should bracket the likely range. As well, the estimates do not yet incorporate additional ESSR and Economic harvests within the Skeena River and at Babine Lake itself and so will be biased low for some years.

Exploitation rates alone do not appear to be causing the recent declines in Babine Lake sockeye returns, as production from both the highly productive enhanced sockeye and the less productive wild sockeye has declined as exploitation has decreased. Disease issues at the BLDP sites in 1994 and 1995 (Wood et al. 1998) did dramatically suppress adult returns in 1998 and 1999 (<1.0m, Table 2), but since then those years have been the only ones affected. In addition, while the general decline in Babine Lake returns appears to have started after the record large runs in 1995 and 1996, it does not seem likely that over-escapement from those years was somehow a triggering mechanism as Babine Lake sockeye returns were very good in 2000 (4.4m) and 2001 (4.0m), the result of very strong age 4 and age 5 returns from the record "escapement" in 1996 (Table 2). Since 2001 or so, other than an average return of 2.7m in 2006, adult returns have all been less than 2.0m. In 2009 and 2010, preliminary estimates suggest adult returns were less than 900,000 fish (Table 2).

3.2 Adult Returns to Babine Lake

The number of sockeye entering Babine Lake (Table 4, Fig. 6) mirrors the pattern of total Babine Lake returns shown in Figure 4. The Babine fence counts increased substantially from the 1970's throughout the 1980's and through most of the 1990's as enhanced returns increased. Since then, the fence counts have decreased as sockeye production has declined. Very low fence counts were recorded in 2009 (672,000) and 2010 (639,000) (Table 4).

Trends in the number of enhanced BLDP sockeye counted past the fence are shown Fig. 7, indicating an increase throughout the 1980's and 1990's and a decline since then. In contrast, the number of wild sockeye counted past the fence has declined since enhancement began, especially in recent years. Since 1970, an average 74% (35%- 91%) of the sockeye entering Babine Lake have come from the Pinkut Creek and Fulton River, compared to 20% - 40% prior to enhancement (Fig. 8).

3.3 Spawning Escapements

The majority of individual stream records for wild Babine Lake sockeye exhibit high annual variability (Appx. Table 4, Fig. 9) and variable survey coverage which makes distinguishing trends somewhat difficult. Still, there has been a definite declining trend in "aggregate" wild spawning escapements in Babine Lake since the 1970's that does not seem to be an artifact of survey underestimate bias, missing spawning ground surveys, or the escapement adjustment process itself (Fig. 10). Most concerning, the magnitude of the wild stock decline has not been consistent across all wild run-timing groups, but seems more prevalent in the once large "late-timed" Babine River component (Fig. 11**,** bottom right panel), which is driving the total pattern.

Wood et al. (1998) also evaluated escapement trends by run-timing group (their Fig. 3 is reproduced here as Fig. 12). They concluded all run-timing groups (except Pinkut/Fulton) had declined and stabilized to lower levels because of increased exploitation rates on the enhanced returns. At the time, this seemed plausible because the early runs seemed least affected whereas the mid-timed runs seemed most affected. Wood et al. (1998) further concluded that the late-timing runs (bottom right panel of Fig. 12) seemed to be increasing, especially given the large late-run escapements in 1992 and 1993, and attributed the response to more conservative Skeena River management policies, as suggested by Henderson and Diewert (1989). This may have been partially true, but marine survivals for late 1980's brood years (Table 6) were actually quite high (>6%) which might also explain the good returns seen in the early 1990's.

The updated data series (Table 4, Fig. 11) now suggests the wild late runs have actually been on a long-term decreasing trend since the 1970's, especially for sockeye spawning in the Lower Babine River, despite the good escapements in the early 1990's and even in 2001. Spawning escapements to the late runs were consistently in the 300k to 500k range prior to the mid-1970's but then dropped to the 100k to 200k range through most of the 1980's and 1990's. Since 2007 late run escapements have all been below 100k, dropping to just 94k and 75k in 2009 and 2010.

Spawning escapements to the wild early runs, as observed by Wood et al. (1998), dropped slightly (from ~65k) after enhancement and seemed to be maintaining themselves in the 30k-50k range since then. Since 2007, the early run escapements have all been below 30k, dropping to 20k in both 2009 and 2010.

Spawning escapements to the wild mid-timed runs, as observed by Wood et al. (1998), dropped from the 20-40k range to the 10k - 20k range after enhancement and also appeared to be stable at those lower levels. Despite apparently high mid-timed escapements in 2003 and 2004 (83k and 63k respectively), the mid-timed escapements have fallen dramatically since 2006 (<15k) with only 6k seen in 2010.

3.4 Enhanced Surplus

Since 1975, there has been an *apparent* enhanced surplus at the Babine River Fence (spawners in excess of the 509,000 maximum BLDP capacity) for 28 of the past 36 years , ranging from a lows of 29,000 fish in 2009 and 2010 to almost 1.3m fish in 1996 (Appx. Table 3, top panel Fig. 13). The largest apparent surpluses occurred from the mid-1980s through the mid-1990's and early 2000's but have been declining since then. The actual *biological* enhanced surplus since 1975 (after Babine Fence/Lake catch and final spawner loading takes place) is also shown in the bottom panel of Fig. 13 (Appx. Table 3). There has been a biological surplus at the BLDP sites every year since 1975, ranging from a low of 9,000 fish in 1999 to almost 900,000 fish 1985. The biological surplus reflects the number of enhanced sockeye that arrived at the BLDP sites but were not spawned successfully. As with apparent surpluses, the largest biological surpluses occurred from the mid-1980s through the mid-1990's and early 2000's but have been declining since then.

3.5 Fry and Smolt Production

Fry recruitment to the Main Arm of Babine Lake (Table 5, Fig.14) has increased threefold since completion of the BLDP (Wood et al. 1998), from an average 61m from 1950-1970 (41m Pinkut/Fulton fry and 20m wild fry) to an average 192m since then (175m Pinkut/Fulton fry and 17m wild fry). Pinkut/Fulton fry recruitment now accounts for ~91% of all Main/Morrison/Hagan Arm fry recruitment compared to 67% prior to 1970. While average fry recruitment to the Main Arm has remained relatively stable since the 1980's, average smolt recruitment increased through the 1980's and early 1990's but was downward trending prior to cessation of the smolt program in 2002, despite some good production for brood years 1996 and 2000 (Table 6, Fig.15). No smolt data are available after 2002, the last year of the smolt program, and so it is not known if the pattern has been maintained.

In contrast to the Main Arm, and with some annual exceptions, estimated fry recruitment to the North Arm/Nilkitkwa Lake has declined since completion of the BLDP, down from averages in the 50m – 100m range prior to enhancement to averages in 25m-50m range since then, all consistent with reduced numbers of wild late-run spawners (Table 5, Fig.16). There have been four or so larger spikes in estimated North Arm/Nilkitkwa Lake fry recruitment (>100m) since 1950 (Table 5, Fig. 16), all related to years with larger than average numbers of spawners. However, none of these spikes have resulted in subsequent large smolt recruitment (2m -16m), suggesting rearing capacity may have been exceeded in those years. Indeed, maximum smolt recruitment appears to be at ~70m fry in the North Arm/Nilkitkwa Lake (Table 5, bottom panel Fig. 17). There also appears to be a negative relationship between fry to smolt survival as fry densities increase in the North Arm/Nilkitkwa Lake (top panel Fig. 17). Average fry recruitment to the North Arm/Nilkitkwa Lake has been on a long-term declining trend since the 1970's, as has average smolt recruitment (Table 5, Fig. 18). No smolt data for the North Arm are available after 2002, the last year of the smolt program, and so it is not known if the pattern has been maintained.

Estimated fry recruitment to all of Babine/ Nilkitkwa Lake is shown in Fig. 19 (Table 6). The total fry rearing capacity of Babine/Nilkitkwa Lake is estimated to be >300m fry, while that of the Main Arm alone is estimated to be 219m. Fry recruitments greater than 300m have only occurred 6 out of the last 60 years. This suggests that the lake rearing capacity of Babine Lake has not been exceeded at historic levels of fry recruitment, although much of the current rearing capacity of Babine Lake is clearly being used by enhanced fry rather than wild fry. Shortreed et al. (2000) concluded that most fry recruitments to date have not been excessive, but that increases beyond the maximum recruitments observed to date would likely reach or exceed the lake's rearing capacity and not result in additional smolt production.

3.6 Factors Limiting Fry and Smolt Production

Wood et al. (1998) concluded that egg-fry survival and overall incubation capacity at the enhanced sites were the main factors limiting fry recruitment to the Main Arm, while spawning escapements to the Upper and Lower Babine Rivers was the main factor limiting fry recruitment to Nilkitkwa Lake and the North Arm. This still seems to be the case although fry recruitment to Morrison Arm is likely being limited by spawning escapements as well.

The updated data series does not provide any new insights into factors limiting smolt recruitment to the Main Arm since Wood et al.'s (1998) evaluations. They found increased fry recruitment from the BLDP had not yet caused a detectable reduction in fry to smolt survival in the Main Arm; the updated data series still indicates fry-smolt survival in the Main Arm has been variable but essentially without trend just prior to cessation of the smolt program (Table 6, top panel Fig. 20). Additionally, Wood et al. (1998) found smolt production from the Main Arm had yet to decline as fry recruitments increased, suggesting maximum smolt numbers and maximum smolt biomass has yet to be achieved. This too still seems to be the case, at least up to cessation of the smolt program (Table 6, bottom panel Fig. 20). Newer data were not available for this update, but Wood et al. (1998) found higher fry recruitments to the Main Arm resulted in higher smolt biomass (Table 5, bottom panel Fig. 21) and while the smolts are smaller at high fry densities (Table 5, top panel Fig. 21), average smolt weight over a wide range of higher fry densities in the Main Arm is still quite large (4g- 5g) relative to other productive B.C. sockeye rearing lakes (Wood et al. 1998).

Despite all this, there have been some interesting temporal shifts in fry to smolt survival in the Main Arm over time that are hard to explain. Fry to smolt survival in the Main Arm ranged from lows of ~25% prior to enhancement to highs in the early 1980's of >50%, then subsequently declined through the 1990's to <35% (Table 6, top panel Fig. 22). Fry to smolt survival in the North Arm/Nilkitkwa Lake shows an even more striking temporal pattern as it has declined to much lower levels over time (data in Table 5, bottom panel Fig. 22). Wood et al. (1998) noted that fry-smolt survival in the Main Arm, estimated after pre-spawning mortality, had been below average and declining since the 1993 brood year, and suggested some "other" agent(s) of mortality may be responsible without being able to identify what those agents might be.

Recent discussions with DFO limnologists (Ken Shortreed, Dr. Daniel Selbie, Cultus Lake Research Laboratory, Cultus Lake, British Columbia) suggests there could be other factors limiting fry and smolt production from Babine Lake for which little or no data currently exists. For example, it is possible that BLDP fry loading patterns themselves are driving temporal patterns in fry-smolt survival in the Main Arm, especially when they are sustained at high levels approaching lake rearing capacity. BLDP fry loadings were maintained at a steady high rate during the first half of the 2000's (>220m), and for the past 15 years or so, BLDP loadings have exhibited less variability and more continuous high fry recruitment than any previous period. Lake rearing capacity in sockeye lakes can be compromised when high fry densities are sustained over consecutive years because of adverse grazing pressure on the available plankton community. Variable fry loading densities (among years) more often allow lakes to "fallow" which can help maintain plankton community structure following periods of high grazing pressure.

Additional factors besides spawner abundance could be limiting fry and smolt recruitment to the North Arm/Nilkitkwa Lake. In shallow Nilkitkwa Lake, macrophyte densities appear to have increased substantially since the 1970's which could be providing refuge for predators and driving strong depensatory mortality at low fry and smolt densities, as well as altering water quality to the detriment of alevin migration and fry and smolt production. In the North Arm, there is concern about changing trophic web dynamics relative to the Main Arm given its dramatically different food-chain trophic structure for juvenile sockeye with stronger and more prolonged stratification, and different plankton seasonality. The North Arm also appears more susceptible to trophic alteration and climate change impacts than the Main Arm. Further research would help assess some of these possibilities.

Resource extraction in the Babine lake watershed has also been cited as a possible influence on sockeye production from Babine Lake. In 1966, Granby Mining Co. began production in an open pit copper mine located on an island complex in Hagan Arm (Shortreed and Morton 2000). A second mine, owned by Noranda Mines Ltd, opened on a peninsula separating the Main and Hagan Arms. Both mines closed in 1982 after producing a combined 520 million kg of copper ore, and tailings ponds associated with mines are located adjacent to the lake (Shortreed and Morton 2000). Permitted discharge from the ponds has been entering Babine Lake since the mines closed. No significant changes in water quality as a result of the tailings ponds have been reported but the potential long-term affects on fish production have been questioned by the Lake Babine First Nation (Gottesfeld and Rabnett 2008).

Logging activity within the Babine Lake watershed has been extensive. Selective logging of spruce and pine began in 1925 and clear-cut logging started in the 1950's (Shortreed and Morton 2000). In the 1970's logging mostly occurred in the drainages of Pinkut Creek and Fulton River. During the 1980's logging extended to the eastern side of the lake near Hagan and Morrison Arms. While the cumulative affects of logging related sedimentation in the Babine Lake watershed (if any) are currently unknown, concerns about impeded fish access to spawning sites have been identified (Gottesfeld and Rabnett 2008).

3.7 Marine Survival and Adult Recruitment

Smolt to adult marine survival has been highly variable for Babine Lake sockeye, averaging ~4% (1% - 8%) since brood year 1959 (Fig. 23). Marine survival for brood year 1995 (14%) seems to be an anomaly and likely relates to under-estimation of smolt abundance due to flooding that year. Although adult recruitment does increase as smolt production increases (Table 6, top panel Fig. 24), the relationship is not linear because smolt to adult survival is inversely related to smolt abundance (Table 6, bottom panel Fig. 24), presumably because of density-dependent ecological interactions (Peterman 1982, McDonald and Hume 1984, Wood et al. 1998, Wood 2001). R. Peterman, in Walters et al. (2008) has suggested that wild smolts from Babine Lake likely face reduced survival rates when BLDP smolt abundance is high, although no data exist to test this possibility.

Since cessation of the smolt program in 2002 (brood year 2000), it has not been possible to assess more recent relationships between adult recruitment and smolt production from Babine Lake. Marine survival was trending downward just prior to cessation of the smolt program, with three of the last four brood years below 2%. It is not known if this pattern has been maintained since then, or if poor smolt-adult survival has been the main reason Babine Lake brood year recruitment has declined so markedly in recent years (Table 7, top panel Fig. 25) compared to Wood et al.'s (1998) last assessment (Table 7, bottom panel Fig. 25).

Observations from other sockeye populations on the North Coast suggests marine survival might now be an issue for Babine Lake sockeye but any distinct patterns are difficult to infer from other stocks as there has been extremely wide variation in brood year recruitment among sockeye stocks on the North Coast for much of the last decade (Steve Cox-Rogers, Fisheries and Oceans Canada, unpublished data on file). For example, sockeye stocks on Haida Gwaii (QCI) and some of those in the lower Skeena River and outer North Coastal region have been exhibiting a pattern of increased production in recent years. In contrast, Meziadin Lake sockeye, a very productive stock and the largest in the Nass River watershed, has been showing a declining production pattern similar to Babine Lake sockeye. Sockeye stocks in the Atnarko River, Rivers Inlet, and Smiths Inlet areas on the Central Coast have been in a long term and persistent period of poor production for 15 years or more. Assuming freshwater productivity has been relatively stable (a reasonable assumption), these observations suggest marine survival has been locally variable on the North/Central coast, although the mechanisms are poorly understood and data do not exist for a proper evaluation. Indeed, "the elimination of monitoring programs that historically provided observations to partition ocean versus freshwater survival events for Babine Lake (Skeena) and Meziadin Lake (Nass) sockeye indicator stocks has weakened our ability to clearly identify whether current production variations influencing returns of sockeye on BC's North Coast are clearly due to marine or freshwater events" (Dr. Kim Hyatt, Pacific Biological Station, DFO, pers. comm.).

3.8 Escapement Target Development

Escapement targets for Babine Lake sockeye cannot be based on conventional assessments of stock productivity because adult returns to Babine Lake originate from both wild and enhanced sites with very different productivities (Wood et al. 1998). Substantially different escapement levels are needed to maximize fry and smolt recruitment from the enhanced compared to the wild runs (Wood et al. 1998). For example, less than 500,000 spawners are needed to maximize BLDP fry production (top panel Fig. 26) which, in most years, can account for ~90% of the Main Arm's estimated fry rearing capacity (219m). This level of spawning escapement has always been achieved at the BLDP sites. In contrast, it appears ~300,000 wild late-timed spawners producing ~70m fry, are needed to fully seed Nilkitkwa Lake and the North Arm (Fig. 17 and Fig. 27). Spawning escapements to the late runs are now well below this level (~30%). Similar escapement concerns exist for the early and mid-timed sockeye runs as well, with some of the individual streams now seeing some very poor returns (Appx. Table 4).

Escapement targets for Babine Lake will also need to consider the Wild Salmon Policy (DFO 2005) which requires the development of lower and upper escapement benchmarks for individual Conservation Units (CU's). Currently, two sockeye CU's have been identified for the Babine Lake watershed based on rearing lake criteria (a mid-timed Tahlo/Morrison CU and a Babine Lake CU, Holt and Ciruna 2007); however, more could be specified if other criteria are considered. For example, three wild sockeye "CU's" exist based on run-timing differences (the early, mid, and late wild runs) not including the enhanced mid-timed sockeye from Pinkut Creek and Fulton River.

Escapement benchmarks for Babine Lake sockeye CU's will likely be developed from considerations of historical escapement patterns, new technical assessments of intrinsic productivity and spawning capacities, and from updated estimates of juvenile rearing capacity and associated spawning escapements in each of the rearing basins. The exploitation rates required to maintain stock status within benchmark boundaries can be calculated, and computer models exist to show the trade-offs (risks) in stock status when CU's are fished at different rates (Walters et al. 2008, Cox-Rogers et al. 2010). These types of technical analyses will become especially important for Babine Lake sockeye given the known overlap between the early, mid, and late-timed runs as they pass through "mixed-stock" fisheries in Alaskan and Canadian marine areas, the main stem Skeena River, and as they pass the Babine River fence to enter Babine Lake itself. These types of technical analyses should also help address a fundamental issue concerning Babine Lake sockeye and Skeena River sockeye fisheries in general: how many enhanced sockeye should be produced by the BLDP in support of harvest fisheries targeting Skeena River sockeye, and what harvest strategies are most appropriate for maintaining wild stock biodiversity (Wood 2001, Walters et al. 2008).

4.0 Conclusions

Babine Lake sockeye returns have been on a declining trend for most of the 2000's, down from the previous highs seen through the 1980's and most of the 1990's. Exploitation rates have also fallen as returns have declined. It is not known when (or if) a return to higher sockeye production from Babine Lake might be expected, and it is not known if the recent downward trend in recruitment for all Babine Lake run-timing components (early, mid, and late) will continue. Approximately 90% of all Skeena River sockeye are from Babine Lake, and of these, an average 75% have been enhanced fish from Pinkut Creek and Fulton River. Even if return rates for Babine Lake sockeye decrease, modest enhanced production from Pinkut Creek and Fulton River would still be expected in future years because they are so productive. Concern exists, however, for production from all the wild runs, especially the late-timed sockeye spawning in the Lower and Upper Babine River.

It is currently unclear how freshwater and/or marine survival variation may be influencing recent Babine Lake brood year recruitment. Reduced adult returns the past decade could be due to fewer smolts leaving Babine Lake, fewer smolts surviving as adults in the ocean, or some combination of both. Several mechanisms affecting freshwater and marine survival have been proposed, but data are lacking to make a proper assessment. Future research will be required to address some of the concerns.

1) Escapements: Escapements to the various Babine Lake run-timing components (early, mid, and late) have changed somewhat since the last evaluations conducted by Wood et al. (1998). Escapements to enhanced Pinkut Creek and Fulton River continue to exceed spawning

requirements, even with the recent declines in total production. Escapements to the unenhanced late-runs exhibit a long-term declining trend which was not evident in the last assessment conducted by Wood et al. (1998). Late-timed escapements in recent years have been much lower than historic levels. Escapements to the early-timed and mid-timed unenhanced runs, although relatively stable through most of the 2000's, have also been very low in recent years.

2) Main Arm Fry and Smolt Production: The majority of fry and smolt production from the Main Arm of Babine Lake continues to come from Pinkut Creek and Fulton River. Main Arm smolt production, as inferred from enumeration of late-migrant smolts, increased dramatically after enhancement began in the 1970's but was on a declining trend prior to cessation of the last brood year assessed (2000), even though enhanced fry output has remained relatively stable. It is not known if this pattern has been maintained. Fry production from Pinkut Creek and Fulton River continues to account for ~90% of fry recruitment to the Main Arm; yet total fry recruitment to the Main Arm still appears to be below maximum rearing capacity.

3) North Arm/Nilkitkwa Lake Fry and Smolt Production: North Arm/Nilkitkwa Lake smolt production, as inferred from enumeration of early-migrant smolts, was on a declining trend prior to cessation of the last brood year assessed (2000), consistent with reduced numbers of late-run spawners and reduced (inferred) fry production. It is not known if this pattern has been maintained but low returns of adults the past decade suggests this has been the case.

4) Marine Survival and Adult Returns: Both annual and brood year adult returns for Babine Lake sockeye have declined from the previous highs observed in the 1980's and most of the 1990's. Up until brood year 2000, the available data still shows increased smolt production from Babine Lake leads to increased adult recruitment, but the relationship is non-linear because smolt to adult survival is inversely related to smolt abundance, probably because of competition between smolts (Wood et al. 1998). However, it is not known how smolt production in more recent years relates to adult returns. Marine survival for Babine Lake sockeye was on a declining trend prior to cessation of the smolt program, down from averages of 4% to <2%. Observations from other sockeye populations on the North Coast suggests marine survival could be an issue for Babine Lake sockeye but any patterns are difficult to infer from other stocks as there has been extremely wide variation in brood year recruitment among sockeye stocks on the North Coast for much of the last decade, with some stocks doing well (e.g. Haida Gwaii, lower Skeena/Coastal) and others not (e.g. Meziadin, Rivers/Smiths/Atnarko). Assuming freshwater productivity has been relatively stable, these observations suggest marine survival has been locally variable on the North/Central coast, although the mechanisms are poorly understood and data do not exist for a proper evaluation. Re-establishing the Babine Lake smolt program would assist in tracking trends in smolt to adult marine survival, as well as tracking smolt recruitment from Babine Lake.

5) Exploitation Rates: Total exploitation on Skeena River sockeye has averaged just under 60% since Babine Lake enhancement began in the 1970's, with decade averages of 56% through the 1970's, 56% through the 1980's, 65% through most of the 1990's, and 43% since 2000. Exploitation rates alone do not appear to be the cause of declines in Babine Lake

sockeye returns, as recruitment to both the highly productive enhanced sockeye and the less productive wild sockeye has declined as exploitation has decreased.

6) Escapement Targets: Although just two sockeye Conservation Units have been identified to date for the Babine Lake watershed based on rearing lake criteria (mid-timed Tahlo/Morrison and Babine Lake), more could be specified if other criteria are considered. For example, three wild sockeye “CU’s” exist based on run-timing differences (the early, mid, and late wild runs), not including the enhanced mid-timed sockeye from Pinkut Creek and Fulton River. Escapement benchmarks for Babine Lake sockeye CU’s will likely be developed from considerations of historical escapement patterns, new technical assessments of intrinsic productivity and spawning capacities, and from updated estimates of juvenile rearing capacity and associated spawning escapements in each of the rearing basins. The exploitation rates required to maintain stock status within benchmark boundaries can be calculated, and computer models exist to show the trade-offs (risks) in stock status when CU’s are fished at different rates. These types of technical analyses will become especially important for Babine Lake sockeye given the known overlap between the early, mid, and late-timed runs as they pass through “mixed-stock” fisheries in Alaskan and Canadian marine areas, the main stem Skeena River, and in Babine Lake itself.

Acknowledgements

We thank Dave Peacock (DFO), Peter Hall (DFO), and Doug Lofthouse (DFO) for reviewing the manuscript and providing helpful edits. Ken Shortreed, Jeremy Hume, and Dr. Daniel Selbie (DFO Cultus Lake Research Laboratory) provided valuable interpretive assistance. Thanks to Dr. Kim Hyatt (DFO) for his discussions and broader perspectives concerning sockeye production issues in Northern B.C.

