



ACKNOWLEDGEMENTS

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GOALS AND OBJECTIVES

ATTEMPT TO DETERMINE:

- if hatchery fish spawn at the same time and location as wild fish
- if early-migrating fish have a different spawning distribution than late-migrating fish
- if wild fish have different migration patterns than hatchery fish
- if males have different migration patterns than females
- if there is an incidental mortality as a result of angling
- if individual fish are recaptured by anglers
- if steelhead spawning occurs in the vicinity of the Vedder Floodway gravel-removal pits (near Yarrow)

APPROACH



Step 1
Public Involvement and Compliance

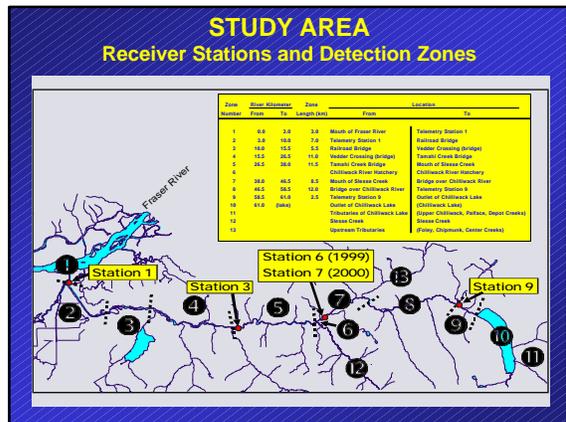
- Consult with local fishing groups and tackle shops
- Establish toll-free number for tag recapture reporting
- Offer incentives for involvement ("Study Team" hat, entry in prize draw, end-of-study letter with data RE "their" fish)
- Announce program through media releases, posters, flyers, presentations at local fishing group meetings, on the river
- Approach successful anglers on the river, offer incentives for opportunity to tag and release captured fish, and encourage anglers to release radio-tagged recaptures and call all recapture data in to the toll-free number

APPROACH

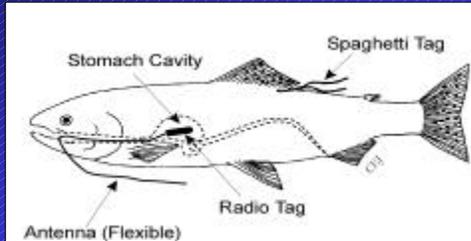
Step 2
Study Design



- Establish fixed-station receiver stations with directional antennas at strategic locations on the mainstem Vedder and Chilliwack rivers to provide 24 h/d monitoring of radio tagged fish for the duration of the study
- Establish monthly radio tag application targets based on the number of tags available, and stratified by:
 - 1) Hatchery and Wild
 - 2) Male and Female
 - 3) Tag Month (Jan-May, 1999; Dec-Apr 2000)
- Capture steelhead in the lower Vedder River, upstream of the lowest receiver station, using conventional angling methods
- Apply radio tags to "bright" (new) fish assessed to be in good condition
- Monitor the subsequent movements of radio-tagged steelhead using a combination of fixed-stations and mobile surveys

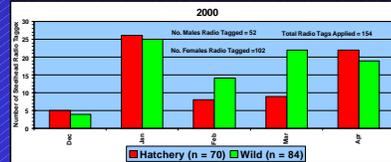
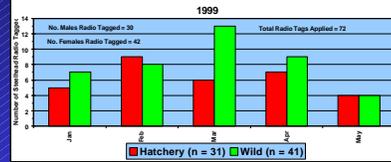


Radio Tag and Spaghetti Tag Placement



Spaghetti Tag included unique 3-digit number and toll free number
 Biosampling included: sex, type (H/W - based on adipose status), FL, scale sample, presence of scars/wounds, "brightness", condition

