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Mr. Mark Walker
Public Affairs Director,
NW Power and Conservation Council

29 September 2006

c.c. Jim Kempton, Judi Danielson, Larry Cassidy, Shirley Lindstrom, Ben Zelinsky

re: Response to ISRP Comments & NWPPC Recommendations, Acoustic Tracking For Survival, Proposal # 200311400

Dear Mr. Walker:

I write in response to the NWPPC preliminary recommendation on the Acoustic Tracking for Survival Proposal, which suggests the project should be funded at 50% of the requested annual amount of $1.5M. I would like to highlight the developments that have gone on this spring and summer (after the ISRP review and response were completed), which we believe address the key concerns about the relevance of the work and establishing proof of concept for Columbia R salmon. These are covered in the attached Appendix A; Appendix B provides a specific response to the 11 points raised by the ISRP in their final August communication to your staff about our project (Final Review of Projects, dated 31 August 2006).

We have reviewed the consequences of the funding being reduced and can advise you that it will not be possible to address both of the two major questions that we propose to answer using the POST array in 2007-09, or to ensure that the answers are sufficiently rigorous to be useful to the region in their deliberations. The reasons for this are simple:

(1) Our statistical analysis indicated that we require implantation of 1,000 tags to address both key questions with sufficient statistical power (a result supported by this year's work, which shows that we did reach the required statistical rigor).

(2) Even if we were to only answer one of the two key questions we would still need to build the full array to have the necessary tracking rigor to make the at-sea measurements that are needed. Thus 50% of the funding does not make it possible to do one of the two questions, because the array is a shared infrastructure used by both studies.

The various review comments received by the Council are as follows:

ISRP ***"Fundable in part: ISRP recommended the project be funded in part until proponent results can demonstrate proof-of-concept. Ensure that this level is adequate to meet the needs of the scope of work that was approved last year"***

MSRT ***"Ocean research. Questions have included whether management benefits are to gained from research and the cost"***

<u>NWPPC Staff(?)</u> ***"Some prioritization of tasks proposed in the suite of ocean projects must occur. These projects address a Core Program need, but it is unclear which tasks within the project meet that standard"***

The two questions we addressed in 2006 with the full $1.5M level of funding from BPA involve:

a) Whether barging (transport) improves survival of Snake R spring chinook relative to smolts migrating in-river.
b) Whether delayed mortality is manifest below Bonneville Dam for Snake R spring Chinook.

The answer to both questions appears to be "no"—although barged Snake R fish initially do as well after release as the ROR Snake R fish (the intended goal), it appears that the additional month of ocean mortality imposes greater mortality than if the fish were left to migrate to sea on their own. That is, the level of ocean mortality we are measuring is higher than the in-river mortality, so transport places the fish in a higher mortality environment for a longer time period. (That is, we may have traded "the frying pan for the fire"). As a result, there may not be a benefit from operating the barging system once the role of the ocean is considered.

Second, we find no evidence for a difference in mortality between Snake & Yakima R spring chinook smolts migrating all the way to the northern tip of Vancouver Island (815 kms beyond Bonneville Dam, 1,470 kms from the Snake R release site). As Yakima spring chinook SARs have been 5.2X higher than that of the Snake R SARs (similar to a number of other Columbia R stocks), some in the region have suggested that delayed mortality due to the extra stress of migrating past the Snake R dams is the cause of the poor adult returns. We find no evidence of this. This suggests that the poor Snake R survival occurs somewhere later in the ocean life history and that differential effects of the ocean have been confounded with the operation of the hydrosystem. We do not find evidence that the "delayed" mortality has been expressed over the region that we conducted the 2006 pilot.

The basic survival measurements we obtained in 2006 are reported in the following Table 1, which shows the numbers released in freshwater and then detected in the ocean. In a nut-shell, these constitute the core of the 2006 field work. Although our post-season analysis, now underway, will increase the best estimate of survivals to the ocean, the basic numbers reported in Table 1 will not decrease—and they are inconsistent with the concept that the hydrosystem is the major cause of the problems.

While we caution that our first-year results should be viewed as tentative, they strongly suggest that the ocean plays the critical role in the management and conservation of Columbia R salmon stocks, and that ignoring these issues leads to more blame being ascribed to the hydrosystem than is in fact appropriate. This has consequences both for the science and management—in terms of time and money lost on, in some cases, answering the wrong questions.

The ISRP review stated that "*…the project be funded in part until proponent results can demonstrate proof-of-concept*". We have further documented the key findings from this year's work in Appendix A to this letter to demonstrate that the "proof-of-concept" requirements are being met. This data has just been collected in the last two weeks from the array, and as you may appreciate, is not intended by us to be a definitive proof of all aspects of our study. However, we find ourselves being put in the

awkward Catch-22 that the ISRP review previously argued both that full funding should not be given for this Columbia River proposal until we can provide prove proof-of-principal for Columbia R fish, and that our work and results for British Columbia salmon stocks do not provide this standard-- that is, that the performance of the POST array for British Columbia salmon stocks was not sufficient proof of applicability to Columbia R smolts on the open shelf. Without the funding, we cannot meet the requirement.

Table 1. 2006 estimates of survival to the two ocean listening lines. These are raw numbers recorded by the listening lines, and have not been expanded to account for lost equipment or less than 100% detection efficiency. Two separate releases were completed of each group. ROR: "Run of River"; Barged: Snake R smolts transported from Lower Granite Dam to below Bonneville and released. Standard errors (SE) have been calculated as SE= √S(1-S)/N.

	Yakima R		Snake R		Snake R	
Tag Group	**ROR 1**	**ROR 2**	**ROR 1**	**ROR 2**	**Barged 1**	**Barged 2**
Release Date	**30-May-06**	**06-Jun-06**	**01-May-06**	**08-May-06**	**07-Jun-06**	**15-Jun-06**
Number Released	***199***	***199***	***198***	***198***	***102***	***101***
Willapa Bay Ocean Line (Uploaded 27-28 July 2006) 960 km from Snake R release site						
Number Detected	***19***	***60***	***37***	***38***	***47***	***30***
Survival to Willapa Bay	***9.5%***	***30.2%***	***18.7%***	***19.2%***	***46.1%***	***29.7%***
±SE(Survival)	***±2%***	***±3%***	***±3%***	***±3%***	***±5%***	***±5%***
Lippy Point Line (Uploaded 19-20 September 2006) 560 km from Willapa Bay Line; 1,520 kms from Snake R release site.						
Number Detected	***2***	***0***	***1***	***3***	***8***	***3***
Survival from Willapa Bay to NWVI	***11%***	***0%***	***3%***	***8%***	***17%***	***10%***
±SE(Survival)	***±7%***		***±3%***	***±4%***	***±5%***	***±5%***
Survival from Release to NWVI	***1.0%***	***0.0%***	***0.5%***	***1.5%***	***7.8%***	***3.0%***
±SE(Survival)	***±0.7%***		***±0.5%***	***±0.9%***	***±2.7%***	***±1.7%***

We would also like to note that the reductions in funding are also likely to undermine other sources of funding for the POST array coming from outside the Columbia basin. We would respectfully point out that this will reduce the size and value of the array that is being built for answering the Columbia's conservation and management questions. Although we recognize that we are requesting a substantial amount of financial support from the region for building the array, the funding requested from BPA is less than 40% of the total west coast funding secured in 2006. As POST begins its expansion to a permanent system for the entire west coast, the Columbia region will benefit further by the array's expansion, and the information it will then provide on where your fish move to, and what their survivals are.

