Southern Resident Killer Whale Project

As you may already be aware, 2013 has been a most unusual year for the endangered Southern Resident killer whales. During the months when these whales would typically be seen in and around the San Juan Islands on a regular basis, these Residents were quite simply absent from what is supposed to be their "core summer habitat". This unprecedented absence may very well be due to a lack of Fraser River Chinook salmon.

Over the past few months, with the support of several individuals and organizations, I have worked on a project that has culminated in the attached report showing a relationship between the presence of these whales in their "core summer habitat" and a declining abundance of Fraser River Chinook stocks.

The fundamental questions that now need to be asked: Who is responsible for ensuring these whales have enough Chinook salmon in their "core summer habitat", also known as their "Critical Habitat"? What steps need to be taken to ensure that a lack of Chinook salmon does not drive these whales elsewhere to find the food they need to survive?

Jane Cogan
Retired Engineer

Southern Resident Killer Whale Project

For those of us who regularly watch the Southern Resident killer whales in and around the San Juan Islands during the summer months, and for those of us who care deeply about these endangered whales and the lessons to be learned about human effects on the environment, 2013 has us asking ourselves, "*where are the whales this year?"*

The year began oddly with some of the J pod whales spending time here early in the year, but not Granny's group. Granny (J2) is the matriarch of J pod. After not seeing Residents at all in April, every member of J pod, including Granny and her group, finally appeared for a few days in mid-May. Then they left. This perplexing pattern of being gone for days and weeks at a time persisted throughout June, July, and August. September brought more whales on more days, but with different family groups coming and going so much that even September was a peculiar month.

The seemingly unprecedented absence of the Southern Resident killer whales from what is supposed to be their core summer habitat from late spring into fall has people talking about Chinook salmon. As the saying goes, "*no fish, no blackfish*". After comparing Fraser River test fishery data for Chinook salmon with Southern Resident killer whale sightings data, some questions can be answered with more than anecdotal evidence; a host of sobering new questions need to be addressed.

So Where Do the Southern Resident Killer Whales Spend Their Days?

For decades, the inland waters of the Salish Sea have been home to the Southern Resident killer whales from April or May into September. In this context, "inland waters of the Salish Sea" equates to the "core summer habitat" for the Southern Resident killer whales, and spans an area that includes both US and Canadian waters in and around the San Juan Islands, the Canadian Gulf Islands, and Georgia Strait as far north as the Vancouver area or thereabouts. Geographically, the "core summer habitat" runs from about the southern end of Vancouver Island east into Rosario Strait, and from the Hein Bank area (south of San Juan Island) north to the Fraser River near Vancouver, BC. This area, including both US and Canadian waters, has been declared to be Critical Habitat for the endangered Southern Resident killer whales. The Critical Habitat also includes the Strait of Juan de Fuca and a southern region (Admiralty Inlet, Possession Sound, Saratoga Passage, Puget Sound, etc.). However, the southern waters of the Critical Habitat are more likely to be visited by these Resident killer whales during the fall and winter months, not the summer months.

As for how much time the Southern Resident killer whales spend in these local waters, their "core summer habitat", times are indeed changing, and the changes started at least a decade ago.

After being immersed in a data mining effort involving the Center for Whale Research records, Jeanne Hyde's detailed observations, and the Orca Network sightings archives, then supplementing with OrcaMaster as needed, an interesting trend has emerged. Based on sightings information dating back to 2004, the J pod whales do appear to be spending less and less time in the inland waters of the Salish Sea during the months of April through September.

In the good old days, there was a perception that J pod whales could be seen in the inland waters of the Salish Sea on nearly any day during the month of May. As shown in Figure 1, the J pod sightings

data for the month of May from 2004 through 2013 demonstrate a steady decline in the number of days these whales were sighted in their "core summer habitat". Although May of 2010 started slowly, once the J pod whales arrived, they stayed and stayed – well into September.

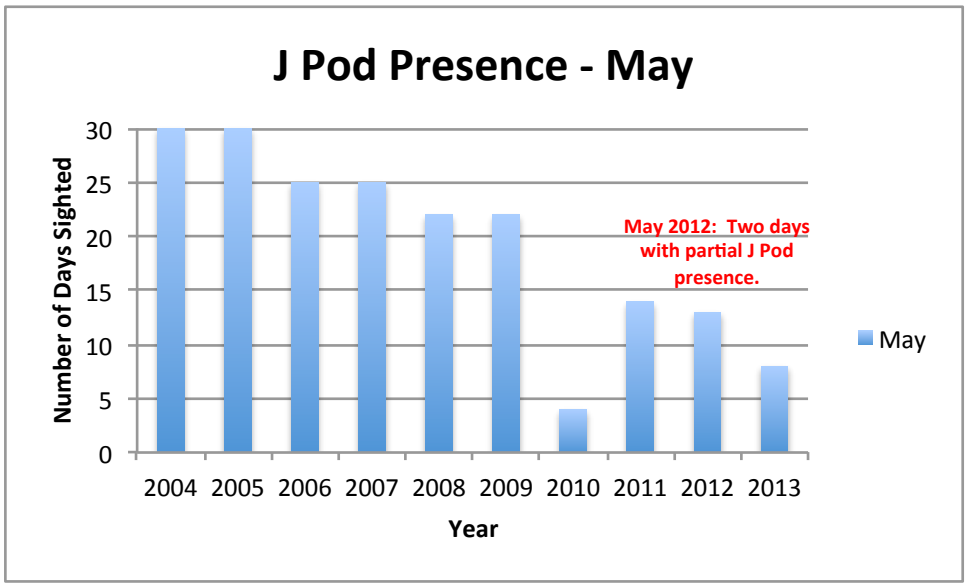

Figure 1. J Pod Presence During the Month of May, 2004-2013

The presence of J pod whales during the month of June has remained relatively steady over the last 10 years with the whales typically spending 3-4 weeks in local waters (Figure 2). The exceptions are 2009 and 2013. The 2009 attendance increased in the July-September time frame (more discussion to follow). In June of 2013 the J pod whales were seen in inland waters on only eight days.

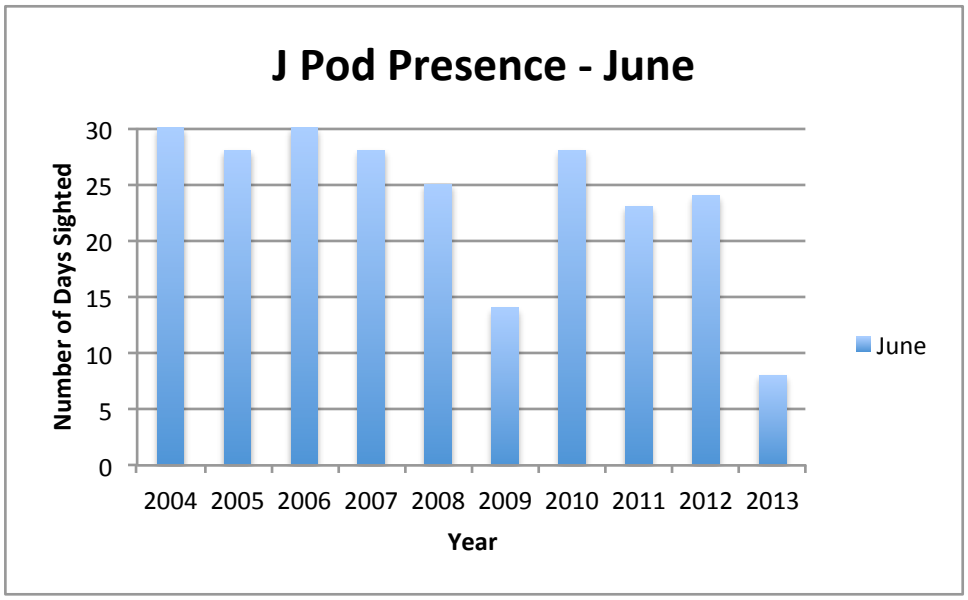

Figure 2. J Pod Presence During the Month of June, 2004-2013

As shown in the next graph (Figure 3), July of 2013 was yet another exceptional month when it comes to the absence of J pod whales in the local area. In July of 2013, the J pod whales were seen on only five days instead of the typical 25 or more days.

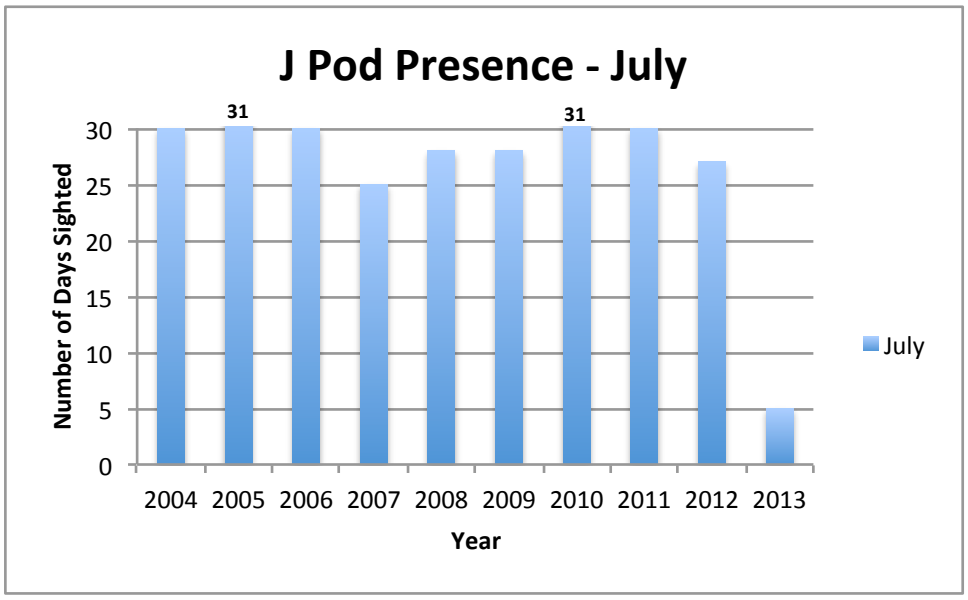

Figure 3. J Pod Presence During the Month of July, 2004-2013

During the months of August and September from 2004 through 2013, the J pod attendance in local waters has shown more variation from year to year (Figure 4). In 2013, the record low attendance for the month of August was offset to some extent by an average attendance in September. However, not all of J pod was present on several of the September days. Additional comments are reserved for a subsequent section.