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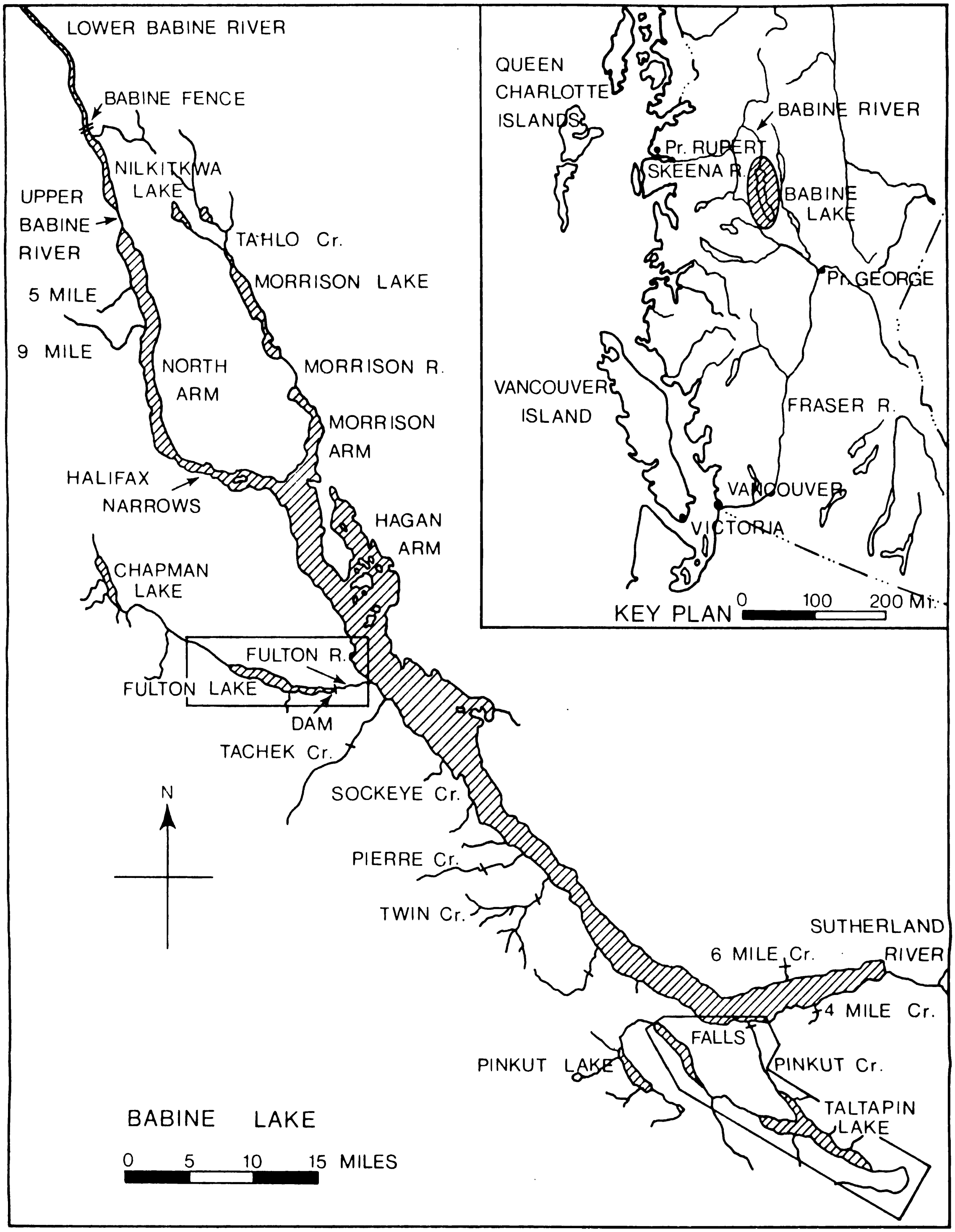


Figure 1. Map of Babine Lake.

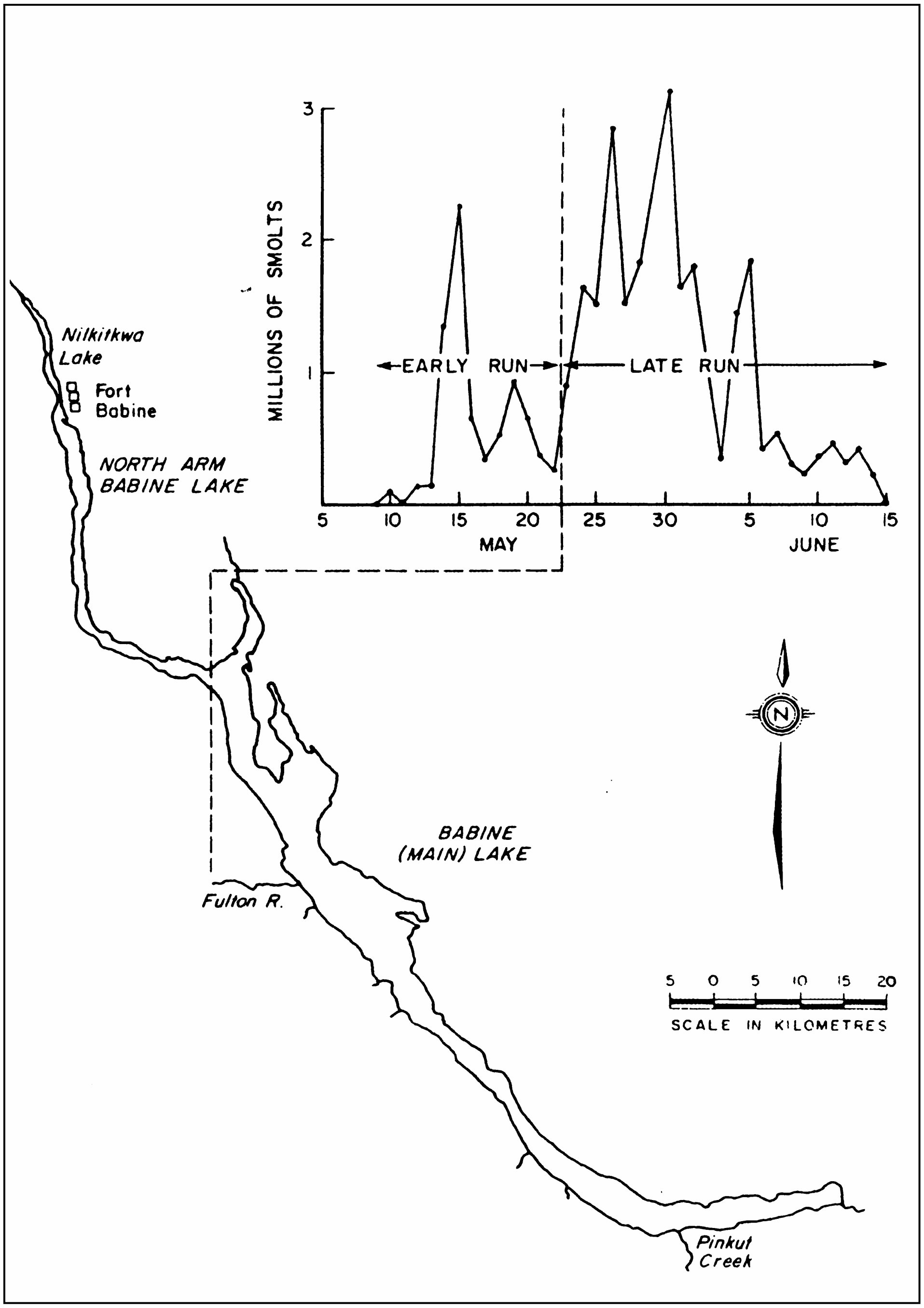


Figure 2. Rearing areas and typical timing of early migrant smolts and late migrant smolts from Babine Lake (after Wood et al. 1998). Early migrant smolts originate from late-timed spawners in the Upper and Lower Babine River which rear as fry in the North Arm and Nilkitkwa Lake. Late migrant smolts originate from early-timed and mid-timed spawners in tributaries to the Main Arm, Morrison Arm and Hagan Arms including Pinkut Creek and Fulton River.

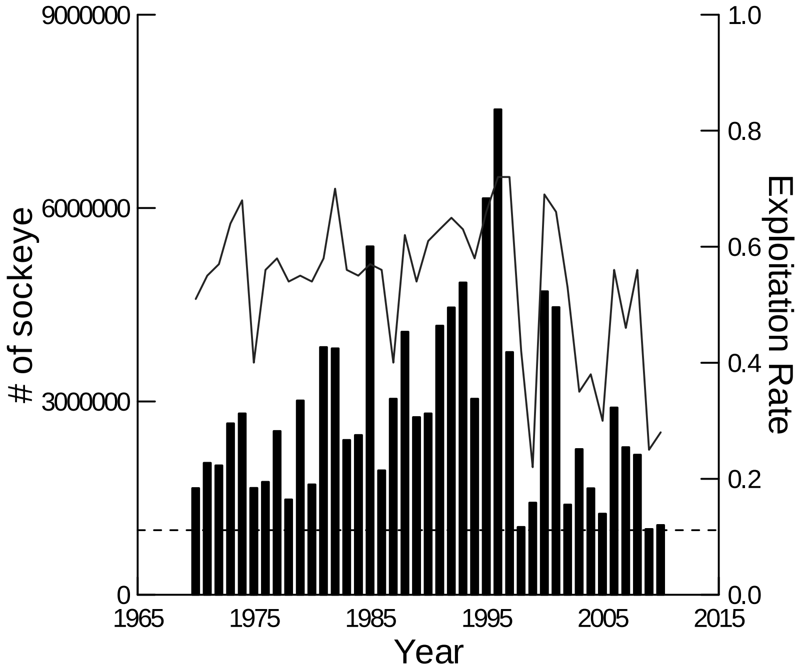


Figure 3. Trends in annual Skeena River sockeye returns of all ages (bars) and all-fishery exploitation rates (line), 1970-2010. The lower horizontal like represents the current minimum escapement goal of 1,050,00 (2009 and 2010 are preliminary).

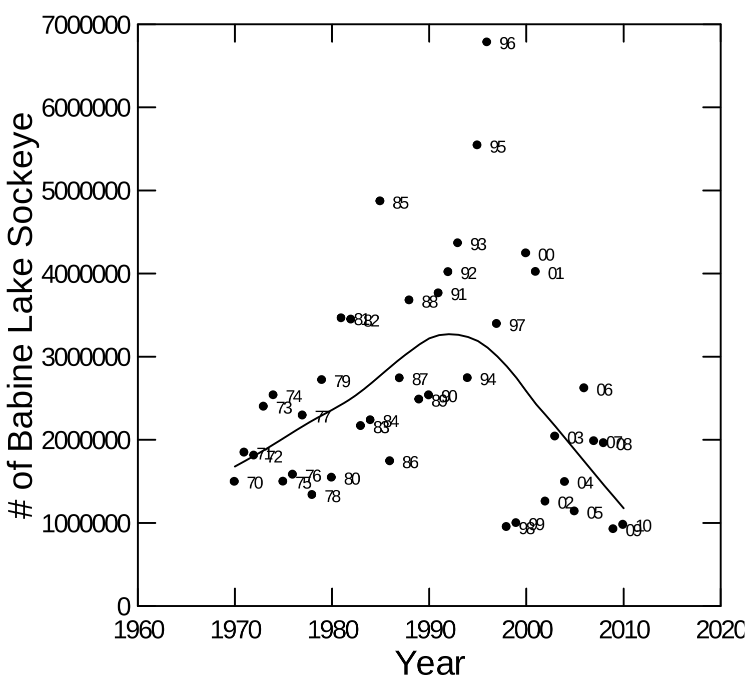


Figure 4. Trends in annual Babine Lake sockeye returns (catch plus escapement), 1970-2010. The trend line is fitted by LOWESS (F=0.5)

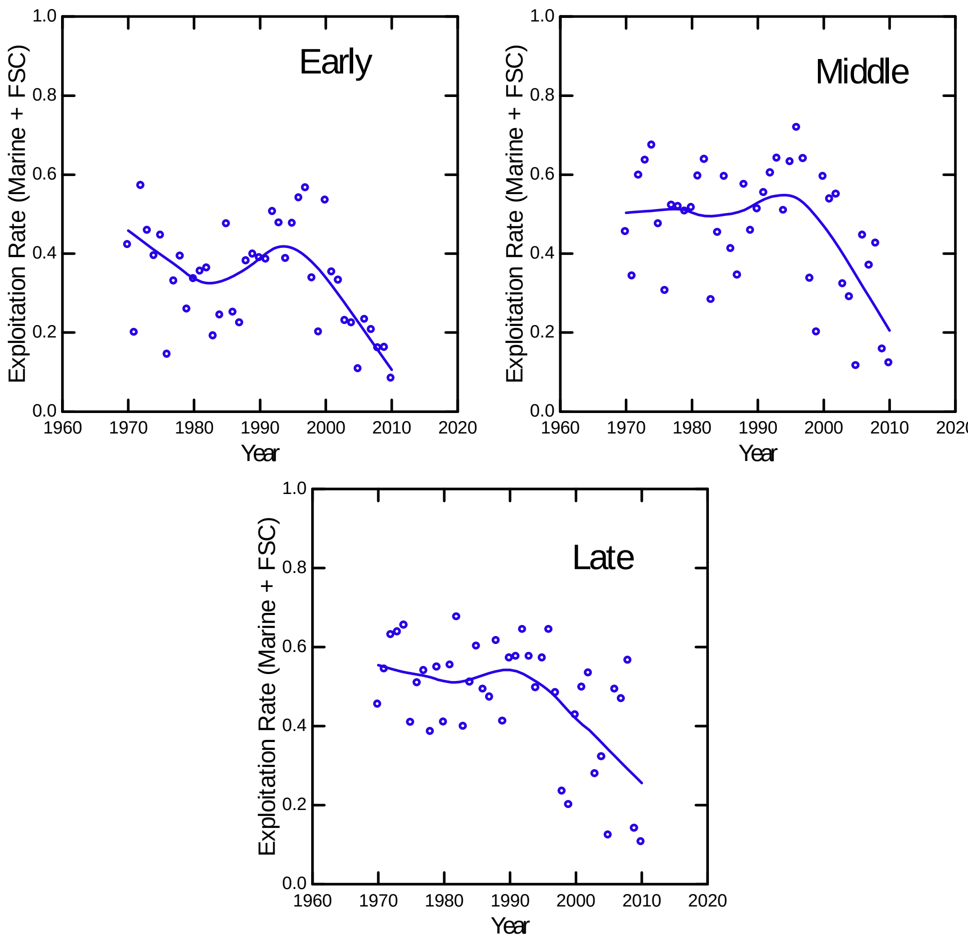


Figure 5. Trends in <u>modeled</u> exploitation rates (marine + in-river FSC) for Early, Middle and Late-timed Babine River sockeye: 1970-2010. The exploitation rate estimates do not yet include any annual ESSR and/or Economic harvest of Babine Lake sockeye within the Skeena River or within Babine Lake, which would affect the mid-timed and late-timed runs. The trend lines are fitted by Lowess (F=0.5).

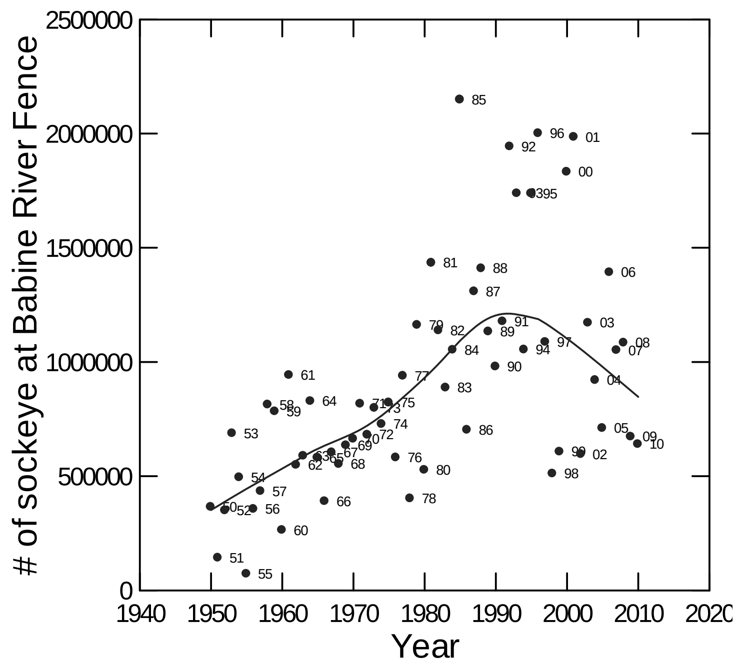


Figure 6. Trends in the total number of adult (age 4 and age 5) sockeye arriving at the Babine River counting fence, 1950-2010. The trend line is fitted by LOWESS (F=0.5).

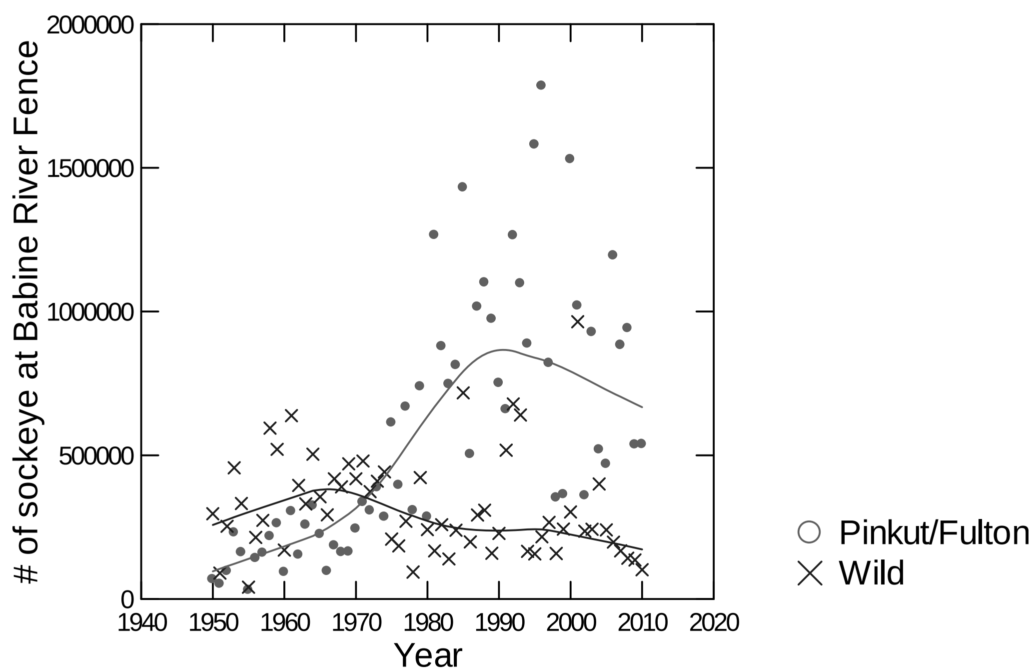


Figure 7. Trends in the number of adult (age 4 and age 5) Pinkut/Fulton and wild Babine Lake sockeye arriving at the Babine River counting fence, 1950-2010. The trend lines are fitted by Lowess (F=O.5).

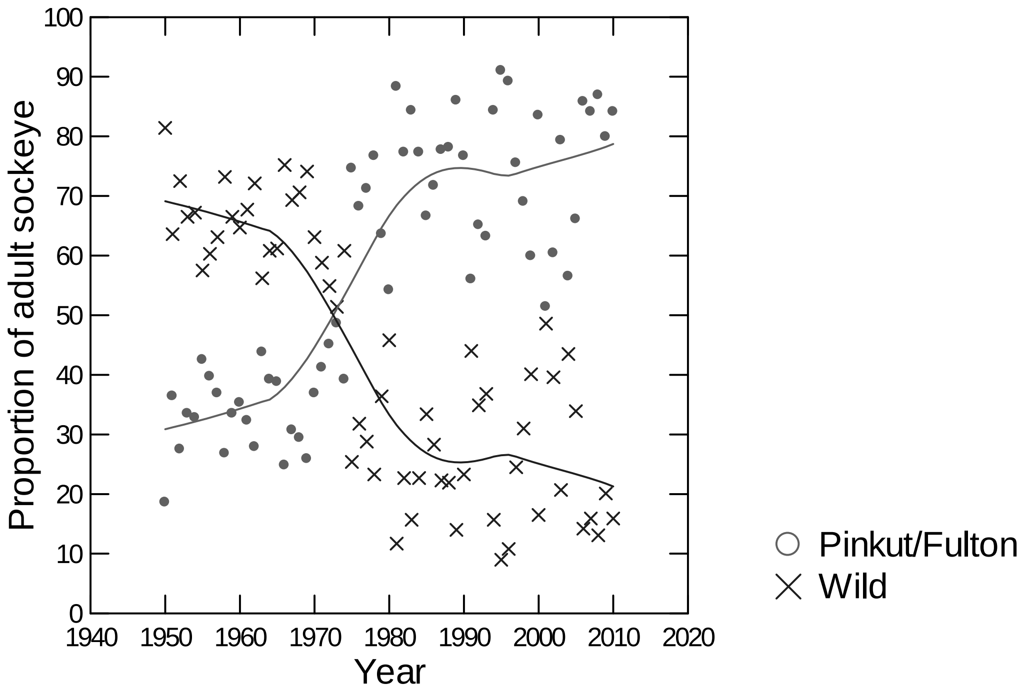


Figure 8. Trends in the proportions of adult (age 4 and age 5) Pinkut/Fulton and wild Babine Lake sockeye arriving at the Babine Lake counting fence, 1950-2010. The trend lines are fitted by LOWESS (F=0.5).

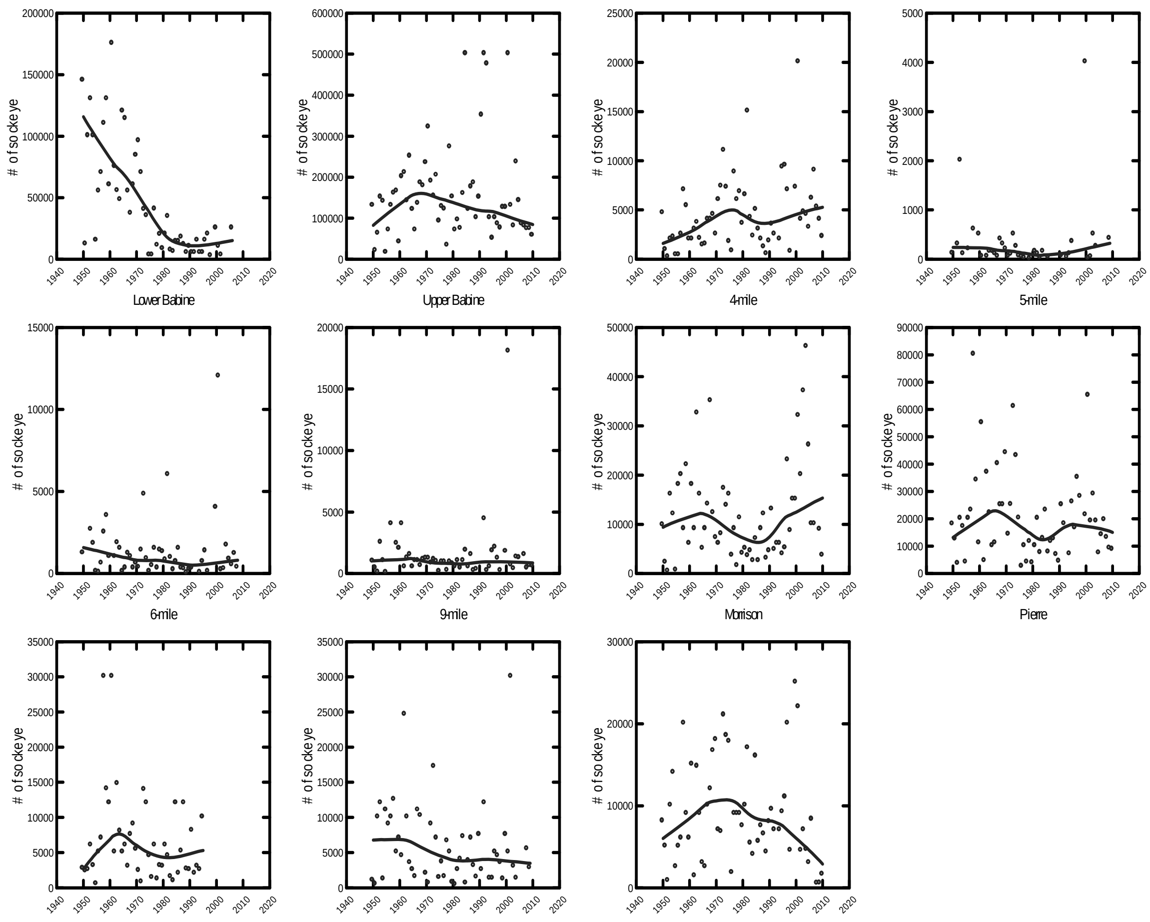


Figure 9. Trends in observed (reported) sockeye adult (age 4 and age 5) spawning escapements for the major wild Babine Lake spawning populations, 1950-2010. Trend lines fitted by LOWESS (F=0.5).

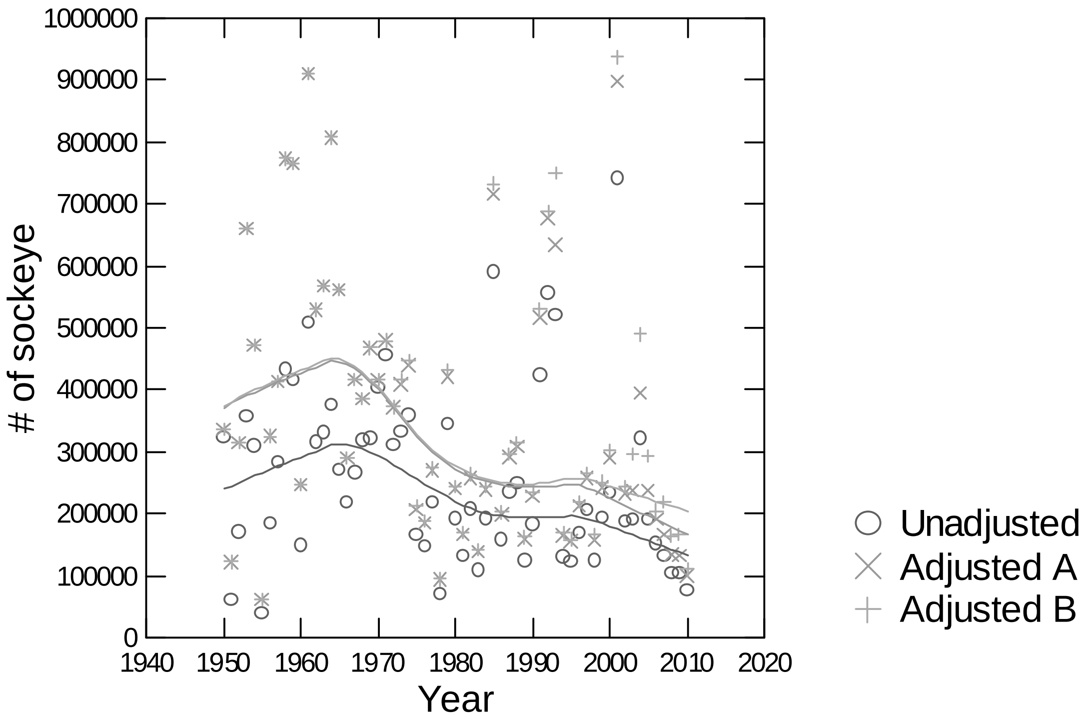


Figure 10. Trends in total spawning escapements, 1950-2010, for adult wild Babine Lake sockeye using unadjusted escapement data (bottom line), adjusted (A) escapement data corrected for visual underestimate bias (after Wood et al. 1995, 1998), and adjusted (B) escapement data corrected for visual underestimate bias (after Wood et al. 1995, 1998) **and** missing annual survey data (fill routine provided by Bill Gazey, Gazey Research, Victoria, B.C.) Trend lines fitted by LOWESS (F=0.5).