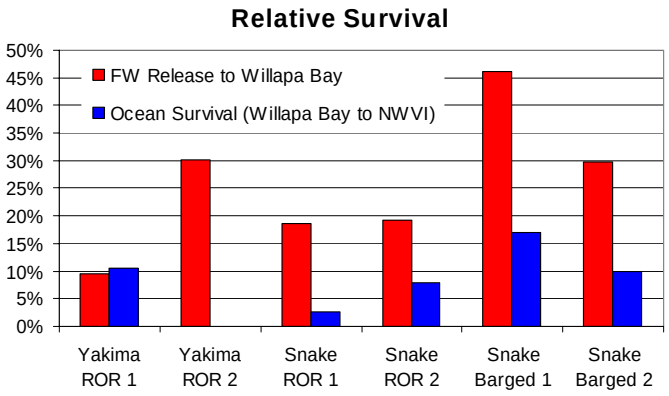


Figure 1. Summary of our preliminary 2006 ocean tracking results. Note that for each group of Snake R smolts that ocean survival for the 560 km distance from Willapa Bay to NW Vancouver Island is generally substantially less (blue bars) than the survival measured through the entire 960 km freshwater migration out to the Willapa Bay line (red bars). As a significant number of sensors were lost on the Willapa Bay line to trawlers but not at Vancouver Island line, correction for this difference should further accentuate the greater mortality experienced in the ocean.

In a nutshell, we see no evidence for higher mortality on average of Snake R chinook relative to Yakima chinook out to Willapa Bay or then to Vancouver Island. Similarly, we see the expected doubling of survival to Willapa Bay and Vancouver Island for barged fish, but this ignores the fact that they must now remain in the ocean for one month longer than if they had not been transported—and survival per month in the ocean appears to be lower than in the river.

Finally, we would like to refer back to a point that the ISRP noted in 1997:

> ***"In spite of these investments, the salmon continue to decline and additional listings under the federal Endangered Species Act have been proposed… Against this background of apparent failure, it is logical to ask whether there is some basic qualitative flaw in the recovery and mitigation efforts".***
>
> (Independent Scientific Review Panel, 1997)

We believe that our findings indicate that the ISRP was perceptive in their comments. Our 2006 results point to the role of the ocean as being the cause of the "Delayed" mortality apparently affecting Snake River chinook, and also the cause of the poorer performance of transport than originally expected. If we are correct, then not only will we be able to address several key management issues in the Columbia, but we will also build a tool that Columbia Basin researchers need in order to address the impact of the ocean on their stocks.

We thank the Council and its advisors for the time taken to review our proposal and appreciate the efforts that you have gone to.

Respectfully yours,

President, Kintama Research Corp

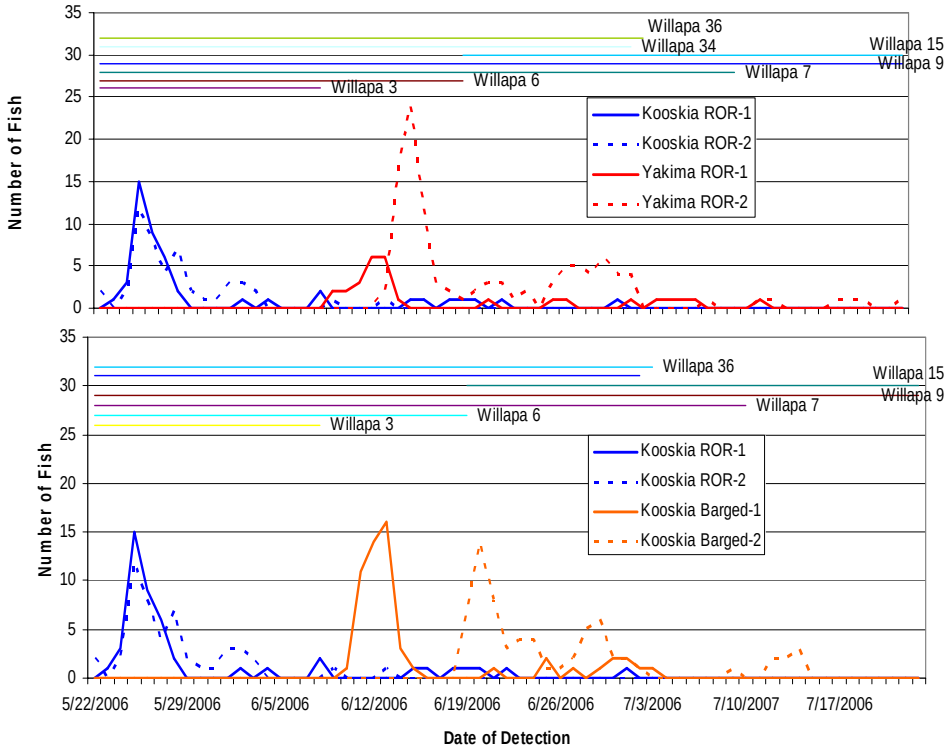
Appendix A- Summary of POST 2006 Results for Columbia/Snake R Salmon Smolts

The ISRP review identified a number of issues surrounding the question of whether a "proof of concept" level had been reached for the outer coast POST detection lines, as they apply to Columbia River salmon issues. We report here the preliminary results from the operation and recovery of these detection lines in the summer of 2006, in order to allow an initial assessment by the NWPCC staff of several issues. These results are based on our preliminary analysis, as the NW Vancouver Island line was only retrieved 10 days ago.

