## REVISION NOTICE TABLE

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| DATE | DESCRIPTION OF REVISION |
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|  |  |

## PROCESSING NOTES

Cruise: 2022-084

Agency: IOS, Ocean Sciences Division, Sidney BC

Chief Scientist: Bokvist J. Platform: Nita Maria

Location: WCVI / Barkley Sound Project: Follow the Fish Barkley Sound Purse Seine

Date: 24 May 2022 –26 August 2022

Processed by: Germaine Gatien

Date of Processing: 29 May 2023 – 2 June 2023

Number of original HEX files: 62 Number of CTD files: 62

# INSTRUMENT SUMMARY

A SeaBird Model SBE-19 CTD (s/n 4345) was mounted with a Wetlabs ECO Fluorometer #4185 and dissolved oxygen sensor #3234.

# SUMMARY OF QUALITY AND CONCERNS

This program involved repeat trips over 3 months. The same CTD was used throughout.

The deployment scheme varied with 10m soaks being done for most casts. For casts #8-14 there was a surface soak only; it was long enough for pumps to come on but would not have allowed for removal of air from the system. For the casts with a 10m soak, the wait was too short after the return to the surface. It is recommended that the CTD be kept at the surface for at least 30s before starting the full cast and even longer if local conditions are very quiet with low currents. This will allow near-surface water to settle from the effects of the CTD moving upwards.

Dissolved oxygen data were significantly low in the top 5m for most casts. There were DO maxima during most upcasts at about 4m. The problems in downcast DO may be the result of smoothing those maxima due to the mixing caused by the rising CTD. For the casts with no 10m soak the near-surface data are of very poor quality, probably due to air in the tubing.

The SBE oxygen data were padded in the top 5db for all casts. Other sensors have faster response times and did not appear to have been seriously affected by the deployment methods used.

There was no log available, but a table was provided with times and positions of casts. The times differ by highly variable amounts from those in the internally-recorded CTD records; usually the CTD times are slightly earlier but for a few cases the differences were up to an hour or more and sometimes they were later than the CTD times. The differences may be due to time being recorded at different stages of the operations or errors in clocks. Errors in the CTD times don’t explain this since the difference varies so much, and no such problem was noted when the same CTD was used during another multi-leg cruise (2022-030) that overlapped in time with this one.

There was no calibration sampling. When the CTD was used during 2022-030 there was limited calibration sampling, but enough to suggest that the temperature, conductivity and fluorescence sensors were well calibrated.

# PROCESSING SUMMARY

##### Seasave

This step was completed at sea.

##### Preliminary Steps

The cruise summary sheet was completed.

##### Conversion of Raw Data

The configuration file used at sea was correct. It was saved as SBE19plus\_4345.xmlcon.

Test plots were made.

The deployment scheme varied through the program.

* For events #8-14 there was a soak at the surface that lasted about 1.5 minutes on average. It takes 40s for the pumps to come on, so it is best to wait at least 2 minutes to allow flow to stabilize in the system, though that will not fully clear the system of air.
* For events #17- 74 there was a 10m soak which is a better approach as it clears the plumbing of air. But the wait at the surface after the soak was often very short, varying from 3s to 20s. At least 30s is recommended to enable near-surface waters to recover from the CTD stirring them.

All expected variables are present. Pressure looks quite smooth.

Temperature, conductivity and fluorescence profiles look normal.

Dissolved oxygen looks odd near the beginning of casts; that will be investigated later.

The minimum fluorescence was reasonable, ~0.08ug/L.

##### 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.

##### FILTER

The resolution of this instrument appears to be good so the pressure does not obviously need filtering. A test showed no major effect but there was a very slight improvement in salinity so a low-pass filter, size 1s was run on pressure.

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.

##### ALIGNCTD

ALIGNCTD is usually run on all casts to advance the DO channel by 2.5s. But during 2022-030 that setting worked fine on aligning oxygen voltage, but when the oxygen concentration was derived the DO appeared to be over-corrected. An advance of 1.5s worked better and was used for the 2022-084 data as well with good results..