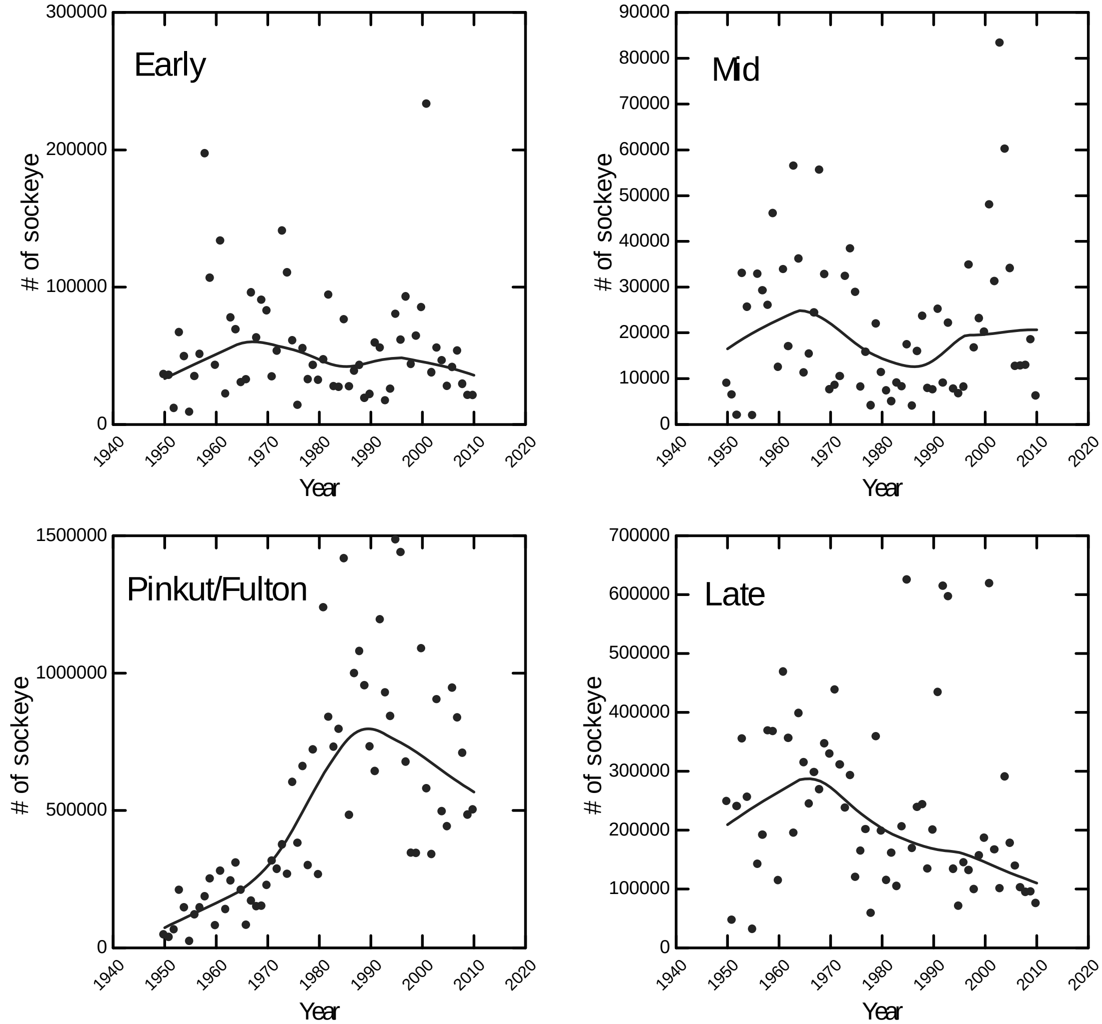


Figure 11. Trends in reconstructed spawning escapements (following Wood et al. 1995, 1998) for adult (age 4 and age 5) early wild, middle wild, Pinkut/Fulton and late wild sockeye, 1950-2010. Pinkut/Fulton 1970-2010 includes actual and surplus spawners. Trend lines fitted by LOWESS (F=0.5).

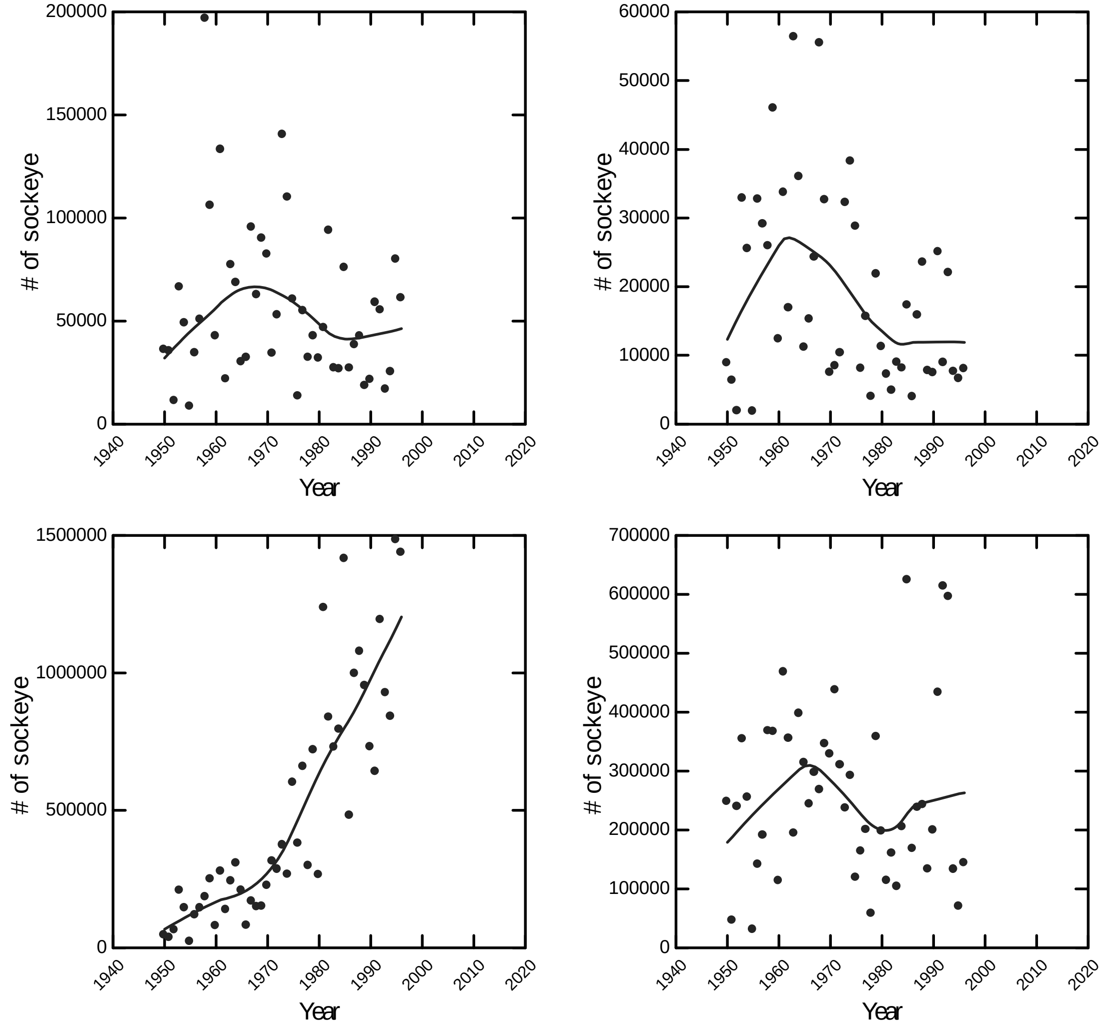


Figure 12. Trends in reconstructed sockeye spawning escapements for adult (age 4 and age 5) early wild, middle wild, Pinkut/Fulton and late wild sockeye, 1950-1996, **as shown in Fig. 3 of Wood et al. (1998).** Graph labels are the same as in Fig. 11. Pinkut/Fulton 1970-1996 includes actual and surplus spawners. Trend lines fitted by LOWESS (F=0.5).

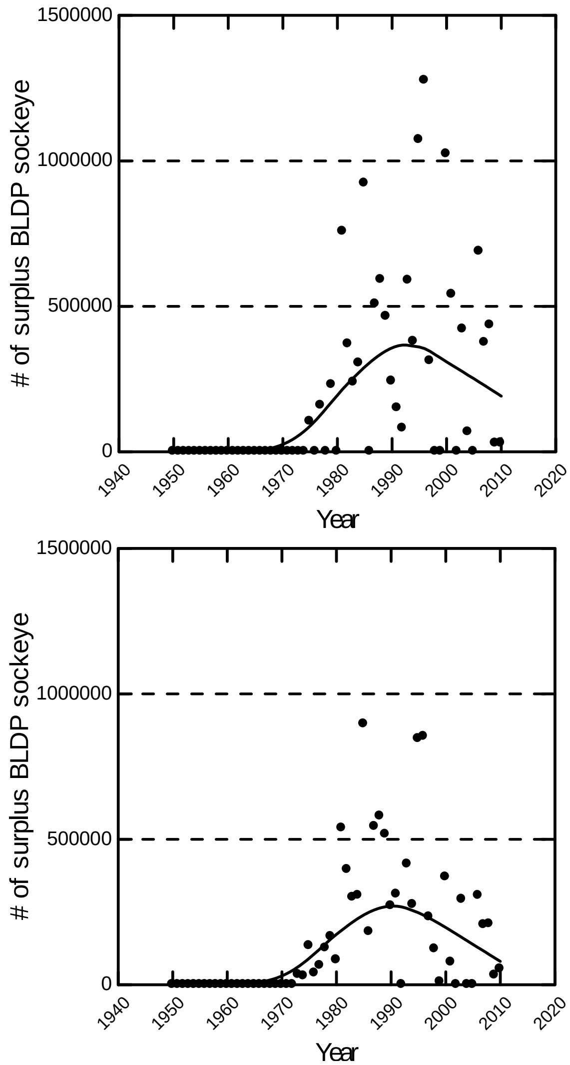


Figure 13. Trends in **apparent** (top) and **actual** (bottom) Pinkut/Fulton BLDP surplus spawners 1970-2010. The apparent surplus is the total number of adult (age 4 and age 5) Fulton/Pinkut sockeye arriving at Babine River fence minus 509,000 maximum BLDP spawning capacity. The actual or biological surplus represents the number of adult (age 4 and age 5) spawners locked out of the Pinkut/Fulton facilities after enhanced catch (at Babine Lake) and final BLDP spawner loading takes place. Trend lines fitted by LOWESS (F=0.5).

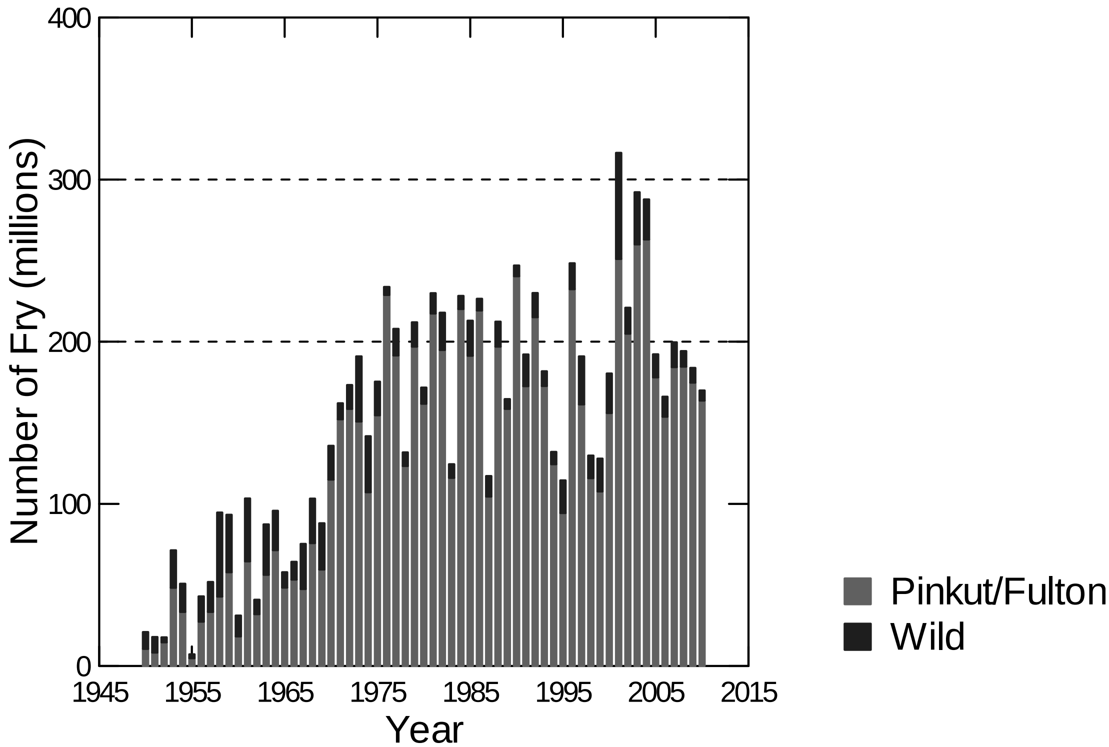


Figure 14. Trends in estimated brood year fry recruitment (millions) to the **Main Arm** (includes Morrison and Hagan Arms) of Babine Lake for the Pinkut/Fulton, early wild and mid wild Babine Lake sockeye, 1950-2010. As shown, the light bars represent fry production from just Pinkut/Fulton. The fry rearing capacity of the Main Arm alone is estimated to be 219 million fry, not including Morrison and Hagan Arms.

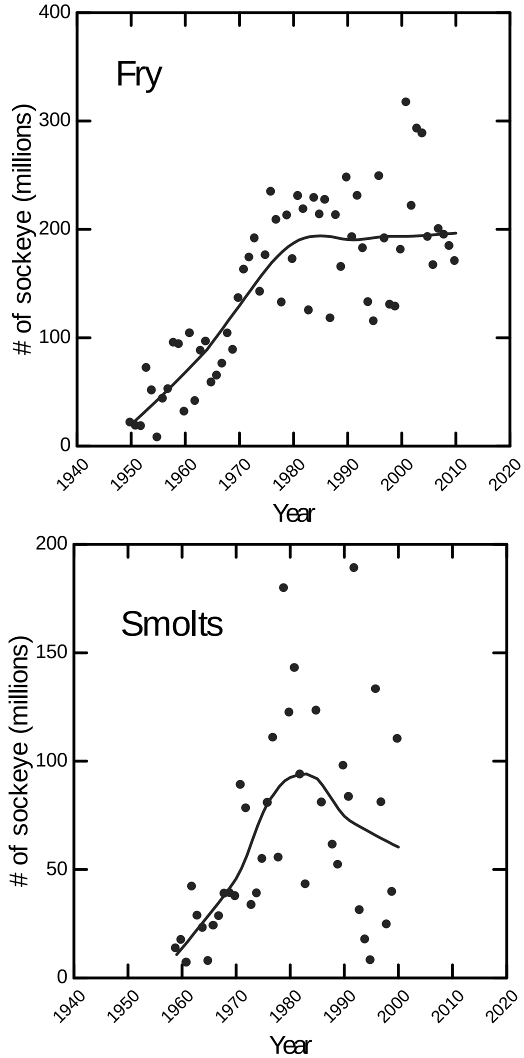


Figure 15. Trends in estimated brood year sockeye fry (top) and late-migrant smolt (bottom) recruitment from the **Main Arm, Morrison Arm and Hagan Arm** of Babine Lake (brood years 1950-2010 fry, 1959-2000 smolts). The smolt program ended in 2002 (brood year 2000). Lines fitted by LOWESS (F=0.5).

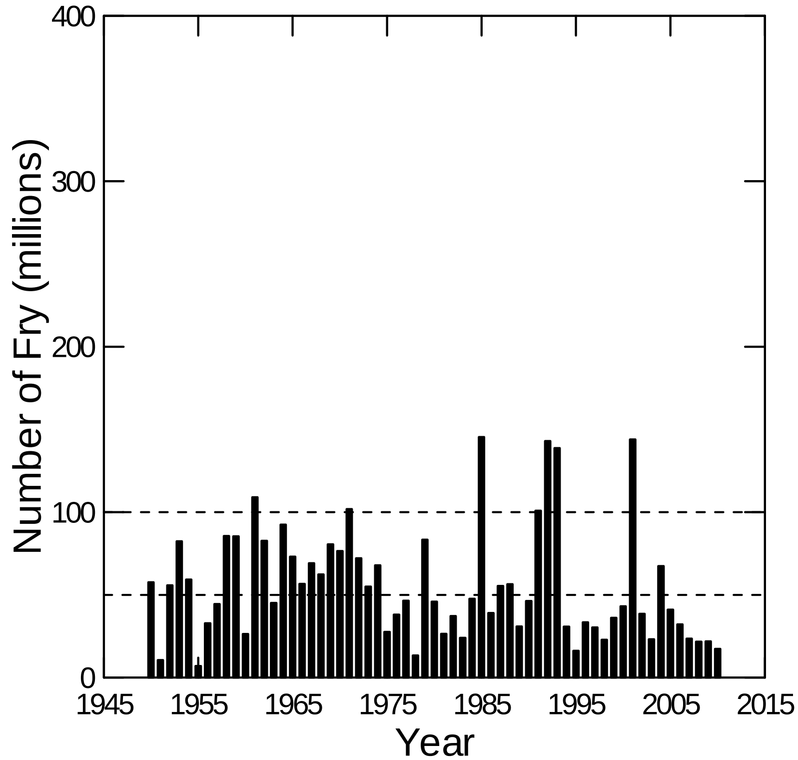
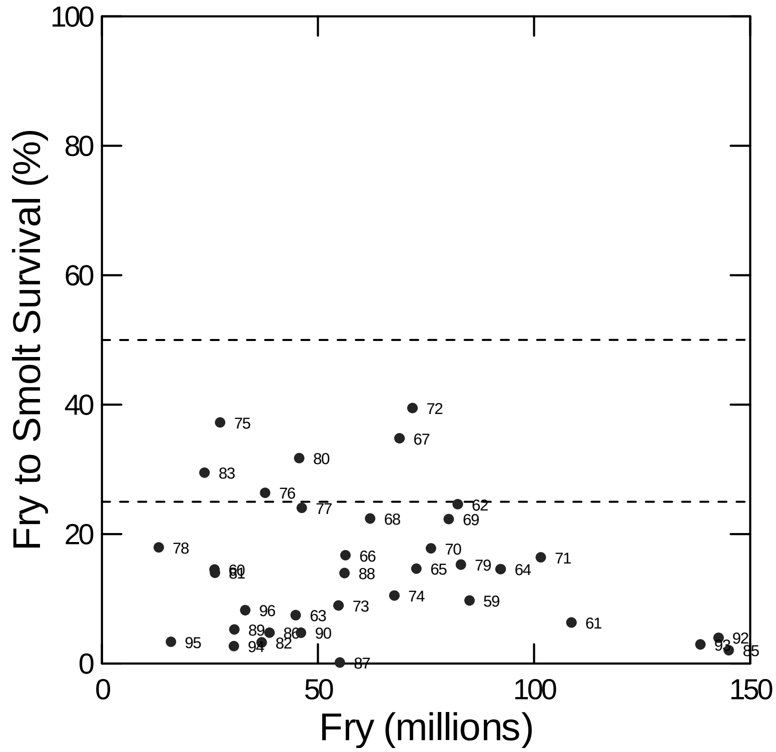


Figure 16. Trends in estimated brood year fry recruitment (millions) to the **North Arm/Nilkitkwa Lake** for the wild Babine River sockeye, 1950-2010.



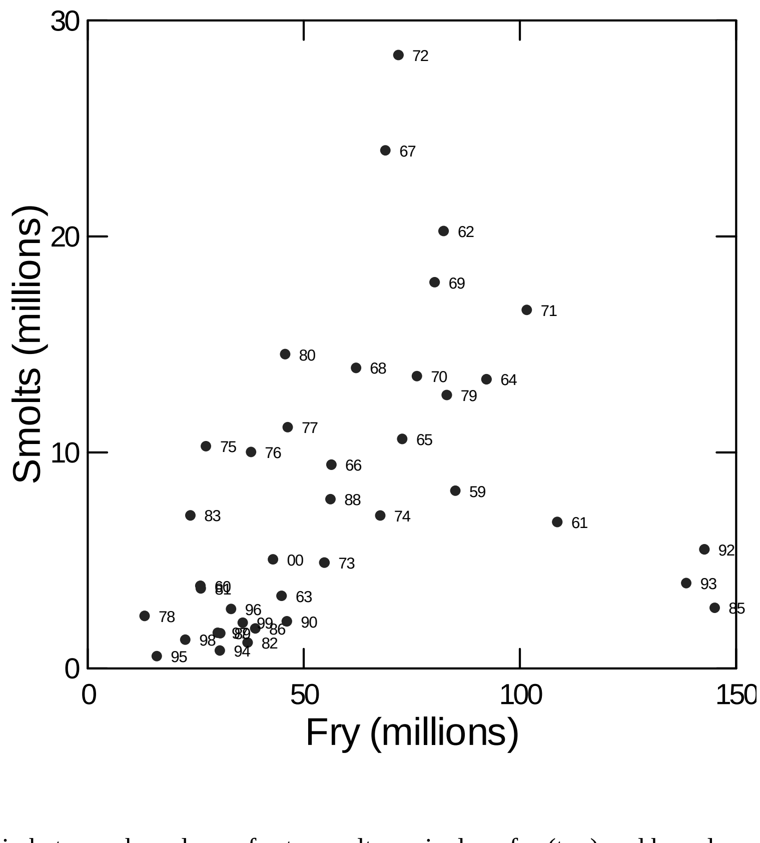


Figure 17. Relationship between brood year fry to smolt survival vs. fry (top) and brood-year smolt recruitment vs. fry (bottom), for sockeye rearing in the **North Arm/Nilkitkwa Lake**, 1959-2000.

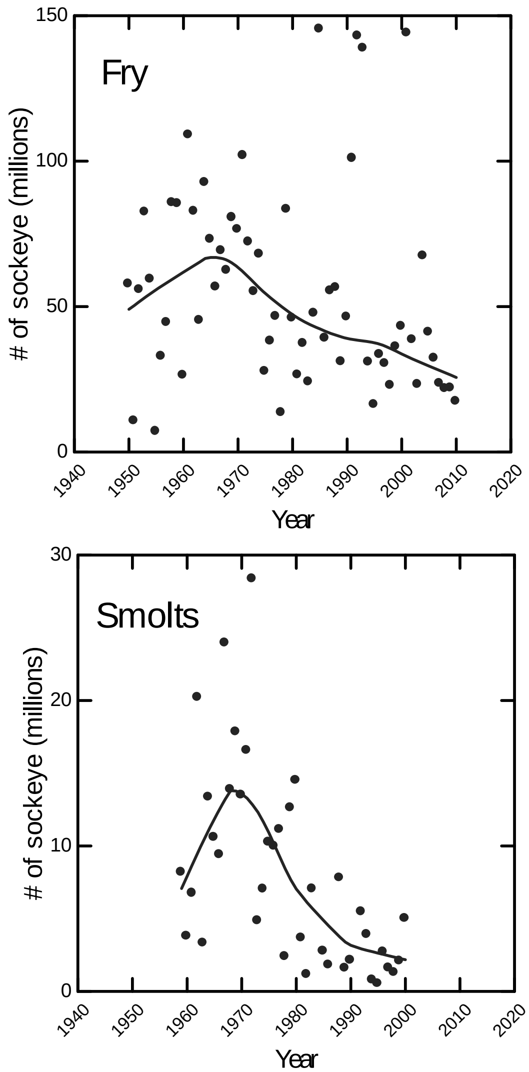


Figure 18. Trends in estimated brood year sockeye fry (top) and early migrant smolt (bottom) recruitment from the **North Arm/Nilkitkwa Lake** (brood years 1950-2010 fry, 1959-2000 smolts). The smolt program ceased operation in 2002 (brood year 2000). Lines fitted by LOWESS (F=0.5).

