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LGL LIMITED
environmental research associates

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Prepared for:

Fisheries and Oceans, Canada
Pacific Biological Station
3190 Hammond Bay Road
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Migration timing and in-river survival of Late-run Fraser River sockeye in 2003 using radio-telemetry techniques

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ABSTRACT

In recent years, large numbers of Late-run Fraser River sockeye salmon have died in fresh-water before reaching their spawning grounds. An investigation was conducted in 2002, using radio-telemetry methods to determine the river entry and migration periods of Summer-run and Late-run sockeye stocks, and to estimate survival rates from river entry to the spawning grounds. During 2003, a similar investigation was conducted to assess the level of interannual variation in migration behaviour and survival.

Fishery removals and in-river detections accounted for 56% of the 559 sockeye released in marine areas. The percentage detected was lowest (46%) for the first release group, and higher (66-68%) for the following releases. These detection rates were comparible but slightly lower than those observed in 2002.

Data from 16 fixed-stations were used to determine the river entry times, assess the in-river migration rates, and confirm the spawning destinations. The detection efficiency estimates for the fixed-stations deployed at Hope and beyond were all >85%. Lower detection efficiencies for fixed-stations below Hope were due to the width and depth of the river channel and varying degrees of environmental noise due to vessel activity near each site. The median run timing dates for Late-run stocks passing through the Juan de Fuca fishery and the Mission hydroacoustic site were 14 and 25 August, respectively. The run timing through Juan de Fuca Strait was similar to that observed in the previous sub-dominant cycle year (1999), but run timing past Mission was two weeks earlier than in 1999 and a month earlier than the median timing observed prior to 1994.

The median travel times between the release site in Johnstone Strait and Mission for Summer-run sockeye (5.9-6.7 d) amount to migration rates of 42-48 km/d through coastal waters. The Late-run sockeye that entered the river with the Summer-run stocks had slightly slower travel times (7.5-10.5 d; 27-38 km/d) compared to those of Summer-run fish. Within the three groups, 23-43% of the Late-run fish delayed in Georgia Strait, and entered the river after the Summer-run migration. The estimated delays for Late-run stocks were in the 10-20 d range depending on the tagging period, with longer delays evident in the earlier tag groups. Between Mission and the Thompson Junction, the estimated median migration speed for Summer-run stocks (34-37 km/d) was faster than that of Late-run sockeye (17-24 km/d). Detailed tracking data for individual fish indicated that the radio-tagged sockeye maintained the same chronological order as they migrated passed the monitoring stations along the Fraser and Thompson rivers.

After removing all the radio-tagged fish classified as potential fishery removals, the average survival of Summer-run and Late-run fish were 77% and 63%, respectively. As observed in 2002, survival increased from 41% to 92% with river entry times for Late-run stocks. However, the survival rates estimated for radio-tagged sockeye that passed Mission between 18 August and 10 September were lower in 2003 than those estimated using the same methods and time period for in the 2002 Fraser sockeye radio tagging study.

INTRODUCTION

Fraser River sockeye stocks make up the largest, most productive salmon population in British Columbia (BC), and contribute to many fisheries in Canada and the United States (US). Sockeye returning to the Fraser River migrate through marine, estuarine, and freshwater environments on their way to the spawning grounds. In most years, the vast majority of those fish that escape through the fisheries survive the remainder of their migration to their natal streams where they spawn and die. In some years, some Fraser River stocks show above-average pre-spawning mortality rates. In the 1960's, the International Pacific Salmon Fisheries Commission (IPSFC) estimated that 47-62% of the Horsefly River sockeye died before spawning. In 1963, the IPSFC investigated the causes of pre-spawn mortality after the loss of 90% of the Chilko run (Wood 1965). Gilhousen (1990) noted that high pre-spawn mortality for Summer-run sockeye was related to early run timing and above-average water temperatures during the spawning migration. In support of this hypothesis, Roos (1991) indicated that rebuilding the Horsefly stock in the 1980's was facilitated by later marine and freshwater migration timing. In the late 1990's, high pre-spawn mortality was observed for stocks migrating at the end of the Fraser River sockeye run (the "Late-run" stocks). In 2000-01, pre-spawn mortality was estimated at >90% for Weaver Creek sockeye (a Late-run stock). The possibility that the 2002 dominant cycle-year of the Adams River sockeye (another Late-run stock) would also be subject to high mortality lead to the implementation of conservative fishing plans, and the initiation of a multi-year research program focused on the survival of Late-run Fraser sockeye. One component of these studies was the 2002 assessment of migratory timing and in-river survival of Late-run sockeye using radio-telemetry techniques (English et al. 2003). This report provides the results from a similar radio-telemetry study conducted in 2003, where Fraser sockeye were tagged in marine fishing areas and tracked as they migrated towards their spawning destinations within the Fraser River watershed.

Fraser River sockeye spawn mostly during August-October. Depending on the stock of origin, sockeye have adapted to enter the river predictably within distinct periods (Fig. 2). Four timing groups are currently used for management purposes (Early Stuart, Early Summer, Summer-run and Late-run). The first three timing groups usually migrate rapidly through coastal fisheries in July-August and enter the river with little or no delay in the ocean or estuary. Late-run stocks arrive on the coast from late July to early September, migrating through coastal fisheries about two weeks later than Summer-run stocks. Prior to 1996, most Late-run fish accumulated in schools off the mouth of the Fraser River for three to six weeks before moving upstream in mid-September through late October. From 1996 to 2001, the portion of the Late-run stocks that entered the Fraser River with little or no delay has increased along with the pre-spawning mortality rate. In 2001, the median river entry time for the primary Late-run stock (Weaver Creek) was about seven weeks earlier than previously observed (M. Lapointe, PSC, pers. comm.). It has been hypothesized that the relatively high pre-spawning mortality observed in freshwater was due to:

1. Stress related to the non-adaptive early river entry behaviour;

2. Longer freshwater residence times before spawning, during which a myxosporan parasite, *Parvicapsula minibicornis*, contracted upon river entry, induces additional mortality via renal failure before spawning occurs (St-Hilaire et al. 2002); and

3. Exposure of fish to higher freshwater temperatures, which promote the development of the parasite (S. Jones, DFO, pers. comm.)

A review of existing information revealed significant knowledge gaps on the migration of Late-run stocks. For management purposes, there is a need to know: (i) if fish entering early survive to spawn at rates equal to late migrating fish; (ii) do constant proportions of Late-run sockeye delay in Georgia Strait throughout the run; (iii) where and when does most of the mortality occur; and (iv) are Late-run mortality estimates from tagging studies comparable to those based on differences in abundance between Mission (hydro-acoustic) and the spawning grounds. These questions lead to the objectives of the 2002 and 2003 studies, namely:

1. Determine if Late-run stocks enter the river in the same order as they move through the coastal fishing areas;

2. Estimate the delay of Late-run sockeye in Georgia Strait by marine timing component; and

3. Estimate the in-river mortality and spawning success of Late-run stocks by river entry timing component.

The first two objectives required tagging in marine fishing areas and tag recovery or detection soon after the fish entered the lower Fraser River. The last objective required monitoring of the freshwater migration from the river mouth to the spawning grounds for tags applied in both marine and freshwater areas. Several tagging methods were considered initially, with radio-telemetry selected because of the slightly lower costs and the past success of large-scale radio tagging studies conducted on the Nass, Skeena, Fraser, and Columbia rivers (Koski et al. 1995, 1996a,b; Alexander et al. 1996, 1998; English et al. 1998; 1999, 2000, 2001; Nelson et al. 1998; Bjornn et al. 2001).

MATERIALS AND METHODS

Study area

The Fraser River drains two-thirds of British Columbia, and supports the largest salmon fisheries in Canada. Fraser River sockeye are harvested in marine and freshwater fisheries in southern BC, and marine fisheries in Washington State. The most intensive BC fisheries operate in Johnstone Strait (JS), Juan de Fuca Strait (JF), Georgia Strait (GS), and the Fraser River (FR) below Sawmill Creek. Historically, commercial fisheries have not been permitted upstream of Sawmill Creek but both recreational and First Nation fisheries harvest sockeye above this location.

The main study area extends from the Johnstone and Juan de Fuca straits, to the upper reaches of the Fraser River (Fig. 1). Within the Fraser River drainage, the 2003 sockeye monitoring program focused on the Thompson watershed to assess Late-run returns to Shuswap Lake (Adams River stock), and in the lower Harrison watershed (Weaver Creek stock). Virtually all of the Late-run sockeye were expected to spawn in these locations in 2003. Within the late Shuswap stock group, most fish were expected to spawn in the Adams River (85%) based on historical patterns on the 2003 cycle line, with others going to the lower Shuswap River (2%), Little River (8%), and the Shuswap Lake shoreline (5%) (J. Cave, Pacific Salmon Commission, pers. comm.).

Study design

The basic components of the radio-telemetry study proposed were:

1. marine tagging of Summer-run and Late-run stocks in the major approach fisheries;
2. fixed-station tracking at strategic locations along the Fraser River;
3. in-river tagging of Late-run sockeye in the lower Thompson River; and
4. fixed-station and mobile tracking of Late-run stocks in the Thompson and Harrison river drainages.

During 2002, marine tagging was conducted during 3-24 August in Johnstone and Juan de Fuca straits. Tagged fish released from the two locations showed similar movement and survival patterns. Based on the 2002 findings, tagging in 2003 was to be conducted along one migration route only. When the in-season monitoring indicated higher migration through Johnstone Strait, the decision was made to conduct all tagging there (Fig. 1). Late-run stocks co-migrate mainly with Summer-run stocks through both areas (Fig. 2). Historically, the average peak arrival date of the Late-run stocks through Johnstone Strait is mid-late August, about two weeks later than the peak arrival date of the Summer-run stocks (Roos 1991).

The initial goal for marine tagging was to apply sufficient numbers of tags to each timing component of the Late-run migration (early, middle, and late) so that 50-60 radio-tagged Late-run sockeye would be available for detection in fresh water for each of the three timing components. Tagging was to commence when the Late-run stocks exceeded 20% of the sockeye in samples obtained from the Johnstone Strait test fishery (expected to be around 8-12 August 2003). Pre-season abundance and run timing forecasts for Summer-run and Late-run stocks were used to set the initial tagging goals at 335, 160, and 100 fish for the early, middle, and late tagging periods. The exact tagging periods and tag allocations were expected to change slightly in-season based on actual run timing and relative abundance of the Summer-run and Late-run stocks. The pre-season forecast for the total return of Fraser sockeye in 2003 was 5.5 million fish. The total return forecasts were 3.4 million Summer-run fish, and 1.6 million Late-run fish (Birkenhead stock = 300,000), 89,000 Early Stuart fish, and 412,000 Early Summer-run fish (Cass 2003). Tagging during mid-late August was expected to result in no Early Stuart and few Early Summer sockeye being caught and tagged.

The fixed-station tracking involved the deployment of antennas and receivers at strategic locations along the Fraser River to provide data on river entry times, in-river movement patterns,

and spawning destinations. Radio tag signals cannot be detected in marine and brackish waters, so the first fixed stations were deployed upstream of tidal influence, near the Mission hydro-acoustic site. The farthest upstream fixed station was located at the junction of the Quesnel and Fraser rivers, to monitor the Summer-run stocks migrating to or above this location.

Despite considerable planning efforts to ensure that Late-run fish are tagged at sea and tracked to destinations, it was acknowledged that the planned marine tagging operations might not intercept sufficient numbers of earliest arriving fish of Late-run stocks. To ensure that some data would be obtained on this group (a primary goal), additional in-river tagging was planned to complement the marine tagging operations. In-river tagging was to be conducted 50 km below Ashcroft on the Thompson River, with the objective of applying >60 radio tags to the first group of Late-run sockeye entering the Thompson River. During the in-river tagging period, an additional fixed-station was deployed near Spences Bridge, 22 km upstream of the tagging site. This station and the Thompson Junction station, below the tagging site, provided in-season information on downstream movements, delay or mortalities that could be attributed to the handling and tagging procedures.

Radio-transmitters

The radio transmitters used during this study are model MCFT-3A micro coded fish transmitters manufactured by Lotek Wireless, Inc. of Newmarket, Ontario. They are 16 mm in diameter, 46 mm long, with a 460 mm antenna. The transmitters were powered by 3-volt batteries, with an expected life of 761 d, but programmed to stop transmitting after 154 d to minimize interference with other studies. Some of the radio tags applied in the lower Thompson River were those recovered during the 2002 spawning ground surveys, and from marine and fresh-water fisheries in 2003. These tags were de-activated by applying a magnet to the tag, and the transmission life was reset to 154 d when the magnet was removed prior to being inserted in the fish. Transmitters were on seven different frequencies in the 150 MHz band. Within each frequency, three different pulse intervals (4.5, 5.0, and 5.5 s) were used to reduce the incidence of signal collisions when several transmitters were present at the same location at the same time.

Tracking procedure

Radio-tagged sockeye were monitored using fixed stations and mobile tracking. Both monitoring systems used SRX400 or SRX400A radio receivers manufactured by Lotek Wireless, Inc., and 3-4-element Yagi antennas manufactured by Max, Inc., Hanover Park, Illinois or Grant Systems Engineering Inc., of King City, Ontario.

Fixed stations

Sixteen stations similar to those used in 2002 (English et al. 2003) were deployed at 15 sites along the Fraser River to monitor the movement of tagged fish (Fig. 1). The first two fixed stations were located near the Mission hydro-acoustic site, some 50 km above tidal waters. As in 2002, the two receivers were positioned 730 m apart, on opposite banks, for maximum coverage of radio-tagged fish passing Mission. Fixed stations were also installed at three sites in the lower Fraser River, at Hell's Gate, at four major river junctions, and six sites in the Thompson River

watershed. Details on the station locations, identities, and operation are given in Appendix A (Tables A1-A2).

Up to three antennas were used at each site to determine the direction of movement of tagged fish based on their sequential detection pattern. Multiple antennas used at tributary junctions were positioned to detect fish downstream of the station, up a tributary (if present), and upstream of the station. At Mission, the antennas were aimed in different directions so that radio and equipment noise would not affect all antennas simultaneously. For each site, signal collisions and environmental noise that would affect the detection of tagged fish was monitored periodically, and adjustments were made when required, to minimize interference and monitoring gaps during the survey period.

Mobile tracking

Mobile tracking was conducted to confirm the final destinations and spawning success of radio-tagged sockeye, and track the movement of fish tagged in the river in areas that could not be monitored by fixed stations. Mobile tracking was conducted at Weaver Creek, Birkenhead River, Portage Creek, Horsefly River, lower Shuswap River, and Shuswap Lake. Mobile tracking was conducted by foot, boat, and helicopter (Bell 206). During foot surveys, either a hand-held 3-element Maxrad or a folding antenna (AF Antronics, Inc., Urbana, Illinois) was used to detect radio-tagged fish. During boat and helicopter surveys, a 3-element Maxrad antenna was mounted on a wooden mast, and held vertically in the boat or mounted horizontally on the skids of the helicopter. All radio-tagged fish detected during mobile surveys were assigned to standard reaches used during the DFO escapement surveys. Mobile survey data, methods, effort, and numbers detected by area are provided in Appendix A (Tables A3-A4).

Pre-season sampling and tagging tests

As in 2002, pre-season testing was done in late July, about two weeks before the main tagging period, mainly to assess the suitability of the 2003 bio-sampling procedures. Tests were conducted on the test-fishery seine vessel, *Royal Mariner I*, in the Juan de Fuca Strait (DFO statistical Area 20) during 26 July (holding study) and 27 July (tagging and release tests). On the first day, 15 sockeye were sampled, tagged and held, according to the 2002 procedures, which did not require anaesthetizing fish before collecting scales, adipose fin tissue, and radio tagging. All sockeye subject to this procedure comprise the non-physiologically-sampled group.

Another 15 sockeye were subject to the same treatment, with additional sampling of blood and gill tissue, and measurements with an electronic fat probe meter (Distell Fish Fatmeter Model 692, Scotland). These fish are referred to as the physiologically-sampled group. Physiological sampling was conducted by researchers from the Simon Fraser University (SFU) and the University of British Columbia (UBC) conducting studies on the hormonal, physiological, and energetic adaptations of the fish to river entry required to assess several hypotheses relating to early river entry of some Late-run sockeye. Besides information on age and stock identities obtained from scales and adipose tissue samples, blood, gill tissue and fat probe readings were collected to measure levels of reproductive hormones, enzymes and energy

reserves to assess their fresh water readiness. After tagging and sampling, fish were placed in a revival tote for 1 h, and then transferred to a holding pen for about 24 h. These fish were assessed for mortalities the next day; had their tags removed and modifications were made to the holding facilities (increased flow) on the vessels to maximize survival of tagged fish.

Test tagging commenced from test seine sets and 52 sockeye were radio-tagged in the same manner as during the previous day, alternating between physiological and non-physiological sampling for individual fish. For radio-tagged fish, only half (26/52) were physiologically-sampled before release after a 1 h recovery period.

Since fish caught in July tend to be Early Summer or Summer-run fish that should enter the Fraser River and arrive at Mission within 6-14 d from the release date, the relative survival of the two groups to Mission was expected to provide insight into the effects of the additional physiological sampling before conducting these procedures on some radio-tagged fish during the main study.

Capture and tagging procedures

The radio tags used during 2003 consisted of 600 tags purchased that year and 40-50 tags recovered from spawning areas in 2002. Marine tagging was done on board the purse seine vessel, *Sunfisher*, that is often used for test-fishing in Johnstone Strait (DFO Statistical Area 13). Tagging periods and locations were chosen to coincide with the early, peak, and later portions of the Late-run Fraser River migration, based on the in-season stock composition estimates from micro-satellite DNA analyses (Withler et al. 2000), and abundance indices from the test fisheries. Marine tagging and sampling in Johnstone Strait occurred during three periods in 2003 (11-15, 19-22, and 26-28 August).

Tagging procedures followed those described in the pre-season tests with physiological and non-physiological sampling conducted during tagging sessions. During each tagging period, the seine net was retrieved and pulled alongside the boat. After securing the net, 20-30 sockeye were selected from each set based on their dorsal surface color ("blue-back"), body shape (not thin) and size (55-65 cm nose-fork length) to increase the probability of selecting Late-run Fraser stocks (English et al. 2003; S. Latham, PSC, pers. comm.). The fish were transferred to one of two totes (726 l and 239 l capacities) using a long hand-held dipnet. Fish were first removed from the smaller tote, then the larger tote, and placed in a V-shaped tagging trough filled with a constant supply of fresh sea water using an onboard pump.

Non-physiological tagged fish were measured (nose-fork length), a tissue sample was taken from the adipose fin for DNA analysis, a scale was taken, and the radio tag was orally inserted into the stomach of the fish using a plastic tag applicator. External cinch tags used in 2002 were not applied during 2003 because of recent concerns of increased vulnerability of tagged fish to predators. Instead, individually numbered pieces of plastic tubing (similar to Floy anchor tags) were attached to the radio-tagged antenna wire so that tagged fish subsequently caught could be identified without removing the radio tag. Physiological tagged fish were tagged

similarly as non-physiological fish with the exception of additional samples collected: blood was taken below the anal fin using a 3 ml vacutainer with a 2 cm long 21 gauge needle, a piece of gill tissue was removed using blunt-nose scissors, and a dorso-anterior reading of the percent body lipid was taken on the left side of the fish using the fat probe meter. Processing of tagged fish took 0.5-3.0 min depending on the sampling procedure.

After tagging, fish were placed in either a small or large recovery tote depending on the numbers held. All fish were released 30-60 min later. The smaller tote had a constant supply of fresh sea water entering through the bottom, a drain near the top, and a cover that could be used to prevent fish from jumping out. All totes were drained and refilled after each tag release operation. Radio-tagged fish were usually released in areas (e.g., Separation Head) that were protected from predators and had lower probabilities of being intercepted in net fisheries (i.e., area closed to fishing) to maximize mixing rates and high post-release survival in marine waters.

Acoustic transmitters were also applied to some sockeye caught in Johnstone Strait during the middle and late radio tagging periods. The transmitters (Vemco Model V16, 16 mm in diameter and 62 mm in length) were orally inserted into the stomach of some sockeye to study their timing, movement, and behaviour in the Fraser River estuary. These fish were handled and tagged in the same manner as those radio-tagged, including alternating physiological and non-physiological sampling. However, the acoustic tagged fish were released immediately after tagging because the holding facilities were limited and could not accommodate both the acoustic-tagged and radio-tagged fish. The results of the acoustic study will be reported elsewhere (D. Welch, DFO, pers. comm.).

As in 2002, in-river tagging was conducted at certain times based on run timing data from test fisheries and travel times estimated from the tracking of radio tags applied in the marine areas. A total of 79 fish were radio-tagged in the Thompson River Canyon downstream of Nicomen, below Ashcroft, during four tagging sessions (25-29 August, 5-11 September, 16-20 September, and 24 September – 1 October). Tags were applied mainly during the first period to hopefully intercept the early component of the Late-run group. The number of tags applied after 29 August was determined by the number of tag returns available prior to each tagging period. The primary purpose of these later tagging periods was to apply the EMG radio tags as part the physiological investigations. The conventional radio tags were deployed for comparison with the EMG tagged fish released during the same periods.

During the first two days, fish were caught using a light aluminum dip net. This method was found to be ineffective and physically exhausting for those catching the fish. Therefore, a hand-made wooden net (long pole with large basket) was used afterwards. The net was tied in place and caught fish as they rose to the surface to navigate around rocks in the canyon. Fish caught were placed immediately in a container with water and transported to the nearby tagging area, located next to a back eddy pool, downstream of the swift canyon water. Cursory observations suggested that tagged fish were quite vigorous and could be released without additional holding. Fish selected for tagging had no wounds or net marks, and could vary in coloration. Other procedures were identical to ocean tagging, with at least half of the fish tagged subject to physiological sampling before release.

The distribution of in-river fishing effort and catch statistics for the fresh water tagging session are given in Appendix B (Table B3), with details on radio-tagged releases given in Appendix C (Table C3).

Telemetry data management

Data from fixed stations were downloaded at regular intervals, depending on the number of fish passing the stations and their accessibility (about every 7 d for remote stations, and 2-3 d for closer stations monitoring large movements). After downloading, and before erasing the internal memory in the receiver, a diagnostic program was run on the download file to ensure that all data had been transferred, the file was readable, and the receiver and antennas had been operating properly.

Data analysis

Tagging records were processed and analyzed using LGL's custom database software which facilitates data organization, noise filtering, record validation and analysis. Original data sets were archived so that data selection criteria could be modified to get estimates with specified spatio-temporal resolutions. Before analyzing the telemetry data, false records in the receiver files caused by electronic noise were removed. Records considered as valid had power levels >50 (1-232 scale), and two detections within 20 min in a zone located in the middle of two detection sites. After the removal of false records, a compressed database was created to hold the sequential detections for each radio-tagged fish. Each record identified each fish by a unique combination of tag number, a zone number (antenna or general location), the first and last time and date for the sequential detections in a specific zone, and the maximum power for all detections in that interval. The compressed database was used to determine when each fish arrived in the lower Fraser River, the residence period at each station or spawning area, movement rates between detection sites, and the last detection site.

Fishery recovery estimates

The Pacific Salmon Commission (PSC) compiles the catch estimates of Fraser River sockeye in marine fisheries along their migration routes, and escapements passed Mission on a daily basis (J. Gable, PSC, pers. comm.). These data were used to estimate daily harvest rates and the number of tag recoveries. In the following formulas, (d) represent a calendar day, (f) an in-river fishery below Mission, (T) a radio-tagged group, and (N_T) the number of radio-tagged fish of a particular group (early, mid, late) caught and reported by in-river fishers. Daily catches by fishery (C_{fd}), and escapements passed Mission (E_d) are used to estimate daily harvest rates (H_d), in-river catches of a tagged group (C_T, or 'estimated recoveries'), tag reporting rate for the tagged group (P_T), and total return of the tagged groups to the lower Fraser (R_T). Based on the results of previous studies, it was assumed that radio-tagged fish needed one day to move from the in-river fisheries in the lower Fraser to the Mission detection site. The following equations are used to estimate the in-river harvest rates for radio-tagged sockeye detected at Mission on a given day. Estimates for fisheries below Mission were computed using:

(1) $$H_d = \frac{\sum_{f=1}^{F} C_{fd-1}}{E_d + \sum_{f=1}^{F} C_{fd-1}}$$

(2) $$C_T = \sum_{d=1}^{D} \left(\frac{H_d E_{Td}}{1 - H_d} \right)$$

(3) $$P_T = \frac{N_T}{C_T}$$

(4) $$R_T = \sum_{d=1}^{D} \frac{E_{Td}}{(1 - H_d)}$$

In 2003, harvest rate and tag removals were also estimated for fisheries above Mission. It was assumed that only half the fish moving passed Mission on any given day were available for harvest that day, with the survivors available for harvest during the next two days. Let $S_{d,d}$, $S_{d,d+1}$, and $S_{d,d+2}$ denote the number of fish that escaped on day d, that survived each day. Assuming that each daily cohort contributed to the catches above Mission in proportion to its relative abundance, catches and harvest dates by cohort were estimated in a step-wise fashion as follows:

(5) $$C_{Ed,d} = \frac{0.5 E_d C_d}{0.5 E_d + S_{d-1,d-1} + S_{d-2,d-1}}$$

(6) $$S_{d,d} = E_d - C_{Ed,d}$$

(7) $$C_{Ed,d+1} = \frac{S_{d,d} C_{d+1}}{0.5 E_{d+1} + S_{d,d} + S_{d-1,d}}$$

(8) $$C_{Ed,d+2} = \frac{S_{d-1,d-1} C_{d+2}}{0.5 E_{d+2} + S_{d-1,d-1} + S_{d-2,d-1}}$$

(9) $$H_{Ed} = \frac{C_{Ed,d} + C_{Ed,d+1} + C_{Ed,d+2}}{E_d}$$

(10) $$C_T = \sum_{d=1}^{D} E_{Td} H_{Ed}$$

Survival estimation

In-river survival rates from Mission to the spawning grounds were computed for each tagged group (combination of run type by release period). Each radio-tagged fish detected at Mission was classified into one of three categories: 1) survivors; 2) in-river (en route or pre-spawn) mortalities; or 3) likely fishery related mortalities. Survivors were those fish tracked to predefined spawning areas during the spawning periods. Fishery related mortalities were those tags returned by fishers and those that were last tracked in the vicinity of a known fishery during a period when harvest levels were sufficient results in the capture of at least one radio-tagged fish (i.e. harvests exceeding 10,000 sockeye). The remainder of the fish were assigned to the "in-river mortality" category. Equation 11-12 provide estimates of survival (S) and the standard deviation using the formulae for proportions based on high sampling fractions (Cochran 1977, p. 52) .

(11) $$S = \frac{O_T}{E_T - C_T}$$

(12) $$\sigma(S) = \sqrt{\frac{S(1-S)}{E_T - C_T - 1}}$$

where E_T is the number of tagged fish detected at Mission, C_T is the number of tags caught above Mission, and O_T is the number of tagged survivors for timing group T.

Stock assignment

During this study, information was obtained on stock movement through various fisheries, and the location and time of pre-spawn mortality. The spawning area of each fish (termed 'stock of origin') serves to determine stock-specific movement rates. Tagged fish detected in spawning areas were assigned to that river (i.e stock). Radio-tagged fish caught in various fisheries, and those that died before reaching the spawning areas, were assigned to a stock group based on a DNA analysis of their tissue sample (T. Beacham, DFO, pers. comm.).

RESULTS

Tag releases, recoveries and total detections

Details on the purse seine fishing periods and catch statistics for the marine tagging operations are in Appendix B, with the associated tag release records given in Appendix C. In all, 611 radio-tagged fish were released in marine waters during 2003 (Table 1). Of these, 52 were released in Juan de Fuca Strait in late July to assess the effect of physiological sampling on post-release survival, and 559 sockeye were tagged and released in Johnstone Strait during three release periods (11-15, 19-22, and 26-28 August). All radio-tagged fish in the first tagging period were physiologically sampled. Afterwards, physiological samples were obtained from only half of the radio-tagged fish. A total of 178 fish with acoustic transmitters were also released in Johnstone Strait during the middle and late tagging periods.

Data for all radio-tagged fish caught, reported and verified through tag returns (i.e tag recoveries) are given in Appendix D. For the Johnstone Strait releases, four recoveries were from Canadian marine fisheries, all released during the first tagging period (1.3% of releases). Another five were recovered from in-river fisheries below Mission (Table 2). Not all tagged fish that entered the Fraser River were detected at the Mission site (see next section), but the approximate times when tagged fish passed Mission was estimated based on 2003 migration times. These suggest that tags first detected at the Harrison Junction, Hope and Hell's Gate, respectively, passed Mission 0.5, 2.0 and 3.5 d earlier.

Using the harvest rate estimation procedures described above, we estimated that six radio tags were likely caught in the in-river First Nation fisheries below Mission. Only three tags were returned from these fisheries, which equates to a reporting rate of 50% for the lower river First Nation fisheries (Table 3). This reporting rate was applied to the four reported recoveries from marine fisheries to produce an estimated catch of eight tags. Recoveries in recreational fisheries were not expanded because the number of tags returned by anglers both below and above Mission was higher than that estimated for the reported recreational catch. By combining the estimated fishery recoveries below Mission (eight marine, six First Nation and two recreational) with the 297 tags detected at or above Mission, 313 tags or 56% of all Johnstone Strait releases were accounted for.

Using the daily harvest rate estimates for First Nation fisheries above Mission (Equations 5-10), we estimated that 19 radio tags were caught in the fisheries above Mission. The 13 tags returned from the First Nation fisheries above Mission amount to a reporting rate of 67% in 2003. Adding the estimated First Nations catch of radio-tagged sockeye to the eight tags returned by anglers produced our estimate that 27 radio-tagged sockeye were removed in fisheries above Mission. Daily estimates of the number of tags caught in First Nation fisheries above Mission (Table 3) were compared with the number of tags returned by recapture date, to identify the likely harvest periods for the 6 unreported removals. Fish last tracked between Mission and Sawmill Creek during these periods (3 Summer-run, 2 Late-run and 1 Early Summer-run) were classified as fishery removals.

Fixed-station detection efficiencies

Data from the fixed-station receivers was used to determine the timing of river entry, the in-river migration rates and arrival times to spawning areas. Daily detections of radio-tagged fish and corresponding receiver noise levels recorded by each fixed-station receiver are given in Appendix A (Fig. A1). Detection efficiencies are estimated from the ratio of the unique tags detected at a site, over all unique tags detected at that site, and those further upstream. Detection efficiencies in 2003 were similar to those estimated for the 2002 study (Table 4). Fixed stations above Hell's Gate had detection efficiencies of 95-100%. The detection efficiencies for the Hell's Gate Station were lower than during 2002 because of excessive noise on one of the tag frequencies (150.400 Mhz). The noise originated from the tramway that services the Hell's Gate tourist center, so this frequency could not be effectively monitored by the Hell's Gate receiver. The detection efficiency for tags on the other frequencies monitored at or above Hell's Gate was estimated at 99.5%. The detection efficiency was lowest at the Harrison Junction because this station was configured to detect fish entering the Harrison River rather than those migrating

upstream on the Fraser. As in 2002, this station detected all fish detected by other fixed-stations and by mobile tracking within the Harrison watershed. While only detecting 49.8% of all fish that passed upstream on the Fraser in 2003, the efficiency was better than achieved in 2002 (29.1%). Several tags were detected by mobile tracking operations (Table A4), mainly in Weaver Creek (14), Harrison River (13), Adams River (11), Horsefly River (15), Birkenhead River (11) and Shuswap Lake (8). All of the fish detected during the mobile surveys were previously detected by the fixed stations immediately downstream from these spawning areas.

Tags applied by stock group

Prior to the arrival of radio-tagged sockeye in known stock areas, DNA micro-satellite analyses provided estimates of stock origins for 555 of the 559 fish tagged in marine waters. Information from the 203 fish detected in known stock areas was used to assess the classification accuracy of the *a priori* DNA analysis and define the final stock group for those fish. The radio tag tracking data indicated the DNA analysis assigned radio-tagged fish to their correct destination stock, 94-100% of the time (Table 5). Late-run stock group provided the largest sample (n=96). A complete breakdown of the stock assignments for all radio-tagged sockeye by release group is provided in Table 6. Late-run stocks represented 34% of all the sockeye tagged in marine areas. The remaining were Summer-run (54%), Early Summer-run (6%), known others (6%, mostly Birkenhead) and unknown (1%). The portion of Late-run stocks in each release group increased from 20% for the first release period to 50% for the last release period.

River entry run-timing

The migration pattern of sockeye radio-tagged in Johnstone Strait was determined from the 262 tags detected at Mission, estimates of river entry for the 35 tags that passed by Mission undetected, and the recovery dates for five tags caught in river below Mission. The distribution of travel times was largely unimodal for the three release groups of Summer-run fish (Fig. 3). These groups had fairly consistent travel times to Mission (medians 5.9-6.7 d) throughout the run (Table 7). Travel times of Late-run sockeye were longer (medians 9.6-12.8 d), and more variable between the release groups. The distribution of travel times of Late-run sockeye was multi-modal for all release groups, with a tendency for fish to take 6-14 d or 15-32 d to reach Mission.

Summer-run sockeye were radio-tagged during the latter 45% of the Summer-run migration through Johnstone Strait. Tagged fish moved by the Mission site during the period that the last 64% of the escapement passed Mission. Consequently, the movement and survival patterns of the radio-tagged Summer-run sockeye do not represent the entire Summer-run but may be representative of the mid-late components of these stocks (Fig. 4). The portion of the Late-run sockeye migration that overlapped with the radio-tagged fish was higher than that for Summer-run stocks. Late-run sockeye were radio-tagged slightly before and after the peak, and near the end of the migration period of that stock group. Tagged fish were distributed in the latter 68% of the Late-run migration through Johnstone Strait. Tagged fish then moved by the Mission site from 19 August to 19 September, coinciding with the latter 85% of the Late-run migration (Fig. 5).

The consistency in travel times for the Summer-run stocks resulted in chronological movement of each tag release timing group between the Johnstone Strait release sites and Mission (Fig. 4). The observed migration patterns for the radio-tagged fish was consistent with the daily abundance estimates derived from the marine test fisheries, and the Mission hydroacoustic site. In contrast, the river entry timing for Late-run stocks was very different from the release timing (Fig. 5). Radio tags were not applied to the first 32% of the Late-run return that arrived in coastal fishing areas, some of which were harvested prior to reaching the tagging site and others migrated passed the tagging site in Johnstone Strait before tagging began on 11 August. Many of these latter fish migrated passed Mission prior to 19 August. The abundance estimates from Mission hydroacoustic system suggest that most of the Late-run stocks entered the Fraser in two periods during 2003. The first group passed Mission from 19 August to 3 September along with the end of the Summer-run migration. This group included tagged fish from all release periods. The second pulse passed Mission from 10-15 September and also included tagged fish from each of the release periods. In 2003, roughly equal numbers of Late-run fish passed Mission in August and September. This pattern differed from that observed in 2002, when 79% of the escapement of Late-run fish passed Mission in September (60% from 11-20 September). The daily migration of tagged Late-run sockeye at Mission did not track the total escapement of Late-run sockeye as well as during 2002. The most likely explanation for these results were: 1) radio tags were not applied to the first 32% of the Late-run migration, and 2) less mixing time in Georgia Strait for many Late-run fish, especially those that entered the river with little or no delay. In 2002, tagging began on 3 August after only 10-15% have migrated passed the tagging sites and most of the tagged Late-run fish delayed for 15-33 d in lower Georgia Strait and entered the Fraser River after 11 September 2002 with large numbers of untagged sockeye.

