Comments on the USFWS
WY2016 Adult Delta Smelt Salvage Incidental Take Calculation Proposal

Before the LOBO Panel
November 5th, 2015

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Conclusions:
• The statistical distribution of predicted salvage is biased low because the moderately wet years that contain the highest potential for salvage have been heavily underweighted • The use of the 20% lower confidence limit for December population will cause the ITL to be exceeded more frequently than exceedance criterion set by USFWS in the document. This contradiction needs to be resolved. • Until the December SKT can be statistically linked to the January and February SKT, USFWS should rely upon the FMWT survey as an abundance proxy.

The USFWS proposal for how to estimate the Incidental Take Limit (ITL) for 2016 is conceptually very similar to what MWD and USBR presented to LOBO for 2015:

- Explain historical adult Delta Smelt salvage/abundance ratios using
    - Sacramento Secchi depth during the winter
    - Old and Middle River (OMR) flow levels during the winter, excluding years with positive OMR.
- Reverse the direction of the equation to generate multiple predictions of future salvage/abundance ratios assuming that the future is similar to the recent past.
- Analyze the distribution of estimated future salvage/abundance values and determine the ratio that would be exceeded approximately 20% of years. This ratio becomes the ITL multiplier.
- To generate a salvage ITL each year, multiply the abundance estimate each year * to ITL multipler.

The USFWS methodology is considerably more sophisticated than the method proposed last year. However, the proposed method has issues of its own as discussed below.