Background We conducted two simultaneous tagging studies to compare survival of barged and run-of-river (ROR) Snake R spring chinook smolts, and to compare survival of ROR Yakima & Snake R spring shinook. The Yakima stocks has historically had about 5.2X greater survival to adult return; these types of differences with the Snake R chinook have caused some to suggest that the difference is due to higher mortality below Bonneville due to the greater number of dams that they passed on their migration. Similarly, since the role of barging (transport) has been difficult to demonstrate, some have argued that the barged smolts may be disoriented following release and are easily preyed upon, potentially negating the benefits of transport. The map shows the overall POST deployment in 2006, and the place names referenced.

Equipment Performance

A number of units on the Willapa Bay line were trawled up this spring, reducing the effectiveness of this line (Horizontal lines on the graph show the date that particular units were recovered). In most cases, data was recovered from displaced units and they had remained in place



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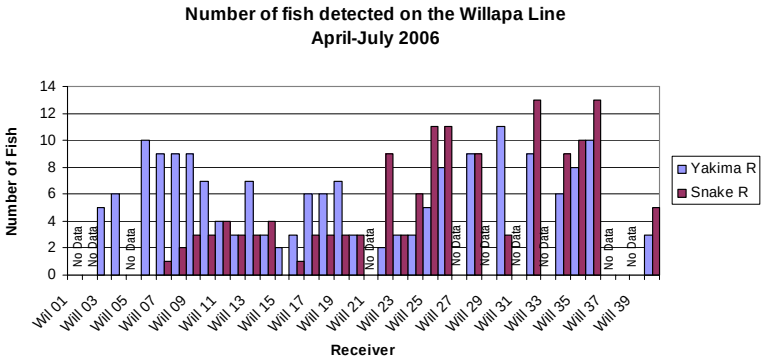
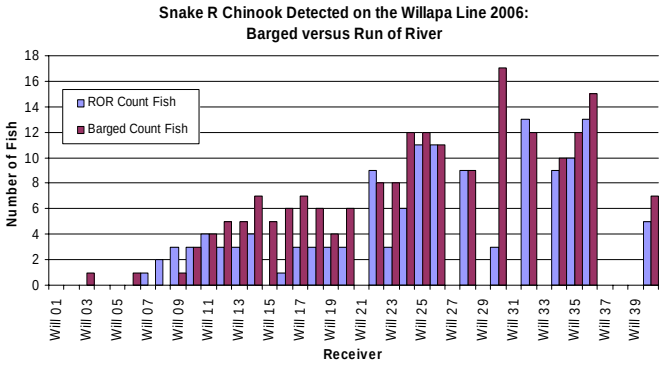
Appendix A (Cont'd)

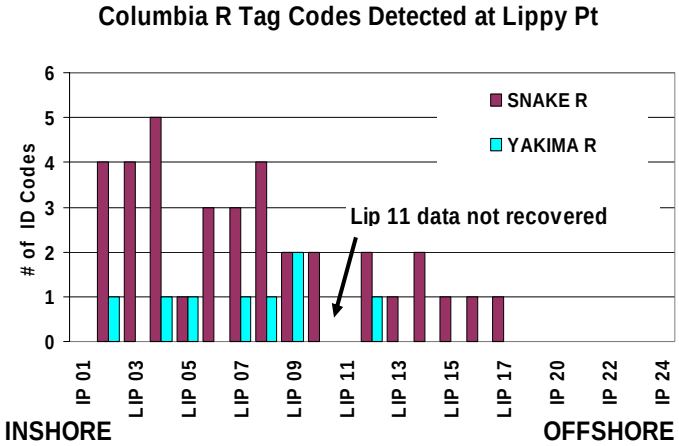
place for most of the time that the smolts were travelling past the listening line. However, this loss did reduce the efficiency of the line, and we report in Table 1 the raw or *minimum* estimates of survival to the Willapa Bay line, without expansion for either gaps that occurred in the line or the estimated detection efficiency of equipment remaining in place (~95%, based on measurements in BC shelf waters).

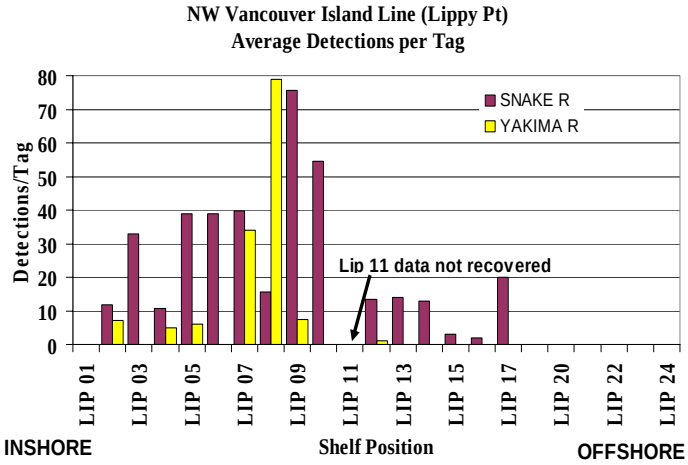
At the north end of Vancouver Island, 560 kms north of the Willapa Bay Line, 23 out of 24 units were in position and provided full data in mid-September, 3 months after deployment. The data from this line shows that the Columbia R smolts are (a) still distributed on the shelf, (b) that they are not found close to the offshore end of the line at the shelf break (200m), and (c) that detection rates of individual smolts are high (a large number of detections for each tag). These results indicate that the detection line is likely sited to cover the full migration path, and that the array geometry and tag programming is such that it makes the likelihood of a smolt passing by without being detected small.

The argument about "delayed" mortality of Snake R chinook being the result of accumulated stress from migrating past 8 dams is based on the assumption that below the dams mortality rates of run of the river Snake R chinook smolts increases relative to that of either barged Snake R smolts or Yakima R smolts. We found no such differences, either qualitative or quantitative. Although some receivers were lost at the Willapa Bay line to fishing gear (Fig. 1), the timing of the losses was such that can show that we had most of the array line operational while the different groups of smolts went past. As such, we can estimate minimal survival to









the Willapa Bay line, located 265 kms away from Bonneville Dam (225 kms downstream and 40 kms north along the coast (Fig. 2)).

