Sturgeon Acoustic Telemetry Update

1 November 2010

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All information in this document should be considered preliminary as data quality assessment is still underway and because tracking may continue into 2012.

Receiver Deployment

There are currently ten receivers deployed (Figure 1). An eleventh receiver had been deployed, but it was removed (Figure 1) due to damage, and to avoid potential future damage resulting from construction activities in the area. Receiver locations were selected to monitor movements in the Pitt River and near the Port Mann Bridge (five receivers), and out of the Fraser into the Strait of Georgia via the South Arm (four receivers – two near Steveston and two in Canoe Pass) or the North Arm (one receiver) of the Fraser River.

Receiver locations were selected to be easily accessed by boat (i.e., near boat launches), and to be in relatively constricted parts of the river which are free of line-of-sight obstructions (to ensure maximum detection efficiency). Where channel-widths exceeded the expected range of the receivers (~ 500 m), two receivers were deployed on opposite banks to provide a synoptic 'picture' of the whole channel. In the Pitt, Port Mann, and Canoe Pass areas, pairs of receivers were deployed at distances of > 500 m from each other, in order to provide information about the directionality of sturgeon movements.

Receivers were mounted to a trolley, and the trolleys were threaded onto vertical tracks measuring 3.7 to 5.5 m (12 to 18 feet) in length. Vertical tracks were tied and lag-bolted to wooden pilings such that the bottom of the track would be submerged during all tidal and flow conditions; and the top of the track would remain above water during all but the highest waters. Steel cables were attached from the top of the track to the trolley to allow the receiver to be pulled up to the surface for downloading and battery replacement (without need of a SCUBA diver). The receiver-trolley assemblage was secured in place by threading a PVC tube through the track, drilling a hole through both the track and the PVC, and by fixing a padlock through the holes.

Nine track-trolley-receiver assemblages were deployed in three days between 19 and 21 Aug, 2008 (Table 1). After seeing initial sturgeon movement data, and after discussions with Kwikwetlem officials, it was decided to deploy two additional receivers at the upstream-and downstream-ends of the lower Pitt River: one was deployed near the lake on 27 February 2009; and the other near Douglas Island on 30 October 2009 (Table 1). In February 2009, during a routine downloading trip, it was discovered that one of the trolley assemblages (at the site on the north side of the Fraser River near the Port Mann Bridge) had been damaged and that the receiver had fallen off. A SCUBA diver was employed (13 March 2009) to recover the receiver, and to remove the track and trolley assemblage from the piling (Table 1). This receiver site has been decommissioned as it is close to, and possibly redundant with the site on Douglas Island.

Sturgeon Tagging

In June, LGL staff visited the International Centre for Sturgeon Studies to observe the sturgeon surgical methods used by Dr. John Morgan and Gordon Edmondson (Vancouver Island University, Malaspina Campus). These methods included anesthetization, incision, and suturing (also described in Parsley et al. 2008). Incision location was determined through personal communications with Dr. Michael Parsley (USGS, Cook, WA).

Sturgeon selected for the application of acoustic tags were anesthetized in an MS222 bath (125 mg per L of river water) until consciousness was lost. The sturgeon were scanned for PIT tags, and recaptures were recorded. Those without a PIT tag were given one by injection behind the head on the left-hand side of the fish. The sturgeon were then placed in a surgical sling ventral side up, with anesthetic flushed into the mouth and over the gills (using a 1000 gallon per hour bilge pump, with 2 feet of vertical draw, and 10 feet of hose with a flow-control valve near the end). A #21 rounded-edge scalpel was used to make a 5 cm incision located 20% between the midline and the ventral row of scutes along the belly, and 33% of the distance to the pectoral fin base from the anal pore. An otoscope was put into the incision to look for structures that would indicate the sex of the sturgeon, and we recorded whether the structure in the field of view looked "grainy" (female) or "smooth" (male). An acoustic tag was then inserted into the gut cavity. The incision was closed using multiple interrupted sutures. Suturing was performed using Ethicon PSII #0 monofilament with either a CT-2 tapered 27 mm needle (August) or a CP-1 36 mm reverse cutting needle (October and thereafter). These sutures are absorbable, but last long enough to allow healing. Once 50% of the suturing was complete, the bilge pump was moved from the MS222-solution into the river, allowing fresh river-water to flush the gills, and commencing recovery from sedation. Once the suturing was completed, the fish was placed in the river and held at the surface until full consciousness was regained, at which time it was released. To avoid transmitting disease, all surgical equipment and tags were disinfected for 10 minutes (in Super-Germiphene), and then rinsed in distilled water before coming into contact with a fish.

Before enlisting volunteers to help catch and tag sturgeon, a trial tagging session was conducted on 23 August, 2008. Two sturgeon were caught, tagged, and then held overnight in a 2718 L holding pen (2.43 m × 1.22 m × 0.91 m; or 8×4×3 feet). The pen was tied to a dock in the river, allowing the flow-through of river water for the duration of the holding period. During these first two surgeries, the sturgeon were under sedation from 12 to 17 minutes. The surgical durations were abnormally long (relative to those for other species) because the suturing was made very difficult by the thickness of the skin, which caused the sutures to dull almost immediately. Regardless, both fish were very vigorous the next day. One was inspected closely, and all sutures were in place, and no inflammation was evident. Given these positive results, the tagging methods were accepted as adequate. Nevertheless, we wanted to improve our suturing rates. For the summer (August 2008) tagging session, it was decided to start a fresh suture for every stitch (i.e., use four sutures per fish). Starting with the fall (October 2008) tagging session, we used veterinarian-recommended sutures whose needles have cutting-edges.

Summer tagging session (August 2008)

FRSCS volunteer fishermen were coordinated to fish in the Port Mann area on 30 August, and in the Pitt River on 31 August. However, only 6 fish were caught by 5 boats on 30 August, and, given the purported lack of sturgeon in the Pitt River in the summer, it was decided to continue fishing in the Port Mann area on 31 August. However, the fish were much easier to catch on 31 August; all required fish were captured by noon. Six fish were held in a sturgeon holding pen, and 19 fish were tagged and released immediately upon capture. At noon, fishing efforts were moved into the Pitt River (despite expressed reluctance from all volunteers) for the remainder of the day, but only one sturgeon was caught and tagged (2 km from the junction with the Fraser River). By the end of the day, fishing in the Pitt River was aborted, and the surgical team returned to the sturgeon holding pen, where 5 of the 6 held sturgeon were tagged and released.

