## REVISION NOTICE TABLE

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| DATE | DESCRIPTION OF REVISION |
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## PROCESSING NOTES

Cruise: 2022-004

Agency: IOS, Ocean Sciences Division, Sidney BC

Chief Scientist: Young K. Platform: Neocaligus

Location: Strait of Georgia Project: Strait of Georgia Zooplankton

Date: 14 March 2022 –18 March 2022

Processed by: Germaine Gatien

Date of Processing: 4 August 2022 –

Number of original HEX files: 28

Number of CTD files: 28 Number of BOT files: 15

##### INSTRUMENT SUMMARY

A SeaBird Model SBE-25 CTD (s/n 0404) was used with temperature sensor #5724, conductivity sensor #1763, Wetlabs ECO Fluorometer #2215, dissolved oxygen sensor #47 and pressure sensor #0464.

# SUMMARY OF QUALITY AND CONCERNS

There was a digital log book with positions and notes about sampling and a digital sampling log. Header information was entered in the raw files in a format that enabled easy conversion into IOS Header format.

There were surface bottles fired at 15 sites; they were given separate event numbers from the CTD casts. At 3 of those sites there was also a Niskin mounted about 3m above the CTD to collect near-bottom samples. In the BOT files all sample data are identified by the event number of the corresponding CTD cast.

Searchable bottle files were prepared by combining bottle sample data with CTD data from as close to the sample depths as possible. BOT files were prepared for some casts that had only HPLC sampling; no HPLC data were available at the time of processing, but they can be added later.

Bottle samples were available for comparison with CTD salinity and fluorescence. The CTD salinity was reading a little higher than samples, but incomplete flushing of Niskin bottles might explain the differences seen. All extracted chlorophyll samples came from the surface, so there is insufficient evidence to judge how well the CTD fluorometer performed overall. Surface values show the usual relationship with Fluor>CHL for CHL <1ug/L and.Fluor<CHL when CHL is >1ug/L.

Pressure was recalibrated by adding 0.5db.

# PROCESSING SUMMARY

##### 1. Seasave

This step was completed at sea.

##### 2. Preliminary Steps

A digital daily log was obtained as well as a sampling log.

The cruise summary sheet was completed.

CTD Deployment method: Timer set to 2 minutes. CTD down to 10m for soak until 1m 30s mark, bought back to surface to sit until 2 minutes are up. Then full cast begins. Log notes mentioned occasions when casts started a little before or after the 2-minute mark.

BOTTLES:

1. For casts with bottom sampling a 1.7L Niskin bottle was mounted ~2.5-3m above the CTD.

2. Surface sampling was done for each cast after the CTD was taken out of the water and turned off. A 5L Niskin bottle was attached to the wire, sent to the surface and triggered. A separate event number is given for the surface samples.

##### 3. Conversion of Raw Data

The configuration file used at sea was correct. It was saved as 2022-004-ctd.xmlcon and used to convert all HEX files.

Plots were made of a few casts and all expected variables were present and produced reasonable values.

Fluorescence dark value is ~0.3ug/L; while a little high for deep water, this is not unusual in the Strait of Georgia. The pressure has steps and a few reversals.

##### 4. WILDEDIT

The only spikes noted in the data occurred at the beginning or end of the casts or included many points, and will be removed in the normal course of editing. So WILDEDIT was not run.

##### 5. FILTER

Normally pressure is filtered later in processing when running DELETE, but the poor resolution of this instrument means it is necessary to do this early to make sense of the other data which update more often than pressure. So program FILTER was used to apply a low-pass filter with a time constant of 0.5s to pressure. The results were excellent.

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.

Running WFILTER without the previous pressure filter did not produce as good results.

##### 6. ALIGNCTD

Based on tests run for other cruises in this project using the same DO sensor, ALIGNCTD was run on all casts to advance the DO channel by 2.5s. Plots were examined after this step and the results look good, though the profiles of T and DO were extremely complex; given the slow response of the DO sensor this test is difficult to interpret.

##### 7. CELLTM

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

##### 8. DERIVE

Program DERIVE was run to calculate salinity and dissolved oxygen concentration (tau correction included). Plots were examined and confirmed that steps 5, 6 and 7 had improved the data.

There were no fluorescence values <0.

##### 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

A cross-reference list was produced and file #18 had no latitude due to a missing hemisphere entry in the CNV file. That was fixed and no further problems were found.

Track plots looked ok so were added to the end of this report.

Surface Check was run and the average was -0.5db with a range from +0.2 to -0.7db. All files were put through REVERSE and another run of Surface Check gives an average of -0.5db with a range of -0.5 to ‑0.8db. Adding 0.5db looks appropriate.