The reason for a better response in DO is unknown. See the processing report for 2022-030 for more details.

##### CELLTM

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

##### DERIVE

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

Plots were examined to see if steps 5, 6 and 7 had worked well.

It was found that the CELLTM step seemed to have worked poorly in some places, well in others but the tests are hard to interpret where variability is high. No obvious explanation emerged and the odd values may be real.

There are also some odd DO data at the beginning of some casts.

These issues will be easier to examine once the soak data are removed.

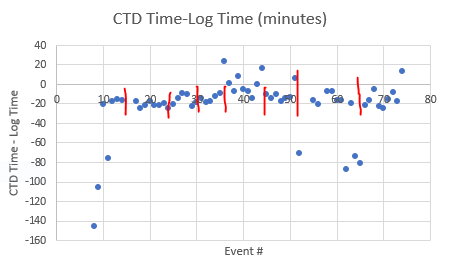
##### Conversion to IOS Headers

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

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

There was no log available, but a table was provided with times and positions of casts. The times are said to be PDT. During 2022-030 CTD times during May to August were found to be in PST; adding 8 hours made the start times agree with sampling plan outlined in the cruise description with sampling soon after sunset. So it seems likely that the CTD times in this program are also in PST.

The times differ from those in the internally-recorded CTD header entries but not by roughly an hour as would occur if it were simply a matter of a different time zone used. Usually the CTD times are earlier but not always and the differences are random. The average difference was the CTD being 21.6 minutes earlier than the log, but the range was from 145 minutes earlier to 23 minutes later. The difference in time was plotted against event number and roughly divided into the various sampling trips. It shows that the early trips had a similar pattern of the CTD Time being earlier by about 20 minutes; perhaps the spreadsheet time was recorded after the CTD was returned to the vessel. There is more variability in the later trips but nothing that suggests a problem with the CTD time since the results are so random.



The difference may be due to the choice of when to record time coming from different stages of the operation or errors in watches/clocks in use. Errors in the instrument time are unlikely given the random variations. During the Barkley Sound Euphausiid Survey the summer casts were all found to be in PST, so it seems likely that is the case for this program as well. The spreadsheet lists all entries as PDT so the differences found above may mean the spreadsheet entries were 40 minutes before the CTD times rather than 20 minutes later. Perhaps the times reflect when the vessel arrived on site and other activities may have occurred before the CTD cast. The 2022-030 cruise had some doubts about time zone, but no significant differences from the log times.

ADD TIME CHANNEL was run to add 8 hours to all files.

##### Checking Headers

A header check was run and turned up an error in the position of cast #9. Once corrected vessel speeds between casts looked much better and a plot of the station sites looked correct.

A cross-reference list was produced and no problems were found. It was added to the end of this report.

Track plots are not informative since there were repeated visits to the various sites, but one was made of a selection of casts to show where most stations were located. There is some variation in positions among repeat visits, so this is just a rough guide.

Surface Check was run and the average was -0.16db with a range from -0.23 to 0 to -0.08db and very low salinity at the surface. This is very close to the results from 2022-030 using the same CTD. All files were put through REVERSE and another run of Surface Check gives an average for the upcast of -0.26db with a range of -0.41db to -0.13. Conductivity was near zero, so the CTD was clearly at the surface. These readings are well within expectations. No recalibration will be applied to pressure.

##### CLIP and CALIBRATE

The next step is to remove the data collected during soaks either at the surface or at 10m.

Plots were made to see how many records needed to be removed and those data were put in file clip.csv.

CLIP was run removing the records based on clip.csv. Plots were made to identify casts that needed a different choice and CLIP was run on those individually, until plots showed an appropriate number of scans had been removed.

At this point a study of dissolved oxygen was made.