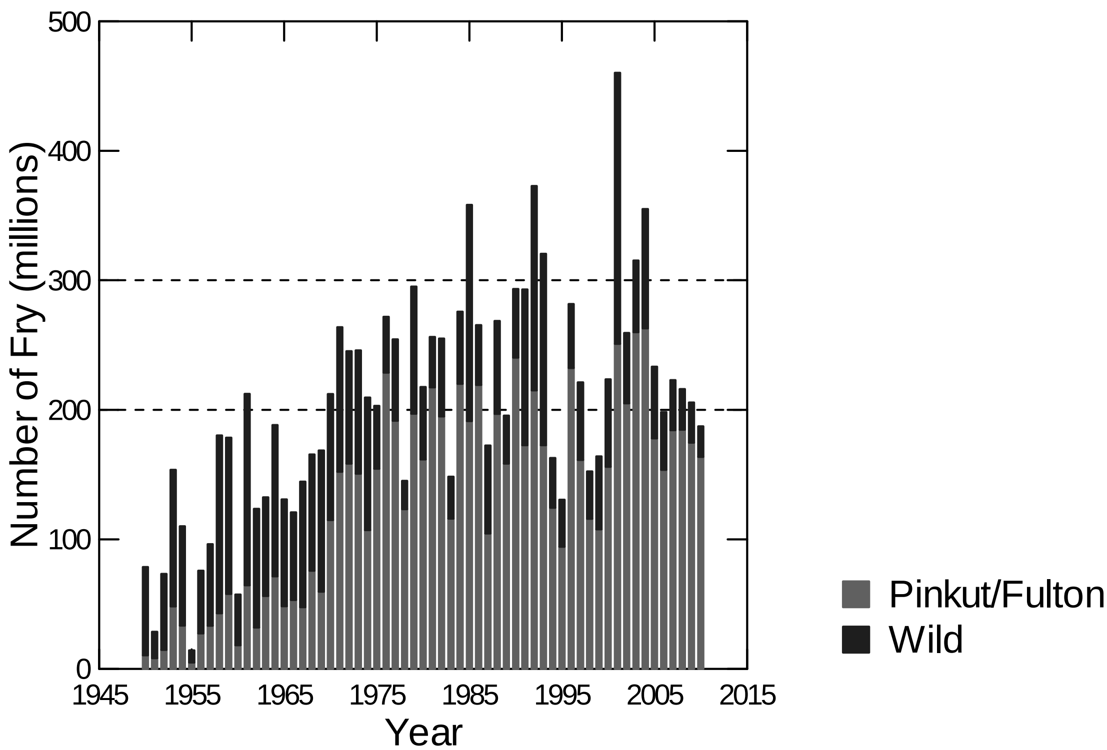
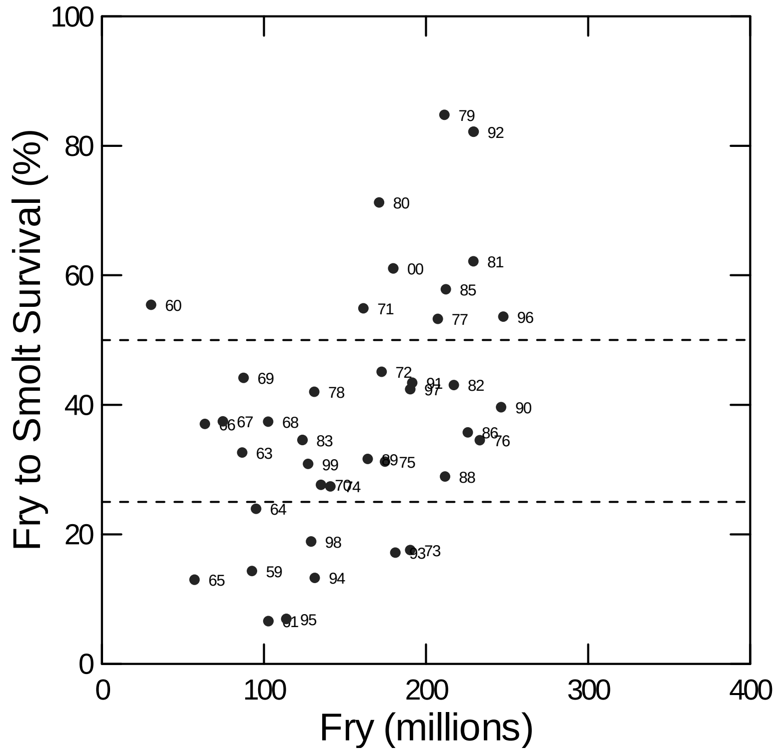


Figure 19. Trends in total brood year fry recruitment (millions) to all of **Babine and Nilkitkwa** Lakes for the Pinkut/Fulton, early wild, mid wild and late wild sockeye, 1950-2010. The light bars represent fry production from just Pinkut/Fulton. The fry rearing capacity of all of the Babine/Nilkitkwa Lakes is estimated to be >300 million fry.



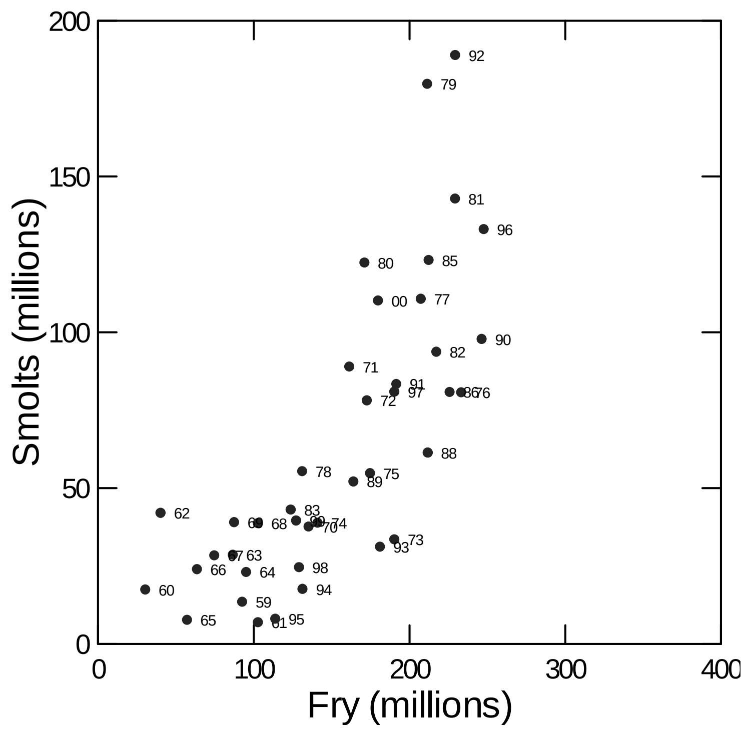


Figure 20. Relationship between brood year fry to smolt survival vs. fry (top) and brood year smolt recruitment vs. fry (bottom) for sockeye rearing in the **Main Arm**, **Morrison Arm** and **Hagan Arm** of Babine Lake (1959-2000)

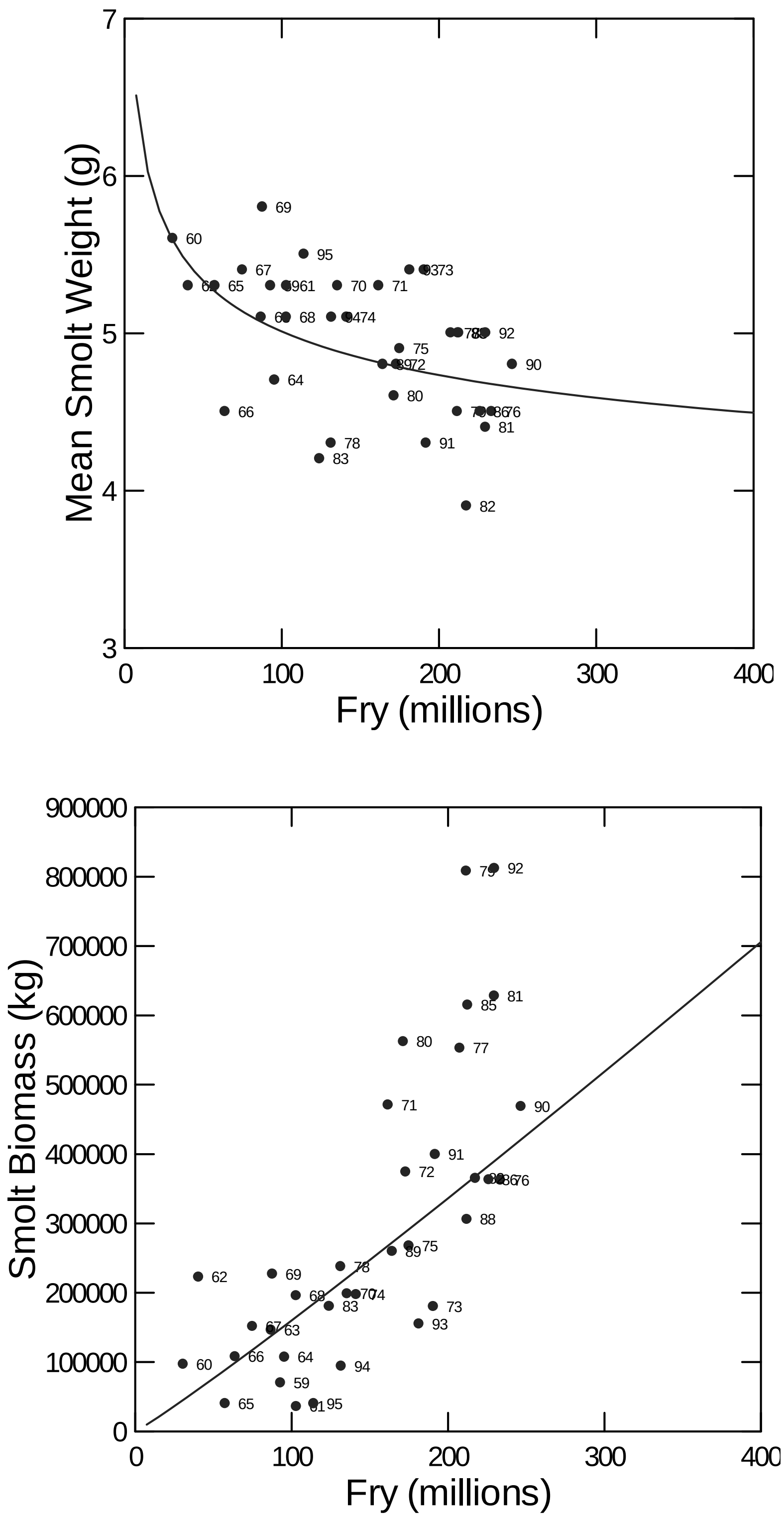


Figure 21. Relationships between mean late-migrant smolt weight (upper) and late-migrant smolt biomass (lower) vs. brood year fry recruitment to the **Main Arm**, 1960-1995. Lines fitted as Power Functions after Wood et al. (1998).

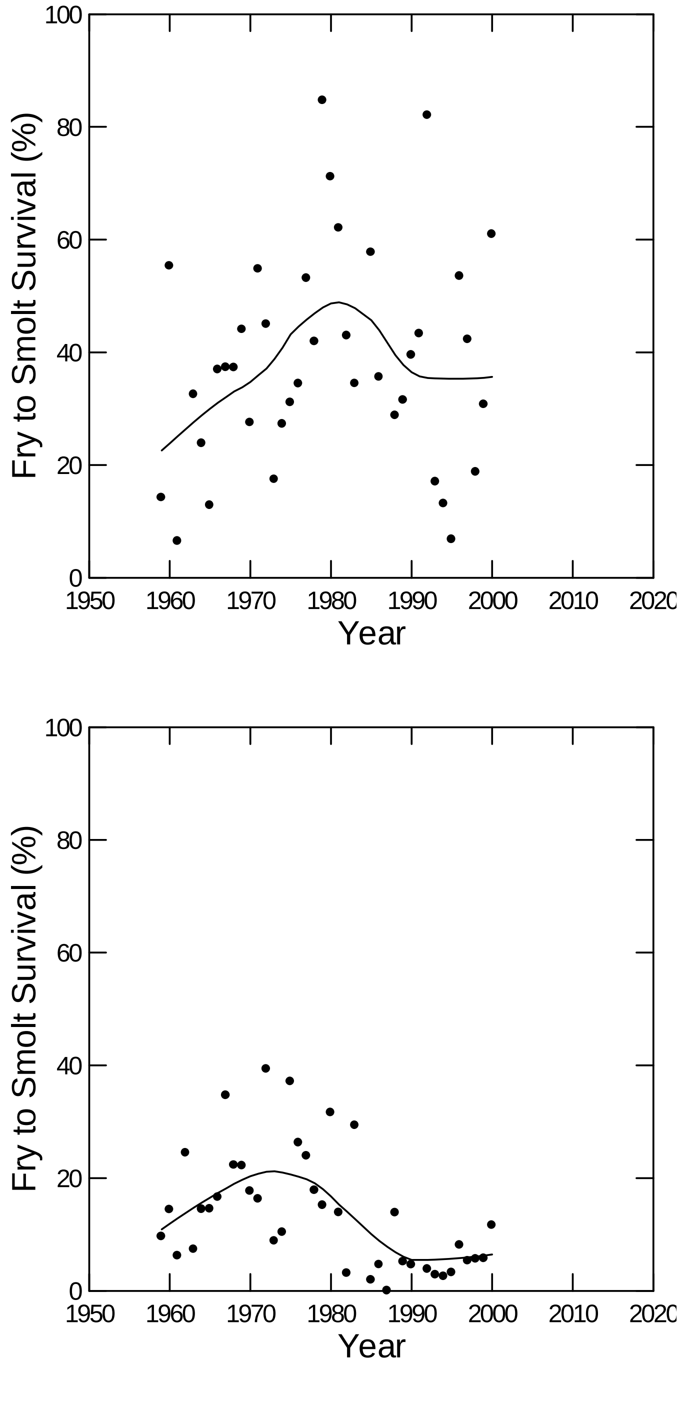


Figure 22. Trends in brood year fry to smolt survival for sockeye rearing in the **Main Arm, Morrison Arm and Hagan Arm** of Babine Lake, 1959-2000 (top), and in the **North Arm/Nilkitkwa Lake**, 1959-2000, (bottom). Lines fitted by LOWESS (F=0.5).

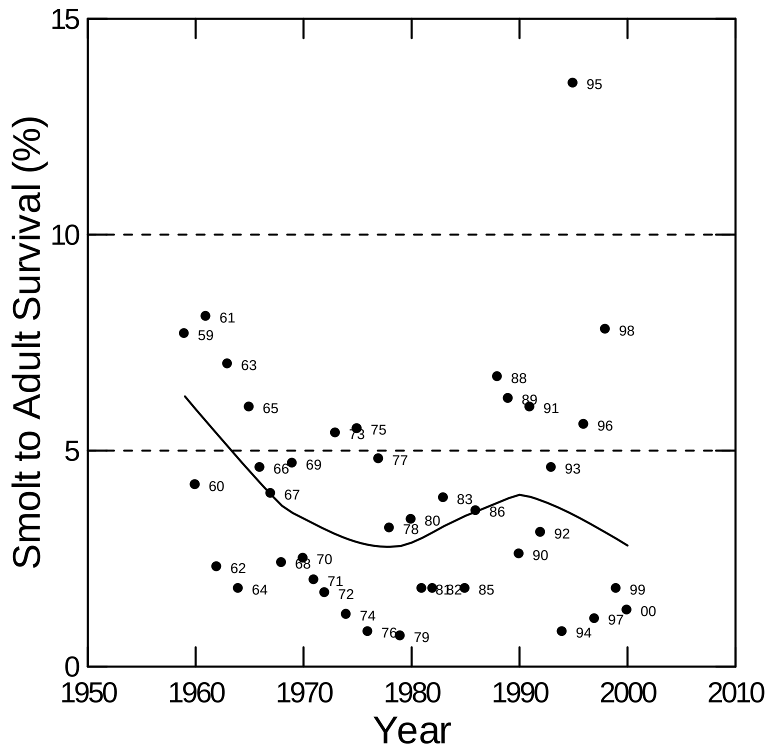
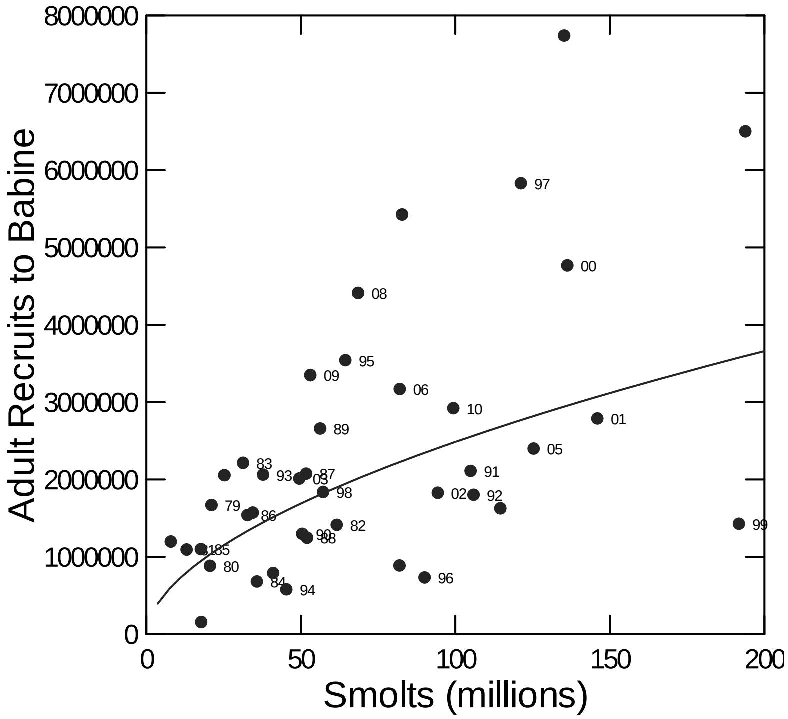


Figure 23. Trends in brood year smolt to adult marine survival for **Babine/Nilkitkwa Lake** sockeye, 1959-2000. Lines fitted by LOWESS (F=0.5).



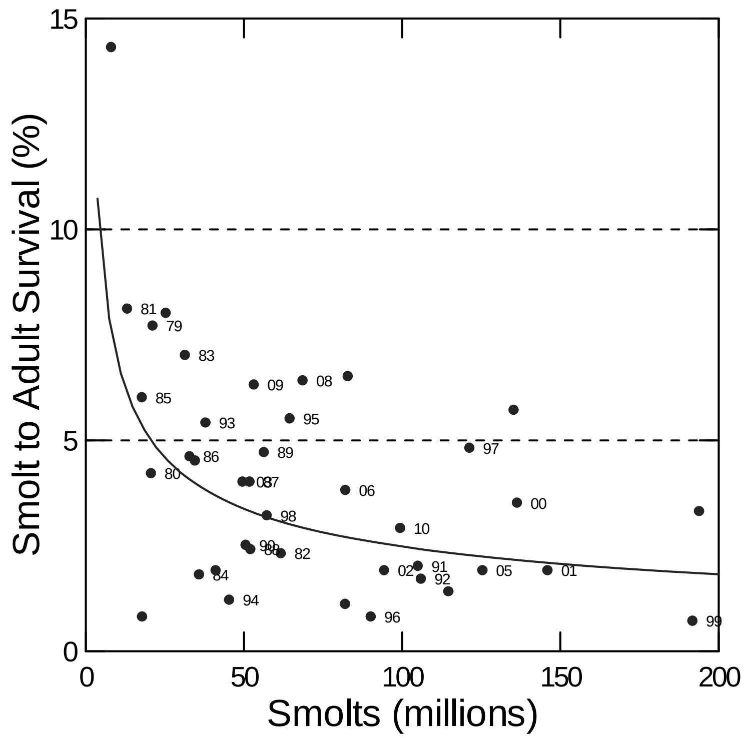
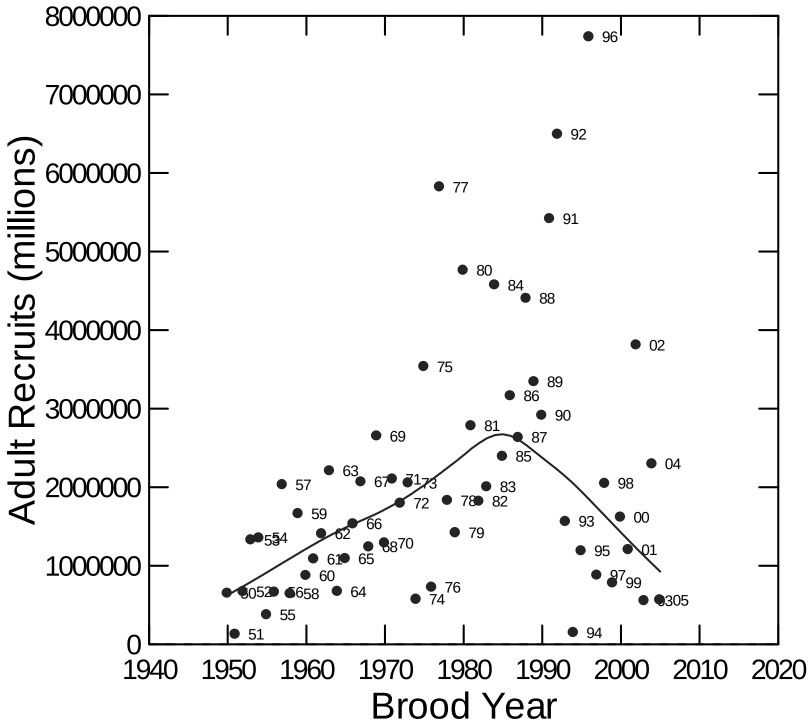


Figure 24. Relationship between brood year adult recruitment (age 3, 4 and 5) vs. smolts (top) and smolt to adult survival vs. smolts (bottom) for all **Babine Lake/Nilkitkwa Lake** sockeye, 1959-2000. Lines fitted as a Power Function.



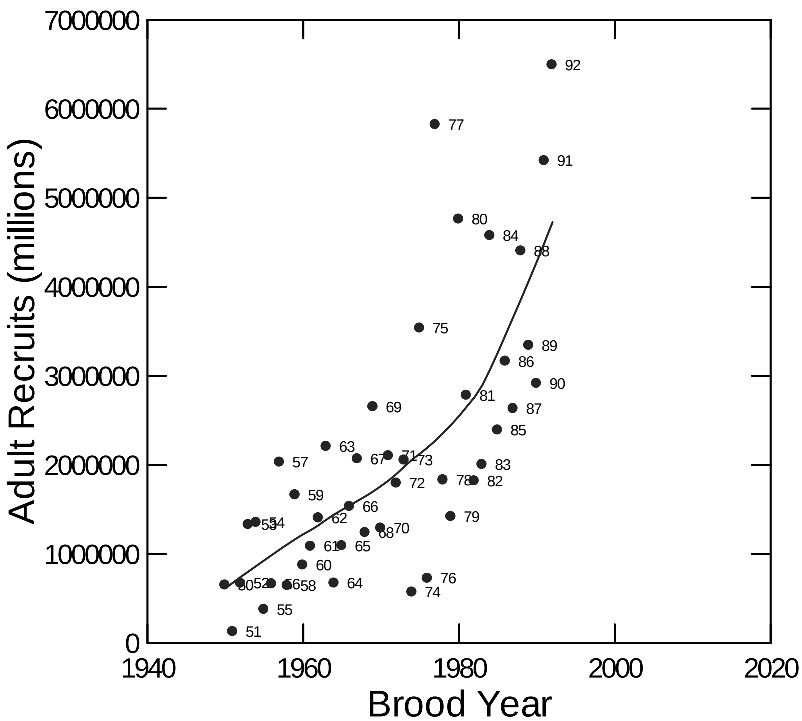


Figure 25. Trends in adult brood year recruitment (age 3, 4 and 5) for **Babine Lake/Nilkitkwa Lake** sockeye, 1950-2005 (top) and as reported for 1950-1992 (bottom), in Fig. 8 of Wood et al. (1998). Line fitted by LOWESS (F=0.5).

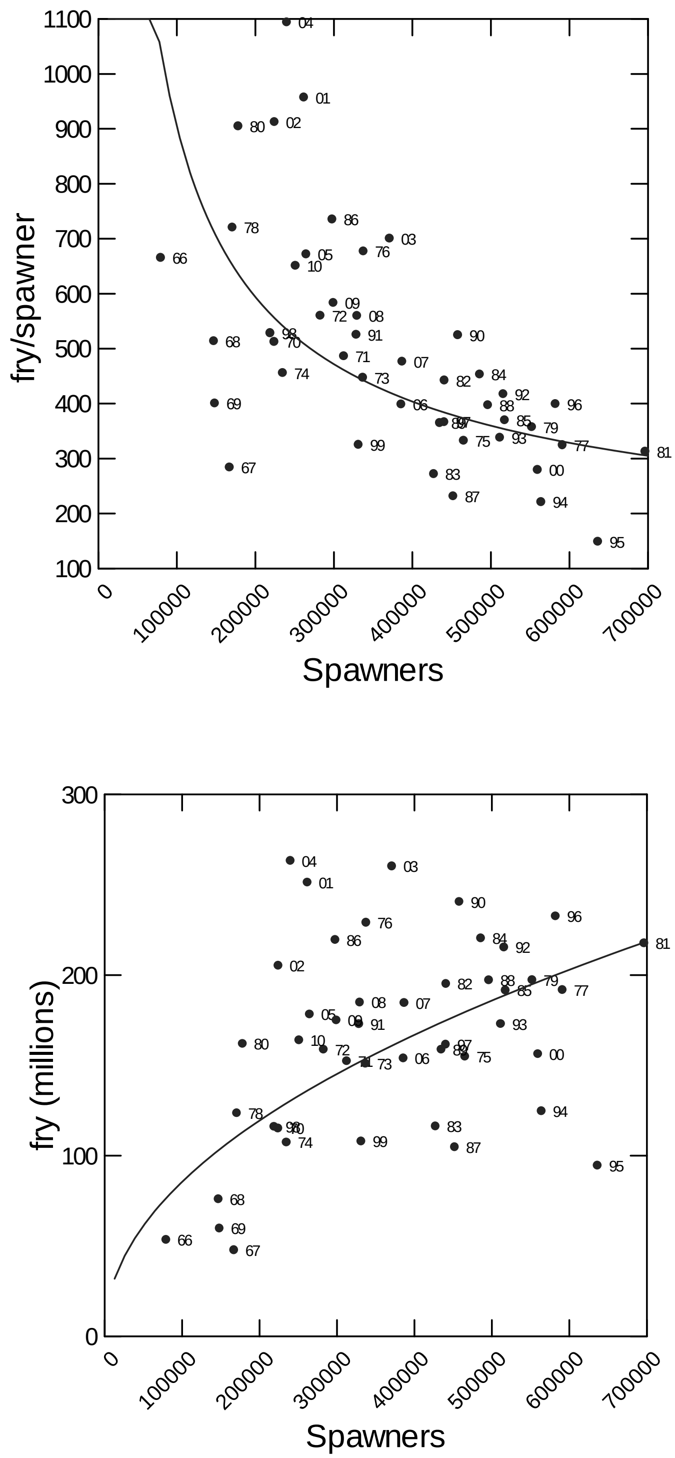


Figure 26. Relationship between **Pinkut/Fulton** brood year fry (millions) vs. actual (effective) spawners (age 4 and age 5) (top), and fry/spawner vs. actual (effective) spawners (age 4 and age 5) (bottom) for the BLDP production years, 1966-2010. Lines fitted as Power Functions.