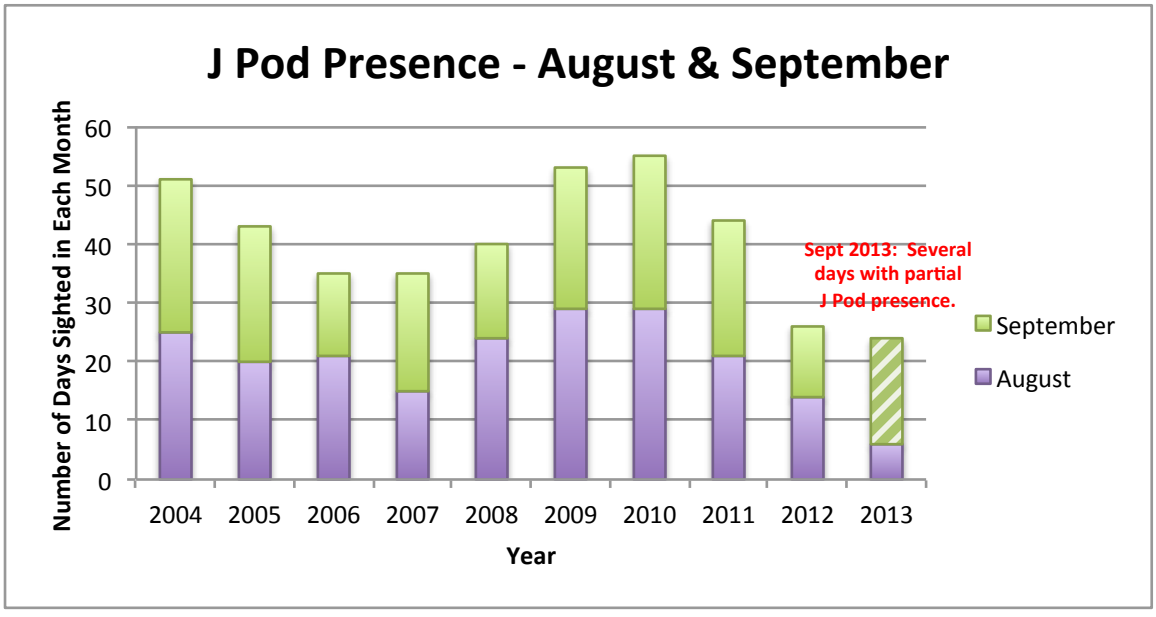

Figure 4. J Pod Presence during the Months of August and September, 2004-2013

The final J pod sightings chart (Figure 5) shows how much time J pod whales have been spending in local waters during the months of April through September, from 2004 to 2013. The vertical axis is scaled to represent 180 days, or six months.

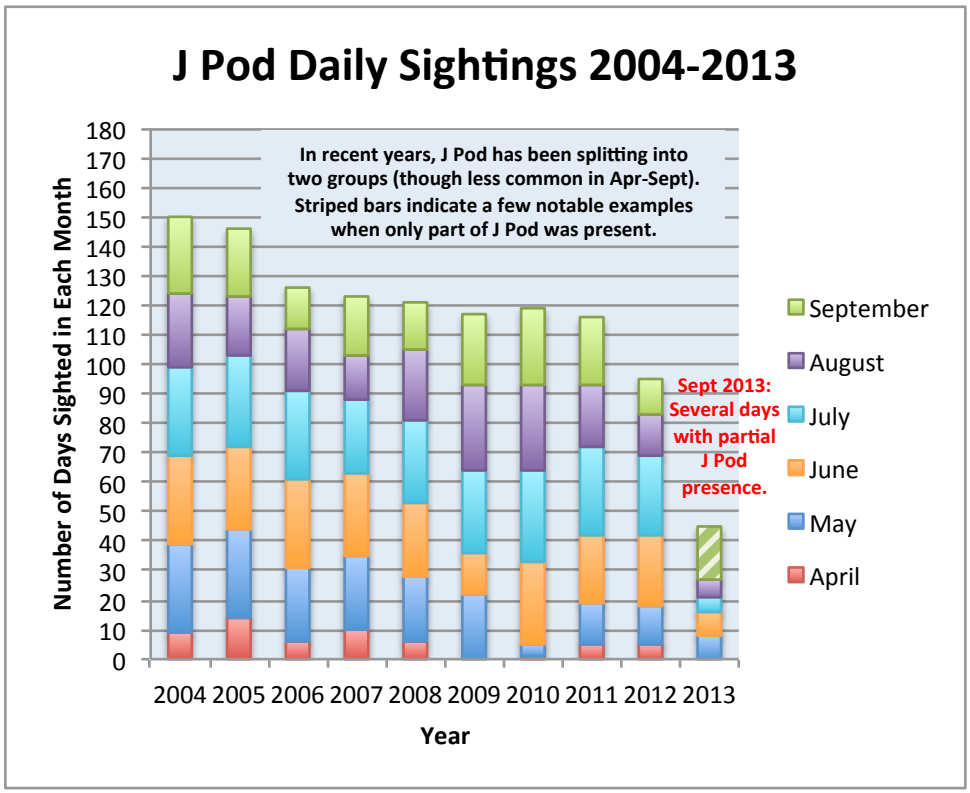

Figure 5. J Pod Presence During the Months of April-September, 2004-2013

For the past decade (prior to 2013), the J pod whales have spent the majority of the April-September time period in local waters, but there is an obvious downward trend which is only driven in part by the May trend.

In 2004, the J pod whales were present on about 150 of the 183 days in the April-September time frame (82%). By 2012, the J pod whales were present on about 55 fewer days. In 2013, the J pod whales were present on only 45 days in the April-September period (25%), with 18 of those days coming in September (and only part of J pod was present on some of the days in September).

Excluding the month of September, in 2004 and 2005, the J pod whales were sighted in local waters on more than 120 of the 153 days in the April-August time period (80%). In 2013, the J pod whales were sighted in their "core summer habitat" on only 27 days from April through August (18%).

As for "record-setting years", between June 1 and September 30 of 2010, J pod whales were seen and/or known to be present in the area for at least 116 of the 122 days in this time period. In contrast, in 2013, it is the prolonged absences that have people talking, if not worrying. In 2013, the J pod whales were absent for 28 straight days in the June-July time frame, and these whales were absent for another 29 consecutive days in the July-August time frame.

Similar graphs are included for K and L pod presence during the months of April through September (Figure 6, Figure 7). However, it is significant that these K and L pod charts have subtitles, "*All or Part of Pod*". Neither the K pod whales nor the L pod whales travel as cohesive groups; seeing part of K pod or part of L pod does not mean the rest of the pod is present. Although the J pod whales have recently been splitting into two groups, for the most part if some of the J pod whales are in the local area during the summer months, the rest of J pod is present, perhaps many miles away, but present in the local area. That is not at all true for either the K or L pods.

The most recognized example may be that of L87, perhaps more appropriately dubbed "JKL87". Although L87 used to travel with his L pod family, consistent with time-honored whale traditions, when his mother died he began traveling with the two oldest females in the K pod. After they died a few years ago, L87 began traveling with the J pod whales. Thus, when it comes to measuring L pod presence in local waters, a sighting of L87 is no longer a reliable indicator that other L pod whales are also present. Ideally when L87 is the only L pod whale in the area, his presence should not count as an "L pod" sighting. Unfortunately not all sightings reports contain enough detail to make the distinction between an "L pod" sighting and an "L87" sighting. In addition to L87, there are several other L pod whales who from time to time have chosen to travel with J pod whales for short periods of time, and one L pod whale was recently seen with K pod whales.

For the K and L pods, the situation is actually quite a bit more complicated. Here are just a few examples:

1) In June of 2009, there were a number of days when just two K pod whales were present with J and/or L pod whales;
2) There are four K pod whales who have often had their own unique itinerary;
3) The "L12's" have been known to spend a lot of time at the south end of San Juan Island (and when people use the term, "L12's", they are likely to be referring to a group of whales that includes a few members of three other matrilines as well);
4) Most recently, just three L pod whales (the L22's) were present day after day at the south end of San Juan Island. Later, only six L pod whales were present in that same area (the small L pod group that is seen the least often).

As a consequence, caution is warranted when trying to draw too many conclusions from graphs that simply tally the number of days when at least one member of K or L pod has been sighted. Despite the inherent limitations, such graphs can help establish in a general sense how often at least some of the K and L pod members have been present in the inland waters of the Salish Sea, their "core summer habitat".