The Joint Density Subspace Causes Bias

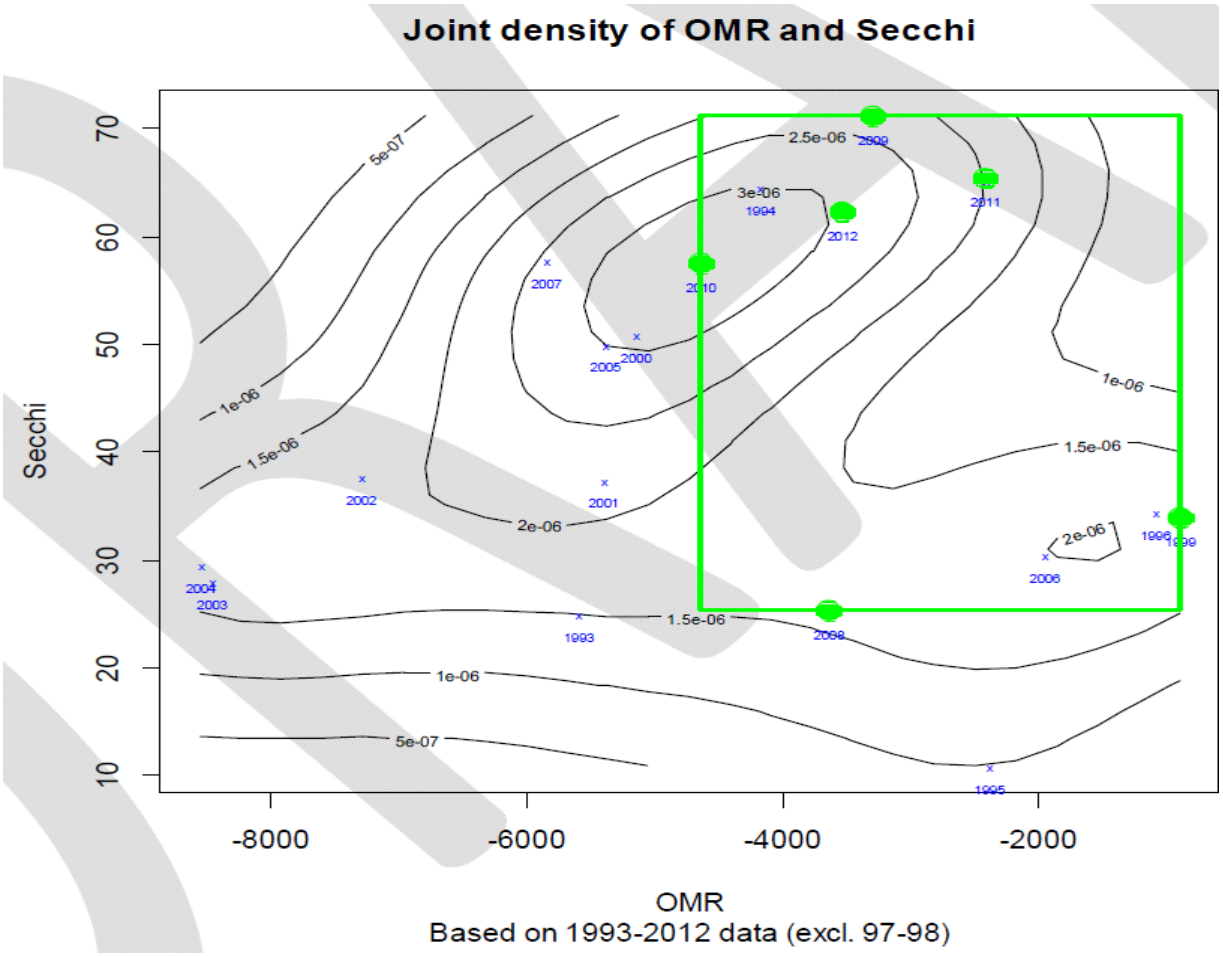

Figure 1

The creation of a subspace within the Joint Density map for drawing pairs of OMR and Secchi depth creates bias in the predictions of future salvage/abundance ratios. Data points that lie outside the subspace have relatively little impact on the probabilities within the subspace. Six of the 9 years that lie within the subspace had hydrological conditions so favorable to low salvage that the RPA would not have even been applied. The other three years would have only required modest reductions in negative OMR to comply with the RPA (Figure 1)

By contrast, most of the years that lie outside the subspace would have required relatively significant reductions in exports in order to comply with the RPA.

The problem with allowing "favorable" years to dominate the Monte Carlo analysis is that the ITL is supposed to reflect the distribution of all years, not merely "favorable" years. Figures 2 and 3 show what the years which were included in the joint density subspace (the green box) and which were excluded. In general the years within the subspace are either so wet that the San Joaquin River was running high enough to bring OMR close to zero or were so dry that Sacramento turbidity was low and there was so little water to pump that OMR could not become very negative. In general, the years that were excluded were moderately wet years. Moderately

wet years are characterized by a combination of three problematic characteristics for salvage: (1) low Secchi depth in the Sacramento River, (2) enough Delta inflow to allow higher export pumping under State Water Board Standards and (3) low San Joaquin inflows, opening the door to high negative OMR values. From 1993 to 2012 nearly half of all years were of this type. These are the kinds of years that generate high salvage ratios and these are the years that were heavily deweighted in the joint density subspace.