HEADER CHECK was run. No problems were found.

##### 11. CLIP and CALIBRATE

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 plots examined after until all looked appropriate.

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CALIBRATE was run using file 2022-003-recal1.ccf to add 0.5db to the Pressure and Depth channels.

##### 12. SHIFT

Conductivity

Tests were run to see what shift to conductivity made the best improvement to stability in T-S space. A shift of +0.3 records made a slight improvement. That setting was applied to all casts.

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 there was too little variation to judge alignment. 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. No further adjustment was made.

##### 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 no warnings.

##### 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.

CTDEDIT was used to do some light editing of 16 files, mostly removal of a few records near the top and/or bottom and light editing of salinity.

Notes of editing details were made in the headers.

T-S plots were examined after this step. Small unstable features remain in Baynes Sound and the Gulf Islands area, but that is common in those areas and may well be real.

##### 15. Initial Bottle Data Steps

There was no rosette available for this cruise. There were surface bottles fired at 15 sites; they were given separate event numbers from the CTD casts. At 3 of those sites there was also a Niskin mounted 2.5-3m above the CTD to collect near-bottom samples.

BOT files were prepared with the sample data plus CTD gathered at the same site.

The event numbers will be those of the CTD cast at the site.

Each of the analysis spreadsheets were examined to see what comments the analysts wanted included in the header file. These were used to create file 2022-004-bot-hdr.txt which will be updated as needed during processing.

* Chlorophyll analysis was obtained in spreadsheet QF 2022-004\_CHL\*.xlsx.
* Salinity analysis was obtained in spreadsheet QF 2022-004\_SAL\*.xlsx.
* Nutrient analysis was obtained in spreadsheet QF2022-004\_NUTS..xlsx.

Note that only HPLC sampling was done at a few sites. At the time of processing HPLC data were not yet available, but BOT files were prepared so that those data can be added later.

Workbook 2022-004-bottles\_plus\_CTD\_6linehdr. csv was created. Data from the QF worksheets were added to one sheet of the workbook. A 6-line header was prepared using entries from the event log relevant to Niskin sampling plus bottle data. Space was included for the addition of CTD data.

There are no CTD data right at the surface, so data from as close to the surface as possible were obtained; this varied from 1.2 to 2.0db. For the bottom samples data were found from ~2.5db above the maximum sampling pressure before editing. Those data were added to the 6-line header file. This file will also be used to create bottle files, but with final CTD data. (See section 22.)

File 2012-004-bottles\_CTD-comparison.xlsx was prepared to do a comparison of CTD and bottle data for salinity and fluorescence.

##### 16. Compare

Salinity Comparison

There were 8 bottle samples, 5 from the surface and 3 near the bottom.

Of the 5 surface bottles, 1 was clearly an outlier as no salinity that high (30.1132psu) could be found above 100db for that cast. There is no note of a problem by the analyst and there is no obvious way that a sample could come from mid-depth as there was only 1 Niskin available and the planned duplicates were taken and look good. No samples are missing. If there was a typo in recording the value and it should really be 31.1132, then it could possibly be a 3rd sample from the bottom bottle. The analyst was contacted and decided the value should be padded with flag 5 as she could find no explanation for it.

A second surface bottle was flagged by the analyst as possibly having a leaky insert. The CTD is lower than the bottle, which would support that there was likely some evaporation of the sample since the overall comparison suggests that the CTD was reading high.

From the 3 remaining surface bottles there is a lot of variability with the CTD reading high by 0.002psu, 0.123psu and 0.013psu, for an average of 0.004psu. Since the CTD data come from 1 to 2db rather than the actual surface, we expect CTD values to be higher than bottles.

Of the 3 bottom bottles the 2 deepest show the CTD reading high by 0.006psu while the 3rd shows it reading low by 0.001psu. The 3rd sample was at 163db where the salinity gradient was high at 0.027psu/m. Previous uses of this sensor suggested it was reading high by 0.008psu but the comparisons were not considered sufficient to justify recalibration.

Since the bottles were mounted above the CTD and fired when the CTD was at the bottom, they are likely to entrain water from above which would have slightly lower salinity. Looking at local gradients a difference of 0.006psu would be found within 6 to 7m for those 2 casts. So incomplete flushing of Niskin bottles could easily account for the difference. No recalibration is justified.

Fluorescence

The only extracted chlorophyll sampling was at the surface. Values ranged from 0.32 to 2.4ug/L, a range within which fluorescence is usually fairly close to CHL, and that is the case for these data. As usual the fluorescence is higher than CHL when CHL is at the low end of that range and as CHL increases, the FL/CHL ratio decreases. The fluorescence values come from lower in the water column and earlier.