In 2003, the median date for radio-tagged Late-run sockeye detected at the Mission site was 3 September, (3 September for Shuswap, 7 September for Weaver). These median dates were about 6-8 d later than those based on the daily hydroacoustic escapement estimates from Mission weighted by DNA stock composition estimates (28 August for Shuswap, 31 August for Weaver), resulting from a lack of tagging on the first third of the run.

Delay behaviour of Late-run sockeye

The amount of time that Late-run sockeye hold in Georgia Strait before entering the Fraser River is not known with certainty because radio-tagged fish cannot be tracked in saltwater. Crude estimates of holding (or delay) periods are based on differences in travel times from Johnstone Strait to Mission between Summer-run and Late-run fish. For estimation purposes, Late-run fish are divided in two groups; those that entered the Fraser River with the Summer-run fish (termed early-entry group), and those that entered after the Summer-run fish (late-entry group). For purposes of simplification, it is assumed that early-entry fish took $\leq$15 d to reach Mission, while late-entry fish took >15 d (based on Fig. 3). To estimate holding periods, it is assumed that: (i) Summer-run and early-entry Late-run fish migrate through marine waters and enter the Fraser River with negligible delays; (ii) the effect of capture and handling on the behaviour of radio-tagged fish was similar for all tagged fish; and (iii) differences in travel times between the early-entry and late-entry groups of Late-run fish indicate holding periods in Georgia Strait. All radio-tagged fish recaptured or detected in the lower Fraser River were used to estimate the holding periods of late-entry fish, which ranged from 10-20 d, with later release

groups showing increasingly shorter holding periods (Table 8). The portion of each release group that entered the Fraser River without delay was relatively high for the 1st release group (77%) and decreased as the season progressed (62% and 57% for the last two release groups).

Effects of bio-sampling on marine survival

A prevailing hypothesis at the onset of this study was that physiological sampling of sockeye tagged at sea might induce substantial stress that would make them more susceptible to dying after release. To assess this hypothesis, the numbers of radio tags released from Johnstone Strait were cross-tabulated into the numbers that survived to Mission (yes, no) for each run type (late, early) and physiological sampling category (yes, no). A log-linear analysis of this 2x2x2 contingency table (245 records) was done to test for interactions between the response variable (alive/dead) and the two design variables (or factors, namely sample category and run type). Chi-square values indicated that neither factor had significant effect on survival ($P>0.65$, $P>0.27$ respectively), nor did the interaction of both factors. Cooke et al. (2004) provides a more detailed assessment of the non-invasive sampling techniques used in 2003 and concluded that there were no statistically significant differences between the fish tagged without physiological sampling an those tagged and physiological sampled. Consequently, further analyses of marine and in-river survival patterns were conducted using all radio-tagged fish, without making further distinction based on their bio-sampling history.

In-river migration rates

Radio-tagged sockeye from each timing group exhibited median movement rates that were similar across release groups (Table 7). Movement rates of Summer-run fish between Mission and Thompson Junction were similar to those observed in 2002, or about 34-37 km/d across release groups. As in 2002, Summer-run sockeye moved faster than Late-run sockeye (17-24 km/d). Above Thompson Junction, Summer-run sockeye moved upstream 36-48 km/d, compared to 13-24 km/d for Late-run stocks migrating through the river and lake environments in the Thompson drainage.

Examination of detailed tracking data for Summer-run sockeye showed they maintained their chronological order as they moved up the Fraser, with those detected early at Mission arriving earlier at the Chilcotin and Quesnel junctions. Late-run sockeye detected early at Mission also tended to arrive earlier at the upper sites along the Thompson River stations.

In-river survival by release timing group

Summer-run sockeye were classified as surviving to a spawning area if they were detected in the Chilcotin River, Quesnel River, or the Quesnel Junction either by fixed stations or during mobile surveys conducted further upstream (Fig. 1). All Late-run sockeye from marine releases that were detected on the upstream antenna of the Adams River station, mobile tracked on the Eagle or lower Shuswap river, or detected in Little River or to the Shuswap Lake shoreline during the spawning periods were classified as spawners. Three marine-tagged fish last tracked at the Little River station before spawning period, and five tags detected on the downstream antenna at Adams River but never detected on the upstream antenna at this site,

were classified as pre-spawn mortalities. Mobile tracking was conducted in these Late-run spawning areas, and about 28,000 sockeye were examined during the dead pitch operations.

Preliminary estimates of survival from Mission to the spawning grounds (including tags removed by fisheries) were different for Late-run and Early-run fish. Since the fishing pressure was not equal for each release group, the effect of the fisheries above Mission must be removed before comparing the survival rates between the release groups. After removing the estimated tag recoveries for each release group, the fishery-independent survival estimates were 77% and 63% for Summer-run and Late-run stocks, respectively. The lowest survival in 2003 was for Summer-run fish tagged during the 1st release period (69%), while the highest was for Summer-run stocks tagged during the 2nd release period (86%, Table 9). The survival of Late-run sockeye increased slightly for each subsequent release period, ranging from 48% to 69%. One should note that each release group included Late-run sockeye that entered the Fraser after variable delays (0-4 weeks) near the mouth of the Fraser River, which highlights the need to also partition in-river survival by river entry timing group (i.e., Mission passage dates).

In-river survival by Mission timing group

Three timing groups were defined for Late-run passage at Mission (18-31 August, 1-10 September, 11-20 September). Radio-tagged Summer-run sockeye were detected at Mission during the first two periods, so in-river survivals were also estimated for these groups. As in 2002, in-river survivals for Summer-run stocks were substantially higher than those of Late-run stocks migrating at the same time (Table 10). Survival of Late-run stocks in the two groups that passed Mission before 11 September 2003 (41% and 55%) were substantially lower than for the group that passed after this date (92%).

Mission acoustic abundance estimates were combined with these period-specific survival estimates to calculate an overall abundance-weighted estimate of in-river survival for Summer-run and Late-run fish, which were 76% and 58%, respectively (Table 10). These estimates may not be representative of the overall in-river survival of either stock assemblage because tags were not applied to the first half of the Summer-run return and first 35% of the Late-run return migrating through Johnstone Strait.

Survival rates for in-river releases

Radio tags were applied in-river to augment the information obtained from marine releases. In-river tagging efforts focused on the early portion of the Late-run entering the lower Thompson River to hopefully applying some tags to Late-run stocks that migrated passed Mission before 19 August 2003. While these efforts were hampered by the low abundance of sockeye in the lower Thompson River, and the presence of early Summer-run stocks, 47 radio tags were applied to sockeye caught near Nicomen from 25-29 August. DNA and tracking data suggests that 25 of these were likely destined for Late-run spawning areas. Of these, only seven (28%) were tracked to spawning grounds, five were last tracked at or below Ashcroft, and 13 were last tracked upstream of Kamloops (11 at Little River) prior to the spawning period. While tagging and handling effects may have reduced the survival of these freshwater releases, most tagged fish moved considerable distances upstream after tagging, and had survivals not unlike

those observed for the early entry Late-run fish that arrived in the Thompson River in late August in 2002. In contrast, 19 of the 31 sockeye radio-tagged and released into the lower Thompson River between 5 September and 1 October 2003 were last detected at or below the Nicomen tagging site. The failure of these fish to migrate upstream from the release site may be due to their greater susceptibility to tagging and handling effects than those released in August. If so, the resulting tracking observations are probably not representative of unmarked sockeye that migrated through the Thompson River in September 2003.

Comparison of survival estimates for Weaver and Shuswap stocks

A detailed examination of the tracking data for the radio-tagged sockeye assigned to the two major Late-run stocks revealed substantial differences in their survival from Mission to spawning areas. While in-river survival was >90% for stocks that passed by Mission after 7 September 2003, tagged fish from each stock that entered earlier had very different survival rates (Table 11). The survival for Weaver stock that passed Mission prior to 7 September was only 27%, much lower than that of co-migrating Late-run Shuswap sockeye (50%). Overall survival for the portion of these stocks represented by the radio-tagged fish was 61% for Weaver sockeye, and 65% for Shuswap sockeye. These figures are reduced to 54% and 61%, respectively, after weighting them for period-specific abundance levels, and assuming that Late-run sockeye passing by Mission before 19 August 2003 had survivals of 10% and 30% for Weaver and Shuswap stocks, respectively (Table 12).

River entry timing versus survival of Late-run sockeye

A comparative analysis of the relation between Mission timing and survival of Late-run sockeye was conducted using the 2002 and 2003 data sets, after exclusion of the fishery removals in both years (as in Fig. 6). Survival estimates (± 2 SD) were computed for seven consecutive Mission river-entry timing periods in 2002, and five periods in 2003, with each 5 d stratum containing at least 10 Late-run tags. English et al. (2003) showed that two different curve shapes fit the temporal trend of increasing in-river survival with later river entry timing. The two curve types fit to the 2002 data were: 1) sigmoid curve; and 2) a "cut-off" or Michaelis-Menton curve. Sigmoid curves are "S" shaped curves where survival rates asymptote as they approach 0% and 100% but remain between these values over the range of possible river entry dates. Cut-off curves are curves with an X-intercept that defines the date when survival is estimated to be nil for all fish that enter the river on or before that date.

Additional fitting of survival curves was conducted after the completion of the study report for the 2002 sockeye run. In these analyses, we used the family of curves and procedures developed by Schnute and Richards (1990) for modeling survivorship data. We found that similar likelihood estimates were derived for each of the six curve shapes. The two curves with the best fit included one sigmoid curve and one cut-off curve. There was no statistical difference between these curves (Fig. 7). The cut-off curve with the best fit, as defined through the Schnute and Richards (1990) approach, was essentially identical to the Michaelis-Menten (MM) curve described in English et al. (2003) (Fig. 8).

The above analyses were repeated using the survival estimates for the Late-run sockeye that entered the Fraser River during the five periods between 19 August and 20 September 2003. The survival estimates for the three river entry periods before 5 September 2003 were all notably lower than those estimated for similar periods in 2002 (Fig.7). Consequently, all the curves fit to the 2003 data were shifted down and right of the 2002 survival curves. As in 2002, both sigmoid and cut-off curves fit the data equally well. Given these results, we tested the fit of the 2002 MM curve where only the X-intercept was free to change. The best fit to the 2003 data was derived from a curve with an X-intercept of 20 August 2003 (six days later than the curve fit to the 2002 data) (Fig. 8). The equation for the MM curves that provided the best fit to the 2002 and 2003 data was:

$$S_d = 1.17685 * (d - d_o) / (d - d_o + 9.7792)$$

where S_d is the estimated survival from Mission to spawning areas for fish that passed Mission on day d, d_o is the day associated with the X-intercept (survival = 0) and both d and d_o are measured from 1 August (i.e. if the X-intercept is 20 August, $d_o = 20$).

The X-intercept estimated from the 2003 data was consistent with the observation that none of the Late-run sockeye that migrated passed Mission prior to 24 August 2003 were tracked to known spawning areas during the spawning period (Fig. 6). These fish were last tracked along the migration route or in holding areas close to known Late-run spawning streams (e.g. lower Harrison Lake and Shuswap Lake).

Fish size versus survival

The sizes of sockeye tagged and released were statistically compared to determine if those that survived from the release site to Mission differed from those that died at sea. Mann-Whitney tests revealed no significant differences between the mean fork lengths of survivors and non-survivors, both for Summer-run and Late-run stocks ($P>0.1$ and $P>0.29$, respectively). The same tests revealed no significant difference between the mean fork lengths of tagged fish that survived the migration from Mission to the spawning grounds and those that died along the way, again for both Summer-run and Late-run stocks ($P>0.69$ and $P>0.46$, respectively). Such results were somewhat expected since the mean fork lengths of the fish in each category never differed by more than 0.5 cm. The results differ slightly from those observed in 2002, where survivors reaching Mission tended to be significantly larger than non-survivors for both run types. However, no significant difference in size was detected in 2002 between survivors and non-survivors beyond Mission for both run types.

DISCUSSION

River entry timing

The river entry timing for Summer-run sockeye was very consistent with historical timing data for the Chilko stock for which timing information is available for most years since 1974 (Fig. 9). In 2003, 50% of the Summer-run fish had passed Mission by 15 August which was

slightly later than the median date of 13 August for 1974-2002. The Mission timing for Late-run stocks varied more than for Summer-run stocks. In 2003, the median dates for Adams and Weaver stocks (28 and 31 August, respectively) were earlier than observed in the previous sub-dominant cycle year (1999) and in 2002, and substantially earlier than the historical median dates. Prior to 1995, the median Mission timing date was 24 September for Adams-Shuswap Late-run stocks, and 4 October for the Weaver Creek stock. From 1995-2002, the run timing for Weaver sockeye varied considerably (range 13 August - 16 September), with earlier median dates than observed during 1974-95. The abundance of the Adams River stock fluctuates with a persistent 4-year cycle (dominant, sub-dominant, low, low). The Adams River timing in the dominant and sub-dominant cycle years has been similar to that of the Weaver stock. Unfortunately, due to the low abundance of Adams River stock in off-cycle years, no reliable estimate of Mission timing exist in the historical data set available. In two recent years (2000-01) the Weaver stock had the earliest river entry timing observed (Fig. 9). In these years, the Late-run Weaver stock passed Mission at about the same time as the Summer-run Chilko stock, and managers estimated that >90% of the Weaver stock that passed Mission died prior to spawning in both years (Jim Gable, PSC, pers. comm.).

Delay behaviour

Radio-tagged sockeye data from 2002 and 2003 were used to determine the delay periods of individual fish from different segments of the Late-run stocks. In previous years, this delay period was computed from the median migration dates through the Juan de Fuca Strait and the Mission hydroacoustic site. The difference was considered as the median travel time estimate from Area 20 to Mission. Prior to 1995, the median of these annual travel time estimates were 38 d and 50 d for Shuswap and Weaver creek stocks, respectively. Over 1995-2002, the travel time estimates for both stocks were decreased to 30 d and 34 d, respectively. In 2003, travel time estimates were reduced to 13 d and 16 d respectively. However, the radio-telemetry data have shown that delay behaviour can vary substantially between individual fish and timing components. Some of the Late-run sockeye tagged in early August took less than 10 d to migrate from Area 13 or Area 20 to Mission. These fish must have entered the river with little or no delay, but other fish tagged during the same period took >40 d to cover this distance. The telemetry data provided evidence that the delay behaviour of Late-run sockeye was much more complex in 2002 and 2003 than suggested by simple comparison of median dates for the run passing Area 13 and Area 20 and the Mission hydroacoustic site. The complete tracking histories of radio-tagged fish detected at Mission have provided data to link the delay behaviour with the survival of Late-run sockeye (see below). In addition, these data can be used to identify and evaluate alternative hypotheses for the year-to-year variability in delay behaviour and the in-river survival observed in recent years.

In-river migration rates

Historical data on travel times from the PSC hydroacoustic site at Mission and daily counts of the escapement into Quesnel Lake were used to compute the average annual in-river migration rate for Summer-run stocks. Comparison of the 50% passage dates at Mission and Likely (near the outlet of Quesnel Lake) produced annual travel times of 14-19 d (mean 15.8 d) for the available data for 1993-2001. This is equivalent to a migration speed of 41.5 km/d and

13.2 d between Mission and the Quesnel Junction. These estimates are similar to those derived from the 80 radio-tagged Summer-run fish detected at the Mission and Quesnel Junction monitoring sites in 2002 (43 km/d and 12.7 d) and 47 Summer-run fish tracked at the sites in 2003 (40 km/d and 14 d). Similar quality historical data is not available for Late-run stocks migrating to the Shuswap Lake watershed, but some fishery managers observed that Late-run sockeye tend to migrate slower than Summer-run sockeye. Estimates from tagging studies in the 1940's showed a travel rate between Hell's Gate and the Adams River of 27 km/d (Killick 1955). In 2002 and 2003, migration speed between the Thompson Junction and Little River was 22 km/d.

In both study years, the migration rate for Late-run fish was slower than for Summer-run fish through the same section of river. In 2002, elapsed travel times between Mission and the Thompson Junction was 4.8 d for Summer-run fish (38 km/d) compared to 9.2 d for Late-run sockeye (20 km/d). In 2003, elapsed travel times between Mission and the Thompson Junction was 5.2 d for Summer-run fish (35 km/d) versus 8.6 d for Late-run fish (21 km/d).

Indicator of survival in marine waters

The vast majority of the radio tags accounted for were detected at fixed-station sites or removed by fisheries in the lower Fraser River; therefore, the portion of each release group accounted for provides an indicator of survival in coastal marine waters. These survival rates account for capture, handling and tagging effects as well as natural mortality. The bright orange cinch tags applied to all radio-tagged sockeye in 2002 were not applied in 2003 to ensure that the radio-tagged fish were not more visible to predators than untagged sockeye. This combined with higher abundance during the 1st release period could explain the higher marine survival for these releases (46%) than those released during the 1st release period in 2002 (35%). However, marine survival rates for the 2nd and 3rd release periods (66-68%), while higher than the 1st period, were lower than the rates estimated for similar periods in 2002 (74-75%) when sockeye abundances in Johnstone Strait were substantially higher than those observed in 2003. It was hypothesized in 2002 that the differences between the estimates for each release period may be induced by the relative changes in total sockeye abundance. While a portion of the observed differences both within and between years may be attributable to changes in sockeye abundance, the results from the releases of acoustic tags suggest that other factors may be equally important.

A total of 178 acoustic tags were implanted in sockeye during the 2nd and 3rd release periods in Johnstone Strait and 144 (81%) of these releases were detected by a V2 Vemco hydrophone receiver located near the Mission hydroacoustic site (D. Welch, DFO, pers. comm.). The only differences between the acoustic-tagged and radio-tagged sockeye were: 1) the radio tags have an antenna; and 2) all acoustic-tagged sockeye were immediately released after tagging (see *Material and Methods*). Generally, we would not anticipate that these are relatively small differences between the tags and handling techniques could result in the observed 14% difference in post-release tag retention/survival. However, the tagging crew did record higher instances of tag regurgitation in 2003 than in 2002. On one occasion a member of the tagging crew observed a tag regurgitation event when the radio tag antenna became entangled with another fish in the holding tank. Concerns were raised by the tagging crew that the piece of spaghetti tag attached to each antenna, to provide an external tag number, may have contributed

to the increase in the regurgitation rate. In addition, the radio-tagged sockeye were held for 20-30 min after tagging in recovery tanks with the hope that this would increase their post-release survival. The limited space in the recovery tanks resulted in the acoustic-tagged sockeye being released immediately after tagging. While studies have shown that recovery tanks can improve survival for fish captured using gillnet gear, other studies have documented higher relative survival for radio-tagged fish released immediately after tagging than those for fish held or transported in recovery tanks (Alexander et al. 1996).

Survival from Mission to spawning areas

The radio-tagged Late-run sockeye that passed Mission in late-August had a much lower probability of survival to their spawning areas than those that passed Mission after the first week in September. These results are consistent with the 2002 study findings and earlier observations of higher pre-spawn mortality when a large portion of the Late-run sockeye entered the Fraser River in August (e.g. Late-run returns in 2000 and 2001).

English et al. (2003) suggested that changes in environmental factors could affect spawning timing and/or the development of the mortality agent, thus shifting the curve to the left or right. It was hypothesized that higher water temperatures could increase the rate of development of the mortality agent (such as a parasite) thus decreasing survival (i.e. shifting the curve to the right). Fraser River water temperature data were obtained for the period when Late-run sockeye were migrating upstream in 2002 and 2003 (i.e. 10 August through 30 September). These data showed that 2003 water temperatures measured on the Fraser River near Hope and on the Thompson River near Chase were only slightly higher than those measured in 2002 for the same Late-run migration period. However, more important water temperatures may be those for the Harrison River, Harrison Lake and Shuswap Lake where the early-entry Late-run sockeye are known to reside for extended periods prior to spawning. Unfortunately, water temperature data were not available for these locations (Dave Patterson, DFO, pers. comm.). Other research has shown that water temperature is a key determinant of survival for Late-run sockeye infected with *Parvicapsula* (Simon Jones, DFO, pers. comm.). Given these findings we recommend that temperature data recorders be deployed in Shuswap Lake and the lower Harrison River to collect data from early August through late October each year, and a study be undertaken to identify the locations and depths where Late-run sockeye are holding in Harrison Lake prior to spawning in 2004. A similar study of sockeye holding areas in Shuswap Lake should be conducted during the next dominant cycle year for this stock (i.e. 2006).

The radio-telemetry data collected in 2002 and 2003 suggest that river entry time is related to subsequent in-river survival of Late-run sockeye. While further investigations are required to increase our confidence in this relation and explain observed variability in survival between stocks (e.g. Shuswap versus Weaver), the available observations should be considered when formulating fishery management plans. The survival curves derived from the 2002 study were used in 2003 to provide in-season predictions of in-river survival for Late-run sockeye. The in-season prediction on 19 September 2003, when 98% of the Late-run sockeye had passed Mission, was that the in-river survival rate (excluding fishery removals) would be 63% for Late-

run stocks. This estimate was similar to the PSC estimate of 60% derived by comparing the final split-beam Mission hydroacoustic estimate, less in-river harvests, with the DFO spawning ground escapement estimates for Late-run stocks.

As noted in 2002, future studies should focus on finding "why some Late-run fish enter the Fraser River early and others delay for extended periods in Georgia Strait?" The river entry timing observed in 2003 for Late-run sockeye provides further support for the hypothesis that the early entry behaviour may be related to the schooling behaviour of sockeye and the degree of overlap in the run timing and abundance of Summer-run and Late-run stocks. In 2003, Summer-run stocks were consistently more abundant than the Late-run stocks, and the portion of the Late-run that entered with little or no delay in lower Georgia Strait was higher for each release group than that observed in 2002. About 64% of all Late-run sockeye tagged in 2003 migrated through coastal waters and directly into the Fraser River during periods when large schools of Summer-run sockeye were entering the Fraser River. The early entry component varied from 77% for the 1st release group to 57% for the 3rd release group. Data from the Mission hydroacoustic site and troll test fisheries in lower Georgia Strait indicate the estimated daily abundance of Summer-run stocks arriving in lower Georgia Strait was consistently higher than that for Late-run stocks. Consequently, there was little or no accumulation of Late-run fish off the mouth of the Fraser until late August when the peak of the Late-run arrived in lower Georgia Strait (J. Cave, PSC, pers. comm.).

If early entry of Late-run fish is influenced by the relative abundance and timing overlap with Summer-run stocks, we would expect that the potential for early entry and lower in-river survival would be greatest in years like 2004 and 2005 when the Late-run stocks are expected to be much smaller than Summer-run stocks, and there will likely be almost complete overlap in the marine migration timing of both run types. Consequently, the implications of early river entry and lower in-river survival for Late-run stocks should be explicitly addressed when preparing fishing plans for the 2004 and 2005 Fraser sockeye fisheries.

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TABLES

Table 1. Summary of the 2003 tag releases by type, sample category, period and location.

Juan de Fuca Strait (radio-tags)							
Tagging	Non-physio			Physio			
date	early	mid	late	early	mid	late	Total
27-Jul	26			26			**52**

Johnstone Strait (radio-tags)							
Tagging	Non Physio			Physio			
date	early	mid	late	early	mid	late	Total
11-Aug				39			39
12-Aug				52			52
13-Aug				63			63
14-Aug				62			62
15-Aug				82			82
19-Aug		7			8		15
20-Aug		31			30		61
21-Aug		22			22		44
22-Aug		16			16		32
26-Aug			20			20	40
27-Aug			20			21	41
28-Aug			14			14	28
		76	**54**	**298**	**76**	**55**	**559**

Johnstone Strait (acoustic-tags)							
Tagging	Non Physio			Physio			
date	early	mid	late	early	mid	late	Total
20-Aug		3			4		7
21-Aug		29			28		57
22-Aug		20			19		39
26-Aug			19			21	40
27-Aug			17			18	35
		52	**36**		**51**	**39**	**178**

Table 2. Confirmed recoveries by tagging session and recovery location for the Johnstone Strait radio tags released in 2003.

	Tagging Session			
	First	Second	Third	Total
Tags applied	298	152	109	559
Reported fishery recoveries				
Marine				
Canada	4	0	0	4
US	0	0	0	0
Fraser River Below Mission				
First Nations Fishery	3	0	0	3
Recreational Fishery	2	0	0	2
Fraser River Above Mission				
First Nations Fishery	6	5	2	13
Recreational Fishery	7	1	0	8
Sub-total	22	6	2	30
Estimated fishery recoveries				
Marine				
Canada	8	0	0	8
US	0	0	0	0
Fraser River Below Mission				
First Nations Fishery	5	1	0	6
Recreational Fishery*	2	0	0	2
Fraser River Above Mission				
First Nations Fishery	11	6	2	19
Recreational Fishery*	7	1	0	8
Sub-total	33	8	2	43
Detections at or above Mission	122	103	72	297
Tags accounted for	137	104	72	313
% of tags applied	46%	68%	66%	56%

* Recoveries in recreational fisheries were not expanded because the number of reported tag recoveries was higher than would be estimated for the reported recreational catch

Table 3. Predicted in-river catches, harvest rates and total returns to the Fraser River of radio-tagged sockeye from Johnstone Strait. Regions below Mission (BM) and above Mission (AM). Label HR denotes the harvest rates in fisheries below Mission (BM HR), supplied by the PSC. Harvest rates in fisheries above Mission (AM HR) estimated in this study using daily catch and escapement figures supplied by the PSC.

	Escapement			BM	BM Catch			Total return			AM	AM Catch		
Date	early	mid	late	HR	early	mid	late	early	mid	late	HR	early	mid	late
8/15/2003	1			0.0012	0.0	0.0	0.0	1.0	0.0	0.0	0.1510	0.2	0.0	0.0
8/16/2003				0.0690	0.0	0.0	0.0	0.0	0.0	0.0	0.0890	0.0	0.0	0.0
8/17/2003				0.2788	0.0	0.0	0.0	0.0	0.0	0.0	0.0530	0.0	0.0	0.0
8/18/2003	5			0.1926	1.2	0.0	0.0	6.2	0.0	0.0	0.0400	0.2	0.0	0.0
8/19/2003	20			0.0024	0.0	0.0	0.0	20.0	0.0	0.0	0.0550	1.1	0.0	0.0
8/20/2003	24			0.0021	0.1	0.0	0.0	24.1	0.0	0.0	0.1090	2.6	0.0	0.0
8/21/2003	26			0.0017	0.0	0.0	0.0	26.0	0.0	0.0	0.1430	3.7	0.0	0.0
8/22/2003	12			0.0015	0.0	0.0	0.0	12.0	0.0	0.0	0.1350	1.6	0.0	0.0
8/23/2003	8			0.0477	0.4	0.0	0.0	8.4	0.0	0.0	0.0870	0.7	0.0	0.0
8/24/2003	6			0.2881	2.4	0.0	0.0	8.4	0.0	0.0	0.0540	0.3	0.0	0.0
8/25/2003	5	3		0.1066	0.6	0.4	0.0	5.6	3.4	0.0	0.0338	0.2	0.1	0.0
8/26/2003	3	16		0.0020	0.0	0.0	0.0	3.0	16.0	0.0	0.0357	0.1	0.6	0.0
8/27/2003	2	13		0.0029	0.0	0.0	0.0	2.0	13.0	0.0	0.0537	0.1	0.7	0.0
8/28/2003	2	11		0.0034	0.0	0.0	0.0	2.0	11.0	0.0	0.1172	0.2	1.3	0.0
8/29/2003	1	9		0.0028	0.0	0.0	0.0	1.0	9.0	0.0	0.1578	0.2	1.4	0.0
8/30/2003		9		0.0146	0.0	0.1	0.0	0.0	9.1	0.0	0.1141	0.0	1.0	0.0
8/31/2003		3	1	0.1081	0.0	0.4	0.1	0.0	3.4	1.1	0.0522	0.0	0.2	0.1
9/1/2003		3	10	0.0026	0.0	0.0	0.0	0.0	3.0	10.0	0.0264	0.0	0.1	0.3
9/2/2003		6	16	0.0014	0.0	0.0	0.0	0.0	6.0	16.0	0.0286	0.0	0.2	0.5
9/3/2003		6	14	0.0016	0.0	0.0	0.0	0.0	6.0	14.0	0.0321	0.0	0.2	0.4
9/4/2003		2	2	0.0017	0.0	0.0	0.0	0.0	2.0	2.0	0.0385	0.0	0.1	0.1
9/5/2003		1	3	0.0011	0.0	0.0	0.0	0.0	1.0	3.0	0.0563	0.0	0.1	0.2
9/6/2003		1	1	0.0011	0.0	0.0	0.0	0.0	1.0	1.0	0.0593	0.0	0.1	0.1
9/7/2003		1	3	0.0010	0.0	0.0	0.0	0.0	1.0	3.0	0.0537	0.0	0.1	0.2
9/8/2003		1	3	0.0057	0.0	0.0	0.0	0.0	1.0	3.0	0.0404	0.0	0.0	0.1
9/9/2003		1	2	0.0011	0.0	0.0	0.0	0.0	1.0	2.0	0.0307	0.0	0.0	0.1
9/10/2003	2	1	2	0.0017	0.0	0.0	0.0	2.0	1.0	2.0	0.0227	0.0	0.0	0.0
9/11/2003		3	1	0.0014	0.0	0.0	0.0	0.0	3.0	1.0	0.0177	0.0	0.1	0.0
9/12/2003			2	0.0018	0.0	0.0	0.0	0.0	0.0	2.0	0.0131	0.0	0.0	0.0
9/13/2003	2	3	2	0.0014	0.0	0.0	0.0	2.0	3.0	2.0	0.0070	0.0	0.0	0.0
9/14/2003	3	5	8	0.0014	0.0	0.0	0.0	3.0	5.0	8.0	0.0033	0.0	0.0	0.0
9/15/2003		4	2	0.0011	0.0	0.0	0.0	0.0	4.0	2.0	0.0042	0.0	0.0	0.0
9/20/2003		1		0.0011	0.0	0.0	0.0	0.0	1.0	0.0	0.0060	0.0	0.0	0.0
Total	122	103	72		4.8	1.0	0.2	126.8	104.0	72.2		11.3	6.2	2.0
# Reported					3	0	0					6	5	2
% Reported							49%							67%

Table 4. Total detections of radio-tagged sockeye from marine releases, and detection efficiencies for each fixed-station site in the Fraser River watershed. Frequencies in the 'Never Detected' category represents tagged fish not detected previously but captured and reported by fishermen above the lower detection site(s).

Fixed-station sites	Never Detected	First Detection	Total Detected	Total Passed	Detection Efficiency
Mission		262	262	297	88.2%
Recovery between Mission and Harrison Junction	1				
Harrison at Fraser Confluence		15	139	279	49.8%
Below Harrison Lake			40	40	100.0%
Hope		17	221	225	98.2%
Canyon - Below Hells Gate		2	173	203	85.2%
Canyon - Above Hells Gate			167	201	83.1%
Fraser - Thompson Confluence			192	194	99.0%
Thompson River					
Ashcroft			63	66	95.5%
North Thompson			3	3	100.0%
Above Kamloops Lake			61	62	98.4%
Little River			59	61	96.7%
Adams River			53	53	100.0%
Chilcotin River Junction			108	108	100.0%
Chilko River Junction			49	49	100.0%
Quesnel River Junction			49	49	100.0%
Total		296	296	297	

Table 5. DNA classification accuracy for major Fraser sockeye stock groups assessed using radio-telemetry data.

	DNA Stock Assignments				
	Early Summer	Stellako/L. Stuart	Chilko/Quesnel	Late Run	Total
Radio-Tags Tracked					
Early Summer	3				3
Stellako/L. Stuart		18	2		20
Chilko/Quesnel		1	78	5	84
Late Run			3	93	96
Total	3	19	83	98	203
Percentages					
Early Summer	100.0%	0.0%	0.0%	0.0%	
Stellako/L. Stuart	0.0%	94.7%	2.4%	0.0%	
Chilko/Quesnel	0.0%	5.3%	94.0%	5.1%	
Late Run	0.0%	0.0%	3.6%	94.9%	
Total	100.0%	100.0%	100.0%	100.0%	

Table 6. Stock origins for radio-tagged sockeye released in marine areas derived from tracking data for all fish detected in known stock areas and DNA analysis for all other releases.

	Johnstone Strait			
Stock Group	1st	2nd	3rd	Total
Stock unknown	2	2		4
Early Summer-run				
Bowron	6	2		8
Nahatlatch	1			1
Upper Pitt	2	1	1	4
North Thompson	5	1		6
Early South Thompson	10	2		12
Seton Anderson	1			1
Summer-run				
Chilcotin	98	39	29	166
Stellako/L. Stuart	34	5	1	40
Quesnel	66	16	14	96
Late-run				
Harrison	2	1		3
Late Shuswap/Portage	45	55	32	132
Weaver	14	16	23	53
Other				
Birkenhead	12	12	9	33
Stock Timing Groups (No.)				
Stock unknown	2	2	0	4
Early Summer-run	25	6	1	32
Summer-run	198	60	44	302
Late-run	61	72	55	188
Other	12	12	9	33
	298	152	109	559
Total				
Stock Timing Groups (%)				
Stock unknown	1%	1%	0%	1%
Early Summer-run	8%	4%	1%	6%
Summer-run	66%	39%	40%	54%
Late-run	20%	47%	50%	34%
Other	4%	8%	8%	6%
	100%	100%	100%	100%
Total				

Table 7. Comparison of median travel times and migration speeds for Summer-run and Late-run sockeye by radio tag group for the Johnstone Strait releases in 2003. Marine travel speeds for Late-run sockeye are minimum estimates due to delays in lower Georgia Strait.