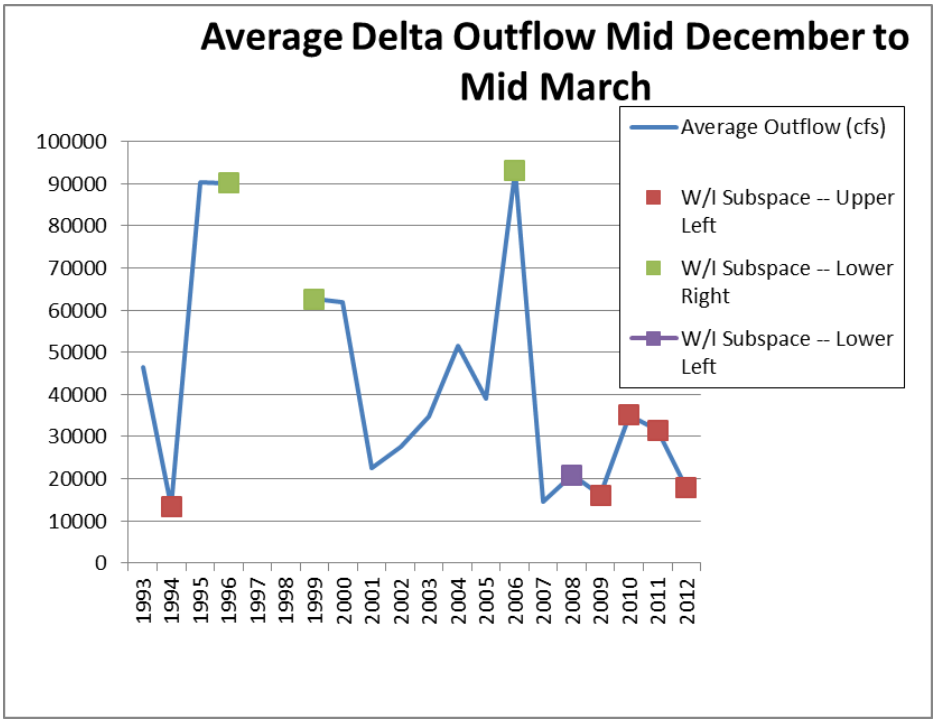

Figure 2. Years within the joint density subspace

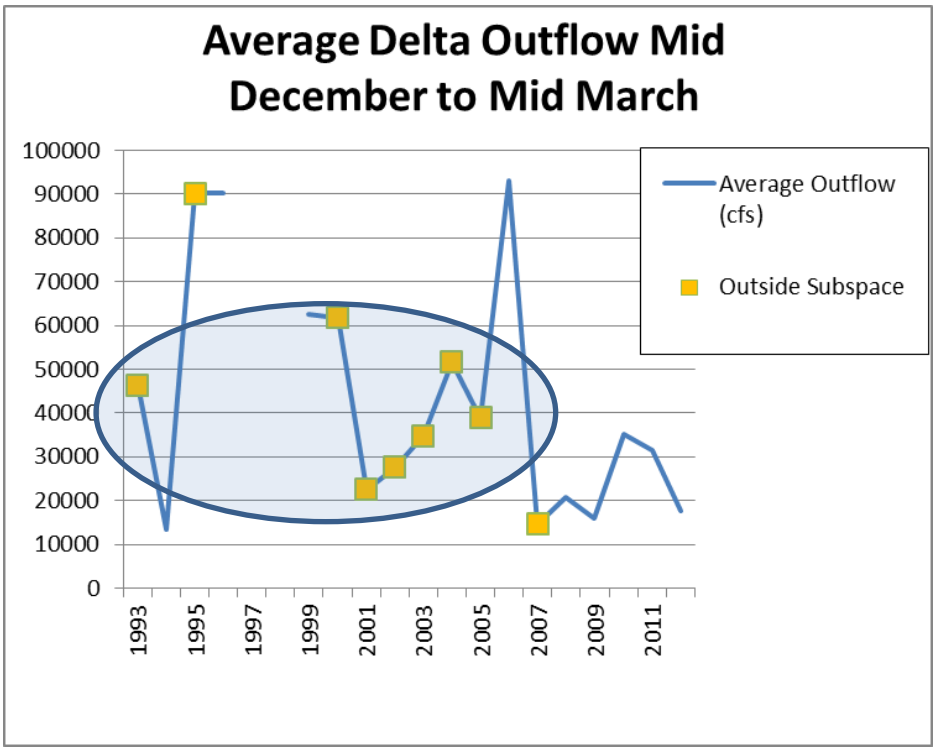

Figure 3. Years outside the joint density subspace

The USFWS rationale for deweighting years that did not conform to the RPA is that inclusion of these years would introduce OMR:Secchi pairings that violated the RPA and which would therefore bias future estimates of salvage too high. This is a fair point. But the analytical choice is not simply between including historical OMR values that did not conform to the RPA (driving up predicted salvage/abundance ratios too high) or excluding these years (biasing predicted salvage abundance ratios too low). There is a third choice – one which was presented in the 2014 LOBO review.

USBR and MWD developed an RPA compliance model and applied it to the winter hydrology from 1993 through 2012. In essence, the model identified hydrological conditions under which the RPA would likely have been imposed on project operations. The model then made adjustments to export levels in order to bring OMR down to levels that would likely comply with the RPA. The model is by no means exact because actual operations depend upon many factors at short time scales. But the results are approximately correct. Figures 4 and 5 show how the RPA compliance model would have changed the OMR values for the years 1993 – 2012. All years except the six years identified by USFWS as RPA compliant shift to less negative OMR values.