The next two charts (Figure 6, Figure 7) present K and L pod daily sighting numbers for April-September, 2004-2013. The striped bars highlight a few months when only part of the pod was present for a significant number of days during that particular month.

The K and L pod daily sighting graphs (Figure 6, Figure 7) do show that during months of April through September when Southern Resident whales are more likely to be found in local waters, members of these two pods typically spent quite a bit less time in local waters than the J pod whales in the 2004 to 2013 time period. It should be noted that it is normal for the K and L pods to be elsewhere during the months of April and May.

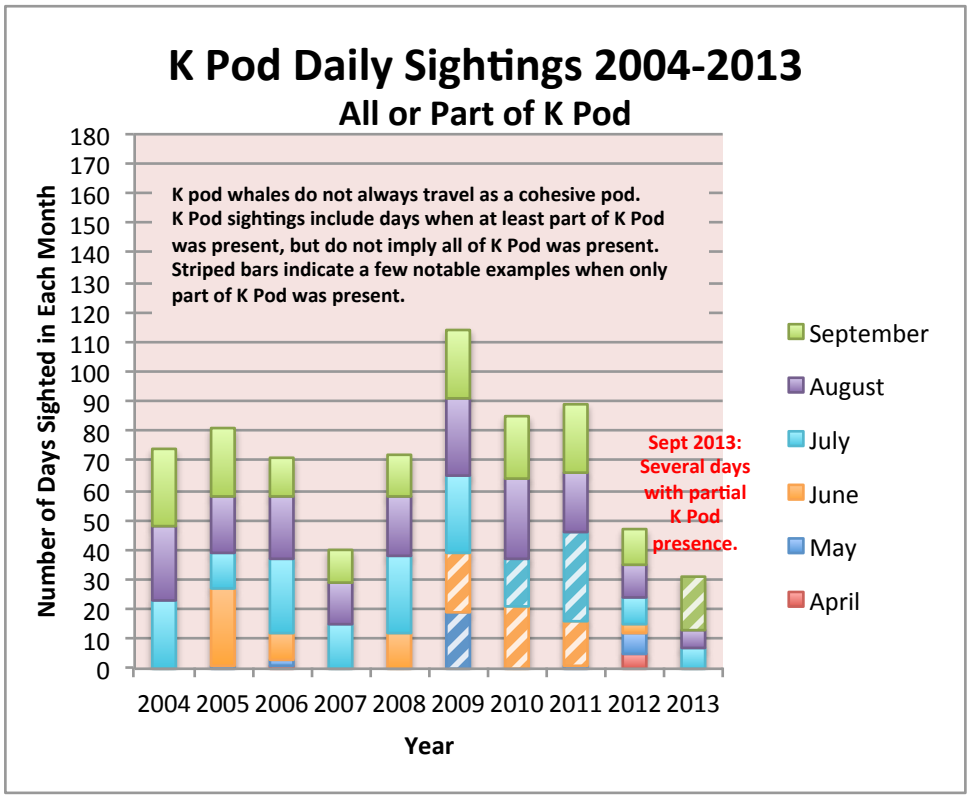

Figure 6. K Pod Presence During the Months of April-September, 2004-2013

In May of 2009 (Figure 6), only the K13 family group was present (about a third of the K pod whales), not any other K pod members. In June of 2009, only two K pod members were present on about half of the days when K pod was sighted, not the rest of K pod. Similar exceptions were observed in June and July of 2010 as well as June and July of 2011. The K pod whales were split several different ways throughout September of 2013.

The L pod sightings chart is shown in Figure 7. During the months of April through September from 2004-2012, members of the L pod were sighted in the local area on fewer days than J pod members (Figure 7). Oddly enough, during June, July, and August of 2013, L pod members were seen in local waters on more days than J pod members. However, on 11 of the days when L pod members were seen in the area, only three of the 37 L pod members were present, reiterating the need for caution when trying to draw too many conclusions from what is "low resolution" data in the case of the K and L pods.

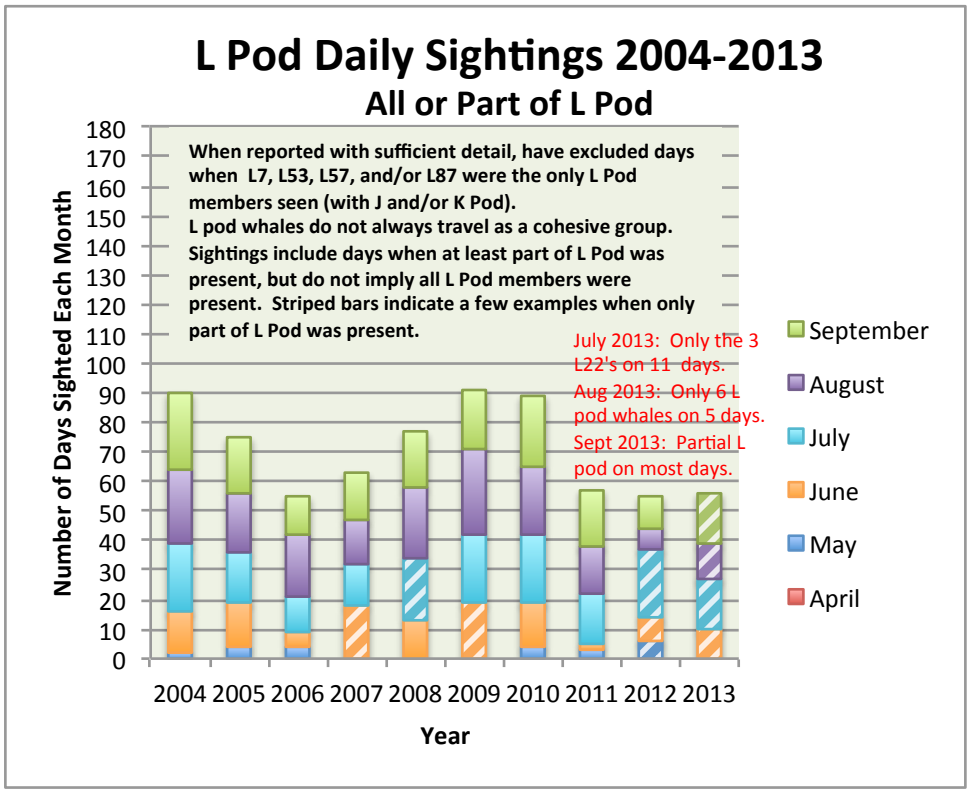

Figure 7. L Pod Presence During the Months of April-September, 2004-2013

L pod presence may be changing in a different manner. Knowing how many L pod whales are present might tell a different story than simply reporting that some or all of L pod is present. This level of detail is not normally available from the "public" sightings reports, but valuable information can be gleaned from the Center for Whale Research data and from other sources.

For example, in July of 2013, members of L pod were seen in the area on 17 days (and heard on the local hydrophones one night); however, this count alone reveals nothing about how few L pod whales were actually present on most days. On 11 of the 17 days, only three L pod members were present. At no time in July of 2013 was all of L pod seen.

K and L pod presence at the matriline level offers more insight into how many K and L pod whales are likely to be present. For those who are not familiar with "matrilines", a matriline is a family unit consisting of mothers and their offspring (multiple generations). The size of a Southern Resident matriline varies from a single whale to perhaps a dozen (living) whales. Although there are exceptions, some of which have been noted elsewhere in this paper, Southern Resident killer whales tend to travel with their family groups. Hence, when one member of a family group or matriline is seen, there is a strong possibility that the rest of the matriline is also present.

Below is a daily log showing patterns of J, K, and L pod presence at the matriline level for July of 2010 (Table 1). Colored cells indicate that at least one member of the matriline was seen on that particular day. The cells with the diagonal pattern indicate that the presence of many L pod whales was reported, but without sufficient detail to determine which matrilines were represented.

So, for July of 2010, J pod was present every day. At least part of K pod was in the area for about half of the month, with only four K pod whales on eight of these days. There were quite a few days when most if not all of L pod was present. On some days, only L7 and L53 were seen because they were traveling with the J pod whales. At this time, L87 was traveling with K pod whales. As for salmon abundance at this time, there will be more information in a subsequent section. Suffice it to say that 2010 was, in relative terms, a better year for both Chinook and Sockeye salmon returning to the Fraser River near Vancouver, BC.

Table 1. J, K, and L Pod Representation at the Matriline Level During July, 2010

Matriline Presence by Date - July 2010																				
	J				K					L										
Date	J2 (J2, J14s)	J4 (J11s, J19s)	J7 (J16s)	J9 (J17s, J22s)	K4 (K12s)	K7 (K7, K11, K13s)	K8 (K14s, K16s)	K18 (K21, K40)	K-Klik (2-K8 2-K18)	L2 (L2s)	L4 (L27, L55s, L86s)	L9 (L84)	L12 (L12s)	L21 (L47s)	L25 (L25s)	L26 (L90, L92)	L28 (L85)	L32 (L85, L22s, L87)	L35 (L54s)	L37 (L53, L72s, L95)
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6-Jul-10																				
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29-Jul-10																				
30-Jul-10																		L87		L7, L53
31-Jul-10																		L87		L7, L53

The data for this particular table (and the next two tables) came from the Center for Whale Research with some data gaps filled by Jeanne Hyde. Although the Orca Network sightings reports played a vital role in piecing this whole story together, most of the sightings reports from the general public do not contain sufficient level of detail to produce matriline-level sightings tables like these.