	Summer-run Releases				Late-run Releases[1]				Distances
Statistic/from-to	1st	2nd	3rd	Total	1st	2nd	3rd	Total	km
Median travel time (d)									
Johnstone Strait - Mission	6.7	6.7	5.9	6.4	9.6	12.8	11.5	11.6	
Mission - Hope	2.0	1.9	2.1	2.0	3.0	4.0	5.1	3.8	
Mission - Hell's Gate	3.5	3.4	3.4	3.5	5.5	6.7	8.2	6.7	
Mission - Thompson Junction	5.3	4.9	5.0	5.2	7.5	8.4	10.6	8.6	
Mission - Chilcotin Junction	10.7	9.5	9.6	10.2	0.0	0.0	0.0	0.0	
Mission - Quesnel Junction	14.5	12.9	12.4	13.6	0.0	0.0	0.0	0.0	
Thompson Junction to Ashcroft	0.0	0.0	0.0	0.0	3.3	2.9	2.7	3.0	
Thompson Junction to Kamloops	0.0	0.0	0.0	0.0	12.4	8.0	7.8	8.2	
Thompson Junction to Little R.	0.0	0.0	0.0	0.0	14.7	9.2	9.0	9.8	
Thompson Junction to Chilcotin R. Junct.	5.5	4.5	4.7	5.0	0.0	0.0	0.0	0.0	
Thompson Junction to Quesnel R. Junct.	8.9	7.6	7.6	8.2	0.0	0.0	0.0	0.0	
Travel speed (km/d)									
Johnstone Strait - Mission	42	42	48	44	29	22	25	24	282
Mission - Hope	40	41	38	40	27	20	16	21	80
Mission - Hell's Gate	36	37	37	36	23	19	15	19	126
Mission - Thompson Junction	34	37	36	35	24	22	17	21	181
Mission - Chilcotin Junction	36	41	40	38					386
Mission - Quesnel Junction	37	42	44	40					544
Thompson Junction to Ashcroft					20	23	24	23	67
Thompson Junction to Kamloops					13	20	21	20	163
Thompson Junction to Little R.					15	24	24	22	219
Thompson Junction to Chilcotin R. Junct.	37	45	44	41					205
Thompson Junction to Quesnel R. Junct.	41	48	48	44					363
Sample Size									
Johnstone Strait - Mission	87	38	31	156	30	52	35	117	
Mission - Hope	76	34	30	140	21	34	19	74	
Mission - Hell's Gate	55	30	28	113	13	24	19	56	
Mission - Thompson Junction	61	32	27	120	19	32	17	68	
Mission - Chilcotin Junction	51	30	25	106	0	0	0	0	
Mission - Quesnel Junction	25	14	8	47	0	0	0	0	
Thompson Junction to Ashcroft	0	0	0	0	15	31	15	61	
Thompson Junction to Kamloops	0	0	0	0	16	27	15	58	
Thompson Junction to Little R.	0	0	0	0	16	27	14	57	
Thompson Junction to Chilcotin R. Junct.	51	30	25	106	0	0	0	0	
Thompson Junction to Quesnel R. Junct.	25	14	8	47	0	0	0	0	

[1] marine travel speeds for Late-run sockeye are underestimated due to delays in lower Georgia Strait.

Table 8. Estimates of median travel times to Mission and holding periods in Georgia Strait for Late-run sockeye, by entry timing group and release period. Early-entry and late-entry stocks respectively entered the Fraser River with or after the Summer-run stocks.

	Early Entry			Late Entry			Delay (d)		
	1st	2nd	3rd	1st	2nd	3rd	1st	2nd	3rd
Median travel time (d)									
Johnstone Strait - Mission	8.3	10.5	7.5	28.6	23.8	17.4	20.3	13.3	9.9
Sample Size							% Early Entry		
Johnstone Strait - Mission	23	32	20	7	20	15	77%	62%	57%

Table 9. Last detection site and survival estimates of radio-tagged sockeye that passed Mission, by run type and release timing group. All figures include fishery removals above Mission. Numbers tracked to spawning grounds do not include 3 Late-run fish tracked to Little River before the spawning period, and 5 fish detected on the Adams River (but not on its upstream antennas), and one Portage Creek fish. Summer-run figures do not include fish from stocks above the Quesnel River.

	Summer-run Release Groups				Late-run Release Groups			
Location	1st	2nd	3rd	Total	1st	2nd	3rd	Total
Mission	5	2	1	8	2	5	1	8
Harrison at Fraser Confluence	3			3	3	2	1	6
Harrison River								
Weaver Creek					1	5	8	14
Below Harrison Lake						1	3	4
Harrison Lake					1	4	2	7
Hope	9	1	2	12	2	2	1	5
Canyon - Below Hells Gate	1	2		3				0
Canyon - Above Hells Gate	3	1	1	5			1	1
Fraser - Thompson Confluence	7	2	2	11	1	1	2	4
Thompson River								
Spences Bridge								
Ashcroft						2		2
North Thompson						2		2
Above Kamloops Lake							1	1
Little River					3		1	4
Lake Shuswap at the outlet						1		1
Adams River					14	26	13	53
Eagle River								0
Lower Shuswap						1	1	2
Portage Creek					1			1
Chilcotin River Junction	2	1	1	4				
Chilcotin River	1	3	1	5				
Chilko River	23	12	15	50				
Quesnel River Junction	1	0	0	1				
Quesnel River	2	2	7	11				
Horsefly River	8	7		15				
Total	65	33	30	128	28	52	35	115
Above Mission Fisheries	14	5	2	21	3	2	0	5
Net Escapement	51	28	28	107	25	50	35	110
Tracked to spawning grounds	35	24	23	82	12	33	24	69
% Survival to spawning areas								
Estimate	68.6%	85.7%	82.1%	76.6%	48.0%	66.0%	68.6%	62.7%
SD	6.6%	6.7%	7.4%	4.1%	10.2%	6.8%	8.0%	4.6%

Table 10. Last detection site and survival estimates of radio-tagged sockeye that passed Mission, by run type and Mission timing group. All figures include fishery removals above Mission. Numbers tracked to spawning grounds do not include 3 Late-run fish tracked to Little River before the spawning period, and 5 fish detected on the Adams River (but not on its upstream antennas), and one Portage Creek fish. Summer-run figures do not include fish from stocks above the Quesnel River.

	Summer-run at Mission				Late-run at Mission			
Location	1st	2nd	3rd	Total	1st	2nd	3rd	Tota
Mission	7	1		8	5	3		
Harrison at Fraser Confluence	3			3	3	3		
Harrison River								
Weaver Creek					2	4	8	14
Below Harrison Lake						3	1	
Harrison Lake					4	3		
Hope	9	3		12	2	3		
Canyon - Below Hells Gate	3			3				
Canyon - Above Hells Gate	4	1		5		1		
Fraser - Thompson Confluence	9	2		11	1	2	1	
Thompson River								
Spences Bridge								
Ashcroft					1		1	
North Thompson					1	1		
Above Kamloops Lake							1	
Little River					3	1		
Lake Shuswap at the outlet						1		
Adams River					16	13	24	53
Eagle River								
Lower Shuswap						2		
Portage Creek					1			
Chilcotin River Junction	3	1		4				
Chilcotin River	4	1		5				
Chilko River	34	16		50				
Quesnel River Junction	1			1				
Quesnel River	5	6		11				
Horsefly River	15			15				
Total	97	31		128	39	40	36	115
Above Mission Fisheries	19	2		21	5	0	0	
Net Escapement	78	29		107	34	40	36	110
Tracked to spawning areas	59	23		82	14	22	33	69
% Survival to spawning areas								
Estimate	75.6%	79.3%		76.6%	41.2%	55.0%	91.7%	62.7%
SD	4.9%	7.7%		4.1%	8.6%	8.0%	4.7%	4.6%
Mission escapement (x1000)	1418	70		1488	385	107	207	700
Survivors to spawning areas	1072	56		1128	159	59	190	407
% Survival (weighted by Mission escapement)				75.8%				58.2%

Table 11. Survival estimates for radio-tagged late-run sockeye destined for the Shuswap and Weaver Creek watersheds by Mission passage periods. Weaver stock includes fish from Weaver and Harrison River stocks. Shuswap stock includes fish from Adams R., Little R., lower Shuswap R., Eagle R, and Shuswap Lake.

	On or Before Sep. 7			After Sep. 7			All		
	Shuswap	Weaver	Total	Shuswap	Weaver	Total	Shuswap	Weaver	Total
Fishery removals	5	0	5			0	5	0	5
Enroute Mortalities	25	11	36	3	0	3	28	11	39
Spawners	25	4	29	27	13	40	52	17	69
Total	50	15	65	30	13	43	80	28	108
Survival Rate	50.0%	26.7%	44.6%	90.0%	100.0%	93.0%	65.0%	60.7%	63.9%
SD	7.1%	11.8%	6.2%	5.6%	0.0%	3.9%	5.4%	9.4%	4.6%

Table 12. Numbers of sockeye destined for the Shuswap and Weaver Creek watersheds by Mission passage period, number of spawners by area, and survival estimates based on alternative hypotheses for the survival of fish that passed Mission before 19 August 2003.

	Total at Mission			Number Surviving			Survival Estimates		
	Shuswap	Weaver	Total	Shuswap	Weaver	Total	Shuswap	Weaver	Total
Assuming 0% survival for fish that passed Mission before 19 Aug 2003									
Before 19 Aug	63,789	22,095	85,884	0	0	0	0.0%	0.0%	0.0%
19 Aug- 7 Sep	243,873	116,077	359,950	121,937	30,954	152,890	50.0%	26.7%	42.5%
After 7 Sep	164,063	90,981	255,043	147,656	90,981	238,637	90.0%	100.0%	93.6%
Weighted Mean	471,725	229,152	700,877	269,593	121,934	391,527	57.2%	53.2%	55.9%
Assuming 10-30% survival for fish that passed Mission before 19 Aug 2003									
Before 19 Aug	63,789	22,095	85,884	19,137	2,209	21,346	30.0%	10.0%	24.9%
19 Aug- 7 Sep	243,873	116,077	359,950	121,937	30,954	152,890	50.0%	26.7%	42.5%
After 7 Sep	164,063	90,981	255,043	147,656	90,981	238,637	90.0%	100.0%	93.6%
Weighted Mean	471,725	229,152	700,877	288,730	124,144	412,874	61.2%	54.2%	58.9%

FIGURES

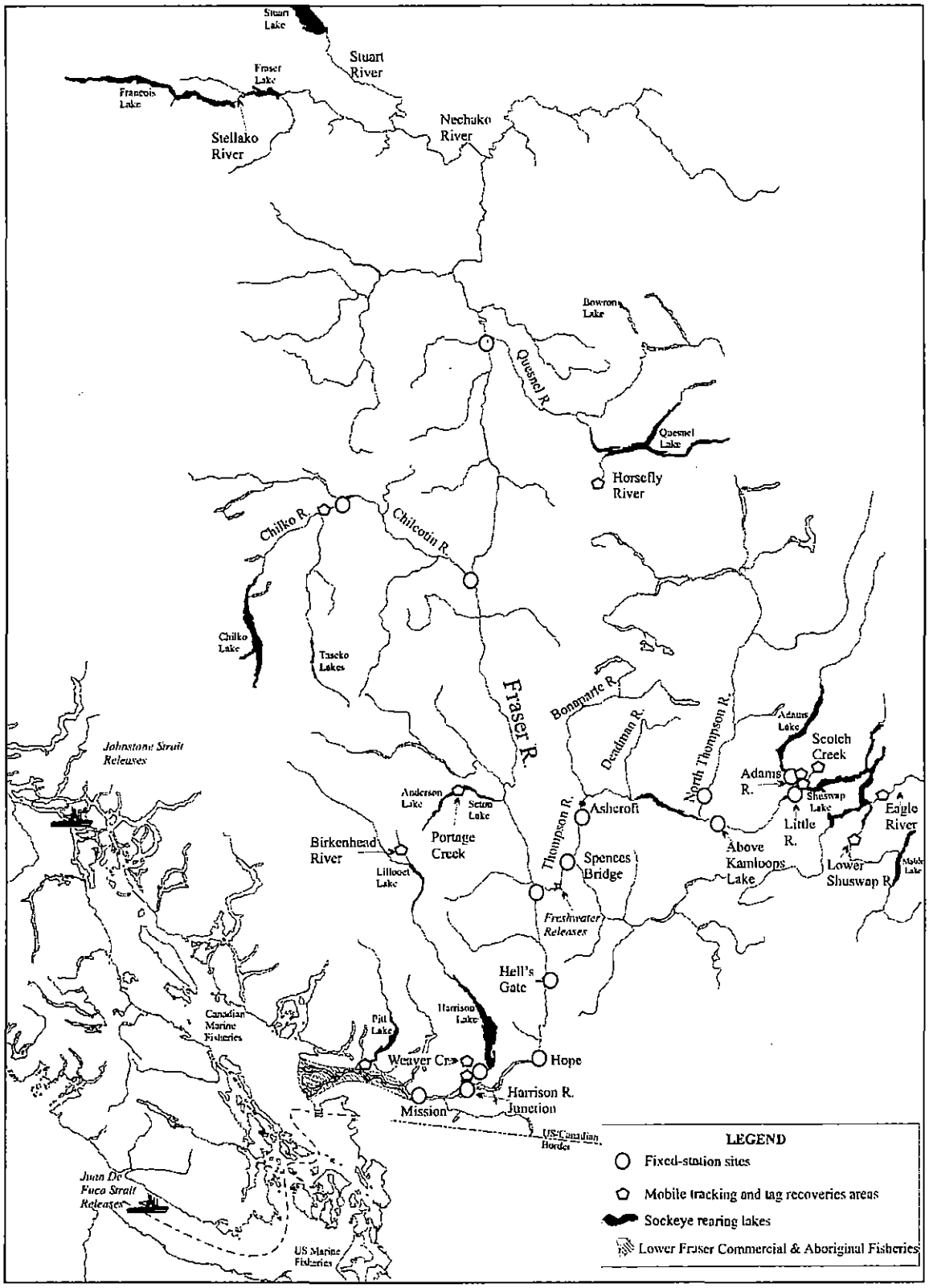

Figure 1. Location of release sites, fixed-station sites, mobile tracking areas and tag recovery areas for the 2003 sockeye radio-telemetry study.

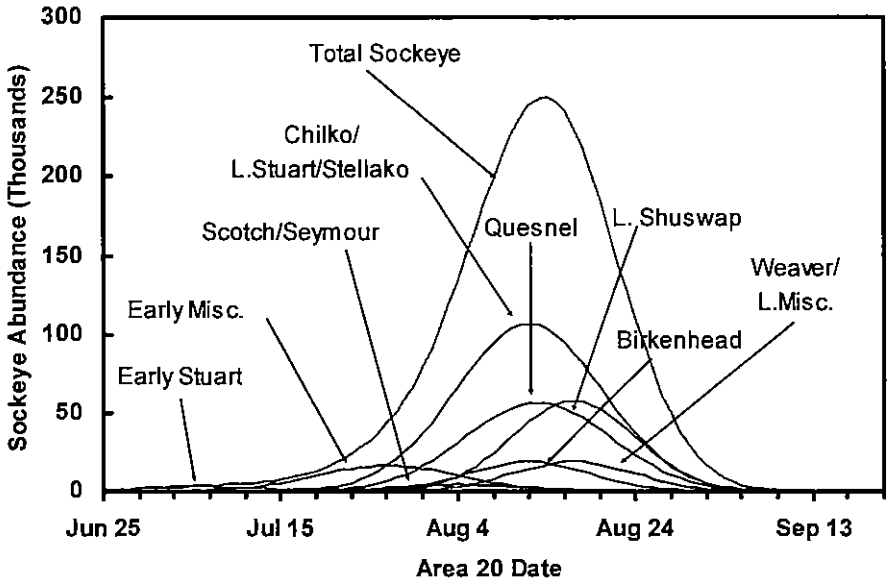

Figure 2. Pre-season run-timing curves for Fraser sockeye stock groups based on average historical timing and the 2003 abundance forecasts (J. Cave, PSC, pers. comm.).

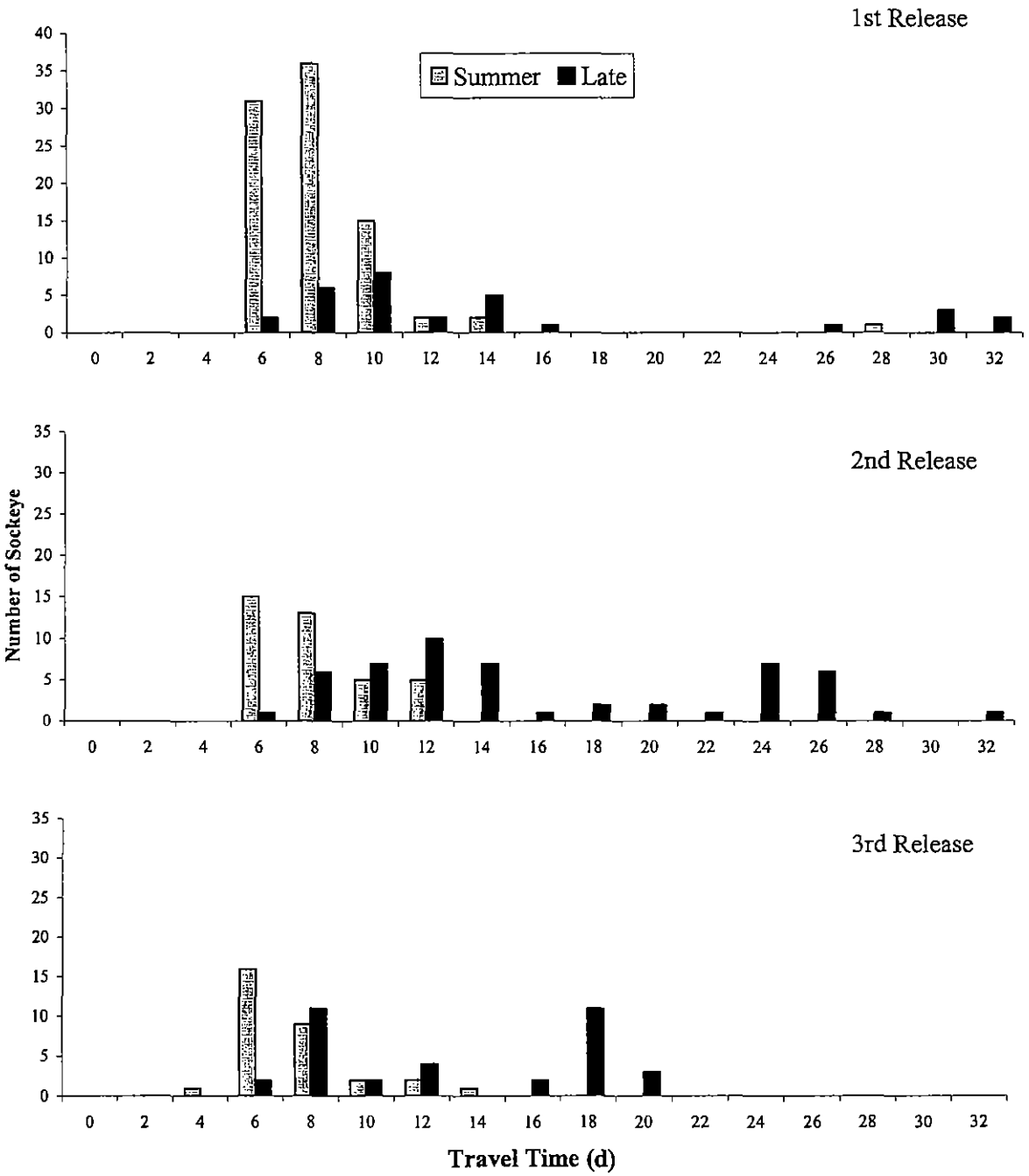

Figure 3. Distribution of travel times from the Johnstone Strait tagging sites to the Mission hydroacoustic site for radio-tagged Summer-run and Late-run sockeye, by release timing group, 2003.

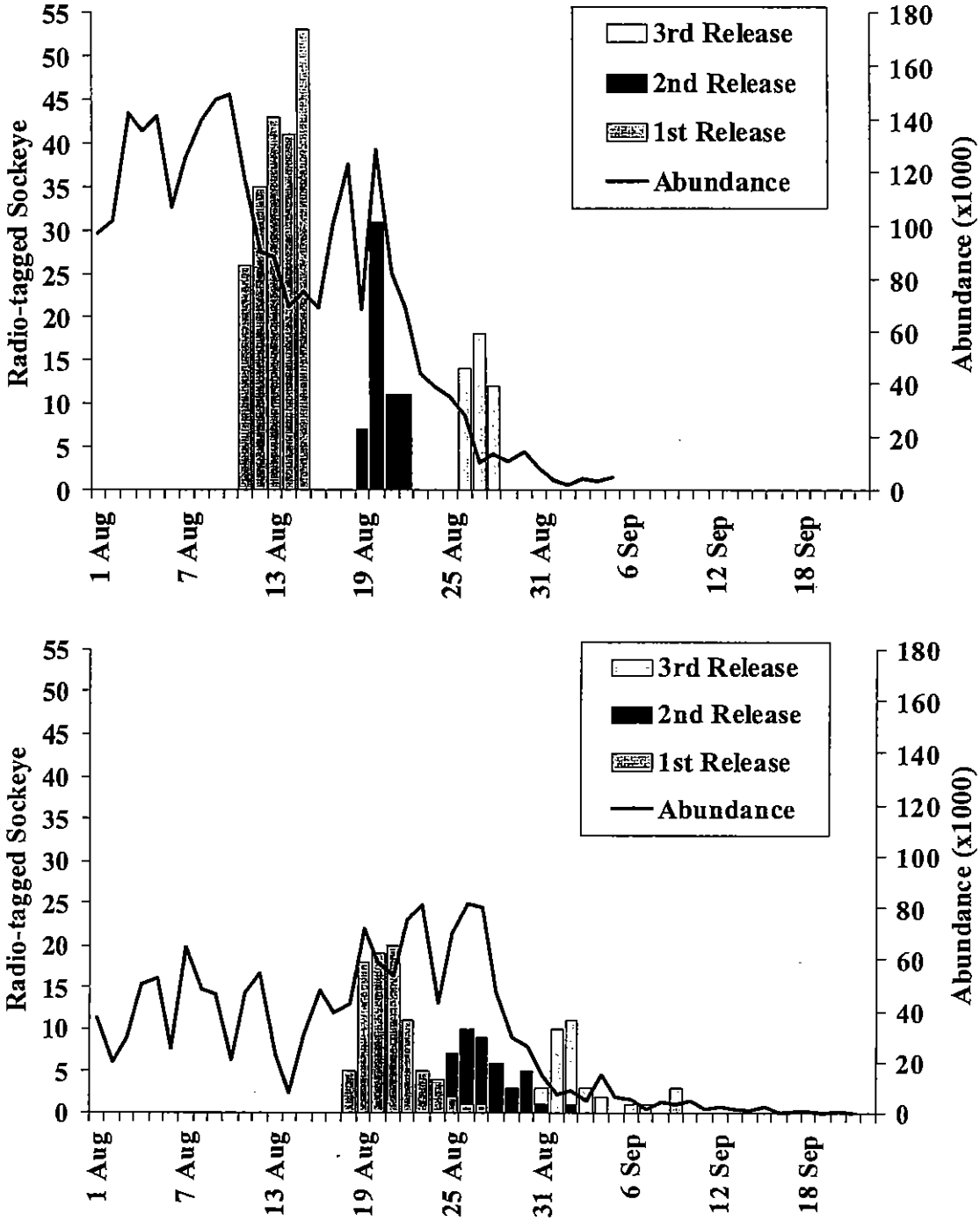

Figure 4. Radio tag releases and estimated daily abundance of Summer-run sockeye entering coastal areas (pre-fishing abundance) referenced to the Johnstone Strait tagging sites (top). Corresponding tag detections and estimated daily post-fishing abundance at the Mission hydroacoustic site (bottom).

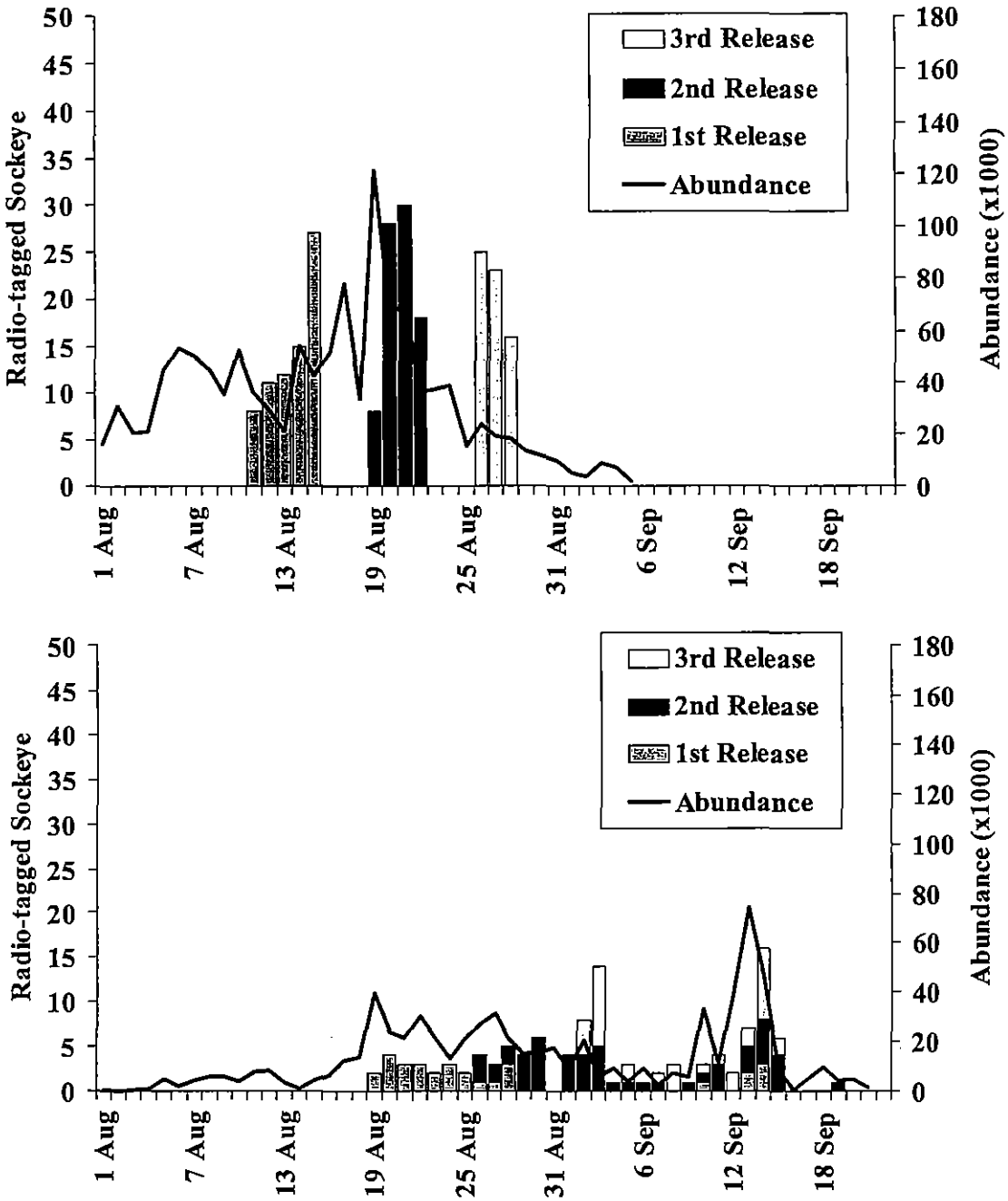

Figure 5. Radio tag releases and estimated abundances for Late-run sockeye. Tag release and abundance at marine tagging sites (top). Corresponding tag detections and abundance at the Mission hydroacoustic site (bottom).

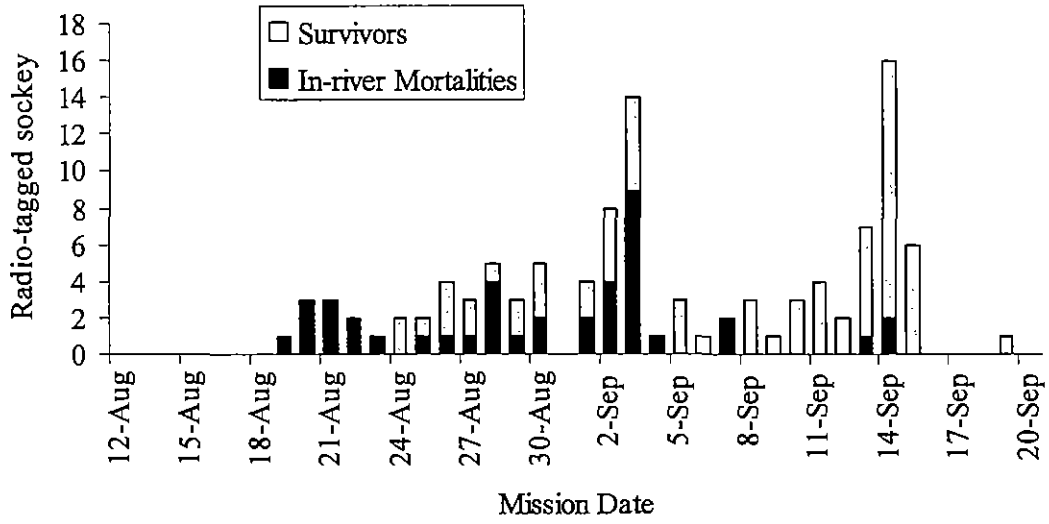

Figure 6. Fate of the radio-tagged Late-run sockeye detected at Mission and above, excluding fishery removals.

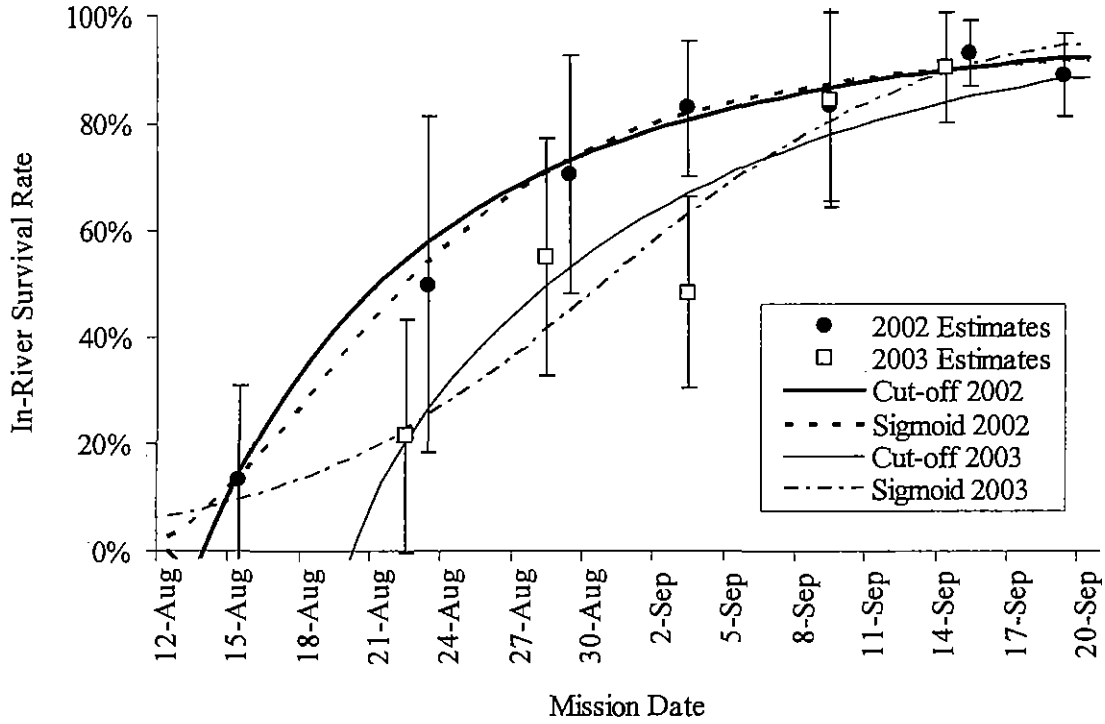

Figure 7. Mission passage time versus in-river survival of Late-run sockeye, excluding fishery removals for 2002 and 2003. Survival rates are for consecutive 5 d migration periods passed the Mission hydroacoustic site. The trends shown correspond to that of the fitting model proposed by Schnute and Richards (1990).

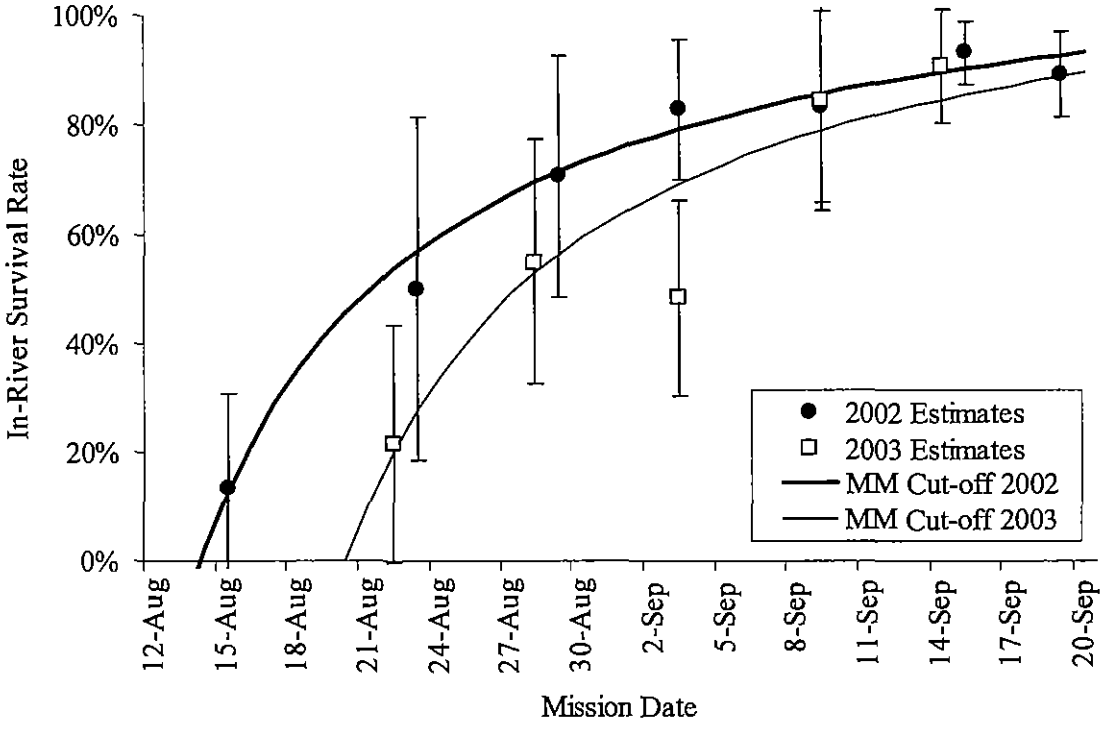

Figure 8. The two Michaelis-Menten (MM) cut-off curves fit to the 2002 and 2003 survival estimates, where the equation defining the curve only differs in the value that defines the X-intercept.