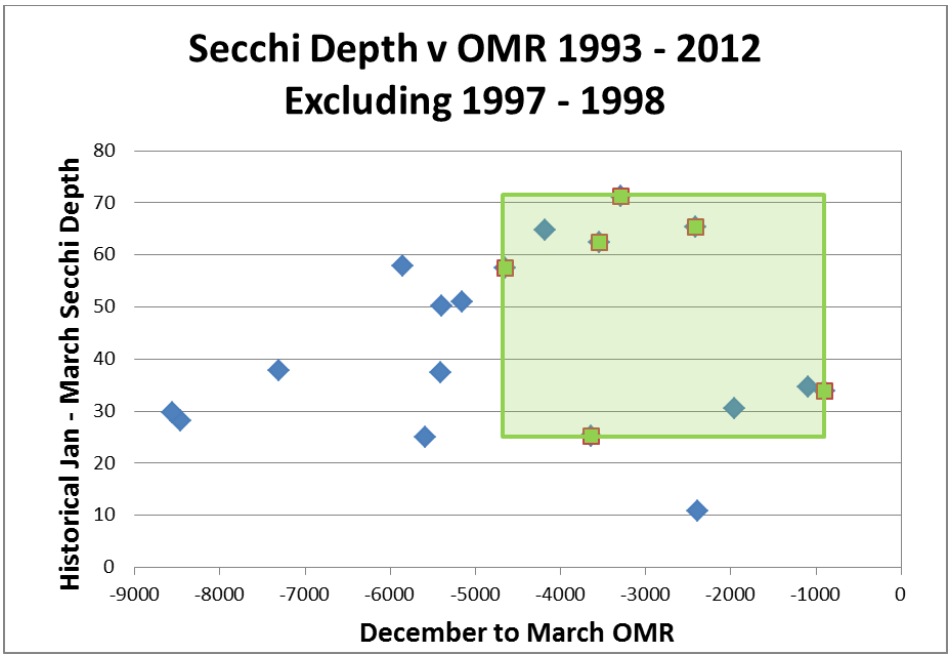

Figure 4

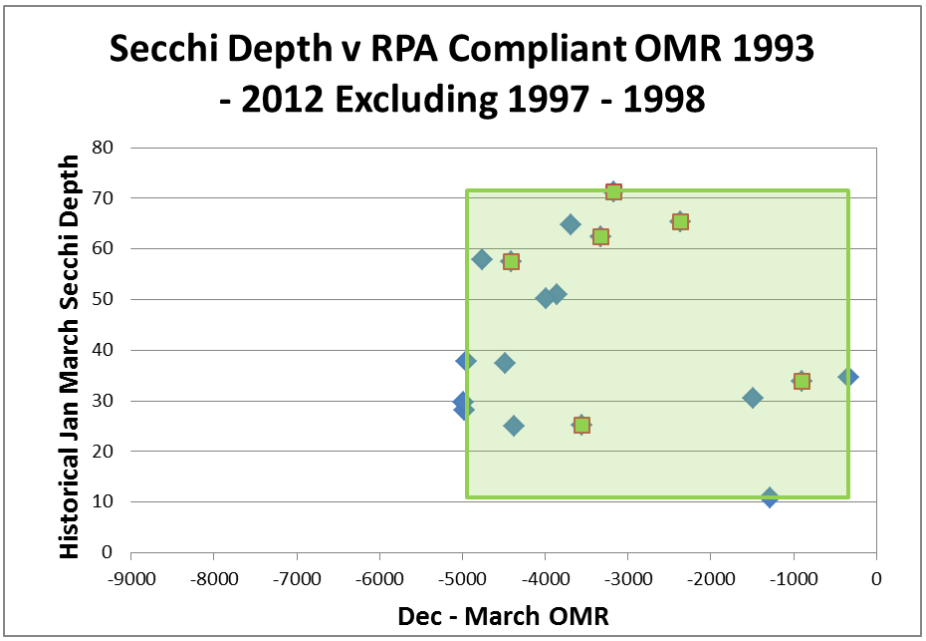

Figure 5

In essence, the use of the OMR compliance model allows all data points to be treated as RPA compliant and eliminates the need for a subspace. The new joint density map now includes all 18 years with negative OMR from 1993 – 2012, including the years in which the RPA will actually be applied. It is a much better foundation from which to predict future salvage/abundance distributions.

Use of the 20% confidence level for December Abundance violates the ITL exceedance criterion defined by USFWS.

The USFWS correlation for salvage/abundance v OMR and Secchi depth uses point estimates of December Delta Smelt populations taken from (1) the January and February SKT and (2) the 20mm Survey, the Summer Townet Survey, and the Fall Midwater Trawl Survey assuming exponential decline in population over time. In turn, the application of Monte Carlo analysis to estimate the distribution of future salvage ratios is implicitly based on point estimates of population from 2002 - 2012. Finally, the ITL coefficient (0.84) which is to be multiplied by December population every year is predicated on an analysis using point estimates of abundance.