Here is a similar chart for July of 2012 (Table 2). As with July of 2010, J pod whales were present nearly every day, with K pod whales spending less time in the area than the J pod whales. During the first 18 days of the month, the only L pod members in the area were the four members of the L37 matriline and L87, all traveling with the J pod whales. No other L pod whales were seen until July 19. There were only five days when "most" or all of L pod was present. This particular year was not a particularly good year for Chinook salmon returning to the Fraser River.

Table 2. J, K, and L Pod Representation at the Matriline Level During July, 2012

Matriline Presence by Date – July 2012																				
	J				K					L										
Date	J2 (J2, J14s)	J4 (J11s, J19s)	J7 (J16s)	J9 (J17s, J22s)	K4 (K12s)	K7 (K7, K11, K13s)	K8 (K14s, K16s)	K18 (K21, K40)	K-Klik (2-K8 2-K18)	L2 (L2s)	L4 (L27, L55s, L86s)	L9 (L84)	L12 (L12s)	L21 (L47s)	L25 (L25s)	L26 (L90, L92)	L28 (L85)	L32 (L85, L22s, L87)	L35 (L54s)	L37 (L53, L72s, L95)
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The daily calendar for July of 2013 shows all three pods being conspicuously absent at a level some of us have never seen before (Table 3). Note that the July 1 "sighting" was a hydrophone detection of L pod calls, presumably the calls of the whales seen on July 2.

For 11 days during July of 2013, only three L pod whales were present with no other sightings of the Southern Resident population anywhere in the area.

These unusual behaviors in 2013 have lot of people asking whether the abundance of Fraser River Chinook salmon has dropped so low (two years in a row) that even the J pod whales are not willing to spend time in local waters scouring the underwater landscape looking for Chinook salmon. The Pink salmon appear to be plentiful this summer (with the Pacific Salmon Commission's Fraser River Panel estimating a run size of 26,000,000 Fraser River Pink salmon). These and other smaller salmon have been seen leaping their way north in Haro Strait; however, the Southern Resident killer whales are known to prefer the much larger Chinook salmon.

Table 3. J, K, and L Pod Representation at the Matriline Level During July, 2013

Matriline Presence by Date – July 2013																					
	J				K					L											
Date	J2 (J2, J14s)	J4 (J11s, J19s)	J7 (J16s)	J9 (J17s, J22s)	K4 (K12s)	K7 (K7, K11, K13s)	K8 (K14s, K16s)	K18 (K21)	K-Klik (2-K8 2-K18)	L2 (L88)	L4 (L27, L55s, L86s)	L9 (L84)	L12 (L12s)	L21 (L47s)	L25 (L25s)	L26 (L90, L92)	L28 (L85)	L32 (L85, L22s, L87)	L35 (L54s)	L37 (L53, L72s, L95)
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What Happened to the Chinook Salmon in the Critical Habitat?

There is a test fishery on the lower Fraser River near Albion, BC. Since 1980 there has been a disciplined effort to monitor the abundance of a variety of fish, including Chinook, Chum, and Sockeye salmon. Each year from about the first of April into October, fish are caught in test gill nets and counted. The test gill nets are deployed twice a day during the peak season (prior to September 1), and once a day for the duration of the test season. Of particular interest to the whales are the Chinook salmon. The Fraser River Chinook salmon begin to arrive at the lower Fraser in March. The "spring" stocks return to the river in the March-July time period. The "summer" stocks begin their journey up the river from July through early September. The "fall" stocks return to the Fraser River beginning in August and continuing into November.

The fisheries folks talk about salmon abundance in terms of "CPUE", or "Catch Per Unit of Effort" (in units of "catch per thousand fathom minutes"). To those who are not familiar with this (including myself), right away it becomes difficult to relate the fisheries methodology to more tangible measures of Chinook abundance. Although it makes sense that there would be a need to normalize data collected over many years to account for differences in the test set-up (the length of the nets, the times the nets are down, etc.), it is not at all obvious how this CPUE parameter relates to the number of Chinook salmon that are moving through the "core summer habitat".

The Albion web site provides the historical data in terms of both "fish counts" and CPUE. In the material that follows, a number of detailed bar charts are provided to show how the Chinook salmon counts (and CPUE) vary from month to month and day to day. Caution is warranted not to try to view these charts with a microscope, but instead to assess the higher level trends, not only in the Chinook salmon data but the apparent connection with J pod attendance records dating back to 2004. The objective is not to connect the two with an excess of precision, but to connect the trends with a broader stroke. Even when trends can be established, allowances have to be made for random variations. In other words, in the real world there will be times when something does not fit the mold, but that exception by itself does not invalidate the assertion that a trend or a correlation does in fact exist.

Here is a plot of cumulative Chinook counts as of June 1 for each year from 1988-2013 (Figure 8). Each bar represents the number of Chinook salmon that were netted by the test nets since the start of that season's test sampling period (typically early April). The bars for some of the recent years are barely visible on a scale that is suitable for the early years. The companion plot using cumulative CPUE is provided in Figure S- 1 at the end of this report.

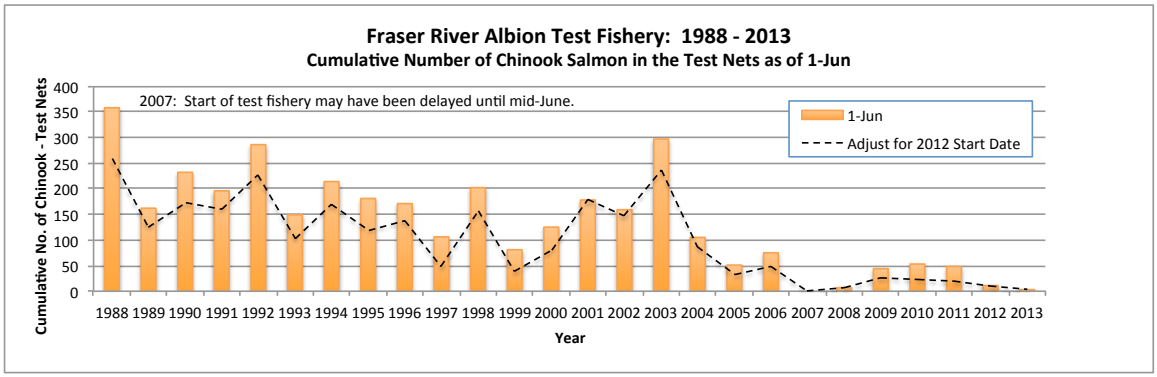

Figure 8. Fraser River Albion Test Fishery – Cumulative Chinook Counts as of June 1 for 1988-2013

In both 2012 and 2013 the start of the test season was delayed until later in April. The dashed line reflects the cumulative Chinook counts if the same start date is used for the remaining years. Although this adjustment has a variable effect on the cumulative Chinook salmon total for each individual year, the overall trends are not significantly altered; the Chinook salmon counts for recent years are still very low when compared to the early years.

In the figure below (Figure 9), the focus is on the same Chinook salmon counts, but only for the past 14 years (2000-2013). Obviously 2003 was a good year. By June 1 of 2003, 297 Chinook salmon had been caught in the test nets between April 1 and June 1 (236 Chinook salmon if the start date is adjusted to match the 2012/2013 start date). A few weeks later in June of 2003 (after the June 1 cut-off date for this chart), there were three different days when more than 100 Chinook salmon were netted in a single day (June 20-24, 2003). Contrast that with the following year, 2004. In 2004, only 105 Chinook salmon were caught in the test nets during the 2-month period between April 1 and June 1 (87 Chinook salmon if the start date is adjusted to match the 2012/2013 start date).

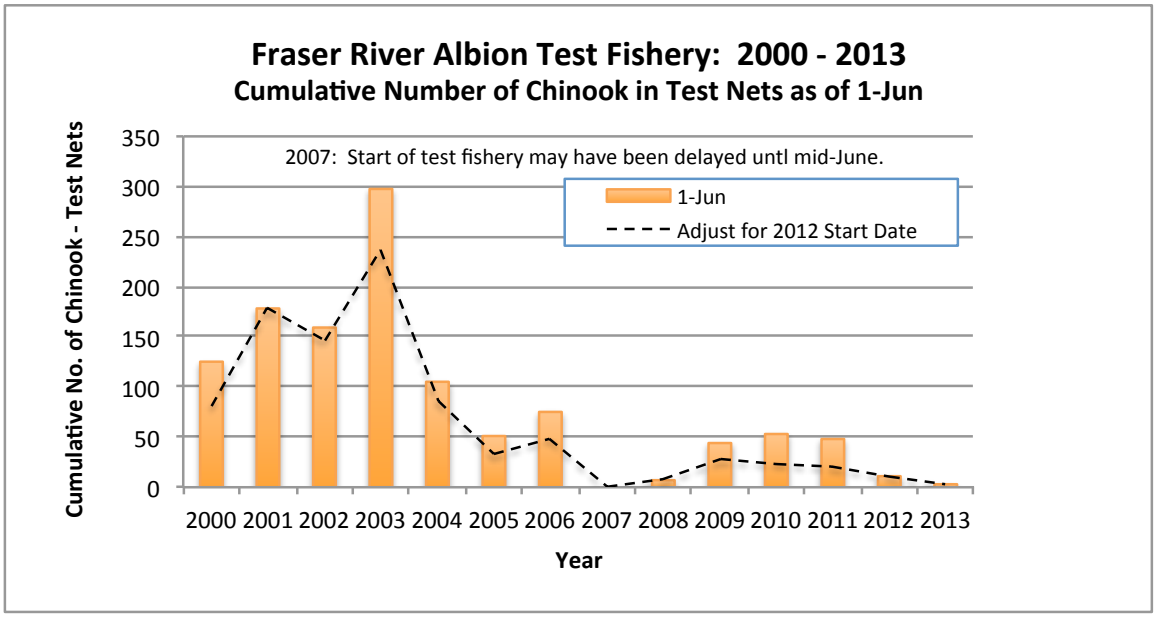

Figure 9. Fraser River Albion Test Fishery – Cumulative Chinook Counts as of June 1 for 2000-2013

Note the downward trend in the spring Chinook salmon counts since 2003 – and recall the downward trend in J pod presence during the month of May since 2004 (Figure 1). Are the similarities in these two trends providing valuable insight into why the J pod whales are spending less and less time in local waters in May? Is a steady decline in early season Chinook salmon abundance causing the J pod whales to search elsewhere for food at this time of year?