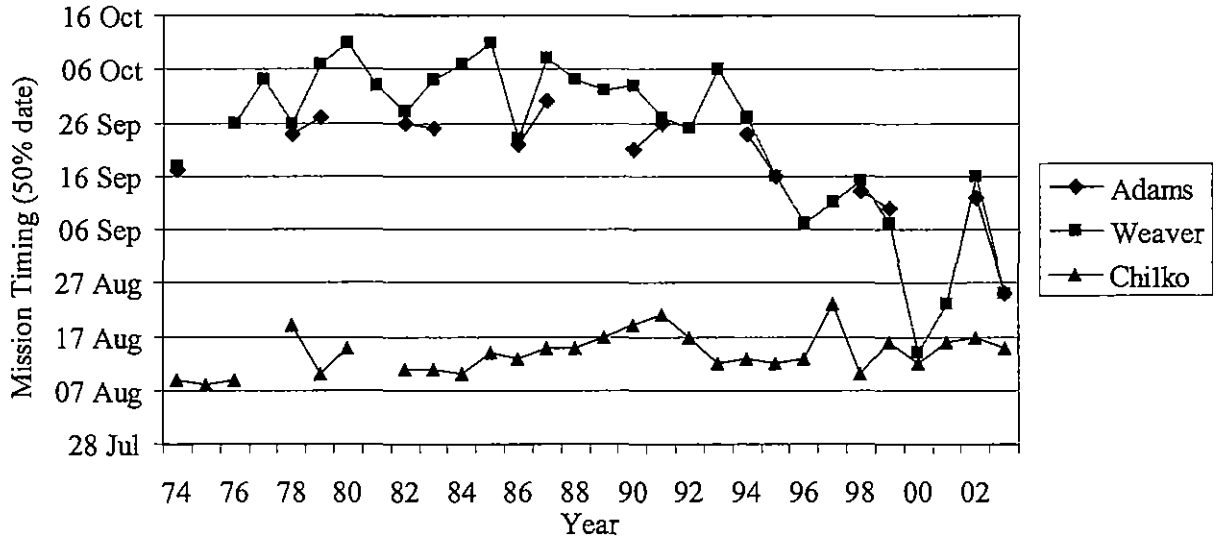

Figure 9. Annual estimates of the median date for the migration of Adams, Weaver and Chilko stocks at the Mission hydroacoustic site, 1974-2003.

APPENDICES

APPENDIX A

Appendix A: Description of fixed station sites and mobile tracking effort

Sixteen fixed-station receivers were set-up at 15 sites in 2003 to monitor radio-tagged sockeye moving up the Fraser River (Fig. 1). The 2002 stations that were not used in 2003 included; Barnston Island, Seton River, and lower Shushwap. The Spences Bridge site was used for only two weeks during the in-river tagging, and the Ashcroft station was 1 km downstream from its 2002 location. New stations for 2003 included the North Thompson site at Kamloops, and the Chilko River site. Sockeye processed at three packing plants in Vancouver were also monitored periodically to detect tags. Fixed-station receiver numbers, identities, and locations for 2003 are presented in Table A1.

With the exception of the Chilko River junction and the Spences Bridge sites, all fixed-stations along the Fraser River were tested and operational before radio-tagged sockeye were released. The Spences Bridge site was a temporary site installed during late August to monitor fish tagged 15 km downstream. Tributary fixed station sites were located in the lower reach of Little River and the Adams River.

Fixed-stations usually had two to three directional antennas (usually "Yagi" models) secured to the tree stem or aluminum pole >10 m above ground, a peripheral unit to switch between antennas, a Lotek model SRX_400 receiver, a 12V deep cycle battery to power it, a waterproof metal enclosure to house the receiver, and a co-axial cable joining the antennas to the switcher unit (attached to port connectors in the enclosure). Several stations had solar panels and a voltage regulator to keep the batteries charged. The Mission South, Hell's Gate and South Thompson sites were the only stations powered by an AC source. Koski et al. (1993) describe the operations of the antenna switching units and the antenna orientations used to determine presence and movement of radio-tagged fish, along with the detection probabilities. Maintenance of the receiver sites included checking the 12V battery power levels, and downloading data from the receiver using a portable laptop computer.

Differentiation of directionality was tested when the stations were set. Following the basic set up procedure (antennas raised, cables connected to the receiver, etc.), an active radio tag was attached to a weighted rope, and lowered to a depth of 5-10 m in the river. Hand-held devices were then used to test the signal reception and signal strength of the each radio tag at different positions and depths. Typically, testing was conducted in the center channel from a position starting 500-700 m upstream of the station to a point approximately 500-700 m downstream of the station. Gain settings used at the stations described below refer to the power of the antenna, the higher the gain the further away a tag can be detected. During testing of the stations, the gain was set so that tags would be picked up at the farthest distance possible, but the gain was low enough to prevent background noise from interfering with tag detection.

Receiver stations along the mainstem of the Fraser River (not at a tributary junction) had two antennas to detect signals from upstream and downstream locations. Stations at the confluence of a tributary had three antennas to detect signals from upstream, downstream, and

from radio-tagged fish heading up the tributary. Station set-up and antenna position were identical in the stations used in 2002 unless otherwise noted.

Driving directions, receiver settings and operational details.

Directions for the receiver sites are described going upstream along the Fraser River.

Canadian Fisheries Company: This plant is located in downtown Vancouver at the foot of Gore road. From Highway 1 west take the Hastings Street exit into downtown and turn right onto Main Street. Continue to the end of the road as it curves left to reach a stop sign. Turn left at the stop sign and the plant is on the left. To get to the receiver site, follow the walkway on the left side of the plant to the back, and go right at the end of the building. The single antenna was mounted about 5 m up above a large sliding door and the receiver was inside the door on a large metal table.

Ocean Fisheries Plant: From the Canadian Fisheries Company, head back to Main Street, turn right on West 12th, then left on Oak Street and stay on until Highway 99. Follow it, then take the Steveston Highway exit before the Deas Tunnel. From here, turn left onto Number 5 Road, then left onto Rice Mill Road. The plant is at the end on the right. Walk to the far right, through the processing plant until you get behind the buildings, then turn left and you will see a set of stairs on your right. The single antenna was mounted at the top of the stairs, and the receiver was located behind the door to the left.

Bella Coola Fisheries Plant: From the Ocean Plant, take Rice Mill Road, turn right on No. 5 Road, and turn right onto the Steveston Highway, and then onto Highway 99 South. Follow 99 through the Deas Tunnel, and turn left at the next overpass onto River Road. Follow River Road almost to the end, and the plant is on the left before you get to the Pitt River Bridge. The single antenna was located inside the main gate on the right, just behind the main office.

Mission North Site (Receiver 1): Traveling west on the highway from Mission to Harrison, take the first driveway to the right downstream of the Tourist Information Booth. This leads to the BC Frozen Foods parking lot and factory. Park at the end of the lot closest to the road, and head up the trail crossing the railway track down to the river bank. The receiver is upstream of the pathway and is obvious from the river bank. There are two antennas mounted 20 m above the water in a large cottonwood tree. The first antenna scans downstream, and the other scans upstream. Both signals were amplified near the antenna with Grant systems amplifiers, powered at the receiver box via inserters.

This site was tested by placing the tag over the side of a boat at 2 m depth, and drifting from 500 m above the station to 500 m below the station. The test involved three transects including ¼, ½, and ¾ of the channel widths. Results indicated that at a gain of 75, the tag was easily detected on all transects. This station was located directly in front of frequent train traffic and occasional boat traffic, which was an issue of concern. Before this study, a noise analysis of background interference was done at this station, and it was determined that 75 was the optimal gain. By amplifying and balancing the antennas at

this site, the noise to signal ratio was improved, and the station ran efficiently during the study.

Mission South Site (Receiver 2): Traveling north on the Mission Abbotsford Highway, turn right on Harris Road, just before the Mission Bridge. Then left on Bell Road, then left on Page Road, and right on Sim Road. Head down to Kelleher Road and turn left. The test fishery site is at the end of this road on the left, and the cottonwood tree is straight in front of you. Setup consisted of two antennas mounted about 10 m above water. One antenna scanned downstream, and the other scanned upstream. The battery charger at this station was powered from the AC voltage source at the acoustic site.

This station was tested in the same manner as Mission North, with similar results in that the tag was detected easily at ¼, ½, and ¾ of the channel widths at a 2 m depth. Background noise from boat traffic was a slight concern at this site, but this station was able to operate efficiently at a relatively high gain (75) throughout the study with no major problems.

Harrison-Fraser Confluence Site (Receiver 3): Traveling west on Hwy #7 (Lougheed Highway), turn left on School Road just before the Harrison River Bridge. Turn left on Kilby Road, and when reaching the railway tracks, turn right and travel through the Skowlitz Reservation. When you reach a dyke, turn left and head to the gate. If the gate is locked, walk up the dyke about 250 m to reach the antenna located on the cottonwood tree nearest the water on the right hand side. Three antennas were mounted about 13 m above water. The first scanned downstream, the second scanned the Harrison River, and the third scanned upstream.

This station was tested in a similar manner to the Mission sites. The tag was placed at 2 m depth and drifted at ½ and ¾ of the channel width on the Fraser mainstem and Harrison River channel confluence. Results indicated good detections and good separation between Fraser and Harrison antennas. When the tag drifted down the Fraser mainstem, it was picked up strongly on the upstream and downstream Fraser antennas but very weakly or not at all on the Harrison antenna. Similarly, when the test was performed on the Harrison channel, the tag was picked up strongly on the Harrison antenna, weakly on the Fraser downstream antenna, and not at all on the Fraser upstream antenna. Tag position distinction was improved over last year by re-orienting the antennas. From the testing and initial background noise test, it was determined that a gain of 75 should be used for all antennas at this station to detect tags efficiently. This was a slight modification over the 2002 settings, when the Fraser antennas were run at a lower gain (68) than the Harrison antenna (75). The increased gain and re-orientation of the antennas at this station improved detection efficiency in 2003 by 50%, as compared to 29% in 2002. Background noise from motors of fishing boats still made detection of tags difficult, and may have compromised the efficiency of the this station slightly.

Below Harrison Lake Site (Receiver 4): The upper Harrison site is accessible by boat and is located on the east side of the river near the last cottages upstream of Weaver Creek and downstream of Harrison Lake. Traveling by boat, head up the Harrison. Just before

reaching an active logging area on the right bank, there is a house with a green tin roof on the same bank. The station is located across the river on the left bank near the boat wharf. Two antennas were mounted about 20 m above water in a large fir tree. The first antenna scanned downstream, and the second scanned upstream

This station was tested by boat from 500 m upstream to 500 m downstream with a tag at 2 m depth and transects ½ and ¾ of the channel width. Results indicated strong detections of the tag for both transects and good separation between the upstream and downstream antennas for tag position. From pre-season noise analysis and tag testing, it was determined that a gain of 75 was optimal for this site. There were no major background noise issues at this site and the receiver performed very efficiently. One issue of concern at this site was whether fish entering Weaver creek were detected by the downstream antenna at this station. Given the distance (2850 m) between the confluence of Weaver Creek and the station, it is not likely that tags here would have been picked up unless the fish traveled at least half the distance to the station before doubling back to enter Weaver Creek. The three fish detected at the mouth of Weaver Creek during a mobile survey near the end of September, were not recorded on the downstream antenna at this station.

Hope Site (Receiver 5): From Chilliwack, head east on Highway 1. Take exit 165, turn left over the highway and proceed east on Frontage Road past the Husky Station. Continue to the next intersection with Highway 1. Valley Helicopters is on the left. Turn left just past Valley Helicopters and continue on across the railroad tracks. At the fork, turn right. The access road to the station site is a small dirt/gravel trail between the trees just before the first building on the right. Follow the trail out to the bank above the river. There are two antennas mounted about 20 m above water in a spruce tree. The first antenna scanned downstream, and the second scanned upstream. This station was not powered by a solar panel, so the 12 volt batteries had to be changed every 10 d.

This station was tested from land by walking the tag approximately 200 m upstream and downstream of the site and placing the tag at 2 m depth along the edge of the riverbank. Results indicated strong detections and good separation between the downstream and upstream antennas. There were no background noise issues at this site, and the receiver performed efficiently at a gain of 75, throughout the study.

Hell's Gate Site – above and below (Receiver 6): Take the Tramway down to the lower tourist area. There are two sets of antennas at this site. The downstream array which monitored below Hell's Gate consisted of two antennas on a cliff about 25 m above water, directly under the walkway of the north bank. The antennas from the lower area were amplified, and the coax cable was linked to the upper site. To get to the upper site, you need several keys to get to the receiver, take the boardwalk to the left, go right through the locked gate at the north end of the suspension bridge and follow the road to the building the farthest upstream and along the river. The receiver is in an old garage on a table at the back. There were two antennas, combined on a 5 m conduit, positioned about 25 m above water, upstream of the garage used to monitor the upstream passage at Hell's Gate.

Testing of this site was performed by lowering a tag from the start of the left bank fishway to a depth of 2 m, which placed the tag slightly upstream of the downstream antennas. Results of the testing of the downstream array indicated good detection. To test the upstream array, a tag was placed at a 2 m depth off the edge of the upstream portion of the left bank fish ladder. The upstream array also showed good detection of the tag. There was also good separation between antenna detections, as the tag was detected very weakly by the downstream antenna and strongly by the upstream antenna when the tag was placed upstream and vice versa. Pre-season noise testing of the site indicated a major noise problem on channel 5, which was determined to be generated from the tram. The only way to overcome this problem was to eliminate channel 5 from the scan cycle and use channel 5 for the Thompson tagged fish. Once channel 5 was removed from the receiver, the station performed effectively with nearly 100% detection efficiency.

Fraser-Thompson Confluence Site (Receiver 7): Once in Lytton, head north towards Lilloett across the Thompson. About 2 km down that road, take the ferry to cross the Fraser. Then travel up the road and take the first main road to the left. Head south down the Fraser for about 2 km until you are across from the mouth of the Thompson River. The station is on your left, about 100 m from the road. The 3 antennas are visible from the road. They are mounted about 10 m up a large spruce tree on a steep bank, on the far side of the meadow, about 20 m above water. The first antenna scanned downstream, the second scanned the Thompson River, and the third scanned upstream. The GPS coordinates for this site are (50.23202° N; 121.58930° W).

To test this site we placed the tag at a depth of 2 m about 100 m upstream in the Thompson mainstem and 200 m upstream from the confluence in the Fraser mainstem. The antennas were re-oriented in 2003 to improve tag position detection between the Fraser and Thompson systems. Results showed good separation between antennas with stronger detection for the Thompson antenna when the tag was placed in the Thompson mainstem and weaker detection for the Thompson antenna when placed upstream in the Fraser mainstem. The same was true for the Fraser upstream antenna, the signal was much weaker when placed in the Thompson compared to the Fraser placement. The downstream Fraser antenna recorded the tag as well, but the signal was weaker than for the Thompson and upstream Fraser antenna for both placements. There were no apparent noise problems at this station and the receiver worked efficiently at a gain of 75.

Spence's Bridge Site (Receiver 17): Travel north from Spence's Bridge until you reach a pullout on the right about 1 km out of town. Directly across the river is the mouth of the Nicola River, and the train bridge. Park inside the pullout and look over the bank. There are 3 antennas mounted about 6 m up the tree on the cliff about 20 m above water. The first antenna scanned the downstream section of the Thompson River, the second scanned the Nicola River, and the third scanned the upstream section of Thompson. This was a temporary station installed to confirm passage of fish tagged in late august in the Thompson canyon about 15 km downstream.

Because this station was implemented when tagged fish were already traveling through the system, the testing involved visual observation of fish passing the station and adjustment of gain to maximize detection. It was not necessary to have clear distinction between the Thompson and Nicola antennas, since the main objective was to determine if tagged fish passed the station. Because of high background noise levels, the gain had to be lowered to 60 to detect tags efficiently. At this gain, visual inspection suggested that all antennas were coding tags effectively.

Ashcroft Site (Receiver 8): About 15 km south of Ashcroft on Highway #1 take the Basque Ranch Road south off of the highway. Take the first right and stay right until you come to a brown house. Park on the left near the house. There is a horse corral in front with horse shelters on the left. Walk towards the horse corral until you reach the end of the shelters on your left. Then turn right and walk to a large gate across an alfalfa field. Head left to the far corner of the field. Two antennas are mounted on a 5 m long piece of 2"x4", strapped to the corner fence post. This site was located on a cliff about 25 m above the water surface which was approximately 5 m lower and approximately 2 km downstream of the 2002 placement. The first antenna scanned the downstream section of the Thompson, and the second antenna scanned upstream.

Because of difficulty of access to the river at this site (25 m straight down a cliff), this site was tested by walking with a tag about 300 m downstream and 50 m upstream of the station (further access was not possible). This allowed a quick verification that both antennas were working. An additional in-season test was performed by visually observing the tags approaching and leaving the station. Visual inspections revealed that there were strong detections on both antennas and good seperation for tag position. There was a significant noise problem on channel 1 at this location due to background noise from train traffic. To overcome this noise problem the gain was lowered to 60 on both antennas. A test with a tag on channel 1 showed that signals were masked by the background noise occasionally but otherwise the station operated very efficiently with no major problems.

North Thompson Site (Receiver 16): From Highway 1 east in Kamloops, take the Columbia Street exit and turn onto Summit Drive. Follow this road down the hill, then take the exit for the north shore, and turn right onto Tranquille Road, that eventually turns into 8th Street. Turn right on Westsyde, then right onto Walkem, and at the end park beside the last house on the left. Walk through the gate on the side of the house. The antennas were mounted about 10 m up a large cottonwood tree in the back yard, with a box mounted on the back of the fence. The first antenna scanned the confluence of the North Thompson, and the second scanned upstream in the North Thompson.

Testing of this station involved walking the tag along the bank approximately 200 m downstream and 50 m upstream and placing at a depth of 2 m. Results indicated good detections on both antennas. This station had a similar noise problem to the Ashcroft site, in that the proximity to the train tracks generated a lot of noise on channel 1. To overcome this noise problem and still be able to code tags on channel 1, the gain had to be lowered to 63. A tag test using a channel 1 tag revealed that the tag was only masked

occasionally by background noise on this channel. Despite this small problem, this station operated very efficiently.

Above Kamloops Lake -Timber's House (Receiver 9): Timber Whitehouse (Tel: 250-851-4833 or 250-573-2743). Take Lafarge Road about 20 km east of Kamloops. Cross the river and turn right. Follow the road past the golf course and sod farm. There is a small shed and wood fence at the entrance to Timber's place. The receiver box is along the upstream side of the house and the antennas are on the balcony above the box. The first antenna scanned the downstream section of the South Thompson, and the second scanned the upstream section.

Testing of this station was performed by boat with the tag at a 2 m depth and transects at ½ and ¾ of the channel width. Results indicated good detections and separation between antennas. This station was also plagued by very acute noise on channel 1 from train traffic. Although the gain was set relatively low (63), background noise on channel 1 was quite significant and probably compromised the efficiency of this station slightly. A test with a channel 1 tag revealed that the signal was masked about half of the time which was much greater than the North Thompson or Ashcroft site.

Little River Site (Receiver 10): Take the exit to Scotch Creek/Adams and Lake'Quaaout Lodge off of Highway #1. Cross the bridge over Little River and take the first left past the bridge. Follow the road for 1.8 km and turn left onto a dirt road. Follow this road to the end keeping to the left. There is a wooden gate with the numbers 177 and 288. This is Frank's cottage. Go through the gate and to the edge of the river. Follow the path upriver to the station about 50 m to a large cottonwood tree. There are two antennas located about 10 m above water. The first antenna scanned downstream to the confluence of Little Shushwap Lake, and the second scanned the upstream section of Little River.

Tag testing at this site involved positioning it at a 2 m depth 100 m upstream and downstream of the station. Results indicated good detection and separation between the antennas. There were no noise problems at this station and the receiver operated efficiently at a gain of 65. Several fish remained near the station from mid September to mid October, and loaded the receiver memory banks. When a fish remains near a station for several days, the tag and code is usually filtered out so that the memory banks do not fill up. There was a worry that this receiver might filter out an excessive number of codes on the same channel, so the filters were removed until late October when the receiver was replaced with another that did not have a potential filtering problem.

Adams River Site (Receiver 11): Take the exit to Scotch Creek/Adams Lake/Quaaout Lodge off of Highway #1. Cross the bridge over Little River and continue straight on the main road to Scotch Creek for 6.2 km. There is a sign indicating the Cottonwood campsite. Turn right just before the sign. There is DFO log building on the right. Stay on the main road past the building and continue 0.6 km to a parking area. Take the trail to the left that initially parallels the lake. Turn right at the first intersection (left goes down to the lake), and right at the second (left goes down to the river below the station). At the next intersection, turn left. There is a creek on the left. Follow it for about 30 m until you

reach a large tree fallen across the creek. Cross the log, walk along the shore, then along a dry back slough. As you come out, there is a box and a solar panel. Continue down this path, past the tree until you reach the cottonwood trees (GPS coordinates are 50.89579° N; 119.55288° W). There are three antennas mounted about 13 m above water. The first antenna scanned downstream to the lake, the second scanned straight across toward the secondary right channel, and the third scanned upstream on the main channel.

Testing of this station involved placement of the tag at a 2 m depth about 200 m downstream, upstream and in front of the station. Results indicated good detection and separation of the antennas. Since the far channel had been tested in 2002 by boat, and the antennas were located in the same areas, it was assumed that the far channel antenna would pick up any fish in this area. There were no apparent noise problems at this site and the receiver performed efficiently at a gain of 65. Several fish tended to hold near the station which loaded the receiver banks at this site, so the data had to be downloaded frequently. Initially, data from fish that stayed near the station for several days were filtered out, but there was concern that the receiver would also block out tags on the same channel as the filter, so the filters were removed. Near the end of October, this receiver was replaced by with another receiver that did not have the apparent filtering problem.

Chilcotin River Junction Site (Receiver 14): From Williams Lake, head west on Highway 20 (toward Alexis Creek, Bella Coola). Cross the Fraser River ("Sheep Creek Bridge"), drive passed the Toosey IR, and turn left (south) on the "Big Creek - 2000 Road". There are signs to the Junction Wildlife Area. Drive south passed the entrance to Junction, proceed down the switchbacks, and cross the Chilcotin River (this is "Farwell Canyon"). There may be a dipnet fishery there. Proceed up the hill on the south side of the canyon. You need to turn left, but not on the first, small road which is rough, and not shown in the Recreational Atlas. Turn left at 27 ¾ km. That road is narrow with several shallow mud puddles. Stay left on this road at all major intersections, and stay on the well used path. It is the lowest elevation road paralleling the south side of the Chilcotin River on the main ridge. There are other roads above this one with similar directions, but this is the only one that goes to the Fraser River. Travel on this road for 14 km until you reach a T-junction. Turn left and go through the gate onto Ward Ranch. Keep left, and go downhill. The road is rough, and there is one place where a spring cuts across the road, and the banks are yellow-gold. You will reach a grassy flat with an old log cabin on the left. Drive passed the cabin 200 m and turn left (downhill). This area is about 2 km from the river. Park in a wide area on the right side of a curve about half way down (you can turn around here). Walk down to the flat in front of the Chilcotin-Fraser confluence. The station is in the last line of trees downstream of the Chilcotin. The station box is on one tree, and the solar panel is to the right. Three antennas are mounted in a large spruce tree, about 20 m above water. The first antenna scanned the downstream section of the Fraser mainstem, the second scanned the Chilcotin River, and the third scanned the upstream section of the Fraser.

Testing of this site involved placement of the tag in 1 m of water about 200 m downstream on the Fraser mainstem and 200 m upstream in the Chilcotin mainstem (further access was not possible). Tag detections were good for the downstream Fraser

antenna, weak for the Chilcotin antenna and weak for the upstream Fraser antenna when the tag was placed downstream in the Fraser mainstem. Similarly, detections for the Chilcotin antenna were strong, while the Fraser antennas were weak when the tag was placed in the Chilcotin mainstem, which was expected. Since there was no background noise at this station, this station could be operated at a very high gain (80), and the system ran very efficiently.

Quesnel River Junction Site (Receiver 15): Head north on the main highway into Quesnel. When coming down a hill before crossing the Quesnel River, take exit to the McDonalds, and travel south on Johnston Avenue. Travel through the roundabout, turn right on Carrie Street, and cross the railroad track. The station is on your right on the third big cottonwood tree. Identify yourself to Carolyn's parents in the trailer nearby. Three antennas are mounted about 10 m up a large cottonwood tree, some 15 m above water. The first antenna scanned the downstream section of the Fraser River mainstem, the second scanned the Quesnel River, and the third scanned upstream.

Testing of this station involved placement of the tag at a 2 m depth about 100 m upstream, downstream and in front of the station. Results indicated good tag detection for all antennas with the expected separation related to tag position. This station was also very quiet and ran efficiently at a gain of 75 for all antennas with no problems from background noise.

Chilko River (Receiver 20): From Williams Lake, travel west on Highway 20 for about 2.5 h to Tatla Lake. Before reaching the town, take the turnoff for Chilko Lake, and travel about 45 km toward Henry's Bridge. The turnoff for Lingfield Ranch is about 5 km south of the bridge on the left. Open a wooden gate and follow the main road for about 2 km to an old wooden bridge over Lingfield creek. Park here and walk across the old bridge toward some old cabins. Two antennas were mounted in a small tree about 6 m above water. The first antenna scanned the confluence of the Chilko River, and the second scanned upstream in the Chilko.

To test this site, a tag was placed at a 1 m depth, 100 m upstream and downstream of the site. Results indicated good detection on both antennas with the expected separation between antennas. There were no noise problems at this site when operated at a gain of 70, but the receiver experienced a problem, and data was lost for the period of Sep. 25 to Oct. 3.

Appendix A: Noise to signal profiles by station

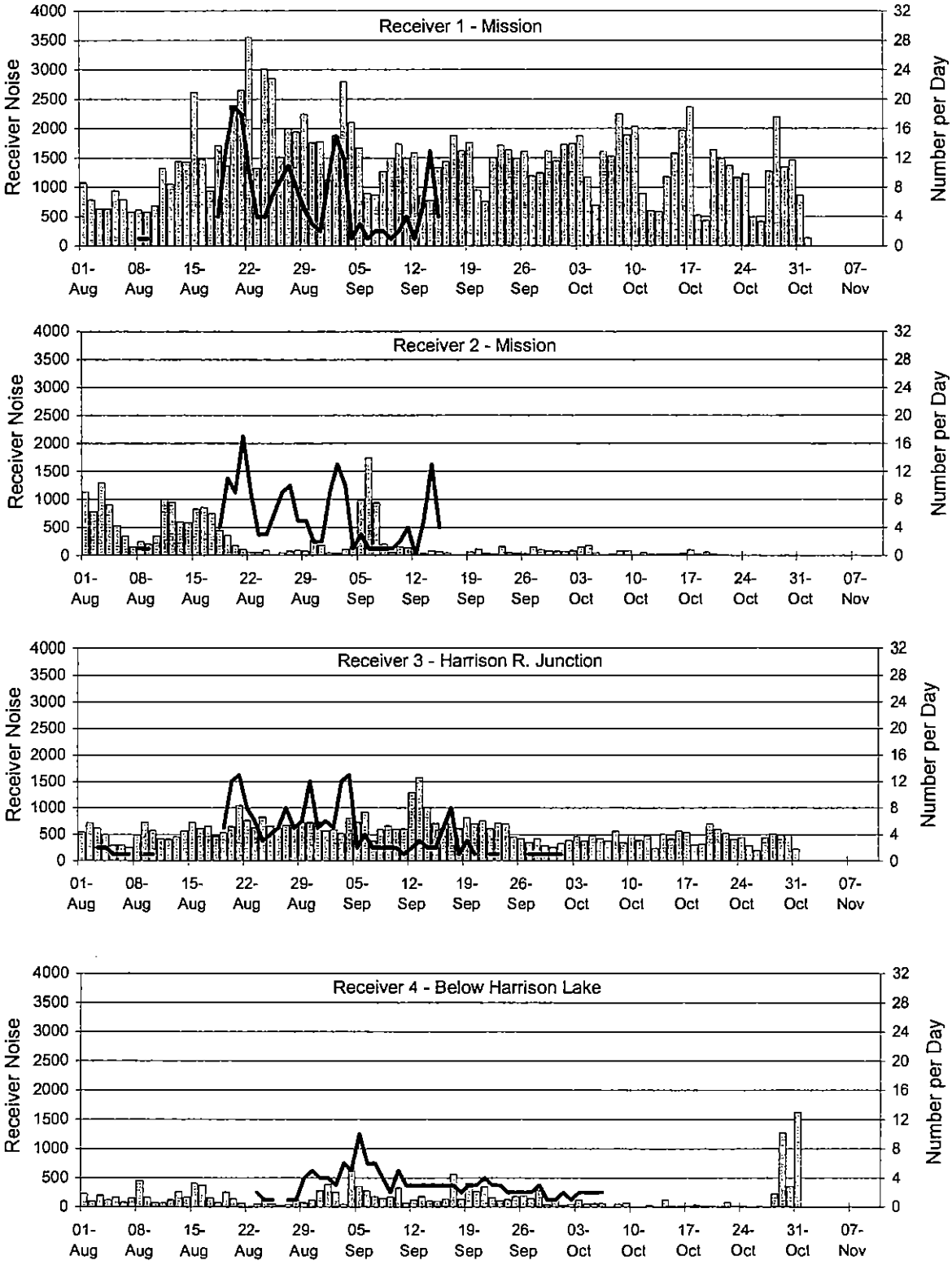

Figure A1. Receiver noise/collision (bars), and number of fish detected (line) by day and station during 2003.

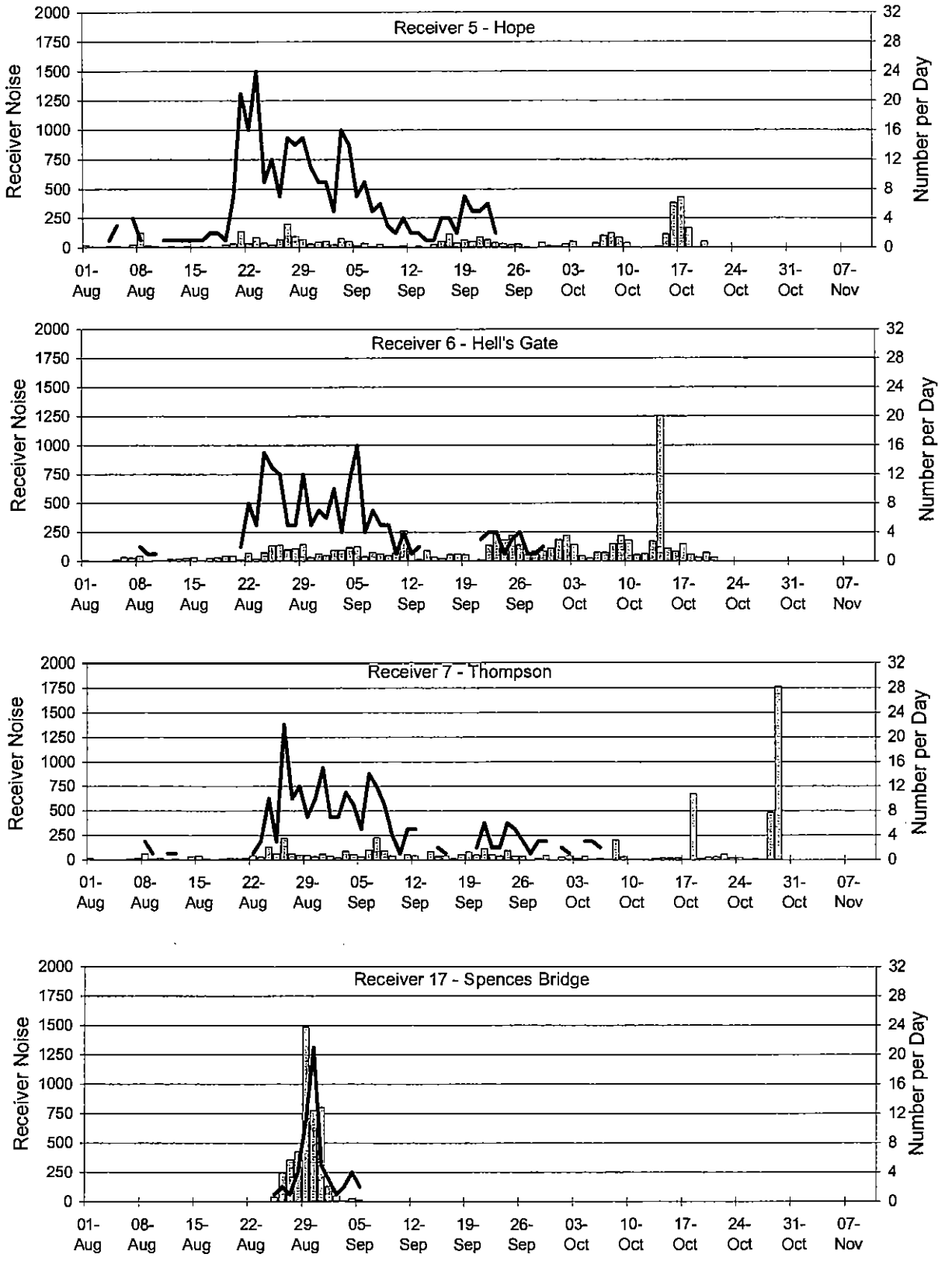

Figure A1 (continued). Receiver noise/collision (bars), and number of fish detected (line) by day and station during 2003.

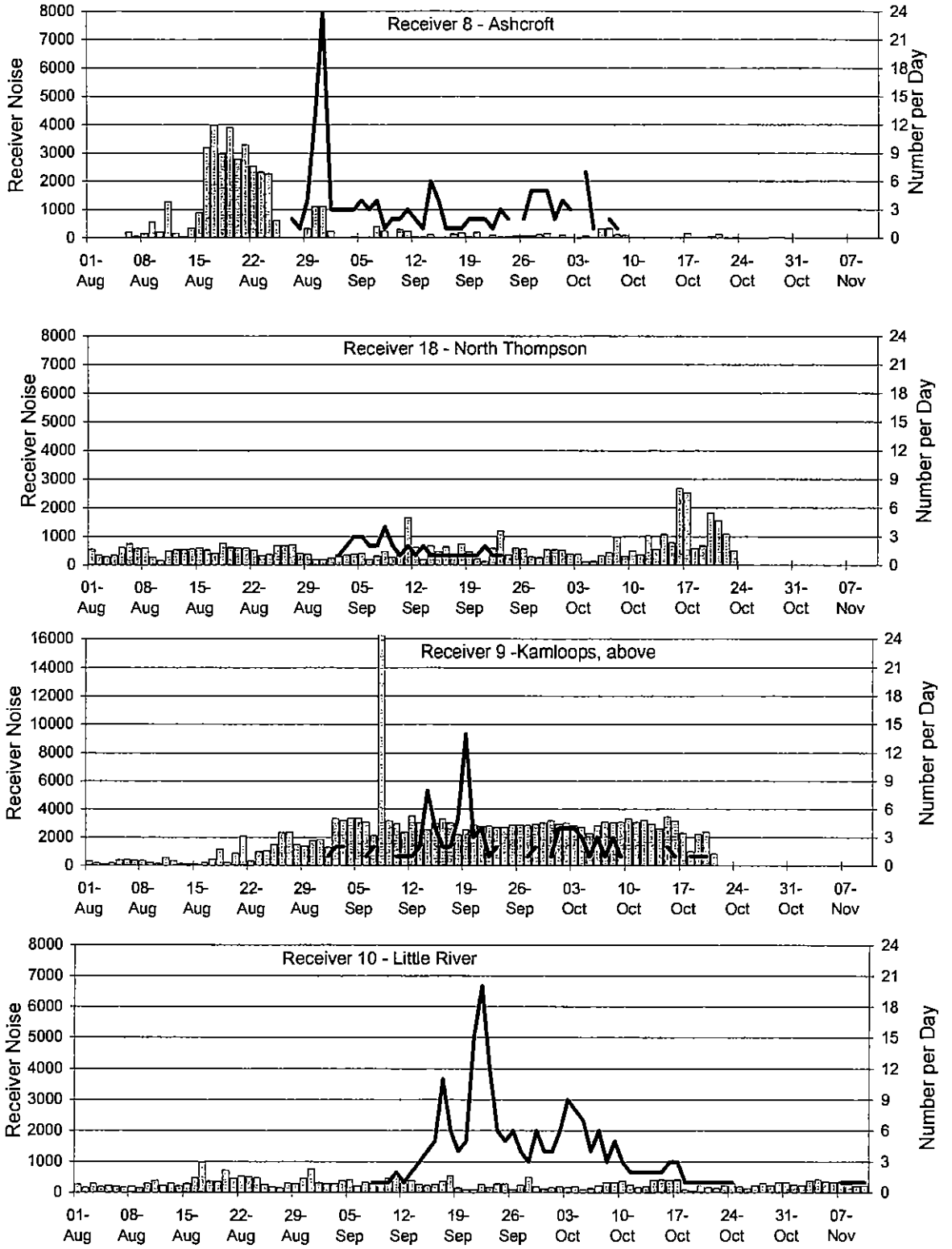

Figure A1 (continued). Receiver noise/collision (bars), and number of fish detected (line) by day and station during 2003.