However, the USFWS paper then proposes to use the 20% confidence level for population when it comes to computing the annual ITL salvage level. In the one example given for December 2014 the 20% confidence level is 42% lower than the point estimate of December population. Thus, the salvage that would have been allowed for the winter of 2015 would have been 42% lower than the salvage that would have been allowed using the point estimate (Figure 6).

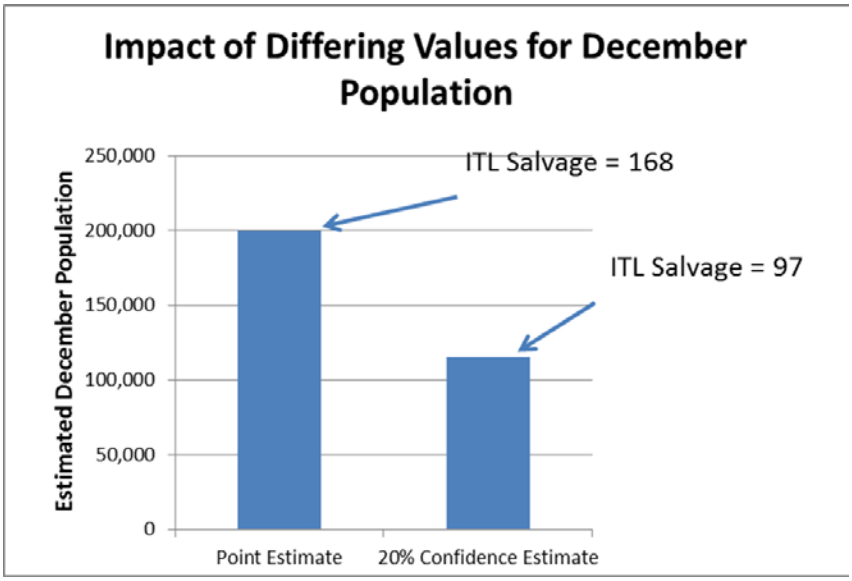

Figure 6

The rationale given for using the 20% confidence level is a paper by NMFS titles, "Revisions to Guidelines for Assessing Marine Mammal Stocks". But the USFWS does not show that management of fish stocks can be equated to management of mammal stocks, nor that the application of the 20% value used in that paper is analogous to the 20% application suggested here. But more generally USFWS argues that the use of the 20% confidence level is justified to assure that the ITL is not set too low each year. This is a reasonable concern. But it contradicts another position also endorsed by USFWS in this paper – that the ITL should be set such that the measured salvage/population ratio each year should exceed the annual ITL value in only 20% of years. This was the criterion used to create the equation: ITL = December population * 0.84. But if the December population is now discounted by between a third and half each year, the ITL will be exceeded far more frequently than 20% of years.

There are several possible approaches to resolving this contradiction:

- Define the ITL each year in explicitly statistical terms rather than as a single number. For example, give the point value of the ITL salvage each year, but also the 20% and 80% confidence levels for ITL (using the 20% and 80% confidence limits for December population. This would put all the information on the table for everyone to see and interpret.
- Reduce the variance in the December abundance estimates by modifying the survey protocols. For example, would increasing the number of tows/station from one tow to two or three tows reduce the variance?
- Increase the ITL multiplier to represent a value that would be exceeded less than 20% of the time. Combined with the use of the 20% confidence value for December population the net effect would be an annual ITL that was not exceeded routinely, but which still would protect against December abundance estimates which are too high.

<u>The Use of December SKT as the basis for December Population Estimates</u>

The USFWS paper notes (page 8, Section D) that:

> Backcasted estimates of December abundance were used for fitting the model while a weighted combination of $\widehat{Dec}_m$ and $\widehat{Dec}_d$ will be used to predict salvage. Preferably, the model would be fit using the weighted combination in the denominator of the ratio. However, if the two measures of December abundance were the same on average, the effect of the difference might be negligible. Looking just at $\widehat{Dec}_d$ for the one year where a historical estimate is available (water year 2015), however, the two estimates were quite different. The backcasted estimate was 192,381 in contrast to $\widehat{Dec}_d$ of 77,707. Thus there is cause for concern about the accuracy of predicted salvage when based on a model parameterized with backcasted estimates, assuming this backcasted estimate is the worse of the two here.