The quota of 33 sturgeon was reached by tagging 2 fish on 23 August, 6 fish on 30 August, and 25 fish (one in the Pitt River) on 31 August (Figure 1, Table 2). During surgeries on 30-31 August, the sturgeon were under sedation from 3 to 9 minutes (average 6.25 minutes), except for one sturgeon that was PIT-tagged despite being a recapture, and the confusion surrounding this mistake resulted in a sedation time of 11 minutes. Reductions in sedation times from the previous week were the result of an increased preparedness for the dulling of the sutures, and an increase in comfort-level of the surgical team. There was no significant difference in sedation duration between recaptured fish and those that had a PIT tag newly applied. Sedation duration also was not significantly related to fork length.

The field of view of the otoscope appeared “smooth” for 21 of the tagged sturgeon, and appeared “grainy” for 11 (one sturgeon could not be examined, as the incision was through muscle that was deeper than the length of the otoscope cone). Although ripe adults should be simple to distinguish, immature or undeveloped gonads look more similar, and can be the same colour. In general, ovarian tissue if immature is grainy in appearance without a membrane and the testes are smooth with a membrane (Gordon Edmondson, Vancouver Island University, Malaspina Campus, pers. comm.).

Autumn tagging session (October 2008)

FRSCS volunteer fishermen were contacted regarding their availability to fish in the Pitt River, upstream of the Highway 7 Bridge on 6 and 7 October. On 6 October, no volunteer anglers were available. Fishing effort consisted of 5 rods (3 on the ‘surgical’ boat; 2 on the ‘transport’ boat) angling from 9 AM until 6:30 PM (47.5 rod-hours). On 7 October, there were four volunteer anglers in two boats. Fishing effort consisted of 10 rods (4 on the ‘surgical’ boat; 2 on the ‘transport’ boat, and 4 volunteer anglers) angling from 9 AM until 11:30 AM (25 rod-hours). Glen Joe and Craig Orr (Kwikwetlem First Nation) were present on 7 October to help catch fish, and to observe the tagging. They brought along a reporter and photographer from the Globe and Mail (article appeared on 13 October 2008).

Fishing occurred just off the Grant Narrows boat launch (rkm 20) for one hour, and then near Sturgeon Slough (rkm 13) for the remainder of the tagging session. Fishing at Sturgeon

Slough was very productive. The quota of 34 sturgeon was reached by tagging 24 fish on 6 October, and 10 fish on 7 October (Figure 1, Table 2). During surgeries on 6-7 October, the sturgeon were under sedation from 3 to 9 minutes (average 5.4 minutes). There was no significant difference in sedation duration between recaptured fish and those that had a PIT tag newly applied. Sedation duration was significantly and positively related to fork length ($F_{1,33}$ = 12.7; P = 0.0012).

The field of view of the otoscope appeared "smooth" for 22 of the tagged sturgeon, and appeared "grainy" for 11 (one sturgeon could not be examined, as the otoscope battery died while the sturgeon was under sedation).

In total, 6 of the sturgeon tagged in the Pitt River in October were recaptures. These fish were previously detected between 21 Jan 2001 and 7 Oct 2006, in the mainstem of the Fraser from rkm 22 to 90.

Spring tagging session (June 2009)

Once Fraser River water temperatures rose to above 10 degrees C, the tagging staff and volunteers were coordinated, and the summer tagging session occurred on 1-3 June, 2009. Fishing effort on June 1, 2 and 3 consisted of 14 rods (128 rod-hours), 11 rods (104 rod-hours) and 11 rods (79 rod-hours), respectively. On each day, fishing started in the Pitt River, near Sturgeon Slough, and continued until catch rates declined. Subsequently, anglers moved to an area just upstream of the Highway 7 Bridge, and then into the Fraser River (off Douglas Island or directly below the Port Mann Bridge). The quota of 43 sturgeon was reached (Table 2) by tagging 12 fish on 1 June (8 in Pitt, 4 in Fraser), 17 fish on 2 June (8 in Pitt, 9 in Fraser), and 14 fish on 3 June (7 in Pitt, 7 in Fraser).

During surgeries on in June, the sturgeon were under sedation from 3 to 9 minutes (average 6.5 minutes). There was no significant difference in sedation duration between recaptured fish and those that had a PIT tag newly applied. Sedation duration was not significantly related to fork length. The field of view of the otoscope appeared "smooth" for 33 of the tagged sturgeon, and appeared "grainy" for 10.

In total, 7 of the sturgeon tagged in the Pitt River in June were recaptures (30%). The recapture rate for fish tagged in the Fraser in June was 40% (8 of 20).

Mobile Tracking

In order to pinpoint sturgeon positions more accurately, and to help find sturgeon over-wintering locations, mobile tracking efforts were added to the study plan. Between November 2009 and January 2010, three students from BCIT conducted an independent study program, which involved performing periodic mobile tracking surveys of acoustic-tagged sturgeon in the Pitt and Fraser rivers.

The mobile tracking surveys were performed from a small boat, and occurred about one day per week, lasting several hours per day. Surveys typically started in an upstream location,

and the boat was allowed to drift downriver over the course of the day. The starting location was left up to the mobile trackers, but the general idea was both to cover as large a proportion of the study area as possible over the course of the year (to identify areas of sturgeon aggregation), and to repeatedly sample key locations (to determine small-scale movement patterns, and residence times in the aggregation areas).

During each survey, a unidirectional hydrophone was deployed over the side of the boat, pointed in the downstream direction, for the duration of the survey. The hydrophone was wired into a Vemco mobile tracking receiver (model VR100), which recorded for each detection: the date, time, tag code, power of the signal, gain setting on the receiver, and GPS location of the boat.

In total, eight surveys were performed (Table 3), and 62 of the acoustic-tagged sturgeon were detected. These tracking efforts came at no cost to the program. All costs have been levied as in-kind contributions from BCIT (contributing the costs of the boat, gas, and the student's time, etc.) and from POST (contributing the costs of the receiver rental).

Additional mobile tracking is planned for next winter.

Receiver Downloading and External Databases

All fixed-station receivers were downloaded most recently in October 2010 (Table 1). The internal batteries were replaced in all receivers in September or October of 2009, after about 13 months of use. The receiver manufacturer reports receiver battery life estimates of 15 months. The battery life of our receivers showed no sign of decay. If the sturgeon monitoring is extended beyond the current funding, the batteries will need to be replaced again before 2011.

Downloading has occurred about every 4 months. Thus far, memory banks of the receivers have never been more than 4% full, despite thousands of detections. It is clear that the rate of memory bank filling will not be a problem relative to our download schedule.