Monthly Radio Tag Applications 1999 and 2000



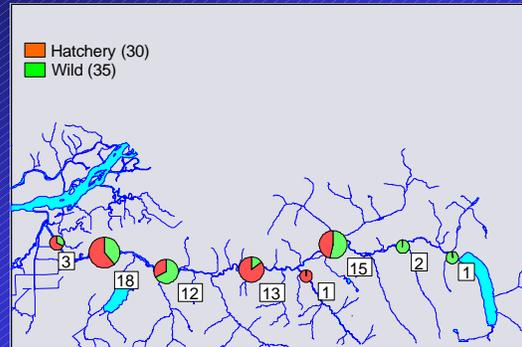
Imagine...all the steelhead

- that the behaviour and fates of radio-tagged steelhead are represented proportionately within the total steelhead population
- that, following release, the behaviour and fate of individual radio-tagged steelhead, both singularly and as part of a defined group, represent:
 - holding locations
 - susceptibility to recapture
 - survival to spawning rates
 - timing of spawning
 - spawning locations
 - survival-to-kelt rates

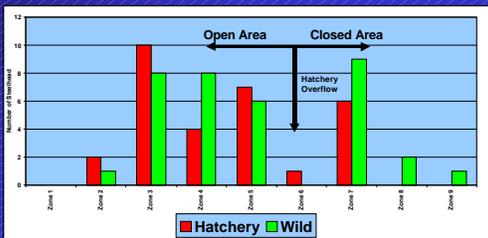


for all defined groups

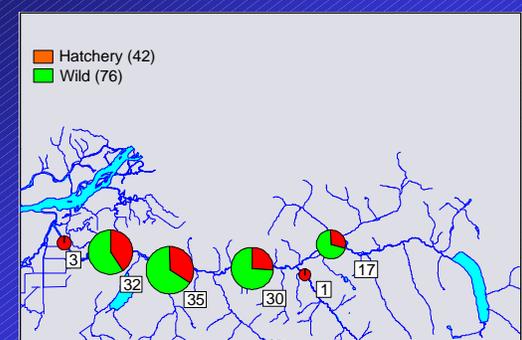
Holding Locations 1999

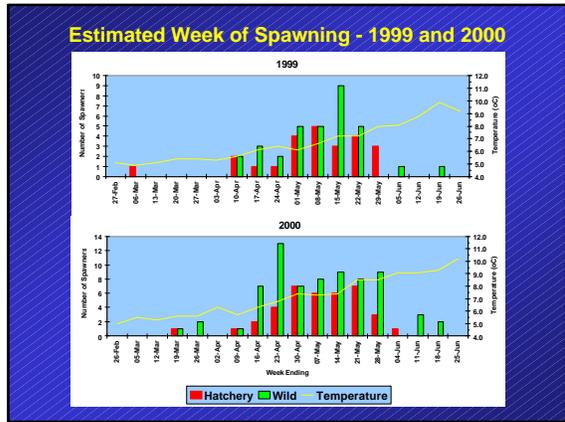
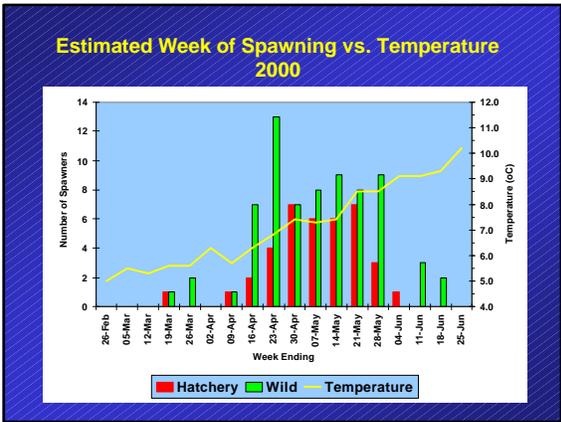
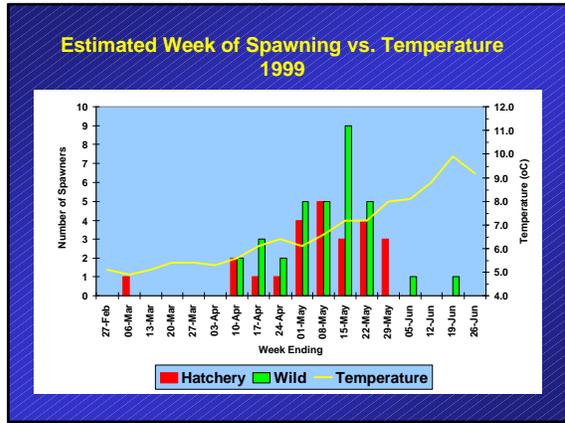
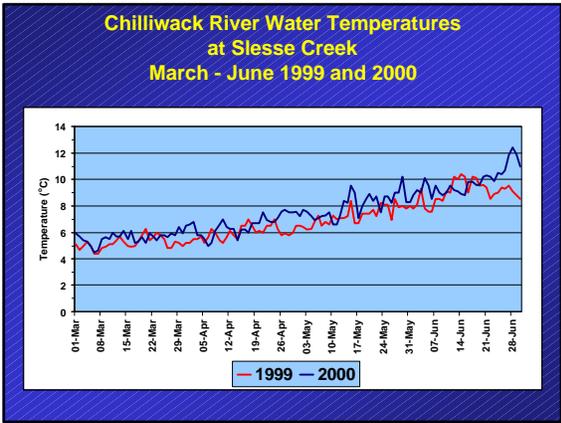
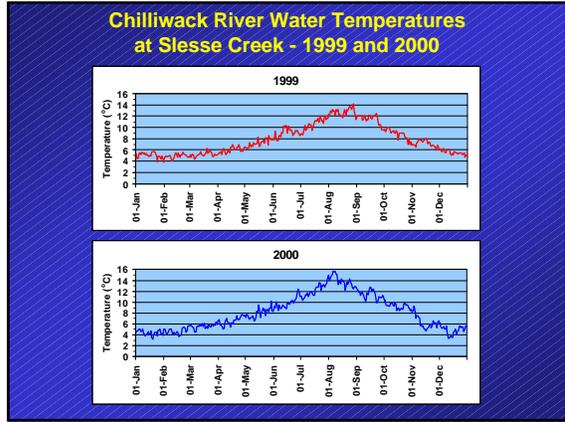
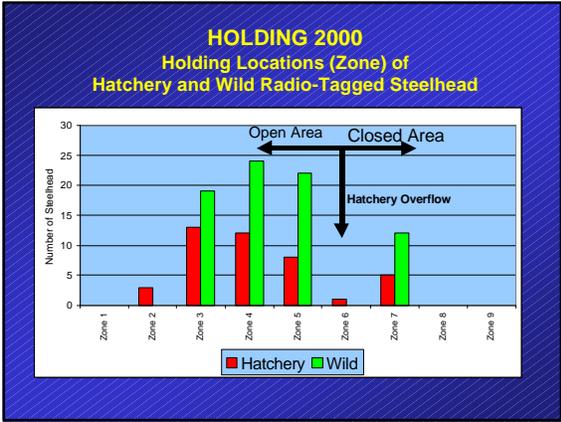