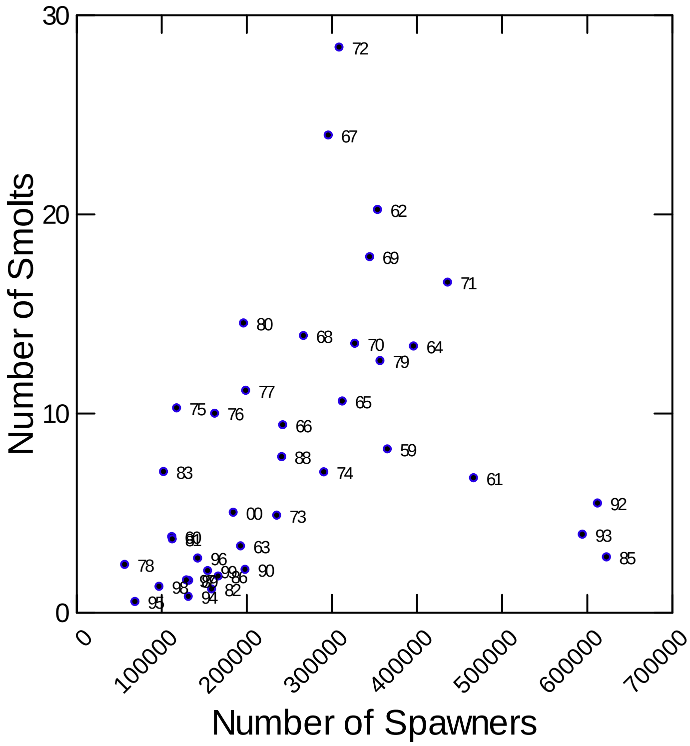


Figure 27. Stock-recruitment relationship (early-run smolts vs. late-run spawners) for sockeye rearing in the **North Arm/Nilkitkwa Lake** for brood years 1959-2000.

Table 1. Estimated annual Skeena River sockeye catch by fishery, exploitation rate by fishery and total stock size, adults only, 1970-2010 (2009 and 2010 preliminary).

Table 1. Skeena River sockeye catch, escapement, and exploitation rates by fishery: adults only (age 4, age 5, age 6) (a), (b)

												Total
	Alaska	Can Com	FSC	non-FSC	Total		Total	Alaska	Can Com	FSC	non-FSC	Exploit.
Year	Catch	Catch	Catch (b)	Catch (b)	Catch	Escape.	Return	Exploit.	Exploit.	Exploit.	Exploit.	Rate
1970	34664	725292			810078	678652	1488730	0.02	0.49			0.51
1971	39758	1058410			1169259	821850	1991109	0.02	0.53			0.55
1972	102362	895998			1050252	697237	1747489	0.06	0.51			0.57
1973	102576	1459503			1631808	820196	2452004	0.04	0.60			0.64
1974	110234	1638234			1830945	723898	2554843	0.04	0.64			0.68
1975	26393	584358			696706	822633	1519339	0.02	0.38			0.40
1976	77303	760579			919078	575590	1494668	0.05	0.51			0.56
1977	173769	1263185			1541097	951805	2492902	0.07	0.51			0.58
1978	103966	538580			758466	424075	1182541	0.09	0.46			0.54
1979	182003	1422703			1758654	1166236	2924890	0.06	0.49			0.55
1980	265162	528535			934362	542164	1476526	0.18	0.36			0.54
1981	211422	1934193			2261455	1424509	3685964	0.06	0.52			0.58
1982	334566	2079506	207320		2622392	1140737	3763129	0.09	0.55	0.06		0.70
1983	462772	550611	139966		1153949	893724	2047673	0.23	0.27	0.07		0.56
1984	197568	925942	178660		1302170	1055215	2357385	0.08	0.39	0.08		0.55
1985	489937	2368597	184072		3042606	2294963	5337569	0.09	0.44	0.03		0.57
1986	277149	601906	150766		1029821	812943	1842764	0.15	0.33	0.08		0.56
1987	99737	724644	139307		963688	1436754	2400442	0.04	0.30	0.06		0.40
1988	502204	1863255	134586		2500045	1502652	4002697	0.13	0.47	0.03		0.62
1989	376414	894378	148828		1419620	1213319	2632939	0.14	0.34	0.06		0.54
1990	458585	1046504	157185		1662274	1059699	2721973	0.17	0.38	0.06		0.61
1991	616938	1611620	139069		2367627	1391927	3759554	0.16	0.43	0.04		0.63
1992	709784	1908324	118229		2736339	1463130	4199469	0.17	0.45	0.03		0.65
1993	543054	2110657	188355	133735	2975801	1777997	4753798	0.11	0.44	0.04	0.03	0.63
1994	543389	842181	136311	42276	1564157	1155786	2719943	0.20	0.31	0.05	0.02	0.58
1995	593982	2779134	135416	209421	3717953	1892062	5610015	0.11	0.50	0.02	0.04	0.66
1996	597789	4237419	140469	384280	5359957	2126453	7486410	0.08	0.57	0.02	0.05	0.72
1997	636313	1728870	125466	226106	2565649	1193807	3759456	0.17	0.46	0.03	0.06	0.72
1998	178138	109045	129790		416973	585899	1002872	0.18	0.11	0.13		0.42
1999	64662	24979	112855		202496	725746	928242	0.07	0.03	0.12		0.22
2000	241259	2058267	169979	784404	3253909	1438336	4692245	0.05	0.44	0.04	0.17	0.69
2001	463894	1620187	96334	702979	2845777	1538898	4384675	0.11	0.37	0.02	0.16	0.66
2002	45573	527354	153740		726667	645859	1372526	0.03	0.38	0.11		0.53
2003	143714	478577	119558		741849	1387199	2129048	0.07	0.22	0.06		0.35
2004	187586	302150	131205		620941	1013961	1634902	0.11	0.18	0.08		0.38
2005	179643	19059	129310		328012	775582	1103594	0.16	0.02	0.12		0.30
2006	185911	884312	138959	393137	1602319	1273096	2875415	0.06	0.31	0.05	0.14	0.56
2007	388064	463413	133254	13777	998508	1151358	2149866	0.18	0.22	0.06	0.01	0.46
2008	41079	703417	165717	301483	1211696	939608	2151304	0.02	0.33	0.08	0.14	0.56
2009	80000	23663	141093		244756	750280	995036	0.08	0.02	0.14		0.25
2010	18000	67656	184324	3038	273018	690820	963838	0.02	0.07	0.19	0.00	0.28

a) non-FSC = First Nation Economic catch in-river Skeena and/or Escapement Surplus to Spawning Requirements (at Babine Lake)
(b) 2009 and 2010 are preliminary

Table 2. Annual Skeena River sockeye escapement, total stock size and estimated Babine Lake stock size, all ages, 1970-2010 (2009 and 2010 preliminary). Updates to Appendix Table 3 of Wood et al. (1998).

Table 2. Skeena River sockeye escapement, total stock size and Babine Lake stock size

Year	Skeena Escapement	Skeena Sockeye Stock Size Age 3 (a)	Age 4	Age 5	Other	Total (b)	Est. Babine Stock Size (c)
1970	678652	166000	926914	454716	107100	1654730	1461195
1971	821850	54600	1133835	761638	95636	2045709	1786865
1972	697237	258700	423086	1240480	83923	2006189	1779015
1973	820196	208350	1154733	1058988	238283	2660354	2341593
1974	723898	256772	832560	1630041	92243	2811615	2479485
1975	822633	137396	1127519	364351	27469	1656735	1459221
1976	575590	255458	544756	918877	31035	1750126	1555819
1977	951805	47697	1129887	1291903	71112	2540599	2216522
1978	424075	296274	263423	863534	55585	1478815	1325085
1979	1166236	90509	2498755	313467	112667	3015399	2635163
1980	542164	233886	288607	1095404	92515	1710412	1518464
1981	1424509	155395	3182751	411933	91280	3841359	3362184
1982	1140737	60223	618162	3021288	123679	3823352	3334145
1983	893724	353135	729422	1238674	79577	2400808	2134611
1984	1055215	120752	1432854	775824	148708	2478137	2171677
1985	2294963	66714	1799386	3458978	79205	5404283	4710399
1986	812943	88125	631494	1151486	59784	1930889	1691330
1987	1436754	638641	1011883	1311529	77030	3039083	2727026
1988	1502652	77631	2726551	1112026	164120	4080328	3559977
1989	1213319	122711	882714	1641712	108513	2755650	2413368
1990	1059699	89631	847865	1683853	190254	2811604	2457748
1991	1391927	416049	925815	2525501	308238	4175603	3686861
1992	1463130	258240	1614836	1895226	689408	4457709	3911778
1993	1777997	90580	1553897	2810679	389223	4844378	4226384
1994	1155786	320804	654232	1868288	197423	3040747	2687154
1995	1892062	542895	2682910	2478357	448748	6152910	5423608
1996	2126453	43476	4022989	2974681	488740	7529886	6556653
1997	1193807	6348	815479	2583448	360529	3765804	3277075
1998	585899	48627	61124	868838	72911	1051499	921126
1999	725746	174687	768584	92824	66833	1102929	982258
2000	1438336	17068	4090793	495008	106445	4709313	4399625
2001	1538898	76335	335051	3940129	109495	4461010	4026927
2002	645859	18398	676005	618348	78173	1390924	1245436
2003	1387199	131655	491810	1509495	127743	2260703	1828506
2004	1013961	18103	1177129	343329	114443	1653005	1375072
2005	775582	155249	595830	470683	37081	1258843	1065714
2006	1273096	28858	2070299	718854	86262	2904273	2697243
2007	1151358	48616	130067	1986476	33323	2198482	1953397
2008	939608	20852	1669627	448762	32915	2172156	1954874
2009	750280	26747	214600	723347	57089	1021783	866557
2010	690820	116594	530111	385535	48192	1080432	916580

(a) Age 3 jacks are those counted at the Babine River fence and thus underestimate total Skeena jack production. Thease are added to the total Babine Stock size (last column)

(b) sum of age 3, age 4, age 5, and age other

(c) using annual Tyee Test Fishery % Babine (genetic) from 2000-2010, and the average (87%) from 1970-1999: Only applied to age 4, age 5, and age other. Age other includes age 6 etc and the calculation may overestimate Babine contributions as most adults are age 4 and age 5.

Table 3. Estimated (modeled) annual exploitation rates (Marine + In-river FSC) for Skeena River sockeye sub-stocks peaking in Canadian Statistical Areas 3/4 during each specific week. Wk 71 is first week of July, Wk 72 is second week of July, etc. Babine Lake sub-stock timing is estimated to be Wks 64 to 72 for the early runs, Wks 73 to 74 for the middle runs, and Wks 74 to 75 for the late runs, but there is significant overlap (Smith and Jordan 1973).

Table 3. Estimated exploitation rates for Skeena sockeye stocks entering Area 4 that week (Marine +FSC)

				Babine Sub-Stocks (2)				
		Early		Middle	Late			
Stat (3)_	64	71	72	73	74	75	81	Aggregate
Year	Jn 25-1	Jl 1-7	Jl 8-14	Jl 15-21	Jl 22-28	Jl 29-04	Au 5-11	Exploit. (1)
1970	0.357	0.421	0.444	0.454	0.456	0.454	0.472	0.51
1971	0.152	0.199	0.258	0.342	0.447	0.543	0.601	0.55
1972	0.463	0.571	0.601	0.597	0.604	0.630	0.650	0.57
1973	0.357	0.457	0.551	0.635	0.672	0.637	0.538	0.64
1974	0.241	0.393	0.556	0.673	0.709	0.654	0.522	0.68
1975	0.321	0.445	0.493	0.474	0.442	0.408	0.361	0.40
1976	0.107	0.144	0.214	0.305	0.406	0.508	0.573	0.56
1977	0.212	0.329	0.446	0.521	0.546	0.539	0.520	0.58
1978	0.254	0.392	0.499	0.518	0.459	0.385	0.331	0.54
1979	0.158	0.258	0.393	0.506	0.557	0.548	0.487	0.55
1980	0.240	0.335	0.448	0.515	0.496	0.409	0.303	0.54
1981	0.244	0.354	0.495	0.595	0.604	0.553	0.501	0.58
1982	0.250	0.362	0.510	0.637	0.698	0.675	0.578	0.70
1983	0.175	0.190	0.225	0.282	0.344	0.398	0.447	0.56
1984	0.192	0.243	0.341	0.452	0.517	0.510	0.460	0.55
1985	0.357	0.474	0.555	0.594	0.609	0.601	0.559	0.57
1986	0.202	0.250	0.325	0.411	0.475	0.492	0.476	0.56
1987	0.190	0.223	0.277	0.344	0.413	0.472	0.505	0.40
1988	0.278	0.380	0.491	0.574	0.611	0.615	0.598	0.62
1989	0.321	0.397	0.449	0.457	0.436	0.411	0.386	0.54
1990	0.332	0.388	0.448	0.512	0.560	0.571	0.543	0.61
1991	0.295	0.384	0.481	0.553	0.584	0.575	0.536	0.63
1992	0.393	0.505	0.574	0.603	0.626	0.643	0.634	0.65
1993	0.351	0.476	0.587	0.640	0.628	0.575	0.512	0.63
1994	0.298	0.386	0.466	0.508	0.513	0.496	0.464	0.58
1995	0.358	0.475	0.580	0.631	0.620	0.571	0.514	0.66
1996	0.408	0.540	0.655	0.718	0.711	0.643	0.534	0.72
1997	0.463	0.565	0.630	0.639	0.585	0.483	0.371	0.72
1998	0.283	0.337	0.361	0.336	0.282	0.234	0.210	0.42
1999	0.200	0.200	0.200	0.200	0.200	0.200	0.200	0.22
2000	0.407	0.534	0.600	0.594	0.529	0.427	0.311	0.69
2001	0.227	0.352	0.469	0.537	0.544	0.497	0.412	0.66
2002	0.203	0.331	0.462	0.549	0.572	0.533	0.451	0.53
2003	0.146	0.229	0.298	0.322	0.305	0.278	0.251	0.35
2004	0.168	0.223	0.266	0.289	0.304	0.321	0.324	0.38
2005	0.103	0.107	0.110	0.115	0.122	0.123	0.115	0.30
2006	0.145	0.232	0.346	0.445	0.497	0.492	0.443	0.56
2007	0.165	0.206	0.279	0.369	0.444	0.468	0.425	0.46
2008	0.104	0.160	0.275	0.425	0.544	0.565	0.470	0.56
2009	0.157	0.161	0.162	0.157	0.149	0.140	0.134	0.25
2010	0.069	0.083	0.103	0.122	0.125	0.106	0.078	0.28
70-79 Mea	0.262	0.361	0.446	0.502	0.530	0.531	0.506	0.559
80-89 Mea	0.245	0.321	0.412	0.486	0.520	0.514	0.481	0.563
90-99 Mea	0.338	0.426	0.498	0.534	0.531	0.499	0.452	0.583
00-09 Mea	0.172	0.238	0.306	0.357	0.376	0.359	0.310	0.456

1) 1985-2006 Aggregate Skeena sockeye exploitation rate as reported in Appendix D, Table 1, ISRP, 2008, updated thru 2010
2) 1970-2002 Original source App. Table 6, in Cox-Rogers et al, 2010. A Risk Assessment Model for Skeena River sockeye salmon. Can Man. Rep. Fish and Aquat. Sci. 2920. (updated through 2010, data on file)
3) Stat week for a given sub-stock with peak timing in that week as it enters Canadian Area 4.

Table 4. Reconstructed (adjusted) annual Babine lake sockeye escapements by run-timing group: 1950-2010. Updates to Table 1 of Wood et al. (1998)

Table 4. Reconstructed Babine Lake sockeye (age 4 and age 5) spawning escapements by run-timing group (updates to Wood et al 1998)

Year	Fence Count	Catch (a)	BLDP as % of escapement (b)	BLDP as % of fence count (c)	Early Total	Middle: Pinkut-Fulton	Middle: Surplus	Middle: Morrison	Middle: Total	Late Total	Total Escape. (d)
1950	364356	27449			35844	44962		8812	53774	247289	336907
1951	141415	19007			35149	35342		6276	41618	45641	122408
1952	349011	34404			11056	62702		1844	64546	239005	314607
1953	686586	26913			66241	207070		32828	239898	353534	659673
1954	493677	21847			48773	143139		25447	168586	254470	471830
1955	71352	10423			8338	20721		1776	22497	30094	60929
1956	355345	30582			34283	117093		32651	149743	140736	324763
1957	433149	20434			50518	142785		29033	171817	190379	412715
1958	812050	38580			196599	183674		25850	209524	367347	773470
1959	782868	16727			105867	248223		45921	294145	366129	766141
1960	262719	16754			42485	78262		12298	90560	112920	245965
1961	941711	30856			133007	276734		33657	310391	467457	910855
1962	547995	18122			21587	136862		16828	153690	354597	529873
1963	588000	20021			77002	241061		56280	297341	193636	567979
1964	827437	19855			68409	306324		35960	342284	396889	807582
1965	580000	18540			29888	207236		11094	218330	313242	561460
1966	389000	18652			31977	80044		15196	95240	243131	370348
1967	602807	18992			95242	167718		24201	191919	296655	583815
1968	552000	19146			62457	147571		55410	202981	267415	532854
1969	634000	17293			89905	148885		32575	181460	345342	616707
1970	662000	20048	35.0	36.9	82164	224536		7423	231959	327830	641952
1971	816000	23450	39.5	41.2	34049	313244		8381	321625	436876	792550
1972	680145	24283	43.2	45.1	52692	283389		10277	293666	309504	655862
1973	797461	17015	47.6	48.6	140253	337492	34382	32179	404053	236140	780446
1974	726990	22318	37.6	39.2	109851	235408	29780	38189	303377	291444	704672
1975	820795	13896	74.3	74.6	60353	465933	133442	28686	628061	118485	806899
1976	580597	18157	67.2	68.2	13336	338263	39683	8022	385967	163137	562440
1977	937992	10777	70.9	71.2	54679	591788	65464	15573	672825	199711	927215
1978	401318	10920	76.1	76.7	32032	171267	125767	3931	300965	57402	390398
1979	1160966	21500	63.0	63.6	42455	552632	165164	21765	739562	357449	1139466
1980	526259	22635	52.4	54.2	31679	178863	84885	11166	274914	197031	503624
1981	1432734	30300	88.1	88.3	46466	697207	538251	7178	1242636	113332	1402434
1982	1136835	42000	76.4	77.3	93630	441473	395310	4827	841610	159595	1094835
1983	886393	20000	84.0	84.3	26965	427789	299708	8904	736401	103027	866393
1984	1052385	20500	76.8	77.3	26503	486395	306475	8065	800935	204447	1031885
1985	2148044	17500	66.4	66.6	75649	518259	895769	17229	1431257	623637	2130544
1986	701507	23500	70.8	71.7	26865	298412	181419	3874	483705	167437	678007
1987	1307852	20296	77.4	77.7	38206	452629	543535	15786	1011950	237400	1287556
1988	1408879	25000	77.8	78.1	42435	496753	579258	23459	1099470	241974	1383879
1989	1132316	22000	85.7	86.0	18412	435371	516269	7701	959341	132563	1110316
1990	978646	22000	76.2	76.7	21328	458633	270425	7395	736454	198864	956646
1991	1176318	20800	55.3	56.0	58719	328999	310238	24980	664217	432582	1155518
1992	1942588	73789	63.8	65.1	55071	516297	675454	8863	1200614	613114	1868799
1993	1737426	177590	59.4	63.2	16646	512122	413728	21962	947812	595377	1559836
1994	1052905	48465	83.6	84.3	25124	564623	274833	7560	847016	132299	1004440
1995	1737009	98592	90.5	91.0	79679	637049	845628	6555	1489232	69506	1638417
1996	2000591	352234	87.1	89.2	60909	582946	853222	7975	1444143	143305	1648357
1997	1086610	156408	72.4	75.5	92245	441132	232190	34660	707982	129975	930202
1998	510246	10744	68.5	69.0	43130	219484	122462	16545	358491	97880	499502
1999	606136	23220	58.5	59.9	63692	331993	9246	22946	364184	155040	582916
2000	1831613	455756	79.0	83.6	84558	716744	369554	19982	1106280	185020	1375857
2001	1984261	509760	39.1	52.9	232802	499527	76952	47818	624298	617401	1474501
2002	595227	24985	67.6	68.7	29324	385619	0	24573	410192	130726	570242
2003	1170359	32000	79.1	79.4	55028	607748	293147	83151	984046	99284	1138359
2004	919250	31261	61.7	62.7	39546	547464	0	51747	599211	249231	887989
2005	709198	33117	67.5	68.8	25141	456391	0	31371	487762	163178	676081
2006	1391679	257830	83.2	86.0	40874	636579	306221	12515	955315	137660	1133849
2007	1050481	49847	83.4	84.1	52862	628681	205733	12595	847010	100762	1000634
2008	1083319	242994	84.0	87.1	28667	497117	208638	12744	718499	93158	840325
2009	672002	58597	78.4	80.0	20503	448164	32606	18341	499111	93791	613405
2010	639054	43454	83.1	84.2	20455	441100	53854	6065	501020	74126	595600
50-74 avg	563923	22068			66545	175619		24015	202201	273108	541855
75-10 avg	1125272	84512	73.0	74.5	49333	472540	289570	18514	780625	210803	1040760

(a) Harvest at Babine Fence and in Babine Lake above the fence after initial enumeration
(b) includes Pinkut-Fulton B30(after 1969) and actual surplus
(c) from Appendix Table 3, last column
(d) Babine fence count - catch

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Table 5. Brood year fry and smolt production by run-timing group from Babine/Nilkitkwa Lake: 1950-2010. The smolt program ended in 2002. Modifications and updates to Table 2 of Wood et al. (1998).

