## REVISION NOTICE TABLE

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| DATE | DESCRIPTION OF REVISION |
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## PROCESSING NOTES

Cruise: 2023-053

Agency: IOS, Ocean Sciences Division, Sidney BC

Chief Scientist: Neville C. Platform: Sir John Franklin

Location: Strait of Georgia Project: Salmon Marine Interactions – Juvenile Salmon Survey

Date: 14 June 2023 –26 June 2023

Processed by: Germaine Gatien

Date of Processing: 17 August 2023 – 24 August 2023

Number of original HEX files: 34

Number of CTD files: 33

##### INSTRUMENT SUMMARY

Two SeaBird Model SBE-25 CTDs were used.

CTD #1 (s/n 0456) was used with temperature sensor #6566, conductivity sensor #5046, Wetlabs ECO Fluorometer #2216, dissolved oxygen sensor #3779, pH sensor #1585 and pressure sensor # 0573.

CTD #2 (s/n 0404) was used with temperature sensor #5724, conductivity sensor #1763, Wetlabs ECO Fluorometer #FLRTD-8101, dissolved oxygen sensor #0047 and pressure sensor # 0668.

# SUMMARY OF QUALITY AND CONCERNS

A scan of the Daily Science Log was available.

Header information was entered in the raw files in a format that enabled easy conversion into IOS Header format; this is a big help in processing.

Times in the files for CTD #0456 were in PDT and for CTD #0404 were in PST; both were converted to UTC in processing.

No data will be archived from channels Salinity:T0:C0 and Conductivity:Primary due to salinity values being much higher than bottle samples and well above the local climatology. The problem first arose during 2023-003 in March and was also seen during 2023-020, 2023-021 and 2022-022. During those earlier cruises salinity sampling showed that the CTD salinity gradually grew a little closer to expected values but not close enough to archive. No objective method was found to correct salinity. As noted in 2023-022 there were also random spikes and strange offset features in many of the salinity profiles

For details, see document “Study of CTD0456.docx” and associated documents:

CTD456\_vs\_Bottles.xlsx – Comparison of CTD salinity and bottles from 4 cruises

 CTD456\_vs\_CTD1255.xlsx – Comparison of 2 CTDs from cruise 2023-022

The study showed that conductivity data were unreliable from all cruises between March and June 2023, so conductivity and salinity channels were removed.

The study also examined data from the SBE Dissolved Oxygen sensor. While there were problems seen in 2022-003, particularly at the bottom of casts and during upcasts, none were noted during 2021-020 or 2021-021. For 2021-022 the oxygen sensor behaved much like it did during 2022-003 with the first cast looking normal, the rest needing a higher alignment correction and later casts having very poor upcast data and suspicious downcast data. Similar results were obtained during this cruise; channel Oxygen:Dissolved:SBE data were removed from casts #32, 37, 43, 47, 52, 83, 120, 127, 136, 141, 145, and 157. For the other casts the values appear to be reasonable but must be considered nominal.

The waits at the surface after the soak periods were generally about 10s, but occasionally less than that; longer waits, preferably 30s, should allow near-surface waters to recover from the stirring caused by the CTD rising.

# PROCESSING SUMMARY

Based on results of cruise 2023-003 a study was made of all 2023 cruises that used this CTD using preliminary data.

Document “Study of CTD0456.docx” compared the performance of this equipment during the following cruises which were all in the Strait of Georgia:

2023-002 – Feb

2023-003 – March

2023-022 – April

2023-022 – Early May

2023-022 - May/June

2023-053 – mid-June

##### 1. Seasave

This step was completed at sea.

##### 2. Preliminary Steps

A digital daily log was obtained.

The cruise summary sheet was completed.

##### 3. Conversion of Raw Data

The configuration files used at sea had current factory settings, but pressure offsets need updating.