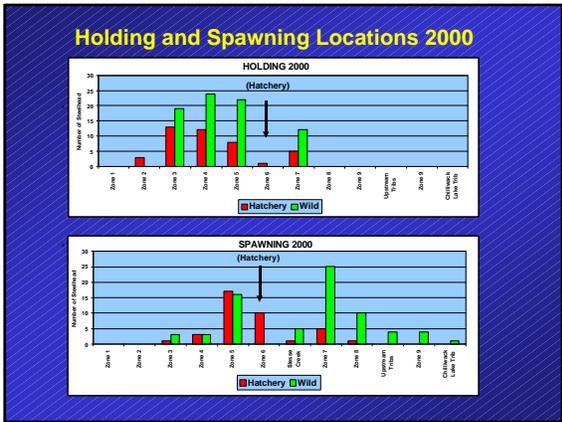
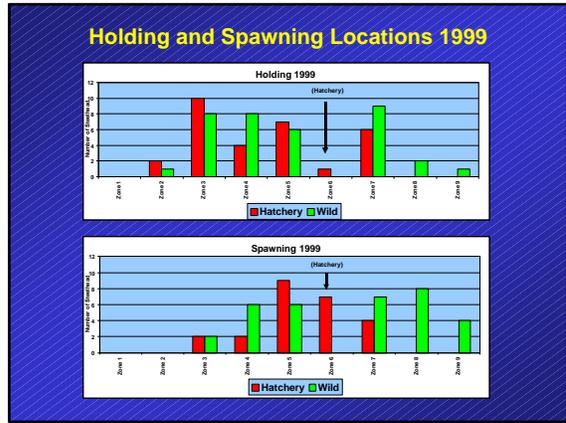
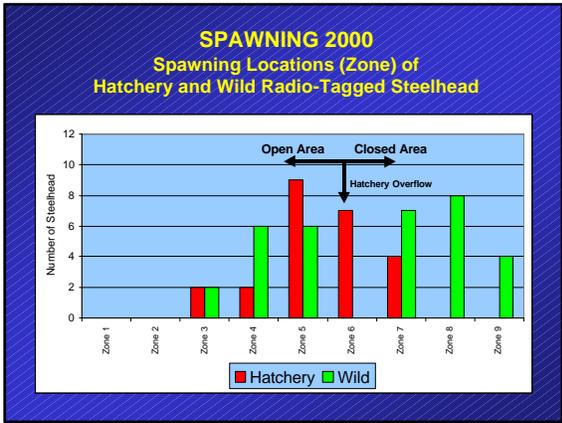
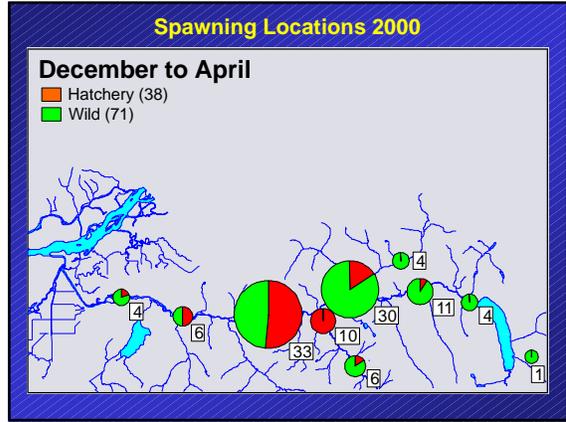
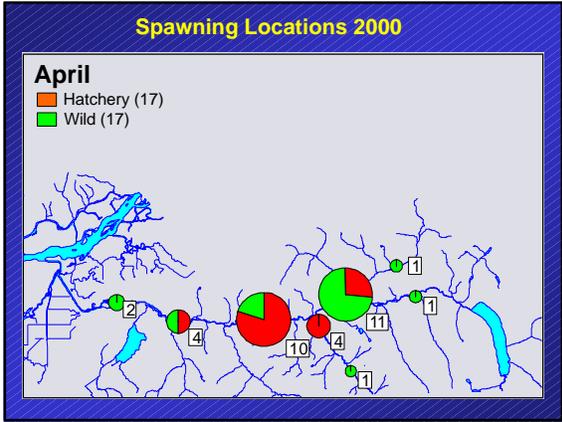
HOLDING 1999 Holding Locations (Zone) of Hatchery and Wild Radio-Tagged Steelhead



Holding Locations 2000







Assessment of Mortality Levels of Radio-Tagged Steelhead Following Release from Capture by Conventional Angling Methods

Approach

- Assessments based on survival to spawning
- Estimates for hatchery and wild (male and female)

Considerations

- All steelhead assessed were handled by trained personnel
- Only steelhead in good condition were radio tagged (however, very few steelhead were rejected, and these were based on coloration or pre-existing wounds)
- Radio tagging and sampling procedure likely more stressful than release without sampling, thus survivals from radio-tagged group would represent the minimum survivals

Survival to Spawning Following Release

1999 Sample size of 61 steelhead, 100% survival to spawning (this group included a minimum of 19 unique recaptures)

2000 Sample size of 112 steelhead, minimum survival to spawning was 97.3% (included 23 reported recaptures)

Number and percent of radio-tagged hatchery and wild steelhead that were assessed to have spawned successfully following release (from the 2000 Vedder/Chilliwack steelhead telemetry program). Only those steelhead that could be assessed for survival to spawning were used in this analysis (steelhead that were recaptured and killed, or disappeared from the study area, were not included in this assessment).