On-Shelf Distribution

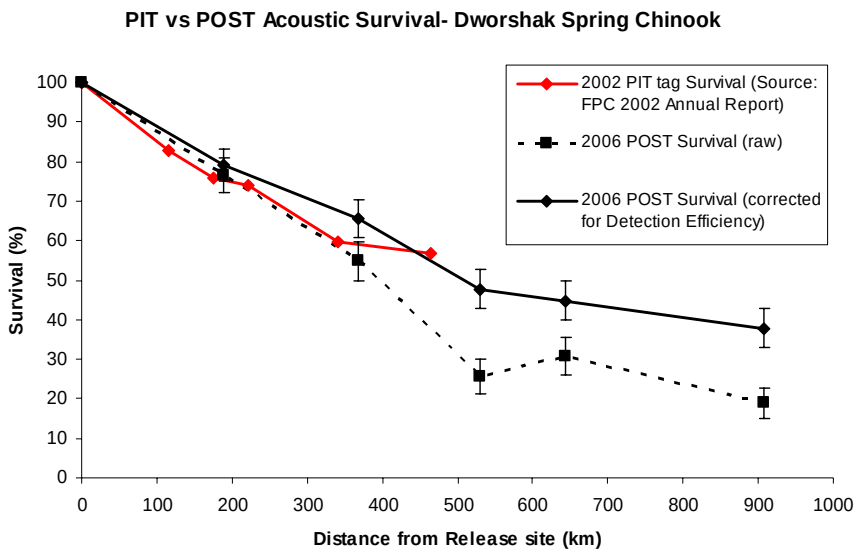
We found some difference in the shelf distribution of Yakima and Snake R smolts. The distribution of the Yakima fish was oriented more inshore than that of the Snake R chinook. Although we did not find definitive proof that the smolts remained on the shelf at the Willapa Bay line (smolts were detected out to the last receiver at the 200m isobath), the data for NW Vancouver Island clearly shows that the surviving smolts are not close the shelf edge.

Ability to Measure Survival

I. PIT vs POST Acosutic Tag Survival Measurements

There have been arguments that the relatively large tags used with the POST array will affect the subsequent movements and survival of the smolts after release, thereby distorting the study results. As this is an important issue, we measured "raw" survivals down the Snake and Columbia Rivers using the 4 acoustic listening lines placed in-river this spring. We also can calculate a corrected estimate of the survival of acoustically tagged smolts that takes into account tags detected downstream that were not detected at a given freshwater detection point.

The black lines compare our measured survivals for acoustically tagged Snake R spring chinook out to various distances post-release (as far as the ocean detection line at Willapa Bay) with those previously estimated for Snake R spring Chinook using the PIT tag system at the dams, and reported by the Fish Passage Center (red line; 2006 PIT tag estimates of survival have not yet been finalized). The POST acoustic tagged smolts in 2006 had slightly higher survival than the measured survivals for the 2002 PIT tagged Snake R chinook (Dworshak stock was



used for both studies) for that part of the migration track measured in common. (Error bars on the POST tag survival estimates are ±2 SE). Note that at distances beyond where PIT tag data are available, the POST tagged fish show a fairly steady attrition in numbers, and do not show a sudden jump in mortality that would be consistent with "delayed" mortality being expressed. We are currently searching for additional years of PIT tag-based survival estimates for Dworshak chinook, but our conclusion is that the POST acoustic tag seems to be handled without particular difficulty by the smolts.

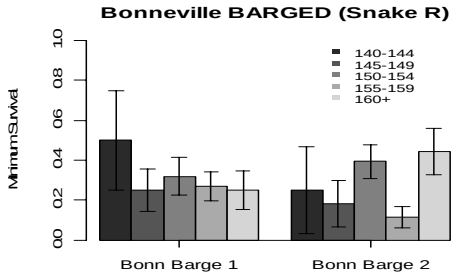
Our preliminary conclusion is that, therefore, there is no evidence that the acoustic tags used with the POST array seriously distort the measurement of survival within the hydrosystem, and seem to provide similar results to that of the PIT tag system. Beyond the hydrosystem, they provide the only known means of measuring movement and survival.

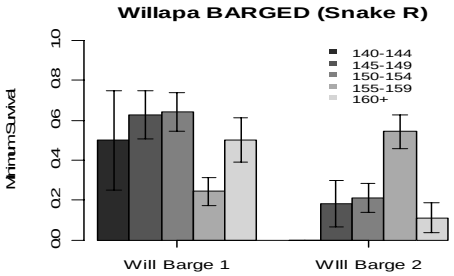
Appendix A (Cont'd)

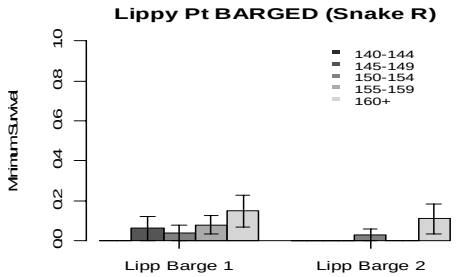
II. Effect of Smolt Size on Survival Measurements

One additional assessment of the effect of the acoustic tag on the tagged smolts can be made by breaking out the survival measured to various listening lines based on the initial size of the smolts (5mm size intervals). This was done separately for the ROR Yakima R smolts, and both the ROR and barged Snake R smolts. Again we see no consistent pattern suggesting that larger smolts have better survival within the Columbia R (there is some very slight evidence for this at the northern end of Vancouver Island).

In conclusion, the size of the acoustic tag used with the POST array does not seem to have a significant influence on smolt survival over the size range tagged, and allows us to extend the research effort out into the ocean where much of the key mortality seems to be expressed.







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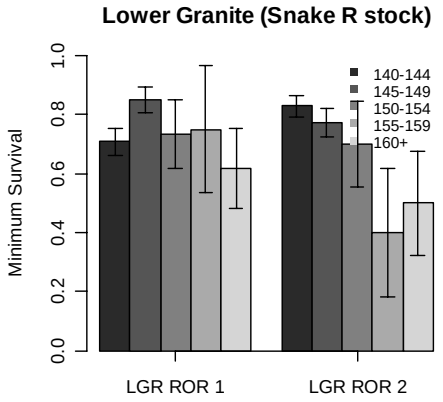