POST maintains data from a suite of receivers that are compatible with our sturgeon's acoustic tags, and which are located at key locations in the Fraser River, and in the surrounding marine areas. As the POST receivers are downloaded, the data are uploaded into their database. Periodically, we query the POST database for detections of our fish on the POST receivers. Data from POST were received on 10 December, 2008, on 20 July 2009, on 27 January 2010, and on 3 March 2010. The most recent detection of one of our sturgeon in the POST database occurred on 14 December, 2009. To date, 15% of all sturgeon detections have been recorded on POST-associated arrays, and 85% on LGL-maintained receivers.

Sturgeon Movements

Of the 110 sturgeon released, all have been detected at least once. Sturgeon have been detected on all receivers except that in the North Arm of the Fraser, near the Vancouver airport. The data from the POST receivers included detections of 72 study-fish, including 41 fish

detected at Annacis, 46 at Maple Ridge, 24 at Hatzic, 1 at Dewdney, 17 at Highway 99, and 18 at three receiver sites in the North Arm.

Detection sequences for each fish were used to determine minimum distance traveled, and minimum travel speeds. Minimum distances moved ranged from 1 to 882 km (Figure 2). These distances, divided by time at large, yielded minimum travel speeds ranging from 0.1 to 70 km/day (Figure 3).

To date, 15 acoustic-tagged sturgeon have been detected on receivers near the outer entrances of the Fraser (Figure 4). It is not known whether any of these fish moved from the river into the Strait of Georgia, since none have (to date) been detected on POST receivers deployed in marine waters. Importantly, all 15 of the sturgeon that were detected at the mouth of the Fraser subsequently returned upriver to areas around the Port Mann Bridge and the Pitt River (Figure 4).

Of the 110 acoustic-tagged sturgeon, 91 were detected at the receiver near the Highway 7 Bridge. Including repeat visits, there were 598 detections at this bridge. Of these 598 encounters, 316 were followed by detections on the other side of the bridge, indicating a certain bridge crossing. In 273 of the cases, the fish's next detection was on the same side of the bridge, thus bridge crossing could not be confirmed. In the remaining 9 cases, further downloads will be required to determine where the fish will be next detected. Bridge encounters were detected in all months, but the busiest times were in late spring (~10% in each of May, June and July) and in autumn (19% in September, 15% in October).

Of the 110 acoustic-tagged sturgeon, 87 were detected at a receiver near the Port Mann Bridge. Including repeat visits, there were 618 detections at this bridge. Of these 618 encounters, 570 were followed by detections on the other side of the bridge, indicating a certain bridge crossing. In 48 of the cases, the fish's next detection was on the same side of the bridge, thus bridge crossing could not be confirmed. Bridge encounters were detected in all study months, but the majority were late in late-summer / autumn (61% between August and November).

Upcoming Scheduled Activities

If the sturgeon monitoring budget cannot be extended beyond the current deadline, the next activity will be the production of a final report, including maps that depict the movements of tracked sturgeon, and more detailed analyses of the movements.

If funding is extended, the fixed-station receivers will be maintained until June 2012, and will be downloaded every three-four months. The POST database will continue to be queried for detections of the tagged sturgeon. Additional mobile tracking surveys will be conducted to further resolve specific habitats occupied by overwintering sturgeon. A further interim report (similar to this one) will be prepared in June, 2011, and the final report will be prepared for August 2012.

Acknowledgements

Thanks are due to study planners, coordinators and funders, including the Glen Joe and the Kwikwetlem First Nation, Craig Orr (Watershed Watch), Troy Nelson (Fraser River Sturgeon Conservation Society), Karl English (LGL), Jonathan Thar (POST) and Marvin Rosenau (BCIT). We thank the BCIT students (Jeremy Mothus, Paul Neufeld and Kaid Teubert) for their mobile-tracking efforts. We also thank LGL staff for tagging (Lucia Ferriera, Megan Mathews), for downloading (Shawn Tyerman, Wade Kennedy) and for coordinating (Jim Rissling, Karl English) field work and volunteers. Thanks to Yogi Carolsfeld, who designed, built and helped deploy the track and trolley receiver systems. Thanks to professional diver, Chris Wood for deploying the receivers and for finding ones that have gone missing. We greatly appreciate the help of the volunteer Fraser River Sturgeon Conservation Society members, without which, no sturgeon would have been caught, including: Kim Aliprandini, Darrell Armstrong, Colin Bond, Chris Ciesle, Bill Evans, Ed Gohl, Fred Helmer, Peter Krahn, Mike Parenteau, Randy Puchailo, Jim Rissling, John Rissling, Ralph Roberts and Tony Nootebos.

Literature Cited

Parsley, M. J., N. D. Popoff, B. K. Van Der Leeuw, and C. D. Wright. 2008. Seasonal and diel movements of White sturgeon in the lower Columbia River. Transactions of the American Fisheries Society 137:1007–1017.

Table 1. Deployment and most-recent download dates for Fraser and Pitt river acoustic receivers.

Station	River km	Deploy Date	Recent Download	Note
Canoe Pass South	1	21 Aug 2008	29 Oct 2010	
Canoe Pass North	2	21 Aug 2008	29 Oct 2010	
Woodward Island	6.5	20 Aug 2008	29 Oct 2010	
Steveston Island	7	20 Aug 2008	29 Oct 2010	
Sea Island (Airport)	4	21 Aug 2008	29 Oct 2010	
DS Port Mann Bridge	33	20 Aug 2008	22 Oct 2010	
US Port Mann Bridge	35	20 Aug 2008	13 Mar 2009	Decommissioned 13 Mar ‘09
Douglas Island	39	30 Oct 2009	22 Oct 2010	
Highway 7 Bridge	43	19 Aug 2008	22 Oct 2010	
Pitt River (rkm 16)	55	19 Aug 2008	22 Oct 2010	
Pitt Lake mouth	60	27 Feb 2009	22 Oct 2010	

Table 2. Allocation of 110 acoustic tags by location, tagging period, and sturgeon size category.

Tagging Location	Size Bin (FL, cm)	Sturgeon Tagged Summer 29-30 Aug	Fall 6-7 Oct	Spring 1-3 Jun	Total
Pitt River		1	34	23	58
	60 - 100	0	5	9	
	100 - 140	1	17	10	
	140 - 180	0	8	4	
	> 180	0	4	0	
Port Mann Bridge		32	0	20	52
	60 - 100	15	0	11	
	100 - 140	11	0	7	
	140 - 180	6	0	2	
	> 180	0	0	0	
Total		33	34	43	110

Table 3. Mobile tracking surveys for acoustic-tagged sturgeon in the Fraser and Pitt rivers.