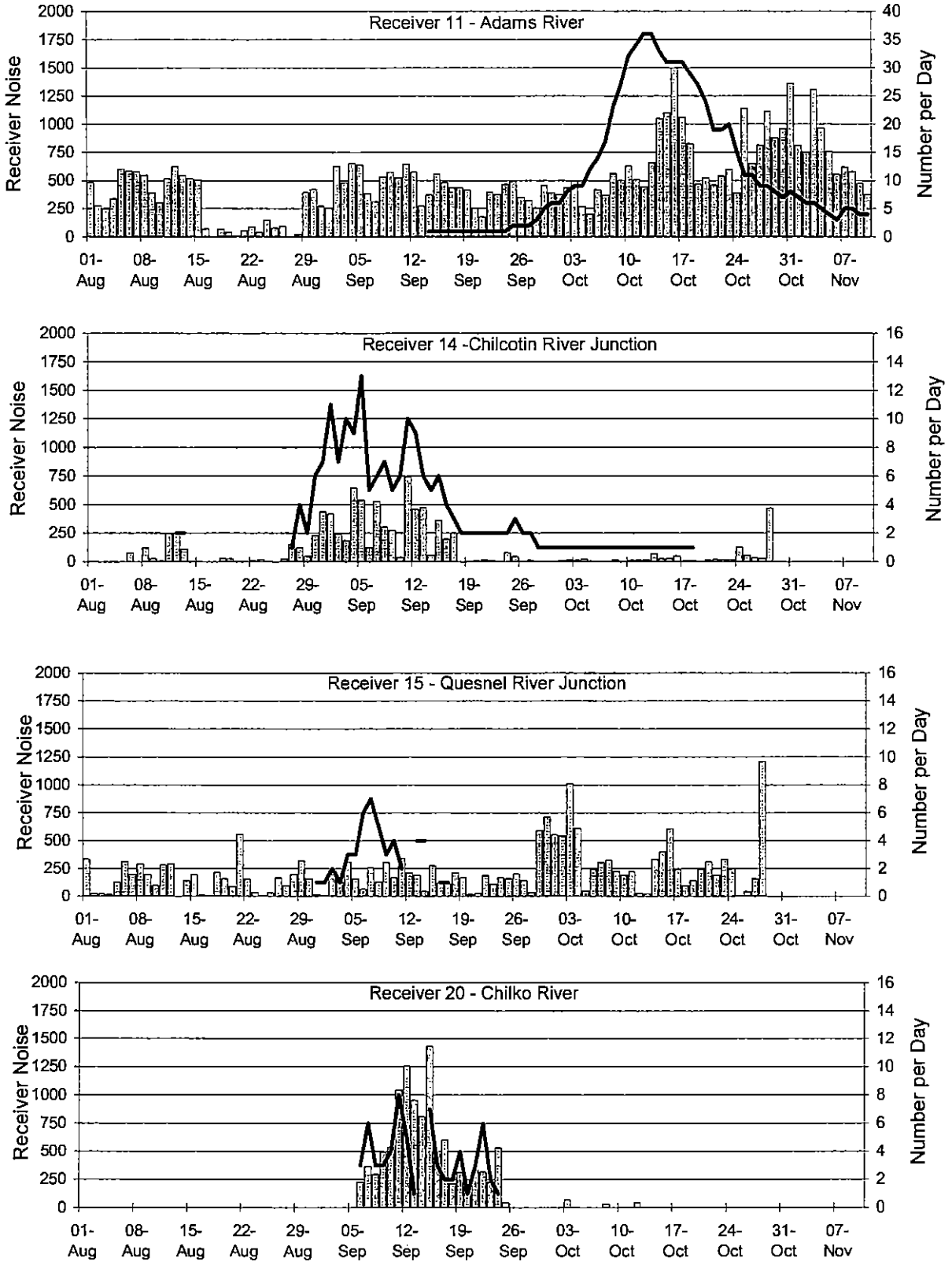

Figure A1 (continued). Receiver noise/collision (bars), and number of fish detected (line) by day and station during 2003.

Table A1. Fixed station tracking zones used in the Fraser River drainage during 2003.

River	Zone	Location	Antenna Code	Receiver Number	Antenna Number
Lower Fraser					
	11	Lower Fraser - Mission - Downstream	2	1	1
	12	Lower Fraser - Mission - Upstream	3	1	2
	21	Lower Fraser - Mission - Downstream	10	2	1
	22	Lower Fraser - Mission - Upstream	11	2	2
	31	Lower Fraser - Harrison at Fraser Confluence - Downstream	18	3	1
	32	Lower Fraser - Harrison at Fraser Confluence - Harrison R.	19	3	2
	33	Lower Fraser - Harrison at Fraser Confluence - Upstream	20	3	3
	41	Below Harrison Lake - Downstream	26	4	1
	42	Below Harrison Lake - Upstream	27	4	2
	51	Hope - Downstream	34	5	1
	52	Hope - Upstream	35	5	2
	61	Canyon - Below Hells Gate	42	6	1
	62	Canyon - Above Hells Gate	43	6	2
	71	Fraser - Thompson Confluence - Downstream	50	7	1
	72	Fraser - Thompson Confluence - Thompson	51	7	2
	73	Fraser - Thompson Confluence - Upstream	52	7	3
Thompson River					
	76	Spences Bridge - Downstream	130	17	1
	77	Spences Bridge - Upstream	131	17	2
	81	Thompson - Bonaparte R. Junction - Downstream	58	8	1
	82	Thompson - Bonaparte R. Junction - Upstream	59	8	2
	91	Thompson - Above Kamloops - Downstream	66	9	1
	92	Thompson - Above Kamloops - Upstream	67	9	2
	101	Little River - Downstream	74	10	1
	102	Little River - Upstream	75	10	2
	111	Adams River - Downstream	82	11	1
	112	Adams River - Upstream	83	11	2
Upper Fraser					
	141	Upper Fraser - Chilcotin River Junction - Downstream	106	14	1
	142	Upper Fraser - Chilcotin River Junction - Chilcotin	107	14	2
	143	Upper Fraser - Chilcotin River Junction - Upstream	108	14	3
	145	Upper Fraser - Chilcoting River - Chilko R. Junction - Downstream	258	20	1
	145	Upper Fraser - Chilcoting River - Chilko R. Junction - Chilko	259	20	2
	148	Upper Fraser - Chilcoting River - Chilko R. Junction - Upstream	260	20	3
	151	Upper Fraser - Quesnell River Junction - Downstream	114	15	1
	152	Upper Fraser - Quesnell River Junction - Quesnell	115	15	2
	153	Upper Fraser - Quesnell River Junction - Upstream	116	15	3

Table A2. Fixed station monitoring effort (h) by week for all sites monitored during 2003.

	Lower Fraser River										Thompson River			Upper Fraser River		
Week	Mission		Harrison R. at	Harrisson	Below	Hell's	Thompson R.	Spences	Bonaparte R.	North	Kamloops	Little	Adams	Chilcotin R.	Chilko	Quesnel R.
end	Site #1	Site#2	Fraser R. inters.	Lake	Hope	Gate	Junction	Bridge	Junction	Bonaparte		R.	R.	Junction	R.	Junction
2-Aug	168	168	168	62	168	168	168	0	0	88	168	168	168	168	0	168
9-Aug	168	168	168	168	168	168	168	0	84	168	168	168	168	168	0	168
16-Aug	168	168	168	168	168	168	168	0	167	168	168	168	168	168	0	130
23-Aug	168	168	168	168	168	168	168	9	168	168	168	168	168	168	0	168
30-Aug	168	168	168	168	168	168	167	168	133	168	168	168	168	168	0	154
6-Sep	168	168	168	168	168	168	168	132	168	168	168	168	168	168	156	168
13-Sep	168	168	168	168	168	168	168	0	168	168	164	168	168	168	168	168
20-Sep	168	168	168	168	168	168	168	0	168	168	168	168	168	168	168	168
27-Sep	168	168	168	168	168	168	168	0	168	168	168	168	168	168	91	168
4-Oct	168	168	168	168	168	168	168	0	168	168	168	168	168	168	40	168
11-Oct	168	168	168	168	168	168	168	0	168	168	168	168	168	168	149	168
18-Oct	168	168	168	168	168	168	168	0	168	168	168	168	168	168	158	168
25-Oct	168	61	168	168	37	64	168	0	168	112	56	168	168	168	0	168
1-Nov	156	0	136	134	2	0	90	0	87	0	0	168	168	63	0	67
8-Nov	0	0	0	0	0	0	0	0	0	0	0	168	168	0	0	0
15-Nov	0	0	0	0	0	0	0	0	0	0	0	168	168	0	0	0
Total	**2340**	**2077**	**2320**	**2212**	**2055**	**2080**	**2273**	**309**	**1983**	**2048**	**2068**	**2688**	**2688**	**2247**	**930**	**2199**

Table A3. Dates and locations of mobile tracking surveys conducted during September-November, 2003. Code 'ns' indicates that no survey was conducted in the zone/period stratum. Codes 'F' and 'B' indicate foot and boat surveys, respectively.

Date	Pitt River	Weaver Creek	Harrison River	Birkenhead River	Shuswap Lake	Adams River above/below	Eagle Creek	Scotch Creek	L. Shuswap River	Portage Creek	Chilko River	Horsefly River
15-Sep	F	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
16-Sep	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	B	ns
17-Sep	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	F
23-Sep	ns	ns	ns	F	ns	ns	ns	ns	ns	ns	ns	ns
30-Sep	ns	ns	B	ns	ns	ns	ns	ns	ns	ns	ns	ns
9-Oct	ns	ns	ns	F	ns	ns	ns	ns	ns	ns	ns	ns
10-Oct	ns	ns	ns	F	ns	ns	ns	ns	ns	ns	ns	ns
11-Oct	ns	F	B	ns	ns	ns	ns	ns	ns	ns	ns	ns
14-Oct	ns	F	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
22-Oct	ns	F	B	ns	ns	ns	ns	ns	ns	ns	ns	ns
23-Oct	ns	ns	ns	ns	B	ns	ns	ns	ns	ns	ns	ns
27-Oct	ns	ns	ns	ns	ns	ns	ns	ns	B	ns	ns	ns
31-Oct	ns	ns	ns	ns	ns	ns	F	ns	ns	ns	ns	ns
4-Nov	ns	ns	ns	ns	ns	ns	ns	ns	ns	F	ns	ns
7-Nov	ns	ns	ns	ns	B	B	ns	F	ns	ns	ns	ns
Totals	1	3	3	3	2	1	1	1	1	1	1	1

Table A4. Number of radio tags released in Johnstone Strait that were subsequently detected by mobile surveys during September to November 2003. Code 'ns' indicates that no survey was conducted in the zone/period stratum, and '0' indicates that no radio tags were detected in the stratum.

	Number of distinct tags by date											
Zone ->	15	38	37/40	45	105	115/116	117	119	121	130	147	155
	Pitt	Weaver	Harrison	Birkenhead	Shuswap	Adams River	Eagle	Scotch	Lower Shuswap	Portage	Chilko	Horsefly
Date	River	Creek	River	River	Lake	above/below station	Creek	Creek	River	Creek	River	River
10-Sep	0	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
16-Sep	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	2	ns
17-Sep	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns	15
23-Sep	ns	ns	ns	4	ns	ns	ns	ns	ns	ns	ns	ns
30-Sep	ns	ns	12	ns	ns	ns	ns	ns	ns	ns	ns	ns
09-Oct	ns	ns	ns	2	ns	ns	ns	ns	ns	ns	ns	ns
10-Oct	ns	ns	ns	8	ns	ns	ns	ns	ns	ns	ns	ns
11-Oct	ns	4	4	ns	ns	ns	ns	ns	ns	ns	ns	ns
14-Oct	ns	14	ns	ns	ns	ns	ns	ns	ns	ns	ns	ns
22-Oct	ns	5	2	ns	ns	ns	ns	ns	ns	ns	ns	ns
23-Oct	ns	ns	ns	ns	8	ns	ns	ns	ns	ns	ns	ns
27-Oct	ns	ns	ns	ns	ns	ns	ns	ns	2	ns	ns	ns
31-Oct	ns	ns	ns	ns	ns	ns	0	ns	ns	ns	ns	ns
04-Nov	ns	ns	ns	ns	ns	ns	ns	ns	ns	1	ns	ns
07-Nov	ns	ns	ns	ns	1	11	ns	0	ns	ns	ns	ns
Total Unique Fish	**0**	**14**	**13**	**11**	**8**	**11**	**0**	**0**	**2**	**1**	**2**	**15**

APPENDIX B

Catch and Effort during Tagging Periods

Table B1. Purse seine fishing effort and capture/release statistics for radio tagging operations in the Juan de Fuca Strait, 2003.

								Number of salmon captured											
Date	Set_Number	Site Name[1]	Tide	set time_Out	set time_In	Duration	Set_Quality[2]	SO_Kept	SO_Released	SO_Radio_Tag	SO_Acous_Tag	PK_Kept	PK_Released	CH_Kept	CH_Released	CO_Kept	CO_Released	CM_Kept	CM_Released
Juan de Fuca - Area 20																			
26-Jul	1	Sherringham Pt.	Ebb	6:15	7:02		2	39	22			0	56	0	5	0	2	0	0
26-Jul	2	Sherringham Pt.	Ebb	7:40	8:34		2	17	2			0	10	0	1	0	1	0	0
26-Jul	3	Sherringham Pt.	Ebb	8:45	9:45		2	19	2			0	31	0	6	0	1	0	0
26-Jul	4	Sherringham Pt.	Slack	10:15	10:56		2	27	5			0	77	0	0	0	0	0	0
26-Jul	5	Jordan R.	Flood	11:50	12:30		2	16	0			0	32	0	3	0	0	0	0
26-Jul	6	Sherringham Pt.	Flood	12:45	13:25		2	4	0			0	20	0	1	0	0	0	0
Day Total								**122**	**31**	**0**	**0**	**0**	**226**	**0**	**16**	**0**	**4**	**0**	**0**
27-Jul	1	Sherringham Pt.	Ebb	6:10	6:58		2	14	0	11		0	26	0	0	0	2	0	0
27-Jul	2	Sherringham Pt.	Ebb	7:30	8:10		2	25	0	15		0	20	0	5	0	4	0	0
27-Jul	3	Sherringham Pt.	Ebb	8:50	9:30		2	11	0	8		0	12	0	2	0	2	0	0
27-Jul	4	Sherringham Pt.	Ebb	10:01	10:45		2	2	0	2		0	11	0	0	0	0	0	0
27-Jul	5	Jordan R.	Flood	11:03	12:05		2	23	0	16		0	27	0	1	0	4	0	0
27-Jul	6	Sherringham Pt.	Flood	12:27	13:06		2	14	0	0		0	20	0	2	0	0	0	0
Day Total								**89**	**0**	**52**	**0**	**0**	**116**	**0**	**10**	**0**	**12**	**0**	**0**

[1] Names of shoreline landmarks close to the fishing sites.

[2] Set quality codes are: bad set or catch not representative (0), problems with set but no effect on catches (1), and set with no problems (2).

Table B2. Purse seine fishing effort and capture/release statistics for radio tagging operations in Johnstone Strait, 11-28 August 2003.

								Number of salmon captured											
Date	Set_Number	Site Name[1]	Tide	set time_Out	set time_In	Duration	Set_Quality[2]	SO_Kept	SO_Released	SO_Radio_Tag	SO_Acoust_Tag	PK_Kept	PK_Released	CH_Kept	CH_Released	CO_Kept	CO_Released	CM_Kept	CM_Released
Johnstone Strait - Area 13																			
11-Aug	1	JS-2922	Ebb	6:20	6:45	0:25	2	19	56	11		0	20	0	0			0	0
11-Aug	2	JS-2922	Ebb	8:50	9:20	0:30	2	5	5	3		0	30	0	0			0	2
11-Aug	3	JS-2911	Ebb	10:05	10:35	0:30	2	30	90	16		0	20	0	0			0	1
11-Aug	4	JS-2914	Flood	12:45	13:15	0:30	2	12	4	8		0	24	0	0			0	0
11-Aug	5	JS-2914	Flood	14:20	14:45	0:25	2	3	0	1		0	12	0	3			0	0
12-Aug	1	JS-2922	Ebb	6:00	6:30	0:30	2	22	198	13		0	150	0	0	0	1	0	2
12-Aug	2	JS-2911	Ebb	8:40	9:05	0:25	2	7	30	15		0	51	0	1	0	0	0	0
12-Aug	3	JS-2923	Ebb	11:20	11:50	0:30	2	0	5	0		0	70	0	0	0	0	0	0
12-Aug	4	JS-2914	Flood	12:15	12:45	0:30	2	0	4	1		0	30	0	5	0	0	0	0
12-Aug	5	JS-2911	Flood	13:20	13:55	0:35	2	16	21	15		0	0	0	0	0	1	0	3
12-Aug	6	JS-2911	Flood	15:50	16:15	0:25	2	11	31	8		0	8	0	0	0	0	0	0
13-Aug	1	JS-2922	Ebb	6:05	6:30	0:25	2	9	61	16		0	15	0	1	0	0	0	0
13-Aug	2	JS-2911	Ebb	8:20	8:40	0:20	2	610	90	15		0	50	0	1	0	2	0	3
13-Aug	3	JS-2922	Ebb	11:10	11:40	0:30	2	97	13	12		0	20	0	1	0	0	0	0
13-Aug	4	JS-2922	Flood	13:50	14:15	0:25	2	100	10	10		0	88	0	3	0	2	0	12
13-Aug	5	JS-2922	Flood	16:10	16:40	0:30	2	235	10	10		6	344	0	3	0	0	5	3
14-Aug	1	JS-2922	Ebb	6:10	6:30	0:20	2	329	18	15		0	335	0	4	0	3	0	35
14-Aug	2	JS-2922	Ebb	8:30	9:00	0:30	2	253	17	17		0	300	0	2	0	3	4	12
14-Aug	3	JS-2922	Ebb	11:10	11:55	0:45	2	686	14	14		75	100	0	1	0	0	4	7
14-Aug	4	JS-2911	Flood	14:30	15:00	0:30	2	27	11	9		0	12	0	7	0	0	0	8
14-Aug	5	JS-2922	Flood	16:15	16:45	0:30	2	11	7	0		1	20	0	2	0	1	0	4
14-Aug	6	JS-2911	Flood	17:10	17:30	0:20	2	8	0	7		0	150	0	2	0	0	0	2
15-Aug	1	JS-2922	Flood	6:00	6:25	0:25	2	12	648	17		0	60	0	0	0	2	0	15
15-Aug	2	JS-2922	Flood	9:00	9:25	0:25	2	12	32	17		0	33	0	0	0	0	0	0
15-Aug	3	JS-2923	Ebb	11:40	12:05	0:25	2	14	386	20		0	90	0	1	0	2	0	15
15-Aug	4	JS-2922	Ebb	14:30	14:55	0:25	2	17	453	17		0	140	0	0	0	1	0	10
15-Aug	5	JS-2922	Flood	17:15	17:40	0:25	2	13	33	11		0	185	0	2	0	0	0	4
19-Aug	1	JS-2922	Flood	6:20	6:40	0:20	2	20	230	15		0	30	0	3	0	0	0	0
20-Aug	1	JS-2922	Flood	6:15	6:35	0:20	2	23	1277	20	0	2	398	0	1	0	1	0	0
20-Aug	2	JS-2922	Flood	8:55	9:15	0:20	2	11	589	22	0	0	60	0	0	0	1	0	3
20-Aug	3	JS-2922	Flood	11:30	11:50	0:20	2	11	9	3	0	0	35	0	3	0	1	0	2
20-Aug	4	JS-2922	Ebb	12:55	13:15	0:20	2	3	197	16	7	0	75	0	0	0	0	0	3

[1] Site name codes are: Bodega Point (JS-2908), Logger's Bay (JS-2911), Harry Moon Point (JS-2914), Bluffs (JS-2922), and Seperation Head (JS-2923).

[2] Set quality codes are: bad set or catch not representative (0), problems with set but no effect on catches (1), and set with no problems (2).

Table B2 (continued). Purse seine fishing effort and capture/release statistics for radio tagging operations in Johnstone Strait, 11-28 August 2003.

								Number of salmon captured											
Date	Set_Number	Site Name[1]	Tide	set time_Out	set time_In	Duration	Set_Quality[2]	SO_Kept	SO_Released	SO_Radio_Tag	SO_Acoustic_Tag	PK_Kept	PK_Released	CH_Kept	CH_Released	CO_Kept	CO_Released	CM_Kept	CM_Released
Johnstone Strait - Area 13																			
21-Aug	1	JS-2922	Flood	5:55	6:15	0:20	2	2	348	21	3	0	350	0	1	0	0	0	5
21-Aug	2	JS-2922	Flood	8:35	8:55	0:20	2	3	197	12	11	0	250	0	4	0	3	0	12
21-Aug	3	JS-2911	Flood	11:05	11:25	0:20	2	7	843	11	17	0	125	0	1	0	2	0	15
21-Aug	4	JS-2911	Ebb	13:45	14:00	0:15	2	12	63	0	26	0	40	0	1	0	3	0	2
22-Aug	1	JS-2922	Flood	6:15	6:40	0:25	2	6	344	15	12	0	350	0	0	0	1	0	6
22-Aug	2	JS-2922	Flood	9:20	9:40	0:20	2	0	25	11	6	0	15	0	2	0	0	0	2
22-Aug	3	JS-2922	Flood	11:30	11:50	0:20	2	1	49	6	21	0	13	0	0	0	0	0	0
22-Aug	4	JS-2911	Flood	14:00	14:20	0:20	2	13	0	0	0	0	23	0	3	0	2	0	4
26-Aug	1	JS-2922	Ebb	6:30	6:45	0:15	2	16	634	14	12	0	350	0	2	0	0	0	50
26-Aug	2	JS-2922	Ebb	9:40	10:05	0:25	2	0	6	0	0	10	4	0	0	0	0	0	3
26-Aug	3	JS-2908	Ebb	11:15	11:40	0:25	2	7	0	0	0	0	20	0	0	0	0	0	3
26-Aug	4	JS-2911	Flood	12:10	12:40	0:30	2	3	33	13	19	0	20	0	6	0	0	0	3
26-Aug	5	JS-2911	Flood	15:30	15:55	0:25	2	0	150	13	9	0	600	0	4	0	1	0	25
27-Aug	1	JS-2922	Ebb	6:30	6:50	0:20	2	8	37	16	16	0	110	0	1	0	2	0	3
27-Aug	2	JS-2911	Ebb	9:55	10:10	0:15	2	9	26	15	10	0	100	0	2	0	4	0	12
27-Aug	3	JS-2922	Flood	12:25	12:45	0:20	2	0	0	0	0	0	0	0	0	0	0	0	0
27-Aug	4	JS-2911	Flood	13:15	13:40	0:25	2	1	3	0	0	0	35	0	0	0	0	0	1
27-Aug	5	JS-2911	Flood	14:00	14:20	0:20	2	0	48	10	9	0	75	0	0	0	1	0	4
28-Aug	1	JS-2922	Ebb	6:30	6:50	0:20	2	0	60	22	0	0	410	0	2	0	6	0	6
28-Aug	2	JS-2911	Ebb	9:00	9:20	0:20	2	0	70	6	0	0	280	0	0	0	5	0	5
Area 13 Total	**20**							**88**	**2936**	**185**	**171**	**10**	**3170**	**0**	**29**	**0**	**30**	**0**	**161**

[1] Site name codes are: Bodega Point (JS-2908), Logger's Bay (JS-2911), Harry Moon Point (JS-2914), Bluffs (JS-2922), and Seperation Head (JS-2923).

[2] Set quality codes are: bad set or catch not representative (0), problems with set but no effect on catches (1), and set with no problems (2).

Table B3. Dip-net fishing effort and number of sockeye tagged at Nicomen, in the Thompson River, 2003.

Tag			Handling period			Radio-tag	Tag			Handling period			Radio-tag
Date	site	Set	Start	End	Duration	number	Date	site	Set	Start	End	Duration	number
25-Aug	2	1	6:13	6:23	0:10	1	28-Aug	1	25	12:15	12:16	0:01	41
25-Aug	2	2	9:25	9:35	0:10	2	28-Aug	1	26	12:44	12:45	0:01	42
26-Aug	3	1	18:10	18:25	0:15	3	28-Aug	1	27	12:55	12:56	0:01	43
27-Aug	1	1	5:56	6:02	0:06	4	28-Aug	1	28	13:14	13:15	0:01	44
27-Aug	1	2	6:04	6:05	0:01	5	28-Aug	1	29	13:19	13:20	0:01	45
27-Aug	1	3	6:14	6:20	0:06	6	29-Aug	1	1	13:00	13:01	0:01	46
27-Aug	1	4	6:22	6:28	0:06	7	29-Aug	1	2	13:03	13:04	0:01	47
27-Aug	1	5	6:40	6:42	0:02	8	29-Aug	1	3	13:07	13:08	0:01	48
27-Aug	1	6	7:01	7:02	0:01	9	5-Sep	1	1	19:02	19:03	0:01	49
27-Aug	1	7	7:06	7:07	0:01	10	6-Sep	1	1	6:27	6:29	0:02	50
27-Aug	1	8	7:24	7:24	0:00	11	6-Sep	1	1	7:20	7:21	0:01	51
27-Aug	1	9	8:04	8:05	0:01	12	9-Sep	1	1	19:29	19:30	0:01	52
27-Aug	1	10	9:10	9:11	0:01	13	11-Sep	1	1	6:17	6:25	0:08	53
27-Aug	1	11	9:27	9:28	0:01	14	11-Sep	1	2	6:41	6:42	0:01	54
27-Aug	1	12	9:46	9:47	0:01	15	11-Sep	1	3	7:13	7:14	0:01	55
27-Aug	1	13	10:02	10:03	0:01	16	11-Sep	1	4	7:30	7:31	0:01	56
28-Aug	1	1	5:52	6:02	0:10	17	16-Sep	1	1	19:02	19:03	0:01	57
28-Aug	1	2	6:16	6:17	0:01	18	17-Sep	1	1	6:47	6:49	0:02	58
28-Aug	1	3	6:36	6:37	0:01	19	17-Sep	1	2	7:08	7:10	0:02	59
28-Aug	1	4	6:48	6:49	0:01	20	17-Sep	1	3	7:17	7:18	0:01	60
28-Aug	1	5	6:51	6:52	0:01	21	17-Sep	1	4	7:22	7:24	0:02	61
28-Aug	1	6	7:09	7:09	0:00	22	17-Sep	1	5	n/a	8:36	n/a	62
28-Aug	1	7	7:12	7:12	0:00	23	17-Sep	1	6	n/a	8:43	n/a	63
28-Aug	1	8	7:23	7:24	0:01	24	17-Sep	1	7	n/a	8:59	n/a	64
28-Aug	1	9	7:27	7:28	0:01	25	17-Sep	1	8	n/a	9:05	n/a	65
28-Aug	1	10	7:49	7:50	0:01	26	17-Sep	1	9	n/a	9:15	n/a	66
28-Aug	1	11	8:02	8:03	0:01	27	19-Sep	1	1	10:28	10:30	0:02	67
28-Aug	1	12	8:31	8:32	0:01	28	19-Sep	1	2	11:02	11:04	0:02	68
28-Aug	1	13	8:07	8:08	0:01	29	24-Sep	1	1	18:38	18:41	0:03	69
28-Aug	1	14	9:31	9:32	0:01	30	24-Sep	1	2	18:57	18:58	0:01	70
28-Aug	1	15	9:41	9:42	0:01	31	30-Sep	1	1	17:20	17:21	0:01	71
28-Aug	1	16	9:55	9:56	0:01	32	1-Oct	1	1	16:29	16:30	0:01	72
28-Aug	1	17	10:11	10:12	0:01	33	1-Oct	1	2	16:44	16:45	0:01	73
28-Aug	1	18	10:27	10:28	0:01	34	1-Oct	1	3	17:45	17:46	0:01	74
28-Aug	1	19	10:29	10:30	0:01	35	1-Oct	1	4	17:55	17:56	0:01	75
28-Aug	1	20	11:21	11:27	0:06	36	1-Oct	1	5	18:04	18:05	0:01	76
28-Aug	1	21	11:30	11:31	0:01	37	1-Oct	1	6	18:17	18:18	0:01	77
28-Aug	1	22	11:44	11:45	0:01	38	1-Oct	1	7	18:22	18:23	0:01	78
28-Aug	1	23	12:11	12:12	0:01	39	1-Oct	1	8	18:37	18:38	0:01	79
28-Aug	1	24	12:42	12:43	0:01	40							

APPENDIX C

Tag Release Data

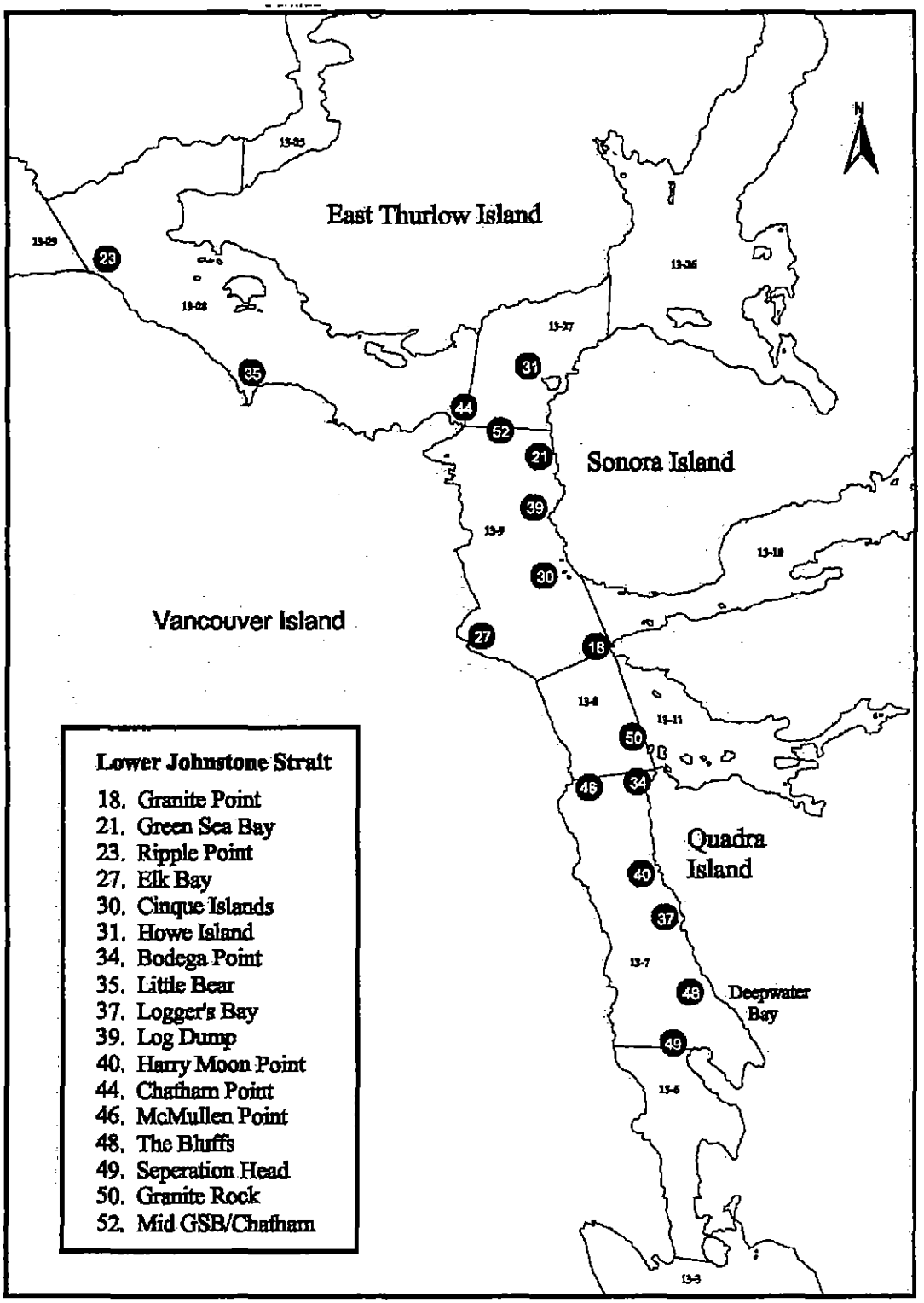

Figure C1. Johnstone Strait test fishing locations used for 2003 radio tagging operations.