Table 5. Babine/Nilkitkwa Lake freshwater fry and smolt production (updates to Wood et al 1998)

Brood Year	Estimated Fry Production by Timing Group (m) Early Wild	Mid Wild	Late Wild	Pinkut/Fulton	Total Fry (m) Main Basin	Total Fry (m) North Arm/Nil.	Total Fry (m) Babine/Nil.	Late-migrant smolts (m) from Main Basin	Early-migrant smolts (m) from North Arm/Nil.	Total Smolts (m) Babine/Nil.	SE	Late-migrant smolt weight (g) Main Basin	SD	Late-migrant smolt biomass(kg) Main Basin
1950	8.4	2.1	57.6	10.5	20.9	57.6	78.5					4.9		
1951	8.2	1.5	10.6	8.2	17.9	10.6	28.5					6.2		
1952	2.6	0.4	55.7	14.6	17.6	55.7	73.3					6.3		
1953	15.4	7.6	82.4	48.2	71.3	82.4	153.7					5.4		
1954	11.4	5.9	59.3	33.4	50.6	59.3	109.9					5.1		
1955	1.9	0.4	7.0	4.8	7.2	7.0	14.2					5.9		
1956	8.0	7.6	32.8	27.3	42.9	32.8	75.7					6.1		
1957	11.8	6.8	44.4	33.3	51.8	44.4	96.2					5.6		
1958	45.8	6.0	85.6	42.8	94.6	85.6	180.2					6.2		
1959	24.7	10.7	85.3	57.8	93.2	85.3	178.5	13.22	8.18	21.40	0.96	5.3		69537
1960	9.9	2.9	26.3	18.2	31.0	26.3	57.3	17.14	3.78	20.92	1.03	5.6		96327
1961	31.0	7.0	108.9	64.5	103.3	108.9	212.2	6.65	6.73	13.38	0.46	5.3		35445
1962	5.0	3.9	82.6	31.9	40.8	82.6	123.5	41.74	20.20	61.94	5.64	5.3		222057
1963	17.9	13.1	45.1	56.2	87.2	45.1	132.3	28.33	3.31	31.64	1.55	5.1		145616
1964	15.9	8.4	92.5	71.4	95.7	92.5	188.2	22.77	13.34	36.11	1.71	4.7		106664
1965	7.0	2.6	73.0	48.3	57.8	73.0	130.8	7.42	10.58	18.00	0.72	5.3		39623
1966	7.5	3.5	56.6	53.2	64.2	56.6	120.8	23.68	9.39	33.07	1.97	4.5		107270
1967	22.2	5.6	69.1	47.5	75.3	69.1	144.5	28.09	23.94	52.03	3.17	5.4		150843
1968	14.6	12.9	62.3	75.7	103.2	62.3	165.5	38.43	13.87	52.30	2.23	5.1		195224
1969	20.9	7.6	80.5	59.5	88.0	80.5	168.5	38.75	17.83	56.58	1.40	5.8		226300
1970	19.1	1.7	76.4	114.9	135.8	76.4	212.2	37.33	13.48	50.81	1.76	5.3		197849
1971	7.9	2.0	101.8	152.1	162.0	101.8	263.8	88.69	16.55	105.24	4.42	5.3		470057
1972	12.3	2.4	72.1	158.5	173.2	72.1	245.3	77.85	28.35	106.20	2.95	4.8	1.3	373680
1973	32.7	7.5	55.0	150.7	190.9	55.0	245.9	33.25	4.85	38.10	1.15	5.4	1.3	179550
1974	25.6	8.9	67.9	107.1	141.6	67.9	209.5	38.59	7.03	45.62	0.96	5.1	1.0	196809
1975	14.1	6.7	27.6	154.6	175.3	27.6	203.0	54.48	10.24	64.72	2.09	4.9	1.3	266952
1976	3.1	1.9	38.0	228.8	233.8	38.0	271.8	80.40	9.97	90.37	4.86	4.5	1.3	361800
1977	12.7	3.6	46.5	191.5	207.9	46.5	254.4	110.42	11.12	121.54	4.86	5.0	0.7	552100
1978	7.6	0.9	13.4	123.3	131.7	13.4	145.1	65.13	2.38	67.51	2.63	4.3	0.9	237069
1979	9.9	5.1	83.3	197	212.0	83.3	295.2	179.43	12.61	192.04	16.89	4.5	1.2	807435
1980	7.4	2.6	45.9	161.7	171.7	45.9	217.6	122.07	14.50	136.57	6.76	4.6	1.2	561522
1981	10.8	1.7	26.4	217.4	229.9	26.4	256.3	142.59	3.66	146.25	16.71	4.4	1.2	627396
1982	21.8	1.1	37.2	194.9	217.8	37.2	255.0	93.46	1.15	94.61	10.01	3.9	1.2	364494
1983	6.3	2.1	24.0	116	124.4	24.0	148.4	42.80	7.04	49.84	2.31	4.2	0.3	179760
1984	6.2	1.9	47.6	220.1	228.2	47.6	275.8	(a) 49.39		(a) 169.05		5.3	1.7	261767
1985	17.6	4.0	145.3	191.3	212.9	145.3	358.2	122.87	2.76	125.63	6.33	5.0	1.3	614360
1986	6.3	0.9	39.0	219.2	226.4	39.0	265.4	80.54	1.80	82.34	3.28	4.5	1.1	362430
1987	8.9	3.7	55.3	104.5	117.1	55.3	172.4							
1988	9.9	5.5	56.4	196.9	212.3	56.4	268.6	61.05	7.79	68.84	2.76	5.0	1.2	305250
1989	4.3	1.0	30.9	158.5	164.6	30.9	195.5	51.81	1.58	53.39	1.46	4.0	1.3	259050
1990	5.0	1.7	46.3	240.3	247.0	46.3	293.3	97.52	2.13	99.65	3.56	4.8	1.1	468096
1991	13.7	5.8	100.8	172.6	192.1	100.8	292.9	83.10		83.10	16.58	4.3	1.3	398880
1992	12.8	2.1	142.9	215.1	230.0	142.9	372.9	188.67	5.46	194.13	8.76	5.0	1.3	811281
1993	3.9	5.1	138.7	172.7	181.7	138.7	320.4	30.89	3.90	34.79	4.08	5.4	1.1	154450
1994	5.9	1.8	30.8	124.4	132.0	30.8	162.8	17.31	0.78	18.09	0.41	5.1	1.1	93474
1995	18.6	1.5	16.2	94.3	114.4	16.2	130.6	(b) 7.75	0.52	(b) 8.27	0.51	5.5	1.4	39525
1996	14.2	1.9	33.4	232.3	248.3	33.4	281.7	132.80	2.70	135.50	10.25			
1997	21.5	8.1	30.3	161.3	190.9	30.3	221.2	80.64	1.60	82.24				
1998	10.0	3.9	22.8	115.8	129.7	22.8	152.5	24.29	1.28	25.57				
1999	14.8	5.3	36.1	107.7	127.9	36.1	164.0	39.28	2.07	41.35				
2000	19.7	4.7	43.1	156.0	180.4	43.1	223.5	109.88	5.00	114.88				
2001	54.2	11.1	143.9	251.0	316.4	143.9	460.2							
2002	8.6	7.2	38.5	205.0	220.9	38.5	259.3							
2003	12.8	19.4	23.1	260.0	292.2	23.1	315.3							
2004	10.7	14.0	67.3	263.0	287.7	67.3	355.0							
2005	6.3	7.9	41.1	178.0	192.2	41.1	233.3							
2006	9.5	2.9	32.1	153.7	166.1	32.1	198.2							
2007	12.3	2.9	23.5	184.3	199.6	23.5	223.0							
2008	6.7	3.0	21.7	184.6	194.2	21.7	216.0							
2009	4.8	4.3	21.9	174.7	183.8	21.9	205.6							
2010	4.8	1.4	17.3	163.7	169.9	17.3	187.2							

(a) BY 1984 questionable smolt estimate. Not used in analyses (Wood et al 1998)
(b) BY 1995 minimum smolt estimate due to flooding and early termination of smolt program, but after normal peak of migration
(c) BY 1991 early migrant smolt estimate uncertain due to poorly defined transition day, therefore not used in analysis

Table 6. Brood year fry, smolt, and adult production (recruitment) from Babine/Nilkitkwa Lake: 1950-2005. Modifications and updates to Table 3 of Wood et al. (1998).

Table 6. Updated summary of total brood year sockeye production from the Babine-Nilkitkwa lake system

Brood Year	Fry (m) Main Basin	Smolts (m) Main Basin	Fry-Smolt Survival (%)	Total Fry (m) Babine/Nil.	Total Smolts (m) Babine/Nil.	Fry-Smolt Survival (%)	Babine BY Return	Age Structure % Age 3	% Age 4	% Age 5	Marine Survival (%)
1950	20.9			78.5			645479	4.3	72.7	23.0	
1951	17.9			28.5			123664	8.1	37.6	54.3	
1952	17.6			73.3			665850	4.7	65.2	30.1	
1953	71.3			153.7			1323931	1.4	38.2	60.4	
1954	50.6			109.9			1348990	3.7	44.7	51.6	
1955	7.2			14.2			371950	8.3	57.7	33.9	
1956	42.9			75.7			659561	4.9	46.9	48.3	
1957	51.8			96.2			2026471	2.4	69.6	28.0	
1958	94.6			180.2			639730	4.4	72.4	23.2	
1959	93.2	13.22	14.18	178.5	21.40	11.99	1658321	2.8	33.0	64.2	7.7
1960	31.0	17.14	55.29	57.3	20.92	36.50	870970	19.9	47.8	32.4	4.2
1961	103.3	6.65	6.44	212.2	13.38	6.30	1081386	5.5	54.0	40.4	8.1
1962	40.8	41.74	102.21	123.5	61.94	50.17	1401039	4.6	35.0	60.4	2.3
1963	87.2	28.33	32.48	132.3	31.64	23.91	2203229	8.3	39.8	51.9	7.0
1964	95.7	22.77	23.80	188.2	36.11	19.19	667969	4.4	26.8	68.8	1.8
1965	57.8	7.42	12.83	130.8	18.00	13.76	1087229	4.9	61.8	33.3	6.0
1966	64.2	23.68	36.89	86.3	33.07	38.32	1528245	10.1	48.5	41.5	4.6
1967	75.3	28.09	37.29	136.0	52.03	38.25	2062906	8.0	45.4	46.6	4.0
1968	103.2	38.43	37.25	124.2	52.30	42.12	1235186	4.4	26.9	68.7	2.4
1969	88.0	38.75	44.02	143.7	56.58	39.38	2647773	9.8	39.1	51.2	4.7
1970	135.8	37.33	27.49	212.2	50.81	23.95	1249662	16.7	58.0	25.4	2.5
1971	162.0	88.69	54.75	263.8	105.24	39.90	2037137	12.6	48.2	39.2	1.9
1972	173.2	77.85	44.96	245.3	106.2	43.30	1735289	7.9	27.3	64.8	1.6
1973	190.9	33.25	17.42	245.9	38.1	15.49	1989734	12.8	49.4	37.8	5.2
1974	141.6	38.59	27.25	209.5	45.62	21.78	549591	8.7	41.7	49.6	1.2
1975	175.3	54.48	31.07	203.0	64.72	31.89	3423193	8.7	63.5	27.8	5.3
1976	233.8	80.40	34.39	271.8	90.37	33.25	699978	12.9	35.9	51.2	0.8
1977	207.9	110.42	53.12	254.4	121.54	47.77	5631400	4.2	49.2	46.7	4.6
1978	131.7	55.13	41.87	145.1	57.51	39.65	1770842	8.8	30.4	60.9	3.1
1979	212.0	179.43	84.65	295.2	192.04	65.04	1369787	4.4	46.3	49.3	0.7
1980	171.7	122.07	71.10	217.6	136.57	62.76	4609029	7.7	27.0	65.3	3.4
1981	229.9	142.59	62.02	256.3	146.25	57.06	2688011	4.5	58.2	37.3	1.8
1982	217.8	93.46	42.90	255.0	94.61	37.10	1757144	3.8	31.3	64.9	1.9
1983	124.4	42.80	34.42	148.4	49.84	33.59	1935926	4.6	45.5	50.0	3.9
1984	228.2	(a) 49.39		275.8	(a) 159.05		4439030	14.4	53.4	32.2	
1985	212.9	122.87	57.70	358.2	125.63	35.07	2310545	3.4	33.2	63.4	1.8
1986	226.4	80.54	35.58	265.4	82.34	31.03	3057540	4.0	24.1	71.9	3.7
1987	117.1	no program		172.4	no program		2543936	3.5	31.7	64.8	
1988	212.3	61.05	28.76	268.6	68.84	25.63	4266247	9.8	32.9	57.3	6.2
1989	164.6	51.81	31.48	195.5	53.39	27.31	3235541	8.0	41.8	50.2	6.1
1990	247.0	97.52	39.48	293.3	99.65	33.97	2815932	3.2	20.2	76.6	2.8
1991	192.1	83.10	43.26	292.9	83.09	28.37	5242908	6.1	44.5	49.4	6.3
1992	230.0	188.67	82.03	372.9	194.13	52.07	6290496	8.6	55.6	35.7	3.2
1993	181.7	30.89	17.00	320.4	34.79	10.86	1508831	2.9	47.0	50.1	4.3
1994	132.0	17.31	13.11	162.8	18.09	11.11	140283	4.5	37.9	57.6	0.8
1995	114.4	(b) 7.75	6.77	130.6	(b) 8.27	6.33	1147952	4.2	58.2	37.5	13.9
1996	248.3	132.80	53.47	281.7	135.5	48.09	7161589	2.4	49.7	47.9	5.3
1997	190.9	80.64	42.25	221.2	82.24	37.19	846525	2.0	34.4	63.5	1.0
1998	129.7	24.29	18.73	152.5	25.57	16.77	1977720	3.9	29.7	66.4	7.7
1999	127.9	39.28	30.72	164.0	41.35	25.21	744969	2.5	57.4	40.1	1.8
2000	180.4	109.88	60.92	223.5	114.88	51.41	1670712	7.9	65.8	26.3	1.5
2001	316.4			460.2			1202633	1.5	44.6	53.9	
2002	220.9			259.3			3782006	4.1	48.9	47.0	
2003	292.2			315.3			490185	5.9	21.1	73.0	
2004	287.7			355.0			2034784	2.4	68.1	29.5	
2005	192.2			233.3			515964	5.8	20.2	74.0	
2006	166.1			198.2							
2007	199.6			223.0							
2008	194.2			216.0							
2009	183.8			205.6							
2010	169.9			187.2							

(a) BY 1984 questionable smolt estimate. Not used in analyses (Wood et al 1998)

(b) BY 1995 minimum smolt estimate due to flooding and early termination of smolt program, but after normal peak of migration

Table 7. Babine Lake sockeye fence counts (includes catch) and adult returns by brood year: 1950-2005. Updates to Appendix Table 4 of Wood et al. (1998).

Table 7. Babine Sockeye Fence Counts and Babine Sockeye Adult Returns by brood year

Brood	Fence	Adult Returns (1)				Age Composition		
Year	Count	Age 3	Age 4	Age 5	Total	Age 3	Age 4	Age 5
1950	364356	28000	469257	148222	645479	4.3	72.7	23.0
1951	141415	10000	46463	67201	123664	8.1	37.6	54.3
1952	349011	31000	434217	200633	665850	4.7	65.2	30.1
1953	686586	18000	506219	799712	1323931	1.4	38.2	60.4
1954	493677	50000	603269	695721	1348990	3.7	44.7	51.6
1955	71352	31000	214794	126156	371950	8.3	57.7	33.9
1956	355345	32000	309078	318483	659561	4.9	46.9	48.3
1957	433149	49000	1410864	566607	2026471	2.4	69.6	28.0
1958	812050	28000	463162	148568	639730	4.4	72.4	23.2
1959	782868	46000	547639	1064682	1658321	2.8	33.0	64.2
1960	262719	173000	416160	281810	870970	19.9	47.8	32.4
1961	941711	60000	584313	437073	1081386	5.5	54.0	40.4
1962	547995	64000	490567	846472	1401039	4.6	35.0	60.4
1963	588000	182000	877467	1143762	2203229	8.3	39.8	51.9
1964	827437	29300	179053	459616	667969	4.4	26.8	68.8
1965	580000	53400	671660	362169	1087229	4.9	61.8	33.3
1966	389000	154000	740532	633713	1528245	10.1	48.5	41.5
1967	602807	166000	936606	960300	2062906	8.0	45.4	46.6
1968	552000	54600	332547	848039	1235186	4.4	26.9	68.7
1969	634000	258700	1034572	1354501	2647773	9.8	39.1	51.2
1970	662000	208350	724327	316985	1249662	16.7	58.0	25.4
1971	816000	256772	980942	799423	2037137	12.6	48.2	39.2
1972	680145	137396	473937	1123956	1735289	7.9	27.3	64.8
1973	797461	255458	983001	751274	1989734	12.8	49.4	37.8
1974	726990	47697	229178	272717	549591	8.7	41.7	49.6
1975	820795	296274	2173917	953002	3423193	8.7	63.5	27.8
1976	580597	90509	251088	358381	699978	12.9	35.9	51.2
1977	937992	233886	2768994	2628521	5631400	4.2	49.2	46.7
1978	401318	155395	537801	1077646	1770842	8.8	30.4	60.9
1979	1160966	60223	634597	674966	1369787	4.4	46.3	49.3
1980	526259	353135	1246583	3009311	4609029	7.7	27.0	65.3
1981	1432734	120752	1565466	1001793	2688011	4.5	58.2	37.3
1982	1136835	66714	549399	1141031	1757144	3.8	31.3	64.9
1983	886393	88125	880338	967463	1935926	4.6	45.5	50.0
1984	1052385	638641	2372100	1428289	4439030	14.4	53.4	32.2
1985	2148044	77631	767961	1464952	2310545	3.4	33.2	63.4
1986	701507	122711	737643	2197186	3057540	4.0	24.1	71.9
1987	1307852	89631	805459	1648846	2543936	3.5	31.7	64.8
1988	1408879	416049	1404907	2445291	4266247	9.8	32.9	57.3
1989	1132316	258240	1351890	1625411	3235541	8.0	41.8	50.2
1990	978646	90580	569182	2156170	2815932	3.2	20.2	76.6
1991	1176318	320804	2334132	2587972	5242908	6.1	44.5	49.4
1992	1942588	542895	3500001	2247600	6290496	8.6	55.6	35.7
1993	1737426	43476	709467	755889	1508831	2.9	47.0	50.1
1994	1052905	6348	53177	80757	140283	4.5	37.9	57.6
1995	1737009	48627	668668	430657	1147952	4.2	58.2	37.5
1996	2000591	174687	3558990	3427912	7161589	2.4	49.7	47.9
1997	1086610	17068	291494	537963	846525	2.0	34.4	63.5
1998	510246	76335	588124	1313261	1977720	3.9	29.7	66.4
1999	606136	18398	427875	298697	744969	2.5	57.4	40.1
2000	1831613	131655	1099439	439618	1670712	7.9	65.8	26.3
2001	1984261	18103	536843	647687	1202633	1.5	44.6	53.9
2002	595227	155249	1850847	1775910	3782006	4.1	48.9	47.0
2003	1170359	28858	103663	357663	490185	5.9	21.1	73.0
2004	919250	48616	1385790	600378	2034784	2.4	68.1	29.5
2005	709198	20852	177045	318067	515964	4.0	34.3	61.6
2006	1391679	26747	491943					
2007	1050481	116594						
2008	1083319							
2009	672002							
2010	639054							

(1) reconstructions use Tyee Test Fishery mDNA % Babine from 2000-2010, and the average (87%) from 1970-1999. Data from 1950-1969 are from Wood et al (1998) who assumed a 90% Babine Lake contribution to the Skeena River sockeye return. Age 3 jacks are Babine fence counts.
Note reconstruction is only for age 3, age 4, and age 5: other ages not yet assigned

Appendix Table 1. Estimated Babine Lake Development Project (BLDP) contributions to Skeena River sockeye returns: 1982-2010.

Appendix 1. Estimated Babine Lake Development Project (BLDP) Contributions (1): adults only

Year	% BLDP at Babine Lake	% Babine in Skeena R. Return	% BLDP in Skeena R. Return	Total Skeena R. Return (a)	Estimated BLDP Return	Estimated Wild Babine Return	Estimated Non-Babine Return
1982	77.3	87.0	67.2	3763129	**2529710**	744212	489207
1983	84.3	87.0	73.3	2047673	**1501675**	279800	266197
1984	77.3	87.0	67.2	2357385	**1584597**	466328	306460
1985	66.6	87.0	58.0	5337569	**3093698**	1549987	693884
1986	71.7	87.0	62.4	1842764	**1149747**	453457	239559
1987	77.7	87.0	67.6	2400442	**1622198**	466187	312057
1988	78.1	87.0	67.9	4002697	**2719103**	763243	520351
1989	86.0	87.0	74.8	2632939	**1969042**	321615	342282
1990	76.7	87.0	66.7	2721973	**1816721**	551396	353856
1991	56.0	87.0	48.7	3759554	**1831873**	1438939	488742
1992	65.1	87.0	56.6	4199469	**2378240**	1275298	545931
1993	63.2	87.0	55.0	4753798	**2612240**	1523564	617994
1994	84.3	87.0	73.3	2719943	**1994413**	371938	353593
1995	91.0	87.0	79.2	5610015	**4440871**	439842	729302
1996	89.2	87.0	77.6	7486410	**5809915**	703262	973233
1997	75.5	87.0	65.7	3759456	**2469413**	801314	488729
1998	69.0	87.0	60.0	1002872	**602051**	270448	130373
1999	59.9	87.0	52.1	928242	**483945**	323626	120671
2000	83.6	93.4	78.1	4692245	**3665617**	716940	309688
2001	52.9	90.1	47.6	4384675	**2088290**	1862302	434083
2002	68.7	89.4	61.4	1372526	**843309**	383729	145488
2003	79.4	79.7	63.3	2129048	**1347956**	348895	432197
2004	62.7	83.0	52.0	1634902	**850505**	506464	277933
2005	68.8	82.5	56.7	1103594	**626028**	284437	193129
2006	86.0	92.8	79.8	2875415	**2294425**	373960	207030
2007	84.1	88.6	74.5	2149866	**1601969**	302812	245085
2008	87.1	89.9	78.3	2151304	**1685224**	248798	217282
2009	80.0	84.4	67.5	995036	**671778**	168033	155226
2010	84.2	83.0	69.9	963838	**673426**	126560	163852
Mean 82-08	74.9	87.2	65.4	3104441	2059732	658252	386457
Mean 82-10	75.4	87.0	65.6	2957889	1964068	623013	370807

1) 2009 and 2010 are preliminary

(a) adults only (from Table 2 age 4+5 + other, no age 3 jacks)

Appendix Table 2. The escapement adjustment process for Babine Lake sockeye as reported in Wood et al. (1995).

Appendix 2. Notation and calculations of adjusted spawning escapements and surplus enhanced production.

Assumptions/comments:

1) Runs to spawning areas downstream of the counting fence are excluded
2) Babine fence count was unreliable in 1992 (not operated by DFO)
3) All catches at or above the Babine fence exploit mid-timing runs
4) The first measurable returns from enhancement (spawning channels in Fulton River and later Pinkut Creek) occurred in 1970.
5) Estimates of escapement below fences in Fulton River and Pinkut Creek are reliable up to but not necessarily above target levels (45,000 and 5000 respectively).
6) Target escapements below fences in Fulton River and Pinkut Creek represent maximum number of successful spawners there; additional fish do not contribute to fry production and are considered surplus.
7) Spawning in Babine Lake itself is not successful.

Notation and definitions:

A run is defined as the number of adults returning to Babine Lake through the Babine fence such that:

R_T = total run = Babine fence count except in 1992

R_E = early-timing run comprising numerous small, wild sub-populations (e.g. Pierre Creek)

R_M^W = mid-timing run to Morrison River subpopulations that have not been enhanced (W for wild)

R_M^{FP} = mid-timing run to Fulton River and Pinkut Creek subpopulations; includes enhanced returns after 1969.

$R_M = R_M^W + R_M^{FP}$

R_L = late-timing run to the Babine River (wild)

$C = C_M = C_M^W + C_M^{FP}$ = all sockeye from the wild and Fulton-Pinkut components of the mid-timing run harvested at or above the Babine fence

$S_T = S_E + S_M + S_L$ = observed number of sockeye spawning in the early-, mid-, and late-timing runs

Appendix Table 2. Continued. The escapement adjustment process for Babine Lake sockeye as reported in Wood et al. (1995).

$S_T^W = S_E + S_M^W + S_L$ = observed number spawning in wild subpopulations

S_M^{FP} = observed number spawning in the Fulton-Pinkut subpopulations
= visual estimate for years 1950-1965
= weir count + min{target, visual estimate} below fence for years 1966-1993

S_V = total visual counts (excluding fence counts) of spawning escapements
= $S_T^W + S_M^{FP}$ before 1966
= S_T^W from 1966 to present

Calculations to adjust escapement and run size estimates:

1) From 1950-1969:

$$\sim S_T^W = R_T - C \quad \text{(before 1966)}$$

$$= R_T - C - S_M^{FP} \quad \text{(from 1966-1969)}$$

$$= a + bS_V$$

and by least squares regression ($r=0.957$, $p<0.001$)
$a = 7855.645$, $b = 1.200$

2) For 1970-1993, excluding 1992:

$$\sim S_T^W = \min \begin{Bmatrix} a + bS_V \\ R_T - C - S_M^{FP} \end{Bmatrix}$$

3) $\sim S_E = \sim S_T^W \ (S_E/S_V)$

$\sim S_M^W = \sim S_T^W \ (S_M^W/S_V)$

$\sim S_L = \sim S_T^W \ (S_L/S_V)$

$\sim S_M^{FP} = \sim S_T^W \ (S_M^{FP}/S_V)$ (for years 1950-1965)

$= S_M^{FP}$ (for years 1966-1993)

4) For all years excluding 1992:

P^{FP} = potential surplus

Appendix Table 2. Continued. The escapement adjustment process for Babine Lake sockeye as reported in Wood et al. (1995).

$= R_T - \sim S_T - C_T$

$= c + d(^\wedge P^{FP})$

where $^\wedge P^{FP}$ is a rough visual estimate of surplus below fences in Fulton River and Pinkut Creek and
$c = 54164$ and $d= 1.568$ by least squares regression ($r=0.853$, $p<0.001$)

5) Then for 1992 where R_T must be estimated:

$R_T = C + \sim S_T{}^W + \sim S_M{}^{FP} + \sim P^{FP}$

where $S_T{}^W = a + bS_V$

$\sim S_M{}^{FP} = S_M{}^{FP}$

$\sim P^{FP} = c + d(^\wedge P^{FP})$

Appendix Table 3. Corrected (adjusted) Babine Lake sockeye escapements and decade means by run-timing group: 1950-2010. Updates to Table 1 of Wood et al. (1995).