Survey Date	Location	Number of Tags Detected
11 Nov 2009	Port Mann to Pitt Bridge and Port Mann to bottom of Barnston Island	18
18 Nov 2009	Pitt Lake to Pitt Bridge	25
25 Nov 2009	Sumas River to top of Matsqui Channel	4
2 Dec 2009	Top of Matsqui Channel to bottom of Barnston Island	7
6 Jan 2010	Port Mann to Pitt Bridge and Port Mann to bottom of Barnston Island	9
13 Jan 2010	Pitt Lake to Pitt Bridge	20
17 Jan 2010	Matsqui Area	1
20 Jan 2010	Whonnock – Crescent Island	8

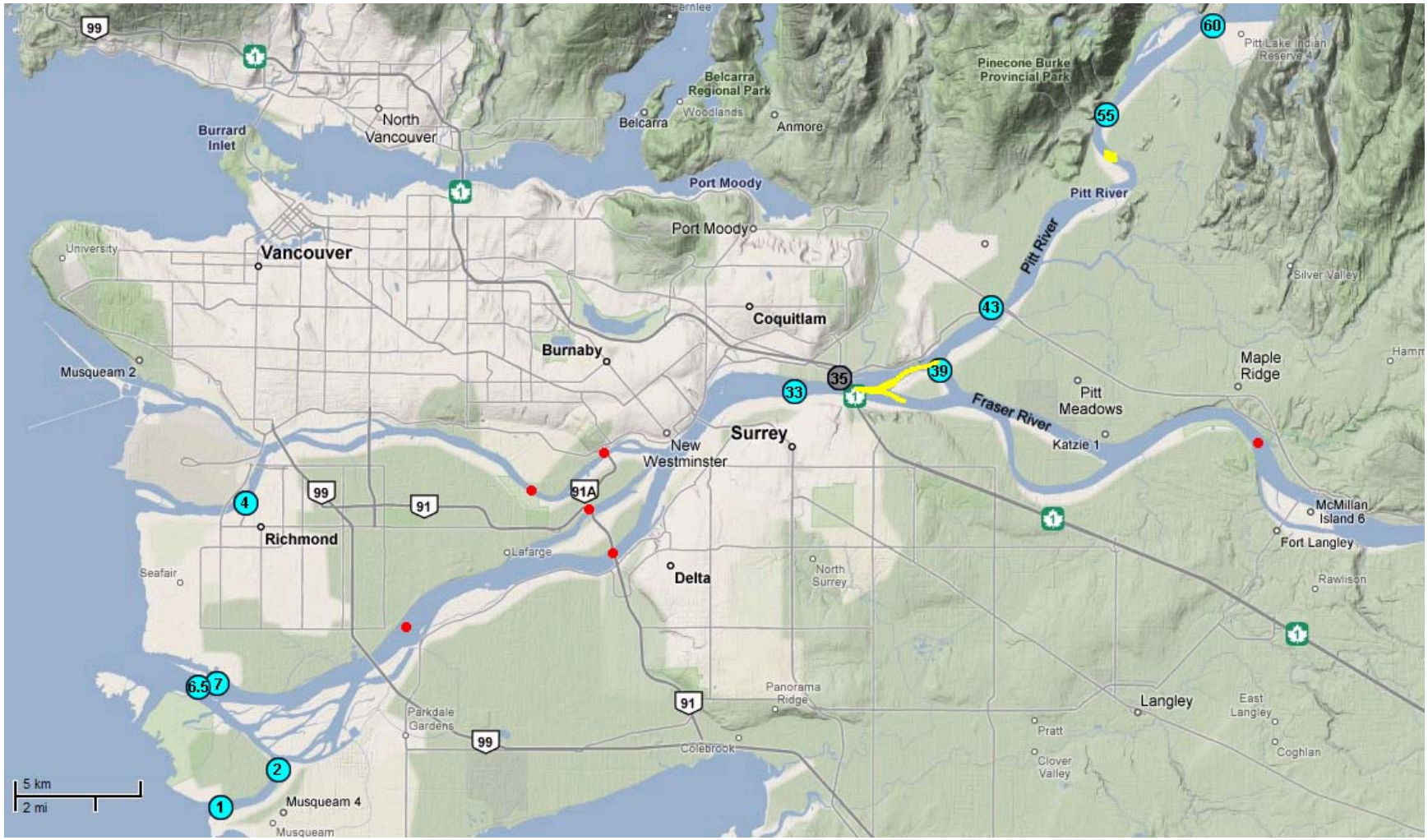

Figure 1. **Locations of ten deployed receivers (blue circles) and one previous deployment (gray circle). Numbers inside circles indicate river kilometer (i.e., approximate distance from Fraser mouth). Receivers at the mouth of the Fraser were given unique river kilometer designations (even if they were in reality closer together) in order to distinguish them on movement plots (see Figure 4). Also shown are the six nearest POST receiver array locations (red). Tagging sites are shown in yellow.**

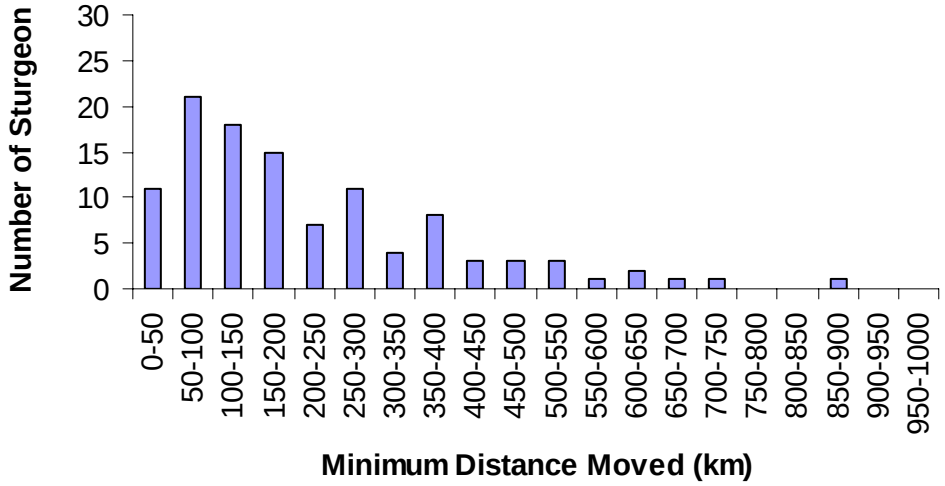

Figure 2. **Frequency distribution of observed minimum distances moved (km) by acoustic-tagged sturgeon in the lower Fraser River. Minimum distances were calculated by summing the distance between successive detections at fixed-station receivers (or as fishery recaptures or in mobile tracks).**