* During the previous uses of CTD 0456 a pressure offset of +0.7db was found appropriate. A test conversion was done using a 0.7db offset and starting and ending pressures were very close to 0. So this offset will be used for this cruise as well.
* For CTD #0404 the pressures look to be low by 1.4db in test conversions.

The configuration files were updated with offsets +1.4db for CTD #0404 and +0.7db for CTD #0456 and saved as 2023-053-ctd0404.xmlcon and 2023-053-ctd0456.xmlcon.

Files #66-77 were converted using file 2023-053-ctd0404.xmlcon.

All other files were converted using file 2023-053-ctd0456.xmlcon.

The pressure offset worked well.

Plots were made of a few casts and all expected variables were present, but there are problems for the casts run with CTD #456:

* Temperature mostly looks ok except the upcasts after the CTD hit bottom during casts #56 and #92 look bad as well as part of cast #62.
* pH profiles are similar to temperature profiles though a few near-bottom values are odd.
* Conductivity looks very bad for CTD0456. Dissolved oxygen also is poor for many upcasts and the down/up oxygen profiles are further apart than usual relative to temperature.
* Fluorescence has spikes at the surface, but other wise looks ok.

For CTD #0404 all channels look ok though dissolved oxygen was unusual in cast #72.

Fluorescence dark value at depth is ~0.13ug/L.

In previous uses of CTD #0456 there were severe problems with the conductivity and erratic performance with the oxygen sensor. Most downcast profiles were considered to be ok.

Waits at the surface were generally about 10s, occasionally less than that. At least a 30s wait at the top is recommended to allow surface waters to settle from the mixing caused in raising the CTD.

##### 4. WILDEDIT

The only spikes noted in the data occurred at the beginning or end of the casts or included many points, so not suitable for correction in this step. WILDEDIT was not run.

##### 5. FILTER

Program FILTER was used to apply a low-pass filter with a time constant of 0.5s to pressure and depth. The results were excellent with pressure steps disappearing.

Next the temperature and conductivity were examined and the usual approach of applying a cosine filter, size 8, in routine WFILTER did a good job of removing small reversals.

In the past running WFILTER without the previous pressure filter did not produce as good results.

##### 6. ALIGNCTD

Generally, a setting of +2.5s is found suitable for aligning data from this type of dissolved oxygen sensor with temperature, so ALIGNCTD was run with that setting on all casts. Tests were run using settings of +4s and +6s, the latter value having been useful for some earlier cruises using this CTD. However, the results were confusing, with no advance showing consistent improvement.

ALIGNCTD was run with a setting of +2.5s for all casts with variable results.

That setting looked good for CTD #0404.

##### 7. CELLTM

CELLTM was run on all casts using the SeaBird recommended parameters, (α, 1/β) = (0.04, 8).

The usual test for this parameter is not useful for CTD #0456 given bad salinity data, but it did show that the setting worked well for CTD#0404.

##### 8. DERIVE

Program DERIVE was run to calculate salinity and dissolved oxygen concentration (tau correction included).

*FOR CTD #0456*

Plots were examined and confirmed that temperature and pressure data were improved by the previous processing steps, but the conductivity and salinity data were of bad quality. The test for CELLTM is not very useful given the bad salinity.

Plots indicate that the DO sensor was behaving erratically. The dissolved oxygen profiles occasionally looked good for a short spell, but frequently had unusual small-scale variability or significant spikes or extreme excursions in values. Similar problems have been noted in past uses of this equipment but the severity varied from one cruise to another, with performance sometimes being normal. It is clear that there are big problems with these data, and whereas the problems were chiefly in upcasts in previous cruises, there are a lot of problems in downcasts as well for 2023-053. There was no dissolved oxygen calibration sampling to help with this assessment, but further checks will be done later.

*FOR CTD #0404*

These data look good with the Alignment and CELLTM steps both showing good results.

##### 9. Conversion to IOS Headers

The IOSSHELL routine was used to convert the CNV files to IOS Headers.