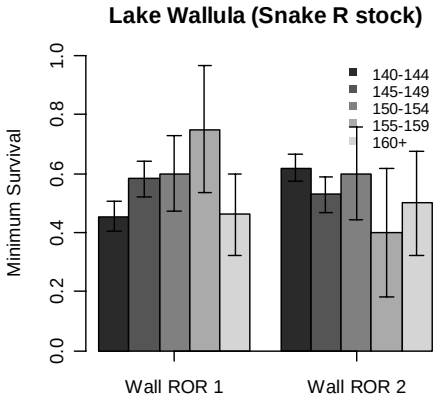

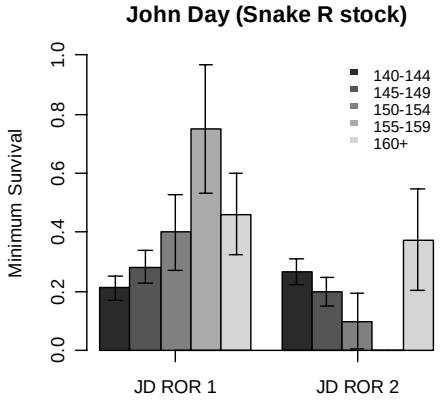

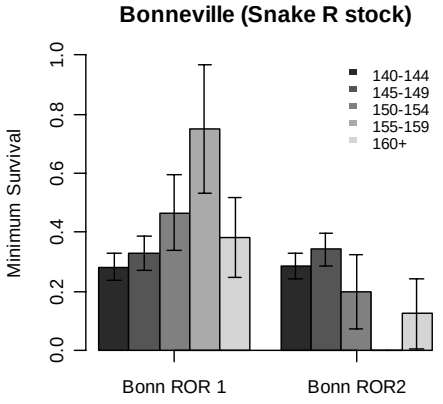

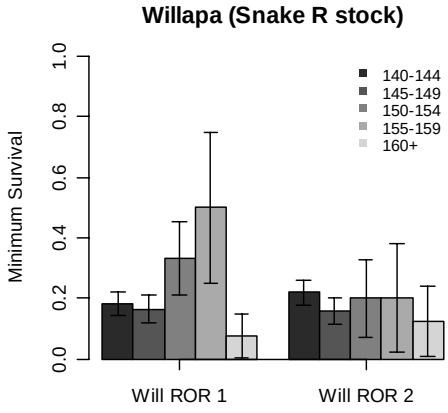

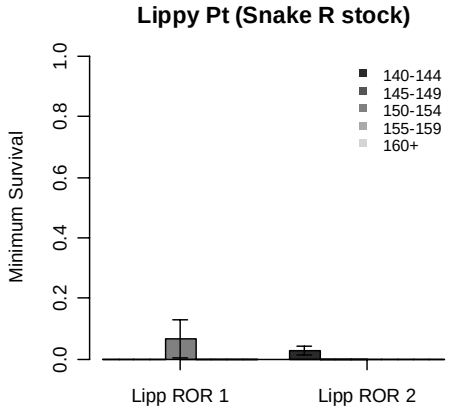

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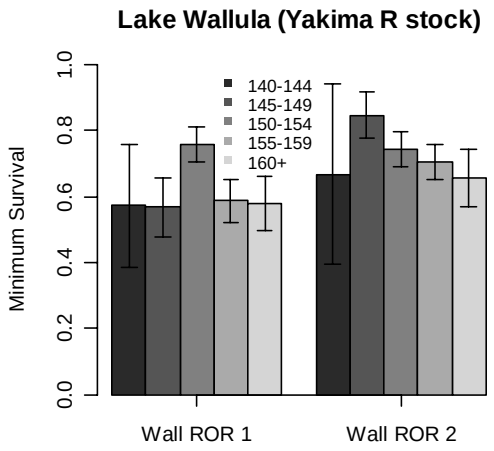
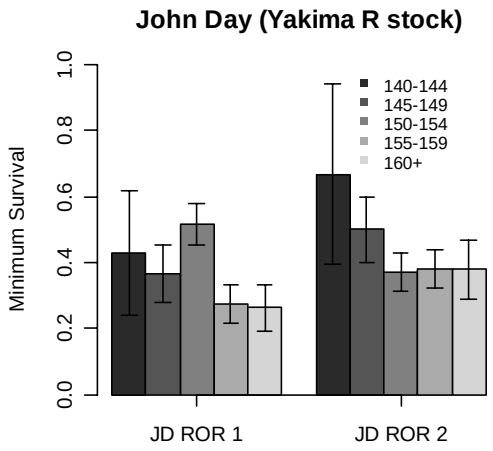
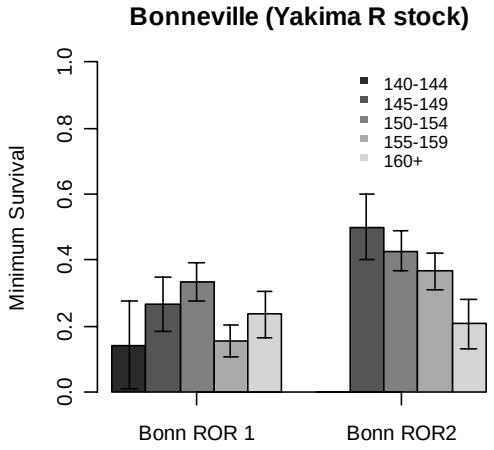
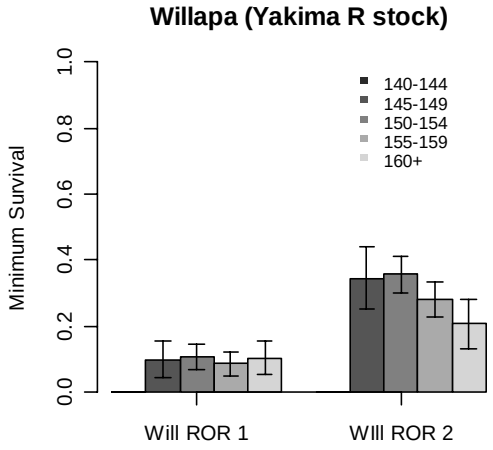
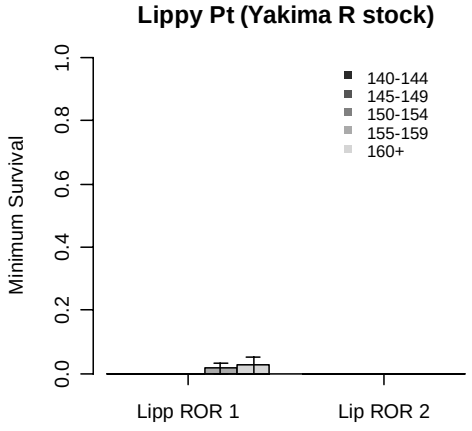






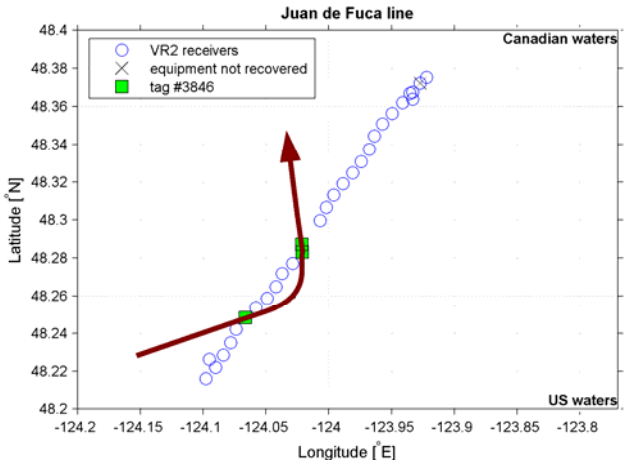




***Appendix B- Response to ISRP's 11 Questions from Final Review of Projects*, 31 August 2006**

1. The ISRP stated that its "primary concern is that results to date indicate effectiveness of detecting tagged juvenile salmon along open coast arrays is not always high . . ." In the open ocean, survival rates can be estimated only if all juvenile salmon movements are confined within the area of the continental shelf where acoustic listening arrays are located . . . " …In addition, the proponent's response "that the Juan de Fuca line . . . showed that Snake River spring chinook do not use that potential migration route" is not in agreement with data in the 9 January 2006 proposal (Fig. 4), which show the detection of a Snake River Chinook on the Juan de Fuca line in 2005. Was this a false detection?