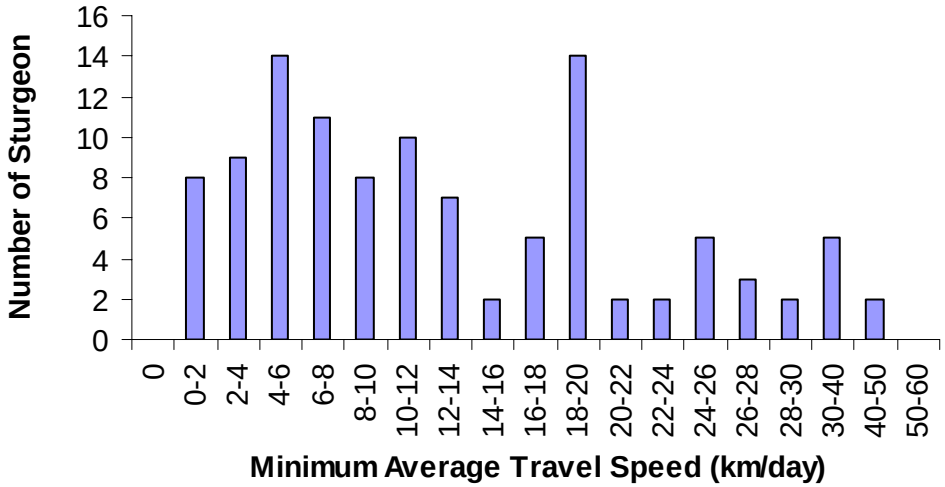

Figure 3. **Frequency distribution of observed minimum travel speeds (km/day) for acoustic-tagged sturgeon in the lower Fraser River. Minimum average travel speeds were calculated by dividing the minimum distance moved by the time at large.**