| Hatchery or Wild | Male | | | Female | | | Male and Female | | |
|-------------------|-----------------------|-------------------------|-----------------------------|-----------------------|-------------------------|-----------------------------|-----------------------|-------------------------|-----------------------------|
| | No. Recaptured Events | No. Successful Spawners | Percent Successful Spawners | No. Recaptured Events | No. Successful Spawners | Percent Successful Spawners | No. Recaptured Events | No. Successful Spawners | Percent Successful Spawners |
| Hatchery | 3 | 4 | 9 | 28 | 7 | 28 | 38 | 11 | 38 |
| Wild | 31 | 3 | 28 | 43 | 7 | 43 | 74 | 12 | 71 |
| Hatchery and Wild | 40 | 9 | 37 | 72 | 14 | 72 | 109 | 23 | 109 |

1999-2000 Combined sample size of 173 steelhead released and assessed for survival (minimum survival is 98.2% and includes a minimum of 42 additional recaptures)



Survival To Kelt 1999

| Hatchery or Wild | Tagging Month | Male | | Female | | Male and Female | | | | |
|---|---------------|-------------|--------------------------|--------------|--------------------------|-----------------|--------------------------|-----------|-----------|--------------|
| | | Sample Size | No. Survived to Kelt (%) | Sample Size | No. Survived to Kelt (%) | Sample Size | No. Survived to Kelt (%) | | | |
| Hatchery | | | | | | | | | | |
| | January | - | - | 3 | 2 | 66.7% | 3 | 2 | 66.7% | |
| | February | 2 | 1 | 50.0% | 5 | 5 | 100.0% | 7 | 6 | 85.7% |
| | March | 3 | 2 | 66.7% | 2 | 2 | 100.0% | 5 | 4 | 80.0% |
| | April | 1 | 1 | 100.0% | 1 | 1 | 100.0% | 2 | 2 | 100.0% |
| | May | 3 | 2 | 66.7% | 3 | 2 | 66.7% | 6 | 4 | 66.7% |
| Total Hatchery | | 9 | 6 | 66.7% | 14 | 12 | 85.7% | 23 | 18 | 78.3% |
| Wild | | | | | | | | | | |
| | January | 5 | 2 | 40.0% | 2 | 1 | 50.0% | 7 | 3 | 42.9% |
| | February | 3 | 1 | 33.3% | 5 | 3 | 60.0% | 8 | 4 | 50.0% |
| | March | 3 | 1 | 33.3% | 9 | 9 | 100.0% | 12 | 10 | 83.3% |
| | April | 1 | 1 | 100.0% | 5 | 5 | 100.0% | 6 | 6 | 100.0% |
| | May | - | - | - | 4 | 4 | 100.0% | 4 | 4 | 100.0% |
| Total Wild | | 12 | 5 | 41.7% | 25 | 22 | 88.0% | 37 | 27 | 73.0% |
| Total Hatchery and Wild (all months) | | 21 | 11 | 52.4% | 39 | 34 | 87.2% | 60 | 45 | 75.0% |

Survival To Kelt 2000

| Hatchery or Wild | Tagging Month | Male | | Female | | Male and Female | |
|---|---------------|-------------|--------------------------|--------------|--------------------------|-----------------|--------------------------|
| | | Sample Size | No. Survived to Kelt (%) | Sample Size | No. Survived to Kelt (%) | Sample Size | No. Survived to Kelt (%) |
| Hatchery | | | | | | | |
| | December | 1 | 1 | 100.0% | 2 | 2 | 100.0% |
| | January | 1 | 1 | 100.0% | 7 | 5 | 71.4% |
| | February | 2 | 1 | 50.0% | 1 | 1 | 100.0% |
| | March | 3 | 3 | 100.0% | 4 | 3 | 75.0% |
| | April | 2 | 2 | 100.0% | 15 | 10 | 66.7% |
| Total Hatchery | | 9 | 8 | 88.9% | 29 | 21 | 72.4% |
| Wild | | | | | | | |
| | December | 2 | 0 | 0.0% | 1 | 1 | 100.0% |
| | January | 6 | 6 | 100.0% | 18 | 13 | 83.3% |
| | February | 8 | 5 | 62.5% | 3 | 2 | 66.7% |
| | March | 6 | 3 | 50.0% | 12 | 11 | 91.7% |
| | April | 6 | 4 | 66.7% | 11 | 10 | 90.9% |
| Total Wild | | 28 | 18 | 64.3% | 43 | 37 | 86.0% |
| Total Hatchery and Wild (all months) | | 37 | 26 | 70.3% | 72 | 58 | 80.6% |