Here is another historical "Chinook count" plot using August 1 as the cut-off date to coincide with the approximate end of the "spring" runs (Figure 10). Once again this shows a sharp decline over the past decade that is not only present early in the season (Figure 8), but also persists into August. In 2003, about 2200 Chinook salmon had been caught in the test nets by the first of August. Ten years later in 2013, only about 180 Chinook salmon had been netted by the same time. The companion plot using CPUE is provided in Figure S- 2 (end of report), and in a different format in Figure S- 4 (end of report). What does this say about the abundance of the "spring" Chinook stocks that spawn in the Fraser River?

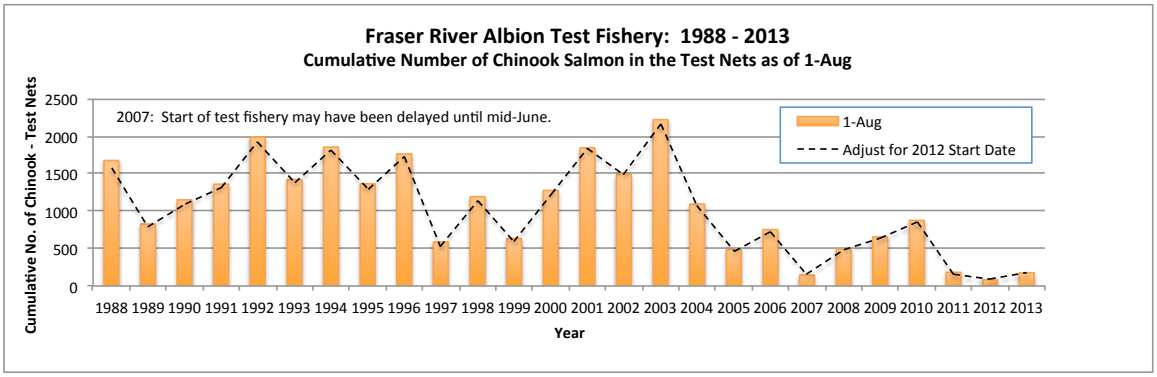

Figure 10. Fraser River Albion Test Fishery – Cumulative Chinook Counts as of August 1 for 1988-2013

The cumulative Chinook counts as of September 1 (Figure 11) reflect not only the spring runs, but also the summer runs and perhaps the early part of the fall runs. For any given year, the Chinook salmon counts for the Albion test fishery do increase throughout August into September, with Chinook salmon counts in some years surging ahead of the counts for other years. However, the data for the past decade suggest an overall decline in the Chinook abundance that started in the 2001-2003 time frame. The associated CPUE plot is found in Figure S- 3 (end of report).

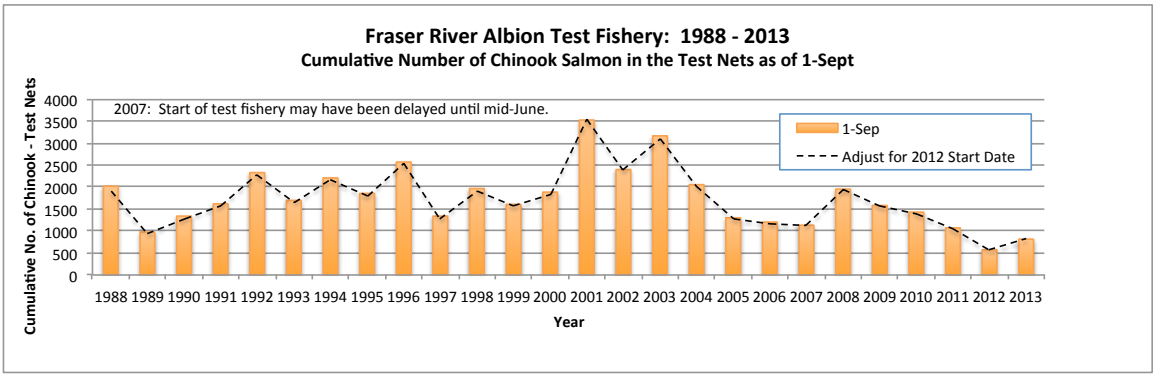

Figure 11. Fraser River Albion Test Fishery - Cumulative Chinook Counts as of September 1 for 1988-2013

Here is the same graph (Figure 12), but scaled to focus on 2004-2013 to be consistent with the sightings data. Note that 2008 was an odd year in that the counts were relatively low until after August 1 (Figure 10) when there was a surge in the number of Chinook salmon caught in the test nets.

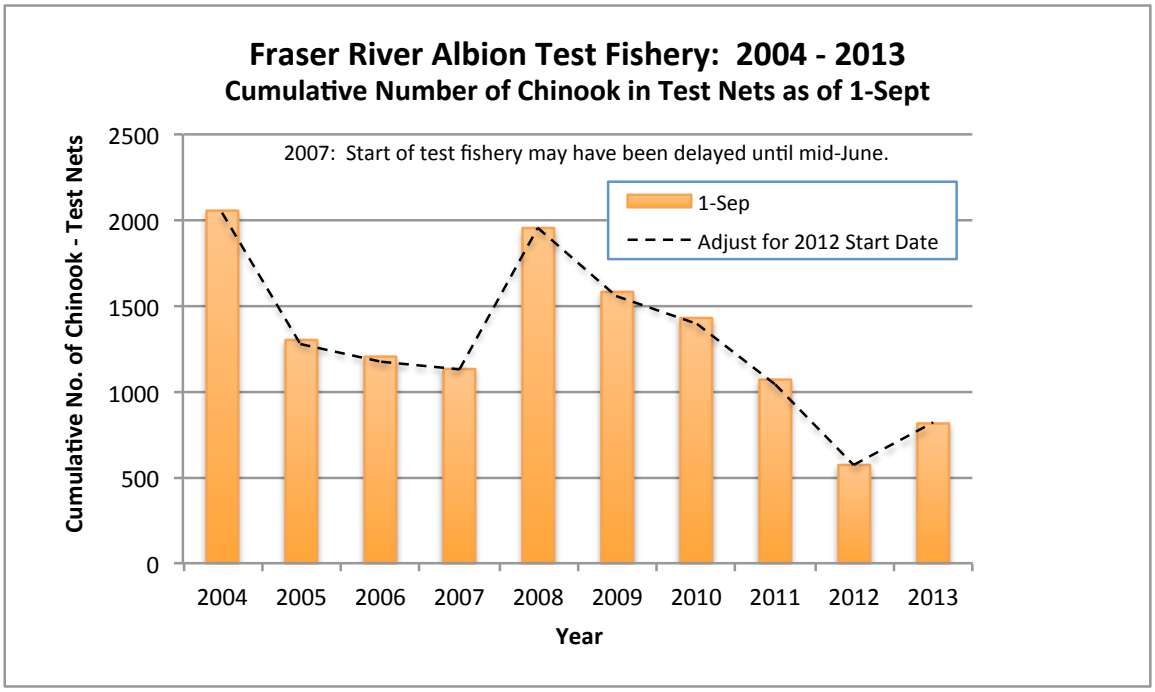

Figure 12. Fraser River Albion Test Fishery – Cumulative Chinook Counts as of September 1 for 2004-2013

It goes without saying that there would be a complex relationship between the Albion test fishery results and the presence of J pod whales in local waters; the use of these charts is not meant to imply that there should be a simple linear relationship between the two. However, that being said, it is hard to dismiss the similarity between the above chart of cumulative Chinook salmon counts later in the summer (or the end-of-season Chinook counts in Figure 13) and the chart showing J pod presence during the months of August and September (Figure 4). During the leaner Chinook salmon years of 2005-2007, the J pod whales were present on fewer days in the August-September time frame. The J pod presence in the months of August and September peaked in 2009 and 2010, when the Chinook salmon counts were higher. The J pod presence in August and September has declined since 2010, a trend that parallels the cumulative Chinook salmon counts (more discussion on 2010 to follow).

In an attempt to isolate the summer Fraser River Chinook salmon run, a cumulative CPUE plot for the July-mid September time frame is provided in Figure S- 5 at the end of the report. No matter how the data are sliced and diced, the conclusion is the same – both the spring and summer Fraser River Chinook runs appear to be in trouble.