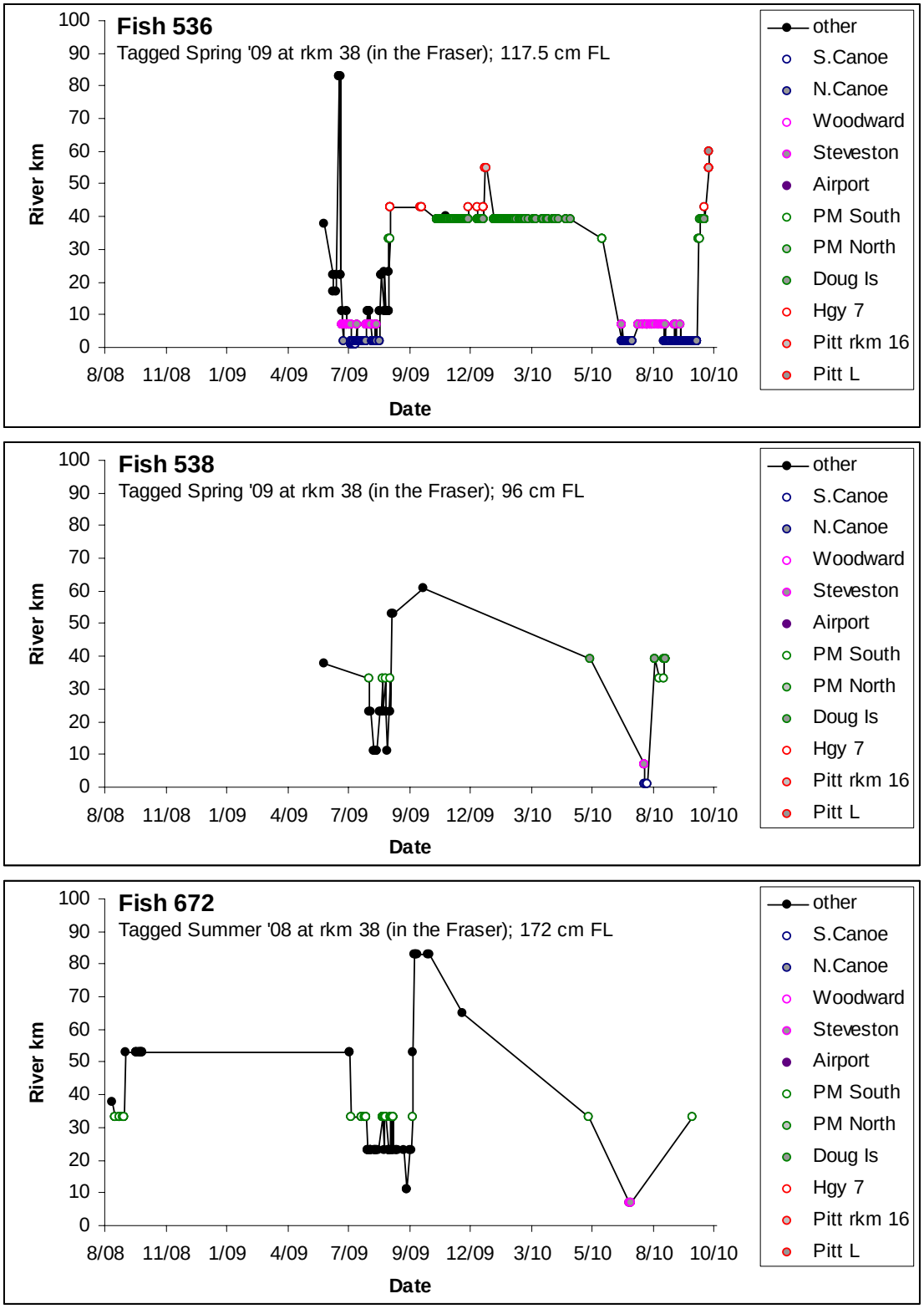

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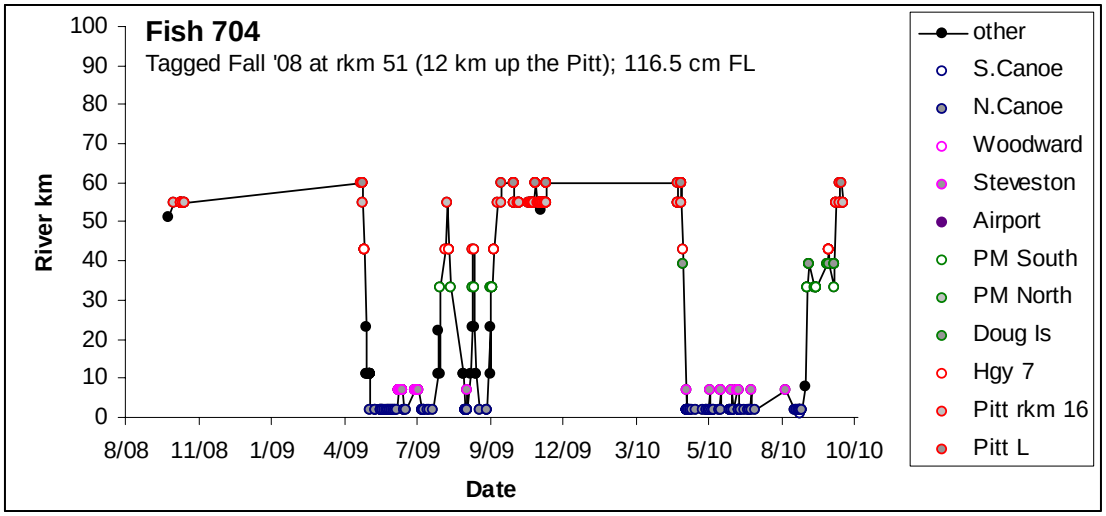
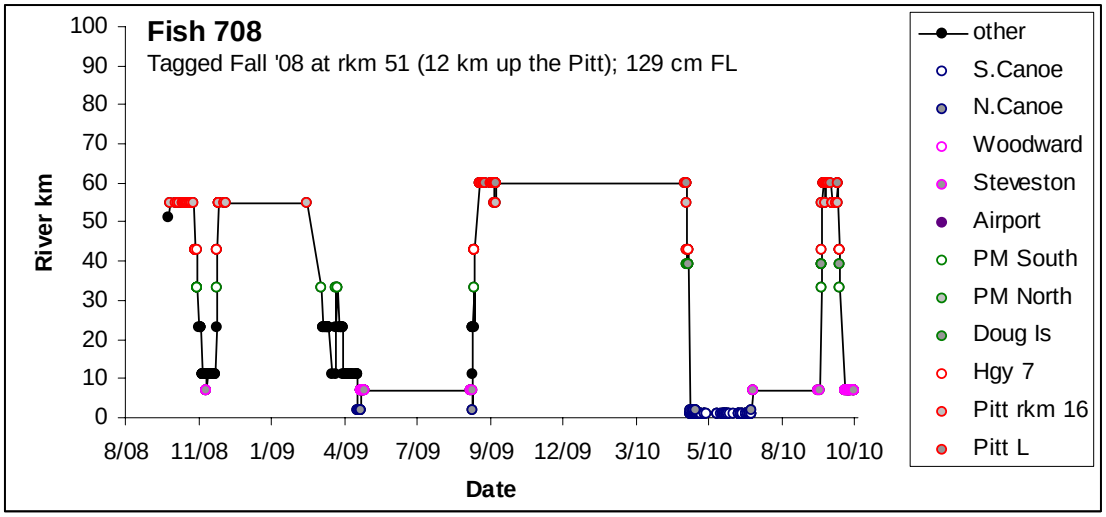
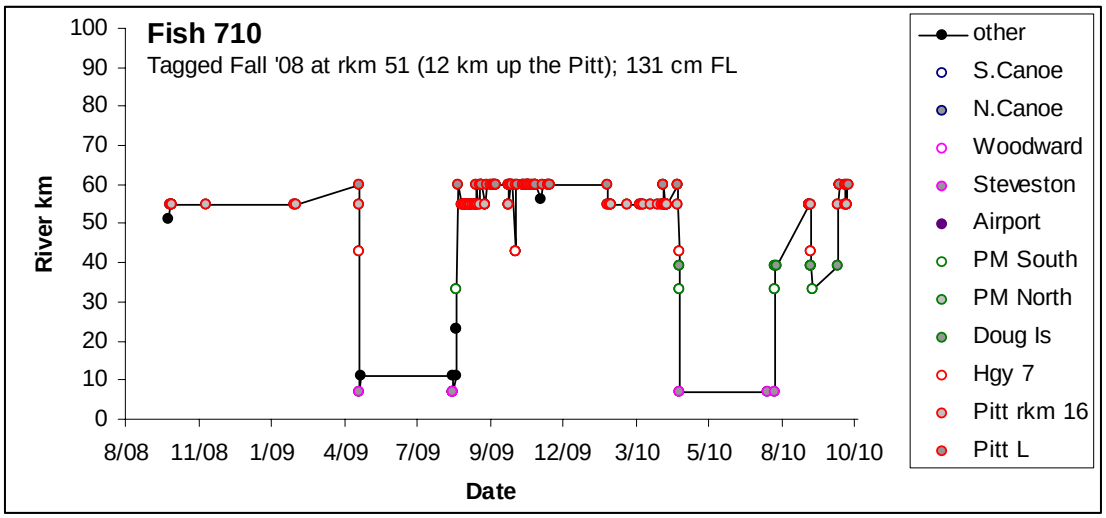
Figure 4. **Movement diagrams for fifteen acoustic-tagged sturgeon that were detected at the mouth of the Fraser River. Detections are connected by straight lines, regardless of the actual path taken by the fish.**







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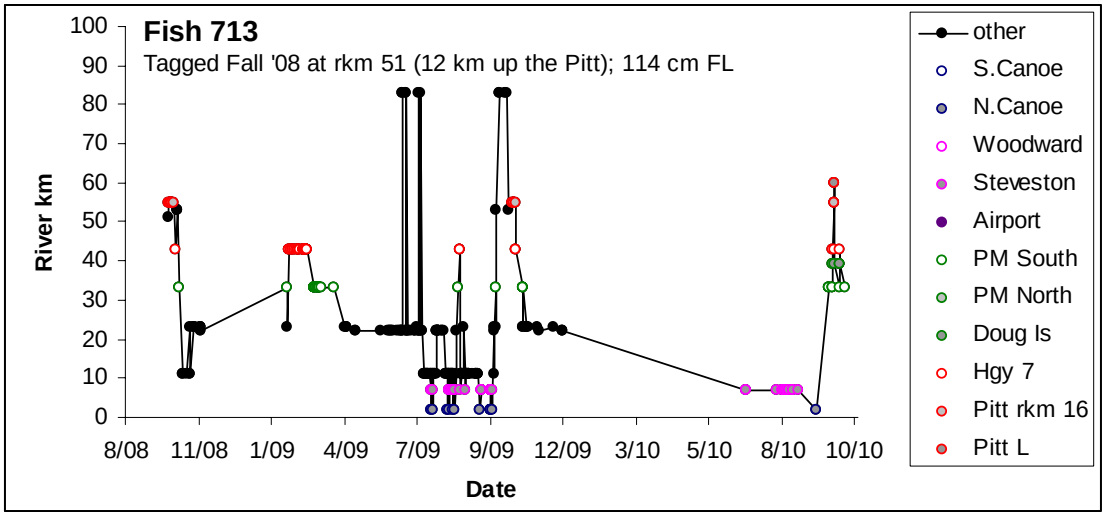