* Downcast and upcast profiles often look very different near the surface. We expect upcast DO values to be slightly lower due to slow response to rising temperatures as the sensor rises and deeper water being carried by the CTD, especially in large DO gradients. But in this case the upcast values are often higher, suggesting a problem in the near-surface downcasts.
* One explanation for small differences is that the CTD data from the upcast get closer to the surface than the downcast data which generally start at about 1db. But that does not seem to explain all the differences.
* Individual casts were examined to see if there is a relationship between poor downcast near-surface DO data and site, date, soak period or descent rate. No particular sites stood out, so this does not seem to be due to very local conditions. Descent rate didn’t seem relevant either.
* The soak method was certainly relevant. For the May casts (1-14) most results look poor near the surface of the downcast, likely because there was no 10m soak. Starting in June the 10m soak method was used. The June casts looked somewhat better, so changing the method was helpful.
* The date also appears relevant. June was better than May but still showed some problems near the surface. July and August were worse than June, with most near-surface downcast DO looking poor. Two issues likely account for this.
  + Wait at the surface after the 10m soak: For most casts there was a very short wait at the surface after the 10m soak, just a few seconds. The CTD does disturb the water somewhat carrying deeper water with it as it rises from 10m. Waiting at least 30s is recommended before running the full cast, and longer if local currents are very low.
  + Near-surface gradients: When the near-surface waters are well-mixed, the problem created by this effect would be small, which would explain why the June casts looked better than those in mid-summer when surface temperature gradients are higher.
* One other concern was that there were sub-surface DO maxima in most casts in both the downcast and upcast. The consistency suggests it is real, but just to confirm this a comparison was made with a cast from cruise 2022-030 at station SWAL. Cast #58 was about 3.5 days after 2022-030-0058 at station SWAL. The results look similar. The earlier cruise had slightly lower surface temperature and DO, but both casts had a near-surface reversal in DO gradient.
* The downcast DO is likely missing the peak value in most casts. The top 5m are not reliable.

While these issues are affecting dissolved oxygen most clearly, conductivity, temperature and fluorescence are likely also affected, but not as severely because those channels respond faster and there were no near-surface maxima. We don’t generally choose to archive upcast data because of the wakes created around the CTD package. But for this cruise there was no rosette and no bottle on the wire, so that sort of disturbance is reduced. However, the package still carries deeper water with it, so values likely are more representative of conditions 1 or 2m lower in the water column.

##### SHIFT

Conductivity

Tests were run on 2022-030 data to see what shift to conductivity made the best improvement to stability in T-S space. A shift of -1.9 records made a sufficient improvement. That setting was applied to all casts for this cruise as well. The results look good.

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 confirm that the alignment is ok.

Dissolved Oxygen

This channel was aligned earlier, but checks were made by examining plots of temperature and dissolved oxygen. No further adjustment was made.

##### 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.

REVERSE was run all SHFC0 files. They were then run through DELETE with output DELREV.

Again there were no warnings.

Comparisons were made of the DEL and DELREV files. While it was clear that dissolved oxygen is better in the upcasts, it is not obviously so in temperature and salinity and downcast data quality is generally superior to upcast, so downcast data were selected for editing and eventual archiving.

##### 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 44 files; this was limited to removal of a few records near the top and records corrupted by shed wakes near the bottom.

18 files required no editing.

Notes of editing details were made in the headers.

T-S plots were examined after this step and some unstable features remain that show no obvious instrumental source, so they may well be real. No further editing was applied.

Data from the top 10db were assessed in more detail by comparing downcast and upcast features. Peaks in upcast data tend to be shallower due to the entrainment of deeper water and those peaks may be slightly low for the same reason. Some differences will be due to real change. There were no significant differences in salinity values in the top 10db, just the expected small vertical offset.

But for dissolved oxygen it is clear that in at least half the casts the downcast sub-surface maxima do not reach the peak seen in upcast data. We would expect the opposite result.