Table C1. Release data for fish tagged during the pre-study tests in Juan de Fuca Strait, 27 July 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
27-Jul	1	1	JDF-Set2	73	680	93	06:58:00	07:00:00	08:21:00	68	1	34	533						1
27-Jul	2	1	JDF-Set2	1092	780	20	06:58:00	07:02:00	08:21:00	68	1	35	534			13.4	13.0		1
27-Jul	3	1	JDF-Set2	474	540	33	06:58:00	07:04:00	08:21:00	58	1	36	535						1
27-Jul	4	1	JDF-Set2	241	600	47	06:58:00	07:06:00	08:21:00	60	1	37	536			16.4	10.3		1
27-Jul	5	1	JDF-Set2	515	720	93	06:58:00	07:09:00	08:21:00	62	1	38	537						1
27-Jul	6	1	JDF-Set2	1139	640	23	06:58:00	07:13:00	08:21:00	63	1	39	538			9.8	9.6		1
27-Jul	7	1	JDF-Set2	918	800	138	06:58:00	07:16:00	08:21:00	57	1	40	539						1
27-Jul	8	1	JDF-Set2	971	600	96	06:58:00	07:18:00	08:21:00	64	1	41	540			6.8	5.5		1
27-Jul	9	1	JDF-Set2	797	640	19	06:58:00	07:21:00	08:21:00	61	1	42	541						1
27-Jul	10	1	JDF-Set2	1044	800	3	06:58:00	07:23:00	08:21:00	66	1	43				17.0	14.3		1
27-Jul	11	1	JDF-Set2	688	780	22	06:58:00	07:28:00	08:21:00	64	1	44	542						1
27-Jul	12	2	JDF-Set3	1285	540	89	08:10:00	08:24:00	09:41:00	63	1	45	543			9.3	8.4		1
27-Jul	13	2	JDF-Set3	262	680	127	08:10:00	08:27:00	09:41:00	58	1	46	544						1
27-Jul	14	2	JDF-Set3	799	720	166	08:10:00	08:31:00	09:41:00	63	1	47	545			8.9	9.0		1
27-Jul	15	2	JDF-Set3	1239	540	80	08:10:00	08:33:00	09:41:00	65	1	48	546						1
27-Jul	16	2	JDF-Set3	1049	640	135	08:10:00	08:39:00	09:41:00	66	1	49	547			12.8	13.6		1
27-Jul	17	2	JDF-Set3	265	780	107	08:10:00	08:42:00	09:41:00	57	1	50	548						1
27-Jul	18	2	JDF-Set3	145	600	86	08:10:00	08:45:00	09:41:00	66	1	51	549			8.3	9.3		1
27-Jul	19	2	JDF-Set3	847	540	47	08:10:00	08:49:00	09:41:00	56	1	52	550						1
27-Jul	20	2	JDF-Set3	836	780	165	08:10:00	08:53:00	09:41:00	62	1	53	551			13.0	12.3		1
27-Jul	21	2	JDF-Set3	856	800	6	08:10:00	08:56:00	09:41:00	62	1	54	552						1
27-Jul	22	2	JDF-Set3	900	640	18	08:10:00	09:03:00	09:41:00	59	1	55	553			14.4	12.8		1
27-Jul	23	2	JDF-Set3	384	780	162	08:10:00	09:06:00	09:41:00	67	1	56	554						1
27-Jul	24	2	JDF-Set3	1167	640	10	08:10:00	09:11:00	09:41:00	59	1	57	555			13.7	12.0		1
27-Jul	25	2	JDF-Set3	1282	800	102	08:10:00	09:14:00	09:41:00	62	1	58	556						1
27-Jul	26	2	JDF-Set3	872	680	123	08:10:00	09:19:00	09:41:00	58	1	59	557			10.3	8.0		1
27-Jul	27	3	JDF-Set4	573	680	99	09:30:00	09:42:00	10:48:00	65	1	60	558						1

Table C1 (continued). Release data for fish tagged during the pre-study tests in Juan de Fuca Strait, 27 July 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
27-Jul	28	3	JDF-Set4	619	800	168	09:30:00	09:46:00	10:48:00	58	2	61	559			18.4	16.6		1
27-Jul	29	3	JDF-Set4	329	800	136	09:30:00	09:51:00	10:48:00	58	2	62	560						1
27-Jul	30	3	JDF-Set4	1042	720	14	09:30:00	09:53:00	10:48:00	54	2	63	561			12.4	8.9		1
27-Jul	31	3	JDF-Set4	1234	720	71	09:30:00	09:55:00	10:48:00	61	2	64	562						1
27-Jul	32	3	JDF-Set4	1176	640	32	09:30:00	09:58:00	10:48:00	59	2	65	563			18.9	16.2		1
27-Jul	33	3	JDF-Set4	861	680	104	09:30:00	10:00:00	10:48:00	63	2	66	564						1
27-Jul	34	3	JDF-Set4	1294	600	89	09:30:00	10:02:00	10:48:00	59	2	67	565			11.9	10.5		1
27-Jul	35	4	JDF-Set5	458	720	13	10:50:00	10:50:00	12:11:00	63	2	68	566						1
27-Jul	36	4	JDF-Set5	562	680	95	10:50:00	10:52:00	12:11:00	58	2	69	567			9.1	8.8		1
27-Jul	37	5	JDF-Set6	424	720	167	12:05:00	12:12:00	13:10:00	63	2	70	568						1
27-Jul	38	5	JDF-Set6	1112	720	144	12:05:00	12:14:00	13:10:00	57	2	71	569			14.6	10.5		1
27-Jul	39	5	JDF-Set6	1028	720	74	12:05:00	12:17:00	13:10:00	66	2	72	570						1
27-Jul	40	5	JDF-Set6	1149	720	147	12:05:00	12:19:00	13:10:00	62	2	73	571			5.5	4.2		1
27-Jul	41	5	JDF-Set6	602	680	120	12:05:00	12:21:00	13:10:00	55	2	74	572						1
27-Jul	42	5	JDF-Set6	829	780	15	12:05:00	12:25:00	13:10:00	66	2	75	573			0.9	0.5		1
27-Jul	43	5	JDF-Set6	1304	720	156	12:05:00	12:30:00	13:10:00	60	2	76	574						1
27-Jul	44	5	JDF-Set6	898	780	137	12:05:00	12:33:00	13:10:00	64	2	77	575			10.6	10.8		1
27-Jul	45	5	JDF-Set6	860	780	19	12:05:00	12:37:00	13:10:00	56	2	78	576						1
27-Jul	46	5	JDF-Set6	507	720	85	12:05:00	12:38:00	13:10:00	63	2	79	577			10.9	8.9		1
27-Jul	47	5	JDF-Set6	1315	680	98	12:05:00	12:41:00	13:10:00	60	2	80	578						1
27-Jul	48	5	JDF-Set6	463	720	59	12:05:00	12:44:00	13:10:00	60	2	81	579			13.3	13.5		1
27-Jul	49	5	JDF-Set6	584	780	117	12:05:00	12:47:00	13:10:00	58	2	82	580						1
27-Jul	50	5	JDF-Set6	677	800	49	12:05:00	12:49:00	13:10:00	66	2	83	581			3.5	3.6		1
27-Jul	51	5	JDF-Set6	1210	640	54	12:05:00	12:52:00	13:10:00	61	2	84	582						1
27-Jul	52	5	JDF-Set6	554	780	149	12:05:00	12:53:00	13:10:00	58	2	85	583			13.6	12.3		1

[1] Release location: JDF=Juan de Fuca set area.

[2] Three digit number corresponds to decimal frequency of 150 MHz (e.g., 600 is 150.600 MHz).

[3] Color code: 1=Bright blue back; loose scales; 2=Bright green back; and 3=Dull green back

[4] Release Code: 1=excellent (little scale loss), 2=good (some scale loss), 3=fair (mod. scale loss), 4=poor (heavy scale loss)

All tagging was conducted by Karl English, assistants were Steve Cook, Dave Patterson, and Jay Sitar.

Table C2. Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
11-Aug	101	1	JS-2923	1	320	86	6:45	7:04	8:29	58	101	1	1	1001	1001	7.5	7.2	2	1
11-Aug	102	1	JS-2923	2	440	114	6:45	7:10	8:29	64	101	2	2	1002	1002	9.7	11.3	2	1
11-Aug	103	1	NR				6:45	7:15			101	3	3					2	
11-Aug	104	1	NR				6:45	7:21			101	4	4					2	
11-Aug	105	1	JS-2923	5	400	39	6:45	7:26	8:29	55	101	5	5	1005	1005	13	12	1	1
11-Aug	106	1	JS-2923	6	780	49	6:45	7:33	8:29	61	101	6	6	1006	1006	8.9	8.6	2	1
11-Aug	107	1	JS-2923	7	320	88	6:45	7:37	8:29	55	101	7	7	1007	1007	12.1	14	2	1
11-Aug	108	1	JS-2923	8	440	24	6:45	7:41	8:29	56	101	8	8	1008	1008	13	11.4	3	1
11-Aug	109	1	JS-2923	9	360	47	6:45	7:55	8:29	58	101	9	9	1009	1009	15.5	13.8	2	1
11-Aug	110	1	JS-2923	10	640	53	6:45	8:04	8:29	66	101	10	10	1010	1010	11.8	10.3	2	1
11-Aug	111	1	JS-2923	11	400	37	6:45	8:08	8:29	65	101	11	11	1011	1011	11.5	9	3	1
11-Aug	112	1	JS-2923	12	780	48	6:45	8:13	8:29	61	101	12	12	1012	1012	14.4	11.1	2	1
11-Aug	113	1	JS-2923	13	320	57	6:45	8:17	8:29	59	101	13	13	1013	1013	18.9	11.3	2	1
11-Aug	114	2	JS-2911	14	440	12	9:20	9:35	10:50	59	101	14	14	1014	1014	11.5	9.9	1	1
11-Aug	115	2	JS-2911	15	360	45	9:20	9:39	10:50	55	101	15	15	1015	1015	11.1	8.7	1	2
11-Aug	116	2	JS-2911	16	640	33	9:20	9:43	10:50	58	101	16	16	1016	1016	10.5	9.1	2	1
11-Aug	117	3	JS-2911	17	400	45	10:35	10:56	12:35	57	101	17	17	1017	1017	8.5	5.8	3	1
11-Aug	118	3	JS-2911	18	400	43	10:35	11:01	12:35	60	101	18	18	1018	1018	7.9	4.9	2	1
11-Aug	119	3	JS-2911	19	780	26	10:35	11:07	12:35	67	101	19	19	1019	1019	6.3	4.9	1	1
11-Aug	120	3	JS-2911	20	320	111	10:35	11:11	12:35	65	101	20	20	1020	1020	5.2	3.9	2	1
11-Aug	121	3	JS-2911	21	440	48	10:35	11:19	12:35	65	101	21	21	1021	1021	10.5	8.7	1	1
11-Aug	122	3	JS-2911	22	360	43	10:35	11:30	12:35	66	101	22	22	1022	1022	10.2	10.1	1	1
11-Aug	123	3	JS-2911	23	640	83	10:35	11:34	12:35	63	101	23	23	1023	1023	10.9	7.3	1	1
11-Aug	124	3	JS-2911	24	400	44	10:35	11:39	12:35	60	101	24	24	1024	1024	12.3	11.5	2	1
11-Aug	125	3	JS-2911	25	400	35	10:35	11:43	12:35	60	101	25	25	1025	1025	15.4	13.2	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
11-Aug	126	3	JS-2911	26	320	84	10:35	11:48	12:35	60	101	26	26	1026	1026	18.3	14.4	1	1
11-Aug	127	3	JS-2911	27	440	29	10:35	11:53	12:35	59	101	27	27	1027	1027	10.9	10.8	1	1
11-Aug	128	3	JS-2911	28	360	77	10:35	11:58	12:35	67	101	28	28	1028	1028	12.6	12.8	1	1
11-Aug	129	3	JS-2911	29	640	58	10:35	12:02	12:35	58	101	29	29	1029	1029	13.2	9.5	2	1
11-Aug	130	3	JS-2911	30	400	105	10:35	12:06	12:35	61	101	30	30	1030	1030	10.7	10	1	1
11-Aug	131	3	JS-2911	31	780	67	10:35	12:11	12:35	67	101	31	31	1031	1031	10.5	9.9	2	1
11-Aug	132	3	JS-2911	32	320	60	10:35	12:17	12:35	60	101	32	32	1032	1032	11.8	10	1	1
11-Aug	133	4	JS-2911	33	440	92	13:15	13:28	15:00	65	101	33	33	1033	1033	8.8	7.2	2	1
11-Aug	134	4	JS-2911	34	360	40	13:15	13:32	15:00	56	101	34	34	1034	1034	10.5	6.6	1	1
11-Aug	135	4	JS-2911	35	640	14	13:15	13:35	15:00	68	101	35	35	1035	1035	10.3	8.5	2	1
11-Aug	136	4	JS-2911	36	400	46	13:15	13:43	15:00	62	101	36	36	1036	1036	7.1	6.7	1	1
11-Aug	137	4	JS-2911	37	780	75	13:15	13:47	15:00	61	101	37	37	1037	1037	6.2	5.1	1	1
11-Aug	138	4	JS-2911	38	320	24	13:15	13:51	15:00	60	101	38	38	1038	1038	12.3	11.6	3	1
11-Aug	139	4	JS-2911	39	440	23	13:15	13:59	15:00	65	101	39	39	1039	1039	5.8	4.8	2	1
11-Aug	140	4	JS-2911	40	360	7	13:15	14:04	15:00	58	101	40	40	1040	1040	8.2	5.8	1	1
11-Aug	141	5	JS-2923	3	360	41	14:45	15:10	15:45	62	101	41	41	1003	1003	7.1	5.8	1	1
11-Aug	142	5	NR				14:45	15:14			101	42	42					1	
12-Aug	143	1	JS-2911	4	640	59	6:40	06:49	8:25	61	101	43	43	1004	1004	4.6	3.2	2	1
12-Aug	144	1	NR				6:40	07:08			101	44	44			2.9	2.2	1	
12-Aug	145	1	JS-2911	42	400	108	6:40	07:01	8:25	59.5	101	45	45	1042	1042	13.8	13	2	1
12-Aug	146	1	JS-2911	43	400	38	6:40	07:08	8:25	64.8	101	46	46	1043	1043	12	9	1	1
12-Aug	147	1	JS-2911	44	780	45	6:40	07:12	8:25	57	101	47	47	1044	1044	12.3	10.9	1	1
12-Aug	148	1	NR				6:40	07:39			101	48	48			16.5	14.6	1	
12-Aug	149	1	JS-2911	46	440	113	6:40	07:29	8:25	59	101	49	49	1046	1046	18.4	17.1	2	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
12-Aug	150	1	JS-2911	47	360	70	6:40	07:35	8:25	61	101	50	50	1047	1047	14.5	14.2	2	1
12-Aug	151	1	JS-2911	48	640	35	6:40	07:39	9:10	58	101	51	51	1048	1048	6.8	4.5	2	1
12-Aug	152	1	JS-2911	49	400	40	6:40	07:44	8:25	54.5	101	52	52	1049	1049	10.6	9.9	3	1
12-Aug	153	1	JS-2911	50	780	44	6:40	07:51	8:25	62	101	53	53	1050	1050	6.9	5.4	2	1
12-Aug	154	1	JS-2911	51	320	90	6:40	07:55	8:25	59	101	54	54	1051	1051	20.3	16.3	1	1
12-Aug	155	1	JS-2911	52	440	100	6:40	08:03	8:25	59	101	55	55	1052	1052	16.8	10.9	2	1
12-Aug	156	1	JS-2911	53	360	21	6:40	08:07	8:25	59	101	56	56	1053	1053	13.8	10.9	1	1
12-Aug	157	1	JS-2911	54	640	43	6:40	08:11	8:25	60	101	57	57	1054	1054	14.9	12.1	1	1
12-Aug	158	2	JS-2923	55	400	98	09:05	09:23	10:55	59	101	58	58	1055	1055	7.9	5	1	1
12-Aug	159	2	NR				09:05	09:27			101	59	59			9.6	9.6	2	
12-Aug	160	2	JS-2923	57	320	70	09:05	09:33	10:55	65	101	60	60	1057	1057	11.3	9.6	1	1
12-Aug	161	2	JS-2923	58	440	16	09:05	09:37	10:55	59	102	1	61	1058	1058	15.9	11.6	2	1
12-Aug	162	2	JS-2923	59	360	4	09:05	09:43	10:55	66	102	2	62	1059	1059	9.1	7.2	2	1
12-Aug	163	2	JS-2923	60	640	32	09:05	09:47	10:55	63	102	3	63	1060	1060	9.7	7.2	2	1
12-Aug	164	2	JS-2923	61	400	100	09:05	09:52	10:55	58	102	4	64	1061	1061	11	7.7	3	1
12-Aug	165	2	JS-2923	62	780	50	09:05	09:56	10:55	61	102	5	65	1062	1062	11.7	9.4	2	1
12-Aug	166	2	JS-2923	63	320	43	09:05	09:59	10:55	57	102	6	66	1063	1063	14.2	18.6	2	1
12-Aug	167	2	NR				09:05				102	7	67			7.8	7.6	2	
12-Aug	168	2	JS-2923	65	360	63	09:05	10:11	10:55	63	102	8	68	1065	1065	13.2	11.5	2	1
12-Aug	169	2	JS-2923	66	640	79	09:05	10:15	10:55	63	102	9	69	1066	1066	11.6	11.3	2	1
12-Aug	170	2	JS-2923	67	400	65	09:05	10:20	10:55	59	102	10	70	1067	1067	6.7	5	2	1
12-Aug	171	2	JS-2923	68	780	88	09:05	10:24	10:55	63	102	11	71	1068	1068	13.2	15.7	2	1
12-Aug	172	2	JS-2923	69	320	69	09:05	10:30	10:55	64	102	12	72	1069	1069	10.8	9.5	2	1
12-Aug	173	2	JS-2923	70	440	93	09:05	10:34	10:55	59	102	13	73	1070	1070	18	13.8	2	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
12-Aug	174	2	JS-2923	71	360	6	09:05	10:41	10:55	59	102	14	74	1071	1071	13.8	11.1	2	1
12-Aug	175	4	JS-2923	72	360	42	12:45	13:00	14:10	65	102	15	75	1072	1072	14.4	12.1	2	1
12-Aug	176	5	JS-2923	73	640	85	14:00	14:13	15:34	59.5	102	16	76	1073	1073	8.1	6.8	2	1
12-Aug	177	5	JS-2923	74	400	64	14:00	14:17	15:34	60	102	17	77	1074	1074	14.6	13.9	2	1
12-Aug	178	5	NR				14:00	14:26			102	18	78			8.4	6.3	2	
12-Aug	179	5	JS-2923	76	320	68	14:00	14:26	15:34	55	102	19	79	1076	1076	17.1	12.5	1	1
12-Aug	180	5	JS-2923	77	440	71	14:00	14:30	15:34	56	102	20	80	1077	1077	8.7	7.3	1	1
12-Aug	181	5	JS-2923	78	360	22	14:00	14:34	15:34	66	102	21	81	1078	1078	5.9	4.7	1	1
12-Aug	182	5	JS-2923	79	640	57	14:00	14:38	15:34	62	102	22	82	1079	1079	2.9	2.1	1	1
12-Aug	183	5	NR				14:00	14:42			102	23	83			4.5	3.7	1	
12-Aug	184	5	JS-2923	81	780	21	14:00	14:47	15:34	63	102	24	84	1081	1081	12.2	10.2	2	1
12-Aug	185	5	JS-2923	82	320	87	14:00	14:50	15:34	62	102	25	85	1082	1082	3	1.9	1	1
12-Aug	186	5	JS-2923	83	440	65	14:00	14:53	15:34	53	102	26	86	1083	1083	16.9	12	1	1
12-Aug	187	5	JS-2923	84	360	46	14:00	14:58	15:34	59	102	27	87	1084	1084	11.5	9.8	1	1
12-Aug	188	5	JS-2923	85	640	50	14:00	15:02	15:34	63	102	28	88	1085	1085	10.2	7.5	1	1
12-Aug	189	5	JS-2923	86	400	26	14:00	15:06	15:34	59	102	29	89	1086	1086	9.4	8.2	1	1
12-Aug	190	5	JS-2911	87	780	71	14:00	12:12	15:45	63	102	30	90	1087	1087	4	3.4	1	1
12-Aug	191	5	JS-2911	88	320	18	14:00	15:17	15:45	64	102	31	91	1088	1088	6.7	4.7	1	1
12-Aug	192	5	JS-2911	89	440	14	14:00	15:20	15:45	65	102	32	92	1089	1089	13.9	10.3	1	1
12-Aug	193	6	JS-2923	90	360	24	16:15	16:35	17:30	68	102	33	93	1090	1090	7.3	8.6	2	1
12-Aug	194	6	JS-2923	91	640	70	16:15	16:38	17:30	64	102	34	94	1091	1091	10.5	8.8	1	2
12-Aug	195	6	JS-2923	41	640	12	16:15	16:42	17:30	62	102	35	95	1041	1041	10.3	8.3	1	1
12-Aug	196	6	JS-2923	45	320	89	16:15	16:45	17:30	66	102	36	96	1045	1045	3.6	2.3	1	1
12-Aug	197	6	JS-2923	56	780	77	16:15	16:49	17:30	60	102	37	97	1056	1056	11.4	10.7	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
12-Aug	198	6	JS-2923	64	440	18	16:15	16:53	17:30	62	102	38	98	1064	1064	7.1	5.6	1	1
12-Aug	199	6	JS-2923	75	320	80	16:15	16:56	17:30	64	102	39	99	1075	1075	12.6	10.2	1	1
12-Aug	200	6	JS-2923	80	400	41	16:15	16:59	17:30	59	102	40	100	1080	1080	13.6	11.5	1	1
13-Aug	201	1	JS-2923	92	400	42	06:30	06:48	8:10	62	102	41	101	1092	1092	10.9	7.8	2	1
13-Aug	202	1	JS-2923	93	780	35	06:30	06:52	8:10	65	102	42	102	1093	1093	12.3	10.9	1	2
13-Aug	203	1	NR				06:30	06:55			102	43	103			7.6	4.6	1	
13-Aug	204	1	JS-2923	95	440	8	06:30	07:00	8:10	59	102	44	104	1095	1095	11.8	8.4	1	1
13-Aug	205	1	JS-2923	96	360	23	06:30	07:03	8:10	63	102	45	105	1096	1096	12.4	9	1	1
13-Aug	206	1	JS-2923	97	640	76	06:30	07:07	8:10	65	102	46	106	1097	1097	11.1	9.3	1	1
13-Aug	207	1	NR				06:30	07:10			102	47	107			10.5	9.9	3	
13-Aug	208	1	JS-2923	99	780	36	06:30	07:15	8:10	63	102	48	108	1099	1099	10.9	9.9	1	1
13-Aug	209	1	JS-2923	100	320	33	06:30	07:18	8:10	60	102	49	109	1100	1100	15.7	12.6	2	1
13-Aug	210	1	JS-2923	101	320	66	06:30	07:23	8:10	59	102	50	110	1101	1101	18.7	14.4	1	1
13-Aug	211	1	JS-2923	102	440	108	06:30	07:27	8:10	60	102	51	111	1102	1102	13.9	9.5	1	1
13-Aug	212	1	JS-2923	103	360	8	06:30	07:31	8:10	63	102	52	112	1103	1103	8.6	5.8	2	1
13-Aug	213	1	JS-2923	104	400	19	06:30	07:34	8:10	60	102	53	113	1104	1104	5.9	3.8	2	1
13-Aug	214	1	JS-2923	105	640	66	06:30	07:37	8:10	59	102	54	114	1105	1105	9.9	6.8	2	1
13-Aug	215	1	JS-2923	106	780	13	06:30	07:45	8:10	59	102	55	115	1106	1106	18.9	16.9	2	1
13-Aug	216	1	JS-2923	107	320	64	06:30	07:51	8:10	63	102	56	116	1107	1107	15.2	11.2	1	1
13-Aug	217	1	JS-2923	108	440	67	06:30	07:55	8:10	61	102	57	117	1108	1108	7.1	5.4	2	2
13-Aug	218	1	JS-2923	109	360	109	06:30	07:58	8:10	61	102	58	118	1109	1109	14.8	11	2	1
13-Aug	219	2	JS-3000	110	640	72	08:40	09:24	10:43	63	102	59	119	1110	1110	6.6	6.6	1	1
13-Aug	220	2	JS-3000	111	400	7	08:40	09:28	10:43	62	102	60	120	1111	1111	16.5	15.6	1	1
13-Aug	221	2	JS-3000	112	780	14	08:40	09:31	10:43	59	103	1	121	1112	1112	15.8	12.3	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
13-Aug	222	2	JS-3000	113	320	4	08:40	09:37	10:43	62	103	2	122	1113	1113	9.6	7.8	3	1
13-Aug	223	2	JS-3000	114	440	66	08:40	09:39	10:43	60	103	3	123	1114	1114	11.5	11.1	2	1
13-Aug	224	2	JS-3000	115	360	35	08:40	09:42	10:43	63	103	4	124	1115	1115	12.9	9.6	1	1
13-Aug	225	2	JS-3000	116	640	65	08:40	09:45	10:43	61	103	5	125	1116	1116	8.7	6.7	2	2
13-Aug	226	2	JS-3000	117	400	8	08:40	09:50	10:43	63	103	6	126	1117	1117	10.7	8.5	2	1
13-Aug	227	2	JS-3000	118	780	69	08:40	09:53	10:43	61	103	7	127	1118	1118	13.9	9.4	3	2
13-Aug	228	2	JS-3000	119	320	7	08:40	09:56	10:43	63	103	8	128	1119	1119	12.4	8.5	1	1
13-Aug	229	2	NR				08:40	09:59			103	9	129			14.2	14.4	1	
13-Aug	230	2	JS-3000	121	360	36	08:40	10:03	10:43	62	103	10	130	1121	1121	11	8.4	2	1
13-Aug	231	2	JS-3000	122	640	37	08:40	10:05	10:43	60	103	11	131	1122	1122	15.6	12.2	1	1
13-Aug	232	2	JS-3000	123	400	9	08:40	10:08	10:43	60	103	12	132	1123	1123	10.5	8	2	1
13-Aug	233	2	JS-3000	124	780	68	08:40	10:12	10:43	62	103	13	133	1124	1124	9.5	8.3	3	1
13-Aug	234	2	NR				08:40	10:17			103	14	134			20.6	16.8	2	
13-Aug	235	2	JS-3000	126	320	106	08:40	10:21	10:43	63	103	15	135	1126	1126	13.8	12.1	1	1
13-Aug	236	3	JS-2923	127	440	36	11:40	12:19	13:35	58	103	16	136	1127	1127	11.8	10.3	1	1
13-Aug	237	3	JS-2923	128	360	69	11:40	12:25	13:35	57.5	103	17	137	1128	1128	14	12.1	1	1
13-Aug	238	3	JS-2923	129	640	49	11:40	12:28	13:35	62	103	18	138	1129	1129	9.3	7.6	2	1
13-Aug	239	3	JS-2923	130	400	17	11:40	12:31	13:35	57	103	19	139	1130	1130	13.9	10.7	1	1
13-Aug	240	3	JS-2923	131	780	11	11:40	12:34	13:35	60	103	20	140	1131	1131	11.1	8.3	1	1
13-Aug	241	3	NR				11:40	12:40			103	21	141			15.1	11.5	1	
13-Aug	242	3	JS-2923	133	440	79	11:40	12:49	13:35	55	103	22	142	1133	1133	12.5	9.4	2	1
13-Aug	243	3	JS-2923	134	360	71	11:40	12:52	13:35	60	103	23	143	1134	1134	12.1	9.4	2	1
13-Aug	244	3	JS-2923	135	640	29	11:40	12:55	13:35	60	103	24	144	1135	1135	11.8	11.1	2	1
13-Aug	245	3	JS-2923	136	400	16	11:40	12:57	13:35	58	103	25	145	1136	1136	13.9	9.9	1	2