##### 17. Other calibration checks

Sensor History – The conductivity and dissolved oxygen sensors were used on 2 other cruises since last being serviced. There was limited calibration sampling on the 2nd of those cruises and salinity was thought to be high by 0.008psu, but was based on little sampling and possibly the result of in complete flushing of the Niskin bottle. The pressure sensor was recently recalibrated, so there is no history.

Historic Ranges – Temperature and salinity data were within the historic ranges for most casts. As was noticed during February 2022 occupation of the same sites, there were some temperature values below the climatology minimum below 180m in 3 casts on the eastern side of the southern Strait of Georgia (events #40, 43, 51). Salinity was high at one of those casts (#51) between 50 and 200m. These excursions from the climatology look more like real conditions rather than the result of calibration drift.

Post-cruise calibrations – None were available.

##### 18 CALIBRATE

Pressure and depth have been recalibrated.

Salinity recalibration will not be applied.

There was no dissolved oxygen calibration sampling.

There are no salinity values <25 so the silicate values will not need correction.

No calibration was applied.

##### 19. Fluorescence Filter

The fluorescence data was not filtered as it had little effect on the data.

**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, Oxygen:Voltage, Descent Rate and Flag channels.

Dissolved Oxygen was derived in mass units and that was used to calculate DO saturation. Plots of near-surface saturation show a range of 75% to 100%, with the lowest values in some casts in the north-east and Gulf Island areas. Those values are likely slightly low but there is no way to establish by how much.

REORDER was used to get the 2 dissolved oxygen channels together.

##### 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.

A header check and 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.

##### 2. Final BOT file preparation

To enable searching of bottle data, BOT casts were created that contain sample data and CTD data from the downcast at the same site. The file that was prepared previously to enable comparison of CTD and bottle files; it was updated by replacing CTD data with that from the final CTD files.

The event number will match the CTD cast. CTD data were extracted from the CTD files and added to spreadsheet 2022-004-bottles\_plus\_CTD\_6linehdr.csv. That file was converted to IOS Header files for each cast.

The time and date are present as channels as these cannot be converted directly into header entries.

CLEAN was run to add START and END time to the headers. The END TIME is identical so the START time so it will be removed later. CLEAN was also used to enter 0 flags where the flag channels are empty.

REMOVE was run to remove Date and Time channels.

The final CTD data include DO in mass units.

There was no DO sampling so there is no need to derive mass units for the sample data.

SORT was run to get entries in pressure order.

Header Edit was run to add comments and to remove END TIME since it is the same as START TIME and TIME ZERO.

The final files have extensions BOT.

The standards check was run and no errors were found.

A cross-reference list and header check were run on the BOT files and no problems were found.

Plots were made of all BOT casts. With just 1 or 2 levels these were not very useful.

Finally all data from BOT files were extracted to a spreadsheet and compared to the event log; no problems were found.

PARTICULARS – notes from log

2. Casts started before 2minutes up.

10. Very clear water.

12. Super clear water.

18. Up and down during soak to attach Niskin.

27. Soak slightly longer than 2 minutes.

31. Depth increased during stop at site – went to bottom -10m.

63. Current & shoaling through cast, stayed 10m off bottom.

40. Hit bottom – 315m on winch.

47. Attached Niskin during soak.

53. Depth decreased slightly during soak.

**CRUISE SUMMARY**

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| Cruise ID#: 2022-004 |
| Dates: Start: 14 March 2022 End: 17 March 2022 |
| Location: Strait of Georgia Zooplankton |
| Chief Scientist: Young K. |
| **CTD#** | **Make** | **Model** | **Serial#** | **Used with Rosette?** | **CTD Calibration Sheet Competed?** |
| 1 | SEABIRD | 25 | 404 | No | Yes |

**CTD CALIBRATION INFORMATION**

**Make/Model/Serial#: SEABIRD/SBE25/0404 Cruise ID#: 2022-003**

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| **Calibration Information** |
| **Sensor** | **Pre-Cruise** | **Post Cruise** |
| **Name** | **S/N** | **Date** | **Location** | **Date** | **Location** |
| **Temperature** | **5724** | **5Dec2019** | **Factory** |  |  |
| **Conductivity** | **1763** | **12Dec2019** | **Factory** |  |  |
| **ECO Fluorometer** | **2215** | **27Nov2018** | **Factory** |  |  |
| **SBE43 Oxygen** | **47** |  **3Feb2021** | **Factory** |  |  |
| **Press** | **0573** | **4Feb2022** | **Factory** |  |  |