For the May casts with no 10db soak, there are peaks in the downcasts not seen in upcasts, between 5db and 9db, even in casts that show no shallow DO maximum in upcasts. Those 5-9db peaks are likely due to bubble release. For the shallower peak seen in most of the casts from June to August, the consistent observation of downcast peak DO values being lower than the upcast peak does support that there was some mixing of water caused by the CTD rising from the 10m soak.

So it is clear that SBE DO values are significantly low in the top 5db, and somewhat deeper for the May casts and first cast in June. Values seem reasonable below that.

CLEAN was run to pad all values in channel Oxygen:Dissolved:SBE in the top 5db for casts #18 to 74. For casts 8 to 17 data were padded to 6, 7 or 8db basing each decision on individual DO profiles..

##### Calibration checks

Sensor History – The pressure, conductivity and dissolved oxygen sensors for CTD #1 were used during another multi-leg cruise that overlapped with this one. Limited calibration sampling suggested that the CTD temperature, conductivity and fluorescence values were reliable.

Historic Ranges – There was no local climatology available, but all temperatures fell within a climatology for a large area around Barkley Inlet except for a few cases where temperature in the top 2m was above the maximum. Salinity fell within that wider climatology as well except for some surface values near the surface of some casts furthest from open waters where it fell below the historic range minimum.

Post-cruise calibrations – None were available.

##### CALIBRATE

Pressure does not require recalibration.

There was no dissolved oxygen or salinity calibration sampling.

No recalibration was applied to these files.

##### Fluorescence Filter

The fluorescence data do not require filtering.

##### Bin Average, Remove, Derive DO in mass units, Reorder

The CLN2 files were bin averaged using 1db bins.

REMOVE was run to remove Scan\_Number, Oxygen:Voltage, Descent Rate and Flag channels.

To study surface DO saturation, Dissolved Oxygen was derived in mass units for the upcast files and that was used to calculate DO saturation. Plots of near-surface saturation show a range of 95% to 140%.

##### 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.

**CRUISE SUMMARY**

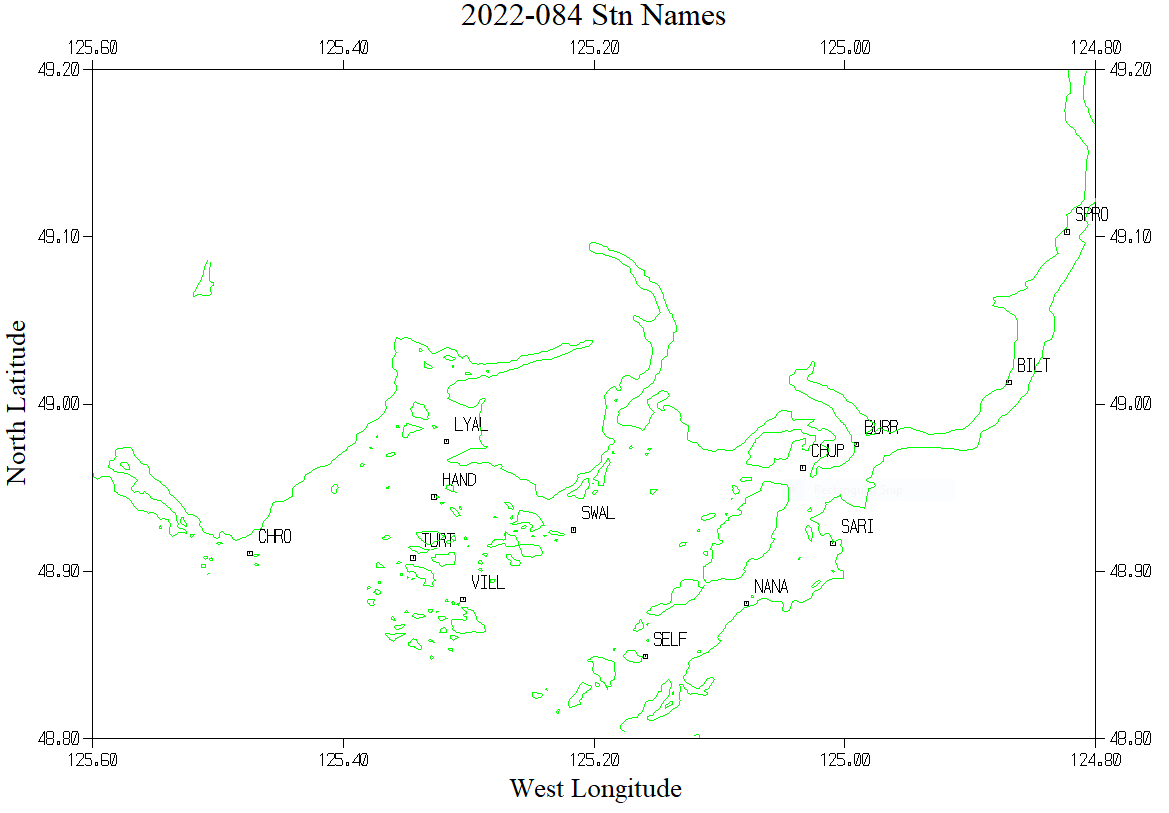
|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Cruise ID#: 2022-084 | | | | | |
| Dates: Start: 24 May 2022 End: 26 August 2022 | | | | | |
| Location: Barkley Sound | | | | | |
| Chief Scientist: Bokvist J. | | | | | |
| **CTD#** | **Make** | **Model** | **Serial#** | **Used with Rosette?** | **CTD Calibration Sheet Competed?** | |
| 1 | SEABIRD | 19+ | 4345 | No | Yes | |