CLEAN was run to add event numbers and replace pad values in the pressure channel with interpolated values.

##### 10. Checking Headers

After correcting the longitude hemisphere entry for cast #26, track plots looked ok and were added to the end of this report.

ADD TIME CHANNEL was used to advance the time channel by 8 hours for casts 66-76 and by 7 hours for all other casts.

A cross-reference list after this step showed good results with times close to the log entries.

Surface Check was run on the CLN files and the average was +0.09db, so the pressure offsets applied in conversion were appropriate.

##### 11. CLIP

The next step is to remove the data collected during soaks at 10m. Plots were examined to see how many records should be removed from each cast. File clip.csv was prepared with 2 columns containing event # and # of records to removed. CLIP was run and output plots examined until all looked appropriate.

The surface check was then run on CLIP files and the average was 1.5db.

##### 12. SHIFT

Conductivity

This step was skipped since the conductivity data are not to be archived.

Fluorescence

The fluorometer was not pumped, so a shift in alignment is expected to be small or unnecessary. Profile plots of temperature and fluorescence were examined and no significant mis-alignment was noted. Shift was not run on fluorescence.

Dissolved Oxygen

This channel was aligned earlier, but checks were made by examining plots of temperature and dissolved oxygen. Only cast #6 and the 3 casts using CTD#404 look good. The other casts have much larger offsets between downcast and upcast profiles than normal; alignment of downcast features with those in temperature looks reasonably good, but that is harder to judge. No further adjustment was made.

pH

The offset between pH down and upcast profiles look slightly larger than those in temperature. The only large differences are associated with hitting bottom.

Tests were done on a few casts using advances of +10s and +20s. The best results were with +10s.

SHIFT was run on all casts with an advance of 10s.

##### 13. DELETE

DELETE was run on all casts using the following parameters:

Surface Record Removal: Last Press Min. Surface Swell Pressure Tolerance: 1.0

Swells deleted. Warning message if pressure difference of 2.00

Drop rates < 0.3m/s (calculated over 5 points) was deleted from 10db to 10db above the maximum pressure.

COMMENTS ON WARNINGS: There were warnings only for cast #111 which was full of spikes in

pressure with large offsets. This cast will not be archived.

##### 14. DETAILED EDITING

All DEL files were copied to \*.EDT so there will be a complete set of files even if some need no editing.

File #111 was not opened in the editor since it is to be deleted.

6 files required no editing.

Editing was mostly a matter of removing a few records from the top and bottom of casts where descent rates were low allowing corruption by shed wakes.

Where there were spikes in dissolved oxygen they were mostly too numerous to make it possible to distinguish signal from noise, but where they were isolated the DO points were removed. Some sections were removed where data was spiky. In other cases the noise in DO is small-scale or 2-sided and will be smoothed in bin-averaging.

pH data mostly look ok, except in event #43 where a large section had negative values. Casts #157 and 161, had odd features near the surface, but these data are nominal and it is not clear that the features are wrong, so no editing was applied.

DO needs editing at the bottom of casts, but generally records will be removed since other channels are also affected.

Fluorescence looks ok mostly but has a few issues at the bottom that will likely be fixed in removing bad records where the CTD hit bottom.