Compared to 2012, the late season Fraser River Chinook salmon seemed to be more plentiful in 2013. Late summer also brings Sockeye salmon. Chum salmon begin to arrive in early fall, and the Southern Resident whales are known to eat Chum salmon at this time of year. These factors may explain why not only the J pod whales were present more in September than in any other prior

month in 2013, but the K pod and L pod whales were also present. Several times in September of 2013, the whales spent more than 24 hours at a time foraging near the mouth of the Fraser River.

The end-of-season Chinook salmon totals for the Albion test fishery are provided in the following chart (Figure 13) for each year beginning with 1988. Once again, the trend suggests a steady decline in Chinook salmon abundance that has persisted for more than a decade.

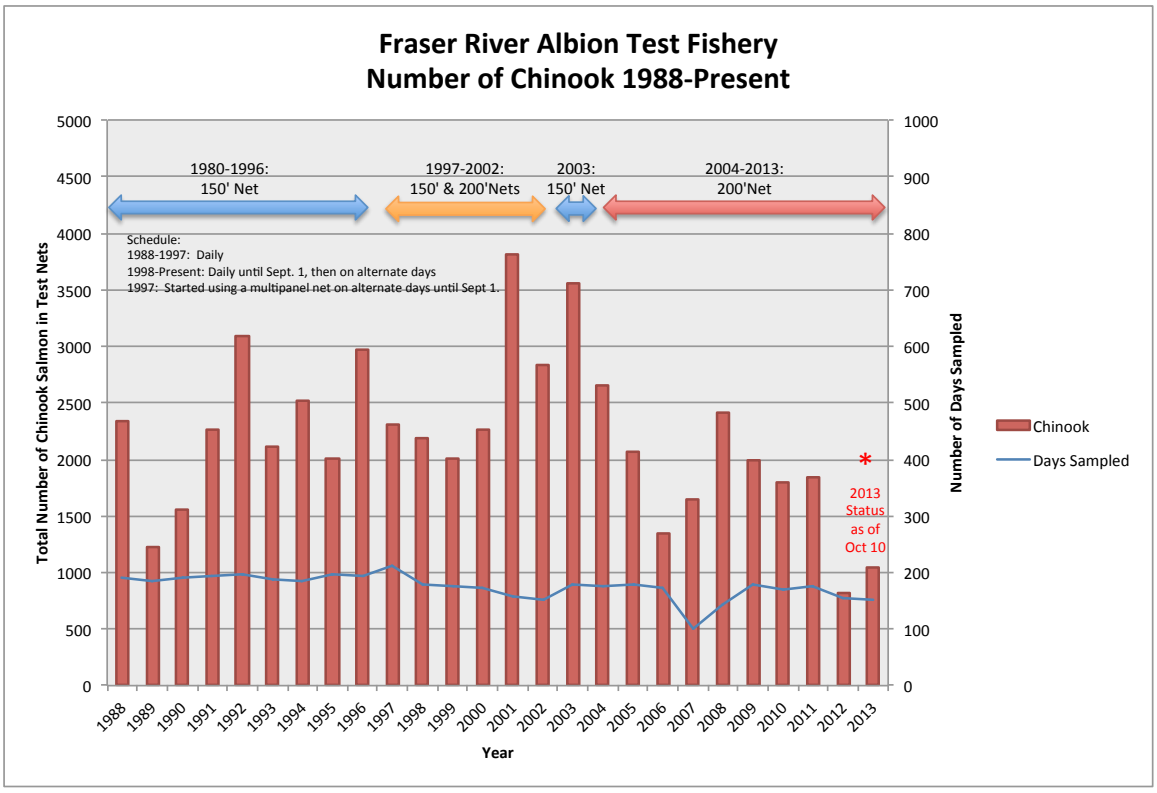

Figure 13. Fraser River Albion Test Fishery – Cumulative Chinook Counts for 1988-2013 Test Seasons

How does this decline in Chinook counts relate to the decline in actual salmon abundance? How can a decline like this be a good thing – for whales, for commercial fisheries? What is being done to reverse this trend?

Do these Albion test fishery numbers for Chinook salmon explain why the J pod whales have been spending less and less time in local waters during the month of May (Figure 1), and why since 2010 these whales have been spending fewer days in the local area in the August-September time frame (Figure 4)? Does this overall downward trend in Chinook counts explain why the Southern Resident killer whales are spending less and less time in their core summer habitat from April through September? As for the extended absences in 2013, do these Albion test fishery results hold the key to unraveling the mystery?

There are other ways to look for trends in the Albion test fishery data for Chinook salmon. Below is a plot showing the cumulative Chinook totals for a period of particular interest to the Southern Resident killer whales – from mid-May through the end of August for analysis and plotting purposes (Figure 14). For each year shown, the daily results from the test fishery were accumulated to compute the total number of Chinook salmon caught in the test nets as of each day.

To show an alarming trend, the data for the older years of 1988-2004 are colored pale grey, except for three relatively bad years which are pale pink (1989, 1997, and 1999). The years starting with 2005 are plotted in the bright colors. Of interest here are the general trends (because there are seasonal variations in addition to some variations in the test set-up from day to day and year to year). Note that nine of the twelve worst years have occurred starting with 2005, and even the best of these recent years (2010) is still near the lower end of the graphs for all years (1988 and on).

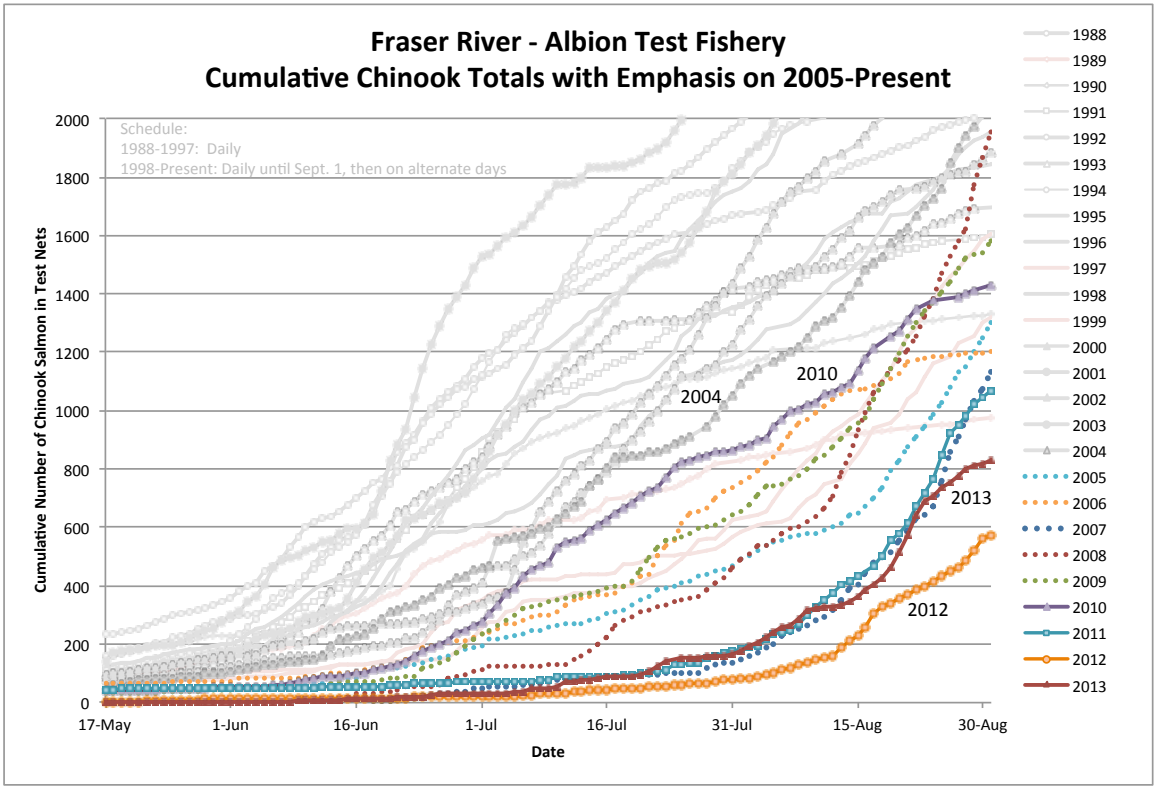

Figure 14. Fraser River Albion Test Fishery – Cumulative Chinook Counts from Mid-May through August

Could the 2010 test fishery data explain why the whales were here for so many consecutive days in 2010 and why more L pod whales were here in 2010 (Table 1)?

Although 2012 appears to be the worst of all years, 2013 was only a little better than 2012. Does the apparent lack of Fraser River Chinook salmon in 2013 explain the chronic absence of the J pod whales from May through August? Does this explain why so few Southern Resident whales were present throughout July of 2013 (Table 3)? Even the J pod whales were not seen in the area 28 days in a row in the June-July time frame, and were here for only five days in July before disappearing again for another 29 consecutive days.

Looking at trends yet another way, in the plot below (Figure 15) the mountainous region represents the cumulative Chinook totals for the first day of each month, and the 15th day of each month. Of more interest are the general trends -- how these Chinook counts change from year to year. A "trend line" function was used to do the curve-fitting, choosing second and third order curve fits over straight-line approximations.

For the early summer sampling periods, there is an obvious downward trend from 1988 to 2013. For the late summer and early fall sampling periods, the Chinook counts are boosted in the middle years because of some late season bursts in Chinook counts in the 2001-2003 time frame; however, over all and especially in the past decade, there is a sharp decline in Chinook counts in these late season counts.