**CTD CALIBRATION INFORMATION**

**Make/Model/Serial#: SEABIRD/SBE19+/4345 Cruise ID#: 2022-030**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Calibration Information** | | | | | |
| **Sensor** | | **Pre-Cruise** | | **Post Cruise** | |
| **Name** | **S/N** | **Date** | **Location** | **Date** | **Location** |
| **Temperature** | **4345** | **3Feb2022** | **Factory** |  |  |
| **Conductivity** | **4345** | **3Feb2022** | **Factory** |  |  |
| **ECO Fluorometer** | **4185** | **11Dec2019** | **Factory** |  |  |
| **SBE43 Oxygen** | **3234** | **6Dec2019** | **Factory** |  |  |
| **Press** | **4345** | **20Jan2022** | **Factory** |  |  |

Station positions are approximate as they varied among different legs of the program.



Cross-Reference List

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Filename | Event | Station | Latitude | Longitude | Date & Time |
| 2022-084-0008.mrh | 8 | SPRO | 49 6.73 N | 124 48.93 W | UTC 2022/05/24 18:46 |
| 2022-084-0009.mrh | 9 | BILT | 49 0.77 N | 124 52.16 W | UTC 2022/05/24 21:59 |
| 2022-084-0010.mrh | 10 | CHUP | 48 57.20 N | 125 1.56 W | UTC 2022/05/25 01:22 |
| 2022-084-0011.mrh | 11 | CHRO | 48 54.64 N | 125 28.47 W | UTC 2022/05/25 12:46 |
| 2022-084-0012.mrh | 12 | VILL | 48 52.92 N | 125 18.20 W | UTC 2022/05/25 16:35 |
| 2022-084-0013.mrh | 13 | SATE | 48 50.89 N | 125 9.69 W | UTC 2022/05/25 18:31 |
| 2022-084-0014.mrh | 14 | SARI | 48 54.96 N | 125 0.86 W | UTC 2022/05/25 20:19 |
| 2022-084-0017.mrh | 17 | SPRO | 49 6.84 N | 124 48.95 W | UTC 2022/06/15 16:38 |
| 2022-084-0018.mrh | 18 | CHUP | 48 57.84 N | 125 1.70 W | UTC 2022/06/15 19:11 |
| 2022-084-0019.mrh | 19 | HAND | 48 56.64 N | 125 14.96 W | UTC 2022/06/15 21:35 |
| 2022-084-0020.mrh | 20 | CHRO | 48 54.68 N | 125 28.33 W | UTC 2022/06/16 00:53 |
| 2022-084-0021.mrh | 21 | TURT | 48 54.57 N | 125 20.53 W | UTC 2022/06/16 13:29 |
| 2022-084-0022.mrh | 22 | SWAL | 48 55.25 N | 125 18.37 W | UTC 2022/06/16 15:37 |
| 2022-084-0023.mrh | 23 | VILL | 48 52.98 N | 125 17.68 W | UTC 2022/06/16 17:15 |