Recaptures

| Hatchery or Wild | Male | | | | Female | | | | Total Male and Female | | | |
|--|--|--|---|---|--|--|---|--|---|--|---|---|
| | Radio-tagged Steelhead Sample Size (n) | Number of Individual Steelhead Recaptured by Anglers Prior to Spawning | Percent of Individual Steelhead Recaptured by Anglers | Percent of Radio-tagged Steelhead Recaptured by Anglers | Radio-tagged Steelhead Sample Size (n) | Number of Individual Steelhead Recaptured by Anglers Prior to Spawning | Percent of Individual Steelhead Recaptured by Anglers | Percent of Radio-tagged Steelhead Recaptured by Anglers | Radio-tagged Steelhead Sample Size (n) | Number of Individual Steelhead Recaptured by Anglers Prior to Spawning | Percent of Individual Steelhead Recaptured by Anglers | Percent of Radio-tagged Steelhead Recaptured by Anglers |
| Hatchery | 14 | 6 | 42.9% | 42.9% | 56 | 27 | 48.2% | 48.2% | 70 | 33 | 47.1% | 47.1% |
| Wild | 38 | 11 | 28.9% | 28.9% | 46 | 5 | 10.9% | 10.9% | 84 | 16 | 19.0% | 19.0% |
| Total Number of Reported Recaptures of Radio-Tagged Steelhead | | | | | | | | | | | | |
| Hatchery or Wild | Male | | | Female | | | Total Male and Female | | | | | |
| | Radio-tagged Steelhead Sample Size (n) | Number of Unique Recapture Events by Anglers Prior to Spawning | Percent of Unique Recapture Events by Anglers | Radio-tagged Steelhead Sample Size (n) | Number of Unique Recapture Events by Anglers Prior to Spawning | Percent of Unique Recapture Events by Anglers | Radio-tagged Steelhead Sample Size (n) | Number of Unique Recapture Events by Anglers Prior to Spawning | Percent of Unique Recapture Events by Anglers | | | |
| Hatchery | 14 | 6 | 42.9% | 56 | 31 | 55.4% | 70 | 38 | 54.3% | | | |
| Wild | 38 | 17 | 44.7% | 46 | 7 | 15.2% | 84 | 24 | 28.6% | | | |

Survival to Kelt - Single vs. Multiple Recaptures

| Hatchery or Wild | Single Capture (No Reported Recaptures) | | | Multiple Capture (Reported Recaptures) | | | Single and Multiple Capture | | |
|--------------------------|---|-----|-------|--|-----|--------|-----------------------------|-----|-------|
| | n | No. | % | n | No. | % | n | No. | % |
| Hatchery | | | | | | | | | |
| Male | 6 | 5 | 83.3% | 3 | 3 | 100.0% | 9 | 8 | 88.9% |
| Female | 23 | 17 | 73.9% | 6 | 4 | 66.7% | 29 | 21 | 72.4% |
| Male and Female | 29 | 22 | 75.9% | 9 | 7 | 77.8% | 38 | 29 | 76.3% |
| Wild | | | | | | | | | |
| Male | 23 | 16 | 69.6% | 5 | 2 | 40.0% | 28 | 18 | 64.3% |
| Female | 38 | 33 | 86.8% | 5 | 4 | 80.0% | 43 | 37 | 86.0% |
| Male and Female | 61 | 49 | 80.3% | 10 | 6 | 60.0% | 71 | 55 | 77.5% |
| Hatchery and Wild | | | | | | | | | |
| Male | 29 | 21 | 72.4% | 8 | 5 | 62.5% | 37 | 26 | 70.3% |
| Female | 61 | 50 | 82.0% | 11 | 8 | 72.7% | 72 | 58 | 80.6% |
| Male and Female | 90 | 71 | 78.9% | 19 | 13 | 68.4% | 109 | 84 | 77.1% |