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
13-Aug	246	3	JS-2923	137	780	24	11:40	13:00	13:35	65	103	26	146	1137	1137	3.3	3.5	2	1
13-Aug	247	3	JS-2923	138	320	78	11:40	13:12	13:35	58	103	27	147	1138	1138	12.6	11	1	1
13-Aug	248	3	JS-2923	139	440	70	11:40	13:16	13:35	57	103	28	148	1139	1139	11.2	10.1	1	2
13-Aug	249	4	JS-2923	140	360	86	14:15	14:45	15:40	65	103	29	149	1140	1140	8.3	6.6	1	1
13-Aug	250	4	JS-2923	141	640	73	14:15	14:48	15:40	61	103	30	150	1141	1141	7	5.8	2	1
13-Aug	251	4	JS-2923	142	320	101	14:15	14:50	15:40	60	103	31	151	1142	1142	13	10.3	1	1
13-Aug	252	4	NR				14:15	14:54			103	32	152			7.4	6.8	1	
13-Aug	253	4	JS-2923	144	780	39	14:15	14:56	15:40	56	103	33	153	1144	1144	12.8	10.6	1	1
13-Aug	254	4	JS-2923	145	320	67	14:15	15:00	15:40	58	103	34	154	1145	1145	10.5	10.2	1	1
13-Aug	255	4	NR				14:15	15:05			103	35	155			15.5	16.1	1	
13-Aug	256	4	JS-2923	147	360	9	14:15	15:08	15:40	62	103	36	156	1147	1147	11.3	9.8	1	1
13-Aug	257	4	JS-2923	148	640	112	14:15	15:11	15:40	57	103	37	157	1148	1148	13.3	12.3	1	1
13-Aug	258	4	JS-2923	149	400	20	14:15	15:15	15:40	60	103	38	158	1149	1149	7.8	7.1	1	1
13-Aug	259	4	JS-2923	150	780	12	14:15	15:18	15:40	58	103	39	159	1150	1150	9.6	7.1	1	1
13-Aug	260	4	NR				14:15	15:21			103	40	160			13.8	13.4	1	
13-Aug	261	4	NR				14:15	15:28			103	41	161			11.4	9.6	1	
13-Aug	262	4	JS-2923	153	360	76	14:15	15:32	15:40	60	103	42	162	1153	1153	5.8	3.4	1	1
13-Aug	263	5	JS-2920	154	640	111	16:40	17:12	18:15	69	103	43	163	1154	1154	7.3	5	1	1
13-Aug	264	5	JS-2920	155	400	73	16:40	17:15	18:15	58	103	44	164	1155	1155	13.4	10	1	1
13-Aug	265	5	JS-2920	94	320	17	16:40	17:20	18:15	60	103	45	165	1094	1094	9.9	7.9	1	1
13-Aug	266	5	JS-2920	98	400	34	16:40	17:24	18:15	60	103	46	166	1098	1098	17.6	15	1	1
13-Aug	267	5	JS-2920	120	440	106	16:40	17:28	18:15	61	103	47	167	1120	1120	11.3	9.4	2	2
13-Aug	268	5	JS-2920	125	320	45	16:40	17:32	18:15	62	103	48	168	1125	1125	7.1	7.1	1	1
13-Aug	269	5	JS-2920	132	320	103	16:40	17:36	18:15	63	103	49	169	1132	1132	12	10.2	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
13-Aug	270	5	JS-2920	152	440	94	16:40	17:42	18:15	63	103	50	170	1152	1152	11.1	8.2	1	1
13-Aug	271	5	NR				16:40	17:47			103	51	171			7.8	4.8	1	
13-Aug	272	5	JS-2920	146	440	76	16:40	17:50	18:15	64	103	52	172	1146	1146	8.9	6.2	2	1
13-Aug	273	5	JS-2920	151	320	107	16:40	17:55	18:15	60	103	53	173	1151	1151	13.1	10.3	1	1
14-Aug	274	1	JS-3000	143	400	15	06:30	06:52	8:20	59	103	54	174	1143	1143	4.8	8.2	1	1
14-Aug	275	1	NR				06:30	06:54			103	55	175			12.7	9.2	1	
14-Aug	276	1	JS-3000	157	320	91	06:30	06:57	8:20	61	103	56	176	1157	1157	8.4	9.4	1	1
14-Aug	277	1	JS-3000	158	440	107	06:30	07:00	8:20	60	103	57	177	1158	1158	1.8	1.3	1	1
14-Aug	278	1	JS-3000	159	360	112	06:30	07:03	8:20	62	103	58	178	1159	1159	10.3	7.3	1	1
14-Aug	279	1	NR				06:30	07:06			103	59	179			12.3	7.4	1	
14-Aug	280	1	JS-3000	161	400	95	06:30	07:10	8:20	62	103	60	180	1161	1161	11.4	8.2	1	1
14-Aug	281	1	NR				06:30	07:14			104	1	181			4.1	2.4	1	
14-Aug	282	1	JS-3000	163	320	65	06:30	07:18	8:20	60	104	2	182	1163	1163	10.5	6.9	1	1
14-Aug	283	1	JS-3000	164	440	19	06:30	07:22	8:20	58	104	3	183	1164	1164	13.8	12.1	1	1
14-Aug	284	1	JS-3000	165	360	34	06:30	07:24	8:20	61	104	4	184	1165	1165	14.1	11.5	1	1
14-Aug	285	1	JS-3000	166	640	68	06:30	07:27	8:20	61	104	5	185	1166	1166	10.4	8	1	2
14-Aug	286	1	JS-3000	167	400	5	06:30	07:31	8:20	60	104	6	186	1167	1167	16.9	13.9	1	1
14-Aug	287	1	JS-3000	168	780	37	06:30	07:35	8:20	60	104	7	187	1168	1168	16.1	13.3	1	2
14-Aug	288	1	JS-3000	169	320	81	06:30	07:38	8:20	65	104	8	188	1169	1169	9.2	8.5	1	2
14-Aug	289	1	JS-3000	170	440	20	06:30	07:43	8:20	63	104	9	189	1170	1170	12.6	10.5	1	1
14-Aug	290	1	JS-3000	171	360	79	06:30	07:47	8:20	59	104	10	190	1171	1171	14.6	13.8	1	1
14-Aug	291	1	JS-3000	172	640	42	06:30	07:51	8:20	60	104	11	191	1172	1172	14.4	11.9	1	1
14-Aug	292	2	JS-3001	173	400	47	09:00	09:25	10:50	59	104	12	192	1173	1173	13.1	10	1	1
14-Aug	293	2	JS-3001	174	780	23	09:00	09:29	10:50	61	104	13	193	1174	1174	15.5	13.1	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
14-Aug	294	2	JS-3001	175	320	83	09:00	09:34	10:50	60	104	14	194	1175	1175	11.6	9.4	1	1
14-Aug	295	2	JS-3001	176	320	92	09:00	09:37	**11:05**	65	104	15	195	1176	1176	13.8	11.2	1	1
14-Aug	296	2	JS-3001	177	440	69	09:00	09:41	10:50	59	104	16	196	1177	1177	15.6	13.1	1	1
14-Aug	297	2	JS-3001	178	360	73	09:00	09:43	10:50	62	104	17	197	1178	1178	5.9	5.3	1	1
14-Aug	298	2	JS-3001	179	640	44	09:00	09:48	10:50	58	104	18	198	1179	1179	15.1	13	1	1
14-Aug	299	2	JS-3001	180	400	18	09:00	09:54	10:50	64	104	19	199	1180	1180	10.5	11.4	1	1
14-Aug	300	2	JS-3001	181	780	53	09:00	09:57	10:50	62	104	20	200	1181	1181	10.5	9.2	1	1
14-Aug	301	2	JS-3001	182	320	98	09:00	10:02	10:50	58	104	21	201	1182	1182	13.8	11.5	1	2
14-Aug	302	2	JS-3001	183	440	80	09:00	10:06	10:50	65	104	22	202	1183	1183	8.2	7.1	1	1
14-Aug	303	2	JS-3001	184	360	78	09:00	10:10	10:50	59	104	23	203	1184	1184	11.5	7.5	1	1
14-Aug	304	2	JS-3001	185	640	64	09:00	10:12	10:50	63	104	24	204	1185	1185	12.1	11.3	1	1
14-Aug	305	2	JS-3001	186	400	112	09:00	10:15	10:50	60	104	25	205	1186	1186	10.1	7.3	1	1
14-Aug	306	2	JS-3001	187	780	79	09:00	10:20	10:50	63	104	26	206	1187	1187	10.2	8.4	1	1
14-Aug	307	2	JS-3001	188	320	108	09:00	10:23	10:50	57	104	27	207	1188	1188	11.8	9.6	1	1
14-Aug	308	2	JS-3001	189	440	68	09:00	10:28	10:50	56	104	28	208	1189	1189	10.7	10	2	1
14-Aug	309	3	JS-2923	190	640	22	11:45	12:35	14:00	64	104	29	209	1190	1190	0.8	0.8	1	1
14-Aug	310	3	JS-2923	191	400	74	11:45	12:41	14:00	58	104	30	210	1191	1191	7.8	6.4	1	1
14-Aug	311	3	JS-2923	192	780	38	11:45	12:47	14:00	60	104	31	211	1192	1192	10.9	8.5	1	1
14-Aug	312	3	JS-2923	193	320	94	11:45	12:51	14:00	62	104	32	212	1193	1193	11.7	8.5	1	1
14-Aug	313	3	JS-2923	194	440	115	11:45	12:55	14:00	61	104	33	213	1194	1194	12.2	8.9	1	1
14-Aug	314	3	JS-2923	195	360	111	11:45	13:00	14:00	60	104	34	214	1195	1195	5.1	3	1	1
14-Aug	315	3	JS-2923	196	640	113	11:45	13:03	14:00	59	104	35	215	1196	1196	8.2	6.3	2	1
14-Aug	316	3	JS-2923	197	400	72	11:45	13:06	14:00	59	104	36	216	1197	1197	7.8	5.8	2	1
14-Aug	317	3	JS-2923	198	780	18	11:45	13:09	14:00	59	104	37	217	1198	1198	11	9.7	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
14-Aug	318	3	JS-2923	199	320	104	11:45	13:12	14:00	56	104	38	218	1199	1199	7	5.6	1	1
14-Aug	319	3	JS-2923	200	440	37	11:45	13:15	14:00	55	104	39	219	1200	1200	11	10	1	1
14-Aug	320	3	JS-2923	201	320	3	11:45	13:18	14:00	61	104	40	220	1201	1201	12.9	9.2	2	1
14-Aug	321	3	JS-2923	202	440	52	11:45	13:22	14:00	63	104	41	221	1202	1202	6	5.7	1	1
14-Aug	322	3	JS-2923	203	360	104	11:45	13:30	14:00	60	104	42	222	1203	1203	11.1	10.9	1	1
14-Aug	323	4	JS-2923	204	360	99	15:00	15:24	16:55	65	104	43	223	1204	1204	7.1	6.4	2	1
14-Aug	324	4	JS-2923	205	640	61	15:00	15:26	16:55	59	104	44	224	1205	1205	4.9	3	1	1
14-Aug	325	4	JS-2923	206	400	12	15:00	15:30	16:55	60	104	45	225	1206	1206	5	4.3	1	1
14-Aug	326	4	JS-2923	207	780	76	15:00	15:33	16:55	57	104	46	226	1207	1207	8.5	6.5	1	1
14-Aug	327	4	JS-2923	208	320	35	15:00	15:36	16:55	63.5	104	47	227	1208	1208	11.9	10.5	1	1
14-Aug	328	4	JS-2923	209	440	40	15:00	15:38	16:55	62	104	48	228	1209	1209	13.4	10.5	1	1
14-Aug	329	4	JS-2923	210	360	105	15:00	15:42	16:55	56	104	49	229	1210	1210	10.2	8.5	1	1
14-Aug	330	4	JS-2923	211	640	60	15:00	15:48	16:55	61	104	50	230	1211	1211	13.1	12.5	1	1
14-Aug	331	4	JS-2923	212	400	21	15:00	15:52	16:55	61	104	51	231	1212	1212	10.7	9.3	1	1
14-Aug	332	4	NR				15:00	16:01			104	52	232			15	12.7	1	
14-Aug	333	6	JS-3000	214	320	61	17:30	17:48	18:30	57	104	53	233	1214	1214	8.9	7.4	1	1
14-Aug	334	6	JS-3000	215	440	39	17:30	17:51	18:30	65	104	54	234	1215	1215	2.2	2	1	1
14-Aug	335	6	JS-3000	216	360	87	17:30	17:54	18:30	56	104	55	235	1216	1216	9.7	6.1	1	2
14-Aug	336	6	JS-3000	217	640	62	17:30	17:58	18:30	60	104	56	236	1217	1217	9.9	7.4	1	1
14-Aug	337	6	JS-3000	218	400	24	17:30	18:01	18:30	59	104	57	237	1218	1218	12.6	10.7	1	1
14-Aug	338	6	JS-3000	219	780	73	17:30	18:04	18:30	60	104	58	238	1219	1219	8.3	6.9	1	1
14-Aug	339	6	JS-3000	220	320	102	17:30	18:09	18:30	65	104	59	239	1220	1220	4.9	3.7	2	1
15-Aug	340	1	JS-3000	156	780	16	06:27	07:05	8:35	59	104	60	240	1156	1156	9.7	7	1	1
15-Aug	341	1	JS-3000	160	640	31	06:27	07:08	8:35	59	105	1	241	1160	1160	12.5	10.7	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
15-Aug	342	1	JS-2922	162	780	17	06:27	07:13	7:14	59	105	2	242	1162	1162	9.6	7.6	1	1
15-Aug	343	1	JS-3000	213	780	47	06:27	07:17	8:35	58	105	3	243	1213	1213	11.5	9.2	1	1
15-Aug	344	1	JS-3000	221	440	78	06:27	07:20	8:35	60	105	4	244	1221	1221	7.3	5.7	1	1
15-Aug	345	1	JS-3000	222	360	68	06:27	07:26	8:35	62	105	5	245	1222	1222	13.3	9.6	1	1
15-Aug	346	1	JS-3000	223	640	55	06:27	07:29	8:35	62	105	6	246	1223	1223	9.6	7.9	1	1
15-Aug	347	1	JS-3000	224	400	14	06:27	07:32	8:35	63	105	7	247	1224	1224	7.2	6.6	1	1
15-Aug	348	1	JS-3000	225	780	80	06:27	07:36	8:35	61	105	8	248	1225	1225	12.9	11.6	1	1
15-Aug	349	1	JS-3000	226	320	105	06:27	07:39	8:35	62	105	9	249	1226	1226	14.4	12.6	1	2
15-Aug	350	1	JS-3000	227	440	87	06:27	07:43	8:35	56	105	10	250	1227	1227	9.2	6.6	1	1
15-Aug	351	1	JS-3000	228	360	97	06:27	07:47	8:35	63	105	11	251	1228	1228	16	13.4	1	1
15-Aug	352	1	JS-3000	229	640	77	06:27	07:52	8:35	62	105	12	252	1229	1229	6.6	5.4	1	1
15-Aug	353	1	JS-3000	230	400	23	06:27	07:55	8:35	61	105	13	253	1230	1230	14	12.3	1	1
15-Aug	354	1	JS-3000	231	360	95	06:27	07:58	8:35	62	105	14	254	1231	1231	18.8	15.5	1	1
15-Aug	355	1	JS-3000	232	780	64	06:27	08:07	8:35	62	105	15	255	1232	1232	8.3	7.5	2	3
15-Aug	356	1	JS-3000	233	320	100	06:27	08:11	8:35	63	105	16	256	1233	1233	14.2	12.5	1	1
15-Aug	357	2	JS-2923	234	440	55	09:25	09:47	11:20	64	105	17	257	1234	1234	10.1	7.6	1	1
15-Aug	358	2	JS-2923	235	360	84	09:25	09:49	11:20	62	105	18	258	1235	1235	12.4	13.2	1	1
15-Aug	359	2	JS-2923	236	640	69	09:25	09:52	11:20	65	105	19	259	1236	1236	10.5	10	1	1
15-Aug	360	2	JS-2923	237	400	33	09:25	09:54	11:20	62	105	20	260	1237	1237	7.9	6.9	1	1
15-Aug	361	2	NR				09:25	09:57			105	21	261			8	6.4	1	
15-Aug	362	2	JS-2923	239	320	96	09:25	10:01	11:20	60	105	22	262	1239	1239	14.4	11.9	1	1
15-Aug	363	2	JS-2923	240	440	49	09:25	10:03	11:20	57	105	23	263	1240	1240	15.4	12.6	1	1
15-Aug	364	2	JS-2923	241	360	74	09:25	10:05	11:20	61	105	24	264	1241	1241	7.1	5.5	1	1
15-Aug	365	2	JS-2923	242	640	71	09:25	10:16	11:20	63	105	25	265	1242	1242	10.1	9.6	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
15-Aug	366	2	JS-2923	243	400	13	09:25	10:19	11:20	63	105	26	266	1243	1243	6.3	4.6	1	1
15-Aug	367	2	JS-2923	244	640	74	09:25	10:22	11:20	60	105	27	267	1244	1244	15.8	13.6	1	1
15-Aug	368	2	JS-2923	245	780	52	09:25	10:25	11:20	59	105	28	268	1245	1245	8.9	6.2	1	1
15-Aug	369	2	JS-2923	246	320	34	09:25	10:29	11:20	57	105	29	269	1246	1246	15.1	13.8	1	1
15-Aug	370	2	NR				09:25	10:32			105	30	270			8.1	7.1	1	
15-Aug	371	2	JS-2923	248	360	83	09:25	10:36	11:20	64	105	31	271	1248	1248	14.4	13.8	1	1
15-Aug	372	2	JS-2923	249	400	32	09:25	10:40	11:20	61	105	32	272	1249	1249	12.9	9.6	1	1
15-Aug	373	2	JS-2923	250	640	67	09:25	10:44	11:20	61	105	33	273	1250	1250	8.2	7.4	1	1
15-Aug	374	2	JS-2923	251	320	48	09:25	10:48	11:20	61	105	34	274	1251	1251	10.7	9.7	1	1
15-Aug	375	2	NR				09:25				105	35	275					1	
15-Aug	376	2	JS-2923	253	360	3	09:25	10:53	11:20	57	105	36	276	1253	1253	10.8	8.5	1	1
15-Aug	377	3	JS-2923	254	640	88	12:05	12:26	14:10	58	105	37	277	1254	1254	10.5	7.4	1	1
15-Aug	378	3	JS-2923	255	400	36	12:05	12:32	14:10	62	105	38	278	1255	1255	11.8	9.7	1	1
15-Aug	379	3	JS-2923	256	780	90	12:05	12:37	14:10	59	105	39	279	1256	1256	13.1	9.5	1	1
15-Aug	380	3	JS-2923	257	320	42	12:05	12:40	14:10	59	105	40	280	1257	1257	8.9	7.7	1	1
15-Aug	381	3	JS-2923	258	440	77	12:05	12:45	14:10	61	105	41	281	1258	1258	11.9	11	1	1
15-Aug	382	3	JS-2923	259	360	33	12:05	12:49	14:10	59	105	42	282	1259	1259	10.1	9.6	1	1
15-Aug	383	3	JS-2923	260	640	86	12:05	12:53	14:10	60	105	43	283	1260	1260	13.6	11.4	1	1
15-Aug	384	3	JS-2923	261	400	97	12:05	12:58	14:10	61	105	44	284	1261	1261	8	7.4	1	1
15-Aug	385	3	JS-2923	262	780	33	12:05	13:01	14:10	57	105	45	285	1262	1262	8.4	6	1	1
15-Aug	386	3	JS-2923	263	320	77	12:05	13:05	14:10	59	105	46	286	1263	1263	5	3.7	1	1
15-Aug	387	3	JS-2923	264	440	62	12:05	13:08	14:10	60	105	47	287	1264	1264	11.1	8	1	1
15-Aug	388	3	JS-2923	265	360	62	12:05	13:12	14:10	60	105	48	288	1265	1265	8.5	7.6	1	1
15-Aug	389	3	JS-2923	266	640	87	12:05	13:14	14:10	59	105	49	289	1266	1266	12.6	9.3	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
15-Aug	390	3	JS-2923	267	400	99	12:05	13:17	14:10	60	105	50	290	1267	1267	11.9	11.2	1	1
15-Aug	391	3	JS-2923	268	780	40	12:05	13:20	14:10	62	105	51	291	1268	1268	10.4	9.8	1	1
15-Aug	392	3	JS-2923	269	320	97	12:05	13:23	14:10	60	105	52	292	1269	1269	15.8	12	1	1
15-Aug	393	3	JS-2923	270	440	28	12:05	13:27	14:10	59	105	53	293	1270	1270	12.5	11.8	1	1
15-Aug	394	3	JS-2923	271	360	54	12:05	13:31	14:10	58	105	54	294	1271	1271	6.8	4.8	1	1
15-Aug	395	3	JS-2923	272	640	110	12:05	13:37	14:10	59	105	55	295	1272	1272	10.2	7	2	1
15-Aug	396	3	JS-2923	273	400	62	12:05	13:41	14:10	63	105	56	296	1273	1273	11.9	10.2	1	1
15-Aug	397	4	NR				14:55	15:28			105	57	297			14.8	13.5	1	
15-Aug	398	4	JS-2923	275	320	55	14:55	15:31	17:02	62	105	58	298	1275	1275	9.4	8.2	1	1
15-Aug	399	4	JS-2923	276	320	32	14:55	15:34	17:02	59	105	59	299	1276	1276	12.5	11.1	1	1
15-Aug	400	4	JS-2923	277	440	81	14:55	15:38	17:02	64	105	60	300	1277	1277	7.7	6.5	1	1
15-Aug	401	4	JS-2923	278	360	5	14:55	15:41	17:02	57	106	1	301	1278	1278	8	5.9	1	1
15-Aug	402	4	JS-2923	279	640	36	14:55	15:44	17:02	55	106	2	302	1279	1279	9.8	8.5	1	1
15-Aug	403	4	JS-2923	280	400	71	14:55	15:51	17:02	56	106	3	303	1280	1280	11.1	7.9	1	1
15-Aug	404	4	JS-2923	281	780	78	14:55	15:57	17:02	58	106	4	304	1281	1281	5.7	4.5	1	1
15-Aug	405	4	JS-2923	282	320	93	14:55	16:00	17:02	64	106	5	305	1282	1282	8.9	7.1	1	1
15-Aug	406	4	JS-2923	283	440	99	14:55	16:04	17:02	59	106	6	306	1283	1283	16.6	13.8	1	1
15-Aug	407	4	JS-2923	284	360	26	14:55	16:06	17:02	59	106	7	307	1284	1284	11.6	7.9	1	1
15-Aug	408	4	JS-2923	285	640	26	14:55	16:09	17:02	62	106	8	308	1285	1285	7.9	7.1	1	1
15-Aug	409	4	JS-2923	286	400	66	14:55	16:13	17:02	60	106	9	309	1286	1286	13.4	10.4	1	1
15-Aug	410	4	JS-2923	287	780	66	14:55	16:19	17:02	63	106	10	310	1287	1287	10.9	10.7	1	1
15-Aug	411	4	JS-2923	288	320	31	14:55	16:22	17:02	60	106	11	311	1288	1288	17	15	1	1
15-Aug	412	4	JS-2923	289	440	54	14:55	16:25	17:02	60	106	12	312	1289	1289	13.8	11.5	1	1
15-Aug	413	4	JS-2923	290	360	32	14:55	16:29	17:02	64	106	13	313	1290	1290	11.9	11.5	2	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
15-Aug	414	4	JS-2923	291	640	15	14:55	16:33	17:02	64	106	14	314	1291	1291	7.9	7.3	1	1
15-Aug	415	5	NR				17:40	18:06			106	15	315			13.8	11.1	1	
15-Aug	416	5	JS-3000	293	780	32	17:40	18:09	19:35	60	106	16	316	1293	1293	11.5	10.9	1	1
15-Aug	417	5	JS-3000	294	320	63	17:40	18:17	19:35	59	106	17	317	1294	1294	9.2	7.5	1	1
15-Aug	418	5	JS-3000	295	440	13	17:40	18:20	19:35	59	106	18	318	1295	1295	7.3	10.8	1	1
15-Aug	419	5	JS-3000	296	360	110	17:40	18:25	19:35	58	106	19	319	1296	1296	8.7	7	1	1
15-Aug	420	5	JS-3000	297	640	89	17:40	18:31	19:35	60	106	20	320	1297	1297	11.3	8.5	1	1
15-Aug	421	5	JS-3000	298	400	67	17:40	18:39	19:35	60	106	21	321	1298	1298	12	10.8	1	1
15-Aug	422	5	JS-3000	299	780	41	17:40	18:44	19:35	64	106	22	322	1299	1299	8.4	7.4	1	1
15-Aug	423	5	JS-3000	300	320	62	17:40	18:47	19:35	62	106	23	323	1300	1300	6.7	4.8	1	1
15-Aug	424	5	JS-3000	301	320	39	17:40	18:52	19:35	60	106	24	324	1301	1301	10.3	6.9	1	1
15-Aug	425	5	JS-3000	302	440	61	17:40	18:55	19:35	61	106	25	325	1302	1302	8.3	6.7	1	1
15-Aug	426	5	JS-3000	238	780	43	17:40	19:03	19:35	59	106	26	326	1238	1238	10.2	6.9	1	1
19-Aug	427	1	JS-2923	247	440	53	06:55	07:02	8:18	59	106	27	327	1247	1247	8.8	6.5	1	1
19-Aug	428	1	JS-2923	274	780	91	06:55	07:05	8:18	58	106	28	328					1	1
19-Aug	429	1	JS-2923	292	400	63	06:55	07:07	8:18	62	106	29	329	1292	1292	6.3	5	1	1
19-Aug	430	1	JS-2923	303	360	48	06:55	07:09	8:18	61	106	30	330					1	1
19-Aug	431	1	JS-2923	304	640	24	06:55	07:12	8:18	62	106	31	331	1304	1304	11.2	8.8	1	1
19-Aug	432	1	JS-2923	305	400	61	06:55	07:15	8:18	63	106	32	332					1	1
19-Aug	433	1	JS-2923	306	780	29	06:55	07:17	8:18	63	106	33	333	1306	1306	1.7	1.1	1	2
19-Aug	434	1	JS-2923	307	320	49	06:55	07:19	8:18	62	106	34	334					1	1
19-Aug	435	1	JS-2923	308	440	64	06:55	07:21	8:18	58	106	35	335	1308	1308	15.3	11.2	1	1
19-Aug	436	1	JS-2923	309	360	16	06:55	07:25	8:18	61	106	36	336					1	1
19-Aug	437	1	JS-2923	310	640	4	06:55	07:32	8:18	61	106	37	337	1310	1310	10.5	10.7	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
19-Aug	438	1	JS-2923	311	400	10	06:55	07:37	8:18	59	106	38	338					1	1
19-Aug	439	1	JS-2923	312	320	13	06:55	07:39	8:18	60	106	39	339	1312	1312	9.3	6.1	1	1
19-Aug	440	1	JS-2923	313	440	110	06:55	07:42	8:18	59	106	40	340					1	1
19-Aug	441	1	JS-2923	314	360	50	06:55	07:48	8:18	63	106	41	341	1314	1314	5.5	2.5	1	1
20-Aug	442	1	JS-3000	315	640	100	06:50	07:04	8:30	59	106	42	342					1	2
20-Aug	443	1	JS-3000	316	400	60	06:50	07:09	8:30	65	106	43	343	1316	1316	13.2	10.6	1	1
20-Aug	444	1	JS-3000	317	780	65	06:50	07:12	8:30	59	106	44	344					1	1
20-Aug	445	1	JS-3000	318	320	14	06:50	07:13	8:30	62	106	45	345	1318	1318	7.9	6.5	1	1
20-Aug	446	1	JS-3000	319	440	105	06:50	07:19	8:30	62	106	46	346					1	1
20-Aug	447	1	JS-3000	320	360	49	06:50	07:23	8:30	63	106	47	347	1320	1320	6.7	4.3	1	1
20-Aug	448	1	JS-3000	321	640	104	06:50	07:27	8:30	61	106	48	348					1	1
20-Aug	449	1	JS-3000	322	400	59	06:50	07:28	8:30	58	106	49	349	1322	1322	10.3	6.9	1	1
20-Aug	450	1	JS-3000	323	320	16	06:50	07:32	8:30	56	106	50	350					2	1
20-Aug	451	1	JS-3000	324	440	63	06:50	07:33	8:30	58	106	51	351	1324	1324	9	6.9	1	1
20-Aug	452	1	JS-3000	325	360	93	06:50	07:36	8:30	60	106	52	352					1	1
20-Aug	453	1	JS-3000	326	320	9	06:50	07:39	8:30	55	106	53	353	1326	1326	8.4	5.5	1	1
20-Aug	454	1	JS-3000	327	440	111	06:50	07:41	8:30	56	106	54	354					1	1
20-Aug	455	1	JS-3000	328	360	98	06:50	07:43	8:30	59	106	55	355	1328	1328	12.1	9.6	1	1
20-Aug	456	1	JS-3000	329	640	101	06:50	07:46	8:30	59	106	56	356					1	1
20-Aug	457	1	JS-3000	330	400	68	06:50	07:50	8:30	65	106	57	357	1330	1330	7.5	5.1	1	1
20-Aug	458	1	JS-3000	331	780	55	06:50	07:52	8:30	57	106	58	358					1	1
20-Aug	459	1	JS-3000	332	320	74	06:50	07:57	8:30	56	106	59	359	1332	1332	10.7	8.4	1	1
20-Aug	460	1	JS-3000	333	440	112	06:50	08:00	8:30	59	106	60	360					2	1
20-Aug	461	1	JS-3000	334	360	12	06:50	08:02	8:30	62	107	1	361	1334	1334	9.4	6.2	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
20-Aug	462	2	JS-2923	335	640	106	09:30	09:40	11:00	61	107	2	362					1	1
20-Aug	463	2	JS-2923	336	400	58	09:30	09:43	11:00	59	107	3	363	1336	1336	12.3	10	1	1
20-Aug	464	2	JS-2923	337	320	8	09:30	09:45	11:00	57	107	4	364					1	1
20-Aug	465	2	JS-2923	338	440	44	09:30	09:47	11:00	55	107	5	365	1338	1338	10.7	9.6	1	1
20-Aug	466	2	JS-2923	339	360	15	09:30	09:50	11:00	58	107	6	366					1	1
20-Aug	467	2	JS-2923	340	640	20	09:30	09:53	11:00	60	107	7	367	1340	1340	5.1	3.4	1	1
20-Aug	468	2	JS-2923	341	400	57	09:30	09:56	11:00	60	107	8	368					1	1
20-Aug	469	2	JS-2923	342	320	37	09:30	09:58	11:00	58	107	9	369	1342	1342	12.7	9.8	1	1
20-Aug	470	2	JS-2923	343	440	41	09:30	10:01	11:00	55	107	10	370					1	1
20-Aug	471	2	JS-2923	344	360	94	09:30	10:03	11:00	61	107	11	371	1344	1344	9.9	8.4	1	1
20-Aug	472	2	JS-2923	345	640	16	09:30	10:06	11:00	60	107	12	372					1	1
20-Aug	473	2	JS-2923	346	400	11	09:30	10:08	11:00	58	107	13	373	1346	1346	12.2	10.7	1	1
20-Aug	474	2	JS-2923	347	780	61	09:30	10:09	11:00	63	107	14	374					1	1
20-Aug	475	2	JS-2923	348	440	6	09:30	10:12	11:00	56	107	15	375	1348	1348	13.1	10.1	1	1
20-Aug	476	2	JS-2923	349	360	10	09:30	10:14	11:00	59	107	16	376					1	1
20-Aug	477	2	JS-2923	350	640	105	09:30	10:17	11:00	61	107	17	377	1350	1350	13	11.2	1	1
20-Aug	478	2	JS-2923	351	440	95	09:30	10:19	11:00	59	107	18	378					2	1
20-Aug	479	2	JS-2923	352	360	107	09:30	10:22	11:00	60	107	19	379	1352	1352	8.4	8.2	2	1
20-Aug	480	2	JS-2923	353	640	84	09:30	10:25	11:00	58	107	20	380					1	1
20-Aug	481	2	JS-2923	354	400	107	09:30	10:28	11:00	58	107	21	381	1354	1354	7.5	5.7	1	1
20-Aug	482	2	JS-2923	355	320	38	09:30	10:31	11:00	60	107	22	382					2	1
20-Aug	483	2	JS-3002	356	440	96	09:30	10:35	**10:45**	62	107	23	383	1356	1356	4.8	3.5	1	1
20-Aug	484	3	JS-2923	357	360	108	11:45	12:07	12:33	55	107	24	384					1	1
20-Aug	485	3	JS-2923	358	640	9	11:45	12:10	12:33	60	107	25	385	1358	1358	9.9	6.8	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003..