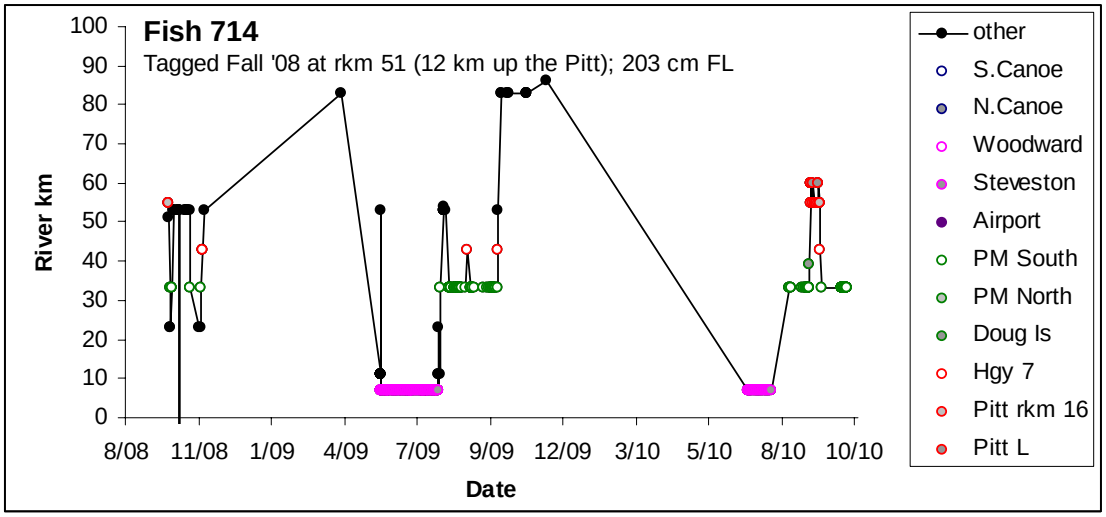

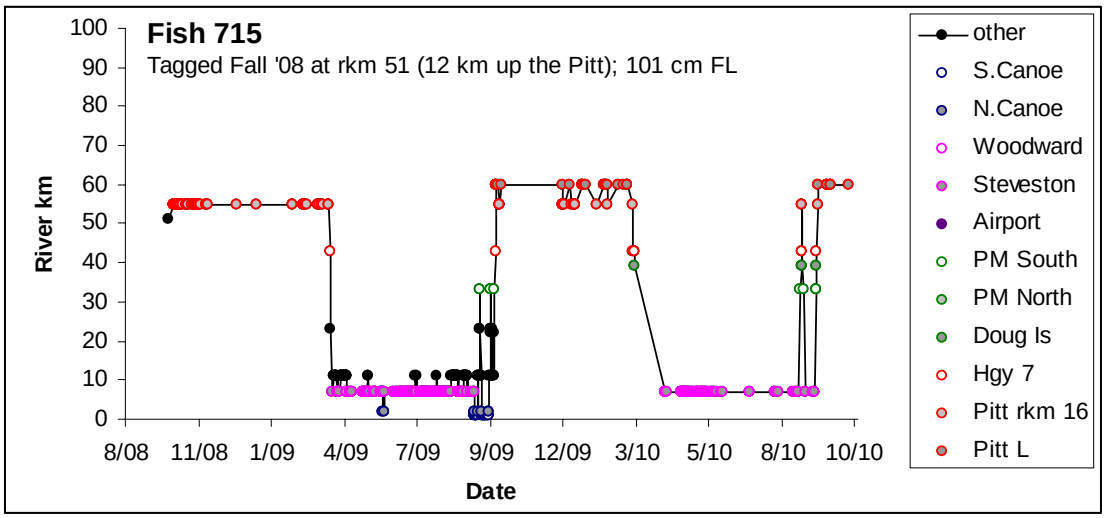

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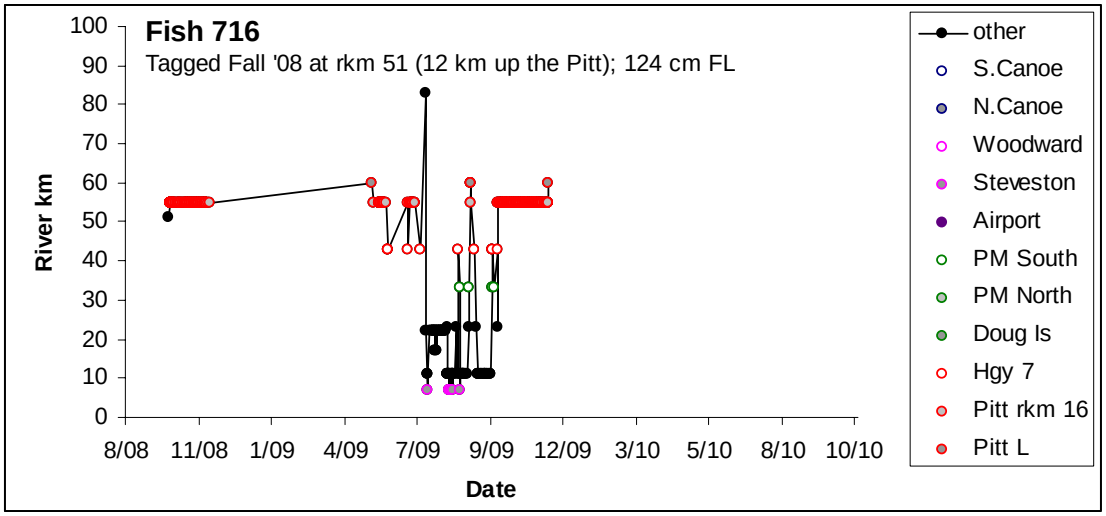