CONCLUSIONS

ATTEMPT TO DETERMINE

- If hatchery fish spawn at the same time and location as wild fish - Yes. Absolutely
- If early-migrating fish have a different spawning distribution than late-migrating fish - No. Spawning distribution is broad within the watershed for all run-timing groups
- If wild fish have different migration patterns than hatchery fish - Slightly. Wild fish tend to have less extreme movements prior to spawning
- If males have different migration patterns than females - Yes. Male kelts tended to spend a longer period of time in the river post spawning than females
- If there is an incidental mortality as a result of angling - Perhaps. Although very low pre-spawning, perhaps there is increased mortality post spawning for captured and especially recaptured steelhead (lower survival to kelt)
- If individual fish are recaptured by anglers - Yes. More than half of all steelhead captured in the Vedder/Chilliwack will likely be captured at least twice
- If steelhead spawning occurs in the vicinity of the Vedder Floodway gravel removal pits (near Yarrow) - Yes. Spawning and holding of radio-tagged steelhead occurred within 1 km of the sites in both 1999 and 2000



**VEDDER / CHILLIWACK RIVER
STEELHEAD TELEMETRY PROGRAM 1999-2000**



Fate of 7 Air-Spawned Wild Female Steelhead

Summary of post-release information for 7 air-spawned wild female steelhead, radio tagged at Chilliwack River Hatchery on 19 April 2000.

| Fish No. | Tag Date | Radio Tag Channel Code | Forke Length (cm) | Final Detection Location | Final Detection Run | Fate | Date Past Station 1 | No. Days Past Station 1 |
|----------|-----------|------------------------|-------------------|--------------------------|---------------------|----------------------|---------------------|-------------------------|
| 1 | 19-Apr-00 | 1 | 114 | 80.5 Hatchery Outlet | 39.5 | Died near hatchery | - | - |
| 2 | 19-Apr-00 | 1 | 117 | 67.0 Station 1 | 3.0 | Killed past St. 1 | 08-May-00 | 19 |
| 3 | 19-Apr-00 | 1 | 120 | 78.5 Station 1 | 3.0 | Killed past St. 1 | 29-Apr-00 | 9 |
| 4 | 19-Apr-00 | 1 | 121 | 86.5 Station 1 | 3.0 | Killed past St. 1 | 28-Apr-00 | 8 |
| 5 | 19-Apr-00 | 1 | 123 | 75.0 Chipmunk Cr. | 43.0 | Died Upstr. hatchery | - | - |
| 6 | 19-Apr-00 | 1 | 124 | 76.0 Station 1 | 3.0 | Killed past St. 1 | 23-Apr-00 | 3 |
| 7 | 19-Apr-00 | 1 | 125 | 76.0 Station 1 | 3.0 | Killed past St. 1 | 27-Apr-00 | 6 |

Air-Spawn Summary

- 7 wild female steelhead, 67-86 cm FL, were captured by hatchery staff using angling gear (near hatchery)
 - All steelhead were held at the hatchery 80-90 days prior to air spawning
 - All steelhead were anaesthetized prior to air spawning
 - Air spawning was performed by hatchery staff (by hand); a needle was inserted below pectoral fin and air was injected in to body cavity; hand pressure used to force eggs out (total processing time 5-7 minutes)
 - Following air spawning, all steelhead were held for 1-2 days prior to tagging
 - All steelhead were radio tagged at hatchery on 19 April
 - Following tagging, all steelhead were held at the hatchery for 2 days prior to release
 - All steelhead were transported by truck to the hatchery intake and released into the Chilliwack River
- Following Release:**
- 3 air-spawned steelhead survived to left past Station 1 to Fraser River; this represents 71% of sample
 - 2 air-spawned steelhead died in the Chilliwack River (one near hatchery, one 4 km upstream of hatchery)
 - 2 air-spawned steelhead moved upstream (3-5 km) from hatchery outlet after release
 - 1 air-spawned steelhead beta passed Station 1 (to Fraser River) from 3-15 days following release