| 2022-084-0024.mrh | 24 | NANA | 48 52.79 N | 125 4.98 W | UTC 2022/06/16 20:17 |
| 2022-084-0025.mrh | 25 | SPRO | 49 6.69 N | 124 48.93 W | UTC 2022/06/30 16:08 |
| 2022-084-0026.mrh | 26 | CHUP | 48 57.56 N | 125 1.98 W | UTC 2022/06/30 18:45 |
| 2022-084-0027.mrh | 27 | SWAL | 48 55.81 N | 125 13.36 W | UTC 2022/06/30 20:53 |
| 2022-084-0028.mrh | 28 | LYAL | 48 58.27 N | 125 19.35 W | UTC 2022/06/30 22:31 |
| 2022-084-0029.mrh | 29 | HAND | 48 56.63 N | 125 19.15 W | UTC 2022/06/30 23:50 |
| 2022-084-0030.mrh | 30 | WILL | 48 54.38 N | 125 20.52 W | UTC 2022/07/01 01:28 |
| 2022-084-0031.mrh | 31 | VILL | 48 52.99 N | 125 18.27 W | UTC 2022/07/01 13:50 |
| 2022-084-0032.mrh | 32 | SELF | 48 50.94 N | 125 9.55 W | UTC 2022/07/01 15:39 |
| 2022-084-0033.mrh | 33 | NANA | 48 52.85 N | 125 4.71 W | UTC 2022/07/01 17:13 |
| 2022-084-0034.mrh | 34 | SARI | 48 54.99 N | 125 0.58 W | UTC 2022/07/01 18:46 |
| 2022-084-0035.mrh | 35 | BURR | 48 58.55 N | 124 59.45 W | UTC 2022/07/01 20:31 |
| 2022-084-0036.mrh | 36 | SPRO | 49 6.18 N | 124 49.39 W | UTC 2022/07/13 16:50 |
| 2022-084-0037.mrh | 37 | CHUP | 48 57.71 N | 125 2.01 W | UTC 2022/07/13 19:37 |
| 2022-084-0038.mrh | 38 | SWAL | 48 55.48 N | 125 12.98 W | UTC 2022/07/13 21:50 |
| 2022-084-0039.mrh | 39 | LYAL | 48 58.65 N | 125 19.08 W | UTC 2022/07/14 00:10 |
| 2022-084-0040.mrh | 40 | HAND | 48 56.67 N | 125 19.65 W | UTC 2022/07/14 02:36 |
| 2022-084-0041.mrh | 41 | TURT | 48 54.49 N | 125 20.66 W | UTC 2022/07/14 14:10 |
| 2022-084-0042.mrh | 42 | VILL | 48 53.04 N | 128 18.56 W | UTC 2022/07/14 15:57 |
| 2022-084-0043.mrh | 43 | NANA | 48 52.92 N | 125 4.86 W | UTC 2022/07/14 18:40 |
| 2022-084-0044.mrh | 44 | HEND | 48 58.65 N | 124 59.47 W | UTC 2022/07/14 21:12 |
| 2022-084-0045.mrh | 45 | CHUP | 48 57.60 N | 125 2.00 W | UTC 2022/07/27 17:08 |
| 2022-084-0046.mrh | 46 | SWAL | 48 55.51 N | 125 12.90 W | UTC 2022/07/27 19:13 |
| 2022-084-0047.mrh | 47 | LYAL | 48 58.34 N | 125 19.36 W | UTC 2022/07/27 21:12 |