##### 17. Calibration checks

Sensor History –

* 2023-002: The sensors were all used during 2023-002 and data looked good. Pressure was found to be low by 0.7db. Salinity data were in reasonable agreement with the few bottles collected and all salinity profiles fell within local climatology. Some temperature profiles were occasionally outside the climatology but the variations looked real and certainly did not look like evidence of calibration drift. There was no dissolved oxygen sampling but profiles looked reasonable..
* 2023-003: Pressure was converted with 0.7db offset and looked accurate. Conductivity data were bad, producing salinity higher than bottles by as much as 4psu and well above climatology maxima. There was no dissolved oxygen sampling. Temperatures were mostly within the climatology except for some low temperatures in deep water in south-central Strait of Georgia.
* 2023-020: Pressure was converted with 0.7db offset and looked accurate. Conductivity data were bad, producing salinity higher than bottles by 3.7psu early in the cruise and gradually dropping to 1.3psu at the end.; all were well above climatology maxima. There was no dissolved oxygen sampling, but profiles looked good. Temperatures were mostly within the climatology except for some low temperatures in deep water in south-central Strait of Georgia.
* 2023-021: Pressure was converted with 0.7db offset and looked accurate. Conductivity data were bad, producing salinity higher than bottles by an average of 1.3psu when one outlier was excluded; all salinity were well above climatology maxima. There was no dissolved oxygen sampling, but profiles looked good. Temperatures were mostly within the climatology except for some low temperatures below 250db.
* 2023-022: Pressure was converted with 0.7db offset and looked accurate. Conductivity data were bad, producing salinity higher than bottles by an average of 0.8psu; all salinity were well above climatology maxima except where the ranges were very wide including Baynes Sound and Cowichan Bay. Dissolved oxygen profiles looked ok. Temperatures were mostly within the climatology except for some low temperatures at mid-depths to the north and below 200db at station 42.

Historic Ranges – Where local climatology was available all temperature data were within the climatology except for cast #111 which had pressure spikes and looks very bad. Salinity data from CTD #0404 were within the climatology but from CTD #0456 most salinity data were extremely high, above the climatology maximum by at least 5psu and as much as 25psu. There were also many spikes. The data are much worse than in the previous uses in 2023.

Post-cruise calibrations – None were available.

##### 18 CALIBRATE

Pressure looks good. Salinity cannot be corrected and will not be archived. No calibration method is available for dissolved oxygen.

No recalibration was applied to CTD casts.

Next decisions were made on which data should be archived.

* Cast #111 will not be archived.
* Salinity and conductivity channels will not be archived.
* Temperature and fluorescence look ok.
* pH looks ok except during cast #43.

What to do with dissolved oxygen is more complicated.

With no calibration sampling and no local climatology for dissolved oxygen, the only methods available for judging DO are examination of profiles, calculation of DO surface saturation and comparison of 2 CTDs during a previous cruise:

1. Comparing up and downcasts is limited by the fact that the CTD hit bottom a few times and that performance often looks worse on upcasts due to shed wakes. Differences were studied to see if they have the usual offsets or if down or up look bad. DO profiles were also compared with temperature profiles as they tend to have similar shapes. Downcasts that appeared to be bad were: 32-52, 83, 120-145, 157. There are others with small spikes and problems at top or bottom of the cast. Those should be examined in CTDEDIT to make a final judgement.

2. DO surface saturation is one way to check near-surface values, but salinity is part of the calculation. Tests were done on 2 casts by subtracting 6psu from a few values near the surface for one cast and 10psu for another. The oxygen saturation was reduced from 131% to 126% and from 107.3% to 100.7% respectively. Temperature differences were much smaller for the 2nd test, so it may be a better estimate. Plots were examined for all casts and allowing for a reduction of roughly 5% the near-surface values look reasonable.

3. Comparing casts with different CTDs: Casts #62 and 66 used different CTDs and were in the same channel though some distance apart. The cast using CTD #0404 had a surface saturation about 7% lower than the one using CTD #0456. There are too many variables to conclude much except that the saturation values are reasonable for both sensors.

Dissolved oxygen will be archived for most casts with the usual statement that it is nominal.

DO should be removed from casts 32, 37, 43, 47, 52, 83, 120, 127, 136, 141, 145, and 157.

##### 19. Fluorescence Filter

The fluorescence data did not require filtering.

**20. Bin Average, Remove, Derive DO in mass units, Reorder**

The files were bin averaged using 1db bins.