Appendix Table 3. Corrected (adjusted) Adult (age 4+5) Babine Lake sockeye escapements by timing group based on algorithm in Appendix 2 (after Wood et al 1995, 1998)

	Babine Fence Count (adults)	Early Stream Esc.	Mid Stream Esc.	Late Stream Esc	Total Stream Esc.	Fulton / Pinkut Effective Esc.	Catch at Babine Fence & Above	Pinkut / Fulton Total Adult Visual Counts	Fulton / Pinkut Estimated Surplus	Unaccounted Difference between Babine Fence Count and esc.	Catch, Mid-timing Wild	Catch, Mid-timing, Fult./Pink	Vis. Wild Counts incl. FP before '66	Adjusted Total Wild Spawners	Adjusted Early timing Spawners
Year	R_T	S_E	S_M^W	S_L	S_T^W	S_M^{FP}	C	(bc16)	$\hat{P}^{FP}$	Uncounted	C_M^W	C_M^{FP}	S_V	$\tilde{S}_T^W$	$\tilde{S}_E$
1950	364356	39861	9800	275000	324661	50000	27449	50000	0	-37754	4498	22951	374661	336907	35844
1951	141415	24644	4400	32000	61044	24779	19007	24779	0	36585	2866	16141	85823	122408	35149
1952	349011	7494	1250	162000	170744	42500	34404	42500	0	101363	983	33421	213244	314607	11056
1953	686586	52463	26000	280000	358463	164000	26913	164000	0	137210	3683	23230	522463	659673	66241
1954	493677	46000	24000	240000	310000	135000	21847	135000	0	26830	3298	18549	445000	471830	48773
1955	71352	8450	1800	30500	40750	21000	10423	21000	0	-821	823	9600	61750	60929	8338
1956	355345	30450	29000	125000	184450	104000	30582	104000	0	36313	6668	23914	288450	324763	34283
1957	433149	53071	30500	200000	283571	150000	20434	150000	0	-20856	3453	16981	433571	412715	50518
1958	812050	144500	19000	270000	433500	135000	38580	135000	0	204970	4760	33820	568500	773470	196599
1959	782868	85300	37000	295000	417300	200000	16727	200000	0	148841	2611	14116	617300	766141	105867
1960	262719	38000	11000	101000	150000	70000	16754	70000	0	25965	2275	14479	220000	245965	42485
1961	941711	106700	27000	375000	508700	222000	30856	222000	0	180155	3346	27510	730700	910855	133007
1962	547995	17350	13525	285000	315875	110000	18122	110000	0	103998	1984	16138	425875	529873	21587
1963	588000	78260	57200	196800	332260	245000	20021	245000	0	-8881	3790	16231	577260	567979	77002
1964	827437	51364	27000	298000	376364	230000	19855	230000	0	201418	2086	17769	606364	807582	68409
1965	580000	22900	8500	240000	271400	158780	18540	158780	0	133280	942	17598	430180	561460	29888
1966	389000	24200	11500	184000	219700	80044	18652	80044	0	70654	2343	16309	219700	290304	31977
1967	602807	61000	15500	190000	266500	167718	18992	167718	0	149597	1607	17385	266500	416097	95242
1968	552000	51850	46000	222000	319850	147571	19146	147571	0	65433	4550	14596	319850	385283	62457
1969	634000	61960	22450	238000	322410	148885	17293	148885	0	145812	2266	15027	322410	467822	89905
1970	662000	79700	7200	318000	404900	224536	20048	224536	0	12916	623	19425	404900	417416	82164
1971	816000	32500	8000	417000	457500	313244	23450	313244	0	21806	584	22866	457500	479306	34049
1972	680145	44094	8600	259000	311694	283389	24283	283389	0	60779	715	23568	311694	372473	52692
1973	797461	114630	26300	193000	333930	337492	17015	337492	0	109024	1230	15785	333930	408572	140253
1974	726990	89906	31255	238529	359690	235408	22318	235408	0	109574	2616	19702	359690	439484	109851
1975	820795	48390	23000	95000	166390	465933	13896	502689	36756	137820	654	13242	166390	207524	60353
1976	580597	10640	6400	130159	147199	338263	18157	338263	0	76978	337	17820	147199	184494	13336
1977	937992	44240	12600	161583	218423	591788	10777	591788	0	118604	225	10552	218423	269963	54679
1978	401318	24447	3000	43810	71257	171267	10920	171267	0	147874	188	10732	71257	93364	32032
1979	1160966	34720	17800	292325	344845	552632	21500	552632	0	241989	671	20829	344845	421670	42455
1980	526259	25535	9000	158815	193350	178863	22635	178863	0	132417	1084	21551	193350	239876	31679
1981	1432734	36900	5700	90000	132600	697207	30300	697207	0	572927	246	30054	132600	166976	46466
1982	1136835	75650	3900	128947	208497	441473	42000	551550	110077	334788	368	41632	208497	258052	93630
1983	886393	21200	7000	81000	109200	427789	20000	472789	45000	284404	322	19678	109200	138896	26965
1984	1052385	21360	6500	164773	192633	486395	20500	631395	145000	207857	270	20230	192633	239015	26503
1985	2148044	62350	14200	514000	590550	518259	17500	1068259	550000	471735	467	17033	590550	716516	75649
1986	701507	21500	3100	134000	158600	298412	23500	343412	45000	175995	242	23258	158600	198176	26865
1987	1307852	30980	12800	192500	236280	452629	20296	797629	345000	253847	558	19738	236280	291392	38206
1988	1408879	34460	19050	196500	250010	496753	25000	796753	300000	337166	923	24077	250010	307868	42435
1989	1132316	14584	6100	105000	125684	435371	22000	505467	70096	479165	304	21696	125684	158676	18412
1990	978646	17160	5950	160000	183110	458633	22000	618633	160000	154903	282	21718	183110	227588	21328
1991	1176318	48188	20500	355000	423688	328999	20800	573999	245000	157831	1220	19580	423688	516281	58719
1992	1942588	45360	7300	505000	557660	516297	73789	916297	400000	-314051	1029	72760	557660	677048	55071
1993	1737426	13700	18075	490000	521775	512122	177590	762120	249998	275941	6054	171536	521775	633986	16646
1994	1052905	19940	6000	105000	130940	564623	48465	654774	90151	218736	510	47955	130940	164984	25124
1995	1737009	63050	5187	55000	123237	637049	98592	1012049	375000	503831	796	97796	123237	155740	79679
1996	2000591	48878	6400	115000	170278	582946	352234	1182946	600000	295848	3825	348409	170278	212189	60909
1997	1086610	74520	28000	105000	207520	441132	156408	541132	100000	182950	9335	147073	207520	256880	92245
1998	510246	34150	13100	77500	124750	219484	10744	219484	0	155318	605	10139	124750	157556	43130
1999	606136	51352	18500	125000	194852	331993	23220	351993	20000	87423	1226	21994	194852	241677	63692
2000	1831613	68553	16200	150000	234753	716744	455756	874744	158000	266460	10073	445683	234753	289559	84558
2001	1984261	192305	39500	510000	741805	499527	509760	502527	3000	230269	37355	472405	741805	898022	232802
2002	595227	29834	25000	133000	187834	385619	24985	400619	15000	-18111	1521	23464	187834	184623	29324
2003	1170359	44340	67000	80000	191340	607748	32000	707748	100000	239421	3177	28823	191340	237464	55028
2004	919250	37447	49000	236000	322447	547464	31261	557464	10000	8078	2568	28693	322447	340525	39546
2005	709198	21878	27300	142000	191178	456391	33117	456391	0	28512	1869	31248	191178	219690	25141
2006	1391679	32661	10000	110000	152661	636579	257830	741579	105000	239669	3988	253842	152661	191049	40874
2007	1050481	41970	10000	80000	131970	628681	49847	745171	116490	123593	780	49067	131970	166220	52862
2008	1083319	22495	10000	73100	105595	497117	242994	572117	75000	172688	4792	238202	105595	134570	28667
2009	672002	16074	14379	73530	103983	448164	58597	468164	20000	41137	1822	56775	103983	132635	20503
2010	639054	15715	4660	56950	77325	441100	43454	441100	0	74321	454	43000	77325	100646	20455
50-59	448981	49223	18275	190950	258448	102628	24637	102628	0	63268	3364	21272	361076	424344	59267
60-69	592567	51358	23968	232980	308306	158000	19823	158000	0	106743	2519	17304	411884	518322	65196
70-79	758426	52327	14416	214841	281583	351395	18236	355071	3676	103736	784	17452	281583	329427	62186
80-89	1173320	34452	8735	176554	219740	443315	24373	604332	161017	325030	478	23895	219740	271544	42681
90'99	1282848	41630	12901	209250	263781	459328	98384	683343	224015	171873	2488	95896	263781	324393	51654
00-10	1095131	47570	24822	149507	221899	533194	158146	587966	54772	127822	6218	151927	221899	263182	57251

Appendix Table 3. Continued. Corrected (adjusted) Babine Lake sockeye escapements and decade means by run-timing group: 1950-2010. Updates to Table 1 of Wood et al. (1995).

Appendix 3 cont'd. Corrected (adjusted) Babine Lake sockeye escapements by timing group based on algorithm in Appendix 2 (after Wood et al 1995, 1998)

Year	Adjusted Wild Mid-timing Spawners $\sim S_M^W$	Adjusted Wild Late-timing Spawners $\sim S_L^W$	Adjusted Fulton/Pinkut Mid-timing Spawners $\sim S_M^{FP}$	Potential Surplus (corrected) P_FP	Adjusted Fulton/Pinkut Mid-timing Spawners + Surplus Sum	Early-Timing Run at Babine Fence R_E	Mid-Timing Wild Run (Morrison) at Babine Fence R_M^W	Mid-Timing Fulton/Pinkut Run at Babine Fence R_M^{FP}	Total Mid-Timing Wild and Fulton/Pinkut Run at Babine Fence R_M	Late-Timing Run at Babine Fence R_L	Potential Fulton/Pink. Surplus at Babine Fence $R_M^{FP\text{-}509k}$	Prop. Early-Timing Run at Babine Fence $R_{E/RT}$	Prop. Mid-Timing Wild Run (Morrison) at Babine Fence $R_M^{W/RT}$	Prop. Late-Timing Run at Babine Fence $R_{L/RT}$	Total Prop. Wild at Babine Fence (sum)	Prop. Mid-Timing Fulton/Pinkut Run at Babine Fence $R_M^{FP/RT}$
1950	8812	247289	44962	0	44962	35844	13311	67912	81223	247289	0	9.8	3.7	67.9	81.4	18.6
1951	6276	45641	35342	0	35342	35149	9142	51483	60625	45641	0	24.9	6.5	32.3	63.6	36.4
1952	1844	239005	62702	0	62702	11056	2827	96123	98950	239005	0	3.2	0.8	68.5	72.5	27.5
1953	32828	353534	207070	0	207070	66241	36511	230300	266811	353534	0	9.6	5.3	51.5	66.5	33.5
1954	25447	254470	143139	0	143139	48773	28745	161689	190433	254470	0	9.9	5.8	51.5	67.2	32.8
1955	1776	30094	20721	0	20721	8338	2599	30321	32920	30094	0	11.7	3.6	42.2	57.5	42.5
1956	32651	140736	117093	0	117093	34283	39319	141006	180325	140736	0	9.6	11.1	39.6	60.3	39.7
1957	29033	190379	142785	0	142785	50518	32486	159766	192251	190379	0	11.7	7.5	44.0	63.1	36.9
1958	25850	367347	183674	0	183674	196599	30610	217494	248104	367347	0	24.2	3.8	45.2	73.2	26.8
1959	45921	366129	248223	0	248223	105867	48533	262339	310872	366129	0	13.5	6.2	46.8	66.5	33.5
1960	12298	112920	78262	0	78262	42485	14573	92740	107314	112920	0	16.2	5.5	43.0	64.7	35.3
1961	33657	467457	276734	0	276734	133007	37003	304245	341247	467457	0	14.1	3.9	49.6	67.7	32.3
1962	16828	354597	136862	0	136862	21587	18812	153000	171812	354597	0	3.9	3.4	64.7	72.1	27.9
1963	56280	193636	241061	0	241061	77002	60070	257292	317362	193636	0	13.1	10.2	32.9	56.2	43.8
1964	35960	396889	306324	0	306324	68409	38046	324093	362139	396889	0	8.3	4.6	48.0	60.8	39.2
1965	11094	313242	207236	0	207236	29888	12036	224834	236870	313242	0	5.2	2.1	54.0	61.2	38.8
1966	15196	243131	80044	0	80044	31977	17539	96353	113892	243131	0	8.2	4.5	62.5	75.2	24.8
1967	24201	296655	167718	0	167718	95242	25807	185103	210911	296655	0	15.8	4.3	49.2	69.3	30.7
1968	55410	267415	147571	0	147571	62457	59960	162167	222127	267415	0	11.3	10.9	48.4	70.6	29.4
1969	32575	345342	148885	0	148885	89905	34841	163912	198753	345342	0	14.2	5.5	54.5	74.1	25.9
1970	7423	327830	224536	0	224536	82164	8045	243961	252007	327830	0	12.4	1.2	49.5	63.1	36.9
1971	8381	436876	313244	0	313244	34049	8965	336110	345075	436876	0	4.2	1.1	53.5	58.8	41.2
1972	10277	309504	283389	0	283389	52692	10992	306957	317949	309504	0	7.7	1.6	45.5	54.9	45.1
1973	32179	236140	337492	34382	371874	140253	33409	387659	421068	236140	0	17.6	4.2	29.6	51.4	48.6
1974	38189	291444	235408	29780	265188	109851	40804	284891	325695	291444	0	15.1	5.6	40.1	60.8	39.2
1975	28686	118485	465933	133442	599375	60353	29340	612618	641957	118485	103618	7.4	3.6	14.4	25.4	74.6
1976	8022	163137	338263	39683	377946	13336	8359	395765	404124	163137	0	2.3	1.4	28.1	31.8	68.2
1977	15573	199711	591788	65464	657252	54679	15798	667804	683602	199711	158804	5.8	1.7	21.3	28.8	71.2
1978	3931	57402	171267	125767	297034	32032	4119	307766	311885	57402	0	8.0	1.0	14.3	23.3	76.7
1979	21765	357449	552632	165164	717796	42455	22436	738625	761062	357449	229625	3.7	1.9	30.8	36.4	63.6
1980	11166	197031	178863	84885	263748	31679	12250	285299	297549	197031	0	6.0	2.3	37.4	45.8	54.2
1981	7178	113332	697207	538251	1235458	46466	7423	1265513	1272936	113332	756513	3.2	0.5	7.9	11.7	88.3
1982	4827	159595	441473	395310	836783	93630	5195	878415	883610	159595	369415	8.2	0.5	14.0	22.7	77.3
1983	8904	103027	427789	299708	727497	26965	9226	747175	756401	103027	238175	3.0	1.0	11.6	15.7	84.3
1984	8065	204447	486395	306475	792870	26503	8335	813099	821435	204447	304099	2.5	0.8	19.4	22.7	77.3
1985	17229	623637	518259	895769	1414028	75649	17696	1431062	1448757	623637	922062	3.5	0.8	29.0	33.4	66.6
1986	3874	167437	298412	181419	479831	26865	4115	503090	507205	167437	0	3.8	0.6	23.9	28.3	71.7
1987	15786	237400	452629	543535	996164	38206	16344	1015902	1032246	237400	506902	2.9	1.2	18.2	22.3	77.7
1988	23459	241974	496753	579258	1076011	42435	24382	1100088	1124470	241974	591088	3.0	1.7	17.2	21.9	78.1
1989	7701	132563	435371	516269	951640	18412	8005	973336	981341	132563	464336	1.6	0.7	11.7	14.0	86.0
1990	7395	198864	458633	270425	729058	21328	7677	750777	758454	198864	241777	2.2	0.8	20.3	23.3	76.7
1991	24980	432582	328999	310238	639237	58719	26200	658817	685017	432582	149817	5.0	2.2	36.8	44.0	56.0
1992	8863	613114	516297	675454	1191751	55071	9892	1264512	1274403	613114	755512	2.8	0.5	31.6	34.9	65.1
1993	21962	595377	512122	413728	925850	16646	28016	1097386	1125402	595377	588386	1.0	1.6	34.3	36.8	63.2
1994	7560	132299	564623	274833	839456	25124	8070	887412	895481	132299	378412	2.4	0.8	12.6	15.7	84.3
1995	6555	69506	637049	845628	1482677	79679	7351	1580473	1587824	69506	1071473	4.6	0.4	4.0	9.0	91.0
1996	7975	143305	582946	853222	1436168	60909	11800	1784577	1796377	143305	1275577	3.0	0.6	7.2	10.8	89.2
1997	34660	129975	441132	232190	673322	92245	43995	820395	864390	129975	311395	8.5	4.0	12.0	24.5	75.5
1998	16545	97880	219484	122462	341946	43130	17150	352085	369235	97880	0	8.5	3.4	19.2	31.0	69.0
1999	22946	155040	331993	9246	341239	63692	24171	363233	387404	155040	0	10.5	4.0	25.6	40.1	59.9
2000	19982	185020	716744	369554	1086298	84558	30056	1531980	1562036	185020	1022980	4.6	1.6	10.1	16.4	83.6
2001	47818	617401	499527	76952	576479	232802	85174	1048884	1134058	617401	539884	11.7	4.3	31.1	47.1	52.9
2002	24573	130726	385619	0	385619	29324	26094	409083	435177	130726	0	4.9	4.4	22.0	31.3	68.7
2003	83151	99284	607748	293147	900895	55028	86328	929718	1016046	99284	420718	4.7	7.4	8.5	20.6	79.4
2004	51747	249231	547464	0	547464	39546	54315	576157	630472	249231	67157	4.3	5.9	27.1	37.3	62.7
2005	31371	163178	456391	0	456391	25141	33241	487639	520879	163178	0	3.5	4.7	23.0	31.2	68.8
2006	12515	137660	636579	306221	942800	40874	16502	1196643	1213145	137660	687643	2.9	1.2	9.9	14.0	86.0
2007	12595	100762	628681	205733	834414	52862	13376	883481	896857	100762	374481	5.0	1.3	9.6	15.9	84.1
2008	12744	93158	497117	208638	705755	28667	17536	943958	961493	93158	434958	2.6	1.6	8.6	12.9	87.1
2009	18341	93791	448164	32606	480770	20503	20163	537545	557708	93791	28545	3.1	3.0	14.0	20.0	80.0
2010	6065	74126	441100	53854	494954	20455	6520	537954	544474	74126	28954	3.2	1.0	11.6	15.8	84.2
	21044	223463	120571	0		59267	24408	141843	166251	223463	0	12.8	5.4	48.9	67.2	32.8
	29350	299128	179070	0		65196	31869	196374	228243	299128	0	11.0	5.5	50.7	67.2	32.8
	17442	249798	351395	59368		62186	18227	428216	446442	249798	49205	8.4	2.3	32.7	43.5	56.5
	10819	218044	443315	434088		42681	11297	901298	912595	218044	415259	3.8	1.0	19.0	23.9	76.1
	15944	256794	459328	400743		51654	18432	955967	974399	256794	477235	4.8	1.8	20.3	27.0	73.0
	29173	176758	533194	140610		57251	35391	825731	861122	176758	327756	4.6	3.3	15.9	23.9	76.1

Appendix Table 4. Babine River unadjusted escapement counts 2010: Source DFO "Escapement Table Database" (Spilsted and Spencer 2009). The run-timing group each has been assigned beside each stream name.

STREAM	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	AVERAGE 2010-19
BABINE FENCE COUNT*	639,054										639,054
BABINE SUB AREA:											
BABINE UNENHANCED STOCKS:											
BABINE RIVER (SECTIONS 1 - 3) Late	56,950										56,950
BABINE RIVER (SECTION 4) Late	1,714										1,714
BABINE RIVER (SECTION 5) Early	A/P										
BABINE LAKE Early	N/I										
BERN-ANN CREEK Early	N/O										
BOUCHER CREEK Early	N/O										
DONALDS CREEK Early	N/I										
FIVE-MILE CREEK Early	415										415
FORKS CREEK Early	N/I										
FOUR-MILE CREEK Early	2,260										2,260
HAZELWOOD CREEK Early	N/I										
KEW CREEK Early	N/I										
MORRISON CREEK Middle	3,600										3,600
NICHYESKWA RIVER Early	N/O										
NILKITKWA RIVER Early	29										29
NINE-MILE CREEK Early	570										570
ONERKA LAKE Early	N/I										
PENDELTON CREEK Early	N/I										
PIERRE CREEK Early	8,700										8,700
SHASS CREEK Early	A/P										
SIX-MILE CREEK Early	A/P										
SOCKEYE CREEK Early	A/P										
SUTHERLAND RIVER Early	A/P										
TACHEK CREEK Early	90										90
TAHLO CREEK Middle	2,780										2,780
TAHLO CREEK - UPPER Middle	A/P										
TELZATO CREEK Early	N/I										
TSEZAKAWA CREEK Early	1,520										1,520
TWAIN CREEK Early	1,580										1,580
WRIGHT CREEK Early	N/O										
UNENHANCED TOTAL	80,208										80,208
BABINE ENHANCED STOCKS: Middle											
FULTON CHANNEL #1	16,534										16,534
FULTON CHANNEL #2	110,854										110,854
FULTON ABOVE WEIR	184,564										184,564
FULTON BELOW WEIR	10,000										10,000
PINKUT CHANNEL #1	59,427										59,427
PINKUT ABOVE WEIR	19,721										19,721
PINKUT AIRLIFT											
PINKUT BELOW WEIR	40,000										40,000
ENHANCED TOTAL	441,100										441,100
HARVEST AT OR ABOVE WEIR	43,454										43,454
BABINE - UNACCOUNTED	74,321										74,321
SUB AREA TOTAL	595,629										595,629

The Babine unaccounted sockeye number is derived by subtracting the sum of the escapement estimates for all Babine Lake tributary streams and spawning channels, and the native harvest at and above the Babine River counting fence, from the actual fence count.

* Babine Fence count in 1992 began late and ended early as fence deteriorated to point where it needed to be rebuilt.

Appendix Table 4 Continued. Babine River unadjusted escapement counts 2000-2009: Source DFO "Escapement Table Database" (Spilsted and Spencer 2009).

STREAM	2000	2001	2002	2003	2004	2005	2006	2007	2008	2009	AVERAGE 2000-09
BABINE FENCE COUNT*	1,831,613	1,984,261	595,227	1,170,359	919,250	709,198	1,391,679	1,050,481	1,083,319	672,002	1,140,739
BABINE SUB AREA:											
BABINE UNENHANCED STOCKS:											
BABINE RIVER (SECTIONS 1 - 3)	125,000	500,000	130,000	80,000	236,000	142,000	85,000	80,000	73,100	73,530	152,463
BABINE RIVER (SECTION 4)	25,000	10,000	3,000	UNK	N/I	N/I	25,000	A/P	A/P	N/I	15,750
BABINE RIVER (SECTION 5)	UNK	UNK	UNK	UNK	N/I	A/P	A/P	N/I	A/P	A/P	
BABINE LAKE	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	
BERN-ANN CREEK	N/I	1,000	N/O	60	347	1,410	800	750	500	N/O	695
BOUCHER CREEK	UNK	UNK	UNK	UNK	N/O	A/P	N/O	30	N/O	125	78
DONALDS CREEK	N/I	N/I	N/I	N/I	N/I	N/I	N/I	2,800	N/I	N/I	2,800
FIVE-MILE CREEK	400	4,000	10	40	500	250	A/P	N/O	N/O	N/I	867
FORKS CREEK	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	
FOUR-MILE CREEK	7,263	20,000	4,000	4,750	4,500	3,200	6,151	9,000	5,250	4,000	6,811
HAZELWOOD CREEK	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	
KEW CREEK	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	
MORRISON CREEK	15,000	32,000	20,000	37,000	46,000	26,000	10,000	10,000	A/P	8,900	22,767
NICHYESKWA RIVER	N/O	N/O	N/O	N/O	N/O	A/P	N/I	A/P	N/I	A/P	
NILKITKWA RIVER	100	100	100	150	UNK	A/P	60	100	75	239	116
NINE-MILE CREEK	1,759	18,030	650	350	1,300	1,250	A/P	1,500	400	600	2,871
ONERKA LAKE	N/R	N/R	N/R	N/R	N/R	N/I	N/I	N/I	N/I	N/I	
PENDELTON CREEK	100	N/O	N/O	610	400	910	N/O	N/O	N/I	N/I	505
PIERRE CREEK	21,281	65,000	19,000	28,900	19,000	7,350	14,000	19,500	13,000	9,100	21,613
SHASS CREEK	N/I	N/I	UNK	N/I	N/I	N/I	N/I	A/P	N/I	A/P	
SIX-MILE CREEK	4,000	12,000	200	260	1,700	850	500	1,190	350	A/P	2,339
SOCKEYE CREEK	4,000	26,000	350	UNK	1,300	1,100	1,100	1,100	1,000	A/P	4,494
SUTHERLAND RIVER	N/I	UNK	N/I	N/I	N/I	N/I	N/I	N/I	N/I	A/P	
TACHEK CREEK	3,500	19,000	624	2,050	2,900	1,350	750	5,500	1,300	770	3,774
TAHLO CREEK	1,200	7,500	5,000	30,000	3,000	1,300	A/P	A/P	N/I	5,479	7,640
TAHLO CREEK - UPPER	N/I	N/O	UNK	UNK	UNK	N/I	N/I	A/P	N/I	A/P	
TELZATO CREEK	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	
TSEZAKAWA CREEK	850	5,100	400	130	900	1,100	1,000	500	120	710	1,081
TWAIN CREEK	25,000	22,000	4,500	7,000	4,600	3,000	8,300	A/P	500	530	8,381
WRIGHT CREEK	300	75	N/O	40	UNK	108	A/P	A/P	N/O	N/I	131
UNENHANCED TOTAL	234,753	741,805	187,834	191,340	322,447	191,178	152,661	131,970	95,595	103,983	235,357
BABINE ENHANCED STOCKS:											
FULTON CHANNEL #1	16,963	15,500	4,338	17,328	8,712	13,584	16,675	19,118	9,094	14,591	13,590
FULTON CHANNEL #2	168,663	86,035	116,571	110,130	127,803	113,877	111,375	122,783	115,749	128,416	120,140
FULTON ABOVE WEIR	330,172	261,281	170,756	309,023	311,923	184,957	310,067	300,970	226,939	168,326	257,441
FULTON BELOW WEIR	200,000	40,000	10,000	100,000	UNK	15,042	100,000	100,000	60,000	20,000	71,671
PINKUT CHANNEL #1	94,093	51,883	58,421	65,459	61,860	76,666	78,315	59,678	70,335	59,831	67,654
PINKUT ABOVE WEIR	30,350	24,017	20,533	28,617	27,166	26,958	30,000	35,972	25,000	27,000	27,561
PINKUT AIRLIFT	26,503	15,811		27,191		21,157	40,147	40,160			28,495
PINKUT BELOW WEIR	8,000	8,000	20,000	50,000	15,000	4,150	55,000	66,490	65,000	50,000	34,164
ENHANCED TOTAL	874,744	502,527	400,619	707,748	552,464	456,391	741,579	745,171	572,117	468,164	602,152
HARVEST AT OR ABOVE WEIR	455,756	509,760	24,985	32,000	31,261	33,117	257,830	49,847	242,994	58,957	169,651
BABINE - UNACCOUNTED	266,460	230,269	UNK	239,421	13,078	28,512	239,669	123,593	172,688	41,137	150,536
SUB AREA TOTAL	1,375,957	1,474,601	588,453	1,138,509	887,989	676,081	1,133,909	1,000,734	840,400	613,284	972,992

The Babine unaccounted sockeye number is derived by subtracting the sum of the escapement estimates for all Babine Lake tributary streams and spawning channels, and the native harvest at and above the Babine River counting fence, from the actual fence count.

* Babine Fence count in 1992 began late and ended early as fence deteriorated to point where it needed to be rebuilt.

Appendix Table 4 Continued. Babine River unadjusted escapement counts 1990-1999: Source DFO "Escapement Table Database" (Spilsted and Spencer 2009).