This concern is well founded. Until the December SKT has been run for several years we will have no way of knowing whether December SKT tends to capture fewer smelt than the January and February SKT (adjusted for mortality) or whether the high discrepancy between December 2014 SKT and January/February SKT was just a very unlikely event. The consequences could be very significant. Figure 7 shows how different estimation methods might have modified the ITL for 2015. The actual ITL salvage number for 2015 was 196. Use of the December 2014 population estimate with the 20% confidence population would have reduced the ITL salvage to around 44 (perhaps a little higher) and the ITL would have been exceeded during the winter of 2015, even though salvage was exceptionally low during the year.

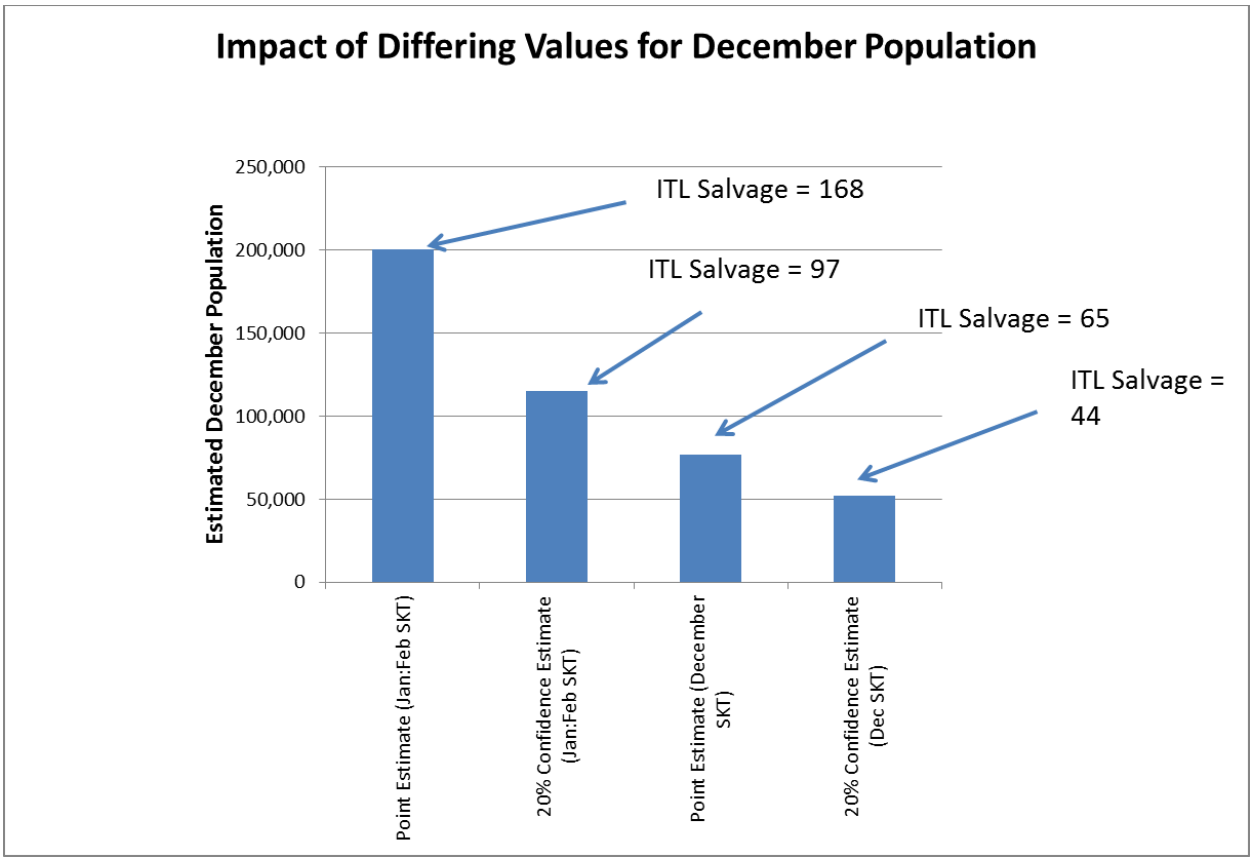

Figure 7

There are many reasons why December SKT could run lower than January and February SKT, including (1) differences in the distribution of smelt in the channels (vertically and transversely) prior to the first storm of the year, (2) differences in smelt surfing behavior during the winter compared to the fall, and (3) other differences in catchability.

Until the December population estimate derived from the December SKT is validated as having the same mean value as the backcasted January and February SKT surveys, USFWS should continue to use the FMWT Index as the abundance term for purposes of analysis.