| 2022-084-0048.mrh | 48 | TURT | 48 54.44 N | 125 20.49 W | UTC 2022/07/28 01:20 |
| 2022-084-0049.mrh | 49 | HAND | 48 56.82 N | 125 19.90 W | UTC 2022/07/28 13:56 |
| 2022-084-0050.mrh | 50 | VILL | 48 53.02 N | 125 18.54 W | UTC 2022/07/28 15:54 |
| 2022-084-0051.mrh | 51 | NANA | 48 53.02 N | 125 4.97 W | UTC 2022/07/28 18:34 |
| 2022-084-0052.mrh | 52 | SARI | 48 55.00 N | 125 0.92 W | UTC 2022/07/28 19:09 |
| 2022-084-0055.mrh | 55 | SPRO | 49 6.55 N | 124 48.96 W | UTC 2022/08/08 16:11 |
| 2022-084-0056.mrh | 56 | CHUP | 48 57.64 N | 125 1.96 W | UTC 2022/08/08 18:45 |
| 2022-084-0058.mrh | 58 | SWAL | 48 55.35 N | 125 12.83 W | UTC 2022/08/08 20:50 |
| 2022-084-0059.mrh | 59 | LYAL | 48 58.41 N | 125 19.42 W | UTC 2022/08/08 22:50 |
| 2022-084-0060.mrh | 60 | HAND | 48 56.88 N | 125 19.17 W | UTC 2022/08/09 00:22 |
| 2022-084-0061.mrh | 61 | TURT | 48 54.48 N | 125 20.65 W | UTC 2022/08/09 13:57 |
| 2022-084-0062.mrh | 62 | VILL | 48 52.99 N | 125 18.19 W | UTC 2022/08/09 14:22 |
| 2022-084-0063.mrh | 63 | NANA | 48 52.87 N | 125 4.94 W | UTC 2022/08/09 17:22 |
| 2022-084-0064.mrh | 64 | SARI | 48 54.97 N | 125 0.92 W | UTC 2022/08/09 17:55 |
| 2022-084-0065.mrh | 65 | HEND | 48 58.62 N | 124 59.44 W | UTC 2022/08/09 19:23 |
| 2022-084-0066.mrh | 66 | CHUP | 48 57.75 N | 125 1.84 W | UTC 2022/08/25 16:51 |
| 2022-084-0067.mrh | 67 | SWAL | 48 55.51 N | 125 12.91 W | UTC 2022/08/25 19:01 |
| 2022-084-0068.mrh | 68 | LYAL | 48 58.30 N | 125 19.64 W | UTC 2022/08/25 21:19 |
| 2022-084-0069.mrh | 69 | HAND | 48 56.71 N | 125 19.50 W | UTC 2022/08/25 22:26 |
| 2022-084-0070.mrh | 70 | TURT | 48 54.42 N | 125 20.66 W | UTC 2022/08/25 23:59 |
| 2022-084-0071.mrh | 71 | VILL | 48 53.03 N | 125 18.47 W | UTC 2022/08/26 14:35 |
| 2022-084-0072.mrh | 72 | NANA | 48 52.89 N | 125 4.72 W | UTC 2022/08/26 16:54 |
| 2022-084-0073.mrh | 73 | SARI | 48 54.99 N | 125 0.97 W | UTC 2022/08/26 18:21 |
| 2022-084-0074.mrh | 74 | HEND | 48 58.58 N | 124 59.49 W | UTC 2022/08/26 20:35 |