STREAM	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	AVERAGE 1990-99
BABINE FENCE COUNT*	978,646	1,176,318	1,233,785	1,737,426	1,052,905	1,737,009	2,000,591	1,086,610	510,246	606,136	1,211,967
BABINE SUB AREA:											
BABINE UNENHANCED STOCKS:											
BABINE RIVER (SECTIONS 1 - 3)	150,000	350,000	500,000	475,000	100,000	50,000	100,000	85,000	75,000	125,000	201,000
BABINE RIVER (SECTION 4)	10,000	5,000	5,000	15,000	5,000	5,000	15,000	20,000	2,500	UNK	9,167
BABINE RIVER (SECTION 5)	N/R	N/I	N/R	N/I	UNK	500	500	1,250	N/I	N/I	750
BABINE LAKE	N/R	N/R	5,000	N/R	N/R	N/R	N/I	N/I	N/R	UNK	5,000
BERN-ANN CREEK	N/R	N/R	N/R	N/R	330	N/R	400	N/R	N/R	N/R	365
BOUCHER CREEK	N/I	N/I	100	UNK	50	50	20	20	20	N/I	43
DONALDS CREEK	N/O	12	N/O	N/I	N/R	N/R	N/O	200	N/I	N/I	106
FIVE-MILE CREEK	N/I	N/I	60	N/O	30	100	350	N/R	N/R	N/I	135
FORKS CREEK	N/R	N/R	N/R	N/R	N/I	N/R	N/I	N/I	N/I	N/I	
FOUR-MILE CREEK	1,800	3,500	2,500	UNK	2,000	9,300	9,500	7,000	750	N/I	4,544
HAZELWOOD CREEK	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	N/I	
KEW CREEK	N/R	N/R	N/R	N/R	N/I	N/R	N/I	N/I	N/I	N/I	
MORRISON CREEK	4,500	13,000	4,800	6,000	6,000	3,900	5,100	23,000	8,600	15,000	8,990
NICHYESKWA RIVER	N/I	N/I	N/R	N/I	10	N/O	N/I	N/I	UNK	N/I	10
NILKITKWA RIVER	N/O	N/O	N/R	N/O	N/I	200	215	150	50	UNK	154
NINE-MILE CREEK	N/I	N/I	4,400	200	500	1,800	2,100	1,200	200	N/I	1,486
ONERKA LAKE	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	#DIV/0!
PENDELTON CREEK	200	400	1,100	UNK	100	N/R	650	4,000	500	N/I	993
PIERRE CREEK	4,300	25,000	18,000	UNK	7,000	26,000	16,500	35,000	28,000	N/I	19,975
SHASS CREEK	2,500	8,100	2,000	3,000	2,500	10,000	N/I	N/I	N/I	N/I	4,683
SIX-MILE CREEK	230	300	N/O	UNK	40	700	1,343	100	N/O	N/I	452
SOCKEYE CREEK	N/O	320	2,700	3,500	30	3,000	3,500	2,900	N/O	N/I	2,279
SUTHERLAND RIVER	N/I	900	N/I	N/I	UNK	UNK	N/I	N/I	N/O	N/I	900
TACHEK CREEK	130	156	2,500	7,000	300	2,000	2,000	2,200	100	N/I	1,821
TAHLO CREEK	1,450	7,500	2,500	12,000	N/I	1,287	1,300	5,000	4,500	3,500	4,337
TAHLO CREEK - UPPER	N/O	N/O	N/O	75	N/I	N/R	N/I	N/I	N/I	N/O	75
TELZATO CREEK	N/R	N/R	N/R	N/R	N/I	N/R	N/I	N/I	N/I	N/I	
TSEZAKAWA CREEK	N/R	N/R	N/R	N/I	50	200	800	500	30	N/I	316
TWAIN CREEK	8,000	9,500	7,000	UNK	7,000	9,200	11,000	20,000	4,500	N/I	9,525
WRIGHT CREEK	N/R	N/R	N/R	N/R	N/I	N/R	N/I	N/I	N/O	N/I	
UNENHANCED TOTAL	183,110	423,688	557,660	521,775	130,940	123,237	170,278	207,520	124,750	143,500	258,646
BABINE ENHANCED STOCKS:											
FULTON CHANNEL #1	16,181	12,409	14,577	21,129	18,200	23,144	13,811	14,627	6,946	13,137	15,416
FULTON CHANNEL #2	108,108	97,010	122,021	102,125	188,700	180,004	133,975	103,161	55,481	72,285	116,287
FULTON ABOVE WEIR	172,904	52,068	178,144	164,173	164,600	222,749	207,780	150,017	54,700	104,811	147,195
FULTON BELOW WEIR	150,000	20,000	250,000	100,000	125,000	200,000	400,000	125,000	40,000	25,000	143,500
PINKUT CHANNEL #1	69,715	84,339	79,009	85,243	88,377	91,881	99,320	74,308	41,659	70,657	78,451
PINKUT ABOVE WEIR	25,047	25,924	35,221	34,773	27,421	25,050	33,676	19,212	17,698	29,455	27,348
PINKUT AIRLIFT	16,678	32,249	37,325	54,677	27,325	44,221	44,384	29,807	N/R	11,648	33,146
PINKUT BELOW WEIR	60,000	250,000	200,000	200,000	15,151	225,000	250,000	25,000	3,000	25,000	125,315
ENHANCED TOTAL	618,633	573,999	916,297	762,120	654,774	1,012,049	1,182,946	541,132	219,484	351,993	683,343
HARVEST AT OR ABOVE WEIR	22,000	20,800	73,879	177,590	48,465	98,592	352,234	156,408	10,744	23,220	98,393
BABINE - UNACCOUNTED	154,903	157,831	N/R	275,941	218,736	503,831	295,848	182,950	155,318	87,423	225,865
SUB AREA TOTAL	956,646	1,155,518	1,473,957	1,559,836	1,004,450	1,639,117	1,649,072	931,602	499,552	582,916	1,145,267

The Babine unaccounted sockeye number is derived by subtracting the sum of the escapement estimates for all Babine Lake tributary streams and spawning channels, and the native harvest at and above the Babine River counting fence, from the actual fence count.

* Babine Fence count in 1992 began late and ended early as fence deteriorated to point where it needed to be rebuilt.

Appendix Table 4 Continued. Babine River unadjusted escapement counts 1980-1989: Source DFO "Escapement Table Database" (Spilsted and Spencer 2009).

STREAM	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989	AVERAGE 1980-89
BABINE FENCE COUNT*	526,259	1,432,734	1,136,835	886,393	1,052,385	2,148,044	701,507	1,307,852	1,408,879	1,132,316	1,173,320
BABINE SUB AREA:											
BABINE UNENHANCED STOCKS:											
BABINE RIVER (SECTIONS 1 - 3)	150,640	70,000	94,647	74,000	158,986	500,000	120,000	175,000	185,000	100,000	162,827
BABINE RIVER (SECTION 4)	8,175	20,000	34,300	7,000	5,787	14,000	14,000	17,500	11,500	5,000	13,726
BABINE RIVER (SECTION 5)	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
BABINE LAKE	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
BERN-ANN CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
BOUCHER CREEK	N/I	N/I	N/I	N/I	N/R	N/R	N/I	N/I	N/I	N/I	
DONALDS CREEK	N/R	N/R	N/R	100	N/R	N/R	N/R	50	50	N/O	67
FIVE-MILE CREEK	4	N/R	150	100	20	150	N/R	30	N/R	N/I	76
FORK CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
FOUR-MILE CREEK	3,600	6,500	15,000	4,200	2,300	5,000	3,000	2,000	1,200	500	4,330
HAZELWOOD CREEK	50	N/I	N/I	N/I	N/I	N/R	N/I	N/I	N/I	N/I	50
KEW CREEK	N/I	N/I	N/I	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
MORRISON CREEK	4,000	5,000	3,500	4,500	2,500	7,000	2,500	9,000	12,000	3,000	5,300
NICHYESKWA RIVER	1,000	300	N/R	N/R	N/R	N/R	N/I	N/I	N/I	N/I	650
NILKITKWA RIVER	6	N/R	N/R	N/R	N/R	N/R	N/I	200	50	N/O	85
NINE-MILE CREEK	750	500	1,000	400	1,000	1,850	500	1,500	200	300	800
ONERKA LAKE	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
PENDELTON CREEK	25	600	5,500	150	100	850	550	700	600	80	916
PIERRE CREEK	3,750	10,000	20,000	7,500	12,650	23,000	7,700	11,500	12,500	6,750	11,535
SHASS CREEK	3,000	6,000	4,500	1,500	950	12,000	2,000	5,150	12,000	2,600	4,970
SIX-MILE CREEK	1,300	800	6,000	950	200	700	1,500	300	250	10	1,201
SOCKEYE CREEK	3,100	1,500	2,500	500	40	2,000	50	600	600	30	1,092
SUTHERLAND RIVER	500	N/R	N/R	N/R	N/R	N/R	N/I	350	N/R	N/I	425
TACHEK CREEK	950	700	4,000	400	100	800	600	1,100	500	14	916
TAHLO CREEK	5,000	700	400	2,500	4,000	7,200	600	3,800	7,000	3,100	3,430
TAHLO CREEK - UPPER	N/R	N/R	N/R	N/R	N/R	N/O	N/I	N/O	50	N/O	50
TELZATO CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/I	N/R	N/R	N/R	
TSEZAKAWA CREEK	UNK	N/I	N/I	N/I	N/I	N/I	N/R	N/R	N/R	N/R	
TWAIN CREEK	7,500	10,000	17,000	5,400	4,000	16,000	5,600	7,500	6,500	4,300	8,380
WRIGHT CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	10	N/R	10
UNENHANCED TOTAL	193,350	132,600	208,497	109,200	192,633	590,550	158,600	236,280	250,010	125,684	219,740
BABINE ENHANCED STOCKS:											
FULTON CHANNEL #1	8,550	20,795	16,845	21,712	16,655	17,208	13,640	16,438	13,685	16,032	16,156
FULTON CHANNEL #2	64,100	144,969	115,507	164,810	109,803	104,340	85,696	102,471	104,301	115,315	111,131
FULTON ABOVE WEIR	42,558	175,302	221,714	156,552	210,022	200,312	86,100	136,239	200,000	150,000	157,880
FULTON BELOW WEIR	6,000	100,000	45,000	5,000	10,000	300,000	5,000	10,000	200,000	100,000	78,100
PINKUT CHANNEL #1	41,655	79,847	55,085	94,520	69,500	76,377	51,800	74,076	58,382	66,800	66,804
PINKUT ABOVE WEIR	15,000	25,541	25,000	25,195	19,566	19,235	20,378	20,266	24,429	24,501	21,911
PINKUT AIRLIFT	N/R	90,753	22,399	N/R	45,849	50,787	30,798	88,139	45,956	12,819	48,438
PINKUT BELOW WEIR	1,000	60,000	50,000	5,000	150,000	300,000	50,000	350,000	150,000	20,000	113,600
ENHANCED TOTAL	178,863	697,207	551,550	472,789	631,395	1,068,259	343,412	797,629	796,753	505,467	604,332
HARVEST AT OR ABOVE WEIR	22,635	30,300	42,000	20,000	20,500	17,500	23,500	20,296	25,000	22,000	24,373
BABINE - UNACCOUNTED	132,417	572,927	334,788	284,404	207,857	471,735	175,995	253,847	337,166	479,165	325,030
SUB AREA TOTAL	504,630	1,402,734	1,094,835	866,393	1,031,885	2,130,544	678,007	1,287,756	1,383,929	1,110,316	1,149,103

Appendix Table 4 Continued. Babine River unadjusted escapement counts 1970-1979: Source DFO "Escapement Table Database" (Spilsted and Spencer 2009).

STREAM	1970	1971	1972	1973	1974	1975	1976	1977	1978	1979	AVERAGE 1970-79
BABINE FENCE COUNT*	662,000	816,000	680,145	797,461	726,990	820,795	580,597	937,992	401,318	1,160,966	758,426
BABINE SUB AREA:											
BABINE UNENHANCED STOCKS:											
BABINE RIVER (SECTIONS 1 - 3)	234,000	321,000	189,000	153,000	203,529	92,000	127,159	121,232	32,915	272,555	174,639
BABINE RIVER (SECTION 4)	84,000	96,000	70,000	40,000	35,000	3,000	3,000	40,351	10,895	19,770	40,202
BABINE RIVER (SECTION 5)	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
BABINE LAKE	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
BERN-ANN CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
BOUCHER CREEK	N/O	N/I	N/O	N/O	N/O	N/I	N/R	N/R	6	N/R	6
DONALDS CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	400	N/R	N/R	400
FIVE-MILE CREEK	300	200	47	90	500	250	60	40	16	N/R	167
FORK CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
FOUR-MILE CREEK	2,500	6,000	7,370	11,000	7,256	1,750	800	8,800	6,000	6,800	5,828
HAZELWOOD CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
KEW CREEK	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/O	N/R	
MORRISON CREEK	7,200	6,000	8,000	17,200	13,755	16,000	3,600	9,000	1,500	11,200	9,346
NICHYESKWA RIVER	N/R	N/R	N/R	N/R	N/R	N/R	N/R	1,600	N/R	N/R	1,600
NILKITKWA RIVER	400	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	400
NINE-MILE CREEK	1,200	1,200	802	1,100	950	140	900	900	215	900	831
ONERKA LAKE	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
PENDELTON CREEK	N/R	N/R	N/R	N/R	100	N/R	1,000	600	300	N/R	500
PIERRE CREEK	44,000	14,200	25,075	60,890	42,920	20,100	2,430	10,000	4,000	11,500	23,512
SHASS CREEK	5,400	2,400	750	13,900	12,000	4,500	1,400	6,000	1,200	3,100	5,065
SIX-MILE CREEK	600	350	1,400	4,800	880	100	450	1,500	300	1,400	1,178
SOCKEYE CREEK	4,800	650	650	600	3,500	2,600	1,300	1,700	1,500	800	1,810
SUTHERLAND RIVER	N/R	N/R	N/R	400	400	N/R	N/R	N/R	400	N/R	400
TACHEK CREEK	2,400	500	1,200	850	2,900	1,150	500	3,500	1,500	1,200	1,570
TAHLO CREEK	N/R	2,000	600	9,000	17,200	7,000	1,400	3,600	1,500	6,600	5,433
TAHLO CREEK - UPPER	N/R	N/R	N/R	100	300	N/R	1,400	N/R	N/R	N/R	600
TELZATO CREEK	100	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	100
TSEZAKAWA CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	200	10	20	77
TWAIN CREEK	18,000	7,000	6,800	21,000	18,500	17,800	1,800	9,000	9,000	9,000	11,790
WRIGHT CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
UNENHANCED TOTAL	404,900	457,500	311,694	333,930	359,690	166,390	147,199	218,423	71,257	344,845	281,583
BABINE ENHANCED STOCKS:											
FULTON CHANNEL #1	25,483	24,746	21,600	25,272	12,530	14,874	16,834	19,080	10,613	21,284	19,232
FULTON CHANNEL #2	58,786	115,481	106,491	112,062	62,397	108,199	110,676	127,548	88,648	126,035	101,632
FULTON ABOVE WEIR	99,789	125,869	81,387	99,975	46,709	192,670	140,561	345,403	39,042	244,568	141,597
FULTON BELOW WEIR	11,500	16,705	N/R	N/R	17,575	81,756	20,000	10,000	5,000	25,000	23,442
PINKUT CHANNEL #1	19,763	21,665	57,083	63,260	51,655	48,083	N/R	64,556	23,716	68,411	46,466
PINKUT ABOVE WEIR	8,257	7,878	15,828	17,969	17,000	12,000	20,227	20,201	4,248	26,000	14,961
PINKUT AIRLIFT	N/R	N/R	N/R	16,654	25,542	40,107	28,965	N/R	N/R	36,334	29,520
PINKUT BELOW WEIR	958	900	1,000	2,300	2,000	5,000	1,000	5,000	N/R	5,000	2,573
ENHANCED TOTAL	224,536	313,244	283,389	337,492	235,408	502,689	338,263	591,788	171,267	552,632	355,071
HARVEST AT OR ABOVE WEIR	20,048	23,450	24,283	17,015	22,318	13,896	18,157	10,777	10,920	21,500	18,236
BABINE - UNACCOUNTED	12,916	21,806	60,779	109,024	109,574	137,820	76,978	118,604	147,874	241,989	103,736
SUB AREA TOTAL	642,352	792,550	655,862	780,446	704,672	806,899	562,440	928,815	390,398	1,139,466	740,390

Appendix Table 4 Continued. Babine River unadjusted escapement counts 1960-1969: Source DFO "Escapement Table Database" (Spilsted and Spencer 2009).

STREAM	1960	1961	1962	1963	1964	1965	1966	1967	1968	1969	AVERAGE 1960-69
BABINE FENCE COUNT*	262,719	941,711	547,995	588,000	827,437	580,000	389,000	602,807	552,000	634,000	592,567
BABINE SUB AREA:											
BABINE UNENHANCED STOCKS:											
BABINE RIVER (SECTIONS 1 - 3)	41,000	200,000	210,000	141,450	250,000	120,000	70,000	135,000	185,000	178,000	153,045
BABINE RIVER (SECTION 4)	60,000	175,000	75,000	55,350	48,000	120,000	114,000	55,000	37,000	60,000	79,935
BABINE RIVER (SECTION 5)	N/R	N/R	N/R	N/R	N/R	2,000	N/R	N/R	N/R	N/R	2,000
BABINE LAKE	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
BERN-ANN CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
BOUCHER CREEK	N/O	N/O	N/O	N/R	N/R	N/O	N/O	N/R	N/R	N/R	
DONALDS CREEK	N/R	N/R	N/R	N/R	800	N/R	N/R	N/R	N/R	N/R	800
FIVE-MILE CREEK	N/R	500	50	N/R	50	150	150	100	50	400	181
FORK CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
FOUR-MILE CREEK	2,000	2,000	3,000	3,690	2,064	1,400	1,500	4,000	4,000	4,500	2,815
HAZELWOOD CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
KEW CREEK	N/O	N/O	N/O	N/O	N/R	N/O	N/O	N/O	N/O	N/O	
MORRISON CREEK	6,000	18,000	9,000	32,500	16,000	5,000	9,000	14,000	35,000	12,250	15,675
NICHYESKWA RIVER	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
NILKITKWA RIVER	N/R	N/R	N/R	400	200	N/R	50	N/R	N/R	400	263
NINE-MILE CREEK	2,000	4,000	500	1,230	1,500	500	1,000	1,000	600	1,110	1,344
ONERKA LAKE	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
PENDELTON CREEK	N/R	N/R	200	N/R	1,400	N/R	N/R	N/R	N/R	N/R	800
PIERRE CREEK	11,000	55,000	4,500	36,900	22,000	10,000	11,000	40,000	25,000	25,000	24,040
SHASS CREEK	12,000	30,000	5,000	14,760	8,000	5,000	6,000	3,000	7,500	9,000	10,026
SIX-MILE CREEK	1,000	N/R	1,000	1,845	1,500	100	300	1,200	1,000	300	916
SOCKEYE CREEK	2,000	N/R	1,100	3,075	1,500	50	1,400	700	1,200	2,140	1,463
SUTHERLAND RIVER	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
TACHEK CREEK	2,000	N/R	600	1,600	3,000	700	300	1,000	500	2,350	1,339
TAHLO CREEK	5,000	7,000	4,500	24,600	10,000	3,500	2,500	1,500	11,000	10,200	7,980
TAHLO CREEK - UPPER	N/R	2,000	25	100	1,000	N/R	N/R	N/R	N/R	N/R	781
TELZATO CREEK	N/R	N/R	N/R	N/R	350	N/R	N/R	N/R	N/R	100	225
TSEZAKAWA CREEK	N/R	200	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	200
TWAIN CREEK	6,000	15,000	1,400	14,760	9,000	3,000	2,500	10,000	12,000	16,660	9,032
WRIGHT CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
UNENHANCED TOTAL	150,000	508,700	315,875	332,260	376,364	271,400	219,700	266,500	319,850	322,410	308,306
BABINE ENHANCED STOCKS:											
FULTON CHANNEL #1	N/R	N/R	N/R	N/R	N/R	N/R	18,186	21,752	26,043	21,034	21,754
FULTON CHANNEL #2	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	23,770	23,770
FULTON ABOVE WEIR	40,000	175,000	80,000	180,000	140,000	135,000	40,395	110,224	99,244	60,555	106,042
FULTON BELOW WEIR	N/R	N/R	N/R	N/R	N/R	N/R	N/R	4,000	N/R	N/R	4,000
PINKUT CHANNEL #1	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	13,479	33,745	23,612
PINKUT ABOVE WEIR	30,000	47,000	30,000	65,000	90,000	23,780	21,463	31,742	6,633	7,331	35,295
PINKUT AIRLIFT	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
PINKUT BELOW WEIR	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	2,172	2,450	2,311
ENHANCED TOTAL	70,000	222,000	110,000	245,000	230,000	158,780	80,044	167,718	147,571	148,885	158,000
HARVEST AT OR ABOVE WEIR	16,754	30,856	18,122	20,021	19,855	18,540	18,652	18,992	19,146	17,293	19,823
BABINE - UNACCOUNTED	25,965	180,155	103,998	N/R	201,418	133,280	70,654	149,597	65,433	145,812	119,590
SUB AREA TOTAL	245,965	910,855	529,873	577,260	807,782	563,460	370,398	583,815	532,854	617,107	573,937

Appendix Table 4 Continued. Babine River unadjusted escapement counts 1950-1959: Source DFO "Escapement Table Database" (Spilsted and Spencer 2009).

STREAM	1950	1951	1952	1953	1954	1955	1956	1957	1958	1959	AVERAGE 1950-59
BABINE FENCE COUNT*	364,356	141,415	349,011	686,586	493,677	71,352	355,345	433,149	812,050	782,868	448,981
BABINE SUB AREA:											
BABINE UNENHANCED STOCKS:											
BABINE RIVER (SECTIONS 1 - 3)	130,000	20,000	62,000	150,000	140,000	15,500	70,000	130,000	160,000	165,000	104,250
BABINE RIVER (SECTION 4)	145,000	12,000	100,000	130,000	100,000	15,000	55,000	70,000	110,000	130,000	86,700
BABINE RIVER (SECTION 5)	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
BABINE LAKE	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
BERN-ANN CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
BOUCHER CREEK	N/R	N/O	400	4,000	400	N/O	N/O	N/R	N/O	N/R	1,600
DONALDS CREEK	N/R	N/R	N/R	300	300	N/R	N/R	200	N/R	800	400
FIVE-MILE CREEK	N/R	111	N/R	300	2,000	100	N/R	200	N/R	600	552
FORK CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	600	600
FOUR-MILE CREEK	4,664	927	192	2,000	2,200	400	400	2,500	7,000	5,400	2,568
HAZELWOOD CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
KEW CREEK	N/R	N/R	N/R	100	300	N/R	N/O	N/O	N/O	400	267
MORRISON CREEK	9,800	2,200	400	16,000	12,000	600	18,000	20,000	9,000	22,000	11,000
NICHYESKWA RIVER	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
NILKITKWA RIVER	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
NINE-MILE CREEK	978	407	75	2,500	1,000	50	N/R	4,000	N/R	2,400	1,426
ONERKA LAKE	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
PENDELTON CREEK	1,341	N/R	N/R	1,500	1,100	N/R	N/R	300	N/R	2,500	1,348
PIERRE CREEK	17,920	12,460	3,500	20,000	17,000	4,000	20,000	23,000	80,000	34,000	23,188
SHASS CREEK	2,697	2,333	2,500	6,000	3,100	500	5,000	7,000	30,000	14,000	7,313
SIX-MILE CREEK	1,225	N/R	N/R	2,663	1,800	100	50	600	2,500	3,500	1,555
SOCKEYE CREEK	900	786	N/R	600	900	500	N/R	2,500	2,000	4,000	1,523
SUTHERLAND RIVER	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
TACHEK CREEK	2,055	2,600	N/R	2,500	1,900	300	N/R	6,771	3,000	6,000	3,141
TAHLO CREEK	N/R	1,000	450	10,000	12,000	1,200	11,000	9,000	10,000	12,500	7,461
TAHLO CREEK - UPPER	N/R	1,200	400	N/R	N/R	N/R	N/R	1,500	N/R	2,500	1,400
TELZATO CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	900	900
TSEZAKAWA CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	400	400
TWAIN CREEK	8,081	5,020	827	10,000	14,000	2,500	5,000	6,000	20,000	9,000	8,043
WRIGHT CREEK	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	800	800
UNENHANCED TOTAL	324,661	61,044	170,744	358,463	310,000	40,750	184,450	283,571	433,500	417,300	258,448
BABINE ENHANCED STOCKS:											
FULTON CHANNEL #1	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
FULTON CHANNEL #2	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
FULTON ABOVE WEIR	50,000	19,000	35,000	140,000	110,000	17,000	80,000	120,000	90,000	120,000	78,100
FULTON BELOW WEIR	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
PINKUT CHANNEL #1	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
PINKUT ABOVE WEIR	N/R	5,779	7,500	24,000	25,000	4,000	24,000	30,000	45,000	80,000	27,253
PINKUT AIRLIFT	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
PINKUT BELOW WEIR	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	N/R	
ENHANCED TOTAL	50,000	24,779	42,500	164,000	135,000	21,000	104,000	150,000	135,000	200,000	102,628
HARVEST AT OR ABOVE WEIR	27,449	19,007	34,404	26,913	21,847	10,423	30,582	20,434	38,580	16,727	24,637
BABINE - UNACCOUNTED	N/R	36,585	101,363	137,210	26,830	N/R	36,313	N/R	204,970	148,841	98,873
SUB AREA TOTAL	374,661	122,408	314,607	659,673	471,830	61,750	324,763	433,571	773,470	766,141	430,287