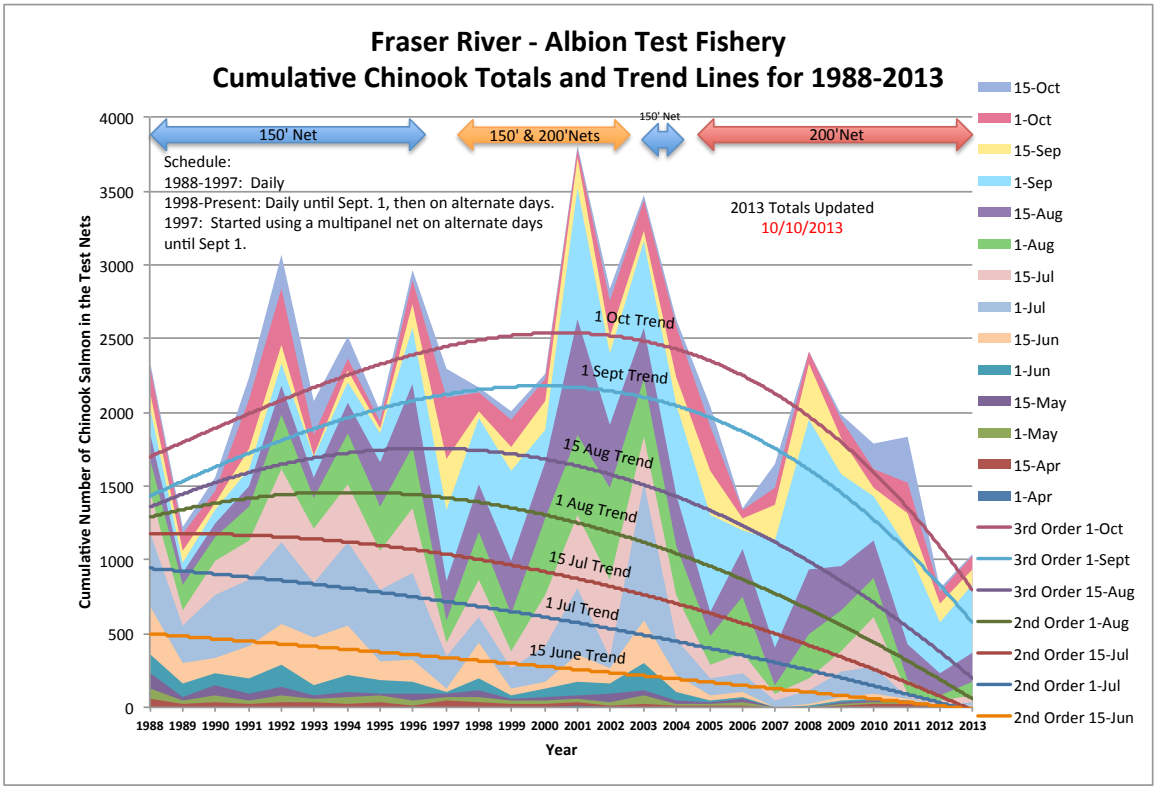

Figure 15. Fraser River Albion Test Fishery – Cumulative Chinook Counts and Trend Lines for 1988-2013

As mentioned earlier, the fisheries folks use something called CPUE. It is my understanding that "CPUE" is way of normalizing the fish counts to account for variations in the size of the net, the time the nets are down, etc.

Here is the mountain chart using cumulative CPUE instead of fish counts (Figure 16). Since a shorter net was used in the early years (presumably reducing the number of fish caught back then), it seems the earlier years look better (in a relative sense) using CPUE — CPUE is helping to level the playing field when the test set-up changes. However, the conclusion remains the same. It appears that the preferred measure of salmon abundance is pointing to a serious decline that has persisted for more than a decade. That being said, CPUE still remains something of an abstract parameter because there is no obvious connection with the actual number of Chinook salmon or Chinook salmon abundance.

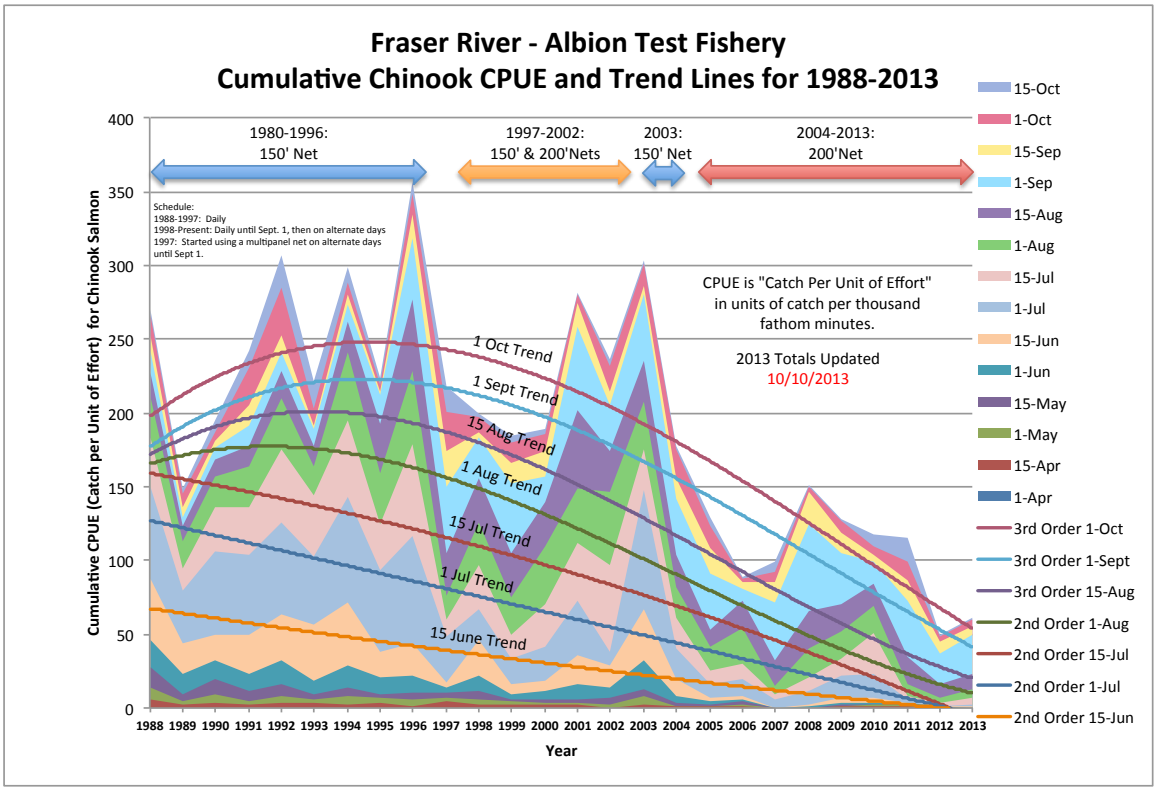

Figure 16. Fraser River Albion Test Fishery – Cumulative Chinook CPUE and Trend Lines for 1988-2013

Conclusions

There does appear to be a correlation between the presence of the Southern Resident killer whales in local waters and the Chinook salmon trends that are visible in the Albion test fishery data. How this will affect the Southern Resident killer whale population in the long run is not obvious.

As for sightings of Southern Resident killer whales in the waters of the Salish Sea, 2013 is proving to be cause for concern. These "resident" whales, even the J pod whales, were quite simply absent.

Regarding the matter of the Fraser River Chinook stocks, based on the Albion test fishery data it does appear that the measures of salmon abundance show an alarming decline over the past decade. What is the prognosis for the abundance of the spring, summer, and fall Fraser River Chinook stocks?

The J pod is showing the best growth rate of the three pods, but how long can this continue if the Critical Habitat where these whales have been spending the vast majority of their time from April through September no longer has enough Chinook salmon to sustain the 26 members of J pod?

Then there is the bigger picture. What does it mean to declare a region to be Critical Habitat for an endangered population while at the same time basic food supplies are becoming depleted with no real solution in sight? What protection does the endangered status really offer to the Southern Resident killer whales and Chinook salmon? What individual or agency is responsible for ensuring these endangered whales have enough Chinook salmon to eat in their core summer habitat?