No, the 2005 data seems reliable and is unlikely to be a false detection. We detected the same smolt twice, once on the flood tide near the US shore, and then again 12 hours later on the ebb tide near the middle of the Strait of Juan de Fuca. The most reasonable interpretation is that the smolt made a U-turn over the listening line, entering and then exiting the Strait. (The graph shows the sensor locations in 2005; the trajectory away from the sensor locations denoted by the arrow is of course hypothetical).



Effectiveness of the detection array is a relative term. Prior to the development of the POST array technology, it was not possible to track the movements of West Coast salmon smolts at all—there was zero efficiency. The 2004-05 results demonstrated 95% detection efficiency with 20 km long listening lines, a quantum leap. (Following small refinements to the array geometry in 2005, most of the undetected smolts occurred on listening lines at times when physical gaps occurred because of equipment loss to commercial fishing). We expect to progressively reduce listening line losses to fishing gear over time as part of our technology development program. We would also like to put in perspective our current detection efficiency; at approximately 95%, it is well above that of the in-river PIT tag detection systems at the dams.

2. Table 1 of the proponent's response is useful supplemental information to Table 2 of the 9 January 2006 proposal, because it provides data on the specific BPA-sponsored arrays proposed for 2007-2009. However, a prioritized list including data on equipment and maintenance costs, as requested by the ISRP, was not provided. Information on month of deployment would also have been useful, as it is not clear whether new arrays would be installed in time to detect releases of tagged fish in the year of deployment. The project design would be improved if installation of the second array south of the mouth of the Columbia River (presumably at Tillamook, OR, not "WA" as listed in Table 1) occurred at the beginning of the proposed project (early in 2007) before tagged smolts are released. This would

provide three years of data at two stations south of the mouth of the Columbia River rather than only two years of data. If the FY 2007 results show that tagged Columbia/Snake spring Chinook smolts are detected at the outermost nodes, then curtain lengths of the arrays would need to be extended well beyond the 200-m isobath.

If funding is received in sufficient time for all equipment to be ordered and delivered, it is our intention to have the array deployed in the spring of 2007, prior to the Snake and Yakima R smolts leaving the river. The prioritized list of BPA-funded ocean acoustic listening lines is as follows: (1) Willapa Bay (possibly moved back north to the original deployment site at Cascade Head if trawler losses this winter are too severe); (2) NW Vancouver Island (Lippy Point); (3) Tillamook Head; (4) Cascade Head. As noted in the original proposal we will also deploy a listening line just inside the actual mouth of the Columbia River (near the Astoria Bridge), to clearly partition freshwater from ocean survival.

Equipment costs are described in response to the ISRP's Point #10, below. Maintenance costs are just being evaluated. There was a 25% loss of equipment over the summer at Willapa Bay (a substantial fraction of which was returned), but only a 4% loss at the NW tip of Vancouver Island (1 of 24 receivers was non-responsive). These geographic differences in our first year make it difficult to generalize, but we are aiming for a 10% per annum loss rate. We expect to do that via successive refinements to the deployment technology, and judicious movement away from some areas where experience dictates prudence. Off Willapa Bay, for example, the anchoring systems were not heavy enough, and were lifted up by the trawlers, rather than pulling the sensor package out of the trawl mouth.

2006 results showed that a few Columbia smolts were detected at the outer edge, near the 200m isobath (see the graph of our results), but that the distribution of these fish at NWVI was more limited and smolts were not detected near the outer edge of the listening line. We have not had time to try to examine satellite photos to see if clear images can be obtained to show where the Columbia R plume was relative to the Willapa Line when the smolts were migrating past. As the survival estimates from the Willapa Line are already high—and inconsistent with the lower Columbia R & plume area being the major location where mortality occurs—extending the line farther offshore at Willapa Bay is probably somewhat less important than improving the reliability of the sensor array in the presence of trawlers.

3. The ISRP asked, "How would the fully-implemented ocean array and long-term monitoring data on seasonal and interannual variations in survival rates or migration rates among years or stocks actually be used by managers of the Columbia River Basin hydrosystem? … The proponent did not answer ISRP's question about how hydrosystem managers would actually use the data. The proponent mentioned the possible over-emphasis of other past projects on freshwater mortality. A balanced approach would consider habitat and environment needs for the community of salmonid fishes, which after all show a wide diversity of life history types. For example, even very good ocean conditions apparently did not enable survival of sockeye in Redfish Lake.

The key point is that solid data will allow discriminating between the effects of the hydrosystem and

*the effects of the ocean, which is currently not possible. The ISRP's citation of the Redfish Lake sockeye problem is a good example of the common belief in the region that the cause must have a freshwater origin related to the operation of the hydrosystem. Yet in the central coast region of British Columbia the Rivers Inlet sockeye stock collapsed because: "*All available data indicate that the recent decline *[since the late 1970s]* resulted from poor marine survival, not a failure in freshwater production" *(http://www.dfo-mpo.gc.ca/csas/Csas/publications/ResDocs-DocRech/1998/1998_091_e.htm). In the 1950s and 1960s the Rivers Inlet sockeye stock was, depending upon the year, the largest or second largest sockeye run in British Columbia, yet the Fraser R sockeye smolts (which did not decline at the same time) migrate directly past the mouth of the river where Rivers Inlet smolts entered the ocean. This points to a difference in where the smolts from these sockeye stocks migrate to, and the conditions that they experience either along the way, or when they got there. In contrast to what the ISRP suggest, if Redfish Lake sockeye could be shown to migrate to the same ocean region(s), substantial light could be shed on their management, and how better to address the conservation issues.*