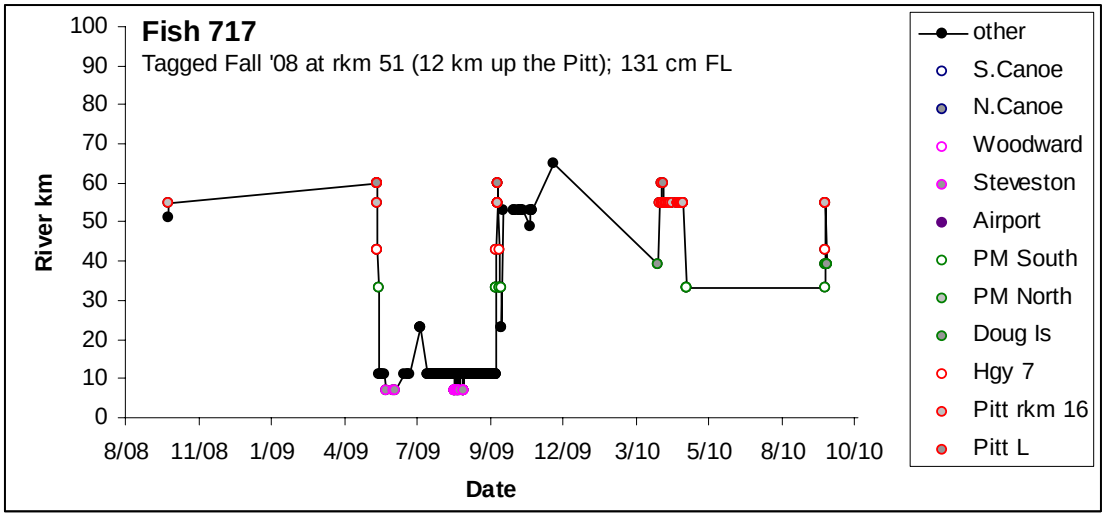

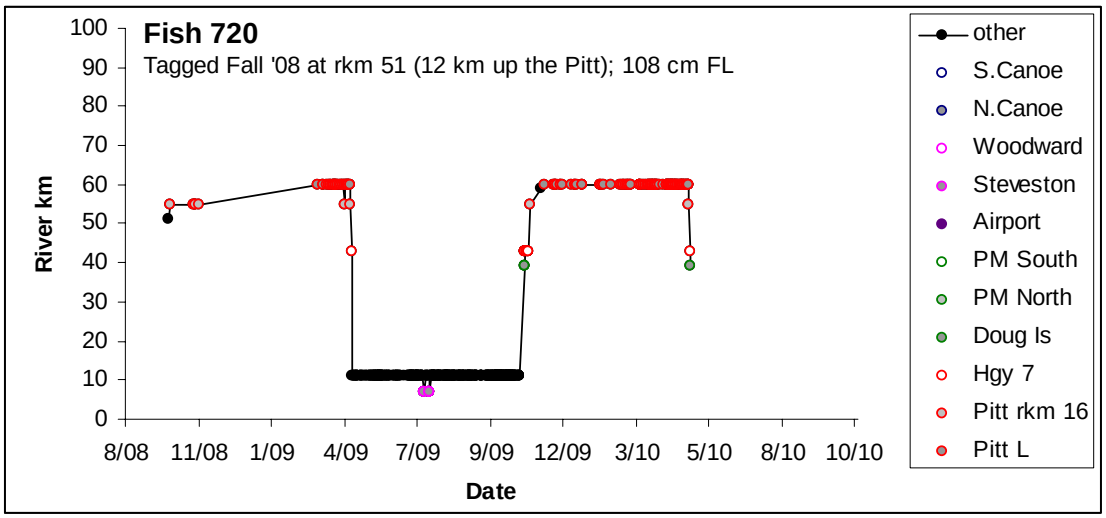

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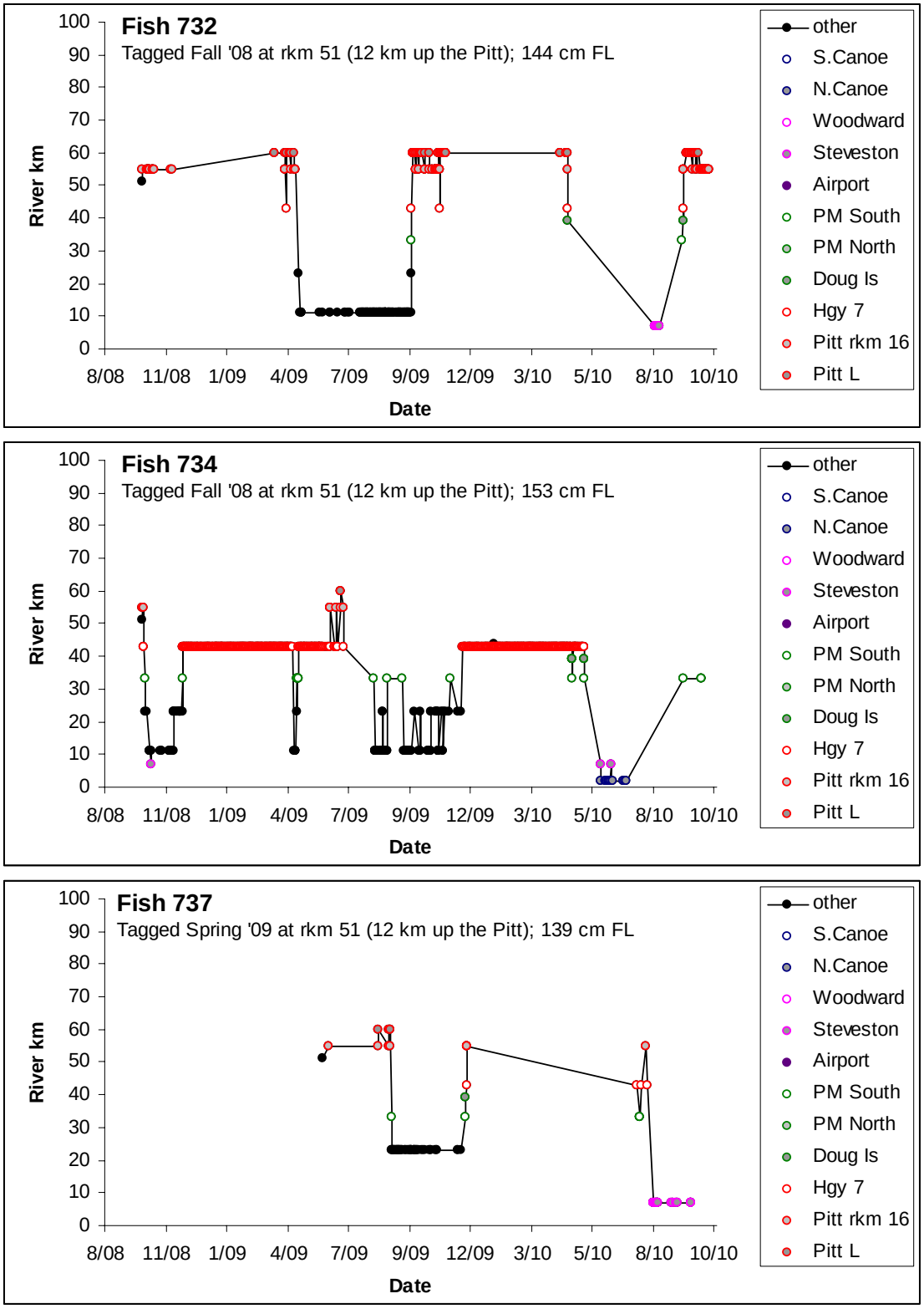

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