REMOVE was run to remove Scan\_Number, Conductivity, Salinity:T0:C0, Oxygen:Voltage, Descent Rate and Flag channels. (Bottle\_Number and Bottle:Position were also removed – these channels were accidentally converted; there was no bottle sampling during this cruise.)

Oxygen:Dissolved:SBE data were removed from casts #32, 37, 43, 47, 52, 83, 120, 127, 136, 141, 145, and 157.

pH:SBE was removed from cast #43.

Dissolved Oxygen in mass units will not be archived for any casts since the salinity data are not reliable.

##### 21. HEADER EDIT and final checks of CTD files.

Header Edit was used to fix headers, fix formats and to add comments about processing.

A cross-reference listing was produced. An error was found in one longitude – this was fixed in all files from step DERIVE to the end of the cruise. The track plots were replaced after this correction.

A header check was run, a few problem found and fixed until all looked correct.

Standards check were run on the CTD files and no errors were found.

The sensor history was updated.

Plots of CTD casts were examined and no problems were found.

PARTICULARS

Two CTDs in use:

456 was main CTD

404 was backup CTD (used for event #66, 72 and 77 only)

6- 62. Soak at 5m for 2 minutes

66-166. Soak at 10m for 2minutes

56 & 91. CTD hit bottom and came up with sediment on it using CTD 456 during events 56 and 91. We rinsed the CTD off with freshwater and tried to flush it out after these events. On the second occasion discovered error in meter block, so not accurately measuring wire out. An additional 10-20m clearance above the bottom was applied thereafter.

66, 72, 77. Switched to CTD 404 while we cleaned CTD 456.

83. Back to CTD 456.

111. Bad pressure; data full of spikes. Not archived.

**CRUISE SUMMARY**

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| Cruise ID#: 2023-053 |
| Dates: Start: 14 June 2023 End: 26 June 2023 |
| Location: Salmon Marine Interactions - Juvenile Salmon Survey |
| Chief Scientist: Neville C. |
| **CTD#** | **Make** | **Model** | **Serial#** | **Used with Rosette?** | **CTD Calibration Sheet Competed?** |
| 1 | SEABIRD | 25 | 456 | No | Yes |
| 2 | SEABRID | 25 | 404 | No | Yes |

**CTD CALIBRATION INFORMATION**

**Make/Model/Serial#: SEABIRD/SBE25/0456 Cruise ID#: 2022-053**

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| **Calibration Information** |
| **Sensor** | **Pre-Cruise** | **Post Cruise** |
| **Name** | **S/N** | **Date** | **Location** | **Date** | **Location** |
| **Temperature** | **6566** | **30Mar2021** | **Factory** |  |  |
| **Conductivity** | **5046** | **30Mar2021** | **Factory** |  |  |
| **ECO Fluorometer** | **2216** | **8Mar2017** | **Factory** |  |  |
| **SBE43 Oxygen** | **3779** | **15Oct2021** | **Factory** |  |  |
| **pH** | **1585** | **17Mar2023** | **Factory** |  |  |
| **Pressure****D:\Te****lewo****rk\2022-0** **28\Process****ing\ios\** | **573** | **4Feb****2022** | **Factory** |  |  |

**Make/Model/Serial#: SEABIRD/SBE25/0404 Cruise ID#: 2022-053**

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| **Calibration Information** |
| **Sensor** | **Pre-Cruise** | **Post Cruise** |
| **Name** | **S/N** | **Date** | **Location** | **Date** | **Location** |
| **Temperature** | **5724** | **27Jan2023** | **Factory** |  |  |
| **Conductivity** | **1763** | **11Jan2023** | **Factory** |  |  |
| **ECO Fluorometer** | **8101** | **28Mar2023** | **Factory** |  |  |
| **SBE43 Oxygen** | **0047** | **25Jan2023** | **Factory** |  |  |
| **Pressure****D:\Te****lewo****rk\2022-0** **28\Process****ing\ios\** | **668** | **13Feb2023****2022** | **Factory** |  |  |

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