4. The ISRP asked, "Are the proponents relying on these other studies (DFO "Canada-USA Salmon Shelf Survival" project #200300900 and NOAA/NMFS "Ocean Survival of Salmonids" project #199801400) to provide data needed on ocean conditions . . . that might affect survival? The proponent responded, "The goal of the POST project is not to address how the fish die, but to provide hard numbers on where the mortality occurred—and how great the mortality actually is." The ISRP notes that the "hard numbers" will be estimates (statistical probabilities) of survival of two hatchery stocks of spring Chinook salmon. Collaboration with other projects would provide multiple lines of scientific evidence based on different methodologies, including mechanistic approaches and results to explain causality. This would strengthen support for the proponent's hypotheses about the relations between fish passage over dams, barging, and ocean survival of Columbia River salmon. The proponent's response used partial preliminary unpublished data from POST lines to refute alternative hypotheses and technological approaches of other projects, which is not good scientific methodology, even though parenthetical cautions were provided. Although the emphasis in this research is survival, as stated in the response, and not the causes per se, the ISRP considers it important to note that the estimated ocean locations or ages of high of ocean variability. Therefore, it will be important to correlate minimal ocean survival rates with ocean conditions in the future by collaborating with other research programs. The proponent does not seem to acknowledge that ocean variability will make the concept of tracking the geography of ocean mortality and subsequent adjustment of hydropower system management very difficult to operationalize. For example, the proponent's response regarding one year of results along a Kintama-sponsored Alaska line: "No Snake R. smolts appear to have migrated over the (Alaska) line, providing a very useful boundary on where the Snake R spring Chinook survival problems must occur." The ISRP advises that this "boundary" is not a fixed line in the ocean. The ISRP asked, "What specific efforts are underway by the proponents to collaborate with these and other BPA-funded estuary, plume, and ocean studies on salmon survival?" The proponent responded, "We look forwards to closer collaboration in future as POST is proven and we can devote greater time to looking at the linkages." The ISRP advises that the achievement of common biological objectives of the various BPA-funded ocean distribution and survival projects would benefit from better coordination. The ISRP also reiterates its previous suggestion that the proponent coordinate development of the final acoustic array design with other projects in the Columbia River Basin and Plume, as this issue was inadequately addressed in the proponent's response.

(a) We accept the ISRP's comment on the benefits of improved collaboration, but simply note that the current work schedule is focused on operating the array and collecting the data needed to make any post-season collaborative comparison possible. Our experience is that significant pre- and in-season planning tends to fall apart because of the vagaries of weather, vessel scheduling, and changes in run timing. We do think that meetings to conduct a post-season comparison of data would be of significant benefit.

(b) We do not agree that "ocean variability will make the concept of tracking the geography of ocean mortality and subsequent adjustment of hydropower system management very difficult to operationalize". *First, our results to date do not give much reason to support existing beliefs that the operation of the hydrosystem is a major influence on smolt survival. If true, then manipulating the hydrosystem will be of little benefit because it is the inherent variation in ocean survival that is the issue and which has been mistakenly attributed to the dams. (We recognize that this statement is heresy). The most important component of our study will be to establish (1) whether it is events in the freshwater hydrosystem or in the ocean that is the primary cause of what has been variously described as "delayed" or "latent" mortality for Snake R Chinook, and (2) whether barging can bring a benefit by improving adult returns.*

5. The ISRP noted that "survival rates will be calculated as a combination of mortality, nondetection, and tag shedding," and asked: "Can the proponents distinguish between detections of tags in live salmon, tags in dead salmon that are drifting with the current, and tags in live predators that ate tagged salmon?" The ISRP agrees with the proponent that a technological solution (mortality sensor) to distinguish between tags in live salmon vs. dead salmon is not feasible at this time. More to the point, the response would have been improved if the proponents had provided information on the acoustic data analysis or interpretation methods that they use to distinguish between tags in live and dead salmon.

At this time, we do not feel that there is a need to put a priority on interpretation methods to detect dead fish that are either drifting in the current or present in a predator's stomach. The array lines are hundreds of kilometers apart and the length of time a dead smolt will float is relatively short, as is the likely passage time of a tag through a predator's gut (generally, a few days).

6. The ISRP asked for an evaluation of the effect of the acoustic tags on the behavior and survival of spring Chinook salmon smolts. The response partially addressed the ISRP's concerns about behavior by presenting data from an experiment on coho salmon (Chittenden's M.Sc. thesis), but did not adequately address Chinook salmon survival over the period of study for the V6, V7, and V11 tags.

The proponent provided a letter documenting good cooperation and involvement of hatchery managers in the project but did not respond to ISRP's request for more detailed methods, timelines, and schedules for releases of tagged smolts from the two hatcheries participating in the project (Kooskia National Fish Hatchery and Chandler Juvenile Monitoring Facility). The ISRP advises that differences between hatcheries in rearing and release conditions and schedules could affect experimental results. The ISRP asked, "How comparable is the ocean distribution of tagged Snake River hatchery fish to

wild Snake River Chinook? Is there a size difference? If so, how much will this influence their results and interpretation?" The proponents did not answer this question adequately: *"To our knowledge, the answer to this question is currently impossible to ascertain. We hope to address such questions with the POST array over time.*" Surely the literature could have provided at least a partial answer to this question. Size data are published and extrapolation from Chittenden's thesis work could have been interpreted.

(a) Partly in response to the ISRP's concern over the applicability of surgical trial results for steelhead and coho to spring Chinook smolts, we instituted an experiment this past spring at both hatcheries, so that we can compare the survival and tag retention of these two stocks in hatcheries with the results from their free-ranging counterparts. The protocol follows that of our coho and steelhead studies. The study is still on-going, and seems to be providing very similar results. This study will form part of Rechisky's Ph.D. Thesis.