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
20-Aug	486	3	JS-2923	359	400	77	11:45	12:19	12:33	60	107	26	386					1	1
20-Aug	487	4	JS-3001	360	780	63	13:15	13:28	15:05	62	107	27	387	1360	1360	5.8	3.6	1	1
20-Aug	488	4	JS-3001	361	320	26	13:15	13:30	15:05	57	107	28	388					1	1
20-Aug	489	4	JS-3001	362	440	43	13:15	13:33	15:05	64	107	29	389	1362	1362	5.8	4.3	1	1
20-Aug	490	4	JS-3001	363	360	18	13:15	13:38	15:05	63	107	30	390					1	1
20-Aug	491	4	JS-3001	364	640	92	13:15	13:40	15:05	63	107	31	391	1364	1364	6.3	5.3	1	1
20-Aug	492	4	JS-3001	365	440	42	13:15	13:43	15:05	58	107	32	392					1	1
20-Aug	493	4	JS-3001	366	360	17	13:15	13:45	15:05	56	107	33	393	1366	1366	9.2	8.3	1	1
20-Aug	494	4	JS-3001	367	640	47	13:15	13:48	15:05	57	107	34	394					1	1
20-Aug	495	4	JS-3001	368	400	54	13:15	13:50	15:05	64	107	35	395	1368	1368	7.2	5.3	2	1
20-Aug	496	4	JS-3001	369	320	72	13:15	13:53	15:05	61	107	36	396					1	1
20-Aug	497	4	JS-3001	370	440	59	13:15	13:56	15:05	63	107	37	397	1370	1370	10.8	9.4	1	1
20-Aug	498	4	JS-3001	371	360	19	13:15	14:00	15:05	60	107	38	398					1	1
20-Aug	499	4	JS-3001	372	640	91	13:15	14:02	15:05	60	107	39	399	1372	1372	8.4	6.4	1	1
20-Aug	500	4	JS-3001	373	400	113	13:15	14:04	15:05	57	107	40	400					1	1
20-Aug	501	4	JS-3001	374	320	73	13:15	14:07	15:05	57	107	41	401	1374	1374	13.8	11.1	1	1
20-Aug	502	4	JS-3001	375	440	85	13:15	14:12	15:05	60	107	42	402					1	1
21-Aug	503	1	JS-3000	376	440	60	06:25	06:37	8:10	60	107	43	403	1376	1376	10.2	6.9	1	1
21-Aug	504	1	JS-3000	377	360	20	06:25	06:44	8:10	61	107	44	404					1	1
21-Aug	505	1	JS-3000	378	640	90	06:25	06:46	8:10	66	107	45	405	1378	1378	9.4	6.2	1	1
21-Aug	506	1	JS-3000	379	400	111	06:25	06:49	8:10	63	107	46	406					1	1
21-Aug	507	1	JS-3000	380	320	71	06:25	06:51	8:10	64	107	47	407	1380	1380	10.9	9	2	1
21-Aug	508	1	JS-3000	381	440	72	06:25	06:54	8:10	62	107	48	408					2	1
21-Aug	509	1	JS-3000	382	360	96	06:25	06:57	8:10	70	107	49	409	1382	1382	6.4	5.3	2	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
21-Aug	510	1	JS-3000	383	640	78	06:25	07:00	8:10	64	107	50	410					1	1
21-Aug	511	1	JS-3000	384	400	53	06:25	07:02	8:10	64	107	51	411	1384	1384	6.2	5.7	2	1
21-Aug	512	1	JS-3000	385	320	76	06:25	07:05	8:10	69	107	52	412					2	1
21-Aug	513	1	JS-3000	386	440	91	06:25	07:07	8:10	65	107	53	413	1386	1386	4.5	3.9	2	1
21-Aug	514	1	JS-3000	387	360	92	06:25	07:10	8:10	65	107	54	414					2	1
21-Aug	515	1	JS-3000	388	640	81	06:25	07:12	8:10	66	107	55	415	1388	1388	9.4	8.4	1	1
21-Aug	516	1	JS-3000	389	400	55	06:25	07:14	8:10	62	107	56	416					1	1
21-Aug	517	1	JS-3000	390	320	99	06:25	07:17	8:10	65	107	57	417	1390	1390	8.4	6.1	1	1
21-Aug	518	1	JS-3000	391	440	5	06:25	07:20	8:10	61	107	58	418					2	1
21-Aug	519	1	JS-3000	392	360	88	06:25	07:22	8:10	63	107	59	419	1392	1392	16.2	15.1	1	1
21-Aug	520	1	JS-3000	393	640	97	06:25	07:25	8:10	65	107	60	420					3	1
21-Aug	521	1	JS-3000	394	780	62	06:25	07:28	8:10	63	108	1	421	1394	1394	5.4	3.4	2	1
21-Aug	522	1	JS-3000	395	440	3	06:25	07:38	8:10	60	108	2	422					1	1
21-Aug	523	1	JS-3000	396	360	91	06:25	07:46	8:10	68	108	3	423	1396	1396	4.6	3.7	2	1
21-Aug	524	2	JS-3000	397	640	80	08:55	09:21	10:30	65	108	4	424					1	1
21-Aug	525	2	JS-3000	398	400	104	08:55	09:23	10:30	65	108	5	425	1398	1398	4.4	4.2	1	1
21-Aug	526	2	JS-3000	399	320	12	08:55	09:26	10:30	62	108	6	426					1	1
21-Aug	527	2	JS-3000	400	440	84	08:55	09:29	10:30	61	108	7	427	1400	1400	12.7	11.8	2	1
21-Aug	528	2	JS-3000	401	320	15	08:55	09:32	10:30	63	108	8	428					2	1
21-Aug	529	2	JS-3000	402	440	22	08:55	09:49	10:30	62	108	9	429	1402	1402	10.7	10.5	2	1
21-Aug	530	2	JS-3000	403	360	90	08:55	09:52	10:30	65	108	10	430					1	1
21-Aug	531	2	JS-3000	404	640	17	08:55	10:03	10:30	61	108	11	431	1404	1404	3	2.5	2	1
21-Aug	532	2	JS-3000	405	400	96	08:55	10:06	10:30	63	108	12	432					1	1
21-Aug	533	2	JS-3000	406	320	28	08:55	10:08	10:30	63	108	13	433	1406	1406	9.8	8.5	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
21-Aug	534	2	JS-3000	407	440	109	08:55	10:10	10:30	66	108	14	434					2	1
21-Aug	535	2	JS-3000	408	360	89	08:55	10:13	10:30	65	108	15	435	1408	1408	1.2	1	1	1
21-Aug	536	3	JS-3000	409	640	98	11:15	11:44	13:04	62	108	16	436			8.3	8.7	1	1
21-Aug	537	3	JS-3000	410	780	60	11:15	11:47	13:04	62	108	17	437	1410	1410	15.6	13.8	1	1
21-Aug	538	3	JS-3000	411	440	97	11:15	11:51	13:04	67	108	18	438			2.2	1.5	1	1
21-Aug	539	3	JS-3000	412	360	58	11:15	11:57	13:04	61	108	19	439	1412	1412	10.1	9.6	1	1
21-Aug	540	3	JS-3000	413	640	48	11:15	12:02	13:04	65	108	20	440			6.7	4.2	1	1
21-Aug	541	3	JS-3000	414	780	59	11:15	12:04	13:04	63	108	21	441	1414	1414	15	13.1	1	1
21-Aug	542	3	JS-3000	415	320	20	11:15	12:07	13:04	65	108	22	442			3.3	2.4	2	1
21-Aug	543	3	JS-3000	416	440	58	11:15	12:15	13:04	66	108	23	443	1416	1416	6.2	4.9	1	1
21-Aug	544	3	JS-3000	417	360	60	11:15	12:23	13:04	60	108	24	444			5.2	3.9	2	1
21-Aug	545	3	JS-3000	418	640	46	11:15	12:29	13:04	60	108	25	445	1418	1418	10.2	8.7	1	1
21-Aug	546	3	JS-3000	419	400	29	11:15	12:32	13:04	61	108	26	446			10.7	8.7	1	1
22-Aug	547	1	JS-3001	420	320	36	06:50	07:15	8:50	62	108	27	447	1420	1420	8.6	6.4	1	1
22-Aug	548	1	JS-3001	421	440	26	06:50	07:22	8:50	60	108	28	448			10.3	8.6	1	1
22-Aug	549	1	JS-3001	422	360	57	06:50	07:34	8:50	65	108	29	449	1422	1422	10.3	7.8	1	1
22-Aug	550	1	JS-3001	423	640	99	06:50	07:43	8:50	62	108	30	450			7.4	5.5	1	1
22-Aug	551	1	JS-3001	424	780	57	06:50	07:49	8:50	60	108	31	451	1424	1424	11.7	9.3	1	1
22-Aug	552	1	JS-3001	425	440	57	06:50	07:56	8:50	63	108	32	452			12.6	8.9	1	1
22-Aug	553	1	JS-3001	426	440	98	06:50	07:58	8:50	57	108	33	453	1426	1426	5.8	4.8	1	1
22-Aug	554	1	JS-3001	427	360	59	06:50	08:01	8:50	58	108	34	454			0.9	0.8	1	1
22-Aug	555	1	JS-3001	428	640	45	06:50	08:04	8:50	62	108	35	455	1428	1428	13.1	11.8	1	1
22-Aug	556	1	JS-3001	429	400	31	06:50	08:13	8:50	61	108	36	456			12.6	10.2	1	1
22-Aug	557	1	JS-3001	430	320	22	06:50	08:16	8:50	53	108	37	457	1430	1430	11.1	8.9	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
22-Aug	558	1	JS-3001	431	440	88	06:50	08:20	8:50	60	108	38	458			7.1	6.2	1	1
22-Aug	559	1	JS-3001	432	360	81	06:50	08:22	8:50	62	108	39	459	1432	1432	11.5	8.6	1	1
22-Aug	560	1	JS-3001	433	640	38	06:50	08:29	8:50	62	108	40	460			9.3	7	1	1
22-Aug	561	1	JS-3001	434	400	3	06:50	08:32	8:50	63	108	41	461	1434	1434	12.7	13.4	1	1
22-Aug	562	2	JS-3001	435	320	10	09:50	10:01	11:04	59	108	42	462			7.2	6.5	1	1
22-Aug	563	2	JS-3001	436	440	10	09:50	10:03	11:04	64	108	43	463	1436	1436	4.4	4	1	1
22-Aug	564	2	JS-3001	437	360	114	09:50	10:06	11:04	61	108	44	464			11.4	7.1	1	1
22-Aug	565	2	JS-3001	438	780	54	09:50	10:11	11:04	60	108	45	465	1438	1438	10.2	7.8	1	1
22-Aug	566	2	JS-3001	439	640	95	09:50	10:18	11:04	57	108	46	466			6	5.1	1	1
22-Aug	567	2	JS-3001	440	440	89	09:50	10:22	11:04	60	108	47	467	1440	1440	9.9	6.9	1	1
22-Aug	568	2	JS-3001	441	360	85	09:50	10:29	11:04	59	108	48	468			12.8	9.8	1	1
22-Aug	569	2	JS-3001	442	640	94	09:50	10:31	11:04	60	108	49	469	1442	1442	11.3	8	1	1
22-Aug	570	2	JS-3001	443	780	58	09:50	10:37	11:04	59	108	50	470			4.8	3.6	1	1
22-Aug	571	2	JS-3001	444	360	80	09:50	10:41	11:04	58	108	51	471	1444	1444	4.9	3.7	1	1
22-Aug	572	2	JS-3001	445	640	96	09:50	10:51	11:04	61	108	52	472			10.9	8.1	1	1
22-Aug	573	3	JS-3000	446	400	4	12:05	12:13	13:15	61	108	53	473	1446	1446	5.3	4.5	1	1
22-Aug	574	3	JS-3000	447	320	54	12:05	12:15	13:15	61	108	54	474					1	1
22-Aug	575	3	JS-3000	448	440	90	12:05	12:18	13:15	57	108	55	475	1448	1448	6.5	5.1	1	1
22-Aug	576	3	JS-3000	449	360	113	12:05	12:21	13:15	58	108	56	476			6.8	6.8	1	1
22-Aug	577	3	JS-3000	450	640	93	12:05	12:23	13:15	60	108	57	477	1450	1450	12.4	11.5	1	1
22-Aug	578	3	JS-3000	451	320	52	12:05	12:29	13:15	63	108	58	478			8.9	7.1	1	1
26-Aug	579	1	JS-3000	452	440	86	07:00	07:16	9:10	61	108	59	479	1452	1452	5.2	4.5	2	1
26-Aug	580	1	JS-3000	453	360	55	07:00	07:20	9:10	61	108	60	480			6.1	4.7	1	1
26-Aug	581	1	JS-3000	454	640	13	07:00	07:30	9:10	58	109	1	481	1454	1454	6.7	5.7	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
26-Aug	582	1	JS-3000	455	360	66	07:00	07:33	9:10	58	109	2	482			9.2	9.7	2	1
26-Aug	583	1	JS-3000	456	780	42	07:00	07:50	9:10	64	109	3	483	1456	1456	5.8	4.4	2	1
26-Aug	584	1	JS-3000	457	320	50	07:00	07:54	9:10	60	109	4	484			11.3	10.8	1	1
26-Aug	585	1	JS-3000	458	440	33	07:00	08:02	9:10	62	109	5	485	1458	1458	9.9	10.2	2	1
26-Aug	586	1	JS-3000	459	360	28	07:00	08:05	9:10	65	109	6	486			9.6	8.3	1	1
26-Aug	587	1	JS-3000	460	640	63	07:00	08:19	9:10	59	109	7	487	1460	1460	7.4	5.5	1	1
26-Aug	588	1	JS-3000	461	440	7	07:00	08:24	9:10	60	109	8	488			11	8.8	1	1
26-Aug	589	1	JS-3000	462	780	81	07:00	08:27	9:10	60	109	9	489	1462	1462			2	1
26-Aug	590	1	JS-3000	463	320	5	07:00	08:33	9:10	59	109	10	490			5.9	2.2	2	1
26-Aug	591	1	JS-3000	464	440	38	07:00	08:36	9:10	65	109	11	491	1464	1464	6	5.7	2	1
26-Aug	592	1	JS-3000	465	360	53	07:00	08:53	9:10	62	109	12	492			13.9	13	1	1
26-Aug	593	4	JS-2923	466	640	41	12:55	13:11	15:00	63	109	13	493	1466	1466	4.6	4	2	1
26-Aug	594	4	JS-2923	467	320	58	12:55	13:14	15:00	60	109	14	494			6.1	4.9	1	1
26-Aug	595	4	JS-2923	468	780	83	12:55	13:56	15:00	59	109	15	495	1468	1468	2.9	2.4	2	1
26-Aug	596	4	JS-2923	469	320	109	12:55	14:05	15:00	56	109	16	496			2	2.7	2	1
26-Aug	597	4	JS-2923	470	440	101	12:55	14:10	15:00	61	109	17	497	1470	1470	11.4	9.4	2	1
26-Aug	598	4	JS-2923	471	360	13	12:55	14:12	15:00	58	109	18	498			7.9	6.4	2	1
26-Aug	599	4	JS-2923	472	640	40	12:55	14:16	15:00	64	109	19	499	1472	1472	4.4	3.5	2	1
26-Aug	600	4	JS-2923	473	360	72	12:55	14:23	15:00	62	109	20	500			6.1	5	2	1
26-Aug	601	4	JS-2923	474	320	95	12:55	14:28	15:00	60	109	21	501	1474	1474	7.8	6.6	2	1
26-Aug	602	4	JS-2923	475	440	104	12:55	14:31	15:00	60	109	22	502			7.8	7.2	2	1
26-Aug	603	4	JS-2923	476	360	14	12:55	14:33	15:00	60	109	23	503	1476	1476	5.9	5.6	2	1
26-Aug	604	4	JS-2923	477	440	11	12:55	14:38	15:00	64	109	24	504			3.4	2.5	1	1
26-Aug	605	4	JS-2923	478	320	29	12:55	14:41	15:00	59	109	25	505	1478	1478	6.1	6	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
26-Aug	606	5	JS-3000	479	360	44	16:10	16:39	17:30	60	109	26	506			2	1.8	2	1
26-Aug	607	5	JS-3000	480	440	31	16:10	16:40	17:30	58	109	27	507	1480	1480	7.5	6.4	1	1
26-Aug	608	5	JS-3000	481	360	100	16:10	16:43	17:30	64	109	28	508			3.2	3	1	1
26-Aug	609	5	JS-3000	482	320	53	16:10	16:46	17:30	60	109	29	509	1482	1482	9.9	8.1	1	1
26-Aug	610	5	JS-3000	483	780	70	16:10	16:50	17:30	63	109	30	510			3.3	2.6	2	1
26-Aug	611	5	JS-3000	484	640	21	16:10	16:52	17:30	60	109	31	511	1484	1484	11.7	11.5	1	1
26-Aug	612	5	JS-3000	485	360	64	16:10	16:54	17:30	59	109	32	512			6.2	5.2	2	1
26-Aug	613	5	JS-3000	486	440	46	16:10	16:56	17:30	57	109	33	513	1486	1486	7.1	6.2	1	1
26-Aug	614	5	JS-3000	487	320	40	16:10	17:00	17:30	61	109	34	514			3.5	2.7	1	1
26-Aug	615	5	JS-3000	488	440	74	16:10	17:03	17:30	61	109	35	515	1488	1488	10.9	10.1	1	1
26-Aug	616	5	JS-3000	489	640	107	16:10	17:07	17:30	60	109	36	516			6.3	5.8	2	1
26-Aug	617	5	JS-3000	490	360	65	16:10	17:09	17:30	61	109	37	517	1490	1490	8.4	7.3	1	1
26-Aug	618	5	JS-3000	491	440	103	16:10	17:12	17:30	62	109	38	518			7.5	6.8	2	1
27-Aug	619	1	JS-3000	492	320	85	07:10	08:04	9:25	65	109	39	519	1492	1492	7.3	5.6	2	1
27-Aug	620	1	JS-3000	493	780	31	07:10	08:16	9:25	62	109	40	520			8.8	7	2	1
27-Aug	621	1	JS-3000	494	360	115	07:10	08:19	9:25	61	109	41	521	1494	1494	9.7	8.1	2	1
27-Aug	622	1	JS-3000	495	640	3	07:10	08:21	9:25	63	109	42	522			8.3	6	1	1
27-Aug	623	1	JS-3000	496	320	110	07:10	08:23	9:25	65	109	43	523	1496	1496	8.3	5.7	1	1
27-Aug	624	1	JS-3000	497	440	17	07:10	08:30	9:25	62	109	44	524			8.6	7.5	1	1
27-Aug	625	1	JS-3000	498	320	113	07:10	08:32	9:25	65	109	45	525	1498	1498	6.9	8.2	1	1
27-Aug	626	1	JS-3000	499	780	86	07:10	08:35	9:25	61	109	46	526			9.9	7.9	2	1
27-Aug	627	1	JS-3000	500	360	101	07:10	08:37	9:25	64	109	47	527	1500	1500	7.5	6	2	1
27-Aug	628	1	JS-3000	501	320	44	07:10	08:41	9:25	61	109	48	528			2.7	2	2	1
27-Aug	629	1	JS-3000	502	440	32	07:10	08:43	9:25	60	109	49	529	1502	1502	8.2	7.1	2	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
27-Aug	630	1	JS-3000	503	360	11	07:10	08:48	9:25	60	109	50	530			10	8.5	2	1
27-Aug	631	1	JS-3000	504	640	39	07:10	08:50	9:25	64	109	51	531	1504	1504	1.8	1.6	1	1
27-Aug	632	1	JS-3000	505	320	115	07:10	09:00	9:25	63	109	52	532			3.3	3.1	1	1
27-Aug	633	1	JS-3000	506	780	84	07:10	09:02	9:25	62	109	53	1533	1506	1506	9.7	8.2	1	1
27-Aug	634	1	JS-3000	507	320	41	07:10	09:09	9:25	65	109	54	1534			0.9	0.7	1	1
27-Aug	635	2	JS-2923	508	640	6	10:25	11:10	12:00	59	109	55	1535	1508	1508	4.4	3.4	1	1
27-Aug	636	2	JS-2923	509	360	29	10:25	11:12	12:00	65	109	56	1536			2.8	3	1	1
27-Aug	637	2	JS-2923	510	640	28	10:25	11:14	12:00	63	109	57	1537	1510	1510	1.8	1.5	1	1
27-Aug	638	2	JS-2923	511	360	67	10:25	11:17	12:00	57	109	58	1538			6.5	5.5	1	1
27-Aug	639	2	JS-2923	512	780	89	10:25	11:22	12:00	59	109	59	1539	1512	1512	8	7.1	1	1
27-Aug	640	2	JS-2923	513	320	11	10:25	11:24	12:00	58	109	60	1540			3.2	2.5	1	1
27-Aug	641	2	JS-2923	514	440	34	10:25	11:26	12:00	62	110	1	1541	1514	1514	4.3	3.2	1	1
27-Aug	642	2	JS-2923	515	360	31	10:25	11:30	12:00	63	110	2	1542			7.8	6.4	1	1
27-Aug	643	2	JS-2923	516	640	109	10:25	11:34	12:00	61	110	3	1543	1516	1516	4.6	3.9	1	1
27-Aug	644	2	JS-2923	517	440	4	10:25	11:37	12:00	61	110	4	1544			7.3		1	1
27-Aug	645	2	JS-2923	518	780	72	10:25	11:39	12:00	60	110	5	1545	1518	1518	5.3	4.4	2	1
27-Aug	646	2	JS-2923	519	320	6	10:25	11:42	12:00	57	110	6	1546			10	8.2	1	1
27-Aug	647	2	JS-2923	520	440	102	10:25	11:45	12:00	60	110	7	1547	1520	1520	10.2	7.7	1	1
27-Aug	648	2	JS-2923	521	360	61	10:25	11:48	12:00	62	110	8	1548			4.3	2.4	1	1
27-Aug	649	2	JS-2923	522	640	108	10:25	11:50	12:00	56	110	9	1549	1522	1522	7.7	6.6	1	1
27-Aug	650	5	JS-3000	523	440	15	14:30	15:04	15:45	61	110	10	1550			6.6	7.1	1	1
27-Aug	651	5	JS-3000	524	640	34	14:30	15:06	15:45	55	110	11	1551	1524	1524	6.8	6.3	1	1
27-Aug	652	5	JS-3000	525	320	46	14:30	15:09	15:45	60	110	12	1552			3.4	2.1	1	1
27-Aug	653	5	JS-3000	526	360	106	14:30	15:11	15:45	61	110	13	1553	1526	1526	9	7.9	1	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
27-Aug	654	5	JS-3000	527	440	9	14:30	15:14	15:45	61	110	14	1554			9.4	8	1	1
27-Aug	655	5	JS-3000	528	320	112	14:30	15:16	15:45	60	110	15	1555	1528	1528	4	3.1	1	1
27-Aug	656	5	JS-3000	529	640	52	14:30	15:18	15:45	59	110	16	1556			5.5	5.1	1	1
27-Aug	657	5	JS-3000	530	440	45	14:30	15:21	15:45	62	110	17	1557	1530	1530	9.2	8.1	1	1
27-Aug	658	5	JS-3000	531	780	46	14:30	15:24	15:45	61	110	18	1558			8	7.2	1	1
27-Aug	659	5	JS-3000	532	320	59	14:30	15:27	15:45	61	110	19	1559	1532	1532	8.9	8.1	1	1
28-Aug	660	1	JS-2923	533	780	28	07:00	07:10	9:25	64	110	20	1560			5.7	4.3	1	1
28-Aug	661	1	JS-2923	534	360	102	07:00	07:11	9:25	64	110	21	1561	1534	1534	7.4	6.7	1	1
28-Aug	662	1	JS-2923	535	640	8	07:00	07:14	9:25	62	110	22	1562			8.6	6.5	1	1
28-Aug	663	1	JS-2923	536	320	114	07:00	07:16	9:25	62	110	23	1563	1536	1536	3.7	3.4	1	1
28-Aug	664	1	JS-2923	537	780	34	07:00	07:18	9:25	57	110	24	1564			13	12	2	1
28-Aug	665	1	JS-2923	538	640	103	07:00	07:20	9:25	64	110	25	1565	1538	1538	6	4.2	1	1
28-Aug	666	1	JS-2923	539	440	50	07:00	07:23	9:25	59	110	26	1566			5.9	4.6	1	1
28-Aug	667	1	JS-2923	540	360	103	07:00	07:25	9:25	65	110	27	1567	1540	1540	4.9	3.5	2	1
28-Aug	668	1	JS-2923	541	640	11	07:00	07:30	9:25	65	110	28	1568			3.9	2.9	1	1
28-Aug	669	1	JS-2923	542	360	38	07:00	07:32	9:25	60	110	29	1569	1542	1542	8.5	6.8	1	1
28-Aug	670	1	JS-2923	543	780	87	07:00	07:35	9:25	59	110	30	1570			8.1	7	2	1
28-Aug	671	1	JS-2923	544	320	23	07:00	07:37	9:25	61	110	31	1571	1544	1544	12.1	10.5	1	1
28-Aug	672	1	JS-2923	545	440	35	07:00	07:40	9:25	59	110	32	1572			9.4	8.1	2	1
28-Aug	673	1	JS-2923	546	320	47	07:00	07:43	9:25	59	110	33	1573	1546	1546	11.3	11	2	1
28-Aug	674	1	JS-2923	547	640	102	07:00	07:46	9:25	59	110	34	1574			4.2	3.1	2	1
28-Aug	675	1	JS-2923	548	440	47	07:00	07:48	9:25	61	110	35	1575	1548	1548	8.4	7.2	2	1
28-Aug	676	1	JS-2923	549	320	79	07:00	07:55	9:25	65	110	36	1576			4.2	2.6	2	1
28-Aug	677	1	JS-2923	550	440	83	07:00	07:56	9:25	64	110	37	1577	1550	1550	4.1	2.3	2	1

Table C2 (continued). Release data for fish tagged in Johnstone Strait, 11-28 August 2003.

Release	Fish	Set	Rel.	Floy	Radio tag		Time			NFL	Scale		Vial no.			Fat Probe		Code	
date	no.	no.	Loc.[1]	no.	Freq.[2]	Code	Cap.	Tag.	Rel.	(cm)	Book	no.	DNA	Blood	Gill	Ant.	Pos.	Color[3]	Rel.[4]
28-Aug	678	1	JS-2923	551	320	21	07:00	08:00	9:25	60	110	38	1578			7.6	6.8	2	1
28-Aug	679	1	JS-2923	552	640	7	07:00	08:01	9:25	58	110	39	1579	1552	1552	7.3	5.6	2	1
28-Aug	680	1	JS-2923	553	360	39	07:00	08:04	9:25	56	110	40	1580			13	10	2	1
28-Aug	681	1	JS-2923	554	360	52	07:00	08:06	9:25	60	110	41	1581	1554	1554	6.7	5.4	2	1
28-Aug	682	2	JS-3000	601	640	25	09:40	09:57	10:30	63	110	42	1582			5.3	4.5	1	1
28-Aug	683	2	JS-3000	602	360	25	09:40	09:59	10:30	61	110	43	1583	1602	1602	4.7	3.7	1	1
28-Aug	684	2	JS-3000	603	780	25	09:40	10:01	10:30	62	110	44	584			2	2.3	1	1
28-Aug	685	2	JS-3000	604	320	25	09:40	10:05	10:30	65	110	45	585	1604	1604	6.8	5.2	2	1
28-Aug	686	2	JS-3000	605	400	25	09:40	10:08	10:30	62	110	46	586			9.1	7.9	2	1
28-Aug	687	2	JS-3000	606	440	25	09:40	10:11	10:30	60	110	47	587	1606	1606	1.9	1.6	1	1

[1] Release locations codes (JS-xxx) are: not released (NR), Bodega Point (2908), Logger's Bay (2911), Harry Moon Point (2914), McMullen Point (2920), Bluffs (2922), Separation Head (2923), Brown's Bay (3000), Plumber bay (3001), and Deep Water bay (3002).

[2] Three digit number corresponds to decimal frequency of 150 MHz (e.g., 600 is 150.600 MHz).

[3] Color code: 1=Bright blue back; loose scales; 2=Bright green back; and 3=Dull green back

[4] Release Code: 1=excellent (little scale loss), 2=good (some scale loss), 3=fair (mod. scale loss), 4=poor (heavy scale loss)

Tagging was conducted by R. Alexander, assisted by Steve Cook, Glenn Grossin, Dave Patterson, and Trisha Watson .

Table C3. Data for sockeye tagged at Nicomen, 25 August – 1 October 2003[1].

Release	Fish	Set	Rel.	Radio tag		Time			NFL	Vial	Fat Probe		Color
date	no.	no.	Loc.	Freq.	Code	Cap.	Tag.	Rel.	(cm)	Blood	Ant.	Pos.	Code
25-Aug	1	1	2	400	115	6:11	6:13	6:23	57				PG
25-Aug	2	2	2	400	92	9:20	9:25	9:35	55	6102	1.8	1.6	PG
26-Aug	3	1	3	400	49	18:00	18:10	6:25	56				PG
27-Aug	4	1	1	400	93	5:52	5:56	6:02	55	6104	3.0	2.5	PG
27-Aug	5	2	1	400	109	6:00	6:04	6:05	66				PG
27-Aug	6	3	1	400	102	5:40	6:14	6:20	62	6106	2.8	1.9	PG
27-Aug	7	4	1	640	5	6:20	6:22	6:28	57				PG
27-Aug	8	5	1	400	90	5:35	6:40	6:42	63	6108	9.6	8.7	PG
27-Aug	9	6	1	400	103	7:00	7:01	7:02	60				PG
27-Aug	10	7	1	400	22	7:05	7:06	7:07	62	6110	4.5	3.3	PG
27-Aug	11	8	1	400	86	7:23	7:24	7:24	57				PG
27-Aug	12	9	1	780	74	8:03	8:04	8:05	58	6112	5.2	4.5	PG
27-Aug	13	10	1	400	69	9:09	9:10	9:11	61		6.3	5.6	PG
27-Aug	14	11	1	400	80	9:25	9:27	9:28	61	6114	8.1	6.4	PG
27-Aug	15	12	1	400	101	9:45	9:46	9:47	62		6.2	5.5	PG
27-Aug	16	13	1	400	87	10:00	10:02	10:03	74	6116	2.8	2.3	PG
28-Aug	17	1	1	400	50	5:50	5:52	6:02	66		1.2	1.1	PG
28-Aug	18	2	1	400	85	6:15	6:16	6:17	62	6118	1.4	1.1	PG
28-Aug	19	3	1	400	52	6:35	6:36	6:37	66		5.6	4.5	PG
28-Aug	20	4	1	400	84	6:47	6:48	6:49	53	6120	2.4	1.1	PG
28-Aug	21	5	1	440	21	6:50	6:51	6:52	63		5.3	4.8	PG
28-Aug	22	6	1	400	89	7:08	7:09	7:09	57	6122	3.2	2.7	PG
28-Aug	23	7	1	400	70	7:11	7:12	7:12	62		1.5	1.1	PG
28-Aug	24	8	1	400	81	7:22	7:23	7:24	57	6124	1.5	1.2	PG
28-Aug	25	9	1	400	88	7:27	7:27	7:28	61		3.6	2.9	PG
28-Aug	26	10	1	400	106	7:48	7:49	7:50	64	6126	4.2	3.3	PG
28-Aug	27	11	1	400	94	8:01	8:02	8:03	60		2.7	1.7	PG
28-Aug	28	12	1	400	48	8:30	8:31	8:32	62	6128	3.9	2.8	PG
28-Aug	29	13	1	400	110	8:06	8:07	8:08	63		1.5	1.2	PG
28-Aug	30	14	1	400	114	9:00	9:31	9:32	57	6130	3.4	3.2	PG
28-Aug	31	15	1	400	83	9:40	9:41	9:42	62		4.8	3.9	PG
28-Aug	32	16	1	400	6	9:54	9:55	9:56	60	6132	3.5	2.6	PG
28-Aug	33	17	1	400	28	10:10	10:11	10:12	64		6.8	4.5	PG
28-Aug	34	18	1	400	76	10:26	10:27	10:28	66	6134	4.4	3.6	PG
28-Aug	35	19	1	360	37	10:28	10:29	10:30	60		5.6	5.0	PG
28-Aug	36	20	1	400	78	11:20	11:21	11:27	64	6136	1.5	1.5	PG
28-Aug	37	21	1	320	19	11:29	11:30	11:31	61		4.1	3.5	PG
28-Aug	38	22	1	400	91	11:43	11:44	11:45	60	6138	5.6	5.1	PG
28-Aug	39	23	1	780	85	12:10	12:11	12:12	61		1.9	1.5	PG
28-Aug	40	24	1	400	79	12:42	12:42	12:43	65	6140	0.9	0.8	PG
28-Aug	41	25	1	800	151	12:14	12:15	12:16	63		5.2	4.0	PG

Table C3 (continued). Data for sockeye tagged at Nicomen, 25 August – 1 October, 2003.

Release	Fish	Set	Rel.	Radio tag		Time			NFL	Vial	Fat Probe		Color
date	no.	no.	Loc.	Freq.	Code	Cap.	Tag.	Rel.	(cm)	Blood	Ant.	Pos.	Code
28-Aug	42	26	1	720	166	12:44	12:44	12:45	66		7.3	5.4	PG
28-Aug	43	27	1	720	71	12:54	12:55	12:56	62		0.8	0.7	PG
28-Aug	44	28	1	440	65	13:13	13:14	13:15	59		5.6	4.8	PG
28-Aug	45	29	1	800	57	13:18	13:19	13:20	64		4.4	3.6	PG
29-Aug	46	1	1	720	145	12:59	13:00	13:01	64		3.6	3.1	PG
29-Aug	47	2	1	800	136	12:35	13:03	13:04	59		8.9	7.8	PG
29-Aug	48	3	1	680	123	12:40	13:07	13:08	61		1.0	1.0	PG
5-Sep	49	1	1	680	95	19:01	19:02	19:03	63		n/a	n/a	PG
6-Sep	50	1	1	400	31	6:25	6:27	6:29	66		4.1	2.6	PG
6-Sep	51	1	1	780	75	7:19	7:20	7:21	63		6.5	6.0	PG
9-Sep	52	1	1	800	16	19:28	19:29	19:30	62		0.6	0.6	R
11-Sep	53	1	1	900	16	6:15	6:17	6:25	62		n/a	n/a	R
11-Sep	54	2	1	440	100	6:40	6:41	6:42	63		n/a	n/a	R
11-Sep	55	3	1	360	112	7:10	7:13	7:14	64		n/a	n/a	R
11-Sep	56	4	1	320	65	7:28	7:30	7:31	60		n/a	n/a	S
16-Sep	57	1	1	400	41	19:00	19:02	19:03	63		1.6	1.2	PG
17-Sep	58	1	1	360	85	6:45	6:47	6:49	64		1.8	1.1	R
17-Sep	59	2	1	780	86	7:06	7:08	7:10	64		1.8	1.4	R
17-Sep	60	3	1	320	61	7:12	7:17	7:18	65		2.6	2.0	R
17-Sep	61	4	1	320	70	7:20	7:22	7:24	66		2.8	2.0	R
17-Sep	62	5	1	320	57	n/a	n/a	8:36	62		2.9	2.1	R
17-Sep	63	6	1	640	77	n/a	n/a	8:43	66		4.1	3.1	R
17-Sep	64	7	1	780	73	n/a	n/a	8:59	63		4.1	2.8	R
17-Sep	65	8	1	640	72	n/a	n/a	9:05	64		0.5	0.4	R
17-Sep	66	9	1	440	39	n/a	n/a	9:15	63		0.5	0.4	R
19-Sep	67	1	1	780	33	10:26	10:28	10:30	57		2.1	1.8	R
19-Sep	68	2	1	400	42	11:01	11:02	11:04	60		3.1	2.0	PG
24-Sep	69	1	1	440	107	18:37	18:38	18:41	57		0.9	1.0	PG
24-Sep	70	2	1	320	81	18:56	18:57	18:58	65		1.2	1.1	PG
30-Sep	71	1	1	780	59	17:18	17:20	17:21	64		1.2	1.0	R
1-Oct	72	1	1	440	73	16:27	16:29	16:30	65		0.6	0.5	R
1-Oct	73	2	1	780	76	16:44	16:45	16:36	63		0.5	0.5	R
1-Oct	74	3	1	440	112	17:44	17:45	17:46	55		0.5	0.5	R
1-Oct	75	4	1	780	134	17:54	17:55	17:56	65		1.2	0.9	R
1-Oct	76	5	1	360	54	18:03	18:04	18:05	64		1.7	1.5	PG
1-Oct	77	6	1	780	53	18:15	18:17	18:18	60		1.8	1.6	R
1-Oct	78	7	1	440	50	18:20	18:22	18:23	60		0.5	0.4	R
1-Oct	79	8	1	400	25	18:35	18:37	18:38	65		0.6	0.6	R

[1] Release location codes are: fish market (1); 500 m upstream of fish market (2); and S-curves (3). Radio tag frequencies are decimals of 150 MHz (e.g., 320 is 150.320 MHz). Color codes are Pale Green (PG), Silver (S) and Red (R). First 48 fish tagged by Jim Ferguson, last 31 by Steve Cook and Jeff Young.

APPENDIX D

Tag Recovery Data

Table D1. Tag recovery information for all fishery recoveries reported before 31 December 2003.

Date		Radio tag			Reported by	Tagging	Recovery Location	Capture
Recovery	Tagging	Freq.	Code	Floy tag #		Location[1]	Name	Method
Canadian Commercial/Recreational Marine Fisheries								
15-Aug	14-Aug	360	105	210	Dave Bates	JS	Johnstone Strait	seine
16-Aug	15-Aug	320	63	294	Dave Bates	JS	Johnstone Strait	seine
14-Aug	12-Aug	440	65	83	Ken Nelson	JS	Deep Water Bay-Campbell River	trolling
15-Aug	12-Aug	440	100	52	Brad Browlin	JS	Johnstone Strait	trolling
Canadian First Nation Fishery								
20-Aug	14-Aug	780	73	219	Howard Grant	JS	Fraser River - New Westminster	gillnet
22-Aug	15-Aug	640	77	229	Brad Cross	JS	Fraser River - Island 22	gillnet
21-Aug	15-Aug	780	33	262	Tony Dandurand	JS	Fraser River - Mouth	gillnet
24-Aug	14-Aug	320	61	214	Charles Henry	JS	Fraser River - downstream of Stein River	gillnet
30-Aug	21-Aug	780	59	414	Robert M. Phillips	JS	Fraser River-5km downstream of Aggasiz Bridge	Unknown
31-Aug	22-Aug	400	31	429	anonomous, c/o Dave Southgate	JS	Fraser River, Skuppah site	Unknown
25-Aug	11-Aug	780	75	37	Len Stirling	JS	Fraser River, Kwoiek Creek site, Siska Canyon	Unknown
18-Aug	14-Aug	320	65	163	Brad Bowling	JS	Fraser River - Mouth	gillnet
03-Sep	22-Aug	360	85	441	Anonymous, c/o Dave Southgate	JS	Fraser River, downstream of Stein River	Unknown
10-Sep	28-Aug	400	25	605	Anonymous from First Nation	JS	Fraser River - Unknown Area	Unknown
08-Sep	28-Aug	440	50	539	anonymous, c/o Donny Sam	JS	Siska Creek area	Unknown
29-Aug	14-Aug	780	53	181	Gilbert Baptiste	JS	Fraser River at Texas Creek	Unknown
05-Sep	20-Aug	440	112	333	Michael Oates	JS	Fraser River btw Boston Bar and Boothroyd	Unknown
22-Aug	13-Aug	780	36	99	Rose-Marie Jack	JS	Ruby Creek	gillnet
11-Sep	14-Aug	320	91	157	Della A. Victor	JS	Fraser R. at Agassiz Bridge	Unknown
30-Aug	20-Aug	640	106	335	Tony Peters	JS	Fraser River - Seabird Bluffs	Unknown
15-Sep	20-Aug	440	41	343	Anonymous	JS	Nechako River	Unknown

Table D1 (continued). Tag recovery information for all fishery recoveries reported before 31 December 2003.

Date		Radio tag			Reported by	Tagging	Recovery Location	Capture
Recovery	Tagging	Freq.	Code	Floy tag #		Location[1]	Name	Method
Canadian Commercial Freshwater Fishery								
02-Aug	27-Jul	720	166	720	Cris Friesen	JDF	Area 29 - Bend of River	gillnet
05-Aug	27-Jul	680	123	872	Morley McElwain	JDF	Deas Island Tunnel-Fraser River	gillnet
08-Aug	27-Jul	720	71	1234	Mark Petrunia	JDF	Area 29	gillnet
05-Sep	27-Jul	680	95	562	Danny Jenewein	JDF	Albion	gillnet
05-Aug	27-Jul	540	33	474	Telephone info supplied by DFO	JDF	Fraser River	gillnet
07-Aug	27-Jul	640	19	797	Telephone info supplied by DFO	JDF	Fraser River	gillnet
Canadian Freshwater Fishery								
21-Aug	12-Aug	320	70	57	Jeremy Birch	JS	Fraser River - Island 22	fishing pole
21-Aug	14-Aug	360	112	159	Terry Schmunk	JS	Fraser River - near Hope	fishing pole
21-Aug	13-Aug	640	72	110	Gunter Wagner	JS	Fraser River - below Mission	fishing pole
20-Aug	14-Aug	440	39	215	John Mark	JS	Fraser River - near Hope	fishing pole
23-Aug	14-Aug	440	107	158	Maggie Savino	JS	Fraser River - Mouth	fishing pole
22-Aug	14-Aug	780	76	207	Recovered from a DFO staff member	JS	Fraser River - Lakahamen	fishing pole
24-Aug	11-Aug	320	57	13	Recovered from a DFO staff member	JS	Fraser River - Yale	fishing pole
24-Aug	13-Aug	400	42	92	Recovered from a DFO staff member	JS	Fraser River - Yale	fishing pole
01-Sep	14-Aug	320	81	169	Dropped off at Chilliwack office	JS	Fraser River - Aggasiz Bridge	fishing pole
31-Aug	19-Aug	640	4	310	Lionel McIntyre	JS	Fraser River - Seabird Island	fishing pole
American Commercial Fishery (Washington)								
08-Aug	27-Jul	800	136	329	Telephone info supplied by DFO	JDF	Unknown	Unknown

[1] JDF=Juan de Fuca; JS=Johnstone Strait

Table D2 . Tag recoveries from spawning areas within the Fraser watershed reported before 31 December 2003.

Date		Radio tag			Reported by	Tagging	Recovery Location	Capture
Recovery	Tagging	Freq.	Code	Floy tag #		Location[1]	Name	Method
Canadian Commercial Freshwater Fishery								
02-Aug	27-Jul	720	166	720	Cris Friesen	JDF	Area 29 - Bend of River	gillnet
05-Aug	27-Jul	680	123	872	Morley McElwain	JDF	Deas Island Tunnel-Fraser River	gillnet
08-Aug	27-Jul	720	71	1234	Mark Petrunia	JDF	Area 29	gillnet
05-Sep	27-Jul	680	95	562	Danny Jenewein	JDF	Albion	gillnet
05-Aug	27-Jul	540	33	474	Telephone info supplied by DFO	JDF	Fraser River	gillnet
07-Aug	27-Jul	640	19	797	Telephone info supplied by DFO	JDF	Fraser River	gillnet
Canadian Freshwater Fishery								
21-Aug	12-Aug	320	70	57	Jeremy Birch	JS	Fraser River - Island 22	fishing pole
21-Aug	14-Aug	360	112	159	Terry Schmunk	JS	Fraser River - near Hope	fishing pole
21-Aug	13-Aug	640	72	110	Gunter Wagner	JS	Fraser River - below Mission	fishing pole
20-Aug	14-Aug	440	39	215	John Mark	JS	Fraser River - near Hope	fishing pole
23-Aug	14-Aug	440	107	158	Maggie Savino	JS	Fraser River - Mouth	fishing pole
22-Aug	14-Aug	780	76	207	Recovered from a DFO staff member	JS	Fraser River - Lakahamen	fishing pole
24-Aug	11-Aug	320	57	13	Recovered from a DFO staff member	JS	Fraser River - Yale	fishing pole
24-Aug	13-Aug	400	42	92	Recovered from a DFO staff member	JS	Fraser River - Yale	fishing pole
01-Sep	14-Aug	320	81	169	Dropped off at Chilliwack office	JS	Fraser River - Aggasiz Bridge	fishing pole
31-Aug	19-Aug	640	4	310	Lionel McIntyre	JS	Fraser River - Seabird Island	fishing pole
American Commercial Fishery (Washington)								
08-Aug	27-Jul	800	136	329	Telephone info supplied by DFO	JDF	Unknown	Unknown

[1] JDF=Juan de Fuca; JS=Johnstone Strait