Jane Cogan
Retired Engineer

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Supplemental Data

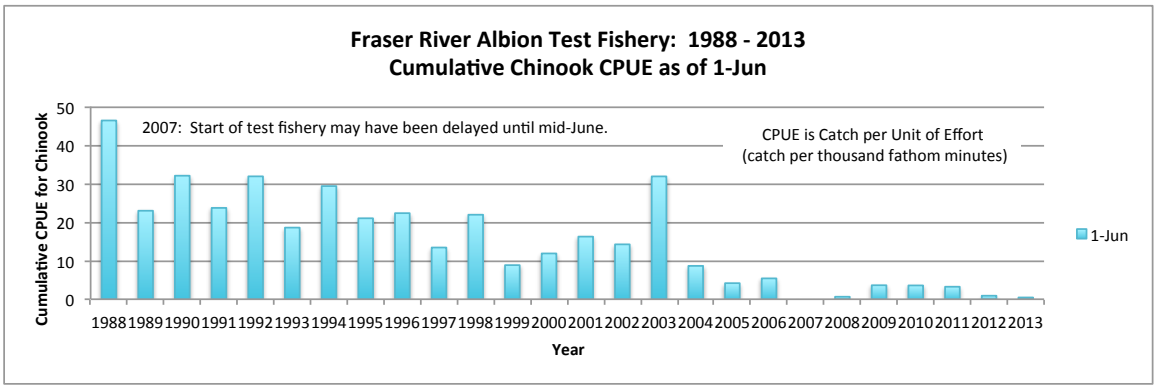

Figure S- 1. Fraser River Albion Test Fishery – Cumulative Chinook CPUE as of June 1 for 1988-2013

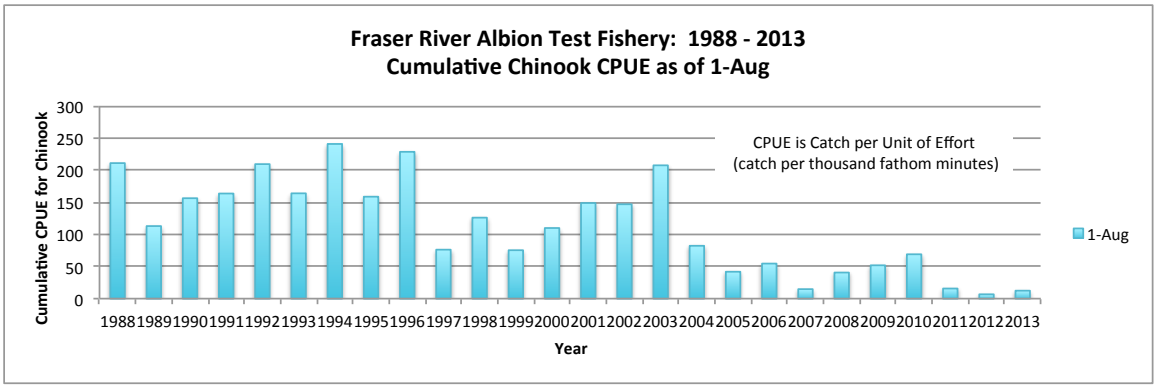

Figure S- 2. Fraser River Albion Test Fishery – Cumulative Chinook CPUE as of August 1 for 1988-2013

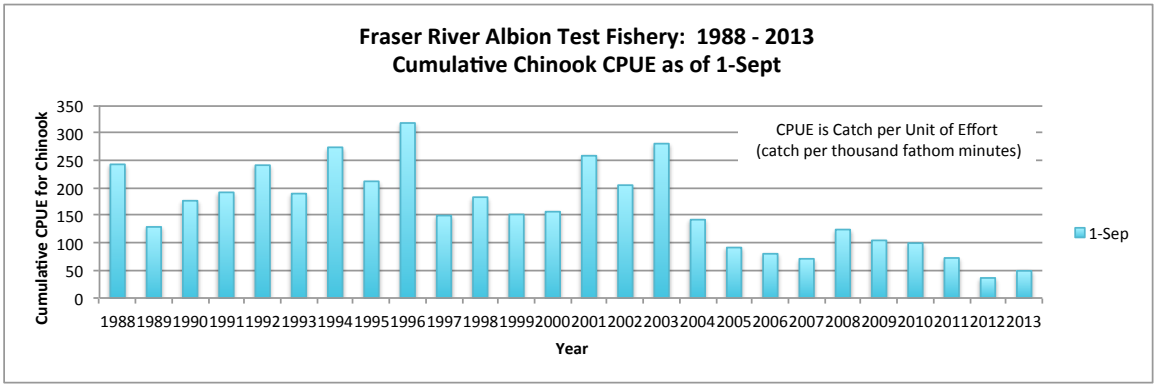

Figure S- 3. Fraser River Albion Test Fishery – Cumulative Chinook CPUE as of September 1 for 1988-2013

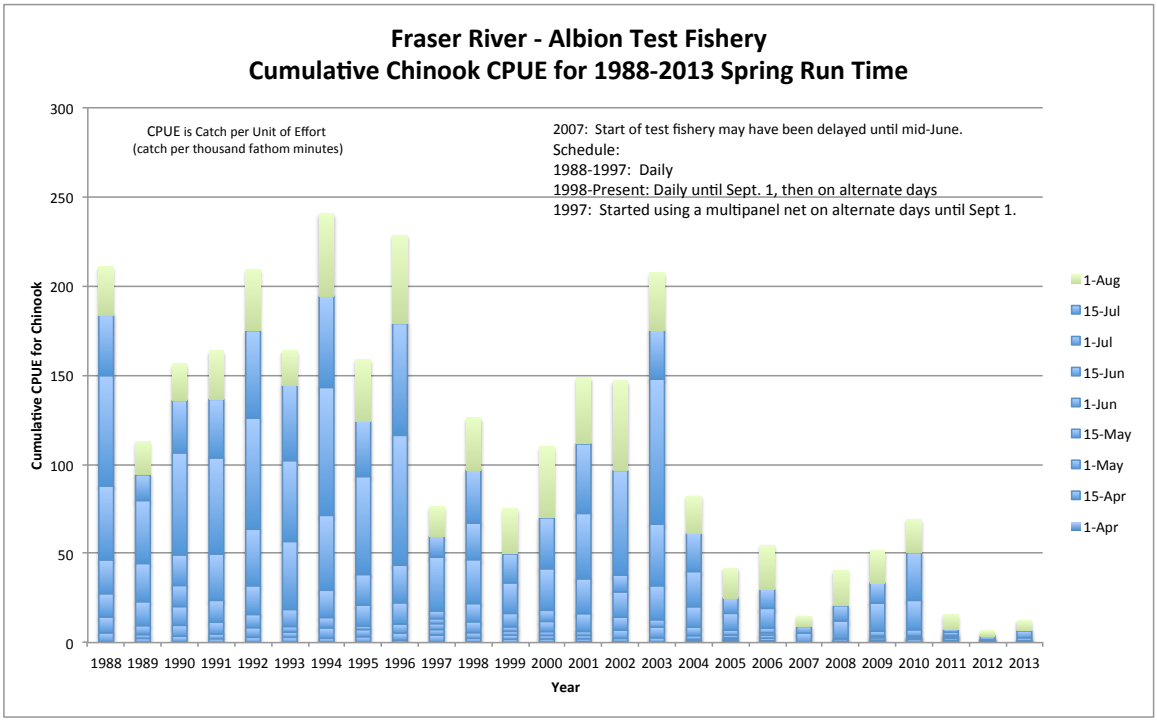

Figure S- 4. Fraser River Albion Test Fishery - Cumulative CPUE for Spring Run Time (April - July)

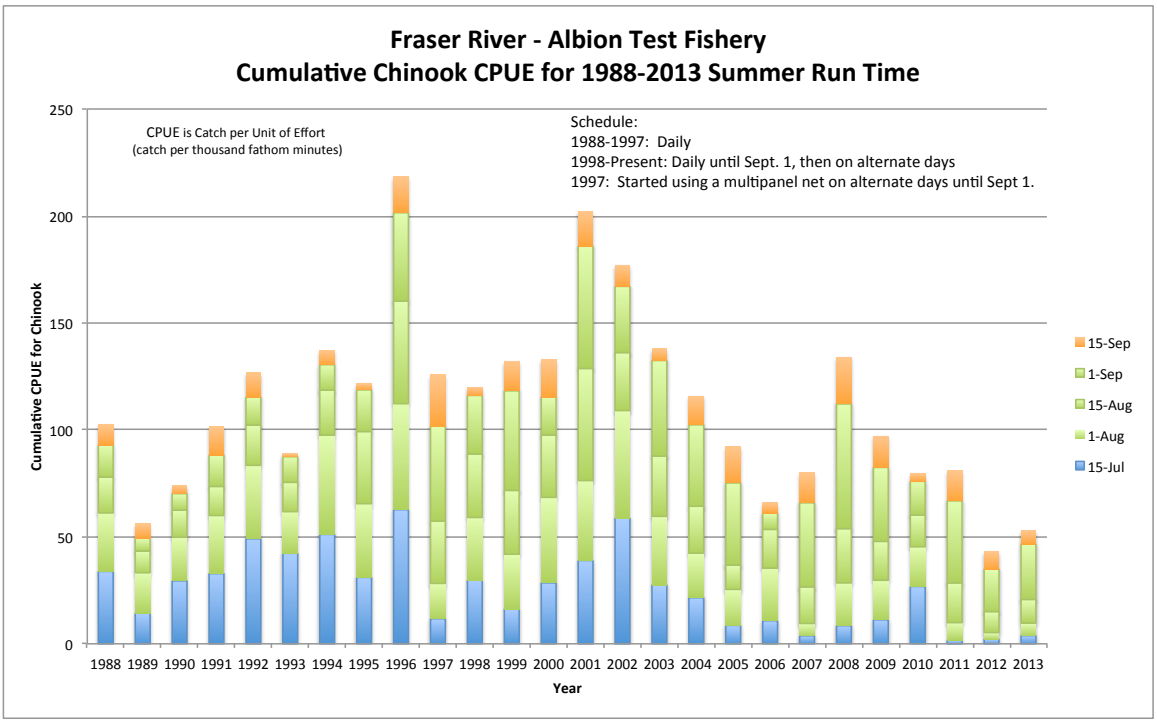

Figure S- 5. Fraser River Albion Test Fishery - Cumulative CPUE for Summer Run Time (July – mid September)