(b) Providing "detailed methods, timelines, and schedules for releases of tagged smolts from the two hatcheries*" is difficult. The methods are straightforward, as they follow our established protocols. Timelines and schedules are complicated because the growth of smolts at a given hatchery is not constant between years, and even hatchery staff estimates of when the fish have reached an acceptable size are not necessarily reliable—this spring, for example, we sent a surgical crew of four trained taggers to one of the participating hatcheries only to discover that almost none of the 1,000+ smolts being held had reached an acceptable size for tagging--yet the average size that had been estimated and reported to us was larger than almost any of the fish in the tank. We have already begun discussions with the two hatcheries (Cle Elum/Yakima; Dworshak-Kooskia/Snake) in preparation for the 2007 field season and will have the smolts held and growth accelerated with feeding so that an equivalent size range of both stocks can be released concurrent with the natural migration timing. This should maximize comparability of the release timing, and (we hope) match the timing of the wild run—which of course also varies between years and cannot be accurately provided in advance.*

(c) We stand by our assertion that the literature will provide little answer to the ISRP's question "How comparable is the ocean distribution of tagged Snake River hatchery fish to wild Snake River Chinook? Is there a size difference?*" The reasons for our response this spring were straight-forward: there has only been a handful of known origin Snake R chinook smolts that have been caught, and the need to partition this data into hatchery and wild fish makes any attempt to use the literature unlikely to be successful—there are too many variables for too few samples: variation in time and location of the small known Snake-origin catches means that a direct comparison of the two groups caught at the same time and location is probably impossible. In contrast, we would respectfully point out that the results from this year's work, reported above, show that the distribution of barged and run-of-river hatchery origin Snake R Chinook is virtually identical over the Willapa Bay line, and differs from that of the Yakima R Chinook smolts. It would be straight-forwards to extend this POST-style experiment to include wild-run Chinook smolts, if there was a need for answering this question. The ability of the POST array to potentially address these types of questions in a direct experimental sense is what makes this approach to scientific issues a key difference from the methodologies that have had to be used in the past.*

7. In response to ISRP's request, the proponent provided useful and detailed information on permits and permitting processes required to deploy the POST array on the ocean floor. However, the response did not demonstrate ISRP-requested coordination and cooperation with coastal fishing communities through Washington, Oregon, and Alaska Sea Grant.

We are unlikely to be able to "demonstrate ISRP-requested coordination and cooperation with coastal fishing communities through Washington, Oregon, and Alaska" *or with* "Sea Grant [Agencies]" *without a very large increase in staff costs. We submit official "Notice to Mariners" which are published in both the US & Canada, and deal with interested individuals who contact us as a result of the official Notices or via our toll-free number posted on all of our sensor nodes. Where possible, we also develop personal contacts when we are in various ports, and we rely on the skippers of the chartered vessels to also inform local fishers. However, the POST array already covers half a continent, and coordinating with all relevant coastal fishing communities is a gargantuan task.*

8. The ISRP requested more information on the proposed method for recovering lost acoustic receivers. Previous ISRP reviews raised concerns about detecting lost receivers and the use of expensive ROVs and side-scan sonar. The proponent's response was informative with respect to problems with acoustic releases. The proponent stated, "as a percentage of the POST array, operations costs for ROVs are reasonable, and the POST array's data is invaluable." Although requested by ISRP, a breakdown of these costs was not provided.

See response to #10 below for a cost breakdown on ROVs. We would note that the technical and cost evaluation of these units only started after our June response to the ISRP was submitted.

9. The ISRP asked, "How will the data from other investigators who used VEMCO tags be made available to them and at what cost? How will VEMCO and Kintama facilitate other research programs that want to use the coastal receiver network?" The proponent noted that Kintama would probably handle scientific consultation and financial charging for use of the POST array by other researchers who own Vemco tags. It is not clear, however, if other BPA funded projects that want to use the BPA-sponsored listening lines will be also be charged a fee for these services. Charging (the cost of membership) for use of POST array is troublesome given the significant BPA funding. The use of BPA-funded lines by other researchers should be specified by the proponent and evaluated by the Council and BPA. The proponents remain optimistic that State, Federal, Provincial, and International agencies will buy into the idea of a continental-scale array and support it in the long term. The cooperation of these agencies is key to the long-term success of POST in this part of the ocean. However the difficulty of continuing long term and expensive monitoring in the ocean may be underestimated.

A business model for the POST array is under development, and a final decision has not been made on the financing structure, so it is not possible to give a definitive answer at this time. As the ISRP note, securing the co-operation of the fishery agencies is indeed the key issue.

Appendix B- Response to ISRP's 11 Questions (Cont'd)

10. The ISRP noted that "justification for expensive equipment described in the narrative was insufficient" and asked: "What are the specific costs of tags and acoustic nodes? What are the costs of the ROV and additional equipment needed for the ROV, including high-resolution optics, and manipulator, plus surface electronics? What are the projected costs for the single special-purpose vessel that may be required in the future? What are the costs for the wireless (cell, satellite) communications, and other marine electronics? Are these costs shared with other programs funding the POST array? If so, how is BPA's share determined?" The proponent did not provide the requested estimates of specific costs for expensive equipment.

We generally split array costs in proportion to the lines funded by BPA and the Moore Foundation ("Salish Sea" lines for the latter). Acoustic nodes are formed from a VR-3 acoustic modem equipped tracking sensors ($6,500 with taxes and shipping). To this we need to add the cost of the proprietary syntactic foam flotation collar to orient and position each sensor ($2,500) and the bottom anchors, (currently) bronze brackets, and vertical risers forming the entire deployment structure (~$400). Acoustic tags are about $350 when taxes and costs of implantation are included.

We have an on-going evaluation of sonar sensors running since the summer. A final solution will involve several sonar systems(both on-boat for searches and on-ROV for actual recovery). To put costs in perspective, sonar systems run from $8,000 to $250,000, exclusive of software. An intermediate class ROV which we have trialed (Seaeye Falcon) is $250,000 exclusive of a number of key peripherals. Short term lease of the Seaeye Falcon with operator (which we have done once for sonar trials) is $2,500/day plus mobilization/demobilization costs. Satellite phone costs (Iridium) are about $3,500/yr and wireless phone costs (Blackberry; key staff) total about $8,000/yr.

11. The ISRP requested justification for the PI's allocation of 100% FTE to this BPA-funded project. The proponent's response explained that FTE is allocated "between the various POST project sponsors" and "is difficult to precisely define." The ISRP is concerned that FTEs allocated to the proposed BPA-funded project will not be adequate. The ISRP notes that there is a patchwork of FTEs and associated costs that cannot be explained.

We are unclear as to what would constitute adequacy. At present, the POST array stretches from the Cascade Head, Oregon, to north of the Alaska panhandle, and about 70% of that array has transitioned to a permanent multi-year operation. Our time allocation to the POST project is 100%, and we did not intend to suggest that our time was only spent on the BPA funded component, which will likely constitute <40% of the funding in 2007.

Our goal with this proposal is to demonstrate the performance and relevance of the POST array to resolving long-standing and extremely important management questions concerning the role of the oceans in directly determining the present conservation status of key Columbia R salmon stocks. If we are correct, many of the expensive and contentious issues concerning salmon management in the Columbia will be shown to have an ocean origin, and have been incorrectly ascribed to failures in freshwater salmon management. We recognize that our staff are spread very thin, relative to most

other science projects, but this is the reality of trying to develop a new scientific approach where potential success can only be demonstrated by making large strides in deploying the array—and there are no pre-existing models to copy.